Is spill response more about luck and timing than preparedness?

Introduction

"Standing 210m high, the world's largest oil platform Petrobras 36 had been wracked by a gas explosion – killing 10 crewmen – and then slowly, it had begun to topple. In the immediate aftermath of the March 2001 accident, Brazil held its breath, anticipating further disaster. This collapse threatened to unleash a 1.5 million cubic litre oil spill on the lush coastline of Rio de Janeiro. In the event, the tower toppled slowly enough to prevent an oil slick. Salvage workers stopped the rig from sinking, and the oil company placed boats and absorption barriers on the water around it to head off any spill. It was a lucky escape, but no-one can be lucky every time."
European Space Agency (ESA) (1).

A large part of a successful oil spill response operation is actually down to elements beyond the responder's control. The factors that influence every spill response are invariably the same, for example: weather, season, location, environmental and socio-economic sensitivity, and industry operations, but they can produce very different outcomes. An oil spill that occurs in 'rough' weather could be an environmental and socio-economic disaster, the *Erika* (France, December 1999), or perhaps reduce the response required, the *Braer* (UK, February 1993). Equally a spill that occurs in 'calm' weather can help or hinder a response, the calmer conditions in the Gulf of Mexico allowed for the use of insitu-burning as a response option, whilst the same conditions may reduce the effectiveness of chemical dispersant application on the water surface, as less immediate mixing will take place. If we look back over the past five decades of oil spill response, we can see that sometimes Mother Nature and luck are on our side and sometimes against us. If we cannot guarantee luck and timing we can at least be prepared.

"The birth of the Oil Spill Response Industry"

Torrey Canyon, March 18th 1967, runs aground on Pollard Rock on the Seven Stones Reef, near Lands End, Cornwall. During the next 12 days the entire cargo, approximately 119,000 tonnes of Kuwait crude oil was lost. This oil impacted the South West of England, the Channel Islands and the Brittany region of France. Detergents were sprayed on the floating oil to emulsify and disperse it by the Royal

Navy and Royal Air Force, within four hours of the grounding. A panel of expert scientists was assembled to consider scientific problems involved with the cleanup procedure and a response command post was established at Plymouth. However, the vessel lost structural integrity, due to an explosion on board on March 26th, releasing more oil into the water. Since towing the vessel off the reef was deemed impossible, the government decided to bomb the vessel. Local authorities were instrumental in dealing with the oil beached within their jurisdictions, but the use of detergents on the intertidal zone of England's resort beaches proved lethal to grazing organisms. The most effective treatment of oil-tainted water and beaches was through storm action combined with metabolic breakdown by microorganisms. Efforts to clean the large number of oiled seabirds proved largely futile, as they succumbed to hypothermia, stress, and poisoning.

When this spill occurred we had no purpose-built equipment for containing and recovering large quantities of oil on water, the available dispersants were more toxic than the oil itself, there was no contingency planning, no compensation schemes and we had no real understanding of what would happen to oil once it was on the water. The Torrey Canyon incident provided a major stimulus to the development of two voluntary agreements and two international conventions through which compensation was made available to those affected by spills of persistent crude oil and fuel oil from tankers. The interim voluntary agreements of TOVALOP (Tanker Owners Voluntary Agreement concerning Liability for Oil Pollution) and CRISTAL (Contract Regarding an Interim Supplement to Tanker Liability for Oil Pollution) were eventually terminated in 1997 having been superseded by the international conventions:

- The 1969 International Convention on Civil Liability for Oil Pollution Damage (1969 CLC) – later revised and amended to 1992 CLC, and
- The 1971 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (1971 Fund Convention), also subsequently revised to the 1992 Fund Convention.

Lessons Learnt

Amoco Cadiz, March 16th 1978, the oil tanker transporting 227,000 tonnes of crude oil suffered a failure of her steering mechanism, and despite the efforts of the crew of

a German tug boat and two unsuccessful towing attempts, she ran aground on Portsall Rocks on the Breton coast. The entire cargo spilled out as the breakers split the vessel in two, progressively polluting 360 km of shoreline from Brest to Saint Brieuc. This was the largest oil spill caused by tanker grounding, ever registered in the world. The consequences of this accident were significant, and it caused the French Government to revise its oil response plan (the POLMAR Plan), to acquire equipment stocks (POLMAR stocks), to impose traffic lanes in the Channel and to create the Centre of Documentation, Research and Experimentation on Accidental Water Pollution (CEDRE). This preparation was rewarded on the 30th January 1988, when the Italian oil tanker *Amazzone* en route from Anvers lost a number of bunker covers in a storm off the coast of Finistère.

