Offshore Information for Area Contingency Planning

Gulf of Mexico

Offshore Response Strategies and Best Management Practices (BMPs)

Technical Document #4

December 2022

Record of Changes

Change Number	Change Description	Section Number	Change Date	Name
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Table of Contents

List of tables

List of Figures

1 Introduction

In 2019, the Bureau of Safety and Environmental Enforcement (BSEE) sponsored a project in cooperation with the United States Coast Guard (USCG) to improve the content of the coastal zone area contingency plans (ACPs) with respect to the information necessary to effectively plan for and respond to large oil spills from offshore oil and gas facilities. This collaboration between BSEE, USCG District Eight, resource trustees, state agencies, oil spill removal organizations (OSROs), and Area Committees resulted in a series of technical documents that provide offshore information for the Gulf of Mexico (GOM) on:

- Oil and Gas Infrastructure (GOM Technical Document #1)
- Worst Case Discharge Scenarios (GOM Technical Document #2 and Appendices 2A-F)
- Response Concept of Operations (GOM Technical Document #3)
- Response Strategies and BMPs (GOM Technical Document #4)
- Sensitive Species Profiles (GOM Technical Document #5)

These documents were developed specifically for incorporation by reference into the coastal zone ACPs and are hosted on the BSEE Oil Spill Preparedness Division's (OSPD) website. In addition to the above technical documents, an inventory of offshore spill response equipment and a set of offshore Environmental Sensitivity Indices (ESI) maps were created and embedded in NOAA's Environmental Response Management Application (ERMA). Collectively, these materials provide a foundation of risk assessment, resources at risk, and conceptual response information to inform coastal zone ACP planning and responses to a significant offshore facility oil spill incident.

This technical document contains response strategies and best management practices (BMPs) to compliment the Offshore Response Concept of Operations (CONOPS) described in GOM Technical Document #3. Neither the CONOPS, nor these offshore response strategies and BMPs, should be seen as requiring the use of any specific offshore spill response strategy during an incident or as prioritizing response strategies. The use of any response strategy in an actual spill is subject to the authorization requirements of that strategy. During an actual incident, each strategy's geographic laydown and prioritization should be continuously reassessed and adjusted based on the conditions offshore. Responders must consider at all times how one strategy will impact others. In selecting the best strategies to use at any one point in the response, the Unified Command (UC) must consider the properties of the oil and the size, spread and location of the oil slick.

The response strategies discussed in this technical document align government and industry offshore best practices and follow the general structure for response outlined in the Offshore Response CONOPS (Technical Document #3).

2 Initial Response Actions

Aerial surveillance should be conducted immediately to provide an initial assessment of the incident and better understand the nature and volume of the oil discharge (see Section 3). If the origin of the oil discharge is known, plans for controlling and securing the source should be developed and put into action as soon as possible (see Section 4). Response resources with rapid response times should also be dispatched immediately if oil spill reporting or surveillance observations indicate that recoverable or dispersible amounts of oil have been discharged into the water. The potential deployment of dispersant aircraft, which have quick arrival times and high oil encounter rates, should be guided by and strictly follow Authorization of Use agreements in the Region 6 Regional Contingency Plan (RCP), an assessment of operational conditions and the properties of the discharged oil, and a comparative analysis of environmental tradeoffs. This assessment can be coordinated quickly with resource trustees by the NOAA Scientific Support Coordinator (SSC) when requested by the USCG FOSC. Oil spill fate and trajectory modeling, based on initial and subsequent spill reporting observations, should be completed shortly thereafter for large offshore discharges in order to understand the spatial and temporal windows of opportunity that exist, and guide deployment of response strategies. The Unified Command will meet to discuss these initial findings and start developing an incident-specific Concept of Operations (CONOPS) for the continued employment of different response strategies. Figure 1 shows the divisions of a CONOPS that was developed as a baseline for responses to large offshore spills (for more detail, see GOM Technical Document #3).

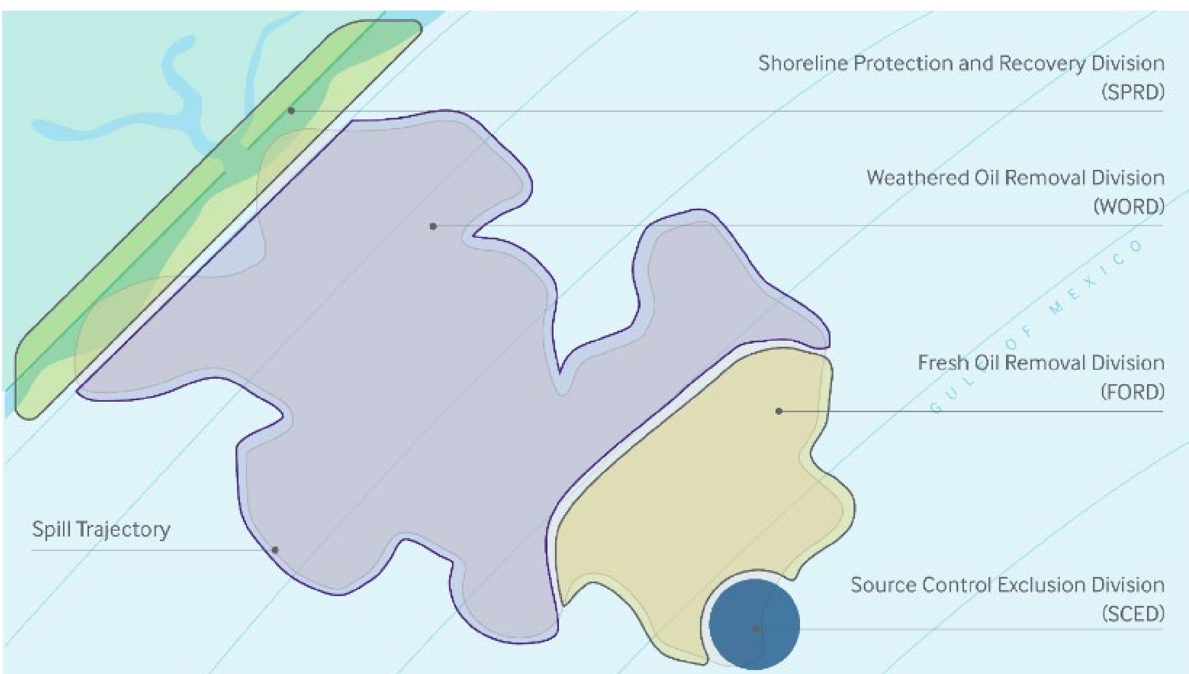


Figure 1. CONOPS Geographical Divisions.

3 Oil Spill Surveillance and Monitoring

The use of aerial surveillance is a long-established tactic for detecting, assessing, and monitoring oil spills, and is critical for gaining situational awareness over the scope of an incident. Reporting in near or real-time from visual observers in aircraft has always been essential to assessing an incident, locating actionable oil slicks, and the tactical positioning of operations including the application of dispersants, skimmers, or ISB. Remote sensing tools have now progressed in their development to the point where they can also be used in the real- or near-real timeframes for these critical tasks.

Drones and aircraft mounted sensor packages should be considered for detection, assessment, mapping, and tactical support of response operations for offshore oil spills at real- or near-real timescales. Aerial support of oil containment, recovery, burning or dispersant operations can greatly increase the oil encounter rates of these tactics and improve their effective deployment and operations in the field. Similarly, improvements in the processing and workflow of remote sensing data have changed the way responders can use satellite data. Satellite observations are fast becoming a frequently used, real or near-real time tool for detecting and monitoring oil spills, such as NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) reporting done during Hurricane Ida in the Gulf of Mexico.

One practical way to discern remote sensing technologies is by separating the platforms based on sensors that are used and the altitudes at which they operate. Starting from sea level, handheld or tethered devices and sensors can be used from a responding vessel; these include cameras, thermal imagers, spectrophotometers, fluorometers, etc. These sensors, which are used to conduct direct in-situ measurements and observations, can also be mounted on various aerial-based platforms that provide a much larger area of coverage (e.g., drones, aircraft, satellites, etc.). Figure 2 shows the commonly used sensors for oil spill detection along with their characteristic platform and altitudes.

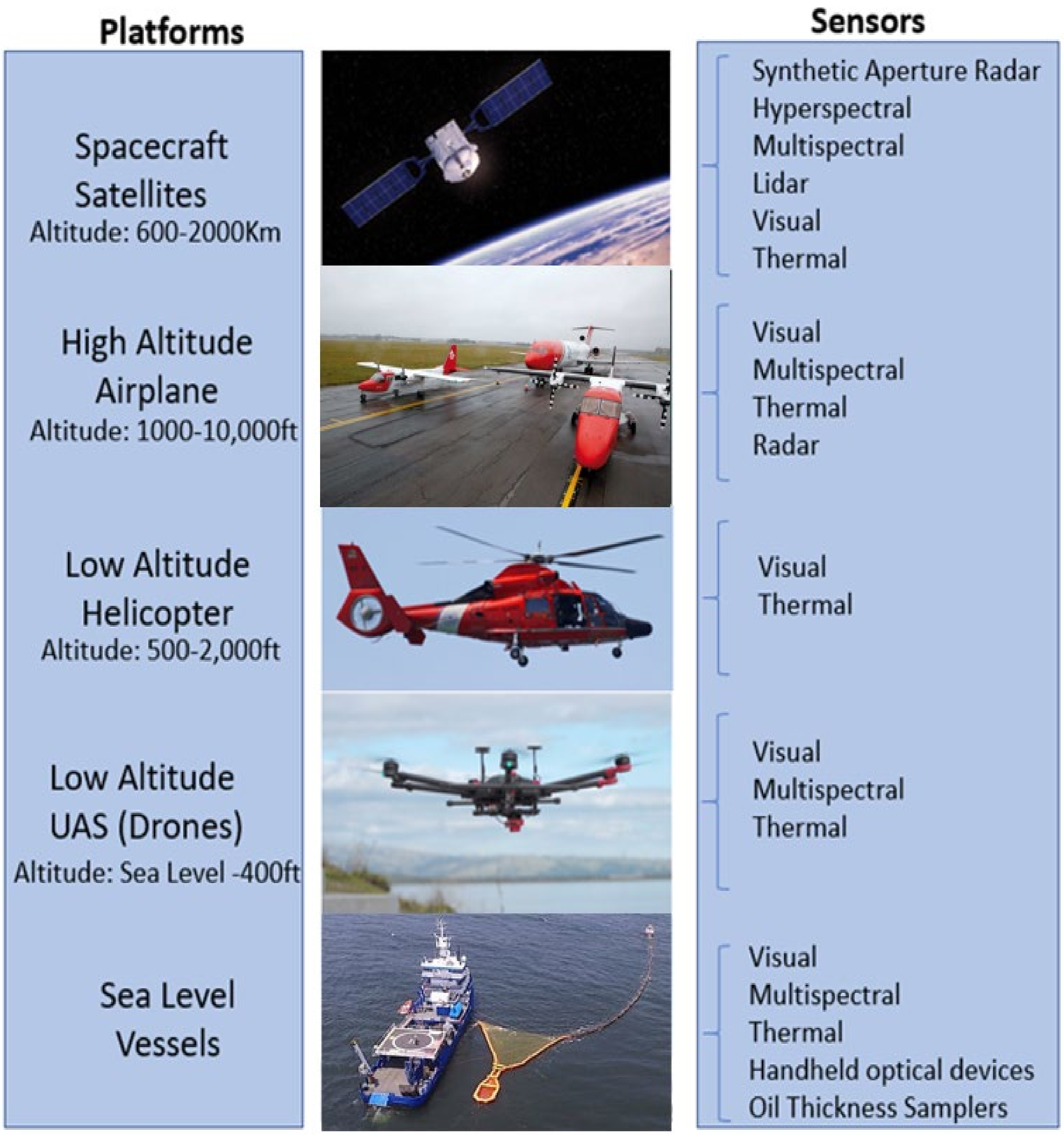
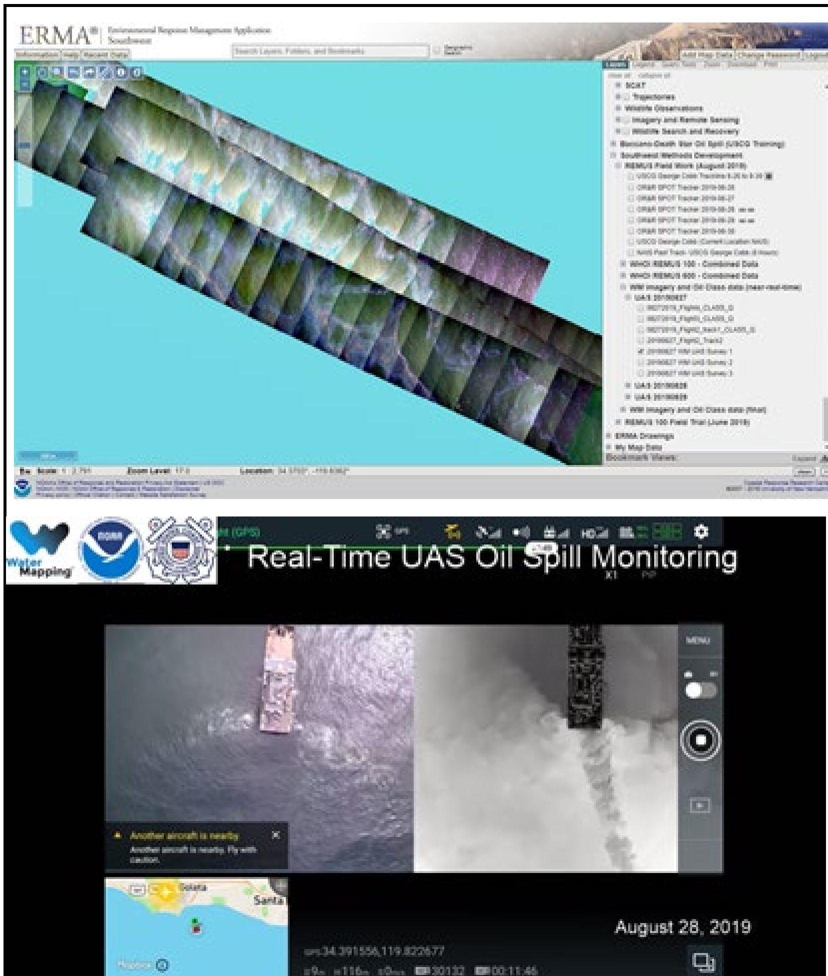


