Oil Spill in Estancia

Iloilo Province, Western Visayas, Philippines
Resulting from Typhoon Haiyan (Yolanda)
8 November 2013

Joint Assessment Report

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Cover photo: Oil spill in Estancia town, Iloilo province, Philippines, picture taken on 21 November 2013 by Corporal Ariane Montambeault

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The Joint UNEP/OCHA Environment Unit (JEU) assists Member States in preparing for and responding to environmental emergencies by coordinating international efforts and mobilizing partners to aid affected countries requesting assistance. By pairing the environmental expertise of the United Nations Environment Programme (UNEP) and the humanitarian response network coordinated by the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), the JEU ensures an integrated approach in responding to environmental emergencies. The Environmental Emergencies Centre (EEC) (www.eecentre.org) is an online tool designed to build the capacity of national responders to environmental emergencies developed by the JEU.

Executive summary

A significant spill of heavy oil (bunker C type) occurred when Power Barge No. 103 ran aground at the shores of Estancia during the height of typhoon Haiyan. Between 21 and 23 November, environment experts from the Philippines Environmental Management Bureau visited the site of the oil spill together with a United Nations Disaster Assessment and Coordination (UNDAC) environment expert, and a public health expert from the World Health Organization, in order to jointly undertake a preliminary assessment of the threats the spill poses to human health, livelihoods and the environment.

Current estimates by the management of the power barge amount to around 800,000 litres of oil having leaked. As the ruptured tanks continue to leak and up to 600,000 litres of oil remain in the tanks, the amount of spill is increasing steadily. Urgent action is required to pump out the remaining oil or seal the holes in the tanks.

Most of the spilled oil has washed ashore, contaminating the coast and mangroves up to 10 kilometres downstream. The containment booms deployed are not sufficient to effectively contain all of the free phase oil in the water. The free phase oil has been blown ashore by southeastern winds so far. A change of wind direction or a tropical depression could further complicate the containment of the free phase oil. A faster, mechanical clean-up process with oil skimmers is urgently required.

An urgent need for recovery and clean up equipment and expert advice has been identified. A request for technical assistance to the Environmental Management Bureau in Iloilo has been received by the United Nations on 22 November and an oil spill clean-up expert was deployed on 27 November.

Temporary workers who have been hired for the clean-up operations continue to stay close to the site of the accident. The workers are currently exposed to significant occupational health risks due to the unsafe and ineffective practice of manual recovery of free phase oil in the open water and the insufficient and inappropriate provision of personal protective equipment. Immediate change in the management of the clean-up operation is required in order to protect the workers from unacceptable health risks.

The contamination of the coast is putting the resident population at risk from accidental fires and other physical injuries. The chemical risk to the affected population is limited as long as direct contact with contaminated debris is avoided. The physical risk to the people sheltering in the immediate vicinity of the oil spill has been mitigated with the evacuation of most of the population to a temporary evacuation centre. With every day the clean-up process is delayed, the affected population does not get the opportunity to recover and will continue to depend on humanitarian relief.

The oil spill is a threat to the livelihoods of the population who depend mainly on fishing and tourism, and having been heavily affected by the typhoon. This increases the vulnerability of the population who has been severely affected by the typhoon with many houses severely damaged. As of 27 November, electricity is still not available in Estancia. The sea, shore, rivers and mangroves south of Estancia have been affected by the oil spill. Appropriate mitigation measures are urgently required in order to limit the effects on human health, livelihoods, and the ecosystem. Some preliminary recommendations have been formulated in this report.

