PACIFIC STATES/BRITISH COLUMBIA
OIL SPILL TASK FORCE

ALTERNATIVE RESPONSE TECHNOLOGIES
In Situ Burning and Dispersants

Project Report and Recommendations

Submitted To The:

Province of British Columbia
State of Alaska
State of Washington
State of Oregon
State of California

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EXECUTIVE SUMMARY

These reports provide a discussion of the issues surrounding the use of two alternative oil spill response technologies: in situ burning and dispersants. Use of both in situ burning and dispersants has been controversial because - while they remove an oil slick from the water's surface - these methods do so by transferring some pollution to another environmental medium, either to air or to the water column.

What must be recognized by spill responders - as well as the rest of us who judge their decisions - is that once oil has been spilled, pollution is already a fact. What a responder must then seek to accomplish is to weigh environmental trade-offs and make strategic decisions which afford the greatest environmental gain. These decisions are extremely complex due to a wide range of variables which influence environmental impacts as well as efficacy. Such variables exist with every oil spill response decision, however. No response technique - dispersant use, mechanical recovery, or in situ burning - completely removes spilled oil. Moreover, every response technique can result in environmental consequences. On-scene coordinators must use their best judgement to weigh the potential consequences of each choice, including no response, and choose those which best implement the multiple objectives of protecting public health and safety, natural resources, and economic interests.

If traditional mechanical removal technologies such as booming and skimming are used, recovery rates average about 20%. Oil that remains in the environment can destroy fisheries, kill wildlife, foul beaches, damage cultural resources, and contaminate coastal habitat. If an oil slick is moving towards an area where marine birds and/or mammals congregate, breed, or feed, burning that slick or dispersing it may protect that wildlife and their habitat. On the other hand, burning requires booming and is subject to some of the same constraints which affect booming and skimming. Likewise, burning can also produce air pollution which may adversely affect downwind populations; or dispersing oil from the surface into the water column may adversely impact sensitive aquatic and fishery resources.

In order to weigh these various environmental concerns one against another, responders must have accurate and current data regarding the trajectory of the oil slick, the natural resources likely to be affected by that trajectory, the current status of fishery resources in the area, or the likelihood that burning will affect populations downwind. This information changes by the hour, the day, or the season. Nevertheless, responders must have this information and have it as soon as possible, since the volatile components in spilled oil which make it ignitable and dispersable evaporate quickly. In addition, the type of oil spilled will affect whether the

oil can be effectively burned or dispersed. Likewise, weather conditions, sea state, and the availability of equipment for burning or dispersant applications must also be considered.

Using in situ burning or dispersants can add environmental protection under the right circumstances, however. For that reason, the workgroups for these two projects have both brought forth recommendations to the States/British Columbia Oil Spill Task Force which call for use of these technologies under appropriate circumstances. In order to weigh the various considerations regarding environmental gain and efficacy, expedited decision-making processes as already developed by some Task Force member jurisdictions are recommended for consideration by the remaining members.

The Dispersant Project Report discusses these tradeoffs and related environmental concerns, and describes the current dispersant use policies in place among Task Force jurisdictions on the West Coast. Because those policies vary among members to the extent that current law would not allow pre-approval zones to be utilized in every jurisdiction, the workgroup recommends that the risk criteria and general decision-making procedures in use by Alaska and Washington be considered by British Columbia, Oregon, and California to the extent appropriate in these jurisdictions. For instance, some variation in the risk analysis criteria may result due to ecological variations among jurisdictions; or some jurisdictions may choose to designate quick-approval rather than pre-approval zones. In any case, the workgroup recommends consideration of these existing models to facilitate expedited decision-making.

The Dispersant Project Workgroup further recommends that Washington's monitoring plan guidelines and refined risk analysis criteria, as well as the results of California's dispersant research program be shared with other Task Force jurisdictions as available. This sharing of effort or models already developed represents the essence of the Task Force, which exists to coordinate efforts and avoid "re-inventing the wheel." While use or application of these methodologies and criteria may not be absolutely uniform among west coast jurisdictions, a level of consistency will exist which will provide greater certainty to the response community with regard to use of these alternative response technologies. To respond to that effort at consistency among west coast jurisdictions, the Project Workgroup recommends that contingency plan holders and response organizations assure the availability of dispersants and dispersant application systems.

The In Situ Burning Project Workgroup has recommended that in situ burning (ISB) be used when appropriate, maximizing protection of the environment and human health. Noting the environmental tradeoffs discussed above, the group also notes that air quality impacts are fairly predictable and can be mitigated by ensuring that air pollution levels do not exceed safe levels in populated areas, monitoring of in situ burns (monitoring guidelines are included in the recommendations), and extinguishing burns quickly if necessary.

The Workgroup recommends an emphasis on consistency among West Coast policies, since consistency will enhance training and response across jurisdictional borders. They also recommend that decisions to use ISB be made by the on-scene coordinators in a Unified Command. They suggest that the input of various state, local, and federal agencies to that decision come at the policy development stage rather than during a spill response. The Workgroup also notes that the use of pre-approval zones, a monitoring program, and setting acceptable ambient air quality criteria, will expedite decision-making.

