GUIDELINES ON THE USE AND APPLICATION OF CHEMICAL DISPERSANTS FOR OIL SPILLS IN THE GULF OF THAILAND

2024

IMO PEMSEA GISEA OSRL

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Abbreviation List

ASEAN	The Association of Southeast Asian Nations
ESI	Environmental Sensitivity Index
GoT	Gulf of Thailand
IMS	Incident Management System
IMO	International Maritime Organisation
MoNRE	Ministry of Natural Resources & Environment (Viet Nam)
NCP	National Contact Point
NEBA	Net Environmental Benefit Analysis
NOSC	National On Scene Commander
NOSRC	National Oil Spill Response Centre
OSCP	Oil Spill Contingency Plan
OSRL	Oil Spill Response Limited
PCD	Pollution Control Department (Thailand)
PEMSEA	Partnerships in Environmental Management for the Seas of East Asia
SIMA	Spill Impact Mitigation Assessment
SMART	Special Monitoring of Applied Response Technologies
SOSC	Sub-regional On-Scene Commander
TPR	Tiered Preparedness and Response
VASI	Vietnam Administration of Seas and Islands
VINASARCOM	Viet Nam National Committee for Search and Rescue

Revision	Date of Approval	Description	Author	Reviewer	Approval
01	2016	First draft	Various experts from participating countries	PEMSEA	
02	01/07/2020	Content and structure update by OSRL	Yow Lih Hern	Ken Church	Dong Xin
03	21/11/2024	Content and structure update, including regional input and latest operational experience in the Gulf of Thailand	Various experts from participating countries, OSRL and GI-SEA	Technical Review Team	GOT Countries

Introduction

1 Purpose and Scope

The Framework Programme for Joint Oil Spill Preparedness and Response in the Gulf of Thailand ("Framework Programme") was adopted under the Joint Statement on Partnership in Oil Spill Preparedness and Response in the Gulf of Thailand ("Joint Statement") with Cambodia, Viet Nam and Thailand as participating countries. More details about the Joint Statement and Framework Programme can be found in Section **11.2**.

While the three participating countries have established their national system for oil spill preparedness and response, there are differences in their policies specifically on the use and application of dispersant. As a result, the three countries, in collaboration with the Partnerships in Environmental Management for the Seas of East Asia (PEMSEA), has embarked on a project to develop a sub-regional guideline on the use and application of dispersants in the Gulf of Thailand (GoT).

The Guidelines on the Use and Application of Chemical Dispersants for Oil Spills in the Gulf of Thailand ("Guideline") aims to provide decision making process and technical direction for the use and application of dispersant in oil spill response. This will help to achieve the overall vision of a prompt and effective response to major oil spill accidents stated within the Joint Statement.

These guidelines provide technical information for the assessment of the viability of oil spill dispersant as one of the response techniques and field guidance on the application of dispersant. It also extracts relevant response management procedures under the Framework Programme that will aid response planner to ensure adherence to existing rules and regulations for the use of dispersant during an oil spill.

2 Using the Guidelines

The Guidelines are separated into two parts where,

Part 1: Action Plan contains information related to use of dispersant in a transboundary oil spill incident and technical elements of dispersant application. Users would be able to navigate quickly to the required actions in an actual incident as Part 1 follows the flow of a response leading to the adoption of dispersant application as part of the response strategy. The process flow is summarised below:

- Response management which outlines the roles and responsibilities of affected country and assisting countries;
- Net Environmental Benefit Analysis which considers a range of response techniques without any prescribed restriction;
- Approval process once dispersant application is determined as a suitable response technique;
- Dispersant effectiveness test which provides indication on the possible match of dispersant to spilled oil;
- Technical guidelines in the application and monitoring of dispersant;
- List of resources under the Tiered Preparedness and Response framework; and
- Supporting documents required during the spill.

Part 2: Reference Materials contains background information that does not contribute directly to the execution of a response. Nonetheless, users should read through Part 2 as part of preparedness work as it helps to gain better understanding on Part 1.

Part 2 provides reference information that will be useful to gain in-depth knowledge on:

- Typical behaviour of spilled oil to understand and anticipate impact of spill;
- How dispersants work;
- Details of the sub-region including the Joint Statement, Framework Programme and the participating countries; and
- Relevant excerpts of the Sub-regional Oil Spill Contingency Plan (OSCP).

Part 1: Action Plan

3 Response Management During Transboundary Oil Spills

3.1 Lead State

According to Section 3 of Framework Programme, each of the participating countries shall designate a National Oil Spill Response Centre (NOSRC) or an assigned Oil Spill Response Centre. The designated NOSRC, led by National On-Scene Commanders (NOSC), will be responsible for the national oil spill preparedness and the lead response agency for oil spill as indicated in each national contingency plan. The designated NOSRC for each country is available in **Table 3-1**.

Table 3-1: NOSRC of Participating Countries

Country	NOSRC
Viet Nam	Viet Nam National Committee for Search and Rescue (VINASARCOM)
Cambodia	General Department of Waterway-Maritime Transport and Port, Ministry of Public Works and Transport
Thailand	Marine Department, Ministry of Transport

Note: The NOSRC is also termed as Operational Authority in the Sub-regional OSCP.

Section 2 of the Framework Programme states that during a major oil spill threatening the GoT, the country assuming the lead role is determined by whose jurisdictional water the spill initially occurred. The said country should take the initial response activities and any other actions necessary for initiating response. In the event that oil crosses a jurisdictional boundary, the NOSRC of the affected country should be notified promptly by the country where the spill occurred. The process and format of oil spill reporting is available in **Section 3.2**.

Sub-regional OSCP

To further build on the Framework Programme, the Sub-regional OSCP was created to establish a mechanism for mutual assistance at the operational level. The Sub-regional Plan shall be activated by the Operational Authority of one of the participating countries in the following cases:

- Occurrence of an oil spill which threatens to affect or has already affected the territory of another participating country;
- Occurrence of an oil spill whose severity surpasses the response capabilities of the initial affected country.

Once the Sub-regional OSCP is activated, Joint Response Operations will commence where the NOSC of the Lead State shall assume the role of the Sub-regional On-Scene Commander (SOSC). Refer to **Section 3.3** for details on Joint Response Operations.

Further to the roles provided in Framework Programme, the role of the Lead State also includes:

- Activating the Sub-regional Plan;
- Surveillance of the pollution;
- Assessment of the situation;
- Spill movement forecasting;
- Reporting regularly on the situation to the other Participating countries, particularly those whose interests may be threatened by the pollution incident;
- Exercising Operational Coordination over Joint Response Operations.

The lead role shall be transferred from one country to another, when a major part of the pollutant has moved from the jurisdictional water of initially affected country to another country, and/or when the main response activities have moved to such other country.

For any response operations by the Lead State in jurisdictional water of other affected countries, the Lead State shall only act with the mutual consent of both or all affected countries. In the case of dispersant application, the decision to use dispersants will require consent from affected country and following the approval process of the affected country.

3.2 Reporting of Oil Spill

The participating country where the spill occurs shall report the said incident using the Pollution Report Form, available in **Section 9.1**. The report should be promptly sent to the NOSRC of other participating countries that may be impacted by the incident. This is expedited through identification of National Contact Points (NCP) in each participating country where NCP will contact directly and communicate with each other. The positions of NCP of the participating countries are listed in **Table 3-2** while the contact person is available in **Section 9.2**.

Table 3-2: NCP of Participating Countries

Country	NOSRC
Viet Nam	Vietnam National Southern Oil Spill Response Center 4th flr, PVFCCo Tower, 43 Mac Dinh Chi St., District 1 Ho Chi Minh City, Viet Nam **Hot line: +84 933008860 (24/7)** Email: khanhnk@pvdrilling.com.vn; Email: nasos@pvdrilling.com.vn;
Cambodia	Merchant Marine Department General Department of Waterway-Maritime Transport and Port Ministry of Public Works and Transport Street 598, Sangkat Chrang Chamres2, Khan Russey Keo , Phnom Penh, Cambodia Telephone no.: 855-88-7878-777
Thailand	Marine Department- Environment Group Maritime Safety and Environment Bureau Marine Department of Thailand 1278 Yotha Road, Talardnoi Samphanthawong District Bangkok 10100, Thailand Website: www.md.go.th/md/ Telephone/Fax: 66 2234 3832 Hotline: 1199 (24 hrs)

The Pollution Reporting System is divided into **three parts**:

Part I (POLWARN) is an initial notice (a first information or a warning) of a pollution incident.

Part II (POLINF) is a detailed supplementary report to Part I.

Part III (POLFAC) is used for requesting assistance from other participating countries and for defining operational matters related to this assistance.

In the case of dispersant application, it is very important the reporting NOSRC indicates that dispersant application is deployed as part of the response strategy so the other participating countries could prepare for the potential use of dispersant in their jurisdictional water.

In addition, the pollution report given to the affected participating countries shall be updated at least once every 24 hours. The update shall cease only when the spill no longer threatens the affected countries.

3.3 Conduct of Joint Response Operations

If the spill escalates beyond the national capacity or there is a need of specialist resources from another participating country, the affected country may seek assistance from another participating country through activation of the Sub-regional OSCP. The NOSC of the Lead State shall assume the role of SOSC. To relieve the duties on operational control of the national resources, another officer will be designated as the NOSC of Lead State, allowing the SOSC to focus on cross country coordination. The coordination structure of the Joint Response Operations is shown in **Figure 3-1**.

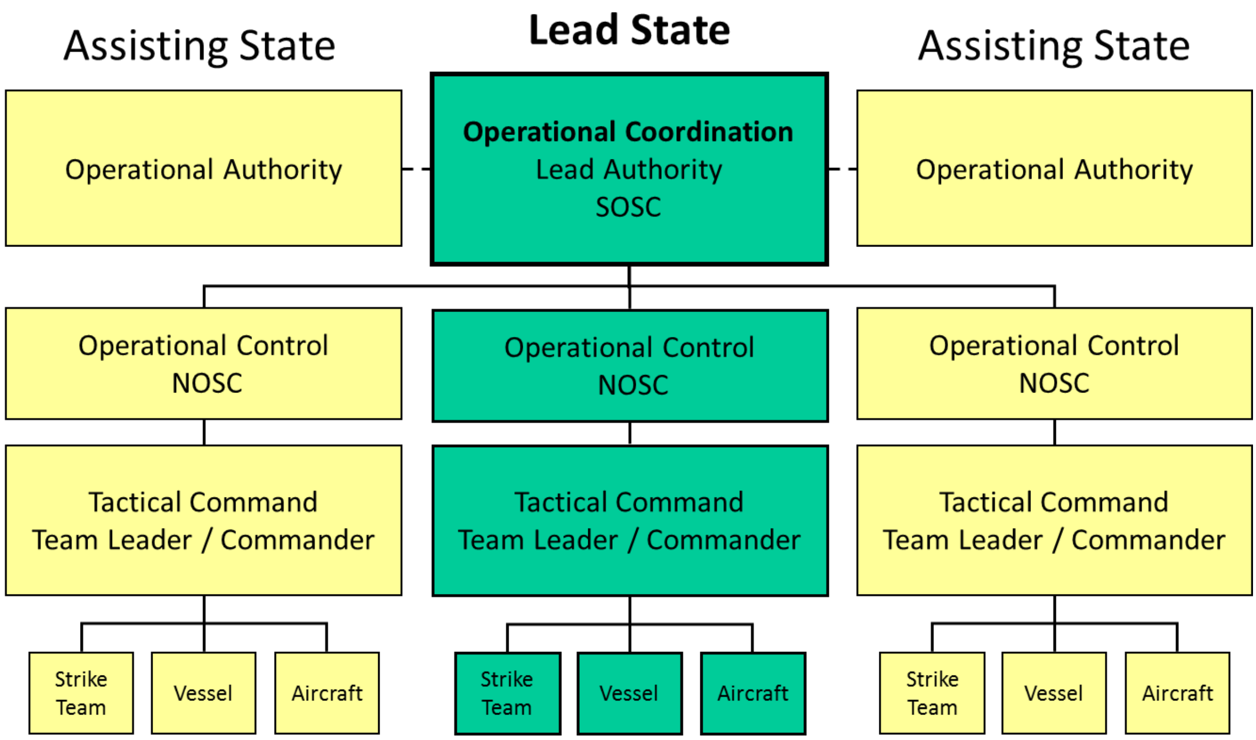


Figure 3-1: Coordination Structure of Joint Response Operations[1]

[1] Sub-regional Oil Spill Contingency Plan of the Gulf of Thailand. December 2019

The SOSC shall have the overall responsibility for all decisions and actions taken in order to combat the pollution and to mitigate its consequences and for co-ordination of Joint Response Operations. The SOSC, working in liaison with his/her Lead Authority, exerts Operational Coordination over Joint Response Operations. The NOSCs of the assisting Participating countries shall operate under the overall Operational Coordination of the SOSC, but shall nevertheless retain operational control over personnel, equipment and self-contained units of their respective Participating countries.

Although the NOSC of the assisting countries have operational control over their own resources mobilised into the requesting country, the requesting country shall also be fully responsible for the use and maintenance of equipment belonging to other assisting countries while in its custody. The requesting country shall reimburse the assisting countries for all reasonable expenses incurred in rendering the assistance.

For requests of resources related to dispersant application, SOSC shall notify the NOSRC of the other participating country of the oil spill incident including the request for dispersant support. The request form for additional dispersant is provided in **Section 9.1**. The requested dispersants used in the affected country will be the dispersants that are approved by the affected country. Refer to **Section 0** for information on approved dispersants.

For the application of dispersants during a Joint Response Operation, the procedures set forth in this Guideline on the use of dispersant shall be followed.

4 Net Environmental Benefit Analysis

The aims of any oil spill response are to:

- minimise damage to environmental and socioeconomic resources; and
- reduce the recovery time of affected resources by achieving an acceptable standard of cleanliness.

Once an incident led to an oil spill, urgent decisions need to be made about the options available for response and clean-up. This is to ensure that environmental and socioeconomic impacts are minimised. Getting the correct balance is a difficult process and conflicts need to be resolved in a practical and timely manner. The advantages and disadvantages of different response techniques need to be considered and compared with the advantages and disadvantages of a natural clean-up. This process is known as Net Environmental Benefit Analysis (NEBA). (NOTE: For nearly all ecosystems, a NEBA can be and should be conducted well before any spill occurs followed by periodic reviews and updates.)

The process considers the circumstances of the spill, the practicalities of clean-up response, scientific understanding of oil characteristics, and judgement of the relative importance of the receiving environment (coastline type, habitats and species) and socioeconomic factors.

It is especially important to perform NEBA when dispersant application is considered because of the fact that dispersion does not initially remove oil form the environment but transforms it into a state which is better suited for natural biodegradation, e.g., small droplets in the water column vs surface slicks. In this case, NEBA can help to determine if the use of a dispersant in a specific area, at a certain time of year is an appropriate response technique. A simplified example of such a trade-off discussion would be the discussion concerning the use of dispersants to disperse floating oil into near-surface waters, wherein short-term potential impacts to exposed aquatic organisms need to be balanced against longer-term potential impacts on coastal habitats and communities if the oil is not dispersed.

Coastlines and near shore waters have various levels of sensitivities to oil and to clean-up methods. The most appropriate clean-up method must be determined after considering factors such as the type of beach, its sensitivity, access issues and reviewing the NEBA outcome. NEBA should be considered in detail when deciding on the most suitable response strategy to follow.

Figure 4-1 shows the decision-making process including the NEBA considerations.

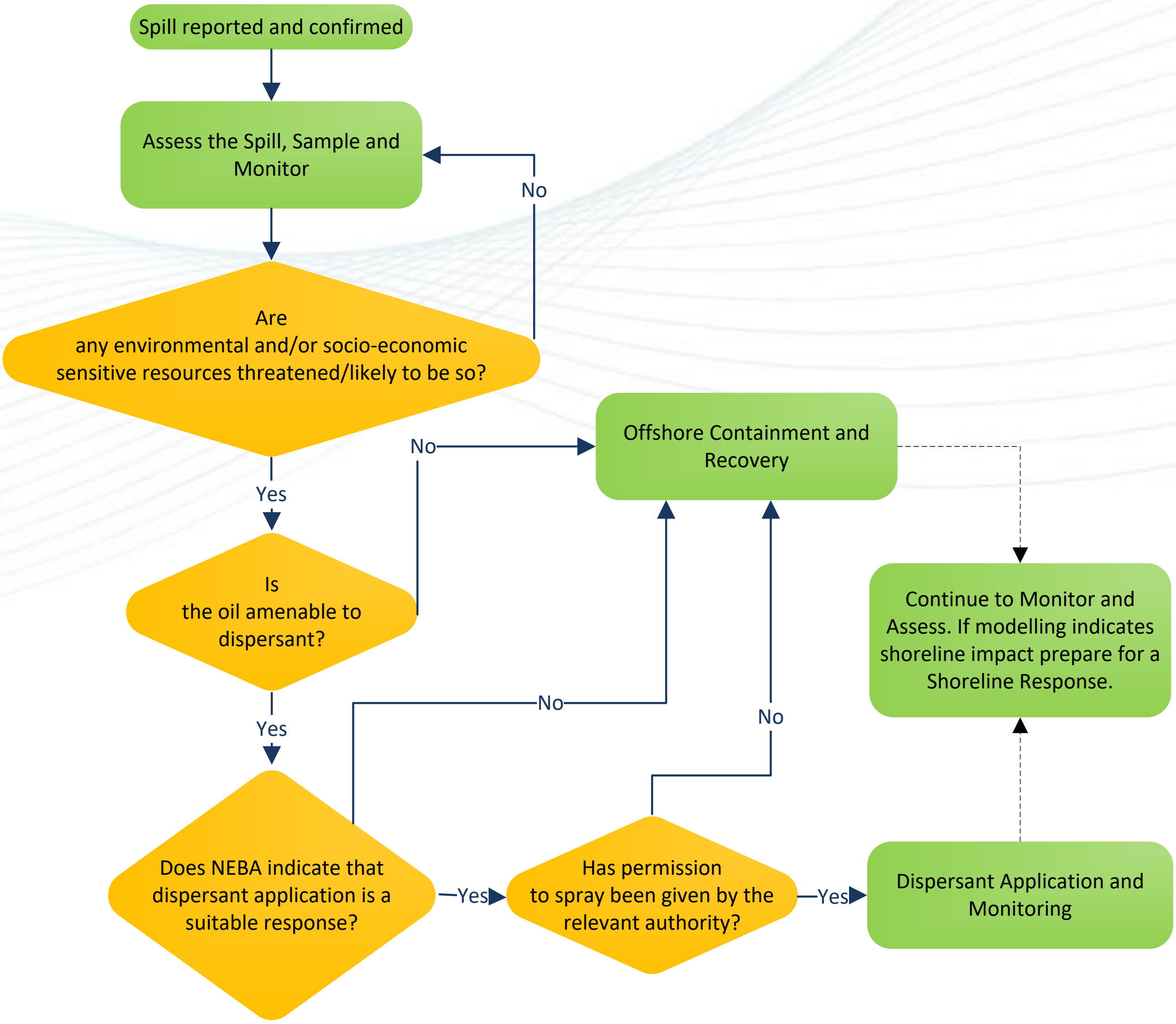


Figure 4-1: Example of the NEBA Decision Making Process (High Level)

To answer the questions illustrated in **Figure 4-1**, the NEBA Decision Making Form in **Section 9.1** could be used. The form also provides documentation of the decision-making process.

