The goal is to design a response strategy based on Net Environmental Benefit Analysis (NEBA)/Spill Impact Mitigation Assessment (SIMA)
Optimum Response Strategy

- Use appropriate combination of response tools to minimize impacts
  - If possible, deploy mechanical in thick oil to maximize recovery
  - Consider dispersant use early in a response
  - Responder and public safety is critical

- Environmental protection priorities
  - Minimize wildlife exposure
  - Minimize habitat contamination
  - Minimize oil stranding on sensitive shorelines

- Human resource protection priorities
  - Tourist beaches
  - Marinas, commercial activities
  - Shoreline property values
NEBA

- A risk comparison process to improve decision-making
- A planning and response tool
  - Rank response options by least negative environmental consequences and effectiveness in treating/remove spilled oil
  - Speed the selection of response options for various locations, weather conditions and spill circumstances
- Can be an intensive and detailed process to arrive at a consensus with respect to the response decision
  - Have the necessary discussions in advance of a spill

NEBA is being changed to SIMA: Spill Impact Mitigation Assessment to reflect broader socioeconomic considerations.
Primary Goal of Oil Spill Response

Maximize Encounter Rates and Effectiveness…

…to Minimize Impact
Rapid Response is Key

Slick Continuously Expands as Oil Thins

Direction of Wind/Currents

The size of the problem increases with time

Response is less efficient with time
Challenges to Oil Spill Response

- **Weather**
  - Recovery Impossible In Rough Seas (>2 M) or High Winds (>25 kts)
  - Safety concerns In high seas and inclement weather

- **Thousands of different oils with a wide range of properties**
  - Weathering Effect

- **Remote locations may not have immediate logistical support**

- **Wide Range of Impacted Habitats**
  - Rock Beaches to Sensitive Marshes

- **May have limited access to impacted areas**
Spill Conditions May Limit Response Options

Mechanical, In-Situ Burning, & Dispersant Efficiencies

Typical Windows of Opportunity for Spill Response Options

Notes:
1. Variable wave conditions, including short wavelengths, decrease efficiency more rapidly.
2. Containment boom is essential when average oil thicknesses are less than 2 mm.
Dispersants – What are they?

- Dispersants are solutions of surfactants dissolved in a solvent
- Surfactants reduce oil-water interfacial tension – allows slicks to disperse into very small droplets with minimal wave energy

- Dispersed oil rapidly dilutes to concentrations <10 ppm within minutes, <1 ppm within hours, ppb range within a day
Common Misunderstandings...
“Dispersants are used to simply hide the oil from sight”

- This is not the intention, it is an inevitable result of successful dispersant application.

- Successful dispersant application remove oil from sea surface into the water column.

- Enhance the natural biodegradation process.
“Dispersants are used to simply hide the oil from sight”

- This is not the intention, it is an inevitable result of successful dispersant application.

- Successful dispersant application remove oil from sea surface into the water column.

FACT: Dispersants reduce the potential impact on sensitive coastlines by moving the oil into water column where it is diluted by wave and current actions and biodegraded by naturally occurring bacteria.

- Enhance the natural biodegradation process.
“Dispersant use is just a cheap alternative to other proper response techniques”

- There is a common misunderstanding that containment & recovery is the best response option
- C&R also has its limitations
- Slow process, low efficiency rate, logistical and weather constraints
- May not be able to meet the challenges of a large offshore spill
“Dispersant use is just a cheap alternative to other proper response techniques”

- There is a common misunderstanding that containment & recovery is the best response option
- C&R also has its limitations
- Slow process, low efficiency rate, logistical and weather constraints
- May not be able to meet the challenges of a large offshore spill

FACT : Dispersants are an effective response tool in many cases compared to other response techniques. With proper NEBA considerations, dispersants often provides the best option to reduce the overall environmental impact
“Using dispersants is adding a toxic chemical to an already polluted sea”

- Dispersants increase the amount of oil entering the water column

- They do not make oil more toxic to marine species

- Modern dispersants are formulated to avoid problems encountered during Torrey Canyon
“Using dispersants is adding a toxic chemical to an already polluted sea”