Figure 2. Representative platforms and sensors used for oil spill remote sensing monitoring. Platforms are classified by altitude and coverage.

3.1 Remote sensing data integration

NOAA's Environmental Response Management Application (ERMA) is an online mapping tool offering comprehensive access to localized oil spill response information. Responders can now use ERMA for the integration and dissemination of the remote sensing data gathered through various forms of aerial surveillance.



Top: ERMA interface showing a collection of UAS flights that overlapped. These maps were made available on the online system in near real time.

Bottom: Live streaming video of the UAS. Bottom center shows the coordinates and altitude of the aircraft. The left panel shows the visual camera, and the right panel shows the thermal camera.

The real-time UAS video was made available through ERMA. The objective of this test was to demonstrate this UAS technology as a potential tool for further missions in which multiple responders could use the view from the UAS at the same time.

Figure 3. Example of ERMA's use in oil spill monitoring.

4 Source Control Actions

One of the first priorities for any response to an oil spill is to secure the source of the discharge. For large discharges of oil from offshore facilities, such as a well blowout, this effort can be a complex and long-term endeavour (See Figure 4). There are numerous methods related to the intervention of a well blowout. The quickest option is to use the original well control equipment (blowout preventer, (BOP), or a production tree) attached to the wellhead to regain control and shut-in the well. Often this option is ineffective due to damage sustained by the well control equipment during the blowout.

The next method is to install a new, temporary well control device onto the well. This operation often involves removing part or all of the original well control equipment and can be a complex series of activities conducted in a dangerous or difficult environment.

In a surface blowout, a modified BOP or production tree may be attached to the wellhead after the original control device is removed, and several cuts are made to the wellhead to ensure the device can be secured. The well may be discharging large amounts of oil, water, sediments, and gas, or may be on fire. In addition, the drilling rig or platform supporting the well may be damaged and structurally unsound, and there may be significant debris that must be cleared before source control personnel can access the well.

In a subsea blowout, the response may utilize divers, remotely operated vehicles (ROVs), and other specialized subsea equipment to gain access and contain the well. In the Gulf of Mexico, the primary tool for controlling a blown-out subsea well are prefabricated capping stacks. Subsea capping stacks and their associated equipment are designed to ensure a subsea well blowout can be isolated and contained in a relatively short period of time.

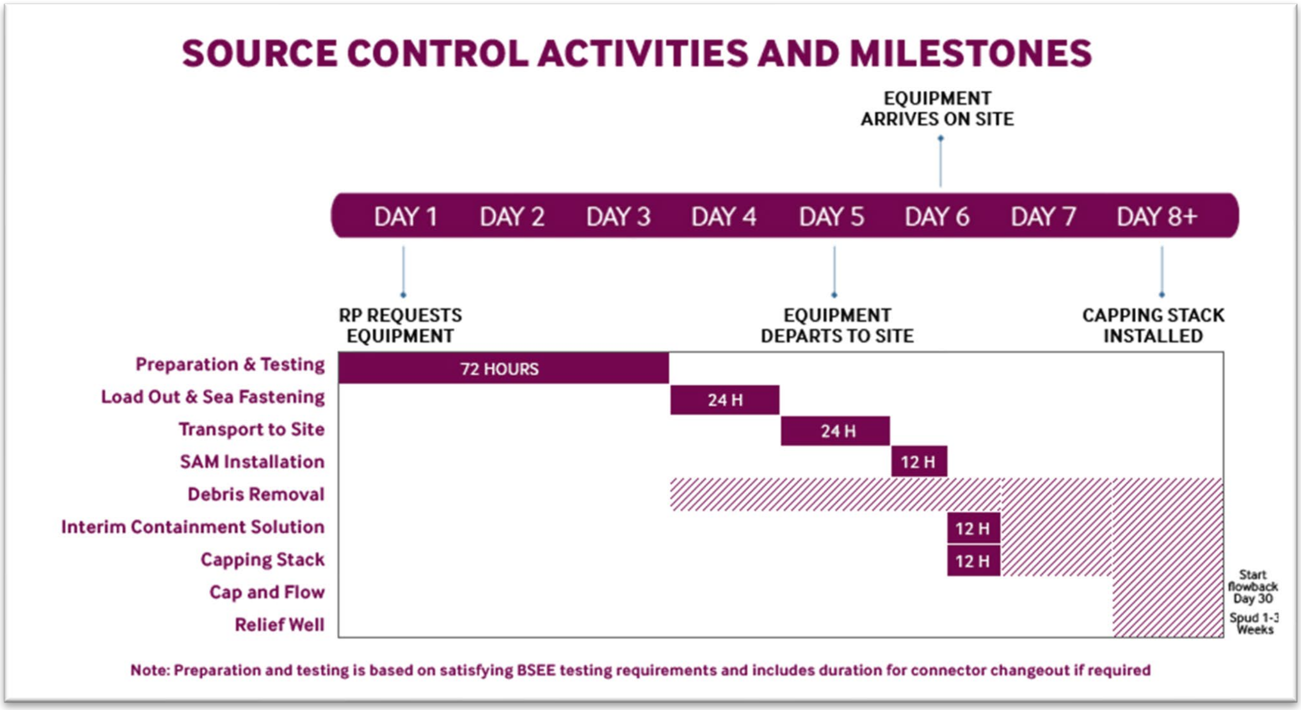


Figure 4. Source Control Activities and Milestones. Figure based on graphic included in the MWCC Functional Specifications.

If there are concerns about the well's integrity that prohibit the safe capping and shut-in of a flowing well, subsea containment (Cap and Flow) is utilized (Figure 5). Subsea containment involves installing a capping stack onto a well and then flowing hydrocarbons back to the surface for surface capture and disposal. Containment is a response option that follows from capping and is, essentially, the constructing and commissioning of a mini subsea production and offloading system. Containment equipment includes subsea infrastructure and control components, production risers, surface production vessels, and offloading/disposal systems. In these situations, interim collection and containment methods are employed to reduce the environmental impacts while responders work to drill a relief well.

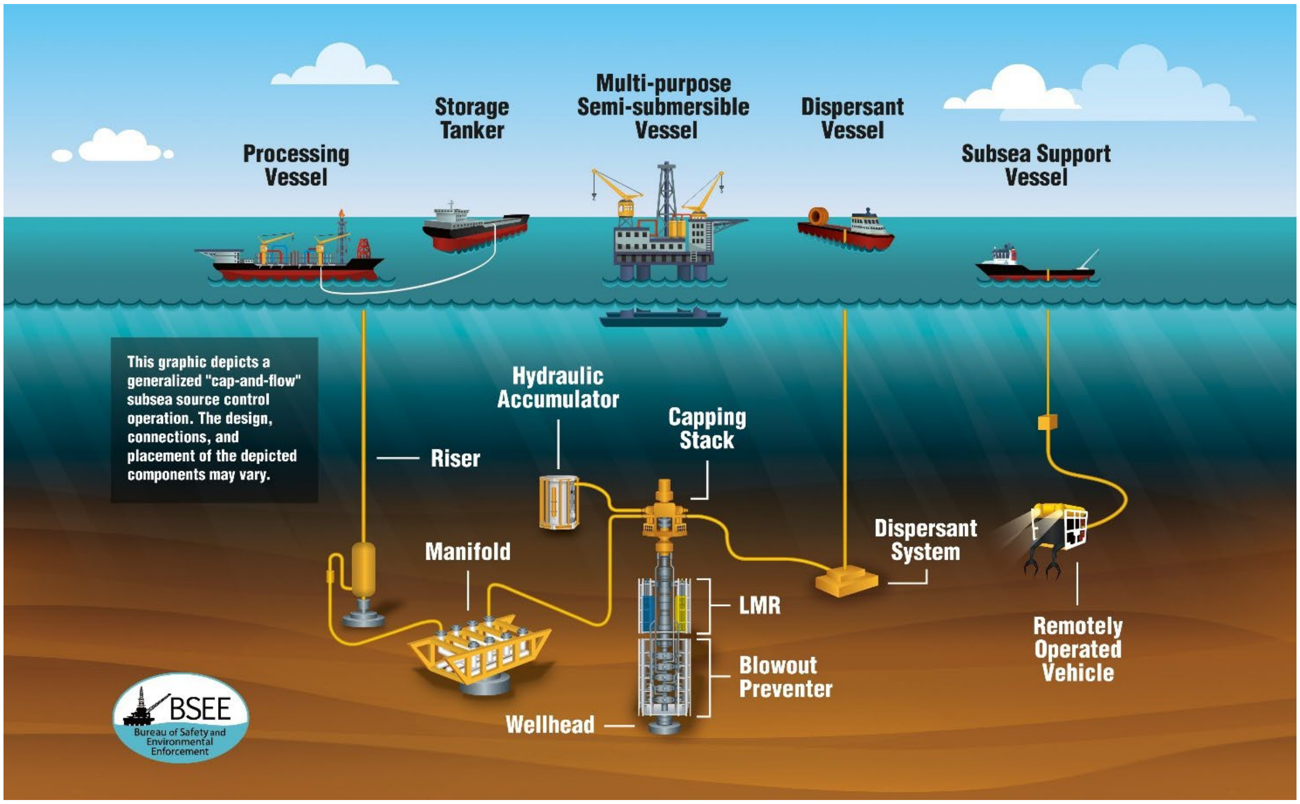


Figure 5. Subsea Well Containment (Cap and Flow) components.