The In Situ Burning Workgroup further recommends that the U. S. Center for Disease Control develop a one hour exposure standard for small particulates (PM-10). In addition, they recommend that further research is needed on the health effects of exposure to the volatile components (PAHs) in spilled oil as well as on the fate of other potentially toxic components of a ISB smoke plume. Finally, they encourage West Coast agencies to cooperate on an educational campaign targeted at the general public, public health officials, and elected officials regarding the environmental considerations and tradeoffs involved in decisions regarding the use of alternative response technologies.

CHAPTER I: In Situ Burning Project Report

A. Project Background

When the States/British Columbia Oil Spill Task Force Members adopted the 1994-1999 Strategic Plan, one of our primary objectives was to enhance response capabilities on the West Coast, with an emphasis on consistency and effectiveness. One of the initial priorities for analysis and coordination has been policies governing the use of alternative technologies such as in situ burning and dispersants.

Consistent with Task Force procedure, one of our member agencies volunteered to provide leadership on this project: the Washington Department of Ecology. Lin Bernhardt was named by Ecology to lead this project. Representatives from other member agencies have also participated, as have interested stakeholders representing response organizations, the Texas General Land Office, and the environmental community. A list of project workgroup participants can be found in Attachment C.

The In Situ Burning project workgroup was formed in early 1994 and reported to the Members at their 1994 Annual Meeting that they had completed the following tasks:

- Development of a work plan;
- Review of literature on in situ burning;
- Review of current policies among Task Force member jurisdictions; and
- Providing a forum for information exchange among workgroup members.

Although the workgroup's review of current policies indicated that there were different legal and political considerations in each jurisdiction, it also demonstrated that there were key elements of the existing policies which could be coordinated for consistency. Recognizing that a large oil spill could impact more than one jurisdiction, and that it would be advantageous to promote consistency in response policies for this reason, Task Force Members gave the workgroup direction to develop recommendations for policy consistency on the use of in situ burning.

The recommendations below represent a consensus position of the workgroup members based on current information. This position was developed for the purpose of promoting consistency among jurisdictions in the areas of planning, training, and response, and to alert industry that the West Coast states view in situ burning as a viable response option under the right conditions. Technical support for these recommendations can be found in *Alaska's Unified Plan, In Situ Burning Guidelines*, and in the *Northwest Area Contingency Plan, In Situ Burning Policy and Operational Guidelines*.

B. <u>Recommendations on the Use of In Situ Burning</u>

RECOMMENDATION #1: Use in situ burning when and where appropriate, and maximize environmental protection while protecting human health.

<u>Rationale</u>: In situ burning (ISB) is a response methodology which has only recently been considered a viable tool to combat oil spills. In addition to dozens of lab and field test burns conducted over the years, the large-scale field test conducted in August of 1993, known as the Newfoundland Offshore Burn Experiment (NOBE), has yielded valuable and definitive information from air and water samples. Data from other more recent burns has also been collected and analyzed. As a result, in situ experts are now more confident in assessing potential impacts.

The project workgroup has concluded that ISB can be conducted in a way that provides for maximizing environmental protection while protecting population areas from harmful concentrations of smoke. Under the right conditions, ISB can be an efficient response tool. Once spilled oil is gathered and contained in fireproof boom, burning can remove up to 99% of this contained oil. (Please note, however, that gathering and containing the oil is a difficult and slow process. In addition, the availability of fireproof boom is currently quite limited on the West Coast. It is also worth noting that the quality and durability of fireboom is constantly being tested and improved).

Although modeling of smoke plume behavior continues to be refined for hilly or mountainous terrains, air quality impacts are largely predictable taking into consideration meteorological changes. The fact that in situ burning is done in a controlled manner, and that the fire can be extinguished almost immediately, adds an extra level of protection.

In situ burning is not a replacement for other response methods, but is one tool which can be used in conjunction with other response options to enhance the response. The use of ISB may be limited in some situations due to strong winds, high waves, a high water content in the oil, or proximity to human population.

When considering the use of ISB, all tradeoffs must be examined. Oil that remains in the environment can destroy fisheries, kill wildlife, foul beaches, damage cultural resources, and contaminate coastal habitat. Even a small amount of oil may be extremely toxic, and once oil is trapped in sediments it can be recirculated into the water and may remain in the food chain for hundreds of years. Short term impacts to air quality must be weighed against the long term impacts of leaving oil in the marine environment. Although air pollution in a smoke plume near the source of a burn is acute, depending on meteorological conditions, pollutants are likely to dissipate to safe levels several miles from the burn site. (For an expanded discussion of the tradeoffs, please refer to the *Northwest Area Contingency Plan, In Situ burning Policy and Operational Guidelines.*)

It should also be recognized that the evaporation from unburned oil also causes air pollution which poses a potential threat to human health and the environment. Although the fate and affects of evaporating volatiles from unburned oil has not been adequately researched (see Recommendation #6), it may be more harmful to expose a nearby population to these pollutants than to the smoke from burned oil.

RECOMMENDATION #2: In situ burning policies and operational guidelines should be consistent among Task Force jurisdictions wherever possible.
Rationale: General consistency among Task Force jurisdictions has been encouraged since the Task Force was formed. Information sharing and response assistance is facilitated by consistency. Consistency will enhance the possibility of sharing educational materials, which will be more effective when the messages are compatible. Information and educational materials produced by one jurisdiction could be used by another, thus saving staff resources.

