Offshore Information for Area Contingency Planning

Pacific

Offshore Response Strategies and Best Management Practices (BMPs)

Technical Document #4

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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 Sector Los Angeles-Long Beach (LA-LB), resource trustees, state agencies, oil spill response organizations (OSROs), and Area Committees resulted in a series of technical documents that provide offshore information for southern California on:

- Offshore Oil and Gas Infrastructure (Pacific Technical Document #1)
- Offshore Worst-Case Discharge Scenarios (Pacific Technical Document #2 and Appendices 2A-B)
- Offshore Response Concept of Operations (Pacific Technical Document #3)
- **Offshore Response Strategies and Best Management Practices (Pacific Technical Document #4)**
- Sensitive Species Profiles and Best Management Practices (Pacific Technical Document #5).
- Offshore Environmental Sensitivity Indices (ESI) Atlas (Pacific Technical Document #6)

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 Pacific 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 were discharged into the water. The potential deployment of dispersant aircraft with quick arrival times and high oil encounter rates, should be guided by and strictly follow Authorization of Use agreements in the Region IX Regional Contingency Plan (RCP) (outlined in the RRT IX Dispersant Use Plan for California), an assessment of operational conditions and the properties of the discharged oil, and a comparative analysis of environmental trade-offs. 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 offshore discharges in order to understand the spatial and temporal windows of opportunity that exist and to 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 Pacific Technical Document #3).

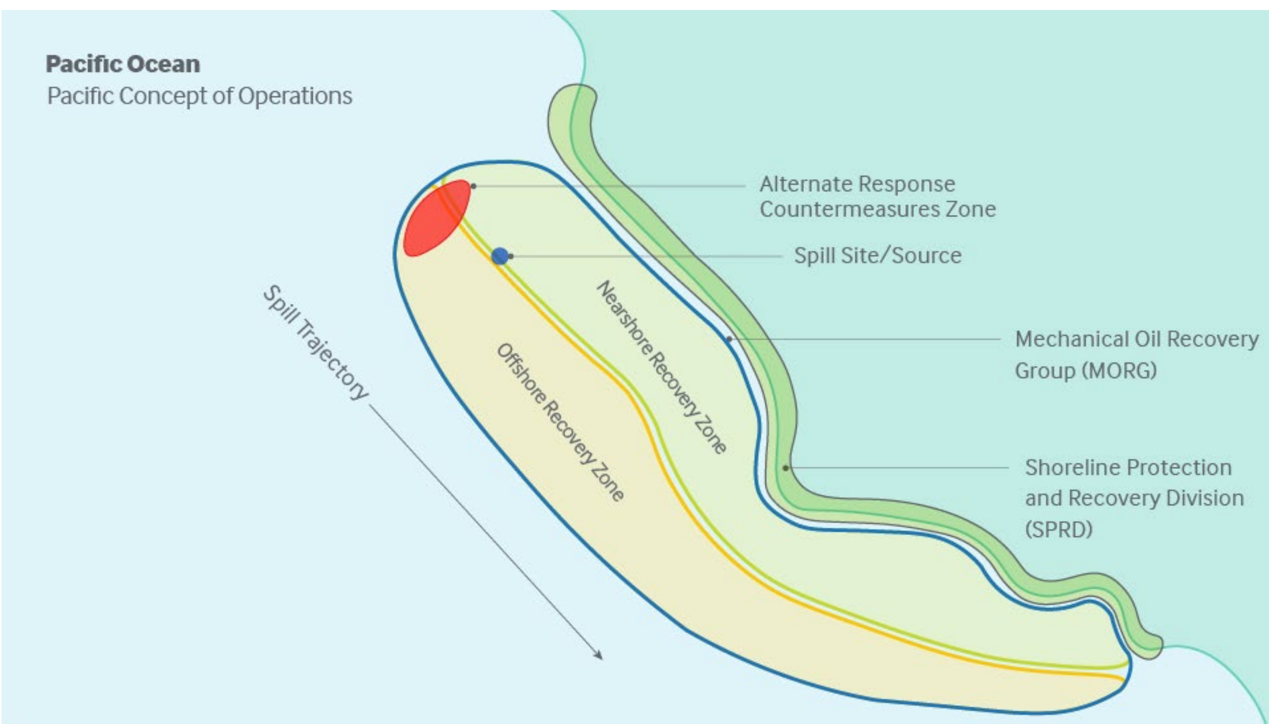


Figure 1. CONOPS Geographical Breakdown.

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 tactically positioning 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 several recent incidents (i.e. Huntington Beach Oil Spill Incident 2020, Hurricane Ida in the Gulf of Mexico 2021, MPOG pipeline incident 2023). Some of the newest satellite imagery technologies include the implementation of processing algorithms that allow the interpretation of oil thicknesses (Figure 2).

