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# Effective Planning for Dispersant Operations – Making Decisions, Analyzing Options and Establishing Capability

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## ABSTRACT

Within the oil spill response community, dispersant use is considered to be a key tool for the treatment and mitigation of oil spills. As a response technique, the benefits of dispersant application have been long proven, particularly in the case of large offshore spills such as those associated with the Sea Empress (UK, 1996), Montara (Australia, 2009) and Macondo (USA, 2010) incidents. Compared to other spill response techniques, dispersant application has less operational constraints associated with adverse weather conditions and can be rapidly applied from an aerial platform for larger spills far offshore. These reasons render dispersant application a critical tool in the toolbox for many offshore operators.

Developing a successful dispersant application strategy requires comprehensive planning. For an offshore operator with a subsea well blowout risk, a number of elements should be carefully considered to ensure the successful execution of the dispersant application strategy. The decision making process should include a detailed evaluation of the oil type, release scenario and location, and the consideration of these parameters against the larger environmental and socio-economic needs of the stakeholder community. Once dispersant application is established to be a viable response option using a process such as Net Environmental Benefit Analysis (NEBA), the operator also needs to ensure that it is adequately resourced in terms of application platforms (vessel vs aircraft), monitoring techniques and supporting logistics. Well planned and detailed operational strategies are critical for successful subsea and surface dispersant operations, especially in the unlikely event of a large offshore spill.

This paper summarizes the various operational considerations an offshore operator needs to assess during the preparedness stage for developing a viable dispersant application strategy. Drawing on the authors' experiences in developing and implementing various preparedness projects globally, the different aspects of the dispersant planning process, including oil spill modelling to support decision making, ascertaining dispersant effectiveness for the oil type, selecting appropriate application techniques, establishing necessary logistical support and the setting up of an incident management team to support dispersant operations, will be discussed in detail. The goal of the paper is to build upon prior dispersant strategy discussions and provide an operationally focused blueprint for planning and implementing an effective dispersant application strategy in support of offshore operations.

## Introduction

The potential application of dispersant to marine oil spills has been an important tool in the responder's toolbox for over 40 years. For a large oil spill in an offshore location, it may be the single most effective response technique to prevent or mitigate impact to sensitive coastal resources, however, for dispersant to be used at all requires careful consideration of a number of variables and an appropriate level of pre-planning. Three fundamental questions need to be answered:

- **Is it possible?** (i.e., with regard to the physical properties of the oil and the "window of opportunity" in which dispersant can be applied. Also with respect to regulatory approval of their use)
- **Will it be beneficial?** (i.e., does the evidence support that, overall, dispersant use will mitigate the potential impact of a spill?)
- **Is it feasible?** (i.e., are the logistics in place to provide continuity of supply, together with the availability of the appropriate required application platforms?)

When a spill occurs is probably not the best time to pose, or answer these questions as each one requires careful and candid examination, discussion, and input from experts in addition to agreement before implementation can occur.

Dispersants, whether injected sub-sea to combat an ongoing release or applied from vessels or aircraft to a surface slick, may be just one facet of an overall response strategy. A robust decision-making process provides responders with an objective-led methodology to make sound, justifiable choices about the possibilities and potential limitations of the use of dispersants and / or other response techniques.

## A Decision Making Process

Since every oil spill is unique, it is important to select the most appropriate technique(s) for any given response, particularly with respect to the opportunities and drawbacks associated with each technique. Response to any emergency response is a very pressured situation, often with emotions running high and demands for tangible response actions to be taken, sometimes without due consideration of all the possible consequences. Good practice, therefore, is to examine likely spill scenarios in peacetime and carefully consider which response techniques offer the greatest opportunity to mitigate the spill impacts, taking full account of associated trade-offs. Going through a systematic process and involving all potentially impacted stakeholders, is a key part of the contingency planning process.