The *Amazzone* made her way through the Ushant Traffic Separation Scheme without warning the French authorities, leaving a trail of 2100 tonnes of crude oil in her wake. Over the following weeks 450km of coastline, from South Finistère to Cotentin, were hit by the slicks. The POLMAR Sea Plan for the Atlantic and the POLMAR Land Plans for Finistère, the Côtes d'Armor and the Channel coastline were activated. The viscosity of the oil and bad weather delayed and hindered the response at sea, contributing to an increase in the onshore pollution. Clean-up operations were complicated, due to the extent of the pollution and the diverse nature of the shoreline, so response teams had to apply many different response techniques. Manual and mechanical methods were proposed by CEDRE, allowing the oiled seaweed to be collected and removed. An in situ pebble clean-up machine was used for the first time, allowing the pebbles to be put back in their original environment. This disaster forced pollution response methods to evolve and highlighted the importance of an oil spill information network. Lessons learned from the incident resulted in a valuable contribution to the revision of Finsitère's POLMAR Land Plan, which had only been set up the previous year. It was clear that there was a real need to develop a pollution response stockpile and the improvement of on land response strategies (8). This is a perfect example of learning from each incident and building on preparedness ready for the next one.

Unprepared but very lucky

Argo Merchant, December 15th 1976, *"The tanker ran aground on Nantucket Shoals. When less than a week later it broke in half and spilled enough oil to heat 18,000 homes for a year, residents off the Cape and the Islands began imagining the worst. Luckily, the wind shifted to the northwest so it never impacted the Cape at all. But the huge amount of oil, No. 6 crude, served as a wake up call for the peninsula. While close to 8 million gallons of oil was covering the water 25 miles southeast of Nantucket, it became clear to those on the Cape that they were woefully unprepared. "At the time there was no oil spill response equipment available to anyone, there was no training, there was no oil spill contingency plan...all that came about in response to that spill," Richard Hisscock, volunteer assistant harbour master in Chatham. The good news was that the spill was a catalyst and the state Coastal Zone Management Office (CZM), as well as other local and regional agencies, began formulating the Cape's response plan, completed in 1979. The plan is updated on a regular basis. "If the wind had gone the other way it would have been a real disaster," Richard Delaney, regional coordinator, CZM,"* Wicked Local Cape Cod (2). Sometimes we have been very lucky, and thankfully can learn from the experience and prepare for the future.

Another example of being lucky is the - *Hawaiian Patriot* incident, February 25th 1977, fully loaded with 99,000 tonnes of light Indonesian crude oil, en-route from Indonesia to Honolulu, reported a crack in her hull plating during a storm which resulted in a leak of oil from the cargo holds about 300 miles west of Hawaii. Approximately 18,000 tonnes of oil had leaked into the sea and on the following day the tanker caught fire and exploded. It burnt fiercely for several hours and sank with the remaining cargo on board, and unfortunately one crew member died as a result. The resultant oil slick which was estimated to contain about 50,000 tonnes of oil was carried westward away from Hawaii by ocean currents and naturally dissipated. An environmental and socio-economic disaster was avoided because of Mother Nature, lucky again.

Prepared and Lucky

Sometimes being prepared is not enough but with a little luck everything can go your way even when disaster strikes - *Ocean 225 barge,* August 10th 1993, was one of three vessels that collided at the entrance to Tampa Bay leaving more than 300,000

