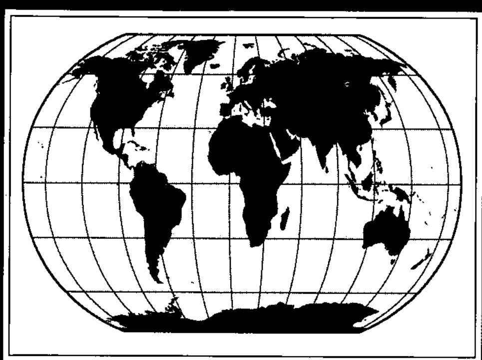
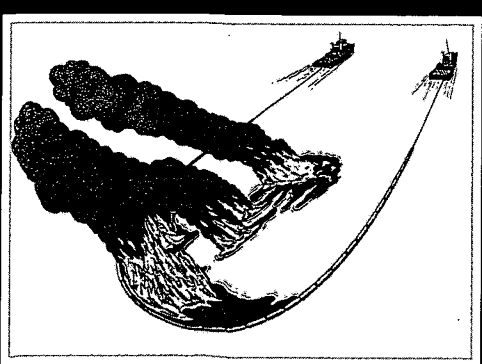
IMPLEMENTING AN EFFECTIVE RESPONSE MANAGEMENT SYSTEM





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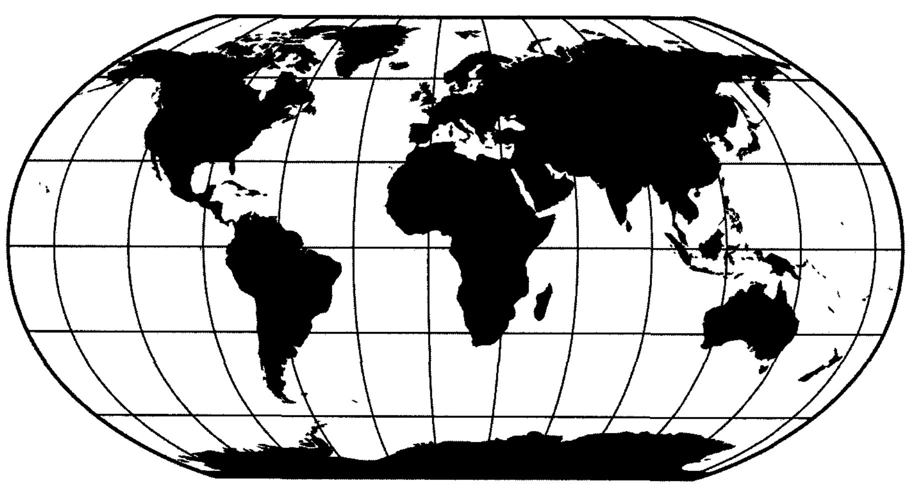
IMPLEMENTING AN EFFECTIVE RESPONSE MANAGEMENT SYSTEM



A White Paper Prepared for the 1995 International Oil Spill Conference

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PREFACE

The 1995 International Oil Spill Conference sponsors, American Petroleum Institute, U.S. Coast Guard, U.S. Environmental Protection Agency, International Maritime Organization, and International Petroleum Industry Environmental Conservation Association, commissioned three white papers to address issues of special importance to the oil spill community. They assigned the responsibility for general management and oversight, scope definition, peer review, and publication of the white papers to the Program Committee.

The goals of the white papers are to educate the spill community, to stimulate open discussion of complex and controversial issues, and balance the diverse positions of stakeholders. Each topic addresses varying scientific/technical and socio/political concerns. Therefore, each white 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 1995 Conference, each white paper will be the topic of a special panel session. Separate publication of the white papers initiates the International Oil Spill Conference Technical Report Series. The Technical Reports are to be published in conjunction with the International Oil Spill Conference on a biennial basis.

It is the Program Committee's hope that each white paper will stimulate substantive discussion and serve as a catalyst for solutions.

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Chairman, Program Committee

1995 International Oil Spill Conference

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International Petroleum Industry Environmental Conservation Association

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ABSTRACT

The challenge for oil spill response professionals is to develop a process during pre-spill planning that enables a responder to incorporate the positive aspects of both closed and open management systems. By building a system that has the potential for operational efficiency offered by closed systems and the adaptability of open systems, the capability to successfully manage the full range oil spill response operations can be developed. Developing and implementing an effective Response Management System is difficult due to the technological, political, economic and socio-cultural differences between organizations and nations. It can best be accomplished during the preparedness process by reaching detailed organizational agreements among members of the response community on how organizations will respond together, and then reinforcing and/or modifying those agreements at the outset of a response. This paper is intended to stimulate thoughtful discussion within the spill response community on how to better address these problems associated with managing response operations.

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EXECUTIVE SUMMARY

Management of oil spill response operations throughout the world is the subject of continuing discussion, particularly in light of the high visibility of oil spills and evolving requirements for a unified command form of spill management resulting from the Oil Pollution Act of 1990. This paper considers response management systems (RMSs) in terms of theoretical research and the practical experience of response specialists. As used in this paper, **a response management system (RMS) is the combination of organizational structure, management processes, individual roles, and operational strategy employed during an oil spill response.** The focus of this paper is on the design and implementation of an RMS which brings together the organizational entities in spill response, that is, the overall system that connects the individual RMSs of responding organizations.

This paper is intended to stimulate thoughtful discussion within the spill response community on how to better address the problems associated with managing response operations. This paper:

- Reviews the background, including the historical perspective, of RMSs used for oil spill response;
- Presents a systems view of response management based on theoretical research and field studies in various crises and disasters, including oil spills;
- Identifies types of RMS applicable to oil spill response operations;
- Presents Critical Success Factors and system design requirements for effective RMS;
- Describes general types of RMS in use worldwide;
- Presents a view of future actions that could improve response management; and,
- Proposes unresolved issues in RMSs.

The general conclusion reached in this paper is that the types of RMSs comprise a continuum, with no system exhibiting characteristics of a single system type. Towards one end of the organizational spectrum is the open, problem solving system, characterized by a reliance on flexibility and improvisation by team members, decentralized or distributed decision making (often by *ad hoc* functional groups) and a high degree of both internal and external communication and feedback. These types of organizations have proven to be very adaptive, learning quickly and using a wide range of resources from both the internal and external environments. Such a system tends to lose effectiveness when the various components, either individuals or groups, are "strangers," that is, they do not work together regularly. In that case, the lack of common culture and shared goals can lead to dissolution and lack of purpose. The recent revision of the US National Contingency Plan calls for a system that is to operate in an open manner, one that integrates the organizations of the On-Scene Coordinator, state representative and responsible party into a single, highly interactive and purposeful organization.

Towards the other end of the continuum are closed types of RMSs, typical throughout the world and characterized by structured, hierarchical, command and control design. Closed systems work quite well in managing spills with little or no interaction with outside influences or organizations; usually these are routine spills, which comprise the majority of incidents. The success in these relatively controlled circumstances can be attributed to the emphasis on centralized decision making and direction of operations by a single person and execution of pre-spill planned actions. Closed systems tend to fall short of their ability to achieve success as perceived by external organizations, including the public. Closed systems have difficulty in the complex, highly turbulent environment of significant oil spills. The two typical weakness in the closed system design are the inability to adequately address the concerns of emergent groups and the inadequacy of feedback mechanisms to enable the organization to determine how the response as a whole is progressing, and to make the necessary adjustments. The closed system typically does not respond well when, as the significance of an operation increases, the organization must get not only bigger, but different — when the fundamental nature of the response changes.

The Incident Command System, which is being widely adapted for use as an RMS for oil spill response, is based on a closed system design but offers the potential to be implemented as an open type of system.

The challenge for government and private industry oil spill response professionals is to develop a process during pre-spill planning that enables a responder to incorporate the positive aspects of closed systems, with the ability of open systems to respond to the external influences that are predicted to emerge in a significant or catastrophic oil spill. This challenge is difficult, made more so by the technological, political, economic and socio-cultural differences between organizations, and the fact that oil spill planning and response activities are collateral duties in most organizations. However, by building a system that has the potential for operational efficiency offered by closed systems and the adaptability of open type of systems, the capability to successfully manage the full range oil spill response operations can be developed. Developing and implementing an effective RMS, especially for significant events, is a sufficiently complex activity that can best be accomplished during the preparedness process by reaching detailed organizational agreements among members of the response community on how organizations will respond together, and then reinforcing and/or modifying those agreements at the outset of a response.

SECTION 1.0

INTRODUCTION AND APPROACH

This paper examines organizational systems used to manage oil spills which affect navigable waters in the US and other countries. This paper describes current response management systems (RMSs) in terms of theoretical research findings and practical experience of response specialists as a way of exploring how to implement an effective RMS during oil spill preparedness and response.

1.1 PROJECT OBJECTIVES

Since the *Torrey Canyon* oil spill in 1967, governments and private entities throughout the world have become more aggressively involved in managing oil spill response operations. Many governments around the world have recognized a need for and value in cleaning up the after-effects created by accidental releases of oil into the environment. As governments have developed regulations and procedures to minimize the political, economic, socio-cultural and environmental impacts of spills, managing spill response has become more complex. Consequently, the issue of how oil spills should be managed to enhance the potential for success has become an issue of widespread interest and discussion.

This paper was commissioned by the five sponsors of the 1995 International Oil Spill Conference as a reference and discussion document to describe:

- The historical evolution of RMSs;
- The state of knowledge of RMSs, including the institutional approaches used for managing spill response operations throughout the world and the types of RMSs that are currently in use; and,
- Unresolved issues and a view of the future of spill RMS design and implementation.

In addressing these objectives, this effort examined and analyzed what the authors believe to be the critical factors influencing the design and effectiveness of oil pollution RMS. In doing so, it was also necessary to:

- Examine the applicability of academic research on organizational behavior during emergencies to the management of spill response operations; and
- Discuss the factors that influence RMS effectiveness during spill response operations.

1.2 RESPONSE MANAGEMENT SYSTEMS: DEFINITION AND CONTEXT

As used in this paper, **an RMS is the combination of organizational structure, management processes, individual roles, and operational strategy employed during an oil spill response.** In this respect, almost every organization that responds to oil spills, whether government or industry, as a single entity or as part of a multi-entity organization, is using some form of RMS. However, not all RMSs are formalized to the same extent, i.e., written down and agreed upon by the internal and external entities which interact with that organization.

There are two basic types of organizational activities which occur in an RMS: the first is making decisions about what to do; the second is executing or implementing the decisions, including how to appropriately implement decisions. The issue of who makes the decisions regarding response activities is a key factor in the design and implementation of an RMS. Command levels of organizations are responsible for making the fundamental decision on objectives, priorities, and strategy which guide the overall management of the spill event. The execution of decisions is carried out by the functional portions of response organizations.

How decisions will be made and the identification of the entities having decision making authority is traditionally the right and function of government and is communicated through the laws, regulations, and policies for specific political units, e.g., national, regional, state, and local levels of government. The governments of many countries have established laws and regulations requiring the clean up of oil. Institutional requirements comprise the basis of policy, i.e., a high level overall plan that reflects the general goals and acceptable procedures of a governmental body.

Generally, the government policies which deal with oil spill response have addressed the roles of government and the private entity responsible for the event, known as the Responsible Party (RP). In some countries and under some circumstances, a single entity in government clearly has the decision making and operational responsibility for response, with the RP having a financial responsibility, i.e., paying for the cost of response. Singapore is an example of this institutional approach for response management (Garnett, pers. comm., 1994). In these situations, the RMS is fairly one dimensional; a single entity makes decisions and executes the response. In other countries, such as the US, the RP and other agencies also participate, along with government agencies, and have decision making and operational, as well as financial, roles. In these situations, the RMS becomes an approach used to unify the organizational structures, roles and responsibilities of the principal entities involved in the response.

Spitzer (1992) notes that the multiple organizations involved in spill response can be combined in three ways; they are listed in order of decreasing linkage:

- **Integrated** — One organization formed out of resources and components furnished by participating organizations. The individuals assigned are governed by the goals, objectives and rules of the integrated system.
- **Unified** — A single organizational structure formed through the mutual agreement of cooperating organizations. Individuals are governed by both the goals of the unified organization and the goals, objectives, and rules of their "home" organization, e.g., Spill of National Significance organization.
- **Coordinated** — Cooperating organizations maintain their independent identity, but cooperate to achieve mutual goals, e.g., pre-OPA 90 response organization, and the Federal response plan organization for natural disasters.

The principal entities who have responsibilities and actions during response are the national government (e.g., Federal government in the US); sub-national level(s) of government (e.g., state and/or local governments in the US); the RP; and the private contractors whose business function is the removal and cleanup of oil, i.e., oil spill removal organizations (OSROs).

Because oil spills are accidents, the above principal entities who respond to spills actually have two modes of operation: (1) normal, or steady state, used for day-to-day operations, and (2) emergency, used for oil spill response (and perhaps other types of emergencies). In the steady state mode, these entities make decisions and work independently of one another; in the emergency mode these organizations may make and execute decisions together, depending upon the government policies that determine how response will be conducted in a particular geographic area. The dilemma for developing an effective RMS is determining the optimal way for these organizations to be brought together to make and execute spill response decisions, when they normally operate independently of one another.

The focus of this paper is on the design and implementation of an RMS which brings together the organizational entities in spill response, that is, the overall system for interconnecting the individual RMSs of responding organizations. To accomplish this, general organizational principals relevant to emergency management will be reviewed to provide a foundation for considering the overall, unifying RMS. Also, some existing systems will be reviewed to explore the commonalties and differences among their organizational relationships that would have to be resolved before a unifying system could be developed.

It is important to recognize that organizational diagrams are one of the most common tools used to describe a system. Yet these two-dimensional diagrams are an overly simplified way to describe a system that is multi-dimensional. Readers are reminded that the organizational diagrams displayed in this paper are being used to graphically represent only a portion, i.e., structure, of the overall system. Considering that organizational structure refers to formal patterns of authority, responsibility, and communications organizational diagrams actually give only a limited view of organizational structure.

1.3 ORGANIZATION OF THIS REPORT

Section 1: Introduction and Approach. This section identifies the project objectives and defines RMS as used in this paper. This section also describes the potential utility of this document and the approach used in compiling this report.

Section 2: Background. This section lays the conceptual foundation and perspective for discussions of RMSs in the remainder of the report. It provides an overview of the RMS problem in spill response, and discusses the concepts of response goals, objectives, effectiveness and efficiency, and their relationships to implementing effective RMSs. This section also examines the historical evolution of RMSs used in managing oil spills. To relate theoretical research findings on post-disaster organizational behavior, this section also describes the relative significance of spills that response organizations are typically required to manage, and two central organizational concepts relevant to emergency management.

Section 3: Systems View of Response Management. This section discusses a systems view of response management. This section of the paper discusses the theoretical considerations for RMS design and implementation, and provides a model for the organizational environment that influences RMS design and implementation. Two basic types of RMSs are identified and discussed: open and closed systems. Section 3 also describes the conceptual components of RMSs and the theoretical factors which influence their development, design, implementation and adaptation during a spill response. Both theoretical research findings and opinions of responders are used as the basis for this discussion.

Section 4: Current State of Knowledge. This section begins with a discussion of the critical factors that must be accomplished for a spill to be managed successfully. This section contains a detailed discussion of current RMSs in use internationally and in the US.

Section 5: View of the Future. Based on the research conducted during this effort, this section discusses the trends in RMS that are likely to continue in the immediate future, and the implications for implementing effective RMSs. A summary of important points and concluding remarks are also presented.

Section 6: Unresolved Issues. This section identifies those RMS issues that warrant additional attention from oil spill professionals. These issues which need to be resolved before an effective RMS for oil spill response can be developed. This section also discusses organizational challenges which are likely to impede implementing a successful RMS.

References and Bibliography. These include all written and verbal references sited in this document. It excludes the sources of opinions described in the Appendix B.

The appendices contain detailed information which is referenced in the report, including a Glossary and the summary of responses obtained from oil spill professionals on their opinions for implementing effective RMSs.

1.4 USE OF THIS REPORT

This report has been developed to foster thoughtful discussions among the international and US response community on oil spill RMS issues to be considered during each country's preparedness process. Since it is based in part on the opinions of a wide range of oil spill professionals, the report is intended to facilitate this community discourse by discussing RMS issues that affect all responders. Given the theoretical research which has been integrated into this report, this document is intended to serve as a general reference document and conceptual foundation for understanding the design and implementation of effective RMSs.

In the US, this document may enhance the planning and preparedness efforts of the National Response System, particularly the Area Planning Committees, as well as vessel and facility response plan users. For the international readers, this report advances the organizational development trends which are predicted to occur during emergencies, including significant oil spills, by the theoretical researchers.

This report can also be used to provide feedback to the research community on those RMS issues that warrant further examination.

1.5 SCOPE AND LIMITATIONS

This paper considers the organizational systems that are in use worldwide to manage oil spills which can affect navigable waters. The primary focus is on those discharges affecting open ocean and coastal waters. The spills might originate from manned and unmanned tank vessels; commercial vessels carrying fuel in bunkers; facilities ashore which store, handle or use oil; transportation pipelines; or offshore platforms.

The scope and time available to conduct this project resulted in distinct limitations, specifically:

- The theoretical literature reviewed is broad but incomplete, and comes primarily from US sources. The sources for information on international response systems and government policies were the International Maritime Organization (IMO) and International Tanker Owners Pollution Federation (ITOPF). The ITOPF information was used without direct confirmation of the authors' interpretation of information from countries. However, since the information was used primarily as a classification mechanism for gross comparisons, this was not judged to be a significant shortcoming.
- The information is significantly more detailed in the area of marine oil spills. An effort was made to gather equivalent information, both in terms of quality and level of detail, on inland/freshwater spills and those that originate from facilities. However, the information was not readily available from existing sources and an extensive research effort was beyond the scope of this project.
- The information is more detailed for the US than for other countries. This is a distinctive aspect of this report since detailed information on other countries was not readily available from existing sources, other than ITOPF.
- The opinions solicited from the response community are neither representative of all viewpoints, nor was this information gathered in a statistical manner. The collection method was informal, and would not meet the rigors of a peer-reviewed research methodology. The only new information generated during this project is that derived from the opinion solicitation.

1.6 APPROACH

The approach used to achieve the project objectives was to integrate the theoretical research in the area of organizational design for crisis management and disaster decision making, with the practical experience and personal observations of spill response professionals. The intent of this approach was to provide a well-reasoned basis for considering what constitutes an effective RMS and how RMSs can be designed and implemented. Specific steps included:

1. Define RMS.
2. Conduct a search of the theoretical literature, then compile and organize the research findings related to oil spill RMSs.
3. Obtain information on international and US RMSs, including various government, industry and responder systems.
4. Develop considerations for what constitutes an effective RMS.
5. Identify ways to enhance existing approaches to RMS to increase response effectiveness and success.
6. Identify issues which may limit effectiveness of RMS.
7. Describe existing RMS approaches.
8. Identify possible advantages of resolving RMS issues.

The principal types of information used to develop this report are existing literature sources and personal communication with oil spill response specialists and organizations.

LITERATURE SEARCH

The theoretical research incorporated in this paper concerns the field of organizational development for emergency, crisis, and disaster response. The majority of this information was derived from refereed literature. The theoretical research was used as the basis for understanding how people and organizations behave during emergencies. This knowledge is based on accepted social science principles and field research, and encompasses such disciplines as human systems engineering and management, organizational behavior, decision sciences, political science and sociology, among others. Most of the research findings are based on extensive field studies of organizational performance during technological and natural emergencies over the last 25 years.

Both peer-reviewed literature and other publications, e.g., government documents and regulations, in-house reports and the Proceedings of the International Oil Spill Conferences from 1969 through 1993, were reviewed. The libraries of the paper authors and oil spill professionals contacted during the project were additional sources used in the literature search. The principal sources of information on international approaches to response management were publications of the IMO regulations and agreements; ITOPF presentations and publications, including a draft of their Countries Summaries document; and one document from International Petroleum Industry Environmental Protection Council (IPIECA). Other sources included in-house documents of various industry and government agencies.

OPINIONS OF RESPONSE SPECIALISTS AND ORGANIZATIONS

Although research provided valuable insight into organizational development and behavior, most of the theoretical researchers, with the exception of one of the authors who served as a United States Coast Guard (USCG) On-Scene Coordinator (OSC) have not actually had the responsibility for managing oil spills. The other two authors also have had actual management experience in oil spill responses — one served as a Scientific Support Coordinator (SSC) from 1980–1990, and the other was responsible for coordinating Dept. of Defense support on the Ashland and Exxon Valdez oil spills. The authors, therefore, believed that including the broad practical views and experience of oil spill response specialists and organizations would be of significant value to the community.

The views of oil spill response professionals and organizations were solicited during the project in two ways. First, teleconferences and face-to-face meetings were held with several individuals having in-depth and extensive oil spill response experience. Second, a questionnaire was distributed to a broad cross-section of response professionals to obtain their views on what constitutes effective response management and the variables that influence the effectiveness of an RMS.

To provide a diversity of experience and, hence, perspectives, a total of 51 questionnaires were distributed to a selected audience, as depicted in Table 1, with the types of experience listed below:

- USCG and US Environmental Protection Agency (EPA) representatives;
- Federal On-Scene Coordinators;
- State oil spill response representatives;
- Representatives of potential RPs, both large and small, operating vessels and facilities internationally and in the US in coastal and inland environments;
- Technical Advisors, both international and US; and
- Response contractors.

The questionnaire was designed to solicit open ended comments, rather than a choice of limited responses, with the hope that the observations would more adequately reflect the respondents' experience and judgment. While compiling and analyzing the responses proved to be somewhat subjective, this method was generally successful in obtaining an insightful look at the perspective of experienced spill response professionals. Although it is not a statistically verifiable survey, the results reflect, nonetheless, the reasoned thinking of experienced response professionals from a variety of backgrounds.

A total of 34 individuals responded. Table 1 also depicts the number of response for each type of perspective that was solicited. Appendix A includes a sample questionnaire and a list of individuals to whom the form was sent. Appendix B contains a summary of respondents' comments. Some of the opinions received are explicitly discussed in Section 2.3; other opinions are woven into the overall fabric of this paper.

TABLE 1. SUMMARY OF SURVEY RESPONSES

Background of Questionnaire Recipient	Number of Questionnaires Distributed	Number of Completed Questionnaires Received
Potential RP (Coastal vessels)	2	2
Potential RP (Inland vessels)	2	2
Potential RP (Coastal facilities)	3	0
Potential RP (Vessel/facility)	5	5
Potential RP (International vessels)	4	3
Potential RP (Pipeline)	1	0
Potential RP (Utility)	1	0
Potential RP (Technical advisor)	4	3
US Coast Guard	6	6
Environmental Protection Agency	7	3
State representative–Gulf Coast	2	1
State representative–East Coast	3	2
State representative–West Coast	2	2
Response contractor	8	5
TOTAL	50	34

SECTION 2.0

BACKGROUND

This section provides a background and context for the remainder of this paper by exploring the philosophical rationale that underlies spill response, as well as the evolution of some RMS models for spill response. This section also begins to develop the relationship between the theoretical literature, which will be explored in detail in Section 4, and current thinking about oil spill response.

2.1 OVERVIEW OF THE OIL SPILL RESPONSE PROBLEM

The *Exxon Valdez* oil spill in Alaska on March 24, 1989 focused the attention of the world on marine oil pollution and ushered in a new era in oil spill planning and response, not only in the United States, but in the international community as well. The *Exxon Valdez* spill and others, such as the *Mega Borg, World Prodigy, Presidente Rivera,* and *American Trader,* reinforced US public opinion that oil spills are unacceptable, and led the US Congress to pass the Oil Pollution Act of 1990 (OPA 90). This law requires, among other things, the submission of response plans by owners and operators of vessels and facilities which could discharge oil into the navigable waters of the US. Government and industry leaders alike attest that one of the most critical components of these response plans is that they must describe the corporate organizational structure and the spill management team that will be used to manage response actions (US Coast Guard, 1993a, §154.1045 [for facilities] and US Coast Guard, 1993b, §155.1035 [manned vessels carrying oil as primary cargo], US Coast Guard, 1993b, §155.1040 [unmanned tank barges carrying oil as primary cargo] and US Coast Guard, 1993b, §155.1045 [vessels carrying oil as secondary cargo]).

While the US attention has focused on OPA 90 and its requirements, the international community also has reacted to minimize the effects of catastrophic discharges of oil into sensitive environmental areas. In October 1989 the IMO, working through its Marine Environment Protection Committee (MEPC), began two initiatives which would later become agreements intended to enhance international response capabilities. MEPC sponsored a series of conferences which led to the adoption on November 30, 1990 of the International Convention on Oil Pollution Preparedness, Response, and Cooperation, 1990 (OPRC). This Convention provides a framework for international cooperation in combating major oil pollution events. Principal activities under the OPRC Convention are conducting specific preparedness activities in cooperation with the oil and shipping entities, and establishing a national system within signatory countries for responding promptly and effectively to oil pollution incidents (IMO, 1991). In addition, MEPC also began preparation of guidelines for the development of shipboard oil pollution emergency plans for oil tankers of 150 gross tonnage and above, and every other ship of 450 gross tonnage and above. These guidelines, approved on March 6, 1992 with the passage of resolution MEPC.54(32), are now incorporated into MARPOL 73/78 as Regulation 26 to Annex I. MARPOL 73/78 is the legal instrument for making shipboard emergency plans a mandatory prerequisite for receiving an International Oil Pollution Prevention (IOPP) Certificate (IMO, 1992). New vessels were required to have plans by April 15, 1994, and existing vessels by April 15, 1995.

The reasons for conducting spill response operations may be complex and dynamic, involving statutory requirements, economic impacts, public perception, company image, criminal and civil penalties and environmental concerns. However, the authors accept IMO's fundamental rationale, reflected in the OPRC, that industry and governments are "conscious of the need to preserve the human environment in general and the marine environment in particular" and that they "recognize the serious threat posed to the marine environment by oil pollution incidents involving ships, offshore units, sea ports and oil handling facilities." It is this social dimension to both the impact of the spill and the conduct of the response that leads the authors to suggest that consideration of social science theory and research may provide a more inclusive approach to the question "What can the response community do to implement an effective management system which will support the overall goals and objectives of the response?"

The rationale for taking action to manage the effects of marine oil spills is the belief that doing something better is preferred to just doing something or doing nothing at all. There appears to be widespread concurrence that it is possible to act in ways that will positively change the outcome of a spill response — changes that would not occur if no actions were taken. It should be noted, however, that in some limited cases, doing nothing can be better for the environment than other options, such as aggressive actions to remove oil from some types of shoreline. Nevertheless, the overriding goal in response is to rapidly intervene in the natural course of events following an oil spill to reduce the adverse effects that would otherwise occur if no actions were taken, or if actions were taken too late to be of any net benefit.

When an oil spill occurs, a response organization must be mobilized to direct response operations, address public and government concerns and provide accurate, timely information to the public. The organization must be operating effectively within a very short period of time at a location determined by the spill event (Harrald *et al.*, 1992). The rationale for a rapid mobilization of resources is defined by Lindstedt-Siva (1992) in describing three windows of opportunity when human intervention can make a significant difference in the environmental outcome of a spill:

- **Very early** — Responders can "attack" the oil to contain, collect and remove it while it is concentrated near the source of the discharge;
- **Early** — Responders deploy resources to protect environmentally sensitive areas; and
- **Later** — Responders can use ecologically sound methods to clean up shorelines or other impacted areas.

In addition to taking immediate action to mitigate adverse effects, there is a general assumption on the part of government oversight agencies and the public that all post-spill actions will be managed effectively to ensure that they are appropriate and effective. The common term "managing the response" implies that the decisions are being made in a way that enables the organization to achieve pre-determined operational and social goals and that activities are being directed with a reasonable degree of skill. Yet, the environmental effects of oil spills are influenced by many variables, such as the type and quantity of oil spilled, prevailing weather conditions, location of the spill, time of year, availability of the proper equipment, among others, over which even the most responsive and qualified managers have no control.

As the principal strategy for reducing adverse effects, a primary emphasis in spill response in the US, since 1966 when the Oil Pollution Act of 1924 was amended, has been removal of spilled oil from the environment. Yet removing oil as quickly and effectively as possible in order to reduce the overall adverse effects is challenging, both in those countries that require the use of mechanical equipment as the primary response strategy, as well as those, such as Great Britain, that rely on dispersants as the first line of defense for oil spills (US Congress, 1990).

No organization, even with the best resources available, can recover the majority of oil from open water once it has spilled. Mielke (1990) notes — and the history of spill response operations substantiates — that it is unusual for more than 10% to 15% of the oil to be recovered from a large spill. It is widely accepted that the effectiveness of oil booms and skimmers are significantly constrained by sea, wind, and current conditions. Use of newer technologies, specifically dispersants and *in situ* burning, remain the subject of discussion related to the window of opportunity for use, effectiveness on various types of oil, impact of use in highly sensitive areas, seasonality, government approval, pre-use testing and post-application monitoring, toxicity relative to the undispersed oil, and availability of adequate logistical support. In short, attempts to recover large quantities of oil after a significant spill have been likened to trying to pick up mercury from a broken thermometer with one's fingertips (McCall, pers. comm., 1994), or emptying a very large swimming pool with eyedroppers (Ott *et al.*, 1993) — except that picking up mercury or emptying the pool with eyedroppers is easier. Two important realities reflected in this paper are that: (1) nature is uncontrollable and (2) technology limitations tend to hinder the ability of responding organizations to succeed in removing spilled oil from the environment. These two realities are acknowledged and not explored further in this paper. The effect of these realities on spill response activities is unpredictable; sometimes spill conditions are fortuitous, as when prevailing winds carry spilled oil away from shore, and sometimes spill conditions are unfortunate as when prevailing winds carry oil toward shore. Yet, organizations still persevere under the belief that taking action is better than no action.

All responders aim for an effective response but there is a public perception that few of the well-known responses to major or significant spills have been successful. The *Exxon Valdez* may be the premier example in the US public's memory of an oil spill response that did not go well. On the other hand, the *American Trader* spill which occurred in California in 1990 is an example of a response that is widely viewed as having been successful (Card *et al.*, 1991; Rolan and Cameron, 1991). If history demonstrates, and the entire response community accepts, that removing all spilled oil from the environment is unrealistic, then what are the goals and objectives of spill response? This paper is optimistic; it presumes that implementing an effective RMS can improve the ability of spill responders to succeed.

2.2 GOALS AND OBJECTIVES OF OIL SPILL RESPONSE OPERATIONS

The response community, those involved in or affected by an oil spill, is comprised of multiple private and public groups, as well as individuals. For purposes of this paper, the primary components of the response community whose goals and objectives must be satisfied to achieve a successful response are the government, the RP, and the public.

RESPONSE GOALS

Goals are the **articulation of what is considered important,** and they are likely to vary with different groups. What is considered important to one group may not be the same to another, even within the same country or city. One of the characteristics of all disaster or crisis response operations, including oil spills, is that multiple groups of people, all of whom have something at stake but who do not know each other well or at all, are involved in responding. The goals of responding entities may be shared (agreed upon among all groups), conflicting (agreed upon in some areas but mutually exclusive in some other, or potentially all, areas), or unique (having no common elements) (USCG Marine Safety School, 1994). Understanding that this spectrum of goals exists for each element involved in the response enhances the probability that the organization as a whole can function effectively and increases the potential for achieving a successful response. Yet the existing literature suggests that for any organization to succeed in responding to an oil spill, clear and meaningful strategic goals must be established (USCG Marine Safety School, 1994). It follows that **shared goals** would be a prerequisite for a unified or integrated RMS, comprised of multiple, diverse organizations, to execute a successful response. The theoretical literature supports this premise; one of the characteristics of high performing systems, i.e., ones that succeed, is clarity of purpose (Vaill, 1982).

The previous discussion suggests that some spill response goals, such as mitigating adverse effects on the environment or protecting human life and safety, are fundamental. Thus, they do not change from event to event; they can be identified during preparedness activities as part of a contingency or response planning process. Some of the most obvious sources of goal definition are the laws, regulations and agreements (such as OPA 90 and the OPRC), which provide the regulatory framework for response activities. If a country has established a set of national goals, then the minimum goals of every responding element must conform. For example, the US establishes its goals as the National Response Priorities in the National Oil and Hazardous Substances Pollution Contingency Plan (called the National Contingency Plan (NCP)) (US EPA, 1994a, §300.317). All response operations in the US must be conducted with the following three goals of the federal government, in priority order, clearly in mind.

1. Safety of human life;
2. Stabilizing the situation to preclude the event from worsening; and
3. Use of all necessary containment and removal tactics in a coordinated manner to ensure a timely, effective response that minimizes adverse impact to the environment.

Although individual principal components of the response community may have goals which may be the same or different from those articulated in laws and regulations, agreement on goals is fundamental to managing a spill response. Therefore, RMSs must be centered upon overall goals which do not change from spill to spill, such as those in laws or regulations.

EVENT-SPECIFIC OBJECTIVES

The agreement upon event-specific strategic objectives, which we will call **event objectives** should provide the basis for all response activities, including deployment and use of resources. The event objectives should aim to achieve the overall fundamental goals while taking into account the nature and details of the particular spill. The absence of well-defined event objectives from the outset of a response could result in: the lack of clear priorities and tactical objectives; misdirected organizational focus; confusion in deployment of resources; internal dissent as divergent groups work to meet their own, rather than the common, objectives; and a perception of failure within the responding organizations and by the public. The agreement on initial event-specific objectives as soon as possible during the emergency phase of a response is essential, even though some objectives may change and others may be added as the long range requirements for response become clearer.

Operational objectives implement the event objectives. They provide the foundation necessary for the preparation of **action plans,** which specify the detailed tactics for operational level activities. These four elements — shared goals, event (strategic) objectives, operational (tactical) objectives and action plans — form a hierarchical framework for translating the highest level policy decisions into supporting actions "on the water" or "on the ground." The following example illustrates this decision making and implementation framework.

Goal	Use all necessary containment and removal tactics in a coordinated manner to ensure a timely, effective response that minimizes adverse impact to the environment. (Third National Response Priority from the US NCP.)
Event (strategic) Objective	Protect all sensitive environmental areas listed in the Area Contingency Plan.
Operational (tactical) Objective	Boom the marsh on the south side of the entrance to Smith Creek no later than 6 hours prior to projected landfall.
Action Plan	Have Jones Response Company boom the area south of the entrance to Smith Creek using 18" harbor boom and boom anchoring kits. Anchor the boom north of the boat landing and south of the bend near the old fishing pier. Make sure one boom tending boat in the area is assigned to maintain the boom. Use sorbent pads and a vacuum truck at the boat landing to remove oil if it gets inside the boom.

EFFECTIVENESS VERSUS EFFICIENCY

A central issue to considering how to implement an effective RMS is understanding how "effective" can be defined. The authors offer the following definitions to distinguish between effectiveness and efficiency. Both concepts reflect value judgments that are related to response goals and objectives.

Response **effectiveness** relates to the accomplishment of response objectives — **doing the right things** (or getting the right things done) — such as:

1. Conducting the response safely, without injuries or deaths;
2. Preventing further spillage of oil;
3. Maximizing the recovery of oil;
4. Minimizing the environmental impact of the spill; and
5. Ensuring the media and the public perceive the response as effective.

Response **efficiency** relates to the ability to use resources appropriately — **doing the right things correctly** (or getting the right things done with the right amount of resources) — including:

1. Mobilizing and using only the type and number of resources appropriate for the spill;

2. Attaining the sustained maximum output from available resources;
3. Keeping the scale of the response effort in proportion to the size of the spill and the threat of environmental damage; and
4. Drawing a balance between the cost of damage mitigation and the damage that might otherwise occur (Gilbert, 1983).

Oil spill response organizations are under intense pressure to be both **effective** and **efficient.** The pressure for effectiveness appears to come from those external to the oil transport community, such as government agencies, elected officials, the public and public interest groups, media and environmental groups, while the pressure for efficiency comes from within, including oil company management, stockholders, Prevention and Indemnity (P&I) clubs and other insurers. This context leads one to reason that responding both effectively and efficiently will increase the probability for the spill response to be perceived as successful. The findings of researchers will be used to further explore this premise in subsequent sections.

2.3 Practical Views on Response Management Systems

Successful response to an oil spill is a mixture of real and perceived accomplishment of goals and objectives. In part to access what experienced government and industry response managers think constitutes a successful response, and to determine if there was any agreement among them, questionnaires were sent to 51 individuals in the spill response community (see Appendices A and B).

An interesting observation from this solicitation of viewpoints was that the perception of success or effectiveness of a spill response was not necessarily linked to the objectives. A review and comparison of questionnaire responses illustrates this point. First, consider the following top ten responses to the question "What is a successful response?"

Table 2. Indicators of a successful spill response

Response	Number	Percentage
Damage to the environment is minimized	18	53
The public and media perceive success and are satisfied with the response	14	41
The spread of oil is minimized	10	29
The response occurred in an expeditious manner	10	29
The government, Responsible Party and other involved parties are satisfied with the response	8	24
The maximum amount of oil possible is removed	8	24
There is multi-party synergism	6	18
There are no fatalities or injuries	5	15
Costs are controlled	4	12

Note: **Percentage** indicates the percentage of the 34 respondents who gave that particular answer.

Next consider the top nine responses to the question "What are the legitimate objectives of response activities?"

A comparison of responses to the two questions reveals an inconsistency between the answers. Of those responding, 71% said prevention or minimization of environmental damage is a legitimate objective of a spill response operation, while only 53% of the same group said it is an indicator of success. At

Table 3. Objectives of spill responses

Response	Number	Percentage
Prevent or minimize environmental damage	24	71
Remove the oil effectively and with proper techniques limiting human impact on the activities	14	41
Safety and protection of human health and property	13	38
Control the source	6	18
Control costs	6	18
Create a "team" approach to solve problems and work with the government and local communities	6	18
Get the message and facts to the public and create a positive image	3	9
Leave the environment in a position to recover on its own within a short period of time	2	6
Establish a command and control environment	2	6

Note: **Percentage** indicates the percentage of the 34 respondents who gave that particular answer.

the other end of the scale, only 9% said creating a positive public image was an objective, but 41% said it was an indicator of success.

Why is there a discrepancy in the two indicators? One might expect a one-to-one correlation — that the number of respondents who indicated that a function was both an Objective and an Indicator of Success would be the same. Yet, these data suggest that while 24 individuals (71% of the respondents) said "minimizing environmental damage" is an Objective, only 18 (53% of the respondents) think it is an Indicator of Success (Table 4). If an action is not required for success, why make it an Objective — in short, why do it at all? Similarly, if 14 individuals (41% of the respondents) believe that good public affairs, in one form or another, is a prerequisite for success, why did only 3 (9%) list it as an objective? The effect of this inconsistency, i.e., when the responders' objectives do not address what they believe is required for success, on response management, is an issue worth pondering. In such an ambivalent environment, how can response managers provide event objectives, operational objectives, guidance, focus and direction to the overall effort?

Table 4. Comparison of survey responses

Response	Indicator of Success	"Legitimate" Objective
Prevent or minimize environmental damage	53	71
Remove the oil effectively and with proper techniques	24	41
Safety and protection of human health and property	15	38
Control the source	29	18
Create a "team" approach to solve problems and work with the government and local communities	18	18
Get the message and facts to the public and create a positive image	44	9

Note: Numbers in column headed **Success** and **Objective** are the percentages of the 34 respondents who g particular answer.

Another noteworthy result from the questionnaires is that only 19% of the respondents agreed that developing some form of team approach to response management was both an Objective and Indicator of Success. Considering this low percentage, the implications for those who develop and evaluate RMSs appear to be that a minority of respondents believe that a team-based form of response management will lead to a successful response.

One of the questions, from the questionnaire, concerned the relationship between an effective response and a successful response. Approximately 79% of the respondents indicated that the two concepts are different; an effective response is defined in operational and technical terms, while a successful response is defined in terms of more subjective and political issues. The common theme expressed was that a response could be effective, given the circumstances of the spill, but still might not be considered successful by the media or the public.

Just 15% of respondents indicated that the concepts are the same; both effectiveness and success are needed to satisfy the RP and the public. One individual specifically stated that they are not different because in a command and control environment, the response organization knows exactly what is being done, by whom and where; that the organization uses this information to monitor, and therefore achieve, effectiveness in the response operation. This is a significant answer because it reflects a widely held presumption that command and control management environments are conducive to achieving an effective response.

The next section explores how different types of RMS models evolved, including the command and control model.

2.4 Historical Perspective

As a means of understanding the rationale behind the current RMSs used for oil spill response, it is enlightening to examine the roots of the present organizational systems for response to understand how management of oil spills has evolved in recent times.

Evolution of Oil Spill Response

The *Torrey Canyon* spill off the coast of Great Britain on March 3, 1967 is frequently viewed as the catalyst that initiated modern governmental planning and response activities for marine oil spills. Certainly there were other oil spills prior to the *Torrey Canyon,* such as the loss of 2 million gallons of crude oil from the tanker *Thomas W. Lawson* off Sicily in 1907 (Biglane, 1969), but this 860,000 bbl marine spill of Kuwait crude oil received worldwide attention and prompted many countries to begin looking at oil spills as a specific regulatory issue, primarily because it was a catastrophic release of oil relatively close to shore that caused international and significant environmental impacts. The OSC for the *Torrey Canyon,* Capt. Mike Garnett (retired) who was a Royal Navy junior officer at the time, emphatically noted that there was no management system in place for the *Torrey Canyon* (Garnett, pers. comm., 1994).

The US began formally developing a federal plan as a direct result of the *Torrey Canyon* incident. A Presidential memorandum dated 26 May 1967 directed the Secretaries of the Interior and Transportation to conduct a joint study on how best to mobilize the resources of the federal government and the nation to prevent disasters involving major spillage of oil. The President's directive stated that a required action was development of contingency plans to deal with these emergencies (Charter, 1971). Consequently, the first edition of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) was issued in September, 1968. In fact, the opening of this NCP stated, "The development of a national awareness and concern over the hazards and damages to water related resources from oil pollution can be traced in large part to the sinking of the tanker, *Torrey Canyon.*" This first NCP defined the management framework for oil spill response in the US.

Evolution of Response Management Systems

When considering the evolution of RMSs is it useful to consider all oil spills as a type of emergency. Given this context, a brief review of the RMSs used during emergency response, as well as oil spill-specific RMSs, is warranted. There are three trends in the historical evolution of RMSs that are related to oil spills: the command and control or "military" model; the response system prescribed by the US National Contingency Plan which we call the US model for oil spill response; and the Incident Command System (ICS). This section presents the history and description of these three models for oil spill response management.

Military (Command and Control) Model

The dominant civilian emergency management model has been described by Dynes (1990) as the "military model." This formal, centralized command and control structure and process of the World War II military was imported into the emergency management community through the passage of the Federal Civil Defense Act of 1950, the first comprehensive legislation in the US to deal with emergency planning. The prime focus of this legislation was on enemy nuclear attack, although the legislation indicated that the organizational structure could be used to provide relief and assistance for other types of emergencies. The development of civil defense policy and programs was assigned to the Secretary of Defense. Later these responsibilities were transferred to new civilian agencies, such as the Defense Civil Preparedness Agency, which staffed the civil defense positions of the Korean War era with retired military offices.

In 1970 when the Disaster Relief Act was passed, various emergency planning activities were merged into the Federal Emergency Management Agency (FEMA). FEMA was designed to coordinate the federal response and encourage state and local planning in shared governance of emergencies (May and Williams, 1986 as cited in Dynes, 1990). The command and control model, although it does not address shared governance well, was widely retained and remains the dominant model used in emergency planning and response today.

Historically in the US, a military approach to oil spill response was used, with the Secretary of the Army given the authority under and responsibility for administering the Oil Pollution Act of 1924.

Although the authors had little historical information available on the how international response systems evolved — which appear to be command and control type RMSs — some inferences can be drawn from the present systems. In many places throughout the world and particularly for the countries bordering the North Sea, military organizations are the primary agencies used by government to oversee the response to oil spills at sea (Archer and White, 1985). In a number of countries the preparation and implementation of spill response plans is the responsibility of the naval service within a Ministry of Defense. This is the case, for example, in both Belgium and France. In the former, the Navy has the responsibility for responding to oil spills in the Belgian zone of the North Sea and the Scheldt Estuary. In France the coastline is divided into three maritime regions, each of which is headed by a Maritime Prefect, a naval authority responsible to the Ministry of Defense. Singapore and South Africa also have used traditional command and control approaches for oil spill management (Garnett, pers. comm., 1994). It appears that the military model also has been applied, in a civilian context, for emergency planning and response operations to an undetermined extent internationally.

US MODEL FOR OIL SPILL RESPONSE

This section describes how the pre-OPA 90 response organization evolved in the US. The US evolved a unique system of oil spill response management because of historical and organizational influences. In the context of this paper, it is not feasible to discuss the historical evolution of RMS(s) used for oil spill response in other countries.

The primary influence over how oil spills are managed in the US has been government legislation and regulations, especially at the federal and state levels. The early government organization with a response role was the USCG, which was responsible for enforcing the Oil Pollution Act of 1924, that was aimed at reducing the occurrence of oil slicks. As described in the minutes of a 1964 conference, as recounted by Charter (1971), "this responsibility was concomitant with the duties related to the safety of vessels and waterfront structures. The Coast Guard operates through the Captain of the Port, a Coast Guard officer assigned to the area to supervise Coast Guard law enforcement, safety, search and rescue (SAR), and similar duties. In addition to reporting spills and citations of violations, the duty of the Captain of the Port includes evaluation and recommendation for proper action on the cleanup of oil spills."

The NCP is the single most influential document that addresses response organization. The first NCP was issued in September, 1968 following the *Torrey Canyon* as an interagency agreement. The next version of the NCP, published by the Council on Environmental Quality in 1970, was the first federal spill response regulation to be issued. The NCP has been revised numerous times since 1968 to incorporate the changes resulting from new laws, e.g., OPA 90, and amendments to existing laws.

The basis for the regulatory philosophy regarding oil spill management in the US comes from the founding documents in US history, i.e., the Declaration of Independence and the Constitution. In these documents, the philosophy underlying federal-state relationships is articulated. The constitutional framework for the division of powers between the federal and state governments has been summarized and its effect on oil spill regulations has been described (Wilkes, 1971).

With regard to oil spill response, the federal OSC's authority supersedes if there is a disagreement with a state, however US regulations provide for a strong state input to the decision making process (US EPA, 1994a). The following summarizes the unique aspects of federal-state relationships in the US:

> "The central paradox of American politics has always been, from the time of the Declaration and of the Constitution, the existence of ineradicable states within a indissoluble Union. The sovereignty of the people, from whom both the national and state governments derive their just powers, is the basis for the distinctively American form of Federalism. Neither is the central government the creature of the states nor do the states exist at the mercy of the central government, but both exercise those limited and delegate powers that are assigned them by the people" (Levy *et al.,* 1986).

This paradox is a distinguishing characteristic of the US National Response System (NRS) described in the NCP and used during oil spill response operations, and is one of the reasons that OPA 90 and the latest NCP call for a unified command form of RMS. Another reason the states have a substantial role in spill response is because at the time the first draft of the NCP was developed in 1970, the states were the principal government entities involved in on-site response. Therefore, it appeared reasonable to include them as specific components of the US national response system (Biglane, pers. comm., 1994).

The other major party in spill response is the RP. There is a history within the US of having the RP take an active role in response. In the Oil Pollution Act of 1924, violators were assessed a penalty of no more than $2,500, but it did not require specific response activities. In 1966, prior to the *Torrey Canyon* incident, it is interesting to note, Congress amended the 1924 Act to require that the spiller remove the oil from navigable waters. If the discharger failed to do so, the federal government then was authorized to take action and seek reimbursement for the clean up. Thus, the concept of environmental protection through direct action was clearly established (Biglane and Wyer, 1971). In fact, the RP was considered the entity with primary responsibility for oil removal, until the passage of OPA 90 and the issuance of the revised NCP tasked the RP and government to respond as partners.

The team aspect of the NRS reinforces the requirement for an RMS that provides for the participation of groups representing various entities. Since the first versions of the NCP, multiple federal agencies have provided representatives to the National Response Team (NRT), Regional Response Teams (RRT) and the Special Forces (now called Special Teams), that are active components of the NRS. The rationale behind their inclusion in the system is to provide appropriate response resources and capabilities during spill response operations. When the NRS was established, there were very few private resources available and the only substantial resources were from the various agencies. Therefore, it made sense to also include them in the NRS (Biglane, pers. comm., 1994).

As the NRS evolved, it relied upon the Coast Guard to be the nucleus of the federal spill response organization, as noted earlier. However, in 1968 the President assigned responsibility for response **planning** to the Department of the Interior (DOI). Coast Guard units were then directed to work with the Federal Water Pollution Control Administration in DOI, which became the Water Quality Office in the EPA, when EPA was

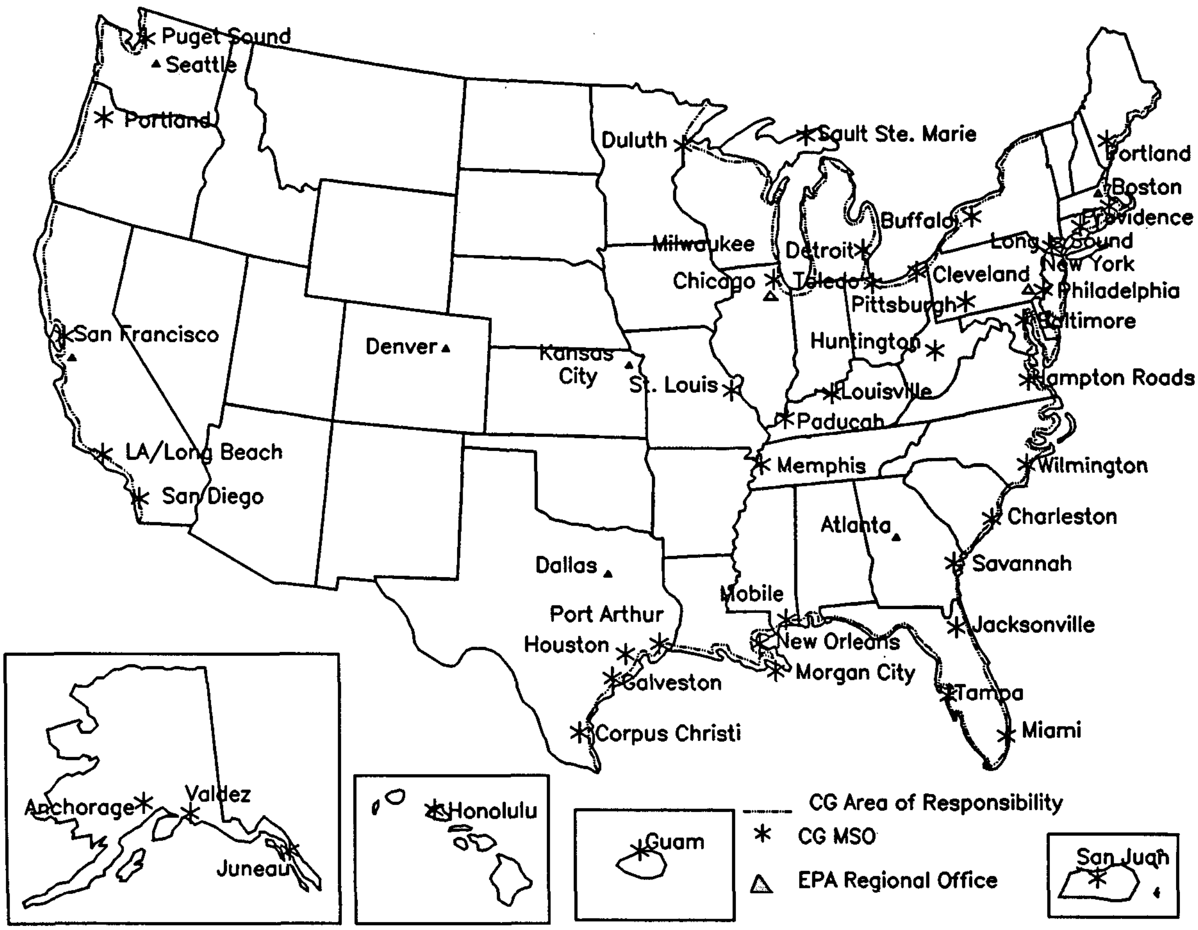


FIGURE 1. GEOGRAPHICAL BOUNDARIES OF EPA AND USCG

established in early 1970. The present agreement on planning and response responsibilities, i.e., the Coast Guard is responsible for planning and providing pre-designated On-Scene Coordinators in the coastal areas and EPA does the same for inland areas, is a result of meetings in early 1970.

The geographic boundaries of the two agencies, which have changed little in 24 years, are illustrated in Figure 1. This figure is enlightening. It clearly indicates that EPA has an immense domestic area in which to manage spills from primarily fixed facilities (by mutual agreement, the USCG retains OSC responsibility over spills from commercial vessels on inland waters), while the Coast Guard must manage spills resulting from the vessels, and facilities, which operate in the comparatively narrow coastal zone. These significant differences between the Coast Guard and EPA, coupled with their style differences, i.e., the hierarchical, military-based management structure of the Coast Guard in contrast to EPA's decentralized, regional approach, has significant implications for developing a single RMS for use during oil spills in the US. These implications will be explored in Section 4.4.

The differences inherent in USCG, EPA, state and RP organizational concepts quickly became evident during the *Exxon Valdez* response operation, leading to the creation of an *ad hoc* response organization (Harrald, *et al.* 1992). The resulting pre-OPA 90 response organization is perceived to have failed during the *Exxon Valdez*. This perceived break down of response management, which prevents most citizens from considering the *Exxon Valdez* a success even though tremendous resources were deployed, has precipitated considerable interest in how to manage spill responses effectively.

THE NATIONAL INTERAGENCY INCIDENT MANAGEMENT SYSTEM (NIIMS) INCIDENT COMMAND SYSTEM (ICS)

During the last several years, a type of RMS, known as the Incident Command System (ICS), has become the prominent model used in oil spill response. ICS is one subsystem of the National Interagency Incident Management System (NIIMS). The five sub-systems that make up the NIIMS are: ICS, Training, Qualifications and Certification, Publications Management, and Supporting Technologies (NIIMS, 1981). ICS is based upon a command and control model for emergency management.

This section describes the history of ICS as a model for emergency management and the NIIMS ICS, as it was originally designed. The traditional design of the Incident Command System (ICS) is derived from the command and control model. The NIIMS form of ICS has been modified in numerous different ways by various entities for oil spill response management. The ICS variants for oil spill response are discussed in Section 3.4.

ICS was developed as a result of major fires in Southern California in the early 1970s, when a need was identified for a system whereby different agencies could work towards a common goal in an effective and efficient manner. Problems which ICS was designed to remedy included different organizational structures, terminology, communications between agencies and during operations, poor joint planning and information gathering and dissemination, and inadequate prediction capability (Miller and Gallagher, 1993). The standardization of organization, terminology, procedures and communications resulted in the development of the NIIMS ICS.

The Operational System Descriptions (ICS-220) and the Field Operations Guide (ICS-420) (Incident Command System, 1983) establish the standard system, including management concepts, organizational design, guidelines for incremental increase of resources, description of both section functions and individual roles and responsibilities, and explanation of system components. These two documents provide a structured and detailed design that enhances the effectiveness of fire fighting operations in the forest and wildfire environment. The advantages of the system are clear — its use enables the organization, regardless of which entity has overall management responsibility, to quickly integrate management resources, all of whom have common training and skills and a consistent understanding of the procedures, into an effective, productive goal oriented team.

Over time, the fire fighting community began to understand that ICS was useful in a wide range of non-fire events to which public safety organizations respond. As it was applied more widely to responses to both natural disasters (hurricanes, tornadoes, floods, earthquakes), technological accidents (plane crashes, oil and hazardous material spills, transportation accidents, pest control programs, search and rescue) and planned events such as major athletic events and parades, the system became more generic, while purportedly retaining the fundamental concepts that made it valuable during fire fighting operations (Josephson, pers. comm., 1994; Gallimore, pers. comm., 1994). Current training programs emphasize that ICS is an "all hazards, all risk" type of RMS (Jensen, pers. comm., 1994).

The standard ICS components that work interactively to provide the basis for its concept of operation (Incident Command System, 1983) are:

1. Common terminology,
2. Modular organization,
3. Integrated communications,
4. Unified command structure,
5. Consolidated action plan,
6. Manageable span of control,
7. Pre-designated incident facilities, and
8. Comprehensive resource management.

Operating under the NIIMS ICS, once a decision is made to expand a fire fighting force, the leaders can rely on getting people who are trained, qualified and certified in the specific duties they are to assume, using a common terminology and a standard set of publications and training materials. They know, for example, that if someone asks for a "Type 2 Engine" over the radio, they are talking about a truck with a 500 gallons per minute pump, a 400 gallon water tank, 100 feet of 2 1/2" hose, 500 feet of 1 1/2" hose and 300 feet of 1" hose, a 20 foot extension ladder and 3 people.

An underlying principle is that the system must have the flexibility to adapt so that it can be used to manage the response to various types of situations. Major fires, such as those in Yellowstone National Park in 1989 and throughout the western United States in the summer of 1994, required augmentation of forces by a variety of federal and state agencies. In the case of military personnel assigned to assist, the managers quickly identified the training required and qualified fire bosses to conduct it, for example, so that the soldiers could be utilized effectively as quickly as possible. Private organizations are seldom, if ever, used in the NIIMS ICS.

The specific organizational structure established for any given event will be based on the management needs of the situation (Incident Command System, 1983). However, the principal functional areas of the standard ICS organizational structure for a single jurisdiction are displayed in Figure 2. As designed by NIIMS, ICS has the flexibility to adapt to multiple jurisdictions by the addition of a unified command structure at the highest decision making level, i.e., Incident Commander.

According to the NIIMS ICS, a unified command structure is called for when:

(1) The incident is totally contained within a single jurisdiction but more than one entity shares management responsibility, e.g., airplane crash.

(2) The incident crosses multiple geographic jurisdictions.

NIIMS offers an organizational structure to accommodate each of the above situations. Oil spills, however, generally involve both situations simultaneously. In a unified command structure, the individuals designated by their jurisdictions **jointly** determine objectives, strategy, and priorities. The determination of which entity serves as the operations chief must be made by mutual agreement. This can be done on the basis of existing statutory authority, greatest jurisdictional involvement in the response, mutual concurrence of the knowledge needed for the specific incident (Incident Com-

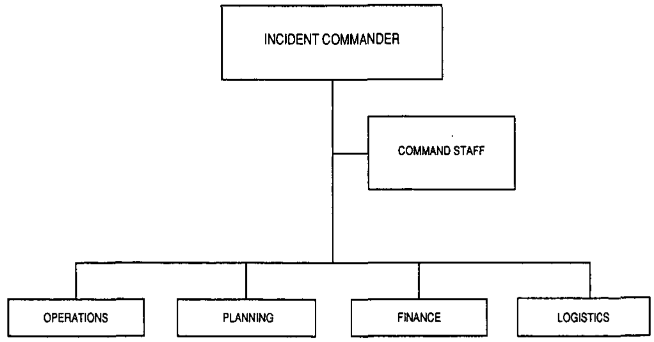


FIGURE 2. THE FIVE PRINCIPAL COMPONENTS OF THE INCIDENT COMMAND SYSTEM (ICS) (FROM: ROLAN AND CAMERON, 1991)

mand System, 1983). Unified command has taken on special meaning in the context of oil spill response. This will be discussed in Section 4.4.

One critical issue regarding ICS is what the term means when someone refers to "ICS." For those who originated it, "ICS" has a very specific meaning. It refers to the complete and detailed system defined in two documents, noted above. The NIIMS doctrine, including the ICS sub-system, is maintained by the National Wildfire Coordination Group, currently headed by a representative of the United States Forest Service. As a wide range of organizations with emergency management and response duties have adopted incident management systems based on the standard ICS, the principles of the system have been inconsistently embedded in the variant organizations. Many of these agencies call their systems "ICS," and state that they are using the standard ICS, when, in fact, they are using only parts of one of the five interrelated NIIMS subsystems. Those in the oil spill response community who are adopting ICS as the basis for their RMS tend to adopt the basic organizational structure, as depicted in Figure 2 (5 components of ICS), and the concepts of flexible expandability, including the Unified Command Structure for managing multiple jurisdictions.

For the remainder of this paper, the term ICS refers to the oil spill variants which consist of primarily five principal components of the ICS structure, including the Unified Command Structure. In this context, ICS is not a complete system but a conceptual building block on which numerous RMSs for managing response to significant oil spills are being developed by various government and industry organizations. The term NIIMS ICS refers to the formal system maintained by the National Wildfire Coordinating Group.

The previous discussion identified three organizational models which over time have been used to manage oil spills and other emergencies. Given the topic of this paper, "Implementing **an** Effective Response Management System," the authors needed to consider whether or not one model can be used to manage all spills, regardless of size and complexity. The next section considers the effect of the complexity of spill on RMS design and implementation.