Subsea source control involves a number of complex, cross-functional activities with significant logistics and Simultaneous Operations (SIMOPS) considerations. The activities require the deployment of equipment and specific detailed plans not specifically related to normal drilling and completion operations. Subsea capping equipment is available industry-wide through membership or subscription to either Marine Well Containment Company (MWCC) or HWCG LLC, or direct purchase from manufacturers.

The third method, used for permanently securing a well blowout, is to drill a relief well. A relief well intercepts the wellbore of the blown-out well, and permanently abandons the well by pumping cement into it. The UC may direct two relief wells be drilled simultaneously; the second relief well is drilled as a contingency. Relief well operations are an effective but time-consuming method and may take two to five months to reach the target interval and begin kill operations.

With reference to the CONOPS, these source control operations will occur within the Source Control Exclusion Division (SCED). Figure 6 illustrates depicts an example of a potential SCED layout.

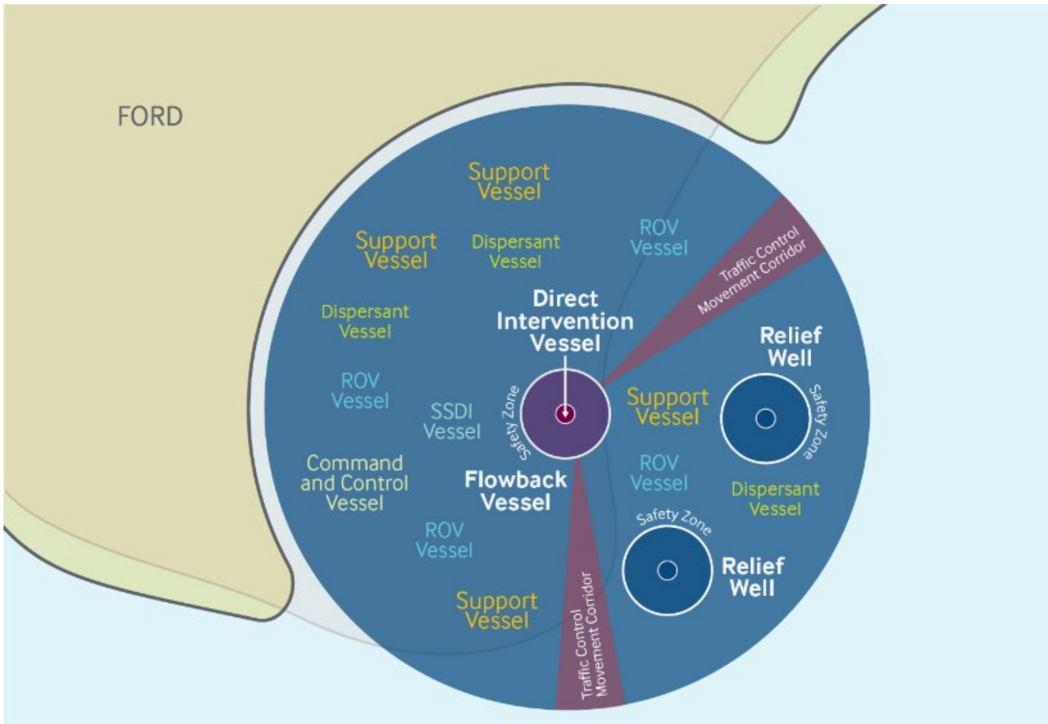


Figure 6. Source Control Exclusion Division (SCED) Configuration. Figure is not to scale.

5 Offshore Response Countermeasures and Strategies

Four main categories of offshore response strategies are described in this Technical Document. These various countermeasure strategies compliment the CONOPS framework for an offshore response from an OCS facility. The response strategy categories are:

- Source Control
- Mechanical Recovery
- Dispersants (Subsea Dispersant Injection and Aerial/Surface Dispersant Application)
- In-situ Burning

In addition, the use of these countermeasures and strategies require support from a number of critical tasks. These tasks include:

- Vessel and Aircraft Tracking
- Effectiveness and Environmental Monitoring Capabilities
- Wildlife Monitoring
- Best Management Practices (BMPs)

Although source control and mechanical recovery operations are the primary response strategies for any large offshore oil spill, a Unified Command (UC) will likely need to consider utilizing multiple response strategies to mitigate the significant volumes of oil that could be discharged in many of the offshore worst case discharge (WCD) scenarios in the Gulf of Mexico. The Deepwater Horizon (DWH) Incident Specific Preparedness Review (ISPR) noted the following, "...efforts to contain, control, and remove the oil at the well and offshore areas provided the first line of defense for protecting environmentally sensitive areas. While they did not prevent oiling and impact to shorelines and sensitive areas, the use of the full range of response tools, including mechanical removal, dispersants, and in-situ burning, diminished immediate impacts."

The selection of response strategies using multiple countermeasures is dependent upon many incident-specific factors involving resource availability, efficacy, and assessing environmental impacts. From an environmental impact mitigation perspective, this has traditionally been accomplished through the use of comparative risk assessment models, with the most recently proposed model being described as a Spill Impact Mitigation Assessment (SIMA). SIMA is an updated approach to Net Environmental Benefit Analysis (NEBA) that also incorporates socio-economic considerations. Ideally, these assessment models are used in the planning phase to identify and assemble the information that will inform the use of response options for representative planning scenarios. During a spill response, the Unified Command can conduct an expedited or qualitative SIMA to rapidly select the response option(s) that are expected to yield the greatest overall environmental benefit. SIMA should neither pre-empt a response decision nor be the starting point for every decision. The goal of the SIMA methodology is to obtain agreement among the various parties over which response options will be most effective and result in the least overall impact on the environment.

When selecting response strategies for deployment, it's also important to understand how incident specific conditions offshore will affect the efficacy of employing the various countermeasures for any given operational window of time. Figure 7 was developed by Mr. Al Allen of Spilltec to capture the effectiveness of response countermeasures under different wind speeds and wave heights.

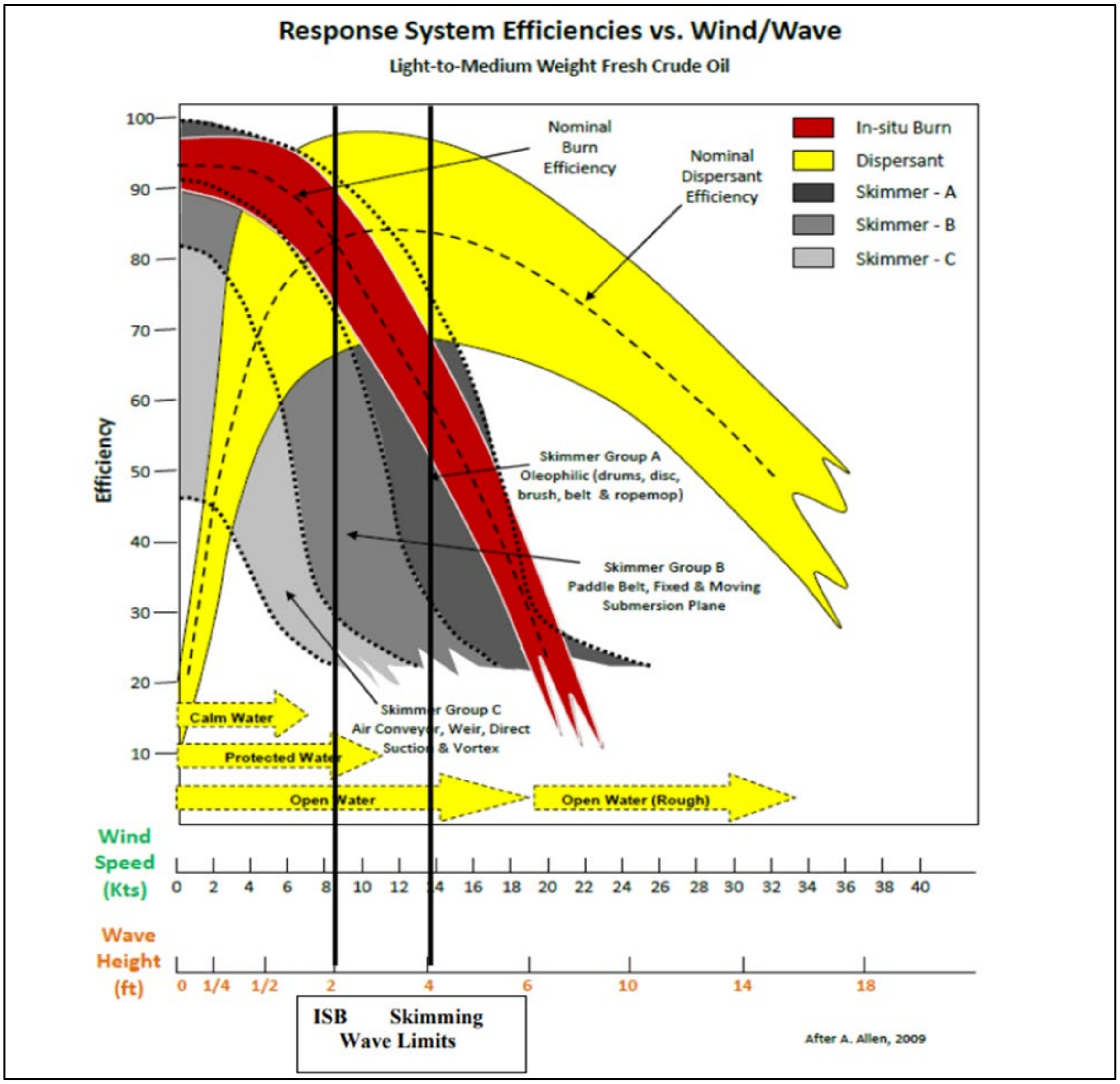


Figure 7. Response System Efficiencies of Response Countermeasures under Different Wind Speeds and Wave Heights. Source Al Allen, Spilltec.

6 Mechanical Recovery

During an offshore incident on the OCS, mechanical recovery will always be the primary response strategy for oil removal in accordance with the National Contingency Plan. The mechanical recovery of oil offshore involves the use of advancing skimming systems with containment arms, a collection or sump area with a skimming device designed to separate the oil from the water through such means as weirs or oleophilic surfaces, pumps, and primary temporary storage. Typical advancing mechanical recovery systems can operate on average around 0.75 knots relative to the oil slick and currents.

Table 1. Oil Removal Strategy.

Oil Removal Strategy	Advantages	Disadvantages
Mechanical Oil Recovery	• Physically removes the oil from the environment • Can be deployed immediately and doesn't require Authorization of Use procedures • Mechanical recovery systems exist in substantial numbers and are readily available in the GOM	• Low oil encounter rates may result from slow speeds of advance or narrow swath widths • Slow transit speeds may result in longer response times on scene • Skimming operations are subject to operational limitations due to sea state • Requires temporary storage and waste disposal

6.1 General Considerations

The laydown of mechanical recovery resources will be based on the oil properties of the slick in the vicinity of the discharge and as it moves along its trajectory. The offshore response Concept of Operations (CONOPS) for the Gulf of Mexico (see GOM Technical Document #3) is organized into two separate divisions based on the principal that oil weathers and spreads out over time as it is transported away from the source. Figure 1 illustrates these divisions, namely the Fresh Oil Removal Division (FORD) and the Weathered Oil Removal Division (WORD).