- Dispersants increase the amount of oil entering the water column

- They do not make oil more toxic to marine species

**FACT:** Modern dispersants are formulated to have low toxicity and high biodegradability. Dispersants do not increase the toxicity of the oil.
“Dispersant Use sinks oil into the seabed”

- Based on the common assumption that anything introduced to water will either float or sink
- Small droplets formed by dispersant application remain suspended in the water column
- These suspended oil droplets are biodegraded by oil eating microbes
“Dispersant Use sinks oil into the seabed”

- Based on the common assumption that anything introduced to water will either float or sink
- Small droplets formed by dispersant application remain suspended in the water column
- These suspended oil droplets are biodegraded by oil eating microbes

**FACT:** Successful dispersant application break oil slicks into small droplets tens of microns in diameter that remain suspended in the water column. These oil droplets are biodegraded by naturally occurring microbes.
“We don’t have enough information. Dispersant use is just a big experiment”

- National Research Council (2005) publication was quoted without proper understanding of the report context.

- Effect of dispersant use were extensively studied following the Sea Empress Spill (UK, 1996).

- Effects of naturally dispersed oil were studied after the Braer incident in the UK in 1993.
“We don’t have enough information. Dispersant use is just a big experiment”

- National Research Council (2005) publication was quoted without proper understanding of the report context.
- Effects of dispersant use were extensively studied following the Sea Empress Spill (UK, 1996).
- Effects of naturally dispersed oil were studied after the Braer incident in the UK in 1993.

FACT: While there are uncertainties surrounding the environmental fate and effects of dispersed oil in some habitats, environmental monitoring during and after the spill events in many parts of the world as well as extensive field and laboratory studies have enabled scientists to anticipate the likely impacts of dispersed oil. Credible NEBA efforts have consistently provided a reliable basis for determining when dispersant use is appropriate.
How Dispersants Work

The Goal: Rapidly Reduce Oil Concentration to Below Impact Levels Rapidly

1) OIL/WATER INCOMPATIBILITY

2) APPLICATION OF DISPERSANT

3) OIL SLICK DISPERSES INTO DROPLETS WITH MINIMAL ENERGY

Surfaces of Droplets Repel Each Other... No Coalescence
Dispersant Dosages

Typically 5 gallons per acre

Oil Thickness
- 0.1 mm
- 5 + mm

Oil Viscosity
- Low: 2 US gallons/acre
- High: 10 US gallons/acre
Dispersants – What do they do?

- Dispersants Enhance Removal of Oil from the Environment Through Biodegradation
  - Each dispersed oil droplet is a concentrated food source that is rapidly colonized and degraded by marine bacteria
  - Dilution allows biodegradation to occur without nutrient or oxygen limits

Graphic consistent with Venosa & Holder, EPA 2007
Dispersants work in a similar fashion to the cake analogy above: oil is broken into tiny droplets that are more easily consumed by microorganisms.
Dispersants – NEBA perspective

Without Dispersant: Limit Water Column Organism Exposure

With Dispersant: Limit Surface Organism Exposure
Factors Influencing Effectiveness

- **Oil Type/Properties**
  - Viscosity
  - API Gravity
  - Wax Content/Pour Point
  - Emulsifiers

- **Environmental Conditions**
  - Water Temperature
  - Sea State (Mixing Energy)
  - Extent of Weathering (How Long on the Sea)
  - Water Salinity
Environmental Impacts

• Toxicity of oil > toxicity of the dispersant
• Modern dispersants use ingredients found in household products
  – NALCO website*
  – Centers for Disease Control assessment supports low health risk
  – NOAA & FDA test results for dispersants in Gulf seafood, "There is no question Gulf seafood coming to market is safe from oil or dispersant residue.”

