# Oil spill dispersants: Developments in regulations and industry perspectives

**A background discussion paper**
**for a dispersant session**
**at Interspill 2012**

## 1. THE ORIGIN OF DISPERSANT REGULATIONS

Regulations concerning oil spill dispersants were first introduced in the UK after the use of industrial detergents during the response to the *Torrey Canyon* spill in 1967. Very large amounts of industrial detergents were used at sea and on the shoreline in an attempt to clean up the spilled oil. The industrial detergents that were used were subsequently found to be acutely toxic to marine organisms because they contained solvents with a high content of aromatic compounds. These compounds, often referred to as BTEX (Benzene, Toluene, Ethylbenzene and Xylenes) are exactly the same compounds found in spilled crude oils and now known to be responsible for some of the acutely toxic effects caused by oil spills. The detergents were also found to have been not very effective. Large quantities of detergent had been used at very high treatment rates often approaching one part of detergent to one part of spilled oil. Approximately 10,000 tonnes of detergents were used to treat the estimated 14,000 tonnes of oil that came ashore on the beaches of Cornwall. In many cases, the detergent/oil mixture was flushed off with freshwater from fire-hoses. The negative effects on coastal and marine organisms caused by the use of these detergents were severe (Smith, J. E., 1968).

The UK authorities introduced two sets of regulations:

i. **<u>Dispersant approval regulations</u>** that required that dispersants be tested to ensure a low level of inherent toxicity and a minimum level of effectiveness before they could be approved for use on spilled oil in UK waters. Dispersants had to be tested:

a) <u>Toxicity testing of the dispersant to ensure less than a maximum permitted level of toxicity.</u>

A 48-hour $LC_{50}$ toxicity test procedure with brown shrimp (*Crangon crangon*) using only dispersant (Portmann, 1972; Wilson 1974) was used until 1976. The industrial detergents used at the *Torrey Canyon* had $LC_{50}$ values of around 6 ppm as assessed by the test procedure with brown shrimp (*Crangon crangon*). The low-toxicity UK Type 1 dispersants introduced in the early 1970s typically had 48-hour $LC_{50}$ values of >3000 ppm. It became impossible to generate the range of dispersant concentrations in water necessary to establish the $LC_{50}$ value because at the very high concentrations in water required, the dispersant formed a layer on top of the water.

b) <u>Efficacy testing to ensure that the dispersant produced more than an acceptable minimum level of effectiveness.</u>

Candidate dispersants were tested in a small-scale harbour test using small boats. Dispersant was sprayed onto a small slick of test oil and an 'agitation device' (a wooden pallet) was towed through the dispersant-treated slick from one boat. A second boat carried a panel of people who made visual estimations of the effectiveness of the dispersant. This was time-consuming, relatively expensive and subject to weather restrictions. The Labofina rotating flask method, originally developed by the Fina oil company in Belgium, was selected and subsequently modified and formalised to become the WSL (Warren Spring Laboratory) LR 448 efficacy test method and was adopted in 1983.

Dispersants that met the specified requirements were placed on an approved UK dispersant list.

ii. **Dispersant use regulations** that required that prior permission be sought and obtained before dispersants could be used on spilled oil in shallow water (legally defined as the 20 metre depth as marked on the charts or within 1 nautical mile of this depth). The use of dispersants on spilled oil in water depths of greater than 20 metres does not require prior permission, but the use of dispersants on spilled oil in water depths of 20 metres is only allowed after prior permission has been granted.

The original justification for this depth was that, under moderate seas conditions, dispersed oil would be dispersed into approximately the upper 10 metres of water depth. It was considered that it would be undesirable for the dispersed oil to come into contact with the sea bed as this could cause negative effects to the benthic organisms that live there. Dispersant use on spilled oil floating on water in shallow (10 metre depth) water needed to be regulated. In order to provide a "safety margin the water depth of 20 metres was selected.

Subsequent experience has shown that where dispersants are used on spilled oil in circumstances of adequate water depth and water exchange, the dispersed oil concentration will rapidly decline as the dispersed oil is diluted vertically and horizontally. Marine organisms inhabiting a small volume of water will be exposed to a brief 'pulse' of elevated dispersed oil concentration that rapidly declines. Past experience from the *Braer* and *Sea Empress* oil spills has also shown that any negative effects on marine organisms caused by a short exposure to elevated dispersed oil concentrations are likely to be localised and temporary. In contrast, the effects of oil drifting into coastal habitats can be severe and long-lasting. On the other hand, if dispersants were to be used on spilled oil in shallow water, the exposure of marine organisms would be to higher concentrations of dispersed oil for a much longer duration and this could be potentially harmful.

## 2. EXAMPLES OF CURRENT NATIONAL APPROACHES TO DISPERSANT REGULATION

The UK regulations described in the previous section have been modified over time and many other countries have developed test protocols and regulations that control dispersant use on spilled oil in national waters.

Some of these countries have two parts to the regulations consisting of (i) Dispersant approval regulations with specified toxicity test and effectiveness test procedures, and (ii) Dispersant use regulations that specify where dispersants can be used on the basis of a minimum water depth and distance from shore. Other countries have followed slightly different regulatory routes

### 2.1 FRANCE

In France, chemical dispersion is one response option: dispersants are used when deemed suitable in the given conditions (especially to combat large quantities of oil) and when environmental considerations allow.