gallons of heavy oil and another 33,000 gallons of jet fuel in their wake. "*A raging fire aboard the crippled Ocean 255, carting nearly eight million gallons of gasoline, jet and diesel fuel, took more than 16 hours to snuff out. Miraculously no one was seriously injured. Even the tides and winds cooperated, pushing the black mass offshore for four days, buying response team's valuable time to deploy. When the oil finally came ashore, the black goo tarred a 13-mile stretch of Pinellas Country beaches. But even that black cloud revealed a silver lining. The beach landing enabled cleanup crews with front-end loaders and shovels to scoop up the mess; mangrove thickets, much harder to flush out, were largely avoided. Beach cleanup was completed prior to Labor Day, and while vestiges of the disaster and its damages lingered, so too did an un-escapable conclusion: We were lucky – very lucky. Lucky the spill didn't occur inside the bay. Lucky the winds and tides pushed the oil slick offshore. Lucky that oil spill contingency plans had just been finalized. And lucky for oiled seabirds that just 10 months before 100 volunteers had trained for just such an event, learning rescue and rehabilitation techniques that would dramatically improve their chances for survival.*

Had the '93 spill occurred inside the bay, the results would have been devastating. Lush mangrove and marsh fringe, and fertile grass beds, would have been destroyed. "It would have been a real nightmare" says Chris Rossbach, an environmental manager with Florida Department of Environmental Protection, Bureau of Emergency Response. "It would have changed the entire way we responded, turning a three-week response effort into I can't even speculate how long." We would still be cleaning up years later, and the costs would likely have exceeded the companies' liability, forcing taxpayers to pick up the tab." Bay Soundings (3.). Preparedness and training combined with 4 days of favourable weather proved that when you get it right a spill response can be completed effectively and efficiently.

Nature helps out

As we have already seen nature can help or hinder a response, and defines how bad the impact will be. Sometimes nature is on our side - *B-14 well Bravo platform*, April 22nd 1977– An oil and natural gas blow-out occurred on the Phillips Petroleum Company's production platform, in the Norwegian Ekofisk field. The platform is

located about 300 km south-west of the Ekofisk oil field centre. The blow-out caused the first major release of oil in the North Sea. A mixture of oil and mud spurted up to 50m into the air above the offshore drilling rig. The 112 crew members were safely evacuated. The blow-out resulted in the continuous release of about 30,000 tonnes of oil from a pipe 20 metres above the sea surface until the leak was finally stopped seven days later on 30 April, a delay caused by poor weather conditions and hazardous gas accumulations. A large part of the oil (30 - 40 %) rapidly evaporated due to higher than average air temperatures. The remaining oil slicks were monitored using three satellite-monitored drift buoys and around 2,000 plastic-wrapped drift cards. The oil was gradually broken down by wave action. No shorelines were oiled and the Norwegian Pollution Control Board declared that no major ecological damage resulted from the spill. This was one of the first spill responses to utilise tracking buoys to monitor the trajectory of the spill.

Occasionally, a spill will occur where Mother Nature prevents us from mounting a rapid response but does most of the cleanup herself - *Braer, 5th* January 1993**,** following an engine failure ran aground in severe weather conditions on Garth's Ness, Shetland, United Kingdom. Over a period of 12 days the entire cargo of 84,700 tonnes of Norwegian Gulfaks crude oil plus up to 1,500 tonnes of heavy bunker oil, were lost as almost constant storm force winds and heavy seas broke the ship apart. The adverse weather conditions rendered response operations at sea impossible and limited the onshore operations. Fortunately for Shetland, the Gulfaks crude is lighter and more easily biodegradable than other North Sea crude oils, and this, in combination with some of the worst storms seen in Shetland assisted in the natural dispersion of the oil by wave action and evaporation, which prevented the event becoming an even bigger disaster.

Hindered by nature

On other occasions Mother Nature does everything to thwart us - *Erika,* 12th December 1999, the Maltese tanker laden with 31,000 tonnes of heavy fuel oil (n°6), en route from Dunkirk, France to Livorno, Italy in very rough sea conditions was faced with structural problems off the Bay of Biscay. The *Erika* split in two in international waters about thirty miles south of Penmarc'h, Southern Brittany. The stern section sank on site but the bow section was taken under tow, to prevent it

impacting on the coastline. The quantity of oil spilt at that time was estimated between 7,000 and 10,000 tonnes, and the two parts of the wreck ended up 10km apart from each other, 120m deep. Initial aerial survey missions carried out by French Customs and Navy planes reported slicks drifting at sea, one of which was 15km long and estimated at 3,000 tonnes. The slicks were moving eastwards at a speed of about 1.2 knots. Since the heavy fuel could not be dispersed, the only response option offshore was containment and recovery, with the final estimation of fuel recovered being 1,200 tonnes.

