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Dispersant Use in Ice-Affected Waters: Regulatory Status and Opportunities to Advance Decision Making

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ABSTRACT 300064:

There is increasing interest in, and evolving technological capability to, conduct offshore oil and gas exploration and production operations in sensitive arctic regions. This has focused attention on oil spill preparedness and response for waters which have an ice cover for some part of the year. Given the logistical challenges associated with transporting and deploying mechanical equipment in these remote, ice-prone areas, the application of dispersants below and on the water surface is being considered as one of the ways to mitigate the impact of accidental oil spills from offshore exploration, production and transportation operations.

In 2013, the International Oil & Gas Producers (OGP) commissioned a study about using dispersants in ice-affected waters. Part of the study scope was a regulatory review concerning the dispersant use in twenty-one Northern Hemisphere nations having Arctic/ice-prone waters. An important issue for government policy and decision makers is considering where and when dispersant use might reduce the net economic and environmental damage from an oil spill. Industry is aware that their resources and knowledge can help inform nations as they examine dispersants as a response option. This paper presents an overview of the regulatory status regarding the use and/or limitations of dispersants in countries that have oil and gas exploration and production operations ice-affected waters; potential obstacles in decision making which may limit industry's ability to stand up the logistical infrastructure necessary to implement an effective dispersant operation; and potential strategies, e.g., industry technical support and stakeholder engagement, to address identified obstacles in countries with ice-affected waters.

INTRODUCTION:

Increasing pressure to discover and develop oil and gas resources in the Arctic and other locations which have ice cover for part of the year has focused attention on oil spill response preparedness in these areas. Even where exploration and production (E&P) activities are limited to the open water season, an accidental spill could occur when ice is beginning to form or melting. This dynamic situation requires national governments and the oil and gas industry consider all appropriate response options should the need arise to protect the sensitive arctic

environment and cultural uses of natural resources.

A goal shared by government, industry, and citizens is to prevent oil spills from occurring and international, regional, national, and local prevention policies, procedures, and plans have been put in place over the last several decades. Yet, it's impossible to guarantee that all oil spills can be prevented. Thinking ahead to prepare for the unwanted situation of an oil spill is a necessity – to plan for spill control options which are effective and allowed, and then to put in place the procedures and systems to implement those options. Response options may include, among others, potential surface and subsurface applications of dispersants. It is reasonable for government authorities considering dispersants to ask, "Do dispersants do more good than harm, and enough good to be a desirable option?" A Net Environmental Benefit Analysis (NEBA) or Net Environmental Damage and Response Analysis (NEDRA), informed by research, field scientists and resource managers, is the process which policy and decision makers have used to address that question. NEBA is a process which was developed in the 1990s (IPIECA, no date); NEDRA is a scenario-based analysis used in Norway to evaluate which response options lead to the overall least environmental impact.

Countries may consider a range of regulatory choices in defining their respective decision making framework for dispersants, beginning with a national policy that allows dispersants to be used to treat spilled oil. This paper discusses aspects of the regulatory decision process for using dispersants, identifies current technical/policy obstacles to dispersant decision making, and suggest strategies to enhance dispersant decision making, including dispersant pre-authorization.

METHODS:

This paper is based upon the authors' report to OGP to evaluate the status of dispersant decision making in ice-prone countries. It was compiled from a review of available online literature, reports (EMSA, 2010) and regulatory information in these countries; sources may have changed since the study was developed. The primary focus of this paper is crude oil spills that could result from oil and gas E&P activities in ice-prone countries, although the findings are relevant to other sources of spills, such as transportation incidents, and other dispersible oils.

DISCUSSION:

When a spill occurs, time-critical decisions using best professional judgment must be made to select a course of action that will yield the best outcome, given incomplete knowledge about the situation and how a specific oil will interact with the environment. Effective response strategically uses a mix of response options to mitigate pollutant hazards and impacts. Determining the best mix of response options is done using NEBA or NEDRA. Each response option may reduce a threat to resources at risk when used appropriately. But no single response option is a complete solution. Each response option presents both opportunities and limitations.