4.1 Spill Impact Mitigation Assessment (SIMA)

Even with the aid of NEBA Decision Making Form, the trade-off analysis process involves multiple factors, which can be complicated and overwhelming. In 2017, SIMA was developed to provide a structured framework to facilitate response option selection in a semi-quantitative and transparent manner. The SIMA process is summarised in four stages[2]:

1. **Compile and evaluate data** for relevant oil spill scenarios including fate and trajectory modelling, identification of resources at risk and determination of feasible response techniques.
2. **Predict outcomes/impacts** for the 'no intervention' (or 'natural attenuation') option as well as the effectiveness (i.e. relative mitigation potential) of the feasible response options for each scenario.
3. **Balance trade-offs** by weighing and comparing the range of benefits and drawbacks associated with each feasible response option, including no intervention, for each scenario.
4. **Select the best response option(s)** to form the strategy for each scenario, based on the technique or combination of techniques that will minimize the overall ecological, socio-economic and cultural impacts and promote rapid recovery.

The four stages will guide the response planner to complete a comparative matrix with scoring system which facilitates the evaluation of candidate response options. An example of the comparative matrix is available in **Appendix 5**.

It is recognised that the SIMA process is not widely adopted in this region, but it should be the target for participating countries to incorporate SIMA into the national contingency planning process.

[2] IPIECA, IOGP. Guidelines on Implementing Spill Impact Mitigation Assessment. <https://www.ipieca.org/media/4867/guidelines_on_implementing_spill_impact_mitigation_assessment_sima_2017.pdf>. 2017.

4.2 Sensitive Areas

A project to map the sensitivities along the coast within the Gulf of Thailand was completed in December 2013. The product 'Environmental Sensitivity Index (ESI) Atlas of the Gulf of Thailand' was jointly published by PEMSEA, Yeosu Foundation, Korea International Cooperation Agency and International Maritime Organization. It detailed coastal resources at risk during oil spill incidents, locations of oil spill response resources and related services in all coastal provinces of Eastern Thailand, Preah Sihanouk Province of Cambodia, and Kien Giang and Ca Mau Province of Viet Nam. The product is available to the public at the website of Marine Department, Thailand.

Apart from the Atlas, the three participating countries also have individual sensitivity maps and definitions.

For Cambodia, the zones sensitive to high concentration of dispersed oil have been described in the National Guidelines on the Use of Dispersants in Cambodia.

For Thailand, coastal sensitivity maps are available and updated periodically. Under the National Contingency Plan of Thailand, the Pollution Control Department is responsible for providing coastal sensitivity maps to support the Operation Unit during oil spill incidents. Before using dispersants in zones sensitive to dispersed oil, the user must fill out a request form indicating the amount and type of dispersants to be used and send it to Pollution Control Department.

For Viet Nam, national guideline for dispersant use was issued in 2020 as Circular no. 19/2020/TT-BTNMT by The Ministry of Natural Resources & Environment (MoNRE).

5 Guidelines for the Approval of the Use of Dispersants

For Cambodia, the National Guidelines for Dispersant Use were adopted in 2020 following joint development by the General Directorate of Environmental Protection (Ministry of Environment) and the General Department of Waterway-Maritime Transport and Port (Ministry of Public Works and Transport).

For Viet Nam, a set of national guidelines for dispersant use is in the progress of development. The Ministry of Natural Resources & Environment (MoNRE) is the national authority responsible for developing the guideline.

For Thailand, regulations and guidelines for the use of dispersants in oil spill response have been established. The Pollution Control Department is the national authority responsible for developing the guideline.

During oil spills at the national level, the decision to use dispersants will depend on the policy on dispersant application in each country, which is quite different in terms of the required water depth and distance from shore. The requirement and pre-approved zones for dispersant application is discussed further in the next section.

5.1 Prohibited and Pre-Approved Zones

Viet Nam

Dispersant application is prohibited in coastal water less than 20 metres water depth, coastal area less than 1 nautical mile from shore, bay, lagoon and area defined as highly sensitive in the environmental sensitivity map. Disperant application will be possible in area outside of the prohibited area.

Cambodia

Dispersant application is generally allowed in water depths of more than 10 metres and 2 nautical miles from shore. Pre-approved zones for dispersant application are areas that contain resources that are not highly sensitive to dispersed oil and have water depths of 10 metres or more. In contrast, Cambodia does not designate specific prohibited zones for dispersant but rather zones requiring approval prior to dispersant application ("not pre-approved zone"). It refers to areas with less than 10 metres water depth and areas with resources sensitive to dispersed oil. **Figure 5-1** summarises the not pre-approved zone and pre-approved zone in Cambodian water. The area in red refers to not pre-approved zone while the area in green refers to pre-approved zone.

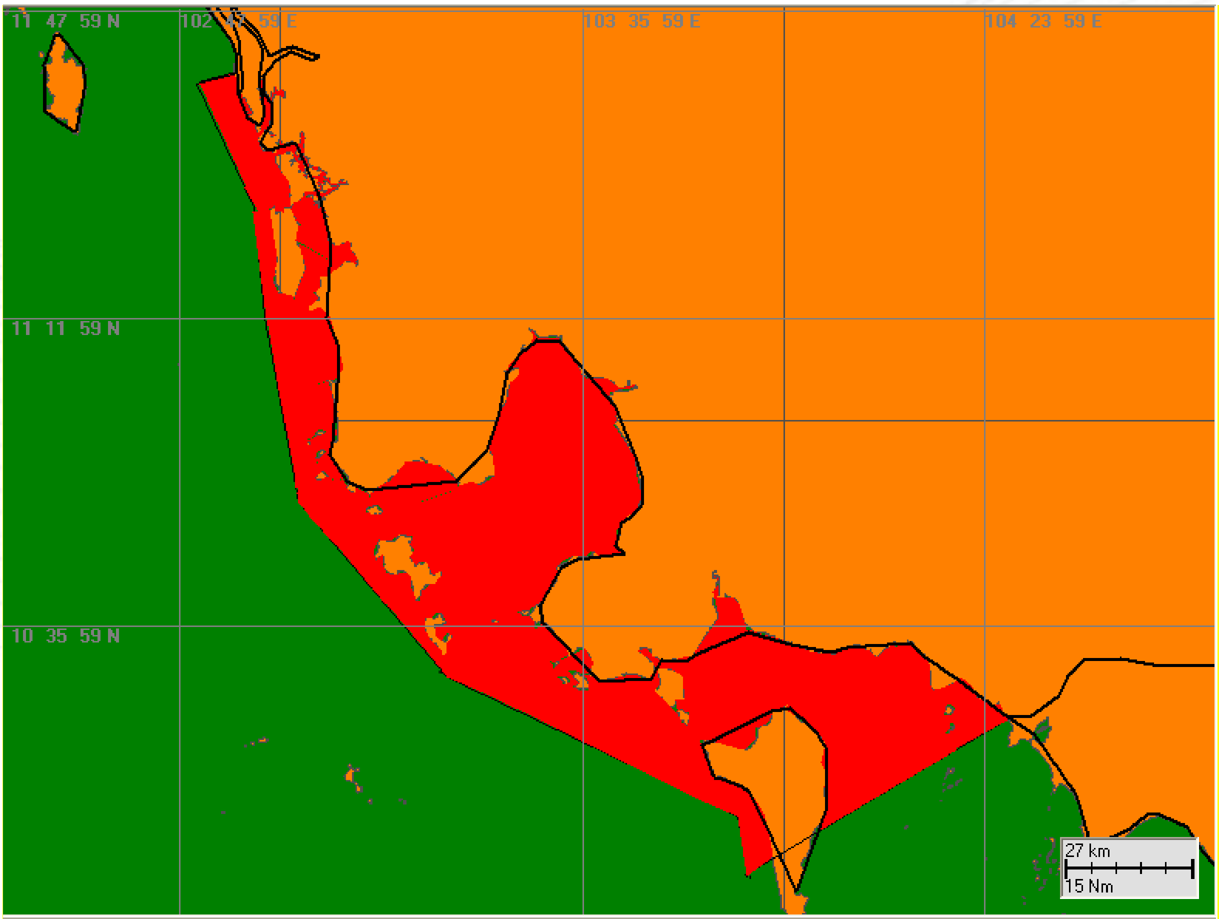


Figure 5-1: **Not Pre-Approved Zone and Pre-Approved Zone for Dispersant Application in Cambodian Water**[3]

Thailand

In Thailand, the categorisation of zones is largely similar to Cambodia. Pre-approved zones for dispersant application are areas which contain resources that are not highly sensitive to dispersed oil and the water depth is more than 10 metres. There is no "prohibited for dispersant application zone" but there is designation of a zone sensitive to high dispersed oil concentrations ("sensitive zone"). It refers to areas with less than 10 metres depth or with resources which are sensitive to dispersed oil. Dispersant application requires approval and is only recommended when there is overall positive net environmental benefit. **Figure 5-2** summarises the sensitive zone and pre-approved zone in Thai water. The area in red refers to sensitive zone while the area in yellow refers to pre-approved zone.

[3] National Guidelines on the Use of Dispersants in Cambodia. 2020.

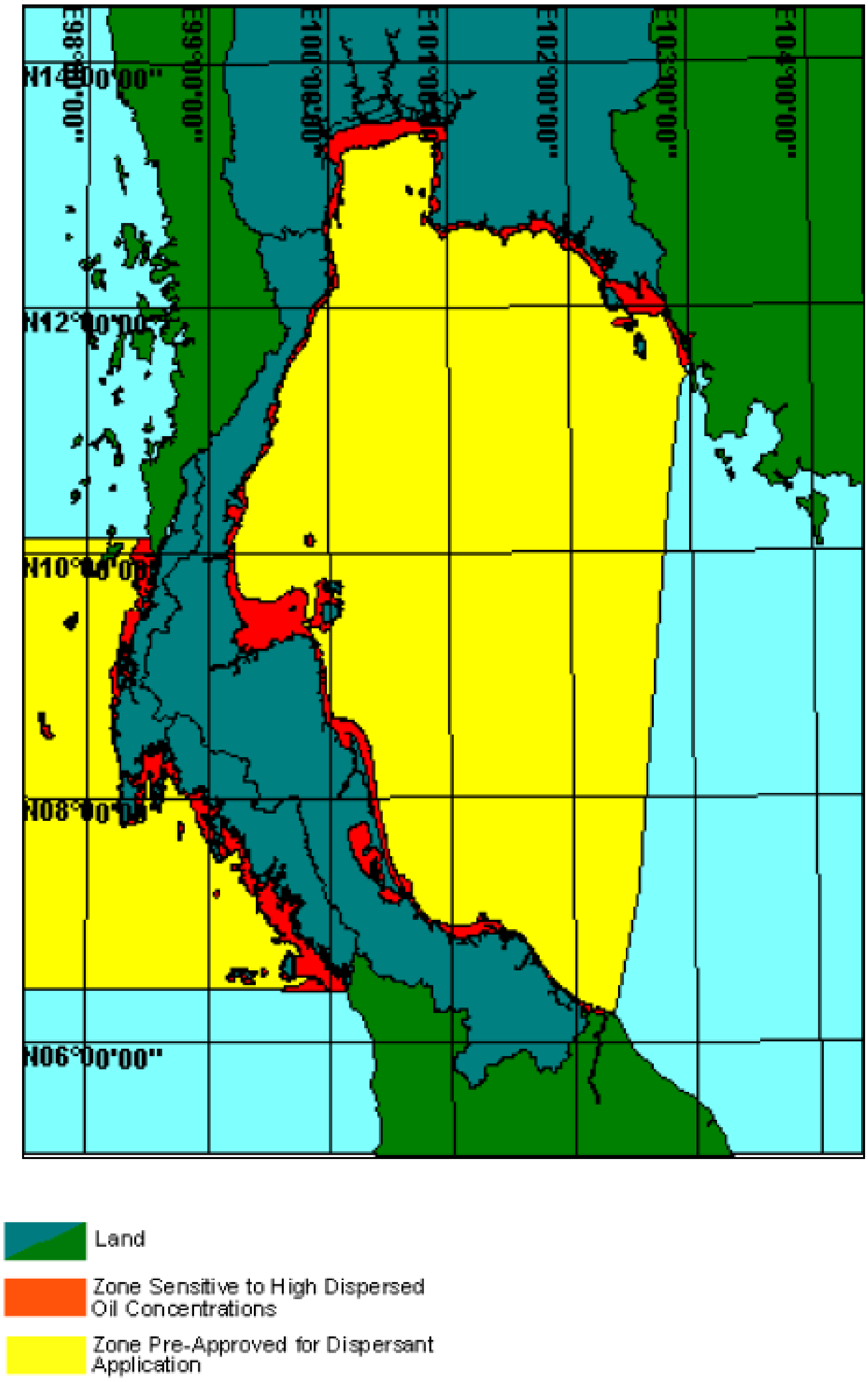


Figure 5-2: Sensitive Zone and Pre-Approved Zone for Dispersant Application in Thai Water[4]

To aid in providing a regional view of various dispersant usage zones in a single map, the GoT participating countries combined the prohibited zones and zones sensitive to high dispersed oil concentration in one of its annual workshops. The result is available in **Figure 5-3**.

[4] Pollution Control Department, Thailand. Chemical Use Handbook (Dispersant).

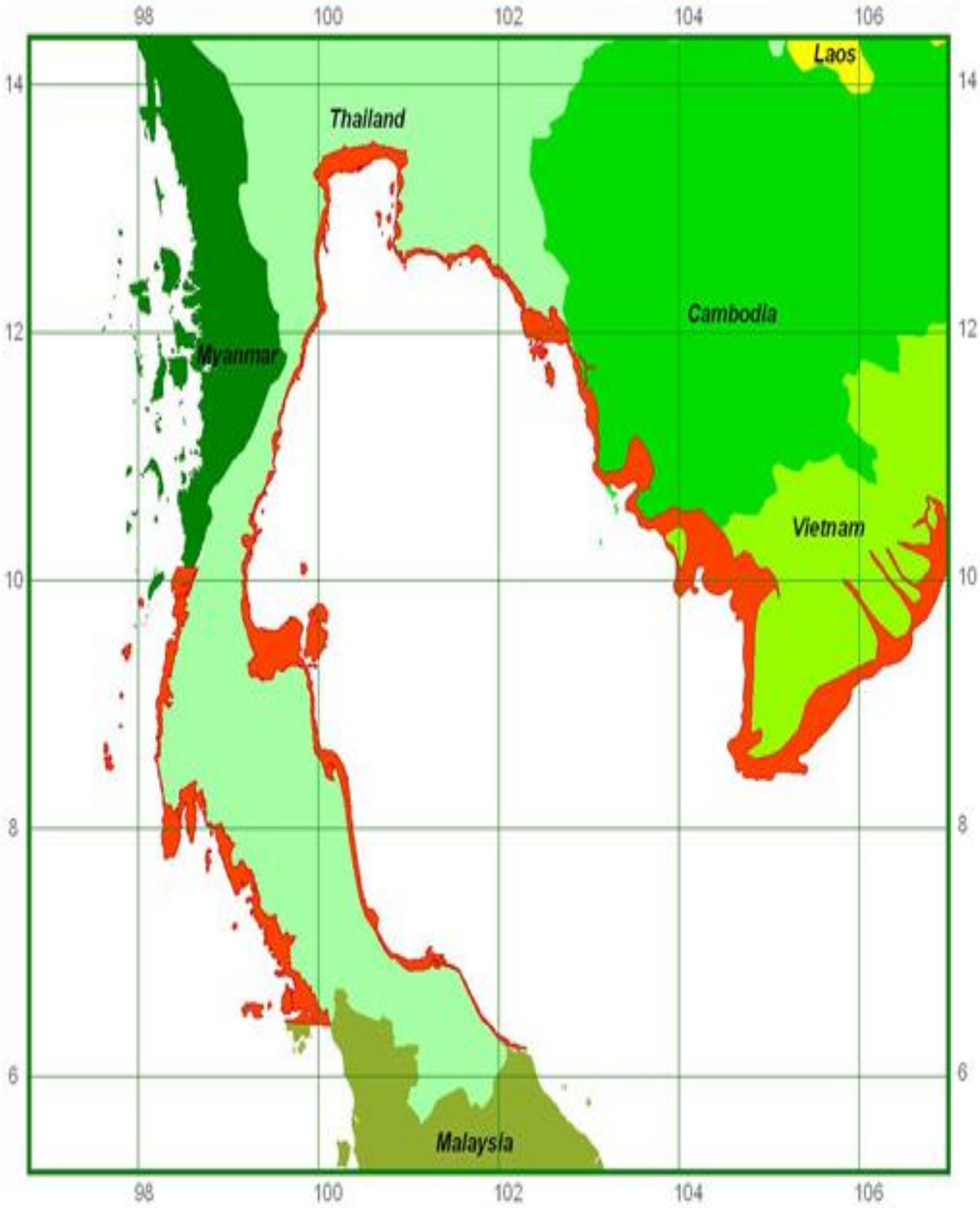


Figure 5-3: Summary of Prohibited Zone and Zone Sensitive to Dispersant Usage

5.2 List of Approved Dispersants

Participating Countries have agreed to a list of approved dispersants that they will use in case of major oil spill and trans-boundary oil spill incidents. These dispersants will be selected from the list of dispersants shown in **Appendix 1**.

