1999 INTERNATIONAL OIL SPILL CONFERENCE

MYTHS AND REALITIES OF OIL SPILL PLANNING AND RESPONSE: THE CHALLENGES OF A LARGE SPILL

Technical Report IOSC-007

MYTHS AND REALITIES OF OIL SPILL PLANNING AND RESPONSE: THE CHALLENGES OF A LARGE SPILL

AN ISSUE PAPER PREPARED FOR THE
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PREFACE

The 1999 International Oil Spill Conference sponsors — American Petroleum Institute, US Coast Guard, US Environmental Protection Agency, International Maritime Organization, and International Petroleum Industry Environmental Conservation Association — commissioned issue papers covering two topics of special importance to the oil spill community. The sponsors assigned responsibility for general management and oversight, scope definition, peer review, and publication of these issue papers to the Program Committee.

The goals of these papers are to stimulate open discussion of complex and controversial issues and balance diverse positions of stakeholders. Each topic addresses varying scientific/technical and socio-political concerns. Therefore, each paper differs as to depth of study and breadth of conclusions. The views and opinions presented are those of the authors solely and do not represent the views, opinions, or policies of the International Oil Spill Conference or its sponsors.

During the 1999 Conference, each of these issue paper topics will be the subject of a special panel session. Publication of these issue papers as separate companion documents to the Conference Proceedings continues the International Oil Spill Conference Technical Report Series. The Technical Reports are published biennially in conjunction with the International Oil Spill Conference.

It is the Program Committee's hope that each issue paper topic furthers substantive discussion and serves as a catalyst for solutions to the topics discussed.

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ABSTRACT

Over the past 20 years, governments and industry have expended considerable effort to improve spill preparedness and response. This paper reviews where improvements have occurred, which elements have been most or least effective, and where future investment should concentrate.

There are a wide variety of approaches to spill response. There is no universal solution to an oil spill, and all available strategies may be required. Despite its proven effectiveness, dispersant use often is discouraged, possibly because of a persistent myth that it will cause lasting environmental damage. Responders, therefore, often are denied use of what could be the most effective tool in the right circumstances.

Other myths persist — for example, the purchase of more equipment is the solution. The reality is that, without proper planning and support, additional equipment solves nothing. Future efforts must concentrate on strengthening spill infrastructure. Another myth is that mobilising every available resource leads to better response. The reality is that, by selecting appropriate techniques and resources, together with strict cost control, successful response can be conducted at a sensible cost.

Politicians, the media, environmental interest groups, and the public must be educated that, despite response improvements, oil almost always will come ashore. In most cases, however, the environment will not be permanently damaged. Unless public expectations can be reduced to accept this, investment will never be perceived as a success.

It is concluded that, in some places, response capabilities have improved. Unfortunately, in many otherplaces, they have not: too many myths remain, and too few realities are understood.

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EXECUTIVE SUMMARY

Over the past 20 years, there has been massive investment in oil spill response capability around the world. Considerable efforts have been made in many countries to improve the general level of preparedness by developing or updating National Contingency Plans and by examining the issues of spill management, spill risk, priorities for protection, and strategies to be employed, as well as equipment and personnel requirements. National laws, together with bi-lateral and international agreements, have introduced compensation arrangements and have attempted to ensure a higher standard of preparedness and international co-operation. This paper attempts to assess whether these investments have been successful using two criteria for post-improvement responses: Were they technically more effective, or were they perceived to be more effective? There is a danger that the latter may be compromising the former.

Using these criteria, the paper asks the following questions: Have improvements in preparedness and response capabilities been worthwhile? Have the policy and infrastructure changes made a real improvement in the response community's ability to reduce the adverse impacts of a spill? Do these improvements matter outside the context of an incident? This paper examines whether improved response capabilities and performance over the past 20 years are myths or realities. Specifically:

- Have response capabilities to clean up large spills improved over the last 20 years?
- Have increased response capabilities resulted in improved performance?
- Has improved performance had a positive effect on political, media, environmental, and public perceptions?

Information was gathered from a number of major oil spills (>10,000 tonnes or 70,000 bbls) around the world. Smaller spills also were used where they would usefully illustrate a key point. This spill information was combined with the practical experience and personal observations of the author and many oil spill response professionals from around the world, thus providing a well-reasoned basis for concluding whether the critical issues listed above are myths or realities.

The paper concludes that it is impossible to make a general statement about improvements to oil spill response capabilities and performance on a worldwide basis. Rather, specific changes must be examined regionally or nationally to determine if increased capabilities and improved performance occurred. There have been huge increases in the quantity of oil spill response equipment in many parts of the world. In co-operation with other countries as well as industry, many governments have improved contingency planning and equipment capabilities. In other parts of the world, there may have been little improvement because of more pressing national priorities. Evidence shows that international, national, and industrial determination to improve spill response capabilities is cyclical, increasing immediately following a major spill event and waning as time progresses.

Some measures of success are difficult to quantify, such as the spill management team's efficiency and effectiveness, vessel salvage plan, or shoreline protection strategy. Other indicators are easier to measure, such as amount of oil spilled versus amount recovered at sea or from the shoreline. The lack of accurate historical information about major oil spills also makes it difficult to identify precise performance improvements. Nonetheless, conclusions can be made about the myths and realities of improvements in a number of areas.

It is a reality that international conventions and agreements have improved the commitment to preparedness planning; however, many provisions of these conventions and agreements have yet to be implemented. It is a reality that the international oil industry has invested considerably in the establishment of local, regional, and international stockpiles of equipment. Another reality is that the international response community now accepts that contingency planning is the essential prerequisite to a successful response. The scope of contingency plans has improved over the years to include risk analysis, forecasts of oil movement, identification and prioritisation of resources at risk, and selection of suitable response techniques. It also is recognised that plans must be constantly tested and updated through regular exercises. There are still far too many places in the world, however, where satisfactory planning has not been conducted, and, in some cases, inappropriate equipment purchases have been made.

In most countries where major spills have occurred, lessons learned from those spills have been incorporated into national response plans. In many countries, there is an increased awareness of the critical role of salvage in improving spill response. There are ample stockpiles of mechanical containment and recovery equipment in most parts of the world.

Dispersant use is still controversial, but is slowly gaining acceptance as the benefits become more widely accepted, and limitations become better understood. Where responders have become experienced at working together during exercises and responses, spill management has improved significantly.

Unfortunately, in those regions of the world where mechanical containment and recovery for major offshore spills remains the only or primary response method, there is unlikely to be any significant improvement in response operations because of the well-known, and to date insurmountable, limitations of this technique. In some parts of the world, spill costs have escalated significantly. Media, environmental interest group, and public pressure undoubtedly has contributed to gross overreaction or inappropriate actions being taken. This is exacerbated by the lack of an independent, effective mechanism to determine technical reasonableness, and there being no means of penalising unreasonable or ineffective decisions or activities that may have contributed to excessive costs by refusing to reimburse them.

Generally, the factors that contribute to improved performance during oil spill response do not match those that are perceived as improved by politicians, the media, environmental interest groups, and the public. The media rarely report on the technical successes of a response and, on most occasions, dramatise potential disaster, which contribute to public outrage. It is unlikely that this will change. Environmental interest groups continue to use oil spills to promote their own agendas, despite evidence that spills are not the permanent environmental disasters that these groups prefer to portray. This also is unlikely to change. In some areas of the world, however, some success has been achieved in creating a climate of trust and co-operation, which tempers political reactions. Politicians, however, remain responsive to their constituents and follow public reaction to oil spill response performance, whether real or perceived. There is a need for the oil industry to make strenuous efforts to improve its image, attempt to educate the public about the realities of oil spill response, and reduce the public expectations of what can be achieved.

The problems that currently inhibit improved performance are not ones that massive increases in equipment will fix. Some problems are insoluble with present-day technology. Organisational problems can be overcome by better planning, acceptance of alternative response techniques, training, exercising, spill management, and cost management, with government and industry working in co-operation to plan, respond, and involve all potentially affected parties. In some countries, their current state of development may well mean that they are not ready to devote scarce national resources to the problem and will need external assistance for some years to come.

The answers to the three critical issues are yes — in some ways and in some places. In most areas, investment has not been just an expensive public relations exercise, but there are worrisome signs that some responders are beginning to think that it is. There have been major improvements in many parts of the world, and many countries are now much better prepared than they were 20 years ago. It is still unfortunately the case that in many places, there has been little or no improvement, either because of lack of resources, understanding of the requirements, or will. In the last two cases, many of the myths remain, and the realities are not yet understood.

SECTION 1

INTRODUCTION

Over the past 20 years, especially in the past 10 years since the *Exxon Valdez* spill, there has been a tremendous investment in equipment and resources to respond to a large oil spill in both the open sea and nearshore environments. This paper examines whether the investment of money, time, and effort has been worthwhile: Have real improvements occurred, or has it been the world's most expensive public relations exercise?

This paper has been written to encourage discussion and analysis in the international response community about changes in oil spill capabilities and performance that have occurred during the past 20 years, and to critically challenge some of the current thinking. Using opinions of many professionals within the response community as a basis, this paper is intended to generate a dialogue within this community with the intent of identifying strengths and weaknesses in response capabilities and ultimately to initiate performance improvements. This paper also can be used to provide feedback to the research community on capability issues that warrant further examination.

1.1 OBJECTIVES

To determine what is reality and what is myth, this paper asks the following questions concerning oil spill response over the past 20 years:

- Have response capabilities to clean up large spills improved over the last 20 years?
- Have increased response capabilities resulted in improved performance?
- Has improved performance had a positive effect on political, media, environmental, and public perceptions?

The answers are intended to challenge existing national or international philosophies and encourage a critical review of these perspectives.

To achieve this objective, information from major spills is integrated with the practical experience and personal observations of spill response professionals. Whenever possible, the paper focuses on responses to large spills (>10,000 tonnes or 70,000 barrels); however, smaller spills also are used to illustrate particular issues because of the lack of detailed information on many spills.

Much of the information in this paper is derived from personal interviews with spill response professionals throughout the world, supplemented by the author's personal knowledge from almost 20 years' experience in the industry, in addition to an extensive literature review. Because of the scarcity of reliable information on many spills, the author has relied on the judgment, perceptions, and opinions of response professionals and regulators, as well as on personal observations and necessarily subjective opinions.

1.2 ORGANISATION OF THIS REPORT

This paper examines capabilities around the world in the areas of equipment, infrastructure, and planning and the resulting reactions.

Section 1. Introduction. This section identifies the paper's objectives and introduces the critical issues to be addressed.

Section 2. Myth or Reality? Have Response Capabilities to Clean Up Large Spills Improved Over the Last 20 Years? This section discusses whether changes in response capabilities in specific countries and regions have resulted in significant improvements in these capabilities. Worldwide implementation of the tiered response concept also is analysed.

Section 3. Myth or Reality? Have Increased Response Capabilities Resulted in Improved Performance? This section discusses whether national and international agreements, contingency planning, and response strategies have resulted in improved oil spill response performance.

Section 4. Myth or Reality? Has Improved Performance Had a Positive Effect on Political, Media, Environmental, and Public Perceptions? Building on the previous section, Section 4 discusses whether increased capabilities and improved performance have been perceived positively outside of the response community.

Section 5. Conclusions and Recommendations. This section summarises the major conclusions regarding the critical issues and recommends direction for future efforts to further improve response capabilities and performance.

Appendix A. International Agreements Following Major Spills. A summary of national and international conventions and agreements is presented.

Appendix B. Summary of Significant Spill Events. This appendix provides brief, descriptive case studies of major oil spills, which constitute much of the reference material for this paper.

1.3 CRITICAL ISSUES

HAVE RESPONSE CAPABILITIES TO CLEAN UP LARGE SPILLS IMPROVED OVER THE LAST 20 YEARS?

There is no simple answer to this question. The answer ought to be "yes," given the enormous investment in equipment. In

some ways and in some places, particularly in developed and advanced developing nations, the answer is yes. In many developing countries, however, the answer is likely to be "no." Any improvement in response capability often is hampered by higher priorities such as national survival and population welfare, which compete for the limited funds and management effort available.

Improvements in response capabilities have not only occurred over the past 20 years. Indeed, international cooperation began in the late 1960s, particularly in Europe, with the signing of the Bonn Agreement and the Helsinki and Barcelona Conventions (see Appendix A). When France suffered the 223,000-tonne (1,561,000-bbl) spill from the *Amoco Cadiz* in 1978, little oil was removed at sea, and overly aggressive shoreline cleaning caused severe shoreline damage, particularly in marshes. In the aftermath of the *Amoco Cadiz* spill, an upsurge of interest in oil spill response and various additional improvements occurred. Interest in spill response then began to wane until the *Exxon Valdez* spill (1989) became a catalyst for a frenetic expansion of response capabilities worldwide. Although there is a general international determination that this capability improvement should be maintained, the pressure of low oil prices and general downturn in the world economy are having an adverse effect on maintaining improved response capabilities.

Have Increased Response Capabilities Resulted in Improved Performance?

The first criterion by which any performance improvement should be judged is whether any subsequent responses were technically better than before improvements were made. Since there has been considerable investment in contingency planning, equipment, and training, as well as international cooperation, there should have been significant improvements. Response professionals, however, recognise the limitations of oil spill response. Despite best efforts, a well-rehearsed contingency plan, ample personnel and equipment resources, and a well-managed response, oil is likely to come ashore. Oil on the shoreline introduces the second criterion: Was the response perceived to be successful?

Has Improved Performance Had a Positive Effect on Political, Media, Environmental, and Public Perceptions?

In today's unforgiving media-driven society, it is essential not only to perform well but also to be perceived to perform well. This is important, because otherwise, the fires of perception — lit by the media, kindled by environmental groups, stoked by politicians, and fanned by the public — can easily consume a Responsible Party (RP) and responders. The twin criteria of effectiveness and perception are not necessarily mutually exclusive, but great care is needed so that media pressure does not force responders to conduct actions that conflict with the best environmental and technical advice.

SECTION 2

MYTH OR REALITY? HAVE RESPONSE CAPABILITIES TO CLEAN UP LARGE SPILLS IMPROVED OVER THE LAST 20 YEARS?

Over the past 20 years, there has been a tremendous increase in the provision of oil spill equipment in many parts of the world. This section discusses the tiered response concept, together with developments that have occurred in various nations and regions. Evidence is presented to show whether these developments have resulted in increased response capabilities or whether further investment is still needed. Many governments, but more especially the oil industry, ports, and private contracting companies, have increased equipment holdings considerably. Improvements also have been made in contingency planning and spill management but regrettably are not universal. A number of international and bi-lateral agreements have been concluded concerning co-operation among countries in the event of oil spills (Appendix A).

2.1 DEVELOPMENTS BY VARIOUS NATIONS AND RELIGIONS

Within the scope of this paper, it is not possible to quantify the improvements made in every country. Summary information of significant developments in response capability is provided from around the world, concentrating on developed countries that have experienced large spills. In these countries following these spills, national response arrangements have been brought to a relatively high standard.

Africa. Until recently in much of Africa, little work had been done to prepare for spills unless it has been driven by oil company commitment. In some countries, such as Nigeria, there is only a draft National Contingency Plan (NCP). In contrast, plenty of oil spill equipment exists for response in the rivers and Niger delta. A recent spill from the Idoho pipeline (1998) highlighted the shortage of offshore equipment in the region, perhaps stemming from lack of properly developed plans. In Angola, it has been decided only recently which ministry shall be the national response authority, without which there could be no NCP. In other African countries, different national problems may be more urgent, with poverty, collapsed commodity prices, and need to develop the economy and feed and house the population placing oil spill response low on the list of priorities. With few exceptions, it is a myth that response capability has improved in Africa.

Australia. Following the *Kirki* spill in 1991, the Australian National Plan (Natplan) was reviewed completely. The outcomes of that review included the purchase of additional oil spill equipment to be stationed around the coast. In an offshore spill, the use of mechanical equipment alone will not prevent the oil from coming ashore (Purkiss, 1998). In addition, the length of the Australian coastline and often-rough weather conditions preclude mechanical equipment use. Dispersant use is allowed in appropriate situations: for example, aerial application using crop spraying aircraft was used briefly during the *Kirki* spill (Sapelli, 1998). Since then, dispersant use has expanded into the Fixed-Wing Aerial Dispersant Capability (FWADC) (Lipscombe, 1998). A minimum of two crop spraying aircraft, which can carry between 1½ and 3 tonnes (10–20 bbls) of dispersant, are available at 4 hours notice, and other aircraft can be made available with longer notice.

As a result of lessons learned during the *Kirki* and other smaller spills, the Australian spill management system is being upgraded to handle the planning and logistics necessary to mount a major oil spill response. The level of government-industry co-operation has increased, which is considered to be one of the greatest improvements. An integrated national response team has been established, and it includes representatives from government and industry. The team has been mobilised for small spills, such as that from the bulk carrier *Iron Baron* (1995) but has not been tested in a major spill. There is a similar government-industry approach to training. Various courses have been introduced covering all aspects of spill response, and the content and programmes are being developed jointly by government and industry (Lipscombe, 1998). It is a reality, therefore, that response capability has improved over the last 20 years in Australia.

France. France is particularly vulnerable to the risk of oil spills since there is considerable passing tanker traffic to the oil ports of Europe along the Atlantic and English Channel coasts (Holt, 1995). Under the National Marine Pollution Plan (POLMAR), the French Navy is responsible for the cleanup of spills at sea. Since the *Amoco Cadiz* spill, which was caused by a steering gear failure in the vessel and the inability to secure a towline onboard, multi-role tugs have been stationed

in the region permanently and equipment stockpiled for use at sea. The French government also established stockpiles of shoreline cleanup equipment at Brest and Marseilles to support the shoreline response plan. POLMAR is tested during major response exercises conducted in co-operation with the oil industry.

The Centre for Documentation, Research, and Experimentation into Accidental Pollution of the Water (CEDRE) was established to conduct research in spill response techniques, provide technical advice to the French and other national authorities in producing response plans, and form teams to assist with spill responses in France and abroad. Today, CEDRE is respected internationally and frequently assists other countries in planning and response. It is a reality, therefore, that response capability has improved over the last 20 years in France.

Gulf of Arabia. Although there has been much discussion over many years and a large increase in the amount of response equipment in the region, particularly during and since the 1991 Gulf War, there has been little governmental determination to make significant improvements. Few countries have signed any of the compensation conventions: only Oman has signed the International Convention on the Prevention of Pollution from Ships of 1973 with its 1978 Protocol, MARPOL 73/78, and only Iran has signed the International Convention on Oil Pollution Preparedness, Response, and Co-operation (OPRC Convention).

The *Pontoon 300* accident in January 1998 off the United Arab Emirates, when 6,000 tonnes (42,000 bbls) of heavy fuel oil were spilled from a barge smuggling oil from Iraq, illustrates this region's inadequate response capabilities. Poor response was exacerbated because the owner could not be identified. Adverse weather and the general unseaworthiness of the barge also hampered the eventual response. There was a 6-day delay before a belated and largely ineffective response commenced, which would not have occurred if there had been committed, determined government action. Throughout most of the Gulf of Arabia, therefore, it is a myth that response capability has improved in the last 20 years.

Norway. The State Pollution Control Authority (SFT) of the Department of the Environment is the responsible authority for marine oil pollution in Norway. Following a major blow-out from the Ekofisk Bravo oil field in 1977, SFT required offshore operating companies to ensure that response equipment was in place and available for use in an open water response. As a result, the Norwegian Clean Seas Association for Operating Companies (NOFO) was formed to manage this project. At the time, the necessary equipment did not exist to meet SFT's requirements, which gave considerable impetus to developing response equipment for open water response. This development was aided by the Norwegian authorities' willingness to allow oil to be spilled at sea for operator training and developing and evaluating new equipment.

Following the *Exxon Valdez* spill, Norwegian authorities imposed strict response preparedness requirements on Norwegian oil terminals, refineries, and industrial complexes, as well as on local authorities, which resulted in large purchases of oil spill equipment. Vessel traffic and pilot services improved, and the Norwegian Centre for Marine Environment and Safety was established, including a National Test Centre for environmental technology and a National Training Centre for oil spill response. There has been no opportunity to test these arrangements on a major scale. However, it is a reality that response capabilities have improved over the last 20 years in Norway.

The UK. Having suffered three of the world's "top twenty" oil spills — *Torrey Canyon* (1967), *Braer* (1993), and *Sea Empress* (1996) — the UK is aware of what is required in a major spill. Though many years before the period covered by this paper, the *Torrey Canyon* spill must be mentioned since it spurred two international compensation schemes — the Civil Liability Convention (CLC) in 1969 and the International Oil Pollution Compensation (IOPC) Fund in 1971 — as well as major research and development programmes in the UK.

In the late 1970s and early 1980s, the government-owned Warren Springs Laboratory (now the privatised AEA National Environmental Technology Centre, AEA Netcen) tested new low toxicity dispersants and developed aerial application methods. Also in the late 1970s, principally the British Petroleum (BP) Sunbury Research Centre undertook a major programme for containment and recovery equipment. AEA Netcen and CEDRE were responsible for the development of "minimally intrusive" shoreline cleanup methods in the late 1980s. Techniques for use and identification of the limitations of booms to protect coastal estuaries were developed and tested by the Hydraulics Research Establishment (Newman and Macbeth, 1970, 1973). Within the UK, these techniques continue to be used for coastal protection, especially of sensitive areas (Perry, in press).

Major government equipment investment was made in the 1970s and 1980s as well. Following the *Cristos Bitos* spill (BP, 1979), emergency lightering equipment was purchased; aerial dispersant spraying was introduced; and dedicated aircraft were contracted. Notable success was achieved during the *Sea Empress* spill with dispersant being used as successfully as it previously had been used during the *Sivand* (1983), *Phillips Oklahoma* (1989), *Rosebay* (1990), and other minor spills. Limited stocks of government-owned, open sea, mechanical recovery equipment and larger stocks of shoreline cleanup equipment also were purchased.

The development of the UK NCP led to the formation of the Marine Pollution Control Unit (MPCU), which was responsible for the cleanup of tanker spills at sea. The MPCU became the focus for all marine pollution matters, with local coastal authorities assuming responsibility for shoreline cleanup. During the *Braer* and *Sea Empress* spills, the NCP was used successfully. Currently, the plan is being revised to incorporate lessons learned, recommendations from independent post-spill reports (ESGOSS, 1994; SEEEC,1998), two reports by Lord Donaldson (Donaldson, in press; Donaldson *et al.*, 1994), and also the input from a national forum consisting of regulators, shipowners, ports, local authorities, and oil spill response organisations. As a result of these efforts, it is a reality that response capabilities have improved over the last 20 years in the UK.

Following an amalgamation of the UK Coastguard Agency and Maritime Safety Agency into the Maritime and Coastguard Agency (MCA) and the formation of four MCA regions, another plan review is underway that involves the MPCU's dissolution. MCA regions will have responsibilities similar to those of the US Coast Guard (USCG): marine safety, port state control, search and rescue, and marine pollution. At the time of writing, the final plan has not been published; however, the regionalisation proposed in the plan is a concern. Prior to the MPCU's formation, spill response in the UK was conducted on a regional basis, and it did not work. This was the *raison d'être* of a central MPCU, and it is hoped that this lesson will not have to be learned a second time. At best, there will be a hiatus for some time until the new arrangements become effective.

The US. The US NCP contains provisions on which spill response operations are based. The first US NCP was drafted in 1968 and refined through the 1970s and 1980s to the time of the *Exxon Valdez* spill. Under the pre-*Valdez* organisation, an RP was considered to have primary responsibility for the cleanup, with oversight by the USCG, US Environmental Protection Agency (EPA), and relevant state.

Throughout the 1970s to the present, both the USCG and US Navy Supervisor of Salvage (SUPSALV) purchased large stocks of pollution equipment. USCG equipment was purchased to ensure that resources would be available as commercial equipment was being mobilised and to cover any shortfalls in provision by an RP. US Navy equipment was purchased specifically to handle spills from Navy vessels and would normally only be mobilised by Federal On-Scene Coordinators (FOSCs) if they considered that an RP and a contracted Oil Spill Removal Organisation (OSRO) were unable to provide the required resources. The requirement for these resources in non-government vessel spills has diminished as the increased level of commercial equipment required by the Oil Pollution Act of 1990 (OPA 90) has become available.

The US NCP was perceived to have failed in Prince William Sound, Alaska in 1989 (Walker *et al.*, 1995). Prior to the *Exxon Valdez* spill, RPs, federal agencies, and individual states tended to plan independently for responses. When a spill occurred, each found that the others' plans were inadequate or incompatible with its own. The result was confusion and recrimination, creating an impression in the public's eyes that chaos reigned. Urgent action was needed to restore public confidence. OPA 90 was the result. Amongst its many provisions, OPA 90 requires government and industry planners to work together to devise appropriate plans and strategies for response management and operations. Vessel and facility owners are required to produce contingency plans with guaranteed levels of response equipment. The revisions to the NCP require establishing local area government-industry planning committees and programmes of joint exercises (National Preparedness for Response Exercise Program, PREP). This fundamental shift in emphasis led to perhaps the greatest improvement, co-operation between an RP and regulatory agencies. Although it is clear that such a partnership is essential, nowhere else in the developed world is the primary responsibility for conducting oil spill response placed on industry, albeit with the government's oversight. Certainly in Europe, spill management is seen as a government responsibility. The US now has a high degree of preparedness based on regulation, contingency planning, training, and exercises, though there is still a need to increase dispersant acceptability. It is a reality, therefore, that response capabilities have improved over the last 20 years in the US.

General observations on national and regional capabilities. It is a reality that most developed nations and several of the more advanced developing countries have devoted much effort to developing a well-resourced and exercised national plan, and improvements have been made. Unfortunately, there are still too many places where response capabilities are not well organised. In the absence of an effective plan and organisation to support an oil spill response, the provision of large amounts of oil spill equipment can be dangerous, especially if managers do not understand the need for planning and responders do not have sufficient training. It is imperative that equipment purchases are not made unless they are part of a comprehensive spill planning process. Persuasive salesmen have sold inappropriate equipment to well-meaning countries that did not have contingency plans to assist in determining what equipment they required. There may be no management organisation in place to direct equipment use or logistic infrastructure to store and move it to a spill site. Often, there are no trained personnel to maintain and operate it. In too many cases, equipment is unused and not maintained and will remain so until it deteriorates and becomes unsuitable.

Even in what are supposedly well-prepared, developed countries, there is still much to be done. Oil Spill Response Limited (OSRL) often has been asked to make equipment recommendations without an existing contingency plan on which to base purchases (Salt, 1998). Within the past 4 years in the UK, the author has observed locked pollution stores or trailers for which the key is been missing, or in which the oil spill equipment is still in the manufacturers' unopened boxes. At one UK installation belonging to a major oil company, the author observed equipment that had been outdoors for so long that international orange had bleached white and skimmer powerpack doors were rusted shut.

2.2 Tiered Response

While individual nations and the oil industry have addressed their internal response planning and management concerns, both have opted to rely primarily on oil spill response organisations to supply most of the equipment and manpower necessary to mount a large-scale response. This has led to the evolution of a worldwide response capability best described by the tiered response concept (Table 1). To plan for spills ranging from small operational spills to catastrophic events, the tiered response concept has been promulgated internationally over the past 10 years by the International Petroleum Industry Environmental Conservation Association (IPIECA, 1991). The US adopted a similar approach employing different but functionally equivalent terminology.

TABLE 1.
SYNOPSIS OF TIERED RESPONSE CONCEPT

Tier 1	Small operational spills at jetties or terminals that are reported to the authorities but managed and cleaned up by the operator. The US functional equivalent is the Average Most Probable Discharge (AMPD).
Tier 2	A larger spill, either at or in the vicinity of a facility, that cannot be handled by the operator alone. The port or local authority will manage it. Personnel and equipment support will be required either from other port users or from a local spill co-operative. The US functional equivalent is the Maximum Most Probable Discharge (MMPD).
Tier 3	A major spill at or remote from a facility that will require the National Contingency Plan (NCP) to be invoked and national resources to be mobilised. Additional support may be required from outside the country under multi-national arrangements. Personnel and equipment may be required from an international Tier 3 oil spill response co-operative. The US functional equivalent is the Worst Case Discharge (WCD).

Source: Adapted from IPIECA (1991).

To avoid duplication of expensive resources that are required infrequently, various co-operative arrangements have been made. Tier 2 facilities have been developed in some major ports. Groups of oil companies have established national or regional Tier 2 oil spill response bases or international Tier 3 bases in strategic locations throughout the world.

Response capability often is measured as a theoretical, numerical cleanup capacity (a total capacity in tonnes of the equipment package or in barrels per day). These capacity estimates can be very misleading since they imply the ability to clean up a specified amount of oil. For example, an equipment stockpile might be rated as having a 10,000-tonne (70,000-bbl) recovery capacity, which is a theoretical figure that may factor in nameplate capacity, downtime, and water pickup under ideal conditions. The actual capability to clean up oil in a real spill situation will depend on many other factors, which are discussed later in this paper.

The concept of co-operative arrangements and establishment of jointly owned response bases have economic merit, particularly for developing countries, especially those where the risk is not great. Such bases also form pools of practical first-hand experience, on which countries that have little or no practical experience can draw. It is anticipated that experienced response personnel would form an important part of international response teams proposed in Section 5.

TIER 1 RESOURCES: OIL INSTALLATIONS AND PORTS

The oil industry has made great efforts to ensure that most industry-owned oil terminals are equipped to handle small spills. As these small spills constitute 92 percent of the total oil spilled from tankers (ITOPF, 1998a), there should be evidence of a marked improvement. Given favourable weather and tidal conditions, it should be possible to deploy equipment rapidly, operate it in pre-determined positions to contain spilled oil close to the source, protect local sensitive areas, and remove oil rapidly. Many ports have Tier 1 response capabilities in place, for example, to respond to bunker spills. The OPRC Convention implicitly requires such response capabilities in facilities, and this requirement will be implemented progressively by national legislation. In the drive for economy, many terminals are short of manpower to handle emergencies. Additional support personnel must be available at very short notice to deploy response equipment, which is not always the case.

TIER 2 RESOURCES: NATIONAL, PORT, AND INDUSTRY

A number of industry-funded national or regional Tier 2 co-operatives have been established where higher risks exist because of oil exploration and production activities or high-volume tanker traffic. Some countries — including Australia, France, Norway, the UK, and the US — have developed national equipment stockpiles (Tier 2) to supplement local Tier 1 resources. Several larger ports also have developed co-operative Tier 2 arrangements to supplement the Tier 1 resources of individual installations within the port. A good example of this is the Thames Oil Spill Control Association (TOSCA) operating within the area of the Port of London Authority in the UK. In the cases reviewed below, most co-operatives are generally well managed, maintained, and operated.

Gulf of Arabia. Oil companies in the Gulf of Arabia purchased large amounts of oil spill equipment. Gulf Area Oil Companies Mutual Aid Organisation (GAOCMAO) was established in 1972 with headquarters in Bahrain. GAOCMAO owns no equipment, but, in the event of a spill, members may request assistance from other companies. This approach is not recommended, as there is no guarantee that a request for assistance will be honoured. Preferably, some equipment should be centrally stored, maintained, and operated. Although there have been increases in equipment holdings, there is some doubt whether mutual support would actually occur.

Hong Kong. There is significant risk from product movement into Hong Kong and also from other shipping in the narrow entrance channel. The oil industry is in the process of establishing a Tier 2 base in Hong Kong. At present, difficulties

in acquiring a suitable site for the base are delaying establishment. It is, therefore, too early to conclude that Hong Kong has been successful in improving response capabilities.

Malaysia. Malaysia has extensive offshore oil production, and there is considerable risk from tanker spills through the Malacca Straits. In 1994, the companies operating in Malaysia led by the state oil company, Petronas, established the Petroleum Industry of Malaysia, Mutual Aid Group (PIMMAG). PIMMAG established large stockpiles of oil spill equipment at three locations (Port Dickson for the Straits of Malacca, Kemaman for east coast Peninsular Malaysia, and Labuan and Miri for Sabah and Sarawak). A full-time team of contractors provides maintenance and a core team of personnel available for deployment to a spill location. Additional industry personnel are trained to supplement this team. The designed response time is 12–24 hours from each stockpile. The equipment resources are designed to have a total response capacity of approximately 20,000 tonnes (140,000 bbls). Malaysia, therefore, has developed suitable equipment capabilities.

Norway. Prior to the Ekofisk Bravo platform blow-out in 1977, SFT produced a very strict requirement for offshore pollution control equipment: equipment must be capable of operating in wave heights of 2.5 metres. When the rules were formulated, this was impossible to achieve with the available equipment; however, oil spill exercises using real oil have been conducted annually to test and evaluate new equipment and train response crews.

Each offshore platform, in addition to its Tier 1 resources, must be able to recover and store 8,000 m^3/day (40,000 bbls/day). Of this amount, 25 percent of the resources must be onsite within 24 hours and the remainder within 48 hours. This is achieved by NOFO, an offshore oil industry organisation that operates five onshore bases from which equipment is deployed. Within the bases, there are a total of 14 oil recovery systems, each with a team leader and three operators. The equipment can be loaded on any of 15 converted rig supply vessels that are classified as oil recovery vessels with onboard storage for 1,000 m^3 (5,000 bbls) of oil. Fishing vessels are available for towing boom. Shuttle tankers are available for recovered oil disposal. As such, Norway has developed suitable equipment capabilities.

The US. The US has the greatest concentration of Tier 2 resources in the world. Even before the *Exxon Valdez* spill, co-operatives had been formed in many parts of the country to support oil industry operations. At the time of *Exxon Valdez,* there were over 90 industry-owned contractor co-operatives in the US, such as the Clean Seas Co-Operative based in California to cover oil production operations in the Santa Barbara Channel.

Other tier 2 co-operatives. Other Tier 2 co-operatives are either forming or in existence: in Alaska, where both Alaska Clean Seas and the Ship Escort Response Vessel Service (SERVS) possess large stockpiles of oil spill equipment; in Thailand, the Oil Industry Environmental Safety Group; in Guam, Guam Response Services Limited (GRSL); and in Korea, Korea Marine Pollution Response Corporation. The increase in oil spill awareness and reduction in oil company staff has provided the opportunity for many private contractors to establish and expand their operations in various parts of the world, and improvements in Tier 2 response capabilities continue to be made.

