REVIEW OF DISPERSANT USE IN U.S. GULF OF MEXICO WATERS SINCE THE OIL POLLUTION ACT OF 1990

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ABSTRACT

Since the Oil Pollution Act of 1990 (OPA 90), dispersants have been used as part of a combined response to mitigate seven oil spills in United States Gulf of Mexico (GOM) waters. Of the dispersant operations reported, four utilized the Regional Response Team VI pre-approval authority to the Federal On-Scene Coordinator (FOSC) that requires a monitoring plan. The successful integration of dispersant pre-authorization along with a fully funded ready response delivery system maintained by industry contributed to the successful use of dispersants to aid in mitigating spilled oil. A key element to gaining the original pre-approval authority was a functional operational monitoring plan. While each response was considered a successful dispersant operation, each incident provided valuable lessons learned that have been integrated into subsequent contingency planning and modifications to existing pre-authorization requirements in the GOM. This paper provides a chronological review of oil spill responses where dispersants were applied in the GOM since OPA 90.

INTRODUCTION

The passage of the Oil Pollution Act in 1990 (commonly referenced as OPA 90) and revisions to the National Contingency Plan (NCP) following the T/V *Exxon Valdez* Oil Spill changed how oil spills are managed within the United States and placed a burden on Regional Response Teams (RRTs) and local Area Contingency Planning (ACP) organizations to address *in-situ* burning, chemical dispersants, and other chemical/biological applied technologies that might enhance oil spill response and mitigation efforts in addition to, or in conjunction with traditional recovery techniques. More than any other event, the passage of OPA 90 changed how industry, as well as state, and federal agencies prepare for and respond to oil spills. The passage of OPA 90 provided a natural starting point to review recent dispersant use in the GOM.

Dispersants are chemical formulations specifically developed to enhance the process of breaking the cohesive nature of oil slicks and allowing a greater percentage of spilled oil to be transported into the water column. The advantage of using dispersants over traditional mechanical recovery is that dispersant application by aircraft can mitigate a larger surface slick in a shorter amount time. The advantage of mechanical recovery is that skimming systems actually remove the spilled oil from the water while dispersants alter the transport and fate of spilled oil. Dispersants simply move oil from one environmental compartment into another—from a cohesive slick on the surface of the ocean into the water column and below the surface as tiny droplets of oil combined with dispersant. The use of dispersants must be justified. By that, the threat (or actual injury) posed by chemically dispersed oil to the water column environment must be less than the threat or injury of the spilled oil on the surface or the threat of stranded oil to coastlines and coastal resources. The use of dispersants requires a trade-off environmental analysis relative to conventional response methods. Dispersants must provide a defined environmental benefit to be used.

Since the passage of OPA 90, dispersants have been applied at eight different oil spills within U.S. Waters. With the exception of a small dispersant application off Hawaii in 2001, all of the dispersant applications have been in the GOM and all were located off Texas and Louisiana. All were within RRT VI's zone of responsibility. In 1995, RRT VI concluded an investigation of possible environmental benefits of dispersant use by granting the FOSC pre-approval authority to use dispersants in offshore waters under a very specific set of guidelines. These guidelines included a distance greater than 3 miles from shore, a water depth of greater than 10 meters, and the use of a monitoring plan to assess efficacy (Calhoun et al, 1997). The monitoring plan developed to meet this guidance was the predecessor to the Scientific Monitoring of Advanced Response Technologies Program, or simply the SMART Program and known as the Special Response Operational Monitoring Plan, or simply as SROMP (Barnea and Laferrier, 1999). In the GOM, the USCG Gulf Strike Team is the pre-identified monitoring team for the FOSC.

Pre-authorization was an essential element for an industry commitment to the continued funding and maintenance of a ready response or "fire house" system capable of applying dispersants. The primary resources for this system in the GOM are located in Houma, Louisiana and consist of several aging (but effective) DC-3 and DC-4 aircraft. In the nine years since pre-approval authorization within RRT VI, dispersants have been used during seven oil spill events in the GOM. No dispersants were applied during the five years between the passage of OPA 90 and pre-approval authorization. It would appear that pre-approval authorization and the availability of readily available dispersant resources in the GOM region have influenced the use of dispersants by providing an option that can be activated quickly when warranted. Rapid response is critical to dispersant success. When oil is spilled, it immediately begins to spread creating a large spill area. At the same time, spilled oil undergoes a series of physical and chemical changes that enhance oil persistence and reduce the effectiveness of dispersants. During a spill event is no time to have a detailed environmental trade-off discussion or to go looking for a dispersant aircraft.

