Case Study #001

Title: Planning and Preparedness – The Risk Assessment Process

Introduction

Risk assessment forms an integral aspect of many incident management phases including planning, preparedness and response. Planning and preparedness will typically involve proactive strategic hazard and risk analysis, whilst risk assessment during response is more likely to be a dynamic process requiring ongoing review as conditions change. In its simplest form risk can be defined as the severity of an event combined with the likelihood of that event occurring under a defined set of circumstances. This process is typically developed further to include likely numbers that may be affected (including sensitive population groups such as the young, elderly and infirm), dose response to the agents under assessment and exposure assessment, as defined within the WHO toolkit for public health risk assessment.

The following UK event illustrates how such assessment was used to plan and manage a potentially hazardous operation.

Summary of Event

The "*Happy Lady*," a gas carrier anchored off Spurn Head in the Humber estuary , England, UK requested permission to vent 40 tonnes of ethylene gas in order to facilitate repairs. The ship could not move further offshore due to hull damage and fears that the hull could split in rougher water.

Ethylene is a common raw material in the synthetic organic chemical industry. It is shipped as compressed gas; under pressure and below 10^{o}C it exists as liquefied gas. The gas has a characteristic sweet odour. It is colourless, lighter than air, extremely flammable and can form explosive gas/air mixtures. Explosive limits are relatively low: 2.7% - 36.0% by volume in air. It is of a low order of toxicity and vapours are not irritating to the eyes or upper respiratory tract. High concentrations may lead to anaesthetic effects. Ethylene can act as a simple asphyxiant, causing suffocation by lowering the oxygen content of the air in confined areas. It is not classified as a human carcinogen. No UK Workplace Exposure Limit exists. As a guide to occupational risks, US standards are a value of 200 ppm (over 8 hours).

Nearby population centres, other shipping in the estuary and media interest suggested possible risks from the activity. A risk assessment was needed to address the fact that venting would take place over an extended period, in which conditions would be variable. Plume modelling was used to identify potential for grounding of the gas and identify the radius of the exclusion zone to be imposed around the vessel.

The results of the modelling confirmed that there was unlikely to be any risk to the public at the levels predicted but that there was a potential risk to the crew. Repeated modelling and interpretation throughout the process enabled assessment of risks until venting was complete and the vessel could enter port for repairs.

Narrative

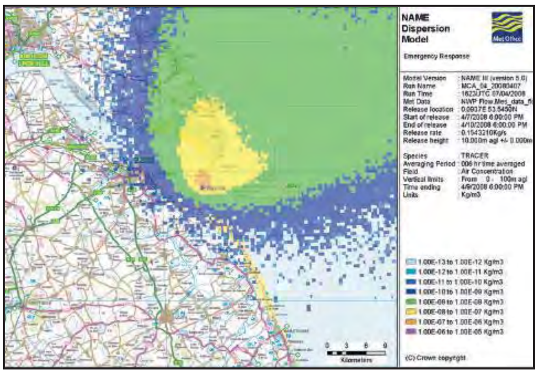
Early on the afternoon of Monday 7th April 2008, the UK Maritime and Coastguard Agency (MCA) contacted the Health Protection Agency (HPA) regarding the “Happy Lady,” a gas carrier anchored off Spurn Head in the Humber estuary. The ship owner had requested permission to vent 40 tonnes of ethylene in order to carry out repairs; thus the MCA sought advice from the HPA over the potential public health risk.

The design of this ship precluded any attempt at ship-to-ship transfer. As such venting would be undertaken over a 3 day period by introducing hot air into the tanks to boil off vapour, followed by backfilling with inert gas. The ship could not move further offshore due to a fracture of the hull.

In view of the flammable and potentially harmful nature of ethylene, undertaking the activity close to shore posed a potential risk to public health, in respect of possible exposure of residents and users of the estuary. As such it was necessary to undertake risk assessment as part of the planning process in order to assess numbers that could be exposed, the probability of exposure and the concentration and duration at which exposure could occur (i.e. the dose).

The nearest populations on the banks of the Humber estuary were Humberstone, Cleethorpes, and Grimsby, some 2, 4, and 6 miles away, respectively. The prevailing wind was forecast from the northwest, changing to blow from the south to southwest from 06:00 on the 8th.

At 14:11 modelling was requested to predict ground-level ethylene concentrations to quantitatively confirm that there were unlikely to be adverse impacts on public health, both in terms of public exposure and explosive risk. Modelling outputs became available early on the evening of the 7th.



The Happy Lady at port and (opposite)
Predictive modelling of ethylene (courtesy HPA)

Predicted concentrations Predicted maximum ground-level concentrations were approximately 8.5 ppm and were many orders of magnitude below those concentrations able to cause health effects, asphyxiation, or explosive limits (Table 1)

Table 1: Indicative Hazardous Concentrations (USEPA)

Chemical	Concentration (ppm) (based upon 1 hour exposure)			
	PAC 1 (transient effects)	PAC 2 (irreversible effects)	PAC 3 (life-threatening effects)	Lower Explosive Limit
Ethylene (74-85-1)	600	6600	40000	27000

PAC = Protective Action Criteria (PAC) (formerly TEEL - Temporary Emergency Exposure Limit) (

The results of the modelling confirmed that there was unlikely to be any risk to the public at the levels predicted but that there was a potential risk to the crew if they were still aboard the vessel, as levels on deck may have been sufficiently high to exceed occupational standards. The MCA determined a 0.5 mile exclusion zone around the ship and reported that the crew were suitably trained in safe working practises including risk assessment, confined space working, dangerous substances and explosive atmospheres and use of personal protective equipment.

Due to delays in starting the operation further modelling runs were undertaken on the morning of the 9th, and as a 3 day model once venting commenced on April 10th. The results of these runs did not alter the HPA's assessment that there was unlikely to be any risk to the public from the release. Once venting was complete, the vessel made for port at Hull in order to carry out repairs.

Key Points

- Risk assessment forms an integral aspect of planning and preparedness in respect of potentially hazardous activities and unplanned incidents
- Predictive modelling provides a valuable tool in the risk assessment process and enables informed decisions on risk.
- Knowledge and forecasts of prevailing and future meteorological and tidal conditions are fundamental to the process
- The process is dynamic enabling changes in conditions to be incorporated and assessed

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Health Protection Agency. Chemical Hazards and Poisons Report April 2009

Case Study #002

Title: Preparedness – Testing and Exercise

Introduction

It is important that response plans and procedures are tested regularly in order to evaluate their effectiveness and applicability and thereby contributing to preparedness. Testing can be achieved by means of assessing actions in response to a real event or alternatively and more commonly it can be achieved by means of staged exercises. Such exercises require development of robust, realistic incident scenarios and involve all of the resources defined within relevant plans. Exercises are generally tailored to test specific elements of a plan e.g. desk top scenarios for communications, risk assessment etc. Furthermore they will ideally provide a well constructed programme to enable evaluation of the entire process from start to finish involving real-time, at scene activities such as mobilisation, decontamination, sampling etc. In all cases exercises should be used to identify outcomes, both positive and negative, and a detailed debrief of all participants is essential to capture these. Outcomes can then inform revisions and development of plans and procedures accordingly.

The following case study illustrates a maritime exercise organised by Pembrokeshire County Council in 2011 as part of the ARCOPOL programme. The exercise was used to test planning and response structures at local, regional and national level and to identify current resilience, potential limitations and areas for improvement.

Summary

"Exercise Celtic Coast" was undertaken in Pembrokeshire, west Wales over 2 days between 5th & 6th October 2011. The aim of the exercise was to test response arrangements to a maritime pollution incident involving both oil and Hazardous & Noxious Substances (HNS). Specific objectives included: Validation & testing of plans from all relevant agencies including those of the local resilience forum, the port authority and the National Contingency Plan for marine pollution; Exercising of officers in their role and responsibilities; Implementation of beach master and Shoreline Clean Up Assessment Team (SCAT) training; Testing of communication arrangements, and management structures and their interactions. Finally the exercise aimed to identify lessons learnt and integrate these into contingency planning.

The format involved a live exercise in real time using different locations for different response cells. A brief was given to all delegates before the exercise, but details of the actual incident were known only to key facilitators prior to the exercise. Around 450 people took part in the exercise from 15 different organisations including: Maritime, Fire and Rescue, local authorities, health agencies, police, and environment groups, based at 12 different locations.