In the FORD, spilled oil should still be concentrated in thicker, more continuous slicks that are relatively fresh in terms of weathering (and associated viscosities). High-volume mechanical recovery assets should be assigned to the Primary Mechanical Recovery Zone in the FORD. These assets should have high oil recovery rates, large onboard storage capacities and be supported by additional secondary temporary storage. Large Oil Spill Response Vessels (OSRVs), Oil Spill Response Barges (OSRBs), and Vessels of Opportunity Skimming Systems (VOSSs) will provide significant operational value in this division.

Figure 8. Fresh Oil Removal Division (FORD).

By closely monitoring the fate of the weathered oil, the Operations Section will also set the boundary for the WORD and the Secondary Mechanical Recovery Zone. The oil will typically be more viscous, potentially more emulsified, and will be broken up into discontinuous and distributed patches and streamers that are more difficult to collect and recover. Different mechanical recovery tactics and equipment will be required in this zone. Containment systems used in this zone that have more rapid speeds of advance (2 to 5 kts), including KOSEQ rigid skimming arms and the Current Buster systems, should be used if possible. Tactics that also increase a mechanical recovery system's swath width, such as towing boom in a "U" configuration with an open apex should be considered (see Section 6.3 for details on these tactics). Surveillance support will be critical for effective containment and recovery operations under these conditions. While any mechanical recovery task force will benefit from persistent aerial surveillance support and nearby secondary temporary storage resources, these supporting components are critical for successful operations in the Secondary Mechanical Recovery Zone (see Figure 9).

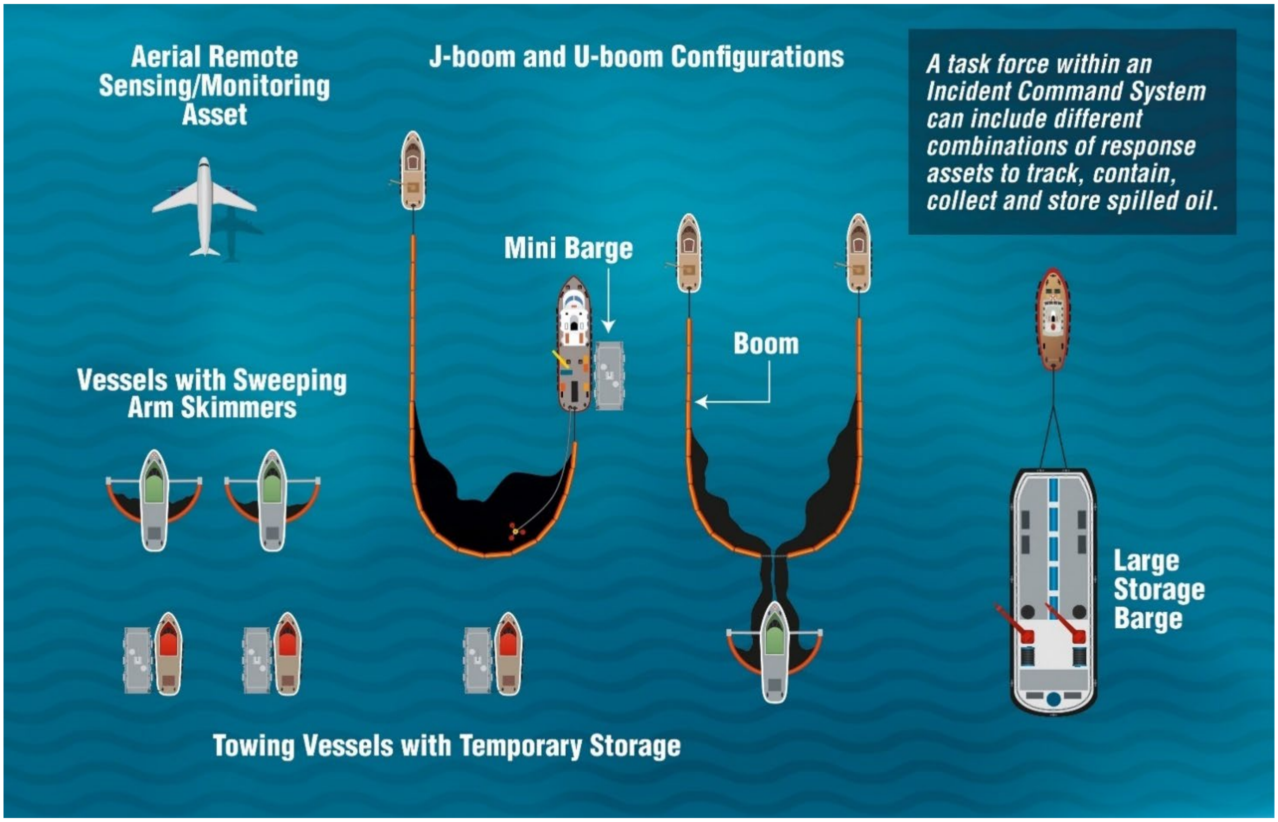


Figure 9. Mechanical recovery task force components.

The Nearshore Mechanical Recovery Zone will be a continuation of operations from the Secondary Mechanical Recovery Zone. However, responders will need to closely evaluate the water depths in this zone and select both mechanical recovery and temporary storage assets with shallow drafts. Nearshore response resources will usually not include large temporary storage capacities or crew accommodations for overnight operations when compared with vessels designed to operate in the offshore/open ocean environments. The smaller storage capacities and limits on operational hours will require different strategies for logistical support and tactical employments.

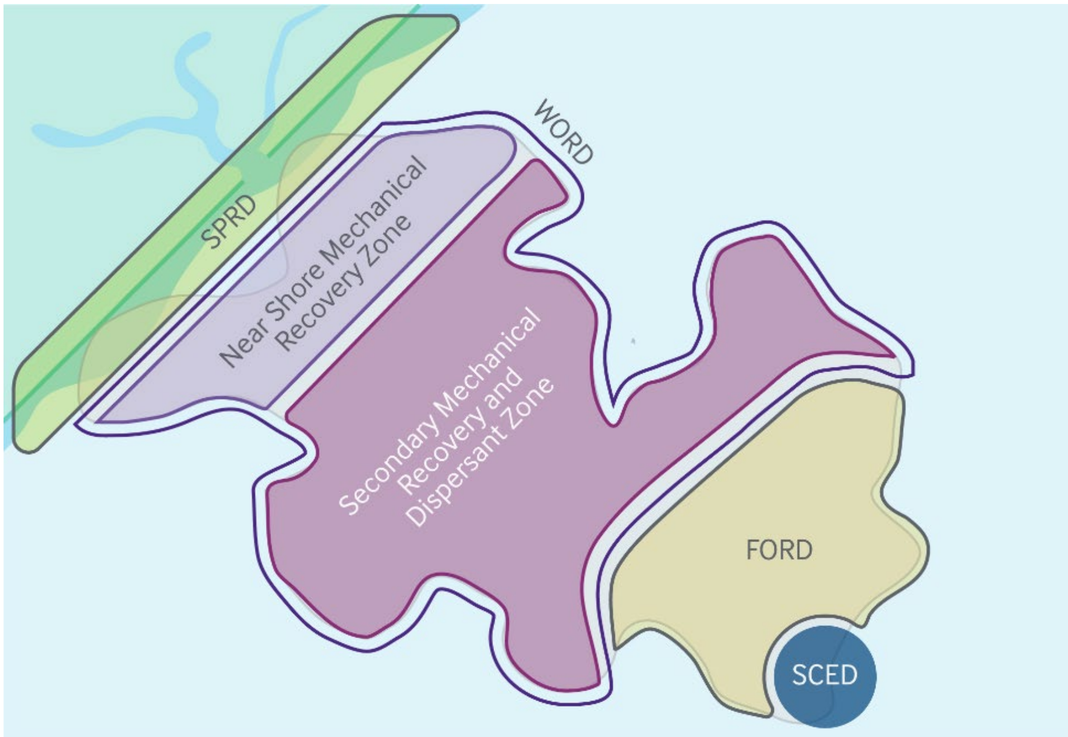


Figure 10. Weathered Oil Removal Division (WORD).

6.2 Mechanical Recovery Systems & Efficiency Factors

Since the performance of different skimmer types can vary considerably, spill responders must evaluate the specific skimmer type and efficiencies as they relate to existing sea conditions and the properties of the discharged oil, and attempt to match and operate the most appropriate recovery systems for the situation. This consideration is especially important to consider as the oil transits from the FORD into the WORD and oil characteristics change. Some skimmer types/systems can be modified with pump changes to accommodate varying oil viscosities as oil weathers to maintain effective operations.

Table 2 describes the different available skimmer types and what oils and environmental conditions are best for their use. This table was taken from the ITOPF Technical Report #5. Figures 11 and 12 were developed by Mr. Al Allen of Spiltec and are provided with his permission. These graphics describe the recovery efficiency of different skimmer types for different wind speeds, wave heights, oil types and viscosities. Emulsification can significantly impact the effectiveness of different response options on major surface oil spills. Emulsified oil typically has both increased volume and increased viscosity. However, not all oils emulsify, and the stability of the formed emulsion is not the same in all cases. Emulsification will be a significant concern for skimmers operating in the WORD.

As the oil weathers, the effectiveness of a particular type of skimmer may change, requiring an alternate design for continued recovery. Source ITOPF Technical Report #5.

Table 2. Generic characteristics of commonly encountered skimmer types.

	Skimmer	Recovery rate	Oils	Sea state	Debris	Ancillaries
Oleophilic	Disc	Dependent on number and size of discs. Tests show grooved discs can be highly effective.	Most effective in medium viscosity oils.	In low waves and current can be highly selective with little entrained water. However, can be swamped in choppy waters.	Can be clogged by debris.	Separate power pack, hydraulic and discharge hoses, pump and suitable storage required.
Oleophilic	Rope mop	Dependent on number and velocity of ropes. Generally low throughput.	Most effective in medium oils although can be effective in heavy oil.	Very little or no entrained water. Can operate in choppy waters.	Able to tolerate significant debris, ice and other obstructions.	Small units have built in power supply and storage. Larger units require separate ancillaries.
Oleophilic	Drum	Dependent on number and size of drums. Tests show grooved drums are more effective.	Most effective in medium viscosity oils.	In low waves and current can be highly selective with little entrained water. However, can be swamped in choppy waters.	Can be clogged by debris.	Separate power pack, hydraulic and discharge hoses, pump and suitable storage required.
Oleophilic	Brush	Throughput dependent on number and velocity of brushes. Generally mid-range.	Different brush sizes for light, medium and heavy oils.	Relatively little free or entrained water collected. Some designs can operate in choppy waters, others would be swamped in waves.	Effective in small debris but can be clogged by large debris.	Separate power pack, hydraulic and discharge hoses, pump and suitable storage required.
Oleophilic	Belt	Low to mid-range.	Most effective in medium to heavy oils.	Can be highly selective with little entrained water. Can operate in choppy waters.	Effective in small debris but can be clogged by large debris.	Can deliver oil directly to storage at the top of the belt. Ancillaries required to discharge from a vessel to shore.
Non-Oleophilic	Vacuum/ suction	Dependent upon vacuum pump. Generally low to mid range	Most effective in light to medium oils.	Used in calm waters. Small waves will result in collection of excessive water. Addition of a weir more selective.	Can be clogged by debris.	Vacuum trucks and trailers are generally self-contained with necessary power supply, pump and storage.
Non-Oleophilic	Weir	Dependent upon pump capacity, oil type etc. Can be significant.	Effective in light to heavy oils. Very heavy oils may not flow to the weir.	Can be highly selective in calm water with little entrained oil. Can be easily swamped with increase in entrained water.	Can be clogged by debris although some pumps can cope with small debris.	Separate power pack, hydraulic and discharge hoses, pump and storage. Some skimmers have built-in pumps.
Non-Oleophilic	Belt	Low to medium.	Most effective in heavy oils.	Can be highly selective with little entrained water. Can operate in choppy waters.	Effective in small debris. Clogged by large debris.	As for oleophilic belt skimmer.
Non-Oleophilic	Drum	Mid range.	Effective with heavy oils.	Can be highly selective in calm water with little entrained oil. However, can be swamped in waves.	As for weir skimmer.	As for weir skimmer.