List of acronyms and glossary of terms

CDC	U.S. Centres for Disease Control and Prevention
DENR	Department of Environment and Natural Resources
DSWD	Department of Social Welfare and Development
ECHO	European Community Humanitarian Aid Office
EU	European Union
EUCP	European Union Civil Protection
EMB	Environmental Management Bureau
IOM	International Organization for Migration
JEU	Joint UNEP/OCHA Environment Unit
NAPOCOR	National Power Corporation
NDRRMC	National Disaster Risk Reduction and Management Council
NIOSH	U.S. National Institute for Occupational Safety and Health
NIPSC	Northern Iloilo Polytechnic State College
NOAA	National Oceanic and Atmospheric Administration
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
PPE	Personal Protective Equipment
SCAT	Shoreline Clean-up and Assessment Technique
UN	United Nations
UNDAC	United Nations Disaster Assessment and Coordination
UNEP	United Nations Environment Programme
WHO	World Health Organization

An environmental emergency is defined as a sudden onset disaster or accident resulting from natural, technological or human-induced factors, or a combination of these, that cause or threaten to cause severe environmental damage as well as harm to human health and/or livelihoods.

UNEP/GC.22/INF/5, 13 November 2002

1 Background and Context

Typhoon Haiyan (known locally as Yolanda) made first landfall in the early morning of 8 November in Guiuan, Eastern Samar province, with maximum sustained winds of 235 km/h and gusts of 275 km/h. Haiyan made subsequent landfalls in Tolosa (south of Tacloban City), Leyte province; Daanbantayan and Bantayan Island, Cebu province; Conception, Iloilo province; and Busuanga, Palawan province. Experts estimate the storm was among the strongest ever to make landfall. It left a wide path of destruction and debris in its wake, with estimates of casualties and damage fluctuating considerably in the immediate aftermath.

On 9 November, the Government accepted the UN offer of international assistance. A global appeal for $301 million was launched on 12 November, with food and shelter requirements the top priorities. Access to people in need was initially severely limited due to damaged roads, fallen trees and debris. All main roads were passable as of 15 November, but debris continues to hamper access to remote areas.

As of 24 November, the Department of Social Welfare and Development (DSWD) and the National Disaster Risk Reduction and Management Council (NDRRMC) reported 13.17 million affected people, 3.43 million people displaced, 1.1 million damaged houses and more than 5,000 reported deaths and 1,600 people still missing as result of the typhoon.

1.1 Oil Spill from power barge in Estancia, Iloilo, Western Visayas

At the height of typhoon Yolanda, Power Barge No. 103 owned by the Philippine's National Power Corporation (NAPOCOR), which was moored to the South of the town of Estancia, broke loose and ran ashore. According to initial reports from the Philippines Coast Guard[1] and in the media, around 200,000 litres of bunker oil spilled into the sea and were mostly washed ashore at Barangay Botongon, Estancia, contaminating about a kilometre stretch of Estancia's coastline in this large tidal bay of the Visayan Sea.

1.2 Bunker oil

Bunker oil is known as a residual oil since it is manufactured from the distillation residues of oil refinery processing. It is a mixture of high molecular weight aliphatic and aromatic hydrocarbon compounds, including poly-nuclear hydrocarbons. Bunker oil is typically contaminated with other chemicals such as nickel, vanadium and sulphur and may contain hydrogen sulphide. It is highly polluting when burned. Bunker oil may be mixed with lighter, more volatile hydrocarbon products. It is heavy, viscous, difficult to pump or disperse and has low volatility. It is likely to form tar balls, lumps and emulsions.[2]

1.3 Potential adverse health effects of bunker oil

Potential adverse health effects from exposure to the spill depend on the route, amount and duration of exposure. Exposure can occur from skin contact, ingestion, or inhalation. Bunker oil is not highly volatile, however there may be some vapours at high temperatures and mist may be generated by wave action or pressure hose cleaning, with a risk of inhalation and eye exposure. Prolonged or repeated skin exposure can result in drying, reddening and irritation of the skin. Ingestion of oil may occur from contaminated food or water, however, most people can smell or taste oil contamination at low levels and this should be a signal not to consume the substance. Ingestion of contaminated food or water may cause gastro-intestinal irritation. Exposure to the fumes or vapour has been reported to cause headache, itchy eyes, nausea, vomiting, dizziness, throat irritation and respiratory symptoms[3]. There may be an exacerbation of pre-existing respiratory conditions such as asthma. In most cases the adverse effects will disappear over a few days once the person is removed from exposure.