"Live" debriefs were undertaken throughout the exercise and a final detailed debrief was completed with all participants following completion. Overall feedback was of a successful event being the first time in England and Wales for an Oil and HNS maritime incident where Maritime Agency Representatives and the Police were involved together. Key outcomes identified a range of things that went well, together with several limitations of the process. Findings will be used as opportunities for improvement of the response planning and resourcing at all levels.

Narrative

Day 1 – 5th October 2011
Day 1 of the exercise focussed upon damage to an oil tanker in Milford Haven, Pembrokeshire, Wales and its subsequent catastrophic failure resulting in a Tier 3 (National response) oil pollution incident. Key objectives aimed to test communications between the port authority and national maritime representatives and the input of specialist advice from environmental and health agencies. Events during the day were prompted by a series of injects requiring actions from relevant response groups.

The exercise began at 06.30 with a reported collision between an oil tanker and a container ship off the coast of Pembrokeshire. Port and national representatives were notified. The damaged oil tanker was to be brought into Milford Haven port following collision, requiring activation of the Port's emergency response plan. The container ship was reported to have lost 2 containers containing HNS and was continuing to proceed to its destination further along the coast.

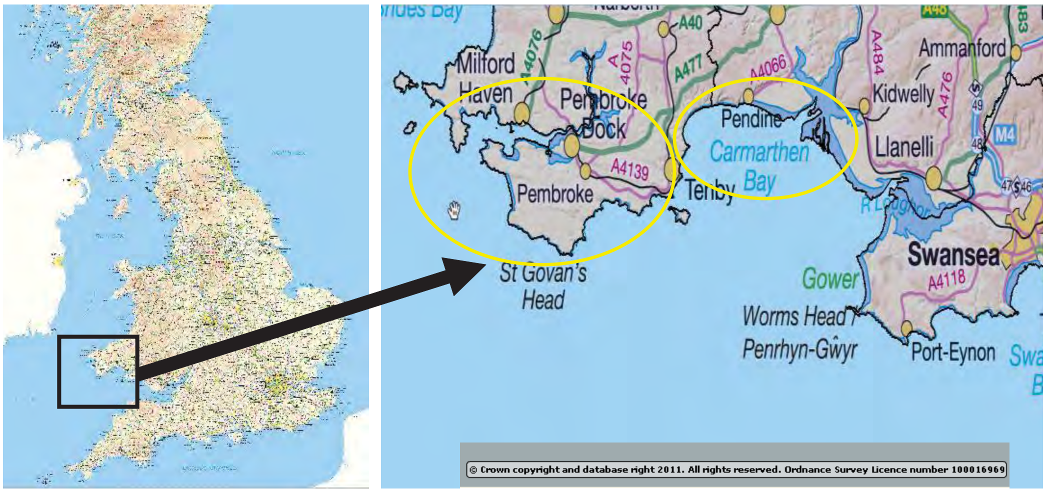
By 09:30 all key agencies had been notified and briefed at pre-defined locations. Initial requests were made for assessment of potential risks from both oil and HNS which was identified as Captafol. This information was then disseminated to command teams.

By 13:00, the structural integrity of the tanker had deteriorated resulting in a Tier 3 oil pollution incident declared with activation of marine and land focussed tactical command units in Pembrokeshire. A decision was made to beach the tanker away from the port. Further risk assessment was required to assess potential shoreline impact from oils both in terms of environmental damage and public health.

Outcomes of these assessments during the day involved Shoreline Clean Assessment team briefings (live) undertaken at Milford Haven Port Authority; Beach master briefings (live) for booming undertaken at Pembrokeshire County Council Thornton Offices; National air quality monitoring cell mobilisation (virtual) requested for in-land impacts of oil vapours, media lines prepared and issued.

At close of play (17:00 hours) a live debrief was undertaken including final media briefings and a hand-over to out of hours teams (virtual).

Example of Media injects and Port Briefing

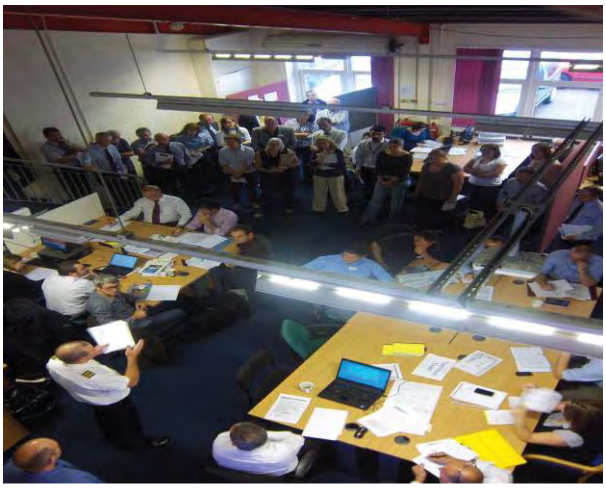


Map of UK and Pembrokeshire coast illustrating areas where exercise was held (HPA GIS)

Day 2 – 6th October

Day 2 widened the event to a multi-regional level as a result of washed up containers including HNS and consumer goods in the adjacent county. This also further developed the potential for public health implications requiring on site decontamination and regional hospital involvement.

08:00 Shoreline Response Centre continued to manage the incident with live deployment of beach masters to the shoreline and technical advice from an environment group. During the morning, containers of both inert and hazardous substances, which were lost by the second vessel on Day 1, washed up on the Pembrokeshire & Carmarthenshire coastline. New events required deployment of a decontamination unit on the affected shore, as well as implementation of emergency plans at local hospitals. These additionally tested the interaction between maritime and land based command structures and widened the advice required by responders and the media. The exercise continued until a hot debrief at 13:30.



Following the exercise a series of group specific debrief meetings were held with all stakeholders to review the exercise, outcomes and views of the participants and facilitators. Specifically this was used to identify lessons learnt.

Conclusion

- Celtic Coast represented the biggest maritime exercise in Wales for ten years and the first in UK to test oil and HNS response.
- Things that went well included participation and enthusiasm from responders, real incident pressure and good interaction such as within the multi-agency media cell and tactical response group.
- The exercise illustrated the potential to combine the strategic groups convened specifically for maritime incidents, with response groups called during land based events.
- The exercise also raised awareness within non-maritime organisations of the control and command structures for maritime incident response and enabled dissemination of experiences from staff involved in previous real incidents i.e. the *Sea Empress* incident in the 1990's.
- Potential issues and limitations were identified including uncertainties of primacy of strategic command, uncertainties over reporting and communication mechanisms between groups, documentation management responsibilities, and IT compatibility and security issues.
- It was also felt that the Strategic management was reactive rather than proactive.
- Comments were also made concerning port jurisdiction and the lack a counter pollution scientist for the exercise.