## It's in the Name

Net Environmental Benefit Analysis (NEBA) is a well-established principle to help make valid and scientifically justifiable decisions about response techniques. (J. Baker; IOGP-IPIECA) In the wake of significant industry investments to learn from the outcomes of two relatively-recent, high-consequence spills, the NEBA process has recently been the focus of renewed attention. Part of this attention has been on the name itself, with an attempt to broaden the interpretation of what the process implies. As a result, the concept of Spill Impact Mitigation Assessment (SIMA) has been developed as a more appropriate means of describing the response technique selection process with the recognition that socio-economic considerations can be as important as environmental impacts. SIMA will continue to gain recognition, however NEBA is a long-established approach which ostensibly amounts to the same process and for reasons of clarity, NEBA will be referred to throughout this paper. Regardless of the name, the four-step process is characterised as follows:

**1) Evaluate data**:

In contingency planning, data are obtained from a variety sources and in many formats and this step requires the planner to make sense of these inputs and present it as useful information that can aid the decision making process. It is usual to consider a number of credible scenarios, ranging from low volume, low-consequence operational spills to a potential Worst Case Credible Discharge. Each scenario will need to draw upon a range of data sources including:

- Stochastic modelling to show probability of impact on sensitive environments
- Sensitivity information (including seasonal variations), often in a paper or electronic map, or digital GIS format indicating ecological resources at risk
- Socio-economic and culturally significant resources at risk.
- Oil characteristics

Recognising the importance of oil characteristics on spill response, the IOGP / IPIECA Joint Industry Project (Oil Spill Preparedness and Response) produced Guidelines on Oil Characterization to Inform Spill Response Decisions. (IPIECA- IOGP Joint Industry Project, outcome report ref.19)

**2) Predict Outcomes**

This stage requires the planner to consider the spill scenario impact on each identified resource at risk assuming that no physical response intervention takes place. The next step is to then consider the impact modification that takes place if different response techniques are used. For example, a sub-sea release from an uncontrolled well blow-out would likely lead to a substantial oil slick on the surface with the possibility of volatile organic compound (VOC) levels in environment immediately above the slick, if no response actions are taken. This could be mitigated by the application of dispersant sub-sea (i.e., at the source) which could substantially reduce the volume of oil presented at the surface.

Computer models can assist with predicting outcomes to support NEBA at this stage, particularly in respect to dispersant use both from sub-sea injection (e.g., 3-D modelling) and conventional surface application. These models typically use a comprehensive database of oil types and can quantify the potential mitigation effects of dispersant use for a given scenario when compared with no intervention.

**3) Balance trade-offs**

Each response technique presents opportunities to mitigate the impacts of a spill, however the "benefits" associated with each technique need to be balanced with any potential detrimental consequences. New methodologies are being developed to help quantify (in simple, relative terms) the spill impact mitigation values derived from this process, but its important to note that this is not a complex calculation performed by computer but relies heavily on knowledge from seasoned professionals who have collective experience responding to a variety of spill scenarios.

**4) Select Options(s)**

Having examined the opportunities for each response technique to mitigate the impacts on any identified sensitivities, the final process step is to choose which technique (or combination of techniques) is best suited to address the spill scenario. At this point it's important to fully engage with the local community and other potentially impacted stakeholders. NEBA should deliver a consensus based outcome, and having broad agreement from a range of stakeholders is a powerful lever to support implementation of a response strategy based on pragmatic science and experience rather than one developed during the emotionally charged reactive phase of an emergency response.

As discussed, NEBA is a consultative process that is best applied during the contingency planning phase for a range of credible scenarios as appropriate to the risk-bearing location. Should a response be required, it will be far easier and quicker to adapt and implement response decisions already documented.

**Operational Considerations**

Once the appropriate decision making process has been followed and dispersant use is determined to be a suitable response option, then it is important to understand how to optimise the success of dispersant operations in the field.

Dispersant can be either applied on the surface of the water via aerial or vessel mounted systems or directly at the source of the release for a continuous sub-sea release using specifically designed dispersant injection equipment.

### Surface v Sub-surface

The sub-surface application of dispersant affords various operational advantages to that of surface application for the specific scenario of a sub-sea release. These advantages include a lower dosage rate, reducing the total volume of dispersant required and increasing the efficiency through more accurate targeting directly as close to the source as possible. However, sub-sea dispersant application is a tool that is used where there is an ongoing, energetic oil release which provides a continuous release of hydrocarbon into the water column, i.e., a well blow out.