About the Response Niche of Dispersants

The use of surface applications of dispersants is an option which has been studied for over 40 years. Subsea application at the well head of dispersants first occurred in 2010 during the Deepwater Horizon (DWH) oil spill in the US Gulf of Mexico. Surface applications of dispersants can reduce the primary risks of oil slicks to wildlife on the water surface and

shoreline (NRC, 2013), but in doing so present a secondary risk by moving the chemically dispersed oil into the water column. Natural dispersion of oil is one of the weathering processes of spilled oil; dispersants increase the rate of this dispersion process. Dispersants also enhance the rate of biodegradation, a weathering process by which naturally occurring marine bacteria, fungi, and microalgae consume hydrocarbons as a food source, and break down the oil in the environment. These marine organisms are everywhere. Subsea applications of dispersants into oil released at the sea bottom reduce the amount of oil which surfaces. Chemically dispersed oil droplets, whether generated from the application of dispersants on surface slicks or are applied sub-sea at the well-head, are sufficiently small to undergo biodegradation on the order of days to weeks. Surface and subsurface applications also can reduce worker safety risks associated from volatile oil vapors by reducing surface oil slicks (Curd, 2011).

Aerial applications of dispersants are considered an important response option by responders because they offer the largest encounter rate (i.e., the area of oil an individual piece of equipment can encounter per day; calculated by multiplying the swath width the equipment, by the speed of the equipment, by the time of operation in a day), can be deployed more quickly, farther away than mechanical recovery equipment, can reduce the volume of recovered waste and disposal, simplify logistics, and reduce the footprint of the oil spill on the water surface and on land. Dispersant aircraft can arrive at spill locations faster than vessel-based mechanical or subsea dispersant application operations especially for remote spill locations, potentially allowing an effective response to start before slicks have spread, moved, or broken apart into smaller surface slicks. Aircraft are able to travel between slicks apart in a matter of minutes while vessel-based response options may require many hours to transport equipment to a new location and redeploy. In this regard, many see their niche as an option to control oil slicks in very large oil spills. However, in extreme cold climates, vessel applications (**Figure 1**) may be the most effective method to target specific smaller slicks for treatment in ice-affected waters, and when aircraft operations are limited by fog/reduced visibility/low ceilings.

Figure 1. Prototype maneuverable, vessel-based dispersant spray system being used to apply dispersant onto oil spilled in ice (Photo Source: P. Daling).

Dispersant use decisions are particularly time critical because their mechanism of action works best on oil that has undergone little natural weathering and emulsification. Weathering changes oil behavior and properties; the more oil emulsifies, the less dispersible it becomes. In

this regard, for surface oil slicks, dispersants have a limited "window of opportunity." To be effective, generally they must be applied within approximately 24-48 hours after the oil is on the water surface, although some oils like the Macondo 252 oil in DWH may be dispersible longer and new formulations of dispersants may extend this window. Subsea applications of dispersants can be continuously applied to "fresh" oil at the source and can be effective as long as oil is being released during a blow-out. In both cases, dispersants are used soon after the oil is released into the environment. It takes time to mobilize the necessary logistics to carry out an effective dispersant application for both surface and subsea applications of dispersants. This underscores the need for timely, rapid decision making.

Dispersant Decision Framework

The authors suggest that if dispersants are to be a viable option, each country needs to create a regulatory environment conducive to their use in the time they can be effective. This means having the ability to make a rapid decision during an incident and apply them soon after the oil has been released. An important first step for government is to consider the body of dispersant knowledge compiled from studies and literature. Some compilations of dispersant literature and information can be found in the Louisiana Universities Marine Consortium (LUMCON) Dispersants Bibliography (http://www.lumcon.edu//library/dispersants/); the IOSC Proceedings (www.ioscproceedings.com) and the Interagency Coordinating Committee on Oil Pollution Research (www.iccopr.uscg.gov). In addition, the rationale for dispersant use has been described by various technical summaries, e.g., Lewis (2009), ITOPF (2011), and IPIECA (2001). An institutional framework for effective decision making should be founded on prior research, experience and NEBA. We suggest that two levels of national decisions are needed:

1. Dispersant Policy. An appropriate lawmaking body and agency must approve a policy to allow and authorize the use of dispersants in that country and assign a competent authority for authorizing dispersant use; and
2. Dispersant Implementation Process. A process needs to be established that assigns decision responsibility to a pre-designated entity in the nation's competent authority to rapidly approve dispersant use under certain conditions. The process should enable the rapid application of dispersants in suitable locations within the time frame when dispersant applications can be effective.