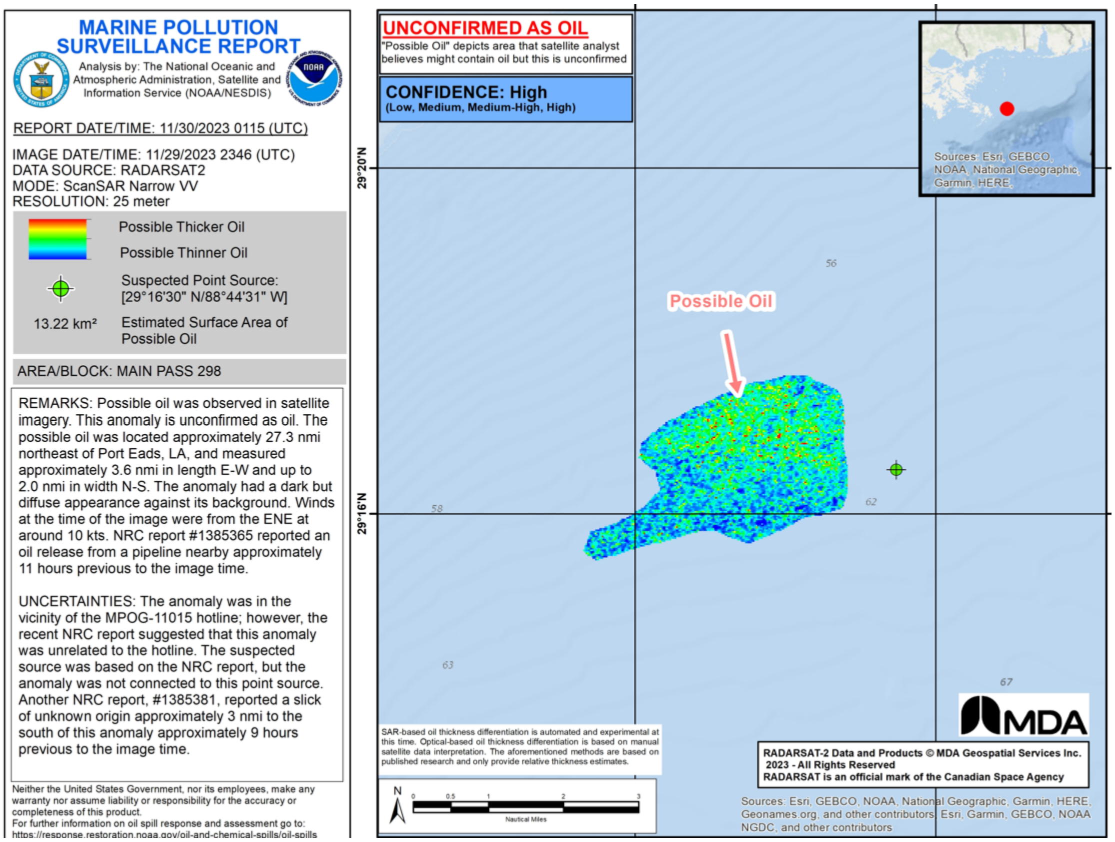


Figure 2. Marine Pollution Surveillance Report issued by NOAA NESDIS during the MPOG incident in 2023. These satellite image reports include the interpretation of oil thickness which is crucial information for oil spill response operations.

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 devices or platforms 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 3 shows the commonly used sensors for oil spill detection along with their characteristic platform and altitudes.

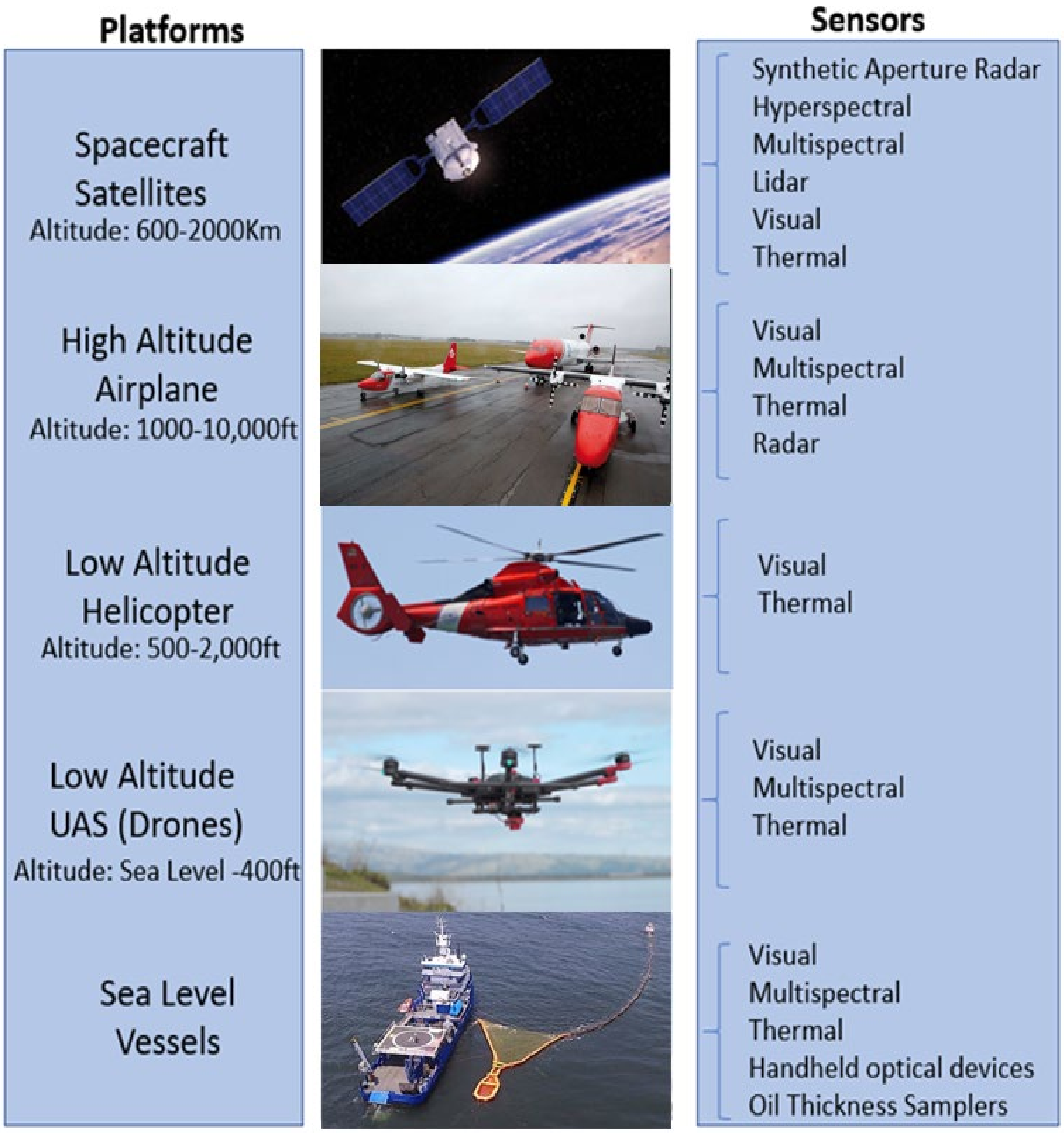
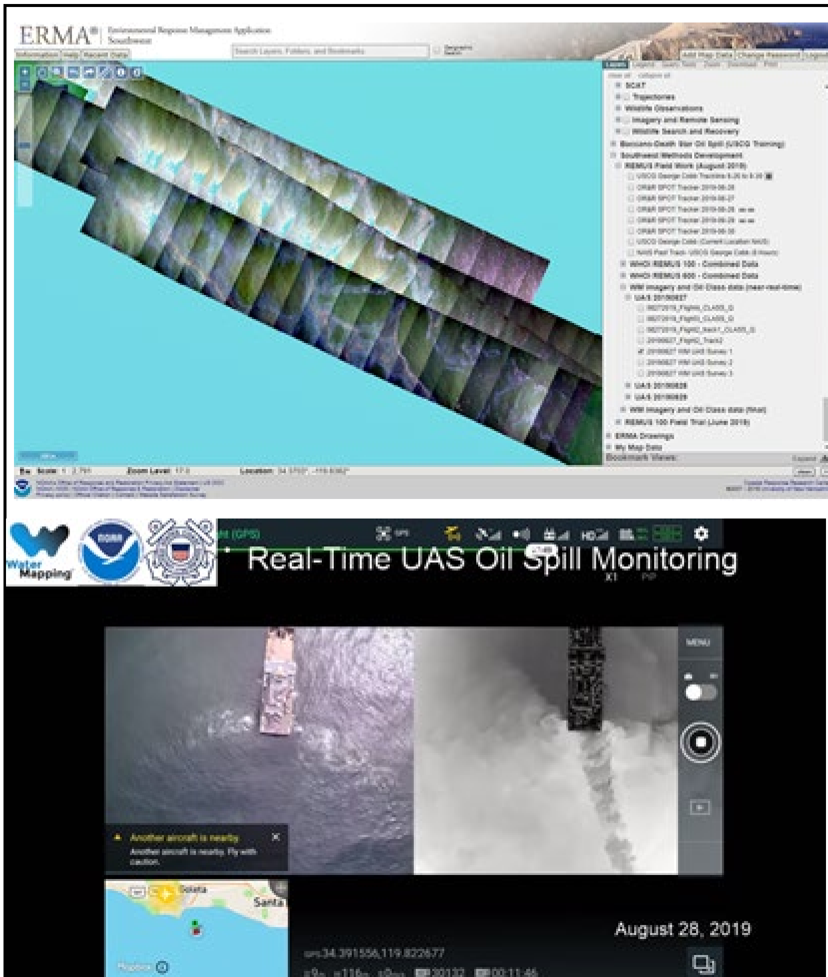