The GoT countries have similar policies on oil spill dispersants application with Cambodia and Thailand adopting the same list of approved dispersants. While Viet Nam has its own list of approved dispersants, all three countries have numerous dispersants on the list. Although there are similarities, certain dispersants approved in one country are not necessarily allowed in the other countries during joint response operations.

Approved dispersants common to the 3 countries and commonly available as Tier 2 and 3 resources (Refer to **Section 8** for definition of Tiers) are:

- Corexit 9500 / Corexit EC9527A (approved by Vietnam);
- Dasic Slickgone NS;
- Finasol OSR 51 / Finasol OSR 52; and
- Shell VDC / Shell VDC Plus.

The NCP will endeavour to develop the process for the approval of additional dispersants suitable to the type of oil transported in respective countries. The participating countries have agreed in principle to use the dispersants following approved lists of USA, UK and Australia.

During major oil spills, the information on approved dispersants available in the participating countries is important for regional response cooperation. The list of all approved dispersants indicating their stockpile volumes in the GoT countries shall be updated annually. The stockpile of dispersant is available in **Appendix 4**.

5.3 Authority to Approve Dispersant Usage

The NOSC, or when Joint Response Operations has commenced, the SOSC, has overall operational control over the response activities. Hence, the NOSC/SOSC will determine if dispersion is a viable response option and will authorise the use of dispersants during major and trans-boundary oil spills that originated at the jurisdictional water of the NOSC/SOSC. However, use of dispersant out of the jurisdictional water shall be under the consent of all parties and follow the approval process of the affected countries. The summary of key authorities involved in the dispersant approval process of each participating countries is available in **Table 5-1**. More details on the dispersant policies of the countries are available in **Section 0**.

Table 5-1: Dispersant Approval Authority of Participating Countries

Country	Dispersant Approval Authority
Viet Nam	Ministry of Natural Resources & Environment (MoNRE)
Cambodia	Ministry of Environment
Thailand	Pollution Control Department (PCD)

6 Dispersant Effectiveness Test

Some oil types are more responsive to dispersants than others. The efficacy of dispersant relies largely on oil viscosity. Use the chart or table below to determine if dispersant is likely to be effective on the spilled oil.

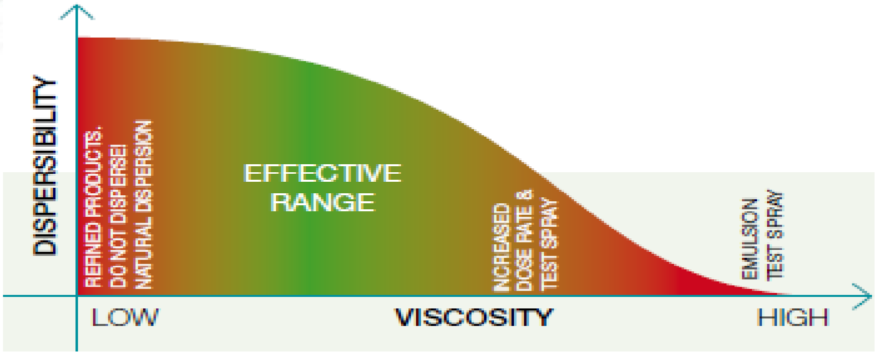


Figure 6-1: Oil Dispersibility Chart[5]

Table 6-1: Oil Dispersibility Range[6]

Generally Accepted Dispersibility Ranges	
Light refined product such as gasoline, kerosene and diesel	No chemical dispersion is required
Viscosity < 500 cSt	Dispersion is generally easy with a concentrated dispersant, applied neat or prediluted in seawater.
500 cSt < Viscosity < 5,000 cSt	Dispersion is usually possible with a concentrated dispersant applied neat.
5,000 cSt < Viscosity < 10,000 cSt	Uncertainty as to the result. Dispersion might be possible with a concentrate applied neat; check whether dispersant is effective before extending the treatment to all of the slick.
Viscosity > 10,000 cSt	Dispersion may be less effective depending on extent of weathering and oil type; check whether dispersant is effective before extending the treatment to all of the slick.

[5] OSRL. Dispersant Application Field Guide. Version 1. December 2011.
[6] IPIECA, IOGP. At-sea Monitoring of Surface Dispersant Effectiveness. Pg. 4. 2014.

Another method to confirm the effectiveness of dispersant is through the dispersant efficacy test or 'jar test'. This is a basic dispersant effectiveness test and can be carried out by personnel onboard a vessel at the spill site if it is safe to do so.

The tools and materials required for the test are:

- 2 x clear glass containers with lids (plastic bottles not suitable)
- Pipette
- Seawater
- Dispersant
- Spilled oil sample

The principle of the 'jar test' is to compare a test sample with desired dispersant against a negative control (i.e. no dispersant added).

1. Take one glass jar and fill ¾ with water
2. Add 20 drops of oil to the water using the pipette, or if not available gently pour a small amount to cover the water surface to about 1 mm thickness.
3. Cap the jar and shake the oil and water mixture lightly about 10 times
4. The oil and water should not mix very well, and the droplets should rise to the surface quickly leaving the water fully clear. This is the comparison mixture.
5. Take the second clean glass jar and repeat steps 1 – 3, but also add one drop of your dispersant to the mixture before shaking. This is the test sample.
6. The oil and water should now mix to form a cloudy mixture in the jar, with very small droplets rising to the surface, very slowly (>1 hour) if left undisturbed.
7. Compare the comparison mixture with the test sample. If the dispersant is effective, you will see an increase in water cloudiness and less surface oiling. The greater the different the more effective the dispersant. If the two jars show similar clarity, dispersant has not been effective and alternative response options should be considered.

A simple infographic of the whole 'jam jar' test is shown in Error! Reference source not found. below.

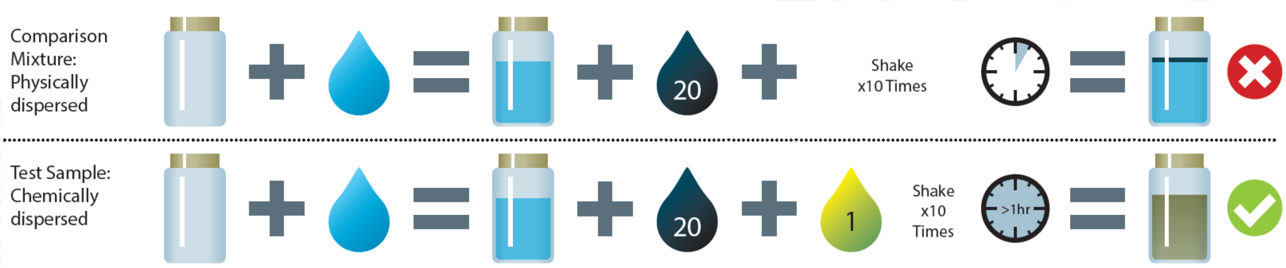


Figure 6-2: Dispersant Effective Test Infographic[7]

Although the 'jar test' is designed to be simple and straightforward, there are precautions to be taken to ensure the consistency of the test. They are:

- Maintain integrity of samples with proper handling and labelling;
- Avoid contamination samples when collecting oil in the field;
- Use appropriate containers (clean glass jar or bottle);
- Record information such as location of sample, date and time of test and person carried out the test; and
- Record test results using photo evidence.

6.1 General considerations

The 'jar test' is only useful for the primary decision to apply dispersant based on the dispersibility of weathered oil against dispersant available. There are no conclusive studies done on the 'jar test' to indicate its reliability. (NOTE: A more consistent field test kit has recently been developed to adapt and improve upon existing methods, *Development of a dispersibility assessment kit for use on oil spill response vessels* (https://doi.org/10.1016/j.marpolbul.2021.112665).)

For a prolonged and ongoing spill with continuous spraying operations, more robust scientific approaches may be required. The use of Special Monitoring of Applied Response Technologies (SMART) protocol (**Section 7.6**) is designed as a systematic field tool for ongoing dispersant effectiveness monitoring. There are also a variety of laboratory testing methods available published by IMO that can be used at the oil spill contingency planning stage or during a response. Refer to **Appendix 2** for information for more details of the laboratory tests.

[7] OSRL. Dispersant Application Monitoring Field Guide. Version 2. December 2012.

On completion of the efficacy test, and prior to full scale application of dispersant, it is also recommended to conduct a small-scale test spray to confirm dispersant efficacy. Prior to operation at the beginning of each day when treating oil slicks at different states of weathering a test spray should also be carried out. Refer to **Section 0** for visual confirmation of efficacy.

7 Dispersant Application Technique

7.1 General Considerations

Safety

Risk assessment should be conducted prior to any dispersant application operation to identify risks and mitigate them where possible. The risks and controls in place should be communicated through a pre-operation safety brief. In the safety brief, the Safety Data Sheet of the dispersant should be referred especially on the first aid measures. The appropriate Personal Protective Equipment (PPE) should be evaluated as part of the safety briefing.

Window of Opportunity

There is a window of opportunity in which dispersants are most effective. The length of this window varies according to:

- **Climate:** Oil viscosity decreases with temperature, potentially making an oil more responsive to dispersants in warmer climates.
- **Weathering:** As oil weathers, a number of processes are important, e.g., volatile components evaporate, and emulsification may occur. As a result, viscosities tend to increase, and dispersants may become less effective. The rate and extent of weathering is determined by the oil type, source of release (surface vs subsurface, instantaneous vs continuous) and environmental conditions (water/air temperature, wind).

Weather

While weather condition is one important element that will affect the conduct of dispersant application operation, it affects some application platforms more than the others.

Vessel operating conditions for dispersant application:

- Minimum wave height 0.2 m or an active chop
- Calmer sea conditions may require mixing energy from the vessel
- Maximum wave height 4 m (12')
- Optimal wind speed 4-12m/s

Aircraft operating conditions for dispersant application:

- Minimum wave height 0.2m
- Maximum wave height 4m
- Optimal wind speed 4-12m/s
- Pilots determine if weather conditions are suitable for flying

Stockpile

The type of dispersant that can be applied follows the approval list of each participating country. Hence, it may be necessary to identify different dispersants for a dispersant application operation. To ensure continuous supply of dispersant, the following questions should be addressed.

- How much is available?
- Where is it being provided from, how is it being transported, when will it be available? If it's being imported, has Customs and Immigration been properly briefed in order to expedite entry of the product and any technicians? (Are Customs and Immigration periodically briefed and/or included in response exercises?)
- Has it been stored correctly?
- Does the dispersant have a valid efficiency test? (e.g., within 5-10 years)

In addition, the equipment, materials and personnel available for dispersant application should be made available under the Tiered Preparedness and Response (TPR) framework. Refer to **Section 8** for more details.

7.2 Application Platform

Determine the appropriateness and availability of the following dispersant application platform.

	Fixed Wing Aircraft	Helicopter	Vessel
Advantages	• Aircraft can get to the spill site quickly. • Large aircraft system can hold a large volume of dispersant and treat a large area of oil in a relatively short period of time.	• More targeted than aircraft application so it can be used to treat oil slick broken away from the bulk of the spillage.	• Can stay on site. In the event of continuous release, it could be effectively positioned to treat spilled oil. • Easier to obtain than aircraft as boat spray systems are easily fitted.

	Fixed Wing Aircraft	Helicopter	Vessel
Disadvantages	• There may be limited number of systems available. • Aircraft have to regularly refuel. • Crew hours are under strict regulation and will affect the amount of spray runs that are possible.	• Shorter range than fixed wing aircraft. • Smaller capacity than fixed wing aircraft spray system. • Require specific model of helicopter	• Transit time may be lengthy • Limited capacity to hold dispersant dependent on deck space and tank capacity • Cover smaller area than an aerial system in the same timeframe.

7.3 Preparation

Communication Plan

Effective communication can enhance operational success. To achieve this, produce a communication plan to document the emergency contacts and names of assets with assigned call signs, and determine radio communication frequencies. It is useful to have an Automatic Identification System (AIS) fitted on all vessels to track the movement and location of vessels and Global Positioning System (GPS) fitted on the aircraft.

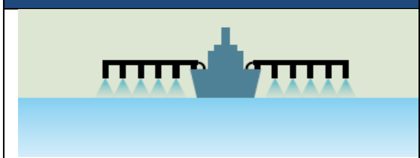
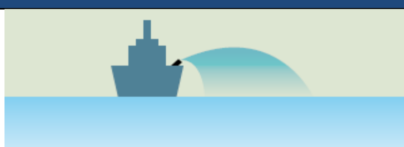
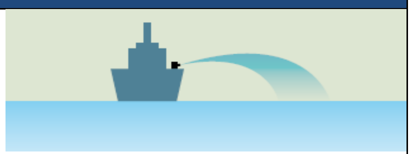
If there are a number of vessels tasked with dispersant operations the use of "Mother Ships" may be considered to ensure that there are clear lines of communication. The Mother Ship may also be useful in being able to provide additional resources to vessels conducting response operations.

Vessels

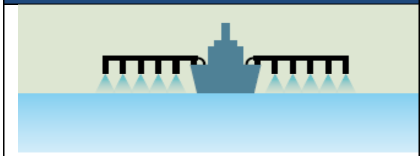
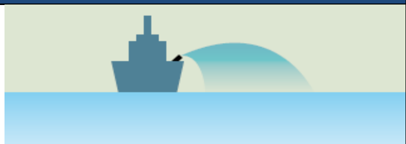
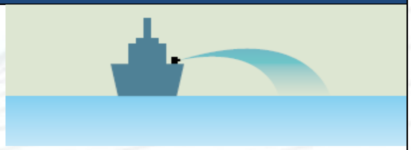
Step 1: Select suitable spray system using

Table 7-1

Table 7-1: Type of Vessel Spray System[8]

Spray Arms	Single Nozzle	Fire Monitor
		
Features	**Features** • Designed for neat application	**Dilute Application**

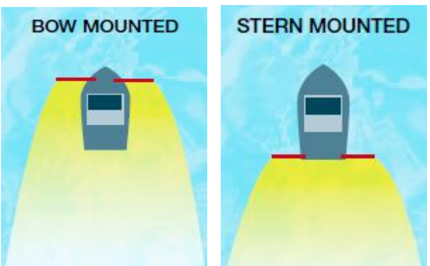
[8] OSRL. Vessel Dispersant Application Field Guide. Version 1. December 2011.

Spray Arms	Single Nozzle	Fire Monitor
		
• Apply dispersant in a controlled and contained manner • Vary pump speed according to concentration • Control dose rate through vessel speed if needed • May need drop down tubes to ensure correct coverage at the water's surface **Dilute Application** • 5-10% dispersant is typical • May need to change nozzles - refer to manufacture's guidelines	• Control dose rate through vessel speed if possible • Wind will deflect the dispersant so vessel should follow the wind **Dilute Application** • Can dilute dispersant, but if applying Type III dispersant neat application is recommended • Seek manufacturer's guidance before spraying diluted dispersant	• Designed for dilute application – **do not use with neat dispersant**. • Difficult to control dosage – often results in under and overdosing • Use spray angle 30 - 40° from horizontal and a coarse mesh screen distribute spray

Step 2: Position the spray system

Position the spray set to achieve maximum efficiency of spraying.

- Deliver dispersant to the oil before the bow wave has pushed or 'herded' the oil away from the vessel
- A fast vessel may push the oil out of the effective reach of the dispersant, or even push the oil under the surface temporarily – this oil will quickly resurface
- Spray arms should ideally be mounted on the bow of the vessel to minimise this effect



Bow mounted:

- Dispersant is sprayed onto the oil
- Bow waves mix the dispersant and oil

Stern mounted:

- Decrease vessel speed to reduce the herding effect of the bow wave

Step 3: Prepare dispersant application recording tools

Record the amount and location of dispersant sprayed and report back to NOSRC. Use the following resources:

- Dispersant log form (Refer to **Section 9.1**)
- GPS
- Digital camera

Step 4: Receive Tasking

Ensure the following information is being prepared for briefing:

- Location of the operational area
- Radio frequencies used in the area and on the response
- Call signs of other vessels operating in the vicinity
- Locations of any temporary or permanent exclusion zones
- Health and safety briefing for the vessel and operation

<u>Aircraft</u>

Step 1: Select a suitable spray system using **Table 7-2**

Use a purpose-built system that has been certified to load into suitable aircraft.