A national policy can apply to the entire country (nationwide), could apply only to areas with potential spills risk, or could be set for specific pre-defined conditions that must be met for dispersant use to be approved during an incident. Some countries like the US have a national policy allowing the use of dispersants as an option and also delegate the conditions for approving their use in geographic sub-regions to the specific authorities in those regions. In all cases, it is probably best to consider all levels of government with jurisdiction in managing spill response as part of the process to authorize dispersant use.

This study considered three types of dispersant authorization:

1. *Case-by-case Approval.* Use of dispersants during each incident must be considered and approved by a national level official. While a case-by-case approach means that the

specific facts for an incident will be used in the decision making process, it may also mean that the possible advanced planning for dispersants could be incomplete and therefore could result in delays to execute an effective dispersant operation.

2. *Expedited Approval.* Use of dispersants for each incident requires the lead response official to compare the situation to pre-established conditions for permissible use and/or to obtain the consent from another authority before dispersant use is allowed. Some expedited approval agreements define the quantity and type of information that must be provided in order to obtain consent, and may define the timeframe authorities may take prior to approving or disapproving use. Expedited approval may be limited to a particular geographic zone, distance from shore, depth of water, or season within a given area or region. This is the most prevalent form of decision making in the countries reviewed for this study.

3. *Pre-authorized Approval*. The authors consider this to be the most rapid decision process for a spill response because using dispersants is at the discretion of a lead response official without further consultation with or approval by other authorities. Geographic zones may be part of the pre-authorization process such as, distance from shoreline (e.g., 3 miles), water-depth (e.g., 30-60 feet), and/or by season. This type of decision making only occurs in the US at the regional level and was in place for the Gulf of Mexico in 2010. However, the extended duration of dispersant use had not been addressed in pre-authorization agreements at the time. The US National Response Team (NRT), has since issued additional guidance to address dispersant use situations which are atypical in comparison to the conditions in regional pre-authorization agreements (NRT, 2013).

When a country approves policies to authorize the use of dispersants, this signals industry and response contractors to invest in the logistics necessary to implement dispersant operations in the future in that country. A government-industry approach to advance dispersant decision making proved to be effective and mutually beneficial in the US (Walker et al. 1999). This approach recognized the respective roles and resources of government and industry; that is, government's role to set policies and make decisions regarding pollution and environmental protection; industry's role to deliver and use resources to carry out operations in accordance with government policies and decisions. Industry often conducts studies to become more knowledgeable about the various aspects of implementing response options, such as the many studies initiated by the US Oil Spill Joint Industry Task Force and the International Oil and Gas Producers since DWH. In this way, industry can share knowledge and resources during preparedness, to help develop a technically-sound concept of operations for using response options appropriately on a national, regional or project-specific basis. A concept of response operations is a verbal or graphic statement, outlining assumptions or intent in regard to an operation or series of operations, designed to give an overall picture of the operation. In other words, what mix of response options will be used, in what order, in what time frame, and for how long?

In September 2012, the International Maritime Organization (IMO)'s Oil Pollution Response Committee (OPRC) working group completed a draft of "*Guidelines for the Use of Dispersants for Combating Oil Pollution at Sea"* which refers to and encourages conducting a NEBA. The draft guidelines developed by the IMO's OPRC consist of four parts:

1. Basic information on dispersants and their application (finalized);
2. Template for a national policy for the use of dispersants (finalized);
3. Operational and Technical Sheets for surface application of dispersants (finalized); and
4. Sub-sea application of dispersant (to be finalized).