Surface dispersant application can be used for instantaneous and continuous releases where the oil spilt is still amenable to dispersant use within the window of opportunity. Surface application of dispersant is generally quicker to implement than other response techniques, using aerial or vessel dispersant application assets from government or industry.

### Choosing the right platform

Rotary and fixed wing aircraft can be fitted / loaded with dispersant application systems. Helicopters can operate smaller “bucket- type” systems which hold a limited amount of dispersant that can be used to accurately target smaller slicks, e.g., tactical dispersant application of slick leading edges. The range and the operating conventions in any given country should be considered before use of such equipment.

In particular, the carrying of under-slung loads by helicopters is generally outside the day-to-day operations of many helicopter operations so applicable training, risk assessments and procedures should be in place prior to operations commencing.

Fixed wing aircraft that can be mobilised to most parts of the world are available as part of government-controlled national assets or industry owned/funded resources. Fixed wing aircraft are able to apply more dispersant than helicopter systems (with loads ranging from 1m3 to

15m3), and together with their much greater transit speed, are thus able to treat a greater oil slick area in one operational period. These aircraft also tend to be dedicated dispersant resources that are regularly used in training scenarios. In planning a successful dispersant operation, attention needs to be paid to the flight crew hours since the number of dispersant sorties per day is dependent on their hours and amount of daylight.

Vessel mounted systems tend to be more widely available locally than aerial assets and are more often present on platform or drilling support vessels as part of the Operator’s Tier 1 response equipment. Additionally, vessels provide a platform which can stay on location for long periods of time, a condition that is also less logistically challenging and demanding than aviation assets. However, it is important to remember that the area that can be treated with dispersants is generally much smaller than that possible using aircraft, especially larger, multi-engine platforms such as the C-130 or Boeing 727.

**Logistics**

Ensuring that the logistics process and plan are in place is key to ensuring the successful dispersant operations.

| | Aerial Dispersant use | Vessel Dispersant Use | Subsea Dispersant Use |
|---|---|---|---|
| Advantages | Treats a large area of the slick in a relatively short period of time.<br>Faster transit times. | Widely available systems that are simple to operate and able to stay on station; greater ease of verification of dispersant effectiveness. | Lower dispersant dosage rate; high encounter rate; potential for 24/7 operations; relatively immune to weather; increases safety for surface responders (reduced VOC). |
| Disadvantages | Application reliant on accurate slick spotting; | Limited area of treatment; slow | Applicable only for continuous sub-sea |

| | | | |
|---|---|---|---|
| | larger aircraft not as suitable for small surface slicks. | transit times; not suitable during heavy weather/rough sea states (personnel safety). | release; complex sub-sea monitoring process. |
| Logistics Considerations | Requirements for permits and overflight permissions; management of crew hours; identification of suitable operating bases (refuelling and reloading with dispersant possible); identification of spotter aircraft to support the application aircraft in targeting the slick. | Support from aircraft or other aerial observation system (such as aerostat) required; potential for long transit times to site and during restaging; dispersant supply replenishment potentially challenging far offshore. | Staging of specialized equipment such as ROVs, coiled tubing etc.; staging and implementation of complex monitoring programme required to collect samples at depth; offshore dispersant supply replenishment potentially challenging because of distance from shore and continuous use. |

**Dispersant Supply Considerations**

The Macondo incident highlighted that with a continuous hydrocarbon release and treatment with dispersants on the surface as well as below the surface for a prolonged period of time required dispersant volumes in excess of those historically required for a single ship-sourced release.

The production of dispersant involves raw materials that are used extensively in other industries to formulate a wide range of consumer products (e.g., hair and skin care, foods, etc.). In the event of additional, short notice volume demands, such as could occur during the ramp-up of large scale dispersant production, there may not be enough slack capacity in the supply chain, at least initially.

In order to provide a "buffer" for these situations, large global industry-owned stocks have been established, e.g., such as the Global Dispersant Stockpile (5,000 m3 of dispersant located strategically) managed by Oil Spill Response Limited.