The first incidences of the oil on the coast were noticed in Southern Finistère 11 days after the accident. Scattered landings continued over the following days, hitting the islands of Groix and Belle-Ile and the Vendée region, north of the island of Noirmoutier. Owing to rough weather conditions, the wind was over 100 km/h, blowing perpendicular to the coast, and with very high tide coefficients, the pollution was thrown up very high on the foreshore, reaching the top of cliffs exceeding 10m. 14 days after the sinking, the island of Groix, opposite Lorient, was severely affected and the bulk of the pollution reached the north and south banks of the Loire River. A viscous oil layer, 5 to 30cm thick and several metres wide, covered parts of the shoreline. Clean-up operations were organised on beaches, rocks and breakers as soon as the slicks reached the shore. More than 5,000 professionals and volunteers worked on the shoreline, collecting approximately 200,000 tonnes of waste. When this kind of incident happens, we just have to continue until the cleanup is finished. If the French authorities had not been prepared and had the POLMAR plans already in place, this incident could have impacted the region for a longer period of time and caused much more damage, leading to greater socio-economic and environmental loss.

Successful Wildlife Response

Quick decision making and good timing can lead to a successful wildlife response operation. The *Treasure***,** June 14th 2000, a bulk carrier, was en route from Brazil to China when she was caught in bad weather and suffered structural damage. She sank early on the 23rd June, after several days of discussion between local officials and her owners, in Table Bay about 30km from Cape Town, 8km northwest of Melkbostrand. It sank approximately 20km north of the African Penguin colony on

Robben Island, and about 40km of the colony on Dassen Island. 1,300tonnes of heavy fuel oil leaked from the ship eventually impacting both islands. Over 20,000 birds were oiled in the first few days on Robben Island and a further 23,000 were threatened on Dassen Island. The oiled birds on Robben Island were rounded up and transported by ship, helicopter and road to the mainland, where they were cared for and fed by volunteers, at any one time there where more than 400 volunteers on duty to cope with the night and day operation. As the oil continued to spread north, a decision was made to evacuate the remaining penguins on both islands. So 22,000 un-oiled penguins where taken by sheep trucks to Port Elizabeth and released there, the swim back to their home colonies took between 10 and 20 days giving the cleanup teams enough time to remove the oil. Once the penguins that had been cleaned were shown to be waterproof again, they too were released and a final analysis showed that more than 90% of the oiled birds were successfully released. This is the highest success rate for any sea bird oiling incident (4).

Jessica, 16th January 2001, a boat carrying fuel to Ecuador's Galapagos Islands was leaking oil into the ecologically sensitive waters near the famous islands. The *Jessica* was carrying 600 tonnes of diesel and about 300 tonnes of IFO 120. The initial impact on San Cristobel Island, affected beaches and harmed 7 sea lions and17 birds, including blue-footed boobies, pelicans and albatrosses. The Charles Darwin Research Station team used the Wildlife Rescue Centres to deal with wildlife casualties, whilst the Galapagos National Park team began clean up operations. With the current pushing the spill south toward Espanola Island, home to large colonies of sea lions, and the island of Santa Fe, home of the land iguana, a species found nowhere else, further assistance was drafted in from the Canadian Nature Federation to assist with the wildlife rescue. On the 23rd of January nature lent a helping hand, when the winds shifted and began to blow the remaining slick back out to sea. The quantity of fuel oil spilled was estimated by the response team at approximately 250 tonnes, whilst the oil recovered directly from the sea was estimated at 147 tonnes. The total known shoreline affected during the Task Force mission was estimated to be between 5 and 15 km (7). The Galapagos is a World Heritage Site, a National Park and the surrounding waters are a Marine Nature Reserve, which contain many distinct species and subspecies of animals found nowhere else. Although the *Jessica* spill may have been relatively small compared to

such spills as Erika and Sea Empress (UK, February 15th, 1996), the potential for a disastrous ecological impact existed given the restricted distribution of much of the flora and fauna found in the area.