Other Uses of Corexit® 9500 Ingredients
(from Nalco website)

<table>
<thead>
<tr>
<th>Corexit® 9500 Ingredients</th>
<th>Common Day-to-Day Use Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Span™ 80 (surfactant)</td>
<td>Skin cream, body shampoo, emulsifier in juice</td>
</tr>
<tr>
<td>Tween® 80 (surfactant)</td>
<td>Baby bath, mouth wash, face lotion, emulsifier in food</td>
</tr>
<tr>
<td>Tween® 85 (surfactant)</td>
<td>Body/Face lotion, tanning lotions</td>
</tr>
<tr>
<td>Aerosol® OT (surfactant)</td>
<td>Wetting agent in cosmetic products, gelatin, beverages</td>
</tr>
<tr>
<td>Glycol butyl ether (solvent)</td>
<td>Household cleaning products</td>
</tr>
<tr>
<td>Isopar™ M (solvent)</td>
<td>Air freshener, cleaner</td>
</tr>
</tbody>
</table>

*http://www.nalco.com/applications/corexit-technology.htm
Dispersants work just like soaps and shampoos. They clean up spills by breaking oil slicks into tiny droplets – smaller than the diameter of a human hair. Dispersants are designed to work in the marine environment and prevent oil from re-coalescing.

Understanding the Composition of Dispersants

The same ingredients in dispersants are also found in:

- Toothpaste
- Sunscreen
- Juice
Environmental Impacts

- **Toxicity**
  - Rapid dilution limits ecosystem impacts of both dispersant and dispersed oil
  - Concentrations start low and rapidly dilute (National Academy of Sciences, 1989)
  - Lab toxicity tests expose organisms to constant concentrations for multiple days
  - Organisms only see elevated concentrations for a few hours during a real spill
  - Dispersants are only applied in areas with high potential for dilution

Relative Toxicity

Environment Canada Study

Product
Palmolive Dish Soap
Sunlight Dish Soap
Mr. Clean
Corexit 9527
Corexit 9500

Toxicity (ppm)
13
13
30
108
350

(96 HR Rainbow Trout LC50)
Encounter Rate is Key to Offshore Response
Vessel Application

- Small spills near land
- Slow transit times
- Low coverage rate
- Low cost, easily procured
- Flat, uniform spray
- Mixing action enhanced by vessel wake
- Fire monitors deliver wider swaths faster but less uniformly
Small Fixed-Wing Aircraft

- Single engine planes modified for temporary use or converted from pest control spraying
- Higher capacity pumps, meters, aft spraying nozzles
- Agricultural sprayers may produce too fine a droplet
- Payload often < 100 gal (380 L)
- Newer aircraft carry 400 - 600 gal (1,500 - 2,300 L)
- Can be used for spotting
Medium Size Twin-Engine Aircraft

- Vary in size: piper Aztec to Canadair CL-215
- Converted for dispersant spraying
- Carry 800 - 1,200 gal (3,000 - 4,500 L)
- Have greater range than small aircraft
- Can operate safely on offshore spills
- Can be used for spotting
Large Multi-Engine Transport Aircraft

- Longer range aircraft
- Carry 1,500 - 3,000 gal (5,700 - 11,000 gal)
- C-130 Hercules may use an Aerial Dispersant Delivery System (ADDS)
Large Multi-Engine Transport Aircraft

- Key tool in long range response
  - Fast with large payload
Dispersant Application Platform Comparison

- **5,000 MT spill** (37K bbl)
- **Slick 0.1 mm thick**
- **100 MT/km²**
- **8 hrs of operation**
- **Continuous encounter with slick**

For reference:
9300 American Football fields
6500 Football (soccer) fields
2900 Australian rules Football fields
Jet Platform

The Issue: The Hercules

- The world fleet is small and diminishing
- To date, no replacement for the civilian Lockheed Hercules L-100 aircraft is either available or planned
- Replacement or development cost is high

Key criteria for 727:

- Readily available
- High transit speed: 478 nautical mph (885 kph)
- Payload: 55,000 lb (25,000 kg)
- Range (with full payload): 2,140 nm (3,960 km)
- Three-engine operation, providing the following advantages:
  - High power-to-weight ratio
  - Improved long-range operations over water
  - High reliability
- High T-tail avoids disruption of spray by turbulence associated with control surfaces
- Strong structure around spray arm attachment

Certified for Use 2016
Subsea Injection of Dispersants

- Preliminary observations of DWH experience
- Benefits of subsea injection
- Long-term fate and effects
Release Site May 9: Prior to Injection

Winds @ 0850 40° / 16 knots
Avg winds 64° / 16 knots

Wind direction

Courtesy of Ocean Imaging

Copyright 2010 Ocean Imaging Corp.
Release Site May 10: 3 hrs of Injection

Winds @ 0850 40° / 12 knots
Avg winds 91° / 10 knots

Wind direction

Courtesy of Ocean Imaging
Release Site May 10: 11 hrs of Injection

05/10/2010 - 5:05pm

@ 11 hrs. after start of subsurface dispersant release

Copyright 2010 Ocean Imaging Corp.