2.5 THE RELATIONSHIP OF RMS AND SPILL SIGNIFICANCE

The complexity and magnitude of spill response activities, including spill management, will vary with the significance of the spill, which is a function of its size, type of oil, location, environmentally sensitive resources at risk, weather, timing, public and government concerns and expectations. Determining the appropriate RMS for a spill event involves considering:

- The relative significance of the spill;
- The legal and institutional requirements of the jurisdictions in the affected area;
- The economic characteristics and socio-cultural values of the affected area; and

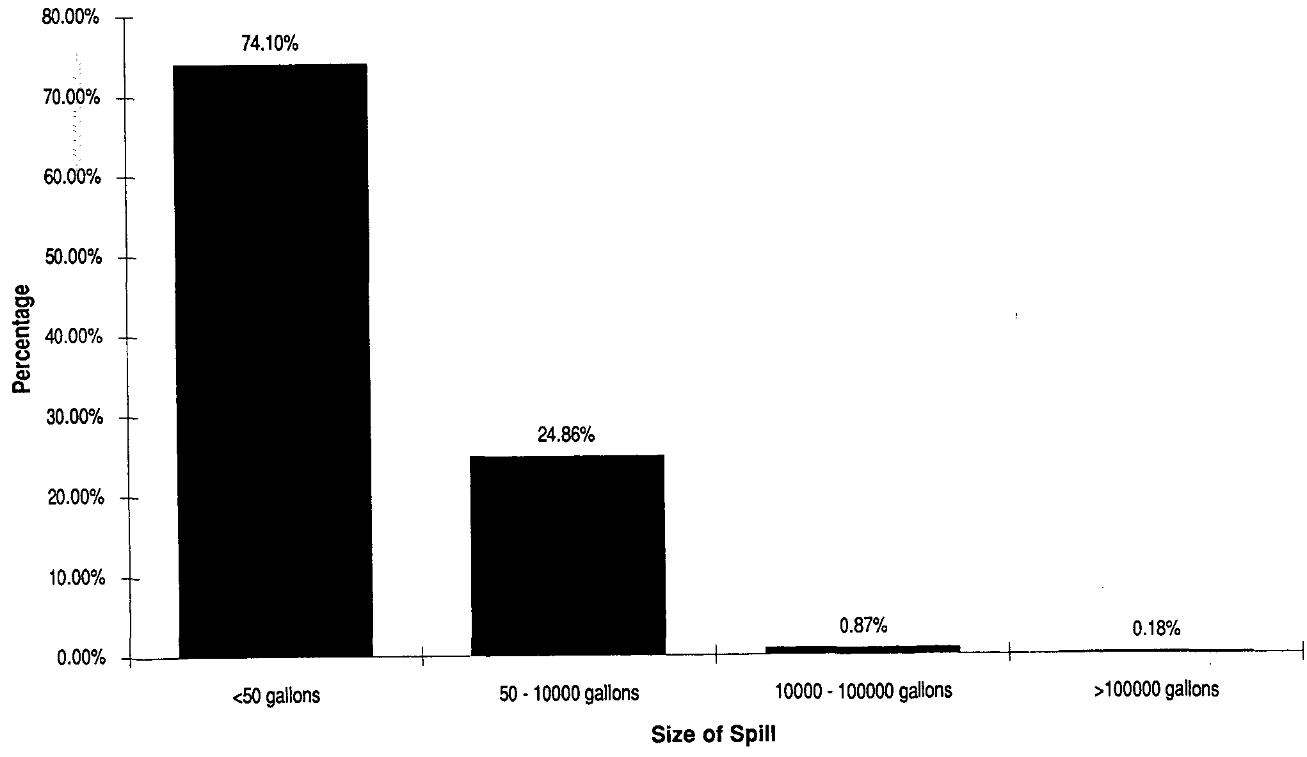


FIGURE 3. PERCENTAGE OF SPILLS BY AVERAGE SIZE (1974–1991) (FROM: USCG, 1993C)

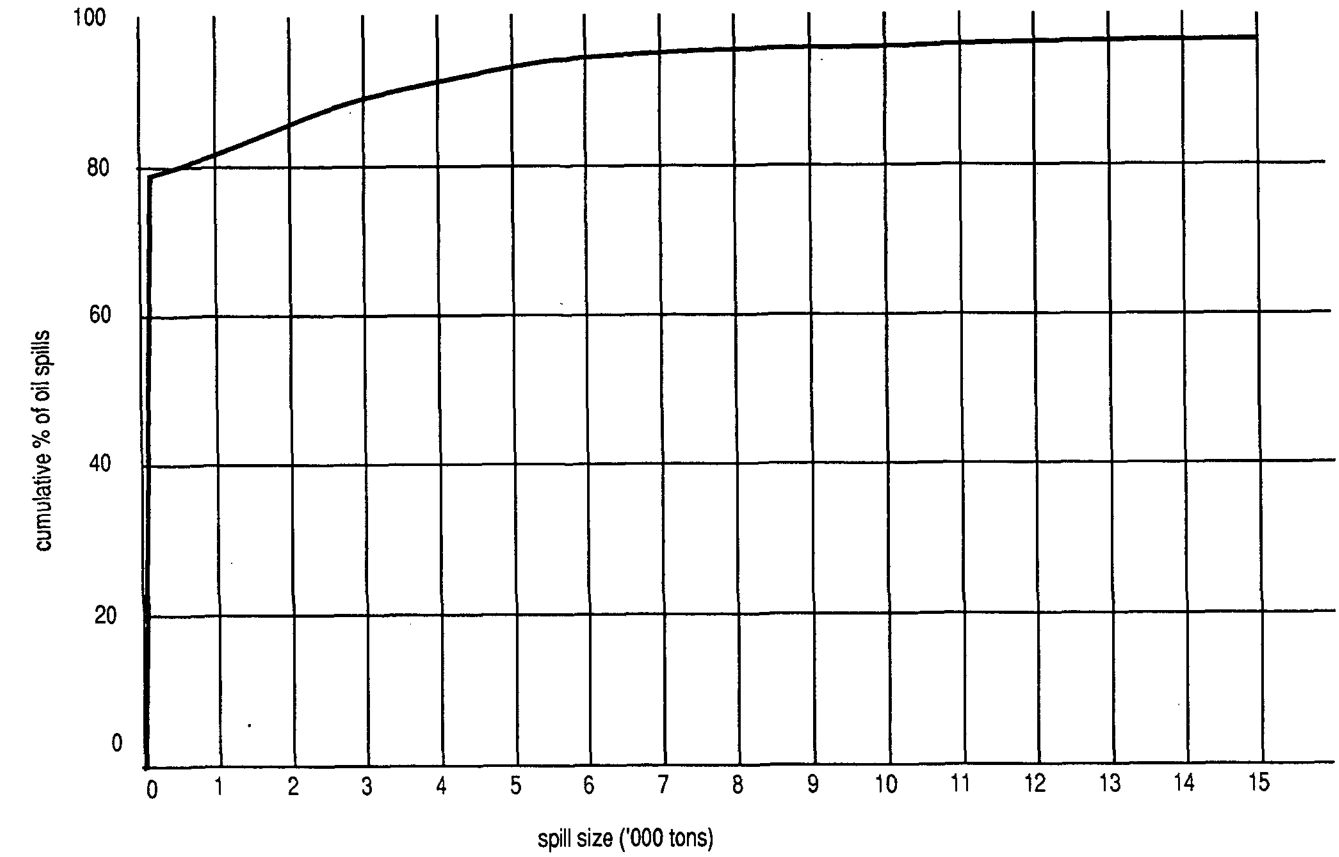


FIGURE 4. CUMULATIVE PERCENTAGE OF SPILLS VERSUS SPILL SIZE (FROM: IPIECA, 1991)

- The response resources and technology available.

Relative significance is discussed this section. Previewing available worldwide and US spill statistics provides a useful context for considering spill significance and whether:

- A single, basic RMS, designed to become larger or "ramp up" in significant and catastrophic spills, is appropriate for the majority of spills; or,
- The basic functional design of an RMS should vary with the significance of the spill.

Most oil spills are not of the magnitude or scope of the *Exxon Valdez,* which was a rare event, a catastrophic event and a spill of national significance. The only other US spill that approached the magnitude of the *Exxon Valdez* was the Ixtoc I blowout in the Gulf of Mexico in 1978. The 68 million gallon spill from the *Amoco Cadiz* off the coast of France in 1978 is another example of a catastrophic spill, as was the *Torrey Canyon* spill. However, these spills are an anomaly. During the period 1974 to 1991, nearly 99% of all spills in the US were less than 10,000 gallons, and over 75% were less than 50 gallons. In fact, in 1991, 81.4% were less than 25 gallons (USCG, 1993c). Figure 3 on page 27 graphically depicts the number of spills which occurred in the US from 1974–1991.

Figure 4 provides a similar view of spills which occurred worldwide (including the US) from 1974–1990 (IPIECA, 1991). During these years there were 774 spills involving the loss of more than 7 tons or approximately 2,058 gallons of oil.[1] Smaller spills are omitted from the IPIECA summary. Over 80% were less than 315,000 gallons (7,500 bbls) and over 95% were less than 3,150,000 gallons (75,000 bbls). Since spills of less than 7 tons were not included in calculation of the percentages, it is clear that only a very small percentage of spills could be considered catastrophic by any standard.

The principal cause of spills less than 7 tons is routine operations, i.e., loading and discharging, which accounted for 77% of the discharges. Loading and discharging accidents are still the prime cause (43.5%) of spills between 7–700 tons; however, collisions are also a significant cause (26.6%). For the major spills, those over 700 tons, grounding (50.6%) and collisions (40.6%) are the major causes; only 8.8% of the major accidental spills resulted from loading and discharge errors.

How can response organizations best prepare with limited resources (i.e. funds, equipment, personnel, manpower) to deal with catastrophic events, when most of the spills to which it responds are routine? Since most of the spills are routine, how can operators justify spending the majority of their preparedness efforts on catastrophic events? Since catastrophic large spills are rare, should there be a simple RMS for routine spills?

The determination of significance is a relative and qualitative process, depending on assessment of a combination of event-specific conditions, such as quantity and type of oil,

[1]While the conversion factor from tons to gallons varies based on the specific gravity of a given type of oil, one ton is assumed to equal 7.0 barrels or approximately 294 gallons.

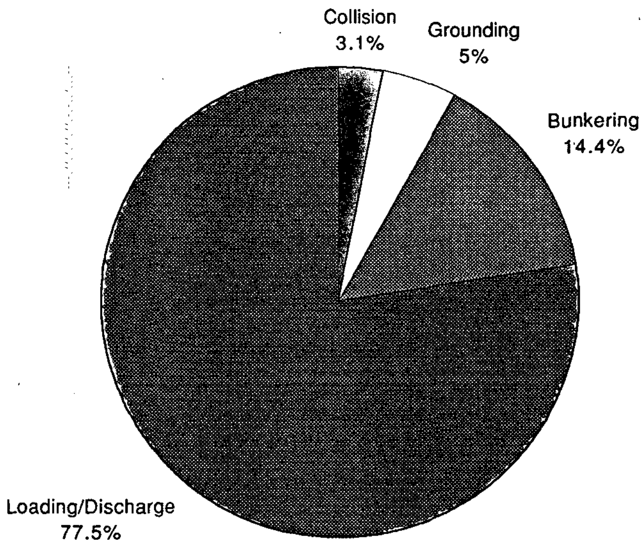


FIGURE 5. MAJOR CAUSES (SPILLS < 7 TONS) 1974–1990 (FROM IPIECA, 1991)

location in relation to sensitive resources, on-scene weather, available response resources, timing and public perception, among others. For example, a spill of 20,000 gallons of diesel fuel, which naturally dissipates more readily than crude or #6 oils, into a large, fast flowing river near highly urbanized areas may not be significant. The same type and quantity of oil

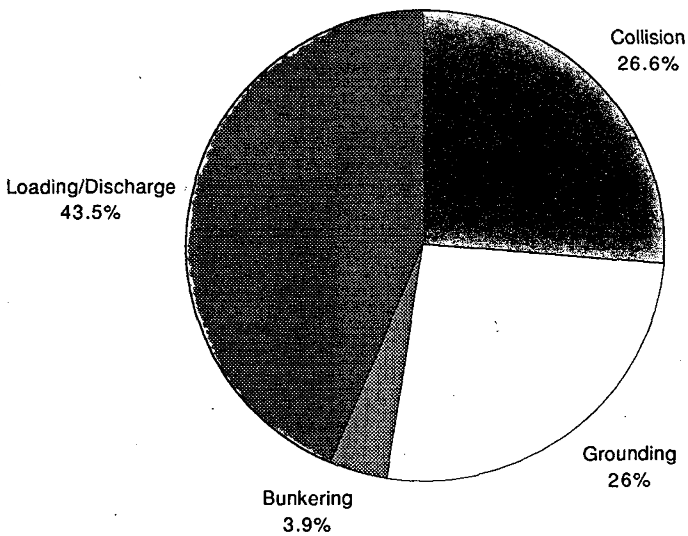


FIGURE 6. MAJOR CAUSES (SPILLS 7–700 TONS) 1974–1990 (FROM IPIECA, 1991)

released in shallow, calm, estuarine areas near seed oyster beds around spawning time could be a very significant event, because of the potential for adverse environmental effects and the requirement to take quick, effective action. The *American Trader* event is an example of the influence of weather — an external, uncontrollable variable — on a spill's significance. Although the vessel spilled just under 400,000 gallons of Alaska North Slope crude oil only 1.3 miles from the shore, prevailing winds held the oil offshore for almost 6 days, which allowed for mobilization of response resources and initiation of protective measures on the shore. Calm weather conditions at the same time facilitated a massive open water recovery (Card and Meehan, 1991). The spill was perceived as significant, because of the proximity of a large marine spill to high-amenity beach areas, a National Wildlife Refuge, sensitive wetlands, nesting and feeding grounds for coastal bird species and estuaries for mollusks, crustaceans and other marine biota (Card and Meehan, 1991). Yet helpful on-scene weather conditions, in combination with the availability of containment and recovery resources and aggressive action by both the USCG

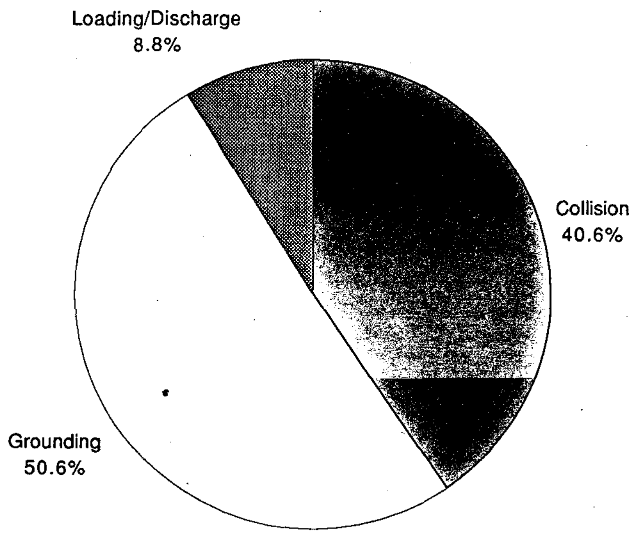


FIGURE 7. MAJOR CAUSES (SPILLS > 700 TONS) 1974–1990 (FROM IPIECA, 1991)

and the RP, dramatically reduced the effects of the spill from what they could have been had different conditions prevailed.

The issue of significance also involves perception. Some spills may be perceived as significant by elected officials, the media, the public and public interest groups, while being viewed as routine — not significant — by responders. Consider the real-world case of an 80 gallon crude oil discharge that occurred on a beautiful winter day in Norfolk, Virginia and created a tar-ball type of impact on a nearby residential beach. This event became significant only when a local newspaper photographer happened to take a picture of a seagull with a 3/4" diameter spot of oil on its chest, then publish it as a 6x8 inch photograph on page 2 of a local newspaper. To spill response professionals, this was not a significant event. But because it was a slow news day and residents were taking advantage of the lull in winter weather to enjoy a stroll on the beach, this minor event prompted heightened media attention and the application of rigorous clean up standards. Clearly significance is relative and subjective, and can vary within the value-based judgments of a wide range of different organizations and individuals.

Potential discharges can also be significant events. The grounding of a tanker or barge close to shore with millions of gallons of oil on board could be viewed as a significant event, and response resources mobilized based on the seriousness of the perceived threat. Whether the grounding occurs on a hard or soft bottom, whether the on-scene weather conditions are predicted to worsen, and whether the vessel has a history of marine safety violations all could contribute to the perceived significance of the threat.

Any event that is considered to be significant will have an effect on the ability of responders to succeed. Overwhelmingly, the results of responders' opinions indicated that highly significant events attract more attention from politicians, interest groups and the media, and this excessive attention will impact the ability of responders to succeed. Spill responders often are compelled to take actions to alleviate perceived concerns over the priority actions identified by response professionals. Opinions also indicated that the numbers of stakeholders involved increases with the perceived significance of the spill. These factors all contribute to the complexity of the spill response.

The simplest way to classify the significance of a spill is by volumetric size, yet using size as the only distinguishing factor is a gross over-simplification of the issue of spill significance. For purposes of this paper, however, it is helpful to use volume as a starting point for classifying the relative significance of oil spills which occur.

Table 5 relates three categories of spills (routine, significant, and catastrophic) to the classification schemes used in the US and IPIECA. These different classes of spills have direct implications for designing and implementing an RMS. Table 6 suggests general response management implications for different sizes of oil spills. This table has been developed on the basis of the experience of the authors to illustrate the relative magnitude of geographic scope, personnel and equipment resources that a RMS could be required to oversee.

ROUTINE SPILLS

Routine spills are typically small, frequently occurring operational spills that generate little outside attention, and although they require prompt action, can generally be effectively managed with local resources. As discussed earlier, approximately 99% of all spills that occur in the US can be categorized as "routine." Routine events would include small spills for which the RP is known, or small "mystery (marine) spills." Most of these spills occur at or near a company's facilities. These spills usually are managed by a small, integrated RMS. In the US for example, when the RP is known, the RP's intended action plan will be discussed over the phone or on-scene among the OSC, the RP, and frequently the state representative for the local area. The company would then provide resources to respond to the spill. In the US, most minor or IPIECA-defined Tier 1 spills, including visible sheens which must be reported, are handled in this way.

TABLE 5. COMPARISON OF EVENT CATEGORIES

SIGNIFICANCE	NCP Categories	IPIECA Tiers
Routine	**Minor** coastal<10,000 gals inland<1,000 gals	Tier 1
Significant	**Medium** coastal>10,000 gals inland>1,000 gals **Major** coastal>100,000 gals inland> 10,000 gals	Tier 2
Catastrophic	Spill of National Significance (SONS)	Tier 3

TABLE 6. OIL SPILL SIZE IMPLICATIONS FOR RESPONSE MANAGEMENT

SIZE	DURATION	NUMBER OF RESPONDERS	RESPONSE RESOURCES	AREA IMPACTED
Less than 1,000 gallons	Up to a few days	Less than 15	Facility/vessel resources plus local OSRO	Localized
1,000 – 10,000 gallons	Days – weeks	15 – 100	Local OSRO – OSRO network – national responder	10 – 30 miles
Greater than 10,000 gallons	Weeks – months	100 – 2,000	All	20 – 100 miles
Spill of National Significance	Months – years	More than 2,000 (Exxon – Valdez – peak 36,000)	All	Greater than 100 miles

SIGNIFICANT SPILLS

A **significant** spill is one which usually involves a discharge of medium or major spill volume, accompanied by the potential for substantial environmental and economic impact and a high level of outside interest, and which requires additional personnel and equipment to augment the resources readily available. IPIECA defines Tier 2 spills as a larger spill in the vicinity of a company's facilities where resources from another company, industry and possibly government response agencies would be called on for assistance. However, depending upon specific conditions, it is possible that a "volumetrically" minor discharge could become a significant spill in a particular area. These spills are of interest to the public, for any number of reasons, e.g., oiling of recreational facilities during a summer holiday period, impact on sensitive environmental areas, or imminent political elections. For the most part, these spills require intensive on scene activity for a period of time (on the order of weeks) by various levels of government, the RP, and response contractors. Widely recognized spills, such as the *American Trader* (which occurred in 1990 in California), *Rosebay* (1990, England), *Mega Borg* (1990, Texas), *Morris J. Berman* (1994, Puerto Rico) and *Shell Isomeria* (1994, Virginia), could be classed as **significant** under this definition.

CATASTROPHIC SPILLS

Catastrophic spills are those rare events which involve a release on the order of millions of gallons of oil into the marine environment in a location and under such conditions that economic, environmental, political, social and cultural impacts result. These major spills are of national, and can be of international, significance — hence the emergence of the term Spill of National Significance (SONS) in the US. A catastrophic spill would generally meet the IPIECA definition of a

Tier 3 spill — the large spills where substantial resources will be required and support from a national or international cooperative stockpile will be necessary. These spills could be either close to or remote from company facilities. The *Torrey Canyon, Amoco Cadiz,* Ixtoc I blowout and the *Exxon Valdez* events are examples of catastrophic spills. The *Braer* spill is an interesting example of a catastrophic release which, because of the type of oil released (light crude oil) and on-scene weather conditions (storm) resulted in a relatively localized impact.

The significance of the spill has important implications for spill management. The RMS for routine spills is likely to be simple, with a limited number of people addressing all the functions required, and working interactively to resolve the problem. For significant and catastrophic spills, the numbers of functions, people and equipment involved in response can be quite large, and require a RMS that is not only larger and more robust, but with the capability to effectively address a range of external influences which might not have been able to be considered in the planning and preparedness process.

To illustrate the dimensions of the management scope in relation to spill significance, it is useful to compare a small set of data from two actual spills, as displayed in Table 7. The *Rosebay* spill was similar to the *American Trader* in a number of ways, including the type and amount of oil discharged and the extent and type of shoreline contaminated. Yet the number of responders, duration of on-scene activity and clean up and clean up costs clearly indicates a difference in the management significance of the two events. Some responders suggest that the main difference between these two events, and the reason for the difference in significance, is their respective geographic locations, i.e., the *American Trader* occurred in the US and the *Rosebay* occurred in Great Britain), and the corresponding difference in regulatory perspective. The socio-economic influences on the design and implementation of RMSs is discussed in Section 3.3.

Although empirical proof is not possible, many response professionals would agree that the differences are due to qualitative factors such as the political and social and economic environment in the US. These factors contribute to a heightened significance, requiring more response managers, personnel and equipment to resolve the event. Not surprisingly, then, the cost of clean up corresponds to the significance of the spill. Interesting questions to consider are "Did the extra effort and cost in one event correspond to increased environmental benefit or a reduction in the adverse environmental impacts?" and "Could the RMSs have worked any more efficiently and effectively?"

A central observation is that RMSs which most effectively manage a response are those that can most readily adapt their size, complexity and functionality based on the significance of the event. The theoretical literature suggests that significant and catastrophic oil spills are not just big routine spills, but more complex organizational events. They are characterized by a high velocity environment in which information is often not available or is incorrect, and a higher volume of decisions must be made more quickly (Carley and Harrald, in press).

TABLE 7. COMPARISON OF THE *AMERICAN TRADER* AND *ROSEBAY* OIL SPILLS

Event Date Location	Oil type	Quantity Spilled	Estimated Number of Responders	Duration (on-scene)	Clean-up Costs
American Trader February 7, 1990 Southern California USA	Alaskan North Slope Crude	9,458 bbl	2,000	36 days	$47 million
Rosebay May 12, 1990 Southern England	Iranian heavy crude	7,700 bbl	200	30 days	$2 million

(Adapted from ITOPF Incident Summaries, and Rolan and Cameron, 1991)

Since this finding has been verified in several studies, the common wisdom that a system simply has to "ramp up" or add more people and functions to handle larger spills is misleading. It does not address how the RMS must adapt to meet not simply more, but fundamentally **different** requirements. How organizations react during crisis or disaster events has been extensively studied by researchers in the social sciences, to the point that predictions can be made on how and why organizations break down when managing events of this type. Successfully managing spills that take on the organizational characteristics of an emergency, crisis or disaster requires: (1) Understanding how the organizations typically weaken or break down so that an RMS can be designed to adapt or grow to address the predictable causes of the breakdown — this is a preparedness step; and (2) Early recognition of significant or catastrophic events (or potentially significant or catastrophic events) based not only on quantitative criteria, but on more qualitative, external factors — this is a response step.

Regardless of the classification or size of a spill, the theoretical literature provides insights into factors which are critical to a successful response, called Critical Success Factors (addressed in detail in Section 4). Researchers who have studied over 500 emergencies, crises and disasters, including oil spills, over the last 25 years predict the organizational implications of such events. As a result of these studies, an extensive body of knowledge is relevant to understanding how to implement an effective RMS for oil spills. Understanding two particular concepts is important background before proceeding further. First, many oil spills are socially defined as disasters and, second, emergent organizations are a sociological phenomena which are characteristic of disasters. The next two sections explain these concepts in greater detail.

2.6 OIL SPILLS AS DISASTERS

Oil spills are **emergencies;** they are **unforeseen situations that call for immediate action.** Regardless of whether one defines an oil spill as a crisis, a disaster, or simply a mess to be cleaned up, made into something more by the politics involved (Garnett, pers. comm., 1994), it is typically a situation that calls for doing something immediately.

As discussed earlier, routine spills usually are emergencies that require immediate action. Yet not all oil spills are crises and disasters. The theoretical literature dealing with crisis and disaster response defines an oil spill as a "disaster agent," the cause of the emergency, crisis or disaster. The **disaster** is a human relations and organizational event, one in which many people are trying to do very rapidly things they do not ordinarily do, in an unfamiliar and rapidly changing environment (Tierney, 1994). In this respect, oil spills, particularly the significant and catastrophic events, are potential disaster situations. The turbulence and complexity of the decision making environment, the fact that each spill is characterized by a unique set of circumstances, and the general unfamiliarity of the public with specific knowledge about oil spill effects can lead to a situation that is socially defined as a disaster. In addition to the effect on the community at large, the social effect on responding organizations is also significant. They *must process information and think, decide, and act quickly in* a situation that is characterized by multiple, stranger organizations, where the various responding organizations, who normally work independently of one another, must collaborate to varying degrees on making decisions and implementing them.

2.7 THE PHENOMENA OF EMERGING ORGANIZATIONS

The Disaster Research Center (DRC) at the University of Delaware has been observing organizational phenomena during more than 500 disaster responses since 1968. Dynes and Quarantelli of the DRC have developed a fundamental typology describing the evolution of organizations during crisis situations, such as during significant and catastrophic oil spill emergencies. Two dimensions, (1) the nature of the disaster tasks undertaken by organizations and (2) the organizational structure during the disaster period, are used to identify the type of organization that evolves during a disaster. The task continuum ranges from routine to non-routine. The organizational structure continuum extends from long-standing organizational entities to new or recently developed forms. The resulting four types of organizations (Established, Extending, Expanding, and Emergent) are shown in the four-fold typology of organizational involvement in emergencies and disasters in Figure 8 (Dynes and Quarantelli, 1968).

Police and fire departments and the USCG could be considered Type I organizations that routinely handle "emergency events." A small oil spill, for example, is a routine emergency task handled by the pre-designated OSC organization.

During a larger scale event, Type II, III and IV organizations all exist. Some organizations are required to extend their normal operations to encompass new tasks. Operational units of the USCG or of Naval forces in other countries that are not routinely involved in or trained for oil spill response may be pressed into action. Other organizations such as the American Red Cross Disaster Services routinely expand to meet the new, higher level demands by mobilizing trained personnel and assigning them to an expanded, but pre-determined organizational structure appropriate to the scale of the event. One of the attractive features of the standard ICS, is that it is designed to facilitate simple organizational expansion.

Emergent organizations, which are comprised of new people performing new tasks within unfamiliar organizational

Organizational Structure \ Tasks	Routine	Nonroutine
Same as Predisaster	Type I Established	Type III Extending
New	Type II Expanding	Type IV Emergent

FIGURE 8. ORGANIZATIONAL ADAPTIONS IN CRISIS SITUATIONS

structures, have appeared at all significant and catastrophic oil spills. Leadership and structure emerge in an *ad hoc* manner in response to the external demands of the disaster operation. Quarantelli is quick to point out that the phenomena of emergence "is not necessarily dysfunctional, bad, or inappropriate ... emergence represents an effort to solve problems." Examples of both functional and dysfunctional organizational emergence were evident during the *Exxon Valdez* spill response.

> "Coast Guard officials were taken by surprise by the urgency which local fishermen, who organized their own efforts to protect hatcheries in the path of the spill, attached to the protection of fishery resources."

> "... the active participation in the shoreline clean up of volunteer organizations, particularly during the winter when Exxon operations were suspended, proved problematic for the FOSC."

> "When other resource agencies took highly proprietary interests and aggressive postures in the name of protecting resources under their jurisdictions, the FOSC frequently found himself faced with difficult to meet demands which required political rather than science based solutions" (US DOT, 1993, p. 561).

Dynes and Quarantelli (1976) extended their analysis of crisis organizations beyond the organizational structure and tasks dimension to include a third dimension, i.e., mechanisms of organizational coordination, as a distinguishing characteristic among organizations during crises. They state:

> "Coordination was seen as the degree to which there is adequate linkage among the organizational parts. It was suggested that organizations tend to coordinate either by plan or by feedback. Crisis situations produce conditions of greater uncertainty, greater diversity, decreased formalization and decreased centralization. Increased complexity of organizations and the non-routine nature of crisis tasks move all organizations toward coordination by feedback ... factors present in crisis situations tend to move all organizations in the direction of coordination by feedback. Such movement runs counter to the usual normative prescription which orients most emergency planning to emphasize coordination by plan. A more effective direction might be

to plan to facilitate coordination by feedback in organizations in crisis."

"Looking more specifically at the consequences of change in organizational structure and their implications for patterns of communication, all of the changes during the emergency period would seem to increase the rate of task communication and the proportion of horizontal task communication. The acceptance of new tasks or new structure would increase organizational complexity and decrease the degree of formalization and centralization. Thus these changes which increase the rate and direction of communication which, in turn would facilitate coordination by feedback."

"It is not by chance that Type IV [Emergent organizations] in the previous typology is illustrated by a group whose function was purely one of coordination. These factors also suggest the difficulty of Type I [Established organizations] in maintaining their pre-disaster coordination structure, since it is usually one of coordination by plan. Coordination by plan characterizes many of the traditional emergency organizations, such as police and fire departments. These conditions also explain why such organizations have great difficulty in utilizing volunteers.... Rather than increase their capabilities to meet the increased demands, such organizations tend to accept only those demands which are within their present capabilities.... When most of the organizations in emergency operations are moving toward coordination by feedback, established organizations are, in many ways, 'out of step.' There is a discontinuity between their attempt to maintain internal coordination by plan when the conditions relating to the emergency period are such as to move most other organizations further toward coordination by feedback."

Emergent organizations are made necessary by: (1) the perception that problems crucial to certain groups or individuals are unresolved, and (2) the heightened necessity for organizational coordination during crisis. Quarantelli concludes that prior planning can preclude dysfunctional or unnecessary emergence. If the response management organization is sensitive to external concerns and responses, they will recognize the presence of emergent groups early, and can incorporate them into the process. There will be no need for groups to emerge spontaneously and informally. Since plans can not, and should not try to, anticipate all problems, some emergence will always occur. Therefore, **the response organization must be flexible enough to manage by feedback** and to allow, perhaps even encourage, the emergence of problem solving *ad hoc* organizational elements. It should be anticipated and managed by the RMS. However, if the core activities of the response are perceived as unresponsive and failing to resolve the concerns of stakeholders, as they were after the *Exxon Valdez* oil spill and Hurricane Andrew, the phenomena of emergence can significantly hinder or disrupt a response.

SECTION 3.0

SYSTEM VIEW OF RESPONSE MANAGEMENT

One of the aims of this paper is to provide both a description of existing systems and an evaluation of what makes an effective RMSs for oil spills. To evaluate RMSs, a framework and qualitative measures for evaluation must be constructed. The authors do so in the next two sections by extracting information that is relevant to the design (Section 3) and evaluation (Section 4) of RMSs from the extensive body of literature on organization theory. This section discusses a systems view of response organizations; it also identifies and compares two fundamental types of organizations, those that are closed and those that are open. Given the need to consider in oil spills an RMS which provides for inter-connections among multiple responding organizations, the systems theory offers a holistic foundation for viewing the organizational environment in which oil spill response is conducted. Section 4 develops measures for evaluating RMSs and applies these measures to existing and evolving RMSs.

3.1 A SYSTEMS VIEW OF RESPONSE MANAGEMENT

Two views of organizations as systems provide useful perspectives for analysis of the pollution RMSs. Schoderbek *et al.* (1985) view organizations as purposeful systems that can be modeled in terms of goals, inputs, processes, outputs, and feedback. A view of the organization as a system of inter-relations is furnished by Rockhard (1981) and Morton (1991). They describe an organization in terms of its strategy, technology, structure, people, and management processes and the interactions between these five elements.

THE ORGANIZATION AS A PURPOSEFUL SYSTEM

Schoderbek *et al.* (1985) define an organization as a set of related parts, working together to achieve some goal or objective. Six characteristics of systems in general, and organizational systems in particular, may be inferred from this definition:

1. Systems are purposeful.
2. Systems are differentiated; the parts of a system can be identified.
3. Systems are synergistic; the whole is greater than the sum of the parts.
4. Systems are holistic; they can not be understood in terms of their component parts.
5. Systems are hierarchical; subsystems exist within systems.
6. System are regulated by both external factors — the environment — and internal factors — feedback.

Schoderbek's definition implies that the successful response system must be goal directed; a clear, shared, and accepted concept of success must exist. Similar goals, such as the US national response priorities discussed in Section 2, and objectives must be agreed upon at a minimum. A second implication of their system view of the organization is that control of the system requires comparison of some system characteristics against standards or expectations. Feedback loops, in which collection and transmission of information are central, are required in order to control the system.

In general, large, complex organizational systems are difficult to comprehend or to manage as a whole. Often, it is advantageous to decouple subsystems in order to minimize the essential interactions and increase the responsiveness of the system. Tight coupling refers to systems where there are invariant sequences (short time sequences, irreversible sequences of actions), limited flexibility in methods of achieving the goal, and limited ability to substitute equipment, supplies and personnel. Loose coupling refers to systems where delay is possible, the order of sequence can be changed, alternative methods of achieving the goal are available, system buffers and redundancies exist, and unplanned emergency substitutions are available (Perrow, 1994).

Large tightly coupled systems can exhibit physical problems associated with resource movement coordination, as well as problems of communication. Large systems may also run down or decay (the process of entropy, or the tendency toward disorder). Tight coupling can magnify the impact of system failures (Perrow, 1984). Decoupling tightly coupled systems, which reduces the need for communication and allows subsystems to communicate with each other on an exception basis, has a number of benefits but also some costs. For instance, there are costs associated with maintaining decoupling mechanisms (i.e., buffers such as stockpiled removal equipment, booms, and dispersant; redundancies such as pre spill contracts with multiple suppliers); further, each subsystem may operate in a manner not optimal for the organization as a whole (suboptimization).

Inferences for oil spill RMSs of the traditional systems view of organizations include:

1. Organizational goals must be clearly stated and universally accepted if the organization is to be a purposeful system.
2. Performance measures must be developed that will

enable a response organization to evaluate its performance and will enable it to adjust its processes (strategy, tactics, and procedures).
3. Feedback loops that will provide critical control information must be established prior to an event.
4. Distributed decision making will reduce the need for communication, increase the responsiveness of the system, and will reduce the potential for system failure.

THE ORGANIZATION AS A SYSTEM OF INTER-RELATIONSHIPS

Another theoretical view of organizational behavior is relevant to oil spills RMSs. Morton's (1991) model of the organization as a system was used as the basis for his MIT study of the Corporation of the 1990s. Morton defines the organization as a system of five interacting components and two categories of external influences as shown in Figure 9.

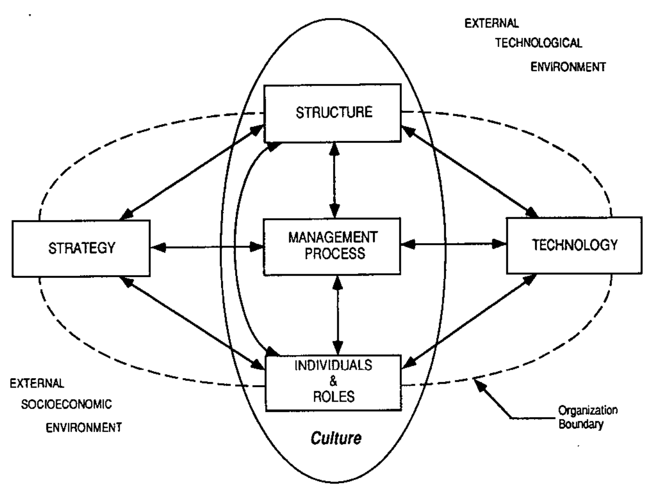


FIGURE 9. THE ORGANIZATION AS A SET OF RELATIONSHIPS IN EQUILIBRIUM (FROM: MORTON, 1991)

The three central elements of the system — structure, management processes and individuals and roles — describe the inter-relationships of people in the organization. Taken together, these elements describe the organizational culture of the system: norms, values, beliefs, and behavior patterns that characterize relationships inside and between groups.

1. Organizational **structure** is the basis of putting the organization together; it defines the formal patterns of authority and responsibility. As pointed out by Senge (1990), structure means the basic inter-relationships that control behavior; structure should not be confused with organization diagrams.
2. **Management processes** are the functions of the organization (planning, control, and management of information) and the decision processes used by the organization.
3. Taken collectively **individuals and roles** is the element that defines the human resources for the system: the development of individual skills and knowledge and the assignment of job tasks and responsibilities.

The two non-cultural components of the organizational system, i.e., technology and strategy, describe what the organization is attempting to do and the financial and technical resources that are available to the organization.

4. **Technology** component consists of the tools and techniques available for the achievement of organizational goals
5. **Strategy** component is composed of the shared knowledge and assumptions about organization, goals, objectives, milestones, budgets, and plans.

An important element of the Morton model is the description of the two external influences, shown as existing outside the "organizational boundary" on the diagram in Figure 9, on an organizational system. Understanding the impacts of these two influences on oil spill response operations is a key element in developing effective RMSs.

1. The external **technological** environment describes the state of the technology relevant or available to the organizations to accomplish its tasks — what is the technological capability of the organization — and the availability of the technology to the organization.
2. The external **socioeconomic** environment consists of the social, cultural, economic, and legal framework in which the organization must operate.

External technological and socioeconomic factors must be considered differently during the pre- and post-event phases of a response. The planning process can establish who needs to interact with whom, by what means and for what reasons, and can establish a set of agreed upon expectations. In a response to an emergency situation, whether a natural disaster or significant spill, event-specific considerations tend to supersede the more general assumptions as the situation unfolds and details emerge (Harrald *et al.*, 1992; Card and Meehan, 1991; and Rolan and Cameron, 1991).

Morton suggests that external technological and socioeconomic factors, including political, economic and sociocultural factors, impact all organizations. He contends that the organizations which can most readily accommodate the influence of these factors are more likely to attain organizational goals. The next two sections look at these factors in the context of spill response operations.

3.2. THE INFLUENCE OF TECHNOLOGY

Technological limitations affect an organization's ability to respond adequately under various spill, e.g., weather, conditions. Most importantly, as mentioned in Section 2.1, existing oil spill technology has operational limitations that significantly limit the ability of response organizations to contain and recover the majority of spilled oil, except under the most helpful of circumstances. Wind and wave conditions also restrict the effectiveness of existing technology. For example, offshore recovery rates and the opportunity for the use of dispersants or *in situ* burning diminishes with high wind and wave conditions. A second consideration is whether the resources necessary to respond are available. Resources required to respond to a particular scenario are typically identified during a contingency planning process, then contracted for or pre-staged. If the resources are not available due to other response commitments, maintenance difficulties or inadequate staffing, then the RMS may have to significantly increase its logistical capability to develop alternate sources of support. Recognizing the implications of technological capabilities, OPA 90 has provided a mechanism to assure that adequate response resources are available in the US for significant spills.

A third consideration is the availability of infrastructure support, such as multi-modal transportation, communications, facilities, lodging/feeding, etc. If the infrastructure is not present, or can not be used, then the RMS must also consider different options to support the response. Prince William Sound is the most obvious example of a spill response effort constrained by the difficult logistical problems encountered.

These technological factors vary widely throughout the world. The availability of response technology is very different in the technological environments of non-industrialized countries or in the US, Europe, and Japan. This directly impacts response strategy: in non-industrialized countries, for example, the primary task may be to mobilize resources from outside the affected area, usually from outside the affected country, while initial response efforts in industrialized countries might be to deploy pre-sited resources and activate pre-planned response organizations.

3.3 The Influence of the Socio-Economic Environment

The other group of external factors that influence organizations are socio-economic. These factors vary among geographic areas and include politics, economics, and sociocultural aspects.

Political Factors

The political framework of laws, regulations, policies and international agreements is developed to direct or guide pre-event planning, training and operational response actions for specific geo-political units, e.g., national, regional, state and local jurisdictions. This framework generally applies to government agencies and commercial entities with specific responsibilities for prevention of and response to spills, as well as such matters as vessel inspection and financial responsibility. Included in each overall national structure are international treaties or conventions, such as MARPOL 73/78 and OPRC, and multi- and bi-lateral agreements, to which the country may be a signatory. Political sub-units within each country may also affect the political framework for spill response. Wilkes (1971) discusses the effects of jurisdictional overlap between federal and state regulations on spill response operations. One area of potential jurisdictional overlap at the federal level which should be considered is the relationship between the National Contingency Plan and the Federal Response Plan. This overlap could pose a significant jurisdictional dilemma in situations where the Federal Response Plan has clear purview, e.g., a community disaster resulting from a flood, which also causes an oil spill.

This framework of laws, regulations, conventions and agreements lays down the overall preparedness and response requirements for industry operating within the jurisdiction, and may include factors such as response planning, notification, emergency actions, resource identification and contracting, protection of the environment, development of an RMS and funding for response operations.

These laws and other binding agreements establish the statutory requirements that all parties must meet in responding to a spill. Each entity with operational, post-event responsibilities — such as government agencies or the RP — must logically have some form of RMS to oversee and supervise every response operation, regardless of how minor or routine. This system should create the maximum probability that the response manager can conduct an effective operation. The authors contend that the RMS must have the capability to adapt to outside pressures, such as emergent political interests, which will likely be present in a significant spill, but are not specifically addressed in law or regulation.

Political factors may exert a substantially different influence over the design into which an RMS evolves after a spill occurs. For example, a combination of factors, including the size and location of the spill, often causes government agencies at all levels, that may not have been included in the planning process, to become involved. What appears to occur is that, in spite of extensive planning, and often approval of plans by various levels of government, elected leaders and government agencies determine that the situation demands a higher and more influential level of oversight, and create new systems that supplant, if not the existence, at least the authority of the RMS. This is one type of emergency that frequently occurs in significant oil spills. Additionally, the individuals involved in the basic technical planning — who develop clear, mutual understanding of response organizations' capabilities, expectations and philosophies — are often replaced by senior officials, with greater political sensitivity but less technical understanding of the issues, once an event occurs. These changes, taken to defuse potential or perceived political issues, tend to remove or limit the personnel with the most knowledge and understanding of response operations in general and the RMS, in particular.

This was the case during the *Torrey Canyon* response in 1967, in which the OSC noted that there appeared to be "more cabinet ministers on scene than in London," and that it appeared that "the Prime Minister managed the spill response" (Garnett, pers. comm., 1994). This apparently characteristic elevation of management also occurred during the *Exxon Valdez* response, as evidenced by the recommendation by Secretary of Transportation Samuel Skinner to the White House Chief of Staff that the response be "federalized"; that a "troika" comprised of Alaska Governor Steve Cowper, VADM Clyde Robbins, USCG FOSC, and Mr. Otto Harrison, Exxon's Operations Manager above both the Steering and Operations Committees (Harrald *et al.*, 1992; US DOT, 1993) be established; and that the Department of Defense also assume substantial responsibility for operations (Smith, pers. comm., 1989; Smith, pers. comm., 1994). Even in those spill response operations characterized as "successful," such as the *American Trader,* the same elevation of guidance or control existed

(Card and Meehan, 1991; Rolan and Cameron, 1991). In the US, the proposed system for management of SONS appears to recognize this phenomena and establishes, in policy, an expanded RMS once a SONS is declared (US DOT, 1992; Jensen *et al.,* 1993). It is interesting to note that the same phenomena appears to occur during natural disasters, as indicated by the establishment of the Presidential Task Force, headed by Secretary of Transportation Andrew Card, during the response to Hurricane Andrew in Florida in August 1992 (Carley and Harrald, in press).

Adding to the complexity during the response is that political concerns unrelated to the spill itself or the response may influence decisions. Elected officials are sensitive to issues raised by constituents, and political issues can emerge which may run counter to stated government policy, particularly during election cycles. For example, Carley and Harrald (in press) suggest that during the response to Hurricane Andrew, concern about the 1992 presidential election, in which winning the electoral votes in Florida would be a key objective, may have influenced President Bush's decisions, particularly establishment of the Presidential Task Force, to enhance the Administration's image as responsive and committed.

ECONOMIC FACTORS

Another factor affecting RMS design and implementation is the impact of economic considerations and financial obligations on the management of the spill response. During pre-spill planning, companies appear to focus on requirements of the laws and regulations in those countries in which the company is operating. In the US, for example, this may include obtaining Certificates of Financial Responsibility; maintaining protection through membership in a P&I Club; entering into contracts or other agreements with Oil Spill Removal Organizations (OSRO) such as the Marine Spill Response Corporation (MSRC), National Response Corporation (NRC), spill response cooperatives or other contractors; training Qualified Individuals (QI) and Spill Management Teams (SMT); and conducting drills and exercises. Additionally, it can be reasonably assumed that each company recognizes the impact not only of the spill response operation, but also of the attendant business disruption (for example, closing a terminal or bulk storage facility during a response operation), on its overall activities and plans for, or at least considers, reestablishment of operations even during the response, if possible. For example, following the March 24, 1989 *Exxon Valdez* spill, the port of Valdez was reopened to limited tanker traffic under tight controls on the morning of March 28, 1989, and by 2:00 pm that afternoon to all traffic. The COTP indicated that in hindsight he should not have done so. He noted that he was already under pressure from the US Department of Energy, ARCO and other members of industry and believed that, if he had not opened the port, he would have been "forced by political pressures to do so ..." in light of the percentages of national oil moving through the port of Valdez (US DOT, 1993, pp. 23–24).

Once a spill occurs, however, a wide range of economic considerations among responders can impact the decision making processes in the RMS. Since each entity involved in the response potentially views the economic or financial concerns differently, the entire issue has the potential to become very complex. Differences in financial perspectives, which can be indicators of conflicting goals, tend to promote adversarial behavior and erode whatever trust exists among responders. When extreme differences or a lack of understanding of the different perspectives occur, there exists a potential for weakening the linkages among the decision making portions of the response organization.

It can be safely assumed that whoever is responsible for paying for clean up operations will probably try to control, if not minimize the costs, while conducting an effective response that complies with the intent of the law and direction of the appropriate government agency. Given that RPs operate on a profit-making basis, this outlook is certainly rational. What constitutes an effective and efficient response is a question that drives many decisions and has financial implications. The RP, in keeping with its fiduciary obligations to its stockholders, investors, and the P&I Club, representing the insurers of the RP, can be expected to press for realistic and reasonable decisions that focus on reducing the damage on the environment. In fact, ITOPF, the technical representative to the P&I Clubs, has developed criteria to assess the reasonableness of claims, where reasonableness generally means "that the measures taken or equipment used in response to an incident were, on the basis of a technical appraisal at the time the decision was taken, likely to have been successful in minimizing pollution damage" (ITOPF, 1994). Both the RP and the P&I Clubs can be expected to support aggressive commitment of all available resources during the emergency phase of an operation, but scaling back as time passes in proportion to operational requirements. Both the RP and the Clubs are likely to oppose inflated government agency staffs, such as personnel included in the response for training purposes, deployment of equipment in a standby status, use of government equipment when less expensive commercial equipment is adequate. P&I Clubs might be expected to also oppose actions taken primarily to satisfy public opinion or media criticism; RPs may or may not consider such actions reasonable.

Some of the responders' opinions believe that if the RP is performing adequately that publicly-owned response equipment is not necessary. Other responders indicated that activities should not be funded if they will be more environmentally damaging than the oil, ineffectual, or unrelated to response priorities. Activities specifically mentioned include research that does not directly contribute to the response and public relations "blitzes."

Government agencies do not share the same view of cost control as RPs and P&I Clubs because response costs are not funded out of agency budgets. In the US, a public fund, the Oil Spill Liability Trust Fund (OSLTF), is used to fund government response actions, including those spills when no RP has been identified. For spills where the RP is known, RPs will be presented with a bill for government response costs to reimburse the OSLTF. Where the RP must reimburse the government, or where the government costs are funded by non-taxpayer sources (such as the OSLTF), there is no apparent imperative for the government to consider the economics in the decision making process. At the time of the *Exxon Valdez* spill there was only $6.7 million in the USCG-administered Oil Pollution Fund, and the USCG would have had to receive special funding arrangements if it were to assume the lead financial role. This funding issues was a factor in the decision not to federalize the response, but to let Exxon, which had pledged from the early hours of the response to fund response operations, continue as the lead response entity (US DOT, 1993).

The difference in viewpoints on financial issues between government and the RP, and their insurers, and the effect the differences can have on effective management of a spill, has been formally recognized by a government/industry Quality Action Team in the New Orleans area. In a letter to the Commander of the Eighth Coast Guard District (Wells, 1994), the Quality Action Team makes recommendations to address issues of concern about the reasonableness and accuracy of bills for government removal costs that are presented to responsible parties following oil spills. The Quality Action Team recommended actions to ensure that response actions are reasonable and implementing the actions would "ensure a more effective overall spill response" (Wells, 1994).

A secondary cost to the government may be compensation for the social impact of the spill, such as claims by individuals who can not work because of the spill. These costs are typically not the responsibility or immediate concern of the response organization. In many cases, it would seem that these impacts can be mitigated to some extent by using the maximum number of local workers in the spill response. A larger consideration that may govern the design of the emerging RMS is the economic impact on the local industry and population in the area affected by the spill. The concerns of the fishing industry, both commercial and subsistence, in Alaska during the *Exxon Valdez* response operation, dictated inclusion of representative groups in the decision making process (US DOT, 1993; Walker and Field, 1991).

SOCIO-CULTURAL FACTORS

A third external set of factors that affects the design and implementation of an RMS are the sociological and cultural characteristics of an area. In the US, for example, socio-cultural differences between the North and the South, and the East and the West are well-recognized. These types of differences certainly also apply to other countries. The socio-cultural differences of various areas influence people both internal and external to response organizations. These factors can compel an RMS to adapt in order to adequately address socio-cultural concerns associated with a spill event, which can differ at the country, regional, and even community levels.

Research into disaster response indicates that when the social fabric of a community is disrupted, the community tends to turn to the responding organization for assistance in meeting basic needs. After Hurricane Andrew, for example, multi-denominational church groups formed a network of food and shelter providers, reaching significant numbers of victims that the government and American Red Cross could not (Carley and Harrald, in press). While the bulk of the research has addressed the ability of responders to provide for basic survival needs after natural disasters, there may be some of the same dynamics at work after an oil spill. After the *Exxon Valdez* spill, for example, the concerns of native Alaskans about the effects of the oil on subsistence fishing and other marine harvesting, the source of the majority of the protein in their diet, led to formation of the Alaska Oil Spill Health Task Force (Walker and Field, 1991). While this group, comprised of state, federal, commercial and local representatives was successful in initiating appropriate action, it indicates how indirect social impacts can cause an RMS to adapt to include emerging interests and groups. Other potential social impacts appear to be the effect of the shutdown of local businesses, even if temporary, with the resultant job loss; the impact of environmental damage on lifestyle, such as recreation; and the specific impact of the spill on ethnic or social groups. The social and cultural impacts of the *Exxon Valdez* spill were major factors in the State of Alaska's decision making process during the spill response and were the basis for many of the areas of conflict with the Federal OSC (Alaska DEC, 1993).

The socio-cultural environment includes other factors that, although less clearly defined, significantly impact response management. These include:

1. The organization, skills, resources, and objectives of other stakeholders such as environmental groups and citizen groups;
2. The society's expectations about the likelihood of an oil spill, the environmental impact of oil spills, and organizational performance of the oil spill response organization;
3. The willingness to spend public funds on spill response preparation; and
4. The ability of citizens to influence government actions during a crisis response through public, political, and media pressure.

3.4 ORGANIZATIONAL RELATIONSHIPS IN TRANSITION

A spill response is a dynamic organizational event. The effect of resource mobilization on the size of the response organization is shown in Figure 10. As the organization expands, it goes through three organizational stages: the emergency phase, the transition phase, and the production phase. During the emergency phase, the response organization consists of initial responders. The organization is required to absorb the mobilized external resources during the integration phase and reaches organizational stability during the production phase. Organizational changes must occur as the response progresses from a pre-event organization through the three response phases. The transition between these phases is, as represented in Figure 11, often marked by an initial regression in organizational output and effectiveness. This degradation in effectiveness is, as pointed out by Chew *et al.* (1991) a common, but not inevitable result of organizational change or transition. The avoidance of the drop in performance at critical points in the spill response is a primary objective of an RMS. Organizational performance and facilitating organizational change during these transitions is enhanced by understanding and balancing the inter-relationships in the organizational system between the **organizational culture** (structure, roles, and processes) and the **organizational strategy and technology** (Morton, 1991).

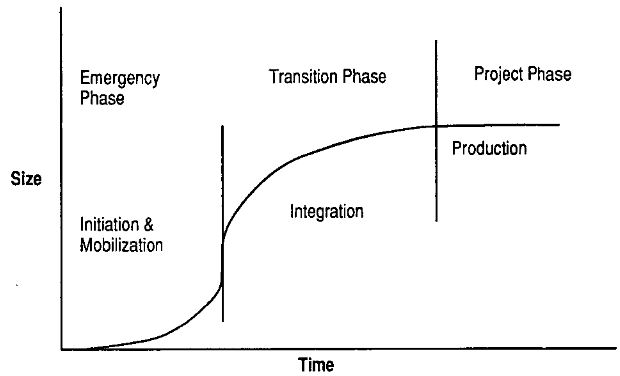


FIGURE 10. STAGES OF A SPILL RESPONSE

The emergency (mobilization and initial response) phase, is marked by the execution of tasks that are pre-defined by the contingency plan. The success or failure of the mobilization effort depends upon the adequacy of the plan and the ability of the various entities to immediately execute the plan. Mobilization is virtually impossible if organizational requirements and resources to be mobilized have not been identified in pre-spill planning. There is agreement between theorists and practitioners on this point. Some practitioners believe that RMS should be initiated with a small emergency group of two to four individuals who are cross-trained in functionality and will form the nucleus of the RMS as it builds over the transition phase (O'Brien, pers. comm., 1994). The theorists note that in the short run, small teams that form on the fly and are empowered to act on the basis of their experience and knowledge effectively deal with crisis (Carley and Harrald, in press). At the same time, inadequate mobilization or lack of resources can doom the response effort from the start. In the *Exxon Valdez* response, for example, the unavailability of Alyeska response equipment, upon which Exxon was relying, caused significant problems in the very early hours of the response. Additionally, the remote location of the spill delayed the arrival of equipment needed to contain the spill near the source during the emergency phase. Likewise, the Coast Guard did not have a well defined billet (staffing) structure until a month after the spill and did not have a smoothly operating personnel mobilization system until the end of the summer (US DOT, 1993).

The second stage of a crisis response, the transition phase, is the period required for the responding forces to arrive on scene and, using the emergency phase as the starting point, develop an effective operating system that can manage the response in the project or production phase. Tuckman (1965)

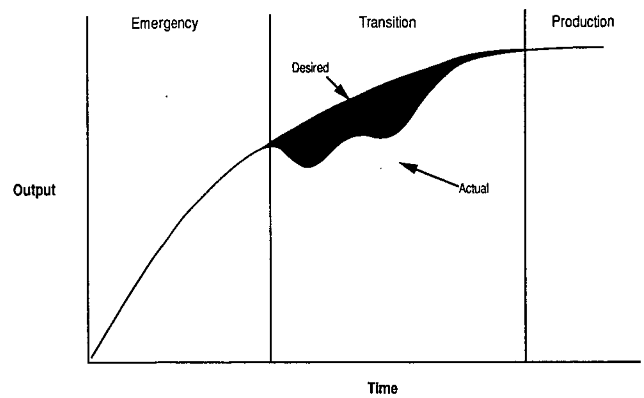


FIGURE 11. TRANSITION THROUGH THE STAGES

has pointed out that all groups go through the stages that may be categorized as orientation, internal problem solving, growth, and productivity and control. He termed these stages as "forming," "storming," "norming" and "performing." The RMS should focus on getting the entire response organization through the integration phase and into the production phase as quickly as possible, while effectively managing the ongoing operations. The ultimate, and unattainable, goal should be to reduce the duration of the transition phase to zero. In optimal situations, transitions can occur over a period of hours or days. For example, some responders are now planning for a one day emergency phase, a one day transition phase, and being in the production phase by the third day of a significant event.

Three factors can impede the transition to the production phase:

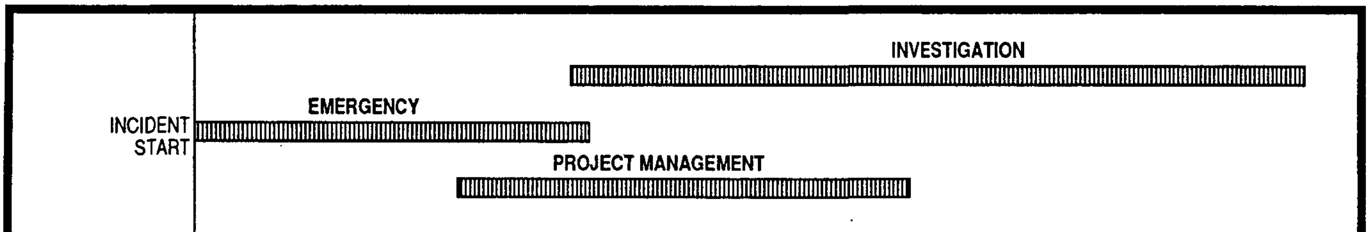
1. *task complexity* — the tasks facing the organization can not be centrally coordinated during the time frame available due to lack of resources or capability. The existence of unresolved problems may lead to the emergence of *ad hoc* organizational groups engaged in problem solving behavior (Dynes and Quarantelli, 1968). A maritime casualty may involve multiple and diverse tasks such as rescue, salvage, firefighting, and pollution response. A weakness of the US system is that the expertise for these tasks resides in different formal organizations and must be integrated during emergency conditions. The pollution response and casualty response systems must either be integrated or coordination channels established to enable managers to make resource trade-offs and avoid conflicts.
2. *organizational incompatibility* — the organizations that must operate as an integrated or unified entity in the response subsystem may be incompatible along one or more dimensions. They may be culturally incompatible, geographically incompatible (e.g., land based or maritime based) and/or functionally incompatible (conflicting functional responsibilities).
3. *political incompatibility* — organizations may not rely on the same processes or same criteria to make decisions. In the extreme case, decision authority may be withheld from the members assigned to the response

organization by the parent organization. A more typical example of this incompatibility would be a conflict between organizations used to centralized autocratic decision making and organizations accustomed to decentralized or group decision making processes. Spill response organizations, particularly those that integrate various levels of government jurisdiction and the RP, may have to accommodate very diverse organizations.

The difficulty of integrating multiple, stranger organizations into a single response organization to manage a significant or catastrophic spill response should not be underestimated. The cultural, organizational, and political capabilities and incompatibilities must be recognized and resolved prior to the event. As stated in the *Exxon Valdez* FOSC report:

> "The common theme of the organizational problems described above is the difficulty of developing, under the conditions of extreme emergency that mark a spill of national significance, an organization which is both politically attuned at the relevant government levels and operationally efficient for the task at hand" (US DOT, 1993).

The objective of the integration/transition phase is to achieve the organizational and functional stability of the production phase. The organization that emerges in the production phase, however, looks and acts quite differently from the organization that responded during the emergency phase. Ott *et al.* (1993) suggests a two phase organizational taxonomy during response with a post-response investigation phase. An emergency phase and a project (or production) phase differ significantly in their tasks, decision structure, and planning methodology as shown in Figure 12. Note that Ott *et al.* suggests that these two phases necessarily overlap for a period of time, creating the transition phase described above. In the emergency phase, decisive action is particularly time critical to making a difference in the outcome. During this period, principal activities include minimizing the spillage at the source and coordinating salvage and rescue operations. These emergency activities are most appropriately handled using an autocratic, or command and control type of organization. In the project management phase, however, response activities occur over a longer time frame and a formal process to plan for future requirements and to meet both anticipated and emergent demands is required. The easing of time pressures allows for a decision making process that accommodates multiple organizations and stakeholders.



	EMERGENCY hours/days	PROJECT MANAGEMENT weeks/months	INVESTIGATION months/years
ACTION DESCRIPTION	**Salvage** • Removal of vessel • Removal of cargo **Search and Rescue** • Safety of people • Stability of vessel • Damage control **Containment and Recovery** • At source • Project resources	**Cleanup** • Documentation • Field survey • QA/QC • Option selection • Action implementation **Conflict Resolution**	**Characterization of Environmental Impact** **Natural Resource (NRDA) Damage Assessment** **Restoration**
DECISION STRUCTURE	**AUTHORITATIVE** **Focused**	**DEMOCRATIC** **Consensus-building**	**METHODICAL**
PLANNING METHODOLOGY	**Operations Plan**	**Coordination Process and Goal Identification Plan**	**Scientific Plan**

FIGURE 12. OVERVIEW OF THE OVERLAPPING PHASES OF A SIGNIFICANT OIL SPILL INCIDENT (ADAPTED FROM OTT ET AL., 1993)

3.5 TYPES OF RESPONSE MANAGEMENT SYSTEMS

During spill response multiple, separate organizations must collaborate to achieve response goals, event-specific objectives and operational objectives, and implement action plans. The need for an effective RMS to bring these organizations together is obvious. Review of the systems used to manage spill responses seems to suggest that, while there are many variations, there are two types of organizations: closed systems and open systems. These types of RMSs represent two opposite ends of the spectrum of how organizations can operate with regard to their external environment. Organizations typically fall somewhere on a continuum between being totally closed and totally open. The following section describes systems that are **relatively** closed as **closed,** and systems that are **relatively** open as **open.**

CLOSED SYSTEM

Strictly speaking, a closed system is one that does not interact with its technological, political, economic, or sociocultural environments. Such an organization operates within the organization boundary, as depicted in the Morton diagram (Figure 9). There is a little impetus to consider or address external influences. All feedback systems are internal to the system. The traditional "command and control" or military model is an example of this type of system; it was originally designed to operate in a closed manner.

The characteristics below generally apply to closed, command and control-type, systems:

1. Hierarchical structure with clear lines of command and supervision;
2. Centralized direction is provided by a single person who is in command or in charge;
3. The overall structure is developed in the planning stages with little provision made for adaptation to emergent groups;
4. Communications are normally conducted through formalized channels;
5. Activities are directed by official (internal) entities with little requirement for outside assistance; and
6. Separate crisis organization, staffed by individuals from separate organizations, is formed to manage the response.

The traditional NIIMS ICS was designed as a closed, command and control system, and it operates effectively in emergency situations where groups of fire fighters are integrated within a single organization and have little interaction with non-fire fighting groups. Generally, their activities are separate and relatively insulated from the political, economic or socio-cultural elements of the environment; and they focus on the same goal, the fire. This is partly because most of their response activities are concentrated in the emergency phase, as depicted in Figure 12 (Ott *et al.,* 1993), where an autocratic or command and control form of management is most appropriate and effective.

The "command and control" type system appears to be a common model for normal, day to day (steady state) operations and crisis management, used by both private and public organizations. It appears that closed systems frequently are used by steady state organizations and then applied to emergency situations. The researchers have documented numerous occasions when closed systems have been ineffective in the overall management of disasters and other emergencies, i.e., Chernobyl, Hurricane Hugo, Hurricane Andrew, *Exxon Valdez.*

Given the reality that multiple organizations must work collaboratively during all phases of response and accommodate emergent groups, however, the closed form of management system does not appear to meet the fundamental organizational needs for most significant oil spills. What is needed is an RMS that allows for multiple organizations, using Spitzer's terminology from Section 1.2, to integrate, or at least unify. A closed system, one perhaps which is command and control based, however, may be a very appropriate organizational model for individual organizations involved in a response, who will execute the decisions made at the command level. For example, the internal organizations of an RP, clean up contractor, or OSRO might function most effectively using a closed type of organizational system. The system that brings together the various entities, who have some shared and different goals, cultures, and responsibilities requires the more open organizational characteristics.

The use of command and control systems in disaster response operations has been strongly criticized by some leading disaster researchers. In particular, many of these researchers see the broad acceptance and application of ICS variants as a significant concern. Careful analysis of the literature, however, suggests that this type of system can be appropriate for managing routine oil spill response operations, and executing decisions made during to significant and catastrophic spills. The single point for decision making, such as the Incident Commander in ICS, does not appear to be appropriate for overall management of significant spills.

1. The organizational cultures of responding organizations are relatively homogeneous.
2. The skills and knowledge of people match tasks and responsibilities required by the jobs to which they are assigned.
3. The goals and objectives of participating organizations and individuals are congruent.

Therefore, the success of command and control models in a significant oil spill situation is problematic, both at the command (decision making) and functional (decision implementation) levels.

Dynes' research indicates that these assumptions inherent in command and control models have been absent in over 50 technological and natural disaster response operations. It is instructive to note that these three assumptions are very similar to the factors, i.e., decentralized decision making and flexibility, that Roberts (1989) independently identifies as necessary for a high reliability or high performance organization, i.e., a human system that performs at levels of excellence far beyond those of comparable systems. It is important to understand that high reliability does not mean perfectly functioning. It means that a system avoids fatal errors and catches small problems before they become major ones. Spill management systems can and should become high reliability systems.