Using Volunteers

Learning how to utilise volunteers, from other national emergencies, helped Japan to deal with a large oil spill response and they were lucky they were prepared or the impact could have been even greater. *Nakhodka,* 2nd January 1997, the Russian oil tanker en route from Shanghai to Kamchatka and transporting 19,000 tonnes of fuel oil, capsized during a storm in the west side of the Japanese island of Honshu and broke in two. 31 crew members were rescued but not the commanding officer. The first oil slicks reached the Japanese coast on 7 January. Little by little, over 300km of coast, major coastal fishing, fish-farming, tourism activities and several remarkable natural sites, were affected. Water inlets of a public aquarium and a nuclear power station were protected by booms. The bow part of the ship ran aground on the coast, the stern part sank with part of its cargo still onboard some 200km off the coast, and now lies 1800 metres deep. More than 200,000 people took part in the cleaning operations, recovering in a little over a month all the oil which arrived on the coast. The large volunteer force was mobilised in part as a consequence of the experience after the Kobe Earthquake, January 1995, when an elaborate volunteer organisation was developed (9). Although there are obvious advantages in utilising volunteer labour, there are also difficulties to contend with such as variable personal fitness for strenuous physical work. It has also sometimes proved difficult to control and direct the work of volunteers who often reject outside supervision. The logistical issues of looking after so many volunteers would also be immense, each person would need: some form of protective clothing, training, food, water, shelter, transport and daily briefings. Nearly 36,000 tonnes of waste stored in barrels, bags or pits had to be disposed of. It was the biggest oil slick Japan has ever faced but by having a volunteer network in place, the authorities where able to mount a large scale manual response quickly.

On much smaller scale but still as effective as they were lucky to have so many response personnel available - *Pacific Adventurer*, 11th March 2009, this cargo vessel was caught in a cyclone off Queensland. It presented a 45 degree list,

causing 31 containers filled with ammonium nitrate to fall overboard. Two hours later, the team realised the ship had a crack in her port side near the engine room. A fuel tank and a bunker tank located below the water line were damaged. An estimated 270 tonnes of oil was spilt, forming a slick 5.5 km long by 500 metres wide. The area worst affected by the oil spill was the south-east coast of the state of Queensland and in particular Moreton Island National Park, the beaches north of Brisbane as well as a few areas around the Brisbane River. In total, 60km of shoreline were affected by this incident. The ship was immobilised in the Port of Brisbane until the accident enquiry was completed. Shoreline clean-up operations lasted 2 months and proved complicated. In total 3,000 tonnes of contaminated sand were removed from Moreton Island. Most of the work involved manual recovery using shovels and rakes. 65% of oiled beaches were rehabilitated. A total of 2,500 people took part in the clean-up including workers from various government departments, local regional councils, private contactors and the emergency services. This included the Australian Maritime Safety Authority (AMSA) personnel as well as 72 members of the National Response team from all States/NT. The oil industry and contractors also provided assistance during this period.

Cross-border and International Co-operation

A spill that impacted several countries led to greater cross-boundary co-operation and integration, it was just lucky at the time of the incident that the individual countries could cope with the impacts. *Vista Bella*, 7th March 1991, the oil tanker registered in Trinidad and Tobago without any pollution insurance sank in waters 600m deep, 15 miles southwest of Nevis Island. She was transporting 2,000 tonnes of heavy fuel oil. The quantity of fuel that actually spilled when she sank is unknown. Winds and currents carried the surfacing pollutant northwards, and despite the efforts of the French Navy spreading dispersants on the slicks they continued to head towards the Islands. The huge number of islands situated in this area meant that this modest pollution became the world record for the largest number of countries struck by a single oil spill. The jurisdictions affected were: Saint Kitts and Nevis, then the Saba islands and Saint Martin (Dutch West Indies), Saint Bartholomew (French West Indies), the British Virgin islands, and finally the American Virgin islands and Porto Rico (USA). Each country managed its response and damages independently, although Saint Kitts and Nevis had no established

organisation to turn to. This spill may have impacted 5 countries but there was no real cross co-operation during the clean-up operations other than the spreading of dispersants by the French Navy. Lessons identified from this spill include: difficulty in reaching agency personnel, lack of commercial response equipment on neighbouring islands and differences in electrical power at the various cleanup sites. This had led to a series of exercises, utilising the Caribbean Island OPRC Plan, overseen by the Regional Activity Center / Regional Marine Pollution Emergency, Information and Training Center (RAC/REMPEITC), to increase co-operation and preparedness in the region (10).