TIER 3 RESOURCES: INTERNATIONAL RESPONSE BASES

The oil industry has established major co-operative response organisations on a regional basis throughout the world to provide equipment and specialist manpower to reinforce local capabilities in responding to the largest spills.

Australian Marine Oil Spill Centre. The Australian Institute of Petroleum (AIP) established the Australian Marine Oil Spill Centre (AMOSC) at Geelong near Melbourne. AMOSC's area of operation includes Australia, New Zealand, the Southwest Pacific, and Papua New Guinea. The equipment, therefore, is ready to be airlifted at short notice to any part of this large region. The centre has a small staff that is supplemented by oil company personnel during response.

Clean Caribbean Co-Operative. Clean Caribbean Co-Operative (CCC) was formed in 1977 by eight oil companies with a base in Fort Lauderdale, Florida. Since the *Exxon Valdez* spill, it has grown in equipment holdings, contractor staff, and membership. Its primary area of operation covers the Caribbean, which is at risk because of extensive oil movements from Venezuela, Africa, and the Middle East. Coverage recently was extended to all of South America, Central America, the Bahamas, and Bermuda.

East Asia Response Limited. In 1989, a recommendation was made to upgrade the Tier 2 Tiered Area Response Capability (TARC) in Singapore (Stacey, 1989). The recommendation was reinforced by a risk study conducted by oil companies operating in the region. Singapore is located near the major oil shipping route through the Straits of Malacca. It is a large refining and product distribution centre and a hub for air routes throughout the region. By 1994, TARC was upgraded and renamed the East Asia Response Limited (EARL) with a 30,000-tonne (210,000-bbl) stockpile. The designated operational area stretches from the Straits of Hormuz and East Africa in the west to the International Date Line in the east (Irvine, in press).

Fast Oil Spill Team. The French oil industry established the Fast Oil Spill Team (FOST) base at Marseilles airport to cover its particular interests in the countries of the Mediterranean and East Africa, recognising that there could be language difficulties for English-speaking responders in these countries. FOST does not have an offshore oil recovery capability but concentrates entirely on nearshore and onshore cleanup. The operating personnel are drawn from the Marseilles Marine Fire Service.

Marine Spill Response Corporation. After *Exxon Valdez,* the US oil industry supplemented the local co-operatives and contractors with a national organisation. Under the umbrella of the Marine Preservation Association (MPA), the Marine Spill Response Corporation (MSRC) was formed. Approximately $1 billion was invested in five stockpiles of equipment, each with a 30,000-tonne (210,000-bbl) cleanup

capacity. Sixteen dedicated response vessels were built to deploy offshore equipment, and barges were purchased for recovered oil storage. Initial start-up costs and infrastructure maintenance costs, however, were so high that, faced with competition from contractors, MSRC was forced to reorganise into three regions, replace management, relocate headquarters, reduce staff numbers, and supplement its resources with a network of local contractors. The overall response capability, however, was not reduced.

National Response Corporation. The National Response Corporation (NRC) is the second Tier 3 responder within the US. Unlike MSRC that owns most of its resources, NRC relies on a network of subcontractors to provide equipment in the event of an oil spill. NRC had initial difficulties in convincing sceptics of the guaranteed availability of equipment from such varied sources, but as much of the capital equipment was already in place and as the overheads and charges were greatly reduced compared to MSRC, membership grew rapidly.

The NRC and MSRC now form the backbone of large-scale response capability in the US. Both NRC and MSRC are Tier 3 organisations, and although they are dedicated principally to response in the US, overseas response feasibility is being investigated actively.

Oil Spill Response Limited. In 1980, BP consolidated its oil pollution equipment for major spill response at the Oil Spill Service Centre (OSSC) in Southampton, which became a facility for worldwide response with a permanent staff and capacity to respond to two 10,000-tonne (70,000-bbl) oil spills. In 1985, five major oil companies, including Exxon, joined BP and formed OSRL. Their commitment was justified when the OSRL team arrived at the *Exxon Valdez* spill within 36 hours of the call out, the first OSRO on scene from outside the state of Alaska.

Following that spill, OSRL increased its capacity to respond to two 30,000-tonne (210,000-bbl) spills with a mix of mechanical and dispersant technologies. The proportion of offshore mechanical recovery equipment stockpiles was reduced with a commensurate increase in the proportion of nearshore and shoreline equipment. This change reflected one of the key realities of spill response that, despite responder's best efforts, a large proportion of spilled oil is likely to come ashore. The OSRL expansion report (Stacey, 1989) recognised that speed of reaction was essential and improved use of aircraft as a means of rapid equipment delivery should be investigated. Following the OSRL expansion, its membership grew rapidly, and now 26 of the world's major oil companies belong to OSRL.

OSRL is the only Tier 3 base with a worldwide area of operation. With the establishment and expansion of other Tier 3 bases, OSRL principally will be employed its respond to spills in Europe, the former Soviet Union, the Mediterranean, Middle East, and Africa. It will be available to support other bases in the remainder of the world, particularly with trained personnel (Irvine, in press).

Petroleum Association of Japan. The Petroleum Association of Japan (PAJ) has taken a different approach. As one of the world's leading importers of oil, Japan established seven response bases in Japan and five abroad (Ras al Khafji, Saudi Arabia; Abu Dhabi; Port Klang, Malaysia; Singapore; and Jakarta, Indonesia). In a spill, equipment use is free, although it must either be returned in good condition or replaced. Although local contractors maintain the equipment, it is the spiller's responsibility to provide operating staff. None of the PAJ bases contains offshore oil recovery equipment, and they are not prepared for air transport (Salt, 1998).

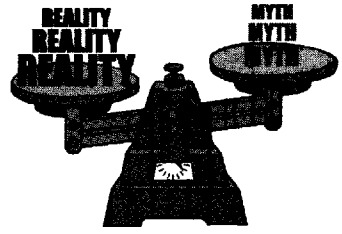
Tier 3 co-operative specialised capabilities. OSRL, CCC, EARL, and MSRC each have high-capacity dispersant spraying capability, namely the Airborne Dispersant Delivery System (ADDS) pack, available for deployment by contracted Hercules aircraft at short notice. For each organisation, these aircraft also are available for rapid deployment of recovery equipment.

OSRL, CCC, FOST, AMOSC, and EARL have placed particular emphasis on equipment mobility. Equipment has been reduced in size and/or weight and stored in containerised or palletised packages, ready for immediate air transportation. Aircraft self-unloading equipment also has been developed for use at airfields that do not have adequate cargo handling equipment.

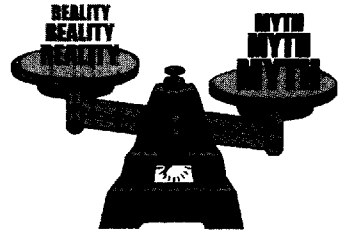
2.3 RESPONSE CAPABILITIES CONCLUSIONS

MYTH OR REALITY? HAVE RESPONSE CAPABILITIES TO CLEAN UP LARGE SPILLS IMPROVED OVER THE LAST 20 YEARS?

The answer varies around the world.



It is a reality for certain nations and regions of the world. Many nations, especially those that have experienced a major oil spill, have devoted much effort to developing a well-resourced and exercised NCP. In general, oil spill response capabilities in those countries have improved.



It is a myth for certain nations and regions of the world. There are some areas of the world where there has been very little performance improvement over the past 20 years. Because of either lack of national resolve or resources, the necessary planning has not occurred in many countries. In the absence of such planning, resource and infrastructure improvements are difficult, if not impossible, to achieve. If equipment alone has been procured, then a false sense of preparedness may exist.

SECTION 3

MYTH OR REALITY? HAVE INCREASED RESPONSE CAPABILITIES RESULTED IN IMPROVED PERFORMANCE?

Over the past 20 years in some regions of the world, there have been improvements in international co-operation, contingency planning, spill management arrangements, dispersant efficiency and methods of aerial application, provision of equipment, and training of personnel. In many instances, most improvements have followed rather than preceded a large oil spill. Two criteria are discussed in this paper to determine whether increased response capabilities have resulted in improved performance during spills. The first criterion is whether responses were technically effective. The second criterion is how politicians, the media, environmental interest groups, and the public perceived performance during spill response. This section examines key issues to discover what contributes to technical success and, hence, help disprove some myths and support some realities of a major spill response. Specific subsections include:

- what is meant by improved performance,
- influence of international conventions and agreements on improved performance,
- influence of OPA 90 on improved performance in the US,
- the essential role of response planning in improving performance, and
- improvements in response performance.

3.1 WHAT IS MEANT BY IMPROVED PERFORMANCE?

This will depend on what is meant by improvement, which yardstick is used, and the many variables involved in a response. Does a better response mean:

- A more technically effective response that is well managed by a closely integrated spill management team, in which damage to the environment is minimised?
- Greater than average amounts of oil are recovered at sea, or large amounts of oil are dispersed chemically, resulting in less oil reaching the shoreline?
- Sensitive resources are well protected, reducing environmental and socio-economic impacts?
- A fast, efficient shoreline cleanup occurs with minimal additional shoreline damage from the cleanup itself?
- Overall cleanup costs are kept to a reasonable minimum?

Or is success only a matter of perception? In that case, does a better response mean: There is a more favourable reaction from regulatory and post-spill review authorities? Media and public perception of the response is favourable or critical? If it is the latter, does any costly political or legislative reaction follow the response, such as OPA 90?

The matters of effectiveness and success were addressed at a previous International Oil Spill Conference (Walker *et al.*, 1995) where there was considerable ambivalence in attitudes. In a survey of spill responders, factors considered to be measures of success did not correspond to their stated objectives for the response. Interestingly, the objective rated most highly by 71 percent of respondents — "preventing or minimising damage to the environment" — was also rated the highest as a measure of success by 53 percent of respondents. Conversely, "perception of the media and the public" was seen as an important objective by only 9 percent of respondents, but it was rated as a measure of success by 41 percent of respondents.

This attitude toward perception has been mirrored in many conversations over the years with response personnel within major oil companies. It often is stated that "Oil spill response is only a public relations exercise anyway!" This probably means that, although a company may state its commitment to oil spill response and the protection of the environment, in reality the protection of the corporate image is actually its most important goal. In the US, a major oil spill is a crisis that is likely to have the most severe adverse impact on an oil or shipping company. The associated response cost in terms of lost business, cleanup costs, litigation, punitive fines, and Natural Resource Damage Assessment (NRDA) is potentially so high as to put company survival at risk.

Neither of these measures of success is wholly right or wrong: to most responders, success is both technical and perceived. But how can the parameters be measured? Only some are quantifiable, for example, amount of oil spilled, amount

recovered at sea, or amount cleaned up on the shoreline. Others are less precise, such as the success or otherwise of a spill management team, vessel salvage, protection measures, amount of oil evaporated or chemically or naturally dispersed, damage done by oil or subsequent cleanup, and environmental or socio-economic impacts. Others are subjective and may depend on public and political perception. Effective relations with the media are very important to perception, as it is quite possible for a good technical response to be marred by a poor media response.

These conventional measures of success ignore the growing realisation that, in certain cases, the best means of achieving environmental recovery, and hence success is to do nothing. Doing nothing is always very difficult to sell as a strategy and almost always is open to severe media and public criticism, being perceived as the "cheap" option. Considerable work is needed to educate opinion formers of the scientific justification for this technique when it is employed.

SCARCITY OF RELIABLE INFORMATION

The paucity of really comprehensive, accurate, and universally available post-spill reports causes major difficulties in deciding whether improvements have occurred. Some basic facts are readily available, but it is often impossible to determine the full details of a response. For many spills, statistics either do not exist or are unobtainable, thus making it difficult to build a fully factual case to support either myth or reality. This difficulty was recognised by Dr. James Butler of Harvard University in a 1978 report (quoted in *International Oil Spill Statistics,* Etkin, 1995, p. 16) that examined available spill data:

> "The news media are heavily biased towards incidents that occur near large coastal cities, the tanker companies and insurance companies do not usually publicise the information they have, and government agencies normally will not concern themselves with events outside their own jurisdiction."

Butler cited many examples of conflicting data from the same major incidents. In her article, Etkin (1995) reports that little has changed since then. The problem is that very few major spill responses result in comprehensive, independent reports being produced. Notable exceptions have occurred in the UK following the *Braer* and *Sea Empress* spills, where independent, scientific, technical evaluations occurred. Parties involved in a response often write comprehensive spill reports, such as those on the *Exxon Valdez* and *Morris J. Berman* spills and MPCU's on the *Sea Empress* spill. Although such reports are useful in matters of fact, any conclusions drawn may be partial and not subject to critical independent analysis. In this paper, therefore, the author has had to place much reliance on the judgment, perceptions, and opinions of response professionals and regulators, as well as on personal observations and necessarily subjective opinions.

DIFFICULTIES IN ESTIMATING PERFORMANCE IMPROVEMENTS

There are many variables in determining whether performance has improved. Although the amount of oil spilled may hit the headlines, spill location, oil type and characteristics, meteorological and oceanographic conditions, and hours of darkness will have a major impact when considering whether response is effective. Other factors that could affect the technical success of response may include:

- effectiveness of the contingency plan,
- effectiveness of the spill management team,
- responders' speed of reaction,
- availability of local equipment and trained personnel resources,
- arrangements to import any additional resources and required assistance,
- logistic support, and
- reception, storage, and disposal facilities for recovered oil and oiled debris.

Despite a well-managed spill response, poor recovery rates or high shoreline impact could occur because of factors that are not in responders' control (e.g., weather, tides). In another spill, high recovery rates and low impact might be achieved regardless of management and resource efficiency. Response performance improvements, therefore, may be difficult to detect. Care must be taken to avoid incorrect conclusions being drawn.

Factors that influence external perception are notoriously variable. The *Exxon Valdez* spill response was not perceived to be effective despite the massive resources brought to bear. The *American Trader, Morris J. Berman,* and *Kure* responses were all perceived to be reasonably successful, which may have been because every resource available was deployed, even though this may have been considered unreasonable under other compensation regimes. The *Evoikos* spill (1997) may be an example of the opposite situation. The overall response was not considered to be well managed by many that observed it, yet it was perceived to be successful. Thanks to nature rather than man, no oil came ashore in Singapore during the time that media attention was still focused on the spill. The media also were managed very carefully and had little chance for direct observation because of haze from the Indonesian fires, which prevented overflying. If perception alone was the yardstick, then things have improved on some occasions.

3.2 INFLUENCE OF INTERNATIONAL CONVENTIONS AND AGREEMENTS ON IMPROVED PERFORMANCE

Various international developments over the past 20 years have been examined to determine whether and where improvements have occurred. The intent of international conventions

and agreements is to ensure that adequate response arrangements are developed universally, at least to a minimum acceptable standard. Among the issues that various conventions attempt to regulate are contingency planning, equipment capabilities, and training and exercises requirements.

Major international and regional conventions are evaluated below for improving spill response effectiveness. Appendix A contains a more-detailed discussion of various international conventions and agreements from around the world.

INTERNATIONAL CONVENTION ON OIL POLLUTION PREPAREDNESS, RESPONSE, AND CO-OPERATION

The International Maritime Organisation (IMO) is the United Nations (UN) body tasked with facilitating co-operation among countries on international watercraft movements. The IMO's responsibilities include regulating tank vessel operations and establishing pollution prevention, preparedness, and response criteria for those vessels. The IMO also provides guidelines and assistance to its member nations regarding issues such as contingency planning and response. In the aftermath of the *Exxon Valdez* spill, the IMO adopted the OPRC Convention in 1990. The OPRC Convention requires tank vessel owners to prepare Shipboard Oil Pollution Emergency Plans (SOPEPs). Signatory governments must ensure that they have a proper NCP and that government and industry co-operate in preparing national measures for planning, training, and response. The OPRC Convention requires governments to provide response assistance to other countries, if requested, at the time of a spill and assist other countries with equipment transport across their territory. The OPRC Convention encourages the promotion of bi-lateral and multi-lateral co-operation in preparedness and response and designates the IMO to facilitate the provision of assistance to states to establish national or regional response facilities.

Prompted by the OPRC Convention, the IMO and IPIECA joined to promote implementation of the OPRC Convention and effective government-industry co-operation in various countries around the world. IMO and IPIECA developed the following three-phase programme:

1. Achieve government-industry consensus on oil spill response objectives, and develop a global education programme to maintain that consensus.
2. Identify priorities for government-industry support.
3. Assist individual countries to develop action plans linking local industry and governments to ensure a sustainable response preparedness programme.

In the first phase of the programme (1991–1995), IMO and IPIECA conducted a series of seminars in various locations (Jakarta, Cairo, Caracas, Gabon, Bahrain, Curaçao, and Hong Kong) to raise government awareness of potential spill risks and need for regional and national commitment to response planning. As part of the global education programme, IPIECA produced a report series covering many aspects of oil spill response, including contingency planning, dispersants, biological impacts, and, in conjunction with the IMO, sensitivity mapping and exercise planning. The second phase, referred to as the "Global Initiative," began in Cape Town, South Africa in 1996. The intent of the second phase is to foster industry-government partnerships at national levels to establish a national response infrastructure and an NCP. IPIECA has developed a priority matrix for action based on risk, preparedness, and exposure. This has identified other regions that need support, and future seminars will be held in those regions, which will incorporate the lessons of Cape Town (Lerch, 1998). Currently, several African nations are involved in the Global Initiative, which may only have limited success in improving oil spill arrangements in these developing nations. There will be support for this programme only if a country is politically secure and economic conditions enable the country to devote adequate resources to it.

In some countries, assistance may well be essential because industry activity has caused a heightened risk. In those countries, assistance may be needed from the IMO to draft laws and regulations. Where a company has a presence, Tier 1 or 2 plans and resources should already be in place. As a result, it may not be necessary for individual, especially poorer, countries to hold fully comprehensive national stockpiles. Although the Global Initiative aims to make countries self-supporting, internal problems may prevent these countries from developing a full spill management team. Should a major spill occur, government might require external management support from an international team of specialists.

It is too early to decide whether all aspects of the OPRC Convention and the IMO-IPIECA Global Initiative will succeed. Some arrangements were tested successfully during Gulf War spills, when offers of emergency assistance were filtered, coordinated, and matched to need by IMO in London. As time passes, and as more countries ratify the OPRC Convention, it certainly should help to improve preparedness.

REGIONAL AGREEMENTS

Bi-lateral arrangements have been implemented around the world to foster co-operation in pollution planning and response among countries on a regional basis, typically those which share a common sea, such as the North Sea or the Caribbean, and are equally at risk from any oil spill incident. It is, therefore, in their best interests to plan and respond jointly.

The Bonn Agreement in the North Sea and the Helsinki Convention in the Baltic are examples of international co-operation among neighbouring countries. Additionally, there are UN-sponsored agreements in other regions of the world, including the Caribbean, South Pacific, and Red Sea. For example, the Regional Organisation for the Conservation of the Environment of the Red Sea and the Gulf of Aden (PERGSA) currently is assisting Sudan in drafting an NCP. The sharing of information on a routine basis (such as aerial surveillance) and regular international meetings have helped to develop good working relationships among participating countries. During the *Volgoneft 263* spill, emergency assistance from other participating countries in the Helsinki Convention was integrated into the response easily (Fagoe, 1991).

3.3 INFLUENCE OF OPA 90 ON IMPROVED PERFORMANCE IN THE US

National laws have assisted spill response improvements in those countries to which they apply. OPA 90 is one example, but as other countries introduce legislation to implement the OPRC Convention, response capabilities and performance should improve more widely. There have been tremendous improvements in contingency planning in the US since OPA 90 passed, including production of vessel and facility response plans and linking of government, regional, and area contingency planning. Large areas of the coast (e.g., Delaware Bay) have detailed coastal protection plans.

PREP reinforces these planning links and ensures that oil companies, vessel owners, and oil-handling facility owners: (1) conduct oil spill exercises with the USCG, EPA, and state authorities; (2) understand each others' problems and agendas; and (3) contribute to the improvement of future responses. PREP also refined the Incident Command System (ICS) to incorporate the Unified Command Structure (UCS). ICS now is practised regularly and works, although further improvements are possible. For example, in comparison with systems elsewhere in the world, ICS produces a very large management organisation that may complicate the decision-making process (Nichols, 1998).

OPA 90 requires continued reliance on mechanical recovery at sea as the primary response option, and, despite the historically poor open sea recovery record of such equipment, vessel and facility response plans still require large quantities of mechanical containment and recovery equipment for major oil spill responses at sea. During congressional hearings on OPA 90, the US Congress Office of Technology Assessment (OTA, 1990) reported:

> "Historically, it has been unusual for more than 10 to 15 percent of oil to be recovered from a large spill, where attempts have been made to recover it" (p. 1). "Improvements in mechanical recovery technologies that can be expected from stepped up Research and Development efforts are unlikely to result in dramatic increases in total oil recovered from a catastrophic spill" (p. 6).

The OTA report was not widely distributed, and its findings appear to have been ignored. As a result, Americans may well have an expectation that future major oil spills at sea will be cleaned up easily, a myth that needs to be dispelled.

Emphasising mechanical recovery may contribute to the noticeable tendency in the US to mobilise every available resource during a response, regardless of need, thus giving an impression of doing everything possible. The *Morris J. Berman* spill in San Juan, Puerto Rico in January 1994 illustrates this point well: the de-rated daily skimming capability provided was ten times greater than the worst case discharge of the Vessel Response Plan (VRP) and five times greater than the total amount of oil carried on the barge (ITOPF, 1994). During the *Kure* spill (1997) in San Francisco, California, all the cleanup contractors specified in the Area Contingency Plan were mobilised for 17 tonnes (119 bbls) of oil (ITOPF, 1998b). Such overreaction, which cannot be justified technically, may likewise be influenced by media pressure rather than by actual technical needs. This strong reaction also is fuelled by the USCG policy of "shoot first ask questions later," thus resulting in inflated response costs.

While OPA 90 acknowledges potential for increased dispersant use, it falls short of mandating dispersant use when appropriate. The resulting over-reliance on mechanical equipment has hindered responders in the past. Although dispersants cannot always be used (because of the type and weathering of oil and the proximity to particular environmental resources), international experience has shown the value of dispersants as a primary, high removal rate, rapid response technique. If dispersant use was supported more enthusiastically in the US, dispersant capabilities would become an integral part of VRPs, thus giving a more balanced armoury of open sea response tools. If this is allied to a guaranteed rapid decision-making process to authorise such use, future responses should benefit considerably.

In the offshore armoury, mechanical equipment will continue to be required on the occasions when dispersants cannot be used. Furthermore, in the inshore areas, mechanical equipment has considerable uses, particularly in the protection of sensitive areas and as a Tier 1 response at terminals. The availability of all types of mechanical oil spill equipment in the US is more than adequate, and the country probably has the best support logistics in the world to deploy it. There are ample supplies of fixed-wing transport aircraft, helicopters, trucks, supply vessels, boom-towing vessels, and recovered oil barges. Based on this, there seems to be no technical justification for the proposed 25 percent increase in mechanical equipment currently being considered by the USCG (1998).

OPA 90 was passed after the *Exxon Valdez* spill amid predictions that reputable shipowners would not trade with the US because of its potential unlimited liability provisions. These dire predictions did not happen. Though many OPA 90 provisions were controversial, those relating to planning, preparedness, and training have been effective, although more still needs to be done to increase the range of response options. The twin drivers of OPA 90 and oil companies' response to public and media pressure following *Exxon Valdez* have combined to produce improvements, although they have yet to be tested in a large spill. Nevertheless, the US should be under no illusion that when the next major spill does occur, despite all these improvements, there is unlikely to be any significant improvement in open sea response. This will only occur if early dispersant use is permitted, in the proper circumstances, as a primary response.

3.4 THE ESSENTIAL ROLE OF RESPONSE PLANNING IN IMPROVING PERFORMANCE

The need for comprehensive contingency planning is widely recognised as the fundamental element in a successful response, and, although not always fully or accurately describing the detail required, this is stressed in almost every book and paper written on oil spill management. Yet, contingency planning has not been conducted comprehensively in many countries and regions.

Without a comprehensive, frequently exercised, updated contingency plan, even the best oil spill management teams will have great difficulty improving response performance, particularly in the early stages of a spill when a team is assembling and not yet fully functioning. To be effective in these early stages, a plan must include detailed initial actions that responders can take based on a prioritisation of resources at risk. These initial actions can save many hours of discussion in a command centre and help initiate response techniques early (e.g., dispersant spraying and protective measures such as booming) while there is still a reasonable chance of success.

An effective planning regime is likely to include multiple planning levels. A national or regional plan will detail overall response policies, including response priorities, strategies, and co-ordination among subregional planning units. Subordinate plans may be specific to a port, terminal, vessel, or facility. These plans are tied to a national plan and provide specific strategies and tactics for implementing guidelines offered in an NCP. In addition to planning requirements prescribed by national governments, ITOPF (1985) and IPIECA (1991) have produced guidelines for the organisation and content of contingency plans.

Contingency plans should contain two main sections. The first, or strategy section, includes all pre-planning issues. The second, or ***operational plan,*** includes actions to be taken when a spill occurs. It is the ***strategy section*** that is so important yet so often poorly written. It should contain the following components: risk analysis, oil movement and fate, resources at risk, selection of techniques, and location of equipment and manpower resources.

Risk analysis. Risk analysis includes historical information about spills (how many, where, size, type of oil). This need not be a numerical risk analysis but a practical assessment of oil operations that may cause spills. Each operation should be specified, and the most likely and worst case situations identified.

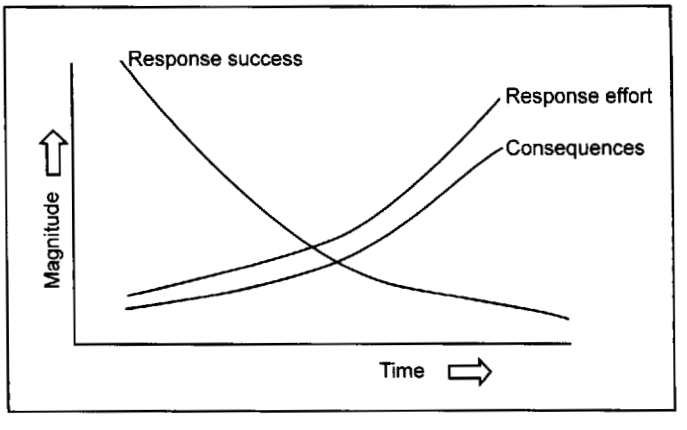
Oil movement and fate. Using the risk analysis results, planners can estimate the likely quantity of oil. The ability to forecast the wind and current and tidal conditions accurately enables a prediction of the most likely movement of oil. Knowledge of oil properties, either from crude assay sheets or spilled oil experiments, enables a prediction to be made of the likely fate of oil.

Resources at risk. By knowing the likely fate of oil, resources likely to be impacted can be identified and probable degree of impact determined. Environmentally sensitive areas, amenity areas, fishing grounds, and industrial seawater intakes should be identified and mapped. It is unlikely that all resources can be protected in a major spill; therefore, they must be prioritised. Only government authorities can make final decisions on priorities after consultation with environmental authorities and the potentially affected community.

Selection of techniques. Appropriate strategies can now be chosen to mitigate impacts. The whole coastline will need to be studied to identify access routes, shoreline types, and appropriate cleanup methods. Cleanup techniques and equipment used to implement appropriate techniques can now be determined and not, as in too many cases, before a contingency plan has identified a need. Response techniques may change with the seasons, depending on the predominant environmental risk. It is important that all participants in the planning process agree on response actions, so that when a spill occurs, these actions may be implemented rapidly. If dispersants have been included in a response strategy, the necessary pre-approvals should be sought to enable rapid authorisation and use. Where protection of sensitive areas is desired, the following items should be specified: access arrangements; location, layout, and amounts of booms and ancillaries; cleanup equipment to be employed; temporary storage locations; and disposal routes. It is equally important to identify and agree on locations that cannot be protected and why. This information will help to deflect pressure from politicians, environmental interest groups, and the media to perform either technically unsound or impossible tasks.

Location of equipment and manpower resources. Once response techniques and priorities are determined, equipment stockpiles should be identified and/or procured and situated to enable rapid deployment. To be effective, a response organisation must become operational quickly. Figure 1 shows that the later response efforts begin, the greater the effort required to control the emergency and the greater the consequences. The location of response equipment and manpower mobilisation times in a plan, therefore, should be determined by the need to react quickly. It is sometimes the case that equipment is stored in remote warehouses, and equipment and manpower mobilisation times are determined by

FIGURE 1.
THE EVOLUTION OF A RESPONSE



economy and not by operational requirements. Given the severe cost pressures within the oil industry, only government regulation, which affects all companies equally, will ensure that adequate numbers of personnel and timely mobilisation times are achieved. Once plans are completed, they must be tested regularly in exercises or responses, evaluated, and amended.

3.5 IMPROVEMENTS IN RESPONSE PERFORMANCE

While assessments of international agreements, domestic legislation, and preparedness activities are indicators of desire to improve performance, trends in response operations, management, and cost can be evaluated to provide measures of performance improvements. For this subsection, spill incidents summarised in Appendix B were reviewed to provide evidence of improvements in operational and administrative issues.

As noted previously in almost all of the cases in Appendix B, records were incomplete, and the accuracy of many of the data, especially total quantity spilled and treated or recovered, could not be verified. Nonetheless, the cases do provide sufficient information to estimate trends in performance.

OPERATIONAL ISSUES

Issues common to large spill responses were selected from the case studies in Appendix B where there has been considerable change during the past 20 years. This subsection focuses on these changes and evaluates whether there have been performance improvements. The selected issues are:

- salvage,
- offshore mechanical recovery,
- offshore chemical dispersant application,
- offshore *in situ* burning,
- shoreline cleanup, and
- computer modelling.

Salvage. Awareness has been heightened regarding the importance of adequate salvage capability in the event of a vessel emergency. In oil spill response, salvors and spill response teams always need to work closely together, as certain stages of a salvage operation may require special pollution control measures. Salvage and pollution operations should be managed together and addressed in any NCP.

There are numerous examples indicating salvage is an integral part of spill response. For example, during the *Cristos Bitos, Exxon Valdez, Kharg V* (1989), *Aegean Sea* (1992), *Sea Empress,* and *Morris J. Berman* spill responses, salvors prevented a potential complete loss of cargo and, therefore, an even greater response effort. On other occasions, drifting or aground vessels have been rescued with no oil, or no further oil, being spilled. In Australia in 1991, the *Kirki,* which had been abandoned by its crew with the remaining cargo still onboard, was rescued by salvage tugs when only 2 miles off the west Australian coast. The cargo was successfully offloaded at sea by salvors.

Maintaining ready salvage capability is a very expensive proposition, and payment to support these vessels is always a difficult matter. Specially chartered tugs are available on standby status in some areas, such as in France since the failure to rescue the *Amoco Cadiz* before she grounded. The UK government also charters tugs during the winter months, one of which, the *Far Minerva,* pulled the tanker *Santa Anna* off the rocks at Torbay, Devon in January 1998. There are numerous other examples where pre-positioned salvage tugs have saved vessels.

There always will be a need for a healthy salvage industry, especially when the likelihood of the need for salvage support in a given area is very remote. Thus salvage capability worldwide continues to erode, while government and industry continue to ponder equitable schemes to maintain it. Marine accidents will never be eliminated entirely because humans are fallible and continue to make mistakes.

Offshore mechanical recovery. According to conventional wisdom, the use of offshore mechanical recovery equipment at an oil spill at sea rarely will collect more than 10–15 percent of the amount spilled. In most cases, the amount recovered at sea will be much less than this, with a range of 1–6 percent being much more common. This is attributed more to the laws of physics than to the responders' competence. Oil spreads so rapidly that, unless it can be contained close to the source, the slick will very quickly approach such proportions that it will be impossible to boom and skim.

An oil slick never remains static; it spreads under the influence of tides, currents, and wind, losing coherency and breaking into smaller, widely dispersed patches. Most often by the time a response can be mounted, it becomes impossible to do more than clean up small parts of a spill. For example, at first light during the *Exxon Valdez* spill, the slick had grown to 8 square miles or just over 2.5 miles in diameter. If four offshore recovery vessels had been available immediately, operating at their maximum skimming speed of 1 knot, it would have taken approximately 24 daylight hours, or 2 to 3 skimming days, to sweep through the entire slick.

In all the cases reviewed in Appendix B, only a small proportion of oil was removed from the water surface. In the *Exxon Valdez* spill, very little oil was recovered on the water despite mobilising the largest amount of mechanical containment and recovery equipment ever assembled. On a smaller scale, only 2 tonnes (14 bbls) of oil were recovered of the 17 tonnes (199 bbls) spilled from the *Kure* despite mobilising a large amount of offshore cleanup equipment and shoreline protection equipment. Yet in the US and other countries such as Norway, mechanical containment and recovery at sea remain the preferred response despite rarely being very successful. In countries that are signatories to the CLC and Fund Convention, very large offshore cleanup efforts may not be considered "reasonable" given this low probability of success. Compensation from the funds may very well not be forthcoming as a consequence. Given the weight of evidence, it is

unclear why so much reliance has been placed on this technique in the US.

The following are two exceptions to poor mechanical recovery results:

- The 1,000-tonne (7,000-bbl) spill from the vessel *Volgoneft 263* in the Baltic in 1991, in which almost all spilled oil was recovered (Fagoe, 1991).
- The 80 percent recovery of heavy fuel oil from the tanker *Katina* in the North Sea in 1982.

On both occasions, the weather was favourable, and the oil slick remained intact. In a more limited way at the *Mega Borg* spill (1990), ORSL crews recovered 375 tonnes (2,625 bbls) of oil in 3 hours. As described earlier, the laws of physics, together with factors such as the time late at the spill, weather and currents, oil spreading, low oil encounter rate, and inability to contain it will reduce the chance for success, despite the best efforts of response personnel.