***Dispersant resupply for aviation:***

In order to maximise the number of flights possible in any one day, an aviation operating base needs to be able to reload the dispersant application system in the quickest and safest way possible. To achieve this, consideration should be given to creating and staging a dedicated loading team who are trained and prepared to load/reload spray aircraft as soon as they arrive. It is important to consider that the dispersant loading operations are dependent upon the type of dispersant storage container that are used. For example, large ISO storage containers are the quickest to load (as one connection between the system and the storage container is required to continuously pump until full) and drums require the greatest amount of time since there is more manual labour involved in managing the hose connections.

***Dispersant resupply for vessels (both surface and subsurface use):***

The main challenge in dispersant resupply for vessels is the consideration of transporting the dispersant to the area where it is to be used. The options are either to load the dispersant application vessels dockside and transit to the site or use alternative "shuttle" vessels to transport the dispersant to the spray vessels in the field, noting that if the dispersant application vessels are required to return to base to re-supply then dispersant spraying operations will cease during the loading and transit time. This might be acceptable in the case of short transit times or if transit and resupply can occur during darkness hours when spraying operations cannot normally be conducted.

While the shuttling of dispersant to the application vessels means that no additional vessel-based spray system is needed for uninterrupted operation, ship-to-ship transfer of dispersant (either transferring containers or pumping liquid from vessel to vessel) should only be carried out after a thorough risk assessment and in conjunction with all operating procedures and within local governing regimes. A possible alternative solution which provides similar benefits if the infrastructure exists is to load the dispersant from the shuttle vessel onto an operating platform and then back from the platform onto the dispersant application vessel, as the operating platform can provide a more stable lifting platform than a vessel.

**Dispersant and Incident Management**

In coordinating a successful dispersant response a variety of roles within a Responsible Party's (RP) incident management team (IMT) will require a specific appreciation of how dispersant works and how it is applied. The following section summarises the impact of a dispersant operations from an Incident Management System (IMS) perspective, i.e., with consideration of the specific IMS-defined section responsibilities. (Ref: Incident Management System for the Oil and Gas Industry: Good Practice Guidelines for Incident Management and Emergency Response Personnel- IOGP / IPIECA 2014).

The primary dispersant exposure that Planning Section members are likely to be engaged in during a response focuses on the development of a response plan and whether dispersant use is a relevant, incident-specific response option. This cannot be completed in isolation, but will be discussed with the Operations Section, often with the involvement of a Planning/Operations liaison, to ensure that the practicalities of developing and deploying specific tactics associated with the response options remain viable. This level of knowledge on dispersant application will often call for support from technical specialists.

From a Preparedness perspective, identifying and embedding these Technical Specialists within the IMS framework prior to their requirement in a spill is a useful exercise. This is also the case with respect to exercising the decision making criteria associated with the possibility of dispersant use.

One of the biggest focus areas within the Planning Section is within the Environmental Unit and will involve the infield monitoring of dispersant application effectiveness, potentially including fluorometric monitoring, water sampling for future evaluation, and interpretation of results.

Dispersant-related responsibilities within the Operation Section will include the Section Chief (OSC)/Deputy Section Chief (Deputy OSC) and involve discussion on the practicalities of the application of specific tactics for the strategies developed within the Planning Section.
In more practical terms the operational exposure will focus in three main areas, including:

***Air operations***

Coordinating dispersant application via plane or helicopter, the Air Operations Branch will be required to organise spotter aircraft in order to ensure the optimal application of dispersants. The staff within the Air Operations Branch will require a solid working knowledge of the potential technical limitations and operational constraints of dispersant application in order to not overstretch their area of operations. The staff within this branch will also be required to understand the specifics of the dispersant burn plan so that accurate accounting of dispersant consumption rates can be obtained and relayed to the Planning and Logistics sections.

***Vessel operations***

Vessel-based application of dispersants whether, organised as a Task Force, Strike Team, Group or Branch (all definitions within the ICS/IMS framework) will require close coordination with the Air Operations Branch to ensure areas of operation don't overlap or conflict. The staff involved in this operation will require a good knowledge of the limitations and constraints of dispersant application, as in the case of air-based operations, but will also need a good knowledge of monitoring protocols since these are typically worked from vessel-based platforms.