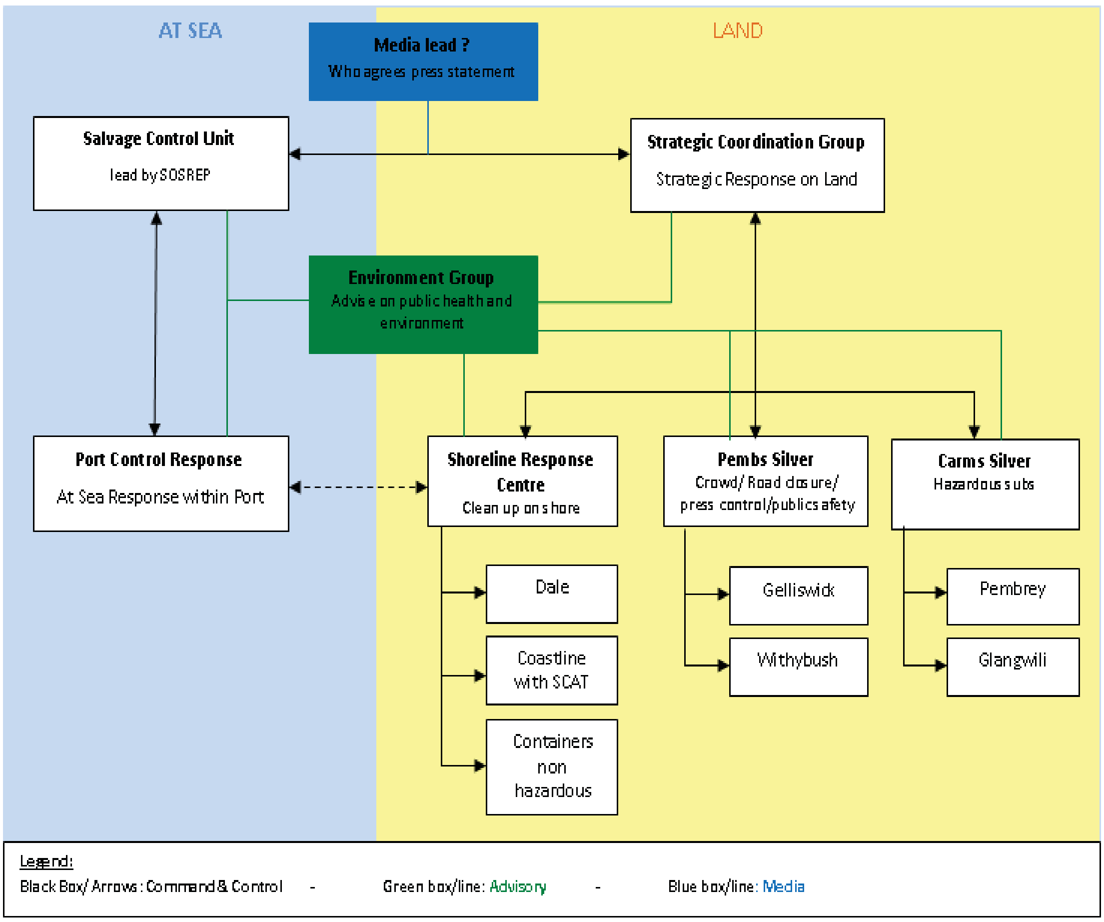


Illustration of Command Structure on Day 2 of Exercise

Recommendations

- Several key recommendations for review within response plans were identified from the exercise.
- These included awareness of upcoming legislation such as that proposed to enact the European Water Framework Directive and review of the existing command and control structure and interaction between Land-based strategic command and the Shoreline Response Centre.
- In addition specific logistical and process improvements were identified including on a local / regional level:
    - Provision of common methods and IT compatibility;
    - Media exercise programmes;
    - Waste management guidance / site plans;
    - Targeted competency training for all command centre staff;
    - Social Media Policy Management.

- On a national level it was recommended that the NCP takes account of changing political environments and the engagement with devolved administrations.

Key Points

- Exercises provide a valuable means of testing incident management and response under realistic emergency conditions;
- Well constructed programmes enable testing of multi-agency procedures and collaboration including where appropriate trans-boundary management and reporting systems;
- Exercises can offer opportunities for attendance by a range of non-participating regional, national and international observers to assess and compare approaches;
- Full and detailed debrief and feed back sessions are vital to identify strengths, weaknesses and opportunities for improvement of incident management.

References

Arcopol http://www.arcopol.eu/buscaDocu.aspx?soc=PCC

Case Study #003

Title: Incident Response – Modelling and monitoring

Introduction

Modelling and monitoring are key elements of the incident response process, providing predictive and real-time data to feed in to the risk assessment and decision making process. Predictive modelling of atmospheric and tidal fate and transport of chemicals can forecast concentrations and impacts over both spatial and temporal distances from an incident and identify areas and times where effects may be most apparent. Such data can be used to target resources and be validated by means of real time monitoring of concentrations or effects. Monitoring can employ incident specific equipment and procedures, or can be obtained via existing networks and collection processes, such as national air quality monitoring networks and geographically collated health databases. It is generally accepted to use all of the above methods as part of the overall response and follow-up strategy to an incident, although this cannot always be achieved particularly where incidents are over short time periods in areas where monitoring networks are limited.

The following case study illustrates a scenario where modelling, monitoring and symptom reporting were combined to identify potential and actual impacts over a wide geographical area, their role in pin-pointing the causative event and the importance of meteorological effects.

Summary

On Sunday 19 January 1997, the UK National Poisons Information Service received 14 enquiries from across the UK requesting information and advice relating to a strong petrol like smell and people experiencing irritation of the eyes, mucous membranes, and upper respiratory tract. The cause of these symptoms was not immediately clear, however, the wide spread origin of the queries suggested it was not from localised events. Discussions with medical services in affected regions, coastguard operations rooms in Great Yarmouth and Dover, and other agencies, led to the hypothesis that the cause was a tanker collision in the English Channel. With this and meteorological information a series of surveillance, modelling and monitoring procedures were initiated that enabled assessment of predicted and actual impacts from the event allowing effective protective advice to medical practitioners and the public as well as validation of modelling accuracy with real time data.

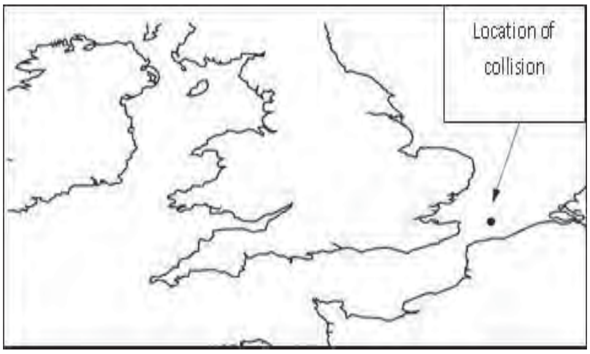


Figure 1: Approximate Location of Collision and Bona Fulmar

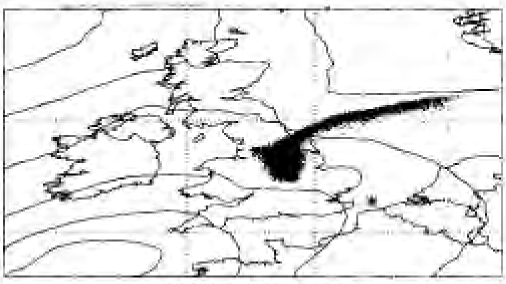
Narrative

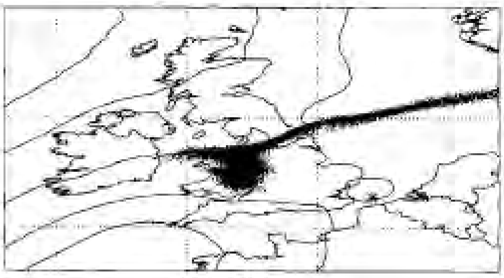
1232 hours Sunday January 19th, 1997

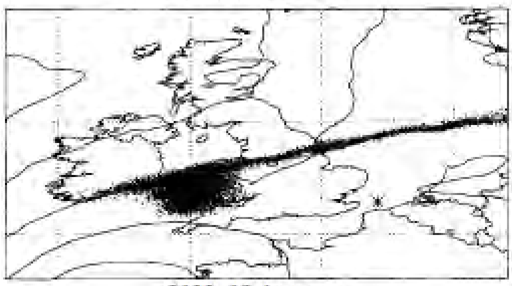
Enquiries received by UK National Poisons Information Service (NPIS) relating to petrol like odours and people suffering ill health effects including eye and mucosal irritation and respiratory effects. Enquiries were from across a wide geographical area and could not be accounted for by local events. A series of discussions were held with relevant hospitals, UK Department of Transport, UK Coastguard and Marine Pollution and from these it was hypothesised that the effects could be related to a collision between tankers in the English Channel, which had resulted in a spill of approximately 7000 tonnes of unleaded petroleum.

The incident occurred on 18 January 1997. The Bahamian tanker *The Bona Fulmar* was sailing in thick fog in the North Sea loaded with 60,000 tonnes of petrol, when she collided with the Mexican chemical tanker *The Teoalt* off Dunkirk. 7,000 tonnes of unleaded petrol spilled from a ruptured tank of the *Bona Fulmar.* Fortunately the Teoalt was not seriously damaged and was able to proceed to Rotterdam. Vessels sailing in the area were warned of the potential risk of fire and explosion. Two divers inspecting and carrying out emergency repairs were affected by the vapours. The *Bona Fulmar* was eventually towed to Brest (CEDRE).

No slick was apparent visually, but sea water sampling confirmed the spillage of petroleum. Meteorological data for the 18th and 19th was then used to predict the behaviour of the slick and subsequent vapour plume using the EUROSPILL and NAME (see case study #1)) models respectively. Marine dispersion of the slick using wind and tidal data was estimated to be no more than a few kilometres, whilst evaporation was calculated as a major factor based upon chemical composition and environmental conditions. Atmospheric dispersion modelling calculated concentrations for 12- hour UK forecasts based upon wind speeds and direction and estimates of release duration of between 3 and 24 hours (figure 2 illustrates outputs for a predicted 9 hour release).