Offshore chemical dispersant application. In responses where the oil type and environmental situation make dispersant use the most appropriate technique, evidence from the case histories in Appendix B shows that dispersants provide the best means of high-rate oil removal from the sea surface. In these circumstances, the toxic effects of dispersed oil do not appear to be significant. This has now been sufficiently well documented as to counter the anti-dispersant argument. There is still much ignorance about dispersant toxicity, which is still being quoted in Alaska as "using a toxic material to disperse another toxic material" (OSIR, 1998a). The marginal costs of aerial application make it the most cost-effective response method as well, although the high cost of retaining aerial application systems at short notice is wasteful unless it can be shared, as is the case in Tier 3 response bases. Another cheaper alternative, where such planes are available, is offered by the use of crop spraying aircraft such as the Australian FWADC.

To date, only Singapore and the UK have used dispersants on a very large spill. No figures have been released for the amounts of oil dispersed from the *Evoikos* in Singapore. In the UK, dispersant use was extremely effective on Forties crude oil during the *Sea Empress* spill (Table 2) and made a major contribution to reducing shoreline oiling and cleanup costs. Successful dispersant use during the *Sea Empress* response appears to confirm the results from earlier uses *(Sivand, Phillips Oklahoma,* and *Rosebay)* in which significant proportions of spills were dispersed.

TABLE 2.
DISPERSANT EFFECTIVENESS IN LARGE-SCALE APPLICATIONS

VESSEL	SPILLED OIL		DISPERSED (%)
	tonnes	bbls	
Sivand	6,857	48,000	16–33[1]
Puerto Rican	6,857	47,999	20–30
Phillips Oklahoma	901	6,307	100[1]
Rosebay	1,100	7,700	60[1]
Sea Empress	72,000	504,000	24–52

[1] Includes natural dispersion and evaporation.

In the US, dispersant use has never been prohibited completely; however, the decision process for dispersant use has been so cumbersome as to make the decision regarding its use unworkable. Over the last 4 years, every region of the US has adopted some form of pre-approval or expedited approval process for dispersant use. In the near future, dispersants are expected to be used more frequently to combat spills in the US. Inclusion of a dispersant equipment capability may be mandated by the USCG as part of the 25 percent increase in the capacity requirements of VRPs (USCG, 1998). The experience of the UK and Texas should help to sway the doubters. For example, in the Gulf of Mexico, dispersants have been used on at least three spills in the past few years: High Island Pipeline (1998), *Red Seagull* (1998), and South Pass Pipeline (1989). UK and US response successes have shown, in the right circumstances and on the right oils, dispersants can have a much more positive influence on an offshore spill than other techniques. In areas where use is allowed, investment in dispersant spraying has been worthwhile.

A strong case can be made for a more positive attitude toward immediate dispersant use in suitable areas by national authorities. New dispersant formulations are increasing efficacy on heavier and more weathered oil, including heavy fuel oils (OSIR, 1997a). The 1:20 dispersant:oil application rate has been shown in some cases to be excessively conservative, and windows-of-opportunity for spraying are becoming longer. During a January 1998 spill in Nigeria, scientists from AEA Technology observed the chemical dispersion of a 6-day old slick, 200 km from the spill site (OSIR, 1998b). Norway, although retaining its preference for mechanical recovery, is considering dispersant use seriously. A recent exercise in Spain (Exercise Cadiz 97) demonstrated that, given the weather conditions likely to be experienced on the Atlantic Coast and high tidal speeds prevalent in some sensitive areas, dispersant spraying might be the only effective offshore response technique.

Offshore *in situ* burning. Burning at sea is unlikely to be more than a niche technique. *In situ* burning depends on containment of oil; therefore, the technique suffers from all the well-known problems of offshore containment. If oil can be contained for burning, it also can be contained for mechanical recovery. If conditions are suitable for offshore recovery, there seems little purpose in burning oil, unless it has not been possible to obtain certificated oil spill recovery vessels and storage barges.

In calm or otherwise confined waters, *in situ* burning may have considerable value. Its utility has been observed for spills on ice and in marshes (Hyde *et al.*, 1998; Pahl and Mendelssohn, 1997). Current fire booms suffer from problems that are not experienced by conventional booms. They are extremely bulky so transport to a spill site can pose logistical problems, and fire booms are not very durable, though recent developments are promising (OSIR, 1998c).

Shoreline cleanup. Before discussing shoreline cleanup, it is important to understand that oil spills are not long-term environmental disasters in the way that, for example, the permanent loss of land habitats to development can be. This is because, in most cases, spill damage will recover naturally over a period of time. Scientific studies conducted after many major spills confirm this. "The recovery times for most spills will be between 3 to 5 years, regardless of whether they had been cleaned or not" (Baker, 1997). One year after the *Exxon Valdez* spill, Baker *et al.* (1990) reported that:

> "Our experience in Prince William Sound, one year after the spill held few surprises..."
> "Only a portion of the shoreline had been oiled, and, as with most other oil spills, the bulk of the damage had disappeared in the first year. The area retains its natural beauty; there are abundant signs of plant and animal life, and recovery is underway in even the most severely impacted beaches..."
> "Since there are few sheltered areas with extensive mudflats, which elsewhere have sometimes taken a long time to recover, the overall impact of the oil spill on the environment of Prince William Sound and the Gulf of Alaska, is likely to be short-lived."
> "If it is allowed to proceed without interruption, it will continue and be robust, as it has been, following other oil spills throughout the world."

Two years later, Baker *et al.* (1992) reported:

> "Oil impacts are short term. Concerns that damage which is not currently apparent will appear in future years is not supported by scientific evidence from any previous spills."

Following the *Braer* spill, an environmental report by the Ecological Steering Group on the Spill in South Shetland (ESGOSS, 1994) stated:

> "Overall, the impact of the oil on the environment and ecology of South Shetland has been minimal. Adverse impacts did occur, but were both localised and limited. The resilience of the ecosystems and species populations has already been powerfully demonstrated and provides confidence and reassurance for the future."

In all the spills in Appendix B when oil came ashore, it was ultimately cleaned up or left to nature. Over the past 20 years, shoreline cleanup equipment improved, became more readily available, and was used extensively to cleanup spills. It has been recognised, however, that aggressive cleanup techniques often cause more environmental damage than they prevent (Baker *et al.*, 1992; OSIR, 1998d). This recognition, coupled with increased research into the environment effects, has shifted emphasis during spill response to reducing spill impacts.

Shoreline cleanup is not an exact science, and there is always room for disagreement on the best cleanup methods in a given situation. Recently, there has been a growing realisation, particularly in Europe, from an environmental benefit standpoint that, wherever possible, the shoreline should be allowed to self-clean. This has normally been the case in high-energy areas such as cliffs and exposed rock platforms and very low-energy areas such as salt marshes, where any cleaning is likely to cause unacceptable damage. Yet as recently as 1997, it was reported that at Martinez, California, marsh cleanup was occurring following a pipeline rupture. It also was reported that cleanup could last a year and that the heavy equipment being used (and pipeline repair equipment) was driving oil into the marsh mud (OSIR, 1997b).

Self-cleaning decisions are becoming more common in other lower-energy areas, especially if oil and fine particle interaction (clay oil flocculation) is occurring. In these situations, careful removal of bulk oil may be required to reduce the smothering effect (for example, in rock pools) and prevent oil migration to previously clean or more sensitive areas. Aesthetic reasons alone are no longer sufficient to require aggressive cleanup, except in amenity areas that must be cleaned to a high standard.

In the most recent major spill (*Sea Empress*), minimum shoreline cleanup was conducted. In a detailed report on the spill, the *Sea Empress* Environmental Evaluation Committee (SEEEC, 1998) found that there were few signs of significant long-term damage. Thus it may be concluded that this was an effective shoreline cleanup response because "the inevitable environmental impacts were not made worse by inappropriate or intrusive cleanup techniques."

Computer modelling. Computer models are useful indicators of likely oil movement. Because of the extreme difficulty and cost of modelling and the variations in tides and currents (particularly close to the coast), models are unlikely to have the ability to predict exact spill movement and, hence, beaching locations with complete and repeatable accuracy. In addition, seasonal variations of ocean currents are very difficult to predict. Unless local observation can be fed into the model at the time of a spill, variation can cause the model to predict oil movement in the opposite direction from what actually occurred. Models are usually very good at showing what happened after an event and can be useful in contingency planning to show the most likely direction of oil movement. There is, however, no substitute for regular visual or remote sensing of exact oil position and movement.

ADMINISTRATIVE ISSUES

Along with the technical, operational issues of an oil spill response, effective administration is essential. Two administrative issues — management and cost — were selected from the case studies in Appendix B because of the magnitude of change that occurred in recent years. For example, the topic of response management was the subject of an issue paper for the 1995 International Oil Spill Conference (Walker *et al.*, 1995). This subsection evaluates whether there have been performance improvements.

Response management. It is axiomatic that, unless an oil spill response is managed successfully, as with any other human endeavour, it will fail both technically and in the minds of the public. Various management systems exist for co-ordinating various spill response activities. For example, the ICS with a UCS is now universal in the US. Other systems are in use elsewhere, tailored to their national requirements. There is no correct way to organise and manage a spill: it is much more important for all personnel to be competent, understand their roles, and have practised regularly in drills and exercises. The value of exercises was well demonstrated at the *Sea Empress* spill, where the core of the response team had regularly exercised together over many years. The ensuing teamwork contributed greatly to response success (author's personal observation).

A poorly managed response is unlikely to be successful even with unlimited access to the most modern equipment and resources. Conversely, a well-managed response with well-trained personnel can result in a successful response in spite of obsolete or makeshift equipment. This seems obvious, yet there are still places where it is not understood. The retention of experienced personnel in the planning and response stages should be beneficial, for example, from ITOPF and Tier 3 response bases.

Well-trained, effective teams can make a successful response. Developing good working relationships among government, responders, regulatory bodies, and environmental groups is one of the key elements necessary for response improvements. Effective training and a carefully devised, progressive series of exercises (such as PREP in the US) can achieve performance improvements.

Response costs. There is no obvious link between cost and spill size. In general, a small spill will cost more per tonne than a large spill, probably because there are no economies of scale for small spills. Many factors influence the magnitude of these costs (Etkin, 1998a, b), including the following:

- amount of oil spilled,
- type of oil,
- location and timing of the spill,
- sensitive areas affected,
- liability limits in place,
- ability of the spiller to pay,
- local and national laws,
- cleanup techniques employed,
- weather during the cleanup operation, and
- human decisions.

Other factors could include local rates of pay and equipment purchase and hire costs. Table 3 lists a number of spills that occurred in various parts of the world since 1977. Using such a small sample, it would be difficult to draw too many conclusions. Since the *Exxon Valdez* spill, the average cleanup cost of oil spills worldwide has more than doubled, while in the US, the average cleanup cost has increased fourfold. Why should costs in the US apparently escalate by so much in comparison to the rest of the world? Table 3 draws attention to the widely varying spill response costs in the US compared to the rest of the world. There are bound to be differences in costs among countries, but, when the differences become great, there is a legitimate interest in analysing the reasons, some of which could include:

1. The aggressive "shoot first ask questions later" policy advocated by the USCG (Appendix B, *Morris J. Berman* spill).
2. Irrational media and public pressure demanding action (Section 4).
3. Technically unsound, or unreasonably large, response actions made in response to this pressure, such as overcleaning of beaches and steam cleaning of shorelines in a cold environment (Appendix B, *Exxon Valdez* spill).
4. Favourable or less unfavourable media response to such over-reaction (Appendix B, *Kure* spill).
5. Vociferous environmental interest groups that either do not understand, or do not wish to understand, the realities of oil spills. These same people often choose to ignore scientific data when they conflict with dearly held prejudices. The dispersant argument is an obvious case (Section 3.5).

TABLE 3.
COSTS OF SELECTED LARGE SPILLS

YEAR	SPILL	SPILL SIZE tonnes	SPILL SIZE bbls	CLEANUP COST (1997 $US)	COST PER TONNE SPILLED (1997 $US)
1979	**Burmah Agate**	36,395	254,765	15,351,510	421
1980	*Tanio*	17,313	121,191	148,652,180	8,471
1984	**Alvenus**	10,088	70,616	67,617,000	7,122
1984	**Puerto Rican**	6,857	47,999	6,811,968	612
1985	*Patmos*	2,000	14,000	12,608,167	6,304
1989	**Exxon Valdez**	37,415	261,905	2,635,000,000	90,145
1990	**American Trader**	1,418	9,926	12,780,000	10,866
1991	*Haven*	142,857	1,000,000	199,765,555	1,637
1991	**Tenyo Maru**	588	4,116	15,587,960	26,096
1992	*Aegean Sea*	74,490	521,430	27,633,500	421
1993	*Lyria*	2,721	19,047	7,749,000	2,572
1994	**Morris J. Berman**	2,684	18,788	91,659,000	34,150
1994	*Seki*	16,000	112,000	11,017,852	688
1994	*Apollo Sea*	2,596	18,172	6,500,000	2,700
1995	*Sea Prince*	1,401	9,828	25,142,090	17,941
1995	*Yuil No. 1*	2,597	18,178	15,281,537	5,883
1996	*Sea Empress*	72,000	504,000	30,922,375	427
1997	*Nakhodka*	6,201	43,407	171,872,000	27,718
1997	*Nissos Amorgos*	8,571	59,997	29,860,000	3,483
1997	*Evoikos*	28,571	200,000	10,786,500	377
1997	**Kure**	17	119	12,000,000	705,882

Note: US spills in bold.

6. High labour rates and equipment hire costs.
7. An RP's Qualified Individual being provided from the OSRO, which might have led to conflicts of interest (OSIR, 1997c).
8. Spill expenditure is in the hands of an RP or his cleanup contractor. Once an RP's limit of liability is reached, provided that the shipowner can limit his liability, funds are provided from the Oil Spill Liability Trust Fund (OSLTF). As it is no longer an RP's money, there is little incentive to economise (de Bettancourt *et al.*, in press). By comparison, the international compensation conventions, CLC and IOPC Fund, have a requirement that cost recovery should only be available for actions judged to be technically reasonable. There is an external oversight mechanism to assist in cost control, with highly experienced agents, normally from ITOPF, appointed by the Protection and Indemnity (P&I) Clubs and the IOPC Fund to note which activities are considered to be reasonable. Although the OSLTF also has a similar requirement to provide reimbursement only of reasonable costs, the oversight appears to come from the UC, led by the USCG, which is not a disinterested party (see 1 above).
9. The utilisation of massive resources is a national characteristic. Anything is possible if enough resources are used to deal with a problem.

The Britannia P&I Club has been moved to observe that,

> "In the United States, there is now a major series of industries which make their money out of oil spills, and in whose interest it is to whip up the greatest possible level of hysteria so as to try to justify the spending of ridiculous amounts of money..." (OSIR, 1998e).

Despite "objective evidence" that ships are spilling less oil and that properly handled spills cause little long-term environmental impact, in the US:

> "Shipowners are treated as criminals; cleanup is about contractors making money and politicians or bureaucrats making reputations; and large and arbitrary penalties are being imposed, either as fines or NRDA Compensation for long term damage which does not exist and cannot be measured in dollars, or paid to those who suffer" (OSIR, 1998e).

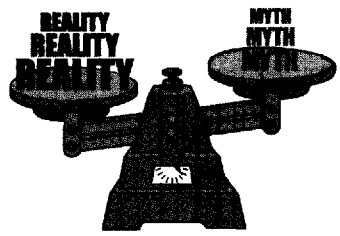
As the response to the *Sea Empress* demonstrated, it is a myth that all spill responses must have massive resources and be vastly expensive to be successful. The reality has been that other factors often unrelated to the technical merits of the spill have driven costs upwards. In the US, the view that it should not be necessary to respond with such massive resources and large response teams has never reached the agenda. Has the US been out of step with the rest of the world, or has the rest of the world been out of step with the US? Recently, there have been encouraging signs that the reasons for cost escalation in the US are now beginning to be critically questioned. It is hoped that this will lead to a full review of how responses are managed and ultimately to a reduction in how much they cost.

3.6 IMPROVED PERFORMANCE CONCLUSIONS

MYTH OR REALITY? HAVE INCREASED RESPONSE CAPABILITIES RESULTED IN IMPROVED PERFORMANCE?

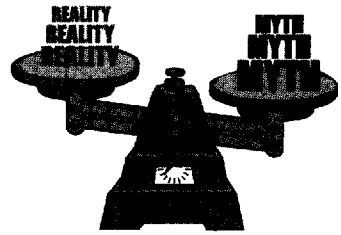
As discussed earlier, the lack of comprehensive, accurate information following spill responses creates major difficulties in quantifiably determining if performance improvements have occurred. Consequently, the conclusions below are qualitative and based on case studies along with the author's experience and input from spill response professionals.

MYTH OR REALITY? HAVE INTERNATIONAL CONVENTIONS AND AGREEMENTS IMPROVED PERFORMANCE?

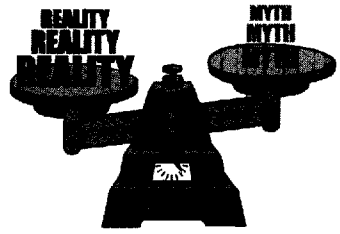


There have been performance improvements as a result of the adoption of international conventions and agreements. The development of the OPRC Convention signifies international commitment to preparedness planning, and the establishment of equipment stockpiles worldwide is a major improvement. Regional agreements such as the Bonn Agreement and the Helsinki Convention provide further evidence that governments are making commitments toward improvement.

While some aspects of conventions and agreements have begun to be implemented, all provisions of these agreements are not yet in place. Further initiatives to implement them have not spread throughout the world.



MYTH OR REALITY? HAS OPA 90 IMPROVED PERFORMANCE?



In the US, OPA 90 has resulted in improved performance, most notably in preparedness because of the emphasis on contingency planning and exercises. OPA 90 also has resulted in increased discussion on dispersant use as another response technique available to responders. Although dispersant use needs more promotion, OPA 90 can be credited with providing the first step toward improved acceptance of dispersant use.

OPA 90 continues to place reliance on mechanical containment and recovery as the primary means of response. This reliance has resulted in false performance expectations on the part of the public and the response community.

Myth or Reality? Has response planning resulted in improved performance?

There have been major improvements worldwide in the acceptance that contingency planning is the fundamental element in a successful response. Further improvements have been made in recognising that planning is an iterative process involving a series of specific steps, exercise, response, and continuous evaluation.

Contingency planning has not been conducted in a comprehensive way in many countries and regions. More work needs to be done to develop contingency plans that includes risk analysis, forecasts of oil movement, identification and prioritisation of resources at risk, and commensurate selection of response techniques.

Myth or Reality? Has response performance improved?

The heightened awareness of the critical role that salvage plays in response to large oil spills should contribute to improve performance. There have been improvements in the use and development of mechanical containment and recovery equipment and in its regional availability. Improved acceptance and use of dispersants and *in situ* burning as a response technique have been recognised. It is a reality that management of a spill response has improved when the responders have planned and exercised together. Finally, there has been greater care given to the selection of appropriate techniques for shoreline cleanup by bringing Net Environmental Benefit Analysis (NEBA) into the decision-making process.

There continues to be an over-reliance on mechanical containment and recovery for offshore spills in many regions of the world as the technique of choice. Along with this is a continuing reluctance to consider using dispersants as a primary or even complementary response technique for offshore spills. *In situ* burning is not an effective response technique for responding to offshore spills. Finally, costs continue to increase, and there appears to be no mechanism to determine technical reasonableness.

SECTION 4

MYTH OR REALITY? HAS IMPROVED PERFORMANCE HAD A POSITIVE EFFECT ON POLITICAL, MEDIA, ENVIRONMENTAL, AND PUBLIC PERCEPTIONS?

The media, environmental interest groups, and the public harbour a deep-rooted suspicion of the oil industry. Although it is not the purpose of this paper to analyse the reasons for this suspicion, this suspicion requires some examination because it makes it difficult for the oil and spill response industries to the present their viewpoints positively.

In the eyes of the public, oil tankers are an integral and inseparable part of the oil industry. Thus, when a tanker accident occurs, public outrage frequently is directed against oil companies, despite only a minority of oil tankers being owned by oil companies and the legal liability for a spill resting with a shipowner. It is very difficult to put a positive spin on the position of companies that, by their own admission, have sold their oil tankers to avoid liability and save money. This is perceived as an avoidance of responsibility, which deepens suspicion. If another objective was to protect the companies' reputations, it may fail.

Whether out of fear, ignorance, or apathy, government and industry partners in response seem to have failed to inform the public effectively about the realities of oil spill response:

- Spills will continue to happen.
- Oil will come ashore.
- Aggressive shoreline cleanup in sensitive areas may be the worst response option.
- Doing nothing may be preferable.

Neither politicians and government agencies dependent on public funding nor oil companies for commercial reasons typically espouse such technically correct but unpopular views publicly. Long-term educational programmes are needed to change the public's attitudes and perceptions about spill impacts and response capabilities. Such programmes will be difficult to implement, given the public's general misperception and deep-rooted suspicion of both government and industry. The public reluctantly accepts that the price of the automobile culture is congestion, air pollution, and road casualties but does not accept that this price also includes large-scale oil transport at sea with inevitable tanker accidents, however rarely they occur. The public also does not understand that the proportion of oil spilled to oil carried is minute, and seafarers are human and, therefore, prone to error. The public does not accept that oil cannot be cleaned up at sea completely, and environmental effects of a spill normally are short term. Media and environmental interest groups continue to perpetuate incorrect and misleading views, and the oil industry seems unable or unwilling to refute them.

4.1 HAS IMPROVED PERFORMANCE HAD A POSITIVE EFFECT ON POLITICAL PERCEPTIONS OF OIL SPILLS?

Probably only in the US has an oil spill (*Exxon Valdez*) had such a major political impact. The slowness and inadequacy of the initial response in an area of unspoiled natural beauty (Prince William Sound, Alaska) must have affected the national psyche profoundly. Such events usually elicit a swift political reaction. In the US, that response was OPA 90. Other countries' reactions were more measured. Although the OPRC Convention was adopted by the IMO in 1990, the provisions are being implemented slowly worldwide. The provisions were never headline news or high-profile issues. Even in the UK following the *Braer* and *Sea Empress* spills in remote and beautiful areas, the political reaction was muted.

In the US, Europe, and Australia, government civil servants, rather than appointed or elected ministers and politicians, have reacted positively to efforts by the oil and spill response industries to co-operate with national administrations in establishing and maintaining adequate response capabilities, such as the OSRL base in the UK and AMOSC in Australia. The IMO-IPIECA Global Initiative (discussed in Section 3.2) has had a positive effect on administrations in regions where seminars

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have been held on response planning. In the US, PREP, which was jointly designed by government and industry, has had a similar positive effect on federal and state authorities and their relations with industry.

4.2 HAS IMPROVED PERFORMANCE HAD A POSITIVE EFFECT ON MEDIA PERCEPTIONS OF OIL SPILLS?

Media response to an oil spill varies and is unpredictable. Some spills, including those from the *Amoco Cadiz, Exxon Valdez,* and *Braer,* attract massive and protracted international media interest. For others, such as the *Aegean Sea* spill, the international media interest fades quickly. Sometimes, media interest is almost non-existent, such as at the *Aragon* spill that oiled the tourist island of Porto Santo in the Canary Islands during winter.

The media may have little to say about the responsibility for a spill. At the *Braer* spill, Ultramar escaped virtually unscathed; yet, at the *Sea Empress* spill, the following headline appeared 1 week into the response:

> "Built in Spain; owned by a Norwegian; registered in Cyprus; managed from Glasgow; chartered by the French; crewed by Russians; flying a Liberian flag; carrying an American cargo; and pouring oil onto the Welsh coast. But who takes the blame?" (Cusick *et al.,* 1996)

The reality is that the way a response is presented by the media does matter, as shown in the following example:

> *"Exxon Valdez* is used by other oil companies as an example of how not to deal with the media."
>
> "The company's [Exxon's] public relations performance at the time of the [*Valdez*] disaster was dismal. Mr. Larry Rawl, the then Chairman, declined to visit the site, saying that it would make no difference to the cleanup operation. That led to scathing treatment in the press, to the extent that the *Exxon Valdez* incident is used by other oil companies as an example of how not to deal with the media in the aftermath of oil spills" (Corzine and Waters, 1994).

Companies' response performance as reported in the media and commented on by environmental interest groups can determine public reaction and influence political opinion. Adverse reporting, therefore, may lead to reactive legislation imposing additional, possibly unnecessary, regulations and costs on the oil and shipping industries. A sound media response policy is essential.

The media do not normally notice any improvement in spill response capabilities because the availability of such capabilities is not news. Local media may run stories about the expansion of facilities at a nearby response base, but this will not reach the world media, even if the response base is international. In a major oil spill, the existence of response resources may be mentioned, but reports rarely acknowledge any improvement in resources. The media are more interested in apportioning blame. Unless oil is prevented from reaching the shore, response has failed in the media's perception. Occasionally, however, a response will get good press because numerous response resources were used on a small spill, even though the response was not especially effective, such as during the *Kure* spill. In a telling comment, the *Kure*'s P&I Club said, "Our spill management got good press, and satisfied the Unified Command" (OSIR, 1997d), but there was no mention of protecting the environment. Has "good press" become the top priority? If so, there will never be any chance of a sensible scale for reasonable response cost containment.

Positive media reaction is possible and potentially important to every spill response. Significant effort, therefore, should be devoted to media issues during both contingency planning and response. This effort should focus on ensuring actions that can foster positive media reaction, such as the following:

1. open but decisive management, particularly early in a spill;
2. a well-prepared contingency plan;
3. a well-conducted cleanup operation, which should not be confused with a technically and environmentally unsound overreaction;
4. a well-thought out and -reasoned media response strategy;
5. consistent, honest, factual accounts of operations by senior response managers;
6. clear evidence of good co-operation among various agencies involved in a response;
7. prompt release of factual information;
8. involvement of local community and environmental interest organisations in the contingency planning process, which should help to educate potentially antagonistic groups about the realities of spill response and environmental damage and recovery, and assist in reducing sources of public criticism; and
9. serious, well-advertised, cost-effective spill prevention programmes to help assuage public attitudes.

4.3 HAS IMPROVED PERFORMANCE HAD A POSITIVE EFFECT ON ENVIRONMENTAL INTEREST GROUPS' PERCEPTIONS OF OIL SPILLS?

Environmental interest groups mobilise and easily prejudice public opinion against the best scientific and technical oil spill response solutions. These groups exert influence on political

opinion as well. This is not to decry their usefulness: environmental interest groups have raised general environmental awareness. This, in turn, has helped to raise performance standards, often against strong industrial opposition. Perhaps as George Bernard Shaw observed "All progress depends on the unreasonable man."

Currently, environmental interest groups in the UK are less vociferous. At the *Braer* spill, Greenpeace was active with an information desk in the press centre; in contrast, at the *Sea Empress* spill, Greenpeace activities were less obvious. Scientific evidence shows that oil spills are not the long-term environmental disasters as once predicted, and some environmental interest groups acknowledge this. Immediately after the *Braer* spill, under the headline "Worse things happen on land," Friends of the Earth stated that other environmental matters should command a higher priority because "however horrendous the short-term impacts, damage from such an oil spill is reversible. Which is more than can be said of [the permanent loss of] unique habitats" (Porrit, 1993). At the *Kirki* spill in Australia, the author observed a Greenpeace representative being shouted down by local fishermen for being critical and negative, by arriving late, and not offering assistance. She was compared adversely to government responders who had kept the fishermen informed and involved in the response. At the Edinburgh International Television Festival, it was reported that "television news executives are to take more care over the future reporting of Greenpeace activities" since the executives were "embarrassed and exploited by the pressure group over the *Brent Spar* story" (Brown, 1995). The British Broadcasting Corporation (BBC) will no longer use film taken by environmental interest groups because footage may be selective and partial (Panton, 1998).

In Europe, some environmental interest groups may be less powerful now than in the 1980s. This may change, particularly with new political alliances in power (for example, the inclusion of the Green Party in the German government after the 1998 elections). These groups' reduced importance does not seem to have occurred in the US, where interest groups exert a powerful influence over public opinion, politics, and regulations. If environmental interest groups can make spills into issues and, hence, raise funds, then it is a myth that improved response performance will influence these groups in the long term.

4.4 Has Improved Performance Had a Positive Effect on Public Perceptions of Oil Spills?

It appears to be a late twentieth century phenomenon in the developed world that certain situations are exaggerated. When the *Sea Empress* spill was described as a "spreading tide of ecological devastation" (1996), the public had no other sources against which to verify this information. Unbalanced media reporting stimulates already offended public sensibilities, which feeds the media frenzy in an ever-increasing spiral. This can cause unwarranted economic effects, for example, on the tourist industries of many coastal areas. At the *Aragon* spill in the Canary Islands, the Portuguese government ensured that the media took little or no interest in the spill because of the economic damage that could have been caused by irresponsible, dramatic reporting. By the tourist season, the beaches were "clean" again. Likewise, the Singapore government played down the *Evoikos* spill because there was minimal effect on the shoreline.

Perceptions also can be formed from the actions of environmental interest groups. Ordinary people throughout the world are outraged by oil spills and offended by the images of dead or dying creatures. They cannot understand why oil cannot be removed completely or environmental damage cannot be prevented. In particular, it is said that Americans find it difficult to accept that the nation that put a man on the moon cannot clean up an oil spill better than anyone else does. The public has unreasonably high expectations of what can be achieved during a spill response. Well-meaning but ill-informed public opinion is susceptible to environmental interest groups and the media. Being unaware of response improvements and suspicious of oil companies prevents improvements from having a positive impact on public opinion.

4.5 Positive Perception Conclusons

Myth or Reality? Has improved performance had a positive effect on political, media, environmental, and public perceptions?

As far as it can be ascertained, it is a myth that increased response capabilities have had significant impact on media, environmental, or public perceptions. In the political arena, some progress has been made in creating the necessary climate of trust and co-operation in many areas of the world.

To overcome the suspicion of the media, environmental interest groups, and the public, an education campaign is necessary, which may take a generation to have an effect. It must begin with a universal international determination to ensure that only the highest quality designed, built, maintained, and manned tankers are used for oil transport. The realities of spill response must be explained, and oil spills must be placed in perspective compared to other accidents. Perhaps this process should start in the schools, where impressions formed can last a lifetime. Until this message is well understood, the expectations of what can be achieved in an oil spill cleanup will remain unrealistically high, and no response will be perceived as successful.

SECTION 5

CONCLUSIONS AND RECOMMENDATIONS

This paper examines whether improvements in response capabilities and performance over the past 20 years have been a myth or a reality. Specifically, is it a myth or reality that:

- Response capabilities to clean up large spills have improved over the last 20 years?
- Increased response capabilities have resulted in improved performance?
- Improved performance has had a positive effect on political, media, environmental, and public perceptions?

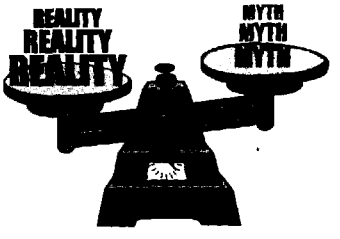
The approach used to achieve the paper's objectives was to integrate information from available literature on major oil spills with the practical experience and personal observations of the author and spill response professionals. The intent was to provide a well-reasoned basis for determining whether the critical issues are myths or realities.

It has been 21 years since the *Amoco Cadiz* spill polluted the Brittany Coast and 10 years since the *Exxon Valdez* spill in Prince William Sound, Alaska. In the aftermath of the *Amoco Cadiz,* the oil industry and governments around the world strove to improve spill response capabilities by greatly increasing response equipment availability. After the *Exxon Valdez* spill, there was renewed determination to improve spill response performance by focusing not only on equipment but also on co-operative planning and management as well. The goal in both cases was to improve response performance, especially the public's perception of effective performance. This paper presents evidence of changes in oil spill response since the 1970s and evaluates whether these changes achieved their intent — improvements in capabilities, performance, and perception.

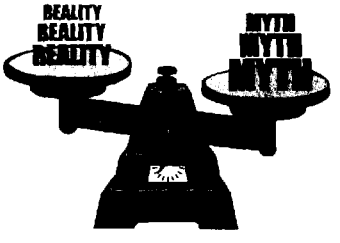
5.1 CONCLUSIONS

IS IT A MYTH OR REALITY THAT RESPONSE CAPABILITIES TO CLEAN UP LARGE SPILLS HAVE IMPROVED OVER THE LAST 20 YEARS?

There has been a tremendous increase in the quantity of oil spill response equipment in many parts of the world. These increases are attributed directly to the actions of several nations and industry implementation of the tiered response concept worldwide. Improvements also have been made in contingency planning and spill management arrangements. A number of international and bi-lateral agreements have been concluded concerning co-operation among countries in the event of oil spills (Appendix A). Neither planning and management advances nor increases in equipment stockpiles have been universal. So, is it a myth or a reality that response capabilities have improved over the past 20 years?



It is a reality for certain nations and regions of the world. Many nations, especially those that have experienced a major oil spill, have devoted much effort to developing a well-resourced and exercised NCP. In general, the oil spill response plans and capabilities in those countries have improved.



It is a myth for certain nations and regions of the world. There are some areas of the world where there has been very little performance improvement over the past 20 years. Either because of lack of national resolve or resources, the necessary planning has not occurred in many countries. In the absence of such planning, resource and infrastructure improvements are difficult, if not impossible, to achieve. If equipment alone has been procured, then this can lead to a false sense of preparedness.

IS IT A MYTH OR REALITY THAT INCREASED RESPONSE CAPABILITIES HAVE RESULTED IN IMPROVED PERFORMANCE?

There have been improvements throughout the world in international co-operation, contingency planning, spill management arrangements, dispersant efficiency and methods of aerial application, provision of equipment, and training of personnel. For all these things to come together perfectly in one plan or during one spill is rare.