Figure 3. Representative platforms and sensors used for oil spill remote sensing monitoring. Platforms are classified by altitude and coverage.

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 Unmanned Aircraft Systems (UAS) flights that overlapped. These maps were made available on the online system in near real time.

Bottom: Live streaming video of the UAS. The bottom center figure 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 4. Example of ERMA's use in oil spill monitoring.

3.2 Emerging remote sensing technologies

The advancement of remote sensing technologies for detection and mapping of oil spills can be seen at every level. For example, the new U.S.-Indian made NISAR [National Aeronautics and Space Administration (NASA) and Indian Space Research Organization (ISRO)] satellite will utilize cross-polarization 'L' and 'S' microwave frequencies. The recent use of 'L' bands SAR sensors mounted on NASA aircrafts [i.e., Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR)] revealed the capacity of this frequency to discern oil slicks of various emulsifications and thicknesses levels. To date, there was not an opportunity to experiment with an 'S' microwave satellite to investigate how this frequency band could be used to study floating oil. The launch of NISAR imagery is planned for 2024 which will provide responders with new capability to assess slick thickness.

One of the most recent advancements on aerial surveillance of oil can be seen on imaging and software developments that allow the real-time interpretation of maps showing the extent of oil slicks. At a low-altitude aircraft level, the incorporation of UAS accelerated remote sensing studies of oil spills. Just recently, USCG acquired hundreds of drones to be used from USCG cutters everywhere in the United States. The USCG and NOAA joined efforts to develop UAS training programs and Standard Operating Procedures (SOP) for capturing and reporting data from USCG drones. This training program evaluated new UAS technologies and established SOPs (Figure 5) for the USCG pilots while using thermal and visual sensors to image oil spills. UAS-USCG instructors and pilots follow these SOPs to facilitate entering oil spill data in near real time to ERMA.

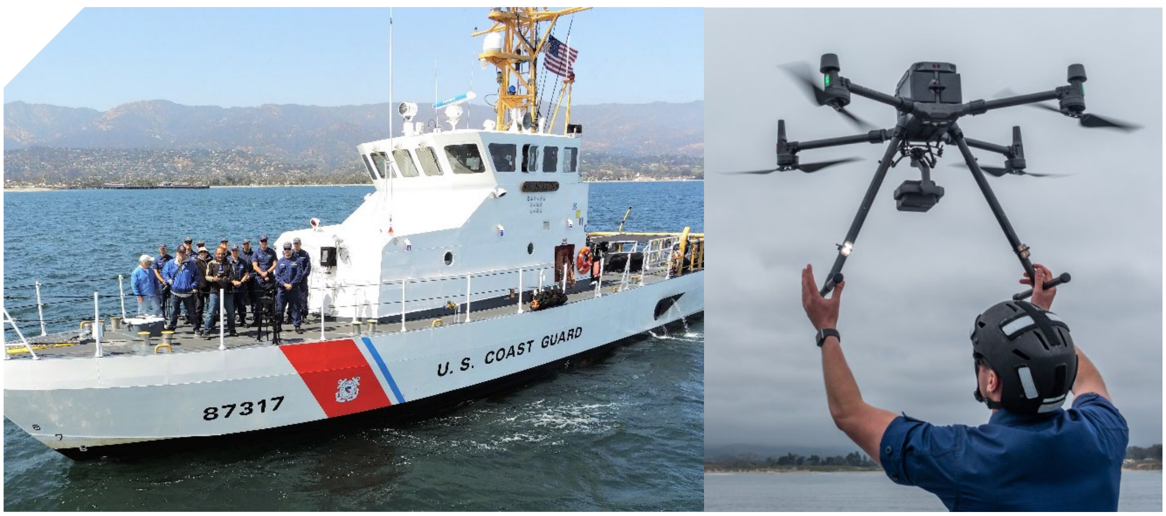


Figure 5. Left, USCG Blackfin from the coast of Santa Barbara California during a UAS research mission. Right UAS deployment from a USCG moving vessel as part of the USCG-NOAA training programs for SOP for oil spill response.