Courtesy of Ocean Imaging
Winds @ 1700 120° / 14 knots
Avg winds 91° / 10 knots
Release Site May 11: 5 hrs after Injection Ended

05/11/2010 - 9:10am CST
Subsurface dispersant release ended 4am
Copyright 2010 Ocean Imaging Corp.

Wind direction

Courtesy of Ocean Imaging
Winds @ 1700 140° / 8 knots
Avg winds 134° / 10 knots
Release Site May 12: 28 hrs After Injection Ended

05/12/2010 - 8:35am CST

 Courtesy of Ocean Imaging
 Winds @ 0850 150° / 7 knots
 Avg winds 130° / 7 knots

Wind direction
Dispersant Use Across the Globe

• Dispersants are a first or second response option in many countries today

Many countries consider dispersants an important tool in oil spill response. However, there is global inconsistency in the types of approved dispersants and how and when to use them.

Source: International Tanker Owners Pollution Federation (ITOPF)
Summary

- Along with prevention, robust oil spill response (OSR) is critical
- Highest priority in emergency response is human health and safety
- Basic strategy for addressing oil spilled from an offshore well
  - Respond as close to the source as possible
  - Utilize all appropriate tools to keep oil from reaching shorelines
- Dispersant use presents significant advantages over the limitations of mechanical recovery and should be considered as a primary response option
- Subsea injection is a step-change advance that may reduce spill impacts by an order of magnitude
- More research would enhance the optimization of subsea injection and allow better understanding of the long term effects of dispersed oil in deep waters
Spill Impact Mitigation Assessment for Dispersant Use
Overview

- SIMA
- SIMA in 4 Stages
- Response Strategy Development using SIMA
- SIMA for Subsea Dispersant Injection
Net Environmental Benefit Analysis (NEBA) to Spill Impact Mitigation Assessment (SIMA)?

- Better reflects the process, its objectives, and the suite of shared values which shape the decision-making framework, including ecological, socio-economic and cultural aspects
- More accurately describes this long-standing practice and its objectives
Principles of SIMA

- International publication aligned with the Good Practice Guidelines
- Integrating ecological, socio-economic and cultural considerations
- Promoting the full response ‘toolkit’
- A qualitative methodology to assess response options’ relative mitigation, not measuring spill damage
- Primarily applicable to larger or higher consequence oil spill incidents
- Can be used during either planning or incident response
Spill Impact Mitigation Assessment (SIMA)

“Structured approach used by the response community and stakeholders during oil spill preparedness planning and response, to compare the environmental benefits of potential response tools, and develop a response strategy that will reduce the impact of an oil spill on the environment”

Helps decision-makers use the response tools to achieve the most beneficial outcome overall i.e. keep damage ALARP
Spill Impact Mitigation Assessment (SIMA)

“Structured approach used by the response community and stakeholders during oil spill preparedness planning and response, to compare the environmental benefits of potential response tools, and develop a response strategy that will reduce the impact of an oil spill on the environment.”

Helps decision-makers use the response tools to achieve the most beneficial outcome overall, i.e., keep damage ALARP.

New IPIECA-IOGP Good Practice Guidance

To Be Updated
SIMA in 4 stages

1. **Compile and evaluate data** to identify exposure scenario and potential response options, and to understand the potential impacts of that scenario.

2. **Predict outcomes** for the given scenario to determine which techniques are effective and feasible.

3. **Balance trade-offs** by weighing a range of benefits and drawbacks resulting from each feasible response option.