***Sub-surface dispersant application***

An area that has only recently gained attention as a result of the 2010 Macondo spill response, this is the most complex area to be addressed in terms of where it resides with the structure of the IMT. It may be that sub-surface activities are viewed by the RP as an integral part of well-related activities and the efforts associated with source control and thus, grouped in this area of operations. In some instances this may even result in sub-surface dispersant activities residing within an Incident Command Post (ICP) dedicated to Source control. This will all largely depend on the scale of the incident and the manner in which the Responsible Party incident and area commands evolve. Regardless of where this operation sits a detailed knowledge of dispersants is required as will very close liaison with the Planning Section and Environment Unit regarding monitoring of this application.

Within the Logistics Section, the involvement with dispersant-related activities will centre on the procurement of the necessary dispersant stocks. This will require closely liaising with both the Planning Section and Operations Section in order to monitor the rate of consumption compared to the supply rate that is arranged through the Procurement Unit. Coupled with this is the identification of suitable storage and staging sites for incoming dispersants. This can quickly become a challenge with the possibility of several plane-loads of dispersant being delivered each day in certain scenarios.

The Command Section will, broadly speaking, only require a high level awareness of the dispersant approval process, operational plans and its actual use. One possible area where the Command Section would benefit from greater awareness of dispersant operations relates to the knowledge of the Public Information Officer (PIO). The PIO is often required to communicate information related to complex issues to media and potentially affected communities and stakeholders through outreach programmes and their role can be enhanced when they work closely with available dispersant subject matter experts.

The discussion so far has focused on the technical aspects of when, where and how to deploy dispersants. When done in an effective manner, the use of dispersants can greatly mitigate the potential impacts of an oil spill. However, it should be noted that a successful oil spill response is rarely judged on its technical merit alone but will necessarily include a well-managed programme of regulatory, stakeholder, and media engagement.

Successful engagement with the media has become an increasingly important component of a successful use of dispersants during a spill response. It is unfortunate that a majority of the public, and indeed many people within the oil and gas industry and government regulatory agencies, do not understand how dispersants work or the potential advantages and trade-offs (recalling the NEBA process describe earlier) that are considered before their use. It is this lack of awareness and possible misunderstanding of the issues associated with dispersants that leads to scepticism over their use. Collectively this can result in broader negative feelings towards the perceived success of the response and a challenge to the decision-making process.

So how can this be avoided?

This requires a structured programme of developing increased awareness within different groups requiring different approaches.

| Community | Dispersant Outreach Options | |
|---|---|---|
| | Before and after an incident | During the incident |
| Public | Engaging with critical stakeholders such as the fisher community and environmental groups providing awareness of the potential balances and trade-offs of response options; providing training in response techniques for better understanding | Town hall meetings covering the basics of the spill response tool box and how dispersants fit within the context – focusing on how they work, their benefits and limitations and how they are appropriately used during a spill; include details on the decision-making (NEBA/SIMA) process.<br><br>Use of spill response community and governmental websites to explain the response. |
| Government | Engage with government regulatory personnel to initiate/continue discussions on dispersant use during Oil Spill Contingency Plan (OSCP) submission.<br><br>Invite government representatives to training on dispersant use and engage during exercises. | An effective establishment of Unified Command .<br><br>Discussions regarding plan development and approval of dispersant use and required monitoring<br><br>Discussions on monitoring results and how this relates to effective dispersant use and ongoing approval-related |

| | | |
|---|---|---|
| | | discussions. |
| Industry | Ongoing industry information development and sharing through conferences and workshops<br><br>Routine and shared training experiences (See below) | Involving key personnel from other organisations to witness, evaluate, or support the incident-specific activities and thus build broader practical knowledge within the industry |
| Academic institutes | Supporting institutions in gaining awareness of response techniques, assessing and critically analysing dispersant studies against real world application and challenges. | Encouraging these institutions to study the use of dispersants in a real world context and thus deepen everyone's knowledge and the benefits and possible trade-offs of its use. |

At this stage it is important to acknowledge that none of the above could take place without a structured programme of training and continuous professional development to ensure ongoing competency. So what does an effective training programme look like?