0900, 19 January


1500, 19 January


2100, 19 January

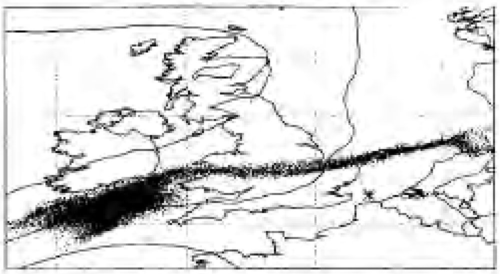

0300, 20 January

Figure 2: Illustration of NAME modelling of atmospheric dispersion from Spill

Atmospheric dispersion predicted concentrations of component hydrocarbons at key receptors such as regions reporting odours and health effects.

Atmospheric data from the UK Hydrocarbon Network monitoring stations were used to validate predictions at key receptors. This network provides continuous monitoring of urban and rural atmospheric hydrocarbons principally to monitor the impact of traffic and industrial emissions. In this case the data used were corrected to remove the contribution of background hydrocarbons enabling the specific impact of the plume to be assessed.

Analysis confirmed the plume composition as mainly C5 and C6 hydrocarbons plus BTEX components (benzene, toluene, ethyl benzene and xylenes), consistent with petroleum range organics. The data collected over time confirmed the predicted trends, with concentrations above background levels over several hours in Birmingham and then at subsequent downwind locations such as Liverpool and Cardiff.

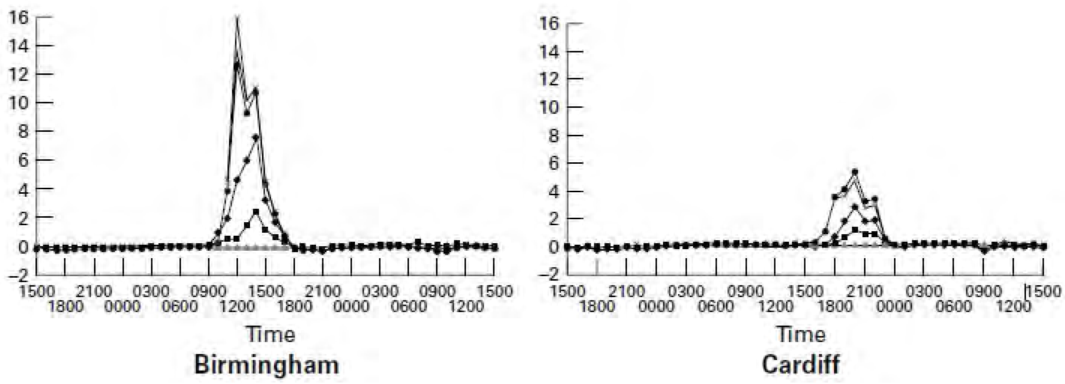


Figure illustrating VOC concentrations (BTEX components ppb corrected for background ambient levels), measured over time using National Hydrocarbon Network Monitors at Birmingham and Cardiff

Monitoring data were able to corroborate predictions that concentrations were not at levels that could result in significant health effects but could cause transient effects consistent with the symptoms reported via local poisons and health care units. Observations from affected areas identified odours that could not be attributed to the components of petroleum. Further investigation of this suggested the possibility of petroleum oxidation products within the plume, such as ketones and esters, which could have arisen during transit and could account for these kinds of odours.

Conclusion

- The events of 18th and 19th January 1997 demonstrated how effects were detected at distances over 500 km from the scene of the accident and how maritime incidents can have national and international implications.
- In this case there were no serious adverse health effects, but had the meteorology been slightly different, or had the incident involved chemicals

with similar physical properties, but substantially more serious toxicological effects, then the consequences could have been serious.

- A combination of symptom monitoring, reporting and multiagency communication was able to quickly link a widespread impact to an incident many miles from the scene.
- On-site observation together with marine and atmospheric modelling enabled rapid risk assessment and targeting for resources.
- Subsequent monitoring was able to corroborate composition and concentrations at relevant receptors, confirm the absence of significant health risks and inform response and advice strategies.

Recommendations

- Marine and meteorological modelling, together with environmental monitoring provide powerful tools for analysis of maritime incidents.
- Combined with multiagency reporting and communication this approach enables rapid assessment to inform response and advice strategies.
- Pre and post incident symptom monitoring can provide valuable data on immediate and longer term effects of exposure and appropriate treatment and advice.

Key Points

- The case study illustrates how a relatively distant maritime incident involving release of mobile substances can have far reaching consequences, potentially requiring regional, national and even international response and co-operation.
- Inter-agency communication and collation of data can help to identify causes of observed effects even when the cause appears far removed from the areas affected
- Modelling and monitoring provide powerful tools in corroborating such events
- Existing monitoring resources such as national ambient air quality networks can provide a useful resource for obtaining data over wide areas.

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CEDRE http://www.cedre.fr/en/spill/bona_fulmar/bona_fulmar.php

Case Study #004

Title: Risk Communications

Introduction

Risk communication plays a vital role in incident management. Risk communication strategies are often divided into pre and post event aspects to include components of communicating risks around likely scenarios in advance of an incident, as well as protocols to inform effective crisis communication during incidents, together with elements of post event follow-up such as public health surveillance. Key objectives of risk communication include establishment of an effective dialogue among those responsible for assessing minimising and regulating risk, and engaging with community stakeholders directly or via local or national media.

Communication can have both positive and negative impacts upon management of maritime incidents. Good communication can provide reassurance to communities and clear messages of what is being done to manage risk. In contrast when not closely managed, communications can often result in public panic and even potential for increased risk, particularly where media and social media influence messages provided to wide audiences.

Such factors are well illustrated in the events arising from the *Napoli* incident in south west England during 2007. In this incident, containers began to come ashore and led to mass public looting fuelled by media coverage and a lack of appreciation of public reaction. The case study further demonstrates how a maritime incident can quickly become an issue of public order with widespread consequences.

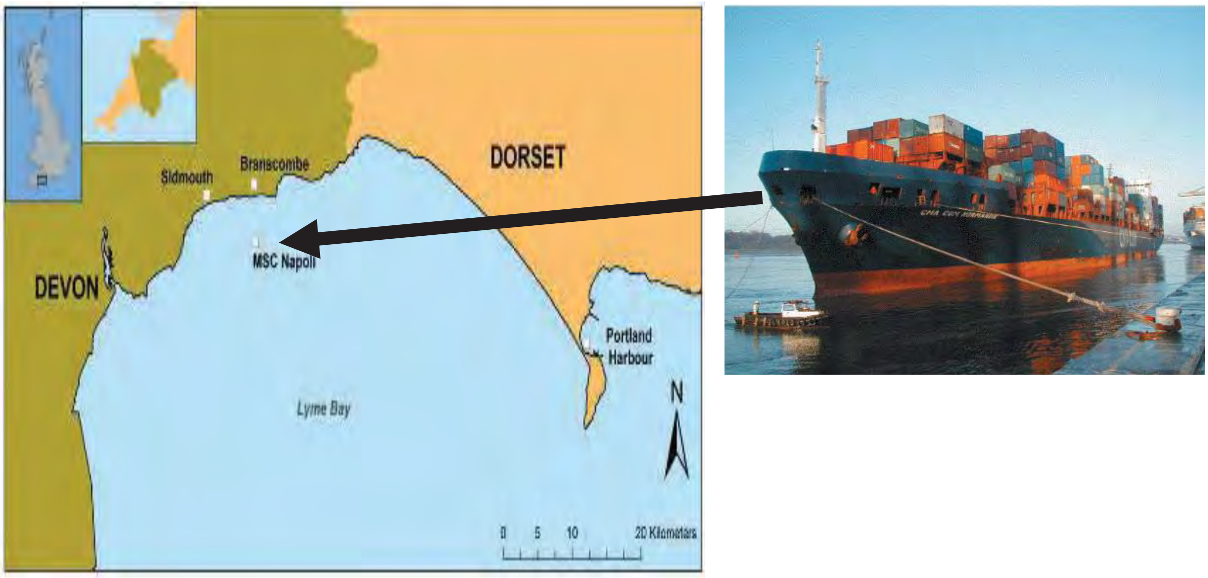

Figure Illustrating MSC Napoli and its final location off the English Coastline (Image courtesy of the Law Offices of Countryman & McDaniel, www.CargoLaw.com. Ref HPA)

Narrative

MSC *Napol*i suffered flooding to the engine room during Force 8 gales in the English Channel on Thursday, 18 January 2007. In view of its location, a combined response between both UK and French authorities was necessary, illustrating how such incidents often require transnational co-operation and liaison. The 26 crew abandoned ship and were safely rescued from their lifeboat by helicopter. The French authorities assessed a number of possible locations for a place of refuge in French waters; however, the south coast of England provided better options for a place of refuge. Working with the French authorities, the Secretary of State's Representative for Maritime Salvage and Intervention (SOSREP) decided that the ship was in danger of breaking and should be towed to Portland Harbour, located on the southern coast of the UK.