Dynes also points to two assumptions concerning the external environment, identified by Morton (1991), which are typically not true in any disaster event, or a significant oil spill, but are central to ICS success:

1. Adequate resources and technology are available.
2. The response can be shielded from external socio-economic forces.

A discussion about adequate resources is beyond the scope of this paper, although the issue is touched upon in Section 2.1. Because the effects of oil spills are so visible and the public tends to react to oil spills in emotional ways, spill response can seldom be shielded from external forces. The next section describes a type of system which is relatively more capable of dealing with forces external to the organization than closed systems.

OPEN SYSTEMS

The second type of organizational system is the open or "problem solving" system (Tierney, 1994 Notes — Red Cross IRM). An open system, strictly speaking, is one in which feedback from external environments is the critical determinant of system behavior, and ultimately, system success. Such a system relies on internal and external feedback, organizational learning from the reactions of the external environments to its decisions, distributed decision making by small *ad hoc* teams and a high degree of flexibility and innovation.

The characteristics noted below generally apply to open, or problem solving systems.

1. Decision making authority is distributed to the lowest possible level;
2. Response organizations are flexible and particularly sensitive to outside influences;
3. Response organizations are capable of improvising based on the results of feedback and analysis of the success of prior actions;
4. Organization relies on informal functionally-based decision making groups, which include both internal and external member, which form as necessary to address specific problems, then disband;
5. Complete details of the structure and process are not pre-event planned; the organization relies on the ability of the organization to learn and develop new appropriate ways to deal with problems; and
6. Response builds on existing organizations.

No discrete example of an open system was identified during the preparation of this paper, probably because of the above characteristics, i.e., open systems are dynamic and evolve during emergencies. However, the response to the *American Trader* oil spill is an example of an open form of ICS which evolved over time. Figure 13 displays the crisis management command staff developed by BP America (BPA) prior to the spill. The BPA organization is an ICS variant. During the oil spill, the basic organization was modified and expanded as displayed in Figure 14 (expansion of the operations section) and Figure 15 (expansion for the planning, logistics, and finance sections). This evolution of the organization during the incident represents organizational learning, one of the characteristics of open systems. This learning continued after the spill, as evidenced by comparing the environmental section in Figure 15 with Figure 16, because BPA saw that the structure needed to provide for expanded functions in the environmental area (Rolan and Cameron, 1991). The openness of the RMS used during the *American Trader* is displayed in Figure 17, which represents the response organization for this incident as presented by the OSC (Card and Meehan, 1991). The command and control and liaison/advisory lines indicate a noticeable degree of integration among the responding entities. The OSC stated in his paper that, "Overall intergovernmental coordination and cooperation … was exceptional … this aspect of the response may be considered its hallmark. The Federal OSC's decision to include all concerned federal, state, and local agencies in the daily planning sessions with British Petroleum helped achieve this solidarity."

The high performing or high reliability organizations described by Vaill and Roberts provide insight on models for organizational design and development for spill situations, particularly significant or catastrophic events High performing systems are those that perform at levels of excellence far beyond those of comparable systems (Vaill, 1982). High-reliability organizations are defined as large scale organizations with complex technical, human, organizational and cultural components which necessitate the development and proliferation of high degrees of organizational reliability and safety (Roberts, 1994). Review of the literature seems to indicate that the Vaill model, with its emphasis on integrated action, innovation and creativity, communication and decision making by *ad hoc* groups and

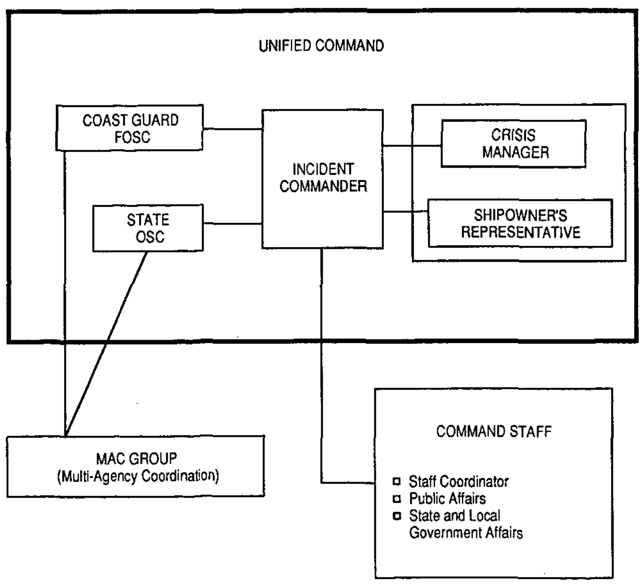


FIGURE 13. MODIFIED VERSION OF THE ICS COMMAND STAFF IN EFFECT PRIOR TO THE *AMERICAN TRADER* SPILL (FROM: ROLAN AND CAMERON, 1991)

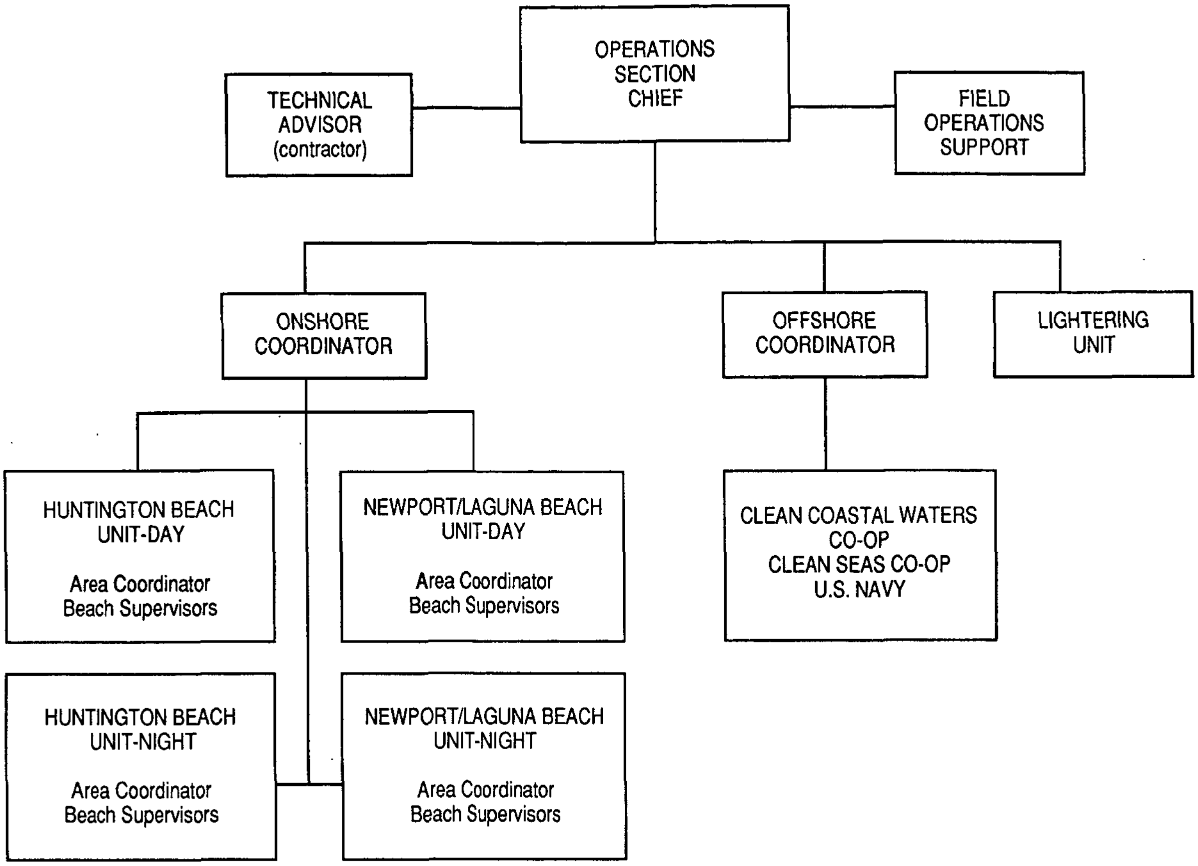


FIGURE 14. STRUCTURE OF THE OPERATIONS SECTION AS EXPANDED FOR THE *AMERICAN TRADER* SPILL RESPONSE (FROM: ROLAN AND CAMERON, 1991)

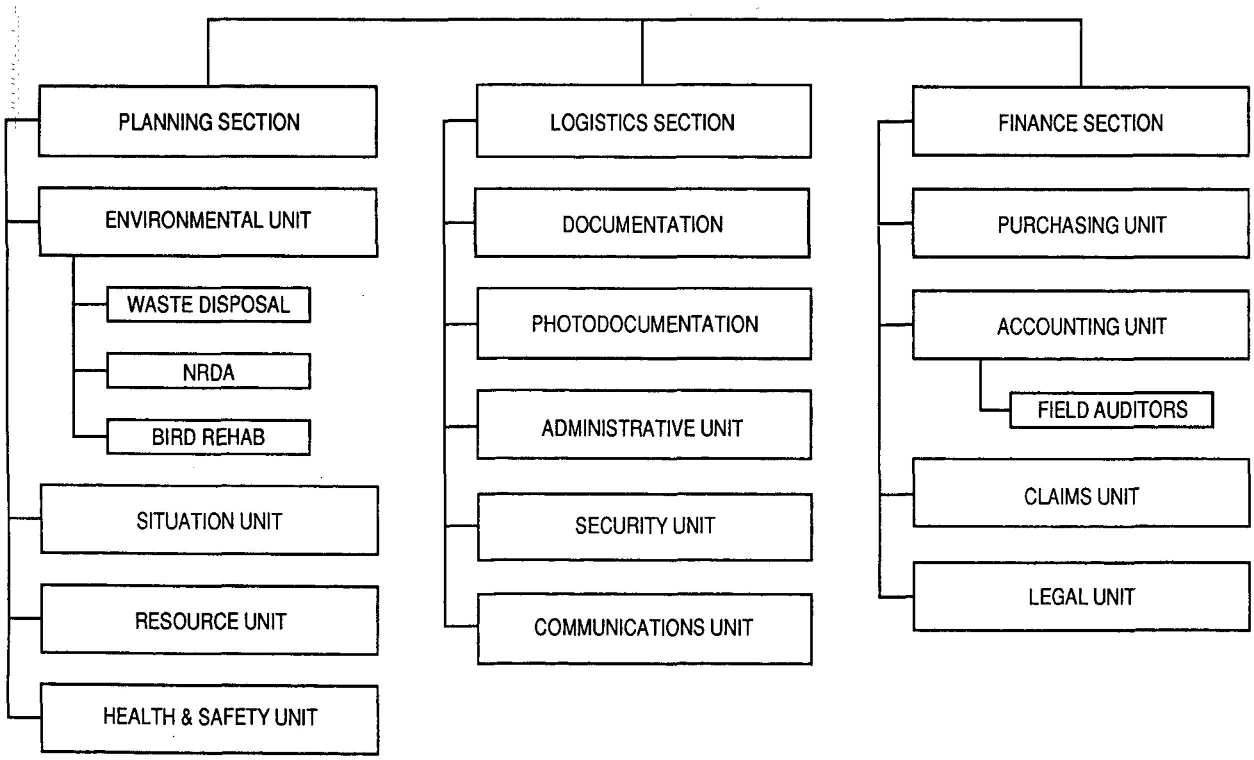


FIGURE 15. STRUCTURE OF THE PLANNING, LOGISTICS, AND FINANCE SECTIONS AS EXPANDED FOR THE *AMERICAN TRADER* SPILL RESPONSE (FROM: ROLAN AND CAMERON, 1991)

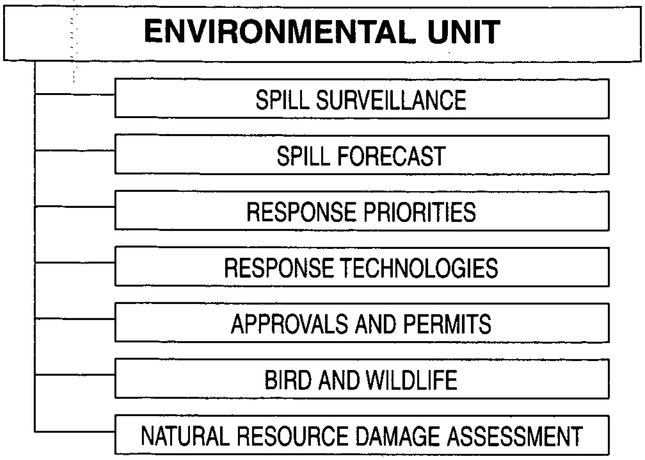


FIGURE 16. STRUCTURE OF THE ENVIRONMENTAL UNIT ESTABLISHED AFTER *AMERICAN TRADER* SPILL (FROM: ROLAN AND CAMERON, 1991)

strong commitment to purpose, can be closely identified with the characteristics most normally associated with open, problem solving systems. The characteristics of high reliability organizations are not incompatible with hierarchical systems typically viewed as command and control systems. The system used as a model by Roberts in her studies of high reliability organizations was, in fact, a military system — a US Navy aircraft carrier during flight operations — although she notes that the Navy, like other DOD services, is moving away from centralized, relatively inflexible command and control systems due to complexities of integrating multiple warfighting functions.

Existing systems, even closed systems, have the potential to undergo change and be **implemented** as open systems during emergencies. The authors consider a fully integrated Unified Command Structure of an ICS variant to function as an open-type of system. The Unified Command Structure as mentioned in the recently published revision of the US NCP also appears to be an open type of RMS. These applications of unified command will be discussed in the next section.

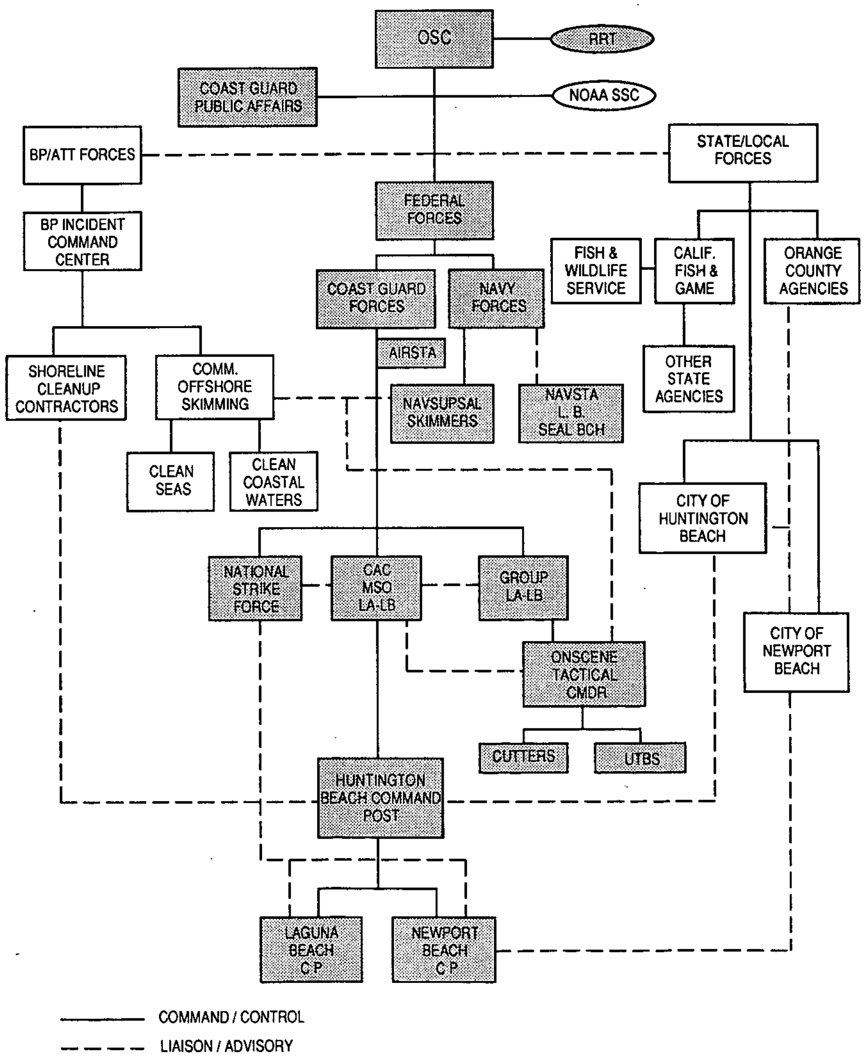


FIGURE 17. DIAGRAM OF THE RESPONSE ORGANIZATION FOR THE *AMERICAN TRADER* (FROM: CARD AND MEEHAN, 1991)

Section 4.0

Current State of Knowledge

The objective of this section is to describe current RMSs in use internationally and in the US and to consider them in light of the theoretical aspects of sound RMSs design and implementation that were set forth in the previous section. To provide a framework for discussion and comparison of existing systems. Section 4.1 also identifies qualitative factors by which RMSs can be thoughtfully considered. Because the available information on existing systems widely varied on type of information and detail, the review and discussion of these systems is necessarily different.

The aim of an RMS is to manage a successful response. As discussed in the first section, definitions of success are qualitative and variable. However, the practitioners have provided a reasonable basis for considering the extent to which an RMS can enhance the potential to achieve a successful response through the identification of Critical Success Factors (CSFs).

4.1 Critical Success Factors

CSFs are defined by Rockhard (1981) as the set of things that must go right if an operation is to succeed. The identification of these factors for an oil spill response was the objective of a series of scenario-based exercises conducted by Harrald (1994) at the USCG On Scene Coordinator Course, the State of Texas General Land Office, Marine Spill Response Corporation and Local Area Team in the Port of New York. Over 100 experts participated in the exercises and identified the following six Critical Success Factors.

1. *The salvage operation for a vessel spill, or emergency response operation at a facility, must minimize spillage of oil and must not interfere with pollution response operations.*

   The best way to minimize the environmental impact of a marine casualty is to secure the source. Yet, this is difficult to accomplish without impeding pollution operations, when only limited resources are available during the emergency phase. This implies the close coordination of search and rescue, salvage and response operations.
2. *The immediate response by the RP and the Coast Guard must mobilize enough appropriate response resources (people and equipment) to contain most of the oil at or near the source and to protect sensitive areas.*

   The second most obvious way to minimize environmental impacts is to prevent the pollutant from spreading to sensitive areas. This can be done only if appropriate response resources can be quickly and effectively brought to bear by the RP and OSC to contain, deflect, disperse, or remove the oil before it comes ashore. This factor is obviously dependent upon the location of the casualty and the forces of wind and weather. In many cases, achievement of this CSF may be physically impossible.
3. *The response organization must be able to communicate and manage information internally and externally.*

   Feedback on the effectiveness of strategy and tactics must be provided to decision makers if the response system is to adapt its strategy and tactics and remain goal directed. Accurate and timely information also must be provided to the media and public. Effective information flow is critical to spill management and expectation management of the public. The problem of management of internal feedback (within the response organization) and external communications (between the response organization and outside entities) must be recognized and solved.
4. *Coordination between federal, state, and local organizations and the RP must be pre-planned, account for stakeholder interests and ensure a response organization that will be cohesive and effective.*

   The response organization must work effectively during the immediate initiation and mobilization phase, while supporting the rapid transition into the production or project phase without losing organizational effectiveness. Integration must be achieved without public conflict. Pre-spill planning must identify and account for stakeholder interests and resolve potential organizational conflicts.
5. *The response organization must be capable of sustained effective operations.*

   Sustained effective operations means that, throughout the phases of response, those in charge must be technically able to identify useful response strategies, recognize when a response strategy is inappropriate, and quickly adjust strategy and tactics to the actual situation. Adequate personnel and equipment capabilities, and logistics support, must be maintained. The success of the response will be jeopardized if appropriate operations can not be sustained.
6. *The response organization must meet the public's realistic and achievable expectation for pollution response.*

   If the public and the media have established and accepted a pre-event definition of success that can not be achieved such as zero environmental impact or immediate and effective response under all weather conditions, the response will be perceived as a failure regardless of how it is conducted. Communications with the public, both during preparedness and response, need to focus on providing them with realistic expectations.

4.2 ORGANIZATIONAL CAPABILITIES AND DESIGN REQUIREMENTS FOR RMSs

Ideally, the scholarly literature should provide clear research findings that describe how to create effective RMSs to support achievement of the CSFs. Unfortunately, as Roberts (1994) points out, the disaster response community does not have an (research-based) understanding of the organizational behavior of **systems of multiple and large organizations.** What follows is an attempt to develop some basic considerations based on implications derived from review of literature that addresses organizations which may be similar to those created to manage spill response operations. According to a USCG representative, response management consists of directing, supervising, and carrying out actions to clean up oil spilled into the marine environment and/or to prevent the discharge of such oil into the marine environment (Giacoma, pers. comm., 1994). Note that there is no size or significance criteria attached to the definition. Therefore, it must be assumed that RMSs must be designed and implemented to manage the response to all spills, from the routine to the catastrophic. According to the opinions of responders, a minimum organizational design requirement is needed for a successful response. Most agreed that it should be based on the ICS, which allows for standardization, expandability and is multi-jurisdictional. Others suggested that there should be, at least, an one person for each of the five functional areas in ICS, plus a individual dedicated to public affairs.

Further research is needed to validate the hypothesis that there may be factors, unrelated to the specific type of organizational design, that must be addressed in order to create the potential for successful management of a spill response. Such research could have significant implications for RMSs design and implementation. These factors could be viewed as fundamental management functions that guide both the internal and external operations of the RMS. As suggested by Dynes and Quarantelli (1976), they must be planned for during the preparedness phase, but constantly evaluated and adapted during the operation.

These observations indicate that, since response to a significant or catastrophic spill is so complex and dynamic, any emergency organization, regardless of the validity of its original design, will change over time. This is consistent with Quarantelli's suggestion that the phenomena of emergence, or the tendency of organizations to adapt as functions change, "is not necessarily dysfunctional, bad, or inappropriate ... emergence represents an effort to solve problems." (Quarantelli, 1983) Examination of three US spill response operations — the *Exxon Valdez, American Trader* and *Morris J. Berman* — seems to validate this thought. The challenge would then become creating not only an organizational design, reflected in a contingency or response plan, that would be appropriate for routine spills while serving as the basic structure for more substantial spills, but also a careful and well-considered process to guide the adaptation or growth during significant or catastrophic spills.

ORGANIZATIONAL CAPABILITIES

A well-designed RMS appears to be a necessary condition for, but does not guarantee, a successful response to an oil pollution event. The CSFs discussed in Section 4.1 suggest that the **organizational capabilities** described below must be created in order for a RMS to be both effective and efficient in all three stages of the response. The authors believe that, to achieve the CSFs listed in the previous section, an organization must possess the following attributes of open, high reliability systems.

1. *Ensure goals and objectives are clearly stated and accepted by the entire organization.*

Schoderbek *et al.* (1985) suggest that the successful response system must be goal directed, that organizational goals must be clearly stated and universally accepted concept of success must exist if the organization is to be effective. It is clear from the practitioners' responses, discussed in Section 2.3, that views on this subject vary considerably. This can contribute to a less than effective response. Vaill (1982) found that high performing systems have clear objectives and strong commitment to purpose, while Roberts (1989) states that high reliability organizations ensure that goals are clearly stated and universally understood.

The system must provide the ability to grow a response organization that is organizationally and politically compatible, comprised of multi-agency stranger groups in a very time constrained period. It appears that expeditious definition and allocation of decision making authority, and validation of overall goals and definition of strategic or event objectives may be particularly important in a unified or integrated structure. Such a structure would likely be made up of stranger groups, comprised of participants from the various entities that enter the system with their own organization goals foremost in mind.

This requirement for goal resolution among stranger groups is an apparently unavoidable feature of emergency management. The response organizations that must make crisis decisions, e.g., Unified Command, as opposed to those that provide resources, such as response contractors, do not typically exist as discrete entities in the non-emergency state. The USCG recognizes this potential problem by listing "develop(ing) a set of incident goals" as the first priority in the Response Considerations (USCG, 1993b). If all participants in the system do not agree with the goals and objectives, then the system could breakdown as was the case during the *Exxon Valdez* response.

2. *Plan for the emergence of groups representing outside concerns and interests.*

All stakeholders should be identified during the preplanning process and action taken to coordinate their input and concerns in all preparedness activities. The developers of plans should know who is likely to demand a role in the management of response operations. The issue addressed here is the emergence of unidentified or unanticipated groups, perhaps ones that did not even exist prior to a particular spill, which formed because they perceived that their concerns were not being adequately addressed by other established groups.

Quarantelli (1983) concludes that prior planning can preclude dysfunctional or unnecessary emergence. If the response management organization is sensitive to external concerns and responses, they will recognize the presence of these unanticipated emergent groups early, and can incorporate them into the process. There will be no need for groups which emerge spontaneously and informally to feel that there is no mechanism to make their concerns known and to ensure that they are addressed by the management structure.

The lessons of the *Exxon Valdez* and *American Trader* are particularly indicative of this phenomena. Most government and industry response plans seem to be aware of a need to address external influences. However, the findings of research indicate that the plan must do more than appoint an ombudsman or point of contact to provide information to emerging groups. There must be a well-considered mechanism to use these groups as resources in the response operation; receive input as well as provide information; include groups in the planning process; and address political, economic and social issues. Even though the identity of specific emergent groups might not be known during pre-event planning, a process to incorporate the groups in the RMS can be still be developed as part of preparedness.

The State of Alaska, for example, uses ten area-based Regional Multiagency Advisory Coordinating Committees (MAC) as advisors to the integrated Unified Command, established in the Area Contingency Plan. This structure is based on the success of the MAC concept that evolved during the *Exxon Valdez* response. These committees provide external groups not represented in the Unified Command (including local government jurisdictions, community organizations, and public interest and environmental groups) the opportunity to comment on and make recommendations concerning priorities, objectives and action plans. There is also a mechanism for highly proactive Unified Command liaison with each committee, as well as a pre-established list of representatives on each MAC with formal procedures for expanding the membership during the response based on event-specific, or even phase-specific issues.

3. *Establish measures to evaluate the performance of the system and adjust its processes.*

Schoderbek *et al.* (1985) also found that "purposeful systems" require comparison of system characteristics against standards or expectations — feedback loops, to control the system, with collection, transmission and analysis of information central to the information management process. They also note that performance measures must be developed that will enable the organization to evaluate its performance and adjust its processes (strategy, tactics, and procedures).

Libuser and Roberts (1994) noted that high reliability organizations establish a process auditing system with "ongoing checks to spot expected as well as unexpected problems."

To accomplish the evaluation process, the system must effectively support decision makers with adequate, appropriate and timely information, without producing information overload or paralysis. Implicit is the ability of the system designer to create the capability to analyze and use information obtained from all levels of both internal and external sources. This is a significant part of the process of addressing the external issues raised by emergent groups; it applies to the input from subordinate levels of the response organization as well.

4. *Distribute decision making to the lowest possible level throughout the organization.*

Schoderbek *et al.* (1985) suggest that distributed or decentralized decision making reduces the need for vertical communication, increases the responsiveness of the system, and reduces the potential for system failure. People learn to make appropriate choices when information, rather than top-down decisions, is made available as the basis for actions. Vaill noted that high performing systems, in which leadership is strong, clear and integrated and team action the norm, are fertile sources of creativity. His work suggests that much of this can be attributed to distributed decision making, which encourages the development of alternatives at all levels. The need for distributed decision making was pointed out in conversations with response professionals. They called for specific decision making authority, appropriate for their level in the organization, to be delegated to the representatives of the unified command organizations (O'Brien, pers. comm., 1994; Garnett, pers. comm., 1994). Without distributed decision making, the potential to respond effectively and efficiently to time-critical opportunities is significantly constrained.

Decisions during the response to a significant or catastrophic spill will likely be made in a turbulent, "high velocity" environment where change is rapid and information is often inaccurate, unavailable, or incomplete. It may not be realistic for all decisions to be made quickly enough and with sufficient certainty by a single individual or small group of individuals "at the top" to influence the outcome of operations. Decision making is difficult in these environments not only because of the rapidity of change, but also because of the complexity of assessing the significant of changes as they occur. (Sutton *et al.*, 1986). This seems to further support the rationale for distributed decision making within established parameters.

Roberts (1994) calls for "a strategy for allowing people to unfold their jobs without continuous direction from the top." The objective of this strategy is to maintain the "big picture" at the top of the organization while ensuring that as much of the big picture as possible is communicated to and sustained throughout the organization, so that individuals at the levels where decisions can be made understand the overall goals and objectives. She describes this decision making style as "decision migration;" authority and responsibility for decisions "migrate" to the portion of the organization best equipped to make the decision, while recognizing the simultaneous requirement for control and flexibility at all levels of the organization.

5. *Facilitate the ability to learn and to then adapt or revise performance based on the learning.*

Roberts (1994) implies that in order to achieve and sustain high levels of performance in low probability, high consequence environments such as significant or catastrophic oil spills, high performance systems must become adaptive, learning systems. This means that response organizations must be able to adapt and adjust during a crisis event based on assessment of lessons learned from each action during the event. Clearly, it is not sufficient to have post-event reviews and critiques to develop long term remedial action programs. Learning and adaptation must be a continuous process during response, focusing on short term adjustments to the dynamic situation.

Senge (1990) echoes these thoughts when he suggests complex and dynamic organizations must become "more learningful." While the need for learning is not related to the type of system, the way the learning is reflected in and how it impacts system performance does differ with the type of system. Carley (1991) notes that "Teams [open, problem solving systems] will learn faster and better than hierarchies [closed, command and control systems] when the task is complex, but hierarchies will fare better when the task is simple. Due to the speed with which they learn, teams should be less affected than hierarchies by increasing complexity and turnover." This suggests that closed systems might be well suited for response to routine spills, while open systems, or "partially" closed systems with positive characteristics of open systems, will adapt more quickly and effectively to the complexity of a significant or catastrophic spill event.

6. *Encourage informal, direct communication among all subsystems.*

Crisis situations produce conditions of greater uncertainty, greater diversity, decreased formalization and decreased centralization. Increased complexity of organizations and the non-routine nature of crisis tasks move all organizations toward coordination by feedback, rather than by plan using pre-established more formal communication paths.

Organizational Design Requirements

There are no doubt a virtually limitless number of opinions from theoreticians and practitioners on the design requirements that are necessary to maximize the potential for a RMS to manage a successful response. Based on the literature reviewed, the authors present the following questions to assist various readers in considering how to develop a integrative RMS that provides an organizational environment conducive to effective, collaborative decision making and execution.

1. <u>What is the distribution of power?</u> Does the responding organization have the authority to exclude other organizations or parties, to force them to participate, or to exercise direct control over them? If this is the case, a command and control organization will work.
2. <u>What is the congruence of goals?</u> If the collaborating organizations differ on critical goals or objectives, then the RMS will be subject to conflicting guidance. Conflicts over WHAT should be done are difficult to resolve in a closed-type of RMS system and will sabotage an integrated organizational design. Conflicts over HOW objectives can be accomplished, once the goals are agreed upon, are easier to resolve in an closed type of system.
3. <u>How close are the organizational cultures of the organizations that are coming together into the unified command?</u> In the US, for example, the "corporate" cultures of the Coast Guard OSCs, and OSROs, such as MSRC and the National Response Corporation (NRC), are reasonably similar because their personnel tend to have military backgrounds. The organizational cultures of EPA OSCs, state agencies and RP organizations are quite variable. Most of these cultures are closed types of systems during non-response periods, and are generally unaccustomed to operating in an open-type of organizational system. If the organizational cultures are not compatible, a unified command is possible, but a fully integrated organization is not. Preparedness, i.e., planning, training, and exercising among response organizations, can enhance the compatibility of multiple response organizations.
4. <u>Does the overall organization have the inherent capability and capacity for success?</u> This concerns whether or not preparedness activities have cultivated a solid foundation within and among response organizations. It is much easier to act collaboratively when things are going well. When things go wrong, any divergence in objectives, culture or lack of trust will be magnified, and the challenges to success might not be overcome. An integrated organization will probably not survive a response that is perceived to be failing by the public, even when the causes of failure are beyond the control of the organization.
5. <u>Does the decision making ability, including knowledge and training, and heterogeneity of decision makers match the complexity of the problem?</u> The RMS must be

sufficiently inclusive, or open, to make optimal use of available technical expertise in the management process to help prevent sub-optimal or naive decision making. Closed systems dealing with large, complex problems run the risk of doing all the small things correctly, but making some poor decision at high levels in the organization, which impact the overall organization. This could lead to a diminished ability of the organization to manage a successful response.

The capabilities listed below are those that must be incorporated into any effective RMS. The list was developed from the theoretical literature and the opinions of response professionals.

1. The RMS must have the ability to deal with multiple, simultaneous, emergencies. Search and rescue, the salvage operation for a vessel spill, fire-fighting or emergency response operation at a facility, must minimize spillage of oil and must not interfere with pollution response operations.
2. The RMS must be capable of sustaining both an effective operation and itself.
3. The RMS must be led by an Incident Manager or OSC with the credibility, knowledge, and experience needed to function as leader of the multi-agency operation.
4. The RMS must formally define roles and responsibilities — all personnel are knowledgeable and trained in their individual duties, and exercised as an organization.
5. The RMS must develop and exercise scenario-based response actions so that the time constrained mobilization of resources required to contain the oil at or near the source and to protect sensitive areas can be accomplished.
6. The RMS must ensure that the scale of the response effort is in proportion to the size of the spill and the threat of environmental damage.
7. The RMS must plan for continuity and unexpected problems.
8. The RMS must use pre-disaster structures and authorities to the maximum extent possible, but be capable of adapting to a wide variety of organizational forms.
9. The RMS must be able to address to response generated demands as well as agent generated commands.

In the following sections, the RMSs currently in use in the international arena, by the US government, and by several states within the US are described and compared. Each of the systems is discussed in the context of the preceding discussion concerning open and closed response systems and are considered in light of the CSFs developed in Section 4.1.

4.3 INTERNATIONAL RMSs

In an effort to determine the range of different RMS designs that exist, the authors conducted an evaluation of the organizational systems in use internationally. In the interest of limiting the research scope of this effort, Country Summaries provided by ITOPF were used as the primary source of information about the systems established in 118 countries. The Country Summaries provide a broad overview of the spill response arrangements, e.g., designated lead government authority and relevant regulatory documents, and capabilities of each country. Most places do not have formal, complete management systems in place just for oil spill response. Country Summaries were not available for the US or Puerto Rico, but information about them was included, since the authors were familiar with their RMSs. A total of 120 countries/territories were reviewed. Because the source material was still draft, the following discussion omits specific country names, with a few exceptions where detailed information was made available, e.g., Canada, and Japan, along with the US.

The institutional systems for responding to and managing spills in both the open ocean and nearshore or port/inland environment were reviewed. Their institutional arrangements are different. **In many, if not most countries, the national government manages the response to spills in the marine environment and local jurisdictions manage those that occur on or impact coastlines and inland areas.** Generally, RPs work with host countries to resolve oil spill problems. The experience of some RPs is that many countries are willing to share the burden with the RP (Jardim, 1994). What differs among countries are the particular requirements for response, e.g., resolving the "how clean is clean?" issue.

Response to spills into the open ocean is conducted by the government in virtually every country. The rationale is simple — most spills are from vessels in transit through a country's waters, rather than the result of economic activities conducted by a company in the nation impacted by the spill. Since the owner of either the oil or vessel does not typically have a presence in the country, it is most realistic for the government to assume the lead role, with the RP, when one can be identified, required to reimburse the government. Additionally, there is a body of thought that contends that even if an RP has a presence in a particular country, trying to compel the company to conduct a complex response operation is not realistic, given the attendant personnel, equipment, training, exercise, logistics and other considerations. This body of thought contends that regardless of what laws or regulations are in place, the government will ultimately have to step in and manage the spill.

There are a handful of countries that have taken the approach that the party responsible for a spill also has the responsibility to conduct the response. The three main countries with this policy are the US (and its territories), Japan and Canada. The prevailing thought in these countries appears to be that since most spills result from the "for profit" economic activities of a company — from tank vessel *en route* to, from or internally within the country — they should be held responsible, accountable and liable for the full range of clean up activities, including initiating, managing and completing the response. However, in each country, in clear recognition of the responsibilities to the populace, there are strict provisions for national and state oversight, as well as a mechanism for the government to take over the response if the RP can not or will not respond, or in the case of a "mystery spill."

Since most countries do not have an organization that deals specifically with oil spills on a full time basis, the ultimate responsibility — in every case — for ensuring that spill response operations are conducted properly falls to the national government, with oversight and support functions shared by a number of agencies or departments. Some countries have formalized — and in some cases, standing — committees that consist of all or designated ministries or agencies. Others have less inclusive, less formal committees, convened only to advise the lead agency representative during a spill response. While the specific functions of these committees appear to vary by country, and can not be empirically determined without additional research, our evaluation suggests that although these committees may have broad responsibilities during non-spill periods, they typically provide only national level guidance, oversight and support during responses.

In categorizing the RMSs of 120 countries, we assumed some level of interaction between the national and local jurisdictions at the decision making level on, at a minimum, those spills with the potential for affecting both the marine and onshore environments. In some countries, the US most notably, the state and local jurisdictions have a more expansive role (EPA, 1994a). However, the different functions performed by the various levels of governmental jurisdiction in the decision making process could not be determined from available data with sufficient clarity or distinction to warrant development of different categories.

In assessing RMSs used to manage responses to spills in the **marine environment,** five general categories were identified. The percentage of countries reviewed are summarized by category in Table 8.

TABLE 8. RMS CATEGORIES FOR OPEN OCEAN SPILLS

Category	No. of countries	Percentage	Attributes
1	65	54%	These countries have: • A single government entity designated as the lead agency, with operational responsibility for managing and conducting the response; • Some form of governmental committee providing oversight and direction for the response; and, • A requirement for the Responsible Party to reimburse the government for response costs.
2	30	25%	These countries are comparatively small with less than significant oil traffic. They have: • A single government agency has both the operational responsibility for managing and conducting the response, as well as the national oversight authority; and, • A requirement for the Responsible Party to reimburse the government for response costs.
3	2	2%	They have: • A single agency with operational responsibility for managing or supervising the response; • A governmental committee with responsibility for oversight and direction for response; and, • A requirement for the Responsible Party to take operational responsibility for the clean up. However, if the RP is unable or unwilling to conduct the clean up operation, or if the clean up exceeds the RP's capability, the government agency assumes responsibility, and the RP's obligation reverts to reimbursement of government costs. If the RP does not or cannot conduct the operation, there are no additional liabilities or civil or criminal penalties.
4	6	4%	They have: • A single agency having operational responsibility for managing the response; • A governmental committee has responsibility for oversight and direction for response; and, • The Responsible Party has operational responsibility for the clean up. If the RP is unable or unwilling to conduct the clean up operation; or if the RP cannot be identified (i.e., a mystery spill); or if the clean up exceeds the RP's capability, a government agency will assume responsibility, and the RP's obligation is to reimburse the government for costs. • An RP is subject to additional liabilities, as well as civil and criminal penalties, if the company does not or cannot conduct the operation.
5	18	15%	They : • Have no established system for responding to or managing spills in their waters. • Typically rely on outside assistance for all management and operational support.

In evaluating response policies governing spills in the nearshore or harbor environment, seven general categories were identified. The percentage of countries reviewed are summarized by category in the Table 9. The countries in Category A for nearshore spills are the same as Category 1 for open ocean spills. The 14 countries included in Category C are the same countries as those in Category 3 for open ocean spills. The 18 countries in Category G are the same countries as those in Category 5 for open ocean spills.

TABLE 9. RMS CATEGORIES FOR NEARSHORE/HARBOR SPILLS

Category	No. of countries	Percentage	Attributes
A	23	19%	They have: • A single government entity designated as the lead agency, with operational responsibility for managing and conducting the response; • Some form of governmental committee providing oversight and direction for the response; and, • A requirement that the Responsible Party reimburse the government for response costs.
B	42	35%	They have: • A single government agency which has both the operational responsibility for managing and conducting the response; • Some form of governmental committee providing oversight and direction for the response; • A requirement that the Responsible Party reimburse the government for the response costs; and,. • A requirement that the owners or operators of facilities which could discharge into the water must maintain spill response equipment at, and respond to a spill from, the facility.
C	14	12%	These countries are comparatively small with less than significant oil traffic. They have: • A single government agency which appears to have both the operational responsibility for managing and conducting the response, as well as the national oversight authority; and • A requirement that the Responsible Party reimburse the government for the response costs.
D	16	13%	They have: • A single government agency which appears to have both the operational responsibility for managing and conducting the response, as well as the national oversight authority; • A requirement that the Responsible Party reimburse the government for the response costs; and, • A requirement that the owners or operators of facilities which could discharge into the water must maintain spill response equipment at, and respond to a spill from the facility.
E	2	2%	They have: • A single agency with operational responsibility for managing or supervising the response; • Some form of governmental committee with oversight and direction for response; and, • The requirement for the Responsible Party to take operational responsibility for the clean up. However, if the RP is unable or unwilling to conduct the clean up operation, or if the clean up exceeds the RP's capability, the government agency assumes responsibility, and the RP's obligation reverts to reimbursement of government costs. If the RP does not or cannot conduct the operation, there are no additional liabilities or civil or criminal penalties.
F	6	13%	They have: • A single agency having operational responsibility for managing the response; • Some form of governmental committee oversight and direction for response; and • A requirement that the Responsible Party assume operational responsibility for the clean up. If the RP is unable or unwilling to conduct the clean up operation, or if the clean up exceeds the RP's capability, the government agency will assume responsibility, and the RP's obligation is to reimburse the government for costs. Countries in this category differ from Category F in that the RP is subject to additional liabilities as well as civil and criminal penalties if the company does not or cannot conduct the operation.
G	18	15%	They : • Have no established system for responding to or managing spills in their waters.

This limited review of available information suggests the following observations.

1. Of the 120 countries with some form of national policy regarding response to spills, all have given a single government agency with some level of responsibility for response operations. The government agency may be different depending on the location of the spill — for example, in the US, the EPA is responsible for spills in the inland zone, while the USCG is responsible for events in the coastal zone. The level of responsibility ranges include complete autonomy with no oversight or support from other government agencies (29%) to opera-

tional responsibility with oversight and support from a government committee (64%) to some level supervision with the obligation to assume full control if required (7%).

2. While the precise nature of the RMS in each of these countries can not be determined during the time available for this analysis, it appears from our review of the draft ITOPF Country Summaries that only 40% of countries use a military or quasi-military organization to manage spill response operations. We could not confirm the premise that most countries use some form of command and control design for their system. This premise is based primarily on the fact that no country has a standing government organization with the sole mission of responding to oil spills. Consequently, it is assumed that the most common form of management system, i.e., hierarchical/command and control, is used internationally to support both normal (steady state) and emergency operations.
3. The most significant single factor that sets the US and its territories, Japan and Canada (a total of 7 countries) apart from the rest of the international community is the role of the RP. All countries, including those listed above, require the RP to reimburse the government for response costs. However, the 7 nations require the RP to conduct the response, with government monitoring operations and preparing to assume control if the RP is unable or unwilling to respond adequately. Because the RP is an integral part of the response in all of seven countries, each RP must have an RMS which is capable of managing the spill and integrating with the oversight agency to ensure that they are satisfied with the progress of the operation. The primary discriminator between the US and its territories on one hand, and Japan and Canada on the other is that if the RP fails to perform adequately in the US, the company could be subject to unlimited liabilities and additional penalties, while there is a "no fault" policy in the other nations. This is an important distinction, but does not appear to be a factor that would affect the design of the RMS.

4.4 DOMESTIC RMSs

Several US government and industry RMSs were examined as a basis for understanding what kinds of systems are currently in use. The findings are discussed in the following categories:

- Incident Command System (ICS)
- Government Response Systems, and
- Industry Response Systems.

INCIDENT COMMAND SYSTEM

Variants of the NIIMS ICS are being adopted as the management system for oil spill response in both government and industry. This development of variations on the NIIMS ICS is not surprising or necessarily inappropriate. Its widespread adoption merits separate discussion here.

The aspect of ICS which provides for unification of the RMSs of multiple responding organizations is the Unified Command Structure (UCS). The UCS is considered a vital component of the ICS by many in the response community. Because many organizations respond to spills, UCS is generally viewed as the ideal solution for integrating multiple response organizations, particularly at the decision making or command level.

UCS is a necessary element of ICS when a disaster crosses jurisdictional boundaries or exceeds the limits of agency responsibility or authority (Miller and Gallagher, 1993). When UCS is implemented, the remainder of the ICS structure, i.e., the functional areas that execute decisions, can be implemented in an integrated manner (one ICS structure) or in a decentralized, coordinating manner (an ICS for each geographical region). In the integrated model, the unified command establishes priorities and the tactical management of the disaster response is controlled by the ICS operations manager (typically selected from one of the organizations represented in the UCS). In the coordinating model of implementation, the overall strategy of the multiple operations is coordinated by the unified command and individual agencies retain the operational control of activities within their jurisdiction.

Under the NIIMS ICS, successful implementation of unified command includes either similar agencies with separate geographic responsibilities (e.g. three counties responding to a forest fire) or agencies with different, clearly defined functions (e.g. firefighting, medical) responding to the same disaster. In either of these cases, the unified command performs a strategic and coordinating role; decisions about tactical operations are delegated to one or more of the participating organizations. In the oil spill case, multiple "ownership" of areas of responsibility can result in the elevation of tactical decision making to the only level where conflict resolution is possible — the unified command. The potential problem of centralizing and elevating tactical decision making to unified command can significantly impede the ability of responding organizations to quickly and effectively respond and to make tactical adjustments as appropriate to changing conditions in the field. This problem could lead to diminished effectiveness and the perception that the spill is not being managed effectively. To use unified command in an optimal way, only high level decisions, e.g., event-specific objectives, strategic objectives, and priorities should be made at the unified command level.

Wenger *et al.* (1990) observe that some of the problems observed with ICS are inherent in the NIIMS model, but that most are due to the way ICS variants are implemented. ICS implementation problems that have been observed include:

1. ICS, as often used, is a buzzword, having considerable differences among organizations as to what it means and how it should be implemented.
2. The bumping of command from initially responding personnel to senior individuals as they arrive and depart results in loss of information and effective management.
3. ICS does not provide for inter-organizational coordination, only joint command.
4. ICS is isolated from other related pre-event emergency planning, e.g., local emergency management agencies and volunteer-based relief organizations.

5. ICS is not designed to integrate volunteers and emerging groups.
6. ICS leads to congestion of emergency forces at localized disasters, e.g., airplane crashes.
7. ICS does not solve disaster-generated inter-organizational communication and coordination problems resulting from the problematic nature of disaster situations.
8. ICS does not guarantee that the pre-event coordination necessary among responders will occur.

Wenger *et al.* (1990) conclude that,

"The basic ICS model was derived from notions of command and control, e.g., the establishment of authority in a higher level position with overall responsibility for action, the division of tasks based on operational considerations, close supervision, cleaner chains of command and defined separation of functions. Such a model might be adaptable for quasi-military organizations such as fire departments, which already have a pyramid-type of organization. However, 'civilian' communities impacted by disasters and the majority of organizations which become involved in disaster related activities are not organized on a military or quasi-military structure .... Thus ICS does not appear to be a useful model that is readily transferable to broader community wide planning and response efforts."

Roberts (1994) notes that even the military has found the command and control model to be inappropriate and ineffective in some types of operations. In those operations conducted in a nuclear environment where units are out of contact with higher headquarters, e.g., aircraft carrier warfare groups in the US Navy, and close communications are degraded, open systems are being adopted.

Nevertheless, there are aspects of ICS which have significant advantages in developing an oil spill RMS, both at the command (decision making) and execution (decision implementation) levels:

- It provides common terminology and organizational structure that enhances the ability of multiple, "stranger" groups to work together by improving their communications about the response organization.
- It provides for all essential response functions.
- It supports mobilization through the pre-event definition of organizational elements and individual roles.
- It clearly defines organizational and individual responsibilities.
- It can support training through the definition of skill and knowledge requirements for each organizational role.
- It supports the integration of multiple, similar organizations by ensuring that personnel and organizational units are similarly defined and prepared.
- It supports the expansion and contraction of the response organization through its modular design.
- It provides for coordination of external organizations which are identified in advance through MACs.
- It is compatible with the unified command concept of the NCP.
- It can sustain a high level of turnover at the lower levels of the organization, since replacement personnel are pre-qualified.

On the other hand, the following potential weaknesses of an ICS-based system need to be addressed in developing an oil spill RMS, particularly for use during significant or catastrophic spills:

- The basic organizational structure is hierarchical and can be relatively inflexible. For example, those organizations that are not adopting ICS, such as public utilities who store, use and transport millions of gallons of oil, will be "out of synch" and at a distinct disadvantage. For those organizations which are developing their own ICS variants, the benefits of common terminology will be reduced unless preparedness activities focus on developing agreements among multiple organizations on how their ICS variants will be integrated.
- It is essentially a closed organizational design that is not open to stakeholders who are not explicitly part of the design (unless the MAC concept or similar structure is universally accepted); its traditional structure does not readily accommodate emergent groups.
- It remains essentially a command and control model with a single decision maker, in the form of an Incident Commander (IC), as agreed upon within unified command; it supports centralized decision making better than distributed decision making or decision making teams; it supports downward information flow better than feedback from the external environment.
- It assumes that participating organizations have similar cultures and congruent goals.
- It is vulnerable to adverse impacts of turnover at the top of the organization due to over-centralization of decision making and information handling functions.

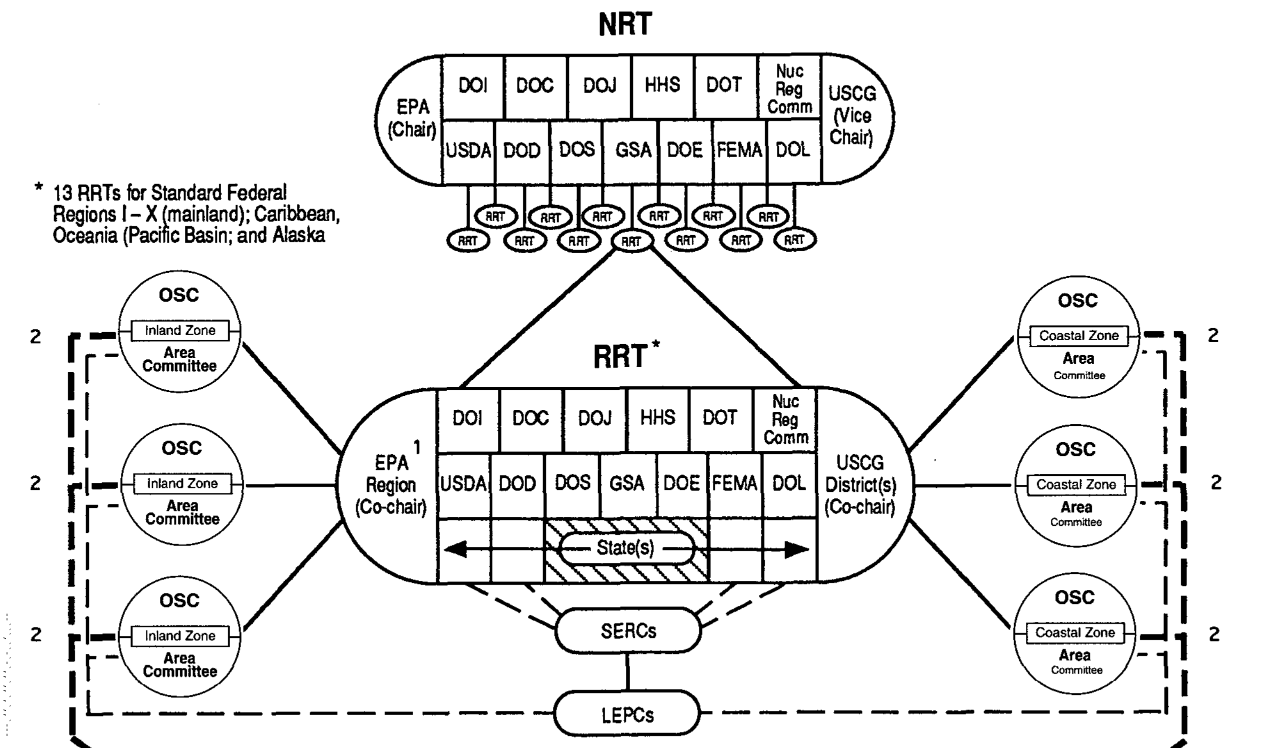
The following sections describe examples of current systems in use in the US, and when relevant note their relationship to ICS. As will be seen, the National Response System of the federal government incorporates very little of the ICS concepts and terminology. The state and industry systems, on the other hand, are where the majority of ICS variants are being developed.

GOVERNMENT SYSTEMS

The National Response System (NRS) of the federal government for oil spill response and six state systems were examined during this effort. No local systems were examined. The Federal Response Plan, which is overseen by FEMA, is excluded from this review because it deals with disasters in general and the emphasis in this paper is on oil spill RMSs. The following sections describe the NRS and the state systems and consider them in light of the CSFs.

THE NATIONAL RESPONSE SYSTEM

The NRS is articulated in the National Oil and Hazardous Substances Pollution Contingency Plan, or the NCP (EPA, 1994a). The US has operated under the NCP since the first



Sources of Input and Guidance to Area Committees	
Government (Section 300.145	Non-government (57 FR 15198)
Strike Teams NPFC ERT RERT DRG DRAT SSC PIAT SUPSALV	Facility and vessel owners/operators 2 Shipping company representatives Cleanup contractors Emergency planning and response officials Marine pilots associations Members of academia Environmental advocacy groups Response organizations/officers Citizens

1 RRT serves as the Area Committee for inland areas not covered by a separate Area Committee, unless a separate Area Committee is designated by the Regional Administrator (57 FR 15198)

2 Federal laws (e.g., CWA Sec 311(j)(5), Clean Air Act Sec 112(r), OSHA (Process safety regulations) require facility owner/operators to prepare a response plan. Additional description is found in Section 300.211.

FIGURE 18. NRS STRUCTURE FOR PLANNING (FROM: EPA, 1994A)

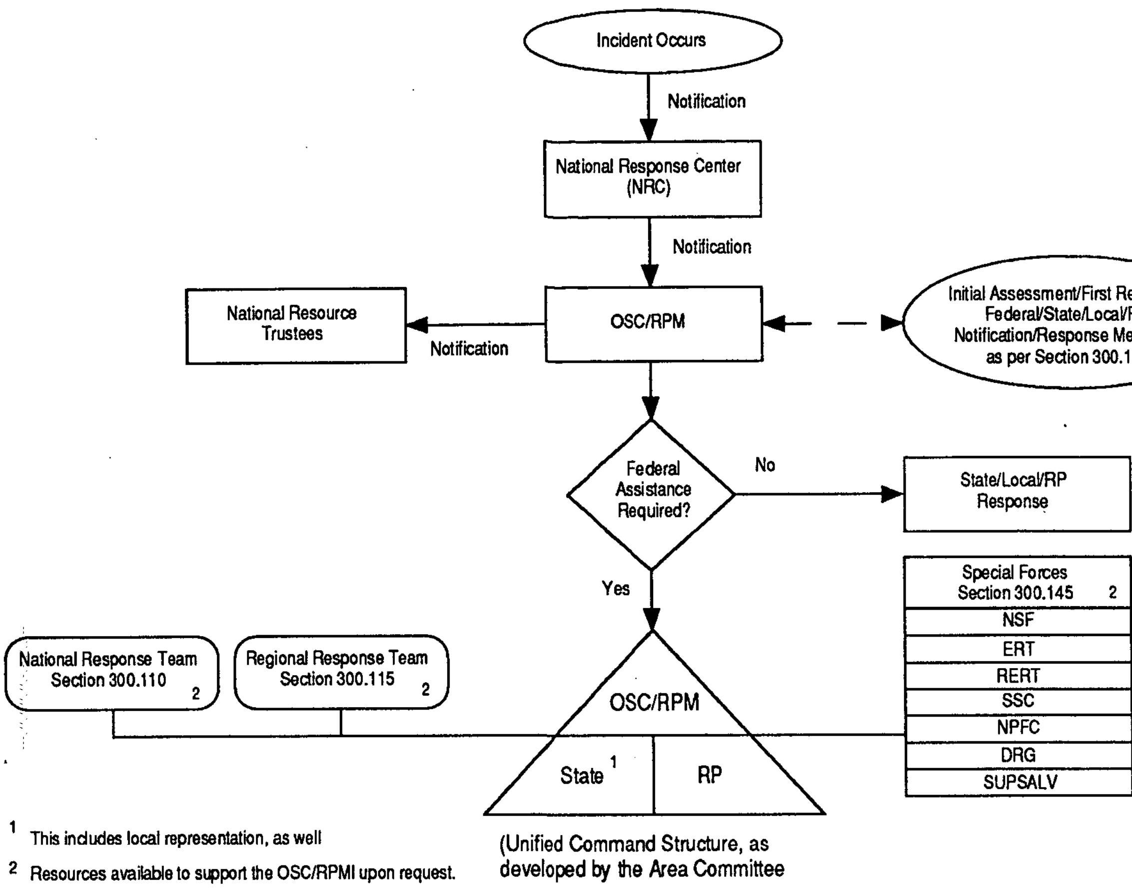


FIGURE 19. NRS STRUCTURE FOR RESPONSE (FROM: EPA, 1994A)

version was published on June 2, 1970; the latest revision was published on September 15, 1994. The NRS is intended to assure a high degree of preparedness with the goal of minimizing adverse effects on the environment, while preparing to deal with public expectations. The NCP provides national level policy guidance on spill response and makes available an array of public resources to respond to and mitigate the effects of a spill. It requires Federal and state oversight of response operations, while supporting the requirement in OPA 90 that the RP must act to effectively and immediately remove the spill.

The NCP provides "the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants and contaminants" (US EPA, 1994a, §300.1). Organizational structures are established at the national, regional, and area levels; preparedness and response roles, responsibilities and activities are defined in the NCP, Regional Contingency Plans, and Area Contingency Plans. In reality, the NRS is not a complete RMS that can be implemented during spill response to unify responding organizations. The NRS, as described in the NCP, lays out a framework and guidelines for developing an effective RMS. The NCP prescribes that the development of the details of the RMS to be used for spill response will be worked out at the local or area levels.

The NCP provides for two different NRS structures — one for planning and one for response. The concept for planning, displayed in Figure 18, generally reflects the same structure that was in effect prior to OPA 90, except for the addition of Area Committees under the oversight of the appropriate agency that provides the OSC for that area, either the EPA or the USCG. The concept for response, displayed in Figure 19, is new in this revision, and reflects the intent of OPA 90 that the response is a shared responsibility of the federal, state (and, if appropriate, local agencies) and the RP. The biggest departure from the draft of this revision, i.e., Interim Rule published on October 22, 1993, is the recognition and formal establishment of the Unified Command Structure.

This structure recognizes several concepts which are mandated in law and are fundamental to the philosophy of response reflected in the NCP.

- The law requires the President to "ensure the effective and immediate removal of a discharge" (US Congress, 1989, §311(c)). The President delegated this authority to the Administrator of the EPA for the inland zone and to the Secretary of Transportation, who passed it to the Commandant of the USCG, for the coastal zone in Executive Order 12777, dated October 22, 1991. The concept for response reflects the requirement for the federal government to take responsibility for the response through the OSCs of the respective agencies.

- State and, in some cases, local governments have mandated responsibilities for public safety, as well as a very strong interest in the overall conduct and management of a spill response. Additionally, many states have requirements in state statutes that mirror or complement the existing Federal requirements. Statutory and regulatory requirements aside, however, including the broadest possible range of agencies in a "shared governance" structure is clearly an appropriate action.
- The RP is expected to conduct the response under the oversight of the OSC, and in accordance with the NCP, appropriate ACP, and its facility or vessel response plan Therefore, must be included in the overall RMS.

A critical element of the NRS, particularly in light of RMSs, is the OSC. The federal OSC is the government officer with the ultimate decision making authority in the US. The OSC is "primarily responsible for directing response efforts and coordinating all other efforts at the scene of a discharge" (US EPA, 1994a, §300.105 (c)(3)). As noted earlier the USCG pre-designates OSCs for coastal zone, and the EPA for the inland zone. USCG Captains of the Port (COTP) are the pre-designated OSCs; there are 49 COTPs (some inland — river environments — COTPs are not OSCs). In EPA, however, the Regional Administrator for each of the 10 federal regions have pre-designated a number of OSCs (approximately 20) within each region. Both the Departments of Defense and Energy also have a limited OSC requirement, specifically for hazardous substances, pollutants and contaminants, and for military weapons and munitions, that are not discussed here.

The OSC retains the authority for the conduct of the response as the agent of the President (US EPA, 1994a, §§300.105 (d), 300.135 (d) and 300.305 (c)). However, the NCP states that "Except in cases when the OSC is required to direct the response to a discharge that may pose a substantial threat to the public health or welfare of the United States ..., the OSC may allow the Responsible Party to voluntarily and promptly perform removal actions ..." and that if the RP is conducting the removal the OSC "... shall ensure adequate surveillance over whatever actions are initiated" (US EPA, 1994a, §300.305 (c)). It is clear, then, that both the law and NCP intend for the OSC to observe and support, rather than direct — to "help the RP succeed," in the words of one senior USCG official.

With regard to spill management, the federal government views the RP as a full operational partner, with the OSC and state representative acting in a monitoring role, participating in making response decisions to support the RP in their execution of an effective response. If the RP is unable or unwilling to accomplish the response, the NCP provides for the federal government to direct response operations through the OSC.

The NCP requires preparation and approval of supporting plans, based on geographic divisions and company-specific scenarios, which, when taken together, enhance the probability for meeting the National Response Priorities (US EPA, 1994a, §300.317). All preparedness activities should jointly involve the full spectrum of public and private entities — Federal, state and local governments, potential RPs, public interest groups, the media, academia, industry — so that every aspect of society has the opportunity for a clear understanding and realistic set of expectations regarding how a response will be conducted.

UNIFIED COMMAND UNDER THE NRS

The unified command context as the RMS for oil spill response in the US is clearly articulated in the recently published revision to the NCP, which, in the section dealing with responsibility and organization for response and general organization concepts, states:

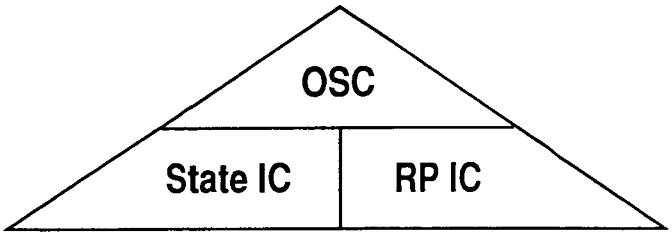
> "The basic framework for the response structure is the system (e.g., unified command system), that brings together the functions of the federal government, the state government, and the Responsible Party to achieve an efficient and effective response, where the OSC maintains authority" (US EPA, 1994a, §300.105.d).

Although the unified command form of RMS has just has been formally acknowledged in this latest NCP, this form of joint decision making and oversight has been occurring informally for some time. The long-standing policy in the US, for example, has been to encourage the RP to clean up spills and, when the RP takes adequate action to remove the pollutant and mitigate its effects, the principal thrust of federal activities is to monitor the situation and provide advice and technical assistance as necessary (Charter, 1971). With the passage of OPA 90, the national spill response policy mandates a full, active partnership between government and the RP. The preamble to the NCP gives a detailed discussion of this intent, "The emphasis during oil spill response is on coordination and cooperation, rather than on a more rigid system of command and control. The OSC, state, local government representatives, and the RP are all involved with varying degrees of responsibility, regardless of the size or severity of the incident" (US EPA, 1994a).

An important issue considered in this paper is how a Unified Command Structure can be used to help develop and implement a meta-system or "system of systems," that integrates the RMSs of individual organizations which participate in an oil spill response. The unified command aspect of an RMS, therefore, can be viewed as the organizational strategy used to manage interdependent groups of responders so that all response actions are executed in a systematic, effective, and efficient manner. Figure 20 illustrates this view of unified command, with the triangle representing the leaders of the RP, federal and state organizations. The notes below the triangle have been developed as part of the California area contingency planning process to define the responsibilities of unified command. Each entity in the unified command will have its own organizational system. How the individual RMSs of responders will be integrated is not specified in the NCP.