In the late 1970s certain administrative regulations were introduced for selecting the dispersants which may be used. This selection method based on efficiency, toxicity and biodegradability measurements was revised in 1989. Following the major Amoco Cadiz oil spill (1978), for environmental purposes, in order to restrict the use of chemical dispersion in coastal waters, a geographical limit was defined along the French coast. This limit determined on the basis of major spill scenarios (>10,000t). In the 1990s, this limit was revised by Cedre based on more common spill scenarios.

These specifications (product approval and geographical limits) are simply recommendations upon which the French Navy – in charge of operations at sea – bases its decisions.

#### 2.1.1 French Dispersant Approval Regulations (Full information available at www.cedre.fr).

The current approval procedure for dispersants aims to select the most appropriate products and is based on the following standard (AFNOR) laboratory tests, in chronological order: efficiency test, toxicity test and biodegradability test. Cedre is in charge of the approval process and publishes the list of approved products

The efficiency test is conducted with low mixing energy in order to select the most efficient dispersant, able to disperse even in low energy conditions. The toxicity test is conducted on the dispersant alone[(1)] and compares, on shrimp, the dispersant with a reference toxicant. The biodegradability test is performed on the dispersant alone.

In addition, the national operational stockpiles undergo periodical controls on the dispersant's quality, upon purchase and, thereafter, every 2 years.

*Footnote*

(1) The approval procedure aims at selecting the most efficient products. However, the more efficient a product *is the more toxic the dispersed oil emulsion will be. The consideration of the toxicity of the dispersed oil would therefore lead to the rejection of the most efficient products. The French approval procedure therefore only considers the intrinsic toxicity of the dispersant itself.*
*The toxicity of the dispersed oil is taken into account when dealing with the conditions for dispersant use, either in actual operations or in contingency planning, when indicating where and to what extent dispersants can be used according to the local environmental sensitivity.*

### 2.1.2 French Dispersant Use Regulations

General geographical boundaries have been defined along the coast of France, beyond which the use of dispersants can be considered without major risks for the marine environment. Three boundaries have been defined [(2)] based on oil spill scenarios of up to 10, 100 and 1000 tonnes, taking into account the dispersion/dilution potential (minimum depth [5, 10 and 20 m], minimum distance from the shore [0.5, 1 and 2.5 NM], tidal current) and local biological factors (presence of sensitive resources). These boundaries have been defined in order to allow operational responders to quickly decide on the use of dispersant, while minimising the environmental risk. Inside these boundaries, special precautions must be taken when using dispersants: dispersant use may be considered but requires consultation with the relevant bodies (operational and scientific) of the French administration.

In addition to these general limits, for some specific coastal areas such as estuaries, harbours...., specific emergency response plans may define the conditions for dispersant use according to the specific local ecological conditions.

*Footnote*

*(2) 2nd IMO R&D Forum, London 1995, Sensitivity maps: the actual limits for dispersant application and operational limits for dispersant application.*

## 2.2 NORWAY

In Norway, any enterprise in charge of oil handling operations (e.g. oil terminals, refineries, offshore oil fields) are obliged to submit oil spill contingency plans where they have to evaluate which response options lead to the overall least environmental impact. If such scenario-based analysis (also called Net Environmental Damage and Response Analysis – NEDRA) show that dispersants may be an appropriate countermeasure in relevant oil spill scenario, the use of dispersants must be documented as a combat strategy in their oil spill contingency plans.

The Climate and Pollution Agency (Klif), under the Ministry of Environment, is the regulator for the pollution preparedness requirements and considers the enterprises' oil spill response analyses and can make specific requirements to include the use of dispersants in the contingency plans and also specific requirements on the capacity of the application system. Norway adopted the present regulations for dispersants usage in 2002. Some minor revision of the regulations entered into force in 2009. This was linked to the inclusion of shoreline cleaning agents into the same regulations, and that the Norwegian Coastal Administration (NCA) became the supervising authority when an incident occurs. There was no change in the national policy regarding dispersant use. (http://www.klif.no/artikkel____34957.aspx ).

### 2.2.1 **Norwegian Dispersant Approval Regulations**

There are dispersant testing protocols both for acute toxicity and effectiveness. There is no official approval list of the dispersants, however, the requirements of the regulation must be fulfilled and documented in all contingency plans involving use of dispersants. The toxicity test method determines the acute toxicity of the dispersant alone, by testing it on a planktonic algae (*Skeletonema costatum* test, ISO/DIS 10253). This is one of the standardised internationally accepted ecotoxicity tests used by the "OSPAR" Convention. Use of dispersant concentrates with $EC_{50}$ < 10mg/l are prohibited. In a recent research study, the *Skeletonema costatum* exhibits a good correlation to other pelagic PARCOM test organisms representing other trophic levels. For use of dispersant on shorelines, a specific toxicity test on a sediment amphipod (*Corophium volutator*, ISO /TC 147/ SC 5) is recommended.

Enterprises that produce or process oil, have to prove the effectiveness of the dispersants on their own oils, using the IFP dilution test, which is the same “low energy” test as used in France. There is therefore no specific effectiveness threshold for approval, as different oils are used. The aim of the screening is to select the most effective dispersants and to optimize the dosage ratios required for the specific oil. The enterprises also have to test the dispersibility at varying weathering degrees for the relevant oil in order to estimate the “time window” for effective use of dispersants under various turbulence conditions. For this, the IFP test is used in combination with the MNS (Mackay, Nadeau and Steelman) test, representing two turbulence conditions. For enterprises required to have response system, but are not linked to specific types of oils, must document the dispersant effectiveness using a "standard" crude oil (weathered Sture Blend) and a Medium fuel oil (IFO 180) using the WSL test.