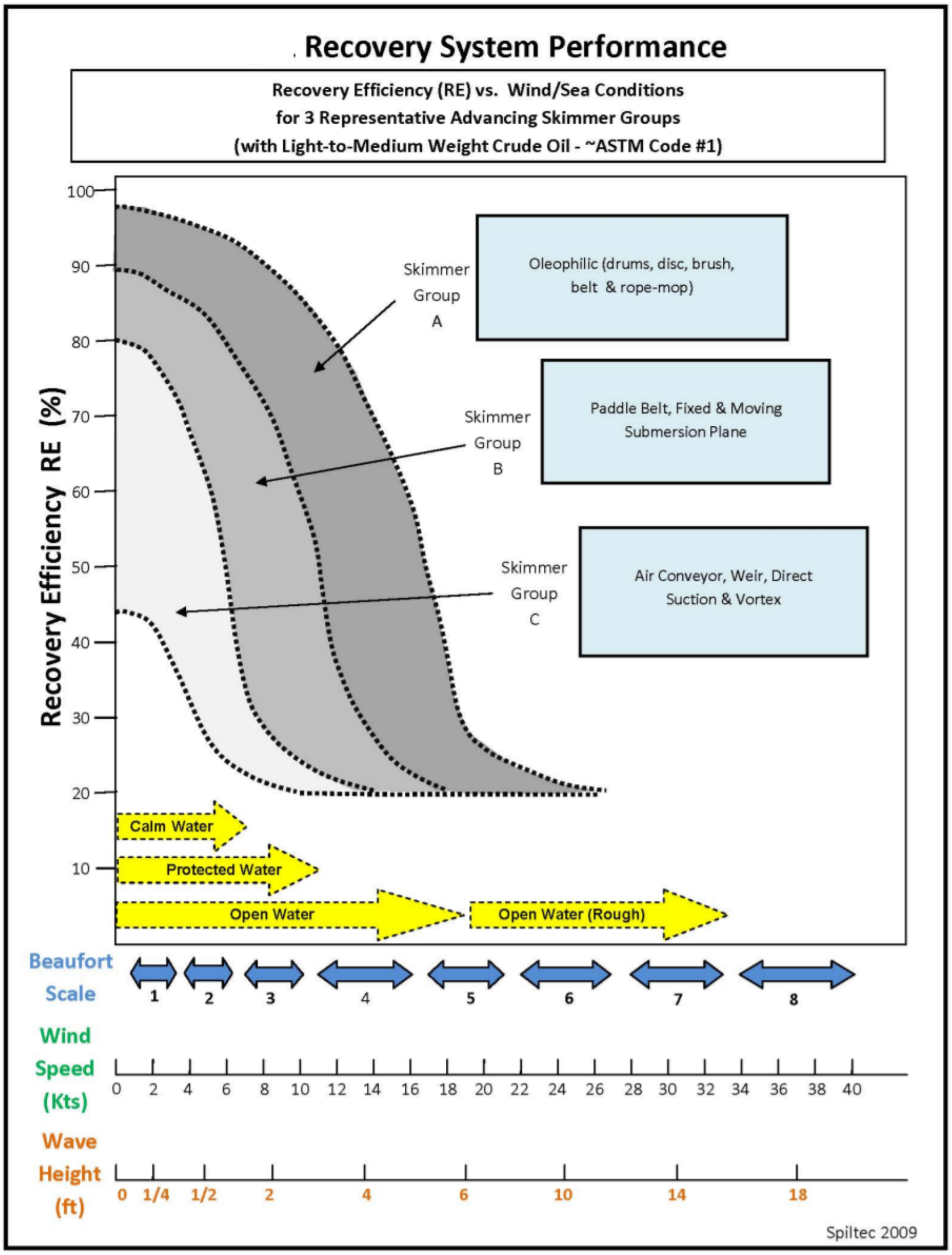


Figure 11. Recovery Efficiencies of Different Skimmer Types based on Wind Speed and Wave Height. Source Al Allen, Spiltec.

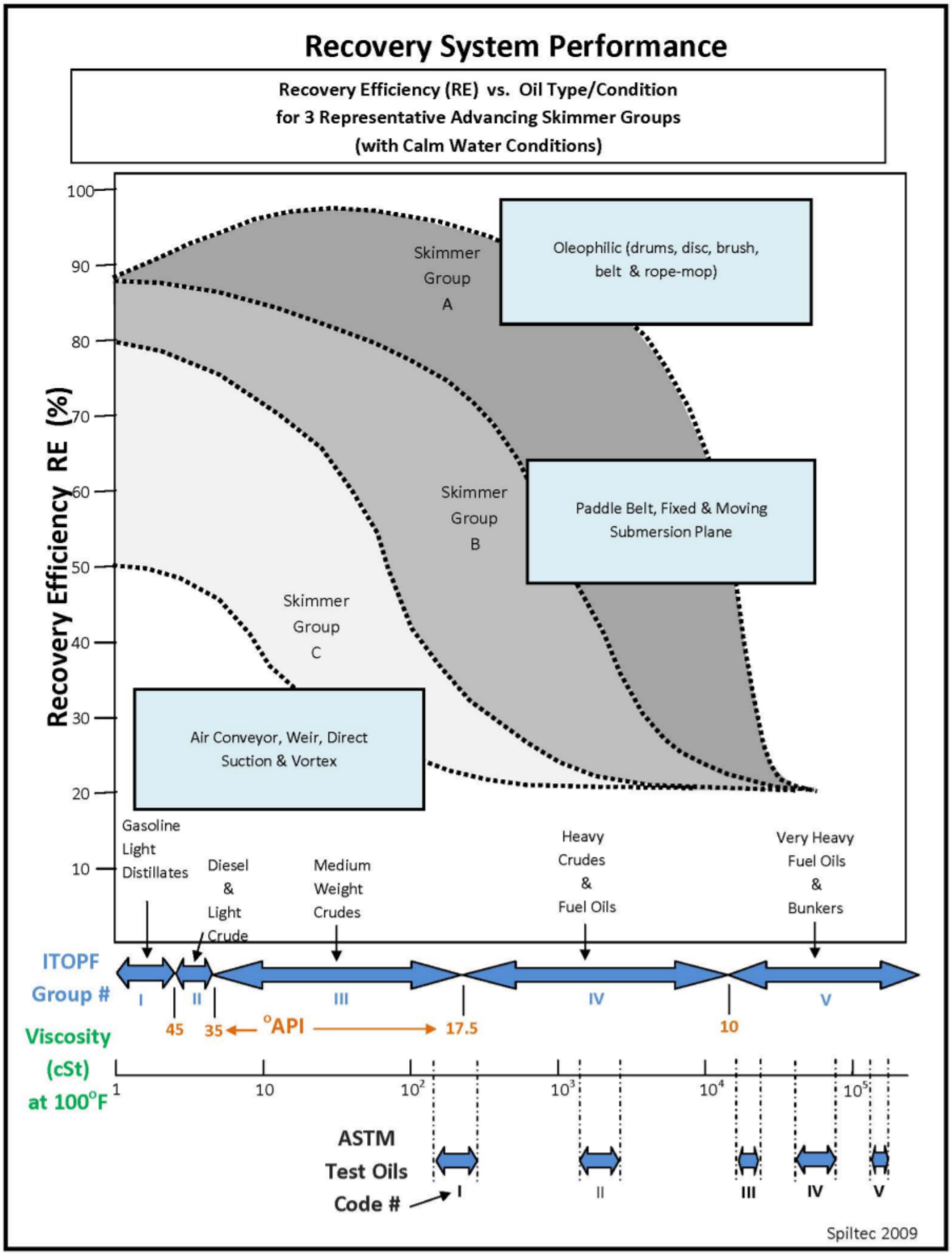


Figure 12. Recovery Efficiencies of Different Skimmer Types based on Oil Type and Viscosity. Source Al Allen, Spiltec.

6.3 Enhanced Recovery Techniques

Responders can potentially improve recovery rates by using various enhanced recovery strategies. Enhanced recovery (or enhanced skimming) refers to different methods of increasing a recovery system's encounter rate. This can typically be achieved through increasing the speed of recovery, the containment boom swath width, or both. Systems may also incorporate an oil/water separator or utilize decanting to increase the efficiency of their temporary storage and skimming capacities. Decanting is discussed in Section 6.4.

High-Speed mechanical recovery systems are capable of being towed at higher speeds which increases the encounter rate. One type of high-speed recovery system is the "Current Busters" that can be used in combination with a variety of skimmer heads, pumps, and ancillary components (Figure 13). These unique systems are designed to facilitate effective oil collection and containment at towing speeds of up to four knots, as compared with the maximum of 0.75 knots possible with normal towed containment boom designs. This relatively high-speed capability allows skimming over a larger sea surface area in a shorter time-period. Smaller Current Buster systems can also be utilized in nearshore areas with shallower waters.

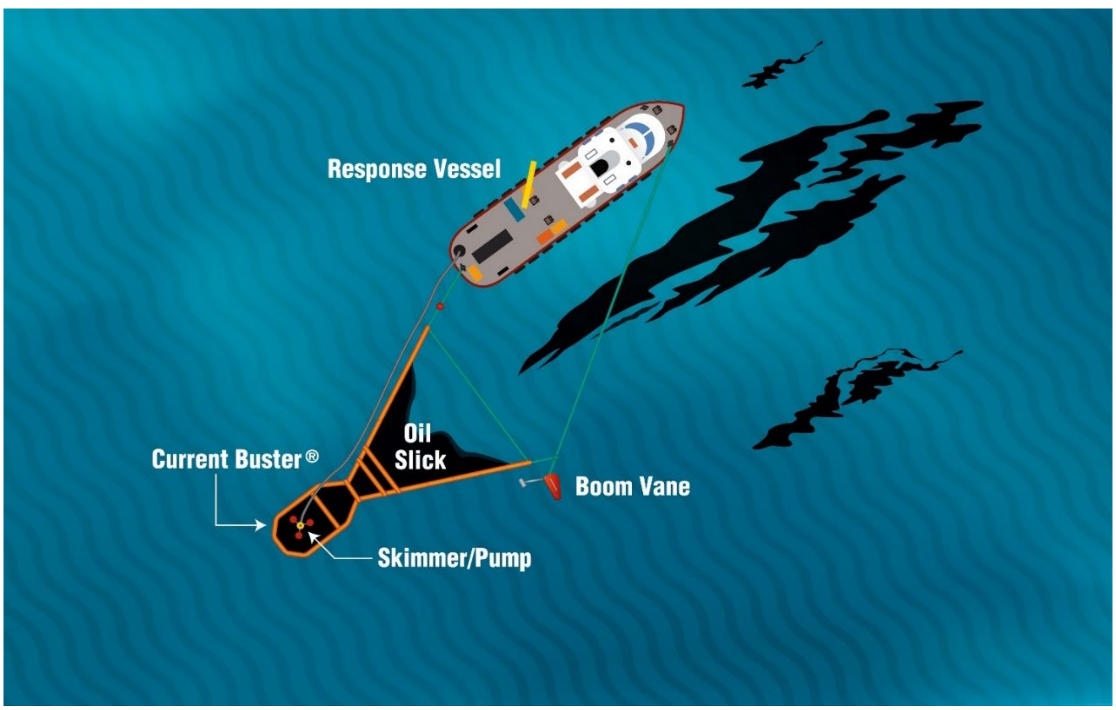


Figure 13. Current Buster Collection/Containment System.