For sea surface and underwater technologies, Remotely Operated Vehicles (ROV) rigged with detection and sampling capabilities to monitor floating and submerged oil were recently incorporated. These vehicles are rigged with fluorometers that detect and report real-time detection of dissolved hydrocarbons in the water and can collect samples of water for chemical analysis.

4 Source Control Actions

One of the first priorities for any response to an oil spill is to secure the source of the discharge. Although, in many regions, large discharges of oil from offshore facilities can require a complex response effort, all offshore production wells in the Pacific region are assisted lift wells. Because all wells are assisted lift, the primary source control measures consist of simply shutting off the pump. The majority of the oil discharged from assisted lift wells would be spilled during the first day. Small intermittent discharges could occur until the well is secured but would represent a very small fraction of the total volume. Other offshore facility sources include pipelines and storage tanks, which would also likely reach hydrostatic equilibrium and stop discharging within a day or two.

Permanently securing the well blowout may require drilling 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 with the second relief well drilled as a contingency. If a relief well needs to be drilled to kill the well, the rig may not arrive on scene for six months or more because equipment will need to be mobilized from the Gulf of Mexico region as there are no drilling rigs operating on the continental U.S. West Coast. Once mobilized, relief well drilling will begin and continue until the original well is intercepted and plugged.

With reference to the CONOPS, these source control operations will occur at the spill site. For a BSEE-regulated facility incident, source control would likely be addressed in the response organization with a Source Control Support Coordinator Technical Specialist to advise the UC. However, the UC could also implement a Source Control Group under the Operations Section or a Source Control Section within the General Staff. This decision will be incident-dependant and made by the UC.

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 (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 consider utilizing multiple response strategies to mitigate an offshore worst-case discharge (WCD) scenario in the Pacific . The 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 is 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 9 was developed by Mr. Al Allen of Spilltec to capture the effectiveness of response countermeasures under different wind speeds and wave heights.

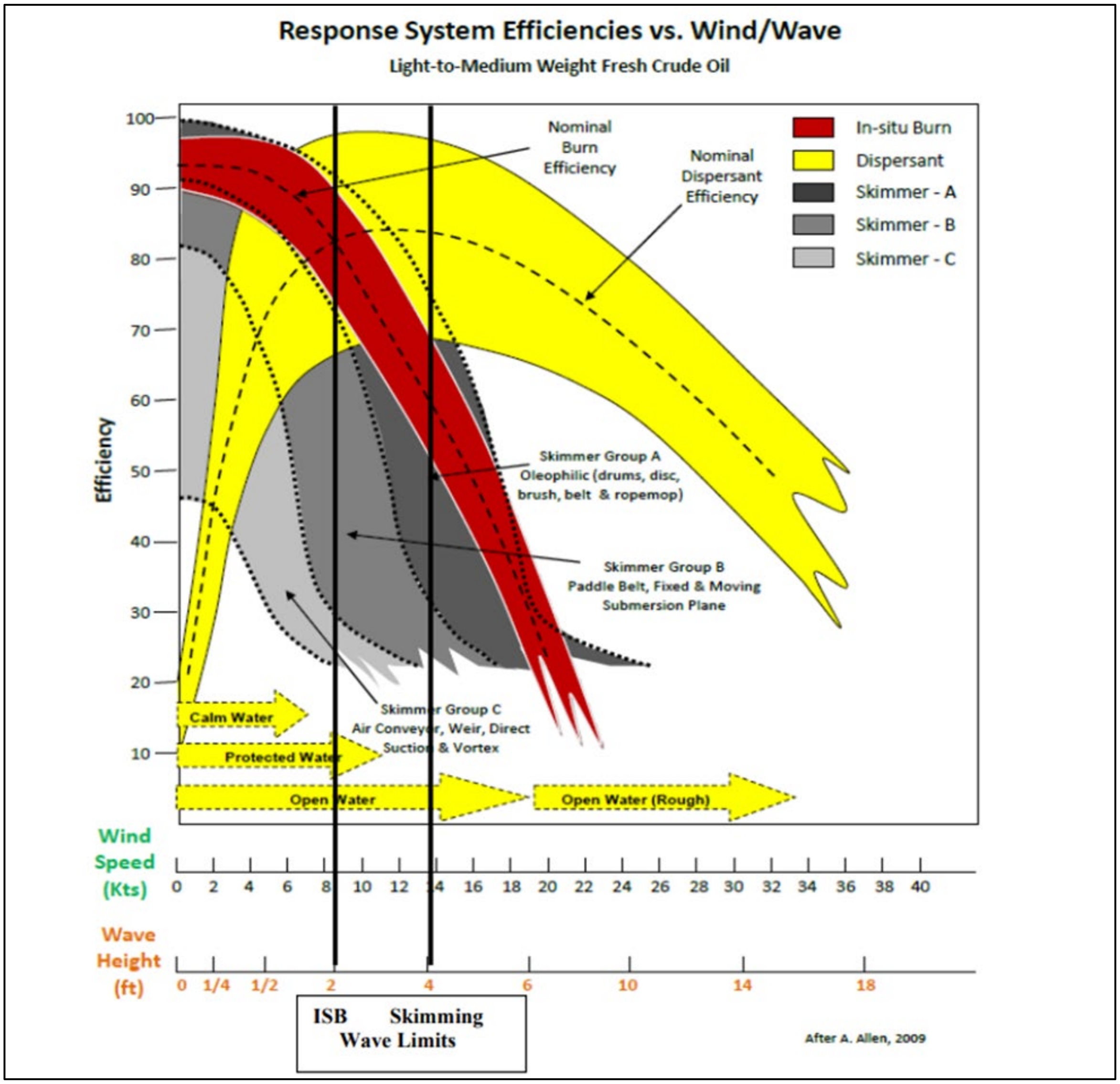


Figure 6. Response System Efficiencies of Response Countermeasures under Different Wind Speeds and Wave Heights. Source Al Allen, Spilltec.

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. Mechanical Recovery – Oil Removal Strategy.

Oil Removal Strategy	Advantages	Disadvantages
Mechanical Oil Recovery	• Physically removes the oil from the environment • Can be deployed immediately and does not require Authorization of Use procedures	• Low oil encounter rates may result from slow speeds of advance or narrow swath widths • The low API oils in the Pacific quickly emulsify and become difficult to recover, even with advanced techniques • 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 Pacific (see Pacific Technical Document #3) is organized into a basic geographical construct to illustrate the changing properties of the oil throughout the response (Figure 1).