Implementing ISB operations would be more effective where training is consistent. Federal government and other response personnel may change residency every few years, and response personnel often go outside their state or province to respond to a spill. These response efforts will be aided by West Coast consistency in the decision process, in applying standards and criteria, and during operational procedures.

RECOMMENDATION #3: A streamlined decision-making process should be established for each state and province. The decision to burn should be made by Unified Command consistent with standards, criteria, and procedures set forth in advance of the spill. Involvement by other interested parties should be during the policy development stage, not during a specific incident. Preapproval areas, also referred to as safe zones or quick approval areas, should be established to help expedite the decision-making process.
Rationale: Because of a limited "window of opportunity," a decision to burn may be needed within hours of a spill. Some oils rapidly become emulsified (i.e., mixed with water) and will not ignite beyond a certain degree of emulsification. The amount of time that elapses before the oil will no longer burn is dependent on the type of oil and weather conditions. Although research is being conducted on burning highly emulsified oils, for the present it remains essential that burning take place soon after the spill has occurred.

The on-scene coordinators - as part of Unified Command - are responsible for overseeing all aspects of the response, including any decision on whether or not to use ISB. That decision should be consistent with standards, criteria, and procedures developed in advance with input from interest groups representing air quality, wildlife, and environmental concerns.

Although partially meteorologically dependent, harmful levels of particulates in the smoke plume generally fall off to safe levels a short distance downwind of a burn. A smoke plume will generally rise several hundred to several thousand feet into the air and remain elevated as it travels downwind. Anticipating the infrequent but possible condition where a plume could fall to ground level and impact a populated area, particulate concentrations should be at safe levels in the smoke plume where the plume is expected to reach populated areas. Therefore preapproval areas, safe zones, or quick approval areas should be established taking this into consideration.

Designation of preapproval areas would expedite the decision-making process and assure industry of the practicality of investing in the equipment needed for in situ burning. Both the Alaska Unified Plan and the Northwest Area Plan have established preapproval areas which are defined as predetermined distance from population. Attachment A depicts the recommended decision process; it may need to be modified somewhat to reflect jurisdictional differences.

RECOMMENDATION #4: The Center for Disease Control should develop a one hour standard for exposure to PM-10 as soon as possible. Such a standard should then be reviewed by the Oil Spill Task Force and its members for possible incorporation into policies governing the use of in situ burning.

Rationale: The primary health concern over in situ burning is exposure to the inhalable particulate of less than 10 microns in size, known as PM-10, in the smoke plume. Inhaling these small particulate can aggravate health problems in sensitive individuals in high concentrations. Spill responders must ensure that the portion of the smoke plume that may reach populations has concentrations below levels which may impact human health. The federal - and in some cases, state - standard for PM-10 exposure is 150 ug/m^3 averaged over 24 hours. This standard has been criticized by some health experts as being inadequate to protect sensitive individuals, since it allows for short-term exceedances as long as the 24 hour average is 150 ug/m^3 or less. The Federal Center for Disease Control (CDC) has been asked by the National Response Team to develop a one hour standard for PM-10. For the interim, CDC has recommended using the 150 ug/m^3 averaged over one hour rather than 24 hours. CDC recognized this to be extremely conservative, and will be looking at developing a more realistic one hour standard in the future. The availability of a one hour standard will allow responders to more accurately predict human health impacts and more accurately define safe distances required to protect human health.

RECOMMENDATION #5: Encourage industry to purchase response equipment for conducting in situ burning.

Rationale: If industrial plan holders and their contracted response organizations have been reluctant to purchase equipment needed to conduct in situ burning because of a lack of policy guidance permitting its use on the West Coast, we suggest that adoption of these recommendations should provide an added degree of certainty. Streamlined decision-making will accomplish little, however, without their investment in more fireboom and other equipment, since current supplies are inadequate.

RECOMMENDATION #6: The potential impacts from the evaporative components of spilled oil should be weighed against the potential impacts from exposure to particulates in burned oil when making a decision regarding use of in situ burning. If needed, additional research should be conducted in order to more clearly assess the potential impacts from unburned oil, and the fate of toxics in the smoke plume. Tables which compare information on evaporative components of unburned oil for common petroleum products with the air quality impacts of in situ burning should be compiled in a format which would be useful for response decision-makers.
Rationale: A recent preliminary assessment by the Washington Department of Ecology concluded that the concentrations of volatiles (PAHs) from unburned oil can be so high as to have a severe impact on human health. In some cases it may be more harmful to expose nearby populations to the volatiles from unburned oil than to the particulate in the smoke of burned oil.

Therefore we recommend that additional research be conducted on this issue. decision-makers should have sufficient information on the potential impacts from volatiles to make a comparison of risks between response options. Research should also be conducted on the fate of other toxic constituents of the smoke plume besides PM-10s, to confirm evidence which currently suggests that toxics are not present in harmful concentrations when PM-10 levels are also below harmful levels.

RECOMMENDATION #7: Through public education and outreach, broaden the acceptance of in situ burning as a viable response tool in appropriate situations.
Rationale: The use of in situ burning in some cases may depend on public acceptance. The sight of a large black smoke plume could cause a very negative public reaction; the public needs to understand what precautions are taken for their protection. Tribes, local air quality and elected officials, public interest groups, and public health officials all need information regarding the technology of in situ burning, the potential impacts, and the environmental trade-offs associated with all response methods. Task Force agencies should work together to develop educational materials which address this need.