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[1] http://www.coastguard.gov.ph/index.php?option=com_content&view=article&id=2811:pcg-contains-oil-spill-from-napocor-barge-in-estancia-iloilo&catid=36:maritime-accidents&Itemid=50

[2] U.S. Environmental Protection Agency - http://www.epa.gov/osweroe1/content/learning/refined.htm

[3] U.S. Centers for Disease Control and Prevention -http://www.cdc.gov/niosh/topics/oilspillresponse/protecting/appendixa.html

People involved in clean-up operations are likely to have prolonged and close contact with the bunker oil if they do not use adequate personal protective equipment. In addition to the adverse effects described above, workers involved in clean-up activities may develop persistent respiratory effects.[4] Bunker oil is classified by IARC as possibly carcinogenic to humans (Group 2B)[5]. Some of the constituents of bunker fuel are known to be carcinogenic following chronic occupational exposures[6][7]. However, short-term exposure is unlikely to increase the lifetime risk of developing a cancer.[8]

1.4 Potential impacts on the food chain

A bunker oil spill can contaminate and kill marine organisms, including fish and shellfish. This will affect both organisms in intertidal areas, such as clams, mussels, and shellfish, as well as organisms in deeper water as the oil sinks and settles on the sea floor. Sale and consumption of contaminated, or potentially contaminated, fish and shellfish should be suspended. The risk that oil will enter rivers or seep into the water table and thereby contaminate drinking-water sources seems small but should be investigated. Water contaminated with oil cannot be cleansed by boiling, filtering or chlorination. In fact chlorination may result in the formation of more toxic compounds.

1.5 Mission's objectives/scope

The experts who have contributed to this report undertook several visits to the site of the accident in order to initially assess the oil spill and the hazards it may pose to the affected population's health and livelihoods as well as to the environment. This report is based on the site visits and discussions described below.

On 21 November, the UNDAC environmental emergencies expert undertook a joint environmental assessment with the Environmental Management Bureau (EMB) of Iloilo, as well OCHA Senior Humanitarian Affairs Officer René Nijenhuis. They met with the management of the power barge and representatives of the municipality to discuss further mitigation actions and the possible need for additional support (including expert advice).

On 22 November, the UNDAC environment expert, EMB and WHO were invited to a status meeting with the management of the barge and the senior management of the operator National Power Corporation (NAPOCOR).

On 23 November, Dr Nick Gent, Consultant in Health Protection, World Health Organization, visited the site of the oil spill, observed the vessel and the shore line, interviewed local officials, workers and residents, and had a meeting with the Chief of Operations of the barge, its crew, and representatives of NAPOCOR.

[4] American Thoracic Society - http://www.atsjournals.org/doi/abs/10.1164/rccm.200701-016OC
[5] WHO, International Agency for Research on Cancer - http://monographs.iarc.fr/ENG/Monographs/vol45/mono45-11.pdf
[6] Polycyclic aromatic hydrocarbons http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1227169968068
[7] Benzene http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1194947376646
[8] Zock et al Health Effects of Oil Spills: Lessons from the Prestige http://www.atsjournals.org/doi/pdf/10.1164/rccm.201102-0328ED

2 Key Findings

2.1 Description of the power barge and status after the accident

Power Barge No. 103 is a 32 MW electricity generating station feeding the power grid of Panay Island from the North of Iloilo Province. It is one of a number of such barges operated around the Philippines by NAPOCOR. This power barge is a relatively old design of vessel, which appears to be single skinned (no internal bunding). It is stationed on a permanent tidal mooring that allows it to rise and fall through the full tidal cycle without rotation. Its generating plant is powered by heavy oil (type Bunker C), with 1,400,000 litres reported to have been in storage before the accident. During the low tides following the storm surges associated with typhoon Yolanda on and around the 8th November the vessel grounded on the seabed which is comprised of heavy uneven rocks. During this, and probably a number of subsequent groundings, six (6) of the seven (7) storage tanks on the vessel are presumed to have been penetrated.