Table 7-2: Type of Aerial Spray System[5]

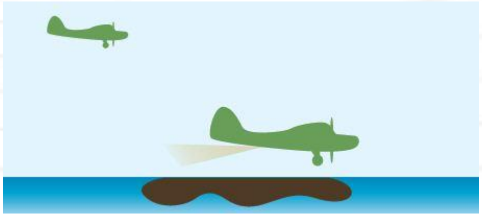
727 TERSUS	C-130 RIDDS	Helicopter
		
Features • 727-based TERSUS Delivery System • High transit speed and treatment rate; TERSUS has a capacity of 15m3 and can fly fully laden to the spill location • Uses Type III dispersant (neat)	**Features** • C-130-based Rapid Installation and Deployment Spray System (RIDSS) • Use to apply multiple types of dispersants in precise patterns at variable dosages that can be adjusted in flight	**Features** • For example, the TC3 Spray System (pod) • Attach to a helicopter • Use to spot spray smaller slicks

Step 2: Spotter aircraft (depends on availability)

The dispersant aircraft will fly at 30-45 m (100-150 ft) above the water to apply dispersant at the correct droplet size and swath width. This limits the aircrew's view of the water's surface.

Use a spotter aircraft to:

- Direct spray aircraft onto target - there will be a communication delay after the spotter crew inform the spray crew to spray
- Assess dispersant efficacy
- Direct vessels measuring dispersant efficacy by fluorometry and water sampling to the dispersant application area
- Monitor wildlife



Step 3: Prepare dispersant application recording tools

Record the amount and location of dispersant sprayed and report back to NOSRC. Use the following resources:

- Dispersant log form (Refer to **Section 9.1**)
- GPS
- Digital camera

Step 4: Receive Tasking

Ensure the following information is prepared for briefing:

- Location of the operational area
- Radio frequencies used in the area and on the response
- Call signs of other aircraft and vessels operating in the vicinity
- Locations of any temporary or permanent exclusion zones
- Health and safety briefing for the aircraft and operation

7.4 Dosage

Vessel/aircraft speed directly affects the volume of dispersant applied to a given patch of oil: the faster the vessel/aircraft the lower the concentration. Adjusting the pump rate will also affect the dosage rate.

$$Speed\ (knots) = \frac{output\ pump\ rate\ \ l/min \times\ 32.4}{swath\ (m) \times application\ rate\ (m^3/km^2)}$$

Optimum speed depends on a number of factors, but generally lies within the range of 1 – 10 knots for vessels and 150 knots for fixed-wing aircraft.

Application Rate is the amount of dispersant to be applied at per unit area. Generally, the application rate is 5 – 20 m^3/km^2, or approximately 5 - 20 G/Acre. Very thick oil patches may need repeat passes. (Spill quantification tool is available in **Appendix 3**). The amount of dispersant varies for different spills as it depends on the dispersant type, oil type and its degree of weathering, thickness, and environmental conditions.

Generally, Type 2 dispersants are rarely used. As a general rule, though, Type 2 dispersants can be applied in doses of about 30 to 50% of the estimated oil quantity for oil with low viscosity (up to 500 or possibly 1000 cSt) and 100% for oil with viscosity between 1,000 to 2,000 cSt.

For Type 3 dispersants, they can be applied in doses of about 5% for oil with viscosity up to 5000 cSt and 5 to 10% for oil with viscosity between 5,000 to 10,000 cSt. Dosage of less than 5% may be sufficient for fresh and light oil.

The **output pump rate** can be varied in accordance with the desired speed of vessel considering the environmental condition to achieve a constant application rate.

Droplet size is a very important factor in achieving maximum effectiveness when applying dispersant. Droplets that are too small may be blown away, and droplets that are too large may penetrate the oil and then pass through it. The optimum droplet size is believed to be between 350 and 1 000 µm, optimally 700 µm.

7.5 Application Procedure

Step 1: Target the thickest areas of the oil

Concentrate dispersant operations on the thickest portion of the slick (leading edge). Aerial support can assist with this.

Step 2: Apply dispersant

Apply in a ladder or zig-zag pattern through the thickest area of the oil, as shown in Error! Reference source not found. below. Maintain the dispersant to oil ratio recommended in the manufacturer's guidance.

Note: Without feedback from aerial support this can be difficult.

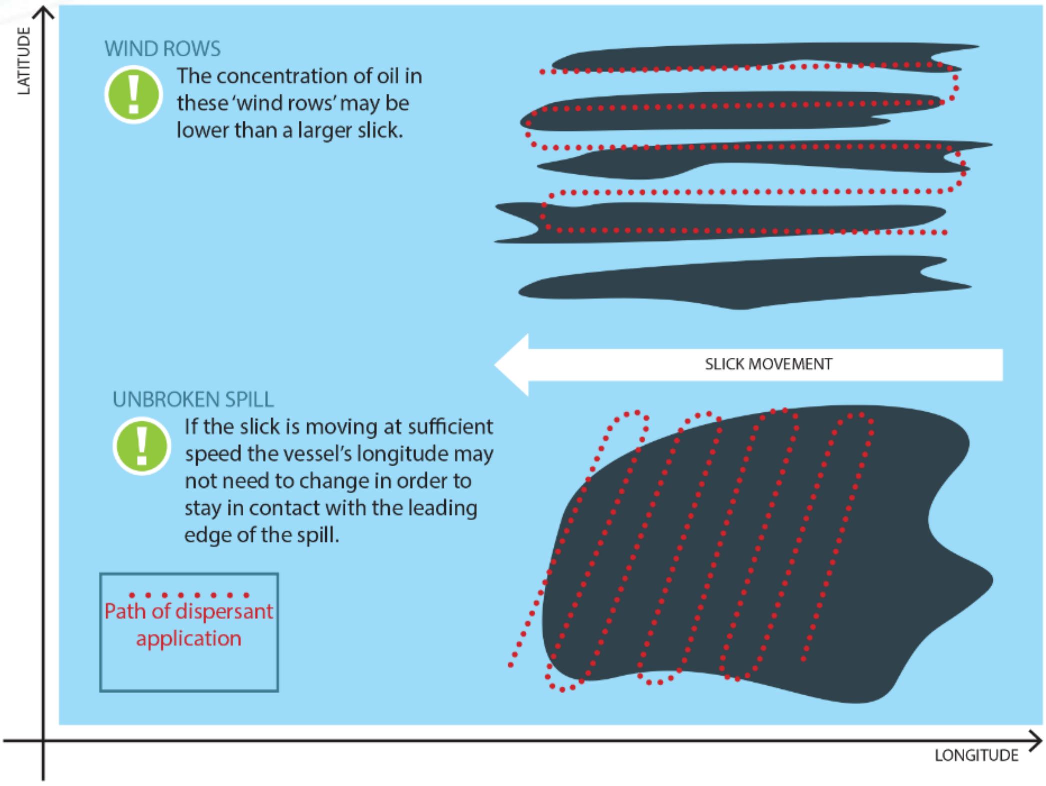


Figure 7-1: Dispersant Application Approach[5]

7.6 Monitoring of Dispersant Efficacy

It is important to monitor the efficacy of dispersant after application operation to assess the correct application rate has been applied. This can be done visually after dispersant application. The colour of the oil/dispersant mixture is a quick method to assess the efficacy. Visual indications are summarised in **Table 7-3**. Refer to **Section 9.1** for standard form to record the observation.

Table 7-3: Visual Indications of Dispersant Efficacy

Underdose	Effective	Overdose or Missed Target
		
• Spray run will be ineffective • Oil will remain on the surface in its normal state • Solution: Reduce vessel speed and review pump rate	• Grey or coffee coloured plume appears in the water • Movement of oil from the surface into the water column • Adjust vessel speed and/or pump rate as needed to maintain efficacy	• Cloudy white plume appears in the water • Solution: Increase vessel speed or reduce pump rate and verify target location

SMART Protocol

The Special Monitoring of Applied Response Technologies (SMART) protocol was designed by the US National Oceanic and Atmospheric Administration (NOAA) as a systematic field tool for dispersant effectiveness monitoring. There are three tiers of monitoring; the higher tiers will produce a more conclusive confirmation. The three tiers are:

Tier 1	Visual monitoring
Tier 2	Combine visual monitoring with in-field teams conducting real time water column monitoring (fluorometer) at a single depth with water sample collection for later analysis.
Tier 3	Expands on the Tier 2 water monitoring to meet the information needs of the incident. This may include monitoring at multiple depth and also taking water quality measurements or more extensive water samples.

Note: The SMART tiers may merge during a response. For example, you may monitor at multiple depths without taking samples if there is a lack of testing laboratories. Following the 2010 Macondo spill in the Gulf of Mexico, the SMART protocol is being re-evaluated to increase its potential effectiveness and relevance to sub-surface dispersant use.

Fluorometry

Fluorometry is the measurement of fluorescence using an instrument known as fluorometer. Specific compounds within crude oils may be excited using ultraviolet wavelengths and fluoresce in the visible wavelength. Knowing this parameter, measuring the amount of fluorescence at a desired wavelength will be able to determine whether oil has been dispersed into water column.

Fluorometry data are collected from the water column in three locations.

1) Background water at location away from spill.
2) Oiled surface spills prior to dispersant application. (natural dispersion)
3) Post chemical dispersant application. (chemical dispersion)

If there is significant difference between the background, natural dispersion and chemical dispersion, the dispersant application is effective. This is illustrated through **Figure 7-2**

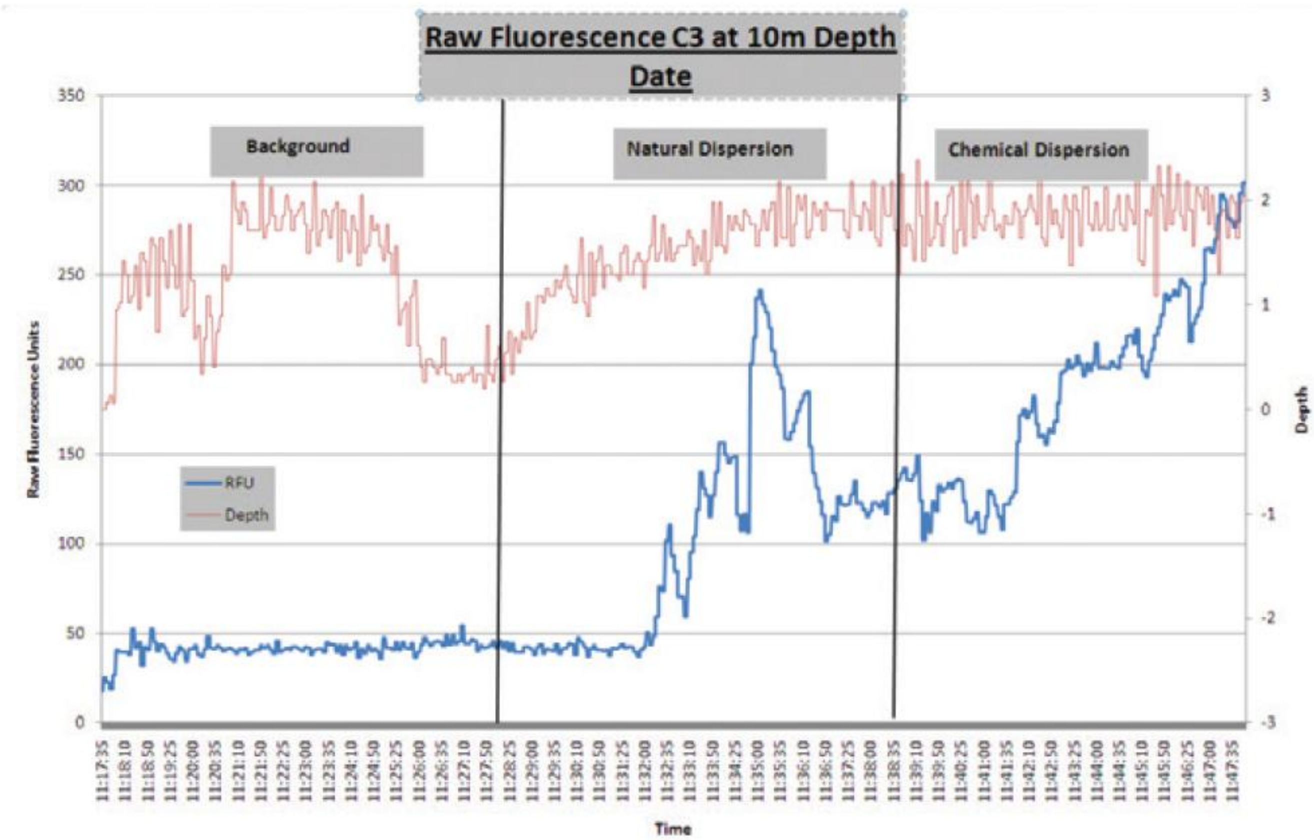


Figure 7-2: Fluorescence Reading Example[9]

[9] OSRL. Dispersant Application Monitoring Field Guide Tier II and III. Version 1. December 2011.

Note: Fluorometry data are considered to be qualitative as they do not provide measurement of exact quantities of oil in water column, but they do provide an indication based on comparative ratio.

7.7 Termination

The dispersant application operation shall cease when one of the following conditions is satisfied:

- The spill is assessed to be no longer a risk to environmental and socioeconomic resources;
- The oil is too scattered for effective application of dispersant;
- The state of oil is weathered beyond the window of opportunity;
- In-field monitoring feedback indicating dispersant is not effective.

The SOSC of the Lead State shall inform and begin demobilisation of resources related to dispersant application, independent of other requested resources if they are still in need. It is the responsibility of the Lead State to facilitate the smooth exit of requested resources during the demobilisation phase.

8 Tiered Preparedness and Response

Tiered Preparedness and Response (TPR) is an approach that allows organisations to plan and define response capability to effectively deal with oil spill incidents from operational spillages to worst case events. It also enables response escalation for an incident of any magnitude. Generally, it is recognised internationally to categorise response resources into three tiers.

The definitions of the tiers are:

Tiers	Definition of Tiers
Tier 1	On-site resources to mitigate events typically operational in nature and happen within or near the facility. These resources provide initial response to an incident that may potentially escalate beyond the scope of Tier 1 capability. For example, a spillage of fuel from small container on a platform.
Tier 2	National or regional resources to supplement Tier 1 when incident spreads and impact a wider area. These resources are usually wider in variety and strategically located to suite a range of response scenarios. For example, a grounded tanker continuous spilling its cargo that requires strategic stockpile held by national authorities.
Tier 3	Globally available resources to further supplement Tier 1 and 2. These resources are wider in variety and comprise specialised equipment and service.

Historically, interpretation of tiered model has been based on spill volume alone, but this approach is simplistic and may not result in the suitable capability being established for all operations. For example, a large spill drifting towards the open sea may require less resources than a small spill approaching a sensitive shoreline. Therefore, the improved definition of tiers does not include any volume of oil spill or any quantitative measurement of resource capacity. It only represents the various levels of resource capacity required to respond to a specific facility or region. Removing the restrictive volumetric thresholds between tiers allows access to resources provided by all three tiers according to the needs of the incident and not purely based on a predetermined spill volume.

Following the definition, a clear picture of resources at each level in the event of an incident shall be made available by each of the participating countries. This allows the responding countries to cascade in additional resources in an effective and timely manner when an incident evolves and escalates. As such, the participating countries shall follow the planning process to determine on the boundary of tier 1 capability and necessary arrangement at Tier 2 and Tier 3, using **Figure 8-1** as a guide. In the figure, TPR is represented in a wheel with 15 segments. Each segment represents a discrete capability that may be required in oil spill response. The segment is subdivided into three layers to illustrate how that specific response capability will be provided across all three tiers.