RECOMMENDATION #8: In situ burns should be monitored whenever possible following standard monitoring protocol.
Rationale: Standard monitoring protocols should include the elements contained in Attachment B, *Monitoring Plan Guidelines*.

CHAPTER II: Dispersant Use Project Report

A. Project Background

One of the original projects undertaken by the States/British Columbia Oil Spill Task Force as part of its 1994-1999 Strategic Plan has been to review the issues associated with dispersant applications during an oil spill response and to make appropriate policy recommendations based on that review. The purpose of such recommendations is to enable oil spill responders to make strategic response decisions which provide the greatest environmental gain.

A workgroup was formed with Dick Logan of the Washington Department of Ecology and Don Lollock of the California Office of Spill Prevention and Response serving as co-chairs. A complete workgroup membership list can be found in Attachment D.

The Dispersant Workgroup set the following tasks for themselves:

- To review the dispersant-use policies among members;
- To conduct a literature review;
- To recommend general criteria to be used in dispersant use risk analysis;
- To develop a prototype risk analysis; and
- To develop a monitoring program.

Dr. Ken Warheit of the Washington Department of Fish and Wildlife was recruited to lead a technical subcommittee of the workgroup in the literature review and to develop a prototype risk analysis. In addition, the Washington Department of Ecology and the Washington Department of Fish and Wildlife have subcontracted for the development of a monitoring plan.

A review of issues and concerns regarding dispersants, a review of current policies among members, and recommendations on risk analysis criteria for use in strategic response decision-making are provided in this report.

B. Dispersants: Issues and Concerns

Dispersants are solvents and agents for reducing surface tension. When applied to a slick of floating oil, dispersants reduce the interfacial tension between the oil and the water and thus allow the oil to be broken into small droplets by the action of the wind, waves, and currents. The treated oil moves down into the water column as fine droplets where it is dispersed by currents and the normal fluid motions of the sea, and is subject to natural processes such as biodegradation. By dispersing oil into the water column, hydrocarbon concentrations on the water's surface are reduced, thereby decreasing explosion and fire hazards as well as the likelihood that oil will impact wildlife, birds, and sensitive habitats. The trade-off is that hydrocarbon concentrations are increased in the water column, thereby increasing potential environmental impacts to aquatic organisms. Dispersed oil is less affected by winds than are oil slicks, but more affected by water currents and turbulence.

Dispersants are made up of several ingredients, the most important of which are surfactants - known loosely as detergents. Surfactants are molecules with both water- and oil-soluble properties. The main surfactants employed in dispersants have both an affinity for oil and an affinity for water. The surfactant adheres to both the oil and water to thus produce finely dispersed droplets of oil-surfactant molecules. Most dispersants also contain a solvent, either hydrocarbon or alcohol/glycol based. Commercially available dispersants are of two primary types:

• "Conventional" hydrocarbon-based dispersants, which primarily contain hydrocarbon solvents and 10-25 percent surfactants; the percentage varies as a function of the physical properties (e.g., viscosity, pour point) of the target petroleum. These dispersants are applied full-strength to spilled oil. Successive generations of this type of dispersant have significantly reduced the toxicity by using aromatic-free solvent.

• Concentrated dispersants contain alcohol or glycol based solvents - rather than hydrocarbon based solvents - and a larger component of surfactant agent. This type is generally considered less toxic than the hydrocarbon-based dispersants. When the concentrate is applied to the oil spill it "self-mixes"; dilution with seawater before application is also possible, although with the application of dispersants by specialized aircraft, this practice has been largely discontinued.

To address concerns about the efficacy and toxicity of dispersants, the National Research Council (NRC) conducted a three year literature review; their findings were published in 1989. The NRC concluded that both the toxicity and effectiveness of dispersants depends on a number of factors, including type of oil, type of dispersant, weather conditions, and characteristics of the sea water.

Since these factors vary in each situation, the use of dispersants needs to be evaluated primarily on a case specific basis. To date, the monitoring and evaluation of dispersant use impacts has produced insufficient data to provide grounds for establishing a policy allowing widespread application of dispersants without clear and specific decision-making guidelines.

Environmental concerns relating to the use of dispersants must be weighed against the environmental consequences of allowing an undispersed oil slick to impact marine birds and mammals and their breeding or feeding habitats. When the NRC (1989) reviewed the environmental concerns related to impacts on natural resources they found that environmental consequences related to dispersant use tended to be less than definitive. Much of the concern has centered around whether dispersants are more or less toxic than the product being dispersed, but the NRC concluded that dispersants in and of themselves have no greater toxicity than oil or an oil/dispersant mixture. In general, the issue with the use of dispersants is the fate and the level of toxicity of the oil itself, rather than the toxicity of the dispersant. However, this conclusion does not account for toxicity impacts to aquatic resources in the water column caused by a mixture of dispersant and oil.

The main concerns about chemical dispersant use in oil spill control are as follows:

• Efficacy: No single oil spill countermeasure can be regarded as a panacea. All spill response methods have limited efficacy, and there are many variables affecting dispersant efficacy. Merv Fingas of Environment Canada noted that "...a review of historical applications does not show a consensus that dispersants significantly removed a measurable portion of the oil." One way to test efficacy prior to a dispersant use decision is to conduct a field test on the spilled oil.