The Mechanical Oil Recovery Group (MORG) is located just around the spill site. In this area, 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 MORG. 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), Fast Recovery Vessels (FRVs), and Oil Spill Response Barges (OSRBs) will provide significant operational value to this group. This group will be able to work within the response in any areas where the freshest, thickest oil is located.

By closely monitoring the fate of the weathered oil using surveillance, the Operations Section will also set the boundaries for the Nearshore Recovery Zone and Offshore Recovery Zone. In these divisions, 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 these divisions. Containment systems with rapid speeds of advance (2 to 5 kts), including 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 both Recovery Zones.

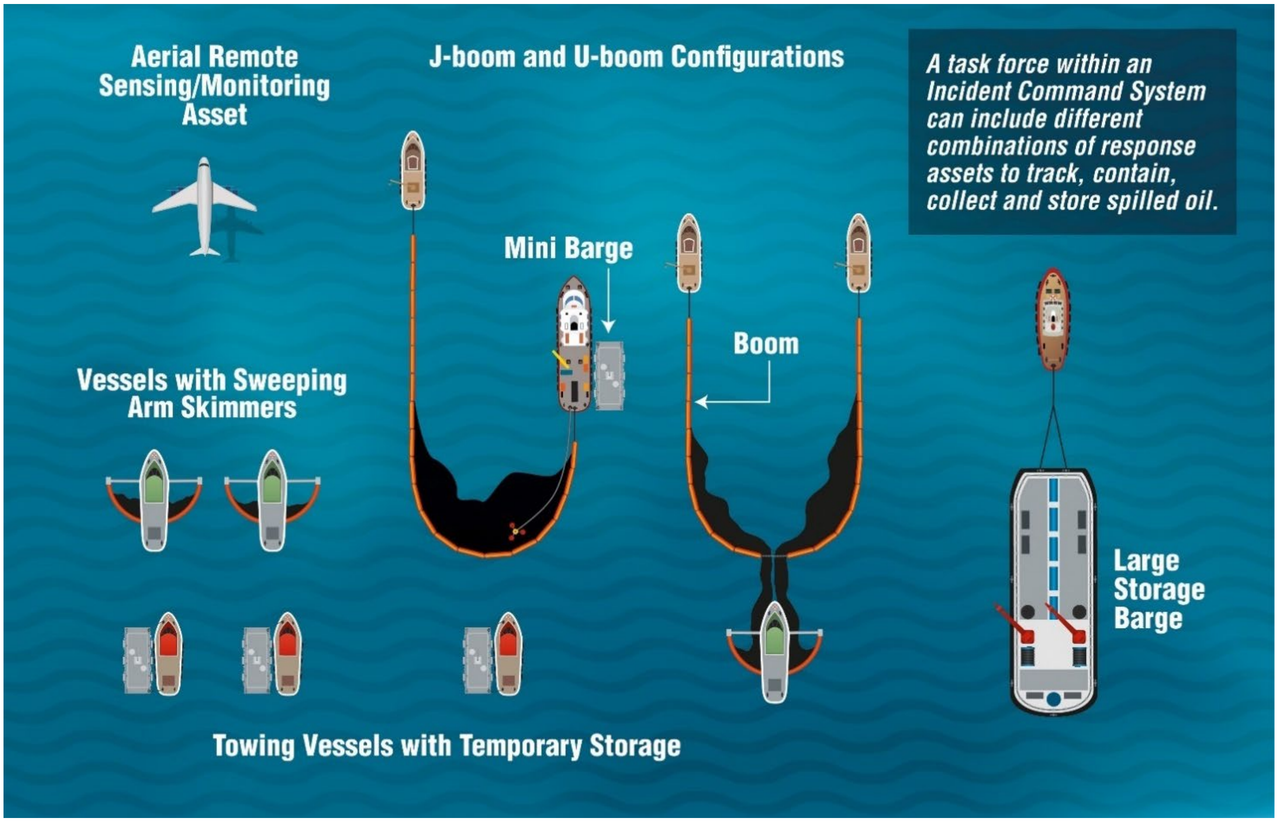


Figure 7. Mechanical recovery task force components.

In the Nearshore Recovery Division, responders will need to closely evaluate the water depths 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.

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 away from the spill site, and oil characteristics change. With the low API oils of this region, it will be particularly important to use high efficiency, oleophilic skimmers for mechanical recovery. 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 8 and 9 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 Recovery Divisions.

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.