The structure as depicted actually reflects "the bottom line" where the federal OSC is the ultimate decision maker, and the "tie breaker" if consensus can not be reached among the participants in the unified command. In light of the current institutional philosophy, the RP can actually be at the top of the triangle to take the initiative to proactively manage the spill, after high level decisions are made within unified command. However, if the spill response begins to deteriorate, the OSC has the authority to take back control.

When considering how to implement an effective RMS, it is important to consider the significant differences between the



- Provide overall response direction
- Develop incident objectives
- Establish priorities
- Review/Approve Incident Action Plans
- Coordinate resources
- Ensure integration of response organizations
- Establish protocols

FIGURE 20. UNIFIED COMMAND STRUCTURE

USCG and EPA OSCs and how they interpret unified command. **Although all federal OSCs have the same authorities and responsibilities, the manner in which they discharge their OSC responsibilities is quite different and subject to their institutional and individual discretion.** This in large part is due to their different jurisdictional (geographic) areas and management style, i.e., differences between the hierarchical, military-based management structure of the USCG in contrast to EPA's decentralized, regional approach. The USCG OSCs are very senior officers (Captains) with relatively large staffs, dedicated to supporting them in their role as COTP. The USCG OSCs change about every 3 years. There are 49 COTPs around the country; the boundaries of each COTP zone are relatively long and narrow and usually within an hour or so drive from the COTP office. Pollution response is a collateral duty, which is routinely delegated to junior officers. The USCG jurisdictional area generally is comprised of navigable waters and the shoreline which immediately borders those waters, as was depicted in Figure 1 in Section 2.4. In contrast, the EPA jurisdictional area depicted in the same figure is the majority of the land area of the US; the area covered in each region is expansive. The approximately 200 EPA OSCs are typically mid-level civil service professionals, who have little or no staff dedicated to them as individuals. OSC responsibilities are full-time in EPA, and not subject to the routine job transfers. All OSCs have response and preparedness responsibilities.

With regard to response, EPA relies very heavily on state and local agencies to perform the on-site monitoring and oversight functions of government for their OSCs (Jarvela, pers. comm., 1994). The large geographic area of their jurisdiction seems to necessitate this approach; in most cases they are too far away to serve in a "first responders" capacity. Consequently, EPA OSCs will almost always have to take over the reigns of on-scene authority from the local or state government officials who were first on-scene. EPA OSCs routinely conduct initial monitoring of spills through phone conversations with local officials and RP representatives on-scene. In fact, the incident command post and UCS will usually be set up by local officials, particularly in cases involving a hazardous materials release. In these cases, it will be EPA who is the incoming member to an already established UCS. This decentralized management approach in inland areas obviously means that EPA normally has a less active role in unified command, unless the incident is of sufficient severity, or political significance, to require their on-scene presence.

Coast Guard OSCs, on the other hand, typically dispatch a junior officer almost immediately to the scene to investigate once a spill is reported. The OSC's representative is on-scene usually within minutes. They will probably be one of the first responders on-scene and will participate in setting up either a formal or informal unified command.

The opening remarks by Capt. Michael J. Donohoe, Chief of the USCG Environmental Protection Division, at the Unified Command Workshop held in Alexandria, Virginia, in May 1994, stressed that for unified command to work, four requirements must be met:

- The system needs to be designed and formalized in hard copy;
- Functions need to be defined;
- Individuals must be designated for each functions; and
- The participating organizations must make a commitment to responding as a unified command.

Capt. Donohoe noted that the last requirement, commitment, is the most difficult to achieve. The NCP does not define the RMS or organizational structure to be used beyond the implementation of unified command (although the functional elements of an ICS-type organization are implied in several places). The implementing system and structure to be used during response are left up to the determination of the Area Committees.

AREA CONTINGENCY PLANS AND RESPONSE PLANS

Under the NRS, Area Contingency Plans (ACPs) and vessel and facility response plans are the mechanisms through which the RMS is formalized. Industry prepares vessel or facility response plans, which describe their spill management (SMT) and RMS approach, for regulated activities which could accidentally discharge oil. These plans are reviewed and approved by the federal government: the USCG (vessels and marine-transportation-related facilities), EPA (non-transportation-related facilities), Research and Special Programs Administration of the Office of Pipeline Safety (pipelines) and the Minerals Management Service (offshore facilities).

ACPs are intended to articulate the view of federal, state and local agencies regarding the RMS to be used in a particular geographic area. In the coastal zone areas, the COTP in the particular zone, who is also the pre-designated OSC, is the chairperson of the Area Committee, with a state representative serving as the vice or deputy chairman. For inland areas, EPA chairs the Area Committee, not individual EPA OSCs. Figure 1 also depicts the division of area planning responsibility between the EPA and USCG. There are approximately 50 coastal Area Committees and 12 inland Area Committees.

The input of potential RPs into the planning process is recognized in the NCP as guidance to the Area Committee. RPs are permitted to participate only informally, at the invitation of the Area Committee, in the planning process — a serious shortcoming in the ACP process, in the view of the authors, because the opportunity to address agreements between government and private responders becomes discretionary and easy to ignore. Yet the unifying RMS to be used in spill response has to include RPs and is to be developed at the area level, according to the NCP. The provision of the NCP that RPs are not members of the Area Committees, and that their input is guidance which can be ignored, appears to be a vulnerability in the process for developing a unifying RMS.

The intent of the US approach is that the ACP and industry plans operate together to provide a "whole solution" during a response (Pond, pers. comm., 1994).

- The ACP spells out what government expects to be accomplished (what to do), e.g., what environmental areas are considered sensitive to oil and warrant priority in developing protection strategies, along with the government resources that can be brought to bear on the response; and
- The facility and vessel response plans are intended to describe how the governments' expectations and strategies will be met (how to do it), i.e., how the RP will manage the event, using what resources in what manner.

In the US, the government requires each response plan holder to have an organizational strategy in place to implement their response plan in the event of an oil spill because of the requirement to identify a SMT. Response management is putting this strategy to work, using the response plan, to execute a spill response (Giacoma, pers. comm., 1994). When the RP is actively responding, the applicable vessel or facility response plan describes their corporate RMSs to be used during the event. Likewise, the federal OSCs and the states can have their own RMSs to be used in managing their internal personnel and resources. However, the NCP intends that **the overall RMS to be used in carrying out joint management, i.e., by the OSC, RP, and the affected state(s), of the spill is to be specified in the ACP.** Again the preamble to the NCP discusses how this should occur at the area level (US EPA, 1994a). If the situation warrants the government to take over spill management, as in the case in "mystery" spills or where the RP is unwilling or unable to implement a response to the satisfaction of government monitors, the RMS described in the ACP will be the RMS used to manage the event. Even without the RP, there still is a need to have joint decision-making between the federal and state government. The RMS in the ACP provides a plan for that joint form of response management.

An ACP must contain a description of the area, including areas of special environmental or economic importance that might be damaged by a spill; a detailed description of the responsibilities of an owner or operator and of federal, state and local agencies in removing a discharge, and in mitigating or preventing a substantial threat of a discharge; a list of equipment, dispersants, or other mitigating substances and devices and personnel available to an owner or operator, and federal and state and local agencies; a description of procedures to be followed for obtaining an expedited decision regarding the use of dispersants; and a description of how the plan is integrated into other ACPs and tank vessel, offshore and onshore facility response plans approved by the President (US EPA, 1994a, §300.210 (c)(3)).

Both types of response plans have been prepared — OPA 90 required that ACPs be submitted February 18, 1992 and the industry plans were due one year later on February 18, 1993. The ACPs have turned out to be, in the first iterations at least, primarily federal documents for several reasons, not the least of which were the difficulties in getting private entities involved in the formal committee process. This is because of the constraints of the Federal Advisory Committee Act and the inherent difficulty in achieving a consensus among the regulated community on what the responsibilities of potential Responsible Parties ought to be.

Again referring to Figure 1 in Section 2.4, ACPs prepared under USCG OSCs for coastal areas focus on a much smaller geographic area than the inland zones. The differences between EPA's and the USCG's geographic scope and, to a lesser extent, their institutional approaches mean that the ACPs prepared under each of the agencies' chairmanship are very different. The ACPs for inland areas are essentially newly revised Regional Contingency Plans. Coastal ACPs, on the other hand, are new and separate documents.

EPA's approach to preparing ACPs varies among the regions and is generic at the regional levels. In keeping with EPA's decentralization, the regions were given little detailed guidance from EPA headquarters on what should be in their ACPs. Most importantly, the large geographic area makes it very difficult to develop the kind of detailed plans and strategies that are being included in the coastal ACPs. Their ACPs are revisions of the Regional Contingency Plans (since the EPA "areas," in most cases, correspond to their regional boundaries) and provide only general RMS and other types of guidance to RPs. This provides an opportunity for state and local officials to indicate priorities for protection and exercise their discretionary authorities as appropriate to the situation. Although this makes sense for the various levels of government in the inland areas, it creates a significant dilemma for RPs. It makes it very difficult for them to comply with inland ACPs because they are so generic. The absence of definitive guidance in the ACP also makes it difficult for RPs to have a clear sense of what EPA expects during response because the initial assessment and monitoring functions of government are, in essence, delegated to local levels without any explicit guidance on how those government levels will work with the RPs to implement unified command and incorporate the RPs RMS. RPs with nation-wide facilities and vessels are at a severe disadvantage — there is inadequate and inconsistent government guidance on what RPs should do to respond effectively in different geographic areas.

Coast Guard OSCs were given guidance from headquarters on what should be in their ACPs. Commandant Instruction 16471 is the primary USCG guidance on preparation of ACPs (US DOT, 1992). It contains pages of "boilerplate" wording which "should" be included as written (page 4), with little flexibility in meeting area-specific concerns. Our review of an admittedly small number of ACPs indicates a high degree of compliance with the "should" portions of the Instruction. Some EPA-led Area Committees have used the USCG guidance in preparing new inland ACPs, while others have merely made modifications to their Regional Contingency Plans, since EPA has not published a similar document.

Existing ACPs have yet to clearly articulate in written form how the response organizations of government and the RP will be integrated during response, although there is acknowledgment that integration is a goal. The authors reviewed seven ACPs from areas on the East, Gulf and West coasts and one ACP from an inland area. As background, in April 1993, USCG headquarters circulated a draft of a Unified Command System Organization developed by the 11th Coast Guard District for use by the three Marine Safety Offices in California. This organization displays approximately 237 functions depicted as blocks in multiple organizational diagrams. The draft was circulated to provide a point of reference and encourage discussion within the committees on how to best manage spills in each area. However, review of various coastal ACPs (excluding one area included in the 11th District area) indicate that all but one plan use that draft UCS as their "template." In fact, four of the five used the 11th District draft, including position descriptions and functions, and organization diagrams, without noticeable modification. Nor was there any clear indication that state or local agencies, or representatives or any RP had any input. Additionally, while the system purports to be "unified," only one ACP had any discussion of how functions would be integrated or if any entity except the local COTP office would be involved. In the one ACP that did include RPs, only 5 of 237 functions were delegated to the RP, and all of those were in the claims and public affairs functional areas — the remainder were allocated to various federal and state agencies. It is clear that, while the requirement for a "unified" structure is acknowledged, many Area Committees have not yet developed one.

In part, this organizational dilemma may be due to the fact that OSCs are faced with a dual requirement. First, they must be prepared to assume responsibility for total management of a response if the RP is unknown or if the RP can not or will not conduct an effective response. In short, they need to have an internal system for managing the response without RP participation and possibly little state involvement in managing response resources. Second, they must be prepared manage jointly by assisting and supporting the "responsible" RP who is actively and effectively executing their response plan. It is possible that the OSC organization, endeavoring to support such divergent missions, will tend to revert to its own internal structure and systems when confronted with the realities of an incident, regardless of its stated "unified" nature. This remains a significant preparedness issue in many areas.

The inland zone ACP which was reviewed was a revised version of Regional Contingency Plan that existed prior to OPA 90. Few of the requirements of the new law had been incorporated. The RMS did not include state, local or RP representation, or any description of the duties or responsibilities of individuals in the various functional areas. In fairness, inland Area Committees face a very different, and significant, problem than the coastal committees — the geographic areas involved are very large, with the potential for wide range of interests and problems. EPA Region IV, for example, encompassing eight states in the southeastern US with countless rivers and waterways, is constituted as a single area. The other EPA regions face a similar geographic challenge. While the Regional Administrators have the authority to either constitute their entire region as a single area or subdivide the region into smaller, more manageable areas, few have done so at this time. The authors suggest that developing an effective, unified RMS under such circumstances does not appear to be a realistic expectation, unless a different approach is taken in the inland areas.

Full integration of the entire response organization, not simply creation of a three-party decision making body at the strategy level, is an important concept for response (US EPA, 1994a). Full integration of federal, state and RP assets into all functional sections, led by the most experienced and qualified personnel assigned by consensus of the OSC, state representative and RP Incident Commander, can lead to more effective response management throughout the organization. It enhances communication and coordination, provides the broadest technical knowledge and experience base, leads to the formulation of joint recommendations, encourages formation of temporary, informal, multidisciplinary decision making groups, and enhances individual acceptance of group decisions and actions. This full integration presumes, however, common goals, event-specific objectives and strategies which would occur through unified command. These are among the minimum requirements for highly reliable organizations, or effective spill response management.

It appears that the unified command structure mandated in the NCP could be implemented in two ways: (1) the Area Committee could prescribe an integrated RMS, or (2) each of the three organizations participating in the unified command may organize and manage its own resources using their own RMS, integrating only at the command or decision making level. There are problems associated with both of these approaches. In the first case, the "integrated" organization may break down during crisis periods when effective decision making is most required because the responding organizations have dissimilar cultures, internal management systems, and, at some point, divergent goals. In the second case, the federal government, state government, and RP can have the same event-specific geographical and functional interests; however, they will differ in who they are responsible to. This can lead to a divisive, and possibly adversarial, perspective in unified command which, in turn, could erode the spirit of cooperation, mutual support and coordination in decision making and the execution of spill management responsibilities.

The need for an integrated form of RMS — one that addresses how multiple responding organizations will be brought together and integrated — is being recognized in some the coastal Area Committees. The most obvious example is in the California Area Committees, where ICS originated. A regional workshop was held in California in March 1994 in which the State, the Coast Guard and several oil companies, e.g., UNOCAL, Chevron, and ARCO, met to:

(1) improve their response efficiency;

(2) develop a letter of understanding of how to integrate the response organizations through discussions of roles, responsibilities and concerns; and

(3) use the lessons learned from the workshop to improve Annex B (Organization) of the ACP.

This workshop produced a consensus on response roles and responsibilities as displayed in Table 10, using an ICS-based system. Columns 1 and 3 in this table indicate the roles (monitoring role, lead management role) of the various principal response organizations, e.g., the federal, state, and local governments and the RP, in relation to functional areas. The management column is especially significant because it clearly shows that in California, except in a few areas such as sensitive area identification, a single entity will have the primary management responsibility. What is not readily discernible from this table, however, is whether or not decisions in the functional areas will be made jointly. The second column indicates the functional areas where response organizations will be integrated, using Spitzer's definition in Section 1.2.

Table 10 is an example of a critical aspect of preparedness with regard to unified command because the workshop provided an opportunity for responding entities to mutually agree on how their organizations will work together during spill response, and this agreement was formalized in writing. The output of this workshop is being included in the next revision Annex B of the ACP. This is the only concrete example the authors could find that specifically defines, and in writing, the basic organizational structure and integration of functions for multiple response organizations in a unified RMS.

This workshop approach used in California appears to be an optimal way for developing an integrated form of RMS that allows for all RPs to have input into determining what kind of RMS will influence them if they have to respond in that area. It does present limitations for RPs who may have to respond in multiple areas because the RMSs in various ACPs will probably be different. It is a challenge for RPs of national and international scope to be familiar with many different government approaches to RMS.

TABLE 10. UNIFIED COMMAND FUNCTIONS IN CALIFORNIA

Functional Activity	Monitor	Integrated Resource	Manage
Coord. of Response Operations	F/S/L	F/S	R
Media Relations		F/S/L	R
Recovery Operations	F/S/L	F/S/L	R
Safety: Response Workers	S/L	F/S/L	R
Safety: Community	F/S/L	F/S/R	L
Alternate Response Technology	F/S/L	F/S/L	R
Trajectory/Dispersion Analysis	F/S/L	F/S/L	R
Sensitive Area Identification		F/L	R/S
Plan Development		F/S/L	R
Wildlife Protection/Rescue		R	F/S
Volunteer Management		S	F/S
Logistical Support	F/S	F/S/L	R
Communications	F	F/S/L	R
Waste Management		F/S/L	R

F=Federal, S=State, L=Local, R=Responsible Party

It is not possible to fully evaluate the integrated form of RMSs in the ACPs because, presently, they are incompletely developed and still evolving. The California area workshop appears to be the farthest along in the process of developing an integrated form of RMS, but even there, the output of the workshop emphasizes structure and functions and does not yet describe the other aspects of a RMS, i.e., management processes and procedures. The output of the workshop also appears to not distinguish among spill significance, it conveys an impression of uniformly using a large organization; it does not appear to offer a scaled down version of RMS for managing routine spills. It does, however, appear that an area workshop is the logical place for domestic RMSs to address in a substantive way how multiple responding organizations will be integrated. As will be seen in the next sections, the RMSs developed within the states and industry focus much more on managing their respective internal organizations, although there are exceptions.

STATE SYSTEMS

Because the states are one of the principal responding entities, it was important to review their current RMS activities. Substantial written descriptions were available for the state RMSs reviewed; consequently, this section reflects greater detail than the other descriptions of existing RMSs. To provide a basic understanding of the range of state RMSs in the United States, states with a reputation for proactive spill response programs were identified. The final selection of states reviewed represents a wide philosophical and geographical range. The response organizations of six states — one each from the mid-Atlantic, southeast, and Gulf Coast, and those from the West Coast — were reviewed. Each state provided a written description of their system; telephone discussions were conducted to clarify points or obtain additional information.

All but one of the state systems are variants of the NIIMS ICS, modified in varying degrees to manage response operations. In the one state system which does not use an ICS variant, spill response is included in the state emergency operations system, and their representative indicated that the state would integrate into the RP's RMS. We reviewed the systems to describe how closely each complied with fundamental ICS concepts, listed in Components of the ICS, in the Operational System Description (ICS-120). We selected these since, according to ICS doctrine, these components "working together interactively provide the basis for an effective ICS concept of operation." The comparison of state RMSs is summarized in Table 11. While flexibility and adaptability are proposed as hallmarks of the ICS, it may be that if a variant does not have the capability to include these basic components, the advantages of ICS may not be fully realized. These components have been identified in Section 2.4.

TABLE 11. ICS COMPONENTS REVIEW MATRIX

REVIEW FACTORS	State A	State B	State C	State D	State E	State F
Modular Organizations	YES	A	YES	YES	YES	YES
Integrated Communications	NO	NO	NO	A	YES	A
Unified Command Structure	YES	NO	NO	YES	YES	YES
Consolidated action plans	NO	NO	A	YES	YES	YES
Manageable span-of-control	A	A	YES	YES	YES	YES
Predesignated Incident Facilities	A	YES	YES	YES	YES	YES
Comprehensive Resource Management	YES	YES	YES	YES	YES	YES

A = Assumed. While the issue is addressed in the plan, but with insufficient detail to confidently give it a YES. In those cases where we could see how the issue was addressed by its relationship to other functions, we assumed it was covered, and assigned it to this category.

Common Terminology was excluded because there is no standard for either position titles or equipment packages in the oil spill response community against which to compare the state plans. Some states use definitions, apparently based on state statutes, which differ from those in the FWPCA (US Congress, 1989) and the NCP, which have the potential to create confusion during a response operation. Specific examples included definitions of "pollutants" and "hazardous substances." In the judgment of the authors, the potential for confusion inherent in the differences in definitions highlights the rationale behind the emphasis on common terminology in the standard ICS.

While the drafters of one plan have developed a common terminology for agencies under the plan, we could not determine whether other, non-governmental response entities, such as RPs and OSROs, have agreed to common terminology in areas such as equipment capabilities, crew size and position designations. The development of common equipment terminology was apparently one of the areas that took the longest to resolve in development of the standard ICS (Johnson, pers. comm., 1994).

In reviewing **Modular Organizations,** we tried to determine whether the states had a mechanism to increase not only the size, but more importantly, the functionality of the organization in a logical manner based on a stated criteria. Each state had some mechanisms to increase the size of the organization as a situation became more significant. The criteria for augmentation of the basic force were size, comparison of the potential involvement by the state to involvement in other spills, and subjective issues, such as the amount of media attention. In some states, the plan describes a structure, but does not address criteria for growth of the overall organization. Also, it was not possible to determine whether adequate consideration had been given to the changing nature of the organization as the response becomes more complex and the decision making environment both more rapid and more turbulent.

In reviewing **Integrated Communications,** we looked for procedures to establish a common communications capability, integrated into the UCS. In the standard ICS, this component consists of both establishment of a single integrated communications center and a single unified communications plan. All state RMSs had provisions for establishment of communications, but the authors generally were not able to recognize provisions to support the integration of the broader communications mission.

For the **Unified Command Structure,** we looked for the mechanism to participate as an equal partner in the management of the response. We looked for positive planning steps that addressed the integration of all functions throughout both the breadth and depth of the organization and how it would be accomplished. Included was whether the state has a mechanism for addressing stakeholder issues, including groups or concerns that surface based on the specific nature of the event which were not considered in pre-planning.

It was interesting to note that four of the states, including two which had their plans in draft — indicating, we assumed, a recent rewrite or revision — did not mention the appropriate Area Contingency Plan and its relationship to the state's participation in the preparedness and response process.

In one case, the state differentiated between the Unified Command and separate federal and state oversight organizations. Unified Command consists of the federal, state and RP representatives, which is responsible for conducting containment, control and clean up. The state and federal oversight organizations appeared to have identical functions to independently manage monitoring, investigations, permitting, damage assessments, restoration and documentation for possible litigation or cost recovery. The plan calls for, but did not describe the mechanism for, coordination between the various structures.

One state has planned very carefully for the full integration of local governments and citizen groups in the decision making process. Their plan uses ten area-based regional MACs as advisors to the Unified Command, providing the opportunity for providing comments and recommendations on event priorities, objectives and the Incident Action Plan. There are provisions for proactive Unified Command liaison with each group, as well as MAC representation based on incident-specific, or even phase-specific issues. (For a full discussion of the way emergent groups or emergent issues of existing groups were addressed during the *Exxon Valdez* response, see Chapter 4, US Department of Transportation, 1993).

It is our general observation that while other states address the emergent group issue in some way, they contain insufficient detail to create the expectation of success in fully integrating these outside influences during the initial phases of a response to a significant spill. While full integration might be achieved later in the response, the chances of success appear to be enhanced if each RMS plans for inclusion from the earliest moments of the event.

One state has also developed useful criteria for determining when a local response organization, such as a fire or police agency, should be included in the Unified Command structure. Their position is that as long as there is an immediate threat to public safety, the Local On Scene Coordinator should be part of the UC. After the imminent threat has passed, the local governments are included in the MACs.

In several states, there did not appear to be pre-spill planning and coordination with either the OSCs (USCG or EPA) or any RPs to facilitate integration of the UCS during a response. For example, one RMS, when referring to the responsibilities of the functional areas, states, "Plug into the ICS structure of the RP/Feds." It is unlikely that this level of detail could be of much help during the emergency phase of a response operation.

In **Consolidated Actions Plans,** we tried to determine if there was a mechanism for incorporating state input into the overall planning process. Planning during the response is a critical area since it is the primary mechanism for the response organization to analyze the overall situation and translate the unified command's overall goals and event objectives into tactical operations. Typically, this is the functional area that addresses environment, wildlife, National Resource Damage Assessment (NRDA), dispersant use, *in situ* burning and waste disposal. Two state RMSs had detailed procedures to participate fully in an integrated Planning Section, while the others acknowledged the requirement, but were less considered in their planning.

In **Manageable Span-of-Control** we looked at only a single factor, which was whether any individual on the organizational diagram had more than seven individuals reporting to him/her. We were unable to evaluate this component for two of the states, which had no diagram in their response planning document.

We evaluated **Predesignated Incident Facilities** only to determine if there was any consideration given to selection and set up of a site for response operations. One plan addressed the issue of providing sufficient space during a response for a fully integrated Unified Command by providing specific locations which could be used in each of their Geographic Response Plans.

In **Comprehensive Resource Management,** we looked at plans for use of any state resources. This turned out to be less than useful since only one of the six states has its own equipment. However, each state did have procedures for initiation of contracts and monitoring of contractor activities in support of response operations. One state had good procedures for activation of state funds and obtaining expeditious access to the Oil Spill Liability Trust Fund to limit state vulnerability.

Pre-event actions are fundamental to the success of any response system, therefore, we tried to determine whether the RMS in any of the states had sub-systems, such as those integrated into NIIMS, to support the preparedness and sustainment of their ICS. We were particularly interested in the areas of training, qualification and certification, and publications development and distribution.

None of the states had any of these sub-systems in place so the issue was not pursued further. Adoption of ICS variants for oil spill response is a fairly new phenomena and development of the full range of support is continuing. It is useful to note that even the standard ICS is a "living system," continuing to evolve after nearly twenty-five years based on the experience of the users. There is currently, for example, a standing interagency ICS Working Team and ICS Training Team considering revisions to enhance the utility of the entire NIIMS system (Munkres, pers. comm., 1994; Josephson, pers. comm., 1994). As Hunter (pers. comm., 1994) from the state of Washington Department of Ecology stated, "The (standard) ICS is like a grandfather, while our ICS is like an infant, or maybe, an adolescent." Hunter and others attending an Oil Spill Incident Command System and Unified Command Workshop in July 1993 noted the need for both standard ICS and "oil spill ICS" training (State of Washington Department of Ecology, 1993).

The type of individual training required to fully support any RMS, but particularly a system such as ICS or one of its variants, is in addition to and distinct from the exercises and drills conducted under OPA 90 or the National Preparedness for Response Exercise Program (PREP) (USCG, 1994a). Members of a response organization need to be trained in their specific individual roles and responsibilities for each position they could be called upon to fill. For example, an individual may be an Incident Manager for a medium spill, but the Operations Chief for a major spill — he or she should be trained in each function to assure they are prepared to fulfill that function. PREP exercises and drills are truly "learning experiences," providing a broad range of significant training opportunities. In general, however, the primary intent is to exercise organizations — and the coordination and relationships between organizations — rather than the individuals in the organizations. If a person comes into an exercise fully trained in his or her individual functional responsibilities, then the exercise will have maximum value. On the other hand, if an individual views an exercise as the only training he or she will need, and is not trained before participating, they will no doubt learn something, but the overall value will be reduced.

The true measure of the effectiveness of the RMS is whether the response is judged by the public to be a success. However, there have not been enough significant spills in these six states to develop any meaningful data based on this criteria. Therefore, we tried to determine from the system descriptions provided, how each of the systems addressed the CSFs, described in Section 4.1. The summary of the comparison of state RMSs by CSFs is displayed in Table 12.

TABLE 12. CRITICAL SUCCESS FACTORS (CSF) COMPONENTS REVIEW MATRIX

	CRITICAL SUCCESS FACTORS	State A	State B	State C	State D	State E	State F
1.	The salvage operation for a vessel, or emergency response operation at a facility, must minimize spillage of oil and must not interfere with pollution response operations.	1	1	1	2	2	1
2.	The immediate response by the RP and the OSC must mobilize enough appropriate response resources to contain the oil at or near the source and to protect sensitive areas.	3	2	3	3	3	3
3.	The response organization must be able to comunicate and manage information internally and externally.	1	1	2	2	2	2
4.	Federal, state and local organizational coordination must be pre-planned, must account for stakeholder interests, and must ensure a response organization that will be cohesive and effective	1	1	2	3	2	3
5.	The response organization must be capable of sustained effective operations.	3	3	3	3	3	3
6.	The response organization must meet the public's realistic and achievable expectation for pollution response.	1	1	2	3	2	3

3 = Appears to meet CSF to a high degree
2 = Appears to meet CSF to a moderate degree
1 = Appears to meet CSF to a lesser degree

The review of the state RMSs against these criteria is more subjective than the review against the ICS components, and reflects not so much a detailed and defensible analysis of each plan, as an attempt to explain how the results of theoretical research can be used as a tool to self-evaluate, and then improve, response plans. As noted above, the most meaningful question to ask is "How well did it work when it had to?" Yet many plans have not had the opportunity to be used in an actual event. Even when they have been used during a spill, the response is subject to so many variables that the best plan may have little impact on effectiveness or success.

State plans for implementation of their RMS against the CSFs were reviewed since they were developed by a broad range of oil spill response experts in several different hindcast exercises conducted under controlled conditions and empirically validated. They are perhaps the most valid indicator of those factors that, if adequately addressed both in the preparedness and response phases, could provide the greatest potential for creating success. It may be possible to evaluate an RMS against these factors to determine strengths and potential weaknesses.

If the goal of response is to minimize the effects of the spill on the environment, then the importance of **Critical Success Factor #1** is self-evident. During the *Exxon Valdez* response, for example, the Coast Guardsmen and contractors who reduced the volume of oil that could impact the environment in Prince William Sound and the Gulf of Alaska from 50 million gallons to 10.8 million gallons through their lightering and salvage efforts over 11 days, had a far greater influence than all the other operations in the next 39 months combined.

Like SAR, salvage and emergency operations, including fire fighting, have different players, such as the Master of the vessel, salvors, ship agents and even different insurers. Yet the salvage and fire fighting functions are typically put under the Operations Section, even though the OSC, in his role as the COTP, has at least as much direct responsibility for SAR, which is not included as part of response operations. There is ample support for keeping the salvage function, for example, separate and distinct from operations, with provisions for constant and considered coordination (O'Brien, pers. comm., 1994; Nichols, pers. comm., 1994). But regardless, it appears that salvage and emergency operations are critically important and should be rigorously addressed in the planning process at all levels, including the ACP. It appeared that only one state had planned at any level for management of the salvage operation.

All six states start with the basic assumption that the RP will manage the response appropriately. In looking at **Critical Success Factor #2,** it also appears that they all have well-considered procedures to assist the RP, along with the OSC, in the event that actions during the emergency or initiation phase do not proceed as planned. All indicate that they have contracts in place to supplement the RP or call out contractors independently at the discretion of the State OSC. While in a catastrophic spill there simply might not be enough appropriate resources to contain the oil at or near the source and to protect sensitive areas, the planning considerations reflected in the RMSs appear to be as much as could be expected of all three responsible entities.

In regard to internal and external communication and management of information, **Critical Success Factor #3,** each element of the UC must commit to participation in an operational partnership. If the OSC and state are to bring their considerable assets to bear to ensure the success of the RP, then the UC should foster a proliferation of new, event-specific ways to ensure everyone is informed and considering how his or her part in the response can help someone else succeed. Waste management decisions are an example. Virtually everyone — the RRT, specific state agencies, the RP, and the operational, planning, logistics and finance command staff sections, the legal officer — has a legitimate role to play. The results of the hindcast exercise (that led to the development of the CSFs) indicate that formation of informal decision making groups to tackle multi-disciplinary, multi-functional problems is the result of exceptional communications more than the placement of blocks on a chart. The RMS must lead to "development of dotted lines [indicating coordination and communication] among organizations, where everyone understands what to expect" (Donohoe, pers. comm., 1994).

Several of the state plans incorporated the establishment of communications in the sense of telephones and radios, rather than in the sense of people talking to one another. Provisions in the RMSs to enhance the internal coordination of the Unified Command should be reviewed with an eye towards a broader definition of communication.

Critical Success Factor #4 is perhaps the clearest example of how detailed planning can enhance the probability of success. The Alaska Unified Plan has detailed provisions for including outside groups — not only those identified during pre-spill planning, but others that emerge during the response — in the decision making process. They have a series of Regional Multiagency Advisory Coordination Committees (MACs), with specified roles and responsibilities, tentative representation and procedures for inclusion of additional members. As noted earlier, the general acceptance of the concept appears to be the result of the success of the program in the later stages of the *Exxon Valdez* response operation. The results of research described earlier in this paper consistently indicate that one characteristic of response management organizations that fail during a crisis or disaster situation is their structural inability to quickly recognize groups with emerging concerns that were not addressed in the pre-event planning process, and incorporate their concerns and input into the overall response strategy.

The standard ICS uses Liaison Officers as "the point of contact for assisting and cooperating agency representatives, Red Cross, law enforcement, public works, engineering organizations and all others" (Incident Command System, 1983). Because of the potential for involvement of a wide range of citizen and environmental groups, as well as local governmental jurisdictions, the authors suggest that the function in an oil spill-specific RMS is fundamentally different. The Liaison Officers will likely have to take a highly proactive approach, seeking out emergent groups, resolving problems, and establishing procedures to include emergent groups at an appropriate level, rather than serving as a more passive "source of information." State RMSs recognized that the organization will have to interact in some way with these types of groups and have included Liaison Officers and Ombudsmen in the various organizations. However, the role description does not appear to a responsibility to address the concerns and potential need for active participation by a community in the initial stages of the operation.

In assessing **Critical Success Factor #5,** it was assumed that since each state has procedures for incremental, modular expansion of the RMS, they are prepared to conduct extended operations.

While **Critical Success Factor #6** focuses on the public's expectations, the authors suggest that the entire response organization can influence or manage these expectations through a combination of integrated public affairs operations and a proactive liaison program with local communities and groups, as noted above in the discussion of Critical Success Factor #4. As noted in Section 1, in the survey of various responders, only 9% indicated that "getting the message and facts to the public and creating a positive image" is a legitimate objective of response activities. However, 41% of those responding to the question "What is a successful response?" indicated that "the public and media perceive success and are satisfied with the response" is a factor in determining success. It was, interestingly, the most common response. These two indicators, while admittedly insufficient to draw empirical conclusions, suggest that while the response is focused on the issues addressed in the National Response Priorities, informing the public of intent and status of operations and ensuring that their expectations are as realistic as possible should be a significant consideration. Each state has a liaison capability, as well as at least an intention to participate in a joint or unified information process. Experience has shown that this is an area that requires a significant planning and coordination effort.

INDUSTRY SYSTEMS

In reviewing RMSs developed by industry, eleven companies were examined — eight major oil companies, having vessels, facilities, and pipelines; one utility company that burns oil as a primary source of fuel in electricity and steam generating activities; one national OSRO (MSRC); and one consulting company (The McCloskey Group-TMG) that advises industry on development and implementation of ICS-based RMSs. The RMS of most of these entities emphasizes how to manage spill response on the basis of internal, and contracted, resources. Very little policy or descriptive material was available on how the industry RMSs would integrate with government RMSs, or how the Incident Managers would participate within a unified command.

Many major oil companies and MSRC have based their RMSs on the McCloskey Response Management System, which is an ICS variant. The McCloskey Group (1994) RMS reflects many of the NIIMS ICS concepts and terminology, including an emphasis on position descriptions, incident action plans, and procedures to transition from the emergency to project management phase, among others. The McCloskey RMS is a complete system from the standpoint that it addresses organizational structure, management process, individual roles and operational strategy. It is close to the NIIMS ICS but it is still a variant because the companies that adopt it change the many of the details of the system to fit their internal corporate culture. In talking with the various companies there was little agreement among them about how they used the system, e.g. some viewed the McCloskey RMS as functional "boxes" while others paid less attention to the "boxes" and emphasized its management process. The differences among companies on the basic organizational structure is a significant issue in developing an overall RMS. For example, one company whose organization diagram is ICS based (and not the McCloskey RMS) has planning, which is one of the five principal functional areas of ICS, as a sub-function under operations.

Comprehensive discussions into the most effective way to manage spill responses have been conducted with some of these companies over a number of years, and in other cases, we only conducted a review of their contingency or response plans. Based on the sensitivity of the information, all but one company representative requested that the company not be identified. Some of the companies have been observed in spill exercises, including those conducted under PREP, over a period of years. There are several specific observations that emerged as a result of our discussions and review.

1. All of the potential RPs understand that they are responsible for managing the spill. Some companies intend to

aggressively manage the response from the outset and have, in fact, done so in spills to date. Companies generally believe that OSCs have an expectation that RPs will use ICS, and that the OSC will require them to integrate into the federal RMS during a spill response.

2. All the oil companies reviewed use ICS variants. Many are quite firm in their belief that such a system is the "only way" to manage a spill response. Some note that state regulations where they operate require use of ICS to manage emergencies. None of the companies address in a substantive way the issue of integrating the RP response organization with the federal and state organizations. Most RPs have plans which are likely to lead to success in the majority of incidents, since most are minor or routine. In preparing to respond to a worst case discharge, however, they do not appear to plan for the fundamental changes that must occur — the plans accept the requirement to get bigger, but are less aware of the requirement to get different as well.

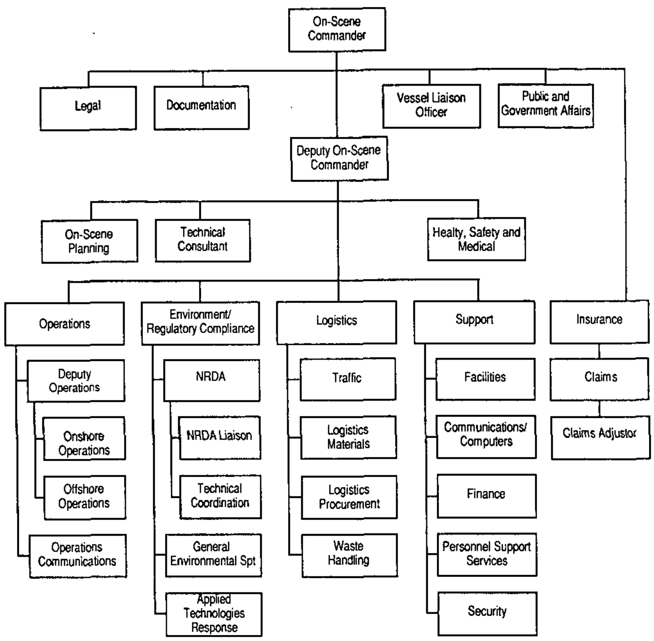


FIGURE 21. COMPANY 1 — RMS ORGANIZATION DIAGRAM

3. While preparing an organization diagram is not the same as developing and implementing a RMS, seven different variations on the ICS are presented as Figures 21 to 26 to indicate the range of system modification within industry. All of the companies say they use "the ICS," but all have adapted it differently for their own purposes. This is viewed as a positive factor, since it implies an analysis of what existing elements of their organization are best suited for response, and how they should be organized — this is a characteristic of an open, problem-solving system. It is interesting to note that several of these companies used a single consultant to develop the system, but later adapted the basic document or did not incorporate critical elements of the design, such as clearly defining the roles and responsibilities of individuals and subsystems. It is possible that integration of federal, state and RP organizations might be hampered by the fact that the entities may not start from a common basis, even though each states that they are using "the ICS."

4. Usually the corporate versions of ICS are not fully developed systems, but more typically a depiction of how the organization is structured in the pre-event period. In many cases it is primarily an organization chart, without documented supporting subsystems and management processes that are the foundation of the NIIMS ICS, such as detailed descriptions of roles and responsibilities, training requirements, or programs to qualify personnel to fill various positions. When asked about how an organization depicted on a chart is expected to work, many managers note that they fully expect their organization to change as a significant response progresses. They understand that initiation and mobilization of resources in the emergency phase is critical, but do not have a set of objectives that define how the organization will transition to and function in the project phase. The theoretical literature indicates that during a significant or catastrophic spill response the management environment becomes more complex and turbulent. Unless the steady-state organization recognizes that it must become not just bigger, but fundamentally different, *ad hoc* decision making organizations, over which the RP could have little control, will very likely emerge.

5. In every case, the companies used in-house assets from various departments, as well as contracted resources, to form response organizations. Personnel with primary responsibility for corporate preparedness typically form the core of this organization, which is fleshed out by pre-identified individuals, whose normal duties have little or nothing to do with oil spill response, but with functional specialties required for each specific event. These individuals normally drill together in spill management team exercises, which provides their only opportunity to work together as a team. It is probably inaccurate to characterize such a team as an *ad hoc* "stranger group," but the term "acquaintance group" might apply.

6. When managers are asked about job descriptions and training, the most common response is that the people will be "doing the same thing they do every day." It is often in major exercises where the everyday functional differences, such as the incompatibility of computer systems that support purchasing functions (buying something) and contracting functions (leasing something) are recognized. A related, common occurrence, although not universal, that could have implications during responses is that many of the most experienced managers within the corporation, who are most involved with preparedness, are the ones that plan and facilitate exercises, but normally do not participate as players. Many of the technical advisors also facilitate or control during exercises, rather than participate with the team.

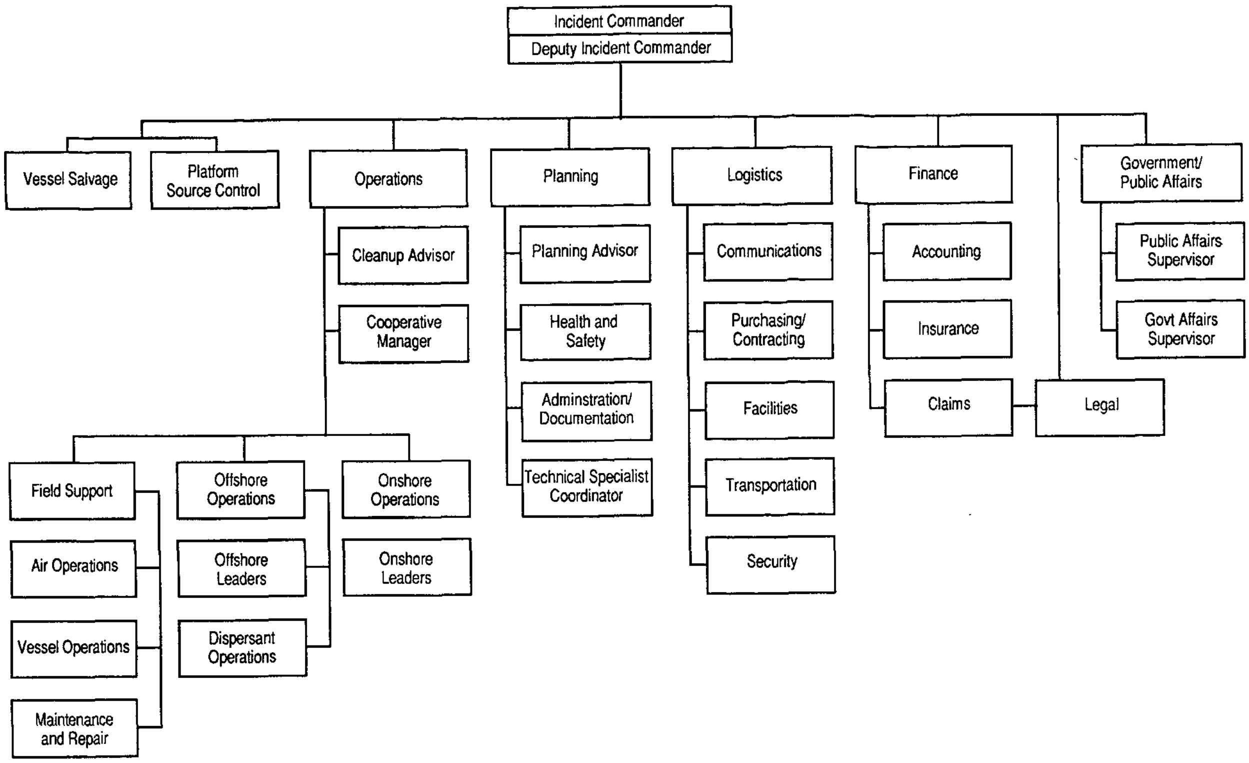


FIGURE 22. COMPANY 2 — RMS ORGANIZATION DIAGRAM

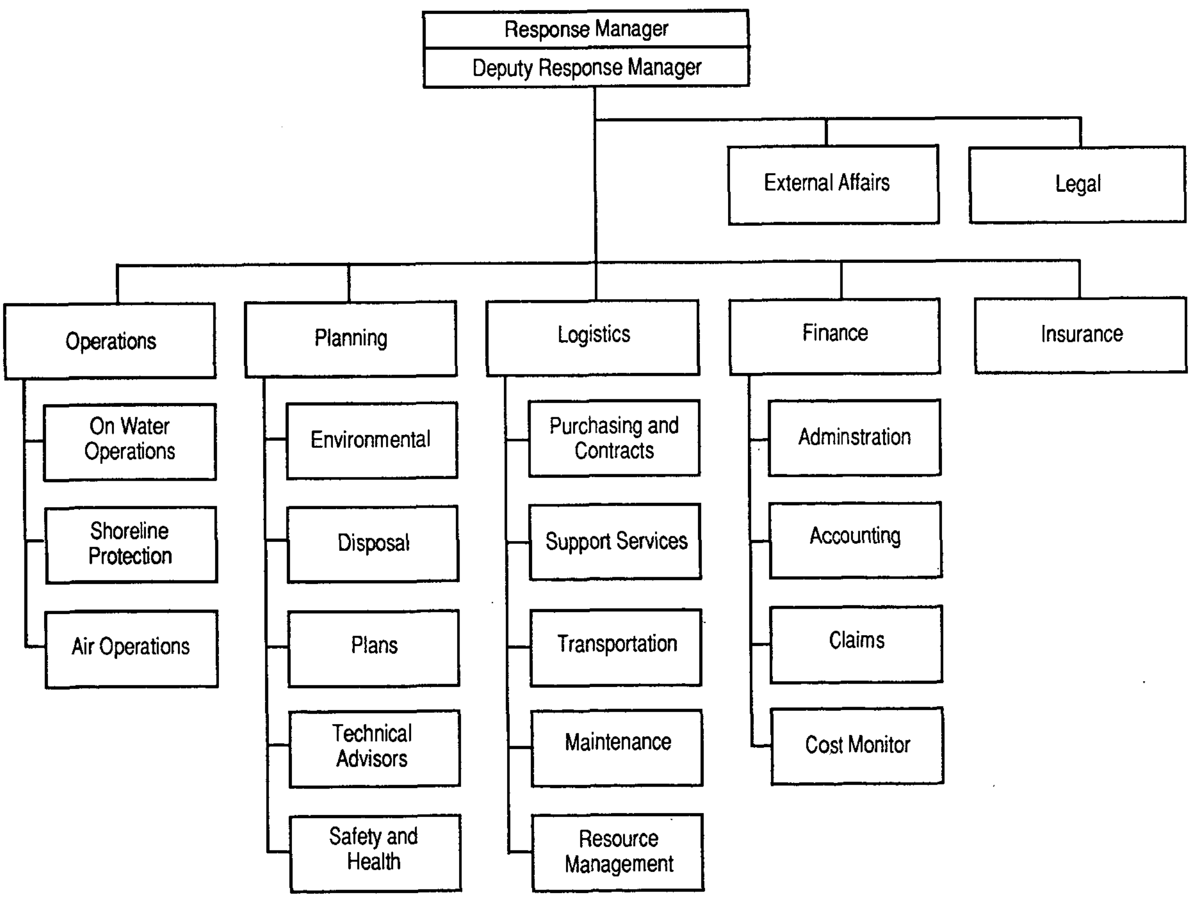


FIGURE 23. COMPANY 3 — RMS ORGANIZATION DIAGRAM

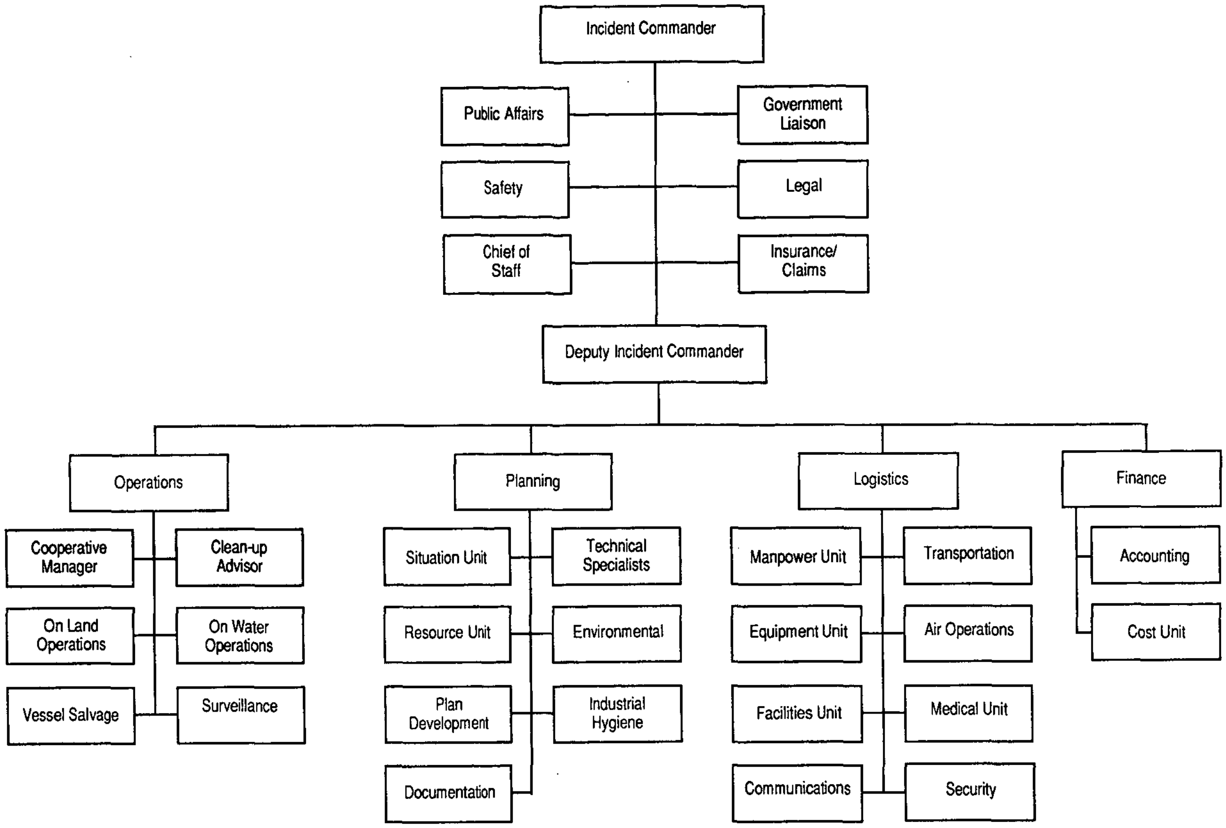


FIGURE 24. COMPANY 4 — RMS ORGANIZATION DIAGRAM

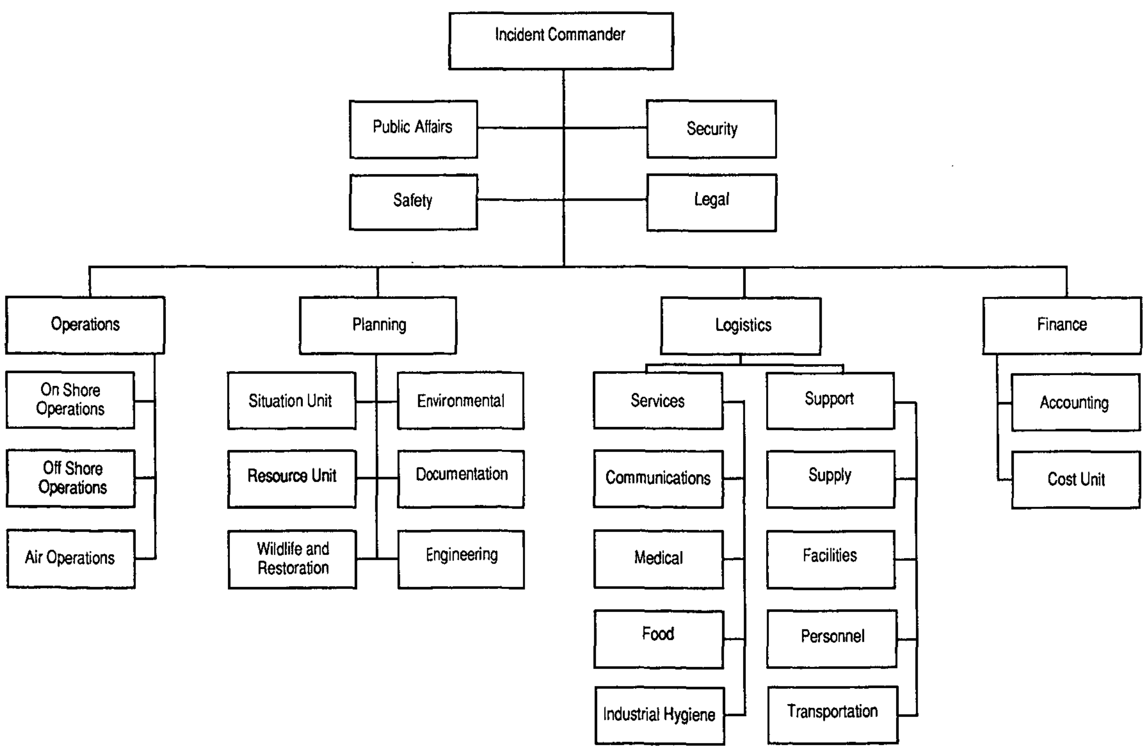


FIGURE 25. COMPANY 5 — RMS ORGANIZATION DIAGRAM

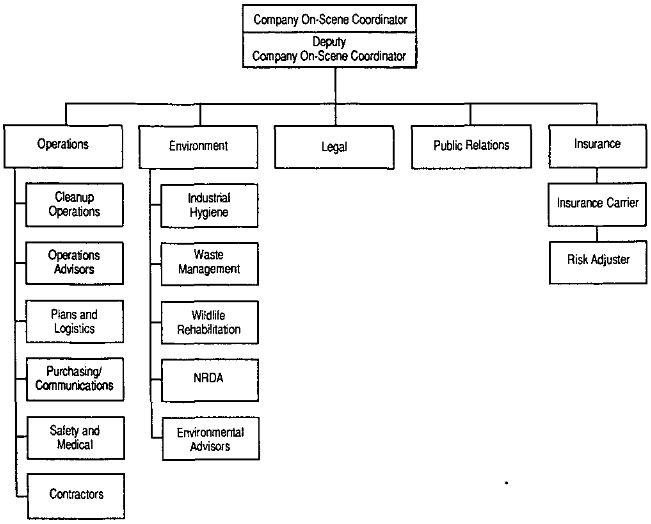


FIGURE 26. COMPANY 6 — RMS ORGANIZATION DIAGRAM

As a result, if an incident occurs, the organization might not be as "trained" as an entire team. Individuals in key positions may not be well known to others in their response role. Consequently, expectations that the response team exits and is ready, because it has been established, may fall short of reality. Many companies are recognizing this shortcoming and adjusting their overall readiness strategy.

7. The level of corporate involvement in the management of response operations varies. At least two companies plan to use corporate assets to manage all but the most minor spills. Most companies have a tiered response strategy, with operating companies or divisions, such as exploration and production, marketing or transportation, managing the response to small or routine spills, with various levels of corporate resources brought in to manage or assist in managing larger, more significant events. One company has a "let's check" system in which the corporate response managers coordinate with and advise operating department personnel regarding the spill-specific use of corporate assets, and assist in activation of the resources if appropriate. While corporate managers do not plan to take over the response, they make available qualified and knowledgeable personnel to the Incident Manager to fill shortfalls at the operational level.
8. Each company is very sensitive to corporate structure, recognizing more clearly than their colleagues in federal and state organizations the inevitable involvement of both corporate personnel and outside groups who are not responsible for preparedness in the pre-event period. As a result, response planners anticipate this involvement and are able to use these corporate assets as resources. There are typically good internal lines of communication established early in a response, and few unanticipated corporate issues emerge. In major exercises, these "super level" officials typically deal with elected officials, provide resources beyond the authorities of other managers, and generally focus and energize their corporate system. This appears to be true for companies with international owners as well as for smaller domestic operators.
9. At the corporate level, spill response is a collateral function, as it is in many governments, with few personnel dedicated to full-time spill preparedness and response duties. Most facilities do not have full time personnel in any response capacity. At some facilities, the overall response capability is extremely limited, with a clear expectation that corporate assets can and will arrive on scene very quickly. For example, many facilities storing hundreds of thousands of barrels of product may have a total staff of four or five personnel, and may actually be unmanned at times.
10. Every company plans to use outside technical specialists, most of whom have extensive oil spill technical knowledge and experience, to provide advice during responses. These specialists are in addition to the OSROs providing actual containment, recovery and clean up contractors. Advisers are most commonly used in operations, planning, public and government affairs, claims and monitoring OSRO costs.
11. In all but two of the oil and utility companies, there is significant decentralization of responsibility for all response activities. At seven companies, responsibility for preparedness, including preparation and maintenance of plans and training and exercising, is delegated to the operational elements, with oversight at the corporate level. At the two remaining companies, response plans were prepared at, or under the supervision of, the corporate level for all vessels, pipelines and facilities, and the corporate level has responsibility for conducting response operations.
12. A specific mention should be made about the RMS development conducted by MSRC (1994). Because of the company's mission, it must plan to respond in various capacities based on the needs of its clients. In some cases, it is simply another OSRO, providing response resources to an RP. In others, a client may use MSRC's full spill management team, retaining only overall control. Third, the USCG could call MSRC to respond to a mystery spill where their role may be different still. To prepare to meet its varying commitments, MSRC has developed an RMS based on the McCloskey RMS that acknowledges the process-oriented nature of the evolution and growth of the system. It plans for both steady state and response functions. It recognizes, perhaps more than other industry-type systems, the need for planning to effectively integrate with a wide variety of organizations — federal and state agencies, RPs, other OSRO and the full range of external players.

SECTION 5.0

VIEW OF THE FUTURE

The major trend in response management systems in the United States is the widespread adoption of five principal components and concepts generally associated with the NIIMS ICS. The view of the future, therefore, is that response organizations, at least in the US, will continue to move toward using ICS variants as the basis for their RMSs. It is unlikely that a significant change in direction will occur because too many organizations have invested admirable and extensive effort, as well as significant amounts of money, in building their response organizations around ICS variants. This trend will probably accelerate as more organizations adopt this model and experience good results on managing routine spill events. The authors anticipate that this trend will continue in developing RMSs for both internal use as well as unified command, integrative applications of response management.

Adoption of ICS variants as an organizational model by federal and state agencies, OSROs, and many major oil companies could enhance the capability of developing an integrated response organization. **National adoption of a version of ICS as a standard by EPA and the Coast Guard OSCs, along with full development of all supporting subsystems, might enhance response management in general, but will not, however, ensure an integrated response organization.** OPA 90 and the NCP place the OSC in the position of "directing" the response through a unified command structure. It is possible and perhaps likely to expect that OSCs, the states, and RPs will establish independent ICS-type organizations, at least for some functions, and coordinate actions "at the top," without integrating or unifying the overall structure. Conversely, it is possible, though unlikely at this point, that a fully integrated, unified organizational system could be established that does not follow general ICS principals. In any RMS, however, it is likely that the different elements of an ICS-based organization will experience different degrees of integration in any unified command structure. The planning and operations elements could, for example, be highly integrated, with logistics sections separate but coordinating, with each organization maintaining totally separate financial and investigative elements. **Since the capabilities of states and RP organizations and their versions of ICS vary widely, and USCG and EPA OSCs discharge their responsibilities differently, it is impractical and unrealistic to expect the federal government, through national policy, to develop a single system that requires state or RP participation in a particular, mandated manner as an essential ingredient for success.**

Internationally, it is difficult to ascertain if the ICS form of RMS will become increasingly popular, but it is reasonable to assume that reliance on command and control, government-controlled and relatively closed organizational systems will continue. This will probably continue to be the case until an event occurs that exceeds the inherent limitations of these closed systems or unless the socio-economic environment in these countries leads to a more open approach to response management.

Multi-organization, multi-stakeholder, highly politicized spill response operations might appear to be unique to the US, but dealing with diverse interests could become more commonplace world-wide as public interest in and access to response operations increases. As other countries continue to move toward open forms of government and increased environmental awareness, it will not be unreasonable to expect that these countries might also experience the difficulty of achieving success or the perception of success when dealing with the potentially diverse interests of multiple stakeholders, particularly during significant and catastrophic oil spills.

5.1 IMPLICATIONS FOR IMPLEMENTING AN EFFECTIVE RMS

As noted earlier, the integrated form of RMS must enhance the probability of achieving the six Critical Success Factors that are essential to the success of a spill response.

RESPONSE	enhances	CRITICAL	leads	
MANAGEMENT	———>	SUCCESS	———>	SUCCESS
SYSTEM	achievement of	FACTORS	to	

The theoretical literature indicates that an effective response management system should possess various organizational attributes, which were discussed in detail in Sections 3 and 4. These attributes can be summarized into four categories: organizational design, information management, decision making, and management processes.

ORGANIZATIONAL DESIGN

- The RMS emphasizes maintaining a flexible, open,organizational system.
- The RMS has planned inter- and intra-organizational coordination; identified and accounted for stakeholder interests, and designed a cohesive response organization that can be implemented.

- The RMS ensures that the scale of the response effort is in proportion to the size of the spill and the threat of environmental damage.
- The RMS rapidly and effectively creates a response organization comprised of multi-agency groups that do not normally work together and defines and allocates decision making authority.
- The RMS creates a common organizational culture centered on reliability that insures that cooperating organizations are organizationally and politically compatible.
- The RMS ensures that organizational subsystems are not called on to serve incompatible functions.
- The RMS uses pre-event planned structures and authorities to the maximum extent possible, but is capable of adapting to a wide variety of organizational forms.

INFORMATION MANAGEMENT

- The RMS communicates with and educates the public about vulnerability, risk and realistic outcomes.
- The RMS has an information handling capability capable of supporting a large, decentralized organization, and quickly and accurately analyzing and distributing large volumes of information.
- The RMS facilitates direct communications between subsystems and minimizes indirect communications.
- The RMS facilitates gathering, processing, and distributing feedback from the external environment.

DECISION MAKING

- The RMS supports the management of multiple, simultaneous, emergencies (e.g., SAR, salvage, fire) or the coordination with the organization that is managing these aspects of the event.
- The RMS can execute a time constrained mobilization of resources.
- The RMS supports the decision making process in a turbulent, high velocity environment where change is rapid and information is often inaccurate.
- The RMS supports distributed decision making.
- The RMS reacts to demands generated by the incident, as well as those which evolve as part of the response itself.

MANAGEMENT PROCESSES

- The RMS has established clear organizational goals and performance measures that will enable it to evaluate and adjust its performance.
- The RMS adapts and adjusts during a crisis event and learns from each action taken during the event.
- The RMS minimizes the impact of tight coupling and complexity through redundancy and by adhering to high standards or responsibility and accountability and through continuous training.
- The RMS plans for continuity and unexpected problems.

Moving toward adoption of the principals of ICS is a positive trend from the standpoint that the overall level of preparedness is being enhanced and a shared understanding of spill response issues is increasing. This positive trend should improve the potential for success in future spills since it might enhance the capability of developing an integrated, efficient response organization. However, from the theoretical research, adoption of ICS will not guarantee success when applied during significant and catastrophic events because of inherent limitations of its closed form of system design. Results of extensive research clearly suggest that such closed systems will be unable to effectively manage a complex event and that errors in the overall management tend to be serious. The complexity of an oil spill is due to both the difficulty of dealing with the event itself and the difficulty of dealing with the public and political reaction to the event. An effective RMS will allow the organization to do both. Good planning and pre-spill coordination will enhance initial spill response and will minimize, but not eliminate, the unresolved problems that lead to emergent groups and political interventions, and the resulting requirement for the RMS to address them in order to achieve success.