In contrast to the above incident is the Gulf of Mexico, 21st April 2010, some 80km off the coast of Louisiana the oil rig completing the Macondo “MC 252” well, suffered an explosion followed by a fire. 17 people were injured and 11 others reported missing. The US Coast Guard managed to swiftly evacuate 115 of the 126 people on the rig at the time of the disaster. The rig sank two days later, and the 2,000 to 2,500m^3 of oil on the rig either burnt off or was released into the sea. A vast mobilisation of spill response equipment was rapidly organised and surveys conducted using underwater remote-operated vehicles showed that a reported 159m^3 of crude oil a day was leaking from the riser located 1,500m below the surface.

By the end of June, more than 30 foreign governments and international organizations had offered aid and equipment to help contain and clean the oil spill. However, the U.S. government announced it had only accepted help from 12 countries and organizations, including from the governments of Croatia, Japan, Mexico, Norway, and the Netherlands, as well as the International Maritime Organization and the European Commission’s Monitoring and Information Centre. The aid was mostly to clean the spill rather than plug the well, which was still considered in BP’s domain (11). The US began receiving shipments of booms, oil skimmers, and chemical dispersants to help clean the Gulf. It was lucky that the US got so many offers of assistance, both for equipment and personnel, and that everyone co-operated in the clean-up operation. This was a prime example of international co-operation at its best. It has also lead to almost every country revising their oil spill contingency plans and their preparedness levels. We are now prepared

in so many ways to conduct good oil spill response, but that doesn't mean that we can't do more.

Conclusion

An estimated million tonnes of oil makes it into the ocean every year, degrading water quality and harming marine and coastal ecologies, ESA (1). If a large spill occurs offshore we have many tools within the response 'arsenal' to deal with it, including natural dispersion, capping devices, insitu-burning, mechanical recovery and chemical dispersant. We use monitoring to assess the amount of oil spilt, the direction it is heading and how it is weathering. Modelling is used to evaluate the trajectory of the spill and to highlight any potential environmental and socio-economic resources that may be impacted. So when it comes to oil spill response operations, is greater success based on luck and timing or being better prepared?

If we are totally honest the answer is both. Effective oil spill response, no matter how well prepared we are, is also dependant on luck and timing. Any oil spill is bad news but the wrong weather, time of year or location, can make even a relatively small spill into a major disaster. But it also follows that if you are unprepared for such an event, again a small spill came become a major incident.

This paper came about because of one small snippet in a newspaper, "*The situation looked bleak when the window of fine weather that followed the grounding turned into stormy seas that buffeted Rena and pushed leaking heavy full oil onto beaches in a black tide. But out of the pollution, seabird deaths and floundering businesses arose – phoenix like – the community's determination not to succumb. Seaside dwellers got stuck in when the first black blobs washed up, followed by an amazing world first for major oil spills. Thousands of volunteers trained for clean-up duties and then enthusiastically took to the beaches Maketu to Mauao. By then, the oiled wildlife recovery centre had swung into action and a Napier factory even knitted cute little jerseys for oiled penguins. Yet it could have ended so differently, with bitter recriminations, if nature had not subsequently lent the Bay of Plenty a mighty helping hand by a long spell of settled weather. It gave the salvors time to pump nearly all the oil off the Rena and so defuse an extremely anxious situation."* Bay of Plenty Times (6). Just when we think it have it all figured out Mother Nature throws a curve ball, and whatever it may be we have to adapt.

We are better prepared and better equipped now than we have ever been. The biggest threat may be complacency. The longer we go without a spill, the tougher it is to keep interest and vigilance high, and companies and equipment waiting in the wings ready to respond at a moment's notice. But all the equipment in the world is futile unless we have the knowhow and personnel to deploy it quickly, making up to date and rigorously tested Oil Spill Contingency Plans and exercising all the more vital. Having luck, timing and nature on our side goes a long way but nothing beats being prepared.

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