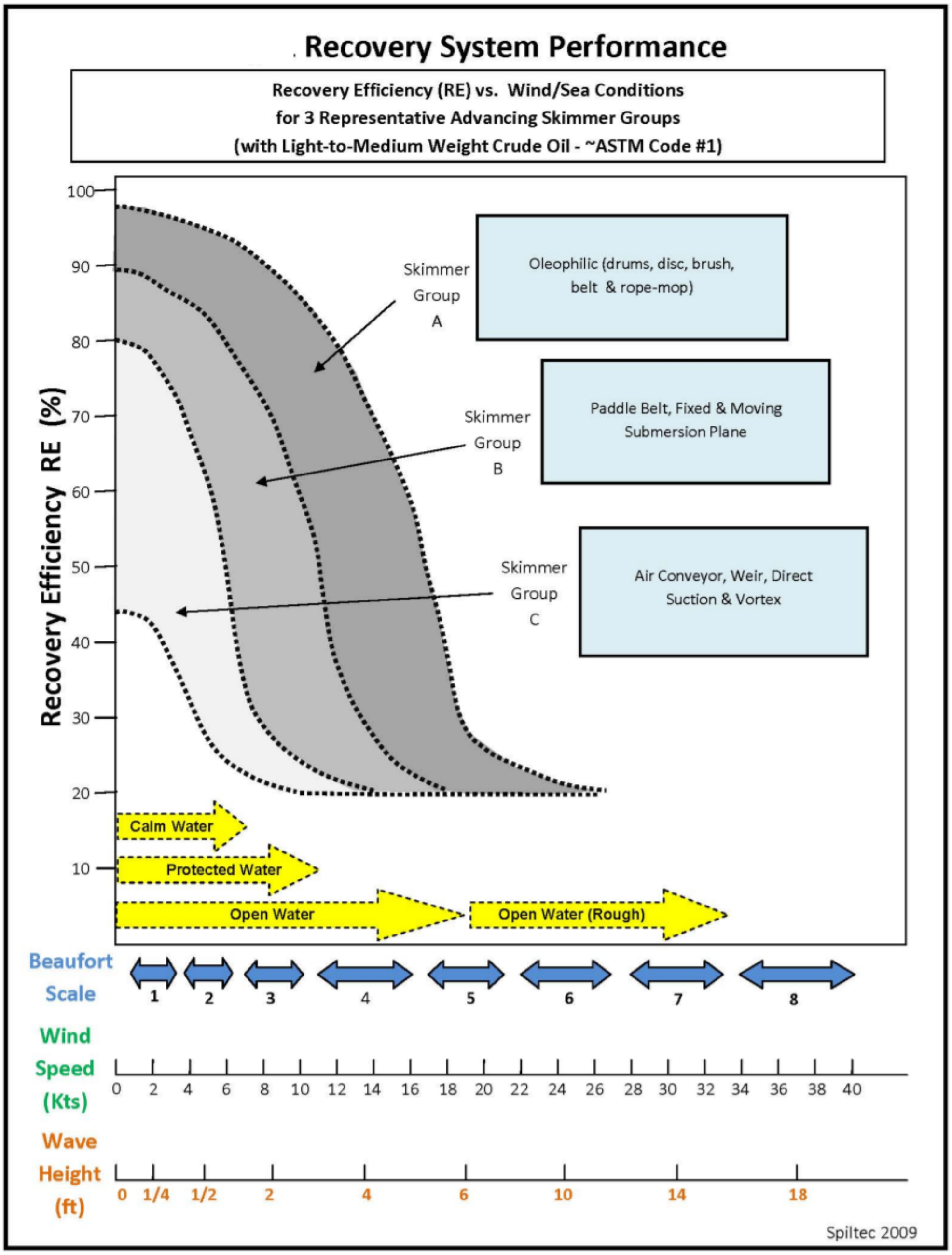


Figure 8. Recovery Efficiencies of Different Skimmer Types based on Wind Speed and Wave Height. Source Al Allen, Spiltec.

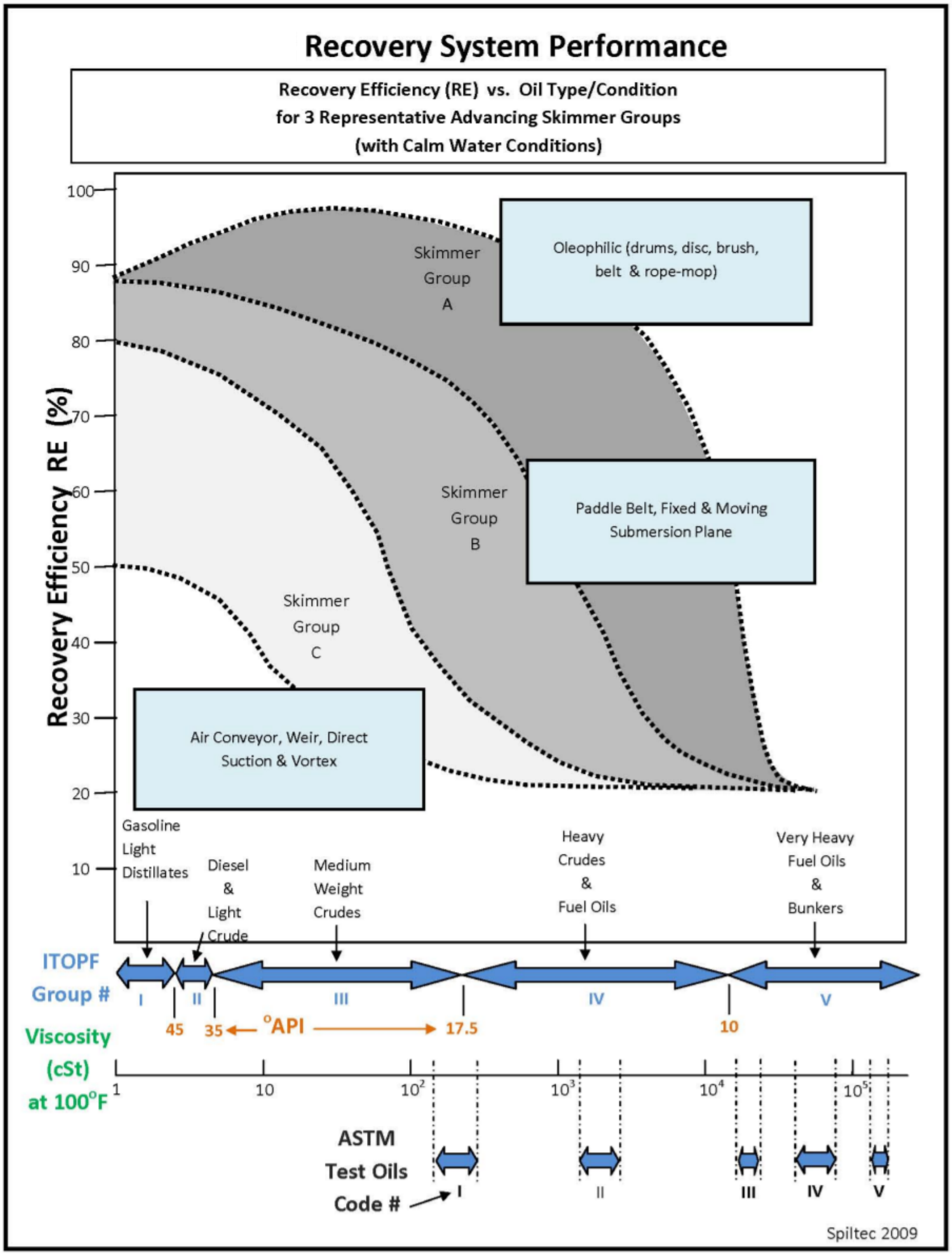


Figure 9. Recovery Efficiencies of Different Skimmer Types based on Oil Type and Viscosity. Source Al Allen, Spiltec.

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 10). 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.