Large, complex spills are qualitatively different than small spills, and organizations are judged by their success in dealing with significant and catastrophic events, not by their performance on routine spills. Additionally, success in small spill response operations does not necessarily impart any predictors of success in large ones. The RMSs used for routine and significant events must reflect the differences between the two, and facilitate success at both ends of the spectrum.

Effective response involves successful management of the clean up and successful interaction with the socio/political environment. As stated by CAPT Don Jensen, Commanding Officer of the US National Strike Force Coordination Center, success requires that "The perception of success is achieved in the minds of the principle stakeholders" (Jensen, pers. comm., 1994). It appears that without an open RMS, achieving success will become difficult as public and political interest in the response increases.

OPA 90 sets out the predominant socio-economic and technological factors that will influence oil spill response in the US for the foreseeable future. The law ensures that equipment and trained personnel will be available by requiring potential responsible parties to submit vessel and facility response plans and by establishing certification requirements for OSROs. It ensures that adequate financial support will be available through increased liability requirements and the national funds administered by the National Pollution Funds Center. It enhances federal and state coordination through local area planning teams and clarifies and expands the authority of the OSC. The increased investment in technology and the availability of financial support generated by OPA 90 has significantly increased the potential response capability in the US. It has, however, also increased the public's expectation that the next response to a major oil spill will be successful.

The revised National Contingency Plan ensures that the RMS used in the United States will include unified command to coordinate the response actions of the federal, state, and responsible party. However, it neither requires the formation of a true integrated response organization nor specifies how one could be formed. A truly integrated federal-state-responsible party organization is desirable, but it will be difficult to achieve in practice in the United States because of the sheer numbers and combinations of different organizations that could be involved in future spill events. PREP will enhance integration efforts, but will not guarantee that integration will be successful. Integrated organizations may work together well during routine spills and during exercises, but may find it much more difficult, and perhaps less desirable, to create a fully functioning unified organization on significant or catastrophic events. The full integration of stakeholders, state response organizations, and federal organizations will probably always be inhibited by differing goals and objectives, some based on statutory responsibilities, and incompatible financial perspectives and other issues. Joint pre-spill planning and training, as promoted in the area planning process and the PREP program, will lay a strong foundation for successful integration. Yet, the ability to successfully manage a response in a unified command also will, in large part, be determined by intangibles that may not be able to be "fixed" by pre-spill planning: good weather and luck during the early phases of an event, and a high degree of commitment to the unified command approach, and a high degree of trust among the partners within the unified command.

All models for response management are dependent upon pre-spill contingency planning and preparedness, i.e., planning activities aimed at becoming prepared for the various contingencies that could arise during response (Donohoe, 1981). The theoretical literature supports the notion that planning leads to improved performance during response (Michael, 1986 and Weingart, 1989 as cited in Carley and Harrald, in press). The rationale to support this includes the following (Carley and Harrald, in press):

- Planning is expected to ensure knowledge of the plan;
- Planning is expected to provide training, which will lead to higher performance during an actual situation;
- Planning is expected to ensure that the plan is followed out because the planners will feel some ownership and be committed to carrying it out;
- Defining roles in advance allows more rapid response because the roles will not have to be negotiated; and
- Planning defines communication and resource channels which will allow for rapid response because the need to locate information and resources will be reduced.

5.2 CONCLUSIONS

Based on theoretical research findings and the views of response professionals regarding the definition of a successful response, it appears that the adoption of ICS-based forms of RMS is not sufficient to guarantee that every response will be managed successfully. There are distinct and vital advantages to using one organizational system, such as ICS. However, the literature predicts that universal application of a single system, which was originally conceived as a closed type of system, will probably not ensure that significant and catastrophic events will be managed successfully, unless it can be implemented in such a way that it operates more as an open system than its original design, and explicit agreements can be reached among responding organizations on how they will merge their ISC variants.

While the factors required for the management of large, complex events are not incompatible with ICS, they have not been explicitly accounted for in the NIIMS ICS or the existing CS variants reviewed for this report. Specifically, the NIIMS ICS does not provide adequately for unidentified issues and groups which the literature predicts will arise during significant and catastrophic emergencies.

In developing this paper one individual shared the following circumstance where the NIIMS ICS unsuccessfully dealt with political problems which emerged during a catastrophic fire event. Most major wildfires that are managed using ICS are, in actuality, managed as a composite of a series of smaller fires. The Yellowstone fires in 1989, however, were of such magnitude that elected officials of several affected states intervened in the fire management process, and required that their concerns be actively addressed. This additional layer of management was not part of the traditional ICS organization. In other words, emergence occurred and the traditional form of ICS did not allow for the management structure to function as designed. This issue was actively reviewed afterwards to determine how ICS should be modified to provide for more successful management of events of that type. NIIMS has yet to resolve this issue.

There is little evidence from organizational research and practical experience, therefore, that one RMS can be utilized everywhere, in all emergency events and by all groups. Most systems reviewed are actually partial systems, with incomplete procedures and processes articulated to define how both internal and external relationships should occur. There are too many variations in the institutional frameworks that govern response in various geo-political units (country, region, state, local area) and there are too many different organizational cultures that could potentially be involved in a significant event. Most of the organizations reviewed in preparing this paper had variations of the basic ICS structure, but they were all different from one another. There appear to be features that differentiate them — some have features which foster a more open form of organizational system, while others have features which promote the closed form of organizational systems.

The vulnerabilities in ICS variants can be overcome if they are implemented in an open manner and if procedures to effectively integrate them are defined and agreed upon during the preparedness process. There does not seem to be any structural or systematic reason why ICS can not be implemented in a open, cooperative, and distributive way that would meet the needs of responding to a complex event. This openness could be facilitated during pre-spill planning by:

- Specifically identifying the stakeholder concerns that can be reasonably anticipated to emerge during a significant and/or catastrophic event and identifying a mechanism, such as the MACs, to address those stakeholder concerns; and

- Designing the RMS to be flexible enough to accommodate unanticipated emergence during significant and/or catastrophic events. This flexibility can be enhanced by providing efficient information management to ensure feedback to the response organization, both on how well they are doing (effectiveness) and how well others think they are doing (success).

Stakeholders will vary from and within geographic area to geographic area, whether the area of issue be international; country; region; state or province; city, county or borough. Recognizing this geographic variation in stakeholder issues and concerns, the area contingency planning process offers an ideal opportunity to develop more open forms of ICS-based RMSs at the lowest level common to responding organizations, e.g., the area levels in the US. ICS-based approaches have clear advantages for supporting the mobilization and integration of large numbers to accomplish common operational goals. On closer examination it looks like theorists and practitioners are not as far apart as it initially appeared; ICS variants can be refined during pre-spill planning and then implemented so as not to be incompatible with the features identified by the research community as essential to a good response management system.

Morton's work (1991) suggests that attempts to define organizations without considering organizational culture may be dysfunctional. Theoretical and practical implications for RMSs include:

1. The creation of a common culture for spill response is a critical task. Different internal cultures and the socio-economic influences in different geographic areas, which define the degree to which openness and inclusion is readily adopted by a RMS, make this a complex and difficult problem. In the US, the interactions in the area contingency planning process and participation in area exercises, and other elements of PREP, are logical opportunities to create a common response culture by "cross pollinating" with one another and developing pre-spill agreements and how to integrate during response. Yet the individual and institutional differences among EPA and USCG representatives, who chair the ACs, make it difficult to have a standard area planning process and output.
2. The imposition of a centralized, command and control organizational structure works well when organizations subsumed in the structure are themselves relatively structured or hierarchical, such as fire departments, military units and some large corporations. However, given the reality of unified command in the US and the phenomena of emergent organizations, such a model will not work as well for overall management of an oil spill in the US or overseas when an event takes on the social characteristics of a disaster.
3. A problem solving, open form of RMS is most appropriate for significant oil spills because of the high visibility of the event, the resulting emergent group phenomena, the need for unified command and integrated response organizations over an extended period of time, and the lack of common cultures among responding organizations. One of the many organizational problems to be addressed is how to ramp up and back down, as the response transitions, with minimal inefficiency, through the stages discussed in Section 3.
4. Depending upon the significance of the event and the extent to which response organizations are integrated, closed, command and control forms of management can be applicable to execute the strategy decisions made in unified command. In routine spills, where few personnel are involved and the impact is quite localized, RPs and response contractors, or OCSs if the event is a mystery spill, will probably use their internal, hierarchical management systems to execute the response without integrating with other organizations.
5. Decentralized decision making on tactical issues is important. This is especially important during the emergency stage of the spill, when decisions must be made on scene by the initial responders. In fact, both the literature and practitioners agree that the authority to decide how to best implement strategic objectives should be delegated down to the appropriate levels within the organization. In an integrated RMS, this means that personnel from individual organizations will need to adjust their thinking and protocols; at tactical levels within functional areas individuals should not go back to their permanent supervisor for decision confirmation. Otherwise, operational efficiency will be reduced.

SECTION 6.0

UNRESOLVED ISSUES

This paper has discussed many considerations for developing and implementing an effective RMS. The previous sections of the paper have detailed **what** needs to be incorporated into an effective RMS, based on the findings and views of theoreticians, practitioners, and mandatory laws and legislation. However, all of the issues to be resolved concern **how** an effective RMS can be developed and implemented. The theoretical literature is unable to assist the response community in this regard. Roberts (1994) states —

> "Because organizational studies of systems of organizations are missing, we do not have a vocabulary for discussing systems in organizational research, conceptual notions about the kinds of systems that can and can not work, or advice to give managers who must operate in systems of organizations."

Roberts (1994) goes on to state that, from the few systems of organizations which have been examined, it appears that flexibility, redundancy and vigilance are important to making them work. The researchers are sending a clear signal that the issue of developing an effective RMS which integrates multiple organizations during spill response is a tough problem.

Several issues remain for response organizations to resolve as they attempt to implement increasingly effective RMSs:

- How to develop more complete and effective individual RMSs, in government and industry, that will lend themselves to integration with other response organizations?
- Given that a universal, specific form of RMS is an unrealistic and impractical expectation, at least for the foreseeable future, what kind of standard process can be implemented nationwide to develop an effective RMS that integrates the individual RMSs of responding organizations, both at the command (decision making) and functional area (decision execution) levels? Assuming a basic framework of unified command and the five principal components of as the starting point, what additional commonalities can be developed in the planning process to enhance the potential for a more universal culture in which response organizations can function collaboratively?
- Assuming a standard process is possible, how to develop an effective, open-type of RMS during the preparedness process that can be tailored to the significance of the event?
- How to build trust and a common culture among the response organizations in a unified command, given the potential divergence in organizational goals?
- How to continue to build upon the advantages of the NIIMS ICS, while minimizing the aspects of closed systems that could inhibit the achievement of success during significant and catastrophic events?
- How to achieve the Critical Success Factors and respond more efficiently, so the cost of oil spill response is rational and clearly related to identified response goals, such as mitigation of adverse environmental effects? This essentially involves balancing the cost of acting (responding) against the cost of not acting (doing nothing) and the net environmental benefit of each.
- How to adequately address the expectations external to the integrated response organization so that the expectations are realistic?

The problem of organizing for response is clearly more complicated than figuring out "who is in charge," particularly when a unified command situation exists as it does for essentially every US spill response. At a minimum, it involves, in the authors' judgment, full integration of the decision making activities at the command level and full coordination of functional activities at the functional operational level.

The response to a significant or catastrophic oil spill could fail if it does not achieve the six Critical Success Factors outlined in Section 4.1. Organizations must have the capability to develop into open, flexible organizational systems to manage the more complex events, not just "ramp up" to a larger size. Problems which will prevent the achievement of these Critical Success Factors include:

Confusion:	The RMS can not execute its plan; can not determine what is to be done or deal with multiple emergencies, can not determine priorities or make decisions.
Capability:	The RMS can not mobilize adequate personnel and equipment.
Controversy:	The RMS can not achieve goal congruence among the participating organizations or can not deal with the media and public.
Conflict:	The RMS can not resolve disputes that arise during the response operations.
Collapse:	The RMS can not sustain the initial response; it reaches the limit of its resource base.

The provisions of OPA 90, the existence of improved contingency plans, and the adoption of the principals of ICS have minimized the likelihood that a spill response in the US will fail due to lack of capability, initial confusion, or collapse.

However, the probability of controversy and conflict remains high. The structured organizational systems currently being adopted by most responding organizations will facilitate planning, training and mobilization within those organizations. However, they might tend to break down when implemented in an integrated RMS using unified command at times when they are needed most — in the complex, highly visible and volatile environment which characterizes significant and catastrophic spills. It is not clear from either the practical experience with ICS variants and other structured organizations or from the theoretical literature at what point they will cease to be effective. It is, however, clear that most existing ICS variants are incomplete RMSs, using this paper's definition, and clear procedures to integrate the functions and command roles of multiple RMSs have not yet been developed. Therefore, using the buzzword "ICS" does not represent an answer to the most difficult response management issues associated with significant and catastrophic spill events.

As pointed out in Section 3.3, two assumptions that underlie the ICS are (1) the goals and objectives of participating organizations are congruent and (2) their organizational cultures are relatively homogeneous. There does not seem to be any way to resolve the fact that federal agencies, state agencies, and private corporations will have some goals that are not congruent. In fact they may, as pointed out by Ott *et al.* (1993) and by Spitzer (1992), have goals that are in conflict. This dual relationship — remaining a member of a permanent organization while participating with stranger groups in a temporary RMS — could affect the information sharing and trust that is an essential part of the integrated organization. Hence, it seems that a key element of an integrated organizational partnership, such as a unified command, is development of a high level of trust, based on a shared understanding of mutual goals, responsibilities and capabilities. How to build and maintain this inter-organizational trust at the local, regional, and national level is a major unresolved issue. This is particularly true in the United States where the federal, state, and business organizations that must trust each other during a spill response are likely to face each other as adversaries in pre-incident inspection and enforcement actions, post-spill civil litigation or even criminal proceedings. Several oil spill response professionals independently identified trust as necessary if a unified command form of RMS is to work (O'Brien, pers. comm., 1994; McCloskey, pers. comm., 1994; Donohoe, pers. comm., 1994).

Mechanisms do exist in which a common response culture and goal congruence can be fostered. Pre-spill planning and training activities, such as the Area Committees and PREP, are critical to the process of building a response organization based on knowledge and trust. The ability to identify stakeholders and their objectives, build relationships, clarify goals, develop shared "mental models," and build realistic public expectations are all elements of this pre-spill planning process. Most importantly, there must be formal agreement (written, to facilitate communication) upon the integrative RMS that will be used in a particular area. This concept was emphasized in the USCG's first Incident-Specific Preparedness Review, which was released in 1994, as part of a new system to study ACP implementation and effectiveness. This document reviewed the *Morris J. Berman* spill and made recommendations relevant to RMS.

> "It is imperative that area committees develop complete response organizations, including naming their organizations to fill key positions and their lines of authorities .... The NRS as a whole is ready to take the next step in the evolution of post-OPA 90 oil spill response and build a SMT that can not only 'shoot first' but also be able to account for all actions taken once the spill response starts" (US DOT, 1994).

When a spill response is perceived to be ineffective, the differences in goals and other areas of conflict in the response organization will become critical issues. As unresolved problems become public issues, the role of emergent groups will increase. The integration of organizations with valid concerns and useful capabilities, including *ad hoc* groups, into the spill response without disrupting the response effort, creating unsafe conditions, or unnecessarily increasing the costs of the response effort is an unresolved issue in the United States.

All organizations participating in the response must understand the complexities of coordination necessitated by the multi-organizational response. The question is not "who is in charge" but "how can the synergy resulting from coordination be maximized?" A critical objective of training is the development of the shared mental models (how one visualizes a particular situation) described by many researchers as key to organizational effectiveness. Knowledge needed for implementation includes both "know how" and "know why." Drawing boxes and assigning people does no good if people do not have individual skills and if teams to not have team skills: practice is essential and experience is invaluable. Finally, the best way to minimize the phenomena of emergence is to anticipate as much as possible. This requires scenario based planning and exercises, which are fundamental to the PREP program in the US.

Chew *et. al.*, (1991) states that, in order to beat Murphy's law, "simulate and prototype everything" and "everything includes the organization." The challenge will be how to sustain momentum on preparedness activities and develop an effective RMS when significant and catastrophic oil spills are low probability, although high risk, events. It is difficult to obtain support for preparing and training for rare events. History has demonstrated that the momentum of preparedness activities declined in proportion to when the last publicly significant event occurred. It is so easy to be convinced that the risk will never become reality, and especially not to you. **This problem of sustaining the momentum in preparedness activities is perhaps the most outstanding unresolved issue of all.**

It is critical to emphasize that response management is the **process** of integrating technically skilled individuals into an organizational framework to solve problems; and that response management is an "action" process that must be appropriately scaled to the significance of an event.

We, responders and others, should always remember that the involvement and commitment of technically skilled individuals in preparing for and responding to a pollution event are the lynch pins of an effective RMS. In addition to their operational skills, awareness, knowledge, and active use of the principals of incident command, the professional response community can provide response organizations opportunities for success, regardless of incident size, location, or complexity.

Consistent with the theme of The 1995 International Oil Spill Conference, "Achieving and Maintaining Preparedness," if we only prepare response management systems for catastrophic events ... every event will be catastrophic.

References

Alaska Department of Environmental Conservation (DEC), 1993. The Exxon Valdez Oil Spill: Final Report, State of Alaska Response. Juneau, Alaska.

Archer, J.N. and I.C. White, 1985. Organisation to combat oil spills: the case for coordination of government practice. Paper presented at a meeting of the Greenwich Forum, Edinburgh, United Kingdom, April, 1985.

Biglane, K. E., 1994. Personal communication. Washington, D.C., August 8, 1994.

Biglane, K.E., 1969. A history of major oil spill incidents. Proceedings of the Joint Conference on Prevention and Control of Oil Spills, American Petroleum Institute, Washington, D.C., pp. 5–6.

Biglane, K.E. and R.H. Wyer, 1971. Oil pollution control legislation and the water quality improvement act of 1970, the federal viewpoint. Proceedings of the Joint Conference on Prevention and Control of Oil Spills, American Petroleum Institute, Washington, D.C., pp. 11–16.

Card, Capt. James C. and Lt. John A. Meehan, 1991. Response to the American Trader oil spill. Proceedings of the 1991 International Oil Spill Conference, American Petroleum Institute, Washington, D.C., pp. 305–312.

Carley, Kathleen M., 1991. The organizational structures most responsive to crises. Working paper prepared for the National Research Council Research Workshop on Organizational Issues in US Nuclear Policy, Sept 17–18, 1990, Oakland, California.

Carley, K.M. and J.R. Harrald. (In press). Organizational learning under fire: Theory and practice. Journal of Applied Political Theory.

Charter, Cmdr. Daniel B., Jr., 1971. National contingency planning. Proceedings of the Joint Conference on Prevention and Control of Oil Spills, American Petroleum Institute, Washington, D.C., pp. 17–26.

Chew, W. Bruce, Dorothy Leonard-Barton and Roger E. Bohn, 1991. Beating Murphy's law. Sloan Management Review, Spring 1991, Cambridge, Massachusetts, pp. 6–16.

Donohoe, Capt. Michael J., 1994. Personal communication, Washington, D.C., August 16 and 23, 1994.

Donohoe, Lt. Cdr. Michael J., 1981. Contingency plans: A useful tool or bureaucratic burden. Proceedings of the 1981 International Oil Spill Conference, American Petroleum Institute, Washington, D.C., pp. 513–515.

Dynes, Russell R., 1990. Community emergency planning: false assumptions and inappropriate analogies. Paper presented at the Workshop on Safety Control and Risk Management, Karlstad, Sweden, November, 1989.

Dynes, Russell R. and E.L. Quarentelli, 1976. Organizational communications and decision making during crises, Report Number 17. Disaster Research Center, University of Delaware, January 1976.

Dynes, Russell R. and E.L. Quarentelli, 1968. Group behavior under stress: A required convergence of organizational and collective behavior perspective. Sociology and Social Research, 52:416–429.

Garnett, Capt. Michael N., 1994. Personal communication, London, United Kingdom, August 9, 1994.

Giacoma, Lt. Cdr. Rhae A., 1994. Personal communications, Washington, D.C., August 3 1994.

Gilbert, John T.E., 1983. Contingency planning for offshore oil and gas development. Technical Environmental Guidelines for Offshore and Gas Development. PennWell Publishing Company, Tulsa, Oklahoma.

Gallimore, Kraig C., 1994. Personal communication. Austin, Texas, August 25, 1994.

Harrald, John R., 1994. Preparing for success: A systems approach to oil spill response. Paper presented to the Prevention, Response and Oversight Five Years After the Exxon Valdez Oil Spill Conference. March, 1994, Anchorage, Alaska.

Harrald, John R., Ruth E. Cohn, and William A. Wallace, 1992. "We were always re-organizing...": some crisis management implications of the Exxon Valdez oil spill. Industrial Crisis Quarterly, 6:197–217.

Harrald, John R., Henry Marcus, and William WA. Wallace, 1990. The Exxon Valdez: An assessment of crisis prevention and management systems. Interfaces 20:5. pp. 14–30.

Hunter, Steven A., 1994. Personal communication. Olympia, Washington, August 25, 1994.

Incident Command System, 1983. Fire Protection Publications, Oklahoma State University, Stillwater, Oklahoma.

IMO, 1991. International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990. IMO, London, United Kingdom.

IMO, 1992. Guidelines for the Development of Shipboard Oil Pollution Emergency Plans. IMO, London, United Kingdom.

International Tanker Owners Pollution Federation (ITOPF), 1994. Note to the International Oil Pollution Compensation Fund. Seventh Intersessional Working Group, Agenda Item 2. London, United Kingdom.

IPIECA, 1991. A Guide to Contingency Planning for Oil Spills on Water. IPIECA Report Series Volume Two. IPIECA, London, United Kingdom.

Jardim, George M., 1994. Letter. October 24, 1994. Chevron, San Francisco, CA.

Jarvela, Stephen D., 1994. Personal communication. Philadelphia, Pennsylvania, August 5, 1994 and November 7, 1994.

Jensen, Capt. Donald S., 1994. Personal communication. Chattanooga, Tennessee, August 4, 1994 and Elizabeth City, North Carolina, November 4, 1994.

Jensen, Capt. Donald S., Cdr. Robert Pond, and Cdr. Mark H. Johnson, 1993. Response to a spill of national significance. Proceedings of the 1993 International Oil Spill Conference, American Petroleum Institute, Washington, D.C., pp. 3–6.

Johnson, Lt. Richard C., 1994. Personal communication, Elizabeth City, North Carolina, August 24, and November 8, 1994.

Josephson, Wally, 1994. Personal communication. Salt Lake City, Utah, August 29, 1994.

Levy, Leonard W., Kenneth L. Karst, Dennis J. Mahoney, 1986. Encyclopedia of the American Constitution, Volume 4. MacMillan Publishing Company, New York, New York.

Libuser, Carolyn B. and Karlene H. Roberts, 1994. A model for managing risk. Paper presented at the 1994 Annual Meeting of the BC/State Oil Spill Task Force, Juneau, Alaska.

Lindstedt-Siva, J., 1992. US oil spill policy after *Exxon Valdez* — is it improving preparedness? Proceedings *Spillcon* 92, 5–8 July 1992, Gold Coast Australia.

McCall, Steven, 1994. Personal communication. Washington, D.C., August 23, 1994.

The McCloskey Group, 1994. Overview of Response Management Systems. Prepared by The McCloskey Group. Santa Barbara, CA.

McCloskey, Thomas G., 1994. Personal communication. Santa Barbara, California, August 15, 1994.

Mielke, James E., 1990. Oil in the ocean: The short- and long-term impacts of a spill (90-356 SPR). Congressional Research Service, The Library of Congress, Washington D.C., July 24, 1994.

Miller, Judith A. and John A. Gallagher, 1993. Unified command and oil spill response, a formula for disaster? Unpublished paper. Gallagher Marine Systems. Inc., Alexandria, Virginia.

Morton, M. Scott, 1991. The Corporation of the 1990s. Oxford University Press, New York, New York.

MSRC, 1994. Response management system (RMS) manual (Final draft). Marine Spill Response Corporation, Washington, D.C.

Munkres, Mike, 1994. Personal communication. Boise, Idaho, August 25, 1994.

National Interagency Incident Management System (NIIMS), 1981. Incident Command System Operational System Description. National Wildfire Coordination Group, Boise, Idaho.

Nichols, J. A., 1994. Personal communication. London, United Kingdom, July 27, 1994.

O'Brien, James E., 1994. Personal communication. Gretna, Louisiana, August 9 and 19, 1994.

Ott, Gary L., June Lindstedt-Siva, and Ann Hayward Walker, 1993. Evolving spill management systems under OPA 90 could reduce response effectiveness. Proceedings of the 1993 International Oil Spill Conference, American Petroleum Institute, Washington, D.C., pp. 73–82.

Perrow, Charles 1994 "Accidents in High Risk Systems," *Technology Studies*. 1(1):1–20.

Perrow, C., 1984. Normal Accidents: Living with High Risk Technologies. Basic Books, New York.

Pond, Cmdr. Robert, 1994. Personal communication. Washington, D.C., August 10, 1994.

Quarantelli, E.L., 1983. Emergent behavior at the emergency time periods of disasters, Final Project Report # 31. Disaster Research Center, University of Delaware, September 1983.

Roberts, Karlene H., 1994. Functional and Dysfunctional Organizational linkages. In C. Cooper and D.M. Rousseau (eds.), Trends in Organizational Behavior. John Wiley and Sons Ltd., New York, New York, pp. 1–12.

Roberts, Karlene H., 1989. New challenges in organizational research: high reliability organizations. Industrial Crisis Quarterly, 3(2):1–15.

Rockhard, J.F., 1981. The changing role of the information system executive: A critical success factor perspective. Sloan Management Review, pp. 15–25.

Rolan, Robert G. and Keith H. Cameron, 1991. Adaptation of the incident command system to oil spill response during the American Trader spill. Proceedings of the 1991 International Oil Spill Conference, American Petroleum Institute, Washington, D.C., pp. 267–272.

Schoderbek, P.P., C.G. Schoderbek and A.G. Kefalas, 1985. Management Systems: Conceptual Considerations. Business Publications, Incorporated, Plano, Texas.

Senge, Peter M., 1990. The Fifth Discipline: The Art and Practice of the Learning Organization. Doubleday, New York, New York.

Smith, James D., 1994. Personal communication. Alexandria, Virginia, September 14, 1994.

Smith, James D., 1989. Personal communication. Arlington, Virginia, April 1989.

Spitzer, Lt. Commander James D., 1992. An incident command system in practice and reality. Proceedings of the Fifteenth Arctic and Marine Oil Spill Program Technical Seminar, Environment Canada, Edmonton, Alberta, p. 315.

State of Washington Department of Ecology, 1993. Oil spill incident command system and unified command workshop summary. Working paper. Olympia, Washington.

Sutton, R., K.M. Eisenhardt and J. Jucker, 1986. Managing organizational decline: Lessons from Atari. Organizational Dynamics, Spring 1986.

Tierney, K.T., 1994. "Stakeholders and Emergent Organizations." Module 3 in Harrald, J.R. (ed.), *Participant Coursebook: American Red Cross Initial Response Management Seminar.*

Tuckman, Bruce W., 1965. Development sequences in small groups. Psychological Bulletin, 63(6):384–398.

US Coast Guard, 1994a. National preparedness for response exercise program (PREP) guidelines. USCG Headquarters, Washington, D.C., May 1, 1994.

US Coast Guard, 1994b. Training for success: A functional management system for response organizations (ICS/UCS). Draft Training Manual. Marine Safety School, USCG Reserve Training Center, Yorktown, Virginia.

US Coast Guard, 1993a. 33 CFR Part 154, Facilities transferring oil or hazardous material in bulk. USCG Headquarters, Washington, D.C.

US Coast Guard, 1993b. 33 CFR Part 155, Oil or hazardous material pollution prevention regulations for vessels. USCG Headquarters, Washington, D.C.

US Coast Guard, 1993c. 25 years of polluting incidents in and around US waters (1969–1993). USCG Headquarters, Washington, D.C.

US Congress, 1990. Coping with an oiled sea: an analysis of oil spill response technologies (OTA-BP-O-63). Washington, D.C.

US Congress, 1989. Federal Water Pollution Control Act.

US Department of Transportation (DOT), 1992. USCG Commandant Notice 16471, Establishment of area committees and development of area contingency plans. United States Coast Guard Headquarters, Washington, DC.

US Department of Transportation (DOT), 1993. T/V Exxon Valdez Oil Spill Federal On Scene Coordinator's Report, Volumes 1 and 2. United States Coast Guard, Washington, D.C.

US Department of Transportation (DOT), 1994. USCG Releases First Incident-Specific Preparedness Review in the Oil Spill Intelligence Report, Volume 17, No. 45. Cutter Information Corporation, Arlington, MA.

US Environmental Protection Agency, 1994a. 40 CFR Part 300, National Oil and Hazardous Substances Pollution Contingency Plan. Washington, D.C.

US Environmental Protection Agency, 1994b. 40 CFR Part 112, Oil Pollution Prevention. Washington, D.C.

Vaill, Peter B., 1982. The purposing of high-performance systems. Organizational Dynamics, Autumn 1982, pp. 23–29.

Walker, Ann H. and L. Jay Field, 1991. Subsistence fisheries and the Exxon Valdez: Human health concerns. Proceedings of the 1991 International Oil Spill Conference, American Petroleum Institute, Washington, D.C., pp. 441–446.

Wells, K., 1994. Recommendations of the Quality Action Team on OPA 90 Removal Costs. Attached with letter to Radm. James C. Cord, US Coast Guard. January 19, 1994.

Wenger, Dennis, E.L. Quarantelli, and R.R. Dynes, 1990. Is the incident command system a plan for all seasons and emergency situations. Hazard Monthly, 10:8–12.

Wilkes, Daniel, 1971. State jurisdiction over oil spills in a federal system. Proceedings of the Joint Conference on Prevention and Control of Oil Spills. Washington, D.C., pp. 57–70.

Bibliography

Carley, K.M., 1991. Designing organizational structures to cope with communication breakdowns: a simulation model. Industrial Crisis Quarterly, 5:19–57.

Carley, K.M., 1991. Coordination for effective performance during crises when training matters. Working Paper. Carnegie-Mellon University, Pittsburgh, Pennsylvania.

Carley, K.M., 1991. Distributed information and organizational decision making models. Working Paper. Carnegie-Mellon University, Pittsburgh, Pennsylvania.

Carley, K.M., 1990. Organizational learning and personnel turnover. Working Paper. Carnegie-Mellon University, Pittsburgh, Pennsylvania.

Grabowski, Martha, John R. Harrald, and Karlene H. Roberts, 1993. Decision support organizational forms in a high velocity environment: Responses to catastrophic oil spills. Working Paper. Rensselaer Polytechnic Institute, Troy, New York.

Johnson, Lt. Richard C., 1993. The national response system: where do we go from here? Proceedings of the 1993 International Oil Spill Conference, American Petroleum Institute, Washington, D.C., pp. 67–72.

Luchun, Capt. Robert E. and Lt. Cmdr. Douglas A. Lentsch, 1990. A standardized catastrophic oil spill response organization. US Coast Guard study, Washington, D.C.

Mintzberg, Henry, 1980. Structure in 5's: A synthesis of the research on organizational design. Management Science, 26(3):322–341.

Nichols, J.A., 1992. Cooperation/organisation/preparation for marine spill control and response. Paper presented at Interspill '92, Wembley, United Kingdom, October 6–8.

NOAA, 1992. Case histories of oil spills from 1967–1991, Summaries of significant US and international spills. HMRAD 92-11, NOAA, Seattle, Washington.

Ott, J. Steven and Jay M. Shafritz, 1994. Toward a definition of organizational incompetence: a neglected variable in organization theory. Public Administration Review, 54(4):370–377.

Rouse, W.B. and N.M. Martin, 1986. On looking into the black box: Prospects and limits in the search for mental models. Psychological Bulletin, 100(3):349–363.

Tell, William K. Jr., 1971. Summary of laws and regulations governing spills and discharges of oil. Proceedings of the Joint Conference on Prevention and Control of Oil Spills, American Petroleum Institute, Washington, D.C., pp. 3–10.

US Department of Defense, 1992. Conduct of the Persian Gulf War: Final report to Congress. Washington, D.C.

APPENDIX A

SAMPLE QUESTIONNAIRE

SOLICITATION OF OPINIONS ON IMPLEMENTING AN EFFECTIVE RESPONSE MANAGEMENT SYSTEM (RMS)

We are soliciting a cross-section of views from the response community as background for a white paper on response management systems for the 1995 International Oil Spill Conference. Please complete the following and fax it no later than *August 26, 1994* (Friday) to:

Ann Hayward Walker
Scientific and Environmental Associates, Incorporated (SEA)
fax: 703-354-4467 (phone: 703-354-5450)

BACKGROUND

Name: ______________________________

Affiliation and address: ______________________________

____

____

Phone and fax: ______________________________

Role in pre-spill planning: ______________________________

____

____

Role in response: Where does your present position most closely fit?

_____ Federal _____ State _____ RP _____ Trustee _____ RRT
_____ Other (please identify) ______________________________

_____ Unified Command _____ QI

_____ Command Post _____ Field

_____ Operations _____ Environmental
_____ Planning _____ External/Public Affairs
_____ Logistics _____ Liaison
_____ Finance _____
_____ Other (please identify) ______________________________

List the spills to which you have responded and note your role/function for each:

____

____

____

____

____

____

____

____

IN YOUR OPINION ....

What is a successful response? (define/describe)

Is an effective response different from a successful response? If so, how?

Do you envision that the response management organization for a spill response varies with the significance (size, complexity, time of year, location, etc.) of the incident? If so, how?

How does the significance of the incident influence the ability of the responders to succeed?

What do you consider the legitimate objectives of response activities? That is, to what end should responders be working? What are we aiming for?

What, if any, response activities should not be funded? Are there conditions during response you can imagine when expenditures would not be reasonable? If so, please describe.

Does the source of funds make a difference (that is, do you think public funds, i.e., the National Pollution Fund should pay for the same things that the RP/insurer(s) pays)? If yes, why? (This question does NOT concern NRDA costs, only the response/cleanup costs)

What are the minimal organizational design requirements of a RMS needed to achieve a successful response? Should the RMS be different for various spill sizes (using the National Contingency Plan classification)?

Minor spill

Medium spill

Major spill

Who are the most visible/prominent parties or organizations who will have an interest in your area in oil spills (e.g., government agencies, interest groups, media)? Please be specific in identifying them.

What is (each of) their interest (e.g., political, environmental, economic, etc.)?

In your view, should they all be involved in pre-spill planning efforts to define the RMS for that area? Why?

Should they be involved in the response organization? If so, how/where?

APPENDIX B

SUMMARY OF VIEWS

APPENDIX B

QUESTIONNAIRE ANALYSIS

NOTE: Numbers in parentheses following statements indicate the number of individuals (out of a total of 34 individuals) who made that statement or one very similar.

What is a successful response?

- Damage to the environment is minimized (18)
- The public and media perceive success and are satisfied with the response (14)
- The response occurs in an expeditious manner (10)
- The spread of oil is minimized (10)
- The government, RP, and other involved parties are satisfied with the response (8)
- The maximum amount of oil possible is removed (8)
- There is multi-party synergism (6)
- There are no injuries or fatalities (5)
- Costs are controlled (4)
- A response organization is established and is able to maintain command (4)
- Proper and least disruptive (to the environment) cleanup techniques are employed (3)
- There is appropriate restoration of the environment (2)
- Response is orderly (2)
- There is effective investigation and enforcement (1)
- The media reports on the spill rather than dictating cleanup priorities (1)
- Good communications is maintained (1)
- Damaged parties are fairly compensated (1)
- Impact to the corporation's image is minimized/mitigated as much as feasible and practicable (1)
- Enhancement of long-term ecological recovery by optimizing response resources (1)
- Disruption to the public is minimized (1)
- Amount of oil recovered or miles of shoreline cleaned is independent of a successful response (1)
- Response objectives are established and met (1)
- Public is informed (1)
- Individuals learn from each spill and use the lessons learned in future spills (1)
- Safety in operations (1)
- Withstand political and media pressure (1)
- Public confidence is maintained (1)

Is an effective response different from a successful response?

- Yes (27)
- The individuals who answered "yes" to this question defined an effective response in terms of operational and technical issues while defining a successful response in terms of more subjective, political issues. "A response could be effective given the circumstances but not be considered successful by the media or public"

Some definitions of effectiveness include:

- Environmental impacts are minimized
- Proper application of resources
- Timely application of resources
- Economic, social, and political damages are minimized
- Protection of sensitive resources are maximized
- Quantity of oil spilled and time and spread of oil is minimized
- The amount of oil recovered is maximized
- Cost is minimized
- Conducted in a well coordinated manner

Some definitions of successful include:

- Negative media and political reaction is minimized
- There is a positive reaction without regard to environmental and economic impacts
- The response is perceived to be effective
- No (5)
- One individual who answered "no" stated that in a command and control environment, the response organization knows exactly what is being done, by whom, and where. Every minute of every day, the organization uses this information to judge the effectiveness of response operation.
- Both are needed to satisfy the RP and the community

Do you envision that the response management organization for a spill response varies with the significance?

- Yes (28)
- No (6)
- The 6 individuals who answered "no" stated that although the basic functions and principles of the RMO do not change with significance, the size and expertise of the organization will vary with each spill and with an increase in spill size. More staff, skills, resources, division of labor, etc. will be needed as spill size and complexity increases.
- Essentially this is the same answer the 28 individuals who stated "yes" gave. These individuals stated that the

tiered response concept changes based on size and complexity of the spill. No two spills are exactly alike, the organization will change based on the spill conditions such as size, location, season, and weather as well as political conditions at the time of the spill. Each RMO will be tailored to the needs of the response.

How does the significance of the incident influence the ability of the responders to succeed?

- A spill of higher significance attracts more attention from the media, politicians, opportunists, and special interest groups — all of which can drain the efforts of the response. The responders have to pay more attention to the operations as well as work harder to accommodate and meet the expectations of these groups. These groups can force the response to address "popular" concerns rather than all concerns in a priority order (16)
- The more significant a spill, the more the response ability is taxed (the less able the current technology is able to cleanup the oil) and the more difficult it is to succeed. Also the number of stakeholders as well as the number of responding organizations are increased which makes the response more challenging and complex (8)
- The more significant a spill, the more important it is to succeed (1)
- A spill of high significance aids in acquiring resources (1)
- The significance should not have any bearing on a responders ability to succeed, if it does, the RMP is defective (1)
- Environmental and economic sensitivity of resources at risk probably more important than quantity of oil spilled (1)
- No correlation (1)

What do you consider the legitimate objectives of response activities?

- To prevent or minimize environmental damage, including shoreline impacts on sensitive resources (24)
- To remove the oil efficiently and with proper techniques limiting human impact on the activities (14)
- The safety and protection of human health and property (13)
- To control the source (6)
- Create a "team approach" to solve problems and work with the government and local communities (6)
- To control costs and remove the oil in a cost-effective manner (6)
- To get the message and facts to the public and create a positive image (3)
- Leave the environment in a position to recover on its own within a short period of time (2)
- To establish a command and control environment (2)
- To minimize economic, social, and political damage (1)
- To restore the environment (1)
- To effectively prepare to respond to all incidents to the maximum extent practicable (1)
- To optimize response resources (1)
- To minimize the impact on public property (1)

What, if any, response activities should not be funded? Are there conditions during response you can imagine when expenditures would not be reasonable?

- Any activity that will cause more harm than good, is ineffectual, improper or not related to minimizing environmental impact (11)
- Use of publicly owned response equipment especially when the RP is doing a good job or when a local contractor is capable of the response. Also large quantities of "staged" equipment that is not needed (4)
- Research that doesn't contribute directly to the response (studies for study sake). (3)
- Public relation blitzes beyond informing the public including the visits of politicians to spill sites (3)
- Improving aesthetics (2)
- Any activity not passing the NEBA (Net Environmental Benefit Analysis) (2)
- Excess, including government excess (2)
- People who want to be there but have no role in response (2)
- Any action not directed or sanctioned by the responsible organization (2)
- Any expenditure not consistent with the NCP (2)
- Unreasonable oversight (1)
- Inconsistent oversight (1)
- Loss income from effected businesses (1)
- Cleaning to a "cleaner than clean" std. (1)
- Addressing environmental problems that existed before the spill (1)
- Legal fees (1)

Does the source of funds make a difference? If yes, why?

- **No (20)**
- If you accept the premise that RP response plans must be consistent with the FOSC's ACP
- 2 areas potentially affecting this — 3rd party claims (not NRDA or cleanup costs) and the FOSC imposing additional demands on a RP
- Unless the RP max limit is reached
- Money is money — if a response technique will be effective to reduce damage, all should support and fund, Expectations should be the same
- All parties should be held to the same standard
- The RP will always pay in the end
- **Yes (9)**
- There is a difference between public and private funding of a response. The RP's greater obligation is to reimburse state and local authorities and businesses
- We need to be prudent when spending federal, state or local money — also must be cautious when directing response and then expecting the RP/Insurer to pay
- The fund should only pay when the RP does not
- Real liabilities or site needs vs. perceived liabilities or

needs — dependent on RP or government viewpoint

- Double funding is silly, duplicate activities are wasteful, perhaps the European std. of government cleanup should be the norm
- There is a conservative utilization of federal dollars because of the burden of stewardship of federal funds and the public scrutiny attached
- Federal and/or state agencies that elect to work on their own agendas outside the unified command should pay the cost of those activities
- **No comment (5)**

What are the minimal organizational design requirements of a RMS needed to achieve a successful response? Should the RMS be different for various spill sizes (using the NCP classification)?

Minimal organizational requirements:

- Base it on the ICS which allows for standardization, expandability/contractability, and is multi-jurisdictional (20)
- Integrate the ICS into the UCS (5)
- Operational person (7)
- Finance person (7)
- Planning person (5)
- Logistics person (5)
- Command person (4)
- Public relations person (3)
- Legal person (1)
- Equipment expert (1)
- Administrative support person (1)

Other:

- QI (2)
- FOSC (1)
- RP (1)
- RP contractor (1)
- PIO (1)
- Expert spill manager or expert OSRO (1)
- Management approach to set objectives, create plans and allocated necessary resources; it is not an organizational structure (1)
- Smallest necessary to achieve success (1)
- A rigid RMS nationwide is not workable (1)
- Clearly identified chain of command (1)
- Must contain a method for accurately documenting all response activities, tracking costs and detailing damages. Should also contain a series of checks and balances to ensure safety and compliance w/the law. Must also contain a system where the public is kept informed; Must also contain a demobilization process (1)
- A RMS is a road map to optimize resources available together to accomplish objectives — turn a response organization into a project team (1)
- Person-in-charge w/operational units each w/ its own person who does assessment, cleanup, etc. It likely will need a group of technical experts to analyze and make recommendations (1)

RMS different for different size spills?

- **Yes (11)**
- tiered
- tailored to spill size and complexity, larger for a larger spill because of additional requirements
- flexible
- **No (7)**
- single flexible organization, the only difference being the # of people involved

Minor spill

- QI (RP?) (3)
- Responder (Contractor) (4)
- IC who performs functions for command, ops., planning, logistics and finance (2)
- FOSC (2)
- One to five people (1)
- Office coordination, part-time (1)
- SOSC (1)
- One or two people may perform all functions (1)
- An operation that does not require a lot of coord. and resources (1)
- On-scene resources (1)
- RMS is not critical as long as the simple objectives can be addressed and managed (1)

Medium spill

- QI (3)
- Responder (3)
- FOSC (2)
- IC who performs functions for command, ops., planning, logistics and finance but calls in others assist and take over roles as situation grows (2)
- SMT (1)
- More resources, more public relations work, more air traffic, more logistics (1)
- Office coordination, full-time (1)
- Outside field and management resource assist (1)
- PIO (1)
- SOSC (1)
- Audit (1)
- Legal (1)
- Media (1)
- Logistics support (1)
- Three to 20 people (1)

Major spill

- RP (3)
- QI (2)
- Planning (2)
- Stand up the full ICS (2)
- Finance (2)
- PIO (2)
- Logistics support (2)
- Communications (2)

- IC who performs functions for command, ops., planning, logistics and finance but calls in others assist and take over roles as situation grows (2)
- SMT (1)
- FOSC (1)
- SOSC (1)
- Operations (1)
- Audit (1)
- Legal (1)
- Media (1)
- Expansion includes bring advisory groups into the structure — all interested persons need to be brought into the command structure (1)
- Response network (1)
- A lot of everything, including politicians and press (1)
- Must have a project management support in order to ensure costs are controlled (1)
- A formalized RMS is necessary (1)
- Federal involvement only if necessary (1)
- Ten to 100+ people (1)

Who are the most visible/prominent parties or organizations who will have an interest in your area in oil spills?

NOTE: it seems that people interpreted this question differently. Some took it literally (who are the most visible?) and gave answers such as media, politicians, etc. while others took it to mean those individuals who are typically involved in spills (FOSC, SOSC, etc.).

- SOSC and other state agencies (25)
- FOSC/USCG (23)
- Media (local, national and international) (19)
- Special interest groups (environmental, tribal governments) (15)
- EPA (14)
- Local government (12)
- DOC (11)
- Other federal agencies (DOT, DOJ, DOL, etc.) (11)
- DOI (10)
- RP (9)
- Politicians (federal, state, local) (8)
- Property owners, local citizens, fishermen, damaged parties (7)
- Co-ops, contractors (3)
- Insurers (2)
- RCAC (1)

What is their interest?

SOSC and other state agencies

- political (16)
- environmental (11)
- economic (10)
- insuring state requirements are met and keeping state politicians happy (1)
- compliance w/ laws and regs (1)
- enforcement (1)
- PR (1)

FOSC/USCG

- political (10)
- environmental (7)
- economic (3)
- insuring fed'l requirements are met and promoting a positive image (1)
- regulatory (1)
- compliance w/ laws and regs (1)
- enforcement (1)
- PR (1)

Media (local, national and international)

- economic (9)
- political (3)
- environmental (3)
- public attention/sensationalism (2)
- coverage (1)
- deadlines (1)

Special interest groups (environmental, tribal governments)

- environmental (9)
- economic (4)
- political (4)
- image (1)
- emotional issues (1)

EPA

- political (6)
- environmental (6)
- economic (2)

Local government

- economic (6)
- political (3)
- environmental (2)

DOC

- environmental (7)
- political (5)
- economic (2)

Other federal agencies (DOT, DOJ, DOL, etc.)

- political (5)
- environmental (5)
- economic (2)

DOI

- environmental (7)
- political (5)
- economic (2)

RP

- economic (5)
- political (2)
- cleanup (2)
- environmental (1)
- PR (1)

Property owners, local citizens, fishermen, damaged parties

- economic (4)

- environmental (3)
- political (1)

Politicians (federal, state, local)

- political (4)

Co-ops, contractors

- economic (2)
- cleanup (1)
- political (1)

Insurers

- economic (2)
- political (1)

RCAC

- environmental (1)
- political (1)

In your view, should they all be involved in pre-spill planning efforts to define the RMS for that area?

- **Yes (28)**
- In order for them to know rules, understand system and get to know each other (8)
- Their perspectives are needed for a well-balanced plan; all have concerns that need to be heard; it will make the process better (4)
- They are stakeholders and have authority, power and political right (4)
- Many already are included (2)
- Because of their tremendously conflicting views (1)
- All should have access to powers (thru advising committee or liaison officer) (1)
- Involved at the AC level (1)
- **No (6)**
- politicians (2)
- media (2)
- public (1)
- environmentalists (1)
- Makes no difference because in a real spill they will react differently than during planning (1)
- Because if a large number of people are involved in pre-spill planning, bottlenecks develop and the size of the plan and length of time to develop it increases (1)

Should they be involved in the response organization?

- **Yes (19)**
- Those that have responsibility (FOSC, SOSC, RP) should be first line response (7)
- Others (environmental groups, secondary gov't agencies) should be available to be called upon and only if they can provide a specific service (5)
- As team members using their expertise and based on functional needs (5)
- Many already are (4)
- All levels of gov't must have way of exercising their interests (1)
- **No (7)**
- Media (5)
- Planning team is not necessarily the response team — response team is action oriented and should be "lean and mean" (2)
- Politicians (1)
- **Maybe (1)**
- Depends on the spill (1)

APPENDIX C

GLOSSARY

APPENDIX C

GLOSSARY

closed system A system that does not interact with its technological or political, economic, or socio-cultural environments. A closed system operates entirely within an organizational boundary. All feedback systems are internal to the system.

contingency A behaviorally or scientifically oriented approach of decision-making predicated on an event that is of possible but uncertain consequence.

control The dynamic application of the plan predicated on observing actions that occur subsequent to the event, evaluating them in relation to the plan, and correcting or modifying them as appropriate to achieve the desired goal.

crisis An unstable or crucial time or state of affairs whose outcome will make a decisive difference for better or worse.

disaster Many people trying to do very rapidly, things they do not ordinarily do, in an unfamiliar and rapidly changing environment.

emergency An unforeseen combination of circumstances or the resulting state that calls for immediate action.

emergent group(s) Groups, internal or external to pre-spill identified organizations, that arise as natural or logical consequence of the event.

incident command system A type of RMS which combines facilities, equipment, personnel, procedures, and communications operating within a common organizational structure with responsibility for the management of assigned resources to effectively accomplish stated objectives pertaining to an incident.

open system A "problem solving" system in which feedback from eternal environments in the critical determinant of system behavior, and ultimately, system success. An open system relies on internal and external feedback, organizational learning from the reactions of the external environments to its decisions, distributed decision making by small *ad hoc* teams and a high degree of flexibility and innovation.

plan A detailed formulation of a program on how to respond and the set of agreements required to support the plan during implementation.

planning The determination, in advance of a specific situation, of the optimum course of action consistent with established goals.

organization A structure of the anticipated functional and administrative relationships established in concert with known jurisdictional and political considerations.

response management system A response management system is the combination of organizational structure, management processes, individual roles, and operational strategy deployed during an oil spill response.

stakeholder Individuals or groups who have vested interest in the outcome of the spill, that is, those who have a special concern or stake in maintaining or influencing the actions taken to manage the post-spill effects.

stranger groups Groups who do not work or function together on a routine basis. Groups who have some marginal familiarity with one another might be better defined as acquaintance groups.

strategy The development of policies, plans, and resources to achieve the goals and objectives for a spill response.

tactic Operational actions taken to implement a strategy.

unified command system A type of RMS which unifies the organizations of the principal entities (government and private) involved in the response. UCS is a system of systems, which integrates the response management systems of individual organizations which participate in an oil spill response. For oil spills in the US, the unified command system brings together the functions of the federal government, the state government, and the responsible party to achieve an effective and efficient response, where the OSC maintains authority.

Appendix D

Acronyms

Appendix D

Acronyms

AC	Area Committee
ACP	Area Contingency Plan (US)
CFR	Code of Federal Regulations (US)
COTP	Captain of the Port
CSF	Critical Success Factors
EPA	Environmental Protection Agency (US)
FRP	Facility Response Plan(US)
FWPCA	Federal Water Pollution Control Act
IC	Incident Commander
ICS	Incident Command System
IMO	International Maritime Organization
IPIECA	International Petroleum Industry Environmental Conservation Association
ITOPF	International Tanker Owners Pollution Federation
MAC	Multiagency Advisory Coordinating Committee
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships (1973/78, IMO)
MSRC	Marine Spill Response Corporation
NCP	National Contingency Plan (US)
NIIMS	National Interagency Incident Management System
NRDA	Natural Resource Damage Assessment
NRC	National Response Corporation
NRS	National Response System (US)
NRT	National Response Team (US)
NSFCC	National Strike Force Coordination Center (US)
OPA 90	Oil Pollution Act (1990, US)
OPRC	International Convention on Oil Pollution, Preparedness, Response, and Cooperation (1990, IMO)
OSC	On Scene Coordinator
OSLTF	Oil Spill Liability Trust Fund
OSRO	Oil Spill Response Organization
PREP	Preparedness for Response Exercise Program (US)
RMS	Response Management System
RP	Responsible Party (US)
RPM	Remedial Project Manager (US)
RRT	Regional Response Team (US)
SAR	Search and Rescue
SMT	Spill Management Team
SONS	Spill of National Significance (US)
SSC	Scientific Support Coordinator
UC	Unified Command
UCS	Unified Command Structure
USCG	United States Coast Guard
VRP	Vessel Response Plan (US)

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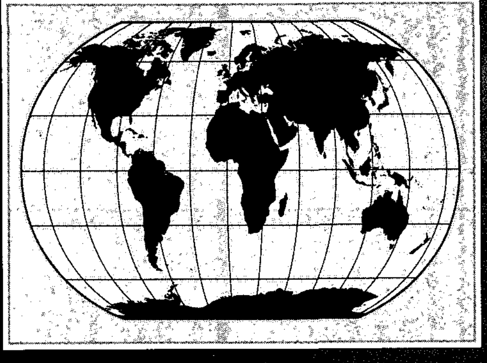
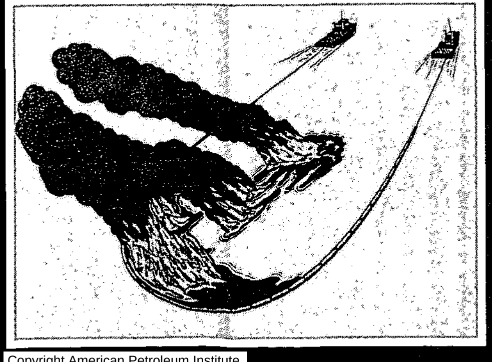
THE USE AND MISUSE OF SCIENCE IN NATURAL RESOURCE DAMAGE ASSESSMENT





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Technical Report IOSC-002

TECHNICAL REPORT IOSC-002

THE USE AND MISUSE OF SCIENCE IN NATURAL RESOURCE DAMAGE ASSESSMENT

A White Paper Prepared for the

1995 International Oil Spill Conference

American Petroleum Institute

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PREFACE

The 1995 International Oil Spill Conference sponsors, American Petroleum Institute, U.S. Coast Guard, U.S. Environmental Protection Agency, International Maritime Organization, and International Petroleum Industry Environmental Conservation Association, commissioned three white papers to address issues of special importance to the oil spill community. They assigned the responsibility for general management and oversight, scope definition, peer review, and publication of the white papers to the Program Committee.

The goals of the white papers are to educate the spill community, to stimulate open discussion of complex and controversial issues, and balance the diverse positions of stakeholders. Each topic addresses varying scientific/technical and socio/political concerns. Therefore, each white 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 1995 Conference, each white paper will be the topic of a special panel session. Separate publication of the white papers initiates the International Oil Spill Conference Technical Report Series. The Technical Reports are to be published in conjunction with the International Oil Spill Conference on a biennial basis.

It is the Program Committee's hope that each white paper will stimulate substantive discussion and serve as a catalyst for solutions.

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Technical Report IOSC–002

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Technical Report IOSC–003

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ABSTRACT

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Oil Pollution Act (OPA) of 1990 confirmed that appointed federal, state, and tribal trustees will seek to recover natural resource damages in the event of discharges of oil of hazardous substances into the waters of the United States. However, the process by which natural resource damages are assessed is not fully developed, is subject to unnecessary delay and conflict, and remains unusually controversial.

The Natural Resource Damage Assessment (NRDA) process generally followed in federal cases is intended to determine and quantify injury and related damages resulting from a pollution event, such as an oil spill. This paper reviews and comments on the fundamental issues raised by recent NRDA experiences and suggests ways in which the process can be significantly improved. The paper also reviews regulations developed by the Department of the Interior (DOI) and the draft regulation proposed by the National Oceanic and Atmospheric Administration (NOAA). Because NRDA is in large part fundamentally a scientific inquiry, the paper addresses the current difficulties, complexities, and constraints in applying the scientific method to real–time pollution events such as oil spills. In addition, these pollution events, in particular large oil spills, generate enormous public scrutiny, creating great political pressures on natural resource trustees and those named as responsible for the spill in determining natural resource damages based on uncertain data.

A workable and reasonable NRDA result requires careful use of available scientific theory and information, which is frequently incomplete. The potential for resolution of NRDAs raises difficult issues of the proper use of science in the context of the confrontational process of litigation. Unfortunately, the NRDA process raises the prospect of the improper use of science — especially where data are not available or are inconclusive or scientific theory is not clearly established — as a tool of selective advocacy serving one side or another rather than the dispassionate search for truth. Various options for preventing the misuse of science are presented. The authors conclude that if the focus of all participants in the NRDA process is the efficient and equitable determination of injury, damage and restoration of the environment where possible, the potential for misuse of science is minimized.

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Executive Summary

This paper provides an historical perspective on the application of science in the Natural Resource Damage Assessment (NRDA) and the positive and negative contributions of science to the NRDA process. The concerns, perspectives, and objectives of trustees, responsible parties, the public, and the academic and scientific communities are presented. The paper attempts to present an objective analysis of the fundamental conflicts between science and law in the NRDA process, critical issues which affect implementation of the process and options for resolving the issues. It is not the intent of this paper to make allegations which adversely affect improvement of the NRDA process. Examples of past successes and failures are presented to further facilitate improvement of the NRDA process.

Current statutes which authorize Federal and State natural resource trustees to pursue damages for injuries to natural resources are based on common law doctrines and suits filed by States early in the century in which the courts ruled that States, as trustees for public natural resources, have the authority to recover damages on behalf of the public for injuries to those resources. The Comprehensive Environmental Response, Compensation, and Liability Act and Oil Pollution Act are the principal Federal statutes which regulate the NRDA process. The United States Department of the Interior (DOI) and United States Department of Commerce (DOC), along with State natural resource agencies, are the trustee agencies most commonly involved with NRDA. The DOI and DOC have been charged with developing regulations to govern the NRDA process for hazardous waste sites under CERCLA and for oil spills under OPA, respectively. The fundamental goal of the NRDA process is to determine and quantify injury to natural resources and implement appropriate actions to restore the injured resource to conditions which would have been present had the discharge or release not occurred and to compensate the public for losses due to resource injury prior to restoration.

The current and proposed NRDA regulations are complex by nature of the discipline and have been the subject of much controversy. In addition, the damage assessment process has been applied to relatively few hazardous waste sites and oil spills since the initial promulgation of regulations in 1985. As a result, trustee agencies, responsible parties and consultants have limited experience conducting NRDA and its scientific, legal and economic components. Regardless of NRDA regulations and guidelines, the authors' experience has been that the tone and NRDA approach are often strongly influenced by subjective human attitudes and inherent biases of trustees and RPs.

The primary objective of environmental assessments is to collect sufficient scientific information to accurately identify and quantify the cause and effect relationship of a specific natural or anthropogenic disturbance. Although significant advances have been made in the area of environmental assessment, the study of natural resources is subject to numerous inherent limitations due to the complexities of the natural environment. Scientific study methods also have inherent limitations concerning their ability to measure a desired effect and the selection and application of sampling methods significantly affects the quality of study results and data interpretation. The effects of natural or anthropogenic perturbations are complex and even the best designed and conducted studies can often only support larger study objectives and cannot be considered conclusive by themselves. In addition, there are often numerous sources and effects of pollutants, and baseline data are commonly lacking, which makes data interpretation difficult.

There are many practical and legal constraints common to academic institutions, agencies, private industry and consultants. These include, but are not limited to, fiscal budget limitations, management goals and priorities, environmental and economic climate, available staff and unrealistic time deadlines. In view of the constraints, it is essential that scientists strive for objectivity and exercise best professional judgement in conducting environmental assessments and interpreting study results.

The ability to apply science effectively within the legal process is sometimes affected by the fundamental conflicts between the scientific and legal processes. A recent Supreme Court decision ruled that "general acceptance" is not a prerequisite to the admissibility of scientific evidence and that an expert's testimony, as determined by the trial judge, should be founded on reliable and relevant information which is based on scientifically valid principles. However, there are conflicts between the scientific and legal requirements regarding the level of proof necessary to establish a basis for a conclusion or decision. Scientists test stated hypotheses through statistical evaluation of data whereas a court forms decisions based on a "preponderance of evidence" selectively presented by attorneys to support their clients interests. Science seeks to establish the scientific truth whereas the legal process is founded on the advocacy of conflicting interests to resolve a truth.

In NRDA, scientists are often asked by their respective clients or employers to be advocates for particular interests in

preparation for possible litigation. The integrity of science is sometimes compromised by lawyers and scientists with various motives such as financial gain and retribution for the injury caused by the spill. The recent escalation of highly visible and potentially lucrative NRDA cases virtually guarantees that there will be adjustments of science in the courtroom as is the case in many human injury and malpractice suits.

Conducting good science within the context of NRDA can be strongly influenced by constituencies, administrative constraints, emotional factors and the need to integrate science and law. The public, the principal constituency of the government, has become increasingly more active in NRDA and even has legal standing to file suit if, in their judgement, adequate compensation has not been recovered by trustees. In fact, the public has sued trustees for inadequate settlements. This has sometimes influenced the objectives and approach of NRDAs. Industry defines the NRDA process in financial terms and seeks to minimize costs in an attempt to satisfy its key constituency, the stockholder.

The quality of science conducted in the context of NRDA often suffers due to time compression. The lack of adequate and pre-established administrative policies and infrastructures often leads to reactive policies or decisions which are not always in the best interest of the environment or political entity involved. The human emotional element can play an important role in determining the climate of a particular NRDA. For example, a scientist's zeal to find fault may be heightened if the scientist knows he or she may be involved in high-profile and expensive studies which are sometimes conducted by trustees since they know the RP is liable for assessment costs. Trustee and RP scientists sometimes take their lead from their respective legal counsel and often the responsibility and authority to determine the scientific approach are strongly influenced by legal counsel.

Several key NRDA issues have manifested themselves as a result of the convergence and divergence of the scientific and legal processes of NRDA and the scientific, practical and legal limitations of science itself. Some of the key NRDA issues include: (1) *ad hoc* scientific studies which typically lack peer review; (2) organization and cooperation between the trustees; (3) coordination between trustees and RPs; (4) the reasonableness and relevance of scientific studies; and (5) the suppression of scientific data. In addition, NRDAs sometimes take on a punitive, rather than compensatory, nature. Although computer models and compensation formulae offer several positive benefits to the NRDA process, existing and proposed computer models and compensation formulae have a poor standard of accuracy and ability to accurately quantify environmental injury and damages. Finally, dealing with third party claims and public involvement are areas which have received a great deal of attention and often influence how NRDAs are conducted.

Several options for resolving some of the above NRDA issues are presented with the objective of maximizing the use of science to accomplish the main goal and legislative intent of NRDA: restoration of the injured resource. Options include participation and recommendations of a scientific jury, removal of the rebuttable presumption, letting either the trustees or RP conduct the NRDA, review and removal of NRDA regulatory components which present obstacles to cooperation, increased training, requiring scientific studies to utilize an "ecological assessment" approach, requiring that RPs be given an opportunity to participate in NRDAs, making NRDA consistent with the International Oil Pollution Compensation Fund, and finally, eliminating financial compensation for injured natural resources in favor of requiring restorative measures.

Section 1

Introduction

For well over 100 years, natural scientists have been assessing changes in ecological systems resulting from natural and man-made disturbances. Scientific methods have been developed to assess and evaluate these ecological changes in response to public concern for minimizing adverse impacts to our environment. These assessment methods have, for the most part, been proven to be effective in determining compliance with a labyrinth of environmental standards and regulations.

The concept of compensating the public for injuries to natural resources and the loss of services provided by these resources is a relatively new addition to the legal/scientific/economic regime. The process of determining injury to natural resources and monetary damages is a complex integration of natural science, law, economics, politics, business and human emotion and sensitivity. The combination of these components, often in a state of emergency, can make the assessment of natural resource damages difficult and subject to considerable controversy.

