INNOVATIVE TECHNIQUES FOR RECOVERY OF DIESEL-BASED DRILLING MUD– THE TRICO MARINE CASE STUDY

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ABSTRACT

On the evening of June 3, 2003 an operational error while circulating mud tanks on the off shore supply vessel Big Horn River resulted in the discharge of 214 barrels of 75 percent diesel-based drilling mud into Redfish Bay at Harbor Island, Texas. The bulk of the drilling mud sank to the bottom of the Aransas Channel with no surface indication as to the extent the product had spread along the channel bottom. Initial response to the release was hampered by severe weather while concern grew over the sensitivity of the surrounding area. Responders were faced with a complex challenge to develop an efficient recovery plan. Divers were utilized to delineate the extent of the underwater contamination and facilitated the cleanup with a unique vacuum truck-air lift system developed on scene.

INTRODUCTION

At 2143 hours on June 3, 2003 an operational error while circulating mud tanks on the supply vessel *Big Horn River* resulted in the discharge 214 barrels of 75 percent diesel based drilling mud off the banks of Harbor Island, Texas. The bulk of the drilling mud sank to the bottom of the Aransas Channel. There was no sheen or other surface water indication as to the extent that the product had spread along the bottom of the Aransas Channel. Initial response efforts were hampered by a severe lightning storm with high winds and rain. At the same time concerns grew over the sensitivity of the surrounding area, which is primary *Spartina* marsh. Responders faced a challenging scenario to develop an effective recovery operation. Divers were employed to delineate the extent of the underwater contamination and facilitate the recovery operations with a unique vacuum truck-air lift system that was developed on scene.

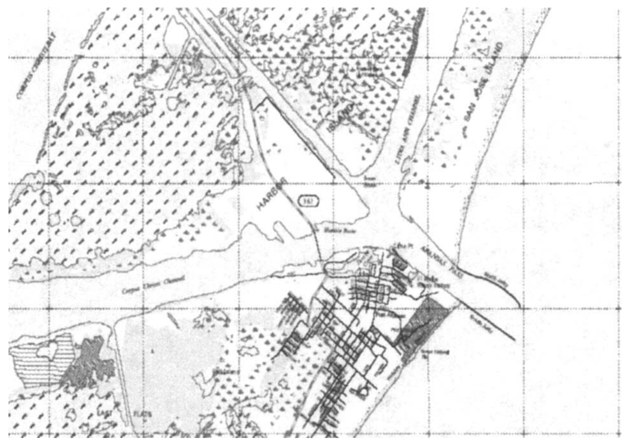
DRILLING MUD

To protect human health and the environmental in the search for petroleum oil reservoirs many safety features have been implemented. One of the more crucial safety elements in oil and gas exploration is the drilling mud. The use of drilling mud addresses four safety issues at once. First, the drilling mud is weighted to hold back the pressure of the reservoirs, thus preventing "blowouts". Second, it cakes or plasters the walls of the drilled hole in order to prevent the drill hole from collapsing, and to minimize leaching into and/or from other formations. Next the mud is developed to be dense enough to float the cuttings out of the drill hole, while still being viscous enough to flow back up to the surface. Finally, it cools and lubricates the drill bit and string during the drilling process. Drilling mud must accomplish all four of the goals in any given location and sediment condition. To do this drilling muds are for specific application. The drilling mud that was spilled was 75 percent diesel mud. The diesel in this case is the lubricant for the drill bit and string. (Ewing, 2004)

LOCATION

Harbor Island is located on the south Texas coast just north of Port Aransas in Redfish Bay. The Aransas Channel cuts the island in half. The bay margins on the northern and western sides of the island are predominantly *Spartina* marsh and sea grass beds with some scattered located oyster reefs. This area is used for recreational activities and is classified as an environmentally sensitive area with limited to no road access. Some of the recreational activities include duck hunting, boating, fishing, bird watching, camping, and kayaking. The eastern side has the historically significant Port Aransas Lighthouse first lit in 1857. All of the industry on the island area located on the southern and southeastern section, which include marina fabrication facilities, oil and gas supply vessel docks and other facilities that support the oil and gas industry. The spill location is near the convergence of the Aransas Channel, the Lydia Ann Channel, and the Corpus Christi Ship Channel. This area experiences some fast moving currents, due to its proximity to the Gulf of Mexico.

The sinking properties of diesel based drilling mud created different environmental concerns than experienced in typical oil spills. The environmental concern changed from acute toxicity or chronic exposure to the oil, to a smothering effect of the diesel laced mud on the bay's benthic communities.



RESPONSE ACTIVITIES

When responders arrived on scene they had to determine how much product was spilled, the extent of spreading, environmental impacts, and how to effectively recover the product. The initial report provided by the responsible party stated that 200 barrels of diesel based drilling mud entered the water. Due to the amount of product spilled, location and environmental concerns, the decision was made to recover as much of the product as possible. A salvage dive team was hired to delineate the extent of the spill. (Baccigalopi and Greytok, 2003)