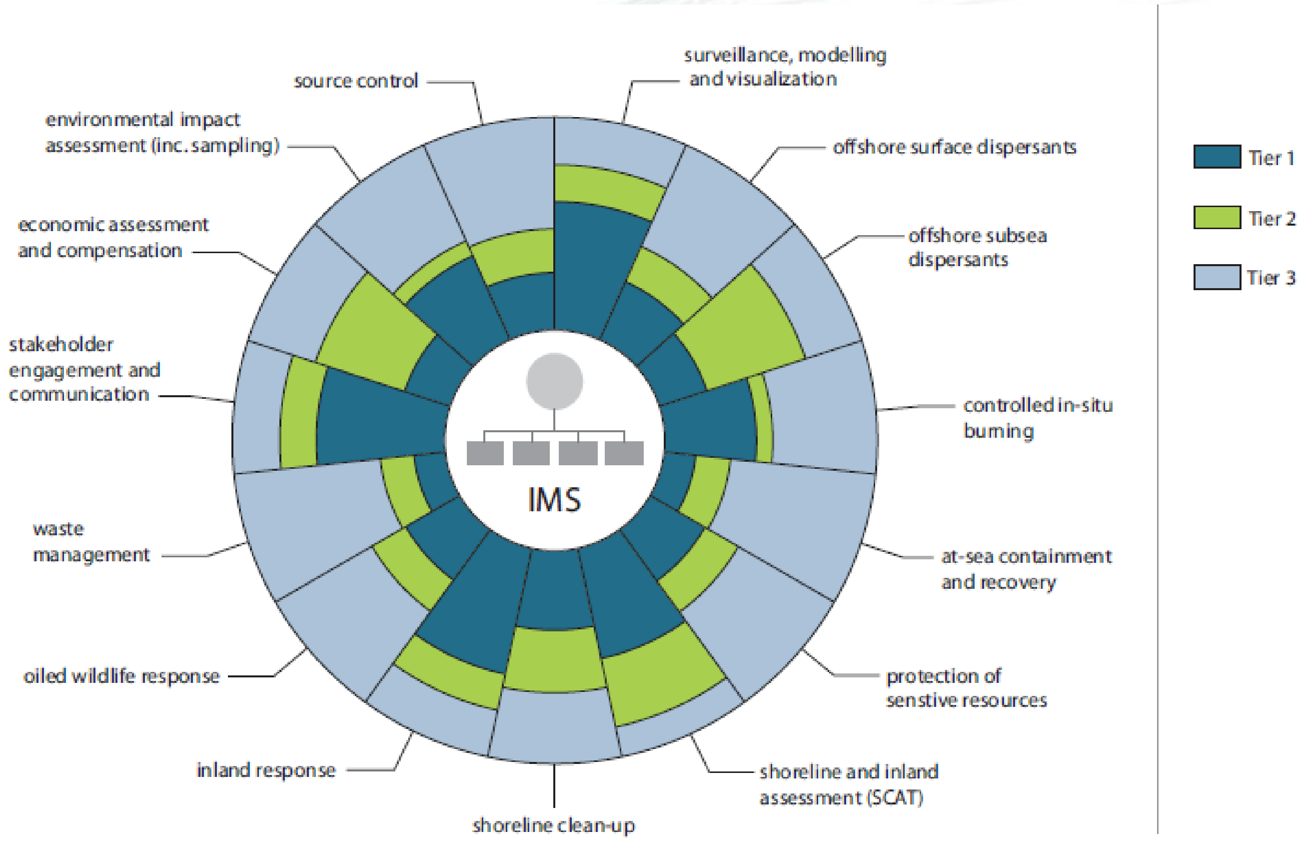


Figure 8-1: Complete Model of Tiered Preparedness and Response[10]

Following the definition of the tiers, an oil spill incident requiring resources at Tier 2 and Tier 3 are likely to involve the activation of Sub-Regional OSCP. However, at the time of an oil spill incident, it should be noted that definition of tiers is strictly for planning purposes and any resources required should be mobilised immediately regardless of the definition of tier. For example, additional Tier 1 resources from a nearby facility without compromising the preparedness of the facility. This is especially critical when the nearby facility is operating in the jurisdictional water of another country. Such challenges can be overcome through activation of the Sub-Regional OSCP where coordination across countries could be made.

[10] IPIECA, IOGP. Tiered Preparedness and Response. Good Practice Guidelines for Using the Tiered Preparedness and Response Framework, pg 15. 2015.

9 Supporting Documentation

9.1 Forms

Pollution Report Form

INTRODUCTORY SECTION	
Contents	**Remarks**
DTG (Date Time Group)	Day and time of drafting of the communication. Always six figures. Can be followed by month indication. The DTG can be used as reference.
IDENTIFICATION	Indicates which part(s) of the POLREP are included.
SERIAL NUMBER	Each single report should be easily identifiable, and the receiving agency should be I a position to check whether all reports of the incident in question have been received. This is done by using a national identifier followed by a stroke system, where the number before the stroke indicates the incident to which the report refers and the number following the stroke indicates the actual number of reports which have been originated on the incident in question. POLREP ASEAN BRUNEI 1/1 indicates the first report from Brunei of the incident in question. POLREP ASEAN BRUNEI 1/2 indicates the second report form the same incident. If the pollution splits into two clearly defined patches the wording "POLREP ASEAN 1 now splitting into POLREP ASEAN 2 and POLREP ASEAN 3" should be indicated in the last report on the incident identified by line 1 preceding the stroke. The first reports on the two patches originating from the incident first reported will then be numbered: POLREP ASEAN BRUNEI 2/1 and POLREP ASEAN BRUNEI 3/1. National identifiers – short forms may be used as follows: Brunei Darussalam BRN Kingdom of Cambodia KHM Republic of Indonesia IDN

INTRODUCTORY SECTION		
Contents	**Remarks**	
	Lao People's Democratic Republic	LAO
	Malaysia	MYS
	Republic of the Union of Myanmar	MMR
	Republic of the Philippines	PHL
	Republic of Singapore	SGP
	Kingdom of Thailand	THA
	Socialist Republic of Viet Nam	VNM

PART 1 (POLWARN)	
Contents	**Remarks**
1 DATE AND TIME	The date of the month as well as the time of the day when the incident took place or, if the cause of the pollution is not known, the time of the observation should be stated with six figures. Time should be stated as GMT for example 091900z (i.e. the 9th of the relevant month at 1900 GMT).
2 POSITION	Indicates the main position of the incident in latitude and longitude in degrees and minutes and may, in addition, give the bearing of and the distance from a location known by the receiver.
3 INCIDENT	The nature of the incident should be stated here, such as BLOW OUT, TANKER GROUNDING, TANKER COLLISION, OIL SLICK, etc.
4 OUTFLOW	The nature of the pollution, such as CRUDE OIL, CHLORINE, DINITROL, PHENOL, etc., as well as the total quantity in tonnes of the outflow and/or the flow rate, as well as the risk of further outflow. If there is no pollution but a pollution threat, the words NOT YET followed by the substance, for example NOT YET FUEL OIL, should be stated.
5 ACKNOWLEDGE	When this figure is used the communication should be acknowledged as soon as possible by the competent national authority.

PART II (POLINF)	
Contents	**Remarks**
40 DATE AND TIME	No. 40 relates to the situation described in figures 41 to 60 if it varies from line 1.
41 POSITION AND/OR EXTENT OF POLLUTION ON/ABOVE/IN THE SEA	Indicates the main position of the pollution in latitude and longitude in degrees and minutes and may in addition give the distance and bearing of some prominent landmark known to the receiver if other than indicated in line 2. Estimated amount of pollution (e.g. size of polluted areas, number of tonnes of oil spilled if other than indicated in line 4, or number of containers, drums, etc. lost). Indicates length and width of slick given in nautical miles if not indicated in line 2.
42 CHARACTERISTICS OF POLLUTION	Gives type of pollution, e.g. type of oil with viscosity and pour point, packaged or bulk chemicals, sewage. For chemicals give proper name or United Nations number if known. For all, give also appearance, e.g. liquid, floating solid, liquid oil, semi-liquid sludge, tarry lumps, weathered oil, discolouration of sea, visible vapour. Any markings on drums, containers, etc. should be given.
43 SOURCE AND CAUSE OF POLLUTION	E.g. from vessel or other undertaken. If from vessel, say whether as a result of a deliberate discharge or casualty. If the latter give brief description. Where possible, give name, type, size, call sign, nationality and port of registration of polluting vessel. If vessel is proceeding on its way, give course, speed and destination.
44 WIND DIRECTION AND SPEED	Indicates wind direction and speed in degrees and m/sec. The direction always indicates from where the wind is blowing.
45 CURRENT DIRECTION AND SPEED AND/OR TIDE	Indicates current direction and speed in degrees and knots and tenths of knots. The direction always indicates the direction in which the current is flowing.
46 SEA STATE AND VISIBILITY	Sea state indicated as wave height in metres. Visibility in nautical miles.
47 DRIFT OF POLLUTION	Indicates drift course and speed of pollution in degrees and knots and tenths of knots. In case of air pollution (gas cloud) drift speed is indicated in m/s.

PART II (POLINF)	
Contents	**Remarks**
48 FORECAST OF LIKELY EFFECT OF POLLUTION AND ZONE AFFECTED	E.g. arrival on beach with estimated timing. Results of mathematical models.
49 IDENTIFY OF OBSERVER/REPORTER IDENTITY OF SHIPS ON SCENE	Indicates who has reported the incident. If a ship, name, home port, flag and call sign must be given. Ships on scene can also be indicated under this item by name, home port, flat and call sign, especially if the polluter cannot be identified and the spill is considered to be of recent origin.
50 ACTION PLAN	Any action taken to combat the pollution.
51 PHOTOGRAPHS OR SAMPLES	Indicates if photographs or samples from the pollution have been taken. Communication addresses of the sampling authority should be given.
52 NAMES OF OTHER STATES AND ORGANIZATIONS INFORMED	
53-59	SPARE FOR ANY OTHER RELEVANT INFORMATION (e.g. results of sample or photographic analysis, results of inspections of surveyors, statements of ship`s personnel, etc.
60 ACKNOWLEDGE	When this line is used the communication should be acknowledged as soon as possible by the competent national authority.

PART III (POLFAC)	
Contents	**Remarks**
80 DATE AND TIME	No. 80 is related to the situation described below, if it varies from lines 1 and/or 40.
81 REQUEST FOR ASSISTANCE	Type and amount of assistance required inform of: • specified equipment • specified equipment with trained personnel • complete strike teams

PART III (POLFAC)	
Contents	**Remarks**
	• personnel with special expertise with indication of country requested.
82 COST	Requirements for cost information to requesting country of delivered assistance.
83 PRE-ARRANGEMENTS FOR THE DELIVERY OF ASSISTANCE	Information concerning customs clearance, access to territorial waters, etc. in the requesting country.
84 TO WHERE ASSISTANCE SHOULD BE RENDERED AND HOW	Information concerning the delivery of the assistance, e.g. rendezvous at sea with information on frequencies to be used, call sign and name of supreme on-scene commander of the requesting country, or land-based authorities with telephone number, telex number and contact persons.
85 NAMES OF OTHER STATES AND ORGANIZATIONS	Only to be filled in if not covered by line 81, e.g. if further assistance is later needed by other States.
86 CHANGE OF COORDINATION	When substantial part of an oil pollution or serious threat of oil pollution moves or has moved into the zone of another Contracting Party, the country which has exercised the supreme command of the operation may request the other country to take over the supreme command.
87 EXCHANGE OF INFORMATION	When a mutual agreement has been reached between two parties on a change of supreme command, the country transferring the supreme command should give a report on all relevant information pertaining to the country taking over the command.
88-98	SPARE FOR ANY OTHER RELEVANT REQUIREMENTS OR INSTRUCTIONS
99 ACKNOWLEDGE	When this figure is used the telex should be acknowledged as soon as possible by the competent national authority.

Dispersant Request Form

DISPERSANT REQUEST FORM

Date ....

To NOSRC of (Cambodia/Thailand/Viet Nam)

1. REQUEST INFORMATION

Organization/Department ....

Contact Person ....

Address ....

Phone ....   Fax ....

Email ....

2. INCIDENT INFORMATION

Name of Incident ....

Location ....

Date(mm/dd/yy) .... Time ....

Type of spill .... Spill Amount ....

3. DISPERSANT REQUEST

No.	Name of Dispersant	Amount
1.		
2.		
3.		
4.		
5.		
6.		

NEBA Decision Making Form

<table>
<tr><th colspan="6">Net Environmental Benefit Analysis – Decision Making During a Response</th><th colspan="2">DATE:</th></tr>
<tr><td colspan="8">Process used by the response stakeholders for making the best choices to minimise the impacts of oil spills on people and the environment. Stakeholders include Governments, industry and local community members.</td></tr>
<tr><td colspan="8">Response Stakeholders – to be identified and contacted before, during and after a spill:</td></tr>
<tr><td colspan="2">Government Authority 1</td><td colspan="2">Name / number</td><td colspan="2">Stakeholder 1</td><td colspan="2">Name / number</td></tr>
<tr><td colspan="2">Government Authority 2</td><td colspan="2">Name / number</td><td colspan="2">Stakeholder 2</td><td colspan="2">Name / number</td></tr>
<tr><td colspan="2">Government Authority 3</td><td colspan="2">Name / number</td><td colspan="2">Stakeholder 3</td><td colspan="2">Name / number</td></tr>
<tr><td colspan="2">Community Member 1</td><td colspan="2">Name / number</td><td colspan="2">Scientific SME 1</td><td colspan="2">Name / number</td></tr>
<tr><td colspan="2">Community Member 2</td><td colspan="2">Name / number</td><td colspan="2">Scientific SME 2</td><td colspan="2">Name / number</td></tr>
<tr><td colspan="8">Spill Information</td></tr>
<tr><td colspan="2">Source Name</td><td colspan="2"></td><td colspan="2">Location</td><td colspan="2"></td></tr>
<tr><td colspan="2">Spill Scenario</td><td colspan="2">Onshore/inland/subsea near shore / offshore</td><td colspan="2">Oil/Product information</td><td colspan="2">Type, viscosity, thickness, depth, movement, volume</td></tr>
<tr><td colspan="2">Weather</td><td colspan="2">Wind / temperature</td><td colspan="2">Waves conditions</td><td colspan="2"></td></tr>
<tr><td colspan="8">Response Tool Selection</td></tr>
<tr><td>Effectiveness</td><td>Tools that remove most oil?</td><td>Feasibility</td><td>Tools which can be safely executed? Enough resources available? Access points?</td><td>Minimise Impact</td><td>Tools that minimise impact on environment and community?</td><td>Regulations</td><td>Tools that are allowed in country?</td></tr>
<tr><td colspan="2">Proximity to local population</td><td colspan="2">Presence of sensitive species</td><td colspan="2">Proximity to sensitive shorelines</td><td colspan="2">Geographical considerations</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
</table>

<table>
<tr><td colspan="2">Previous spill history</td><td colspan="2">Seasonal variables</td><td colspan="2">Impact on regional industries</td><td colspan="2">Impact on regional infrastructure</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><th colspan="2">Dispersant</th><th colspan="2">In situ burning</th><th colspan="2">Mechanical Containment and Recovery</th><th colspan="2">Natural Recovery</th></tr>
<tr><th>Benefits</th><th>Drawbacks</th><th>Benefits</th><th>Drawbacks</th><th>Benefits</th><th>Drawbacks</th><th>Benefits</th><th>Drawbacks</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">Communication and Monitoring Actions During Response</td><td colspan="3">Action 1: Select most effective response approach based upon priorities and tradeoffs (pro's/cons)</td><td colspan="2">Response approach selected</td><td colspan="2">Agreement of response approach and date</td></tr>
<tr><td colspan="3">Action 2: Implement response using appropriate tools and techniques and monitor results</td><td colspan="2">Response approach reviewed</td><td colspan="2">Agreement of response review and date</td></tr>
<tr><td colspan="3">Action 3: Adapt response approach based upon changing conditions and additional information gathered.</td><td colspan="2">Response approach adapted</td><td colspan="2">Agreement of response adaptation and date</td></tr>
</table>

Dispersant Application Log (Vessel)

Incident				Location	
Vessel Name				Date	
Observed Conditions in Spray Area					
Wind Speed			Visibility		
Sea State			Weather Condition		
Dispersant information					
Dispersant Type			Date of Manufacture		
Spray Operators Log					
Run #	Start Time	Start Position Lat/Long	Finish Position Lat/Long	Course bearing	Observed Effects of Dispersant
Name of Operator:				Signature of Operator:	

Visual Dispersant Monitoring Observer Log (Aerial)

Incident		Date		Observers	
Aircraft Type		Call Sign		Area of Survey	
Survey Start Time		Survey End Time		Average Altitude	
Wind Speed (knots)		Wind Direction		Notes	
Cloud Base (feet)		Visibility (nm)			
Time High Water		Time Low Water			
Current Speed (nm)		Current Direction			

Slick	OIL APPEARANCE - Post Dispersant Application %				Log Photo Reference Number (and direction photo taken)		
	1	2	3	4			OIL APPEARANCE- ***Post dispersant application***
A						1	**No obvious dispersion** - Dispersant being washed off the black oil as white, watery solution leaving oil on surface. Quantity of oil on sea surface not altered by dispersant.
B						2	**Slow or partial dispersion** - Some surface activity (oil appearance altered). Spreading out of oil. Droplets of oil seen rapidly rising back to sea surface, but overall quantity appear to be similar to that before dispersant spraying.
C						3	**Rapid dispersion** - Oil rapidly disappearing from surface. Light brown plume of dispersed oil visible in water under the oil and drifting away from it. Oil in some areas being dispersed to leave only sheen on.
D						4	**Other observations**– Such as herding or lacing

9.2 Contact Directory

National Contact Point

Country	NOSRC
Viet Nam	Permanent Deputy Director Vietnam National Southern Oil Spill Response Center 4th flr, PVFCCo Tower, 43 Mac Dinh Chi St., District 1 Ho Chi Minh City, Viet Nam **Contact Person**: Mr. Hai Ho Vu - Director Email: haihv@pvdrilling.com.vn **Alternative contact person**: Mr. Khanh Nguyen Kim – OSR Manager; Email: khanhnk@pvdrilling.com.vn; Cell phone: +84 909883489
Cambodia	Merchant Marine Department General Department of Waterway-Maritime Transport and Port Ministry of Public Works and Transport Street 598, Sangkat Chrang Chamres2, Khan Russey Keo Phnom Penh, Cambodia **Contact Person**: **Mr Suon Vansar** Email: suonvansar@gmail.com/mmd@mpwt.gov.kh **Alternative contact person**: Mrs. Theng Sorachana Email: thengsorachana@gmail.com
Thailand	Marine Department- Environment Group Maritime Safety and Environment Bureau Marine Department of Thailand **Contact Persons**: **Ms Soontharee Pirom** Tel. no. +66 8 5224 5857 Email: soothareep@hotmail.com **Alternative contact person**: **Ms Jittima Suttipotipong** Tel. no. +66 8 6495 9742 Email: sut.jittima.md@gmail.com

Part 2: Reference Materials

10 General Information on Oil Spill and Dispersants

10.1 Fate and Behaviour of Oil

The fate and behaviour of oil spilled at sea depends largely on the physical and chemical properties of the oil. It is the oil's chemical composition, in combination with meteorological conditions, which affect the way in which the oil breaks up and dissipates into the marine environment or persists. This interaction between the spilled oil and its new environment is a process known as weathering, and it can only be predicted if the oil's properties are known.