This paper is intended to be an objective analysis of the fundamental factors, issues and constraints which influence the role of natural sciences in the Natural Resource Damage Assessment (NRDA) process. The role of science in the NRDA process is reviewed with respect to the primary goal provided by law, which is to restore, rehabilitate, replace or acquire the equivalent of natural resources injured or lost as a result of the discharge of oil or release of hazardous substances. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Clean Water Act (CWA) and the Oil Pollution Act (OPA) clearly delineate this goal. The application of science to achieve the goal of restoration presents several challenges, particularly to scientists and administrators acting as trustees of public natural resources. Challenges also arise from evaluating natural resource injury within a legal framework that is foreign, and at times contradictory, to the scientific method and from translating environmental impacts into monetary values. Scientists who typically conduct their work using standard scientific methods are asked to operate in an atmosphere that is driven by numerous legal, economic and political pressures. Of particular concern are the fundamental conflicts between the objectives of science and the objectives of law.

To facilitate understanding by a broad audience of diverse backgrounds, this paper will present a brief discussion of the NRDA origin and process. This is followed by a discussion of how scientific methods, unfettered by the influences of the NRDA process, have been established, and how science has inherent limitations in answering many scientific questions. The conflict between the processes of science and law and the external forces that influence the application of science within the NRDA process are also examined. Critical issues that have resulted from the divergence of scientific and legal processes are discussed in the context of past NRDA cases. Finally, possible conceptual means of resolving or further minimizing future conflict and the misuse of science are outlined as a basis for future discussion.

The process of compensating the environment for injury has evolved greatly in the past several years. As with any evolutionary process there have been successes and failures. Many individuals on all sides have worked hard at making the process function more efficiently. Many advancements have been achieved and many remain to be made. Currently, regulations are being proposed that are the subject of considerable controversy. By reviewing some of the problems of the past, we can best plan solutions for the future. The intent of this white paper is not to point fingers at past transgressions and lay blame, but to recognize past successes and failures with the goal of working toward a positive, equitable approach to restoration of the environment.

Discussions concerning the economic component of NRDA have intentionally been kept to a minimum in this paper. Also, case history examples used in this paper are intentionally not from the EXXON VALDEZ incident. Although all sides of the process have learned and progressed from this incident, the conduct of that particular NRDA is viewed as an aberration of a more typical NRDA proceeding. Rather, the case history examples are from the over four dozen NRDAs which the authors have been involved with prior to and subsequent to the EXXON VALDEZ incident. Where possible, and to the extent that it was deemed appropriate, specific cases have been cited. In many instances, ongoing litigation or negotiation precludes identification of specific cases.

SECTION 2

NATURAL RESOURCE DAMAGE ASSESSMENT BACKGROUND

NRDA is founded on many of the concepts of common law and the legal principle that properties such as natural resources are important and should be conserved for use by the public. Federal statutes, primarily CERCLA of 1980, CWA Amendments of 1977, and OPA of 1990, provide the authority for Federal, State and American Indian natural resource trustees to assess damages for injuries to these trust resources. A brief overview of the NRDA process is provided here. A more detailed discussion of the origin of NRDA, function and authority of trustees and Responsible Party (RP) and NRDA process is provided in Appendix A.

As defined in the NRDA regulation proposed by the National Oceanic and Atmospheric Administration (NOAA), damage assessment is "the process of collecting and analyzing information to determine damages for injuries to natural resources and/or services (provided by the natural resources)." The NRDA process is designed to determine and quantify injury, damages resulting from the injury and the appropriate restoration approach. A claim for damages is submitted to the RP to compensate for injuries to natural resources resulting from the discharge, or threat of discharge, of oil or release of hazardous substances. Regulations developed by the United States Department of the Interior (DOI) define the current NRDA administrative process for hazardous waste sites and oil spills. OPA NRDA regulations being developed by NOAA will address the NRDA process for the discharge of oil into navigable waters of the United States.

DOI regulations provide trustees with two damage assessment methods (Type A and Type B). The proposed NOAA regulations include four alternative damage assessment procedures. The NOAA regulations include the Type A model, compensation formula, expedited damage assessment and comprehensive damage assessment. Trustees can select the most appropriate damage assessment approach from these Federal procedures and available State procedures based on the size and nature of the spill incident, injury to natural resources or the services provided by the resources. Use of any of the DOI or proposed NOAA assessment procedures by the trustee gives the damage assessment a rebuttable presumption of accuracy in an administrative or judicial proceeding. Although no court has determined the precise meaning or effect of this rebuttable presumption, it appears to mean that if the trustees follow the procedure prescribed in the regulations, their damage claim is presumed to be correct in a judicial or administrative review (Bieki, pers. comm., 1994). If the trustees wish to forego utilization of the rebuttable presumption, the trustees may use other damage assessment methods. Finally, the trustees are not required to implement an NRDA for all oil spills or hazardous waste sites.

The fundamental goal of NRDA is to provide for the restoration of injured natural resources and/or services to pre-incident conditions that would have existed in the absence of the discharge or release. The goal is to be accomplished by developing and implementing a plan for the restoration, rehabilitation, replacement or acquisition of equivalent natural resources. For discussion purposes in this paper, the term restoration will be used to include rehabilitation, replacement and acquisition.

Under OPA, damages are defined as the amount of money calculated to compensate for injury to, or destruction of, or loss of use of natural resources including the reasonable costs of assessing or determining the damage, which shall be recoverable by the United States, a State, American Indian tribe or foreign trustee. Injury is defined by the proposed NOAA regulations as "any adverse change in a natural resource or impairment of a service provided by a resource relative to baseline, reference, or control conditions." Natural resources are defined in CERCLA as:

> "...land, fish, wildlife, biota, air, water, ground water, drinking water supplies and other such resources belonging to, managed by, held in trust by, or appertaining to, or otherwise controlled by the United States...any State or local government, any foreign government, any Indian tribe, or, if such resources are subject to a trust restriction on alienation, any member of an Indian tribe."

Examples of trust resources include land resources such as National Wildlife Refuges and National Parks, and living resources such as migratory birds, marine mammals, anadromous fish, terrestrial mammals and their habitats.

The DOI regulations (Rule) have several fundamental concepts that dictate the requirements and procedures which should be followed in conducting a NRDA. These concepts are listed since they are important to understanding the NRDA process:

- Damages are for injuries residual to response or remedial actions;
- Damages are compensatory, not punitive;

- The public and responsible parties are involved in the process through notice, review and comment;
- Recovered damages must be used for restoration;
- The rebuttable presumption (the plaintiff is considered correct unless sufficient data are provided to refute the plaintiff's data) is an important element to decision making;
- Use of the regulations is optional; trustees do not have to follow the regulations or implement a NRDA; and
- Emergency restoration is a temporary action to avoid or minimize injury.

Under CERCLA and OPA, the RP is legally liable for response and cleanup costs and damages for injury to, or destruction of, natural resources, loss of use of natural resources and the reasonable costs of assessing injury and damages. Although NRDAs must be implemented by the trustees, the RP can participate in the NRDA process by providing data, funds or assistance on scientific studies and restoration. The proposed NOAA regulations encourage cooperation with the RP but leave the decision to allow RP participation to the trustees. Several states have developed NRDA programs including California, Florida, New Jersey, New York, Texas and Washington. Some of these states, such as Washington and Texas, provide for ongoing involvement by the RP in the NRDA process (WAC 173–183, 1992; TAC 20.20–20.23, 1994).

SECTION 3

USING SCIENCE TO DETERMINE ENVIRONMENTAL EFFECTS

The enactment of CERCLA, OPA and associated regulations is evidence that this society places ever-increasing value on the environment in which we live. As once common resources are diminished in quantity and quality, environmental concerns become national issues and affect where we live, work and recreate. Environmental concerns also influence the legal, political and economic climates on local, regional and sometimes national levels. The measure for understanding and regulating the environment is science. Science is the basic and most essential component of NRDA. One of the major issues in the damage assessment process is how much science is necessary to form a basis to determine adequate and equitable restoration and compensation? The ability of science to accurately identify injury is not always up to the expectations of all concerned. This section will discuss some of the inherent difficulties and complexities in conducting science as well as some of the practical constraints.

3.1 SCIENTIFIC CONSTRAINTS

Apart from its function in NRDA, one of the primary purposes of conducting scientific assessments of the environment is to provide reliable information regarding the nature and extent of environmental effects resulting from human activities which can be used to conserve and protect the environment. This requires an understanding of what the environment is and the development and utilization of methods to determine the nature of the environment and to quantify significant changes (Suter *et al.*, 1993). Recognizing and identifying the significance of the injury to the environment and uncertainties or confidence regarding the scientific data and conclusions are critical components of credible scientific assessments.

Significant emphasis has been focused on the development of standard and accurate scientific methods for assessing the consequences of human activities on the environment since the passage of the National Environmental Policy Act in 1969. The development of scientific methods and procedures by the United States Environmental Protection Agency (EPA) for assessing the adverse effects of hazardous waste sites has also been key to guiding the practice of environmental assessment. Although significant advances in environmental assessment have been made, the implementation of good science is hindered by the inherent limits of science and practical constraints.

The study of natural resources, outside of the context and constraints associated with NRDA, is subject to numerous limitations due to the very character of natural resources and their environment even in the application of sound scientific principles and practices. The study of natural resources involves complex environments and interactions of biological organisms with one another and with their physical and chemical environments. The accurate identification and quantification of the effect of anthropogenic sources of environmental injuries on a biological community is difficult because effects must be measured in a continually changing, non-static biological community. Complex biological, physical and chemical interrelationships are also confounded by spatial and temporal relationships.

SCIENTIFIC ASSESSMENT METHODS

All scientific study methods have inherent limitations regarding their capability to measure a specific effect, and the selection and use of a particular sampling method significantly influences study results and data interpretation. Scientific sampling methods are rarely unbiased or completely efficient in addressing the study objective not because of specific objectives of an investigator but rather due to the nature of the method. The comparison of study results to background data in the literature must be done with extreme caution and with consideration of variations due to sampling and data handling and analyses. Numerous studies comparing various sampling methods illustrate differences in results and conclusions drawn from the same data (Straughan, 1979; Green, 1979).

Only those effects which are outside of documented natural variability can be attributed to the tested parameter or hypothesis. In an attempt to account for natural variability in biological communities, and arrive at accurate conclusions, it is necessary to measure biotic and abiotic parameters at the site being investigated as well as at control (unaffected or reference) sites. However, it can be extremely difficult to find appropriate control sites and match biotic and abiotic parameters with the parameter or variable being assessed. Also, although the bounds of natural variability can be quantitatively defined using statistically adequate data, there are relatively few situations where adequate or comparable information actually exist (Sharp *et al.*, 1979).

Analyst error presents another concern. Although statistics can quantify the effect of random errors they cannot address the incorrect application of sampling methods such as improper calibration of a sampling device. The scientist must be certain that the method selected addresses specific endpoints or objectives of the study.

COMPLEX EFFECTS

The effects of natural and anthropogenic perturbations are complex and can be direct, indirect, sublethal, secondary or latent and include death, disease, physical deformities, genetic mutations and physiological malfunctions. Physical and chemical changes to the environment can occur, such as increased contaminants or alterations of water flows or sediments. Because of the complexity of potential human influences on the environment, even the best designed and conducted studies can often only support data from other studies to increase confidence in the validity of conclusions and should not be necessarily considered conclusive by themselves. No single scientific method or approach can generate precise and realistic results and often the results of cause-effect studies are inconclusive. As an example:

> "Several sea lions were observed with oiled pelts, and petroleum hydrocarbons were found in tissues. Determining if there was an effect of the spill on the sea lion population was complicated by seasonal movements of sea lions in and out to the spill area, an ongoing population decline and a pre-existing problem with premature pupping." (Exxon Oil Spill Trustees, 1992)

An additional challenge is that of quantifying the magnitude of adverse effects from specific and short-lived incidents such as oil spills is illustrated by the assessment of the effects of oil on marine birds. Marine birds are vulnerable to oil and die from hypothermia, drowning and from toxicological causes. Since the NESTUCCA oil spill on the coast of Washington State and British Columbia in 1988, organized beach surveys are now commonly conducted to search and collect oiled birds for treatment and to document injury to determine and assess damages. However, even the best designed and organized bird search and collection efforts cannot account for all birds potentially or actually impacted by a large oil spill because of environmental and anthropogenic factors. For example, studies have shown that between 10 and 100 percent of the marine birds impacted by an oil spill are not accounted for by search and collection efforts during a spill response (Bibby and Lloyd, 1977; Bibby, 1981; Page *et al.*, 1982; PRBO, 1985; Ford *et al.*, 1987; Burger, 1993). This is a large range with important economic consequences.

NUMEROUS SOURCES AND POLLUTANTS

Natural sources of environmental variation are also confounded by numerous sources of pollution, particularly in urbanized areas. The pollutants being investigated and their environmental effects are often analogous in nature to other pollutants causing similar effects in the same area. The effects of pollutants can be cumulative, synergistic or antagonistic. In these cases, it is difficult or nearly impossible to differentiate the cause-effect relationships between several sources and types of environmental pollutants.

LACK OF BASELINE DATA

Although environmental studies can be conducted using the best available study design and sampling techniques, uncertainties always exist. Uncertainties are exacerbated when pre-impact data, either from baseline and/or monitoring studies, do not exist or are not relevant. The EPA's Environmental Monitoring Assessment Program (EMAP), U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program and NOAA's National Status and Trends Mussel Watch Project are designed to describe the national status and trends of water resources. Information from these programs will help provide a better understanding of the natural and anthropogenic factors which affect the quality of water resources and may provide useful baseline information.

Currently, however, background data required to adequately assess cause-effect relationships generally lack one or more of the following: biological resources, specific contaminant data, collection methods, analytical methods and/or data analysis and interpretation. Often baseline data simply do not exist. Even when these data do exist, they may be unusable due to differences in study objectives, design and methods or due to incomplete descriptions of these study elements. In addition, the sources of baseline data are commonly obscure, diffuse and difficult to locate.

3.2 LIMITS OF SCIENCE

HYPOTHESIS FORMULATION

The testing of hypotheses is fundamental to modern scientific method. Hypothesis formulation is the most important prerequisite to the development of an objective and credible environmental assessment study design. The null hypothesis must be falsifiable, that is, it must have an estimated certainty of being wrong to provide a basis to determine confidence in a conclusion. The scientist must also have the ability to exercise an objective analysis of the study results and accept or reject the results based on these statistical measures of uncertainty.

STUDY DESIGN

The application of proper sampling design, hypothesis testing and data analysis in environmental assessment is essential. The nature of the problem or study objective must dictate the study design, test of hypothesis, data analysis and interpretation and conclusions derived from the results. A critical goal is to minimize ambiguity and bias. Even when studies are properly designed and implemented by highly competent scientists the interpretation of results often varies.

The logical sequence, in order of priority, for developing and implementing a quality and accurate study is:

Numerous questions must be answered by scientists before implementing studies in the field. The first decision, following hypothesis formulation, is to determine what biological media, species or function to sample. The sample type, size, replication, number, location and sampling method and time, all usually for more than one variable, must be determined. The sampling program and data analysis must be designed in concert to accurately reflect the differences between experimental and control areas and answer the study objective. Finally, an internal and external scientific peer review is usually required to help ensure that the study design and methods are appropriate and efficient to accomplish the identified study objective(s).

DATA INTERPRETATION

Once data have been collected and statistically analyzed, the results are then compared to the original hypothesis. The interpretation of these data includes relationships to other proven principles and empirical observation. Data interpretation can result in different conclusions depending on an individual's background, experience and objectives.

Data should also be evaluated against criteria and standards such as the National Ambient Water Quality Criteria. However, these are based on individual responses to specific problems and may not address population responses or the effects of multiple contaminants. Also, criteria are available for relatively few contaminants and species and criteria are often not consistent.

Finally, in view of the inherent limitations and uncertainties of science, scientific assessment "conclusions" usually are based on a weight-of-evidence approach. This approach incorporates the use of various field, laboratory and sometimes modeling assessments. Methods to support findings minimize uncertainty and create the weight-of-evidence.

3.3 PRACTICAL CONSTRAINTS

In addition to the numerous and inherent scientific constraints associated with conducting environmental assessments, there are several practical constraints. These practical constraints are common to academic institutions, government agencies, private industry and environmental consultants. They include, but are not limited to: fiscal budget limitations; ranking priorities; changes in management or administrations and their respective goals and preferences; local, regional and national environmental and economic climate; available time and staff; and unrealistic deadlines. These constraints usually compromise the ability to implement the appropriate studies which are required to address complex scientific questions and hypotheses. This can result in poor quality and poorly timed studies, lack of confidence in study results and/or inconclusive data.

Another practical constraint to conducting sound and cost-effective science is the increasing necessity to satisfy the expectations of constituencies. Government agencies must satisfy the expectation of a diverse and often demanding public constituency in spite of limited budgets, limited staff and constantly changing administrative and political objectives and priorities.

Because of these numerous scientific, practical and legal constraints and in recognition that the study of natural resources is not an exact science, professional judgement plays a critical role in the outcome and utilization of scientific investigations. The scientific challenges and shortcomings must be identified and incorporated in the developmental and interpretation phases of all natural resources studies. It is essential that scientists strive for objectivity and exercise best professional judgement in developing and focusing study designs and objectives to address achievable study hypotheses and objectives within the numerous scientific, practical and legal constraints. For example, the National Academy of Sciences (1977) states that:

> "The most promising approach to natural resource management is an inductive one, based on the accumulation of consistent observations of the responses of systems to management activities and other perturbations."

In summary, science has inherent limitations and complexities and is not exact. Therefore, to minimize uncertainty and reach reliable conclusions, it is necessary to use various assessment methods to create a weight-of-evidence. The ability of science to effectively assess impacts to the environment is dependent on differentiating a true biological impact or signal from the "noise" of background variability. The extent to which this signal can be recognized is largely dependent upon the development and implementation of sound scientific study design and hypotheses and objective data interpretation and

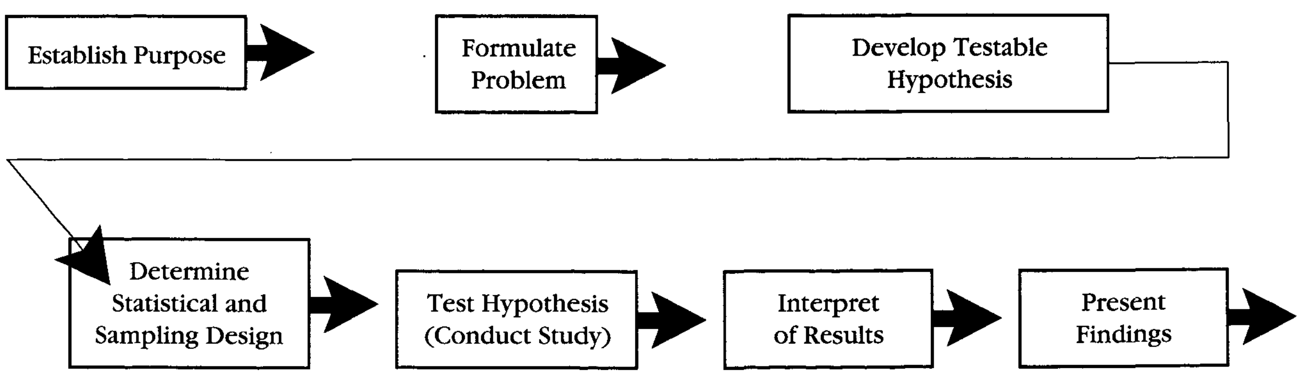

FIGURE 3-1. STUDY SEQUENCE.

may require an enormous effort. Development and implementation of high quality assessments are often subject to practical and administrative limitations.

The extent to which science is "used and misused" is a subjective judgement based on the perspectives, experiences, specific circumstances and other factors of those involved. Regardless of the side taken, some of the basic questions that arise are:

- Are high quality assessments needed?
- Can high quality assessments be performed?
- Is a study practical?
- Is full-scale study appropriate?
- Is a study financially warranted?
- Can a study be used to support or refute a restoration claim?

The use and misuse of science is a function of the answers to these questions. Again, these issues relate to the fundamental question of how much science is necessary to form a basis to determine adequate restoration and compensation.

SECTION 4

CONFLICTS OF SCIENCE AND LAW

To accomplish the objectives of NRDA, the law requires reliable scientific determination of injury to natural resources and the evaluation, planning and execution of appropriate restoration. In the preceding section, many of the prerequisites and limitations to the conduct of reliable science have been identified. However, the ability of science to work effectively within the legal arena has often been compromised by some fundamental conflicts between the scientific and legal processes. Because compensation for injury to natural resources is determined within the legal process, the traditional function and application of science has inevitably become warped to "fit" that process by requesting scientists to conduct investigations to support a given position. Lawyers often wish to negotiate based on the best information available to support their position. Without specific agreement on cooperation between the parties, scientists may be asked to collect evidence to support litigation and/or negotiation or provide opinion in depositions or testimony in court. The threat of litigation, therefore, has a potential to influence the nature and extent of science performed even in a negotiated settlement.

The legal process includes the potential for resolution of civil cases by negotiation. Indeed, NRDA claims have historically been almost exclusively settled by negotiation. In recent years, trustee and RP communities have actively explored and promoted means to facilitate cooperation and negotiated settlements. If negotiation is unsuccessful, however, the system leads to resolution by costly litigation. This potential for litigation requires lawyers to prepare themselves accordingly.

In evaluating appropriate and less than appropriate uses of science in the NRDA process, it is valuable to examine conflict between science and the legal process in terms of: 1) what kinds of evidence can be applied to a given scientific issue, and 2) how information and testimony can be used to influence a judge and/or jury's decision. Subsequent sections of this paper will expand on the influences of these conflicting factors and potential implications for NRDA.

4.1 SCIENCE AS EVIDENCE

Until recently, the test for acceptance of scientific evidence revolved around the 1923 *Frye v. United States* (Frye) case in which in a very brief opinion the court held:

> "Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages it is difficult to find. Somewhere in this twilight zone, the evidential force of the principle must be recognized, and while the courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs." (*Frye v. United States,* 293 F. 1013)

Although the concept of "general acceptance" appears to be consistent with science in that scientists would argue that nobody is better prepared to evaluate the truth of scientific claims than the scientific community itself, there are many pitfalls. These pitfalls include interpretation of the phrase "general acceptance in the particular field." A point of controversy under the *Frye* ruling is that "general acceptance" admissibility has often been resolved by whether expert testimony, theory or technique has been subjected to peer review and publication (Federal Rules of Evidence, Rules 104(A) and 702) (Hoke, 1994). This has occasionally resulted in the rejection of empirically-supported testimony due to lack of meeting a quasi-test of publication.

The evaluation of specific studies by an expert or the application of prior knowledge to a specific issue in the form of an opinion can also be entered as evidence. In a recent United States Supreme Court decision by Justice Blackmun in the case of *Daubert v. Merrell Dow Pharmaceuticals* (1993) (Daubert), the court produced a landmark decision relative to future use of scientific opinion in resolving cases *(Daubert v. Merrell Dow Pharmaceuticals,* 113 S.Ct. 2786 (1993)). In the ruling, the Court held that the current Federal Rule of Evidence 702 supersedes the *Frye* decision. Rule 702 states:

> "If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training or education may testify thereto in a form of an opinion or otherwise."

In the Daubert opinion, Justice Blackmun wrote:

> " 'general acceptance' is not a necessary pre-condition to admissibility of scientific evidence under the Federal Rules of Evidence, but the rules of evidence — especially Rule 702 — do assign to the trial judge the task of ensuring that an expert's testimony both rests on a reliable foundation and is relevant to the task at hand. Pertinent evidence based on scientifically valid principles will satisfy those demands."

The scientific perceptions and acumen of a particular judge will affect his or her determination of the admissibility of scientific evidence based on reliability and relevance. When asked to be a scientist, however, a judge can be expected to make that determination on the basis of non-scientific criteria. The ability of the expert to convince the judge of his reliability and the skill of the attorney to present the relevance of the testimony may outweigh the technical strength of the argument (Fleetwood, 1987).

The potential use of quasi-scientific criteria developed by an impartial, well-intentioned judge to determine technical reliability has raised concern among many scientists. Relative to the compatibility of law with scientific method in the determination of admissible science and opinion, Justice Blackmun wrote,

> "It is true that open debate is an essential part of both legal and scientific analyses. Yet there are important differences between the quest for truth in the courtroom and the quest for truth in the laboratory. Scientific conclusions are subject to perpetual revision. Law, on the other hand, must resolve disputes finally and quickly...Scientific conjectures that are probably wrong are of little use, however, in the project of reaching a quick, final, and binding legal judgement — often of great consequence — about a particular set of events in the past. We recognize that in practice, a gate-keeping role for the judge, no matter how flexible, inevitably on occasion will prevent the jury from learning of authentic insights and innovations. That, nevertheless, is the balance that is struck by the Rules of Evidence designed not for the exhaustive search for cosmic understanding but for the particularized resolution of legal disputes."

4.2 SCIENCE AS PERSUASION

DEGREES OF PROOF

Fundamental conflicts arise between science and the legal process regarding the level of proof required to form a basis for a conclusion. The scientist will strive for the statistical evaluation of a given set of data to prove to a specified degree of mathematical probability that an event was not due to chance or an alternative hypothesis. On the other hand, in civil proceedings, the court will evaluate data and draw conclusions based upon a preponderance of admitted evidence on the issue before the judge or jury. In other words, the trier of fact may find that an event occurred because they believe it is more likely to have occurred than not to have happened at all. In this scenario, the judge or jury make a gut level determination of what is believable. This determination is often a product of the lawyers' desire to persuade a non-scientific judge and/or jury to believe their argument, which furthers the interest they are advocating rather than establishing the technically or statistically proven answer. Another factor in a trier-of-fact's determination of an issue, in addition to a pure evaluation of the preponderance of evidence, may be the jury's desire to compromise between two conflicting parties' positions.

In the current legal system, legal practitioners may seek to present only selective nuggets of "supportable fact" that serve their immediate purpose. In *Science and Common Sense,* Conant (1951) describes science as:

> "...an interconnected series of concepts and conceptual schemes that had developed as a result of experimentation and observation and are fruitful of other experimentation and observations..."

Selective use of portions of a scientific continuum can provide improper weight to invalid science. As stated in Getto *et al.* (1993), in an article analyzing the recent *Daubert* decision regarding the acceptability of scientific testimony, "when courts refuse to measure scientific evidence by scientific standards, the legal result is a misinformed guess."

OBJECTIVE INQUIRY VERSUS LEGISLATIVE INTENT

The legal system has an objective of satisfying the letter of the law as developed by the legislative process. The legislative process is intended to represent the will of the people. Just as individuals may make a decision based on perception as opposed to the best analysis of data, science can be ignored in the legislative process. Also, legislation may falsely assume the scientific community has the ability to effectively address the legislators' objective. Right or wrong, legislative intent often conflicts with the scientific search for a more complete or accurate answer. While the law embodies the needs and wishes of society, science has certain requirements and principles of its own that must be upheld to maintain the integrity of science. When science is used to set criteria or legal standards, the standards are subject to considerable scrutiny by the scientific community and are usually subject to some form of analysis of uncertainty and/or "risk" of not achieving the desired objective.

OBJECTIVE INQUIRY VERSUS ADVOCACY

One of the prime conflicts between the scientific and legal process is that science is classically considered a quest for scientific truth, whereas the legal process is based upon the advocacy of conflicting interests to reach a "found truth" to resolve a dispute. The use of science to advance a particular interest, as opposed to making objective inquiries based on established principles and empirical data, is contrary to the premise of science.

There is no question that one of the necessary conditions for scientific investigation is an exact and impartial analysis of facts. Conant (1951), remarked:

> "The scientific investigator must impose on himself a rigorous self-discipline the moment he enters his laboratory. For his jury today is a large body of well-informed peers and to them he need only present accurate reports with the minimum of emotion."

The legal process on the other hand, is fundamentally compelled by the concepts of adversarialism, which requires that legal practitioners adhere to the principles of advocacy; the idea being if advocates present their best and most influential arguments on both sides of the matter the truth will become evident. This concept is fundamental to our current legal process. This is not to imply that the legal process is flawed to the exclusion of viable science, but to recognize that conflicts between the legal and scientific process are fundamental to, and influence, the current approach to resolution of natural resource damage issues.

Attorneys, in a strident effort to provide their client with the most convincing case, attempt to make scientists deliver positive statements rather than reflect the uncertainty of the state of knowledge. By doing so, they often distort the fundamental missions of science. Just as there are failings of lawyers as opposed to the failings of the legal system, there are failings of scientists as opposed to failings of science. Science in general is involved in the recognition, the quantification and the reduction of uncertainty, always identifying the fact that the scientific process contains inherent uncertainty. In the *Daubert* (1993) decision, Judge Blackmun states that when considering the appropriateness of a given technique the court should consider "the known or potential rate of error" and "standards controlling the technique's operation." However, Judge Blackmun admits that scientific knowledge, method and validity are "matters far afield from the expertise of judges" (West's Supreme Court Reporter, 1992). However, in testimony, legal advocates may act as if inherent uncertainty is not allowable, or use it in an unrealistic manner to persuade the trier of fact to reject conclusions that are scientifically acceptable. For example, after having conducted a lengthy study on the impact of a toxicant on a species of fish the scientist may be asked if concentration "x" will result in death. The scientist responds that given a range of other environmental parameters, his research would indicate that death would occur 90 percent of the time. When asked if the scientist could predict with absolute certainty the exact conditions that could cause mortality the scientist responds "no" because there is the calculated probability of inherent error. Even though the judge or jury has heard that a 90% probability of mortality is expected, a skilled lawyer may focus on the uncertainty of the study to the exclusion of the more rational assumption.

Scientists as Advocates

In most NRDA situations, the opportunity exists for scientific negotiation regarding the goal of restoration of the environment as opposed to maximization of financial recovery. If the scientific and legal practitioners involved with the case focus on the ultimate objective of achieving restoration of the resource, the potential for the mis-application of science exists but is greatly minimized. However, natural science is vulnerable to transgression. For example, studies may be presented for the advancement of a particular position without the benefit of traditional scientific validation. In most cases, the scientific community polices itself relative to the validity of data. If the damage assessment process is conducted in an extreme adversarial mode with secretive data preparation, investigations cannot benefit from objective peer review. This approach also precludes exchange of technical data and professional judgement that may lead to a more expedient and cost effective resolution. If the process takes place in an adversarial proceeding, resolution may ultimately depend on the scientific acumen of the judge to determine the reliability of the data as indicated in the *Daubert* decision with full consideration of scientific testimony presented by skilled lawyers.

As much as it pains scientists to admit it, attorneys are not always at sole fault in straining the bounds of scientific integrity. The potential for the inappropriate use of science may be maximized in litigation. In his book, *Galileo's Revenge: Junk Science in the Courtroom*, Attorney Peter Huber (1991) examines the misuse of science by scientists and lawyers in the legal theater. Huber focuses his analysis on the use and misuse of science as it impacts the legal process with reference to medical malpractice cases. With reference to qualities that may instill confidence in "scientific reliability" and the objectivity of scientific expertise in the courtroom, he makes the following observation:

> "You naturally want an expert who has impressive experience, along with just the right graduate degrees, timbre voice, sartorial habits, and such. The testimony taking the form of on-the-one-hand-this and on-the-other-that is useless, no matter how credible, while vehement support for your side of things, no matter how dubious the science behind, may always be of some help." (Huber, 1991)

In this comment not only do we see the qualities that may instill the jury's confidence in the "scientific reliability" of the expert, we also see a form of advocacy-driven natural selection. Further to this subject, Huber notes,

> "The well-known Melvin Belli, self-proclaimed to be the 'King of Torts', was once quoted: 'If I got myself an impartial witness, I'd think I was wasting my money.' The witness approached by a man like Belli will understand the economics of the relationship quickly enough."

> "Such witnesses are probably not working on a contingent fee basis but his long term financial success likely depends on his contribution to consistently winning cases. The ATLA Law Reporter, a journal for plaintiff's lawyers, identifies the names of the winning expert side by side with the name of the victorious lawyer."

> "In this kind of legal environment, the trial lawyers serves as a sort of Darwinian avenger, like a breeder of prize pigs or exotic dogs. The scientific community is large and heterogeneous to begin with, the lawyers livelihoods depend on selecting witnesses who win-cases, that is, not Nobel prizes...they are hardly ever called scientists, at least not by those in the know. Other labels abound and most are not flattering." (Huber, 1991)

The value of such "hired guns" is preeminently based on the notion of litigation. The motives of scientists to bend their ideas can range from obvious financial benefit reaped from their private or public client to contributing to a higher cause. Causes may range from the conviction that data, if fully analyzed, would support their position, to righteous indignation, to retribution for the injury caused by the spill.

Numerous books and articles have been written about the role of science in the courtroom. The vast majority examine the misuse of science in cases involving direct injury to humans by industry or by medical practitioners. Perhaps due to the historical rarity and comparatively diminutive value of environmental claims, natural scientists have been largely sheltered from adjustments of science in the courtroom. Until recently, natural scientists have not become accustomed to the high-profile, lucrative cases that offer the sort of temptation that affects the conduct of experts in medical malpractice cases as described by Huber. However, recent escalation of what is to be gained or lost by NRDA settlements virtually guarantees that temptation to increase. The conflicts of science and law provide fertile ground for "misuse" of science. The "misuse" of science is largely dependent on an individual's perspective or role in the process. This is not an indictment of individuals, but a recognition of potential conflicts of objectives and processes.

Due to the fact that virtually all oil spill NRDA cases have been resolved by negotiation as opposed to litigation, scientist's mutual respect and ability to focus on reasonable solutions are often more valuable than their ability to sway a judge or jury during expensive litigation. To affect successful negotiations, both sides of a case must recognize the available science and the limitations and flexibility of the legal system within which the NRDA process operates. While litigation may be tempting for many reasons, the effective negotiation of NRDA settlements appears to rest with a maximization of technical interaction within a cooperative legal atmosphere. If for no other reason, the enormous costs associated with litigation should, and has, provided impetus for such interaction and cooperation.

SECTION 5

SCIENCE WITHIN THE CONTEXT OF NRDA

5.1 SATISFYING CONSTITUENCIES

The use of science to evaluate injury and assess damages to natural resources is a complex process due to the legal, political, administrative, emotional and economic aspects of NRDA. The extent to which these factors influence the scientific efforts on behalf of trustees and RPs is highly situational. Just as science may have different objectives while operating within the legal system, the legal process provides for the development of policies to support the needs of various diverse constituencies. Natural resource and regulatory agencies manage natural resources on behalf of their constituency, the public. Industry responds and participates by complying with regulations on behalf of their constituency, the stockholder. Constituencies often play an active role in the development of legislation. In the conduct of everyday environmental science in both government and private industry, constituencies usually play a more passive role. However, the intensity of interest and visibility of constituencies may greatly increase in the atmosphere of an oil spill. If one were to imagine a triangle of the interests of industry, the public and the government, a relationship of constituencies is conceptualized.

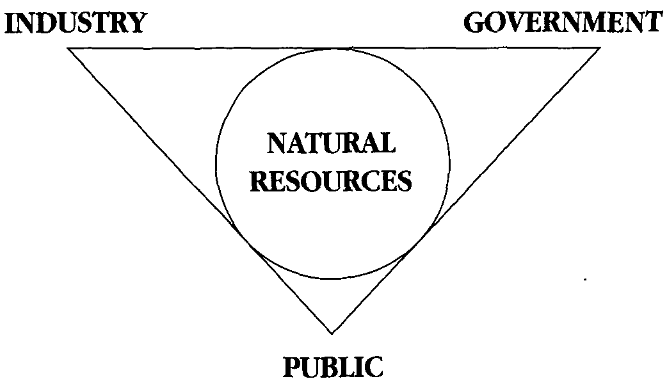

FIGURE 5-1. BALANCE OF CONSTITUENCIES.

Satisfying the various constituencies in the assessment of damages is a particular challenge. Industry regards the damage assessment process in terms of financial implications in the form of cost of cleanup, environmental compensation, non-compensatory penalties and loss of sales via decrease in public image. The profit incentive of industry obviously promotes the minimization of expenditures. For the most part, however, industry has accepted that the concepts of compensation for injury to resources as well as liability and responsibility for cleanup are a part of doing business in the United States. However, to remain competitive in the marketplace, they want to minimize expenses that get passed on to the consumer in the form of higher prices.

The public is a critically important constituency relative to NRDA. Over time, there has been a consistent increase in the activism and tenacity of various public interest groups concerned with environmental degradation. With each spill, the public and special interest groups become more visible, more emotional, more organized and more pervasive. Public groups demand that injured resources be compensated to the fullest extent allowed by law. The public also monitors settlements by trustees and have taken them to court for not pursuing damages or recovering adequate damages.

Often a trustee's technical representative will feel that in his or her best professional judgement, an incident has resulted in a particular environmental outcome. However, there is often a need and responsibility to satisfy their constituencies' demand for data to prove or disprove a particular claim. In several cases, data have been collected with a specific aim to validate scientific judgement that minimal environmental injury occurred. For example, in the MEGA BORG incident of June 1990, the technical representatives of both the trustees and responsible parties concurred that in their best professional judgement no significant environmental injuries resulted from the spill. However, it was the judgement of the group that the public would demand further concrete proof to confirm the hypothesis of no injury. Therefore, studies were conducted to confirm the hypothesis.

Government, in response to the laws generated by its public constituencies, is charged with the execution of those laws. On the one hand, government officials must be fair and reasonable in discharging their duties under the law to extract appropriate compensation derived through the damage assessment process. However, satisfying these various constituencies leads to a quandary within the damage assessment process as to how science can operate to address constituencies with various perspectives and objectives. It would appear that if scientists and lawyers on all sides of an issue could focus on the fundamental objective of the damage assessment process, all constituencies would be best served. Maintaining a unified focus, however, is often difficult in the real world.

5.2 ADMINISTRATIVE CONSTRAINTS

Regardless of the approach taken by trustees and responsible parties, the potential exists for expansive scientific investigations for a spill of substantial magnitude or extensive environmental impact. The costs associated with such endeavors can be staggering. Total costs of trustee and RP environmental injury and damage studies, legal fees, and compensation, in connection with several recent spills have approximated or exceeded the cost of response and cleanup. For example, total NRDA costs associated with both the NESTUCCA spill in 1988 and the TENYO MARU spill of 1992 (settled in 1994) exceeded response and cleanup costs. The settlement for the TENYO MARU of $10.9 million (exclusive of civil penalties) consisted of $5.5 million for government response costs and $5.4 million in damages to natural resources (United States *et al.* v. Maruha Corporation *et al.*, Civil Action 94–1537, Western District of Washington, F.WD, 12 October 1994). To fully evaluate expenditures, add to this amount approximately $1 million in defense costs for the various interest of both vessels involved in the collision (Walsh, pers. comm., 30 November 1994). Vessel interests reportedly spent approximately $80,000 in response and cleanup for the APEX/HOUSTON oil spill of 1986 off the coast of central California. Natural resource damages for this incident were settled in 1994 for $6.4 million plus over $1 million in defense costs (O'Conner, pers. comm., 30 November 1994). In a report of spill unit values to be used in the cost/benefit and analyses of the Regulatory Impact Analyses prepared for OPA 90, it was estimated that cleanup and third party damages from a spill of "dirty" oil (crude) should be expected to be $53,894/ton while natural resource damages (exclusive of defense costs) should be expected to be $25,133/ton. The report also concluded that the cost of cleanup and third party damages from a spill of "clean" oil should be expected to be $832/ton while natural resource damages were estimated to remain $25,133/metric ton (Mercer, 1992).

In both the public and private sector, expansive scientific investigations would ordinarily receive tremendous scrutiny prior to the commitment of funds. The scrutiny would include the determination of staff requirements, and the amount of time and costs required to complete appropriate and technically sound environmental studies. Within the oil spill damage assessment context, time is often severely compressed and leads to short-cutting of the scientific and administrative process which, as pointed out, is often to the ultimate detriment of the quality of the scientific product and the objective of the law. Due to the nature of oil spills and numerous constraints, it is often difficult for administrations within both the RP and the trustees to develop an adequate and appropriate response mechanisms within the time frames given.

An additional constraint in the administrative aspect of NRDA has historically been the lack of adequate policies and resultant infrastructure to deal with an evaluation of injury and subsequent damage assessment. While many strides have been made to revise statutes and regulations and provide technical guidance particularly in the State and Federal sectors, shortcomings in policy exist throughout governmental entities and private industry. When adequate policies and technical guidelines are not pre-established, they are hastily developed when faced with a spill of substantial magnitude. In the past, these reactive policies have not always proven to be in the best interest of the environment and/or the political/commercial entity involved. Accordingly, many trustees and some RPs have sought to establish proactive policies. Well-considered, pre-established trustee and RP policies are extremely important to the efficient and efficacious development of scientific investigations and restoration.

5.3 EMOTIONAL ELEMENTS

Injury to the environment often elicits a certain quantity of human guilt even within those not responsible for that injury. In major incidents, one cannot help but be affected by the feeling that in some manner mankind has produced this injury, and therefore, mankind must strive to rectify this injury. Even following a fruitful quest for blame, observers often feel some measure of personal responsibility. The feeling of kindred spirit and concern for the welfare of the environment is prevalent in many scientists. Realizing that an environment may be impacted often creates an emotional bias that is difficult for even the most experienced scientist and spill-responder to overcome.

During the extended period of study required for some large NRDA cases, individual personalities may play an important role. For example, generation of data by both trustees and RPs may be intended solely for use in litigation and may be subject to secrecy which normally is not the course of science. Initially, confidentiality of data may not seem to be of great significance to the investigator. However, a scientist's zeal to find fault may be heightened if the scientist knows he or she may be involved in research on a high-profile topic of great professional interest that most likely will not be published due to the prosecution of the guilty party. Similarly, a scientist accustomed to operating under severely limited budgets may be tempted to go beyond the "volkswagen" approach with the understanding that the RP will be liable for the entirety of the costs. Conversely, a scientist who feels that the RP is working with the agencies to meaningfully compensate the environment in a responsible manner, or who has had considerable experience in dealing with these matters, may have heightened objectivity and financial sensitivity.

The nature of current NRDA approaches used by trustees is often influenced by past personal experiences, negative and positive, with oil spills, private industry in general or NRDA. Regardless of existing and proposed procedures and guidelines for conducting NRDAs, the trustee's tone and goals are often determined by subjective human attitudes. Some RPs have the reputation among trustees of being difficult to work with and not trustworthy. Consequently, some RPs can be viewed with great skepticism by the trustees. Many trustees believe that RPs are focused on avoiding or minimizing scientific studies and evidence, potential damages and transaction costs. In addition, some trustees and RPs have inherent biases and management objectives which tend to create alienation rather than cooperation.

RPs often view trustees with skepticism as well. This has been partially due to unreasonable damage claims which were not based on actual injury to resources and claims which were not supported by sound scientific evidence. An example is an oil spill that occurred several years ago in an inland river. After only minimal study, the state made an eight-fold extrapolation and concluded that 100 percent of the muskrats over 80 miles of river had been killed. Approximately two months later, a follow-up trapping survey showed abundant muskrats in most areas sampled, including some of the most heavily impacted (Ray, pers. comm., 23 November 1994).

There is also the perception among some RPs that trustees are focused only on monetary damages rather than injury and are often interested in recovering money to fund on-going research or programs or to initiate new studies. While Federal trustees are required by law to apply recovered funds to restoration activities, not all states have this requirement when recovering compensation under State laws, such as Arkansas. Spill response actions of RPs are also often dictated by prior experiences, negative and positive, in dealing with trustees. When costly response actions which effectively minimize environmental injury are not acknowledged in the damage assessment process, RPs can be reluctant to commit to aggressive countermeasures and response in subsequent incidents.

As the NRDA process matures and damage assessment is implemented with greater frequency, responders have more experience in dealing with the natural human issues associated with oil spills. With experience, the scientific community has made significant strides toward reducing emotional influences to science and the NRDA process. Nonetheless, the power of human emotion is a factor that can influence even the most hardened observer.

5.4 INTEGRATING SCIENCE AND LAW

Because of the legal framework, scientists on both sides of the issue may take their lead from legal counsel. The role which science will play in the development of a case is, after all, the purview of legal counsel. The extent to which technical staff may be allowed to develop their approaches, the detail in which their endeavors will be undertaken, and possibly even the hypotheses to be tested, may be out of the hands of scientists. An example would be a case where the RP would not wish to collect certain data if such collection may result in adverse evidence of injury to a resource which the RP had previously considered irrelevant or unlikely to be injured.

5.5 LIMIT OF LIABILITY

The ultimate cost of the damage assessment process is intended to be borne by the RP. In the absence of a RP, OPA provides for recourse to the Oil Pollution Trust Fund for compensation for natural resource damages beyond the liability limits of the RP or in the case of an absentee RP. This limit of liability or ability to collect compensation may indeed affect the level to which the RP and the trustees may wish to utilize science to investigate environmental injury as a matter of practicality.

5.6 COMPENSATION FORMULAE

Although proposed NOAA compensation formulae are based on scientific data, the use of science in the damage assessment process for a specific incident may be almost totally eliminated by the use of these compensation formulae. Because the compensation formulae are based to some extent on technical data, the proposed NOAA regulations presume the compensation formulae are technically correct and propose to limit opportunities to challenge the appropriateness or validity of these schedules. This obviously precludes any use of science other than gathering information necessary as input for the formulae, which in most cases is minimal. While this approach to NRDA may be expeditious and may ultimately result in the reduction of transaction costs, determinations of damages can be grossly disproportionate to probable or actual injuries, restoration costs and reasonable damages.

As recognized throughout this paper, the trustees are faced with difficult challenges in administering the complex and dynamic NRDA process. These challenges result from the inherent limitations of science, practical and administrative constraints, satisfying constituencies and the fundamental differences in the objectives of science and law. The RP is also faced with similar challenges in responding to the NRDA process.

SECTION 6

KEY NRDA ISSUES

The convergence and divergence of the scientific and legal processes within the NRDA context have given rise to several points of controversy that are common to many damage assessment cases. Building on the fundamental concepts of science operating within the NRDA process as outlined earlier, the focus will now be on specific issues that have primarily manifested themselves in NRDAs to date. The following analysis will focus on the legal-scientific conflict as described in the sections above, as well as experience in the conflict between the need for development of scientific certainty and the application of best professional judgement by scientists involved with all sides of the process. Prudent application of known scientific principles and facts by qualified scientists can lead to a minimization of economic excesses and political controversy. The application of best professional judgement by reasonable people has led in many previous cases to reasonable outcomes fulfilling the objectives of NRDA as prescribed by law.

These issues are presented as a basis for future discussions on improving the NRDA process. In many cases, considerable progress has been made toward resolution or minimization of adverse implications to trustees, RPs and the public. However, these underlying themes often remain an influence on the participants. If the participants are aware of these potential influences, it is possible that they can better avoid negative effects on the use of science and build upon proven positive models.

6.1 SCIENTIFIC STUDIES

NRDA scientific studies are conducted *a posteriori*, or after the incident, and typically require that pre-spill environmental conditions be reconstructed because adequate baseline information seldom exists. Also, the studies are commonly conducted after much of the injury has occurred and the natural restorative process has begun so that even the injured condition must be recreated. These can be extremely difficult and unrealistic tasks. As discussed earlier, because of several inherent constraints, science is inexact even in the best of conditions. When NRDA studies are conducted, they are commonly *ad hoc*, and range in complexity from the collection of dead animals, to laboratory toxicity tests, to complex field investigations of contaminated and clean reference sites, to computer modeling and compensation formulae.

Until recently, the design of studies in most NRDA cases has been almost solely determined by the trustee agencies. Although RPs are more frequently given opportunities to review study designs and actively participate in data collection, the final decision regarding what studies are to be conducted and the design and objectives are entirely within the authority and at the discretion of trustee agencies.

Under normal and proper scientific and administrative review and approval procedures for scientific studies, the study review and approval process would take months to years. The process could involve numerous reviews and revisions and cost thousands, and sometimes millions of dollars. Although the comprehensive scientific and administrative review of studies is difficult for NRDA studies because of time constraints, some form of review should be implemented.

Identified sampling methods, timing and method application are sometimes incorrect for the NRDA study objectives. The subsequent data generated are insufficient or inaccurate and data interpretation is difficult or impossible because of the lack of baseline data or study controls. In addition, when unilateral studies are conducted under the veil of legal secrecy, study results and data interpretation, which are not under incident-related time constraints, commonly lack peer review. As a result, costly studies may be conducted with data having minimal defensible utility and application to NRDA. In conclusion, the scientific reliability, as required by the OPA and CERCLA to make or defend a claim of injury, is often lacking or highly questionable.

The level and source of funding often dictate the nature of studies conducted during a NRDA. On major oil spill incidents, RPs are often faced with proposals for numerous and costly studies from trustees, consultants, academia and environmental groups. Many groups and individuals want to be recognized for their involvement and concern for the environment by identifying and conducting a study. Consequently, large and/or costly studies, which may not be relevant, are sometimes proposed and implemented. If an RP cannot be identified, there can be a paucity of studies which reach the proposal stage. In these situations, funds for conducting scientific studies are usually more limited and there is normally more time for internal administrative and scientific peer review, prioritization and approval.

Although a significant amount of attention and regulation has been given to NRDA legal, economic and administrative processes, relatively little attention has been given to criteria for conducting sound scientific damage assessments. The development of the NOAA "injury guidance" document could provide much needed assistance in this area.

6.2 LEVEL OF EXPERIENCE

The NRDA process is relatively new and most State trustees have minimal experience, staff and capability for conducting substantial NRDAs and only a few states have experience with a sufficient number of cases to warrant development of formal procedures and regulations to conduct NRDAs. Federal trustees generally have more experience in conducting damage assessments than do State trustees. In part, this is due to the promulgation of Federal statutes and regulations, training programs and first-hand experience with NRDAs and staff dedicated to working full-time on damage cases on a nationwide basis. The constant change in already complex regulations, recent increase in NRDA statutes, regulations and approaches and constantly changing staff and administrations are all obstacles to developing effective and consistent programs and staff which are properly trained and funded.

Adding to the difficulties in performing science in a NRDA has been the inexperience of legal counsel and environmental consultants with the NRDA process. Few RP defense lawyers have significant experience on more than one case. By the time an experienced lawyer becomes sufficiently familiar with the process to authorize studies, the opportunity to collect perishable data may have passed. Additionally, few environmental consultants involved with NRDAs, either on behalf of the trustee or the RP, have extensive experience in conducting NRDAs.

In response to the continuing increase in the number and complexity of Federal and State statutes and regulations, there is heightened sensitivity to NRDA by both trustees and RPs and a continuing increase in the number and value of claims. These developments have obviously received the close attention of RPs and their insurers. Similar to trustees, RPs historically have been poorly equipped to deal with NRDA but are quickly improving their knowledge and capabilities. A potential benefit of the new statutes and proposed NOAA regulations is more recognition and discussion concerning the need to build trust and foster cooperation between RPs and trustees. The critical question is how effectively these complex damage regulations are implemented by the trustees and responded to by the RPs.

6.3 COOPERATION

In general, cooperation between trustees as well as between trustees and the RP in the damage assessment process is not required by current or proposed regulation. The State of Texas has taken a bold and progressive step by requiring cooperation with the RP. On a national basis, cooperation has been a fundamental component of the majority of NRDAs to date. Cooperation between trustees, co-trustees and RPs makes common sense. Common sense, however, has not always been the credo of all trustees or RPs in a given damage assessment process. The level and quality of cooperation between co-trustees as well as trustees and responsible parties during the scientific element of NRDA often dictates how science is used to reach closure. Cooperation, or lack thereof, can significantly alter the focus of science from objective goals to subjective goals. Most scientists agree that cooperation is a reasonable approach. This may be an outgrowth of scientist's desire to reach consensus on a conclusion and expand a base of knowledge as opposed to the legal process of committed adversarialism. As Bertolt Brecht once put it, "science knows only one commandment: contribute to science" (Cohen and Cohen, 1971).

A cooperative approach between the RP and trustees could help circumvent litigation and mitigate staff, time and funding constraints of trustees as well as promote the proper use of science. Transaction costs are reduced for both sides and the RP may very likely be able to implement restoration in a more timely and cost-effective manner.

COOPERATION BETWEEN TRUSTEES

The extent to which effective cooperation can exist between trustees and RPs is initially dependent on the extent to which the trustees can reach an agreement to coordinate among themselves. Recently, there have been major efforts to facilitate coordination among trustees. However, if there is lack of coordination between trustees, this often precludes any opportunity for the RP to cooperate with an individual trustee unless the RP wishes to adopt the strategy of settling with one trustee at a time, in a divide and conquer mode. This can initiate a race to the negotiation table to settle with one co-trustee for the entire resource at issue and suggesting to the non-cooperating trustee that they seek compensation from the entity with which the RP has settled. In past cases, this has not proven to be a viable technique; however, it has been seriously discussed by RPs.

Over time, and with increasing familiarity with the damage assessment process, trustees have begun to recognize who their counterparts are within the process and have become more accustomed and committed to working with each other. The effects of lack of coordination and cooperation between trustees are both obvious and insidious. The obvious effects are potential redundancies of studies to determine resource injuries and damages, increased cost to the RP, and potential lack of or delay in closure.

The ultimate insidious outcome of a lack of cooperation between trustees is the delay of active restoration which is the primary objective of the damage assessment process. It has been suggested that if a lack of cooperation between trustees results in a delay of restoration of the environment and lost use of services, the trustee should be liable for obstructing that restoration and morally if not financially responsible for the incremental increase in loss of service of that habitat pending restoration to its baseline condition.

COOPERATION BETWEEN TRUSTEES AND RPS

Because the RP is legally liable not only for the damages but also the costs of determining injuries and subsequent damages, cooperation is often the alternative preferred by the RP. In most cases, cooperation is not only cost effective, but can lead to increased effectiveness of restoration and can decrease the period of time between the insult and restoration of services if natural recovery is not selected as the alternative and promote the proper use of science. While cooperation may be the best alternative from many perspectives, occasionally the lack of cooperation has been perceived to be the product of a trustee's desire to incorporate a punitive element into the compensatory process of damage assessment. Other potential reasons for lack of trustee cooperation with the RP may be that the public could perceive cooperation as a conflict of interest or a trustee's concern that the RP may be using the appearance of cooperation to delay the assessment, buy time or undermine studies. On occasion, there are trustees that feel that they cannot cooperate because their particular NRDA process is deemed to be solely adversarial and unilateral in nature. This tendency is decreasing, however. The likelihood that trustees will cooperate, even though existing or proposed regulation may encourage it, is largely dependent on the facts of the case.

Because existing DOI and proposed NOAA regulations give damage assessments performed thereunder the force of a rebuttable presumption, there are situations where there is little incentive for trustees to offer RPs the opportunity to participate in the process. For example, because a trustee may lack sufficient staff and funds to conduct scientific studies even though they may be mandated or preferred by the RP, they may choose to utilize models or compensation formulae. Because this approach would be simple, cost-effective and have the force of a rebuttable presumption, trustees may be unwilling to implement scientific studies or other NRDA methods.

The damage assessment following the December 1988 NESTUCCA spill in Washington State and British Columbia involved a great deal of legal, political and procedural pathfinding on all sides of the case because the NRDA process was truly in its infancy. A cooperative technical committee was allowed to openly assess potential injuries and, for the most part, concurred on probable injuries utilizing best professional judgement. Possible studies were discussed by the technical group but never implemented due to a decision by the group that, in their best professional judgement, although injury had likely occurred, it was not scientifically assessable at a reasonable cost. This was in large part due to a severe freeze concurrent with the spill that would confound results and data interpretation.

The EXXON VALDEZ incident occurred in March of 1989. The magnitude of the incident and other factors set new standards for committed adversarialism. A war of science commenced akin to the battle being waged against the oil itself. The battle included all the traits of secrecy, planning, strategy and financing associated with combat.

Until the June 1990 MEGA BORG incident in the Gulf of Mexico, discussion of cooperative damage assessment between RPs and trustees was less than favorably received by agencies and considered unlikely if not impossible by RPs. In the MEGA BORG case, there was a very spectacular fire during lightering operations outside the limits of State jurisdictions. The incident had a high media profile and presented the potential of causing injury to endangered species under the trusteeship of NOAA and the State of Texas. An agreement negotiated with NOAA and the State of Texas offered the RP the best aspects of the NESTUCCA case (e.g. input to the NRDA process) and assured access to data generated from the studies.

The NESTUCCA and MEGA BORG NRDA approaches have several features which are, or should be, attractive to natural resource trustees. These include public availability of scientific data and, because the RP funded technical investigations, more readily available funds for scientific endeavors that may normally be delayed in bureaucracy. Principal benefits to the RP of subscribing to a cooperative strategy include non-duplication of effort and thus cost savings, insight into trustee concerns as a result of negotiations, technical contributions to study planning and objectives, access to data and ability to review and comment on conclusions. Benefits to both parties also include the potential to reduce loss of service or resources if restoration is appropriate and implemented in a timely manner.

Additional aspects regarding the potential for cooperation include the following questions: If cooperative studies are undertaken, whose studies are they? Who is the final juror of what is to be included within a study? Who interprets the data? There have been suggestions that trustees and RPs can agree to a given plan of study and bind themselves to a predetermined method of analysis to arrive at injury. Ultimately, scientific investigation relative to the NRDA process must be the product of the trustees because they are charged with responsibility to protect particular assets of the public. The extent to which they can cooperate with RPs in developing and conducting study plans is largely a function of the personalities and the trust of the individuals involved.

In most cooperative cases, the prudent RP reserves the opportunity to conduct independent studies of injury and to conduct an independent assessment of damages. It is possible that the trustees and the RP can agree on details of studies to be conducted. Given that the final arbiter as to the content of the subsequent report from the cooperative studies is the trustee, the RP usually reserves the right to diverge from the final product, even if the assessment studies were conducted mutually for later technical or legal resolution. The reservation of this right does not mean that divergence is necessarily exercised, and in an ideal world the entire process could be conducted in unison. If both sides have the ability to diverge on a given study plan, and they are both aware of the potential downside risks associated with divergence, the probability of both sides negotiating a mutually agreeable program can be enhanced.

In 1993 and 1994, API, NOAA and the Coastal States Organization jointly sponsored a series of regional workshops to explore the facilitation of cooperative NRDA. This was a major step toward increasing the potential for future cooperation.

6.4 REASONABLENESS OF SCIENTIFIC STUDIES

To accomplish the objective of the damage assessment process, the level of injury to or diminuation of natural resource services from their baseline condition must first be determined. Unfortunately, in an oil spill situation, trustees, responsible parties and public entities often use a different set of criteria and decision making processes to determine the level of science necessary to establish those parameters and subsequent restoration goals. On a moderate or large incident, the scientific feeding frenzy is predictable on both sides of the liability fence. Scientists with specific, often obscure, scientific interests are anxious to seek a sponsor. Similarly, established scientists or scientific administrators that have even tangential experience or familiarity with a particular subject, approach or species may seek funding to test their suspicions of viability and satisfy technical curiosity. On a large incident, very few techno-fetishes go unadvanced.

The determination of appropriate levels of investigatory effort is also very important. As previously noted, virtually all NRDA cases are resolved outside of litigation. In these cases, the use of best professional judgement in evaluating the level of effort is usually the most logical approach. It would seem eminently appropriate that studies should have a reasonable likelihood of producing a relevant finding. In other words, studies must be directed towards the determination of injury and have a realistic chance of producing a valid or confident outcome.

Because essentially all damage assessments are settled by negotiation, the primary value of data generated by scientific judgement in these cases is to provide negotiators with an estimate of their upside and downside risk and for use in negotiations. The utilization of data generated, and the vulnerability of the RP or trustees to commissioning unreasonable efforts, can be related to their perceived risk in the negotiation process.

Often, RPs are faced with proposals from for-profit consultants who rationalize the level of detail in studies as necessary for defense of potential, heretofore unrevealed, arguments for claims by trustees or third parties. Consultants use various approaches to NRDA, which influence the manner in which science is used in the process and the overall NRDA tone and strategy. For example, some environmental consultants advocate conducting numerous expensive, and often overly extensive, scientific studies on the basis that an RP cannot afford to leave any aspect unexposed due to the lack of data. Some RPs believe it is in their best interest to take this approach. Some RPs hire the largest and most high profile and/or expensive consultant because they believe they are highly vulnerable, want to appear more "responsible" or want to protect or improve their public image. Other consultant approaches focus simply on minimizing NRDA activities and costs to RPs. Finally, other consultants attempt to assist RPs by scaling their level of effort and cost to the oil spill incident and associated environmental impacts with a goal of reaching a reasonable damage settlement.

In the absence of discussion with the trustees regarding environmental concerns, the conservative RP risk manager or legal advisor may err conservatively and proceed with extensive and expensive studies. Even in the cooperative mode, the vulnerability of the RP to proposals by consultants, academia and trustees is often capitalized upon. The true test of reasonableness of studies is difficult to define due to the myriad of parameters against which the elusive "reasonableness quotient" must be measured; nonetheless reasonableness is an important aspect of the damage assessment process.

As a corollary, RPs may decide, either independently or with the aid of consultants, to conduct "cooperative studies" with the trustees. Such studies are conducted by RP contractors at RP expense. The objective may be to deluge the trustees with data, leaving no stone unturned, in completely assessing injury. This approach relies on the over-analysis approach to validate the adequacy and objectivity of the investigations. In many instances, this is cheaper than duplicate parallel investigations by the trustee and RP with the costs of both born by the RP. This approach may be warranted when an RP perceives the trustee is overestimating injury. This is of particular concern due to the threat of a rebuttable presumption under which the RP is obligated to prove that there is less damage than was claimed by the trustee. However, it would be the unusual trustee that could resist the temptation of displacing best professional judgement with a desire for just a bit more data offered free by the RP. Also, the prudent RP will closely and objectively monitor its contractor to keep the costs from escalating out of control.

Depending on the situation, trustees may be deluged with proposals from consultants and academic institutions in an effort to provide credence to the trustee's estimate of damages. The measure of reasonableness of investigations for damage assessment cases under the DOI Rule, is that the trustees should not expend more money on investigation than they have a reason to believe would be recovered for damages. Therefore, a modicum of control is placed on the system. Within the proposed NOAA regulations, however, the criteria for reasonableness is at the sole discretion of the trustee. The trustee is tasked to conduct investigations he or she feels appropriate with no financial guidelines applied and with the entirety of the costs passed on to the RP.

6.5 RELEVANCE OF STUDIES TO NRDA GOAL

Scientific studies are occasionally proposed and conducted by trustees (and less frequently by RPs) which are not relevant to the NRDA objectives of identifying and quantifying injury and damages to natural resources. Basic scientific research, rather than applied science, can be promoted by trustee staff, academia, environmental groups and consultants which is not focused on these NRDA objectives. By nature, scientists never have sufficient data and many are always pursuing funds to conduct research. The research is really focused on defining the impacts of a larger environmental issue, which in this case is the impact of petroleum on the environment rather than impacts of the specific spill incident. Whereas valuable information is often generated, NRDA is not the proper forum for basic research. It should be conducted by researchers and through the proper channels.

An example of an irrelevant research proposal from a west coast spill was for the DNA analysis of marine birds to determine whether they were California, Washington or Oregon birds, in part to determine the allocation of recovered damages. The origin of the birds was not relevant to the purpose of determining injury and damages as the birds are a resource common to the public of the United States and should receive cooperative management by all co-trustees. Although there may have been a question of whether the birds were from discrete populations, the information is critical to proper management of the resource regardless of the potential impacts of an oil spill. Therefore, this is a research issue which should be properly investigated and funded through the appropriate programs and funding mechanisms. There are numerous statutes concerning trusteeship and co-trusteeship developed with the intent of mutual protection and management by Federal and State agencies.