| Course | Attendees | Dispersant specific description |
|---|---|---|
| IMO Level 3 or equivalent (Strategic) | Senior Managers and Administrators | Covers regulations concerning dispersant and pre-use considerations, the use of a dispersant decision tree in planning a response. Focus is given to understanding the concept of net benefit and trade off when authorising or agreeing strategies and that sometimes overriding political considerations may overrule technical choices. It is important to have the compensation implications discussed. |
| IMO Level 2 or equivalent (Strategic / Tactical) | Supervisors and On-Scene Commanders | A greater balance of practical and theoretical understanding including the ability to describe the basic principles of how dispersants work, the advantages, disadvantages and limitations of their use, the different application techniques and policy considerations concerning the use of dispersants |
| IMO Level 1 or equivalent (Tactical) | First Responder | A practical understanding of how dispersants work, where and when they can be applied from the technical viewpoint, and limitations in their use. Demonstrating the ability to Identify the types of dispersants used today |
| Dispersant workshop | All | Specifically designed training to meet the knowledge requirements of the targeted audience. Can cover everything from in-depth theoretical knowledge to practical skills and application. |

| **Exercise Type** | | **Frequency** | **Description** |
|---|---|---|---|
| Incident Management Exercise | Once every 3 years | | Such major exercises are designed to test the response arrangements at all levels. This often incorporates decisions made around the authorisation, use and monitoring of dispersant as a response option. These exercises often include the practical use of dispersant delivery equipment in addition to the table top exercise. |
| Tabletop Exercise | Once per year | | Used to test the emergency management knowledge and capability, and also allow personnel to become familiar with responsibilities and identification of resources. Such exercises should involve other stakeholders to test the coordination of various groups. This often incorporates decisions made around the authorisation, use and monitoring of dispersant as a response option. |
| Practical exercise | Boat spray | Monthly | The start-up of boat spray equipment and the pumping of water to simulate dispersant |
| | Aerial deployment | 1-3 years depending requirements | The use of either heli-buckets or plane-based platforms to test spot treatment and large scale application respectively. |
| | Dispersant monitoring | 6 monthly | The use of equipment to monitor a simulated dispersant application. This can be conducted in the laboratory or in the field. |

During training, in order to make engagement count, a technical expert must understand how attendees actually learn best. For instance, impactful and deep learning is more likely to occur when the students have a sense of ownership, when learning is made highly relevant to them and when it draws upon their own experience and mental models of the world. (Montgomery & Couch, 2015). This points towards the fact that individuals are engaged best when they are responding to challenges that require them to think deeply, to feel something, to actively do and then reflect on what is being communicated. Table top demonstrations of dispersants provide an excellent example of this teaching style, especially if the learners actively conduct the demonstration themselves and if this is contextualised using everyday items such as dish washing liquid and other household goods. The importance is that the learner reaches the conclusion themselves rather than being told the conclusion, as is so often the case.

## Conclusion

This paper has sought to highlight the wide range of considerations needed for effective planning for dispersant operations as part of an overall response strategy. To answer the fundamental questions of whether dispersant application is possible, beneficial and feasible the authors have shown that pre-planning is absolutely essential. Furthermore, the planning must go beyond purely technical considerations but must also address the wider context of this important response technique including training and education to overcome negative perceptions founded on fear and mis-information.

Regarding the technical considerations, planners must be open, consultative and fully engaged with potentially impacted stakeholders to collectively achieve consensus on the best scientific and technical approach, recognising that dispersants is one part of the responders toolbox. If dispersant use is possible, beneficial and feasible then the supporting logistics also need to be planned for in terms of product supply and availability of platforms (vessels, aircraft or sub-sea application tools), and in timescales needed for this time –critical intervention to be effective.

In a response dispersant use must be fully integrating into the Incident Management System and will impact many aspects of the management structure such as Command for decision making, public information and stakeholder communications. Dispersants will also feature in the functional elements of incident management including Planning, Logistics, and multiple aspects of Operations such as aviation support, vessel support and potentially sub-sea intervention.

All of these considerations should be built into a programme of training and exercising, for both management and operations which are essential to the use of this valuable response tool in the context of effective response to marine oil spills.

It all comes down to making agreed decisions, based on experience, good science and an understanding of the technical, operational (and sometimes emotional) context that this response technique can generate. Such decisions are best made in the contingency planning stage for operational expediency when the worst happens

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