The ship began to break up from the heavy seas, creating a significant risk of pollution with over 3,500 tonnes of heavy fuel oil on board and 1,500 tonnes of diesel, together with a very mixed cargo, some of which was highly toxic. Examples included Methyl bromide (34.4 tonnes in cylinders) a highly toxic gas causing nausea, vomiting, convulsions and pulmonary oedema, Tetrachloroethylene (60 drums), a liquid solvent, irritating to skin, respiratory and gastrointestinal tract, causing respiratory depression and loss of consciousness, herbicides, Phosphorus pentasulphide and Toluene diisocyanate with a variety of risks to human health and the environment.

A multiagency Strategic Coordinating Group (SCG) was established on Friday, 19 January, with direct links to Government through the SOSREP. The SCG requested that an Environment Group be convened to advise on the impact on human health and the wider environment. This Environment Group provided scientific and technical advice to the Salvage Control Unit, but it took several days to establish good communications between salvers and land based command. At an early stage, media reporting teams were established to liaise with press and to issue advisory messages to the public and media interest.

Early actions advised were particularly aimed at protecting the environment and the food chain from oils. By Sunday, 20 January, the heavy seas resulted in 150 containers being lost. These were not thought to contain hazardous materials. The ship's manifest confirmed that hazardous materials were stored in the centre of the hold with non hazardous cargo on the outside. Six teams of coastguards walked the beaches to identify oil and containers. Key messages issued from these data included recommendations to close beaches; inform reconnaissance staff to avoid contact with broken containers; and the Salvage Control Unit to be notified if hazardous material was identified.

However, early on in the incident, the valuable nature of some of the cargo attracted public interest. "Sky News" reported that there were beer kegs, motorbikes and Toyota cars on the beach and looting had already begun. As soon as containers were reported as coming ashore on the morning of Sunday 21 January, the tone of the media coverage changed. Newspapers printed maps of where beached containers lay and speculated about their potential contents. One of the first pictures from the scene of a broken container was of a a brand new motorcycle being wheeled away. By Sunday afternoon, drums of nitric acid, potassium hydroxide and Isopropanol were also lost. Isopropanol is a highly flammable chemical and the advice to the shoreline responders was to avoid contact with sparks, try to prevent entry into waterways and cover spillages with sand/soil; the isopropanol would naturally decompose to water and carbon dioxide.

On the Monday morning (22 January), hundreds of people appeared on the beach Any limited Police cordon had gone and there was free and easy access to the beach. Numerous journalists and photo journalists were also roving and reporting from the beach.

The press conferences and media statements issued were now used to promulgate the message that removing goods from the containers was stealing, and was not, as was the general consensus, a ‘free for all’. Overnight news desks were contacted with a robust line about stealing and talk shows were requested to carry the line of discouraging people who were planning to come to the beach. Health protection queries continued to focus on the likely health effects if members of the public and those involved in the environmental clean-up operation were exposed to open containers of chemicals washed up onto the beaches. A decision was made not to use volunteers in the early stages of the clean up due to the hazardous nature of some of the cargo.

Looting however continued throughout the 22nd and the 23rd by which time worldwide TV had broadcast scenes of it in sufficient detail to allow distant individual viewers to recognise their own property in someone else’s hands. Congested villages were made worse by vehicles left on roadsides and in residents’ driveways. Respect for property was negligible and not immune from the looting frenzy.

By early Tuesday, the onshore salvors arrived and set up their compound at the top of the beach, which was a precursor to a different ‘ownership’ of the salvage. Attitudes changed and decisions were promptly taken to close the beach, and police and coastguards were joined by private security.

Despite the public being attracted by ”loot” to an area where a number of hazardous materials were washed up, there was only one casualty overcome by fumes from a burning container.

Images illustrating scenes on beach following containers washing ashore (ship in background) (HPA Archive)

Over the next six months the 3,500 tonnes of fuel oil and all containers were systematically removed. The final container was removed on 17 May 2007.

Conclusions

- The impact of the media and the need to develop and issue prompt and unambiguous messages was clearly illustrated by the events of the Napoli incident.
- Post-incident review by agencies involved identified that communication problems were at the heart of the difficulties experienced during the initial shoreline and landward phase of the incident with three initial distinct problematic areas:
    - Between agencies / responders;
    - Officially to the public;
    - Among the media.
- These findings suggested that, had communication between all parties been tight and comprehensive, the beach could have been properly closed to the public from late on Saturday for reasons of public safety and the prevention of crime.

Recommendations

- Recommendations found that the most important overall lessons to be learned from the whole Napoli landward experience involved:
    - having a single individual in total command,
    - creating a much simplified organisational system,
    - providing a communication protocol that is readily understood and foolproof,
    - planning for confronting the development of the worst case scenario,
    - ensuring that all contingency plans cascade down to all parties.
- Finally the incident illustrates how early engagement with key stakeholders in media and public is vital to disseminate key messages concerning safety and response.

Key Points

- Communications form an intrinsic aspect of incident management and clearly defined protocols are essential.
- This can often have international connotations for maritime incidents requiring trans-boundary response and co-operation
- Media messages can have a significant impact upon public response and as such early engagement between incident managers and the media is essential.
- Social media is becoming an equally powerful tool for dissemination of messages and information to the public and again needs to be given consideration
- Consistent, unambiguous and timely messages are vital to ensure public and media trust.

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Case Study #005

Title: Incident Response – Risk Management

Introduction

Marine incidents require that human safety should have the highest priority, as defined within the International Convention for the Safety of Life at Sea (SOLAS) 1974. However, this requirement is not only restricted to a vessel where there has been a casualty, but also to responders and the public, particularly where potentially hazardous substances e.g. HNS, may be released. Furthermore, incidents may pose risks to the environment and result in an impact upon marine life, coasts and estuaries, with implications for fishing, jobs and tourism. Thus clearly defined risk management and response procedures for all key receptors are essential. In general, response options can be grouped into two categories.

- Onboard actions to safeguard the crew, vessel and cargo. The operational response is designed to prevent, stop or contain a release without putting crew members at significant risk. This can involve salvage activity to contain any hazardous materials, controlled releases and methods to reduce wider dispersion, such as sprinkler systems.

- Wider area risk management actions to safeguard responders, the public, resources, facilities etc., within the area that may be impacted by the release. Risk area actions include: public evacuation, closure of recreational areas, fishing restrictions, etc.

The following examples illustrate the kinds of risk management procedures that have to be implemented in the event of maritime incidents where hazardous chemicals are involved and the impact of such hazards.

Case studies

Two examples are presented to illustrate the impact of and response to maritime incidents involving HNS. The first relates to the *Multitank Ascania* in 1999, carrying 1800 tonnes of highly flammable vinyl acetate monomer. The ship caught fire off the coast of Scotland, requiring prompt actions from responders to prevent a major catastrophe. The second relates to the *Cason,* a cargo ship carrying 1100 tonnes of HNS, which ran into trouble off the coast of Spain in 1987, in this case resulting in severe impact on life and public safety. Both cases have been widely reported.

Narrative

Multitank Ascania

On 19 March 1999, a fire started in the machine room of the Cypriot chemical tanker *Multitank Ascania* as she passed through the Pentland Firth, between Scotland and Orkney in the North Sea. The crew made unsuccessful attempts to extinguish it, the engines were stopped and the carbon dioxide system was activated to try to extinguish the flames. The ship was adrift in heavy seas and gale force winds, which were pushing her towards land. The ship was carrying 1800 tonnes of highly flammable vinyl acetate monomer, as well as several hundred tonnes of fuel and oil.

Vinyl acetate is a highly flammable volatile liquid. It reacts with a range of oxidising agents, acids, alkalis and water. It can cause irritation and damage to the respiratory tract and eyes and is a possible human carcinogen.


Multitank Ascania and location of incident (MCA)

The UK authorities were notified and immediately coordinated onboard response comprising a search and rescue effort consisting of an RAF helicopter, local lifeboats, a coastguard rescue helicopter, a harbour tug and a coastguard emergency towing vessel. All crew except the master were airlifted to safety.