There is a question as to whether or not scientific studies during the assessment phase also constitute a form of compensation for damages. For example, it is accepted that scientific field studies are a component in conducting a comprehensive or expedited NRDA. In some cases, recovered damages are also used to fund scientific research or other studies of interest. These are often done under the premise that the trustee can better manage, and therefore restore the resource if they know more about it. In some cases, trustees simply take advantage of the opportunity presented by an NRDA and pursue damages, very candidly, to conduct studies for which they cannot otherwise gain approval or funds. If funds received as compensation are used to conduct studies why shouldn't the costs recovered for assessment studies also serve as compensation? Therefore, a fundamental issue, with potentially significant legal and economic consequences, is to determine whether studies which are part of the assessment process can also serve as compensation.

6.6 USE OF SCIENTIFIC DATA

Because natural resource damage assessment scientific data can be developed in preparation for possible litigation, data are sometimes suppressed from general availability to the scientific community. Although this paper gives much attention to the shortcomings of many of the NRDA studies, valuable information is often produced. Suppression of these data does not contribute to furthering the understanding of basic or applied science and environmental effects. Data suppression is often inversely proportional to the level of cooperation between the trustees and the RP which, as previously stated, is normally inversely proportional to the size of the spill.

The proposed NOAA NRDA regulations intend to create an administrative record as a mechanism to provide for "adequate public notice, opportunity for a public hearing and consideration of all public comment" (NOAA, 1994). The administrative record requires the inclusion of scientific data relative to damages and also serves to make data available to the public. However, there may be incentives by the RP and trustees to circumvent the administrative record because certain data may minimize the potential for negotiations, the common form of reaching settlement.

Because high stakes are involved, it is natural that litigants, particularly the RPs, develop caches of the best scientific experts in an attempt to develop and support their particular interests and NRDA strategies. The legal elements of NRDA typically associated with large oil spills often have the result of restricting the availability of scientific experts, and their information produced in secret, to the general scientific community for other, more productive tasks. The cadre of qualified specialists available to participate in meaningful research is not infinite in number. Applying the attention of highly-skilled scientists to one or two particular incidents for extended periods greatly reduces the potential for positive contributions to other, often more significant, scientific issues.

6.7 COMPENSATORY VERSUS PUNITIVE DAMAGE ASSESSMENT

It is crucial to remember that the objective of the NRDA process is to adequately compensate the public for injury to the environment. The result of this process is a compensatory, not punitive, settlement. The objective of the RP and trustees should be to arrive at a settlement that provides for reasonable and appropriate compensation for injury to the resources affected. The Federal government and most States have, within their legislation, the ability to impose a separate punitive fine against the RP to act as a deterrent to spilling oil and effectively shape future behavior of oil and shipping industries. These penalties are routinely collected and can be substantial. Nonetheless, the temptation to utilize the damage assessment process in a punitive manner has manifested itself in several prior cases. From the authors' personal experience, for example, when a technical representative asked why a costly injury assessment study was proposed on the NESTUCCA spill, a State resource trustee representative responded, "To teach you not to spill your oil on my beach." As with many negative aspects of the damage assessment process, increasing familiarity of trustees with the NRDA process and its objectives has substantially reduced this tendency to make NRDAs punitive.

The potential for punitive use of science in the NRDA process has been typically linked to the conduct of investigations which are not directly related to restoration objectives. Punitive science can also be needlessly excessive in scope, duration or objective. For example, in several cases, RPs seeking to minimize overall costs have offered to immediately commence restoration activities which are considerably greater than the magnitude of all potentially impacted habitat. The concept behind this approach is that, in some cases, it is less costly to substantially over-compensate the environment immediately than to conduct expensive long-term assessment to determine injury, proceed with a protracted restoration planning process and finally initiate restoration. An example is the Greenhill Platform 250 Blowout of 29 September 1992 in Louisiana in which the owner of the platform constructed 21 acres of *Spartina* marsh as compensation. This was accomplished with the concurrence of the trustees based on their best professional judgement that extensive assessment was not necessary and that the proposed restoration was significantly in excess of injury. However, in an effort to ensure the adequacy of the restoration proposal trustees have chosen, in some cases, to reject such restoration proposals until the completion of injury studies and completion of formal restoration planning. Not only does this result in increased costs to the RP due to funding additional trustee activities, but the term of lost service of habitat is increased resulting in increased restoration costs. The most unfortunate outcome of all is that the ultimate primary objective of the process, restoration of the environment, is delayed unnecessarily.

Similarly, when the extent of injury and restoration are being negotiated, trustees may demand that the RP pay the highest extent of the compensation range. If the RP does not agree to pay this amount, additional studies can be proposed or conducted by the trustees at the expense of the RP. Again, as with most of the issues raised previously, the appropriate use of best professional judgement in developing criteria for reasonable success is the most appropriate method of dealing with this issue. Also, the scientist could benefit from input from legal staff as to whether data generated would be considered relevant and reliable in court. If these standards are adhered to, the likelihood of the use of science as a punitive measure would be minimized.

6.8 COMPUTER MODELS AND COMPENSATION FORMULAE

A simplified damage assessment method, the Type A computer model, was designed by DOI in response to a mandate by CERCLA (CERCLA, Section 301(c)). Compensation formulae and computer models have also been developed by NOAA as part of its proposed NRDA regulations under OPA, although OPA does not mandate that such methods be developed.

CERCLA requires:

> "standard procedures for simplified assessments requiring minimal field observation, including estimating measures of damages based on units of discharge or release or units of affected area" (CERCLA, Section 301(c)(2)(A)).

The primary intent of these regulations is to minimize the transaction costs and effort which could be expended on smaller spills. Another objective is to provide a simple mechanism to assess damages for smaller spills which may not have been pursued in the past. Although there are statutory, economic and political reasons for developing these methods, it must be remembered that these models and formulae are oversimplifications and abstracts of the real environment. Their ability to meet the CERCLA and OPA requirement to be scientifically reliable is debatable for several reasons.

Accurate models for complex environmental systems require hundreds of parameters and interactions as well as generality, realism and precision. There are no perfect models. The lack of adequate data, and of a comprehensive understanding of population and community level effects due to natural and anthropogenic perturbations to the environment, precludes the development and application of computer models which are capable of accurately quantifying the effects of these actions. The mathematics of modeling are often seen and accepted as reality only by individuals who lack biological, scientific and/or economic awareness.

The DOI Type A model and proposed NOAA Type A model contain biological, chemical and economic databases designed to determine and quantify injury and estimate economic damages in coastal and marine environments (DOI, 1987; French *et al.,* 1989; Reed and French, 1989). The concept is that environmental, biological, chemical, toxicological and economic components can be integrated to determine environmental injury and damages. The model integrates these parameters with existing biological effects and physical fate databases in an attempt to estimate biological injury and damages.

Although there is some flexibility for various spill scenarios under the proposed NOAA compensation formulae, the number of oil types is limited and the physical and biological databases are generic and cover large geographical regions. The databases inappropriately extrapolate data across biological provinces and habitats, use inaccurate or outdated information and make other assumptions. Therefore, the proposed NOAA Type A model and compensation formulae (based on the Type A model) generate damages which are often unreliable, can not be supported by impacts from previous spills and have not been validated.

It is very difficult for the proposed NOAA computer models and compensation formulae to reflect the actual, and complex and dynamic biological, physical and chemical conditions surrounding a specific incident. These proposed models and formulae lack specificity, are based on unsubstantiated and inaccurate input data, often do not incorporate recognized natural oil weathering processes, use invalidated laboratory results and lack degrees of certainty and confidence limits. Consequently, these numerous weaknesses compromise the ability of these methods to accurately predict and quantify injury and estimate damages. The significance of this is the potential effect on damage estimates. However, the models and formulae are simple, convenient and can grant trustees the benefit of the rebuttable presumption.

It is recognized in science that it is unrealistic to expect that any computer model can duplicate the real environment and the effects of anthropogenic perturbations. It is also generally accepted in science that computer models and mathematical formulae should not be used alone to determine environmental impact and risk (Suter *et al.,* 1993). Even the most sophisticated scientific models or studies should not be used as independent alternatives to determine environmental effects; they should be used to compliment or support other assessment tools. Nevertheless, the NRDA legal community has condensed science into mathematical formulae without providing measures of uncertainty and confidence. All participants in the NRDA process must recognize that use of simplified approaches requires the integration of the scientific and legal components of NRDA. This results in the compromise of accepted scientific principles and methodologies and legal requirements to make informed discussions based on fact within degrees of certainty.

Some of the spill scenarios generate damages which are hundreds of times greater, in damages per gallon, than previous natural resource damage claim settlements. For example, a spill of only 100 gallons of oil can produce damages of $3.4 million, or $34,000 per gallon (French *et al.,* 1993). These are damages typically associated with major oil spills involving several hundred thousand gallons. Although the proposed formulae have been developed for small oil spills (10 to 50,000 gallons), it must be recognized that these spills constitute approximately 99.8% of all oil spills (NOAA, 1994). Therefore, the financial consequences are significant and further warrant that formulae be accurately constructed if implemented.

A study was implemented to validate the NRDAM/CME by comparing model results to actual field studies (Grigalunas *et al.*, 1989). Numerous fundamental problems were identified and the standard of accuracy for estimating damages was presumed to be an order of magnitude for the NRDAM/CME model. Even the results which varied from empirical data by just under an order of magnitude were viewed as questionable. The Type A model is based on underlying databases which contain many uncertainties and estimated input parameters for the particular spill incident and existing environmental conditions that are themselves generalizations and may not be reliable. However, the model does not provide a level of confidence or certainty to the input data or results.

One of the values of using compensation formulae and models is that the risk of not being accurate by assuming injury may be less than the cumulative costs of injury assessment, negotiations and damages. While statisticians and scientists may not support the validity of a claim, the process and result may be in the best interest of all parties. On the other hand, a claim based on the formulae can also be grossly inappropriate in certain circumstances.

The levels of uncertainty have important impacts on damages and the NRDA process. For example, if the damages are on the order of $1,000, then a level of uncertainty and a possible error factor of two might be acceptable to an RP given the cost of contesting the appropriateness of the claim. However, if there were a level of uncertainty and error factor of two for a damage estimate of $1,000,000, then there would be a more substantive cause for challenge and dispute. The question for both trustees and RPs is what is the level of acceptable scientific error in relation to the amount of damages at risk.

Compensation formulae to determine damages resulting from oil spills have also been developed by Florida and Washington. These formulae also have fundamental scientific weaknesses and flaws. For example, when determining injuries and persistence these formulae do not acknowledge or consider weathering processes known to occur following an oil spill such as evaporation, dissolution, oxidation and biodegradation. The toxicity data used often do not consider environmental conditions such as the volume and depth of receiving water. As in the case of the NOAA formulae, these State formulae also assume injury without requiring proof.

In spite of the negative elements inherent in the use of models and formulae in the NRDA process, there are several potential positive contributions of models to the NRDA process. The models and formulae can form a basis and tool for settlement negotiation and expedite the process. This has the benefit of minimizing transaction costs, for trustees and RPs, and potentially allowing the goal of restoration to be implemented in a more timely manner.

Depending upon the spill scenario and potential environmental damages, the RP may actually desire the application of computer models and formulae. For example, models and formulae may be determined by the RP and their consultants to identify and support damages which are less than those which may be indicated by empirical scientific studies, as well as avoiding scientific study and transaction costs. Also, RPs may want the trustee to use model and formula approaches with the intent of attacking the fundamental problems with these approaches already briefly discussed. Trustees may prefer the use of models and formulae if the resulting damage values appear to exceed those which may be determined by a more intensive study.

In summary, the NRDA approaches using computer models and mathematical compensation formulae have admirable objectives to simplify the process, provide maximum flexibility of approaches to trustees, reduce transaction costs and expedite restoration. However, the reasonableness and appropriateness of simplifying the NRDA process through these simple methods is highly questionable. The concept of computer models and compensation formulae would be much more acceptable if the information used to construct them were more accurate, current and complete. Also, the damage values generated by the proposed formulae need to be validated and more in line with current settlement values.

6.9 THIRD PARTY CLAIMS

Prior to the passage of the OPA in 1990, RPs were accustomed to dealing with oil spill containment, cleanup, penalties and compensation under the CWA and CERCLA and Admiralty Law. The effect of Admiralty Law was to minimize exposure for third party claims and to limit liability. With the advent of the OPA, the potential for third party claimants increased dramatically. Section 1002 of the OPA provides for third party claims from real or personal property owners or lessees as well as: "damages equal to the loss of profits or earning capacity due to the injury, destruction, or loss of real property, personal property or *natural resources, which are recoverable by any claimant* (emphasis added)." The potential need for an RP to develop a defense against third party claims is thus an obvious added factor in any oil spill response action.

Cooperation with a trustee in the determination of actual impacts to the environment may be particularly valuable in dealing with the potential implications of third party claims. The value of a government-sanctioned scientific study may add particular weight to the defense of such a claim when speculative claims are brought by third parties. Even in the event of a well prepared technical defense of a third party claim, a study's acceptance or participation by a trustee agency may lend reliability to the evidence. The potential for third party claims, particularly class actions, have increased rapidly in the past several years. It is not unusual to experience multiple class-action claims for recovery of damages for injury to the same natural resources.

6.10 PUBLIC INVOLVEMENT

Involvement of the public is a relatively new element in the NRDA arena and is a sensitive issue. Issues regarding public involvement include how and when to involve the public and the potential impacts to the NRDA process. It is generally accepted, although in some areas with reluctance, that since it is the public's resource that is at issue, the public must be given an opportunity to participate. Although government agencies are designated as trustees for the public's resources, it is not always appropriate to conclude that trustees are always acting in the best and current interest of the public. Indeed, the public has authority to scrutinize how their natural resources are being managed and protected by agencies and determine if these agencies are acting in the best and current interests of the public.

Several positive contributions can be made by the public since not all scientists, experts and information reside in the government, industry or private consulting firms. The local and academic community have valuable technical expertise and historical information concerning local natural resources and can contribute to the NRDA process. Public participation is also necessary to regain or maintain the public trust in agencies and industry, especially in times of diminishing natural resources and on controversial and visible environmental issues such as oil spills.

There are important considerations concerning the appropriate level and timing of public involvement. Unfortunately, public involvement cannot be screened or selected and participants commonly have objectives other than environmental restoration. NRDA activities often require quick actions or involve litigation-sensitive materials which preclude public involvement. Agencies may not be able to handle extensive public involvement due to limited staff and budgets. Because damages are calculated until recovery of the resource to baseline conditions, time delays caused by public involvement can increase damages and transaction costs to trustees and RPs. If trustees do not act in an efficient manner regarding public participation, are they liable for a portion of the damages due to delays in implementing restoration?

Emotional elements and human attitudes can dominate motives and objectives of certain public participants and environmental groups. This is sometimes due to a deep mistrust of both trustees and RPs. A punitive element can be inserted into the process and the result is alienation—not cooperation. This attitude can often be attributed to lack of familiarity with the letter and intent of the statutes. Rather than contributing to the fundamental goal of restoring the injured resource, limited resources and time can be lost addressing non-productive issues.

Finally, environmental issues, such as oil spills, are commonly debated in the media before the underlying facts and scientific data have been produced. The reporting of environmental advocacy perspectives and environmental facts are often and easily confused. Data can be politicized and used selectively to advocate a political agenda. Media hype and bad reporting of science is partly due to poor reporting but also can be due to scientists not speaking out for fear of losing grants or because of company or agency policies. Because of the influences of the media and special interest groups, these "perceptions" win out and often become reality.

Interest groups lobby strongly to have specific and costly studies conducted on natural resources of special interest. While some are worthwhile and relevant, others are costly and unnecessary. Because most of the public is not trained in science and lack a necessary understanding of the complex NRDA process, science by perception is promoted and conducted. In an attempt to be viewed as responsible, to calm the public, or to protect their public image, RPs commonly fund these studies. The result is that more groups, and even the agencies themselves, find an opportunity to conduct costly and unnecessary studies.

In most cases, the RPs want minimal or no public involvement in the NRDA process since it is viewed as adding additional study and transaction costs and increasing damages due to delayed restoration. This affects the bottom line and questions are raised by stockholders and peers within the industry. However, RPs also recognize the importance of a good public image and expend large sums of money on cleanup, restoration and other related or unrelated actions in response to public pressure, passing costs to their pollution insurers and, ultimately, the consumer. RPs seek to minimize this increase in cost to the consumer because it effects its competitiveness in the marketplace.

The ability to conduct effective settlement negotiations and implement timely restoration is commonly difficult enough under the many scientific, legal and political constraints inherent in NRDA. Trustees are faced with the challenge of preserving the environment as well as the right of the public to be involved. Good judgement must be exercised in determining how or when not to involve the public such as when they do not understand or are not well informed. An unregulated public involvement can further compromise the goals and process of NRDA.

SECTION 7

RESOLUTION OPTIONS

This paper has identified the NRDA processes and associated issues that have effected the use and misuse of science. Several potential concepts and approaches to assist in the resolution of key NRDA issues are presented below. The concepts presented below have not been fully explored in terms of implementation or consequences. These options are presented to stimulate further discussion and improvement of the NRDA process. There is no warranty, expressed or implied, as to the legality and viability of these options but they are proposed with the intent of spurring further discussion. There are likely other options which have not been identified herein which may be identified in the future and be worthy of further of investigation.

The options are presented in two groups. The first group relates to the potential for the use of science in the courtroom. The second group of options relates to application of science to the NRDA process itself.

7.1 SCIENCE AND COURT

SCIENTIFIC JURY OR SPECIAL MASTER

The potential for resolution of conflicting scientific evidence in the negotiation process or within the courtroom may best begin with an independent panel of scientific experts, or an individual Special Master, to review the data provided by both sides and render a recommendation to a judge or jury as to the most probable explanation afforded by the science presented. Scientific experts, optimally, would be dispassionate and objective and qualified in the subject matter at hand. The panel or individual would advise the court as to the reasonableness, interpretation, relativity and reliability of the data presented. This appears to be a more rational solution than expecting a non-technical judge or jury to determine what is "artified science" or "trash science" versus the best representation of reality with an appropriate consideration of the inherent limits of science.

BINDING ARBITRATION OR MEDIATION

In NRDAs where the resolution of disputed claims or conflicting data presented by both sides can not be accomplished through negotiation, the matter could be settled through binding arbitration or mediation. The arbitration or mediation panel could be constructed of scientific, economic and legal experts mutually agreed upon by both sides of the issue.

An example of this option has been mandated by the State of Texas. Their new NRDA regulations require mediation of a disputed NRDA claim as a necessary prerequisite before exercising the jurisdiction of a court (Stolls, 1994).

REMOVE REBUTTABLE PRESUMPTION

Current and proposed Federal damage assessment regulations provide the trustee's damage claims with the force of a rebuttable presumption if NRDA regulations are followed. Although no court has determined the precise meaning of this rebuttable presumption, it appears to mean that if the trustees follow the procedure prescribed in the regulations, their damage claim is presumed to be correct in a judicial or administrative review (Bieki, pers. comm., 18 October 1994). The RP must prove that trustee findings are not correct. The dilemma is that the RP is charged with demonstrating that something did not happen whereas science is constructed on demonstrating that something did happen. The proposed NOAA regulations provide rebuttable presumption to trustees for virtually any approach taken to NRDA.

The leverage provided to trustees by the rebuttable presumption has the potential to be a disincentive for cooperation with RPs. Removal of the rebuttable presumption could reduce adversarialism and promote cooperation. Utilization of a scientific panel or group of scientific experts, as discussed above, can provide a more equal balance between the involved parties while still focusing on the objective of restoration.

7.2 SCIENCE AND NRDA

LET THE TRUSTEES DO IT

Under this concept, a group of trustees would be formed to conduct the NRDA. The trustee group would select an objective, unbiased group of technical experts to lead and conduct all components of the NRDA process including pre-assessment, assessment, restoration planning and restoration implementation. There would be no involvement by the RP and there would be no negotiation or litigation but assessment could be subject to judicial review. The findings of the trustees would be final and the trustees would be the only entity that could implement restoration. This concept would not be palatable to RPs or defense litigators and would be inconsistent with some of the constitutional rights of which we have become accustomed to in this country.

This approach also appears to be in conflict with common or accepted legal and scientific processes. It does not allow the legal process of advocacy or the scientific process of consensus building and peer review. Also, it would violate due process unless there is a right to appeal in court.

LET THE RESPONSIBLE PARTY DO IT WITH TRUSTEE OVERSIGHT

It is only fair to identify the concept of letting the RP conduct the NRDA, while recognizing the legal responsibilities and authorities of trustees. The administrative constraints that trustees must deal with versus the more flexible framework of private industry suggest that RPs could assess and restore the injured environment more efficiently than trustees. Trustees would review and approve all plans and would provide oversight to the process. The fact that the RP ultimately pays regardless of the approach, would provide further incentive for a timely and effective process implemented by the RP.

CONTRACT IT OUT

In this situation, the court would select a private contractor to conduct the complete NRDA without involvement from either the trustee or RP. Restoration alternatives would be identified by the consultant(s) and negotiated and agreed upon by the trustee and RP. The final restoration action would be approved and enforced by a judge and implemented by a consultant(s).

SCIENTIFIC TECHNICAL EXPERTS

This concept would implement the scientific component of NRDA through a group of impartial, objective technical experts mutually agreed upon by the trustee and RP. All scientific components of NRDA would be conducted directly by this group. The only involvement of the trustees and RP would be to provide background information regarding the incident.

TRAINING

Appropriate training is essential to the performance and success in any discipline, including NRDA. Insufficient knowledge and comprehension of the complex NRDA process as well as the perspectives and responsibilities of "the other side" has often been a principal reason that NRDA issues arise. It is necessary for all sides to better understand the overall process and the scientific, legal and economic disciplines involved, not just within their individual area of expertise or responsibility. It is also important for all sides, trustee, RP and public, to better understand the motivations and rationale as well as the legal, political and financial restrictions placed on all sides of the process. Internal training, as well as training conducted in a common forum, is recommended to enhance the knowledge base and facilitate the discussion of relevant issues. This paper is an important step to this end.

COOPERATION

The adverse repercussions of poor cooperation and the positive benefits of cooperation, realized by trustees and RPs, are inherent in nearly all NRDA issues of concern. These benefits and repercussions are discussed throughout this paper and potential concepts are presented for resolving issues. A commitment by trustees, RPs and the legal system should be made to promote and practice cooperation in all NRDA disciplines at all levels. All obstacles to cooperation in the scientific, legal, economic and administrative components should be reviewed and modified where appropriate to enhance the opportunity for cooperation.

REQUIRE OPPORTUNITY FOR RESPONSIBLE PARTY PARTICIPATION IN NRDA

Currently, the participation of the RP in the damage assessment process is at the discretion of the trustees. The justification for this is that the trustees are ultimately responsible for the resource at issue. Although NOAA's proposed regulations recommend that cooperation with the RP be pursued, there is no requirement. Requiring trustees to at least provide the RP with an opportunity to participate is fundamental to promoting cooperation and increasing mutual trust. Cooperation could be based on pre-established guidelines and criteria mutually agreed upon by the trustees and RP. Recent regulations adopted by the State of Texas (31 TAC Section 20.23) is an example of progressive moves toward formalizing RP participation.

REQUIRE ECOLOGICAL ASSESSMENT APPROACH FOR SCIENTIFIC STUDIES

Significant advances in standardizing the methods and approach used to assess complex environmental issues have been made in the past few decades. The overall objective of these methods is to establish standard guidelines and criteria which can help direct the application of science based on established principles and methods (Fumento, 1993). Requiring that all science conducted as part of a NRDA follow established ecological assessment and ecological risk assessment approaches will help minimize the potential for unnecessary or poor science in NRDA. An important step in this direction has been taken by NOAA through the development of damage assessment guidelines for oil spills.

MAKE NRDA CONSISTENT WITH INTERNATIONAL OIL POLLUTION COMPENSATION FUND

The United States is unique in its mechanisms for compensating for injury to its natural resources. The world maritime community has developed the Civil Liability and Fund Conventions (Fund) in 1971 to provide for compensation of "pollution damage." The International Oil Pollution Control Fund has withstood the test of time in over 62 countries and under a wide range of circumstances (ITOPF, 1994). NRDA regulations could be eliminated or modified in the United States or modified to reflect criteria for admissibility of claims for compensation used by the Fund.

Environmental restoration is compensable under both the United States NRDA and IOPC scheme. As noted in the report of the Seventh Intersessional Working Group of the Fund, the IOPC Fund rules allow for reasonable compensation measures —

> "The Working Group agreed that in order to be admissible for compensation measures for reinstatement of the environment would have to fulfill the following criteria:
>
> - the cost of the measures should be reasonable;
> - the cost of the measures should not be disproportionate to the results achieved or the results which could reasonably be expected; and
> - the measures should be approportionate and offer a reasonable prospect of success" (CMI, 1994).

Compensation for loss of services is allowable to the extent that they can be quantified by reliable means. This appears to be in line with the United States procedures. The interpretation of the reliability of injury determination is also of concern to the international community.

> "The Working Group took note of the Resolution adopted by the IOPC Fund Assembly in 1980 (Resolution N°3) which stated that 'the assessment of compensation to be paid by the International Oil Pollution Compensation Fund is not to be made on the basis of an abstract quantification of damage calculated in accordance with theoretical models.'...It was also noted that the position taken by that Working Group had been endorsed by the Assembly at its 4th and 12th sessions" (CMI, 1994).

The skepticism of the IOPC as to the use of "Theoretical Models" versus verifiable quantification has been stated for some time. The methods utilized by the former Soviet Union since the 1980s have not met with acceptance by IOPC. It is important to note that IOPC rejects the acceptability of claims not based exclusively on models but rather those based on abstract injuries based on theoretical models.

In an effort to resolve conflicts of admissibility and assessment of claims for oil pollution damage, the Comit'e Maritime International developed specific guidelines in October of 1994. After days of debate and discussion, lawyers and scientists from over 50 countries fundamentally concurred with the position of the IOPC Fund regarding the need for reliable quantification and set guidelines for reasonable costs of studies and factors in the determination of reasonable restoration measures.

The principal point of divergence between the United States and the IOPC approaches to compensation for quantifiable loss rests not with natural science but with economic losses. The IOPC's view that current means of assessing passive use losses are not reliable and seek to recover for speculative losses has been well established. This issue above all others has led to the United States decision not to participate in the IOPC Fund. Although there are points of divergence, it may be prudent to include the truly global perspective on how the rest of the world is dealing with restoration of the environment following oil spills.

ELIMINATE FINANCIAL COMPENSATION FOR RESOURCES

Following determination of injury, the RP is required to develop and implement restoration. Adequacy of restoration would be evaluated by an independent panel of scientific technical experts. No cash changes hands between RPs and trustees.

Section 8

Summary

This paper has presented several fundamental factors which influence the use and misuse of science in the damage assessment process. The primary goals of this paper are to provide information on the theory and practice of the NRDA process and to serve as a basis for future discussion and improvement of the NRDA process. The ultimate objective of this paper is to maximize the effective use of science to accomplish the legislative intent of NRDA. As discussed in this paper, science has numerous inherent limitations and is inexact in assessing the effects of anthropogenic activities on the environment which is both complex and dynamic. The inherent limitations and complexities of science and the environment are further compounded by numerous legal, administrative and practical constraints and influences placed on science conducted within the construct of NRDA. These limitations and constraints often compromise the ability of scientists to conduct NRDAs which are focused on the matter at hand: the assessment of the injured resource, determination of damages and implementation of the appropriate restoration actions. Recognizing the frailties of the legal and scientific processes the fact remains that trustees have the duty to determine injury and affect restoration. The major issues related to the use and misuse of science center on how much science is needed to appropriately accomplish both of these tasks.

Two critical constraints are the conflicts between the fundamental objectives of science and law and the conflict between management objectives of trustees and RPs which make the need to integrate science and law within the NRDA process difficult at times. Other important constraints have historically been the levels of experience and training and lack of trust and cooperation between RPs, trustees and the public. With increasing frequency of application of the NRDA process this factor has been reduced in recent years. It is recommended that training be conducted in a common forum, to heighten the understanding and appreciation of the perspectives and responsibilities of "the other side" and facilitate the cultivation of mutual trust and cooperation among trustees and among all players — trustees, RPs, consultants and the public.

The additional influences of the respective constituencies of trustees and RPs and the human emotional element also contribute to determining the objectives and style in which a particular NRDA is implemented. The human emotional element can affect the use of science as the potential for high dollar settlements sometimes clouds the application of science and interpretation of science data. Often irrelevant or unreasonable studies are conducted for various reasons such as: the lack of adequate technical and NRDA training and proper peer and administrative review; administrative and practical constraints; and scientific and administrative objectives which are inconsistent with NRDA. Finally, the lack of objective interpretation of scientific data and lack of the use of best professional judgement has a potential to impact the appropriate use of science.

The complexities of science and the environment are used and molded by scientists, administrators, legal counsel, consultants and the public to support and advocate their position, objectives and special interests. For example, in an attempt to expedite the legal and economic components of NRDA and in spite of the complex nature of science and the environment, regulators have reduced science to an abstract of itself through the use of computer models and compensation formulae. These assessment methods lack realism, have high levels of uncertainty and do not accurately determine injury or damages.

An important issue requiring resolution is cooperation among all interested entities. The proposed NOAA NRDA regulations advocate cooperation and steps are being taken by many to promote cooperative NRDA. However, there are no provisions in the proposed NOAA regulations which facilitate cooperation. In fact, the currently proposed regulations may provide a disincentive to cooperation by increasing the flexibility of the trustees and the number of simplified assessment procedures. Although increased training is probably the most effective method to enhance cooperation and develop a certain level of trust, there are additional methods for improving cooperation. These include requiring trustees to offer RPs the opportunity to participate in cooperative assessments, providing they meet some preestablished criteria. Another alternative is to remove or modify the rebuttable presumption provision.

The rebuttable presumption should not be automatic if the trustees simply stay with the regulations and the administrative process. The basis of natural resource damage assessment is intended to be the scientific component of the NRDA process. The level of scientific effort and high scientific standards need to be developed and adhered to and should be the measure by which trustees *earn* a rebuttable presumption. Implementing high standards of accountability can also serve as a criterion and incentive for receiving a rebuttable presumption.

The repercussion of these conflicts, constraints and influences is that numerous critical issues have sometimes adversely affected individual NRDAs and the overall NRDA process. There needs to be more accountability by trustees, RPs, consultants and special interest groups to the public for their decisions, actions and use of limited resources (personnel, time, budgets) and recovered damages.

The NRDA process has benefited from past errors. Much has been accomplished towards equitable and practical NRDA. Much remains to be accomplished. It was the objective of this paper to bring to light controversial issues that may stimulate thought and discussion. Perhaps by open discussion in fora such as this, all participants and the environment will benefit.

SECTION 9

CONCLUSIONS

- The concept of compensation for injury to natural resources has become well established in the United States. The goal of restoring the environment injured by anthropogenic means has met with public acceptance.
- The process of assessing natural resource damages and use of science in this process has been the subject of much discussion and controversy.
- Science plays an essential role in the NRDA process. The equitable determination of injury and implementation of appropriate compensatory actions require objective analysis based on the best information attainable.
- Within the process of assessing damages to natural resources there is the potential for the inappropriate application, conduct and utilization of scientific inquiry.
- Misuse of science occurs when:
  - Scientific inquiry is not focused on the goal of restoration of the injured resource;
  - Inquiry is not conducted in an intellectually honest effort to effectively accomplish the goal of equitably restoring, rehabilitating, replacing or acquiring the equivalent of the environment of the natural resources injured or lost as a result of an incident, and instead reflects an agenda to minimize or maximize damages.
  - Inquiry is punitive and not compensatory.
  - The scientific process can be adulterated by political, legal, or administrative constraints, human emotions, special interests or economic pressures. Examples include:
    - suppression of significant findings,
    - curtailment of investigations when they lead to unfavorable results, and/or
    - selective use of science to advance a particular position
    - high quality science is not applied.
  - There is an attempt to answer the unanswerable. Investigators force-fit conclusions using limited or insufficient data when, in all likelihood, no reasonable expenditure of time and money will produce the necessary data.
  - Investigators are unwilling to accept previously demonstrated facts and apply best professional judgement to reach a sound conclusion.
- The misuse of science can, and has in some cases, compromised the ability to achieve the fundamental goal of restoring affected environments.
- The application of NRDA and use of science has improved measurably in the past few years.

Resolution of the key issues which adversely affect the use of good science in NRDA and the ability to restore the injured environment is imperative and in the mutual interest of all concerned parties. Reasonable people can reach reasonable conclusions. The problem is that not everyone shares the same definition of reasonableness. To minimize the misuse of science, legal, political, economic and scientific interests must be satisfied. Accomplishing the objectives of NRDA should be pursued through a process which is balanced and recognizes the responsibilities and interests of the trustees, RPs and public. Resolution can be achieved by all parties acknowledging their role in the evolution of recurring issues and a joint commitment to reaching a reasonable balance. Balancing the inherent requirements of each party to reach equitable resolution to NRDA cases is the challenge before us.

REFERENCES

Bibby, C.J. 1981. An experiment on the recovery of dead birds from the North Sea. Ornis Scandinavia. 12:261–265.

Bibby, C.J. and C.S. Lloyd. 1977. Experiments to determine the fate of dead birds at sea. Biol. Conserv. 12:295–309.

Bieki, J.R. Shea & Garner, Washington, DC. Personal communication, letter to Gary Mauseth (Beak), dated 18 October 1994.

Burger, A.E. 1993. Mortality of seabirds assessed from beached-bird surveys in Southern British Columbia. Canadian Field-Naturalist 107(2):164–176.

Cohen, J.M. and M.J. Cohen. 1971. *Dictionary of Modern Quotations,* 2nd Ed. Penguin Books, Harmondsworth, Middlesex, England.

Comit'e Maritime International (CMI). 1994. Oil Pollution Damage Guidelines. Proceedings: 85th International Conference of the Comit'e Maritime International (CMI), Sydney, Australia, 2–8 October, 1994.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Superfund) (CERCLA). 1980. 42 USC Sections 9601 *et seq.*

Conant, J.B. 1951. *Science and Common Sense.* Yale University Press, New Haven, CT.

Exxon Valdez Oil Spill Trustees. 1992. Chapter IV in: Restoration Framework, Volume I. Exxon Valdez Oil Spill Trustees, Anchorage, AK.

Fleetwood. 1987. From the People who Brought You the Twinkie Defense: The Rise of the Expert Witness Industry. *Washington Monthly.* p. 33.

Ford, R.G., G.W. Page and H.R. Carter. 1987. Estimating mortality of seabirds from oil spills. Proceedings, 1987 Oil Spill Conference, pp. 547–551.

French, D.P., M. Reed, S. Puckett, S. Pavignano, H. Rines, A. Keller, D. Gifford, F.W. French, III, S. Feng and C. Turner (Applied Science Associates, Inc., Naragansett, RI); G. Brown, E. MacDonald, J. Quirk, S. Natzke and B.S. Ingram (A.T. Kearney, Inc., Alexandria, VA); and M. Welsh and R. Bishop (HBRS, Inc., Madison, WI). 1993. Compensation Formula for Natural Resource Damage Assessments Under OPA: Oil Spills into Estuarine and Marine Environments. Prepared for National Oceanic and Atmospheric Administration. Washington, DC.

Fumento, M. 1993. *Science Under Siege: Balancing Technology and the Environment.* William Morrow and Company, Inc., New York, NY.

Getto, E.J., C.H. Cwik, and J.L. Ferrell. 1993. The Artification of Science: The Problem of Unscientific "Science" Evidence. *News & Analyses.* July 1993, 23 ELR 10435.

Green, R.H. 1979. *Sampling Design and Statistical Methods for Environmental Biologists.* John Wiley & Sons, New York, NY.

Grigalunas, T.A., J.J. Opaluch, D.P. French and M. Reed. 1989. Perspective on Validating the Natural Resource Damage Assessment Model System. *Oil & Chemical Pollution.* 5: 217–238.

Hoke, F. 1994. Science in the courtroom: What evidence is Admissible—and Who Decides? *The Scientist.* 8(12): 1,4,5.

Huber, P.W. 1993. *Galileo's Revenge: Junk Science in the Courtroom.* Basic Books, New York, NY.

International Tanker Owners Pollution Federation (ITOPF). 1994. Criteria for the Admissibility of Claims for Compensation. The International Tanker Owners Pollution Federation Limited, Seventh Intersessional Working Group, IOPC Fund, London.

Mercer Management Consulting, Inc. 1992. OPA 90: Regulatory Impact Analysis Review—Spill Unit Values, Interim Report. Lexington, MA.

National Academy of Sciences. 1977. *Environmental Impacts of Resource Management: Research and Development Needs.* National Academy of Sciences, Commission on Natural Resources, Washington, DC, 66 pp.

National Oceanic and Atmospheric Administration (NOAA). 1994. *Natural Resource Damage Assessments;* Proposed rule. Proposed regulations for 15 CFR Section 990.15(g). *In* 59 *Federal Register* 5:1062–1189. January 7, 1994.

O'Conner, E. Attorney, Freehill, Hogan and Mahar, New York, NY. Personal communication, telephone conversation with Gary Mauseth (Beak), 30 November 1994.

Oil Pollution Act (OPA). 1990. 33 USC Sections 2701 *et seq.*

Page, G.W., L.E. Stenzel and D.G. Ainley. 1982. *Beached Bird Carcasses as a Means of Evaluating Natural and Human-Caused Seabird Mortality.* Report to the Department of Energy, Contract DE-AC03-79EV10254. Stinson Beach, CA.

Point Reyes Bird Observatory (PRBO) with assistance from International Bird Rescue. 1985. The impacts of the T/V Puerto Rican oil spill on marine bird and mammal populations in the Gulf of the Farallones, 6–19 November 1984. A special scientific report. Stinson Beach, CA.

Preston Thorgrimson Shidler Gates & Ellis. 1993. *Natural Resource Damages.* Government Institutes, Inc., Rockville, MD.

Ray, J. Shell Oil Company. Personal communication, letter to Gary Mauseth (Beak), 23 November 1994.

Reed, M. and D. French. 1989. Overview of a Natural Resource Damage Assessment Model System for Coastal and Marine Environments. *Oil & Chemical Pollution.* 5: 85–97.

Sharp, J.M., S.G. Appan, M.E. Bender, T.L. Linton, R.J. Reish and C.H. Ward. 1979. Natural Variability of Biological Community Structure as a Quantitative Basis for Ecological Impact Assessment. *Proceedings,* Ecological Damage Assessment Conference, Arlington, VA, November 12–14, 1979. pp 257–284.

Stolls, A.M. (ed.) 1994. Oil Spill U.S. Law Report: Legislation litigation and enforcement actions from Cutter Information Corporation. Vol. 4(11):16.

Straughan, D. The Importance of Sampling Strategy in Ecological Damage Assessment. *Proceedings,* Ecological Damage Assessment Conference, Arlington, VA, November 12–14, 1979. pp. 3–27.

Suter, II, G.W., L.W. Barnthouse, S.M. Bartell, T. Mill, D. Mackay and S. Paterson. 1993. *Ecological Risk Assessment.* Lewis Publishers, Chelsea, MI.

Texas Administrative Code (TAC), Title 31, Section 20.33. 1994. Responsible person participation.

U.S. Department of the Interior. 1987. *Measuring Damages to Coastal and Marine Natural Resources.* CERCLA 301 Project. U.S. Department of the Interior, Washington, DC.

Walsh, J. Attorney, Davis Wright Tremaine. Personal communication, telephone conversation with Gary Mauseth (Beak), 30 November 1994.

Washington Administrative Code (WAC), Chapter 173–183. 1992. Preassessment screening and oil spill compensation schedule regulations.

West's Supreme Court Reporter, Interim Edition. October Term, 1992. West Publishing Co., St. Paul, MN. 113(B): 1893–End.

Appendix A

Natural Resource Damage Assessment Background

APPENDIX A

NATURAL RESOURCE DAMAGE ASSESSMENT BACKGROUND

The use of scientific data in Natural Resource Damage Assessment (NRDA) is a fundamental requirement. To appreciate how science is used in the legal framework of the NRDA process, it is necessary to understand the process. This section presents a brief review of the origination of current NRDA statutes and regulations, the concept of trust resources and trusteeship and the NRDA process.

Common law provides the basis of much of the theory and many of the concepts used to develop natural resource damage statutes. The principal common law doctrines are the public trust doctrine, the *parens patriae* doctrine and nuisance doctrine. The public trust doctrine is based on the legal principle that certain properties (e.g., land, water, wildlife) are important for the general well-being of the public and should be retained and protected for public use. Lawsuits involving the transfer of or injury to public resources have played an important role in forming natural resource damage statutes. In early legal cases where States used the public trust doctrine to recover damages for injury to public resources, the courts ruled that States do in practice have the authority to bring suit to protect the public resources for which they are responsible (Preston *et al.,* 1993).

The government has authority to act as a steward or guardian for "quasi-sovereign" interests under the *parens patriae* doctrine. This doctrine grants a State the authority to file suit to protect resources that it does not actually own, such as natural resources. Government interests in natural resources have been recognized or determined as a result of suits at the turn of the century. The *parens patriae* doctrine is the doctrine most frequently used to support legal suits involving natural resources (Preston *et al.,* 1993).

An action which substantially interferes with the right of the general public to use natural resources, such as an oil spill incident, is considered a public nuisance. Usually the interference or action must be an unreasonable one.

Although courts have ruled that States have the authority to recover damages for injuries to public resources, the use of these doctrines in the natural resource damage arena is not always consistent. For example, under the public trust doctrine, the courts have sometimes ruled that States do not have a substantive interest in a resource or must demonstrate ownership (Preston *et al.,* 1993). There are also limitations on the application of the doctrines to particular circumstances and claims.

The Trans-Alaska Pipeline Authorization Act (TAPPA) of 1973 and the Deepwater Ports Act (1974) were the first Federal statutes establishing the authority of government agencies to recover natural resource damages from a responsible party (RP). Federal statutes providing authority to recover natural resource damages are the Clean Water Act Amendments (1977), the Outer Continental Shelf Lands Act Amendments (1978), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, Marine Protection Research and Sanctuaries Act amendments (1972) and the Oil Pollution Act (OPA) of 1990.

NATURAL RESOURCE TRUSTEE DESIGNATIONS

CERCLA designates the President of the United States as the trustee for Federally-managed or protected natural resources on behalf of the public. The CERCLA National Oil and Hazardous Substance Contingency Plan (NCP) (subpart G), Clean Water Act, Executive Order 12580 and OPA authorize the Secretaries of Federal agencies to serve as trustees for these natural resources. Federal natural resource trustee agencies include the Departments of Interior, Commerce, Energy, Defense and Agriculture. Federal agencies are designated as trustees based on their statutory responsibility with regard to the protection or management of natural resources or the management of Federally owned land, or both. Federal trustees which own or administer Federal lands are trustees for all "natural resources located on, over, or under" these lands. Federal land management agencies which serve as trustees include the Departments of Interior, Agriculture, Defense and Energy.

Under CERCLA and OPA, individual states are also authorized to act as trustee for natural resources within their boundaries or for resources belonging to, controlled by or appertaining to the State. CERCLA, requires the Governor of each State to designate a natural resource trustee for the State. The designated trustee is normally the head of an agency responsible for environmental protection or fish and wildlife management. Some States have designated more than one trustee agency.

CERCLA and OPA also designate American Indian tribes as trustees for natural resources "belonging to, managed by, controlled by or appertaining to the tribe." The tribal chairman, head of the tribe's governing body or an individual selected by the tribe may act as trustee on behalf of the tribe. The United States Bureau of Indian Affairs, within the United States Department of the Interior (DOI), may act as trustee if requested by the tribe.

TRUSTEE AUTHORITIES AND FUNCTIONS

CERCLA Section 107(f)(2)(a), Clean Water Act Section 311(f) and OPA are the principal Federal statutes which authorize trustees to assess damages for trust resources which are lost, injured or destroyed as a result of the discharge of oil or the release of hazardous substances. Current natural resource damage provisions, requirements and liabilities are primarily set forth in CERCLA and OPA. CERCLA addresses damages due to release of hazardous substances and OPA addresses the discharge of petroleum products into navigable waters of the U.S., adjoining shorelines and the Exclusive Economic Zone. The DOI was charged with developing natural resource damage regulations and procedures for CERCLA and the Department of Commerce (DOC), through the National Oceanic and Atmospheric Administration (NOAA), was charged with developing regulations for OPA.

The Marine Protection, Research and Sanctuaries Act authorizes trustees to file claims for damages to resources which occur in National Marine Sanctuaries resulting from any type of action, including the release of hazardous substances or the discharge of oil. Finally, TAPPA allows for natural resource damage claims resulting from activities which occur along the Trans-Alaskan Pipeline route and from oil originating from the pipeline.

Trust resources are broadly defined in CERCLA (Section 101 (16)) as:

> "...land, fish, wildlife, biota, air, water, ground water, drinking water supplies and other such resources belonging to, managed by, held in trust by, or appertaining to, or otherwise controlled by the United States ...any State or local government, any foreign government, any Indian tribe, or, if such resources are subject to a trust restriction on alienation, any member of an Indian tribe."

Examples of land trust resources include National Wildlife Refuges, National Parks and National Marine Sanctuaries. Examples of living trust resources identified in the NCP include migratory birds, threatened and endangered species, marine mammals, sea turtles, anadromous fish, marine fishery resources and wildlife in general (e.g., deer, bear, raccoons, etc.). The habitats in which these resources live are also trust resources.

Federal and State agencies and American Indian Tribes are commonly considered "co-trustees" for the same natural resource. For example, the DOI and State are considered co-trustees for migratory birds. Also, Federal land management agencies are co-trustees with the DOI, DOC and/or possibly the Tribe or State for most living natural resources on these lands. Federal agencies can also be co-trustees for certain natural resources. For example, the DOC is the trustee for sea turtles when they are at sea and the DOI is the trustee for sea turtles when they are on land. The State is also a trustee for sea turtles in both the water and on land and is, therefore, a co-trustee with both the DOI and DOC.

OBJECTIVES OF THE NRDA PROCESS

The primary objectives of the NRDA process are to identify and quantify natural resource injury, determine damages resulting from the injury and develop and implement appropriate restoration actions. The main purpose of NRDA regulations is to provide procedures and guidelines for the recovery of these damages by natural resource trustees. The primary goal of NRDA is to provide for the restoration of the injured natural resource and/or services to pre-incident conditions that would have existed in the absence of the discharge or release. This goal is to be accomplished by implementing a plan for the restoration, rehabilitation, replacement or acquisition of equivalent natural resources. TAPPA was the first statute to define damages as the "injury to, or destruction of natural resources and loss of use of natural resources" and this definition has been adopted in subsequent statutes and regulations.

THE NRDA PROCESS

The current DOI NRDA process used for hazardous waste sites and, until OPA NRDA regulations are implemented, oil spill natural resource damage claims is defined in regulations developed by the DOI to meet the statutory requirements of CERCLA. At the time this report was prepared, NOAA had published proposed regulations for use on oil spill natural resource damage claims which will implement the requirements of OPA (NOAA, 1994, p. 1062). When final, the NOAA damage assessment regulations will replace the DOI regulations only for those incidents involving oil spills to navigable waters.

The DOI regulations (Rule) include several fundamental concepts which dictate the requirements and procedures which should be followed in conducting a NRDA. These concepts are listed since they are important to understanding the NRDA process:

- Damages are for injuries residual to response or remedial actions;
- Damages are compensatory, not punitive;
- The public and responsible parties are involved in the process through notice, review and comment;
- Recovered damages must be used for restoration;
- The rebuttable presumption (the plaintiff is considered correct unless sufficient data are provided to refute the plaintiff's data) is an important element to decision making;
- Use of the regulations is optional; trustees do not have to follow the regulations or implement a NRDA; and
- Emergency restoration is a temporary action to avoid or minimize injury.

The Rule involves a step-by-step process beginning with notification of the incident and culminating with the implementation of restoration actions (Figure A-1). The order in which the process is implemented is not rigid and is influenced partially by the nature of the particular release and circumstances. The process consists of three phases as briefly discussed below.

Preassessment Phase

In the Preassessment Phase, the trustee(s) receive formal notification from the Environmental Protection Agency or U.S. Coast Guard of a release of hazardous substances or discharge of oil. The trustee gathers relevant information on the discharge or release and determines if there have been actual injuries to trust resources or if there is a potential for injuries to occur. A determination is also made on the probability of a successful damage claim.

Assessment Planning Phase

In this phase, the assessment procedure to be used, Type A or Type B, is determined and an assessment plan is developed for coordination and communication requirements. The plan must provide for confirmation that at least one trust resource has been exposed to the oil or toxic substance. The economic methodology for damage determination is also identified.

Type A assessments involve the use of the Natural Resource Damage Assessment Model for Coastal and Marine Environments (NRDAM/CME). This computer model consists of three submodels: the physical fate, biological effect and economic damages. The model: (1) determines injury, as determined through the interaction of physical fates and biological effects submodels; (2) quantifies injury through the biological effects submodel; and (3) calculates damages through the economic damages submodel. Minimal empirical scientific studies may be conducted to document or supplement model input and findings. The DOI has also proposed a Type A model for Great Lakes Environments (NRDAM/GLE). Type B assessments involve the implementation of specific scientific studies to document and quantify injury. A pathway link must be established to document that the resource injury was caused by the release or discharge of concern. The injury and associated baseline services must be quantified and the resulting damages calculated.

NRDA PROCESSES

CERCLA	OPA
	I. Prespill A. Prespill Planning B. Trustee Coordination
I. Preassessment Phase A. Preassessment Screen B. Data Collection & Sampling C. Preassessment Screen Determination	II. Preassessment Phase A. Preassessment Determination B. Data Collection & Sampling C. Damage Assessment Determination D. Emergency Actions
II. Assessment Phase A. Coordination B. Notification C. Planning D. Decision on Type of Assessment 1. Type A or Type B E. Assessment 1. Injury Determination 2. Injury Quantification 3. Damage Determination	III. Assessment Phase A. Plan Development B. Assessment (Comp. Formula/Type A/EDA/CDA) 1. Injury Determination 2. Injury Quantification 3. Restoration 4. Compensable Values Determination
III. Post Assessment Phase A. Report of Assessment B. Demand C. Restoration Account D. Restoration Plan	IV. Post Assessment Phase A. Report of Assessment B. Demand C. Restoration Account D. Restoration Plan

Figure A-1. Comparison between CERCLA and OPA NRDA processes (adapted from NOAA, 1994, p. 1064).

POST-ASSESSMENT PHASE

A "Report of Assessment" is produced in this phase which describes and presents all decisions and scientific and economic methods and information used in the assessment. A demand for damages is prepared and presented to the RP. A restoration plan is prepared and a restoration financial account is established.

There are several important provisions of CERCLA which govern the damage assessment and restoration process. Again, these provisions strongly influence the flexibilities and limitations of the DOI Rule:

- Trustees can recover the cost of assessment in addition to natural resource damages;
- Recovered damages must be used by trustees for the restoration, rehabilitation, replacement or acquisition of the injured natural resource;
- Regulations specify that injury is for a measurable adverse change in the chemical, physical quality or viability of a natural resource;
- Assessments conducted in conformance with the regulations are afforded the effect of a rebuttable presumption in an administrative or judicial proceeding; and
- Regulations allow for negotiated settlements and requires trustee notification since a covenant not to sue must include written agreement by the trustees.

THE NOAA NRDA PROCESS

The damage assessment regulations proposed by NOAA to implement OPA are very similar to the DOI regulations for CERCLA (Figure A-1). However, there are a few important differences which merit brief discussion. General differences include the promotion of pre-spill planning, the determination of the assessment approach in the Preassessment Phase and the use of additional assessment methods by the trustee. There are also some specific and critical procedural and technical differences.

Injury in the proposed NOAA Rule is defined as "any adverse change in a natural resource, or any impairment of a human or ecological service provided by a resource." This is a much more liberal definition than the DOI definition which requires that a "measurable" adverse change be identified. The effect is that liability is more easily established under OPA as long as compensation can be quantified and is adequate to account for the injury.

Additional assessment methods, not available under CERCLA, which are identified in the proposed NOAA Rule are the Compensation Formula and Expedited Damage Assessment approaches. The NOAA Rule requires the development of an administrative record for all NRDAs which will serve as the primary mechanism for public review and comment. A Draft Assessment Restoration Plan (DARP) must be prepared, become part of the record and be made available to the public and RP for review and comment. The NOAA Rule also allows for the inclusion of "passive use" values in damages. The revised DOI NRDA Rule will also allow the inclusion of "passive use" values referred to by DOI as "non-use" values. The proposed NOAA Rule defines passive use as:

> "the value of knowing the resource is available for use by family, friends, or the general public; the value derived protecting the natural resource for its own sake; and the value of knowing that future generations will be able to use the natural resource" (NOAA, 1994, p. 1169).

Some of the procedural differences between hazardous waste site and oil spill NRDAs can significantly influence the quality of science conducted and nature of damage claims. The most significant factor is the amount of time in which interested parties have to conduct their respective roles in the incident investigation and damage assessment. While the restricted amount of time can compromise the process and quality of the NRDA outcome for oil spills, a more liberal amount of time for hazardous waste site NRDAs presents a better opportunity to conduct science with fewer constraints and reach more reliable and relevant conclusions. However, this does not insure that more reliable conclusions will be reached.

Recognizing that the overall CERCLA Remedial Investigation/Feasibility Study (RI/FS) process for hazardous waste site investigation and remediation is extremely complex, controversial and laden with legal and economic issues, there are some positive benefits to the damage assessment process for hazardous waste sites. For example, the lengthy but comprehensive RI/FS process allows for more thorough data gathering and analysis regarding the release, determination of pathways and exposure and development of well-designed scientific studies focused on specific natural resources at risk. There is also more time available for peer review, improved coordination among trustees and responsible party (RP) and the development of a unified approach by trustees. These factors also facilitate better informed decisions regarding injury documentation and quantification and damage determination. Although there is an emotional element to hazardous waste site issues, it is typically more localized than a large oil spill incident, focused on relevant issues and predictable. Despite these potential benefits, there is no guarantee that NRDAs for hazardous waste sites will be any more reliable than those for oil spills.

ROLE OF RESPONSIBLE PARTIES IN NRDA

Under CERCLA and OPA, the RP is legally liable for response and cleanup costs and damages for the injury to, or destruction of, natural resources, loss of use of natural resources and the reasonable costs of assessing injury and damages. Under OPA, an RP is liable for a discharge of oil into or upon navigable waters, adjoining waters or Exclusive Economic Zone of the United States. Under CERCLA, an RP is liable for releases of hazardous substances which cause injury or the destruction or loss of natural resources and the reasonable costs of assessing injury and damages. In addition, both OPA and CERCLA require that potentially responsible parties pay into an alternate fund for potential future claims for damages and removal costs if an RP is not identified or is financially unable to reimburse these costs.

In response to a release or discharge incident, the RP must acknowledge or deny responsibility. Procedures for submitting damage claims must be advertised by the RP. If responsibility is not acknowledged, or an RP cannot be identified, procedures for submitting claims for oil spills to the Oil Spill Liability Trust Fund are advertised by the government. CERCLA claims are submitted to the Superfund for reimbursement in these situations.

To get legal relief from liability, the RP has certain legal defenses to damage assessments that can be exercised but are very limited under OPA. For example, the spill must be shown to be an act of God, war or an omission of a third party. Claims can only be filed in limited jurisdictions during the three years following the discovery of injury or commencement of a NRDA, whichever is later.

If a damage assessment is implemented, it must be conducted by the trustees as required by law. However, the RP can participate in the NRDA process by providing trustees with data, funds or restorative assistance on scientific studies and restoration actions. RPs can also hire environmental, legal and economic consultants to participate in a cooperative NRDA and/or assist in the development of NRDA defense strategies.

The existing DOI regulations require trustees to offer a RP an opportunity to participate in the NRDA process. Although the proposed NOAA regulations encourage cooperation with the RP, they do not require trustees to offer the RP an opportunity to cooperate on NRDAs. Under the proposed NOAA regulations, the RP is allowed to review and comment on the NRDA on the same level and timeframe as the public. Several states have developed NRDA programs including California, Florida, New Jersey, New York, Texas and Washington. Some of these states, such as Washington and Texas, provide for ongoing involvement by the RP in the NRDA process (WAC, 173–183, 1992; TAC 20.20–20.23, 1994).

APPENDIX B
LIST OF ABBREVIATIONS

APPENDIX B

LIST OF ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation and Liability Act (1980)
DARP	Draft Assessment Restoration Plan
DOC	Department of Commerce
DOI	Department of the Interior
EMAP	Environmental Monitoring Assessment Program (of the EPA)
EPA	Environmental Protection Agency
NAWQA	National Water-Quality Assessment Program (of the U.S. Geological Survey)
NCP	National Oil & Hazardous Substance Contingency Plan
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment
NRDAM/CME	Natural Resource Damage Assessment Model for Coastal Marine Environments
NRDAM/GLE	Natural Resource Damage Assessment Model for Great Lakes Environments
OPA 90	Oil Pollution Act (1990)
PRP	Potentially Responsible Party
RI/FS	Remedial Investigation Feasibility Study
RP	Responsible Party
SARA	Superfund Reauthorization Act
TAPPA	Trans-Alaska Pipeline Authorization Act (1973)
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service

APPENDIX C

GLOSSARY

Appendix C

Glossary[1]

BASELINE

The condition(s) of the natural resources and/or services, taking into account natural or other (human-induced) variability, that would have existed had the discharge of oil under investigation not occurred. In the absence of reliable data on variability, the baseline is the condition of the resources and/or services of interest immediately prior to the discharge.

DAMAGES

The amount of money calculated to compensate for injury to, destruction of, loss of, or loss of use of natural resources, including the reasonable costs of assessing or determining the damage, which shall be recoverable by the United States, a state, Indian tribe, or foreign trustee.

INJURY

Any adverse change in a natural resource or impairment of a service provided by a resource relative to baseline, reference, or control conditions. Injury incorporates the definitions of "destruction," "loss," and "loss of use."

INTERNATIONAL OIL POLLUTION COMPENSATION FUND

Established in 1978, the Fund approves the settlement of claims against the Fund for compensation of damages resulting from the discharge of oil. The Fund is financed by fees collected from Member States (countries).

NATURAL RESOURCE(S) OR RESOURCE(S)

Land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to or otherwise controlled by the United States (including the resources of the Exclusive Economic Zone), any State or local government, Indian tribe or foreign government.

NATURAL RESOURCE DAMAGE ASSESSMENT (NRDA)

Assessment means the process of collecting and analyzing information to determine damages for injuries to natural resources and/or services as set forth in this part.

REBUTTABLE PRESUMPTION

The plaintiff's data is considered accurate in an administrative or judicial proceeding under OPA.

RESPONSIBLE PARTY (RP)

A person described in or potentially described in one or more of the categories set forth in Section 1001(32) of OPA.

RESTORATION

Actions that return injured natural resources and/or services to their baseline condition.

TRUSTEE(S)

Those officials of the Federal and State governments, of Indian tribes, and of foreign governments designated according to Section 1006(b) of OPA who may present a claim for and recover damages for injury to natural resources.

TYPE A PROCEDURE

One of the simplified natural resource damage assessment procedures requiring minimal field observation, found in Subpart D of 43 CFR part 11.

[1] The definition of listed terms is primarily from NOAA (1994), Proposed Rule for natural resource assessments to maintain consistency in the use of these terms.

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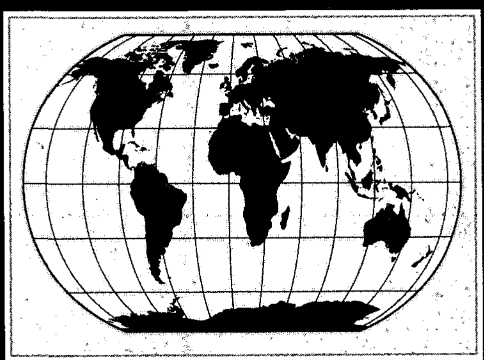
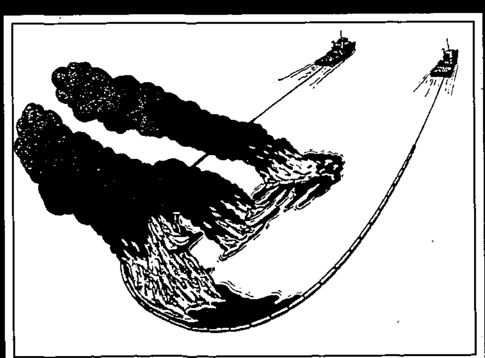
1995 INTERNATIONAL OIL SPILL CONFERENCE

PERSPECTIVES ON ESTABLISHING AND MAINTAINING OIL POLLUTION RESPONSE CAPABILITIES





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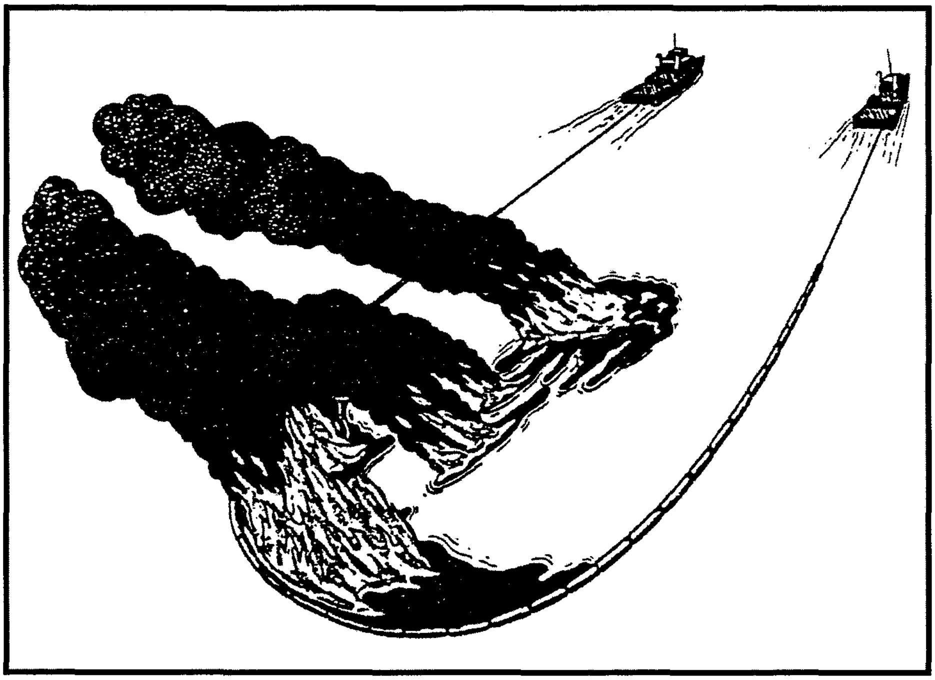

A White Paper Prepared for the

1995 International Oil Spill Conference

American Petroleum Institute

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PREFACE

The 1995 International Oil Spill Conference sponsors, American Petroleum Institute, U.S. Coast Guard, U.S. Environmental Protection Agency, International Maritime Organization, and International Petroleum Industry Environmental Conservation Association, commissioned three white papers to address issues of special importance to the oil spill community. They assigned the responsibility for general management and oversight, scope definition, peer review, and publication of the white papers to the Program Committee.

The goals of the white papers are to educate the spill community, to stimulate open discussion of complex and controversial issues, and balance the diverse positions of stakeholders. Each topic addresses varying scientific/technical and socio/political concerns. Therefore, each white 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 1995 Conference, each white paper will be the topic of a special panel session. Separate publication of the white papers initiates the International Oil Spill Conference Technical Report Series. The Technical Reports are to be published in conjunction with the International Oil Spill Conference on a biennial basis.