The Weathering Process

The weathering process is illustrated in **Figure 10-1** and described in **Figure 10-2**. Tiered resources and response techniques can be planned based on the oil's predicted weathering in the marine environment. This can be done using oil spill models that include algorithms for weathering processes on tested oils and/or using historical spill records for oils with similar properties.

If oil is spilled, additional modelling can predict the fate and behaviour of the spilled oil based on the current and forecast meteorological conditions.

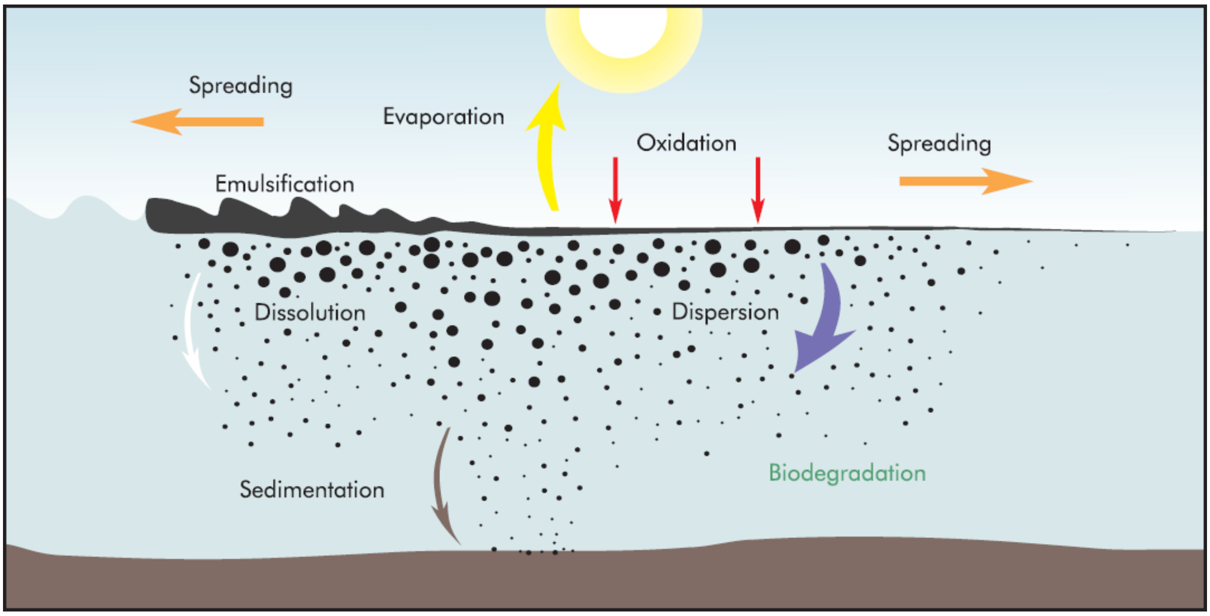


Figure 10-1: Weathering
of Oil Spilled in The Marine Environment[11]

[11] ITOPF. Technical Information Paper 2: Fate of Marine Oil Spills. 2011

Spreading / Fragmentation

- As soon as the oil spilled, it immediately starts to spread over the sea surface and becoming thinner as it spread wider.
- Rate is dependent on oil viscosity, volume, wave action, wind speed, current and water temperature.
- With the consistent wind blowing, oil could get fragmented and create windrows.

Evaporation

- Light ends evaporate quickly, this can produce an explosive atmosphere.
- Rate is dependent on volatile content of oil, wind speed, and air and sea temperature.
- Residues after evaporation will have higher density and viscosity than the original product.

Emulsification

- Seawater mixes with oil to form a viscous and persistent emulsion, increasing the total volume by up to 4-5 times.
- Difficult to recover, cannot be burnt or dispersed.
- Key factors driving rate of emulsification are asphaltene content and sea state or the turbulence in the water.

Dispersion

- Oil breaks down into droplets of different sizes which suspend into the water column.
- Small droplets may remain dispersed in the water column, while large droplets may resurface and get stranded in the shorelines.
- Rate depends on oil viscosity and sea state or turbulence in the water.

Sedimentation / Stranding

- Oil adheres to suspended particles in the water which are heavy enough to sink the oil to the seabed. For the oil that stays in the surface, it could get carried by wind and current and stranded in shorelines.
- Rate depends on suspended sediment concentration. High concentrations usualy occur at river mouths and in coastal waters.

Biodegradation

- Oil is consumed by bacteria that break it down into smaller compounds until it becomes primarily carbon dioxide and water.
- Rate depends on oil type, availability of nutrients (nitrogen and phosphorus), oxygen concentration and water temperature.

Dissolution

- Water soluble components of oil, such as benzene and toulene, dissolve into the water column and can affect marine organisms.
- Extent depends on oil composition, most oils contain small soluble fractions.

Photo-oxidation

- Breaks down oil components into smaller, soluble compounds.
- Can form persistent compounds called tars.
- Extent depends on oil type and the form in which it is exposed to sunlight.

Figure 10-2: Summary of Weathering Processes Acting on Oil Spilled in ihe Marine Environment

Weathering Effects on Oil Spill Response

Each weathering process affects oil spill response, and the extent of environmental damage caused by spilled oil. The advantages and disadvantages of each weathering process are listed in **Table 10-1**.

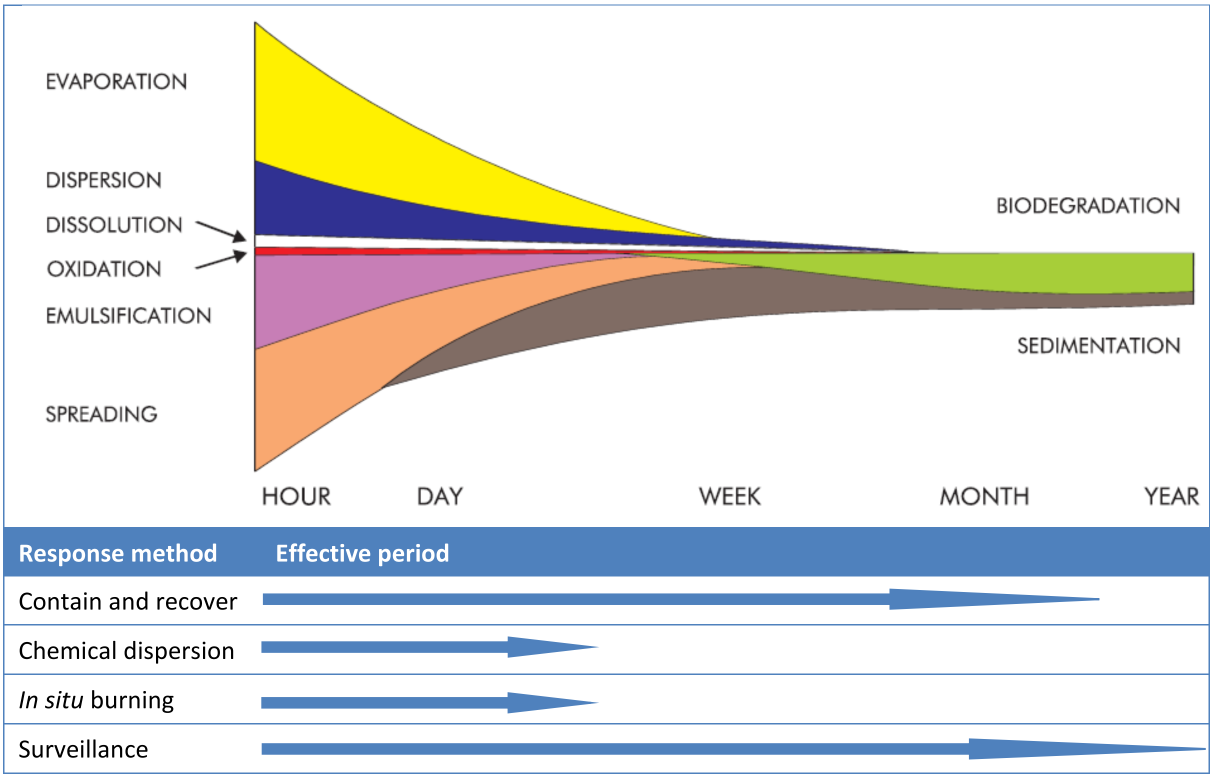
Table 10-1: Summary of How Each Process of Weathering Helps and Hinders Oil Spill Response

	Advantages	Disadvantages
Spreading / Fragmentation	• Provides sufficient area for multiple clean-up efforts • It increases the chance of oil to evaporate as slick thins	• Increases surface area of slick so oil affects a larger area and is more difficult to encounter in booms • Decreases slick thickness, limiting mechanical recovery and in situ burn effectiveness (note: dispersants may be applied to thinner slicks than required for other response tools)
Evaporation	• Reduces volume of oil to be recovered • Removes pollution from marine environment • Evaporating light ends can help ignition of slick (*in situ* burning) • Reduces likelihood of oil reaching shorelines	• Can create explosive environment which can delay response for safety • Volatile, air-borne components may be hazardous to the public and response personnel • Increases oil viscosity making it less amenable to chemical dispersion
Emulsification	-	• Increases volume and viscosity as water becomes incorporated into oil – more waste management needed • May be less likely to disperse or burn • Reduces recovery efficiency
Dispersion	• Reduces volume of oil to be recovered and removes oil from the water's surface • Reduces need for oily liquid/solid waste handling and storage • Encourages natural biodegradation of oil components	• Can harm marine organisms in the immediate area • Human health may be affected by eating contaminated seafood
Sedimentation /Stranding	• Reduces volume of oil to be recovered • Reduces likelihood of oil reaching shorelines • Movement is limited	• Can harm marine organisms, especially on the seafloor • Human health can be affected by eating contaminated seafood • Increased likelihood of longer-term oil spill environmental effects
Biodegradation	• Potential to return environment to pre-spill conditions • Produces no waste • Free (unless fertilisers are used) • Energy from oil is distributed through the food web	• Slow process of transfer from water surface to water column, biodegradation begins immediately once oil is dispersed into the water column • Heavy compounds degrade very slowly • Cannot degrade largest, most complex components, which are generally non-bioavailable, non-toxic

	Advantages	Disadvantages
		• Intermediate products may be toxic to marine organisms – but probably not as toxic as original product
Dissolution	• Reduces volume at surface • Soluble compounds are generally readily biodegradable	• Soluble compounds are generally toxic to marine life but biodegrade quickly Low solubility
Photo-oxidation	• Can break down large aromatic compounds that are resistant to biodegradation	• Oxidised compounds can be more toxic to marine organisms • May increase oil persistence

Spreading, evaporation and emulsification begin as soon as oil is spilled onto water (**Table 10-1**). These processes affect the window of opportunity for techniques such as in situ burning and chemical dispersion (**Table 10-2**). The window of opportunity varies between oil types, meteorological conditions and whether the incident is a continuous spill (for example, leaking tank vessel or well blowout) or a one-time release (for example, an instantaneous of tank vessel storage tank).

Table 10-2: Timescale for each weathering process acting on spilled crude oil and the resultant window of opportunity for different response techniques. Band width represents the importance of the process during that time period.[11]



10.2 Mechanism of Dispersant

The main purpose of dispersant use is to break the oil slick into numerous tiny droplets which become rapidly diluted into the water column and are subsequently degraded by naturally occurring micro-organisms. When appropriately used, it can be an effective response to an oil spill and can minimise or prevent damage to important sensitive resources.

While the same may be said for other response techniques, the use of dispersants must be considered carefully, considering the characteristics of oil, environmental conditions and sensitivities, and regulations on their use in the area. In some cases, significant environmental and economic benefits can be achieved using dispersants, particularly when other response techniques are limited by the magnitude of a spill and its distance from shore, weather conditions and the availability of resources.

Dispersants are oil spill treatment products designed for spraying onto oil spills to enhance natural dispersion (**Figure 10-3**). It has 2 components, surfactants and solvents (**Figure 10-4**). Surfactants are surface active agents. Part of each surfactant is attracted to oil (oleophilic) and while another part is attracted to water (hydrophilic). Once situated at the oil/water interface, the surfactant reduces oil/water interfacial tension and allows for effective formation of small oil droplets that disperse into the water column. The solvent carries the dispersant mixture into the oil for better results. The better the solvent's penetration, the more efficient the dispersant. Modern, commercial dispersants contain some of the same ingredients as everyday household products, such as toothpaste, sunscreen, and cosmetics. However, they are designed to work in the marine environment to prevent oil from re-coalescing. Before dispersant is approved to be used, it would have been tested for efficacy and toxicity.

When dispersant is applied and small droplets are introduced into the water column, biodegradation starts almost immediately, e.g., minutes to hours. Oil droplets of varying sizes disperse into the top 10m of the water column. Marine currents then quickly dissipate the oil to very low concentration over wide areas.

Advances in the science of dispersants has made it more effective and suitable for use in more cases. They are often less effective against heavy oils such as HFOs and viscous emulsions and may have varying degrees of effectiveness for other oils. Hence, which dispersant to apply and how to apply it, will depend on the area to be treated and the type of oil involved. If dispersants are to be used, it should be as early in the response as possible. Oil viscosity and the extent of emulsification will increase with time in the environment. The window of opportunity for the use of dispersant may then be missed.

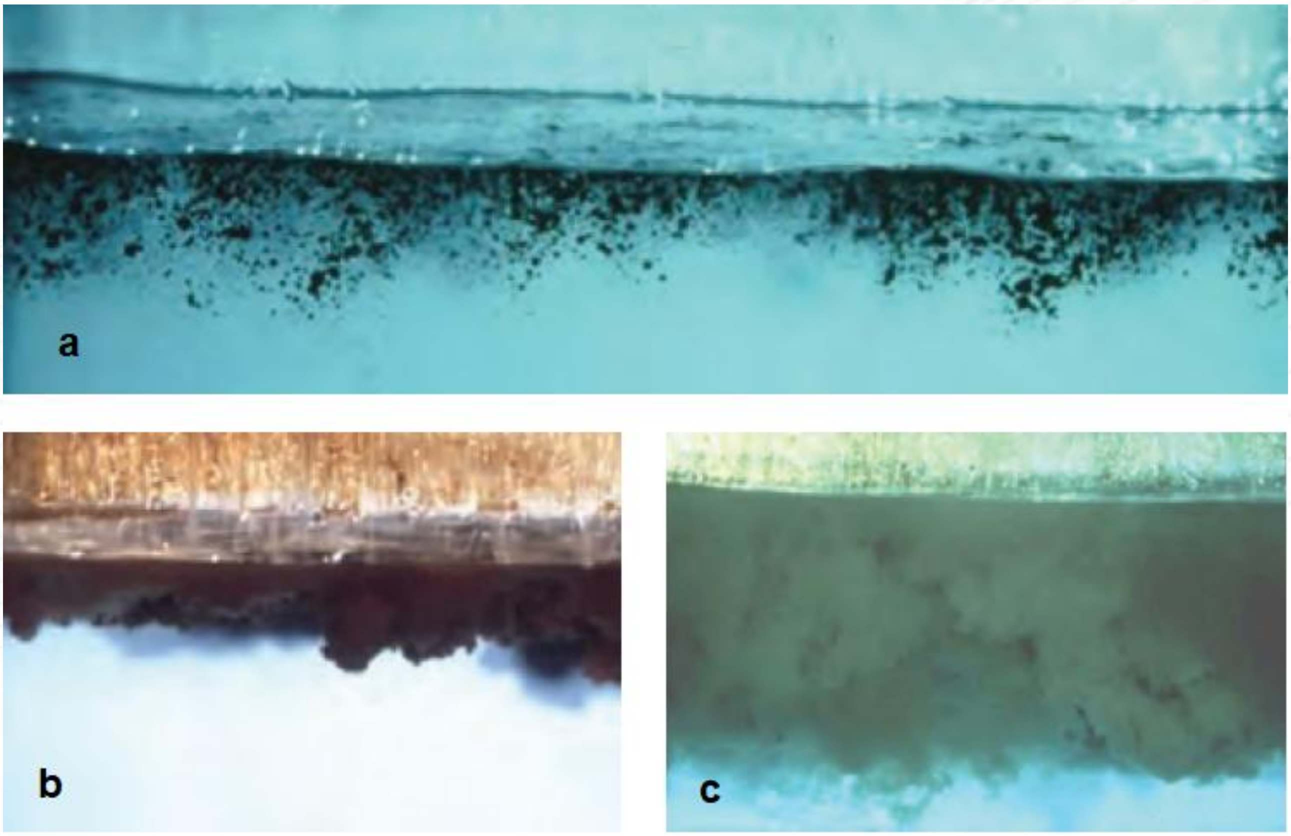


Figure 10-3: Successful Dispersion in Laboratory Conditions[12]

a) Oil without dispersant (natural dispersion), b) Oil with dispersant and c) Oil with dispersant a few seconds later, demonstrating rapid dilution. (Images courtesy of Delft Hydraulics Institute)

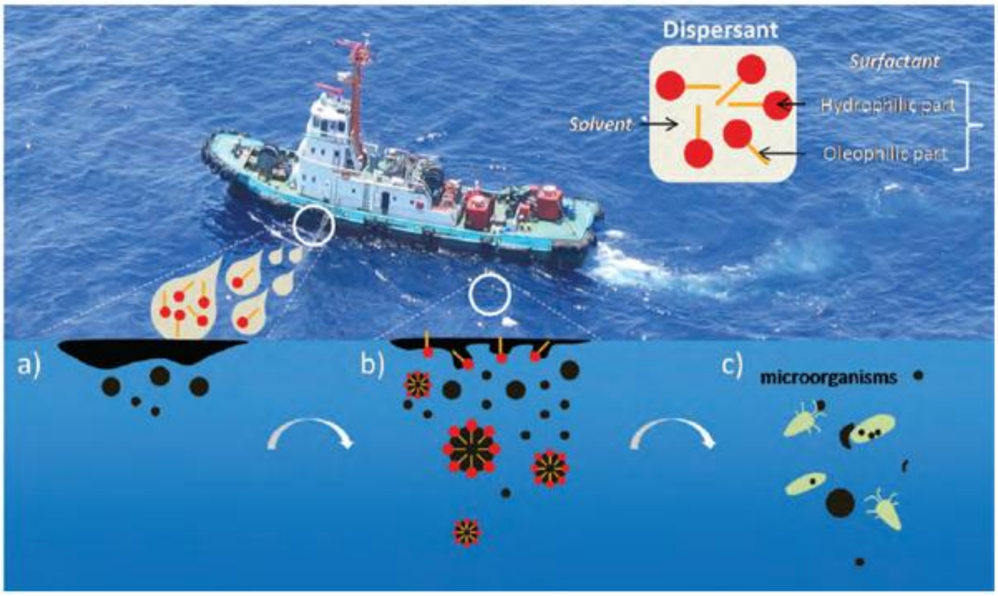


Figure 10-4: The Chemical Dispersion Process[12]

[12] ITOPF. Technical Information Papers 4: Use of Dispersant to Treat Oil Spills. 2011.

a) Dispersants containing surfactants and solvent sprayed onto the oil with the solvent carrying the surfactant into the oil; b) The surfactant molecules migrate to the oil/water interface and reduce surface tension, allowing small oil droplets to break away from the slick; c) The droplets disperse by turbulent mixing and are ultimately degraded by naturally occurring micro-organisms, such as bacteria and fungi. The later stage may require days or weeks to achieve.