The overall consensus at the end of each incident where dispersants were employed was that the dispersant application was, at least to some extent, successful, and that dispersants did provide an environmental benefit relative to the less desirable consequence of stranded oil on the coastlines and impacts to near-shore bird communities. But, what have we really learned about dispersants and dispersant trade-offs during these events and how have these events changed dispersant use policies in the GOM? Have we learned anything new from the use of dispersants in the GOM that would justify our continued support of this alternative response technology, or are we just more comfortable with our original justifications and assumptions? This paper provides a chronological review of the use of dispersants in the GOM since the passage of OPA90 and reports many of the lessons learned in context of improving a best response in the GOM and elsewhere.

CHRONOLOGY OF DISPERSANT USE SINCE OPA 90

Since OPA 90, dispersants have been applied eight times in U.S. waters as part of a managed pollution response. Only spills where dispersants were applied in the GOM are included in the following chronology.

West Cameron 198 Pipeline Spill

On 15 December 1995, a production platform located approximately 35 miles south of Cameron, Louisiana spilled a reported 740 bbls of gas condensate and crude oil. On-water skimming vessels were dispatched to recover the spilled oil as a primary response option, but by the following morning, a slick of approximately 25 square miles was observed. Since the pre-approval window defined in the existing guideline had past, RRT VI was convened and authority to approve dispersant application was granted to the FOSC. Late on the afternoon of 16 December, a DC-4 aircraft conducted a single sortie and applied a total of 500 gallons of Corexit 9527 making a total of seven passes over the slick. SROMP on-water monitoring was not conducted due to the time limitation of transporting the team with their equipment on-scene from Mobile, Alabama. Aerial monitoring was conducted using a commercial helicopter and a USCG Falcon jet to meet the demands of the RRT. The observers reported that the dispersant application was successful. Of the 740 bbls spilled, on-water skimming accounted for 22 bbls being recovered. Evaporation accounted for the greatest net loss of spilled oil, and dispersants were believed to have been applied to between 100 to 200 bbls of weathered condensate crude oil. An estimated effectiveness rate based on a percentage was not reported. Observers only reported that the application was effective. The operation at West Cameron 198 demonstrated that a helicopter platform could serve as both an effective spotter and monitoring platform for a fixed-wing dispersant aircraft (Calhoun et al., 1997).

High Island Pipeline System (HIPS) Oil Spill

On the evening of 22 January 1998, operators of the High Island Pipeline system detected a drop in pipeline pressure due to what might have been a pipeline failure. After prompt notification of a possible spill, a USCG Falcon aircraft using Side Looking Aperture Radar (SLAR) located a slick approximately 100 kilometers southeast of Galveston, Texas. At the request of Responsible Party's On-Scene Commander, dispersant use was approved by the FOSC on 23 January under the existing pre-approval authority and dispersant operations were conducted the same day. An unknown amount of oil (estimated at 2000 barrels) was treated with 3000 gallons of Corexit 9527 during two aircraft sorties. A DC-4 and DC-3 aircraft were used to apply dispersants. A SROMP monitoring team was deployed and both aerial observation and on-water *in-situ* fluorometer monitoring were successfully implemented. Overall effectiveness as a percent was not estimated (or was undocumented), but the consensus was that the overall operation was highly effective. The HIPS response represents the first multiple aircraft mission since OPA 90 and the first field application of SROMP.