This document provides current, globally relevant guidance to jurisdictional authorities in charge of the development or revision of the oil spill response national policy, as well as the competent authorities in the decision making procedures when considering the application of dispersants at the time of the incident.

Dispersant Decision Making Considerations

Implementing an effective dispersant operation involves substantial preparation and complex logistics, especially for remote areas where most E&P activities occur. This implies that government consideration has been given to the oils which could be spilled and treated, the relative proximity of potential spills to ecological, socio-economic and cultural resources at risk, and dispersant products which are viewed as appropriate for the oils, operating environment and resources at risk in a country. This work is time consuming and best carried out during preparedness. When part of the regulatory process, this information can then be incorporated into response strategies contained in risk-based or scenario-based contingency plans approved by authorities. Part II of the draft OPRC guidelines has been designed to support coastal States in the development of their national policy on the use of dispersants, and can also be used for the implementation of a national or local contingency plan for dispersants.

Important issues and actions to address in the decision making process includes:

1. Conceptual approval that dispersants are likely to be effective and could be applied under different conditions, e.g., water depths, currents, wave characteristics and mixing energy, distance from sensitive resources at risk from oil spills, and oil type for surface applications of dispersants.

2. Conducting a conceptual level NEBA or NEDRA to compare the advantages and disadvantages of dispersant use compared of not using them, or with other response options. This may also include conducting weathering studies to determine emulsification rate of various oils and dispersibility with various dispersants, as is done in Norway. Such specific oil weathering and dispersibility data are crucial input to numerical model tools to simulated the 3D oil spreading in various spill scenarios and the efficacy of various response options. One outcome might be a concept of operations for various scenarios.

3. Approval in advance of specific allowed or preferred dispersant products so they can be stocked in regionally accessible areas. Product approval by a jurisdictional authority usually involves testing for both effectiveness and toxicity. For example, in the UK the Marine Management Organization (MMO) is responsible for the approval of oil spill treatment products (OSTPs) in English and Welsh waters (MMO 2013).

4. Pre-staging of logistical requirements. This includes dispersant stockpiles and pre-staged vessels equipped with spray equipment, fixed-wing aircraft or helicopters to operate in certain areas, with necessary back up, air traffic control, and availability of refueling and

loading facilities to logistically support the timely delivery of aircraft or vessel and response personnel.

5. Coordination with stakeholder entities that could impact dispersant decision making, before, during and following oil spills involving dispersant use. It is useful to perform formal stakeholder mapping to identify key stakeholders from the community to national level, and then their perceptions, questions and concerns about response options, including subsea and surface dispersant use. One such stakeholder group of particular relevance to Artic waters might be indigenous peoples, whose presence could require some level of participation in the decision making process if that nation has formally recognized their rights. UN-REDD Programme Guidelines (2012) outline existing international law and emerging State practices affirming that indigenous peoples have the right to effective participation in the decisions, policies and initiatives that affect them and that Free, Prior and Informed Consent (FPIC) is a legal norm that imposes duties and obligations on the States.

NEBAs can be used at two levels: strategic and tactical. A strategic NEBA considers higher level concepts such as the overall potential value of dispersants as a response tool and would explore possible spill situations in a specific country. This type of analysis supports the policy and regulatory development. Strategic NEBAs can be helpful for structured, knowledge-based stakeholder discussions about oil spill response options in general, and including the potential value of dispersants. Tactical NEBAs provide a way to examine the optimal mix of response options and develop a concept of operations for project-level response plan.

Implementing Dispersant Decisions

Once a country develops a policy to allow the use of dispersants, tactical NEBAs can be a tool for evaluating whether or not dispersants are useful in a specific planning scenario and geographic location or actual incident. Tactical NEBAs involve defining important variables for potential spill scenarios, such as location and volumes, types of oils, identifying environmentally sensitive and economically valuable areas that could be impacted, and options available to protect priority sensitive areas. Decision guidelines, checklists, and procedures facilitate the rapid conduct of a scenario-based tactical NEBA, either during preparedness or response.