### 2.2.2 Norwegian Dispersant Use Regulations

Climate and Pollution Agency (Klif) and the Norwegian Coastal Administration (NCA) have issued documents / guidelines that clarify the assessments needed to be documented in oil spill response analyses and in the oil spill contingency plans or before dispersants can be used. Two documents, a "Control form" and a "Decision matrix", have been compiled. The needed assessment before use includes information on e.g.: weathering properties, the chemical and natural dispersibility of the relevant oil, vulnerable natural resources/sensitive areas, salinity of the water, depth and distance to shore, possible stranding of oil, wind conditions, strategy for spraying of dispersants, operations in darkness, spraying capacity, monitoring for assessing efficacy and criteria for terminating the dispersant treatment operation. A methodology for conducting oil spill response analysis of relevant discharge scenarios including use of dispersants has been developed. The methodology forms a basis for preparing generic actions plans most suited to an individual oil spill situation. Enterprises that have such documentation and evaluation in their contingency plans, can submit the simple "Control form" and an eventual dispersant operation can be initiated immediately. If such documentation is not included in the contingency plans, a specific application for using dispersants is needed.

## 2.3 UNITED KINGDOM

### 2.3.1 UK Dispersant Approval Regulations

**Development of UK toxicity testing for dispersant approval**

The industrial detergents used at the *Torrey Canyon* had $LC_{50}$ values of around 6 ppm as assessed by the test procedure with brown shrimp (*Crangon crangon*). The low-toxicity UK Type 1 dispersants introduced in the early 1970s typically had 48-hour $LC_{50}$ values of >3000 ppm. It became impossible to generate the range of dispersant concentrations in water necessary to establish the $LC_{50}$ value because at the very high concentrations in water required, the dispersant formed a layer on top of the water.

It was decided that the toxicity of the dispersant alone was not the relevant factor to consider. Dispersants would only be used on spilled oil and it was known that the toxic effects of dispersed oil would be greater than that of the dispersant. A new ‘at sea’ toxicity test procedure using dispersant and Kuwait crude oil was developed (Blackman et al, 1977).

There are currently two toxicity tests (Kirby et al., 1996). The first test is called the Sea Test and is carried out using the brown shrimp (*Crangon crangon.*) This test compares the relative toxicity of an oil-dispersant mix to that of oil alone. The second test is called the Rocky Shore Test and is carried out using the common limpet (*Patella vulgate*). This test compares the toxicity of dispersant alone to that of the standard test oil.

All products except a class call "offshore dispersants" must pass both tests to become approved products. Offshore dispersants do not need to pass the Rocky Shore Test, but cannot be used within 12 nautical miles of the territorial baseline.

**Development of UK efficacy testing for dispersant approval**

Products are tested for conformity to the specifications outlined in appendix A to WSL Report LR448. This includes aspects of appearance, dynamic viscosity, flash point, cloud point, miscibility and efficiency. Efficacy is determined by a standard laboratory-based procedure described in annex 1 to appendix A WLS Report LR448, often called the WSL (Warren Spring Laboratory) test method. The efficacy test aims to assess the proportion of the total volume of treated oil that is dispersed into the water column. The minimum efficacy requirements depend on the type of dispersant being tested. Type 1 (hydrocarbon solvent-based dispersant applied undiluted) and Type 2 (concentrates diluted 1:10 with seawater before application) must achieve an efficacy of 30 per cent. Type 3 (high efficacy concentrates applied undiluted) must achieve an efficacy of 60 per cent.

Copies of the test protocol described above is available on the MMO website at www.marinemanagement.org.uk/protecting/pollution/documents/approval_lr448.pdf

### 2.3.2 UK Dispersant Use Regulations

The Marine and Coastal Access Act 2009 requires a licence to be issued for the deposit of any substance or article in the sea and the Marine Licensing (Exempted Activities) Orders for the different UK devolved administrations provide for exemptions to be made for the deposit of a substance for the purpose of treating oil in the sea, subject to the following conditions:

Only products from the UK approved product list may be used.

Any use must be in accordance with conditions of approval of the product.

The permission of the licensing authority is obtained for all uses in shallow water. Shallow waters are defined as areas of the sea where the water depth is less than 20 metres or within 1 nautical mile of any such area.

The permission of the licensing authority is also to be obtained before any use under the surface of the sea.

The relevant licensing authorities for spills from sources other than oil and gas production are:

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|---|---|
| England: | MMO |
| Wales: | MMO on behalf of Welsh Government |
| Scotland: | Marine Scotland |
| Northern Ireland: | Northern Ireland Environment Agency |

In the case of spills from oil and gas production, DECC are the licensing authority, but the above organisations currently give approval on behalf of DECC.

## 2.4 UNITED STATES OF AMERICA

### 2.4.1 US Dispersant Approval Regulations

The US EPA (Environmental Protection Agency) lists all dispersants that have been authorized for use in Subpart J of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). While the listing of a dispersant on the schedule does not constitute EPA's approval of the product for use on an oil spill, it is a prerequisite that makes the product lawfully available for use in oil spill response activities. The EPA requires effectiveness and toxicology tests to be conducted and the results reported for dispersants.