T/V Red Seagull

Overlapping with the HIPS pipeline incident in an adjacent area was the report of a leaking supertanker. The tanker vessel *Red Seagull* was preparing to lighter Arabian Light crude oil within the Galveston Lightering Area when a small leak was detected. Initially, the *Red Seagull* believed they had simply picked up oil from HIPS incident and the trailing sheen was from that incident. Subsequently, a leak was discovered while the vessel lay at anchorage in the lightering zone, and the leak was repaired (the reported cause was a missing hold plug). Dispersant operations at the *Red Seagull* were limited to mitigating small patches of oil released and trapped under the 990 foot vessel after repairs were completed and the vessel began to transit out of the area on 25 and 26 January 1998. An estimated 100 bbls of oil was thought to be trapped under the vessel, but only 20-30 barrels were treated with two barrels of Corexit 9500 dispersant applied by a support ship's fire monitor system. In many ways, the use of dispersants during the *Red Seagull* response was a demonstration project of the feasibility of using fire monitors for an emergency application of dispersants; an alternative application method that had been previously discussed but not attempted in U.S. waters. Observers reported that dispersants were effective in mitigating oil where applied, but that regulating the application rate was difficult with an unmodified fire monitor system. The significance of the *Red Seagull* response for future planning was in proof of application—a fire monitor could be modified and used as an emergency dispersant application system for small spills. Since then, RRT VI pre-approval authority has been modified to include fire monitors and at least one response group in the GOM has developed a dedicated fire monitoring system specifically designed to apply dispersants with precision flow rates.

Mississippi Canyon 109, Pipeline Spill

During a routine pipeline transfer operation at Mississippi Canyon 109A, a spill of unknown volume occurred during the night of 30 September 1998 as a result of a pipeline failure. The volume released was estimated at 3700 bbls (with the potential of 7000 bbls). The next day, the first daylight hours of the spill response, the initial oil slick was identified as having migrated toward Southwest Pass. As part of the on water spill response, dispersants were applied to minimize potential shoreline contamination and impacts to the coastal zone. Dispersant use was consistent with provisions outlined in the RRT VI pre-approval guidelines. Dispersant application utilized both DC-4 and DC-3 aerial delivery systems and two dispersants, Corexit 9527 and 9500. The RRT VI SROMP monitoring plan was implemented. Visual observers reported, "separation, clouding, discoloration of the oil, and the sea color became milky (Henry, 1999)." On the second full day of the response, two areas were identified as having sufficient oil to present a continued threat and were treated by two additional sorties. A total of 4900 gallons of Corexit 9527 and 9500 were applied during the response. While the dispersant application was successful, assessing overall effectiveness was difficult (an emerging common theme to dispersant effectiveness observations). No overall percent effectiveness value was estimated. On the third day of the response, 3 October, no large slicks or dispersible oil was identified. The Mississippi Canyon 109 incident represented the first multiple day dispersant use in the GOM since OPA 90.

Lessons learned from the response resulted in additional changes in the pre-approval authority with respect to reporting to the RRT. At the time of the response, the pre-approval authorization required that the RRT receive a verbal report within 3 hours of dispersant application and that any subsequent follow-up application would require RRT approval. It was clear during the Poseidon response that if dispersants were unsuccessful, then any request would be moot (the FOSC would never request to continue an unsuccessful option), and if dispersants were effective and dispersible oil remained a threat, the RRT would never remove the authority from the FOSC with consent of the Unified Command and the on-scene advisors.

M/V Blue Master

On 27 August 1999, the freight ship M/V *Blue Master* was proceeding outbound from Galveston, Texas. In the predawn hours, a fishing boat collided with the freighter causing a 12 inch hole on the starboard side of the vessel and compromising a deep fuel tank that began leaking oil. An estimated 100 bbls of fuel oil, IFO-180, was lost during a 30 minute period before the tank reached hydrostatic equilibrium with seawater. Overflights following the collision reported a continuous narrow slick extending approximately 5 miles and forming a fishhook configuration. At the request of the RP's spill management team, the FOSC in consultation with his advisors authorized the use of dispersants. A reported 700 gallons of Corexit 9500 dispersant was applied by a single DC-3 to the slick. Multiple application passes were conducted on the slick to enhance effectiveness since the oil type was known to be difficult to disperse. The target application ratio was a dispersant to oil ratio of 1:10 rather than the conventional 1:20. No on-water SMART monitoring was available due to the time limitation required to mobilize personnel on-scene from Mobile, Alabama. Observers noted some immediate dispersion, but because of fading daylight the full effects of the application could not be monitored.