Several countries have developed decision trees and flow diagrams to evaluate dispersant use to guide their incident-specific decision making process, such as the US Gulf of Mexico pre-authorization agreement.[1] Another example is the Asia Northwest Pacific Action Plan (NOWPAP) guidelines on Oil Spill Dispersant Applications (UNEP/IMO, 2005).

Status of Dispersant Use in Nations with Ice-Affected Waters

Twenty-one nations were identified as having ice-affected waters for at least a portion of year and located in the Northern Hemisphere, and evaluated for their potential for energy activities and regulatory position on the use of dispersants as a response countermeasure. They are listed in **Table 1** in alphabetical order. This table shows the policy status for dispersant decision making in the 21 countries. Of the 21 countries, all have considered dispersant use and

[1] An example of a detailed decision checklist used in the US Gulf of Mexico can be viewed at http://www.rrt6.org/Uploads/Files/Approvals%20--%20RRT6%20Offshore%20Dispersant%20Pre-Authorization%20Plan%20--%202001.pdf

the majority allow dispersant use with case by case or expedited decision making. Decision making for dispersant use is expedited (4 countries), case-by-case (15 countries), and pre-authorized (1).

Table 1 Dispersant polices of ice-affected countries*

Country	Dispersant Policy?	Policy Implication for Dispersant Use
Belgium	Yes	Case-by-case; 2° response option after tactical NEBA
Canada	No	Guidance only
China	Yes	Case-by-case
Denmark	Yes	Case-by-case; limited as far as possible
Estonia	Yes	Case-by-case; limited as far as possible
Finland	Yes	Case-by-case; limited as far as possible
France	Yes	Expedited in coastal waters for different scenarios; offshore - no limits
Germany	Yes	Case-by-case for specific areas: (a) 2° response option after tactical NEBA (b) in North Sea - last resort; (c) Baltic and Wadden Sea - forbidden
Greenland	Yes	Case-by-case; 2° response option after tactical NEBA
Iceland	Yes	Case-by-case; 2° response option after tactical NEBA
Ireland	Yes	Case-by-case
Kazakhstan	Yes	Case-by-case; seasonal and geographic considerations
Latvia	Yes	Case-by-case; limited as far as possible with qualifications
Lithuania	Yes	Case-by-case; limited as far as possible
Netherlands	Yes	Case-by-case with oil testing and conditions
Norway	Yes	Expedited with NEDRA (Net and Environmental Damage and Response Assessment) as basis for pre-authorized scenario-based contingency planning
Poland	Yes	Case-by-case as secondary option
Russia	Yes	Expedited if meet conditions
Sweden	Yes	Case-by-case; limited as far as possible
United Kingdom	Yes	Expedited
United States	Yes	Pre-authorized in most regions. National policy allows dispersant use and defers decision making to each federal region. Most coastal regions have conditions specified in their pre-authorization agreements; Region 10 (Alaska) does not pre-authorize the use of dispersants.

* Policies address use or no use.

Many countries have policies which identify zones along their coastlines where dispersant use is restricted, based on seasonal or geographic location, successful conduct of a NEBA, testing, or as a response option of last resort. Canada is considering a national dispersant policy but concerns particularly from their First Nations (indigenous tribes) remain unresolved. Instead Canada uses a guidance document to govern their dispersant use decision-making. The United States has pre-authorized decision making in most coastal regions, except Alaska.

Some countries designate areas where dispersants are restricted after considering the likely effects from dispersant mixing and dilution (water depth or distance from the shore), proximity to environmentally sensitive areas or wildlife, or a combination of factors. Spraying dispersants within restricted zones may be prohibited or require prior permission from a national authority. In these instances the national authority is to ensure that the pre-authorization for dispersant use has been prearranged and meets the aforementioned restrictions to their usage. Of those that require NEBAs, some of the nation states require an incident-specific, tactical NEBA to be conducted prior to any consideration of dispersant use. Outside of these zones, dispersants have been authorized for use in order to minimize the impact to the environment.