The UK's MCA were alerted to a pollution risk from the vessel's cargo, together with fuel oil and diesel which was onboard, requiring a wider area risk management response. An eight person chemical strike team was formed and flew to the area, with a second aircraft being chartered to fly response equipment to the scene. The main risk posed by the incident was that of explosion due to the fire igniting the vinyl acetate cargo, and any ensuing pollution. Chemical spill modelling was used to predict the extent of a risk area, in the event that the chemical be released into the atmosphere. An exclusion zone within a radius of 5 km was set up by the MCA, whilst the local police force implemented the evacuation of 600 local residents. The evolution of the fire was monitored using a thermal imaging camera from a helicopter.

The following day, 2 salvage personnel were lowered onto the vessel. They reported that the fire appeared to be out. The fire was thought to have been caused by thermal oil leaking from a pump of the thermal oil system. No pollution was detected. A procedure for a ship-to-ship transfer of the cargo onto a lightering tanker was implemented. As it no longer constituted a danger, the vessel was towed to the coast and moored alongside Lyness Pier. The transhipment was made on 29 March and took 11 hours. On 30 March, the *Multitank Ascania* was then taken under tow to Rotterdam for repair.

Cason

On 5 December 1987, the cargo ship *Cason*, transporting 1,100 tonnes of HNS, caught fire and whilst attempting to seek safety ran aground off the Galician coast near Cape Finisterre, Spain. The cargo was composed of nearly 5,000 barrels, cans, containers and bags of flammable products (xylene, butanol, butyl acrylate, cyclohexanone, sodium), toxic products (aniline, o-cresol) and corrosive products (phosphoric acid, phthalic anhydride). An explosion occurred when the containers filled with sodium on the deck cargo came into contact with seawater, resulting in a violent exothermic (heat producing) chemical reaction.

The Cason on fire (image: CEDRE) and approximate location of incident (google maps)

European and IMO chemical teams were deployed to identify chemical hazards on board as information on the cargo was poor. In addition, 15,000 members of the public were evacuated overnight from local regions as a precaution following the explosion. A plan to unload the vessel was implemented over a 3 month period with continuous monitoring of air and water. Fisheries were closed with corresponding impact upon local trade and commerce until risks had been mitigated. It was discovered that 23 out of the 31 crew members died as a result of the fire and explosion on board.

Conclusion

- Maritime incidents can result in severe impacts to safety of crews and responders and to wider public health and the environment. Risks are higher when ships carry wide ranges of potentially hazardous cargo, posing the potential for fire, explosion and reactions with air and water and other chemicals on board, as illustrated so tragically by the *Cason*.
- Information about cargos and damage is vital for assessing both on-board and wider risks and a rapid on board presence can assist in informing wider risk assessment. Adopting a precautionary approach to wider public health and environmental protection is often the most reliable option until detailed assessment can be undertaken.
- This can however have wider effects, such as disruption of normal life, as in the case of evacuation, and impacts on trade and livelihood such as when fisheries are closed or tourism affected.

Recommendations

- As in the case of planning and preparedness, timely and accurate supply of information is vital to establish appropriate levels of response to a maritime incident.
- Clear lines of command and communication will ensure rapid response both at sea and on the shoreline.
- Precautionary advice is often the primary option for wider health and environmental issues, until detailed risk assessment can be completed. In such cases decisions must be made as to the risks versus benefits of interventions such as evacuation.
- Lessons learnt from such incidents need to be disseminated widely and incorporated into future planning , such that preparedness s enhanced and risks mitigated.

Key Points

- Response generally involves both on board actions and wider area actions
- Obtaining and assessing information as early as possible will greatly assist in the response strategy
- Risk assessment is essential to response and risk management and should consider responders, wider public health and environmental impacts.
- Multiagency communication and command structures will assist in achieving timely intervention.
- Precautionary advice may be the only option at times but may have its own impacts, requiring consideration when decisions are being made.

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Case Study #006

Title: Incident Response and Recovery – Use of Dispersants

Introduction

The appropriate use of chemical oil dispersants in response to maritime spills can be of value for protecting marine and shoreline ecosystems, although some studies have identified concerns regarding potential eco-toxicity of some dispersants. Despite this dispersants have been successfully used to mitigate the impacts of large oil spills such as the Sea Empress spill in the United Kingdom in 1996.

Whilst the treatment of oils is well established, the options for treating chemical spills at sea are less so. Furthermore many novel treatments are still at an early stage of investigation and could in themselves result in detriment to the environment and potentially human health. Similarly, use of established oil dispersants in unfavourable conditions or inappropriately can also risk detrimental impact.

It is critical, therefore, that effective environmental monitoring and impact assessment practices are in place to properly assess the true significance of a spill (and any subsequent clean-up activity) and to learn lessons for future events.

The following case study illustrates how dispersants were applied during the Deepwater Horizon incident in the Gulf of Mexico and some of the issues arising from their use.

Summary

In April 2010, a blow-out on the Deepwater Horizon rig in the Gulf of Mexico, USA caused what is thought to be the largest marine oil spill in the history of the petroleum industry. The ensuing clean-up was one of the largest oil spill response operations ever undertaken, involving more than 3,700 vessels, 75 aircraft and more than 700,000 metres of boom. More than 14,300 people worked on the response. More dispersant was used on the spill than in any other oil spill in U.S. history. Moreover, for the first time ever, the United states Environmental Protection Agency (USEPA) approved using dispersants not only at the surface but deep underwater at the source of the spill. Approximately 1.84 million gallons of dispersant were applied, with more than 1 million gallons on the surface and 771,000 gallons pumped deep into the water column to dilute and disperse the oil.


Deepwater Horizon and Dispersant being applied to an area of the spill.

Narrative

On 20th April 2010 a blow-out on the Deepwater Horizon rig in the Gulf of Mexico caused a massive release of oil from the sea bed, prompting a world-wide response. The spill stemmed from a sea-floor "oil gusher" that resulted from an explosion on the rig, which killed 11 men working on the platform and injured 17 others. An estimated 53,000 barrels of oil per day escaped from the well.

The spill caused extensive damage to marine life and habitats and to the Gulf's fishing and tourism industries. Scientists also reported immense sub-surface plumes of dissolved oil and an 80-square-mile (210 km^2) "kill zone" surrounding the blown well i.e. an area where marine life was unable to survive as a result of the direct and indirect toxicity of released oils. The amount of Louisiana shoreline affected by oil grew from 287 miles (462 km) in July 2010 to roughly 491 miles (790 kilometers) of coastline in July 2011.

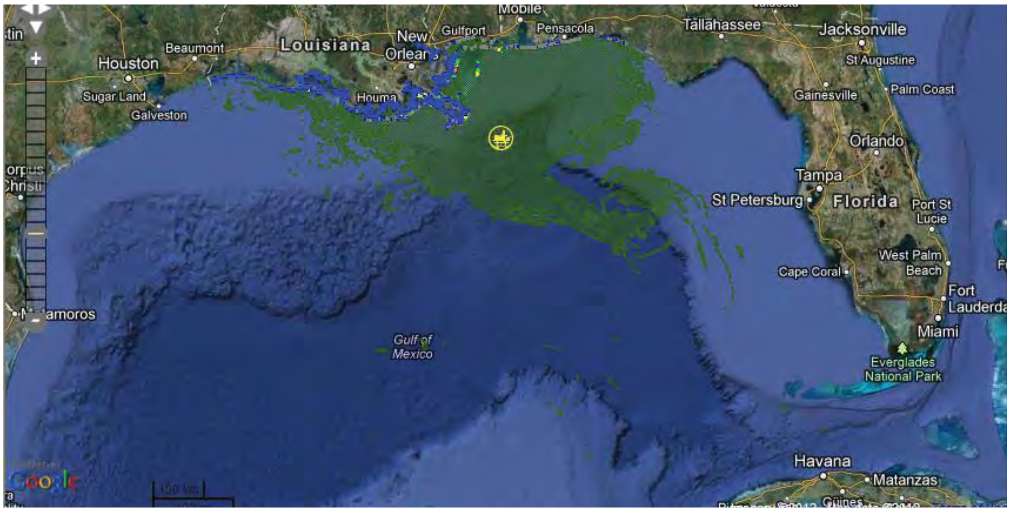

Illustration of impact of oils from Deepwater Horizon (ERMA Gulf Response)

On 15 July 2010, the well-head was capped after it had released about 4.9 million barrels (780,000 m^3) of crude oil. On 19 September 2010, a relief well process was successfully completed, and the federal government declared the well "effectively dead". In August 2011, oil and oil sheen which matched the profile of oils in the field drilled by the Deepwater Horizon were still reported to be surfacing over several square miles of water and seepage of oils was reported as recently as March 2012.