The primary variables in dispersant effectiveness are: *oil type* (waxy crudes, heavy fuels or emulsified oil) where the viscosity much exceeds 2000 centistokes or the pour point exceeds the ambient water temperature, since dispersant effectiveness decreases as viscosity increases; the *salinity* of the oiled waters (Environment Canada has found that efficacy drops dramatically below 25 parts per thousand (ppt) salinity and above the mid 40s ppt); and *weather conditions* (wind, and/or sea state less than two).

• Toxic Effects: As a result of increasing oil's biodegradability in the water column, the dispersion process makes oil and its hydrocarbon constituents more bioavailable. Although documentation of measurable adverse effects - or indeed attempts to measure such effects - on pelagic commercial fisheries is rare, there is a valid concern that these dispersed hydrocarbons may adversely affect fisheries resources in the water column as well as shallow subtidal benthos if water depth and movement are insufficient to rapidly remove and dilute the oil.

a. ***What is the comparative toxicity of dispersants and chemically dispersed oil?*** The acute toxicity of most dispersants currently considered for use is low when compared to the constituents and fractions of crude oils, but some toxicity does result from exposure to dispersants alone. It is unlikely, however, based on concentrations of dispersants that would result from spraying in marine waters at common rates, that dispersants alone would contribute significantly to lethal or sublethal toxicities (National Research Council (NRC), 1989). Acute lethal toxicity of chemically dispersed oil for most species resides not in the dispersant, but primarily in the dissolved, aromatic, and aliphatic fractions of the oil. Additionally, toxicity may be associated with the particulate fractions which may represent up to 90% of the mixture. In its 1989 literature review the NRC concluded that laboratory and meso-scale field experiments indicate that the acute biological effects of dispersed oil are no worse than that of untreated oil, per unit of oil. On the other hand, some benthic organisms (such as mollusks) are apparently more acutely sensitive to dispersed oil, although in the long term the use of dispersants can reduce bioaccumulation and chronic exposure. In shallow water with poor circulation, and in protected bays and inlets, the acute biological effects on some organisms and habitats from high concentrations of dispersed oils may be greater than the effects of untreated oils due to longer exposure periods (NRC, 1989).

b. *What are the impacts on water quality?* Some of the more toxic, low-molecular-weight hydrocarbons evaporate or dissolve relatively early in an oil spill. Use of chemical dispersants will take more of these fractions into the water column than would have occurred beneath untreated slicks. This water column concentration must take place for dispersants to achieve their intended goal - removal of oil from the sea surface. The 1979 API field trials (McAuliffe et al., 1981) showed that concentrations and exposure times of chemically dispersed oil did in fact exceed those beneath the untreated slick, although no significant enrichment of hydrocarbons occurred beneath a depth of 10 meters. Although there is some recent data on water quality impacts from research by AEA Technology of Great Britain, more data on water quality impacts is needed; this will be the focus of the monitoring plan currently under development in the State of Washington.

c. *What are the potential fish or wildlife impacts:* The benefits of dispersant use result when an oil slick is dispersed and thereby prevented from impacting marine bird and mammal populations as well as their feeding grounds and habitats. The major concern of fishery and wildlife agencies is related to the impacts associated with increasing the contact depth of toxic oil fractions as dispersed oil moves from a largely surface-impacting spill to a well dispersed and deeper phenomena. The total volume of the affected area is greatly magnified by the dispersion effect and, consequently, increases the fisheries resources at risk. Organisms in the water column, particularly in the upper layers, will experience greater short-term exposure to oil components if the oil is dispersed. The decision not to use dispersants is often made because of the perceived risks to fish populations. During the winter, spring, and early summer, the marine and estuarine surface waters represent the major nursery area for the entire fishery resource; more that 50% of the species have some pelagic life phase that puts them at risk. Yet no measurable biological effects of either dispersed or untreated oils to commercial fisheries have been reported, due to the mobility of the fish and much of their prey, the natural variability of their populations and, in some cases, the effect of overfishing (NRC, 1989). Fish can also be killed when oil spills affect mariculture sites with moored fish cages, but no major impacts of oil spills have been recorded on wild fish populations (Duval et al., 1981). Zooplankton, specifically crustacean larvae and pelagic fish eggs and larvae, are among the most sensitive and vulnerable organisms, while larger organisms below the water's upper layer are less vulnerable. Also, as noted above, some benthic organisms such as mollusks appear to be acutely sensitive to dispersed oil. However, predicting expected mortalities is difficult due to the rapidly changing concentrations of hydrocarbons in the water column and the difficulty of comparing actual exposure concentrations to laboratory concentrations. Dispersion of oil may increase the effects of a spill by increasing the area covered by sheen; this would increase the area potentially hazardous to birds and mammals (NRC, 1989). Although this remains a possible disadvantage which would offset the benefits to birds and mammals of preventing crude oil impacts on their feeding grounds and habitats by dispersing an oil slick, its occurrence has not been conclusively demonstrated.