**Dispersant effectiveness testing**

The Swirling Flask effectiveness test method with Prudhoe Bay and South Louisiana crude oils is used. This protocol was developed by Environment Canada to provide a relatively rapid and simple testing procedure for evaluating dispersant effectiveness (2). It uses a modified Erlenmeyer flask to which a side spout has been added for removing subsurface samples of water near the bottom of the flask without disturbing a surface oil layer. A dispersant must attain an effectiveness value of 45 per-cent or greater to be added to the NCP Product Schedule. Manufacturers have to submit test results and supporting data to the EPA.

**Dispersant toxicity test**

The standard toxicity test for dispersants and other products involves exposing two species (Menidia beryllina (silversides) and Mysidopsis bahia (mysid shrimp)) to five concentrations of the test product and No. 2 fuel oil alone and in a 1:10 mixture of product to oil. To aid in comparing results from assays performed by different workers, reference toxicity tests are conducted using dodecyl sodium sulfate (DSS) as a reference toxicant. The test length is 96 hours for Menidia and 48 hours for Mysidopsis. $LC_{50}$ s are calculated based on mortality data at the end of the exposure period.

Following the use of dispersants at the Deepwater Horizon / Macondo incident in 2010, the EPA announced that the dispersant approval testing regime was going to be revised.

### 2.4.2 US Dispersant Use Regulations

Dispersant use regulations in the USA are organised on a regional basis. The NCP requires the development of Area Contingency Plans (ACPs), prepared by a designated "Area Committee" comprised of federal, local, and state officials and approved by the EPA and the Coast Guard. In addition to ACPs, Regional Response Teams (RRTs) are responsible for developing and maintaining Regional Contingency Plans (RCPs).

Some RCPs have "pre-authorised" dispersant use in some areas dependent on water depth and distance from shore. For example, in RRT 4 (Mississippi, Alabama, and Florida) dispersant use is pre-authorized for designated "green zone" areas, which are defined as offshore areas at least three miles from shore where the water is at least ten meters (33 feet) deep (>65 feet in Florida). RRT 6 (including Louisiana and Texas) also uses the at least three miles from shore where the water is at least ten meters (33 feet) deep. RRTs that have pre-authorised dispersant use zones issue Dispersant Pre-Approval Guidelines and Checklists. The RRT 6 Guidelines provide pre-approval authority to the Federal On Scene Coordinator (FOSC) for dispersant use.

## 2.5 OTHER COUNTRIES

**China**, **Russia**, **Japan** and **Korea** have developed their own regulations about dispersants:

http://dinrac.nowpap.org/documents/NOWPAP_MERRAC_Technical_Report_No3.pdf

Some countries have used exactly the same effectiveness test procedures as those used elsewhere, but modified the toxicity test procedures test methods to use local marine organism. For example, Australia, New Zealand and India use the UK effectiveness test procedure but some have developed its own toxicity test procedure.

**Australia**

http://www.amsa.gov.au/marine_environment_protection/national_plan/general_information/dispersants_information/OSCAgentsStandards.pdf

**New Zealand**

http://www.cawthron.org.nz/coastal-freshwater-resources/downloads/oil-spill-dispersants-v2.pdf

**India**

http://www.indiancoastguard.nic.in/Indiancoastguard/NOSDCP/NOSDCP%20Publications_files/OSD.pdf

Some countries accept dispersants for use in their own waters that have already been tested and listed in other countries without further testing.

**EU**

Inventory of National Policies regarding the Use of Oil Spill Dispersants in the EU Members States -2010 - EMSA

For example, in Europe, Germany would permit the use of any dispersant that is approved for use in French or UK waters.
http://www.emsa.europa.eu/operations/marine-pollution/item/618.html?cuscat=87

**Mediterranean**

**REMPEC**

http://www.rempec.org/country.asp?IDS=2_0&daNme=&openNum=1

Regional Information System: Part D: operational guides and technical documents: section 2: guidelines for the use of dispersants for combating oil pollution at sea in the Mediterranean region which can be downloaded at:
http://www.rempec.org/rempec.asp?theIDS=2_130&theName=INFORMATION%20RE

**ROPME**

In the Persian Gulf, the ROPME organization accepts the dispersant listed as being accepted or approved in two out of three of France, the UK and the USA.
http://www.ropme.com/

## 3. NEBA (Net Environmental Benefit Analysis)

NEBA (Net Environmental Benefit Analysis) is a process of consideration and judgement to compare the likely outcomes of using different oil spill response methods. Although not mandatory, it is good practice for a NEBA process to be conducted when considering response at any oil spill.

NEBA follows a logical series of steps:

i. Identify the resources, both ecological and human-use, that could be affected by the spilled oil.
ii. Review past experience to estimate the capabilities, limitations and consequences of using different oil spill response methods. The possible oil spill response methods available are:
    a) Containing the oil with booms at sea and recovering the spilled oil with skimmers.
    b) Protective booming of particularly sensitive coastal sites.
    c) Use of controlled, or in-situ, burning.
    d) Use of dispersants.
    e) Shoreline clean-up.
iii. On the basis of previous experience, predict the likely environmental outcomes if the proposed response is used.
iv. Compare and weigh the advantages and disadvantages of possible responses with those of no response.