10.3 Limitations of Dispersant

Dispersant effectiveness, as with other response tools, is limited by certain physical and chemical parameters, the most important of which are the sea condition and oil properties. An awareness of these limitations is important to identify circumstances when dispersant use is appropriate.

Sea Conditions

A minimum amount of wave energy is required for the successful use of dispersant at sea. Below this minimum, dispersion may be slow to occur. In severe sea conditions, the oil will likely disperse naturally, and direct response may not be needed. Field trials indicate that the optimum wind speed is between 4 – 12 m/s or 8 – 12 knots (Beaufort Scale 3 – 6).

Dispersants are manufactured primarily for use in seawater with a salinity of around 20 – 35 parts per thousand (ppt). Performance will decrease rapidly in brackish waters with a salinity below 5 – 10 ppt, especially when applying pre-diluted dispersant. Similarly, efficiency is also negatively affected when salinity rises above 35 ppt. Efficacy is dramatically reduced in fresh water because the surfactants tend to migrate through the oil layer into the water column instead of stabilising at the oil/water interface. However, some dispersants have been formulated for use in fresh water and it is known how to modify existing dispersants for effective use in fresh water. However, in a confined freshwater system such as lakes and ponds, other factors need to be considered, such as whether there is enough depth or water exchange to achieve adequate dilution of the dispersed oil.

Oil Properties

The characteristics of the oil and the way these properties change by weathering at sea, are important when assessing whether the use of dispersant is likely to be successful. The viscosity and pour point of an oil are two properties that provide a good indication of how easily the oil is likely to disperse.

Dispersant effectiveness generally decreases as oil viscosity increases. Fresh, light to medium crude oils are generally considered to be readily dispersible at most sea temperatures. The upper limit for dispersion is likely to be reached with heavier oils (Group 4 Oils). As a general guide, most dispersants are unlikely to be effective for oils with a viscosity above 10,000 centistokes (cSt) at the time that they are spilt. The viscosity of spilt oil will increase because of weathering, primarily via evaporation and emulsification.

Similarly, oils with a pour point that is higher than the ambient temperature are usually transported heated and if spilt will rapidly increase in viscosity as they cool, often becoming semi-solid. As a general rule, oils with pour points close to, or higher than, the sea surface temperature will not be dispersible, but other factors such as solar heating may mitigate this.

Oils with high viscosity, including those with high pour point, do not disperse easily, either naturally or after the application of dispersants because the mechanical resistance of the oil prevents small droplets from breaking away under the slick. Furthermore, dispersants may be ineffective on these oils because they are not able to penetrate the oil before it is washed off and lost into the water below. This may be displayed as a white plume (**Figure 10-5**) that is noticeably in contrast with successful dispersion (**Figure 10-6**). Modifications of dispersant formulations to increase viscosity and promote adhesion to an oil slick may improve performance in these cases.

Some oils are particularly prone to forming water-in-oil emulsions, e.g., those that have a relatively high asphaltene content (>0.5%) and a combined nickel/vanadium concentration greater than 15 parts per million (ppm). However, it has been shown that Macondo-related emulsions could be successfully dispersed indicating that test applications could be beneficially during the decision-making process.

Light products such as diesel, kerosene and gasoline do not readily form emulsions but spread to form very thin layers of films of oil or sheen on the water surface that evaporate or dissipate readily without the need to use dispersant. Irrespective of this, the use of dispersants on light products or on sheens derived from a crude or fuel oil is not advised because the dispersant droplets tend to "punch" through the thin film into the underlying water and cause "herding" of the oil. The dispersant in the water causes the oil film to draw back immediately, creating an area of clear water that should not be mistaken as dispersion (**Figure 10-7**). In practice, light oils and fuels have been found to evaporate significantly and disperse naturally, i.e., no active response is needed or recommended. Dispersants formulated for use on mineral oils have been shown to have little or no effect on non-mineral oils, such as palm oil or rapeseed oil.

Figure 10-5: Ineffective Treatment Of a Heavy Fuel Oil with Dispersant is Characterised by a White Plume in the Water[12]

Figure 10-6: Dispersion Starting After the Application of Forties Crude during the Sea Empress Spill [12]

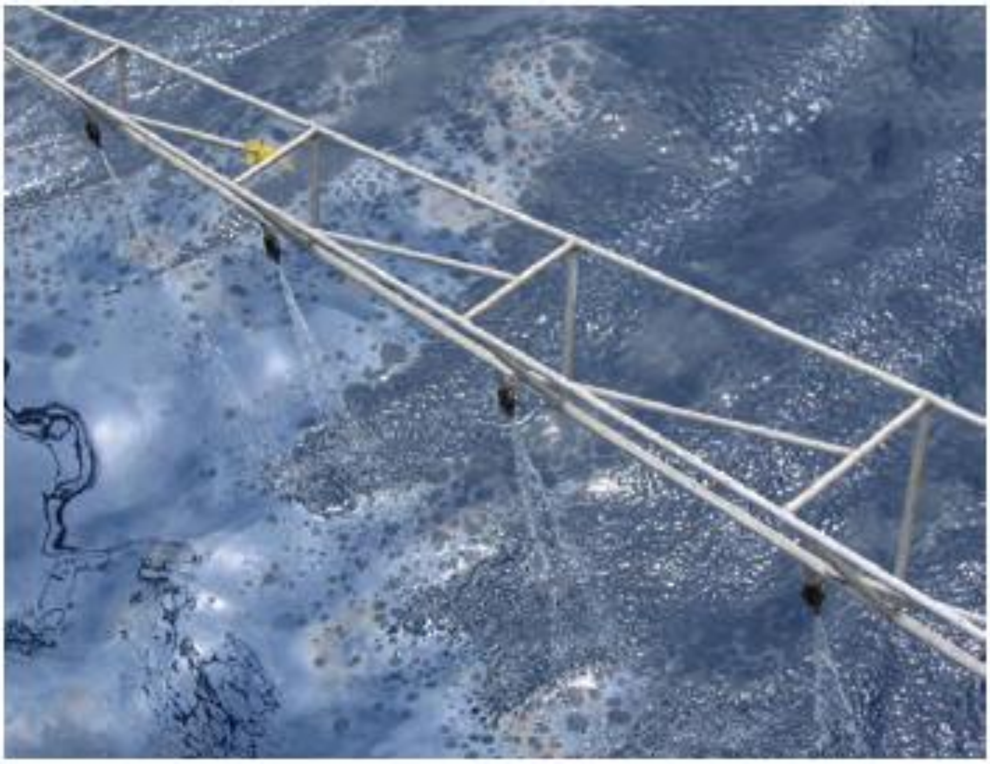


Figure 10-7: Application of Dispersant from Vessel Mounted Spray Arms Onto Sheen Causing Herding of the Oil [12]

Dispersant Choice

Dispersants are manufactured to different formulations, and their effectiveness often varies with oil type. Laboratory testing may be carried out to rank the effectiveness of one dispersant relative to another for a particular oil to identify the most effective dispersant for the oil involved. However, caution is advised when extrapolating the results from these studies to predict the amount of oil that will be dispersed at sea, as accurate replication of the conditions at sea is difficult in laboratory environment.

Conflict with other Response Methods

In a large incident, coordination of all response action is necessary to ensure dispersant use does not overlap or conflict with other response techniques. For example, and as expected, oil dispersed into the water column cannot be contained by booms or recovered by skimmers. In addition, oil adheres to many sorbent materials, such as polypropylene, as a result of the relative surface tension of the oil. As the surface tension of the oil is modified by dispersants, the effectiveness of the sorbent materials can be significantly reduced using dispersant. Oleophilic skimmers will be similarly affected when used alongside dispersants. However, in the case of large, offshore oil releases, there is likely to be room for the deployment of all spill response tools. NEBA should be employed to assist in the ranking and evaluation of the likely success of each option.

11 The Gulf of Thailand Sub-Region

The GoT is a relatively shallow sea, with a mean depth of 45 meters, bordered by the littoral states of Cambodia, Malaysia, Thailand and Viet Nam. It covers roughly an area of 320,000 square kilometres with the boundary defined by the line from Cape Bai Bung in southern Viet Nam (just south of the mouth of the Mekong River) to the city of Kota Bharu on the Malaysian coast.

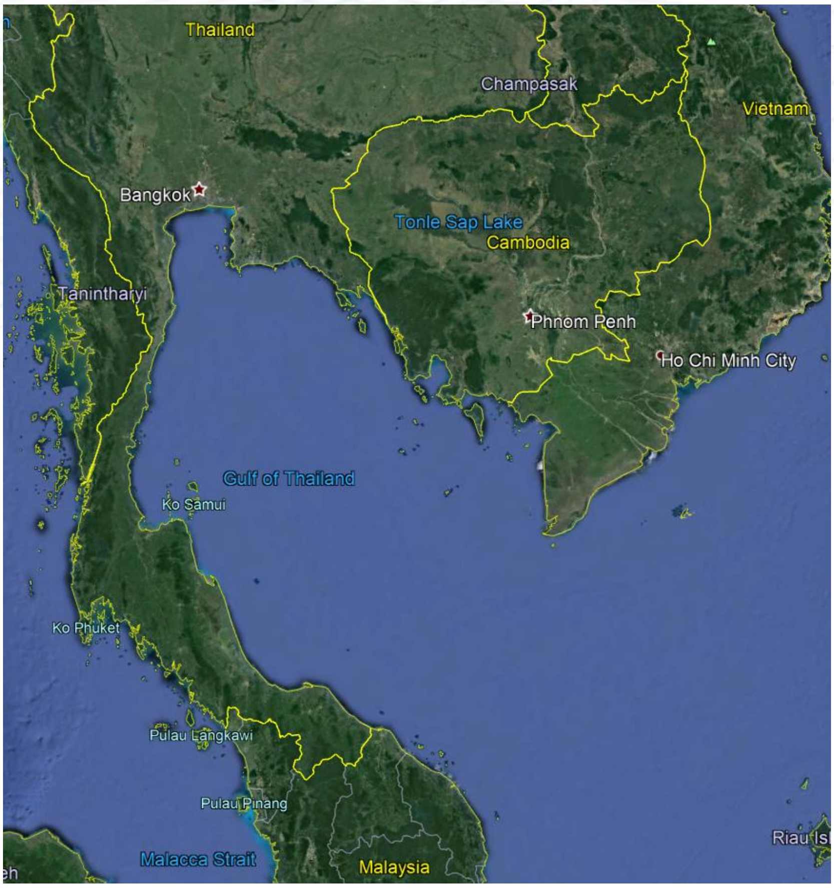


Figure 11-1: Gulf of Thailand Geographic Boundary

Rapid increase of petroleum consumption around the world including the GoT sub-region has increased the potential of oil spills during production and transportation. The oil spill risk assessment in the GoT sub-region indicated that oil spill risk is considered high in the upper part of the GoT, moderate in the central part and from low to moderate in the southern part.

11.1 Oil Spill Incidents

A number of oil spill incidents have occurred within the waters of GoT countries as follows:

Viet Nam

Viet Nam experienced a few larger spills in early 2000 and no spills in the recent years. Table 11-1 shows the record of oil spill incidents in Viet Nam for the period of 2001 to 2013, with an additional spill in 1994 due to its size. The impacted sensitivities, response strategies and challenges were also highlighted in the table.

Table 11-1: Recorded Oil Spill in Viet Nam between 1994 to 2013

Date	Incidents	Spill Amount (Tonnes)	Key Issues
1994	*Neptune Aries* Tanker collided into a terminal jetty in Ho Chi Minh City, releasing gas oil.[13]	1500	• Little clean-up was undertaken although the oil damaged rice paddies.
2001	A tanker FORMOSA ONE collided with another tanker PETROLIMEX 01 in Ganh Rai Bay, Vung Tau City, releasing gas oil cargo.**Error! Bookmark not defined.**	500	• Winds and waves caused oil to impact a nearby beach resort, despite local residents taking part in clean-up efforts.
2005	A tanker *Hong Anh* sank in the river at Ganh Rai bay, Vung Tau.	>100	• 7km of oil spread towards aquaculture farms and beaches of Vung Tau.
2007	A slick, possibly from a damaged Chinese oil rig, impacted the central and southern coast area.**Error! Bookmark not defined.**	NA	• A nature reserve for turtle was affected. Local manual cleanup was initiated
2008	A tanker which was making its way to DaNang from Ho Chi Minh City capsized in Vung Tau area, releasing diesel into the sea.[14]	Est. 1500	NA
2013	A South Korean container ship, *Heung A Dragon* was carrying containers from Hong Kong to HCM City when it collided with the vessel, *Elani* departing from Phu My Port in Tan Thanh District in Ba Ria-Vung Tau Province	Est. 40	• Site security plan was not conducted in proper way; • No information on the dangerous cargoes on board Heung; • Lack of awareness on Hazardous Material Spill response

[13] International Tanker Owners Pollution Federation Limited (ITOPF). *Country Profiles – Vietnam*. 2010.

[14] Sea Alarm Foundation. Country Wildlife Response Profiles – Vietnam. 2009.

Date	Incidents	Spill Amount (Tonnes)	Key Issues
2017	A chemical Tanker named CHEMROAD JOURNEY went aground 10Nm off Phu Quy Island in BinhThuan's water	Est. 1 ton of DO spill to sea	• All the cargoes & Fuels inside were transferred safely as lightering plan.
2017	10 ships sank & went aground in Quy Nhon gulf due to Damrey Tropical Storm	Est. 100 tons DO & FO	• 10 vessels crews were passed away
2017	Hai Thanh 26 –BLC M/V sank down due to a collision with Petrolimex 14 M/V	Est. 40 tons DO	• 9 vessels crews were passed away
2019	VietSun Intergrity sank down in LongTau river	Est. 40 tons DO	• All the cargoes & Fuels inside were transferred safely as lightering plan
2021	Minh Khang CR 59 M/V went aground in BinhThuan's water	Est 5 tons DO	• All the cargoes & Fuels inside were transferred safely as lightering plan
2021	My An 01 M/V sank down during anchoring due to a collision	Est. 40 tons of DO	• All the cargoes & Fuels inside were transferred safely as lightering & salvage plan
2022	Lady R3 M/V sank down in Vietnam water (200 Nm off VungTau)	Est 5 tons of DO	• Est. 300 Sri Lakan refugees were rescued safely.
2022	Van Don ACE M/V sank down in Vietnam water (160 Nm off VungTau)	Est 50 tons of DO	• 10 vessels crews were passed away
2022	CuuLong 07 M/V & Hoang Thien 09 M/V spill at Port	Est 5 tons of DO	• All the cargoes & Fuels inside were transferred safely as lightering plan
2022	Spill FO at Oil Jetty in Cam River Hai Phong City	Est. 2 tons of FO	• Slick was contained in permanent boom at the jetty. No damage to the surrounding environment.
2023	FO Spill at International Container Port in HaiPhong City	Est. 10 tons of FO	
2023	02 barges sank down in BinhThuan Area due to rough sea condition	Est. 20 tons of DO	

Cambodia

Two small spills of oil were recorded. In 2002, a small oil leakage during the pumping process in Tonle Sap River and fuel oil transporting boat caught fire at the same area in 2003.

Thailand

In the recorded oil spill history of Thailand, there were a number of bigger spills since the beginning of 2000 and smaller spills in the recent years. **Table 11-2** shows the record of oil spill incidents in Thailand for the period of 2002 to 2013. The impacted sensitivities and response strategies were also highlighted.