2.2 Size of the spill

As of 23 November 2013, according to the best current estimate of the Chief of Operations of the barge, around 800,000 litres of bunker oil have spilled into the sea. An estimated 600,000 litres of oil remain in the damaged tanks, which continue to leak. The estimates are based on the monitoring of the ruptured tanks. During high tide, seawater intrudes into the tanks. Therefore the exact amount of the remaining oil in the tanks remains uncertain.

2.3 Current control measures

The discharge is uncontrolled so far and there is no facility to pump the oil into another storage facility. On 21 November, the manager of the power barge reported that a tanker vessel from a salvage company was expected to arrive within the next 24 hours to empty the remaining oil from the power barge. The salvage company arrived on site on 23 November, but as of 27 November no pumping has occurred. About 40,000 litres has been collected mainly by hand. No collection of the contained oil takes place due to problems with the hosing system and the single skimmer available. Limited storage capacity for recovered oil is available at the moment.

Some containment booms had been installed to contain the oil on the sea surface, but as of 21 November, these booms were insufficient to contain the amount of free phase oil present. Also, twisting was observed in several cases, which lead to leaking. On 22 November some additional booms from two other power barges were installed south of the already installed containment.

Figure 1: Leaking oil due to insufficiently installed booms, 21 November (Photo: Dennis Bruhn, UNDAC)

A specialist recovery, cleaning and salvage operator has been contracted to manage the situation (Kuan Yu Global Technologies Inc.) and staff from this company were observed to have arrived on-site on the 23rd November 2013, but were not available for interviews. Manual recovery of oil from the water inside the booms has been organised by NAPOCOR and their salvage contractors. According to the manager it is difficult to get sufficient booms capacity. Contaminated debris from the shoreline is being gathered and crudely bagged.

Figure 2 Manual recovery of oil (Photo: Dennis Bruhn, UNDAC)

Figure 3 Manual recovery of free phase oil (Photo: Dennis Bruhn, UNDAC)

On 22 November clean-up of free phase oil on the water table was on-going. The work was being carried out by hand without use of sufficient Personal Protective Equipment (PPE) posing a significant health risk to the workers. No attempts are being made to empty the affected tanks or seal the leaks. No specialist control or recovery equipment is present at the site (apart from floating booms). There is a basic level of security around the port area in which the vessel is moored and its immediate shoreline (200-300 metres); the contamination of water and shoreline outside of this area is not as severe, but present, and these areas are readily accessible to the public.

2.4 Surrounding population

The bay where the vessel is moored is a wide eastern facing one, populated by a number of large inhabited islands. The main industries are tourism and fishing. The vessel is moored in a fully tidal location with no large inland waterways running from its immediate vicinity. There are a significant number of houses (200-500 households estimated within 400 metres) that are situated on steeply rising land immediately adjacent to the shoreline of the affected area. These houses were severely damaged by the typhoon and are without power. Most residents rely on open flame improvised kerosene lamps and cooking fires.

Due to concerns for the health and safety of the population living immediately adjacent to the oil spill, the Iloilo Provincial Governor decided to evacuate the most vulnerable population (children, pregnant and breast feeding women, elderly) living in close vicinity to the affected shoreline in Barangay Botongon on 23 November. The West Campus of the Northern Iloilo Polytechnic State College (NIPSC) was identified as a suitable site. Within less than 24 hours, the Estancia municipality and Iloilo provincial authorities, supported by several humanitarian partners coordinated through the Roxas Humanitarian Coordination Hub, mobilised sufficient resources to enable the relocation to take place. This involved, amongst others, the digging of pit latrines, repairing damaged roofs of the buildings, setting up a reception centre and setting up water bladders and tents.

As of 30 November 2013, 647 families (2,763 individuals) are registered at the NIPSC with a revalidation taking place to ensure only those families most at risk have been prioritised. Efforts are ongoing to provide basic humanitarian services as well as to identify additional suitable sites in order to allow for further relocations. The duration of the relocation is estimated at 3 months, unless conditions improve sufficiently to allow for an earlier return. There is an urgent need for a speedy clean-up process in order to allow the affected population to return to their homes and recover.

Temporary workers employed by NAPOCOR and their contractors to clean the oil spill are still sheltering in the immediate vicinity of the oil spill.