An overflight the next morning reported a marked reduction in surface oil. At the time of the dispersant application, the seas were calm, i.e., very little energy to aid dispersion. Anticipated storm activity that factored into the decision process never materialized, and resulted in very slow oil dissipation. While impossible to quantify the effectives of the dispersant application using visual monitoring under the conditions reported, the monitors did reported that the oil had been altered by the dispersant application and that changes in slick appearance were clearly visible. After two days, no more surface oil was observed—the residual oil was thought to have broken into tarballs rather than remain as a cohesive surface slick. When the tarballs generated from the oil spill did make landfall on Galveston Beach, less than 2 bbls of emulsified oil streamers and tarballs were recovered, which represents less than 2% of the oil spilled. The stranded oil was matched to the *Blue Master* by analytical chemistry or oil fingerprinting. It was concluded that dispersants did enhanced spill mitigation by evidence of the lack of a major impact to a highly recreational beach just prior to Labor Day weekend. The FOSC concluded the application of dispersants a "cautious success" (Kaser et al., 2001).

The *Blue Master* response represents the first application of dispersants to an Intermediate Fuel Oil spill since OPA 90. The dispersant used, Corexit 9500, is marketed as having a greater effectiveness on weathered and low API gravity (or heavier) oils.

Poseidon Pipeline Oil Spill

The USCG received a report of an oil release on 21 January 2000 sourced from a 24" pipeline that normally transports approximately 500,000 bbls of crude oil from offshore to onshore facilities per day. The site of the pipeline failure and leak was located approximately 65 miles South of Houma, Louisiana. The spilled oil was within the pre-approval zone for dispersant use and met all of the requirements established by the RRT VI. Members of the USCG Gulf Strike Team were immediately notified and mobilized a SMART monitoring team. Despite quick actions by the RP, approximately 2000 barrels were discharged into the GOM. The cause of the incident was determined to be an 8.8 metric ton anchor that had accidentally dragged across and imbedded under the pipeline. The flukes of the anchor slid under the pipeline, dragging it approximately 670 feet from its original position. This shift caused the pipeline to leak from three separate discharge points; two of the discharge points were located on the riser and the third at the anchor impact point. Overflights provided by three different airborne platforms provided excellent, timely intelligence from which to develop a tactical response plan. Dispersants were identified as the best response option (Stoermer et al, 2001).

On 21 January 2000, 3000 gallons of the dispersant Corexit 9527 were applied (1000 gallons by DC-3 and 2000 gallons by DC-4) to the targeted slick. Observers (including trained SMART observers from the Gulf Strike Team) estimated a 75% effectiveness rate for the oil initially treated. During the evening, aerial searches by two commercial infrared (IR) flights and a USCG SLAR flight were conducted in an effort to maintain contact with the oil, verify trajectories, and provide tactical information for the morning's operations. The first morning overflight identified dispersible patches of oil remaining in the spill area. As an operational effectiveness test, a single DC-3 was dispatched to apply 1000 gallons of Corexit 9527 on the target slick. The aerial observers reported definite surface herding effects but were unable to visualize a dispersant plume; however, the on-water monitors reported a high level of dispersant effectiveness using flourometric measurements. Based on this report, the FOSC authorized additional applications. An additional 2000 gallons of dispersant was applied by the DC-4 platform. The last overflight on 22 January showed only widely scattered sheens and small patches of emulsified oil. The dispersant spotter and SMART observers jointly determined that the remaining oil was not dispersible. This dispersant response was characterized as highly successful and documented by both visual observation and fluorometric measurements. One estimate suggested that only five barrels of oil remained on the surface at the end of the operation; however, it was virtually impossible to accurately estimate the volume of oil truly remaining on the surface.