• Shoreline Impacts: Partially-dispersed oil which is treated just offshore but which fails to disperse completely may show increased effects on shoreline flora and fauna. Toxic effects of oil plus dispersant mixtures exceeding those of either oil or dispersant alone were observed by Crothers (1983) on a sheltered rocky shore (for limpets and periwinkles). However, these effects were short-lived. Baker et al. (1984) and Howard et al. (1989) also found that oil plus dispersant mixtures were more damaging than oil or dispersant alone on temperate seagrass beds. Thorhaug et al. (1986) had found similar results for subtropical and tropical seagrasses, and a great variation in effects depending on the seagrass species concerned. On salt marshes, both oil and dispersed oil will usually have adverse effects (Baker et al., 1984). Some of the adverse effects of partially dispersed oil on shorelines are probably due to the increased sediment penetration of some oil and dispersant mixtures (Little and Baker, 1989). In the Baffin Island Oil Spill Project, the largest experimental oil spill project to be undertaken in North America, 45,000 liters of medium gravity crude oil were released in a typical coastal Arctic environment to determine the short and long term fate and effect of both dispersed and non-dispersed oil. The results offer no compelling ecological reasons to prohibit the use of chemical dispersants on oil slicks in such nearshore areas (Sergy and Blackall, 1987).

• Fate of Dispersed Oil: NRC summary documents state that we do not know where and how far dispersed oil will go. With regard to information on how turbulent diffusion, surface circulation, and wave motion affect dispersed oil distribution as a function of depth, time, and volume of spilled and treated oil, the NRC (1989) concluded that although circulation phenomena have been observed qualitatively, predictive theories are not yet dependable. Partial resurfacing of dispersed oil, after agitation ceases, occurs under lab conditions. There is disagreement about its occurrence in practical situations due to lack of quantitative information. However, resurfacing of dispersed oil may be less likely than that of untreated oil because of the smaller droplet size (NRC, 1989).

C. Current Legal Requirements and Policies Among Task Force Jurisdictions

U. S. Federal: The use of dispersants and other chemical agents in navigable waters of the USA is governed by a provision of the National Contingency Plan which requires the concurrence of the EPA representative and the state(s) concerned before a chemical agent can be used, although the federal OSC can approve the use of dispersants or chemicals without concurrence if the use of such a product is necessary to prevent or substantially reduce a hazard to human life. Consultation with the U.S. Departments of Interior and Commerce are also required. Since oil spills impact resources beyond state boundaries and since there are a variety of federal and state agencies with concern and authority, the Regional Response Team (RRT) acts as a coordinating body that brings federal, state, and local government agencies together. In addition, the RRT provides a mechanism for planning and preparedness activities before a response action is initiated.

Canadian Federal: The use of dispersants and other chemical agents in marine waters is governed by provisions in the Federal Fisheries Act. Policy on their use is lead by Environment Canada in consultation with other federal and provincial resource agencies. In order to be considered for use, dispersants must first meet certain effectiveness and toxicity criteria. Their actual use can be permitted where safety is an issue of where a net environmental benefit will result. The decision to employ dispersants is vested in the Canadian Coast Guard, in consultation with the Regional Environmental Emergency Teem (REET).

Alaska: Appendix F of the Alaska Federal/State Unified Plan, adopted in May of 1994, includes Oil Dispersant Guidelines for Alaska as approved by the ARRT in April 1986. These include specific guidelines for Cook Inlet; specific guidelines for Prince William Sound were approved by the ARRT in March of 1989. Both the general guidelines for Alaska's marine waters and the specific guidelines for Cook Inlet and Prince William Sound are designed to expedite the decision-making process in order to allow the timely and effective use of dispersants to minimize environmental impacts.

According to the guidelines, decisions concerning dispersant use must be based on an evaluation of potential impacts from dispersed versus undispersed oil.

This means that potential effects on water column organisms - such as migrating salmon, fish or crab eggs or larvae - must be weighed against potential effects at other sites where aggregated population of birds or mammals or particularly oil-sensitive coastal areas such as salt marshes or seagrass beds can be found.

Alaska's dispersant use criteria classify coastal waters into three zones defined by physical parameters such as bathymetry and currents, biological parameters such as sensitive habitats or fish and wildlife concentration areas, nearshore human use activities, and time required to respond.

In Zone 1 the use of dispersants is acceptable and should be evaluated after consideration of mechanical response methods. The FOSC is not required to acquire approval from EPA or the State prior to dispersant use in this zone, but must notify them of the decision as soon as practicable. Zone 1 is characterized by water conditions that will allow dispersed oil to be rapidly diluted, and is far enough away from sensitive resources that dispersant operations would not cause disturbances. There must also be a significant likelihood that spilled oil will impact sensitive resources without the dispersant application.

In Zone 2, the use of dispersants is conditional due to certain seasonal variations. The FOSC is required to consult with the RRT and obtain approval of the EPA and the State. Like Zone 1, Zone 2 areas must be characterized by water conditions that allow for rapid dispersal and must be a sufficient distance from sensitive resources that operations would not cause disturbances.

In Zone 3 the use of dispersants is allowed only on a case by case basis if it is determined that the disturbances of organisms and/or direct exposure to dispersants or dispersed oil would be less deleterious than the impact of spilled oil. The FOSC is required to consult with the RRT and obtain approval of the EPA and the State prior to dispersant applications. Zone 3 is the area immediately in or around the resources requiring protection, including the resources themselves.

Only areas in Cook Inlet and Prince William Sound have been classified as Zone 1 or 2; all other marine waters of Alaska are considered to be in Zone 3.

British Columbia: According to the Provincial Marine Oil Spill Preparedness and Response Strategy, the Province will support dispersant use if its effectiveness can be proven at the time of use, and if its use can be shown not to be deleterious to provincial resources. The Ministry of Environment, Lands, and Parks is committed to keeping abreast of research into dispersant efficacy and toxicity. It is also committed to formulating a decision-making process such as preauthorized use or action.