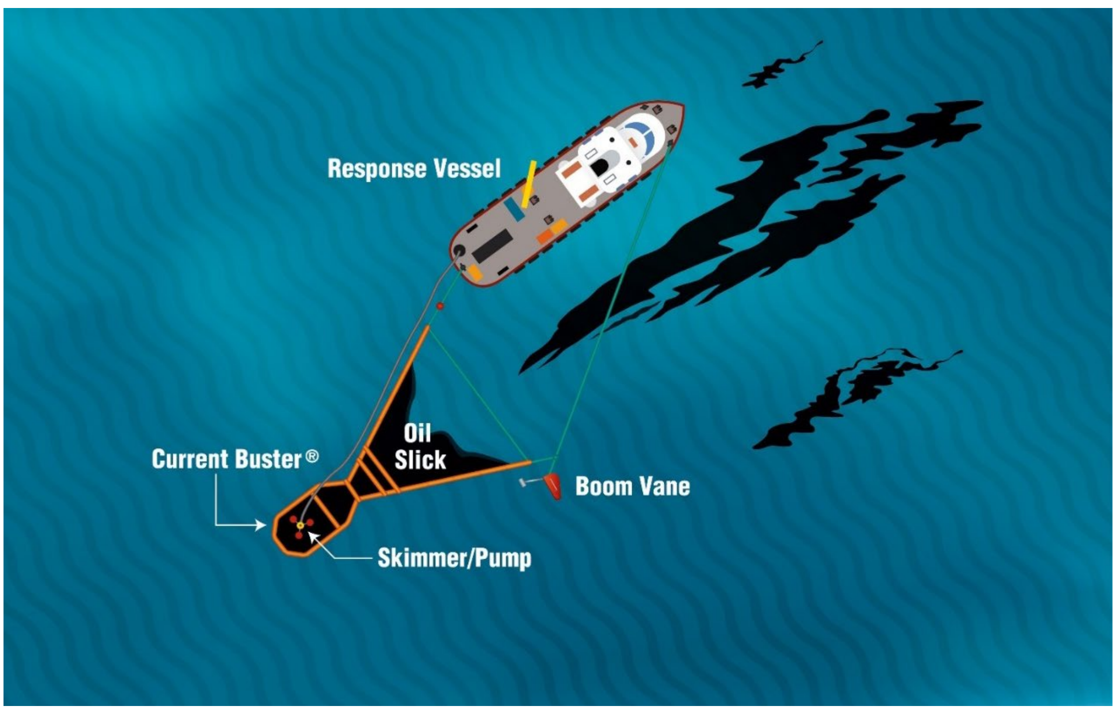


Figure 10. Current Buster Collection/Containment System.

Another type of high-speed recovery system available outside of the Pacific Region 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 11. 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 11). This method increases the encounter rate but requires close coordination of multiple vessels and competent response crews.

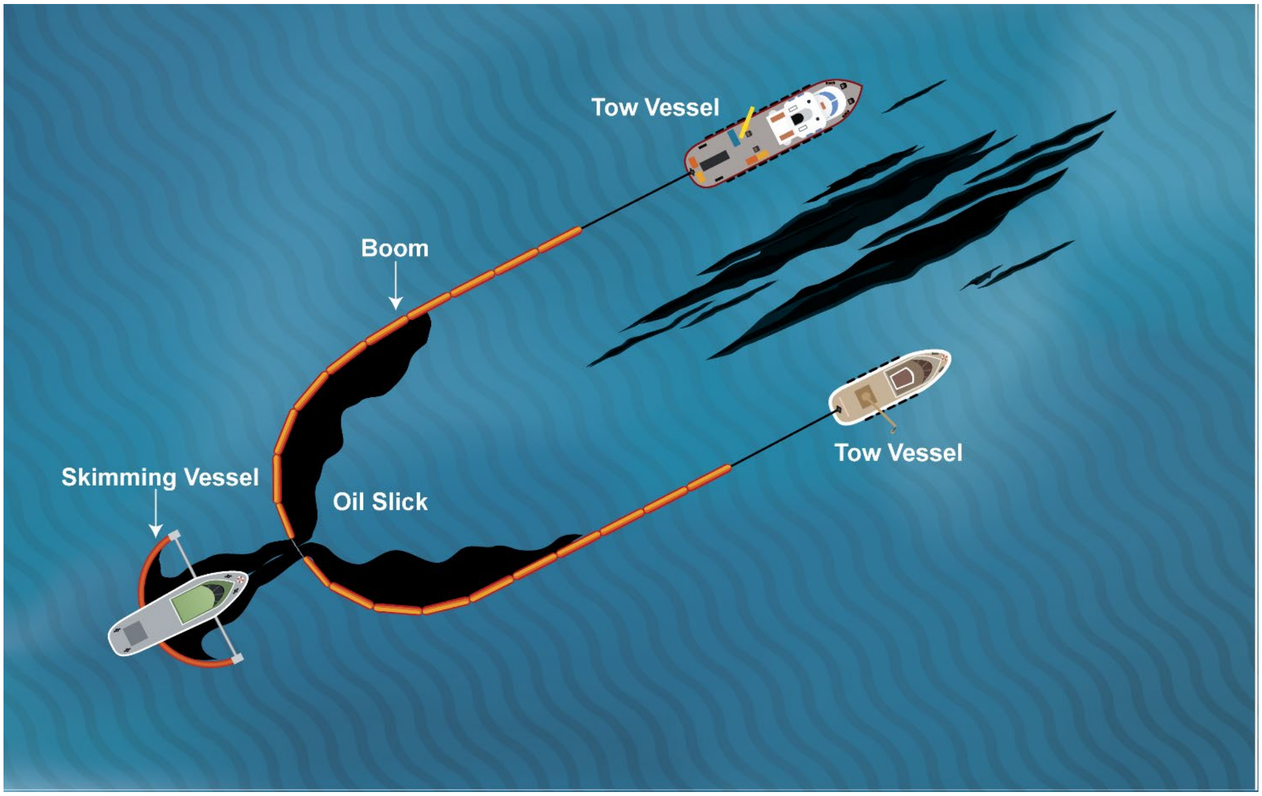


Figure 12. Enhanced Containment Configuration with an open apex U-boom.

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 recycling or disposal facility.

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.

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. 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.