Main Pass 69, Pipeline Spill

When Hurricane Ivan passed over the Mississippi Delta on 15 September 2004, it cause sever impacts to the local oil production and transportation infrastructure. Two major pipelines were completely severed as a result of the storm, storage tanks were destroyed, and platforms damaged by the combination of storm surge and hurricane force winds. Once the sea state diminished, the damage assessment and response process began. Dispersants were only used in connection with one release source. At the crossing of a 18 inch and 20 inch pipeline within Main Pass Block 69, leaking oil was observed due to failures of both pipelines; both lines were damaged and leaking, but it took some time to fully assess the situation since the lines were buried below the mud line. Due to weather complications and the difficult nature of locating and repairing two damaged pipelines sitting atop each other, the source was not fully controlled until 5 October (20 days after the passing of the storm). During this time, a large volume of light crude oil was lost (estimated at over 7000 bbls), but the release rate was not consistent due to source control activities. Unfortunately, the release point was located just under three miles from two major wildlife refuges and adjacent to shallow water (less than 10 meters). The United States Fish and Wildlife Service stated that some 2000 birds on an exposed sandbar at the North Pass of Pass a Loutre were at immediate risk and there were thousands of other birds in the general area. While no final reports were available during the preparation of this manuscript, some details can be reported from the author's observations.

Dispersants were integrated into the overall response along with source control, on-water recovery, and shoreline protection and cleanup. Given that the spill location was outside the existing pre-authorization zone, specific RRT VI approval was required. At times, as many as four skimming vessels were engaged in on-water recovery efforts, and slicks created by the escaping oil were as short as a mile or as long as 24 miles at different times and under different weather conditions. Natural dispersion was high when the winds exceeded 20 knots. Dispersants were primarily used as a tactical response tool to target oil that escaped primary recovery operations and presented a direct risk to wildlife and estuarine habitat. A total 350 gallons of Corexit 9527 were applied by a specifically designed fire monitor system and 5000 gallons of Corexit 9500 were applied during five DC-3 sorties on two different days. Overall, dispersant effectiveness received mixed reports. Dispersants were highly effective when there was sufficient surface energy to provide mixing, but when the winds and sea state slackened, the effectiveness, or at least the rate of dispersion, was noticeably affected. The response at Main Pass 69 represented the first time dispersants were applied in nearshore waters since OPA 90. In addition, it was the first use of a fire monitor application system, at night, applied directly at the source.

CONCLUSION

So what have we learned in the GOM after seven spills were dispersants were used? Without prior debate on environmental trade-offs resulting in pre-authorization guidelines and without a ready response dispersant capability, the "window of opportunity" would have been missed (or at least effectiveness diminished) at many of these events. What monitoring was conducted did meet the operational objectives, but contributed little to the science of dispersed oil. Spills are unplanned and uncontrolled events. Proper science requires proper controls that are inconsistent with an uncontrolled event. Studying dispersant effectiveness, fate, and effects during an emergency spill response in the open ocean environment is nearly impossible within acceptable scientific guidelines. At least during post-spill shoreline studies, the shoreline doesn't continually mix and move, as does the open ocean. Since the debate on dispersants has shifted to the nearshore and inshore waters, I would conclude that we are simply comfortable with the trade-off assumptions originally used to formulate the offshore dispersant policy in the GOM.

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BIOGRAPHY

Charlie Henry is the NOAA Scientific Support Coordinator (SSC) for Texas, Louisiana, Mississippi, Alabama, and the Florida panhandle. Henry has a Master of Science degree in Marine Science from Louisiana State University, 19 years experience related to oil and chemical spill response, and was directly involved with all of the oil spill responses discussed in this report with the exception of the West Cameron 198 incident.

REFERENCES

Barnea, N. and R. Laferriere. 2001. SMART: Scientific Monitoring of Advanced Response Technologies. *Proceedings of the 2001 International Oil Spill Conference*, 4 pages.

Calhoun, J.W., S.P. Glenn, L.M. Henderson, W.T. Duncan, and C. Johnson. 1997. Development of a dispersant doctrine in the Gulf of Mexico. *Proceedings of the 1997 International Oil Spill Conference*, pp 637-641.

Henry, C. 1999. Dispersant application and monitoring results in support of the oil spill off Southwest Pass, Louisiana. Report to RRT VI, 12 June 1999, 12 pages.

Kaser, R.M., J. Gahn, and C. Henry. 2001. Blue Master: Use of Corexit 9500 to Disperse IFO Spill. *Proceedings of the 2001 International Oil Spill Conference*, pp 815-819.

Stoermer, S., G. Butler, and C. Henry. 2001. Application of dispersants to mitigate oil spills in the Gulf of Mexico: the Poseidon Pipeline Spill Case Study. *Proceedings of the 2001 International Oil Spill Conference*, pp 1227-1229.

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