There have been performance improvements resulting from the adoption of international conventions and agreements. The development of the OPRC Convention signified international commitment to preparedness planning. The establishment of industry-owned national and regional equipment stockpiles is

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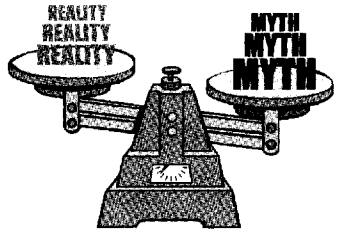
a major improvement. Regional inter-governmental agreements such as the Bonn Agreement and the Helsinki Convention provide further evidence of international commitment to improvement.

In the US, OPA 90 has resulted in improved performance, most notably in preparedness because of the emphasis on contingency planning and exercises. In the US, OPA 90 has increased discussion on dispersant use as another response technique available to responders. Although dispersant use needs more promotion, OPA 90 can be credited with providing the first step toward acceptance of dispersant use throughout the US.

There have been major improvements in some areas of the world in accepting detailed contingency planning as the fundamental element in a successful response. Further improvements have been made in recognising that preparedness is an iterative process involving a series of specific steps: planning, exercise, response, and continuous evaluation.

There is a need to maintain an awareness of the critical role that salvage plays in large spill responses and to closely coordinate the actions of salvors and spill responders, which should contribute to improved performance. There have been improvements in the use and development of mechanical containment and recovery equipment, particularly in coastal protection, and there have been significant improvements in its regional availability. There is a growing awareness of the limitations of mechanical recovery at sea and a resultant increased acceptance of dispersant use as an at-sea response option and *in situ* burning for on-shore and heavy ice response situations. There is a greater acceptance of the need to use shoreline cleanup techniques that have a minimum impact on the environment. Management of spill response has improved when responders have planned and exercised together.

While some aspects of international conventions and agreements have been implemented, not all provisions of these agreements are yet in place. Further initiatives to implement them have not yet spread throughout the world.



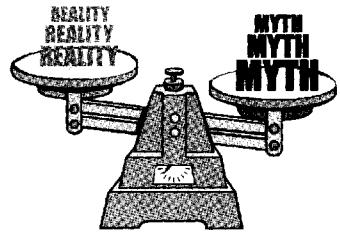
Contingency planning has not been conducted in a comprehensive way in many countries. More work must be done in those countries to develop comprehensive contingency plans that include risk analysis, forecasts of oil movement and fate, identification and prioritisation of resources at risk, and commensurate selection of response techniques. This is an essential pre-requisite for equipment purchase.

There continues to be an over-reliance on mechanical containment and recovery for offshore spills in many regions of the world as the technique of choice, with a reluctance to consider dispersant use as a primary or complementary response technique for offshore spills. OPA 90 continues to place reliance on mechanical containment and recovery as the primary means of response in the US. This reliance has resulted in false performance expectations on the part of the public and response community. In some countries, there is a misguided assumption that *in situ* burning will become a major at-sea response technique, forgetting that it suffers from all the well-known problems of mechanical containment. Finally, proper cost management has deteriorated in some parts of the world because of external pressures generating long-term over-reaction, and the lack of an effective mechanism to ensure the technical reasonableness of decisions that contribute to excessive costs.

Is It a Myth or Reality that Improved Performance Has Had a Positive Effect on Political, Media, Environmental, and Public Perceptions?

Despite the efforts of the oil industry and governments around the world, there is little evidence that the media, environmental interest groups, and the public perceive any improvements in response performance. This may be attributed to the majority of these stakeholders disinterest in response until a major incident occurs.

Generally, the factors that are considered important in an effective response do not seem to match those of the public's perception of a successful response. Increased capabilities have not had any significant impact on perceptions of the media, environmental interest groups, or the public.



Media response is unpredictable. Occasionally, the technical success of a response is reported positively. At other times, there is wild speculation on potential "ecological disasters" being faced. Although reducing their presence and visibility at major spills in Europe, environmental interest groups remain ready to be extremely critical of oil companies, any of their activities, oil spills, spill response, and certain response techniques in particular. In many areas of the world, some progress has been made in political arenas to create the necessary climate of trust and co-operation. Politicians, however, always will remain responsive to their constituents, and, if the public is upset, political support for response operations may well evaporate.

5.2 Recommendations

The Problems That Remain

The problems that remain are not ones that massive additional stockpiles of equipment will fix. As one co-op manager observed "the world is awash with equipment." Some problems, such as those caused by the laws of physics, are insoluble with present-day technology. Organisational problems — such as inadequate or non-existent response planning, lack of training and exercising, and lack of national resolve to make

pollution response a priority — must be overcome to improve response performance. In this regard, the following recommendations are presented:

- Strengthen spill response infrastructure rather than provide additional equipment.
- Review NCPs to identify shortcomings and implement those factors that are considered essential to response success.
- Develop government-industry co-operation more fully in many parts of the world. This will help remove the antagonism that arises during a spill response by having both parties contribute jointly to the success of the response.
- Improve contingency planning. The contingency planning process must be supported by a programme of training and exercises to ensure that staff skill levels are developed and maintained and to validate the plan, enabling any necessary improvements to be made. This also will identify any equipment or logistic deficiencies.
- Co-operate internationally, particularly through the OPRC Convention, Global Initiative, and industry Tier 3 response bases, to assist in providing additional scarce, expensive resources and developing NCPs for countries that do not have the expertise themselves.
- Advance the acceptability of dispersant use as a primary response technique by presenting all available scientific and operational data.
- Research to provide and refine the best methods of shoreline cleanup. Disseminate results widely to responders, politicians, and environmental interest groups.

There are several programme areas where specific initiatives may contribute to both the perception and reality of response performance improvements.

Educational programmes. A sustained campaign is needed to educate the media, public, governments, and environmental interest groups about the fundamental limitations of oil spill response techniques.

International contingency plan. A "supra-national" world contingency plan would consider hazard on a global basis and ensure that adequate Tier 2 equipment resources, with their attendant logistics, are in place to cover the areas of highest risk. The globalisation of the world economy also may lead to the further globalisation of international oil spill response.

The IMO-IPIECA Global Initiative could be used as the basis for such a world contingency plan, building on the provisions of Article 7 of the OPRC Convention. Care would be needed not to infringe national sovereignty; therefore, the plan would have to build on current NCPs. It could draw on additional spill risk analyses, such as those conducted by ITOPF and IPIECA for the Global Initiative. A "supra-national" planning strategy could examine the adequacy of the current locations of Tier 2 and Tier 3 response bases. Specific recommendations on the allocation of those resources could then be based on a global risk assessment. As the number of Tier 2 bases increases in response to an international plan, the role of Tier 3 bases may well change from providing large amounts of equipment to providing certain specialised, high-value equipment and experienced personnel to support Tier 2 bases during oil spills. The planning strategy also should consider whether all response bases are stocked with appropriate equipment, review the adequacy of staffing arrangements, and consider whether logistics arrangements are available to move equipment to a spill site in a rapid and efficient manner.

Spill management. Governments normally lead an oil spill response despite the Global Initiative, but many countries have no more than skeletal spill management teams. There might, therefore, be a need for one or two independent, international spill management teams to assist and support such countries on request. The teams could be centred around ITOPF technical advisers, with support from Tier 3 bases and experienced response professionals. One important function of the team would be technology transfer, to teach national response organisations the necessary skills so that those organisations could mount a self-sufficient response. The team concept should be considered for inclusion into the Global Initiative. Funding for these teams at a spill could come from compensation conventions, and funding for the necessary exercises could be sought from the oil and shipping industries, P&I clubs, or government and international aid programmes.

Oil spill research and development. At the 1995 IMO Conference on Oil Spill Research and Development in London, there was a clear sense from responders that researchers were investigating and researching avenues that had little relevance to spill response. As a result, spill research attracted much adverse comment. Clearly, there is a need for pure scientific research to advance knowledge and turn developing work into more effective response techniques (Fingas, 1998).

Research is needed to continue to improve dispersant formulations that increase the viscosity range of oil that can be dispersed and improve performance against emulsion. This research could further promote dispersant use. In addition, there is a need for research on shoreline cleanup. The process of oil and fine particle interaction or clay oil flocculation is not yet fully understood, and, until it is, its relevance to shoreline cleanup cannot be judged.

FACTORS THAT CONTRIBUTE TO THE SOLUTION

This paper argues that, although equipment plays an important role in an effective response, equipment is by no means the only, or even the most important, element in an effective spill response. In a well-managed response, well-trained personnel have used obsolete or improvised equipment successfully. In a poorly managed response with badly trained or inexperienced personnel, even the most modern and capable equipment has failed to produce a successful response. This paper outlines the policies, programmes, and infrastructure needed for a successful response now and in the future.

Factors essential for a successful response include:

- commitment of government and industry to spill response;
- an effective regulatory regime;
- implementation of international conventions, such as the CLC, Fund Convention, and OPRC Convention;
- a tested NCP with comprehensive, supporting sub-national contingency plans;
- good management arrangements;
- close co-operation among regulatory, operational, and environmental personnel;
- suitably trained, experienced response managers, supervisors, and equipment operators;
- a comprehensive, well-maintained inventory of suitable equipment;
- a successful salvage operation with transfer of unspilled cargo;
- use of the most successful, cost-effective response techniques;
- a well-managed and -conducted shoreline cleanup;
- comprehensive logistic support;
- a comprehensive training and exercise programme; and
- a well-managed media, political, and public information response.

It is suggested that, if these factors are implemented and maintained by government and industry planners consistently, they will serve to advance response performance worldwide.

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REFERENCES

Baker, J.M. 1997. *Differences in Risk Perception: How Clean is Clean?* Technical Report IOSC-006. American Petroleum Institute, Washington, D.C.

Baker, J.M., R.B. Clark, and P.F. Kingston. 1990. *Environmental Recovery in Prince William Sound and the Gulf of Alaska.* Institute of Offshore Engineering, Heriot Watt University, Edinburgh.

Baker, J.M., R.B. Clark, and P.F. Kingston. 1992. *Environmental Recovery in Prince William Sound and the Gulf of Alaska.* Institute of Offshore Engineering, Heriot Watt University, Edinburgh.

British Petroleum (BP). 1979. *The Cristos Bitos Incident.* British Petroleum, London.

Brown, M. 1995. Stations put on red alert over Greenpeace coverage. *Daily Telegraph (London),* August 27.

Corzine, R., and R. Waters. 1994. How not to deal with the media in the aftermath of oil spills. *Financial Times (London),* June 18, p. 9.

Cusick, J., P. Victor, and R. Fowler. 1996. But who takes the blame. *Independent (London),* February 22, p. 1.

de Bettancourt, M., G. Merrick, T. Deal, and B. Travis. In press. Safeguarding the Public Interest. *Proceedings,* 1999 International Oil Spill Conference. American Petroleum Institute, Washington D.C.

Donaldson, Lord of Lymington. In press. Title to be announced. The Stationery Office, London.

Donaldson, Lord of Lymington, J. Rendle, and A. Macintyre. 1994. *Safer Ships, Cleaner Seas.* HMSO, London.

Ecological Steering Group on the Spill in South Shetland (ESGOSS). 1994. *The Environmental Impact of the Wreck of the* Braer. Scottish Office, Edinburgh, Scotland.

Etkin, D.S. 1995. *International Oil Spill Statistics.* Oil Spill Intelligence Report, Cutter Information Corporation, Arlington, MA.

Etkin, D.S. 1998a. *Financial Costs of Oil Spills in the United States.* Oil Spill Intelligence Report, Cutter Information Corporation, Arlington, MA.

Etkin, D.S. 1998b. *Financial Costs of Oil Spills Worldwide.* Oil Spill Intelligence Report, Cutter Information Corporation, Arlington, MA.

Fagoe, T.E. 1991. Coast Guard Response to the *Volgoneft 263* Oil Spill. *Proceedings,* 1991 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 279–283.

Fingas, M. 1998. *Personal Communication,* August 1998. Chief, Emergencies Science Division, River Road Environmental Technology Centre, Ottawa, Canada.

Holt, W.F. 1995. *Perspectives on Maintaining Oil Pollution Response Capabilities.* Technical Report IOSC-003. American Petroleum Institute, Washington, D.C.

Hyde, L.J., K. Withers, and J.W. Tunnel Jr. 1998. *Coastal High Marsh Oil Spill Clean-Up by Burning: Five Year Evaluation.* Center for Coastal Studies, Texas A&M University, Corpus Christi, TX.

Ingham, J. 1996. Slick work that saved the beach. *Daily Express,* June 5, p. 19.

International Oil Pollution Compensation (IOPC) Fund. 1992a. The *Haven* Spill. *Annual Report.* International Oil Pollution Compensation Fund, London. pp. 59–71.

International Oil Pollution Compensation (IOPC) Fund. 1992b. The *Aegean* Sea Spill. *Annual Report.* International Oil Pollution Compensation Fund, London. pp. 73–78.

International Oil Pollution Compensation (IOPC) Fund. 1995. Admissible Claims. *Claims Manual.* International Oil Pollution Compensation Fund, London. pp. 13–26.

International Oil Pollution Compensation (IOPC) Fund. 1997. The *Evoikos* Spill. *Annual Report.* International Oil Pollution Compensation Fund, London. pp. 121–123.

International Petroleum Industry Environmental Conservation Association (IPIECA). 1991. *A Guide to Contingency Planning for Oil Spills on the Water.* IPIECA Series, Vol. II. International Petroleum Industry Environmental Conservation Association, London.

International Tanker Owners Pollution Federation (ITOPF). 1985. *Contingency Planning for Oil Spills.* Technical Information Paper Number 9. International Tank Owners Pollution Federation, London.

International Tanker Owners Pollution Federation (ITOPF). 1994. *Note to the International Oil Pollution Compensation Fund.* Agenda Item 2, Seventh Intersessional Working Group, London, February 7–9, May 3–4.

International Tanker Owners Pollution Federation (ITOPF). 1995. *A Review of the Response to Counter Pollution from the Barge* Morris J. Berman *at San Juan, Puerto Rico in January 1994.* International Tanker Owners Pollution Federation, London.

International Tanker Owners Pollution Federation (ITOPF). 1998a. *Past Spills.* International Tank Owners Pollution Federation, London. (website *http://www.itopf.com/stats.html).*

Previous page is blank.

International Tanker Owners Pollution Federation (ITOPF). 1998b. Kure. *Ocean Orbit* (newsletter). September. International Tank Owners Pollution Federation, London.

Irvine, J.M. In press. The International Tier Three Centres: Background and Future of Clean Caribbean Co-Operative, Oil Spill Response Limited, and East Asia Response Limited. *Proceedings,* 1999 International Oil Spill Conference. American Petroleum Institute, Washington D.C.

Lerch, W.M. 1998. International Oil Industry Approach to Response Planning. *Proceedings,* Spillcon 98. Australian Institute of Petroleum, Melbourne, Australia.

Lipscombe, R. 1998. *Personal Communication.* Manager, Operations Marine Environment Protection Services, Australian Maritime Safety Agency, Canberra, Australia. August.

Moller, T.H. 1997. The *Nakhodka* Oil Spill Response — The Technical Advisers' Perspective. *Proceedings,* Petroleum Association of Japan Oil Spill Response Symposium 1997: Lessons Learned from the *Nakhodka* Incident. Petroleum Association of Japan, Tokyo, Japan. July 10–11.

Newman, D., and I. Macbeth. 1970. *The Use of Booms as Barriers to Oil Pollution in Tidal Estuaries and Sheltered Waters.* Institute of Petroleum/World Health Organisation Seminar on Water Pollution by Oil, Aviemore, Scotland.

Newman, D., and I. Macbeth. 1973. *Oil Booms at a Tidal Inlet.* Report Number INT 118. Hydraulic Research Station, Wallingford, UK.

Nichols, J. 1998. *Personal Communication.* Technical Manager, International Tanker Owners Pollution Federation, London. August.

Office of Technology Assessment (OTA), US Congress. 1990. *Coping With an Oiled Sea.* OTA-BP-0-63. US Government Printing Office, Washington, D.C.

Oil Spill Intelligence Report (OSIR). 1997a. *Dispersants Effective Against Weathered Heavy Oil in Major Sea Trials.* October 16. Cutter Information Corporation, Arlington, MA.

Oil Spill Intelligence Report (OSIR). 1997b. *Texaco Pipeline Leaks Oil into California Marsh.* November 25. Cutter Information Corporation, Arlington, MA.

Oil Spill Intelligence Report (OSIR). 1997c. *P&I Clubs Recommend "Genuine Independence" of Spill Managers,* OSROs. December 11. Cutter Information Corporation, Arlington, MA.

Oil Spill Intelligence Report (OSIR). 1997d. *Punctured Bulk Carrier Oils Humboldt Bay, CA.* November 6. Cutter Information Corporation, Arlington, MA.

Oil Spill Intelligence Report (OSIR). 1998a. *Alaska Moves Cautiously to Reconsider Dispersant.* February 5. Cutter Information Corporation, Arlington, MA.

Oil Spill Intelligence Report (OSIR). 1998b. *Chemical Disperses Six Day Old Slick.* January 22. January 22. Cutter Information Corporation, Arlington, MA.

Oil Spill Intelligence Report (OSIR). 1998c. *Oil Stop Reports Fireboom Success.* November 24. Cutter Information Corporation, Arlington, MA.

Oil Spill Intelligence Report (OSIR). 1998d. *Shoreline Cleanup Strategies Impacts and Costs.* White Paper Series, Vol. 2, No. 2 Cutter Information Corporation, Arlington, MA.

Oil Spill Intelligence Report (OSIR). 1998e. *Insurers, Responders Spar Over Rising US Cleanup Costs.* July 9. Cutter Information Corporation, Arlington, MA.

Pahl, J.W., and I. Mendelssohn. 1997. The Application of *In Situ* Burning to a Louisiana Coastal Marsh Following a Hydrocarbon Product Spill: Preliminary Assessment of Site Recovery. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 823–828.

Panton, S. 1998. *Personal Communication.* Managing Director Greater London Radio, British Broadcasting Corporation (BBC), London. July.

Payne, J.R., T.J. Reilly, R.J. Martrano, G.P. Lindblom, M.C. Kennicutt II, and J.M. Brooks. 1993. Spill-of-Opportunity Testing of Dispersant Effectiveness at the *Mega Borg* Oil Spill. *Proceedings,* 1993 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 791–793.

Perry, R. In press. Protection of Sensitive Coastal Areas in The United Kingdom — From *Torrey Canyon* to the New Millennium. *Proceedings,* 1999 International Oil Spill Conference. American Petroleum Institute, Washington D.C.

Porrit, J. 1993. Worse things happen on land. *Daily Telegraph* (London), January 9, p. 11.

Purkiss, R. 1998. *Personal Communication.* Ex-State Chairman, Western Australian State Committee for Combating Marine Oil Pollution, Bicton, Western Australia. July.

Rolan, R.G., and K.H. Cameron. 1991. Adaptation of the Incident Command System to Oil Spill Response During the *American Trader* Spill. *Proceedings,* 1991 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 267–272.

Salt, D. 1998. *Personal Communication.* Operations Manager, Oil Spill Response Limited, Southampton, UK. August.

Sapelli, C. 1998. *Personal Communication.* Western Australian Department of Transport, Freemantle, Western Australia. August.

Sea Empress Environmental Evaluation Committee (SEEEC). 1998. *Environmental Impact of the* Sea Empress *Spill. Final Report.* The Stationery Office, London.

"Spreading tide of ecological destruction." 1996. *Independent (London),* February 22.

Stacey, M. 1989. *Report of Oil Spill Service Centre (OSRL) Response Study.* Board Report, Oil Spill Response Limited, Southampton, UK.

Tebeau, P.A. 1995. Effectively Managing Level of Effort in Oil Spill Cleanup: Resolving the "How Clean is Clean" Issue. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 663–666.

UK Department of Transport. 1984. *The* Sivand *Incident.* Marine Pollution Control Unit, London.

UK Department of Transport. 1992. *The* Rosebay *Incident.* Marine Pollution Control Unit, London.

US Coast Guard (USCG). 1998. Public Workshops for Response Plan Equipment Caps: Scheduled Increases in Mechanical Recovery and Potential Changes to Dispersant Planning Requirements. *Federal Register,* Vol. 63, No. 121. June 24. pp. 34500–34501.

Walker, A.H., D.L. Ducey, and S.J. Lacey. 1995. *Implementing an Effective Response Management System.* Technical Report IOSC-001. American Petroleum Institute, Washington, D.C.

Westwood, S.S.C., G.M. Dunnet, and K. Hiscock. 1989. Monitoring the Sullom Voe Terminal. In B. Dicks, ed. *Ecological Impacts of the Oil Industry.* John Wiley and Sons, Chichester and New York. pp. 261–285.

ACRONYMS/ABBREVIATIONS

ADDS	Airborne Dispersant Delivery System
AIP	Australian Institute of Petroleum
AMOSC	Australian Marine Oil Spill Centre
AMPD	Average Most Probable Discharge (US)
BBC	British Broadcasting Corporation
BP	British Petroleum
CCC	Clean Caribbean Co-Operative
CEDRE	Centre for Documentation, Research, and Experimentation into Accidental Pollution of the Water (France)
CLC	Civil Liability Convention
EARL	East Asia Response Limited
EPA	Environmental Protection Agency (US)
ESGOSS	Ecological Steering Group on the Spill in South Shetland *(Braer)*
FOSC	Federal On-Scene Co-ordinator (US)
FOST	Fast Oil Spill Team (France)
FWADC	Fixed Wing Aerial Dispersant Capability (Australia)
GAOCMAO	Gulf Area Oil Companies Mutual Aid Organisation (Gulf of Arabia)
GRSL	Guam Response Services Limited
ICS	Incident Command System
IMO	International Maritime Organisation
IOPC Fund	International Oil Pollution Compensation Fund
IPIECA	International Petroleum Industry Environmental Conservation Association
ITOPF	International Tanker Owners Pollution Federation
MARPOL 73/78	International Convention on the Prevention of Pollution from Ships, 1973. Modified by Protocol in 1978. Referred to as MARPOL 73/78
MCA	Maritime and Coastguard Agency (UK)
MMPD	Maximum Most Probable Discharge (US)
MPA	Marine Preservation Association (US)
MPCU	Marine Pollution Control Unit (UK)
MSRC	Marine Spill Response Corporation (US)
NCP	National Contingency Plan
NEBA	Net Environmental Benefit Analysis
NOFO	Norwegian Clean Seas Association for Operating Companies
NRC	National Response Corporation (US)
NRDA	Natural Resource Damage Assessment
OPA 90	Oil Pollution Act 1990 (US)
OPRC Convention	International Convention on Oil Pollution Preparedness, Response, and Co-Operation
OSIR	Oil Spill Intelligence Report
OSLTF	Oil Spill Liability Trust Fund (US)
OSRL	Oil Spill Response Limited
OSRO	Oil Spill Removal Organisation (US)
OSSC	Oil Spill Service Centre (now OSRL)
OTA	Office of Technology Assessment, US Congress
PERGSA	Regional Organisation for the Conservation of the Environment of the Red Sea and the Gulf of Aden
P&I Club	Protection and Indemnity Club
PAJ	Petroleum Association of Japan
PIMMAG	Petroleum Industry of Malaysia, Mutual Aid Group
POLMAR	National Marine Pollution Plan (France)
PREP	National Preparedness for Response Exercise Program (US)
REMPEC	Regional Marine Pollution Emergency Response Centre (Malta)
RP	Responsible Party
SEEEC	*Sea Empress* Environmental Evaluation Committee
SERVS	Ship Escort Response Vessel Service (Alaska, US)
SFT	State Pollution Control Authority (Norway)
SOPEP	Shipboard Oil Pollution Emergency Plan
SUPSALV	Navy Supervisor of Salvage (US)
TARC	Tiered Area Response Capability (Singapore)
TOSCA	Thames Oil Spill Control Association (UK)
UCS	Unified Command Structure
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environment Programme
US	United States
USCG	US Coast Guard
VRP	Vessel Response Plan (US)
WCD	Worst Case Discharge (WCD)

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APPENDIX A

INTERNATIONAL AGREEMENTS FOLLOWING MAJOR SPILLS

Whereas the *Torrey Canyon* spill led to the CLC of 1969 and IOPC Fund Convention of 1971, the *Amoco Cadiz* spill led to an International Conference on Tanker Safety and Pollution Prevention in 1978. The resulting 1978 Protocol amended the 1973 International Convention on the Prevention of Pollution from Ships and commonly is referred to as MARPOL 73/78. It produced little of substance for oil spill response but did introduce a number of spill prevention measures. Specific international measures to handle oil spills developed after the *Exxon Valdez* spill. Progressive amendments to MARPOL 73/78, however, have introduced the SOPEP requirement and additional spill prevention measures, such as requiring double hull tankers or mid-deck design to reduce likely oil outflow in the event of a collision or grounding.

Since spilled oil knows no boundaries, either a major spill would likely affect more than one country, or, alternatively, an affected country's resources would likely be overwhelmed. The process of developing and concluding multi-lateral and bi-lateral international agreements continued.

In Europe, the Bonn Agreement was signed in 1969, specifically to deal with co-operation on oil spill matters around the North Sea. A revised Bonn Agreement for "Co-Operation in Dealing with Pollution of the North Sea by Oil and Other Hazardous Substances" was signed in 1983 among countries bordering the North Sea. Within this agreement, a Joint Maritime Contingency Plan — "The Mancheplan" — sets out how the Anglo-French responsibility is to be exercised in the English Channel. The UK and Norway have signed a similar agreement, "The Norbritplan."

The Helsinki Convention of 1974 and the Barcelona Convention of 1976 contained measures to co-ordinate international oil spill response arrangements in the Baltic and Mediterranean Seas, respectively. A Regional Marine Pollution Emergency Response Centre (REMPEC) was established in Malta under the Barcelona Convention of 1976. Elsewhere, other arrangements followed in the sea areas covered by the United Nations Environment Programme (UNEP), Regional Seas Programme.

In 1990, as a result of the perceived inadequacies of the *Exxon Valdez* response, in particular the lack of close co-operation between government and industry and need for better international co-operation, the IMO approved the OPRC Convention. The OPRC Convention, which came into force in 1995, proposed sensible requirements for oil spill response measures. These included the need for a competent national authority; a national contingency plan; co-operation among governments, port authorities, and oil and shipping industries in planning and training; and improved international co-operation arrangements.

It also was recognised that there was a need to increase the amount of available compensation. In 1992, protocols were signed that amended the CLC and IOPC Fund Convention and established new, higher limits of compensation.

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APPENDIX B

SUMMARY OF SIGNIFICANT SPILL EVENTS

The following is a chronological collection of significant spill events from around the world that contributed to the author's evaluating whether improvements have been made in response capabilities, response performance, and perceptions regarding spill response.

Vessel name: *Amoco Cadiz*

Spill date: 1978

Location of spill: Brittany, France

Amount spilled: 231,000 tonnes

Significant issues:

- Salvage attempts failed.
- Aggressive shoreline cleanup caused serious habitat damage.

Reference: Baker (1997)

Vessel name: *Tanio*

Spill date: 1980

Location of spill: Brittany, France

Amount spilled: 6,500 tonnes

Significant issues:

- Successful shoreline cleanup used mechanical shoreline cleanup and dispersants.

Vessel name: *Sivand*

Spill date: September 1983

Location of spill: River Humber, UK

Amount spilled: 6,850 tonnes

Significant issues:

- Aerial and boat application of dispersants.
- First major aerial application of dispersants in the UK.

Reference: UK Department of Transport (1984)

Vessel name: *Exxon Valdez*

Spill date: March 1989

Location of spill: Prince William Sound, Alaska, US

Amount spilled: 37,415 tonnes

Significant issues:

- Early opportunity to contain and recover oil near the source was missed.
- Lengthy decision process and lack of experience with dispersant use.
- *In situ* burning was limited because of lack of public acceptance of this technique.
- Overly aggressive cleanup of affected shorelines caused more damage than the oil itself.
- Shoreline sensitivities and priorities for cleanup were not identified and agreed on by federal and state government and industry prior to the spill.
- Federal, state, and RP did not co-ordinate their responses and media efforts.

Reference: Tebeau (1995), Westwood *et al.* (1989)

Vessel name: *American Trader*

Spill date: February 1990

Location of spill: Long Beach, California, US

Amount spilled: 1,418 tonnes

Significant issues:

- Effective co-ordination between government and industry.
- Employed 2,000 response personnel and cost $47 million.

Reference: Rolan and Cameron (1991), Tebeau (1995), Walker *et al.* (1995)

Vessel name: *Rosebay*

Spill date: May 1990

Location of spill: English Channel, UK

Amount spilled: 1,100 tonnes

Significant issues:

- Approximately 700 tonnes dispersed or evaporated.
- Approximately 300 tonnes came ashore and cleaned by 200 response personnel.
- Spill stimulated mandate to develop coastal protection strategy plans.

Reference: Perry (in press), UK Department of Transport (1992)

Vessel name: *Mega Borg*

Spill date: June 1990

Location of spill: Gulf of Mexico

Amount spilled: 13,265 tonnes

Significant issues:

- Provided opportunity for dispersant effectiveness testing.

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- Underscored the importance of salvage capabilities.
- Provided support for the concept of *in situ* burning as a response technique.

Reference: ITOPF (1991), Payne *et al.* (1993)

Vessel name: *Haven*

Spill date: April 1991

Location of spill: Port of Genoa, Genoa, Italy

Amount spilled: 142,857 tonnes

Significant issues:

- Lack of co-ordinated spill management between government and industry.
- At-sea mechanical recovery and shoreline protection booming strategies were ineffective.

Reference: IOPC Fund (1992a), Walker *et al.* (1995)

Vessel name: *Nagasaki Spirit*

Spill date: November 1992

Location of spill: Malacca Straits

Amount spilled: 12,000 tonnes

Significant issues:

- No at-sea mechanical recovery or dispersant spraying took place.
- Response involved extensive manual clean up of shorelines.
- Lack of international co-operation between governments.

Vessel name: *Aegean Sea*

Spill date: December 1992

Location of spill: La Corunna, Spain

Amount spilled: 74,490 tonnes

Significant issues:

- Severe weather prevented at-sea recovery of spilled oil.
- Shoreline cleanup minimised environmental damage.
- Perception of spill management satisfactory.

Reference: IOPC Fund (1992b)

Vessel name: *Braer*

Spill date: January 1993

Location of spill: Shetland Islands, UK

Amount spilled: 84,700 tonnes

Significant issues:

- Massive experiment into the effects of naturally dispersed oil.
- After action reports validated dispersant use as UK's primary response strategy and documented inadequate salvage capabilities, and recommended significant changes to the NCP.

Reference: Donaldson *et al.* (1994), ESGOSS (1994)

Vessel name: *Morris J. Berman*

Spill date: January 1994

Location of spill: San Juan, Puerto Rico

Amount spilled: 2,684 tonnes

Significant issues:

- Employed the USCG "shoot first, ask questions later" policy.
- Skimming capacity of 24,615 tonnes per day was assembled.
- Spill management did not fully integrate resources from government, RP, and their contractors.
- Cost management was extremely weak.
- Inside the US, the general perception was that the spill was well managed.

Reference: Etkin (1998a), ITOPF (1995), Tebeau (1995)

Vessel name: *Sea Empress*

Spill date: February 1996

Location of spill: Milford Haven, UK

Amount spilled: 72,000 tonnes

Significant issues:

- Use of aerial dispersants successful.
- Perception of spill management satisfactory.
- Management of salvage operation criticised leading to a major inquiry into salvage and (government) intervention.
- Self-cleaning of shoreline was encouraged.
- Shoreline cleanup minimised environmental damage.

Reference: Donaldson (in press), Ingham (1996), SEEEC (1998)

Vessel name: *Nakhodka*

Spill date: January 1997

Location of spill: Sea of Japan

Amount spilled: 6,240 tonnes

Significant issues:

- Response efforts revealed shortage of seagoing skimming equipment.
- Employed 202,000 response personnel and 100 vessels.
- Resource utilisation not fully co-ordinated.

Reference: Moller (1997)

Vessel name: *Evoikos*

Spill date: October 1997

Location of spill: Singapore Straits

Amount spilled: 28,571 tonnes

Significant issues:

- Smoke haze from Indonesian forest fires made aerial surveillance difficult.
- Observers reported that dispersant spraying continued for too long.

- Mechanical containment and recovery equipment could not be deployed because of the lack of necessary vessels of opportunity.

Reference: IOPC Fund (1997)

Vessel name: *Kure*

Spill date: November 1997

Location of spill: Humboldt Bay, California, US

Amount spilled: 15 tonnes

Significant issues:

- Employed 450 response personnel and cost $12 million to clean up.
- 2 tonnes of oil was recovered.

Reference: OSIR (1997d)

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JUDGING OIL SPILL RESPONSE PERFORMANCE: THE CHALLENGE OF COMPETING PERSPECTIVES

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Technical Report IOSC-008

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AN ISSUE PAPER PREPARED FOR THE
1999 INTERNATIONAL OIL SPILL CONFERENCE

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PREFACE

The 1999 International Oil Spill Conference sponsors — American Petroleum Institute, US Coast Guard, US Environmental Protection Agency, International Maritime Organization, and International Petroleum Industry Environmental Conservation Association — commissioned issue papers covering two topics of special importance to the oil spill community. The sponsors assigned responsibility for general management and oversight, scope definition, peer review, and publication of these issue papers to the Program Committee.

The goals of these papers are to stimulate open discussion of complex and controversial issues and balance diverse positions of stakeholders. Each topic addresses varying scientific/technical and socio-political concerns. Therefore, each paper differs as to depth of study and breadth of conclusions. The views and opinions presented are those of the authors solely and do not represent the views, opinions, or policies of the International Oil Spill Conference or its sponsors.

During the 1999 Conference, each of these issue paper topics will be the subject of a special panel session. Publication of these issue papers as separate companion documents to the Conference Proceedings continues the International Oil Spill Conference Technical Report Series. The Technical Reports are published biennially in conjunction with the International Oil Spill Conference.

It is the Program Committee's hope that each issue paper topic furthers substantive discussion and serves as a catalyst for solutions to the topics discussed.

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ABSTRACT

The history of judging spill response performance documents the early default criterion in the 1970s — remove visible oil — that evolved into ecologically based criteria in the 1980s — minimize spill impacts and protect environmentally sensitive areas. In the aftermath of the 1989 *Exxon Valdez* spill, more stakeholders and more criteria entered the spill response process in the 1990s.