4. **Select the best options** for a given scenario, based on which combination of tools and techniques will minimize impacts.
Response strategy development using SIMA

Before a spill

Compile and evaluate data

A wide range of data is compiled and evaluated to understand the area potentially affected, and to identify and prioritize environmental and community assets within it, based on environmental sensitivities and social values.

Predict outcomes

Planning scenarios are used to assess the potential effects on the environment.
For specific locations, feasible response options are identified from the ‘response toolbox’.

Balance trade-offs

The advantages and disadvantages of the potential response options are evaluated and weighed against the environmental and social effects of each to understand and balance trade-offs.

Select best option(s)

Data, information and viewpoints are taken into account to select the combination of response options that will create the greatest net environmental benefit.
This allows a full response strategy to be developed encompassing detailed plans, capability development and approvals.

If no pre-spill planning work has been undertaken, or if analogue planning scenarios cannot be adjusted to correlate with the specifics of a spill, response strategy development using NEBA follows an expedited version of the process above. In this instance, it is possible that the data which forms the basis of the analysis may be incomplete or limited, thus necessitating a greater reliance on professional judgement to correctly balance the trade-offs and select the best options, especially given the time-pressured nature of a response.

During a spill

Compile and evaluate data

Based on the specifics of the spill, a range of data is evaluated to assess anticipated effects.

Predict outcomes

Response options identified in the pre-spill planning stage are reviewed against the actual spill conditions and anticipated effects, and the list of feasible response options considered.

Balance trade-offs

The balancing of trade-offs carried out in the pre-spill planning stage is adjusted and confirmed against the actual conditions of the spill.
Continued re-evaluation and re-balancing of trade-offs takes place to address evolving conditions.

Select best option(s)

The response strategy is developed based on the optimum response options for the conditions. The strategy is implemented and continually monitored and adjusted based on ongoing evaluations.
Pre-spill planning work facilitates rapid decision making during a response, minimizing delays.

The ongoing application of the NEBA process throughout a response allows clean-up endpoints to be determined and agreed to by stakeholders early and in a systematic manner. This helps to avoid unnecessary clean-up activities which could result in additional detrimental effects on the environment.
Response strategy development using SIMA

Before a spill
- **Strategic** SIMA
  - Compile and evaluate data
    - A wide range of data is compiled and evaluated to understand the area potentially affected, and to identify and prioritize environmental and community assets with links to environmental sensitivities and social values.
  - Predict outcomes
    - Planning scenarios are used to assess the potential effects on the environment.
      - For specific locations, feasible response options are identified from the ‘response toolbox’.
  - Balance trade-offs
    - The advantages and disadvantages of the potential response options are evaluated and weighed against the environmental and social effects of each to understand and balance trade-offs.
  - Select best option(s)
    - Data, information and viewpoints are taken into account to select the combination of response options that will create the greatest net environmental benefit.

If no pre-spill planning work has been undertaken, or if analogue planning scenarios cannot be adjusted to correlate with the specifics of a spill, response strategy development using NEBA follows an expedited version of the process above. In this instance, it is possible that the data which forms the basis of the analysis may be incomplete or limited, thus necessitating a greater reliance on professional judgement to correctly balance the trade-offs and select the best options, especially given the time-pressured nature of a response.

During a spill
- **Operational** SIMA
  - Compile and evaluate data
    - Based on the specifics of the spill, a range of data is evaluated to assess relevant factors.
  - Predict outcomes
    - Response options identified in the pre-spill planning stage are reviewed against the actual spill conditions and anticipated effects, and the list of feasible response options considered.
  - Balance trade-offs
    - The balancing of trade-offs carried out in the pre-spill planning stage is adjusted and confirmed against the actual conditions of the spill. Continuing re-evaluation and rebalancing of trade-offs takes place to address evolving conditions.
  - Select best option(s)
    - The response strategy is developed based on the optimum response options for the conditions. The strategy is implemented and continually monitored and adjusted based on ongoing evaluations. Pre-spill planning work facilitates rapid decision making during a response, minimizing delays.