Dispersants were used in an attempt to protect the hundreds of miles of coastline from the spreading oil. Dispersants have two main components: a surfactant and a solvent. Surfactant molecules are made up of two parts: an oleophilic part (with an attraction to oil) and a hydrophilic part (with an attraction to water). When dispersants are sprayed onto an oil slick, the solvent will transport and distribute the surfactants through the oil slick to the oil/water interface where they create a reduction in the surface tension encouraging oil droplets to drift apart and become degraded by naturally occurring bacteria.

While dispersants were aimed at reducing the impact of surface oils on shorelines and wildlife, dispersants and dispersed oil under the ocean were reportedly increasing the exposure of a wide array of marine life in the water and on the ocean floor to the spilled oil.

Dispersants have to undergo considerable testing and assessment by regulatory authorities before they can be approved for use. Responders used two dispersants which although approved by the USEPA, were banned from use in the United Kingdom because laboratory tests found them harmful to marine life that inhabits rocky shores. Of the 18 dispersants approved for use by the EPA, seven were found to be less toxic than those used in the Gulf. Furthermore dispersants were also permitted to be used below the surface of the ocean to disperse oils emerging from the well, which deviated from standard operating practise.

Despite the potential benefits to the shoreline from the use of dispersants, the combination of using massive amounts of potentially harmful chemicals and the apparent uncertainty and changes in process during the response led to considerable public concern.

The USEPA and operators have undertaken a massive program of environmental monitoring as part of the response process and whilst monitoring has now ceased continues to report its findings. Subsurface oils have been monitored at generally less than 1 part per billion, whilst sampling has that Gulf shown seafood is safe to eat. The recovery program is still ongoing with weathered tar balls still appearing on beaches and oils remaining in wetlands and below tidal sands and sediments.

In January 2011 the White House oil spill commission released its final report on the causes of the oil spill. In June 2010 BP set up a $20 billion fund to compensate victims of the oil spill. To July 2011, the fund has paid $4.7 billion to 198,475 claimants. In all, the fund has nearly 1 million claims and continues to receive claims.

Conclusion

- Maritime incidents can cause extreme environmental and human health impact.
- Whilst the use of dispersants to break-up heavy oils at sea and prevent these coming ashore has proven to be an effective means of response to several major incidents, the use of such chemicals must be carefully controlled and supported by effective monitoring programmes.
- Monitoring not only enables the potential benefits of their use to be demonstrated and the potential impacts of dispersed oils to be assessed, but also provides reassurance to concerned parties.

Recommendations

- Responding to maritime incidents involves assessment of a range of complex issues.
- Treatments need to be assessed in terms of their benefit and potential impact and in the case of dispersants require clear regulation concerning the types used and their application, backed up by robust scientific evidence.
- A hierarchical approach to response techniques should be considered with methods to contain and remove spills being preferential to dilution and dispersion.

Key Points

- Whilst dispersants can potentially remove large amounts of certain oil types from the sea surface some concerns exist around their use, as they do not remove the oil but transfer it into the water column to become more amenable to natural degradation, and can in themselves pose potential eco-toxicity risks.
- Methods that introduce chemicals into the environment must be applied with great care to ensure they do not create actual or perceived problems, with consideration of oil type, sea and weather conditions and potential environmental sensitivity.
- Transparent and scientifically robust selection and regulation criteria for dispersant use in response strategies should be a pre-requisite.
- Comprehensive environmental monitoring is essential to validate any response programme.

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Case Study #007

Title: Recovery – Bioremedation of Oil Spills

Introduction

Once the initial response to a chemical incident has been completed and the release and associated risks have been controlled, the focus inevitably shifts to restoring conditions to their original state, both in terms of environmental aspects and chronic human health risks. For example following a maritime spill of oil, the initial response will be concerned with making the ship and its crew safe, and protecting wider environmental and human receptors by primary treatment actions for mass removal and prevention of further releases. There will undoubtedly however be some degree of impact upon the environment with consequent ecological and human effects such as effects on wildlife, fisheries and amenity. Such impacts require an element of recovery either by natural processes or by means of secondary treatment techniques.

Bioremediation has emerged as one of the most promising secondary treatment options for oil removal as part of the recovery phase. It has been defined as the act of adding materials to contaminated environments to cause an acceleration of the natural biodegradation processes.

The success of oil spill bioremediation depends on an ability to establish and maintain conditions that favour enhanced degradation in the contaminated environment. There are 2 main approaches to achieve this:

• Bio-augmentation, in which known oil-degrading bacteria are added to supplement the existing microbial population, and
• Bio-stimulation, in which the growth of indigenous oil degraders is stimulated by the addition of nutrients or other growth-limiting co-substrates, and/or by alterations in environmental conditions (e.g. surf-washing, oxygen addition by plant growth, etc.).

Bioremediation has several advantages over conventional technologies in that it is relatively inexpensive, is a more environmentally benign technology since it involves degradation of oil to mineral products (carbon dioxide and water), and since it is based on natural processes and is less intrusive to the contaminated site, it is often more acceptable to the general public. Equally the process has its limitations including lengthy timescales to complete the process, agreement of safe end-points (residual concentrations), potential for toxic intermediate products and limited effect on certain chemical components such as polyaromatic hydrocarbons (PAHs)

The following case study illustrates its application as part of the restoration program following the *Exxon Valdez* oil spill in Alaska.

Summary

Following the grounding of the super-tanker *Exxon Valdez* on Bligh Reef in Prince William Sound in 1989, U.S. EPA, in conjunction with the Exxon Corporation and the state of Alaska, embarked on the largest oil spill bioremediation project ever attempted in the field. Extensive field trials at various sites were conducted. Results indicated enhanced reductions in oils on the shoreline and concluded that bioremediation offered an environmentally sound remedial technique based upon

toxicity testing against sensitive marine species and potential indirect impacts such as algal growth from nutrients added during treatment.

Narrative

The *Exxon Valdez* grounded on Bligh Reef in Prince William Sound, Alaska, on 24 March 1989. About 37,000 tonnes of crude oil escaped and spread widely. At-sea response concentrated on containment and recovery. Despite the utilisation of a massive number of vessels, booms and skimmers, less than 10% of the original spill volume was recovered. The oil subsequently affected a variety of shores, over an estimated 1,800km along Alaska's south coast.

The spill attracted an enormous amount of media attention because it was the largest spill to date in US waters. Moreover, it happened in a scenic wilderness area with important fisheries and wildlife. About 1,000 sea otters are known to have died, and over 35,000 dead birds were retrieved. Shoreline cleanup techniques included high pressure, hot water washing, and relatively large scale bioremediation trials.

- The bioremediation technique involved addition of fertilizers to enhance the growth of microorganisms naturally present in the environment. Increased availability of nitrogen and phosphorus thus stimulated the microorganisms present to utilize hydrocarbons as a carbon source for energy and biomass. Approximately 50,000 kg of nitrogen and 5,000 kg of phosphorus were applied over 120 km of the oil contaminated shorelines during 1989 and 1992. The results of the fertilizer application following the Exxon Valdez spill generally demonstrate that bioremediation may enhance oil biodegradation on certain marine shorelines. Specific findings included

- Fertilizer application potentially accelerated the rate of oil removal by a factor of approximately five-fold compared to natural attenuation.
- Oil biodegradation on the shoreline was limited by the concentration of nutrients, and not by the absence of hydrocarbon-degrading microorganisms;
- According to the EPA/Exxon/State of Alaska joint monitoring program, bioremediation was an environmentally sound remediation technique based on the results of testing the toxicity of nearshore water to sensitive marine species, analyzing ammonium and nitrate concentrations, evaluating the potential of algal growth, and monitoring oil release into nearshore water after the application of fertilizers.
- During the cleanup of the spill, the cost of bioremediating 120 km of shoreline was less than one day’s costs for physical washing.