NEBA is not a mathematical process, equation or formula that will produce a 'definitively correct' result of the best response method to use at a particular oil spill on the basis of specified inputs, although the inputs may be used in models to forecast outcomes. NEBA requires decisions to be made on the basis of an in-depth understanding of the relative impacts of spilled oil and the probable capabilities and consequences of response options. Both short-term and long-term impacts need to be considered. Each oil spill response method has certain capabilities and each has limitations. As originally conceived, NEBA has a very wide remit. The practical capabilities of all oil spill response methods were considered in addition to the ecological considerations. For example, if the circumstances of a particular oil spill precluded the use of a response method, then other response methods or no response method at all, would be considered in the NEBA process:

- This could be the case if a very high-viscosity oil (such as M100 mazut) was spilled in a cold, calm sea. Dispersant use would be considered, but would be most probably be assessed as likely to be ineffective and other response methods, such as booming and skimming, would be considered. The capabilities of booming and skimming, in terms of the equipment that could be made available and the time that operations at sea would take, would then be assessed to make an estimate of how the use of booms and skimmers would alter the outcome, compared to no response being taken.

- Similarly, at a spill of crude oil in a rough sea with high winds, the assessment might conclude that the sea conditions precluded the effective use of booms and skimmers, or *in-situ* burning, and that the use of dispersants would be the only response method that was feasible. The consequences, both positive and negative, of dispersant use would then be considered.

The use of NEBA is recommended in many guidelines on oil spill response. An essential part of NEBA is considering all the facts about the probable outcome of an oil spill, given the particular circumstances of its occurrence. NEBA can be used to assess the likelihood of different response methods achieving the aim of minimising the overall impacts that could be caused at a specific oil spill incident.

### 3.1 NEBA and dispersant use

Using NEBA to consider dispersant use involves weighing-up the potential advantages and disadvantages of dispersant use on spilled oil.

- *The potential advantages of dispersant use*
  The successful use of dispersants on spilled oil will remove the oil from the sea surface by transferring it into the water column. The benefit of using dispersants on spilled oil is that the oil that has been dispersed will not drift ashore as the oil on the sea surface could. This is the potentially positive side of the NEBA 'trade-off' of dispersant use. Whether or not this potential benefit of dispersant can be realised depends on the circumstances of the oil spill. Oil spill contingency plans should include mapping of sensitive resources (ecological and human use) on the coast. Knowledge of prevailing winds and currents can be used to estimate whether these would be threatened by spilled oil drifting at sea and subsequently coming ashore. If a particularly oil-sensitive resource would be contaminated by oil, the use of dispersants could be used to prevent this occurring.

- *The potential disadvantages of dispersant use*
  Marine organisms inhabiting the upper water column will be exposed to an elevated concentration of dispersed oil droplets in the water column, compred to the situation if dispersants were not used. This is the negative side of the NEBA 'trade-off' of dispersant use; the potential for negative effects on marine organisms caused by exposure to elevated concentrations of dispersed oil in the water column. The specification of a minimum water depth for dispersant use on spilled oil in dispersant use regulations indicates that this negative aspect of dispersant use will be minimised if dispersants are used on spilled oil in relatively deep water.

One of the often misunderstood aspects of dispersant use is that it is sometimes incorrectly portrayed as simply transferring the amount of damage that could be done by spilled oil from the sea surface and into to the water column; a simple 'trade-off', a choice between an amount of damage on the coast, or the same amount of damage in the water. In game theory, this would be known as a "zero sum game"; the total amount of damage caused by the spilled oil remains the same and the use of dispersants simply redistributes the damage from the coastal resources to the marine resources. If this was true, and using dispersants only altered the location of damage caused by the oil without any reduction in the total amount of damage caused by the spilled oil, dispersant use would not be justified on the basis of NEBA.

While the oil is transferred from the sea surface and into the water column by dispersant use, the magnitude and duration of potential damage that could be caused by the spilled oil in these two compartments (oil-sensitive coastal habitats and marine ecosystems) is often significantly different.

Past experience at several major oil spill incidents has shown that any negative effects on marine organisms caused by the elevated dispersed oil concentrations in relatively deep water due to dispersant use were often localized and of short duration. Ecological studies and monitoring following major oil spills have repeatedly shown that the populations and communities of water column organisms (the algae and zooplankton, larger invertebrates and fish) can recover much more quickly from brief exposure to dispersed oil in the water than the populations and communities of birds, mammals, sea-grasses, or mangroves that may be exposed to oil that comes ashore. It can take years to decades for some of these shoreline communities to recover from oiling, whereas many water column communities can recover in weeks to months. The marine environment is, in general, more resilient that the coastal environment and natural recovery will take far less time.

An essential element of NEBA of dispersant use is that it will be specific to the circumstances of a particular oil spill:

i. If a particularly oil-sensitive coastal habitat is threatened by spilled oil and the sea conditions make other oil spill response options unfeasible, dispersant use might be justified in even in shallow water. The advantage, or benefit, of using dispersant use to minimise shoreline oiling and therefore prevent a lot of persistent and long-lasting damage could be very high compared to the significant, albeit short-term, damage that might be caused to the marine organisms.

ii. The use of dispersants cannot be justified by NEBA in generalised or abstract terms; if no oil-sensitive coastal resource is likely to be affected, what would be the justification for dispersing the spilled oil? It might be considered that dispersing the oil into shallow water would avoid the time-consuming and expensive process of shoreline clean-up, but the damage that might be caused to the marine ecosystem may be significant. The balance between the advantage and disadvantage of dispersant use would be different from the first case.

The use of NEBA involves weighing up the potential advantages (or benefits) of dispersant use compared to the potential disadvantages (or risks) of dispersant use.