In the Pacific, there are several assets available for temporary storage. Three platforms would be capable of response in 6 hours. These assets include a 12,000-bbls barge from Long Beach, a 15,000-bbls barge from Port Hueneme, and a 32,000-bbls barge from Richmond. FRVs with onboard storage would also be available, including four 65-feet FRVs with 215 bbls storage (one from Long Beach, one from Richmond, and two from the Santa Barbara Channel). In addition, there are seven sets of shallow water barges with a total of 400-bbl storage. The US Navy Supervisor of Salvage (SUPSALV) in Port Hueneme can also provide secondary storage assets.

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 or vessels. All of these application platforms use spray systems designed to deliver dispersants at specific dosages and droplet sizes. The use of all chemical countermeasures, including dispersants, are regulated under the National Oil and Hazardous Substances Pollution Contingency Plan (NCP, Subpart J of 40 CFR 300) and require approval under authorization of use protocols (preauthorization plans or incident-specific approval processes) outlined in the RRT IX Dispersant Use Plan for California. 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. In California, only dispersants listed on the NCP Product Schedule, licensed by the State of California, and approved through US Fish and Wildlife Service (USFWS) Endangered Species Act (ESA) Section 7 consultation can be used. As of the publication of this document, only Corexit EC9527A, Corexit EC9500A, Nokomis 3-AA, and Nokomis 3-FA may be used.

The use of dispersants is preauthorized for use by the FOSC in waters greater than 3 NM from the nearest (mainland or island) shoreline, in waters outside a National Marine Sanctuary, and in waters greater than 3 NM from the California/Mexico border and running as a 3 NM band to a distance 200 NM offshore. Dispersants may not be used on Type 1 oils, on sheens, over areas of unoiled open water, on non-petroleum oils, natural seep oil or tarballs, on shorelines, or after dark, during low visibility, or at any time when applying dispersants would be unsafe for workers.

Table 3. Dispersant Application – 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	• 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.)

7.1 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. In the Pacific, vessel-mounted dispersants are immediately available on the FRVs and would likely be the most viable option for quick application following the approval process.

7.2 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 provide distinct advantages with regard to safety, response times, operating range, and the size of dispersant payloads. In the Pacific, aerial dispersants wil take approximately 7 hours to get on scene.

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).

7.3 Dispersant Management Plan (DMP)

Early in the response, a Dispersant Management Plan (DMP) should be developed forecasting aerial and vessel 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.

The RRT IX On-Water ISB Plan for California oversees the authorizations and terms of use of ISB in California waters. Pre-authorization is given by the RRT to the FOSC to use in-situ burning in a timely manner to: (1) prevent or substantially reduce a hazard to human life; (2) minimize the adverse environmental impact of the spilled oil, and (3) reduce or eliminate, the economic or aesthetic losses of recreational areas. This pre-authorization applies in waters from 35 to 200 NM offshore.

Table 4. In Situ Burning – 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

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 an 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 routinely conducted throughout recovery operations to ensure that the values for any airborne hazards do not exceed 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 Strike Teams have special capabilities and trained personnel to perform SMART monitoring. FOSCs are highly encouraged to request NSF assistance when applied response technologies are being considered as a response tactic.

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 National Strike Force, the responsible party for the spilled oil is responsible for implementing the monitoring requirements contained in Subpart J.

10.3 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 National Strike Force (NSF) and/or other qualified personnel. For the Pacific, the RRT IX On-Water ISB Plan for California specifies air monitoring requirements for ISB in the offshore environment.

10.4 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.

10.5 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.

10.5.1 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. 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 UC to determine what operational adjustments may be feasible.

10.5.2 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. 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. 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 Los Angeles/Long Beach California 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 Birds: Adhere to incident-specific flight restrictions over bird concentration areas and avoid hovering or landing aircraft in these areas. Observations of entangled wildlife during a spill response and all distressed or dead birds should be immediately reported to the Oiled Wildlife Care Network: 844-823-6926.

11.1.2 Marine Mammals: Watch for and avoid collisions with marine mammals If marine mammals are sighted oiled or swimming in oil, call 844-823-6926. Response vessel operators shall avoid close approach (<300-500 feet; <100-150 m) to marine mammals in the water. Vessel speeds shall be <10 knots when marine mammals sighted within 1,000 feet (300 m). 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. When operating marine vessels during spill response in sea otter habitat, all operators should abide by the Boat Operation Guidance to Avoid Disturbing Sea Otters.

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://www.greateratlantic.fisheries.noaa.gov/protected/stranding/disentanglements/turtle/seaturtlehandlingresuscitationv1.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.

11.1.4 Fish and Invertebrates: Maintain control of all materials 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 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 animals should be reported to the Oiled Wildlife Care Network: 844-823-6926.

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, marine mammals and sea turtles and reporting distressed or dead animals. If sea otter pupping areas are identified, booms will need to be placed far enough away to minimize disturbance and prevent driving sea otters into oiled areas.

If birds become trapped or entangled in boom, anchor lines, or other response equipment, notify wildlife agency representatives for instructions.

Make efforts to reduce slack in boom lines and if possible, use stiff, non-tangling material. If a marine mammal or sea turtle is observed trapped or entangled in a boom, open the boom carefully until the animal leaves on its own, and call 844-823-6926 to report.

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

11.4 In-Situ Burning BMPs

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

Watch for and avoid marine mammals while operating vessels or aircraft involved directly or in support of in-situ burn operations. A marine species observer on the ignition vessel will monitor 3 areas prior to the burn (the area in front of the tow boats, oil concentrated in the boom, and any oil trailing behind the boom). A survey should be conducted in the burn area after the burn is complete and any distressed or dead marine mammals should be counted and reported to 844-823-6926.

Recover any floating burn residue as quickly and efficiently as possible.

11.5 Aerial Dispersant BMPs

Dispersant applications will maintain a minimum of 500 meters (1,640 ft) horizontal separation from swarming fish, marine mammals, or sea turtles in the water, and/or marine mammal haul-outs. Dispersant applications will maintain a minimum of 300 m (1,000 ft) horizontal separation from rafting birds. A qualified Dispersant Controller will be in a separate aircraft, to direct operations so that fish and wildlife are avoided. Any monitoring required by USFWS and/or National Marine Fisheries Service for Endangered Species Act Section 7 compliance will be conducted.