Table 11-2: Recorded Oil Spill in Thailand between 2002 to 2013

Date	Incidents[15]	Spill Amount (Tonnes)	Key Issues
2002	Panama-registered tanker *Eastern Fortitude* crashed into rocks near Juang Island, releasing bunker fuel into the Gulf of Thailand.	240	• Impacted beaches in Rayong Bay, a popular holiday spot; • Authorities were alerted too late into the incident and struggled to clean up the slick; • Due to thickness and viscosity of oil, manual collection of oil from booms was preferred over the use of skimmer.
2002	The tanker SKY ACE collided with a container vessel, close to the entrance of Laem Chabang Port, resulting a spill of bunker fuel.[16]	210	• Dispersant application and containment & mechanical recovery
2004	Tanker *DRAGON 1* grounded at the entrance to Pattaya Bay, spilling fuel oil.	150	• Clean-up was mainly carried out by mechanical and manual means.
2007	Saraline 185V oil leaked out of a storage tank at the Trident-16 offshore mobile drilling unit of Chevron Thailand.	35	NA
2011	An oil vessel, *Sor Chockthaworn 6*, overturned in Phuket due to high waves and weather disturbance. Diesel B5 oil was released into the Andaman Sea	40	NA
2013	Release of Oman Blend Crude as a result of PTT's Single Buoy Mooring (SBM) hose leakage in the Gulf of Thailand, approximately 14 Nm off the coast of Rayong.	50	• Impacted Ao Phrao beach in Ko Samet Island, a popular tourist attraction; • Mobilisation of Hercules for aerial dispersant application operation.

[15] Coconuts Bangkok. *The 9 Biggest Oil Spills in Thai History*. <http://bangkok.coconuts.co/2013/08/02/9-biggest-oil-spills-thai-history>. 2013. Accessed 28 June 2020.

[16] International Tanker Owners Pollution Federation Limited (ITOPF). *Country Profiles – Thailand*. 2010.

11.2 Joint Statement

As the activities and populations in countries in the GoT continue to grow, the demand for oil products and corresponding infrastructure are increasing in the same pace. This inevitably led to higher frequency of oil transportation-related activities in the Gulf which translated to increased risk of oil spill incident. In view of this, PEMSEA initiated a project with the objective to build the capacity of participating countries in combating sea-based sources of marine pollution and to promote partnership in oil spill preparedness and response among the countries in the sub-region.

A major achievement of this project is the signing of the Joint Statement. The Joint Statement was signed on 12 January 2006 in Hanoi, Viet Nam, wherein the three Participating Countries and other stakeholders expressed their commitment to develop partnerships that are aimed at enhancing national and sub-regional capacities to prevent, control, combat and mitigate marine pollution and to promote technical cooperation and collaboration to safeguard the resources of the GoT.

This Joint Statement defined the vision, mission and action for the three participating countries to work together for oil pollution prevention, preparedness and response. This includes Gulf wide exchange of information, joint research and development projects, training, oil spill response exercises, and mutual assistance in response, collaborative arrangement, and partnership building. One important facet of the Joint Statement is that "the Participating Countries will cooperate in responding to major oil pollution incidents in the Gulf of Thailand." For this purpose, the Framework Programme for Joint Oil Spill Preparedness and Response in the Gulf of Thailand was adopted.

In the Framework Programme, important information such as responsibilities, reporting, contact points and resource list are provided which will be crucial in response operations involving dispersant application. This information will be extracted where relevant and presented in Part 1 of this Guideline.

11.3 Regulatory Framework Relating to Dispersant Usage

The level of oil spill preparedness varies across different ASEAN countries. **Table 11-3** shows the international conventions ratified and signed by ASEAN member countries.

Table 11-3: Summary of International Conventions Signed by ASEAN Countries[17]

Country	OPRC 90	CLC 92	FUND 92	BUNKER
Brunei Darussalam	No	Yes	Yes	No
Cambodia	No	Yes	Yes	No
Indonesia	No	Yes	No	Yes
Malaysia	No	Yes	Yes	Yes
Myanmar	Yes	Yes	No	Yes
Philippines	Yes	Yes	Yes	No
Singapore	Yes	Yes	Yes	Yes
Thailand	Yes	Yes	Yes	No
Viet Nam	No	Yes	No	Yes

Table 11-4 shows the basic chemical dispersant response policy of ASEAN member countries. In many cases this procedure includes a mandatory official approval or permitting process as well as reference to an approved list of dispersant chemicals. This approval procedure generally involves a careful evaluation by officials and technical and scientific experts on the factors of potential effectiveness, environmental impact, and operational feasibility, as well as cost.

Table 11-4: Dispersant Response Policy Summary of ASEAN Countries[17]

Country	Dispersants Allowed?	Policy in Place?	Option	Guidelines/Restrictions
Brunei Darussalam	Yes	Yes	Primary	Restricted to over 1 nm offshore and depth is over 10 meters; Restricted in mangroves and mudflats where water depth is less than 2.5m; Restricted near coral reefs and fisheries; Official approval required.
Cambodia	Yes	Yes	Primary	Restrict to over 2 nautical miles offshore and depth is greater than 10 meters; Official approval required.
Indonesia	Yes	Yes	Secondary	Restricted to use due to abundance of coral reefs and shallow water depth of coastal water; Official approval required.

[17] GISEA. Regional information. <http://www.gisea.org/#regional-information>. Accessed 28 June 2020.

Country	Dispersants Allowed?	Policy in Place?	Option	Guidelines/Restrictions
Laos	No	No	NA	NA
Malaysia	Yes	Yes	Secondary	Official approval required.
Myanmar	No	No	NA	NA
Philippines	Yes	Yes	Secondary	Restricted near sensitive resources; Official approval required.
Singapore	Yes	Yes	Primary	Restricted to offshore and on beaches after manual removal; Official approval required.
Thailand	Yes	Yes	Primary	Restrict to greater than 10 meters of water depth and far from sensitive natural resources; Official approval required.
Viet Nam	Yes	Yes	Secondary	Restrict to over 1 nm offshore and depth is greater than 20 meters.

Cambodia

The Ministry of Environment together with the Ministry of Public Works and Transport has jointly developed the National Policy and Guidelines on the Use of Dispersants in Cambodia. According to the guidelines, '*No marine oil spill response option should be ruled out or limited in advance. Chemical dispersants are an important option which should always be considered in the most effective "first stage" of a response strategy*'. In addition, due to proximity of jurisdictional water of Cambodia with Thailand, Cambodia adopts the approved dispersant list of Thailand as safe to be used in Cambodian water.

Thailand

In Thailand, the National Oil Spill Response Plan which was created by virtue of clause 10 of the Office of Prime Minister's Regulation on the Prevention and Combating of Oil Pollution, 1995 has identified the responsibilities of relevant agencies for the oil spill response operation. According to the Plan, the Pollution Control Department (PCD), Ministry of Natural Resources and Environment, are assigned to supervise and regulate the use of chemical dispersant. PCD have developed a Guideline for the use of dispersants in Thailand. This Guideline provides information on the zones which are pre-approved for dispersant application and zones sensitive to a high concentration of dispersed oil (Refer to **Section 5.1**). The PCD also updates the list of approved dispersants.

Viet Nam

For Viet Nam, MoNRE is the authority responsible in drafting a circular regulating the use of dispersant in Viet Nam's water while Vietnam Administration of Seas and Islands is responsible for controlling and monitoring the implementation of the circular.

In the circular, use of dispersant should only be considered after the other response techniques are not suitable. The use of dispersant must require approval before application and MoNRE shall be the authority to grant permission for the use of dispersant. MoNRE is also responsible for updating the list of approved dispersants annually.

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Appendix 1 – Approved Dispersant List

Table Appendices 1A-1: Approved Dispersant List for Viet Nam, Cambodia and Thailand

Name	Type	Viet Nam	Cambodia	Thailand
Accell Clean DWD			□	□
Agma DR 379	2/3	□	□	□
Agma OSD 569	2	□	□	□
Ardrox 6120		□		
BIODISPERS (FORMERLY PETROBIODISPERS)		□	□	□
BP-AB		□		
Caflon OSD	2/3	□	□	□
CHEMAX 307 Oil Spill dispersant		□	□	□
Compound W-2096	2/3	□		
Corexit 9500	2/3	□	□	□
Corexit 9550		□		
Corexit EC9527A	2/3	□	□	□
Dasic Slickgone EW		□	□	□
Dasic Slickgone LTSW	2/3	□		
Dasic Slickgone NS	3	□	□	□
DISPERSIT SPC 1000TM		□	□	□
Emulsol LW		□		
Enersperse 1037		□		
Enersperse 1040	2/3	□		
FFT-Solution			□	□
Finasol OSR 51		□	□	□
Finasol OSR 52	2/3	□	□	□
Gard Slicksol		□		
JD-109		□	□	□
JD-2000TM		□	□	□
MARE CLEAN 200		□	□	□
Marine D-Blue	1		□	□
NEOS AB 3000		□	□	□
NOKOMIS 3-AA			□	□
NOKOMIS 3-F4		□	□	□
Nu Crew	2/3	□		
OD 4000		□		
OSD/LT Oil Spill Dispersant	1	□	□	□
OSR 4000		□	□	□
Radiagreen OSD		□	□	□
SAF-RON GOLD (A/k/a SF-GOLD)		□	□	□

Name	Type	Viet Nam	Cambodia	Thailand
SEA BRAT #4		□	□	□
Seacare Ecosperse	2/3	□	□	□
Seacare Ecosperse 52			□	□
Seacare E.P. A			□	□
Seacare OSD		□	□	□
Seacare OSD2			□	□
Seagreen 805		□		
Shell Dispersant VDC	2/3	□	□	□
Shell Dispersant VDC PLUS	2/3	□	□	□
SF-Gold Dispersant			□	□
Superdispersant 25	2/3	□	□	□
Supersperse WAO2500			□	□
Tergo R-40		□		
Veclean Oil Dispersant		□		
ZI-400			□	□
ZI-400 (A/k/a ZI-400 OIL SPILL DISPERSANT)		□	□	□

Appendix 2 – Laboratory Test for Dispersant Effectiveness

Extracted from 'Guidelines for the Use of Dispersants for Combating Oil Pollution at Sea. Part I: Basic Information on Dispersants and Their Application' published by IMO.

Tests conducted in laboratory conditions can be used to compare dispersant effectiveness if the energy applied, the oil to water ratio, and the correct analytical methods and quality assurance are controlled. Most of these tests measure the degree and stability of dispersion (droplet size distribution), either by visual observation or by some analytical technique, after mixing oil and dispersants under standard conditions. The measurement of the lowering of interfacial tension between oil and water following the addition of a dispersant or the speed of resurfacing of dispersed oil after mixing can also be used for the assessment of the dispersant's efficiency. Differences in results and rankings often originate from differences in test parameters such as type of oil, temperature, oil and water volumes, dose rates, contact between the dispersant and the oil by way of application or premix, mixing energy, closed test tank or continuous dilution, and test duration (see figure below).

Test ID	Energy Source	Energy Level	Water Volume (L)	Oil/Water Ratio	Dispersant Application Method	Dispersant/ Oil Ratio	Settling Time
IFP	Oscillating hoop	low	5	1:1000 then drop	drop wise	1:20	n.r.
Labofina rotating flask	Rotating vessel	high	0.25	1:50	drop wise	1:25	1min
Swirling flask	Shaker table	low	0.12	1:1200	Premix or drop wise	1:10 to 1:25	10min
Mackay-MMS	High velocity air stream	high	6	1:600	drop wise	n.a.	5min

These are among the main effectiveness laboratory test procedures.

- The LABOFINA test (or WSL test) procedure used in the UK is run in a separatory funnel that is rotated to promote the dispersion;
- The IFP (flow through) procedure used in France is performed in a test tank in which the water is renewed in order to reproduce the dilution which would occur at sea, while gentle mixing energy is supplied by a wave generator (French standard AFNOR NFT 90-345);
- The MNS / Mackay test is a medium to high energy system used in Australia and in Norway;

- The Swirling Flask test (SFT) used in North America is carried out on oil samples premixed with dispersant in a very small funnel which is rotated gently to promote the dispersion process; and
- The newer EPA Baffled Flask test (BFT) derived from the SFT is meant to supersede the SFT and provides a more suitable level of mixing energy.

Appendix 3 – Spill Quantification Tool

Incident		Date		Observers	
Aircraft Type		Call Sign		Area of Survey	
Survey Start Time		Survey End Time		Average Altitude	
Wind Speed (knots)		Wind Direction		Notes	
Cloud Base (feet)		Visibility (nm)			
Time High Water		Time Low Water			
Current Speed (nm)		Current Direction			

SLICK DETAILS

Slick	TIME UTC	OIL POSITION (CENTRE)		SLICK ORIENT Degrees	OIL SLICK LENGTH			OIL SLICK WIDTH			AREA km²	AREA COVERAGE %	OILED AREA km²
		LATITUDE NORTH	LONGITUDE EAST / WEST		G/SPEED kt	TIME Seconds	DISTANCE km	G/SPEED kt	TIME Seconds	DISTANCE km			
A													
B													
C													
D													
E													

Slick	OIL APPEARANCE COVERAGE - %						MINIMUM VOLUME - m³	MAXIMUM VOLUME - m³	TYPE OF DETECTION (etc. visual, IR)
	1	2	3	4	5	OTH			
A									
B									
C									
D									
E									

THE BONN AGREEMENT OIL APPEARANCE CODE (BAOAC)

No	OIL APPEARANCE	MIM. VOLUME m3 / km2	MAX. VOLUME m3 / km2
1	SHEEN	0.04	0.30
2	RAINBOW	0.30	5.00
3	METALLIC	5.00	50.0
4	DISCONTINUOUS TRUE COLOUR	50.0	200
5	TRUE COLOUR	200	>200

Appendix 4 – Stockpile of Dispersants in Participating Countries

Stockpile of dispersants in Thailand

Owner	Name of Dispersant	Stock (liter)
Chevron Offshore	Gold Crew	6,600
	Gold Crew	1,600
	Gold Crew	3,197
Unocal Thailand	Gold Crew	1,000
	EC9500A	10,000
	Gold Crew	400
	EC9500A	10,000
	Gold Crew	1,800
Marine Department	Ro-Clean	5,000
	Dasic	400
	Ro-clean	2,000
Alliance Refining	Shell VDC, Type 3	8,400
Bangchak Petroleum Public	-	6,000
Caltex Oil (Thailand)	Corexit 9527	4,000
	Corexit 9527	800
	Corexit 9527	400
Esso (Thailand) Public	Corexit 9527	5,400
	Corexit 9527	20,000
	Corexit 9527	20,000
	Corexit 9527	400
PTT Public	Gamlen OD-4000	6,800
	Gamlen OD-4000	26,000
	Corexit	5,200
	Corexit	2,600
	Corexit 9527	3,600
	Corexit 9527	2,600
The Shell Companies of Thailand	Shell	1,000
	Shell VDC	1,000
	Shell VDC	800
	Shell	800
	Shell VDC	1,000
Thaioil Public	Shell VDC	16,000

Stockpile of dispersants in Viet Nam

Owner	Name of Dispersant	Stock (litre)
PVD Offshore	Superdispersant - 25	95 barrels x 200L (supply base) 77 barrels x 200L (supply boat)
Vietsovpetro	Superdispersant - 25	33 barrels x 200L (supply boat)
CLJOC	Superdispersant - 25	10 barrels x 200L (supply base)
HVJOC	Superdispersant - 25	5–10 barrels x 200L (wellhead platform)

Appendix 5 – SIMA Comparative Matrix

SIMA Stage 2: Predict outcomes | ***SIMA Stage 3: Balance trade-offs***

1. Resource compartments
2. Relative impact assessment
3. Predict the effectiveness and impact modification potential of the various response options
4. Impact modification factors

1. Resource compartments	NO INTERVENTION: Potential relative impact	A	CONTAINMENT AND RECOVERY: Impact modification factor (B1)	CONTAINMENT AND RECOVERY: Relative impact mitigation score (A x B1)	SURFACE DISPERSANT: Impact modification factor (B2)	SURFACE DISPERSANT: Relative impact mitigation score (A x B2)	SUBSEA DISPERSANT	CONTROLLED IN-SITU BURNING: Impact modification factor (B4)	CONTROLLED IN-SITU BURNING: Relative impact mitigation score (A x B4)	SHORELINE BOOMING: Impact modification factor (B5)	SHORELINE BOOMING: Relative impact mitigation score (A x B5)
Seabed	None	1	0	**0**	0	**0**	Not feasible for a surface spill	0	**0**	0	**0**
Lower water column	None	1	0	**0**	0	**0**		0	**0**	0	**0**
Upper water column	Low	2	1	**2**	-2	**-4**		0	**0**	0	**0**
Water surface	Medium	3	1	**3**	3	**9**		2	**6**	0	**0**
Air	Medum	3	1	**3**	2	**6**		1	**3**	0	**0**
Shorelines		3	1	**3**	3	**9**		2	**6**	1	**3**
Saltmarsh	*High*	*4*	*1*		*3*			*2*		*1*	
Estuarine mudflats	*High*	*4*	*1*		*3*			*2*		*1*	
Sandy beaches	*Low*	*2*	*1*		*3*			*2*		*2*	
High value resources	Low	2	0	**0**	1	**2**		0	**0**	1	**2**
Socio-economic		4	1	**4**	2	**8**		1	**4**	3	**12**
Boat harbour	*Medium*	*3*	*1*		*2*			*1*		*2*	
Water recreation	*High*	*4*	*1*		*2*			*1*		*3*	
Cultural	None	1	0	**0**	2	**2**		1	**1**	1	**1**
Total impact mitigation score:				15		32			20		18
Ranking:				**4th**		**1st**			**2nd**		**3rd**

5. Total impact mitigation score and ranking