Images of the shoreline clean-up and slick following the spillage

Conclusion

Bioremediation was tested as a means of secondary treatment of oil impacted shorelines following the Exxon Valdez spill in Alaska. Several key findings from the results included;

- increased rate of oil degradation from nutrient treatment compared to natural processes, although exact rate dynamics are uncertain.
- safe use in marine shoreline environments
- cost effectiveness compared to other physic-chemical options.
- Mass balance estimated that about 3 years after the spill, approximately 20% of the spilled oil had evaporated and undergone photolysis in the atmosphere; approximately 14% was recovered and disposed of; approximately 2% remained on intertidal shorelines and 13% in subtidal zones. Approximately 30% of the oil was biodegraded in the water column, and nearly 20% was biodegraded on the shorelines, although not specifically on those shores where treatment was trialled.

Recommendations

- Bioremediation offers an option for recovery phase / secondary treatment of oils in shoreline environments.
- Bioremediation is less well understood in terms of its application to spills in open sea, where microbial numbers are considerably lower than those in shoreline environments.
- When considering its use responders should be mindful that not all chemical components in oil are degradable, that nutrient application should be controlled to minimise risks such as eutrophication and that remedial end-points are suitably protective of both health and environmental receptors and sufficiently validated.

Key Points

- Following initial response to maritime incidents there is often a requirement for managed recovery of affected areas, including ecosystems, commercial fisheries and amenities.
- Recovery may often require secondary treatment of residual chemicals.
- Bioremediation is seen as a useful option for secondary treatment of oil spills, being based upon natural processes and being relatively low cost.
- Limitations for its application shoud be considered when designing recovery plans.
- Any treatment regime must be suitably monitored and validated to ensure it has achieved acceptable end-points in terms of ecological and health protection.

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Case Study #008

Title: Recovery – Public Health Follow-up

Introduction

Recovery phase actions following maritime incidents are not just about environmental restoration but also about providing reassurance and after care for communities exposed to the event. The World Health Organisation Manual for Chemical Incidents considers recovery as a broad spectrum of activities including follow-up, aftercare, restoration and rehabilitation and covers economic and environmental aspects as well as health. As such it defines recovery as restoring an affected community back to its original state and prevention of such incidents in the future.

Whilst the acute effects of exposure are fairly well known there is less evidence on the longer-term impacts of maritime spills on public health, particularly in the case of HNS.

Studies to record and interpret health data following incidents can provide valuable information on potential longer term effects on public health and as such recovery phase response should include initiation of health registers via hospital and GP liaison and use of wider health statistics.

Some studies have been undertaken on local communities following major oil spills, including the *Sea Empress* in Wales, the *Braer* in Scotland and the *Exxon Valdez* in the USA. All of these studies indicated that such incidents were followed by increases in physical and psychological symptoms in the exposed population and as in the case of the *Sea Empress*, physical symptoms were consistent with the toxicological effects of the chemicals involved in the spill. As in the case of the *Sea Empress* many of the studies were retrospective and as such their findings should be viewed with an element of caution in view of possible confounding factors such as recall bias.

In addition to impact upon the wider population, large maritime incidents also involve an element of local, often voluntary, participation in clean-up operations. Again longer term health effects need to be considered for these groups.

The following case study illustrates one such follow-up study on the health of local fishermen who assisted in the response following the *Prestige* incident in Spain.

Summary

The wreckage of the oil tanker *Prestige* in November 2002 produced heavy contamination off the coast of Galicia, Spain and resulted in the involvement of large numbers people in the subsequent clean-up operations.

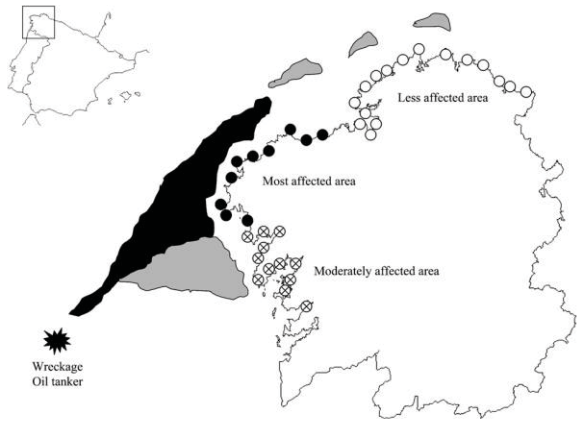
Many of these were local fishermen involved in collection and removal of oils, often without provision of personal protective equipment or information on risks associated with pollutants.

Health assessments indicated a range of acute respiratory symptoms reported by those involved in clean-up activities, whilst follow up studies of volunteer fishermen found clear associations between longer-term respiratory effects and involvement in clean up operations.

Narrative

On Wednesday 13 November 2002, the single-hulled oil tanker *Prestige* sent a distress call offshore in the region of Cape Finisterre (Galicia, Spain). The tanker, carrying 77,000 tonnes of heavy fuel oil loaded in St Petersburg (Russia) and Ventspils (Latvia), was heading to Singapore via Gibraltar. The vessel developed a reported 30 degree starboard list whilst on passage in heavy seas and strong winds and hence requested partial evacuation of the crew.

The ship was taken in tow by a Salvage vessel on 14 November and towed on various differing courses over several days. On the 19th at 9 am, the vessel broke in two, about 130 nautical miles off the Spanish coast, west-southwest of Cape Finisterre. At 12 pm, the stern part of the Prestige sank into 3500 metres of water. The bow followed at about 4 pm. Large quantities of heavy oil were released from the wreck affecting 6 countries in total. Considerable on and off-shore response techniques were employed, many governed by the nature of the heavy weathered oils and prevailing weather and tidal conditions. More than 100,000 people were involved in clean-up activities.



The Prestige sinking (Source: BSAM/Douanes françaises) and map illustrating location of oil

During the first weeks of the disaster, clean-up work was done mainly by local fishermen and their families gathering, transporting, and storage of the oil, and cleaning containers and clothes used during clean-up work.

In a study performed in 2003, various acute health problems were reported by volunteers and paid workers shortly after doing clean-up activities. Apart from musculoskeletal problems, the most commonly reported symptoms included headaches, dizziness, eye and throat irritation, and respiratory problems.

The spilled oil from the Prestige contained a variety of volatile hydrocarbons: principally alkanes and various aromatic compounds, including benzene, toluene, and styrene. Many of these volatiles are known to have irritant properties to the mucosal membranes. Personal exposure measurements in volunteers who gathered oil from the beaches revealed a mean concentration of total volatile hydrocarbons of 500 mg/m3

A large cross-sectional follow-up study was undertaken after the event. Questionnaires including qualitative and quantitative information about clean-up activities and respiratory symptoms were distributed among fishermen's cooperatives. The association between participation in clean-up work and respiratory symptoms was evaluated and adjusted for sex, age, and smoking status. Between 2004 and 2005, data were obtained from 6,780 fishermen (response rate, 76%) 63% whom had participated in clean-up operations. Prevalence rates of lower and upper respiratory tract symptoms were significantly higher in fishermen/women who had participated in clean-up activities Furthermore, a significant dose-related trend was seen when evaluating number of days, average number of hours per day, and number of different activities with reported symptoms. No associations were found between participation in clean-up work and chronic bronchitis or rhinitis

Conclusion

- Maritime incidents can pose significant short and long-term impact, requiring considerable manpower and resources to remediate.
- It is often the case that many of those involved in response and recovery activities will be volunteers, who may not have the training and understanding of risks associated with chemicals arising from the incident. Furthermore local communities may be widely impacted beyond the immediate vicinity of an incident by various hazards both actual and perceived.
- All of these factors have been indicated to give rise to longer-term physical and psychological effects on exposed communities.
- Thus ongoing health assessment is essential as part of any recovery phase in order to provide a means of assessing longer-term effects and treatment and to re-assure those communities involved.

Recommendations

- Whilst the database is small, studies have demonstrated physical and psychological effects on health resulting from maritime incidents, particularly in relation to oils.
- Based upon these studies it is apparent that follow-up health programmes should be a key requirement of recovery phase plans for maritime incidents.
- This will not only benefit the exposed populations in terms of reassurance and treatment but will also strengthen the understanding of longer-term impacts from maritime incidents, particularly in respect of HNS.

Key Points

- Maritime incidents involving oils and chemicals can have both short and longer-term impacts on health of exposed populations.
- Members of local communities volunteering to assist in shoreline and wildlife clean-up may be directly exposed to pollutants during these activities. In addition, potential for exposure of the wider community may also occur such as from airborne chemicals and/or odours.
- Several studies have identified associations between physical and psychological symptoms and exposure to chemicals from maritime spills, although the database is currently limited particularly with respect to HNS.
- Public health follow-up should be a key aspect of the recovery phase following any maritime incident involving oils or HNS

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