It is the Program Committee's hope that each white paper will stimulate substantive discussion and serve as a catalyst for solutions.

Robert G. Pond
CDR, U.S. Coast Guard
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ABSTRACT

A series of catastrophic oil spills in the past five years has caused governments and governmental institutions at the local, national, regional, and international level to reconsider past decisions on appropriate levels and types of oil spill response capabilities, including salvage. This initiative has generally been undertaken by developed countries, but some emerging economies and, to a lesser extent, developing countries, have begun to view large scale oil spills as a potential threat to their interests and are taking action to provide protection for important resources. This paper reviews the recent developments in the decision-making processes used by governments in determining the level and type of oil spill response capability and surveys oil spill response systems in selected countries. This review and survey provide for the derivation of general principles that could be used by governments in future considerations of this issue. The current international legal regime for oil spill response, including the newly enacted International Convention on Oil Pollution Preparedness, Response, and Cooperation, 1990 (OPRC) is examined to determine if adequate instruments are in place for a global and comprehensive approach to oil pollution. There is a significant gap in the existing legal regime insofar as a satisfactory funding mechanism for oil spills threatening the resources of developing countries, in particular. A new approach is required, ensuring an adequate level of protection for any nation threatened with a catastrophic spill, founded on the application of the general principles for determining an oil spill response capability.

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Executive Summary

This document presents a synopsis of current methods used by various governments to determine appropriate levels and types of oil spill response equipment, including the means of funding the procurement and maintenance of the equipment and personnel required to maintain and employ the equipment. Oil spill response capability is broadly defined to include specialized response equipment and personnel, including emergency salvage capability. This summary of decision-making methods provides the background for the development of general principles for determining if a national or regional oil pollution response capability is required and the appropriate level and type of that capability. It also recaps the existing national and regional response systems and the international legal regime to determine if there are gaps that need to be filled to ensure reasonable access to spill response capability irrespective of a nation's wealth.

An informal survey was conducted of selected governments to categorize national or regional systems of response and to determine existing methods of decision-making for oil spill response capability. There are no universally accepted approaches to oil spill response or to determining required equipment levels. Governments rely on different response technologies and different means of funding response operations based on a variety of factors, such as geographical location, prevailing weather patterns and sea conditions, and past spill history. The identification of these factors and the derivation of some general principles for the selection of response technologies and systems of funding is the product of this survey. Additionally, secondary research was employed to analyze the existing international legal regime for oil spill response to determine its sufficiency for providing access to oil spill response capability by governments perceiving a risk to their national interests.

Oil Pollution Response Capability Decision-making by Governments

Few peacetime events so sharply focus political and media attention, and detract from any effort at rational policymaking, as a catastrophic oil spill. Unfortunately, the reality of government systems around the world is that oil pollution response capability is typically not considered an issue until a catastrophic event occurs. The environmental and economic impact of a major oil spill, however, deserves thoughtful consideration by all coastal nations and the international community.

When a government decides to procure and maintain a response capability, it must choose the type of response technology, or mix of response technologies. Two principal types of response technology have emerged over the years, each with its adherents and opponents. Mechanical response (i.e. booms, skimmers, and associated equipment) is favored in some countries, while chemical response (principally dispersants) is favored in others. New technologies, such as bioremediation, are generally not widely accepted for emergency response, but are considered potential tools in the long term process of assisting environments to recover from oil spills. Variant technologies, combining physical and chemical processes, such as *in situ* burning, are still under active consideration by scientists and policymakers around the world.

Once a decision is made regarding an appropriate response technology, the level of required equipment and personnel must be determined. Planning standards are emerging in some countries that form the basis for a quantitative determination of the required level of response capability. Despite the use of such planning standards, governments may still find themselves criticized following a large scale incident if the standards and decision-making processes are not regularly re-evaluated or not reflective of current technology.

The means of funding response capability is the most imposing question faced by policymakers since the equipment and personnel costs of a creditable response capability can be formidable. Compelling the party responsible for a spill to pay for the response, the *polluter pays* principle, is common to all types of funding arrangements and usually provides for payment of the operational costs of a response. A privately funded response system, dependent on commercial arrangements between potential polluters and response companies, offers the most direct means of applying the *polluter pays* principle and can be designed to ensure that potential polluters pay all costs associated with a spill response capability. Privately funded response arrangements appear to work most effectively in countries at risk of oil spills from identifiable sources, such as tankers bound to or from a country's ports. It may not succeed in countries mainly at risk of oil spills due to their proximity to tanker lanes because enforcing commercial arrangements is nearly impossible. Primarily, this *passing tanker syndrome* appears to impact developing countries, but some developed countries, such as France, are not immune to its effects.

Publicly funded response arrangements may ensure a viable response capability, even in the face of the *passing* *tanker syndrome,* but they may fail to uphold the *polluter pays* principle. A publicly funded system based on general revenues, for example, may actually subsidize a polluter at the expense of taxpayers. A revenue generating system to procure and maintain an oil spill response capability needs to reflect the full cost of preparedness and response and to ensure that those costs are passed to the polluter and, ultimately, the consumer.

GENERAL PRINCIPLES IN RESPONSE CAPABILITY DECISION-MAKING

The factors that determine oil spill response capability are:
(1) national or regional history of maritime catastrophes;
(2) oil transportation patterns; and
(3) national economic vitality.

Secondary factors include (a) climatic or oceanographic conditions, (b) social, cultural or political forces, (c) coastal development and population demographics, and (d) environmental awareness. These factors, or general principles, can be used by governments undertaking an evaluation of their existing response arrangements or by governments considering whether their interests are at risk from oil spills.

EXISTING SYSTEMS AND REGIMES

Most developed countries have undertaken reviews of their response capability due to the recent spate of catastrophic oil spills. As a result of these reviews, new equipment was procured, legislation passed, and new technologies explored. Internationally, a new legal regime, the International Convention on Oil Pollution Preparedness, Response, and Cooperation, 1990 (OPRC), was developed to address many issues associated with oil spill response. Many emerging economies and some developing countries have begun to examine the risk of oil spills to their national and regional interests.

CONCLUSION

There is a fundamental need to provide access to pollution response capability to those countries that determine that they are at risk from oil spills. Application of either of the three general principles provides the basis for determining the requisite oil spill response capability, but funding that capability may be beyond the means of most countries. A new global approach to funding response capability needs to be provided that (1) adheres to the *polluter pays* principle, and (2) provides a sufficient level of response capability regardless of the economic vitality of a country. An oil spill impacting the natural and economic resources of a nation needs to be combated in an appropriate manner, irrespective of whether that nation is developed, developing, or an emerging economy. A country lacking access to adequate response resources faces limited response options, all of which may be unsatisfactory. A new international fund, to complement the existing International Oil Pollution Compensation Fund (IOPCF), is required.

An extraordinary effort is still required on the part of international institutions, such as the International Maritime Organization and the United Nations Environment Programme, and national and regional governments to assess the global state of oil pollution preparedness and to ensure access to requisite oil spill response capability for all countries. The OPRC is just the first step in the process.

SECTION 1

INTRODUCTION

The stranding of the tanker *Braer* off the coast of Scotland in 1993 is the latest in a series of catastrophic oil spills that has forced governments to re-evaluate their respective approaches to oil spill preparedness and response. The massive release of oil into the Persian Gulf[1] in 1991, the *Exxon Valdez* grounding in 1989, the *Amoco Cadiz* incident in 1978, and the *Torrey Canyon* in 1969 represent a class of events that have significantly impacted coastal and ocean resources, both economic and ecological. Each of these events resulted in sometimes dramatic changes to the manner in which governments perceive the risk and threat of oil spills to their interests and to the way governments choose to respond to oil spills.

Most of the changes to the manner in which governments perceive the risk and threat of oil spills have occurred in the country or region most directly affected by a particular incident. In recent years, however, more governments have begun to examine the potential impact of a catastrophic spill on their interests. The mere occurrence of a catastrophic incident somewhere in the world often provides the impetus to awaken a government that has been complacent on the issue of oil spills.

Those governments most able to examine oil pollution response capability and effect changes where needed represent the wealthier nations of the world. Most developing nations, and countries with emerging economies, with some exceptions, have not addressed the need for their own oil pollution response capabilities. Notwithstanding the potentially significant economic impact on coastal resources, oil pollution has not been viewed as an important issue by developing countries. This is a completely understandable position in view of the other economic priorities in these countries.

If oil pollution response capability is important for a developed country, it is potentially as important for a developing country. A country with a vital commercial fishery, a coastal tourist industry, or an environmentally important coastal zone will feel the impact of a large scale oil spill, whether it is a developed or a developing country. In fact, given the relative importance of some of these issues to the overall economic well-being of a developing country, it is possible that the effect of a catastrophic spill in a developing country may be more severe than in developed countries. Developed countries rely on oil for their economic well-being. Developing countries, on the other hand, may not benefit from oil production or consumption. Their economies and natural resources may be at risk from oil spills merely because of their proximity to tanker routes or offshore oil production units.

In 1990, following the *Exxon Valdez* incident, the international community met to address the "internationalization" of oil spill response. The result, the International Convention on Oil Pollution Preparedness, Response, and Cooperation, 1990 (OPRC), represents a first step along the long road to global oil pollution response. It was, however, just a first step. Now that the mechanism exists, it needs to be funded and implemented. The OPRC largely represents the developed world's view of cooperation in oil spill response, perhaps too self-protective of existing structures and programs.

Much more remains to be done if protection of natural and economic resources from oil spills is to be available regardless of national wealth. The work ahead needs to be tempered with the reality of the actual risk and impact of a spill and probability of successfully combating it, not perceptions of these things. Rational decision-making processes need to be employed at all levels of government; local, national, regional, and international, and by all "stakeholders:" oil companies, the oil transportation industry, and national and international environmental organizations, to ensure adequate protection for threatened resources.

This paper examines the approaches by governments to oil pollution response capability decision-making used: (a) to assess whether there are any general principles that may be derived to guide a rational decision-making process, (b) to analyze whether those general principles are sufficient in light of the requirements of nations, regions, and the world, and (c) to assess future action that may be required to provide an adequate global oil pollution response capability.

DEFINITION OF OIL SPILL RESPONSE CAPABILITY

In the context of this document, oil spill response capability is defined as the equipment, appurtenances, and personnel typically employed in an oil spill response. Specialized equipment, such as containment booms, offshore dedicated oil skimming vessels, skimmers, dispersants, fire retardant booms, and support boats are all included in this definition. Other specialized equipment that may be used for shoreline protection and cleanup is also included. General purpose construction equipment, often used in shoreline cleanup operations

[1] Some governments refer to the Persian Gulf as the Arabian Gulf. The U.S. Department of State designation of this body of water as the Persian Gulf will be used for the purposes of this paper.

but not maintained as part of an oil spill equipment inventory, is not included. The definition also does not include organizations established to manage resources or to coordinate the various functions undertaken during oil spill response operations.

SALVAGE AS OIL SPILL RESPONSE CAPABILITY

Salvage resources, although not usually included in the strict definition of response capability, can be an important element in a successful response. Emergency salvage, especially, is worthy of consideration because of the inherent difficulty in conducting oil spill response operations in those areas, such as rocky coastlines, for which salvage is particularly useful. Additionally, the preventive nature of some types of salvage operations, such as the use of escort vessels, calls for increased attention to this activity in a system of oil spill response.

There are two principal facets of salvage operations, nonemergency and emergency. Although the work of salvage entails numerous activities, nonemergency salvage involves wreck removal, delivering oil rigs, and towing vessels bound for ship breakers. Emergency salvage requires the rapid deployment of specialized equipment to the scene of marine accidents to minimize the impact of those incidents. Emergency salvage is the focus of this discussion.

During the deliberations on the OPRC, the view was expressed that worldwide salvage capability had declined to the extent that natural and economic resources were seriously at risk from increased tanker accidents.[2] If this view is correct, it was argued, governments should focus their efforts and money on salvage and less on response. If response capability can only be funded at the expense of salvage equipment then, clearly, salvage requirements need to be addressed in the context of oil spill response. However, there may be opportunities to increase salvage capability while enhancing response capability.

Emergency salvage operations, unlike oil spill response activities in many countries, are normally undertaken by private salvors. Even in the U.S., where a large Coast Guard with a specific *safety of life at sea* mission exists, policy prohibits the Coast Guard from interfering with the private activity unless it is apparent that the private enterprise cannot cope with the situation.

The effectiveness of a salvage operation depends on the timely reporting of an incident or, perhaps more importantly, a potential incident, the ability of a salvor to reach the scene of the incident, and the willingness of the ship's Master to accept salvage assistance. Reporting requirements for mariners exist in the International Convention on the Prevention of Pollution from Ships, 1973 (MARPOL) and OPRC. There is no formalized international arrangement for mariners to report to salvors or for government agencies to report incidents to salvors. Therefore, a certain discontinuity exists, since reports of marine casualties are made to government agencies, while slavors tend to be private entities.

Salvage requires large capital investment on the part of salvage companies to procure equipment that may be needed in the event of a marine accident. Commercial salvage opportunities are so sporadic that the emergency salvage industry and some governments have concerns over the future viability of the industry. The worst time to discover the lack of an assumed capability for oil spill containment and the availability of oil spill removal equipment, as the U.S. learned during the *Exxon Valdez* grounding, is during an actual incident.

Some governments, notably France and Spain, have contracted with private salvors to position salvage-ready tugs at specified locations along the coast, following catastrophic incidents in the waters of those two countries. Other governments, such as the U.S., have recently required prior arrangements with salvage resources as part of a tankship's emergency planning process. There is also a trend toward escort tugs in the U.S., for tankships operating in certain ports and port approaches to provide potential salvage resources immediately on the scene.

A cursory review of the location of major marine accidents and oil spills, in relation to major oil transportation routes, shows a preponderance of major spills in chokepoints, port and harbor approaches, leading to the conclusion that those areas are appropriate for prepositioned salvage equipment. Yet, far too many incidents occur in seemingly random locations, and if speed of response is essential in effective emergency salvage, then prepositioning salvage vessels will only solve part of the problem.

There is little debate that oil spill response efforts benefit from sufficient salvage capability to minimize the effects of certain marine incidents, but the question remains what is a sufficient level of salvage resources? Additionally, should these resources be limited to commercial arrangements or should governments contract for the prepositioning of salvage resources? What effect will various options have on the *polluter pays* principle? Can emergency salvage be rendered obsolete by requiring that tankers be built better, with more redundant steering and propulsion systems? These issues are currently under study in a number of forums, for example, the U.S. National Academy of Sciences (National Research Council, 1994).

[2] Germany and the Netherlands submitted a resolution to the OPRC Conference in 1990 on their perspectives of a diminished salvage capability worldwide. The resolution was adopted by the Conference.

SECTION 2

OIL POLLUTION RESPONSE CAPABILITY DECISION-MAKING BY GOVERNMENTS

Those governments that have pursued a thoughtful, conscientious process toward arriving at decisions regarding oil pollution response capability usually ask, "Do we need an oil pollution response capability or are improvements required in the one we have?"

Whether a country needs an oil pollution response capability is more than a rhetorical question, and one not easily dismissed. When raised in the context of rational or deliberative policymaking, away from the hysteria of a massive oil spill, the issue becomes one of determining the legitimate weight to be given to oil pollution response capability compared to other national priorities.

It is unfortunate that the attention of policymakers often only focuses on oil pollution response following a major incident, because the issue may be more important to a government and a society than either is prepared to admit. The risk of a major spill and its environmental and economic impact deserves thoughtful consideration by coastal nations and the international community.

It should be recognized that procuring and maintaining an oil spill response capability at the national or even regional level may not be in a government's best interest. The cost to a developing country of the required equipment and personnel to sustain a reasonable level of response against a massive oil spill may be viewed as a luxury that a country can ill afford, particularly when measured against other national priorities.

The reality of government systems around the world is that oil pollution response capability is typically not considered an issue until a catastrophic event occurs. If a government is fortunate, a massive oil spill that triggers policy interest will occur somewhere else and allow reasonable debate. If a government is not so fortunate, the occurrence of a large oil spill will focus national, and sometimes international, attention on a response capability often neglected, possibly underfunded, and probably insufficient for the incident at hand. The history of oil pollution response around the world is replete with examples of such incidents.

The problem with events dictating debate is that the resulting policy is usually bad policy. If the legal dictum that "difficult cases make bad law" is true, then it is equally true that catastrophic oil pollution incidents make bad national oil pollution response policy. The continuing furor over the U.S. Oil Pollution Act of 1990 (OPA 90) is instructive in this regard.

NATIONAL OR REGIONAL CAPABILITY

If a government decides that establishing and maintaining an oil pollution response capability is necessary, it must then determine whether the capability should be national or whether there is an advantage or opportunity to develop a regional capability with a neighbor or neighbors. Some governments currently maintain a national response capability, but supplement those capabilities with regional arrangements.

Oil spills do not to recognize national boundaries or other political demarcations. Where countries share common maritime borders or where a set of countries virtually surround a body of water, regional arrangements for large oil spills tend to work effectively. There are limits to the effectiveness of regional arrangements, however, such as severe economic disparity between partners. The recognition of the value of partnership among governments regionally and subregionally in oil spill response has proven to be very useful and, more recently, even wider partnerships have proven successful.

TYPE OF OIL SPILL RESPONSE CAPABILITY

The type of response resources appropriate for a national spill response capability is another component of the decision-making process. Two principal types of response technology have emerged over the years, each with its adherents and opponents. Mechanical response, booms, skimmers, and associated equipment, is favored in some countries whereas chemical response, principally dispersants, is favored in others. New technologies, such as bioremediation, are generally not widely accepted for emergency response, but they are under consideration as useful tools in the long term process of assisting environments recover from oil spills. Variant technologies, combining physical and chemical processes, such as *in situ* burning, are still under consideration by scientists and policymakers around the world.

Much of the criticism of mechanical response technology is founded in past failures. It is difficult to argue with direct observations from events in the past; however, the criticism of the technology during past incidents might be characterized as "too little, too late, too small." In other words, the amount of available equipment was limited, it was too far from the site of the incident to allow rapid deployment, and it was often not suited for the environment in which it was finally deployed. These facts often contributed to another criticism of mechanical response technology, particularly from the oil transportation industry: it is not cost effective.

Recent developments and improvements in mechanical response equipment, particularly offshore design changes, are not usually factored into the criticism of this technology. It is expensive to procure, maintain, and operate, unquestioningly. Skimmers of all types have limited recovery capability, perhaps ten to twenty percent recovery efficiency, and containment boom is bulky and difficult to employ. The advent of large skimming ships and portable skimming systems may well cast a different look on the future of mechanical recovery in open water environments. This is particularly important for those countries where other response technologies, such as dispersants, are not considered appropriate.

How Much is Enough?

Decisions regarding the appropriate level of response resources must be made after a determination of the appropriate type of technology that will form the basis for a response capability. How many skimmers does a response unit require? How many feet of boom are sufficient to protect critical environmental and economic resources? How many drums of dispersant are necessary?

It is difficult to predict how much response equipment and personnel are needed to respond to the range of pollution incidents that a country might encounter; there are too many variables that enter into the equation. Hypothetical planning factors are easy enough to develop from published material, such as government test results and manufacturers' design criteria, but few, if any, oil spills in the past have been marked by sufficient equipment, suitable for the sea and weather conditions encountered, located proximate to the spill site to make the equipment available in a timely manner.

In the *Exxon Valdez* incident, the government of the U.S., particularly, the U.S. Coast Guard, and the oil transportation industry were roundly criticized for not ensuring a sufficiently high level of response capability. It may be postulated that large spills the size of the *Exxon Valdez* oil spill would probably have been too large for any equipment stockpile available around the world at the time. However, the criticism was justified in the sense that the oil transportation industry could not defend the state of preparedness in the U.S. for a large scale oil spill, nor could the government of the U.S. defend its oversight of that preparedness. The adage "plan for the worst and hope for the best" was clearly not in operation in the U.S. prior to the *Exxon Valdez*.

Similarly, the government of the U.K. suffered criticism for its planning decisions made prior to the *Braer* incident. The response system, based almost wholly on dispersants, proved to be ineffective during the *Braer* incident. Whether mechanical response equipment would have been any more effective is debatable, given the sea state in the area of the incident. The focus of the criticism appeared to be with the process used to determine the appropriate response capability for the U.K. and how recently that process had been employed, not necessarily with the ultimate decisions.

Recent spill events have brought established planning criteria for response equipment into question, forcing governments to reassess their approach to decision-making. For example, the Canadian government recently determined that levels of response equipment in Canada were insufficient based on a re-evaluation of the size of a spill used for planning purposes. Similarly, the government of the United States established planning standards for evaluating privately arranged response as part of the development of regulations for Vessel Response Plans (VRPs) required by OPA 90.

Offshore vs. Onshore Response Capability

Significant differences exist in response capability that are determined by, among other things, the size and location of a spill. For example, response resources used for an offshore or open water environment differ significantly from those useful in an nearshore environment. Physical or mechanical equipment needs to be able to withstand the forces of nature to which they will be subjected. Dispersants may be effective offshore, but their effectiveness in nearshore environments is the subject of debate. *In situ* burning may be an effective response tool offshore but less appropriate near populated coastal areas.

Funding

The single most imposing question raised in the issue of response capability decision-making is funding. Some governments have pursued a publicly funded oil pollution response strategy, others a privately funded strategy. A mixture of public and private funding is used in some countries, notably the U.S., with the appropriate share of funding from each source still in question.

Through the entire decision-making process, the concept of the *polluter pays* is usually the basis from which response capability funding decisions derive. The Organization for Economic Cooperation and Development (OECD) in 1972 first articulated this principle, and later examined its specific applicability to oil pollution (OECD, 1982). Although a noble concept in theory, some argue that the phrase as applied to oil spills, particularly spills from tankships, should be modified to *polluter pays — to his limit of liability,* recognizing the existence of liability limits in virtually any marine oil pollution liability scheme currently in force. While not a signatory to the international scheme of liability and compensation and often held to be the pariah of the international oil spill community because of OPA 90, the U.S. does provide a limit of liability for oil spill costs.[3]

Determining who constitutes the polluter is not as simple as it appears. Is it the shipowner, whose tankship spills the oil or is it the cargo owner who may not have been very selective in finding a ship to carry his cargo? Is it the flag state that may have obviated basic flag state responsibilities regarding training of seafarers or is it the classification society that may not employ qualified surveyors? Is the polluter ultimately the oil consumer whose increasing demand for oil and oil products initiates the whole process of transporting oil by ship? Even the OECD did not attempt to address the issue of who constitutes the polluter.

[3] Whether the U.S. limit of liability under OPA 90 is real or perceived is the subject of continuing debate.

Current international arrangements identify the shipowner as the polluter in the first instance, with a slight nod to the role of the cargo owner through assessments on imported oil as the funding mechanism for the International Oil Pollution Compensation (IOPC) Fund.

The liability of a polluter and a government's decisions on response capability meet at this juncture in the decision-making process. In a publicly funded system, the polluter pays after the fact: typically, the government performs whatever cleanup is required and bills the polluter. In some instances, the bill for cleanup services includes the fixed cost of the equipment used in the cleanup in addition to the variable costs of the actual response. In other instances, only the actual outlays for the cleanup are charged to the polluter. Many European countries rely on a publicly funded system.

In a privately funded system, the polluter will usually pay the cleanup costs as they are incurred by commercial arrangement between polluter and private responder. In some countries, the potential polluter additionally bears the costs of preparing for the response by funding the response organizations on which the polluter would rely. As will be shown later, the U.S. and Canada are examples of the application of this comparatively new concept.

These examples, of course, beg the question "how much is enough?" In no small way, the answer to this question lies in the source of funding available. Funding response capability, as previously noted, can be provided by public sources or private sources. Public funding of response equipment is typically provided from general revenues through the national treasury.

Private funding of response capability can be accomplished, as the Japan Association for Preventing Marine Accidents is doing in the countries of the Association of Southeast Asian Nations (ASEAN), or through purely commercial arrangements, as in the United States with its requirement for tanker owners to provide commercial arrangements to respond to spills.

Public finding of response capability appears to violate the *polluter pays* principle, unless overhead costs of procurement and maintenance are allowed to be passed along to the polluter. Even then, the relatively infrequent use of response equipment forces a significant portion of overhead to be retained by the government providing the equipment. The polluter then avoids paying a potentially substantial portion of the costs of providing response equipment.

Oil consumers tend to benefit from those countries that rely on a publicly funded response system to the extent that the cost of preparing for a response and the costs expended in excess of a polluter's limit of liability are borne by taxpayers as opposed to consumers. In economic parlance, the cost of preparedness for oil pollution in countries with publicly funded systems and the cost of response in excess of a limit of liability are external to the price a consumer may pay for oil (externalities). High levels of externalities tend to result in inefficient allocation of goods and resources. For example, if a consumer does not pay the true cost of production of a product, such as oil, that cost must be borne by someone else. In effect, the oil consumer is subsidized by the taxpayer.

Externalities tend to diminish in importance as costs are passed on to the consumer. One means of accomplishing this is by allocating external costs to the commodity through a tax on that commodity. In the case of oil pollution, the cost of preparedness and response may be passed on to the consumer through a tax assessed against imported oil. However, the existence of such a tax does not ensure that the entire amount is available for oil pollution response purposes. Using the U.S. as a model, the Oil Spill Liability Trust Fund established by OPA 90 and funded by a tax on imported oil was designed to pay that portion of the U.S. oil spill response capability provided by the government. In fact, the Fund is largely used as a source of general revenue with only a portion earmarked for pollution response.

THE *PASSING TANKER SYNDROME*

The international transportation of oil and oil products by ship poses some difficulties to decision-makers regarding oil pollution response capabilities. Some countries are situated, economically and geographically, so that tankers passing near or through their waters are typically bound for their ports. Other countries are located near tanker traffic routes and are susceptible to the risk of oil spills from such tankers by virtue of their location, irrespective of their national levels of oil production or consumption. This phenomenon, the *passing tanker syndrome,* impacts many coastal states.

Planning appropriate levels of response capability in the face of the *passing tanker syndrome* is particularly vexing, since the risk of spills, source, and potential spill size are useful determinants. More important, however, is the fact that opportunities to fund an oil spill response capability are limited and would potentially fail to uphold the *polluter pays* principle. The *passing tanker syndrome* as a guiding principle in determining response capability is discussed later in this document.

SECTION 3

EXISTING SPILL RESPONSE CAPABILITY SYSTEMS

The following discussion is a brief overview of the various systems of oil spill response used by selected countries.

CANADA

The Canadian system of pollution response has undergone major changes in the past five years. New legislation, written in response to a major government study following the *Exxon Valdez* incident, moved Canada in the direction of an privately funded system of oil pollution response.

Tanker traffic around Canada is generally bound to or from Canadian ports, although Canadian west coast ports share a common point of entry with the U.S. through the Strait of Juan de Fuca. In essence, though, the tankers that pose a risk to Canadian resources and interests are generally known to Canadian authorities.

The grounding of the tanker *Arrow* in 1970 was a watershed in the evolution of the Canadian oil spill response system. Following the *Arrow* incident, the Canadian Coast Guard, the lead agency for purposes of oil spills from ships in Canadian waters, stockpiled equipment at various locations around the country. The system that emerged was a classic government funded one. The presumption that existed immediately following the *Arrow* incident was that, in a manner similar to its search-and-rescue responsibilities, the Canadian Coast Guard would respond to marine spills with resources and equipment necessary and appropriate to the incident.

Following the *Exxon Valdez* incident, the Canadian government convened a panel to re-examine, among other things, the state of preparedness for catastrophic oil spills in Canadian waters. The results of that investigation determined that "...Canada is not prepared to respond to marine spills" and that "...cleanup equipment is limited and often inappropriate." (Public Review Panel on Tanker Safety and Marine Spills Response Capability, 1990.) The government review panel also discerned that historical funding trends for government oil spill response programs was cause for concern and that the concept of *polluter pays* applied to preparedness as well as response.

The Canadian system is fundamentally a privately funded system, reliant on mechanical response technologies. Continuing environmental concerns over the toxicity and effectiveness of dispersants auger against that technology, but the Canadian government is developing provisions in contingency plans to specify those areas in which dispersants may be used and to preauthorize dispersant use where appropriate.

Response equipment in Canada will be provided by industry through oil spill cooperatives that will stockpile the level of response equipment determined necessary. The level of response equipment is predicated on the capability to respond to an oil spill of 10,000 metric tons in any of six regions.

Although Canada and the U.S. share a common border, little has been done toward a regional approach to pollution response. A Joint Marine Pollution Contingency Plan developed by the Canadian and U.S. Coast Guards exists, but the concept of a regionalized approach to oil pollution response by the two countries has never been fully explored. Both countries have generally adopted a go-it-alone approach with a slight nod to the need to cooperate in those areas of common borders.

The evolution of Canada's oil spill response capability from a publicly funded system to an privately funded system provides insight into three general principles. First, the question of the ability of the government to maintain adequate funding levels for oil pollution response in the face of other competing interests, is an issue raised in the report of the government's public review panel. Second, the belief that application of the *polluter pays* principle is best served by requiring potential polluters, in this case the oil industry and tanker owners, to participate in the funding of preparedness as well as response. Third, tanker traffic patterns around Canada allow the identification of tankers posing a risk to Canadian interests, thereby facilitating the assessment of fees to provide an industry funded response system.

EUROPEAN UNION

The countries of the European Union (EU) generally ascribe to a publicly funded response capability, particularly for response to offshore discharges from ships, although some use revenues from taxes on petroleum products, approximating a privately funded system. These countries also tend to associate themselves with other countries within a region looking toward mutual aid as a means of enhancing national response capabilities. Some examples of regional organizations to which EU member states belong are the Bonn Agreement for the North Sea area and the Helsinki Convention for the Baltic Sea area.

EU member states import significant quantities of oil resulting in a large number of tankers operating in EU waters. However, the geography of the EU countries makes them susceptible to the *passing tanker syndrome*. For example, France imports a large volume of oil through its oil ports, but many more ships pass through or near to French waters enroute to other ports in northern Europe than call at French ports. France, as well as other countries similarly situated, is at risk, not only from the ships calling at its ports, but from the ships passing offshore bound for other ports.

In the face of such expanded risk, the evolution of the European approach to oil spill response is quite natural. Where a country, such as Canada, may know that ships operating in its waters are generally bound for its ports, most EU member states and other European countries do not. Establishing a privately funded response system, particularly at the national or subregional level, in the face of the *passing tanker syndrome* is extremely complex and probably impossible to implement.

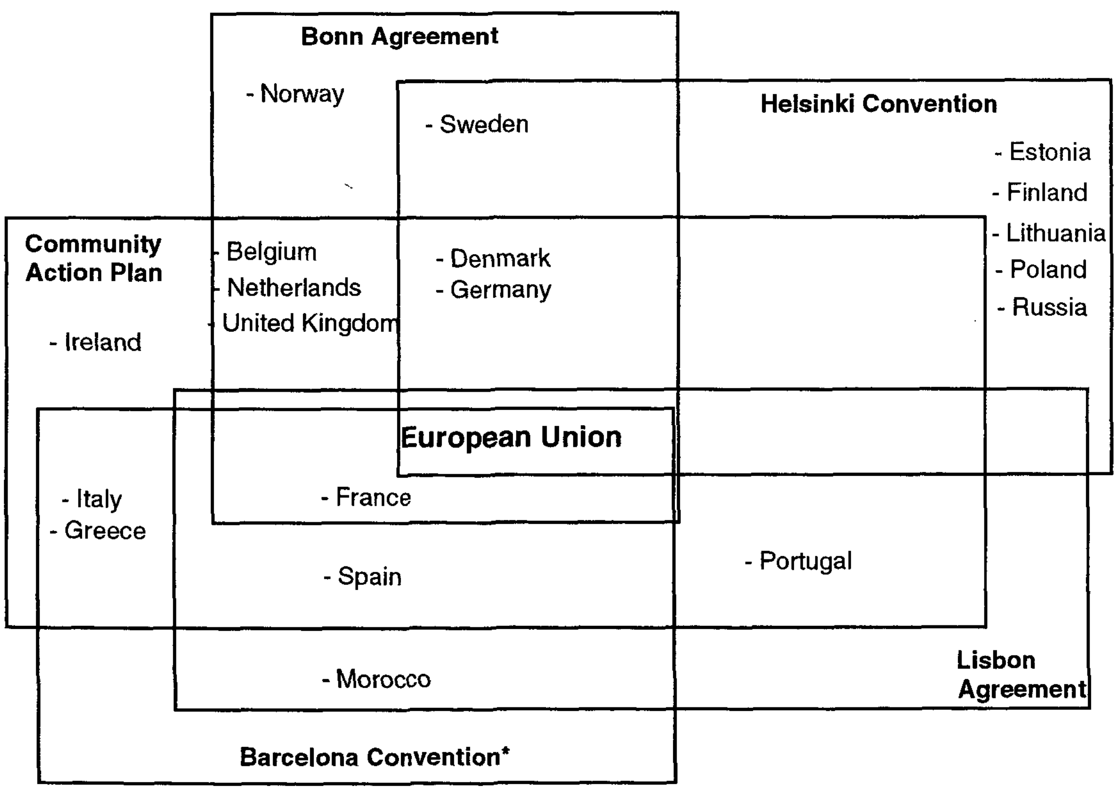
Generally, the countries of the EU divide their water areas into offshore and coastal response zones. A national authority, such as a Coast Guard or environmental ministry, is usually assigned responsibility for pollution incidents in the offshore or open sea area, whereas local jurisdictions, such as states, have responsibility for spills that come ashore or that occur in coastal or harbor areas.

Equipment for offshore response is normally maintained by the government as part of the requisite inventory for rescue work. There is a degree of multiple use capability, of offshore response equipment. For example, a rescue tug may be outfitted with a skimmer capability that would allow it to be used for both rescue work and oil spill response.

Overarching the national and regional response organizational structures of the member states of the EU is the Commission of the European Communities. The Commission has developed the "Community Action Plan" which, among other things, provides for coordination of member states participation in oil spill response that may exceed a national capability. The Commission has recognized that maintaining stockpiles of equipment is an activity appropriately undertaken by national administrations and regional organizations. Its function, as defined in the Community Action Plan, is to "coordinate and disseminate information to the member states" (Commission of the European Communities, 1993).

The Commission is also in the unique position of being signatory to each of the regional agreements to which the individual members of the EU are also signatory. So, for example, France, Spain, Italy, Portugal, and Greece are parties to the Barcelona Agreement, along with other non-EU coun-

FIGURE 1. CONVENTIONS AND AGREEMENTS TO WHICH THE EUROPEAN UNION IS PARTY



* Numerous other countries not listed here are signatory to this Convention

Source: "Community Action Against Accidental Pollution At Sea," Commission of the European Communities, 1993 tries surrounding the Mediterranean Sea, while other EU member states are not. Similarly, Germany and Denmark belong to the Bonn Agreement and the Helsinki Convention, while Belgium, the Netherlands, and the United Kingdom are parties only to the Bonn Agreement. The EU's participation in all of the agreements to which member states are parties provides a significant degree of continuity and uniformity that would not otherwise be available to the individual members.

MALAYSIA

The approach used by Malaysia in addressing the issue of oil spill response capability is instructive because it is an *emerging economy* with a significant amount of tanker traffic potentially threatening its resources and interests not generally bound to or from Malaysian ports. It epitomizes the *passing tanker syndrome* which characterizes so many coastal states situated on or near tanker lanes, such as those on the west coast of Africa. Even though Malaysia is a net oil exporter, the volume of oil moving in tankers along the Malaysian coast is far greater than that departing from its ports. In 1992, for example, Malaysia produced about 9 million tons of crude oil, while shipments of crude oil from the Middle East to Japan, virtually all of which passes Malaysian coasts, exceeded 185 million tons.

There are three principal sources of pollution response equipment in Malaysia: government purchased and maintained equipment for port areas; privately funded equipment in the hands of East Asia Response Private Limited (EARL), funded by six major oil companies; and a newly organized Japanese Oil Spill Preparedness and Response in Asian Waters Project (OSPAR), designed to provide approximately $10 million worth of response equipment from the Petroleum Association of Japan to Malaysia and other ASEAN countries.

The Malaysian Ministry of the Environment is charged with responsibility for pollution response in Malaysian waters and has developed a national contingency plan for response activities.

Many issues regarding Malaysia's response capability are still in the formative stage. It is evident, however, that countries susceptible to the *passing tanker syndrome* do not have to rely exclusively on a publicly funded response system. The efforts of the Petroleum Association of Japan and EARL are evidence that private financing of response capability is possible.

SAUDI ARABIA

Saudi Arabia, as a principal oil exporting nation, relies on the private sector to provide response equipment based on the National Oil Discharge Contingency Plan. All of the ports in Saudi Arabia, the desalination plants, other plants that use sea water as part of their processes, and the major oil company in Saudi Arabia, Saudi ARAMCO, established and have available equipment stockpiles in preplanned positions. Equipment levels for the various sites were based on recommendations by consultants and equipment manufacturers.

Saudi Arabia, like other Arabian Gulf countries, has access to equipment stockpiles maintained by the Gulf Area Oil Companies Mutual Aid Organization (GAOCMAO), the consortium of oil company financed oil spill cleanup cooperatives.

Tanker traffic around Saudi Arabia is generally bound to or from Saudi oil loading ports, but some traffic enroute to Kuwait, Bahrain, and Iran pass within the vicinity of Saudi marine waters. Although the largest oil exporting nation, Saudi Arabia, by virtue of its geographical location, is another nation susceptible to the *passing tanker syndrome.*

One means of addressing passing tankers is Saudi membership in the Regional Organization for Protection of the Marine Environment (ROPME), part of the United Nations Regional Seas program.[4] ROPME comprises the Gulf countries surrounding the Arabian, or Persian, Gulf the Gulf of Oman, and the coastal waters of Oman. The intent of ROPME is to provide regional or extranational assistance to a Gulf country in the event of an oil spill that exceeds national capabilities (Ryan and Brown, 1989). Equipment in countries party to the ROPME Agreement would be made available to other ROPME countries experiencing an oil spill. Whether the ROPME Agreement will work in practice is subject to some debate in view of recent political events in the Region.

UNITED STATES

As with Canada, the U.S. system of response is predominantly privately funded, supplemented by publicly funded equipment and materials. The U.S. has relied on a privately funded system as the basis for its oil pollution response capability since the early 1970s. Under revisions to the system mandated following the *Exxon Valdez* incident by OPA 90, however, the privately funded response system is based on contractual arrangements between a tanker operator and cleanup contractors that must be in place before a tanker can operate in U.S. waters.

Tanker traffic around the U.S. is dominated by ships heading for or departing from U.S. ports. As the largest importer of oil in the world, the volume of tanker traffic around U.S. waters is prodigious, ranging from foreign flag Ultra Large Crude Carriers (ULCCs) and Very Large Crude Carriers (VLCCs) lightering in the Gulf of Mexico and smaller tankers operating in ports along the U.S. East Coast, to U.S. flag VLCCs transporting oil from Alaska to West Coast ports. With the exception of a few tankers trading to Canada through the Straits of Juan de Fuca, few tankers operate around U.S. waters that are not bound for U.S. ports.

The development of the U.S. oil spill response system effectively dates to 1969 following an oil well blowout in the Santa Barbara Channel off the coast of California. As has typically occurred following catastrophic oil spills, legislation was enacted by the U.S. Congress following the Santa Barbara spill to improve the response system in existence at the time. In this instance, the Water Quality Improvement Act of 1970 (WQIA) was the vehicle for change.

[4] ROPME was established by the Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution in 1978 (Kuwait Convention).

The WQIA established the principle that the polluter was responsible for removing any oil he or she spilled. If that person could not or would not remove the oil, the WQIA authorized the designated representative of the President of the U.S. to act to effect the removal. With certain modifications, this system remains in place today: the polluter responds in the first instance, supplemented or replaced by government action.

The system of government in the U.S. has contributed to much confusion in oil pollution response and to the complaint by advocates of strong centralized spill management that emergency oil pollution response decision-making in the U.S. is by committee. OPA 90 did not pre-empt the states comprising the U.S. from active participation in oil spills response activities, making the states partners with the central, or Federal, government in the U.S. system of combating oil spills. Additionally, the U.S. system of response generally does not distinguish offshore from nearshore spills nor facility from vessel spills for purposes of jurisdiction while other countries make such distinctions. A spill from a facility in a European country, for example, may come under the authority of a port authority while a spill from a vessel may come under the jurisdiction of a coast guard or navy. In the U.S., oil spills fall under the same system and jurisdiction irrespective of source or geographic location.

The logic of individual states acting alongside a Federal authority in dealing with a spill, particularly a tanker spill, is questioned by many in the international oil transportation industry. A highly organized environmental community adds further to making the U.S. a paradigm of response that few would like to see emulated.

SECTION 4

REGIONAL APPROACHES

Some countries have created pollution response alliances, pooling resources and sharing information among members of the alliance as a means of providing response capability in a cost effective way. The most common alliances are based on geographic regions, derived from the common water basins around which the countries exist.

Thirteen regional multilateral agreements on oil pollution response cooperation exist around the world covering the following marine areas: North Sea, Baltic Sea, Nordic coastal areas, Mediterranean Sea, Persian Gulf, West Africa, East Africa, Wider Caribbean, Southeast Pacific, South Pacific, East Asian Seas, and Northeast Atlantic (Edwards and Pascoe, 1991). Numerous additional bilateral and trilateral agreements supplement these multilateral agreements. The existence of these various agreements exemplify the basic characteristics of oil pollution incidents: oil spills do not recognize national boundaries and large spills can quickly sap available national resources. These alliances and agreements, however, are only as effective as the pollution response resources that are available to them.

SECTION 5

INTERNATIONAL TREATIES AND RESPONSE CAPABILITY

The International Maritime Organization (IMO), one of the United Nations specialized agencies has sought, since its inception in 1958, to facilitate international cooperation in maritime safety and marine environmental protection.[5] In the past, however, issues pertaining to marine pollution response were left to national or regional entities. Arguably, it was not until the creation of OPRC in 1990 that the specific issue of pollution response was addressed internationally. Nevertheless, several IMO conventions address some of the issues under discussion.

MARPOL

MARPOL is the broadest international agreement pertaining to oil pollution of the body of Conventions under the aegis of IMO. MARPOL seeks to prevent operational discharges of oil from tankships and to minimize oil pollution in the event of an accident.[6]

MARPOL is, in the first instance, a flag state convention; that is, requirements and sanctions focus on countries with ship registries. It also contains "port state" enforcement provisions, however, that allow developing countries without shipping registries to participate in international deliberations on marine pollution control. There are reporting requirements for ships involved in pollution events contained in MARPOL in an effort to harmonize the situations in which reports are provided by ships and the type of information to be passed.

INTERVENTION CONVENTION

The International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969 established the rights of "coastal states" to take actions to "prevent, mitigate, or eliminate grave and imminent danger to their coastline or related interests from pollution or threat of pollution...following upon a maritime casualty."[7] This convention empowers coastal states to initiate response action, particularly salvage action when deemed necessary, even in contravention of the orders of a ship's master (Birnie and Boyle, 1992).

LIABILITY AND COMPENSATION CONVENTIONS

The International Convention on Civil Liability for Oil Pollution Damage, 1969 (the CLC Convention) and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971 (the Fund Convention) represent the international community's effort to establish regimes to implement the OECD *polluter pays* principle and to provide a fund to compensate economic victims of an oil spill.

The CLC Convention establishes the liability of a shipowner in the event of an oil spill to pay for the cost of pollution damage, but limits that liability except in instances of the owner's "personal act or omission, committed with the intent to cause such damage, or recklessly and with knowledge that such damage would probably result."[8] An owner's liability is limited to about $20 million (US).

The Fund Convention sets up an International Oil Pollution Compensation (IOPC) Fund to compensate for pollution damage for which the CLC Convention may be inadequate. The Fund is financed by contracting parties to the Fund Convention through assessments against oil received by contracting parties. The Fund will pay compensation to about US$ 84 million per incident, including the amount paid by the shipowner under the CLC Convention.[9]

The Fund Convention offers some important considerations in the issue of response capability. First, it establishes a provision that a contracting party may use the offices of the Fund administrators to secure personnel, material and services to prevent or mitigate pollution damage arising from an incident "in respect of which the Fund may be called upon to pay compensation under this [Fund] Convention." Second, it provides for "credit facilities" to be arranged to effect preventive actions against pollution damage arising from an incident, again, "in respect of which the Fund may be called upon to pay compensation under this [Fund] Convention."

These modifying phrases have significance in this discussion in view of the limitations of the CLC and Fund Conventions in their applicability and their scope. First, the Conventions are limited to incidents involving persistent oil. Certain grades of oil, such as light diesel oil and gasoline, are not covered by the Conventions. Second, pollution damage

[5] IMO, previously known as the Intergovernmental Maritime Consultative Organization (IMCO), was initially created by a convention adopted in 1948. The current name was adopted by amendment to the convention in 1982.

[6] Other issues addressed by MARPOL include the controlling pollution from bulk noxious liquid substances, packaged hazardous substances, sewage, and garbage.

[7] Intervention Convention, Article 1(1)

[8] CLC Convention, Article V(2)

[9] Protocols to both the CLC and Fund Conventions were adopted in 1984 raising the shipowner's liability and the level of compensation payable by the Funds. Neither of these Protocols are in effect.

covered by the Conventions is limited to costs of reasonable preventive measures taken after an incident has occurred, to economic losses, and to environmental losses, to the extent that environmental losses relate to restoration costs. Third, the Fund incurs no obligation in the event of a pollution incident arising from war or hostilities. This limitation proved particularly significant during the 1991 Persian Gulf War.

1989 SALVAGE CONVENTION

The International Convention on Salvage, 1989 established a new regime for the traditional "no cure no pay" principle of salvage operations. Prior to the 1989 Salvage Convention, a salvor would receive no reward for its services to prevent or minimize pollution damage if the ship were lost. Under provisions of the 1989 Salvage Convention, a salvor is entitled to "special compensation" for salvage operations which prevent of minimize environmental damage. Additionally, salvors have a duty to carry out salvage operations in such a way as to prevent or minimize environmental damage.[10] This Convention, then, provides an incentive to salvors to carrying out salvage operations which have the effect of preventing environmental damage, even in those instances where there is no hope of salvaging the ship or its cargo. The 1989 Salvage Convention is not yet in force.

OPRC

Following the *Exxon Valdez* incident, the United States proposed the development of a new international convention to address oil pollution preparedness and response specifically on a global level. The resulting International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990 (OPRC) establishes the means by which governments may harmonize national and regional oil pollution response programs, technologies, and mutual assistance particularly in the event of a catastrophic spill.

As noted previously, oil pollution response historically focused on the national or, in some instances, the regional level. That focus, however, limits effective pollution preparedness and response to those countries able to afford it. Even with regional arrangements, the effectiveness of agreements depends on the resources and capabilities of the member governments.[11] Developing countries may not have the resources to mount an effective response to a catastrophic incident, even if vital national interests are at stake. As later events would confirm, prior to OPRC, the compendium of international agreements was lacking a comprehensive international mechanism for dealing with massive oil pollution incidents.[12]

The OPRC, which is scheduled to come into force in 1995, provides for obligations on the part of contracting parties to develop basic national oil pollution regimes as a condition to participating in an international system.[13] In return, contracting parties are entitled to request assistance from any other contracting party in the event of a pollution incident. Terms and conditions for financing assistance are specified in an effort to promote the "polluter pays" principle. Technical assistance to developing countries is part of OPRC's global approach to oil pollution response as well.

[10] 1989 Salvage Convention, Articles 8 and 14

[11] Edwards and Pascoe, 1991

[12] The Persian Gulf War exhibited the shortcomings of the existing international regime. Even though not in force, many of the provisions of OPRC were employed during the massive oil spill arising from that conflict.

[13] Regional arrangements, in lieu of national regimes, are possible under OPRC and, in fact, are encouraged.

Section 6

General Principles in Response Capability Decision-making

Certain factors are influential in determining whether a government will establish an oil pollution response capability, the level of that capability, and the type of technology that forms the basis of that capability. The most obvious and compelling factors, derived from the previous examination of national, regional, and the nascent international regime are (1) history of maritime catastrophes, (2) oil transportation patterns, and (3) national economic vitality. Secondary factors include (a) climatic or oceanographic conditions, (b) social, cultural or political forces, (c) coastal development and population demographics, and (d) environmental awareness.

Catastrophic Event History

Past catastrophic oil spills have been the primary driving force in causing governments, and the international community, to re-examine oil spill response capability and regimes. Incidents such as the *Torrey Canyon,* the *Amoco Cadiz,* and the *Exxon Valdez* have all contributed to reassessments on the part of governments most directly affected by the incident, but also by governments with the foresight to see the possibility of a similar event occurring in their waters. Additionally, the international community is typically galvanized for action following a significant marine incident. The development of the Intervention Convention and the CLC and Fund Conventions following the *Torrey Canyon* spill, the prepositioning of French salvage tugs following the *Amoco Cadiz* accident, and the creation of the OPRC following the *Exxon Valdez* grounding give ample proof of the impact of catastrophic events on this public policy issue. Each of these events was a catalyst in reawakening the public and political institutions to the threat that oil pollution on a massive scale poses to a nation's economic and environmental interests.

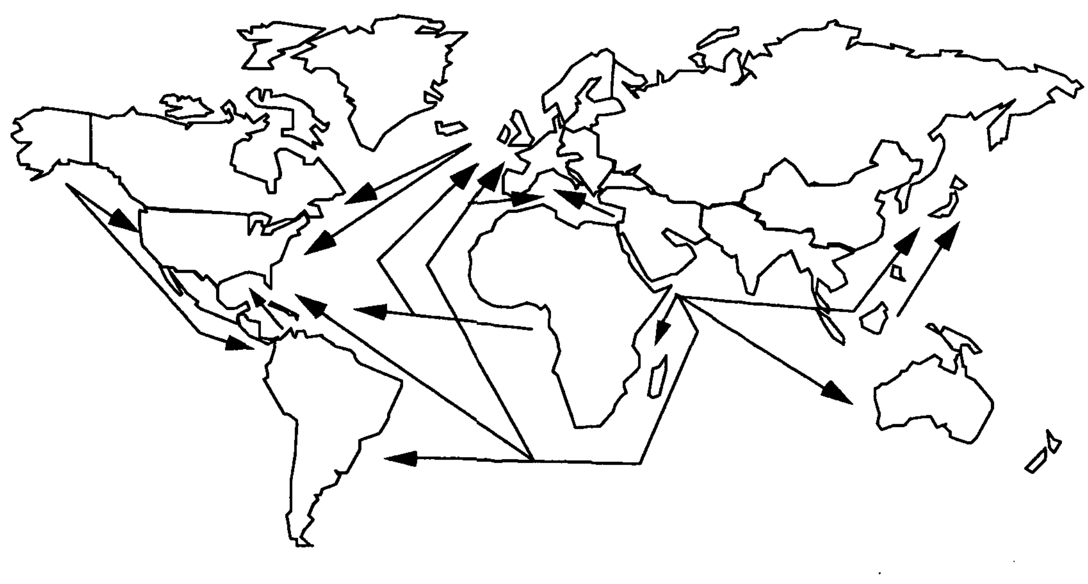
Oil Transportation Patterns

A review of major oil transportation patterns shows major areas at risk from oil pollution: ports of arrival and departure are subject to pollution from groundings and collisions, areas of high traffic density or "choke" points, such as the Strait of Malacca, are susceptible to spills from collisions, and coastal areas along traffic lanes are susceptible to spills from groundings and explosion (Figure 2).

That spills of these various natures have occurred in the areas described is particularly instructive. Despite preventive efforts at the international, regional, and national level, oil spills, especially from tankers, do occur.

Analyzing these spills has been undertaken in the past by

Figure 2. Major Tanker Trade Routes



the International Tanker Owners Pollution Federation (ITOPF) and other industry associations. IMO could do more work in this area as a means of supporting decision-making for national and regional response capabilities.

THE *PASSING TANKER SYNDROME*

As noted previously, the United States, and to a lesser extent, Canada, enjoy a benefit of geography in that ships venturing into the waters of those countries tend to be traveling to or from ports in those countries. The same cannot be said for many other parts of the world, particularly developing countries. This *passing tanker syndrome* poses difficulties and challenges for the application of the *polluter pays* principle.

NATIONAL ECONOMIC VITALITY

The high cost of purchasing and maintaining appropriate systems can be overwhelming despite a government's desire to provide an oil pollution response capability based on past experience or an analysis of risk due to oil transportation patterns. Adequate levels of booms, skimmers, support equipment, dispersants, dispersant applicators, and dispersant delivery systems run into the millions of dollars. Even if a government were to focus its efforts on offshore response capabilities or, alternatively, coastal response, the price tag for necessary equipment can be staggering. When the cost of trained personnel to operate the equipment is added, an oil pollution response capability begins to look like a luxury that only the developed world can afford. Yet, if the economic welfare of a country is dependent on coastal resources or coastal tourism, one wonders how a government can afford to ignore an oil spill response capability in the face of evidence of massive losses, environmentally and economically, associated with a catastrophic oil spill.

It is precisely because of the enormous costs associated with a large spill that no coastal nation can ignore undertaking the process for determining if obtaining an oil spill response capability is in its best interests. The international community also needs to do more to support developing countries to reduce the risk of massive environmental and economic losses because of the enormous costs of procuring and maintaining response equipment.

CLIMATIC AND GEOGRAPHIC CONDITIONS

As a secondary consideration, the type of response capability appropriate for oil spills appears to be a function of the climatic conditions prevailing at a country. For example, the United Kingdom, with the comparatively harsh conditions of the seas surrounding the country, has opted for a response capability based on dispersants, reasoning that mechanical equipment has virtually no chance for success in the prevailing high seas. Conversely, the Kingdom of Saudi Arabia has considered dispersants to be inappropriate in the Gulf of Arabia because of its shallow depth.

New developments in pollution response equipment may render questionable some of the old concepts about what works and what does not. For example, some Nordic countries, facing some of the roughest seas in the world, have effectively used mechanical containment and recovery equipment. Similarly, new generation dispersants are proving to be less toxic than the first "detergents" used to disperse oil, holding out some hope of treating spills economically offshore than possible solely with mechanical devices.

SOCIAL, CULTURAL, AND POLITICAL FORCES

As the government of the U.K. discovered following the *Braer* incident in January 1993 and the government of the U.S. discovered following the grounding of the *Exxon Valdez* in March 1989, time-valued concepts regarding oil spill response are often questioned in the political aftermath of a major spill. In the U.K., questions were raised regarding the effectiveness of a response policy based almost exclusively on dispersant use, while in the U.S., questions were raised regarding a response policy based virtually on mechanical containment and recovery alone.

Cultural issues have appeared as factors in response activities and technologies in the past and should be considered in determining a national response capability. For example, during the *Exxon Valdez* and other subsequent spills in the waters of the U.S., Native American concerns over archeological sites of significant religious and cultural importance needed to be addressed in response decisions. Similarly, during the Persian Gulf War, potential cultural concerns over the use of biotechnology were raised.

Although it may be impossible to anticipate every political, cultural, or sociological maelstrom that may be set off by a major oil spill, a basic understanding of the full scope of issues that may be encountered in the event of a spill is valuable in determining the appropriateness and size of an oil spill response capability.

COASTAL DEVELOPMENT AND POPULATION DEMOGRAPHICS

The use of coastal areas will bear heavily on decisions regarding oil spill response equipment. Beach areas allow a comparatively easy cleanup, but heavily populated beach areas, especially in areas reliant on tourism, raise the specter of potentially massive economic damage costs. A response capability based on the decision to forego offshore cleanup in favor of shoreline response may well be questioned in a spill impacting a beach area in the presence of a large coastal population. A developing or established fisheries industry which may be devastated by a massive spill, will auger in favor of a particular response strategy, probably based on efforts to divert oil away from the fishery. Dispersant use response strategies will need to address concerns over the effects and perceived effects of dispersants and dispersed oil on marketable fish and shellfish.

ENVIRONMENTAL AWARENESS

The level of environmental awareness within a nation may be a factor in determining response resources for oil spills. A high level of environmental awareness will make issues such as the appropriateness of dispersant use subject to scrutiny beyond the mere technical viability of the technology. In the U.S., for example, continuing perceptions by the environmental community over the toxicity of dispersants and the effects of both dispersants and dispersed oil have resulted in a response capability based on mechanical equipment.

SECTION 7

FUTURE REQUIREMENTS

The application of the three guiding principles will assist governments in determining if an oil spill response capability is required and the type and level of response capability that may be appropriate. Funding that capability will continue to be beyond the means of most countries, even on a regional basis.

Developed countries, representing principally oil importers and consumers, in the past were able to develop national oil pollution response capabilities to attempt to protect their economic and environmental interests. In some instances, as has been shown, these national capabilities evolved into regional capabilities to take advantage of economies of scale in equipment procurement, maintenance, and operation. The European Union's Community Action Plan provides the means for additional economies of scale to member countries by providing additional sources and means of providing equipment that extends beyond the geographic range of a regional agreement.

For the developing world, particularly these countries put at risk from oil spills by reason of geography, the OPRC currently provides virtually the sole means for legitimate expansion of limited national response capabilities to combat catastrophic spills. It encourages an examination of the impact such spills may have on the economy and environment of a country and, with minimum investment of time and capital for planning, offers the opportunity for these countries to address oil spills as they have been unable to in the past. The OPRC fosters regional arrangements and, where the economic resources of a region are not sufficient to satisfactorily address catastrophic spill response requirements, promotes the assistance of other nations and the marine transportation industry. The assistance that may be provided during a spill event, equipment and logistical arrangements, will have to be planned well in advance of an incident to be effective.

Funding in developing countries, however, will continue to be the greatest impediment to implementing national or regional response capabilities even with the OPRC. How is a government to justify spending millions of dollars for an oil spill response capability in the face of competing and perhaps more significantly, economic and social issues? If economic and environmental loses can be avoided or reduced by the presence of a response capability, should a country be expected to suffer those loses because it cannot support such a capability? Even if the effects of spilled oil are short term, is it reasonable to expect a country to suffer any loss at all, especially when it is victimized by virtue of geography and not choice?

From this brief description, it is clear that so much more could be done, particularly in providing some global scheme to ensure that developing countries are provided the same level of protection from a devastating oil spill as developed countries. For developed countries, internationally accepted standards for equipment testing and evaluation will facilitate planning and operability. Internationally accepted standards for determining the toxicity and effectiveness of dispersants will improve decisions regarding the use of this technology. Better knowledge of equipment locations, availability, and logistics would allow even greater economies of scale than are currently possible.

If developed countries feel that oil pollution is an environmental and economic problem that deserves national and, potentially, international attention, then developing countries faced with prospects of a catastrophic spill deserve access to oil spill response capability irrespective of their ability to muster the public funds to provide such capability. A spill threatening the economy and environment of northern Europe will be no less an impact on the economy and environment of Brazil.

The guiding principles developed in this paper are useful starting points for governments to assess objectively the threat of oil pollution to their interests. Armed with a better understanding of what is the actual threat will allow for a more rational process of determining equipment and personnel requirements for oil pollution response.

The application of sound economic principles dictates that the price paid for consuming oil and oil products should reflect the cost of production and transportation including costs external to production and transportation, such as preparing for and responding to a spill. This would ensure that the consumer can make reasoned judgments about consuming oil. If society believes that developing countries should not assume added risk from oil spills, then the costs of protecting those developing countries should be reflected in the cost of transporting oil. This fact justifies the concept of an industry funded international mechanism for response capability. Among other things, the industry funded system provides a better opportunity for passing on the costs of oil to the consumer. The existing model for such a system, of course, resides in the IOPC Fund, which is essentially a privately financed compensation scheme.

A new international fund is needed to complement the IOPC Fund, specifically designed to pay for preparedness for oil spills in developing countries, including the costs of training and contingency planning, and to provide a source of funds to pay for cleanup in the event of a spill, especially for those events for which the IOPC Fund will not be involved.

The funding mechanism could be arranged on the basis of assessments on governments on oil imports. Alternatively, it could be based on an assessment against Flag states registered tanker tonnage or on an assessment against oil exports. Assessments against oil imports is the current scheme for funding the IOPC Fund and perhaps the best means for passing costs along to the consumer; the closer to the consumer a levy is assessed, the more likely it will be passed along to the consumer. Funding at the point of export or through a flag state levy may result in the increased cost being absorbed along the price chain and not passed to the consumer.

As an alternative to a new fund, it may be possible to expand the current IOPC Fund to allow funding response capability in developing countries. The IOPC Fund secretariat is well-suited to determining compensation for oil spill damage after an event. It may not, however, be so well-suited to decisions regarding appropriate necessary levels of response capability around the world.

An extraordinary effort is required on the part of international institutions, such as the International Maritime Organization (IMO) and the United Nations Environment Programme (UNEP), as well as national and regional governments, to assess the state of oil spill preparedness worldwide and to ensure access to requisite oil pollution response capability by all countries. The OPRC is just the first step in the process.

Section 8

References

Birnie, Patricia W. and Alan E. Boyle. 1992. *International Law and the Environment.* Clarendon Press, Oxford, England.

Commission of the European Communities. 1993. *Community Action Against Accidental Pollution at Sea.* Directorate General, Environment, Nuclear Safety, and Civil Protection, Brussels, Belgium.

Congressional Research Service. 1992. *The Environmental Aftermath of the Gulf War.* Report of the Senate Committee on Environment and Public Works Gulf Pollution Task Force. Washington, DC.

Edwards, David T. and David P. Pascoe. 1991. Outcome of the IMO Conference on International Cooperation on Oil Pollution Preparedness and Response. *Proceedings,* 1991 International Oil Spill Conference. API Publication No. 4529, American Petroleum Institute, Washington, DC. pp. 357–360.

Holt, W.F. 1993. Implementing the OPRC — Translating Diplomatic Concepts into Reality. *Proceedings,* 1993 International Oil Spill Conference. API Publication No. 4580, American Petroleum Institute, Washington, DC. pp. 655–658.

International Maritime Organization. *CLC Convention,* 1985 edition. IMO Publication 456E.

International Maritime Organization. *Intervention Convention,* 1977 edition. IMO Publication 402E.

International Maritime Organization. *1989 Salvage Convention,* 1989 edition. IMO Publication 450E.

Koops, W. 1992, *Two New Tools and a Working Method for Crisis Management of Accidental Spills at Sea.* Delft University Press, The Netherlands.

National Oceanic and Atmospheric Administration. 1983. *Assessing the Social Costs of Oil Spills: The AMOCO Cadiz Case Study,* U.S. Department of Commerce, Washington DC.

National Research Council. 1992. *Marine Salvage in the United States.* Committee on the National Salvage Posture. National Academy Press, Washington, DC.

Organization for Economic Cooperation and Development (OECD). 1982. *Combating Oil Spills.* OECD Publications, Paris, France.

Pacific Rim Oil Spill Response Directory. 1994. Marine Publishing Inc., Seattle, Washington.

Public Review Panel on Tanker Safety and Marine Spills Response Capability. 1990. *Protecting Our Waters.* Minister of Supply and Services Canada, Ottawa, Canada.

Ryan, P.B. and D.J.S. Brown. 1989. Support for Regional Oil Spill Response in the ROPME Sea Area. *Proceedings,* 1989 Oil Spill Conference. API Publication No. 4479, American Petroleum Institute, Washington, DC. pp. 215–219.

The International Tanker Owners Pollution Federation Limited. 1987. *Response to Marine Oil Spills.* Witherby and Co. Ltd., London.

Vamos-Goldman, Andras. 1994. *The International Convention on Oil Pollution Preparedness and Response: The Last Piece of the Puzzle?* Unpublished Paper for the International Transportation Law Seminar, Georgetown Law School.

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