The magnitude and severity of the damage that could be caused to oil-sensitive coastal resources by spilled oil drifting ashore varies depending on the proximity of the spilled oil to these resources and other factors such as the species in the potentially affected habitats. The benefit of using dispersants on spilled oil to minimise shoreline contamination and thus prevent damage from being caused also varies, depending on the precise circumstances of the oil spill. Similarly, the magnitude and severity of the damage that could be caused by temporarily elevated dispersed oil-in-water concentrations depends on many factors including the organisms likely to be affected and the exposure regime to dispersed oil that they would experience.

NEBA for dispersant use therefore involves comparing;

a. The estimated outcome of not using dispersants, and therefore estimating the magnitude and severity of damage that could be caused to oil-sensitive coastal resources, with;

b. The estimated outcome of using dispersants. This includes the positive aspect of dispersant use; reduction to damage that would be caused to oil-sensitive coastal resources, but also includes the negative aspect of dispersant use; the increase in magnitude and severity of damage that might be caused to marine organisms by exposure to elevated dispersed oil-in-water concentrations.

NEBA for dispersant use is not a simple comparison of the outcome on one resource (coastal) against another (marine). Isolating only one aspect of the consequences of dispersant use from the others can produce a distorted view of the overall outcome.

### 3.2 NEBA and dispersant regulations

Certain aspects of both dispersant approval regulations and dispersant use regulations seek to address the potentially negative aspect of dispersant use; the elevated dispersed oil-in-water concentrations that marine organisms might be exposed to.

#### 3.2.1 NEBA considerations in dispersant approval regulations

It has long been recognised that the potential for negative effects in using dispersants stems from the potential effects of dispersed oil, not toxic effects that might be caused by the dispersant itself. Most countries have toxicity test protocols in the dispersant approval regulations that require the dispersant to exhibit a lower than specified inherent toxicity to the specified test organism. This provides no useful information in estimating the potential effects of dispersant use, but does ensure that inherently toxic dispersants (such as the industrial detergents used at the *Torrey Canyon*) would not be approved for use.

Having identified that it is the elevated dispersed oil-in-water concentrations that marine organisms might be exposed to that is the cause of real concern, not the inherent toxicity of the dispersant, some dispersant approval regulations, notably the current UK and former USA EPA regulations, use a test oil in combination with the candidate dispersant in the toxicity test protocols. This is designed, to some degree, to simulate dispersant use on a spilled oil at an incident. However, the purpose of toxicity testing for dispersant approval purposes is to compare candidate dispersants and ensure that they produce toxic effects less than some arbitrary 'pass mark'. The exposure regime (concentration and duration) to elevated dispersed oil concentrations that the test organisms are subjected to, in order to get the discrimination between different dispersants, may be far higher than that which would occur with actual dispersant use. Exposing even particularly oil-sensitive test organisms to a more realistic exposure regime may not cause sufficient toxic effects for discrimination between the candidate dispersants.

In addition, the use of a test oil and assessing the toxic effects of dispersed oil on test organisms inevitably discriminates against more effective dispersants. A dispersant that more effectively disperses the test oil than another dispersant will, under the test conditions, produce a greater proportion of smaller dispersed oil droplets. If the toxic exposure route to the marine organisms is through water-soluble compounds liberated from the oil or is through ingestion of dispersed oil droplets, the exposure will be higher with a more effective dispersant, than with a less effective dispersant.

A standardised toxicity test protocol requires that variables such as oil type, degree of oil weathering and the agitation available to create dispersed oil to be fixed, in order that the test regime is repeatable and reproducible. At actual oil spill incidents where dispersants may be used, these are genuine variables and will differ from one spill to the next. The standardisation sought in toxicity test protocols produces an inflexible regime that is of little real use in predicting effect that could occur.

The desire to provide a semi-realistic, generalised estimate of the potential effects of dispersed oil in dispersant approval regulations is understandable, but may be technically incompatible with the original purpose of screening out inherently toxic dispersants.

### 3.2.2 NEBA considerations in dispersant use regulations

The specification of a minimum water depth in dispersant use regulations where dispersants can be used on spilled oil is a rudimentary form of NEBA; it is accepted that the negative effects of dispersant use on marine organisms by causing elevated dispersed oil concentrations in water deeper than the specified minimum depth will be minimal.

## 3.3 Summary of NEBA in dispersant regulations

Both types of regulations, dispersant approval regulations and dispersant use regulations contain some elements of a NEBA. Most concentrate on the potential for negative consequences of dispersant use, the potential for toxic effects to be caused to marine organisms by elevated dispersed-oil-in-water concentrations in the water column, but do not address the potential for positive consequences of dispersant use; the removal of spilled oil from the seas surface so that it will not eventually drift ashore.

Dispersant approval regulations were originally intended to prevent dispersants of high inherent toxicity to be approved for use. Many countries continue to have a 'dispersant only' toxicity test in the approval requirements. The toxicity test results obtained have no relevance to actual dispersant use on spilled oil, but the toxicity test 'pass mark' is set to prevent inherently toxic dispersants from being approved.

Toxicity test protocols that involve the use of a test oil in combination with the candidate dispersant aim to provide some degree of simulation of actual dispersant use as it is the toxic effects of dispersed oil that is assessed. However, the aim of the testing is to discriminate between candidate dispersants so that a dispersant can be assessed to pass or fail an arbitrarily set 'pass mark'. This 'pass mark' may have no relevance to real dispersant use on a variety of spilled oils. The two aims of (i) providing a comparative assessment of the effects of dispersed oil produced by the use of candidate dispersants, and (ii) partially simulating the actual use of dispersants on spilled oil may be technically incompatible.