The ice-affected countries adjacent to the Baltic Sea became contracted parties to the Helsinki Convention and have agreed, "*The use of dispersants in oil combating operations is limited as far as possible and any such use is subject to authorization, in each individual case, by the competent national authorities*." This is perhaps due to consideration of potential for large spills, shallow water depths, and the limited circulation in the Baltic Sea. However, countries might benefit from considering targeted applications of dispersants on small spills or slicks by boat spray to reduce the threat of spilled oil to a location-specific bird colony or sensitive shoreline habitat. Any changes to this status would need to be worked through both the regional organization, i.e., European Maritime Safety Agency (EMSA), and in individual countries.

Obstacles and Strategies for Dispersant Decision Making

The authors consider obstacles to be gaps in the decision making process which could delay rapid decision making and immediate implementation of dispersant operations. The authors also suggest strategies for resolving identified obstacles during preparedness. **Table 2** presents decision making obstacles and strategies. **Table 3** presents activities or actions that may be prerequisites to resolving decision making obstacles, such providing technical support through stakeholder engagement, coordination, and risk communication. Stakeholder engagement and dispersant risk communication are discussed more fully in Walker (2014), Walker and Bostrom (2014), and Walker, Scholz and Ott (2014). Some concerns about dispersants have to do with their risk perceptions about dispersants. Since every oil spill involves risks to the environment, applying risk communication principles for all external communications is beneficial.

An appropriate role for industry in the dispersant decision making process is providing technical support to decision makers and other stakeholders in each country on the advantages and disadvantages associated with dispersants. Such support may include sharing knowledge to address stakeholder questions, concerns, and issues of interest related to oil spills, oil types and properties, contingency planning, concept of operations, response options, risk assessment and communication, potential impacts as well as conducting strategic and technical NEBAs.

CONCLUSIONS:

Of the 21 ice-affected countries reviewed, all have considered dispersant use and 20 have a national policy that allows dispersants to be used. Decision making for dispersant use is expedited (4 countries), case-by-case (15 countries), pre-authorized (1) and essentially not currently allowed (1). To further advance opportunities for dispersant use as a viable option for combatting oil spills in ice-prone, and other, countries, the authors observe the following:

- National government agencies in each country should first adopt a policy that allows the use of dispersants, i.e., to authorize their use as a response option in that country.
- Pre-designate the authority responsible for making an incident-specific decision to rapidly approve dispersant use when an oil spill occurs.
- To be practical and effective response: 1) dispersants should also be considered by the local jurisdiction with authority over the spill location as an option they would allow; 2) dispersant use should be included in scenario-based contingency plans in accordance with a concept of operations, approved by authorities; 3) specific dispersant products should be approved for use in a jurisdiction; and 4) the necessary logistics are in place, e.g., the supply and application resources are rapidly deployable and could reach spilled oil.
- A pre-authorization process should include a product testing and approval program.
- Industry has an appropriate role in the decision making process which is technical support for policies and procedures allowing the use of dispersants as a response option, either nationwide or in specific geographic areas, and an expedited approval process for incident-specific use. Energy companies with activities in remote areas with ice-prone waters can share technical knowledge with national authorities. Industry can also support decision makers in conducting NEBAs and NEDRAs, by providing input regarding the role of dispersants in the concept of operations on a project or geographic-specific basis.
- Industry also can provide resources and participate in government-led engagement activities with stakeholders to share knowledge about dispersant use as a response option in ice-prone nations, and develop credible relationships with appropriate entities.