Each stakeholder is concerned with receiving favorable media coverage, or at least minimizing negative coverage, and often views the media as final judges of response performance. The many stakeholders and their many, sometimes conflicting, criteria for judging response are examined, and factors that promote or impede response success are identified.

Recommendations are made to develop response goals and criteria acceptable to all stakeholders in advance of a spill incident. These criteria can then be used to develop contingency and response plans focused on achieving the goals and objectives of all stakeholders. Response performance can then be measured against those criteria either by the response community during exercises and routine responses or an independent panel in the aftermath of a major incident. These evaluations, using stakeholder criteria, can be returned to stakeholders for their consideration in either adjusting criteria that are proven impractical or revising plans to better meet the criteria. Recommendations are offered to foster debate and are aimed at establishing a standard mechanism for response performance measurement and ultimately improvement.

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EXECUTIVE SUMMARY

A large oil spill generates strong negative emotions. The spiller is shocked and embarrassed that the accident occurred. Elected officials and government agencies at all levels respond to public outrage; the media are mobilized quickly; and angry citizens step before microphones denouncing the spiller and call for immediate action. Spill managers, cleanup contractors, scientists, and other spill "experts" are questioned by the media about response details, and spill impacts and how long they will last. When it is all over, how successful was the response effort? Each entity may have a different perspective based on its way of assessing performance. This paper explores the roles of various participants and interested observers in a spill response and the criteria by which they judge it.

A review of the history of judging spill response performance documents an early default criterion in the 1970s — remove visible oil — that evolved toward ecologically based criteria in the 1980s — minimize spill impacts and protect environmentally sensitive areas. After the *Exxon Valdez* spill, more stakeholders as well as different criteria for judgment entered the spill response process in the 1990s. This spill had legislative and regulatory effects far beyond the US. In addition, legal issues now may affect the conduct of the response itself and the judgments that follow.

Participants in the response, interest groups, others affected by the spill, and the media are primary judges of spill response performance. Secondary judges are the public. Almost all observers seem to agree that, at present, the media are the closest to final judges of spill response performance. All response participants fear negative media coverage and crave positive coverage.

In addition to the media, other judges include the spiller's company; scientists in universities, consulting firms, government agencies, and oil companies; government and oil company spill managers; regulatory and trustee agencies; environmental and other citizens groups; elected officials; property owners and business community; and the fishing industry. Criteria important to each in judging spill response performance are many and often conflicting.

Much national and local legislation and an international convention followed the Exxon Valdez incident. Some effects are positive and contribute to improved response performance: strengthened contingency plans and training, more available response equipment, and effective use of research results on all aspects of oil spills. Other factors impede performance: broad-based decision-making systems (involving many jurisdictions that must be satisfied), public outrage, and environmental and other citizens groups with additional demands, as well as polarization among a spiller, regulatory agencies, and citizens groups. The recommended solution to promote performance improvement is to incorporate teamwork and streamlined management, involve spill experts in decision making, and improve communications.

CONCLUSIONS AND RECOMMENDATIONS

The spill response system has become adversarial in some areas of the world. Trust and teamwork are difficult to find in more areas. Currently, the possibility of a response being judged completely successful is remote. Recommendations are offered to move toward a more evaluative system based on teamwork and guided by goals and performance criteria that have been accepted in advance by all stakeholders.

SPILL MANAGEMENT AND DECISION MAKING

If decisions cannot be reached quickly in a command center, they cannot be implemented quickly in the field. Unless some level of teamwork is achieved, timely decision making and implementation to minimize the spread of oil and protect sensitive resources will not occur. Streamlining management during the emergency phase of a spill by minimizing the number of decision makers and relying heavily on spill experts is recommended. Effected communities' and environmental and other citizens groups' concerns must be factored into these deliberations, but decisions should be made as quickly as possible by those most knowledgeable of spill response — that is, spill scientists, operations specialists, and response professionals — especially during the emergency phases of a spill.

USE OF STAKEHOLDERS TO ESTABLISH PLANNING AND RESPONSE CRITERIA

Each stakeholder has performance criteria. By engaging stakeholders prior to an incident, consensus can be sought, compromises attempted, and criteria adjusted to resolve any conflicts before a crisis arises. Response priorities, strategies, and tactics can be modified based on stakeholder input. Involving stakeholders in the initial stages of contingency planning can greatly improve the ability of a response organization to meet stakeholders' goals.

USE OF A SYSTEMATIC APPROACH TO MEASURE PERFORMANCE

The use of a systematic, response performance measurement process is recommended. Such a process encourages stakeholder participation in establishing specific performance criteria for spill response. These criteria form reference points from which goals and strategies are developed in contingency plans. Development of specific, measurable, achievable, result-oriented goals enables a response organization to better manage spill response and measure improvement. Additionally, goals enable a response organization and stakeholders to track performance during exercises and response and adjust performance criteria and strategies in contingency plans. During planning and after most spills, a response organization and stakeholders should conduct this process continuously. It should result in improved relations and increased response preparation.

A third-party panel also can evaluate spill response performance. This panel could be appointed following a major spill incident to study decisions made, reasons for them, and their impact and effectiveness and develop recommendations for the future. The panel could include a variety of disciplines. It is critical, however, that the panel have a framework by which to judge the response — members must be familiar with the goals, objectives, strategies, and constraints that guided response decision making in the first place.

SECTION 1

INTRODUCTION

Who will judge spill response? How will they assess response performance? Will all stakeholders, after applying their individual, disparate, and sometimes-conflicting criteria, agree on whether a given response was effective? It is conceivable but not likely. The most likely scenario in a significant spill is that at least some of stakeholders will make negative judgments, and those negative judgments will impact overall perception of responders' capabilities adversely. The response community has faced this dilemma since the days of the *Torrey Canyon*.

Some oil spill laws and regulations require a contingency planning and response process that involves private sector companies and government agencies with responsibilities for spill response. Others make contingency planning and spill response government functions. With either, many aspects of spill response are planned in advance. Drills and training exercises are conducted on a regular basis. Agreements are reached among participants regarding assignments when a spill occurs. Participants in this process not only have designated roles by law and regulations, but they also develop a level of teamwork by becoming acquainted, working together, and establishing some trust and good faith. When a spill occurs, however, plans carefully made and practiced may not be implemented as intended. Entities not previously involved (e.g., elected officials, citizens groups, additional government agencies, and the media) may thrust themselves into the best-laid plans.

This paper explores the roles of participants and interested observers in a spill response and the criteria by which they judge response performance. Specific factors that promote or impede effective response performance are identified, followed by recommendations to improve the possibility of a "successful" response. Conceptual models for measuring preparedness and response performance are presented, and they offer a structure for evaluating performance and identifying opportunities for improvement.

A large oil spill generates strong negative emotions and presents a challenge to response organization. The spiller is shocked and embarrassed that the accident occurred. Elected officials and government agencies at all levels respond to public outrage; the media are mobilized quickly; and angry citizens step before microphones denouncing the spiller and calling for immediate action. The media question spill managers, cleanup contractors, scientists, and other spill "experts" about response details and spill impacts and how long they will last. Cleanup crews work to contain and recover oil offshore, prevent it from reaching environmentally sensitive areas, set up bird rescue and rehabilitation operations, and treat oiled shorelines.

When it is all over, how successful was the response effort? Each entity may have a different perspective based on its way of assessing. The priorities of the company that had the spill are financial integrity and survival of the company, and being perceived as a responsible corporate citizen. Scientists ask whether ecological impacts were minimized. Were spill impacts assessed adequately? Did the cleanup and restoration methods that were used promote recovery of an affected environment? Response operations personnel are most concerned with prompt deployment and effectiveness of response equipment. Government regulatory and trustee agencies want specific resources protected, rapid cleanup and restoration, and spill impacts assessed. The media cover a spill and its effects as well as the progress of a spill response effort, especially human-interest stories and controversies among participants.

The power of the media in generating interest and action from the public and interest groups cannot be overstated. Most participants in, and observers of, the response process probably view the media as closest to the final judges of response performance.

1.1 OBJECTIVES AND ORGANIZATION OF THIS REPORT

Oil spill preparedness and response have evolved since the *Torrey Canyon* and Santa Barbara spills of the 1960s. More people are involved; research efforts have resulted in greater knowledge about the fate and effects of oil spills; and improved technologies have enabled responders to respond more effectively. The objectives of this paper are:

- to explore the history of judging spill response performance from the 1960s to the present;
- to identify the various parties that are stakeholders and the criteria and standards they use to judge response performance;
- to identify and discuss factors that promote and impede performance;
- to develop recommendations to improve response; and
- to develop recommendations to improve response performance measurement.

Section 1. Introduction. This section identifies the paper's objectives, approach, and potential use.

Section 2. The History of Judging Spill Response Performance. This section presents the historical foundation on which oil spill response is conducted and judged today. Spe-

cific examples of concerns and measurement criteria are presented beginning with the late 1960s and concluding with perspectives in the 1990s.

Section 3. The Stakeholders and Their Criteria for Assessing Performance. This section identifies various individuals and groups that either have responsibility for or take part in spill response. Their roles during oil spill response are discussed along with their criteria for assessing performance. Internal and external stakeholders are identified.

Section 4. Forces that Promote or Impede Performance. Two sets of factors are identified that promote or impede a successful spill response. Factors that promote performance are discussed to emphasize their importance. Factors that impede performance are identified so that they may be overcome and lead to performance improvement.

Section 5. Performance Assessment. This section takes the criteria for assessing spill response performance in Section 3 and presents recommendations on how to use conceptual models to improve how performance is judged.

Section 6. Recommendations. Section 6 contains specific recommendations to improve performance and performance measurement.

Appendix. Print Media Articles. The appendix includes both newspaper and magazine articles, organized by spill and by date, on 12 major spills.

1.2 APPROACH

To achieve this report's objectives, information from case studies of major spills is integrated with scientific and sociologic literature on spill preparedness, management, and response. The intent is to provide a well-reasoned basis for a mechanism to judge oil spill response performance. Information in this report is supplemented by the author's personal knowledge from over 20 years' experience in industry. The author also relies on the judgment, perceptions, and opinions of oil spill response professionals and regulators, as well as personal observations and necessarily subjective opinions in drawing conclusions. For the purpose of this analysis, the following terms are used:

- ***Measures:*** factors or criteria against which response performance is assessed.
- ***Assessment:*** process of using measures to determine a relative level of response performance.
- ***Judgment:*** outcome or conclusion.

This report has been developed to foster discussion on improving spill response performance through improved performance assessment processes. It is hoped that discussion will lead to community consensus on:

- the stakeholders,
- their criteria for measuring performance,
- factors that promote or impede performance, and
- conceptual approaches to aid response performance and assessment.

SECTION 2

THE HISTORY OF JUDGING SPILL RESPONSE PERFORMANCE

This section examines the evolution of spill response and the criteria used to measure performance. During the 1970s and 1980s, criteria evolved from a simple concern of removing free-floating oil from water to a more sophisticated, coordinated government-industry effort minimizing environmental impacts of a spill. In the aftermath of the *Exxon Valdez* spill and Oil Pollution Act of 1990 (OPA 90), the focus on limiting impacts has been hampered by the introduction of concern over assessing damages to the environment.

2.1 SPILL RESPONSE IN THE 1970S AND 1980S

The 1967 *Torrey Canyon* spill in the UK and the 1969 Santa Barbara spill in the US were pivotal events. They focused world attention on oil spills and triggered immediate initiatives in several countries on spill prevention, spill preparedness, research and development on oil spill containment, control, cleanup technology, fate and effects of spilled oil, and spill response planning (see reviews by Gould and Lindstedt-Siva, 1991; Lindstedt-Siva, 1984).

The *Torrey Canyon* and Santa Barbara spill responses were primitive. The application of highly toxic dispersants (actually solvents) to shorelines during *Torrey Canyon* caused greater shoreline damage than did the oil itself (Spooner, 1969). During Santa Barbara, it took 6 days to acquire and assemble a containment boom, which failed when deployed at sea. Beaches were cleaned using straw, rakes, and shovels. Seawalls, jetties, and oiled rocks were steam cleaned or hydroblasted. A cleaning station was set up for oiled birds, but survival rates were low (Gaines, 1969).

During the *Torrey Canyon* and Santa Barbara spills, there were no established criteria by which to judge these responses. For these events and during the early 1970s when spill cleanup cooperatives and industry and government spill response processes were being established, the default criterion was removal of visible oil (Lindstedt-Siva, 1984, 1992). Spill management was relatively simple, conducted either by a spiller with government oversight or by government itself with few, if any, external agencies or organizations involved. Oil was removed from the water surface using containment booms and skimmers (even sinking agents were proposed) and from shorelines by whatever method seemed necessary to produce a "clean beach." The use of toxic dispersants, sand blasting or steam cleaning rocks, bulldozing marshes, excavating large quantities of oiled beach sand, or other similar methods that removed oil without regard for associated ecological impacts.

The *Torrey Canyon* and Santa Barbara spills were global media events. Photos and film of oiled birds and blackened beaches flashed around the world. Newspaper articles and news broadcasts chronicled each spill and progress of cleanup activities. The public was outraged. Scientists were asked to predict spill impacts. Would the environment ever recover? At that time, there were not very many answers.

Public response to these dramatic and serious spill events attracted the attention of elected officials at all levels, setting in motion what would eventually become sweeping environmental legislation. The National Environmental Policy Act was the first of these laws in the US. The International Convention on Civil Liability for Oil Pollution Damage was written in late 1969 and has been adopted internationally. In Santa Barbara, the environmental group Get Oil Out (GOO) was born (Steinhart and Steinhart, 1972). Existing environmental groups took strong positions against offshore oil development, and new environmental groups were formed. Environmental Defense Fund, Friends of the Earth, Natural Resources Defense Council, and Greenpeace were all founded during the period from 1969–1971. These environmental groups often were as critical and distrustful of government as they were of industry. Some observers of environmental issues think that the first Earth Day on April 22, 1970 was triggered by these dramatic spill events. The environmental movement had begun and drew members and financial support from an outraged public.

In response to these two spills, the petroleum industry launched research programs to develop response technologies such as oil containment booms and skimmers, oil sorbents, and less toxic, more effective chemical dispersants. In 1968, the tanker industry formed an organization that was to become the International Tanker Owners Pollution Federation (ITOPF). Based in London, this organization was formed to administer a voluntary compensation agreement. It expanded over the years to provide information and assistance to oil-handling companies and government agencies on laws and conventions covering oil spills, contingency planning, cleanup techniques, and impacts of spilled oil. ITOPF specialists are available 24 hours a day to assist responders during spills. After the Santa Barbara spill, the oil industry began a program to establish spill cleanup equipment stockpiles or cooperatives in many areas of the world. These cooperatives stockpiled and maintained spill response equipment and prepared to respond to spills in their

areas of responsibility. These cooperatives and stockpiles expanded the capabilities of both industry and government.

The first oil spill conference convened in December 1969, jointly sponsored by the American Petroleum Institute and Federal Water Pollution Control Administration, which later became the US Environmental Protection Agency. The first conference contained technical papers on the effects of the *Torrey Canyon* (Spooner, 1969) and Santa Barbara (Straughan, 1969) spills as well as progress reports on research efforts in response technology.

In 1978, the US National Oceanic and Atmospheric Administration (NOAA) was charged with providing scientific support to the US Coast Guard (USCG) during oil spills. At the same time, industry and government spill response teams in Europe and North America were gearing up and began to include environmental scientists. This, and results emerging from industry- and government-sponsored spill research programs, produced a shift in spill response emphasis — minimizing environmental impacts of spills rather than simply removing visible oil (Hum, 1977; Lindstedt-Siva, 1977, 1979; Westree, 1977). This was the beginning of the effort to identify environmentally sensitive areas during the planning process, along with strategies to protect them from oil contamination (Lindstedt-Siva, 1976, 1977; Pavia *et al.*, 1982). Overall environmental impacts of a spill could be reduced significantly if these most vulnerable areas could be protected.

Government and industry began to consider the fate and effects of spilled oil and effects of various cleanup methods. International scientific panels developed consensus recommendations for "low-impact" cleanup methods (API, 1985; Tramier *et al.*, 1981). The scientific community, whether in universities, government, consulting firms, or industry, recognized that the goal of minimizing ecological impacts of spills should be integrated into spill response plans (Lindstedt-Siva, 1977, 1979). Hence, response should be largely based on ecological criteria (Byroade *et al.*, 1981; Cox and Cowell, 1979; Wolfson *et al.*, 1979). This approach was justified because ecological impacts tend to be longer lasting and more difficult to repair than esthetic impacts. Major questions at that time were:

- Did the response minimize the ecological impacts of a spill?
- Were the cleanup methods used ecologically sound?
- Did the response reduce or increase spill impacts versus what would have occurred without human intervention?

Increasingly, governments required advance planning and periodic drills. As a result, site-specific plans were developed that included identification of environmentally sensitive areas with specific strategies to protect them. These plans and required drills brought government and industry spill responders together. Over time, relationships developed, and a level of trust was built. Ideally, there would be teamwork among government and industry responders toward a common goal, thus making response more effective.

During the 6,000-bbl spill in Port Angeles Harbor, Washington (1985), this author observed such teamwork. Government and industry responders agreed on response priorities and methods to achieve their primary goal — minimize the environmental impacts of the spill. Participants worked as a team during response operations and participated jointly in a study to assess the environmental impacts of the spill. Although one environmental group complained that government and industry responders worked too closely together, all involved agreed that working as a team and sharing information seemed the most effective way to conduct a response and ensure that scientific data were available promptly.

2.2 SPILL RESPONSE IN THE 1990S

Because the *Exxon Valdez* spill was so large and in a pristine environment, it generated massive, worldwide media and public attention. Not only did media converge on the small town of Valdez, Alaska, so did cleanup crews and equipment, government agencies and elected officials at all levels, environmental groups, and volunteers who wanted to help. Fishermen mobilized to protect their livelihood. Many groups wanted a part in the response process, most in addition to those that had trained and practiced together and had assigned roles. With the high-stakes legal issues involved in the potential Natural Resource Damage Assessments (NRDAs) and civil or criminal penalties, a highly polarized atmosphere was promoted that interfered with the free flow of information and teamwork (Davidson, 1990).

Internationally, the *Exxon Valdez* spill led to the adoption of the International Convention on Oil Pollution Preparedness, Response, and Cooperation (OPRC Convention) in 1990. The OPRC Convention deals with contingency planning, spill reporting procedures, national and regional systems for response, international cooperation in response, research and development, and technology. By the end of 1996, 30 countries had adopted the OPRC Convention (Moller and Santner, 1997). Additionally, worldwide capabilities of cooperatives and equipment stockpiles established in the 1970s were further expanded.

In the aftermath of the *Exxon Valdez* spill, the focus on limiting spill impacts has been hampered by the assessment of damages to the environment. In the US, the spill resulted in the rapid passage of OPA 90, which included development of new NRDA regulations for oil as well as strengthened response and planning requirements. A good discussion of the content, history, and intended and unintended effects of NRDA regulations is in Mauseth and Kane (1995).

Wells *et al.* (1995) edited the symposium proceedings on the *Exxon Valdez* spill that contains reports of scientists funded by Exxon. Wells *et al.* (1995) state in their introduction to the volume that, at the beginning of the cleanup, lead scientists from government and Exxon attempted to establish a joint research program. This attempt failed when the US Department of Justice imposed confidentiality restrictions on the work of all government scientists. Secrecy became a major factor, along with the possibility that data analysis and interpretation could be delayed pending the outcome of legal action.

Further, Wells *et al.* (1995, p. 20) suggest that, had data entered the public domain, that data might have helped with understanding the spill's impacts and aided initiation of actions to alleviate damage. They quote a 1994 letter from John Robinson, who was in charge of the NOAA team that provided scientific support to the USCG during the spill:

> "To the extent that research conducted during the spill might have offered the potential of changing the course of the cleanup, there were probably several missed opportunities. The adversarial process in which we found ourselves certainly did not work to the benefit of the cleanup. Those of us charged with advising the Coast Guard were effectively blocked from communicating with scientists on either side of the damage assessment issue, much to our unending dismay. People and money to support cleanup related research, as opposed to damage-related research were difficult to come by...We were never able to communicate effectively with scientists employed by the state or federal government's damage assessment efforts."

Legal issues have influenced spill response and the judging of the response effort: the presence of lawyers and the expectation that civil and criminal litigation, as well as NRDAs that may follow, has limited communication between responders representing a spiller and those representing government. There seems to be greater polarization among all concerned with response because of the legal pressures and intense media attention on controversies among participants. Such polarization is seen even in countries that do not have NRDA regulations.

Wells *et al.* (1995) discuss the problems inherent in communicating complex, technical issues to the media and public in a highly charged atmosphere. Some scientists tend to generalize and overstate their conclusions to the media and lawyers in the early phases of an adversarial process. Both the media and legal system encourage individual scientists to make rapid, definite conclusions on controversial issues. In contrast, the slower scientific peer-review system encourages consensus conclusions through criticism by other researchers.

Since the legal system now dominates spill response, scientists are seen as representing one "side" or another. Legal constraints also have affected the quality of science and interpretation of findings. Lawyers want conclusions, not qualifiers. Scientific findings almost always have qualifiers. Scientists working on one "side" do not benefit from peer review of those on the other. Further, there is a conflict of interest when the same government agency plays a major role in directing spill response as well as assessing damages and ultimately receiving damage awards, which response and damage assessment planners should consider. Lindstedt-Siva (1991) recommends separating response and damage assessment functions into different agencies.

Mauseth and Kane (1995) discuss potential conflicts between law and science. Lawyers and scientists have different missions. Lawyers are advocates, trained to present one side and argue its validity. When dealing with scientific issues, their job is not to present the whole literature on a given subject but only those studies that support their case. Scientists' job is to review the whole literature, look at all possible explanations, and let the data drive conclusions. To the extent that scientists are persuaded to become advocates, it represents a corruption of their primary mission.

Wells *et al.* (1995, p. 21) acknowledge that political factors can overwhelm scientific considerations. The authors conclude that objective judging was not possible at the time of the *Exxon Valdez* spill:

> "One major problem for the authorities on both sides was continued public distrust in their deliberations and outputs. Ideally, public representatives should be involved in study design through to data dissemination. But even if all the experts agreed that the best response to the spill was to allow natural processes to take their course, this would have been politically unacceptable because the public was crying, 'do something!' Political and social factors still overshadow the objective analysis of the impacts or lack of them for this particular spill."

Intense media attention may influence the cleanup process and the way it is judged. Davidson (1990) illustrates this point with an example from the *Exxon Valdez*. Davidson notes that the question of how clean is clean became not only a practical matter of recovering oil and cleaning shorelines but also a public relations challenge. Experts could not make decisions on scene because all decisions had to be accepted by the public and public officials. For example, it might be unacceptable from a public relations' standpoint to leave visible oil on a shoreline even though this might be the most ecologically sound option in the opinion of on-scene experts, which reverts to the 1970s default criterion of spill cleanup.

2.3 SUMMARY

As spill response evolved over the past 30 years, the criteria used to assess performance also evolved from simply removing visible oil to the more complex question of how clean is clean. The question of "How clean is clean?" has become not only a practical matter of recovering oil and cleaning shorelines, but also a public relations challenge. Spill managers in the 1990s must now consider competing perspectives of various agencies and organizations involved in a response. Decisions made by spill experts on scene must now be acceptable to the broader public and public officials.

Advances in assessing response effectiveness have not matched the increasing complexity and sophistication of response. This may be due to the response community's focus solely on adding more response capabilities. The tendency of the media and public to judge response based on their own

perceptions rather than factual evidence may have contributed to lack of emphasis on assessing effectiveness. As the limits of increasing capabilities are approached, however, the response community is beginning to recognize the need to assess current practices not from a pass/fail perspective, but from an assessment perspective that identifies strengths and weaknesses. This recognition offers opportunities for performance validation and improvement.

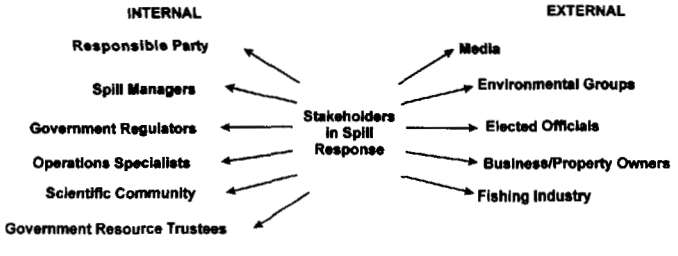
SECTION 3

THE STAKEHOLDERS AND THEIR CRITERIA FOR ASSESSING PERFORMANCE

Everyone who has an interest (or stake) in the outcome will judge spill response. There are two definitions of the term "stakeholder" in the 1997 *American Heritage Dictionary*: (1) anyone who has a share or an interest in an enterprise especially a financial share, and (2) anyone who has a personal interest or involvement. This section will identify who belongs to internal and external stakeholder groups; their roles, responsibilities, or interest in a spill incident; and the criteria they apply in assessing the effectiveness of response performance.

Stakeholders can be divided into two categories, internal and external (Figure 1). Internal stakeholders include those who have direct responsibility for or take part in the spill response. External stakeholders are those who have a stake in the outcome of the response. The decisions and actions of the response organization affect external stakeholders even though these stakeholders are not directly involved in the conduct of the response.

FIGURE 1.
KEY STAKEHOLDERS IN OIL SPILL RESPONSE



The entity with financial responsibility is the company or organization that has the spill accident, the Responsible Party (RP). Some government agencies are charged with overseeing a response, while others are responsible for particular resources that may be affected by the spill. This latter category includes resource trustees. The scientific community sees and assesses the event from a scientific perspective. Response managers and operations specialists, who deploy and run the response equipment, are most directly responsible for the conduct of the response. Indigenous groups with coastal land or subsistence use of resources, property owners, and businesses that depend on coastal activities may be affected by a spill event. Environmental groups may take public positions on spill issues, and they may have considerable input during the planning phase for oil operations generally and spill preparedness. The media are observers of responses to large spills and rely on the other stakeholder groups to provide input to their stories.

3.1 RESPONSIBLE PARTY

The primary concern of an RP is responding in a manner that will minimize liabilities and costs to enable the company to survive. An RP seeks to conduct an effective spill response and to be perceived as doing so through a public and media relations effort. An RP seeks to limit potential liabilities (civil, criminal, and financial) that result from a spill incident. Therefore, some scientific data collection to assess the impacts of the spill will usually be a part of an RP's response effort. Ideally, data collection will be in cooperation with the government agencies that will also be assessing impacts. Many RPs and government agencies have expressed the desire to conduct cooperative studies, and such cooperation is now encouraged in US regulations.

3.2 SPILL MANAGERS

Spill managers are responsible for all aspects of response. The type and degree of response is often influenced by socioeconomic factors, including various amenity and economic uses of shorelines and coastal waters and environmental esthetics, as well as political pressures. For example, a harbor containing expensive recreational and fishing boats generates considerable income for the local community. Bad publicity regarding oil contamination can translate into economic losses. Hence, more extreme methods (e.g., hydroblasting or hot water washing) to remove visible oil often can be justified on socioeconomic grounds. Managers are found in an RP's company and in government agencies (designated as lead agencies for government[s] during responses). Spill managers usually employ some variation of the Incident Command System (ICS), adapted from the command system developed for fire fighting, which is now generally used worldwide.

Poor management can result in delays and disputes. Good management (if backed by adequate resources) can result in prompt, effective action. Criteria for assessing spill response performance are similar among spill managers from various organizations with the notable exception that an RP must also

be concerned with the survival and financial integrity of a company.

The roles of government and industry managers vary from country to country. In some, a government agency assumes responsibility for managing the spill response operation, and an RP is not involved in decision making directly. In others, the government acts as an advisor to or monitor of an RP's management activities. The roles of government spill managers in various countries are described below.

Bulgaria. The Bulgarian Marine Emergency Response Squadron, a government agency reporting to the Ministry of Environment, has overall responsibility for coordinating spill responses. An RP probably will do most of the hands-on management. Companies with operations in a country are responsible for developing contingency plans that identify sensitive areas and detail response strategies, including plans to access equipment from outside the country (Hoagland-Grey, 1995).

Canada. A government-industry partnership is how Shirreff and Berthiaume (1995) describe Canadian oil spill response planning. Spill management can take three different forms: (1) a spiller manages a response with the Coast Guard and other agencies acting as advisors, (2) the Coast Guard manages a response with a spiller acting as advisor, or (3) the Coast Guard manages a spill with no involvement by a spiller. The authors conclude that the government-industry partnership is both sensible and cost-effective. Key to success is working very closely during the planning and training process.

India has designated its Coast Guard as the authority responsible for spill preparedness and response (Mahapatra, 1995).

Norway. The Norwegian Pollution Control Authority has statutory authority for spill response, although a spiller pays for a response. The Head of the Oil Pollution Control Department is the Head of Operations in charge of an Operations Headquarters at a spill scene. Support units include Operations, Information, and Liaison (with a spiller and Military and Civil Defense). Supporting Operations are Logistics, Communications, Expert group on environmental impacts, and Advisors for municipal contingency representing affected municipal areas (Guénette *et al.*, 1997). Additionally, for the Norwegian oil industry, the Norwegian Pollution Control Authority requires well-documented contingency plans at refineries, oil terminals, and offshore installations. The RP takes the lead (with an On-Scene Coordinator [OSC]) in responding to the spill, but in close cooperation with the authorities.

Spain has a National Contingency Plan (NCP) under which a government agency, the Merchant Marine Directorate, functions as On-Scene Commander during marine salvage and pollution events. Pardo (1995) describes how this plan functioned during the *Aegean Sea* spill in 1992 at La Coruña on the northwest coast of Spain. He describes extreme media attention and public interest in the spill. He also documents rapid decision making by the On-Scene Commander regarding the question of dispersant use. The response included on-water recovery, protection of sensitive areas, and shoreline cleanup.

The UK. The Coastguard Agency's Marine Pollution Control Unit (MPCU) manages spill response and implements the UK NCP (Harris, 1997). The agency has a small staff but stockpiles equipment and has numerous contractors on call. The management structure includes an Overall Commander (the chief executive of the UK Coastguard Agency) that is responsible to the Secretary of State for Transport. The Local Commander (director of the MPCU) is based at the Marine Response Center along with the Press Center and the Joint Response Center. These facilities usually are close to the spill scene. The Local Commander (On-Scene Commander) is a senior officer of the MPCU based at the spill scene. Air Operations, Equipment, Salvage, Cargo Transfer, and Marine Resources units support the command structure. These units can tap expertise and contractors throughout the country and beyond. Equipment from other countries is accessed through the Bonn Agreement (Harris, 1997).

The US. Under the US Unified Command Structure (UCS), a company or RP and federal and state government agencies manage response together. The UC manager is an RP's OSC. Operations staff is responsible for the actual response from logistics to waste disposal. Environment, Health, and Safety staffs advise the UC regarding resources at risk and priorities for protection, effects and effectiveness of various spill response countermeasures, shoreline cleanup priorities and methods, and general health and safety issues. Public Relations staff usually forms a joint office within the UC to disseminate information about the spill and cleanup activities. Legal staff advises the company regarding liabilities (Jardim and McDermott, 1993).

For US marine spills, the USCG provides a Federal On-Scene Coordinator (FOSC), who is responsible for oversight and support of an RP's response effort. Other agencies (federal, state, and local) concerned with particular resources may want to be involved in the response process to protect their interests. The greater the number of entities involved in decision making, the more difficult making decisions becomes. If an RP cannot be identified or if RP resources are overwhelmed, the USCG is charged with augmenting these resources to the extent necessary to achieve an adequate response.

Venezuela. The national oil company, Petróleos de Venezuela S.A., is charged by presidential decree with implementing Venezuela's NCP. Its regional subsidiaries implement operations within their areas of responsibility. Response activities include mechanical recovery, dispersant application, protection of identified environmentally sensitive areas, shoreline cleanup, and public affairs (Villoria *et al.*, 1995).

3.3 GOVERNMENT REGULATORS

In most countries, one or more government agencies are assigned legal authority and responsibility to minimize the impacts of oil spill incidents. These are carried out in a variety of ways. Some government agencies directly manage a spill response (e.g., the UK Coastguard Agency). Another responsibility common to most countries is to integrate recommendations of science advisors, operations personnel, and other interested parties toward a final determination of criteria that will be used to measure success. One critical element is determining the point at which a response should be terminated.

3.4 OPERATIONS SPECIALISTS

Operations specialists deploy and run equipment in oil cleanup cooperatives, the oil industry, and government agencies. They are most concerned with timely response to a spill event, timely and proper deployment of equipment, and effectiveness and efficiency of equipment, including the amount of oil removed or controlled. Lees (1993) gives an operations view of response criteria to assess the effectiveness of response:

- equipment readiness,
- speed and efficiency of equipment mobilization and deployment,
- team response time,
- equipment efficiency (barrels of oil recovered, reliability of communications systems), and
- logistical support deployment and effectiveness.

Benson *et al.* (1993) provide another operations perspective by documenting a beach cleanup in Saudi Arabia where performance was assessed solely by percentage of oil removed.

3.5 SCIENTIFIC COMMUNITY

The scientific community likely to work on oil spill issues is located in consulting firms, government agencies, universities, and oil companies and their insurers. The scientific community provides technical and engineering support to spill managers during response. For example, scientists identify sensitive habitats, effects on natural resources, and technical capabilities of response options. Such information is useful to spill managers in devising response strategies and implementing tactics.

The subject of how to assess spill response effectiveness has been debated over several years by the scientific, government, response, and environmental communities. Lindstedt-Siva (1977, 1979, 1991) espouses a position favoring ecological standards because ecological impacts are generally longer lasting and harder to repair than, e.g., esthetic impacts. Baker (1997) offers support for use of ecological standards. Mearns (1995) and Baker *et al.* (1996) use ecological endpoints for measuring the effects of spills and response effectiveness, and to define recovery.