Another type of high-speed recovery system available in the Gulf of Mexico is the rigid sweeping arm system. Rigid arm systems employ a 50-foot-long rigid arm in place of the typical containment boom. The rigid arm has a skimmer mount located at the apex of the arm where it meets the vessel hull. The rigid arm reduces oil entrainment and eliminates the possibility of containment boom failure at higher speeds. Rigid Arm systems can recover oil at 4-5 knots and may also be able to operate at higher sea states. Figure 14 shows an example of a Rigid Arm system.

Figure 14. Example of a Rigid Arm System. (Photograph courtesy of Clean Gulf Associates, KOSEQ Rigid Sweeping Arms - Clean Gulf Associates).

Enhanced oil collection methods use long lengths of towed containment boom and an open apex to increase the area of the ocean surface being swept (effectively increasing the swath width of a recovery system) and includes a dedicated vessel following behind to recover the oil (Figure 15). This method increases the encounter rate but requires close coordination of multiple vessels and competent response crews.

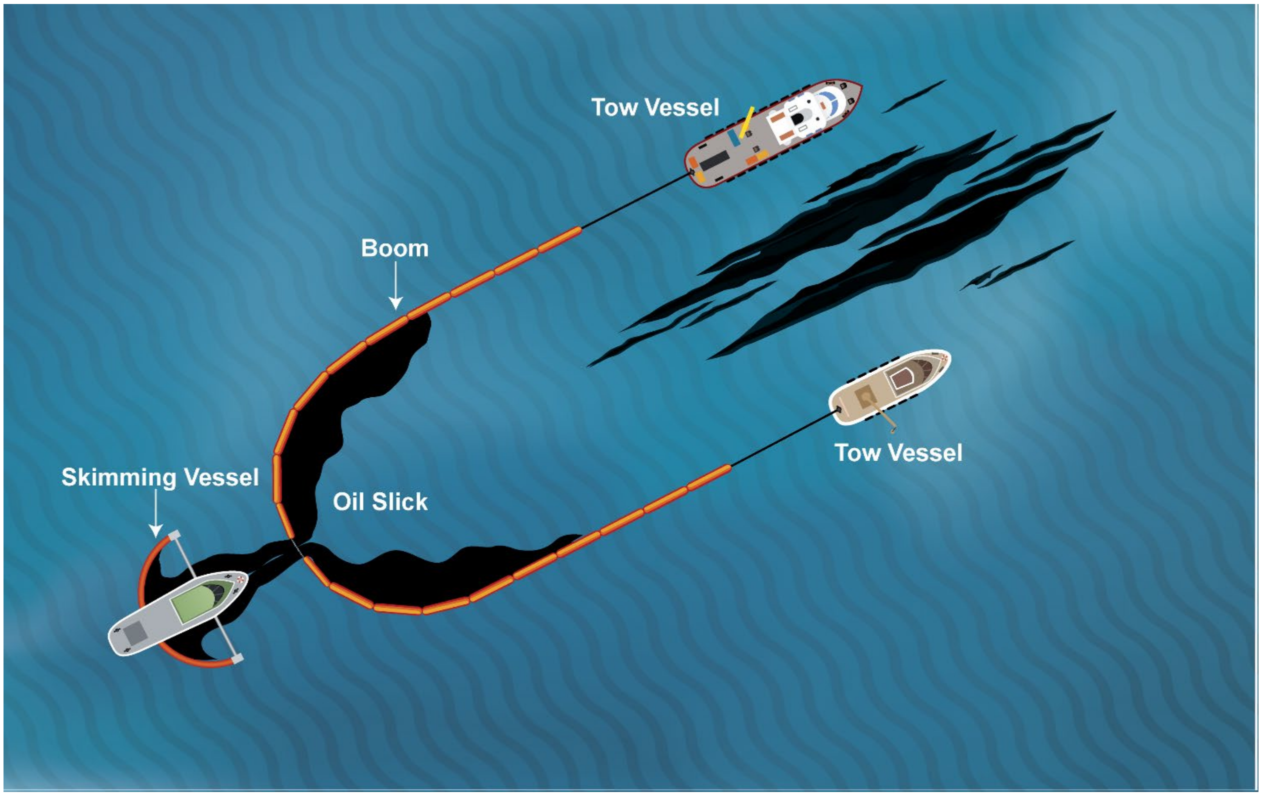


Figure 15. Enhanced Containment Configuration with an open apex U-boom.

Another important method for increasing the total amount of oil recovered by a system is to keep the recovery system skimming as long as possible by limiting the number of times a system needs to discontinue skimming and offtake/discharge the recovered oil/water to a secondary temporary storage unit. The logistics of skimming may be improved by selecting recovery vessels with larger integrated storage tanks, adding additional storage tanks to the vessel deck, and/or providing dedicated secondary storage tank barges or tankships in close proximity to the recovery operations.

6.4 Temporary Storage, Decanting, and Waste Management

Offshore mechanical oil recovery operations generate both solid and liquid wastes. Liquid waste comprises the largest component, consisting of an oil and water mixtures of varying degrees. Management of these wastes involves the setting up of a logistics chain to transfer recovered waste in a safe and secure manner from the recovery vessels to a final authorized recycling or disposal facility deemed compliant by the governing federal/state agencies.

When planning a waste management strategy for an offshore oil spill, the waste management stream should be structured around at least three components:

- primary temporary storage (i.e., storage immediately available as part of the recovery system, such as portable tanks loaded onto the deck or internal tanks onboard a recovery vessel, or towed storage);
- secondary temporary storage (i.e., tank barges/tank ships); and
- shoreside facilities where the final bulk storage, processing, or disposal takes place in conformity with all applicable federal, state, county/parish, and local laws, regulations, and procedures.

The logistics chain needs to be rapidly established and tailored to the specifics of the spill incident. For the recovery of heavy oils or oils that have become emulsified, consideration should be given to using heated temporary storage tanks, positive displacement discharge/transfer pumps, and skimmer types that are efficient/effective with higher viscosity oils.

Strategies must also be cognizant of the regulatory and classification society requirements, such as load line and inspection certificates, when determining the utilization of storage tanks onboard vessels. Not all available storage vessels will have the appropriate certifications for temporary oil storage or offshore/open ocean operations. Responsible Parties need to ensure that their pre-spill planning for temporary storage capabilities include appropriately certificated and classed vessels for the anticipated geographic spill response operating area. Waste management strategies for nearshore operations must consider the secondary temporary storage needs of shallow water recovery systems, which typically have smaller primary storage capacities and operate in limited water depths.

If the waste management logistics and/or capacities becomes overwhelmed, response operations may be interrupted. For many oil recovery systems, primary temporary storage capacities will be limited, especially for many vessels of opportunity or shallow water skimmers. Such systems may rapidly reach their storage limitations and will need to curtail skimming operations if they cannot offload to readily available secondary temporary storage vessels.

For any system where large volumes of oil are encountered, an oil/water separator can be used to concentrate recovered oil and maximize the use of limited storage space. Gravity separation in settling tanks, then decanting the separated water overboard, is also an acceptable process. Vessels with oil/water separation and/or decanting capabilities will be able to extend their time on scene recovering oil. These vessels tend to be larger and well suited for offshore oil recovery but may be limited in their ability to operate in nearshore areas.

Decanting operations are not preauthorized; however, as specified in 40 CFR 122.3(d), the Federal On-Scene Coordinator can authorize the discharge as well as the conditions for that discharge. Although the USCG FOSC is authorized to allow decanting within the coastal zone, it's understood that the USCG FOSC, operating within a Unified Command (UC) construct (in-person or virtually), will consult with the State On-Scene Coordinator (SOSC) if at all possible – before authorizing decanting within state waters (to ensure adherence to any relevant State statute). Decanting consists of oil/water mixtures being collected and pumped into temporary storage tanks, and the water is allowed to settle and separate from the oil. The free water is then discharged into the sea where the skimming vessel and/or secondary storage devices are conducting recovery operations.

The amount of oil recovered by a system is often limited by the size of their primary temporary storage capacity and the amount of time spent offloading to secondary temporary storage vessels. Using towed storage such as dracones or bladders should not be used for offshore operations due to the potential for rough sea conditions, as well as difficulties with offloading these devices. Ultimately, recovered oil will require discharge to shoreside storage and those shoreside facilities need to be identified early in the response.

7 Dispersants

Dispersants are chemical agents composed of detergent-like surfactant and solvent carriers that break up oil slicks into smaller particles that can mix into the water column. These oil droplets are rapidly dispersed throughout the water column and are further broken down by natural processes, such as biodegradation, over a longer time period. Dispersants may be applied from aircraft, vessels, or from remotely operated vehicles (ROVs) operating in a subsea environment. All of these application platforms use spray or subsea injection systems designed to deliver dispersants at specific dosages and droplet sizes. The use of all chemical countermeasures, including dispersants, are regulated under the National Contingency Plan (Subpart J of 40 CFR 300) and require approval under authorization of use protocols (preauthorization plans or incident-specific approval processes) outlined in Annex 11 of the Region 6 RCP. Dispersants should be viewed as a complementary response countermeasure that may be considered in addition to employment of mechanical oil recovery systems.

The decision to apply dispersants must be based on an assessment of their availability and expected effectiveness, and whether their use in conjunction with mechanical recovery systems will provide the best overall result for mitigating impacts to affected resources at risk.

Table 3. Oil Removal Strategy.

Oil Removal Strategy	Advantages	Disadvantages
Chemical Dispersion of Oil	• Aerial application has fast transit speeds and high encounter rates that can treat oil over large areas quickly • Reduces oil concentrations on the water surface which may reduce the risk of fouling or inhalation of oil for wildlife (birds, marine mammals, sea turtles, sargassum communities) • Reduces the need for temporary storage offshore • Increases availability of oil to biodegradation by oil eating microbes • Subsea applications can be applied at the point of discharge and require a smaller dispersant to oil ratio for application • Subsea applications may reduce harmful volatile organic compounds (VOCs) at the surface	• Does not physically remove oil from the environment • Requires authorization of use which may delay deployment • Requires extensive monitoring capabilities • Requires mixing energy to be effective (waves or turbulence) • Dependent upon oil properties and ambient metocean conditions, timeframe for effective use may be short • Aerial application is limited by wind speed • Transfers the risks of exposure to oil from the water surface to the water column (planktonic species, fish larvae, etc.) • Subsea application is logistically complex and may have long deployment times (4-6 days)

7.1 Subsea Dispersant Injection (SSDI)

Subsea dispersant injection aims to prevent subsea discharges of oil from reaching the sea surface by dispersing the oil into the water column in the vicinity of the discharge point. Adding dispersant to a subsea discharge of oil causes a greater proportion of the oil to break into a subsea plume of small droplets that will be dispersed, diluted, and biodegraded in the water column.

During a subsea well blowout, still wind conditions may result in oil vapors at the water surface over the wellhead that pose inhalation hazards to workers. SSDI is a tool that can be used to reduce the concentrations of VOCs (which are hazardous to human health) and improve the safety of responders.

Conducting SSDI requires considerable specialized equipment, trained personnel, and logistical support. Multiple remotely operated underwater vehicles (ROVs) will be required with dedicated offshore supply vessels and a logistical supply chain for dispersant stocks. Specialized sampling and analysis equipment will also be required to monitor the dispersed oil in the water column. The equipment needed for SSDI is maintained by equipment providers that specialize in providing subsea source control services.