The results of such toxicity tests are often misunderstood wrongly interpreted. The recent experience of large-scale dispersant use at the *Deepwater Horizon* incident demonstrated that most people failed to understand the significance (or lack of significance) of toxicity results presented for inclusion of dispersants on the US Federal Register. A great deal of confusion and discussion was generated by various individuals and agencies misinterpreting what the toxicity results (generated by using dispersant and No. 2 fuel oil) actually meant - if anything. A toxicity testing regime that generates confusion instead of clarity when dispersants are used at an actual oil spill is of doubtful usefulness.

Dispersant use regulations that specify a minimum depth for dispersant use on spilled oil provide a 'first level' NEBA consideration. However, concentrating on the potential for negative effects that could be caused by elevated concentrations of dispersed oil in the water column without considering the potential benefits that could be gained from dispersant use by preventing shoreline oiling has led to some countries simply prohibiting dispersant use in shallow water.

Incorporating only the potentially negative effects of dispersant use into dispersant regulations inappropriately highlights the potential risks of dispersant use, without an accompanying consideration of the potentially positive outcomes of dispersant use, provides a biased basis for sensible consideration of dispersant use.

## 4. THE NATIONAL AND INTERNATIONAL ASPECTS OF OIL SPILL RESPONSE

### 4.1 National approval of dispersants

It is the right and responsibility of individual national governments to control and regulate the use of oil spill response methods used in national waters to ensure that the response methods do not pose a threat to the health of their citizens or the ecology of the oil spill affected waters. It is therefore right and proper that national administrations develop dispersant regulations to control the use of dispersants in their national waters.

Experience has shown that different counties have used different test methods, and even different test philosophies, in developing test regimes for dispersant approval purposes. Some of these differences are explicable for obvious reasons.

*Perceived oil spill risk*

One of the differences between the regulations of various countries reflects the perception of the threat of oil spills occurring. In some oil-producing countries, such as Norway, the major threat of oil spills is perceived to be from offshore oil production and the transport of crude oils produced from these oilfields. There is also some element of oil spill risk posed by the transport of crude oil from Russia via northern ports and through Norwegian waters, but the dispersant regulations are predicated on a known oil spill threat from fixed locations with oils of known properties.

In other countries, such as France and the UK, the major threat of oil pollution is seen to be from 'passing traffic', marine traffic passing through French waters en route to places like Europoort, or oil tankers importing crude oil into France or the UK. The types of oil that could be spilled and the locations at which they could be spilled are unknown. The test oils used in dispersant effectiveness tests are therefore selected to be 'typical' or 'representative' of oils likely be spilled in national waters, but can be far different from spilled oils encountered at actual oil spills.

*Dispersant toxicity testing: Test dispersant alone or test dispersant plus a test oil?*

For reasons previously described in section 3.2.1, some countries assess the inherent toxicity of only the dispersant while some countries use dispersant toxicity test protocols that use oil and dispersant. The pros and cons of these two approaches have been discussed and debated on numerous occasions, but no consensus has been achieved.

*Dispersants approved for use in more than one country*

Despite these differences in national dispersant approval regulations, some dispersants that are approved for use in national waters, or is specific oil spill contingency plans, are the same in many countries. For example:

- Dasic Slickgone NS is approved for use in French and UK waters and is specified in many Norwegian oil spill contingency plans.
- Finasol OSR 52 is approved for use in French and UK waters and is listed in the US Federal Register.
- Corexit 9500 is now approved for use in UK waters more than 12 nautical miles from the shore, approved for use in French waters and is listed in the US Federal Register.

However, there are many instances of individual dispersants that are only approved for use in one nation's waters. This is most often because the dispersant manufacturer (who has to pay for dispersant testing for approval purposes) finds no commercial reason to get approval for dispersant use in any other than the 'home' countries waters. Many dispersants approved for use in French waters are manufactured in France and many dispersants approved for use in UK waters are manufactured in the UK. There is no particular reason to believe that many dispersants would not be approved in several countries, if the manufacturers chose to submit them for additional testing.

This generates long lists of dispersants that are apparently only approved for use in one country's waters, simply because they have not been submitted for approval in other countries. Although this situation is readily explained on commercial and bureaucratic grounds, it produces and apparent national exclusivity and multiplicity of dispersants approved for use only individual countries.

There have been discussions at different forums, such as EMSA (European Maritime Safety Agency) about moves to harmonise dispersant approval testing regimes, but these have not yet borne fruit.

### 4.2 International stockpiling and use of dispersants

Oil exploration, production and transport are multinational activities on a global scale. Large oil spills, when they rarely occur, need not respect national boundaries and effective oil spill response to significant oil spills will often involve bilateral or regional agreements and can involve response on an international scale. International cooperation and government/industry cooperation to produce more effective oil spill response are stated aims of organisations such as IMO and IPIECA. Nevertheless, the apparent discrepancies between different national dispersant approval regulations can be a barrier to international cooperation at large oil spills. Some neighbouring countries have bilateral agreements that permit the use of dispersants approved in either country to be used is specified areas of water. An example is the Manche Plan between to UK and France. However, in other areas of the world there are potential barriers to mutual co-operation because lists of approved dispersants have yet to be devised or are incompatible between neighbouring countries.