The ongoing application of the NEBA process throughout a response allows clean-up end points to be determined and agreed to by stakeholders early and in a systematic manner. This helps to avoid unnecessary clean-up activities which could result in additional detrimental effects on the environment.
- Know your oil
- Model fate and trajectory
- Consider sensitivity data
- Identify potential response options:
  - effectiveness
  - feasibility
  - regulation
Factors Influencing Feasibility

Climate and sea state

- e.g. Evaporation
- Spreading
- Emulsification
- Increased viscosity
- Fragmentation

Encounter rate

Spill volume(s)

Oil properties and weathering characteristics

Logistics and support

Proximity to sensitives and shores
- For chosen scenarios, review consequences of “no response” activities.
- Consider how different combinations of response options may change these impacts in order to characterize trade-offs.

<table>
<thead>
<tr>
<th>Example Scenarios</th>
<th>Possible Response Tools</th>
</tr>
</thead>
</table>
| **Offshore Release**
  TANKER SPILL                                          | Dispersants | Mechanical Recovery | In-Situ Burning | Physical Removal | Natural Processes |
| **Offshore Release**
  SUBSEA SPILL                                          |             |                     |                  |                  |                  |
| **Offshore Release**
  SPILL FLOWING TOWARDS POPULATED AREA                  |             |                     |                  |                  |                  |
| **Near Shore Release**
  SPAWNING SEASON                                       |             |                     |                  |                  |                  |
How to predict outcomes?

- ‘No response’ scenario covers the timescale needed for the oil to weather and naturally attenuate
- Identifies potential environmental effects at a general level
- With the number of variables involved, it is impractical to quantify potential damage to any environmental resource in the SIMA process
How to predict outcomes?

- ‘No response’ scenario covers the timescale needed for the oil to weather and naturally attenuate.
- Identifies potential environmental effects at a general level.
- With the number of variables involved, it is impractical to quantify potential damage to any environmental resource in the SIMA process.

Overall, the SIMA process provides an estimate of potential environmental effects which is sufficient to allow the parties to compare and select preferred combinations of response options.
Predict outcomes

Compile and evaluate data

Estimating the baseline environmental impact
- Ecological considerations
- Socio-economic considerations

Characterizing the effects of response options
- Evaluation of candidate response options in combination
  - Benefits
  - Drawbacks
  - Direct or indirect environmental impacts of technique

Predicted outcomes of response options

Baseline predicted environmental impact of spill

Select best option(s)
May be differing priorities relating to perceptions of the importance of sensitive resources

No universally accepted way to assign value or importance to different environmental and socioeconomic sensitivities