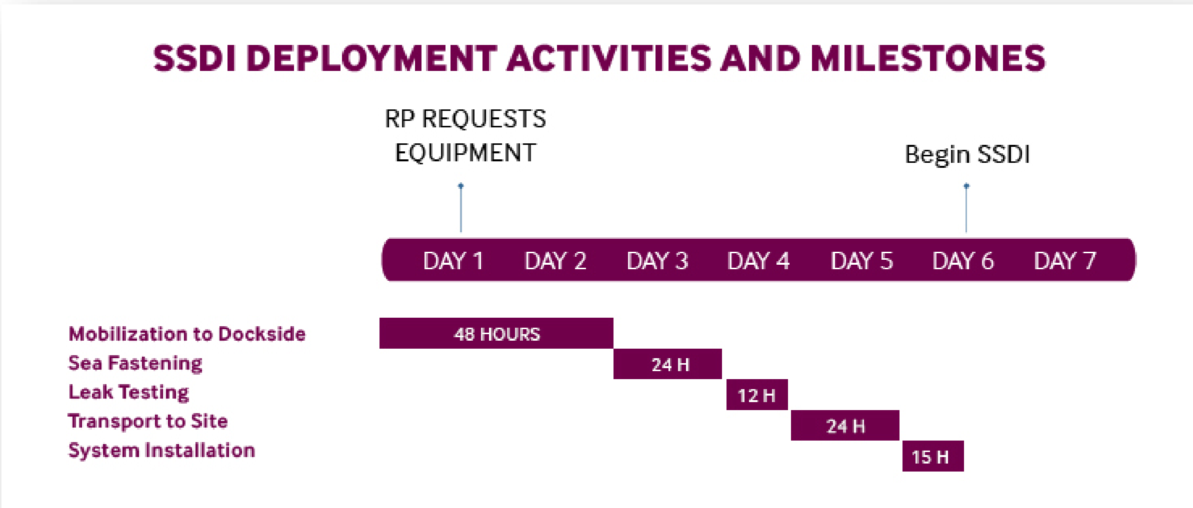


Figure 16. SSDI Deployment Activities and Milestones. Figure based on graphic included in the MWCC Functional Specifications.

Dispersing discharged oil into the water column has potential benefits and risks that, like the consideration of any response method, need to be addressed by conducting a Spill Impact Mitigation Assessment (SIMA).

7.1.1 Authorization of Use for SSDI

There is no preauthorization plan for SSDI and any potential use of SSDI must follow incident-specific approval requirements in Subpart J (40 CFR 300.910(b)) and the procedures contained within Annex 11 of the Region 6 RCP.

Responders must assemble a package of pertinent information to assist the Regional Response Team members that have identified roles in the incident-specific dispersant decision-making process. This information may include:

- Signature page for FOSC authorization
- Summary of SSDI rationale and readiness to execute

- Comprehensive incident data sheet
- Identification of resources at risk
- Site and incident specific 3D modeling information to predict oil and dispersed oil trajectories
- Subsea Dispersant Operations Plan
- Subsea Dispersant Monitoring Plan in accordance with Subpart J of the NCP, 40 CFR 300.913
- Analysis of SIMA and risk assessment associated with SSDI

7.1.2 Subsea Mechanical Dispersion (SSMD)

New or emerging technologies such as Subsea Mechanical Dispersion (SSMD) should be monitored for possible future inclusion in these Response Strategies. Laboratory studies have shown that the use of seawater jets at the wellhead may disperse discharged oil into droplet sizes sufficiently small to achieve the desired effect. While this method may not replace SSDI, it may be performed quickly at the wellsite as an interim measure while other source control and response resources are being mobilized.

7.2 Vessel-Mounted Dispersants

Vessel-mounted dispersant operations are conducted by utilizing dispersant spray arms deployed from the side of a vessel, or fire monitor spray systems. The encounter rate for vessel-mounted dispersant spray systems is substantially less when compared to aerial application systems. The transit time for a vessel-mounted spray system to arrive on scene will usually be significantly longer than aircraft, but once on scene, they can remain on scene for a much longer period of time and can continue to spray oil slicks on scene until their payload of dispersant stockpile (which can be significantly greater than on an aircraft) is exhausted. Vessel-mounted dispersant systems can be used to target particularly thick slicks that would require multiple spray passes from aerial dispersant systems. Vessel platforms can also be a consideration for dispersant operations or around various marine structures, e.g., offshore platforms, in order to avoid overspray by aircraft. Vessel-mounted dispersant systems may also be used near the source of the discharge to reduce VOC concentrations over the water's surface for worker safety.

7.3 Aerial Dispersants

The rapid transit speeds and high oil encounter rates for aerial dispersant aircraft allow for timely applications of dispersant to large amounts of oil on the water surface. Dispersant aircraft range in size, application rates and ranges. For spills occurring significant distances offshore, the use of large multi-engine aircraft as spray platforms have distinct advantages with regard to safety, response times, operating range, and the size of dispersant payloads.

Oil spill surveillance, tracking and spotter aircraft must be capable of arriving on scene prior to the start of dispersant spray operations. Spotter aircraft will assist in spray aircraft in applying dispersants over the patches and streamers of oil. Spotter aircraft will also evaluate the effectiveness of the applications in dispersing the oil into the water. For smaller offshore spills, monitoring of oil dispersed by aircraft may be done by teams employing Special Monitoring of Applied Response

Technologies (SMART) protocols. For larger offshore spills, monitoring of oil dispersed into the water column using aircraft must follow the requirements established in Subpart J of the NCP (40 CFR part 300).

7.4 Dispersant Management Plan (DMP)

Early in the response, a Dispersant Management Plan (DMP) should be developed forecasting aerial, vessel, and SSDI dispersant consumption rates over the duration of the incident. This plan should include details on the allocation of stockpiles to support different tactical uses of dispersants, and if necessary, the arrangements for the replenishment of dispersant stockpiles. The DMP should also address the logistics that will be required to support dispersant operations.

8 In-situ Burning (ISB)

In-situ burning in the offshore environment typically involves the collection, containment, and controlled burning of spilled oil inside of a fire-resistant boom. These "firebooms" are towed through the water in a U-configuration at a slow speed to collect and contain the oil, separate the oil from the source in order to prevent secondary fires, and then to maintain a desired thickness of oil in the boom catenary that is necessary for sustained combustion. Hand-held pyrotechnic devices and helicopter-slung torches are the primary tools used for the ignition of the oil.

Pool fires of oil in open water require that the oil is sufficiently thick to burn (at least 2-3 mm) and is fresh enough to give off the oil vapors that are needed for combustion. The window of opportunity for using traditional open water ISB techniques will depend upon the oil weathering properties, metocean conditions, and whether it can be effectively collected and contained while it is still relatively fresh. There is much research being conducted to extend the window of opportunity for burning oil, improve the efficiency of the burn, and reduce the smoke and particulate emissions.

For a well blowout that provides a continuous discharge of fresh oil over an extended period of time, in-situ burning may be a good strategy to use offshore. It would most likely be implemented within the FORD where the oil will be thicker and will have lower viscosities suitable for burning. The BP Deepwater Horizon oil spill is a recent example of using this tactic on an oil well blowout, where the over 400 in-situ burns were conducted over the duration of the 87 days of oil discharge.

In RRT-6, the use of a burning agent for ISB operations has been preauthorized within the offshore environment. The terms and conditions of this preauthorization may be found in Annex 13 (RRT-6 In-Situ Burn Policy for the Offshore Environment – May 2020). The use of burning agents is not preauthorized within 3 miles of the shoreline and would need to be evaluated on an incident-specific basis.

Table 4. Oil Removal Strategy.

Oil Removal Strategy	Advantages	Disadvantages
In-Situ Burning (ISB) of Oil	• Rapidly removes large amounts of oil on the water surface • Reduces the need for temporary storage offshore • Very little residue remains after burning the oil	• Ignition is usually achieved with a chemical gelling agent which requires authorization of use under Subpart J of the NCP and may delay deployment of ISB resources • Creates a smoke plume that requires air monitoring • Dependent upon oil properties and ambient metocean conditions, the timeframe for effective use may be short • Burn residue may sink

8.1 Surface Collection Agents (aka Herders)

Surface Collecting Agents (SCA), or herding agents, are an oil collection and containment tool available to the FOSC. These chemical countermeasures are applied around the periphery of an on-water oil spill, limiting the oil's ability to spread and therefore decrease in thickness.

The 2012 report, *"Research on Using Oil Herding Agents for Rapid Response in Situ Burning of Oil Slicks on Open Water"*[1], identified some of the potential benefits of herders in conjunction with ISB:

- Potential elimination of the need for fire boom and boom tending vessels, as the herder provides containment of the oil.
- A more rapid in-situ burn response due to the reduced logistical footprint.

If the FOSC wishes to utilize this countermeasure, they must first seek RRT concurrence as their use has not been preauthorized. In addition, the FOSC will need to ensure that the agent is included on the National Product Schedule.

[1] BSEE, S.L. Ross Environmental Research, Research on Using Oil Herding Agents for Rapid Response in Situ Burning of Oil Slicks on Open Water, 2012

9 Vessel and Aircraft Tracking Capabilities

Another strategy that the Unified Command should strongly consider for implementation for a large offshore oil spill is employing tracking technologies for vessels, aircraft and any other deployed resources in the incident area. This is important for both safety management and situational awareness of response operations during the spill. Technologies may include the use of radar-based air traffic control systems and Automatic Identification System (AIS) trackers placed on vessels. These tracking systems are important for monitoring and coordinating operations, tracking the deployment of resources, ensuring adequate separation of different response activities, and deconfliction of air space over the incident to prevent mishaps.

10 Monitoring Operations

For an offshore response, environmental monitoring (air, water, soil/sediment, and wildlife) may be carried out to assess the initial situation, inform safety and operational plans, provide feedback on the effective use of alternative response countermeasures (such as dispersants and ISB), track and characterize the fate and effects of the spilled oil, and protect wildlife. At the outset of a large offshore response, the UC should develop a program to address monitoring/sampling needs, including quality assurance and control. The overlap or separation of response and NRDA samples should be considered in the overall design of the monitoring program for the spill. EPA general references include "Selecting a Sampling Design" and "Guidance on Choosing a Sampling Design for Environmental Data Collection for Use in Developing a Quality Assurance Project Plan"

10.1 Monitoring during an Initial Site Safety Assessment

During any oil spill, air quality is important to monitor for worker health and safety. Protocols for OSROs, upon notification of a large offshore oil spill incident, is to deploy a vessel to conduct a site assessment that will conduct air monitoring for explosive vapor mixtures, hydrogen sulfide (H_2S), and volatile organic compounds (VOCs) to ensure they are all within safe levels. If these readings are above safe levels, no responders will enter the area until the Safety Officer for the incident defines the levels of personnel protective equipment and mitigation measures that are required for the incident. Once this safety assessment is complete, and entry is approved, oil recovery operations can begin; in general, oil spill removal operations on the surface are limited to environments where Level D personnel protective equipment is all that is required. Air monitoring will be consistently conducted throughout recovery operations to ensure that the values for any airborne hazards do not exceed acceptable levels; necessary adjustments will occur if values do exceed prescribed acceptable levels.