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Table 2. Dispersant Decision Making Process – Obstacles and Strategies

Obstacles	Recommended Strategies
• Absence of a national policy to allow use of dispersants (only one country in the study has this obstacle). • Absence of a national procedure to approve the use of dispersants during an incident. • Incomplete agreements and arrangements about response concept of operations for the mix of response options (source control, dispersants, and controlled burning *in-situ*, mechanical) for oil spill response (OSR) plans. • Inadequate information to assess dispersibility, including window of opportunity of oils in a nation state. • Absence of logistics to implement dispersant applications on the water surface or subsurface, e.g., identification and list of acceptable dispersants, stockpile of acceptable dispersants, technological feasibility (available delivery and application equipment within the time window). • Presence of exploration/ production (E&P) activities near places inhabited or used by indigenous peoples.	• Provide science-based, credible information and engage in dialogue with decision makers and other stakeholders in each country to address their risk perceptions, concerns, and questions about dispersant use. • Working in partnership with other international organizations having similar missions, goals, and or objectives, e.g., European Maritime Safety Agency (EMSA) and members, Emergency Prevention, Preparedness and Response (EPPR), Oil Spill Working Group (OSWG) and the Arctic Council. • The initial priorities should be on those countries that currently envision dispersants as a secondary option. • The secondary priorities should be on those countries that currently consider the utilization of dispersants as a last option. • If a *national* dispersant policy is unobtainable, agreements should be attempted between oil and gas producers and each Arctic country on a *specific project* or regional basis at the time of drilling application and submittal of exploration and production oil spill contingency plans. Ideally, dispersant use policies should be incorporated into oil spill contingency plans with some forethought as to logistical concerns and sensitive resources. • Facilitate and support country consideration of a product listing, oil and dispersant testing, policies and procedures of countries that have instituted a program to govern dispersant use as a viable response option, as appropriate. • Depending upon the country, either or both strategic and tactical NEBAs may be needed during preparedness, and some countries seem to require incident-specific NEBAs during a response, that is, tactical NEBAs.

Table 3. Stakeholder Coordination, Engagement and Risk Communication – Obstacles and Strategies

Obstacles	Recommended Strategies
• Unverified and/or unresolved perceptions, concerns, and questions about dispersant risks by important stakeholders, e.g., government decision makers and indigenous peoples. • Inadequate credible information to address concerns and questions of decision makers and other key stakeholders about oil spills and dispersants, e.g., impact on a nations' commercial fishing industry and native fishing. • Inadequate communication of technical information about oil spills and dispersants, e.g., unclear or inconsistent use of terms like subsurface and submerged oil. • Questionable credibility of technical sources and information about oil spills and dispersants. • Inadequate information regarding available compensation regimes for socio-economic and environmental damages and lack of pre-spill consensus about compensation arrangements with local communities and national authorities in the event of a spill incident.	• Identify and map key stakeholders and their concerns which may be barriers to positive consideration and policy development. • For each stakeholder group, identify (map) important stakeholder representatives and/or organizations that serve as opinion leaders and are considered trusted sources of information, i.e., a trusted intermediary, in each country of interest for dispersant information. • "Listen" to and verify stakeholders' risk perceptions, questions and concerns, and their risk perceptions; these are indicative of information needs and misperceptions or incomplete understanding. • Consolidate and share technical information in credible ways to address stakeholder risk perceptions and concerns using presentations at conferences, publishing articles in peer-reviewed journals, facilitating access to oil spill practitioners and dispersant specialists and scientists; literature and research by decision makers, stakeholders and their trusted intermediaries who are viewed as credible sources of information. A searchable database maintained by academia like the Louisiana Universities Marine Consortium (LUMCON) dispersant database, could serve as a credible source for relevant publications. • Provide educational materials (using risk communication principles) to address the risk perceptions, concerns and questions of decision makers and other key stakeholders. • Industry can provide technical specialists possessing stakeholder engagement and risk communication capabilities in addition to technical knowledge, and be given assignments to participate in global workshops, conferences, educational outreach to governmental agencies, non-governmental organizations, media and communities. This team should include industry technical and government and public affairs (GPA) representatives and objective third-party consultants. • Provide knowledge-based support to nations as appropriate for strategic and tactical NEBAs; this can include: providing examples of policies from other countries, helping guide and organizing and/or participating in country-sponsored engagement activities, such as meetings, open houses, seminars. • Consider a stakeholder coordination program as a long-term endeavor (2 to 5 years), to be planned and funded accordingly. • Incorporate UN initiatives to reinforce the credibility of a dispersant engagement plan.