Essentially a qualitative process

- Seeks consensus
- A risk-based decision making approach may allow comparison of disparate resources in order to facilitate consensus on relative values of resources
<table>
<thead>
<tr>
<th>RESPONSE TOOLBOX</th>
<th>BENEFITS</th>
<th>DRAWBACKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dispersants</td>
<td>• High aerial coverage rate possible at the water surface</td>
<td>• Special approvals required</td>
</tr>
<tr>
<td></td>
<td>• High treatment efficiency possible subsurface</td>
<td>• Less known about long-term effects of subsurface use</td>
</tr>
<tr>
<td></td>
<td>• Large volumes of oil can be treated</td>
<td>• Perceived to be unsuitable for calm seas</td>
</tr>
<tr>
<td></td>
<td>• Potentially high oil elimination rate</td>
<td>• Short-term, localized reduction in water quality</td>
</tr>
<tr>
<td></td>
<td>• Reduced vapors at the water surface, improves safety</td>
<td>• Potential impact on water column ecology</td>
</tr>
<tr>
<td></td>
<td>• No recovered oil storage requirements</td>
<td>• Specialized equipment and expertise required</td>
</tr>
<tr>
<td></td>
<td>• Lower manpower requirements</td>
<td>• Usage near shore in shallow water could result in greater water column</td>
</tr>
<tr>
<td></td>
<td>• Potentially the quickest response option</td>
<td>impacts</td>
</tr>
<tr>
<td></td>
<td>• Prevents oil from spreading to shoreline</td>
<td>• Will not work on high viscosity fuel oils in calm, cold seas</td>
</tr>
<tr>
<td></td>
<td>• Useful in higher wind and sea conditions</td>
<td>• Has a limited &quot;window of opportunity&quot; for use</td>
</tr>
<tr>
<td>Mechanical Recovery</td>
<td>• Well-accepted, no special approvals needed</td>
<td>• Inefficient and impractical on thin slicks</td>
</tr>
<tr>
<td></td>
<td>• Effective for recovery over wide range of spilled products</td>
<td>• Ineffective in inclement weather or high seas</td>
</tr>
<tr>
<td></td>
<td>• Large &quot;window of opportunity&quot;</td>
<td>• Requires storage capability</td>
</tr>
<tr>
<td></td>
<td>• Minimal side effects</td>
<td>• Typically recovers no more than 10–20 percent of the oil spilled</td>
</tr>
<tr>
<td></td>
<td>• Greatest availability of equipment and expertise</td>
<td>• Labor- and equipment-intensive</td>
</tr>
<tr>
<td></td>
<td>• Recovered product may be reprocessed</td>
<td></td>
</tr>
<tr>
<td>In-Situ Burning</td>
<td>• High oil elimination rate possible</td>
<td>• Special approvals required</td>
</tr>
<tr>
<td></td>
<td>• No recovered oil storage requirements (except possibly for burn residue)</td>
<td>• Ineffective in inclement weather or high seas</td>
</tr>
<tr>
<td></td>
<td>• Effective over wide range of oil types and conditions</td>
<td>• Black smoke perceived as significant impact on people and the atmosphere</td>
</tr>
<tr>
<td></td>
<td>• Minimal environmental impact</td>
<td>• Localized reduction of air quality</td>
</tr>
<tr>
<td>Physical Removal</td>
<td>• Non-aggressive methods can have minimal impact on shore structure and</td>
<td>• Specialized equipment and expertise required</td>
</tr>
<tr>
<td></td>
<td>shore organisms</td>
<td>• Potential for secondary fires during inland use</td>
</tr>
<tr>
<td></td>
<td>• Useful for detailed cleaning of near shore environment in specific or</td>
<td>• Burn residue can be difficult to recover</td>
</tr>
<tr>
<td></td>
<td>sensitive areas</td>
<td></td>
</tr>
<tr>
<td>Natural Processes</td>
<td>• No intrusive removal or cleanup techniques that further damage the</td>
<td>• Winds and currents can change, sending the oil spill toward sensitive</td>
</tr>
<tr>
<td></td>
<td>environment</td>
<td>areas</td>
</tr>
<tr>
<td></td>
<td>• May be best option if there is little to no threat to human</td>
<td>• Residual oil can impact shoreline ecology, wildlife, and economically</td>
</tr>
<tr>
<td></td>
<td>or environmental well-being</td>
<td>relevant resources</td>
</tr>
<tr>
<td></td>
<td>• When selected for certain areas and conditions, the environment can</td>
<td>• Public perception that responders are doing nothing</td>
</tr>
<tr>
<td></td>
<td>recover from the spill more effectively than it might when using other</td>
<td></td>
</tr>
<tr>
<td></td>
<td>response tools</td>
<td></td>
</tr>
</tbody>
</table>
Target an optimum response strategy for planning scenarios and incident specific conditions

- Before a spill, response strategies are defined for each of the planning scenarios, and response capabilities are designed and developed accordingly.

- During a spill, SIMA supports:
  - the deployment and adjustment of response resources as conditions change
  - decisions about when response end-points have been reached
Dispersant Use

COMPARE

amount of severe and long-lasting damage to oil-sensitive coastal habitats and socio-economic resources that can likely be prevented by dispersant use…

versus

…the highly localized and short-lived effects that might be caused to the marine environment by dispersant use

All feasible response options should be compared, and their advantages and disadvantages weight against each other and compared with the option of no intervention and allowing natural recovery
Summary

A systematic SIMA process can:
• establish an understanding of the potential effects of a spill on environmental and other resources
• help to evaluate various response options
• address potential trade-offs that may result for different response strategies

SIMA has a role once a response is under way:
• safety at the forefront
• SIMA should regularly be considered as a scenario evolves
• response strategies are optimized for a balance of response techniques
• government and industry working together cooperatively
• effective, timely and transparent communication