Baker (1995, 1997) lists chemical standards that could be used to define "clean" based on petroleum hydrocarbon concentrations that:

- do not exceed normal background levels for a particular location;
- do not exceed statutory limits;
- are not lethal to specified organisms;
- do not cause deleterious sublethal effects to specified organisms;
- do not cause tainting of food organisms;
- do not impair the human use of an area; and
- are not visible to the human eye.

The review by Sell *et al.* (1995) summarizes many other scientific papers over a period of 30 years that use such scientific criteria.

3.6 GOVERNMENT RESOURCE TRUSTEES

Government resource agencies that are responsible for managing or monitoring particular resources such as fish stocks, marine mammals, national parks, and wildlife refuges will not only judge the response in this role, but may function as trustees for NRDAs. The usual pattern in the US is to hire contractors to supplement agency scientists. There can be overlap between agencies involved in a spill response and agencies assessing the spill impacts for later legal action against a spiller.

Major performance criteria for trustee agencies include protection of identified environmentally sensitive areas (e.g., wetlands, seal or sea lion haul out areas, sea otter areas, bird nesting areas, fish hatcheries) or particular resources. Such agencies may wish to be part of response decision making when they perceive that the resources for which they are responsible are threatened. In the US, these agencies also may be resource trustees for NRDA purposes.

During any large spill, there is always an effort to rescue and rehabilitate oiled birds and mammals. Bird and mammal surveillance teams are mobilized, permitted collection teams activated, and rehabilitation centers opened, staffed, and equipped. Bird and mammal rescue and rehabilitation components are necessary performance criteria for these resource agencies during a response.

3.7 MEDIA

The traditional media — print, television, and radio — are the judges of response that seem to matter most to nearly everyone involved in the response process. The media play key roles in disseminating information about a spill to an anxious public. Large spills are media events, yet the media are generally not spill experts. Case studies of 12 major spills were reviewed from the literature as well as newspaper and magazine articles on these spills (Appendix).

The most common pattern of media reporting is to seek "sources" representing various "sides" for information, experiences, and opinion. Television and radio news are constrained by time and seem to focus on drama and conflicts. Print media can take more time for technical details and analysis.

3.8 ENVIRONMENTAL GROUPS

Environmental groups are non-governmental organizations usually motivated by concern over human impacts on the environment. They often are involved in many aspects of spill preparedness and will certainly be judges of response. Environmental groups play major roles in fostering environmental laws and regulations through lobbying efforts and during com-

ment processes. They have come to be accepted as interested parties and often are represented in government-formed panels to develop policy recommendations on environmental issues. Environmental groups are nearly unanimously against oil development offshore. Those who favor litigation are as likely to sue the government as industry. All environmental groups, whether lobbyist, litigator, or activist, seek to attract media attention and support.

After the *Exxon Valdez* spill, Greenpeace *(http://www.greenpeace.org)* began a campaign to "highlight the worst practices of the oil industry to pressure them to clean up their acts" and educate people about "alternative solutions to energy problems such as solar- or wind-based power sources and public transport initiatives that could end our addiction to fossil fuels." The group also was a visible presence during the 1993 *Braer* spill in the UK where members opposed chemical dispersant use and suggested the potential for long-term health effects from exposure to spilled oil (Hetherington, 1993).

Friends of the Earth *(http://www.foe.org)* was active during the *Sea Empress* spill (1996) and sued the UK Department of Transport for failure to take command of salvage operations, criticized the Coastguard Agency's enforcement of environmental laws (Brown, 1997), and actively opposed chemical dispersant use ("Slick cleanup report renews spraying debate," 1997).

The Sierra Club *(http://www.sierraclub.org)* is not categorically against offshore oil development but opposes offshore petroleum exploration unless:

- There is adequate funding for studies on the effects of large spills and on the cumulative effect of oil pollution in the marine environment.
- There are readily available adequate containment and recovery systems.
- Baseline biological, geological, and environmental data needed to evaluate the future impacts of petroleum development in a prospective area have been obtained.

3.9 Elected Officials

Elected officials respond to constituents and want to solve problems, especially highly visible problems, in their districts. They often respond to public opinion polls and media pressure and seek ways to advance their careers by participating in activities perceived as beneficial. This means that, to varying degrees, elected officials will be involved in any large spill event. These officials may aid the process if their influence is applied toward, e.g., streamlining the process or expediting equipment access from government sources. Because they are not involved in the planning phase, but only after the event, and because of their dependence on constituent satisfaction, however, the criteria they use to assess performance include:

- satisfying constituent demands,
- positive media reports, and
- positive public opinion.

3.10 Business and Property Owners

Owners of properties other than governments include private landowners, indigenous groups, and businesses. These property owners are concerned that the value of their property may decrease because of a spill. If oil comes ashore on their property, they want immediate cleanup. In addition, there are businesses dependent on shoreline- and water-related activities. Everything from large resorts, to family-owned bed and breakfasts, to bait shops and boat rentals and marina operators can be affected. Property owners usually are angered over the damage to their property or livelihood. The special attention by responders to their needs and requests will determine how they judge a response.

3.11 The Fishing Industry

Fishermen's organizations, like environmental groups, tend to oppose oil development and become very visible during a crisis. The fishing industry is concerned with the health of fish stocks, the ability to fish, potential contamination of boats and equipment, and tainting or perceived tainting of their fish catch, all of which amount to concern over economic impacts of the spill.

Fishermen are motivated to become involved in a spill response when they are affected by a spill directly. Commercial fishermen's groups are impacted when harbors from which they operate or fisheries themselves are threatened with closure, fishing gear could be contaminated, or fish could be tainted or perceived to be tainted because of a spill. Local fishermen can play a part in response decision making and in a response itself by hiring out their vessels and crews (Lindstedt-Siva, 1991).

3.12 Summary of Stakeholder Response Performance Criteria

The response performance criteria from each type of stakeholder are compiled in Table 1. Criteria may be conflicting or complimentary between stakeholders. Some criteria are unique to one type of stakeholder. It is the number and variety of performance criteria, in combination with the potential for conflict, that is a major cause of poor performance. To improve performance, the response community should work to gain consensus on criteria to develop performance goals and expectations.

Table 1.
Summary of Response Performance Criteria

STAKEHOLDERS/RESPONSE PERFORMANCE CRITERIA	REFERENCE
RESPONSIBLE PARTY	
Company survival	
Minimize liabilities	White, 1997
Perceived as good corporate citizen	White, 1997
Contingency plan effectively implemented	Jardim and McDermott, 1993
Effective, timely, complete response	
Minimize impact	Ott *et al.*, in press
GOVERNMENT REGULATORS	
No visible oil on water	Tebeau, 1995
No visible oil on shorelines	Tebeau, 1995
No hydrocarbon odor or 'oily' feel	Tebeau, 1995
Hydrocarbon concentrations are measured below an agreed on standard	Tebeau, 1995
Minimize impact of spill and cleanup	Ott *et al.*, in press
Clear and effective notification and call out procedures	Ott *et al.*, in press
Effective identification and access of response resources	Ott *et al.*, in press
Effective and accurate permitting	Ott *et al.*, in press
Clear and effective authority, chain of command	Ott *et al.*, in press
Positive meetings (spill team and public)	Ott *et al.*, in press
Interested party concerns addressed	Ott *et al.*, in press; Wilkerson and Lauder, 1997
Cooperative and positive media relations	Milbury, 1997; White, 1997
SPILL MANAGERS	
Availability and quality of support staff	Cantwell, 1997; Ott and Stalfort, 1997
Ability to work together, team building, relationships	Christopherson and Slyman, 1993; Harbert, 1995; Ott and Stalfort, 1997
Adequate training and practice	Clark *et al.*, 1997; Eldridge *et al.*, 1997; Martin *et al.*, 1997; Ott and Stalfort, 1997
Same parties respond as practiced and trained	Abordaif *et al.*, 1995; Christopherson and Slyman, 1993; Ott and Stalfort, 1997
Capability for sustained operations	Walker *et al.*, 1995

STAKEHOLDERS/RESPONSE PERFORMANCE CRITERIA	REFERENCE
SPILL MANAGERS (continued)	
Expansion capability to accommodate a large spill	Walker *et al.*, 1995
Coordination between all responding entities	Walker *et al.*, 1995
Effectively communicate and manage information	White, 1997
Ability to shift management styles during emergency and project management phases	Ott and Stalfort, 1997
Involve interested parties in planning process	Patry and Rivet, 1995
Interested party agreement/concerns addressed	Baker, 1997; Ott *et al.*, in press
Minimize the spread of oil	Ott *et al.*, in press; Walker *et al.*, 1995
Minimize impact (environmental and economic)	Ott *et al.*, in press
Protect identified sensitive areas	Ott *et al.*, in press; Walker *et al.*, 1995
Meet public's realistic expectations for pollution response	Walker *et al.*, 1995
Attention to human factors	Cantwell, 1997
No worker injuries	Ott *et al.*, in press
No public injuries	Ott *et al.*, in press
Positive media coverage	Ott *et al.*, in press
Positive public perception	Ott *et al.*, in press
Positive meetings (spill team and public)	Ott *et al.*, in press
Cooperative media relations	White, 1997
OPERATIONS SPECIALISTS	
Ready equipment	Lees, 1993
Ample equipment	Lees, 1993
Timely response	Lees, 1993
Proper deployment	Lees, 1993
Efficient performance (oil control/removal in bbls, % recovery)	Benson *et al.*, 1993; Lees, 1993
Adequately trained, available personnel	Lees, 1993; Nichols, 1992
Salvage operations must minimize spillage	Walker *et al.*, 1995
Ecological effects on impacted populations	Dean *et al.*, 1993; Lindstedt-Siva, 1979, 1991; Mearns, 1995; Sell *et al.*, 1995

(continued)

TABLE 1.
SUMMARY OF RESPONSE PERFORMANCE CRITERIA *(continued)*

STAKEHOLDERS/RESPONSE PERFORMANCE CRITERIA	REFERENCE
SCIENTIFIC COMMUNITY	
Emergency response – minimizing impacts	
Emergency response – protecting sensitive resource	Lindstedt-Siva, 1992
Shoreline cleanup – minimize impacts, promote recovery	Lindstedt-Siva, 1992
Use of Net Environmental Benefit Analysis	Baker, 1997; Lunel *et al.*, 1997; Sell *et al.*, 1995
Toxicological – toxicity of spilled oil to specified organisms	Baker, 1997
Chemical – oil residues remaining	Baker, 1997
Response reduced impacts compared with no intervention	Lindstedt-Siva, 1992
Assessment using ACIP (After Control/Impact Pairs)	Dean *et al.*, 1993
GOVERNMENT RESOURCE TRUSTEES	
Protection of environmentally sensitive areas	Ott *et al.*, in press
Protection of marine mammals	Williams and Davis, 1990
Protection of birds	Williams and Davis, 1990
Protection of fisheries	
Protection of refuges/parks	
Minimize resource damage	Ott *et al.*, in press
Minimize impacts of cleanup	Ott *et al.*, in press
MEDIA	
Timely and accurate reports/responses from sources	Meidt, 1991
24-hour access to information sources	Harris, 1997; Meidt, 1991
Daily press conferences	Meidt, 1991
Level of controversy	
Level of visible cleanup activity	
Public opinion polls	
Interested party interviews/concerns addressed	Wilkerson and Lauder, 1997

STAKEHOLDERS/RESPONSE PERFORMANCE CRITERIA	REFERENCE
ENVIRONMENTAL GROUPS	
Adequate compensation for those affected	Friends of the Earth (website)
Greater representation of interested parties	Friends of the Earth (website)
Adequate funding for spill studies	Sierra Club (website)
Readily available containment and recovery systems	Sierra Club (website)
ELECTED OFFICIALS	
Responsive to constituents needs	
Positive effect on career	
Positive public opinion polls	Meidt, 1991
Positive media reports	Meidt, 1991
BUSINESSES/PROPERTY OWNERS	
No interruption of tourist or other businesses	Cone and Billiter, 1990
Prompt, effective removal of visible oil	
No bad publicity about the city/region of the spill	Churm and Newton, 1990
FISHING INDUSTRY	
No adverse impacts on health of fish stocks	Lord, 1997
No closure of fisheries	Lord, 1997
No closure of harbors	
No contamination of fishing gear	
No tainting (or perceived tainting) of fish	Cone and Billiter, 1990
Prompt settlement of claims	Ott *et al.*, in press

SECTION 4

FORCES THAT PROMOTE OR IMPEDE PERFORMANCE

During any emergency for which human intervention is required (e.g., search and rescue, fire, spill), cooperation among all involved increases the possibility that such intervention will make a difference in the outcomes of an event. In the case of oil spill response, there are a number of factors that can improve or impede performance. This section will examine the following:

- current perspectives in spill response,
- factors that promote response performance, and
- factors that impede response performance.

These factors are examined to define performance issues, identify solutions, and make recommendations to improve performance.

4.1 CURRENT PERSPECTIVES IN SPILL RESPONSE

As the 1990s end, the current state of spill response must be examined. This subsection provides an examination of spill management, media relations, and application of Net Environmental Benefit Analysis (NEBA). In recent years, spill management has received much attention throughout the response community. Media relations are and always will be an important issue. Finally, NEBA is emerging as a method for determining the effectiveness of spill response strategies.

SPILL MANAGEMENT PERFORMANCE FACTORS

Lindstedt-Siva (1992) and Ott *et al.* (1993) divide spill management into three phases: emergency phase, overhaul or project management phase, and investigative phase. The ***emergency phase*** occurs immediately following a spill while resources are being deployed and rapid decisions are being made. The ***project management phase*** occurs after oil has spread and shorelines are contaminated. It includes prolonged oil collection from the water surface and shoreline cleanup. The ***investigative phase*** refers to those activities required to assess a spill's causes and impacts.

There are different management styles for each of these phases (Ott *et al.*, 1993). For the emergency phase, authoritative decision making is recommended, i.e., a management structure similar to a search and rescue or a forest fire with a small number of decision makers and heavy reliance on experts. In contrast, the project management phase involves many jurisdictions and interests and is not as critically constrained by time. More entities may be involved in decision making, and a consensus management style may be possible. The investigative phase requires what the authors call methodical decision making by scientists.

Hereth (1997) stresses the importance of setting spill management objectives for response. In his view, these objectives must be consistent with the "national response priorities" of the US NCP:

1. Preserve safety of human life.
2. Stabilize the situation to prevent the event from worsening.
3. Use all necessary containment and removal tactics in a coordinated manner to ensure a timely, effective response that minimizes adverse impacts on the environment.
4. Address priorities 2 and 3 concurrently, not sequentially.

Walker *et al.* (1995), in their paper on spill management systems, discuss critical factors that "must go right" if the spill response operation is to succeed. These critical success factors were developed at scenario-based exercises conducted by Harrald (1994) during a USCG OSC course. Most critical success factors relate to the operations element of response:

1. The salvage operation for a vessel spill or emergency response operation at a facility must minimize spillage of oil and not interfere with pollution response operations. The best way to minimize the environmental impacts of a spill is to secure the source.
2. The immediate response by an RP and the USCG must mobilize appropriate response resources to contain most of the oil at or near the source and to protect sensitive areas. Minimizing the spread of oil from the source and protecting the most sensitive areas are critical steps in minimizing the overall spill impacts.
3. A response organization must be able to communicate and manage information internally and externally. The importance of external communications is recognized.
4. Coordination between federal, state, and local organizations and an RP must be preplanned, account for the interests of affected and interested parties, and ensure a response organization that will be cohesive and effective. Again, the need is stressed for all involved to work together in advance.

5. A response organization must be capable of sustained operations, that is, must be expandable to accommodate a large event.
6. A response organization must meet the public's realistic expectation for pollution response, which means to be seen as effective by the media/public. A zero impact response is unrealistic. An educational effort should be advanced to develop realistic expectations.

MEDIA RELATIONS

Responders face great difficulty when trying to explain highly complex, technically complicated situations to the media and public. Because of the media's importance during spill events, most government and RP contingency plans have strengthened their media and community relations elements.

Meidt (1991) reviews media coverage of major spills in 1989 and 1990 and finds patterns. Responders' actions tended to be characterized by contradiction and misunderstanding. There were questions about leadership and failure of responders to act in a timely manner. It mattered little that there might have been justifiable reasons for all of these actions. Meidt (1991) makes recommendations to improve media relations:

- ***Access.*** An OSC should have a 24-hour public information office during the early phases of the spill. Community relations programs should be part of this effort. Information must be accurate, and misinformation should be dealt with immediately.
- ***Focus.*** Chaos and confusion are inherent in all crises. They can be dealt with only by acknowledging their presence. An OSC should identify those issues that are most significant to an overall spill event and cleanup and deal with them. Strive to be media-directive rather than media-driven. Maintain focus rather than be driven by media questions and tangential issues.
- ***Coordination/control.*** Daily fact sheets should be used to dispense information, correct errors, summarize action taken, and communicate other significant information about a spill.

In contrast with *Exxon Valdez* and *Mega Borg,* effective media communications have contributed to judgments of favorable performance in a number of large spills. The large 1996 *Sea Empress* spill in the UK attracted the attention of the worldwide media. The UK Coastguard Agency held press briefings twice a day during the first week and issued frequent press notices. Hundreds of interviews and other media contacts were arranged. A press office with its own logistical support was set up to accomplish this. Harris (1997) concludes that the response performance would be judged favorably based on the implementation of the NCP and effective communications.

DeLong (1997) reports on media relations during the *Buffalo 292* fuel oil spill in Galveston Bay. The response was covered by the national media and, in DeLong's view, was covered fairly and accurately. He attributes the quality of the coverage to a public relations contingency plan and the relationships developed with the media during the planning process.

Milbury (1997, p. 333) places the importance of public relations during spills on equal footing with response itself:

> "A successful spill response must win two battles, both of equal magnitude. The first is the battle of response and recovery of oil. The second is winning the support of the public through accurate communication of the response efforts through the news media. To be successful in the second battle, you must prepare and implement your media response strategy just as effectively as your pollution response plan."

White (1997), a public relations consultant, acknowledges that public perception and resulting pressure can drive spill response actions. She stresses the importance of prespill planning and training on communications issues. White also explores options during a spill situation, from disclosing very little to full disclosure with no quality control. Her premise is that any major oil spill response will likely not meet public expectations. The public sees a major spill as an environmental disaster that should not have happened. The public relations effort, therefore, is not starting from ground zero but from 10 feet down. Starting from this point, the media and public often search for scapegoats and where to place blame when a spill is not being cleaned up fast enough. She recommends that RPs and government agencies work together on communications so that, as much as possible, information on critical issues is presented consistently. Lawyers generally want to restrict communications to minimize the risk of liability and litigation, while the media want unfettered access.

Wilkerson and Lauder (1997), crisis management consultants, emphasize the importance of a risk communication program to integrate community and media relations. Such a program should address how to communicate before, during, and after an oil spill. It should be an ongoing process and begin during contingency planning. They suggest the following elements of effective communication during a crisis:

- involving the public in decisions that affect them;
- sharing control of a situation;
- responding to public concerns;
- communicating openly and honestly;
- acknowledging and understanding outrage;
- acting to reduce the uncertainty of risk when possible; and
- building alliances when possible.

Common throughout this discussion on media relations is: (1) the need to plan ahead and practice media and public relations; (2) the need for open, honest, accurate information; and (3) frequent communication.

APPLICATION OF NET ENVIRONMENTAL BENEFIT ANALYSIS

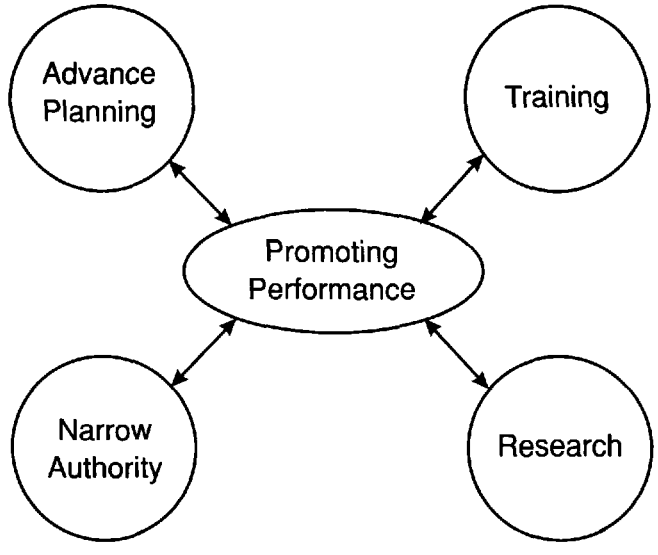
Baker (1995, 1997) proposes the NEBA concept as a means to examine the advantages and disadvantages of various response strategies. This method has appeal because it is quantifiable. There are five steps in the NEBA process:

1. Collect information on ecology, physical characteristics, and human use of environmental resources of the habitat proposed for response and details of a proposed response method.
2. Review previous spill case histories and experimental results that are relevant to an area and response method being assessed.
3. On the basis of previous experience, predict the likely environmental outcomes if a proposed response method is used and compare it with those of natural cleanup.
4. Compare the advantages and disadvantages of a proposed response method with those of natural cleanup.
5. Weigh advantages and disadvantages with reference to the ecological value and human use of environmental resources to arrive at optimum response. All parties must recognize that optimum response cannot avoid all disadvantages. It is always a trade-off.

4.2 FACTORS THAT PROMOTE PERFORMANCE DURING RESPONSE

This section examines the factors that promote performance: advance planning, training, research, and narrow authority (Figure 2). Spill response involves employment of massive amounts of equipment and personnel under emergency conditions. The entire focus is on taking the most effective actions to limit impacts of spilled oil on the environment. Advance planning is necessary to ensure availability of necessary equipment and personnel and outline tactics for deployment. Training ensures that management, operational, and logistics personnel are familiar with their own responsibilities and roles. Research is necessary to identify and prioritize sensitive environments and aid in selecting optimum response strategies. Narrow authority empowers decision makers to act quickly in the best interests of effective response performance.

FIGURE 2.
FACTORS THAT PROMOTE PERFORMANCE



ADVANCE PLANNING

Spill response planning and training are required in every area of the world where oil is produced, handled, and transported. These requirements were strengthened in most countries after the *Exxon Valdez* spill. Equipment stockpiles were expanded, and response times for equipment and personnel decreased. Today's contingency plans provide details of spill management systems and support functions that will be used during an emergency. Plans also specify response equipment and personnel that will be activated and identify environmentally sensitive areas with detailed strategies to protect them or minimize oil contamination. The management structure may involve just one government agency or an RP and several elements or levels of government, supported by technical, legal, and communications specialists. The planning process gives ample opportunity for development of common response goals and priorities. To the degree that these are achieved, the chances of success are increased.

Contingency planning is conducted in a non-crisis atmosphere when there is plenty of time for discussion; reviewing scientific and technical literature on logistics, effectiveness, and effects of various response methods; and weighing options and trade-offs. There are opportunities to involve as many outside experts and groups or individuals (e.g., citizens groups and local officials) as have an interest. These individuals and groups may be involved in the planning process itself or as reviewers and commenters on draft plans.

Presumably, completing these required contingency plans should allow those involved to develop a unified team approach to the response process. As much as possible, they should consider those factors likely to impede performance and address them. Developing overall response goals and priorities in advance (in the US, within the national response priorities listed in the NCP) should save time because they will not have to be debated during an emergency. Advance planning provides ample time to develop basic response strategies and agreements. For example, the question of whether to use dispersants and *in situ* burning as first response options or only if mechanical recovery is not feasible, and decide where their use will be acceptable and unacceptable, can be decided in advance. Ideally, many response decisions can be made during the planning process based on the best available scientific information, which saves critical time if a spill occurs. At this time also, criteria by which response will be assessed should be developed and agreed on by stakeholders.

TRAINING

Most countries require exercising contingency plans through drills and training. Scenario-based exercises have the added benefit of allowing parties to work together, get to know each other, and resolve differences and conflicts. During these exercises and the contingency planning process, some level of trust will develop among the people that must work together during an emergency. There is much less chance today that the first time an RP and government regulators meet is on the day of a spill. Another benefit of exercises is the chance to involve various interested parties outside the planning process, including the media.

RESEARCH

There has been much research and development since the *Torrey Canyon,* Santa Barbara, and *Exxon Valdez* spills. Today's contingency plans may be based on large technical and scientific databases covering every aspect of spill response from performance and specifications of equipment to effectiveness and effects of shoreline treatment methods. Although there are always more questions and a need for more research, there is enough information available to enable responders to base contingency plans on sound science and make informed, science-based decisions. Currently, the fate and effects of spilled oil and recovery times for several habitat types are much better understood. Continuing research is targeted toward examining spill response strategies on various habitats.

NARROW AUTHORITY

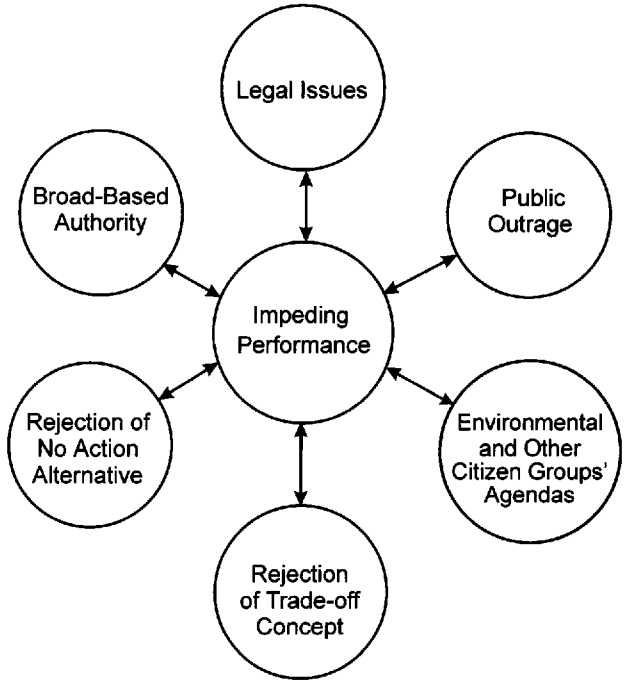
Countries with more authoritarian decision-making processes during spills seem to be able to mount more rapid responses using more techniques during the emergency and project management phases of response, attacking the oil when it is concentrated near the source of release. In the UK, for example, the government assumes responsibility for spill response, and there is one Local Commander responsible for operational decisions (Harris, 1997). Norway has a similar system (Guénette, 1997). It does not appear to be by accident that the term Commander, rather than Coordinator, is used in these management systems.

4.3 FACTORS THAT IMPEDE PERFORMANCE DURING RESPONSE

As illustrated in Figure 3, this subsection examines the factors that impede performance and cause polarization during response: cumbersome decision making by broad-based authority, legal issues, public outrage, environmental and other citizens groups, rejection of trade-off concept, and rejection of no action alternative.

Polarization makes public discussion of various response alternatives and compromise quite difficult, if not impossible. For example, scientists from government agencies and an RP may agree that the most ecologically sound response for a

FIGURE 3.
FACTORS THAT IMPEDE PERFORMANCE AND STIMULATE POLARIZATION



shoreline is no cleanup because leaving a small amount of oil will do less damage than would the methods required to remove it. Environmental activists or even local citizens may allege that an RP just wants to save money by not cleaning up a spill. Spill managers may be pressured into cleanup, contrary to recommendations by scientists. Meidt (1991) describes this as pressure "to be seen to be doing something."

BROAD-BASED AUTHORITY

Countries where response decision making is allocated among multiple agencies and other interests may encounter difficulty in reaching decisions. Broad-based authority often expands to include other OSCs as well, such as local governments and interest groups like fishermen. Since *Exxon Valdez,* there have been attempts to streamline broad-based authority structures in the US, and improvements have been made. The very involvement of several entities that must agree on decisions makes a broad-based system less efficient than a narrow authority structure.

LEGAL ISSUES

Anything that interferes with free, open communication among responders or creates an adversarial atmosphere impedes response and reduces the chance of a successful response. Legal issues often create such interference. It is vital that, *during the event,* all parties responding to the spill exchange information. This includes everything from visual observations or data on the presence and amount of oil on the water surface, in the water column and on shorelines, observed impacts,

observed concentrations of sensitive organisms, to the presence and performance of equipment. It is important to share information so that response operations may be launched, curtailed, or modified based on that information.

PUBLIC OUTRAGE

Another impeding factor during large spills is public outrage. Public outrage brings media attention and elected officials who want to help "solve the problem." All of a sudden, spill managers may be on the nightly news, along with environmental groups and scenes of oiled birds or seals. Rapport built during training may be lost as the opportunity to posture for cameras presents itself. Media presence almost by itself fosters controversy. The media are not spill experts. They get their information from interviewing "sources" from all "sides," thus setting up an adversarial situation from the beginning. Presenting differing perspectives is a more common pattern for the media than attempting to determine actual facts — that is, questioning the sources' perspectives, doing analysis, and coming to a conclusion regarding the validity of claims.

ENVIRONMENTAL AND OTHER CITIZENS GROUPS' AGENDAS

Environmental and other citizens groups have their own agendas and particular interests. Most of these groups are especially anxious to attract the media to promote their particular message. They may stage an event or take advantage of a scheduled event such as a town meeting to present a photo opportunity (e.g., demonstration, confrontation). They have been equally critical of government agencies as of industry. Such tactics increase the distrust and polarization that can exist in these volatile situations.

REJECTION OF TRADE-OFF CONCEPT

The concept of compromises or trade-offs in a spill is one that environmental groups do not seem to accept based on examination of their writings and public statements as well as the author's discussions with them. Other stakeholders may share this attitude as well. Not recognizing the need to consider trade-offs can hamper or even prevent effective decision making.

Once a spill has happened, it is part of the environment. The response decision-making process must be one of evaluating trade-offs, i.e., comparing relative impacts of various response choices, rather than between a spill and no spill. There usually are not enough resources available (trained ***people,*** ready and available ***equipment,*** or, probably most important, ***time***) to prevent all impacts once oil is spilled. In any response, the most human intervention can achieve is some influence on where and what type of impacts there will be. Acceptance of the trade-off concept during planning as well as during response will greatly enhance the opportunity for a response to be judged successful.

REJECTION OF NO ACTION ALTERNATIVE

There may be times when no action is the most ecologically appropriate response alternative to minimize spill impacts. One example is shoreline cleanup using heavy equipment, which may cause more damage than oil itself. The most ecologically sound strategy may be to allow oil to degrade naturally, but there may be tremendous pressure for action. Scientists may be the only advocates for the no action alternative, but they may be overruled, leading to increased environmental impacts.

4.4 RECOMMENDATIONS FOR IMPROVING PERFORMANCE DURING RESPONSE

The following recommendations integrate factors for promoting performance and overcoming impediments during oil spill response:

- teamwork and streamlined management,
- decision making by spill experts, and
- effective communications.

TEAMWORK AND STREAMLINED MANAGEMENT

Spill managers (On-Scene Commanders and/or On-Scene Coordinators) are understandably concerned about how well different entities involved in response decision making and operations work together. Unless some level of teamwork is achieved, it will not be possible to reach and implement decisions in time to minimize the spread of oil and protect sensitive resources. Most papers reviewed emphasize the importance of training, practice, and team building and ensuring that those involved in the planning process will be those involved in an actual spill. The latter does not always happen, whatever the intention, especially during large spills. The importance of a streamlined, rapid, effective decision-making process cannot be overstated. If decisions cannot be reached quickly at a command center, they cannot be implemented quickly in the field. Streamlining management during the emergency phase of a spill by minimizing the number of decision makers and relying heavily on spill experts is recommended.

DECISION MAKING BY SPILL EXPERTS

The goal of human intervention in a spill event is to reduce its impacts versus what would happen if there was no intervention. The most effective way to accomplish this to ensure that decisions are made by those most knowledgeable on the fate and effects of spilled oil, effectiveness of various response options, and capabilities of response equipment (spill scientists and operations professionals). Local input and interested parties' concerns must certainly be factored into these deliberations, but these concerns must not be allowed to unduly delay or obstruct decision making.

EFFECTIVE COMMUNICATIONS

After every drill or training exercise as well as actual spill events, better communications is nearly always identified as a major need. As Roosen (1997, p. 117) states, "In a crisis, infor-

mation is everything." This includes internal communications during the event where problems are usually resolved. A workable system evolves if it is not already in place. The primary problem is usually external communications with the media, communities, elected officials, and citizens groups. Media and community relations have been the focus of many studies and workshops, and several recommendations emerge.

Access. A 24-hour public information office for media and community relations is recommended during the early, emergency phases of a spill event. This office should aid information seekers in obtaining answers to their questions and make information sources available whenever possible.

Frequent, regular updates. This public information office should make fact sheets and information available on a regular basis, updating the status of a spill and activities to combat it. Daily press conferences, daily or twice daily updates, and fact sheets are possible approaches.

Accuracy. Information should be honest and accurate. If mistakes are made, they should be corrected as soon as possible.

Joint public information office. A public information office maintained jointly by an RP and lead government agencies managing a spill is recommended. Whenever possible, a "united front" on critical issues and decisions is most effective. Differences should be explained, along with the reasoning behind each position.

The Internet. A factor that has not been considered in many publications on the media during crises, nor used extensively during spill events, is the Internet. The Internet now plays a major role in disseminating information, and it will play a major role in the next big spill. The Internet provides an opportunity for nearly instant dissemination of information. The web page format makes it possible to post lengthy technical documents, graphs, charts, and even video and audio files. For example, it would be possible to post a data set on concentrations of oil in the water column, measured that day, or maps showing the location of surface oil and response equipment that can be updated every few hours. This kind of information is not likely to be provided by the traditional media.

The Internet is interactive. Bulletin boards can be established to accept and respond to questions from interested citizens and receive their observations. Such bulletin boards also could be major sources of background information for the traditional media.

The Internet is democratic. Anyone with a computer and modem can access it. All interested individuals have the same opportunity to open web pages and disseminate their observations, opinions, and data. Some of this information may be inaccurate, but the more information is available, the greater the chance that an interested individual will be able to make an informed judgment as to accuracy. It is recommended that response planners incorporate dissemination of information via the Internet into contingency plans. For example, an RP could establish a spill response update link from their home page, along with a discussion forum. A government agency, tourist bureau, environmental group, or other citizens groups could do the same. The more information available, the greater the possibility that the various stakeholders, media, and interested public can make informed judgments.