Washington: Washington law (90.56 RCW) states that it is the obligation of any person owning or having control over oil entering waters of the state to immediately collect and remove it. The law further states that if it is not feasible to collect and remove the oil, said person shall take all practicable actions to contain, treat, and disperse it. Chapter 90.48 RCW also authorizes the director of Ecology to prohibit or restrict the use of any chemicals or other dispersant or treatment materials proposed for use whenever it appears that the use would be detrimental to the public interest. In practice this has meant that the person responsible for the spill or other parties involved in spill control and management must obtain approval from the Director of Ecology prior to using a chemical dispersing agent as means of treatment. However, since the decision as to whether or not to use dispersants is needed within a short time frame to be effective, a better decision tool was required. As a result, the Washington Department of Ecology has recommended a risk analysis process based on resource evaluation and rating. Technical experts ranked resource values in 15 coastal and marine regions and 132 subregions by season. The ranking system scored marine mammals, marine fish, shellfish, salmon, marine birds, intertidal and subtidal habitats, and possible recreational resources on a 1 - 5 basis with 5 being the highest score. Five priority habitats were considered for protection to be conferred through the use of dispersants remote from these habitats; these included bird and marine mammal habitats, eelgrass beds, kelp beds, and salt marshes.

All decisions would be based on the fact that there are known tradeoffs associated with the use of dispersants and when these are weighed against the resource value to be protected, there may be times when the value of the resource protection outweighs the added potential loss to another resource value from the use of dispersants, or vice versa. For instance, fish scores were summed in each subregion and then compared seasonally to bird and marine mammal values for the same subregion as well as subregions which might be impacted by undispersed oil.

Each dispersant use decision is governed by such a comparative natural resource evaluation. For example, during the spring season the natural resource values in subregion 201 were 14 for fish, 3 for birds, and 4 for marine mammals; in this scenario, dispersants would not be used.

As this ranking system is applied in Washington, three dispersant use decisions are possible in each subregion: Dispersant Use Recommended, Dispersant Use Conditional, and No Dispersant Use. These decisions are based on known biological consequences and may vary from season to season.

<u>Oregon</u>: According to Oregon Administration Rule 340-47-020, approval by the Department of Environmental Quality is required for use of any chemicals to disperse, coagulate, or otherwise treat oil; thus a proposal with strong justification would have to be developed. The rule further states that physical removal will ordinarily be required except where use of chemical dispersants is warranted by extreme fire danger or other unusually hazardous circumstances.

<u>California</u>: Section 8670.7 of the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act of 1990 vests the Administrator of the Office of Spill Prevention and Response with the state authority over the use of dispersants and any oil spill cleanup agents in connection with an oil discharge. Section 8574.7 further requires

the Administrator to develop an expedited decision-making process and to ensure that a comprehensive toxicity and efficacy testing program is carried out for any dispersant proposed for use in California marine waters.

Title 23, Subchapter 10 of the California Code of Regulations requires the testing and licensing of all oil spill cleaning agents including dispersants, used in State waters. OSPR is required to evaluate the use of such agents in order to ensure that such use will not pose a hazard to fish and wildlife. The State Water Resources Control Board has primary responsibility for the licensing of these agents, although proposed legislation would move the licensing authority to OSPR where the comprehensive testing program is conducted.

The RRT has directed OSPR and NOAA to develop a quick approval decision-making process for dispersant use in areas 15 miles or more offshore. OSPR is currently considering using this process for areas outside of the three mile zone, and is also expecting to draft a proposal for decision-making within state waters by June 30, 1996.

D. Recommendations on the Use of Dispersants

RECOMMENDATION #1: Task Force jurisdictions should implement an expedited decision-making process for dispersant use.

Rationale: Considering the numerous variables in each dispersant use decision, every such decision is essentially made on a case-specific basis. Yet without an expedited process for risk analysis, a dispersant use decision will usually be a no use decision, since the time necessary to gather risk analysis information will most likely preclude a decision within the window of opportunity for dispersant effectiveness. A no-use decision could result in undispersed oil impacting sensitive environments - such as critical habitats, wildlife aggregate areas, or salt marshes - with much greater environmental degradation than might have occurred if dispersants had been applied. Water intakes, mariculture sites, recreational areas, and commercial ports are examples of culturally or economically important resources which must also be considered in dispersant use decisions. It should also be noted, however, that even when dispersant use is approved - either in a preapproved, quick approval, or case by case situation - circumstances can change and the decision can be revoked.

Alaska and Washington have already developed expedited decision-making models which could be adapted as appropriate for use by British Columbia, Oregon, and California. Both weigh impacts of dispersed oil on fish and other aquatic resources against potential impacts of undispersed oil on marine birds and mammals and critical habitats. Thus both are based on an evaluation of resources and habitats in the spill zone, including: 1) feeding, resting, migrating, nesting, spawning, breeding, and nursery areas for marine mammals, marine fish, shellfish, salmon, marine birds, and any threatened and endangered species; 2) intertidal and subtidal habitats, eelgrass and kelp beds, salt marshes, low energy bays and harbors, aquaculture and commercial areas, recreational and industrial areas.