10.2 Monitoring during Surface-based Dispersant Operations

When dispersants are preauthorized for use offshore, monitoring will be conducted in accordance with the SMART Protocols, and as appropriate, the requirements in Subpart J of the NCP; 40 CFR 300.913. SMART establishes a monitoring system for rapid collection of real-time information to assist the FOSC in assessing the efficacy, health, and safety of dispersant (or in-situ burning) operations. The FOSC, in consultation with the NOAA Scientific Support Coordinator, may develop revised monitoring protocols to address incident specific needs. The USCG National Strike Teams have special capabilities and trained personnel to perform SMART monitoring. FOSCs are highly encouraged to request USCG National Strike Force (NSF) assistance when applied response technologies are being considered as a response tactic.

Any use of dispersants (whether preauthorized under RRT-6 Offshore Dispersant Pre-Authorization Plan Annex 11, or through the incident-specific RRT-6 Expedited Near Shore Dispersant Approval Process Guidelines Annex 12 of the Region 6 RCP) will require SMART monitoring to evaluate the effectiveness of the dispersant applications on the spilled oil. This is typically done with visual observations by a trained observer to confirm the oil is dispersing from a spotter plane. Annex 7 of the Region 6 RCP includes the SMART Protocol.

For large offshore oil spills (greater than 100,000 gallons in a 24 hour period), or where surface-based dispersant application operations are carried out over a period greater than 96 hours, water monitoring will also need to be conducted for tracking the dispersed oil and characterizing the potential for biological exposure/impacts. The responsible party is responsible for these water monitoring requirements, contained primarily in Subpart J of the NCP, 40 CFR 300.913. These dispersant monitoring requirements are meant to support operational decision-making, and should be implemented as soon as possible. Additional guidance for these monitoring operations can also be found in the NRT guidance document "Environmental Monitoring for Atypical Dispersant Operations: Including Guidance for Subsea Application and Prolonged Surface Application". It should be noted that the requirements in Subpart J, effective 22 Jan 2022, take precedence over the NRT guidance document, which was published in 2013, in any instance where the contents of these documents may be dissimilar. It should also be noted that the monitoring operations conducted under the SMART Protocol and those required under Subpart J are meant to be complementary in nature for the use of dispersants. While monitoring under the SMART Protocol may be carried out by the NSF, the responsible party for the spilled oil is responsible for implementing the monitoring requirements contained in Subpart J.

10.3 Monitoring during Subsea Dispersant Injection (SSDI) Operations

Any use of SSDI requires water monitoring in accordance with Subpart J of the NCP, 40 CFR 300.913. This monitoring is conducted to assess whether SSDI is being effective, track subsea plumes of oil, and address concerns about the possibility of toxic effects on marine organisms. It will be necessary to conduct water monitoring and water-sampling surveys with subsequent chemical analysis to ensure that the impacts from dispersed oil do not exceed the assumptions that were made during the Spill Mitigation Impact Analysis (SIMA) which would have supported the authorization of use decision for SSDI. The objectives of water column monitoring are to:

- Assess the efficacy of the dispersant injection operations and refine the dispersant to oil application rate
- Characterize the nature and extent of subsea dispersed oil and aid in the validation or accuracy of incident-specific plume trajectory modeling
- Assess particle size distribution and chemical concentration
- Provide an assessment of potential ecological toxicity
- Provide information to Unified Command to make informed decisions.

Water column monitoring equipment is available through industry associations and is addressed in API Technical Report 1152, Industry Recommended Subsea Dispersant Monitoring Plan and in the NRT's Environmental Monitoring for Atypical Dispersant Operations: Including Guidance for Subsea Application and Prolonged Surface Application.

10.4 Monitoring during In-Situ Burning Operations

When ISB is approved for use offshore, potential air quality risks to responders, oil rig workers, wildlife, and the general public from burning large quantities of oil must be monitored. Air monitoring efforts should follow the guidance in the SMART Protocols. Visual and air quality data must be collected at identified locations specified in the ISB plan. Monitoring teams may be staffed by USCG NSF and/or other qualified personnel. For the Gulf of Mexico, Annex 13 of the Region 6 RCP specifies air monitoring requirements for ISB in the offshore environment.

10.5 Monitoring for Environmental Impacts

During an offshore response, waters in an affected area will be monitored for various purposes, e.g., determining the extent of oil contamination, characterizing potential biological effects and addressing seafood safety concerns.

10.6 Wildlife Monitoring

Responders must work to mitigate the potential effects of spilled oil and response actions on wildlife, especially any species that are protected by law. Wildlife can be impacted by mechanical cleanup, dispersants/dispersed oil, or by ISB. Monitoring needs to be carried out to ensure these response countermeasures do not adversely impact marine mammals, sea turtles, birds, or other wildlife.

10.6.1 Wildlife Monitoring During Surface-based Dispersant Operations

When dispersant application is proposed in an area that is adjacent to or near waters less than 30 feet in depth, due consideration shall be given to the trajectory of the dispersed oil. If resources in adjacent shallow areas are at risk, consultation with the trustees must be conducted. Prior to commencing dispersant application operations, an on-site survey should be conducted, in consultation with natural resource specialists, to determine if any threatened or endangered species or designated critical habitat are present in the projected application areas or otherwise at risk from dispersant operations. Dispersants should not be applied near areas known to contain rafting birds. Survey flights in the area of application should be conducted during dispersant operations. Dispersant operations should not be conducted within 2 nautical miles of marine mammals and sea turtles identified through aerial spotting per BMPs. If the detection of species is not possible during certain weather conditions (e.g., fog, rain, wind), the biological monitor/natural resource trustees will assess conditions and will coordinate with the Unified Command to determine what operational adjustments may be feasible.

10.6.2 Wildlife Monitoring during In-Situ Burn (ISB) Operations

A trained observer (if available) should be dedicated to looking for sea turtles and marine mammals during ISB operations. Each sighting event, including GPS location, species (if known), and description of encounter should be recorded on a Marine Species Observation Form. An example form from the Florida Fish and Wildlife Conservation Commission can be found at "Observer Experience and Education Documentation (myfwc.com)". The observer or crew member should be looking for marine mammals and sea turtles that may be affected by the burn or are impacted by oil. ISB operations should avoid burning unoiled or lightly oiled sargassum where juvenile sea turtles are known to hide from predators. A survey for marine mammals/sea turtles must be conducted by a designated observer on the ignition vessel. The observer on the ignition vessel will monitor the following areas prior to the burn:

- The area in front of the collection vessels;
- The oil concentrated in the boom; and
- Any oil trailing behind the boom.

If marine mammals/sea turtles are sighted in the in-situ burn safety zone, measures must be taken to prevent harm such as implementing sea turtle retrieval protocols, relocating the burn area, or standing down until the animals exit the area.

11 Best Management Practices

Best Management Practices (BMPs) are protective actions and procedures carried out in conjunction with oil spill removal activities to ensure any harm to nearby wildlife is minimized to the maximum extent practicable. Some BMPs can be pre-identified and incorporated into ACPs, while others must be developed and/or tailored to the specific circumstances of an incident.

Regardless, the Unified Command must engage with federal, state, and local natural resource trustees to review, adopt, or develop the BMPs that will be used during a large offshore oil spill incident. The BMPs listed below are general in nature and can be used as a starting point for engagement with resource trustees during an incident. These BMPs are grouped according to their applicability to different response strategies. The Gulf of Mexico Technical Document #5, "Sensitive Species Profiles", groups the same set of BMPs based on the natural resource type.

11.1 General BMPs

11.1.1 Floating Aquatic Vegetation: Avoid vessel traffic in areas of dense sargassum. If vessel operations are necessary, follow open paths between dense patches. Secure all materials on vessels to prevent inadvertent loss overboard.

11.1.2 Marine Mammals: All vessels must watch for and avoid collisions with marine mammals and report all distressed or dead marine mammals to the Wildlife Hotline (If no hotline is yet operating, call 877-942-5343 (877WHALEHELP). NOAA's Vessel Strike Avoidance Measures and Reporting for Mariners should be implemented to reduce the risk associated with vessel strikes or disturbance of protected species to discountable levels. If marine mammals are sighted oiled or swimming in oil, call 877-WHALEHELP.

11.1.3 Sea Turtles: All vessels must be equipped with the necessary equipment (dip nets, holding containers, towels, etc.) to capture and hold sea turtles aboard the vessel. Resuscitate any live, unresponsive sea turtles according to the official sea turtle resuscitation guidelines: https://media.fisheries.noaa.gov/dam-migration/sea_turtle_handling_and_resuscitation_measures.pdf Safely release uninjured and unoiled sea turtles over the stern of the boat, when gear is not in use, the engine is in neutral, and in areas where they are unlikely to be recaptured or injured by vessels. Retrieve injured/dead/oiled sea turtles using the Sea Turtle At-Sea Retrieval Protocol. Report stranded or injured sea turtles in the Gulf of Mexico to the NOAA Fisheries Southeast Sea Turtle Stranding and Salvage Network Hotline - (844) SEA-TRTL (844-732-8785).

Juvenile sea turtles associate with floating sargassum, so avoid skimming sargassum that is not oiled or is only very lightly oiled. To avoid entangling sea turtles, a trained observer or crew member is required for all skimming operations.

11.1.4 Fish and Invertebrates: Maintain control of all materials to prevent inadvertent release and sinking.

11.4.5 Coral and Hard bottom Areas: Anchoring methods should avoid coral reef and hard bottom areas. Secure all materials on vessels to prevent inadvertent loss overboard.

11.2 Mechanical Recovery BMPs

A trained observer or crew member is required for all skimming and booming operations, with responsibility for avoiding sargassum, birds, marine mammals, and sea turtles; avoiding tangling marine mammals and sea turtles; and reporting distressed or dead birds, marine mammals, and sea turtles. Dead marine mammals should be reported to 877-942-5343 (877-WHALEHELP).

Maintain control of all materials to prevent inadvertent release and sinking.

11.3 Booming BMPs

A trained observer or crew member is required for all skimming and booming operations, with responsibility for avoiding birds and reporting distressed or dead birds.

All deployed boom must include: (1) gaps between boom or sufficient space under boom to allow sea turtles to go around or under them, (2) boom should be monitored daily for sea turtle presence. If a sea turtle is observed trapped or entangled in a boom(s), open the boom carefully until the animal leaves on its own.

Make efforts to reduce slack in boom lines and, if possible, use stiff, non-tangling material. If a marine mammal is observed trapped or entangled in a boom, open the boom carefully until the animal leaves on its own, and call to report at 877-942-5343 (877-WHALEHELP).

Maintain control of all materials to prevent inadvertent release and sinking.

11.4 In-Situ Burning BMPs

If incident-specific RRT approval allows burning over coral or other hard bottom habitats, recover any floating burn residue as quickly and efficiently as possible.

Avoid burning near bird concentration areas and minimize bird exposure from wind drift of smoke.

Marine species observers on the ignition vessel will monitor three areas prior to the burn (the area in front of the trawlers, oil concentrated in the boom, and any oil trailing behind the boom) to spot any marine species and retrieve any sea turtles prior to the burn. A survey should be conducted in the burn area after the burn is complete and all dead sea turtles and marine mammals should be counted and, if possible, collected. Dead marine mammals should be reported to 877-942-5343 (877-WHALEHELP).

Avoid burning unoiled/lightly oiled sargassum.

11.5 Aerial Dispersant BMPs

No dispersant application over seagrass beds.

No dispersant application directly on dense areas of sargassum.

Avoid dispersant applications near bird concentration areas and minimize bird exposure from wind drift of applied dispersant.

No surface dispersant application within 2 nautical miles of sighted sea turtles or marine mammals.

11.6 Subsea Dispersant BMPs

Spill-specific BMPs to be followed. Ideally, subsea dispersant injection should be avoided where there are identified deep-sea coral colonies >20 km downstream of the injection site, based on studies after the Deepwater Horizon oil spill that showed extensive colony damage at distances of 11 km and lesser impacts at 22 km from the wellhead (Fisher et al. 2014).