SECTION 5

PERFORMANCE ASSESSMENT

All stakeholders assess response performance using criteria similar to those identified in Section 3. It is not likely that all stakeholders, applying their individual, disparate, and sometimes conflicting criteria, will agree on a level of performance in a given response. Everyone is entitled to and will draw conclusions, but are all conclusions equally valid? The most likely scenario in a larger spill is that at least some stakeholders will make negative judgments, and those negative judgments will impact perceptions of responders' capabilities adversely. Should those evaluating spill response performance be spill experts or not? This dilemma has faced the response community since the days of the *Torrey Canyon*.

5.1 CURRENT STATUS

In the 1970s and 1980s, spill experts played a primary role in advising spill managers regarding response priorities and strategies. In the 1990s, experts are but one voice among many. With the emergence of other stakeholder groups, spill experts no longer dominate the decision-making process or the assessment of performance. The long and varied list of stakeholder criteria in Table 1 demonstrates their competing perspectives.

In most countries, there is no other agreed on mechanism for assessing response performance, and the media often are regarded as the final judges of response performance. The media may not have expertise to make such judgments, and their criteria may not be clear or consistent, but they are motivated to judge. This points to the importance of debate about who should assess performance and which criteria should be used.

There is a conflict between judging response performance in terms of scientific assessment of impacts and recovery and other measures such as removal of visible oil, the efficiency of the spill management team, or media and public reaction to the incident. If a response goal is to minimize the environmental impacts of the spill, then performance could be easily assessed. Response strategies that have the best chance of minimizing the impacts of the spill should be used as soon as possible to attack the oil during the emergency phase, while it is still concentrated near the source of the release.

Measuring the environmental effects of spills is a well-developed science that has been done for 30 years. Contingency planning, with the goal of minimizing environmental impacts of spills, also is well known. However, no systematic way to evaluate overall spill response performance has yet been proposed. Conflicts arise when stakeholders have differing expectations. Stakeholders' interests can be determined and discussed during the planning process as well as during a spill. They must be allowed to ask questions and get timely, thoughtful answers. If it is not possible to accommodate these interests, a full explanation should be made. Often, if citizens were told the reasons for scientific recommendations, e.g., leaving a small amount of oil on a beach, they would accept that reasoning.

The importance of rapid, open communication is paramount for education of, and building trust between, stakeholders. Communication among responders and stakeholders is vital. There are many opportunities for this during the contingency planning process when stakeholders may discuss and attempt to reach agreement on response goals and priorities as well as measures they will use to assess spill response performance. Stakeholder agreement and understanding of response goals is essential for the response to be conducted effectively.

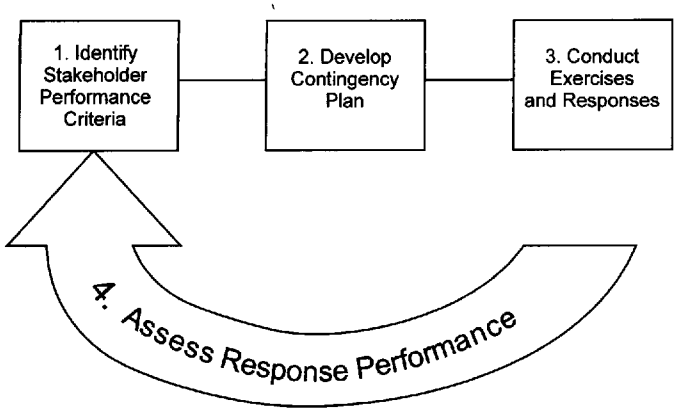
To date, efforts to improve response performance have focused mainly on providing more and better equipment, more personnel, more detailed and deliberate planning, and training and exercises. Until recently, little effort has been expended on devising clear and objective tools to assess the results of those preparedness and response efforts.

5.2 PROCESS FOR ASSESSING PERFORMANCE

The purpose of analyzing and evaluating response performance should be to improve that performance. This section recommends tools to assess spill response performance and make a judgment. Assessing response performance involves agreeing on and adopting performance criteria or standards and measuring performance results against those criteria. What will emerge from an assessment of spill response are aspects of the response where performance was strong and other aspects where improvement is needed. The recommended performance assessment process involves four phases aimed at developing performance criteria and standards for measurement in advance (Figure 4).

The spill response community is familiar with Phases 2 and 3. It is the contention of the author that much more attention is needed on Phase 1 and that a process for improving performance is essential (Phase 4). The feedback loop allows the responders, in consultation with stakeholders, to identify places where improvements are needed. Using lessons learned from exercises and responses the performance criteria can be assessed and contingency plan modified as needed. Discussion of each phase follows.

FIGURE 4.
PROPOSED RESPONSE PERFORMANCE ASSESSMENT PROCESS



PHASE 1: IDENTIFY STAKEHOLDER PERFORMANCE CRITERIA

Developing criteria and standards before a crisis will make it easier to develop response performance measures. This planning process will be further improved if response strategies are developed around stakeholders concerns. The use of external stakeholders in environmental decision making is rapidly increasing. Yosie and Herbst (1998) propose a process for involving both internal and external stakeholders in environmental decision making. This process may be used to identify, evaluate, and adopt criteria and standards by which to assess spill response performance. Performance criteria and measurement standards developed by both internal and external stakeholders become part of contingency plans and form a foundation for response goals and strategies.

The challenge of identifying and engaging stakeholders is difficult. There is not much experience with the stakeholder process yet in spill response planning, but their participation is essential to avoid default negative judgments. Yosie and Herbst (1998) note that some issues may not evoke sufficient interest or concern to merit a stakeholder's involvement. Cultural differences around the world may influence the degree of involvement. The lack of initial involvement should not discourage response organizations. Opportunities to foster stakeholder involvement can often be found following a spill. For example, a spill that attracted much media exposure and public outrage may generate stakeholder interest to participate.

Once stakeholders are engaged, their criteria for assessing response performance can be documented and catalogued. The best defined and most measurable criteria are those of the scientific community and response operations specialists. However, these criteria may not include all concerns of all stakeholders. As additional stakeholder criteria are developed, planners may discover inconsistencies and conflicts that will ultimately have to be resolved. Review of numerous case studies indicated that stakeholders' strategies, tactics, and response performance criteria vary from place to place and incident to incident. Tebeau (1995) studied the *Exxon Valdez, American Trader,* and *Morris J. Berman* spills to determine what criteria were used by FOSCs to determine how clean is clean. For the *Exxon Valdez* spill, cleanup was judged "complete" when:

- no oil was detectable in the water or on adjoining shorelines; or
- further removal caused more environmental harm than good; or
- cleanup was excessively costly in view of risk prevented; and
- activities required to repair unavoidable damage resulting from removal actions had been performed.

For the *American Trader* spill (1990), a beach was determined to be sufficiently cleaned when:

- No hydrocarbon odor, visual evidence of oil, or "oily feel" existed on the beach.
- The average hydrocarbon level of the berm, low tide zone, and high tide zone samples taken every 500 feet along the beach segment was less than 100 ppm (using the EPA 418.1 Method).

For the *Morris J. Berman* spill (1994), how clean is clean guidelines were developed for four habitat type:

- ***Sand beaches.*** Surface sediments must be free of visible oil, oily feel, and the smell of oil. Tarballs should be minimal and high recreational use beaches should be monitored for tarballs. Sand replacement and sand washing should be completed for heavily oiled, very high use, recreational beaches. Beaches should be sampled at regular intervals for buried oil, which should be removed. Sand that is merely stained may be left in place.
- ***Beachrock and riprap.*** In areas of high recreational use, heavily oiled natural bedrock areas should be cleaned using shoreline cleaning agents and high-pressure, hot water flushing (one treatment only). Residual oil should be left in place, as the objective is not to remove all oil but to enhance natural removal. In areas with limited recreational use or no access, gross accumulations of oil should be removed from accessible sites, and the remaining oil left for natural removal. Most inaccessible areas were also high-energy areas.
- ***Seawalls.*** In high recreational use or high visibility areas, hot water, high-pressure washers should be used to the extent that the seawalls do not feel tacky when touched. Residual staining may remain. For other seawalls, gross oil that continues to generate sheen should be removed. Residual staining may remain.
- ***Submerged oil.*** Accumulations of submerged oil should be removed, particularly in sheltered, shallow lagoons. Scattered accumulations in other areas should be removed consistent with operational limitations. Oil should be recovered until declining effectiveness renders further recovery impractical.

PHASE 2: DEVELOP CONTINGENCY PLAN

As discussed in Section 4, contingency planning is required in every area of the world where oil is produced, handled and transported. The contingency planning phase provides opportunity to gain consensus on response goals and priorities. To the degree that this is achieved, the changes of improving performance are increased.

Abordaif *et al.* (1995) define contingency planning as a *process,* not a product. They emphasize the importance of participants gaining an understanding of problems through the planning process. Relationships, and hopefully trust and mutual respect, are established through resolving issues together in a non-crisis environment. Patry and Rivet (1995) recommend involving as many interested parties as can be identified in the contingency planning process and in training. They list 16 different agencies or groups that are interested parties in their area (Quebec, Canada) with a seventeenth category that could include associations, groups, or businesses that could be affected by the spill such as bird watching groups, fishermen's associations, and environmental groups. Certainly the number of interested parties can be quite large. Ott *et al.* (1993) stress the importance of having the same individuals who will participate in the response work together during the planning and training process. Christopherson and Slyman (1993) and Harbert (1995) also recognize this and recommend team building among responders.

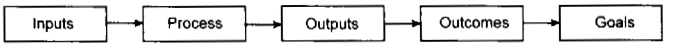
The best way to deal with the competing perspectives of the individual stakeholders is to develop consensus on goals, priorities, and standards to be used by all stakeholders in assessing preparedness and response performance. The process of developing specific goals and critical success factors as part of the contingency planning is described by Ott *et al.* (in press). Their specific success factors are identified below:

- no worker or public injuries,
- clear and effective notification procedures,
- effective identification and activation of resources,
- establishing a clear chain of command,
- identification and protection of sensitive areas,
- minimizing the impact of the spill and of the cleanup operation,
- positive meetings with interested parties and the public,
- positive media coverage, and
- positive public perception of the response.

Roosen (1997) applies the principles of crisis management, which include both human and organizational factors, to spill response and recommends that such principles be incorporated into contingency plans. Cantwell (1997) discusses the psychological factors involved in a spill response situation, including disrupted biorhythms and high stress. He concludes that the success of a response could be compromised by not recognizing and addressing these factors during the planning process.

Translating each stakeholder's performance criteria into coherent strategies with clear, achievable, and measurable goals is the planning challenge. The contingency planning *process* should produce goals that provide responders with clear, specific, realistic, results-oriented measurable response objectives (Ott *et al.,* in press). A process model developed by Brown (1996) is helpful during contingency planning to develop performance measures. The process model was originally applied to business operations and consists of five performance elements that link together in sequence (Figure 5).

FIGURE 5.
MACRO PROCESS OF THE PERFORMANCE OF AN ORGANIZATION



Source: Adapted from Brown (1996).

In the business application, ***inputs*** are skilled, motivated employees, available raw material, and capital. ***Process*** includes product and service design and delivery. ***Outputs*** are the actual products and services and the financial results. ***Outcomes*** are satisfied customers whose needs are met by the product or services. The ***goals*** of such a model are repeat business and long-term survival of the company. Each element (input, process, output, and outcome) contains quantifiable performance criteria that can used to identify performance strengths and areas needing improvement.

During contingency planning, planners can use this model to sort the criteria into performance elements, (e.g., inputs, process, outputs, outcomes) prioritize criteria, and identify conflicting or unachievable criteria. Table 2 lists example stakeholder performance criteria sorted by performance elements. For example,

- Inputs include such criteria as the contingency plan and notification procedures as well as the availability of equipment and trained personnel.
- Processes include the coordination and performance of the response personnel and equipment.
- Outputs include an effective and timely response.
- Outcomes include minimizing the spread of the spilled oil and the amount contaminating shorelines.
- The overall goal of the response is to minimize the impacts of the spill.

To illustrate how Brown's process model can be used to assess spill response performance, Figure 6 uses performance criteria of response operations specialists as an example since their criteria are more easily quantifiable. Specific performance measures that might be developed during the contingency planning process are identified for each model element.

Once the criteria are sorted, stakeholders need to be consulted to resolve conflicts and make compromises. Once conflicts are resolved, planners can develop goals and specific measures of performance for each of the remaining criteria. Brown (1996) stresses the importance of measuring the right variables and offers some general guidelines:

- Fewer are better. Concentrate on measuring the vital few rather than the trivial many.

TABLE 2.
CRITERIA FOR SUCCESS[1]

CRITERIA TYPE	STAKEHOLDERS
INPUT	
Ready equipment	Operations, Managers[2], Environmental groups
Ample equipment	Operations, Managers, Environmental groups
Adequately trained, available personnel	Operations, Managers
Ability to work together as a team	Managers
Same parties respond as practiced and trained	Managers
Capability for sustained operations	Managers
Expansion capability to accommodate a large spill	Managers
Ability to shift management styles during emergency and project management phases	Managers
PROCESS	
Proper deployment of equipment	Operations
Measure ecological effects on impacted populations	Scientists
Assessment using ACIP (After Control/Impact Pairs)	Scientists
Use of Net Environmental Benefit Analysis	Scientists
Measure toxicity of spilled oil to specified organisms	Scientists
Chemical analysis of oil residues	Scientists
Clear and effective authority, chain of command	Managers
Coordination between all responding entities	Managers
Clear notification and call out procedures	Managers
Effective identification and access of response resources	Managers
Teamwork and cooperation	Managers
Effective and accurate permitting	Managers
Effectively communicate and manage information	Managers
Cooperative media relations	Managers
Involve interested parties in planning process	Managers
Attention to human factors	Managers
Greater interested party representation	Environmental groups

CRITERIA TYPE	STAKEHOLDERS.
PROCESS (continued)	
Adequate funding for spill studies	Environmental groups
Timely and accurate reports/responses from sources	Media[3]
24-hour access to information sources	Media
Daily press conferences	Media
Public opinion polls	Media, Elected officials
Interested party interviews	Media
OUTPUT	
Contingency plan effectively implemented	Responsible Party[4]
Effective, timely, complete response	Responsible Party
Efficient performance of equipment (oil controlled/removed)	Operations
Positive team and public meetings	Managers
Promote recovery	Scientists
Fate of spilled oil	Scientists
Effects of spilled oil	Scientists
Protect identified sensitive areas	Scientists, Managers, Resource agencies
Protection of birds	Resource agencies, Scientists
Protection of mammals	Resource agencies, Scientists
Protection of fisheries	Resource agencies
Protection of refuges and parks	Resource agencies
No visible oil on water	Managers (G)[5]
No visible oil on shorelines	Managers (G)
Hydrocarbon levels measured below agreed upon standard	Managers (G)
Prompt removal of visible oil	Businesses, Property owners

(continued)

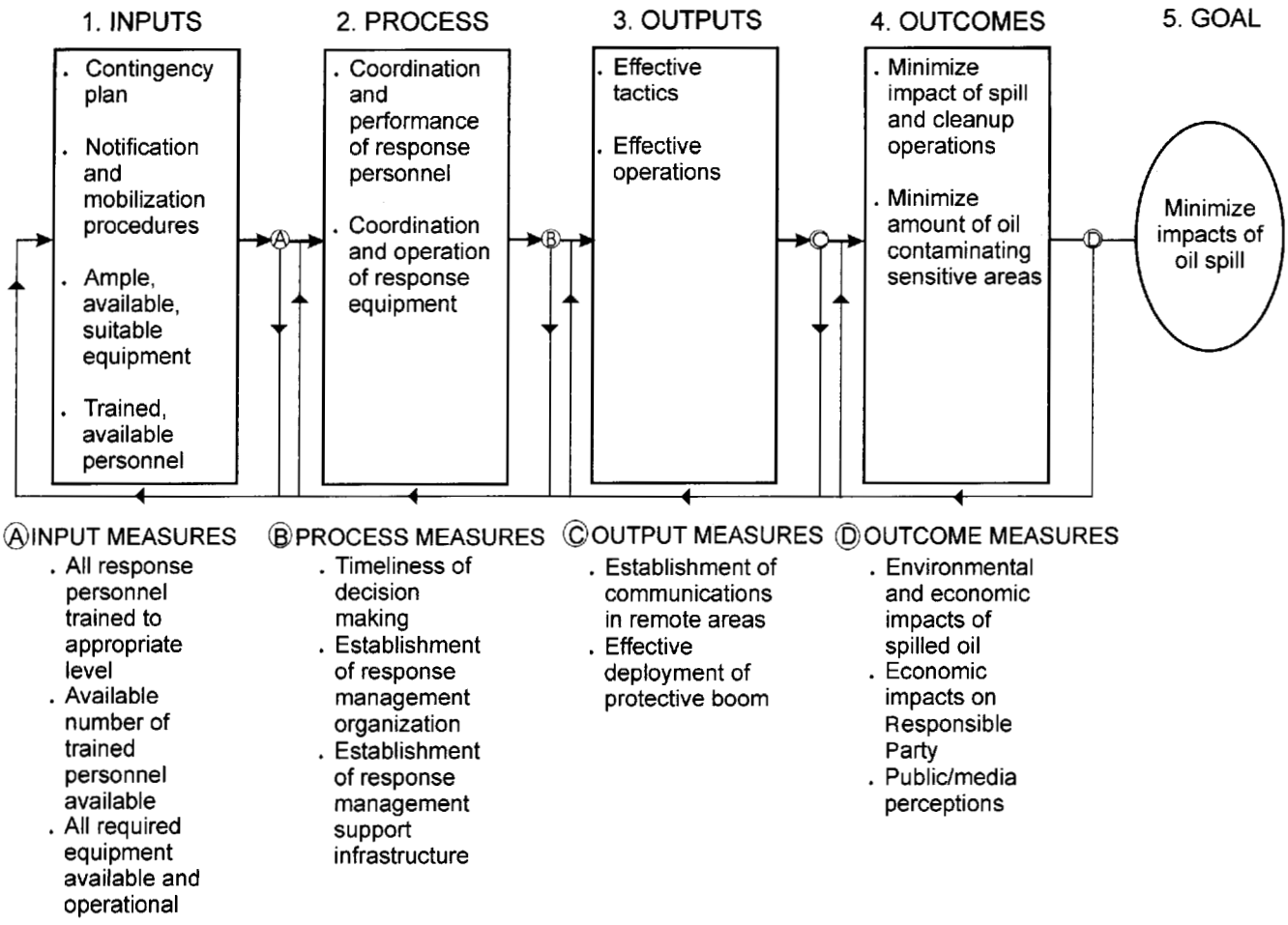
Table 2.
Criteria for Success[1] *(continued)*

CRITERIA TYPE	STAKEHOLDERS
OUTPUT (continued)	
Level of controversy	Media
Level of visible cleanup activity	Media
Public opinion polls	Media
OUTCOME	
Company survival	Responsible Party
Minimize liabilities	Responsible Party
Perceived as good corporate citizen	Responsible Party
Minimize impact of spill and cleanup	Responsible Party, Managers, Scientists
Salvage operations minimize spillage	Operations
Minimize the spread of oil	Operations
Interested party concerns addressed/ agreement reached	Managers, Media
Positive media coverage	Responsible Party, Managers, Operations, Elected officials
Positive public perception	Managers, Operations
Meet public realistic expectations for pollution response	Managers
No worker injuries	Managers
No public injuries	Managers
No visible oil on water	Managers (G)
No visible oil on shorelines	Managers (G)
Minimize impacts (economic)	Managers
Minimize impacts (environmental) of response and cleanup	Scientists, Managers, Resource agencies

CRITERIA TYPE	STAKEHOLDERS
OUTCOME (continued)	
Protect sensitive resources	Scientists, Resource agencies
Response reduced impacts compared with no intervention	Scientists
Minimize resource damage	Resource agencies
Respond to constituent needs	Elected officials
Benefits to career	Elected officials
Adequate compensation for those affected	Environmental groups
Prompt settlement of claims	Fishing industry
Healthy fish stocks	Fishing industry
No closure of harbors	Fishing industry
No contamination of fishing gear	Fishing industry
No tainting (or perceived tainting) of fish	Fishing industry
No interruption of tourist or other businesses	Businesses, Property owners
No bad publicity about the city/region of the spill	Businesses, Property owners
GOAL	
Minimize impacts of the spill	All

1 Organized by Brown (1996) model.
2 Both Responsible Party and government spill managers.
3 Newspapers, magazines, television, and radio.
4 Senior management of the company that had the spill.
5 Government spill managers/regulators.

FIGURE 6.
MACRO PROCESS MODEL APPLIED TO SPILL RESPONSE — OPERATIONS



Source: Adapted from Brown (1996). The boxes contain the stakeholder performance criteria from Table 2.

- Measures should be linked to the factors most important to the stakeholder.
- Measures should be a mix of past, present, and future measures to ensure the organization is concerned with all three perspectives.
- Measures should start at the top and flow down to all levels in an organization.

Detailed contingency plans will enable responders as well as stakeholders to know what must be done during a response and enable them to assess performance and determine when goals have been met.

PHASE 3: CONDUCT EXERCISES AND RESPONSES

Having an agreed on set of goals and performance criteria that may be included in contingency plans enables at least some assessment of performance, during contingency plan exercises as well as actual response operations. A pollution response exercise provides an ideal forum for "testing" strategies in contingency plans. It also provides opportunities for training, team building, and building relationships with stakeholders. Effective exercises can help ensure that contingency plans will actually be used when a spill occurs.

PHASE 4: ASSESS RESPONSE PERFORMANCE

Assessing response performance during response is more challenging because of the emergency nature of the situation and because stakeholders are naturally drawn to their original criteria that may not have survived the planning process. However, response performance can and should be assessed as well. There are many stakeholders, many criteria, and many, sometimes competing, perspectives, on response performance. A company that has experienced a spill has company survival and financial integrity as its primary concerns. Being perceived as a good or bad corporate citizen impacts on a company's financial integrity. Therefore, an adequate and successful response is in an RP's interest. What constitutes an adequate response depends on who is judging and what criteria are used. Some stakeholders are concerned with the removal of visible oil (e.g., government spill managers, property owners),

still others want resources devoted to preservation of a single resource, e.g., fish stocks, and therefore wish to prevent any water column impacts (e.g., fishing industry). Other stakeholders are most concerned with minimizing impacts to birds or shorelines and less concerned with water column impacts (e.g., certain resource agencies). The scientific community wants ecological impacts minimized, ecologically sound cleanup methods, and scientifically credible assessment of the spill's impacts. Spill mangers are concerned with setting up a workable management structure that can reach and implement decisions rapidly.

Acceptable outcomes can range from removing visible oil to minimizing ecological impacts. Pressure from various stakeholders seems to influence what is acceptable. There is agreement by most stakeholders that safety concerns are paramount. The goals of avoiding worker and public injuries rank above even the goal of minimizing environmental impacts. However, when this may mean that response activities are canceled during unsafe weather conditions, there again may be disagreements.

In Phase 4, response (or exercise) performance in each element is assessed against the specific criteria developed in Phase 1 to quantify performance. These performance standards focus on the ability to achieve planning objectives and overall effectiveness of response strategies. Measuring how quickly a boom is deployed or how much oil is recovered by an individual skimmer produces quantifiable but not necessarily relevant information. It is much more important to assess whether an inlet protection strategy works or environmental conditions are appropriate to effective skimmer operations. The first time the assessment is conducted, baseline measures will be obtained. Results from subsequent assessments can be compared to the baseline to judge where improvements, or declines, in performance have occurred. For example, in Figure 6, one of the performance criteria for response operational specialists is ample, available, suitable equipment. The performance measure for this criterion is "All required equipment available and operational." This assessment of equipment availability can then be judged against planning standards to see if criteria have been met. Subsequent assessments can be used to see if performance has improved. Strengths in performance validate stakeholder criteria and the planning strategy. Where improvement is needed, a response organization needs to examine performance criteria and planning strategies. In some cases, performance criteria may be unrealistic or unachievable and the planning strategy may need to be revised. The important point is that the assessments (Phase 4) must be compared to the performance criteria (Phase 1) so that judgment can be made and adjustments in response strategies made to improve future performance.

In the special case of very large spills, many more groups become involved and have an interest in the spill. In these large spills, each group will be making their own independent judgment of the response. Figure 7 illustrates how complicated it may become during large spills when groups begin to assess the spill response after it has happened. What options are available to make sense of this chaos? Whose assessments are most valid? Whose assessment should be relied on? Assessment of a response will be easier to make and consensus more likely if standards and criteria were agreed to during the contingency planning process.

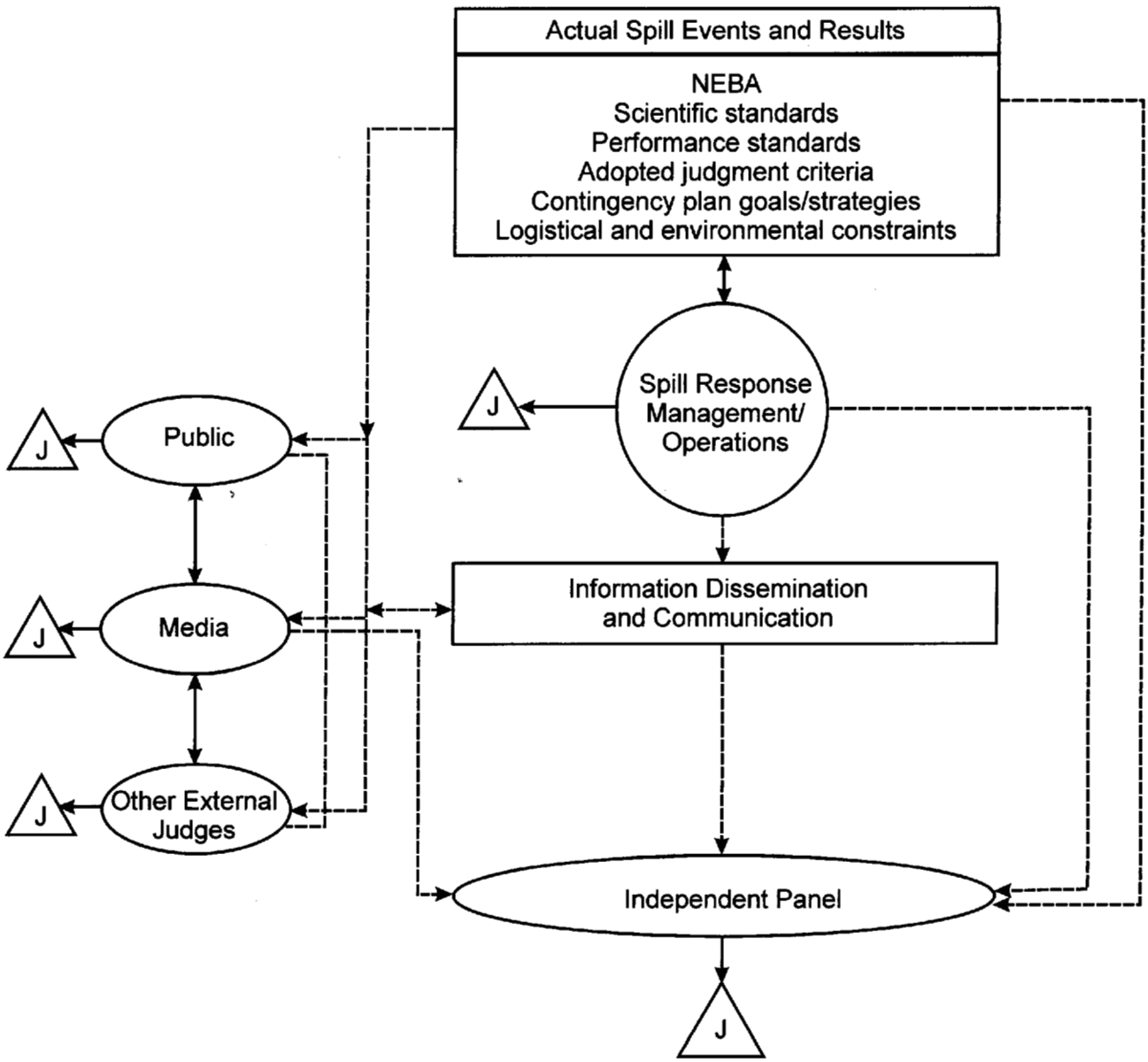
Wells *et al.* (1995) recommend an impartial panel of oil spill scientists to assess spill impact. While both science and management criteria offer quantifiable measurement criteria, neither address all the concerns of all stakeholders. In spite of strengthened requirements for contingency planning in all areas of the world, there may still be conflicting priorities and disputes over the use of certain countermeasures, what shoreline cleanup methods to use, and when to stop cleanup. Some interested stakeholders may call for removal of all visible oil as the measure of "clean." Others favor leaving some visible oil if to remove it will increase environmental impacts or delay natural recovery.

After major spills that require mobilization of large-scale response efforts, use of a third-party panel to evaluate response effectiveness may be valuable. One such independent panel was created at a national level in the UK to review response decision making and performance for the *Sea Empress* spill (Donaldson *et al.*, 1994). A panel or commission could be appointed to study the decisions, the reasons for them, and their impact and effectiveness, and develop recommendations for the future. The panel could be appointed by and report to a national, provincial/state, or local organization. That organization or an independent group (such as the National Research Council in the US) could manage it. The key is to keep the panel management independent of response management or participants. Another approach is to assign one government agency this task, much as the National Transportation Safety Board investigates airplane crashes in the US. A panel could be convened by the designated agency following each major spill.

The independent panel should include not only scientists and response operations specialists but also a variety of disciplines. It could include people in the region of the spill as well as outside. It is critical, however, that panel members have some expertise in spill issues and a framework by which to assess the response. Panelists must be familiar with the goals, objectives, strategies, and constraints that guided the response decision making.

The panel would study the spill case history, fate and effects studies, response operations data, and decisions made during response, as well as the options considered and why they were accepted or rejected. The impacts and effectiveness of these decisions could be documented and analyzed with the ultimate objective of improving the decision-making process during future spills (Figure 7). The review, conducted after the highly charged atmosphere of a spill response is over, would document the reasoning behind the many response decisions and the effects of those decisions on the outcome of the spill event. For example, if spill managers decided to leave some oil on a shoreline because to remove it would cause greater ecological damage, this documentation could vindicate a decision that may have been highly disputed at the time. On the other hand, the review could instill accountability to decision

FIGURE 7.
A RECOMMENDED PROCESS FOR ASSESSING SPILL RESPONSE PERFORMANCE USING AN INDEPENDENT PANEL



Internal judges of spill response (responsible party, government spill managers, response personnel).

External judges (the public, interest groups, media, business and property owners, elected officials) as well as the recommended independent panel.

Incident events (programs, goals, standards, and logistical constraints) that influence and guide response and responders' explanation of events.

Judgments of spill response performance by various judges identified.

Response operations and judgment processes.

Pattern of information collection and communications among spill management team, interest groups, and the media during an incident and communications flow from all stakeholders to the independent panel after an incident.

makers for a poor decision. For example, if spill managers decided against the use of chemical dispersants or *in situ* burning, the independent panel could document whether the decision was justified on scientific and logistical grounds. This analysis would be of great value to improve contingency planning and actual spill responses in the future.

The use of the independent panel offers the opportunity for an objective evaluation of response performance. Optimally, the independent panel would apply consensus criteria, developed using the stakeholder process described in Phase 1, to the assessment model proposed in Phase 2 (Figure 4) to produce a judgment. This independent judgment would then feed directly back to internal and external stakeholders and would be used to improve performance.

Several spill responses provide evidence that effective contingency planning and exercise has improved performance or identified needed improvements. Eldridge *et al.* (1997) studied the response to the tank barge *Buffalo 292* spill in 1996 in Galveston Bay. The barge spilled 3,000 bbls of IFO 380 (intermediate fuel oil). The response included shoreline protection, on-water recovery, and shoreline cleanup (Clark *et al.*, 1997). Eldridge *et al.* (1997) and Clark *et al.* (1997) conclude that the response was successful based on the recovery operations and shoreline cleanup activities. They attribute this success to the training and experience of responding agencies, i.e., the planning process, the large number of drills, and several previous incidents in the Houston-Galveston area during which all parties worked together. The authors stress the close working relationships among federal, state, local, and contractor responders. Martin *et al.* (1997) worked on the shoreline cleanup for the *Buffalo 292* spill and attributed their success to training, which made reaching consensus decisions easier.

The *Kirki* spill occurred 55 miles offshore of western Australia in 1991 where the Australian Maritime Safety Authority (AMSA) was responsible for coordinating the response. In reporting the spill, Brodie (1993) recommends the following changes in Australian response practices:

- clearly define federal, state, and municipal areas of jurisdiction;
- ensure all organizations involved in the response are aware of their regulatory authorities and responsibilities;
- ensure directions issued are in accord with these authorities; and
- ensure persons representing those authorities are given authority to make decisions without constant consultation with parent organizations.

5.3 SUMMARY

Response organizations should be concerned with assessing performance so that improvements can be acknowledged, weaknesses identified, and the ability of the response organization to meet goals increased. A systematic process to evaluate planning, exercise, and response that engages stakeholders and seeks to incorporate their criteria is proposed as the best way to deal with multiple perspectives. Gaining consensus on criteria, strategies, and response goals builds strong relations between response organizations and stakeholders and helps prevent negative judgments of performance.

SECTION 6

RECOMMENDATIONS

All of the discussion in this paper is concerned with improving spill response performance. Over the past 30 years, the number of people involved in spill response has grown; the process of response has become more complex; and the criteria by which response performance can be assessed are confusing. Specific factors that promote or impede performance during preparedness and response activities are identified to clarify major areas needing attention. Factors that promote performance improvement include streamlined management, spill experts as decision makers, and effective communications. Assessment can improve performance by providing a scale by which to judge. Stakeholder involvement in evaluation or decision making is increasing in many areas of the world, so information is presented on how best to involve stakeholders and incorporate their concerns into the planning process. Lastly, a conceptual model is presented as a means to involve stakeholders in adopting criteria and a foundation against which response performance can be measured and improvements made. The model can be used by the response community in consultation with all stakeholders or, in special cases, by an independent panel.