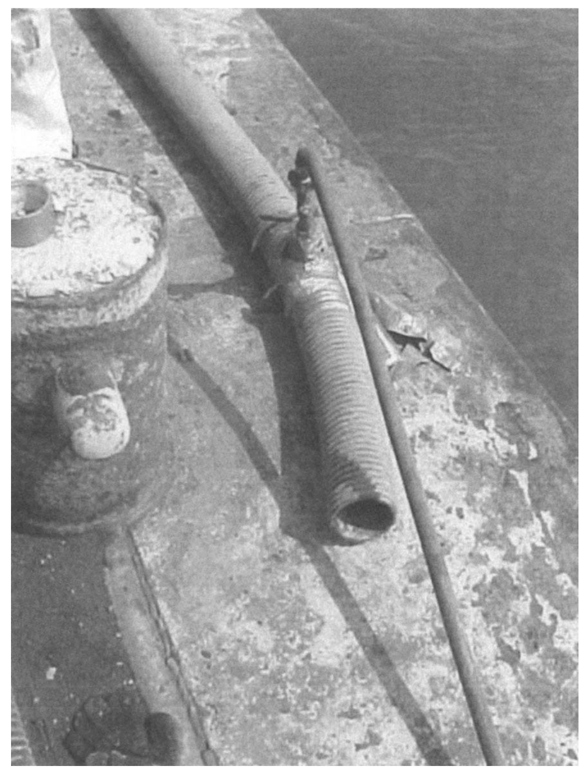
The divers first used staining of an oil absorbent pad to determine the location, extent of the spill, and to differentiate between the drilling mud and natural substrate. After the general location of the drilling mud was determined, a coffee can was used to estimate the thickness of the drilling mud layer. Initial samples indicated the drilling mud layer was an inch to an inch and a half thick. As the divers continued the sampling effort they indicated they could differentiate between the substrate and the drilling mud. The divers discovered the supply vessels had scoured out the shallow docking area leaving relatively firm substrate that contrasted with the gel-like consistency of the drilling mud.

Once the spill zone was delineated, the discussion turned to how to get the product up? Typical recovery methods for Class V oils were considered. This included using shrimp nets or trolling nets, but these were dismissed due to the viscosity of the product allowing it to easily move through the net mesh. The clam shell or hydraulic dredge were both ruled out due to cost, the amount of sediment that would be removed, disposal issues, and US Army Corps of Engineers dredge fill permits.

At 0400, the decision was made to use vacuum trucks (vac trucks) to clean up the spill. The initial recovery operations consisted of the divers applying the vac truck hose directly into locations identified to contain the drilling mud. This method had a low recovery rate versus time and physically demanding. The divers and the SOSC discussed alternative recovery methods and recommended creating an airlift system to help boost the efficiency of the vac truck. The airlift process was used to help over come the head pressure on the vacuum truck due to the height of the hose from the dock (approx. 8 feet), the dock above the water (approx. 5 feet), and the water depth (approx. 18 to 25 feet). (Baccigalopi and Greytok, 2004)

AIRLIFT

An airlift is typically wide PVC or aluminum pipe that acts as a vacuum to remove bottom sediments to allow divers to work in an area that extends below the natural substrate. Airlifts are usually constructed from an eight to twenty-four inch diameter pipe at least ten feet long. One end of the pipe has a hole drilled approximately one-foot from the end of the pipe with a valve and hose fitting inserted in the hole. The air hose from the surface compressor is connected to the hose fitting, and the valve allows the divers to control the airflow while at depth. The top end of the pipe is the discharge end, which connects with the vac truck. The air pressure within the hose creates the vacuum lifting mechanism to the water surface, and the vac truck lifts the product the rest of the way. The major disadvantages of airlifts are that they are very heavy and bulky. This typically limits the diver to a five to ten foot area to clean. The system must also be supported from the surface and direct communication with the surface crew is essential. Another disadvantage is the lift is indiscriminate in what it picks up. The diver must carefully control the suction rate. Finally, the suction pressure from the airlift may it, kick back due to a clog inside the hose or shoot a large object out the discharge endangering recovery personnel. To minimize these disadvantages a valve was added to the bottom of the airlift pipe for diver control, the length of hose was adjusted and tied off at depth to protect the diver.



CONCLUSION

The recovery operation was able to salvage 214 barrels of diesel based drilling mud from Redfish Bay. Unfortunately, when the last volume of drilling mud was loaded onto the *Big Horn River*, the vessel already had product onboard. The crew never gauged the tanks after the final loading. Generally accepted standards for loss due to evaporation, emulsification, and deposition on an oil spill could not be calculated. The 214 barrels of recovered product was deemed the amount of product spilled. (Burns *et al.*, 1997 and Stowe and McMillen, 2001)

What made this recovery operation a true success was the ingenuity of the responders to modify a system predominately utilized for salvage operations and nautical archaeology into a tool for oil spill response. The vac truck was only able to recover 5 barrels of product every hour and a half to two hours of operation without the airlift in place. With the airlift in place the vac truck was able to recover 20 to 30 barrels of product every 20 minutes. The divers also discovered larger pockets of the product trapped in deeper trenches along the dock area. During the response it was determined the incoming and outgoing currents pushed the product into these dockside trenches. By utilizing the airlift system within the trenches, the divers were able to recover a maximum of 45 barrels of product in a 20-minute period.

The airlift vacuum truck system worked exceptionally well for this product and location. However, review of case history has shown that the *Ocean 225* and *Morris J. Berman* spills were unsuccessful in use of an airlift vacuum truck system (Stowe and McMillen; Burns, Et al). Each of these spills dealt with the release of No. 6 fuel oil in a high energy near shore environment, promoting the mixing of sand and oil. The low viscosity of #6 fuel oil mixed with sand turned into very sticky and heavy tar mats and patties. Mechanical pumps and later dredges and clamshells had to be employed to recover this product. Just like skimming systems, it appears obvious the equipment deployed for recovery of class V oils needs to be product and environment specific.

BIOGRAPHY

Michael Baccigalopi has just over four years experience with the Texas General Land Office: Oil Spill Prevention and Response Division (GLO). He is a graduate of Texas A&M University at Galveston with a Bachelor Degree in Marine Science. Michael has also earned a Master Degree in Environmental Science from Texas A&M University-Corpus Christi. Over the past two Michael has been teaching oil spill management as an independent environmental consultant for the National Spill Control School (NSCS).

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