A very large amount of dispersant was used at the response to the *Deepwater Horizon* incident. Offers of some of the dispersant stockpiles held in France, Norway and the UK could not be accepted because the dispersants were not listed in the NCP Product Schedule and were therefore not approved for use in US waters. In the event, the required quantities of dispersant that were listed on the listed on the Federal Register and therefore approved for use in US waters were made available due to a very rapid and prodigious increase in manufacture within the USA. This is unlikely to be possible in almost all other areas of the world.

The national stockpiles of UK and France each contain about 1,000 tonnes of dispersant. Nearly 7,000 tonnes of dispersant was used at the *Deepwater Horizon* incident. It is quite conceivable that a future major oil spill incident could require more nationally approved dispersant than is available, or that could be manufactured in sufficient time.

The international oil industry is considering the establishment of major stockpiles of dispersant at strategic locations around the world. Quantities of dispersant from these stockpiles could then be rapidly deployed to oil spill incidents.

# QUESTIONS TO BE CONSIDERED BY THE PANELLISTS

## QUESTION 1

Both the dispersant approval regulations and dispersant use regulations developed by national authorities in many countries concentrate on the potential for negative effects to marine organisms that could be caused by elevated concentrations of dispersed oil in the water column as a result of dispersant use. The positive side of using dispersant to prevent spilled oil impacting sensitive coastline resources is often not considered in these regulations.

**Does this create an overly negative view of dispersant use?**

## QUESTION 2

The 'trade-offs', both positive and negative, that could be involved in dispersant use on spilled oil will be specific to the circumstances of a particular oil spill and should be considered as part of a balanced NEBA process for all response methods, including the use of dispersants. If many of the variables (spilled oil type, spill site, prevailing winds and currents) are known these can be used to conduct a pre-spill NEBA in specific oil spill contingency plans (as is done in Norway). In other circumstances, many of the variables are not known until an oil spill actually occurs.

**Is there any point is trying to incorporate 'typical' or 'representative' conditions into dispersant testing (particularly toxicity testing regimes with a specified test oil) when they cannot be truly said to be 'typical' or 'representative'?**

## QUESTION 3

Will it is very understandable that national authorities have the right and responsibility to regulate dispersant use in their national waters, the different requirements for dispersant approval testing means that the same dispersant must be submitted for multiple tests in different countries.

Despite the differences in test methods and philosophies, some dispersants are approved for use in several countries and it seems likely that many other dispersants would also be approved for use in several countries, if the manufacturers chose to submit then for testing. This seems to indicate that the various different routes selected to test candidate dispersants for approval that have been adopted in individual countries have achieved a common result. This is, in part, due to the 'pass marks' used for effectiveness and toxicity tests being selected on the very pragmatic basis of not excluding commercially available dispersants.

Although formal harmonisation of different national dispersant approval testing procedures has not been achieved, a *de facto* harmonisation exists; some dispersants are approved for use in several countries that have very different testing regimes.

**The requirement for dispersant approval in separate, and different, dispersant approval testing in individual countries is a potential block to regional or international cooperation in oil spill response. Although each national authority has very good reasons for preferring their own testing regimes, would it not be possible to accept (perhaps with reservations) dispersants approved for use in other countries?**

**QUESTION 4**

The significance of the results of dispersant, or dispersant and oil, toxicity testing for dispersant approval testing purposes are almost always misunderstood by many people, including the general public and up to the level of senior decision-makers.

Dispersant approval regulations were originally developed in the UK to prevent a repeat of the use of relatively ineffective and acutely toxic industrial detergents as oil spill dispersants at the *Torrey Canyon* incident. Low-toxicity and much more effective dispersants were soon produced and the toxicity testing regime was altered to include a test oil. Different countries have since produced different testing regimes for effectiveness and for assessing toxicity for dispersant approval procedures. Some of these use a test oil, some do not, some are quite complex while others are more simple.

Any laboratory toxicity test protocol can only aspire to give an indication of the short-term effects of dispersed oil. In actual dispersant use, the negative effects that could be caused by dispersed oil vary with the circumstances of the oil spill incident.

**Is there any reasonable point in trying to devise toxicity test regimes that aim to simulate some aspects of dispersant use?**

**Given that the significance of the results of toxicity tests for approval purposes are widely misunderstood, would it not be better to use simpler tests with the more modest purpose clearly explained?**

**QUESTION 5**

The Gulf of Mexico Research Initiative in the USA, a 10-year programme with $500 million funding from BP, has solicited research proposals on a range of research themes:

1. Physical distribution, dispersion, and dilution of petroleum (oil and gas), its constituents, and associated contaminants (e.g., dispersants) under the action of physical oceanographic processes, air–sea interactions, and tropical storms.
2. Chemical evolution and biological degradation of the petroleum/ dispersant systems and subsequent interaction with coastal, open- ocean, and deepwater ecosystems.
3. Environmental effects of the petroleum/dispersant system on the sea floor, water column, coastal waters, beach sediments, wetlands, marshes, and organisms; and the science of ecosystem recovery.
4. Technology developments for improved response, mitigation, detection, characterization, and remediation associated with oil spills and gas releases.
5. Impact of oil spills on public health.

These themes are very wide-ranging and a great deal of R&D has already been conducted on these aspects in areas outside of the Gulf of Mexico.

**How are these long-term studies to be conducted in the USA likely to influence the attitude to dispersant use in other parts of the world?**

**Some R&D is "nice to know", not "need to know". What needs to be studied about the the use of dispersants? What is it that we do not know, that we need to know?**