From this review, two broad recommendations are made to challenge the response community to improve response performance worldwide:

- use stakeholder process to establish response criteria and standards; and
- use a systematic approach to assess performance.

6.1 USE STAKEHOLDER PROCESS TO ESTABLISH RESPONSE CRITERIA AND STANDARDS

The current dilemma of response judgments predominantly being made by those external to planning and response needs to be resolved. The most direct albeit labor-intensive way is to incorporate stakeholders' concerns via consultation with them to determine criteria that must be addressed during spill planning and response, as discussed in Section 5.2. Each stakeholder has performance criteria considered important during spill response. By engaging stakeholders, consensus can be sought; compromises can be attempted; and criteria can be adjusted to resolve any remaining conflicts. Response priorities, strategies, and tactics can be modified based on stakeholder input.

Bringing stakeholders together, along with their competing perspectives, to evaluate spill performance can be a challenge. In the absence of a spill emergency, issues may not generate stakeholder involvement, and cultural differences may not encourage or allow such involvement. Nonetheless, when possible, it is vitally important that this occur systematically so that performance can be evaluated and improved. Involving stakeholders in the initial stages of contingency planning can significantly improve the ability of a response organization to plan and prepare.

Stakeholder involvement also improves communications. The response organization better understands the concerns of stakeholders and can take them into account during contingency planning, further improving communications and ultimately improving performance.

6.2 USE A SYSTEMATIC APPROACH TO ASSESS PERFORMANCE

The use of the systematic response performance assessment process as described in Figure 4 is recommended. This process encourages stakeholder participation in the establishment of specific performance criteria (Phase 1) for spill response. These criteria form the reference points from which goals and strategies are developed in contingency plans (Phase 2). Development of specific, measurable, achievable, result-oriented goals will enable a response organization to better manage spill response and measure improvement (Phase 3). Additionally, goals enable a response organization and stakeholders to track performance during exercises and response to adjust performance criteria and strategies in contingency plans (Phase 4). This continuous process should result in improved relations and increased preparation for response.

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REFERENCES

Abordaif, F., J.R. Harrald, and T.A. Mazzuchi. 1995. Evaluating Oil Spill Contingency and Prevention Plans Using Measures of Quality, Not Quantity. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 614–620.

American Petroleum Institute (API). 1985. *Oil Spill Response: Options for Minimizing Adverse Environmental Impacts.* API Publication Number 4398. American Petroleum Institute, Washington, D.C.

Baker, J.M. 1995. Net Environmental Benefit Analysis for Oil Spill Response. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 611–614.

Baker, J.M. 1997. *Differences in Risk Perception: How Clean is Clean?* Technical Report Number IOSC-006. American Petroleum Institute, Washington, D.C.

Baker, J.M., A. Little, and L. Heaps. 1996. *Guidelines for Assessing the Ecological Condition of Oiled Shores.* AURIS Report Number MR264. Aberdeen University Research and Industrial Services Limited, Aberdeen, Scotland, UK.

Benson, R.L., R.S. LeGore, and D. Pascoe. 1993. A Mechanized Approach to Beach Cleanup in Saudi Arabia. *Proceedings,* 1993 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 123–126.

Brodie, D. 1993. The *Kirki* Incident. *Proceedings,* 1993 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 201–207.

Brown, M.G. 1996. *Keeping Score.* Quality Resources, Krause Organization, Limited, New York, NY.

Brown, P. 1997. *Sea Empress* inquiry: Charges to follow report on oil tanker disaster. *The Guardian* (London), July 17, The Guardian Home Page, p. 5.

Byroade, J.D., A.M. Twedell, and J.P. LeBoff. 1981. *Handbook for Oil Spill Protection and Cleanup Priorities.* Office of Research and Development, US Environmental Protection Agency, Cincinnati, OH.

Cantwell, V. 1997. Managing Personnel in Sustained Spill Response Efforts. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 95–99.

Christopherson, S.K., and P.M. Slyman. 1993. Oil Spill Response Planning on The Columbia River Estuary. *Proceedings,* 1993 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 63–66.

Churm, S., and J. Newton. 1990. Last of oil spill blackens shore. *Los Angeles Times,* February 15, p. A-1.

Clark, T., B. Strong, and B. Benson. 1997. Recovery of Tarmats Using Commercial Shrimping Boats During the *Buffalo 292* Spill. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 41–49.

Cone, M., and B. Billiter. 1990. For Huntington Beach, oil spill still isn't over. *Los Angeles Times,* September 2, p. A-1.

Cox, G.V., and E.B. Cowell. 1979. Mitigating Oil Spill Damage — Ecologically Responsible Cleanup Techniques. In G.A. Swanson, ed. *The Mitigation Symposium.* General Technical Report Number RM-65. Forest Service, US Department of Agriculture, Ft. Collins, CO. pp. 121–128.

Davidson, A. 1990. *In the Wake of the* Exxon Valdez: T*he Devastating Impact of Alaska's Oil Spill.* Sierra Club Books, San Francisco, CA.

Dean, T.A., L. McDonald, M.S. Stekoll, and R.R. Rosenthal. 1993. Damage Assessment in Coastal Habitats: Lessons Learned from *Exxon Valdez. Proceedings,* 1993 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 695–697.

DeLong, G.N. 1997. Relationships with the Media During the *Buffalo 292* Oil Spill. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 329–330.

Donaldson, Lord of Lymington, J. Rendle, and A. Macintyre. 1994. *Safer Ships, Cleaner Seas.* HMSO, London.

Eldridge, K.J., J.J. Leonard Jr., D.W. Kurtz, and M.L. Rochester. 1997. Tank Barge *Buffalo 292:* A Unified Response. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 19–23.

Gaines, T.H. 1969. Pollution Control at a Major Spill. *Proceedings,* Joint Conference on Prevention and Control of Oil Spills. American Petroleum Institute, Washington, D.C. pp. 271–280.

Gould, J.R., and J. Lindstedt-Siva. 1991. Santa Barbara to *Mega Borg* and Beyond: A Review of API's Spill Program and Priorities. *Proceedings,* 1991 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 341–348.

Guénette, C.C., L. Aasnes, and O.A. Follum 1997. Shoreline Cleanup in Norway: Lessons Learned and Recommendations. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 265–270.

Previous page is blank.

Harbert, R.W. 1995. *Tampa Bay* Spill: Command and Control Issues. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 621–626.

Harrald, J.R. 1994. *Preparing for Success: A Systems Approach to Oil Spill Response.* Paper presented at the Prevention, Response, and Oversight Five Years After the *Exxon Valdez* Oil Spill Conference, Anchorage, AK, March.

Harris, C. 1997. The *Sea Empress* Incident: Overview and Response at Sea. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 177–184.

Hereth, L.L. 1997. Setting Objectives in a Unified Command: The Cost of Leadership. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 855–863.

Hetherington, P. 1993. Shetland revisited: We are fed up asking about the health risks. We don't believe everything is OK. *The Guardian (London),* January 23, The Guardian Home Page, p. 3.

Hoagland-Grey, H. 1995. Oil Spill Response Planning in Eastern Europe: A Bulgarian Case Study. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 767–773.

Hum, S. 1977. The Development and Use of Resource Sensitivity Maps for Oil Spill Countermeasures. *Proceedings,* 1977 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 105–110.

Jardim, G.M., and H.J. McDermott. 1993. Organizing Company Specialists for Rapid and Effective Response. *Proceedings,* 1993 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 45–49.

Lees, J.E. 1993. Contingency Planning, Contractor Requirements, and Oil Pollution Act of 1990 Implementation. *Proceedings,* 1993 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 51–56.

Lindstedt-Siva, J. 1976. *Oil Spill Response Planning for Biologically Sensitive Areas in the Santa Barbara Channel.* Report prepared for Atlantic Richfield Co. and Clean Seas Cooperative, Santa Barbara, CA.

Lindstedt-Siva, J. 1977. Oil Spill Response Planning for Biologically Sensitive Areas. *Proceedings,* 1977 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 111–114.

Lindstedt-Siva, J. 1979. Ecological Impacts of Oil Spill Cleanup: Are They Significant? *Proceedings,* 1979 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 521–524.

Lindstedt-Siva, J. 1984. Oil Spill Response and Ecological Impacts — 15 Years Beyond Santa Barbara. *Marine Technology Society Journal.* 18(3):43–50.

Lindstedt-Siva, J. 1991. Environmental Sensitivity, Protection, and Planning. *Proceedings,* Sixth Information Transfer Meeting. Pacific Outer Continental Shelf (OCS) Region, Minerals Management Service, US Department of the Interior, Washington, D.C. pp. 21–25.

Lindstedt-Siva, J. 1992. Ecological Effectiveness of Response Measures. *Proceedings,* Marine Technology Society Conference, Washington, D.C. pp. 140–146.

Lord, P. 1997. Oil in the water one year later. *The Providence Journal-Bulletin,* January 21, p. 1A.

Lunel, T., J. Rusin, N. Bailey, C. Halliwell, and L. Davies. 1997. The Net Environmental Benefit of a Successful Dispersant Operation at the *Sea Empress* Incident. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 185–194.

Mahapatra, A. 1995. International Convention on Oil Pollution Preparedness, Response, and Cooperation — An Overview. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 775–778.

Martin Jr., R.D., I. Byron, and R. Pavia. 1997. Evolution of Shoreline Cleanup Assessment Team Activities During the *Buffalo 292* Oil Spill. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 33–39.

Mauseth, G.S., and D.A. Kane. 1995. *The Use and Misuse of Science in Natural Resource Damage Assessment.* Technical Report Number IOSC-002. American Petroleum Institute, Washington, D.C.

McFarland, B., and K. Estes. 1997. From Training to Testing: Details of an Aggressive Drill and Exercise Program. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 15–17.

Mearns, A.J. 1995. Elements to be Considered in Assessing the Effectiveness and Effects of Shoreline Countermeasures. *Spill Science and Technology Bulletin.* 2(1):5–10.

Meidt, R.M. 1991. Public Perceptions in Spill Response. *Proceedings,* 1991 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 333–337.

Milbury, J. 1997. Feeding the Media Frenzy Without Getting Bit. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 331–333.

Moller, T.H., and R.S. Santner. 1997. *Oil Spill Preparedness and Response: The Role of Industry.* Technical Report Number IOSC-005. American Petroleum Institute, Washington, D.C.

Nichols, J.A. 1992. Industry Review — Some Implications of the OPRC Convention and OPA 90 Requirements for the Oil and Shipping Industry. *Proceedings,* Spillcon 92. Australian Institute of Petroleum, Melbourne, Australia.

Ott, G.L., and D.C. Stalfort. 1997. Planning and Exercising for Success: The Four-Step, Scenario-Based Process. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 3–8.

Ott, G.L., J. Lindstedt-Siva, and A.H. Walker. 1993. Evolving Spill Management Systems Under OPA 90 Could Reduce Response Effectiveness. *Proceedings,* 1993 Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 73–79.

Ott, G.L., D.C. Haynes, and R.G. Pond. In press. East Versus West: Area Contingency Plans, Planning for Success? *Proceedings,* 1999 International Oil Spill Conference. American Petroleum Institute, Washington, D.C.

Pardo, F. 1995. Response Operations to the *Aegean Sea* Accident. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 583–588.

Patry, M., and C. Rivet. 1995. To Improve the Response Time: A Community Decision. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 657–661.

Pavia, R., W.D. Ernst, E.R. Gundlach, L.C. Theveau, and J.L. Sadd. 1982. *Sensitivity of Coastal Environments to Spilled Oil.* Southern California Office of Marine Pollution Assessment, National Oceanic and Atmospheric Administration, Boulder, CO.

Roosen, J.T. 1997. Factors Affecting Crisis Management. *Proceedings,* 1997 International Oil Conference. American Petroleum Institute, Washington, D.C. pp. 115–120.

Sell, D., L. Conway, T. Clark, G.B. Picken, J.M. Baker, G.M. Dunnett, A.D. McIntyre, and R.B. Clark. 1995. Scientific Criteria to Optimize Oil Spill Cleanup. *Proceedings,* 1995 International Oil Conference. American Petroleum Institute, Washington, D.C. pp. 595–610.

Shirreff, S., and M. Berthiaume. 1995. Partnerships in Spill Response: A Policy Alternative — The Canadian Experience. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 745-749.

Slick cleanup report renews spraying debate. 1997. *Financial Times* (London), January 10, p. 8.

Spooner, M. 1969. Some Ecological Effects of Marine Oil Pollution. *Proceedings,* Joint Conference on Prevention and Control of Oil Spills. American Petroleum Institute, Washington, D.C. pp. 313–316.

Steinhart, C., and J. Steinhart. 1972. *Blowout: A Case Study of the Santa Barbara Oil Spill.* Duxbury Press, Belmont, CA.

Straughan, D. 1969. The Santa Barbara Study. *Proceedings,* Joint Conference on Prevention and Control of Oil Spills. American Petroleum Institute, Washington, D.C. pp. 309–311.

Tebeau, P.A. 1995. Effectively Managing Level of Effort in Oil Spill Cleanup: Resolving the "How Clean is Clean" Issue. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 663–666.

Tramier, B., G.H.R. Aston, M. Durrieu, A. Lepain, J.A.C.M. Van Oudenhoven, N. Robinson, K.W. Sedlacek, and P. Sivra. 1981. *A Field Guide to Coastal Oil Spill Control and Cleanup Techniques.* Report Number 9/81. CONCAWE, Den Haag, The Netherlands.

Villoria, C., E. Gomez, and N.G. Tavel. 1995. National Drill of the Venezuelan Oil Spill Contingency Plan. *Proceedings,* 1995 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 513–522.

Walker, A.H., D.L. Ducey Jr., S.J. Lacey, and J.R. Harrald. 1995. *Implementing an Effective Response Management System.* Technical Report Number IOSC-001. American Petroleum Institute, Washington, D.C.

Wells, P.G., J.N. Butler, and J.S. Hughes, eds. 1995. Exxon Valdez *Oil Spill: Fate and Effects in Alaskan Waters.* ASTM STP 1219. American Society for Testing and Materials, Philadelphia, PA. pp. 3–38.

Westree, B. 1977. Biological Criteria for the Selection of Cleanup Techniques in Salt Marshes. *Proceedings,* 1977 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 231–235.

White, C.M. 1997. Public Affairs: Balancing on the Tightrope Between Full Disclosure and Avoiding Further Risk. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 335–338.

Wilkerson, B., and T. Lauder. 1997. Communicating the Risks of an Oil Spill: Why, When, and How. *Proceedings,* 1997 International Oil Spill Conference. American Petroleum Institute, Washington, D.C. pp. 339–342.

Williams, T.M., and R.W. Davis. 1990. *Sea Otter Rehabilitation Program: 1989* Exxon Valdez *Oil Spill.* International Wildlife Research.

Wolfson, A., F. Hester, T. Parr, K. Nealson, P. Mankiewicz, and R. Evans 1979. *Environmental Effects of Oil Spill Cleanup at Martinez, California.* Report prepared for Clean Bay, Inc. and Shell Oil Co. by International Biological Consultants, Encinitas, CA.

Yosie, T.F., and T.D. Herbst. 1998. *Using Stakeholder Processes in Environmental Decisionmaking: An Evaluation of Lessons Learned, Key Issues, and Future Challenges.* Report prepared for the American Industrial Health Council, American Petroleum Institute, and Chemical Manufacturer's Association, Washington, D.C. (website *http://www.riskworld.com/Nreports/1998/STAKEHOLD/HTML/nr98aa01.htm*).

APPENDIX

PRINT MEDIA ARTICLES

Organized by Spill and by Date

EXXON VALDEZ

26 March 1989. Jones, T., and M. Parrish. Oil spill cleanup in Alaska drawing fire. *Los Angeles Times,* p. A-1.

26 March 1989. Pryor, L. Grounding of tanker caps lengthy debate over risks. *Los Angeles Times,* p. A-1.

28 March 1989. Jones, T. Oil fouls Alaska shore as winds foil cleanup. *Los Angeles Times,* p. A-1.

2 April 1989. Rempel, W.C. Warnings unheeded. *Los Angeles Times,* p. A-1.

7 April 1989. Stein, M.A. Alaska governor threatens oil shutdown over cleanup. *Los Angeles Times,* p. A-17.

9 April 1989. Stammer, L.B. Moving oil slick sets back effort to save salmon. *Los Angeles Times,* Page A-1.

10 April 1989. Suro, R. For Valdez, a tide of newcomers seeking work. *New York Times,* p. A-8.

29 May 1989. Sanchez, J. Alaska launches ad drive as spill hurts tourism. *Los Angeles Times,* p. D-1.

21 August 1989. Stammer, L.B. The oil spill 5 months later. *Los Angeles Times,* p. A-1.

10 September 1989. Lancaster, J. As oil spill cleanup winds down, damage and fears remain. *Washington Post,* p. A-1.

18 March 1990. Mathews, J. As anniversary of Exxon spill nears, Alaska seems normal — on the surface. *Washington Post,* p. A-3.

5 April 1990. Phillips, D. Oil spill legislation sweeps through Congress. *Washington Post,* p. A-18.

3 February 1991. Schneider, K. In the long run, the oil spill may be less than disastrous. *New York Times,* p. D-2.

10 April 1991. Schneider, K. US says harm from *Valdez* spill is worse than was thought. *New York Times,* p. A-1.

22 April 1991. Lancaster, J. Weighing the gain in oil spill cures. *Washington Post,* p. A-3.

22 December 1992. Kurtz, H. The muckraker and the oil spill: Jack Anderson quits Exxon-funded project. *Washington Post,* p. C-1.

24 January 1993. Cohen, M.J. Lessons learned from *Exxon Valdez* aren't being applied. *Houston Chronicle,* Outlook Section, p. 4.

30 April 1993. Stevens, W.K. Oil spill damages disputed by Exxon. *New York Times,* p. A-18.

23 August 1993. Balzar, J. *Exxon Valdez* cleanup funds squandered, report says. *Houston Chronicle,* p. A-1.

7 July 1994. Schneider, K. In aftermath of oil spill, Alaska waters languish. *New York Times,* p. A-16.

23 August 1994. Kenworthy, T. Pristine forests at stake as Alaskans balance priorities in Valdez. *Washington Post,* p. A-3.

PRESIDENTE RIVERA

25 June 1989. Drogin, B., and W.J. Eaton. Three major oil spills hit US within 13 hours. *Los Angeles Times,* p. A-1.

25 June 1989. Lancaster, J. Crews battle oil spills from 3 tanker accidents. *Washington Post,* p. A-1.

26 June 1989. Drogin, B., and W.J. Eaton. Size, damage estimates for oil spills cut. *Los Angeles Times,* p. A-1.

26 June 1989. Control efforts fail to hold Delaware oil. *New York Times,* p. A-16.

27 June 1989. Jehl, D. Crews use pitchforks on oil globs. *Los Angeles Times,* p. A-14.

27 June 1989. Barron, J. Oil spills leave trail of disturbing questions. *New York Times,* p. A-1.

27 June 1989. King, W. Delaware Guard joining in tanker spill cleanup. *New York Times,* p. A-12.

28 June 1989. King, W. Witness cites anchor in Delaware grounding. *New York Times,* p. B-6.

1 July 1989. Oil spills, thrice clumey. *The Economist.* p. 22.

3 July 1989. Lohr, S. Tanker in big spill typifies freewheeling industry. *New York Times,* p. A-1.

3 July 1989. Martz, L., and M. Hager. An oily blight on the water. *Newsweek.* p. 24.

3 July 1989. Tripett, F. Summer of spills. *Time.* p. 18.

10 July 1989. Rudolph, B. Whose mess is it? *Time.* p. 42.

MEGA BORG

25 June 1990. Adler, J., and P. Annin. *Newsweek.* p. 60.

25 June 1990. Cook, W.J. An easy way out of this mess. *US News & World Report.* 108(25):14.

25 June 1990. Magnuson , E. Who's in charge here? *Time.* p. 19.

16 July 1990. Careless on refinery row? *Time.* p. 44.

Previous page is blank.

AMERICAN TRADER

8 February 1990. Associated Press. Tanker spills oil off California. *New York Times,* p. B-10.

9 February 1990. Churm, S.R., and L.B. Stammer. Oil begins fouling shore at Newport, Huntington Beach. *Los Angeles Times,* p. A-1.

9 February 1990. Mathews, J. Tanker spill threatens beaches in California. *Washington Post,* p. A-3.

10 February 1990. Mydans, S. Workers searching the shoreline at Newport Beach. *New York Times,* p. A-10.

10 February 1990. Mathews, J. Spill from oil tanker remains poised off California beaches. *Washington Post,* p. A-3.

11 February 1990. Newton, J., and J. Needham. A journal written in black: Tracing the oil from ship to shore. *Los Angeles Times,* p. T-3.

13 February 1990. Churm, S.R., and J. Newton. Winds and tides push oil ashore. *Los Angeles Times,* p. A-1.

14 February 1990. Matthews, J. Oil's blessing and curse in Huntington Beach. *Washington Post,* p. A-4.

15 February 1990. Churm, S.R., and J. Newton. Last of oil spill blackens shore. *Los Angeles Times,* p. A-1.

15 February 1990. Mydans, S. Oil blown ashore in California, aiding cleanup. *New York Times,* p. A-24.

16 February 1990. Mathews, J. Lawmaker says Coast Guard overestimated oil cleanup ability. *Washington Post,* p. A-11.

19 February 1990. Churm, S.R., and R. Vanderknyff. O.C. coastal ecosystem has no room for error. *Los Angeles Times,* p. A-1.

19 February 1990. Bad luck, but good behavior. *Time.* p. 67.

24 March 1990. Carlton, J. High tide bursts dam, takes oil into marsh. *Los Angeles Times,* p. A-1.

24 March 1990. Crude justice. *The Economist.* p. 17.

21 April 1990. Tankers: Double trouble. *The Economist.* p. 30.

26 August 1990. Framolino, R. Frizzelle gets it at home for votes against oil spill bill. *Los Angeles Times,* p. B-1.

2 September 1990. Cone, M., and B. Butler. For Huntington Beach, oil spill still isn't over. *Los Angeles Times,* p. A-1.

HAVEN

12 April 1991. Montalbano, W.D. Italian ferry hits oil tanker, killing 140. *Los Angeles Times,* p. A-6.

14 April 1991. Times Wire Services. 3 explosions hit burning tanker off Italy. *Los Angeles Times,* p. A-12.

15 April 1991. Ridding, A. Burning supertanker, spilling oil, sinks off Italy. *New York Times,* p. A-3.

15 April 1991. Associated Press. Stricken tanker sinks off Genoa. *Los Angeles Times,* p. A-10.

KIRKI

22 July 1991. Drogen, B. Big oil spill imperils coast of Australia. *Los Angeles Times,* p. A-4.

22 July 1991. Associated Press. Burning tanker spills oil in waters off Perth. *New York Times,* p. A-2.

22 July 1991. Drogen, B. Tanker fire off Australia spills tons of crude. *Washington Post,* p. A-15.

23 July 1991. Drogen, B. Oil drifts toward Australia coast. *Los Angeles Times,* p.A-4.

AEGEAN SEA

3 December 1992. Houston Chronicle News Service. Burning tanker spills crude in Spanish port. *Houston Chronicle,* p. A-1.

4 December 1992. Millions of gallons of oil spilled off Northwest Spain. *Los Angeles Times,* p. A-6.

4 December 1992. Houston Chronicle News Service. Oil-drenched birds spotted after smoke clears in Spanish harbor. *Houston Chronicle,* p. A-26.

5 December 1992. Montalbano, W.D. Tanker's fire burns out off Spain. *Los Angeles Times,* p. A-18.

6 December 1992. Montalbano, W.D. Spanish rainbow ends in tanker's spilled pots of oil. *Los Angeles Times,* p. A-8.

6 December 1992. Associated Press. Oil from wrecked tanker stains 60 miles of Spanish coast. *New York Times,* p. A-23.

14 December 1992. Another oily shroud. *Time.* p. 19.

14 December 1992. Oil leakage off Spain exceeds Alaska spill. *New York Times,* p. A-10.

1 February 1993. Hawkins, D. Not all ooze is news. *US News & World Report.* p. 10.

BRAER

6 January 1993. Cook, S. Shetland oil disaster: Time and tide expose flaws in plan to combat oil spillage. *The Guardian (London),* The Guardian Home, p. 2.

6 January 1993. Donkin, R. Wildlife at risk as oil spreads: *Braer* spillage 'potentially catastrophic.' *Financial Times (London),* p. 5.

7 January 1993. Maddox, B. The *Braer* Disaster: Long-term fears 'may beunfounded.' *Financial Times (London),* p. 5.

8 January 1993. Jamieson, R.A. Everyday life is difficult enough in Scotland's northernmost isles without the burden of the *Braer* spill. *The Guardian (London),* The Guardian Features, p. 5.

9 January 1993. The wreck of the *Braer. The Economist.* p. 49.

18 January 1993. Europe's turn to practice tanker safety. *US News & World Report.* 114 (2):19.

18 January 1993. Fair Isles fouled by crude oil. *Time.* p. 17.

18 January 1993. How can we protect ourselves. *Newsweek.* p. 37.

23 January 1993. Hetherington, P. We are fed up asking about health risks. We don't believe everything is OK. *The Guardian (London),* The Guardian Home Page, p. 3.

25 January 1993. Hillenbrand, B. Resilient sea. *Time.* p. 50.

1 February 1993. Hawkins, D. Not all ooze is news. *US News & World Report.* p. 10.

4 February 1993. Bowditch, G. Tests show *Braer* oil may have endangered two million salmon. *The Times (London),* Home News Section.

2 July 1993. Hetherington, P., and R. Milne. *Braer* spill forces 1M salmon cull. *The Guardian (London),* The Guardian Home Page, p. 8.

4 January 1994. Clouston, E. Tanker safety fears resurface. *The Guardian (London),* The Guardian Home Page, p. 3.

18 May 1994. Smithers, R., and S. Bates. Environment groups disappointed by voluntary nature of proposals from *Braer* oil spill inquiry. *The Guardian (London),* The Guardian Home Page, p. 2.

17 February, 1996. Harper, K. Playing Russian roulette with a natural paradise. *The Guardian (London),* The Guardian Home Page, p. 3.

MORRIS J. BERMAN

9 January 1994. Clary, M. Mop-up of oily beaches begins in Puerto Rico. *Los Angeles Times,* p. A-1.

9 January 1994. Kenworthy, T. Spill response crews begin cleanup of oil-stained Puerto Rican beaches. *Washington Post,* p. A-3.

10 January 1994. Clary, M. Oil siphoned from Puerto Rico barge. *Los Angeles Times,* p.A-4.

10 January 1994. Kenworthy, T. San Juan spill tests oil protection act. *Washington Post,* p. A-4.

11 January 1994. Smothers, R. Puerto Rico tries to protect tourist season from spill. *New York Times,* p. A-16.

16 January 1994. Associated Press. Leaking oil barge is sunk in deep waters. *Los Angeles Times,* p. A-4.

23 January 1994. Associated Press. Barge sinking poses more damage. *Houston Post,* p. A-20.

30 January 1994. Wald, M.L. Coast Guard accused of error leading to spill. *New York Times,* p. A-40.

SEA EMPRESS

16 February 1996. Reuters. Oil spill threatens coast of southwest Britain. *New York Times,* p. A-13.

17 February 1996. Bowcott, O. Disaster alert after oil spill. *The Guardian (London),* The Guardian Home Page, p. 1.

18 February 1996. Tanker runs aground a second time near Welsh port. *New York Times,* p. A-12.

21 February 1996. Spilling oil on troubled waters. *The Guardian (London),* The Guardian Features Page, p. 16.

21 February 1996. Smithers, R., O. Bowcott, and D. Fairhall. Ministers 'disregard oil warnings.' *The Guardian (London),* The Guardian Home Page, p. 2.

22 February 1996. Addburgham, R., and C. Batchelor. 1996. Port's emergency plan speedy but inadequate. *Financial Times (London),* p. 9.

22 February 1996. Fairhall, D., and O. Bowcott. Bigger tug might have aided tanker. *The Guardian (London),* The Guardian Home Page, p. 5.

22 February 1996. Smithers, R. Government's youngest member left at the helm to brave waves of criticism over handling of spill. *The Guardian (London),* The Guardian Home Page, p. 5.

22 February 1996. Barbash, F. Vast oil spill off coast of Wales imperils fishing, wildlife areas. *Washington Post,* p. A-16.

22 February 1996. Lyall, S. Grounded tanker finally set afloat week after spill. *Houston Chronicle,* p. A-17.

22 February 1996. Lyall, S. Oil tanker refloated off Wales. *New York Times,* p. A-8.

24 February 1996. Batchelor, C. Mopping up after a maritime disaster: Lord Goschen presents a robust defense of government's policy on tanker safety. *Financial Times (London),* p. 4.

24 February 1996. Woollacott, M. Pride goes before a fall: Accidents like *Sea Empress* are an inevitable part of modern life. *The Guardian (London),* The Guardian Features Page, 22.

25 February 1996. Herring, H.B. An oil spill evokes an earlier disaster. *New York Times,* p. D-2.

25 February 1996. Associated Press. Oil pumped from tanker in wake of spill. *Los Angeles Times,* p. A-4.

27 February 1996. Brown, P., and G. Gibbs. Welsh oil spill 'is being played down.' *The Guardian (London),* The Guardian Home Page, p. 7.

27 February 1996. Midgley, C., and N. Nuttall. *Sea Empress* oil disaster 'as bad as *Torrey Canyon.' The Times (London),* Home News Section.

27 February 1996. Reuters. Britain faulted on oil spill damage estimate. *New York Times,* p. A-3.

28 February 1996. A conventional shade of green: Tony Blair's big environmental speech. *The Independent (London) Comment,* p. 13.

28 February 1996. Horowitz, J.M., N. Labi, V. Johanna, and M. Rutherford. Poisoned waters. *Time.* p. 7.

4 March 1996. Barrie, C. Oil spill bills are flowing in. *The Guardian (London),* The Guardian City Page, p. 17.

4 March 1996. Spreading stain in the Celtic sea. *Newsweek.* p. 39.

7 May 1996. Frost, B. Scrubbing-brush army defeats invasion of oil. *The Times (London),* Home News Section.

23 June 1996. Southerland, D. Mobilizing the fleet. *Washington Post,* p. H-1.

10 January 1997. Batchelor, C. Slick cleanup report renews spraying debate. *Financial Times (London),* p. 8.

15 February 1997. Brown, P. Friends of the Earth to sue over *Sea Empress. The Guardian (London),* The Guardian Home Page, p. 11.

10 July 1997. Jones, C. Big concern over the environment. *Financial Times (London),* Whales 97 Section, p. 3.

17 July 1997. Brown, P. *Sea Empress* Inquiry: Charges to follow report on oil tanker disaster. *The Guardian (London),* The Guardian Home Page, p. 5.

12 February 1998. Brown, P. *Sea Empress:* How disaster struck. *The Guardian (London),* The Guardian Home Page, p. 3.

NORTH CAPE

21 January 1996. Keating, S. *North Cape* Spill — Nameless army of workers fights to save shoreline. *The Providence Journal-Bulletin,* p. 19A.

21 January 1996. Lord, P. Grounded barge leaks 700,000 gallons of heating oil. *The Providence Journal-Bulletin,* p. 1A.

22 January 1996. Rhode Island oil spill is more serious than initially thought. *New York Times,* p. A-10.

24 January 1996. Daly, C.B. Nearing storm interrupts Rhode Island spill cleanup. *Washington Post,* p. A-6.

29 January 1996. Mooney, T. The *North Cape* spill — Most of the oil got away. *The Providence Journal-Bulletin,* p. 1A.

9 February 1996. Beardsworth, J. The *North Cape* spill — Oil spill taints sales of fish. *The Providence Journal-Bulletin,* News, p. 1A.

9 February 1996. Salit, R. Combing the sand for answers. Marine science students help gauge impact of the *North Cape* spill. *The Providence Journal-Bulletin,* p. 1A.

15 February 1996. Mooney, T. Committee grills Coast Guard over delay in new safety roles. *The Providence Journal-Bulletin,* p. 1B.

4 May 1996. Alvarez, V.P. Save the Bay weathers rough seas. *The Providence Journal-Bulletin,* p. 1B.

22 May 1996. Poon, C. The nose knows: Oil is gone. *The Providence Journal-Bulletin,* p. 1A.

19 January 1997. Mooney, T. Oil in the water — One year later. *The Providence Journal-Bulletin,* p. 1A.

21 January 1997. Lord, P. Polluters, state join to study spill's impact. *The Providence Journal-Bulletin,* p. 1A.

5 October 1997. Phipps, P. *North Cape* spill a case study in the free market. *The Providence Journal-Bulletin,* p. 1F.

10 November 1997. Lord, P. State pockets cash from workers' overtime. *The Providence Journal-Bulletin,* p. 1B.

12 November 1997. Lord, P. Union workers finally to get oil-spill overtime. *The Providence Journal-Bulletin,* p. 1B.

9 January 1998. Carbone, G.M. 1998. Oil-spill fines won't be paid to lobstermen. *The Providence Journal-Bulletin,* p. 1A.

20 January 1998. Davis, P. North Cape oil spill: Two years later lobstermen ask, Where is our settlement? *The Providence Journal-Bulletin,* p. 1A.

17 July 1998. Lord, P.B. Coast Guard inspections of tugs sought. *The Providence Journal-Bulletin,* p. 1B.

TANK BARGE BUFFALO 292

28 May 1996. Staff. Oil barge passed inspection last year. *Houston Chronicle,* p. A-34.

28 May 1996. Times Wire Reports. Same barge causes second oil spill. *Los Angeles Times,* p. A-9.

29 May 1996. Rendon, R. Estimate of oil spill less than thought. *Houston Chronicle,* p. A-15.

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