Both methodologies utilize the identification of geographic zones. Alaska has assigned Zone 1 (preapproved) and Zone 2 (conditional approval) decision-making categories to zones within the areas where crude oil is transported or produced (Cook Inlet and Prince William Sound) and then categorized the rest of the coastline as Zone 3 (case by case). Washington, on the other hand, has divided its entire coastline into 15 regions and 132 subregions and then assigned numerical values to fish, birds, and mammals within those regions on a seasonal basis. Using that approach, subregions fall into one of three categories each season: Preapproval, Case-by-Case approval, or No Use. PLEASE NOTE: Categorization by zone is a decision-making tool; its use is not restricted to preapproval zones, but may also be adapted for "quick-approval" applications as well. Similarly, the risk analysis criteria itemized above are by way of example; a Task Force member agency could delete or add to the criteria list as necessary to reflect its unique circumstances.

Under both models, on-scene coordinators should determine that an environmentally acceptable dispersant is available, that equipment is available to apply it within an adequate window of opportunity, and that its use will enhance the overall spill response strategy rather than interfere with it.

A summary of the risk analysis criteria applied by the two states is as follows:

a) Water depth (>20 meters (WA)) and/or mixing energy are sufficient to allow dispersed oil to be rapidly diluted to low concentrations (Alaska & Washington);

b) Distance from sensitive resources and nearshore subregions is far enough (> 3 miles(WA)) so that dispersant application operations and dispersed oil concentrations will not cause disturbance or damage (Alaska and Washington);

c) Meteorological and oceanographic conditions suggest that there is a significant likelihood that the spilled oil will eventually impact sensitive resources (Alaska & Washington);

d) A methodology has been developed to weigh the tradeoffs of such impacts in advance (Alaska & Washington); fish values have been ranked relative to the wildlife values and/or sensitive habitats to be protected (WA). In those cases where competing resources have equal values it may be necessary to make case-by-case decisions as to the magnitude of the impact on certain resources.

Generally, in those cases where case-by-case dispersant use decisions are appropriate, the following procedures are used in Washington:

1) The FOSC/STATE OSC will request that the Natural Resource Damage Assessment Committee (NRDAC) - which is already in place as part of the Incident Command System - evaluate the use of dispersants and provide to the FOSC a recommendation for use/non-use. (In Washington this committee is comprised of the Washington State Departments of Fish and Wildlife, Parks, Health and Ecology, plus federal agencies and other ad hoc entities.)

2) The NRDAC will, on the basis of the spill data provided by the FOSC and the environmental sensitivity rankings, make a recommendation whether to authorize dispersant use.

3) The NRDAC will communicate its dispersant decision to the FOSC.

4) Should the decision involve multiple jurisdictions and those jurisdictions fail to reach agreement on a dispersant use/no-use decision, the default decision will be "no dispersant use".

e) The potential dispersant use subregion is larger than 200 sq km (Washington);

To the extent that the following information is available, it should also be incorporated into a dispersant use decision:

- Monitoring plan design guidance;
- An approved monitoring plan;
- Application field test results; and
- A model predicting concentration of dispersed oil in water column.

RECOMMENDATION #2: When Washington's dispersant use monitoring plan guidelines are developed and risk analysis criteria are further refined, other Task Force jurisdictions should review these tools for possible adaptation.
Rationale: As noted under "Issues and Concerns" above, our knowledge regarding dispersant use efficacy and toxicity in applications outside of a laboratory environment is limited. The risk analysis approaches adopted by Alaska and Washington and recommended to other member jurisdictions would benefit from ongoing review and evaluation based on new data produced by monitoring of actual dispersant application fate and effects as generated by the monitoring strategies referenced above. In addition, use of more accurate risk analysis criteria will also enhance the

decision-making process.

RECOMMENDATION #3: The results of California's comprehensive dispersant testing and research program should continue to be made available to other Task Force jurisdictions, and other jurisdictions should be invited to provide input to research and demonstration project design as well.

Rationale: California has implemented research programs for dispersant efficacy testing, toxicity testing protocols, and research on fate and effects of dispersed oil and dispersants. A program to examine the behavior of representative commercial, sport, and forage fish to dispersed oil is proposed, as is one to test the hypothesis that dispersed oil does not adhere to hard substrates such as sand, rocks, fur, and feathers. Just as data from monitoring dispersant applications will enhance our knowledge base and our ability to make appropriate risk analysis decisions, so will the results of this research. (Please see Attachment E for a brief description of current research activities in California)

RECOMMENDATION #4: Contingency plan holders and response contractors should ensure that adequate delivery systems and approved dispersant products are available for spill response on the West Coast.

Rationale: As of March of 1995 there was 156,380 gallons of dispersants available to Task Force members (106,300 gallons in Alaska and 50,350 gallons in Washington and California). The oil spill cooperatives in California and Washington jointly have a dedicated aircraft in Mesa Arizona on standby for dispersants applications use. Cooperatives in Alaska have two Aerial Dispersant Delivery System packs, a contract for a standby aircraft, and an agreement with the U.S. Coast Guard for shore term use of their aircraft in Kodiak if needed. In addition, oil spill cooperatives nationwide have mutual aid agreements in place which would permit rapid access to additional stockpiles of dispersants if the need arose. Task Force member agencies should work with industry and spill response contractors to determine if these resources are adequate for all potentially affected regions. In addition, Task Force member agencies should advise plan holders which dispersant products are acceptable.