2.5 Effects on the environment

The shoreline of the Barangays Botongon, Estancia, Paon and Tanza has been reported to have been contaminated by bunker oil washed ashore. The oil has been reported to have spread up to 10 km downstream (south) from Estancia along the coast. As of now no detailed assessment of the spreading of oil along the coast line south of Estancia seems to have been undertaken.

On 22 November the joint team assessed the bay in Embarcadero, Batad, which showed clear signs of severe free phase oil contamination of the bay and mangroves.

Figure 4 Oil contamination in Embarcadero, Batad (Photo: Dennis Bruhn, UNDAC)

Figure 5 Oil contamination in Embarcadero, Batad (Photo: Dennis Bruhn, UNDAC)

The community close to the bay in Batad mainly lives on fishing in the flood feeding into the bay. According to the local fishermen the flood has been contaminated with oil up to 3 kilometres inland and fishing is no longer possible.

The assessment showed a widespread oil contamination of the mangroves along the coast and riversides. According to the local fisherman the area covered with free phase oil increased during the night of 21 November.

Figure 6 Contaminated mangroves (Photo: Dennis Bruhn, UNDAC)

Figure 7 Oil contamination along riversides (Photo: Dennis Bruhn, UNDAC)

The local population estimates the area of affected mangroves at around 10 ha (100,000 m2). The community has started to partly clean up the sandy beach by raking contaminated sand and debris into heaps.

During high tide the oil will spread and infiltrate the root system of the mangroves. Not only will this process destroy the existing mangroves but will also be a source of continuous contamination of the waters in the future. In turn, this will affect the livelihood of the people depending on fishing in these waters. In addition, the presence of free phase oil and wash-up of oil on the shore may pose a health risk to people in the area especially in case of direct contact.

3 Conclusions

The following conclusions and recommendations are based on the results of the assessments described in section 2 of this report.

3.1 Occupational hazards at the affected site

The most important health and safety considerations that must be managed on this site are:

- working at heights;
- working on uneven surfaces with significant slip hazards;
- penetrating injury risks;
- working in open waters (especially as any falls into the water are likely to be accompanied by mixed oil/sea-water inhalation which is associated with significant morbidity and mortality).

The greatest immediate concern has to be with the manual recovery of oil from the open water that is currently taking place. The amounts of oil that can be recovered by these means is minimal, the hazard avoided is consequently of little benefit, and the risks involved to the workforce is considerable.
Secondary hazards are associated with contact (principally skin contact) with the residual oil and any other chemicals materials, as well as with the physical methods being used for cleaning. These have the potential to cause skin irritation and associated illness. No oil-mist generating procedures are currently being used on the site.
The long-term health risks associated with clean-up activities have not been thoroughly evaluated[9] and therefore the exposure of workers to the oil should be minimised through the use of appropriate procedures and personal protective equipment.

3.2 Protection of the work force

Direct observation of the recovery operations showed that minimal levels of protective equipment are now starting to be supplied to the contracted workforce. However, this equipment appears to be focussed solely on protection from oil contact with the hands and feet (gloves and boots) and does not appear to be associated with a safe system of working to protect against the most important hazards of working in a physically unsafe environment (as opposed to a chemically unsafe one). There is no differentiation in protective equipment, or safety procedures, to be seen related to any differing activities across the site. The protection of the workforce is currently inadequate, or inappropriate, and must be strengthened immediately.
The Provincial Department of Health has issued the workforce with acetylcysteine tablets[10], vitamin B complex tablets[11] and N95 respirator masks[12] to provide protection from respiratory / pulmonary

[9] Zock et al, Health Effects of Oil Spills: Lessons from the Prestige, http://www.atsjournals.org/doi/pdf/10.1164/rccm.201102-0328ED
[10] Acetylcysteine is sometimes found in cough medicines as a mucolytic. However, there is no evidence to suggest its use in circumstances where an occupational workforce can reasonably be presumed to have normal pulmonary function that this has any practical physiological purpose.
[11] The rationale for this is unknown.

injury. There are no international standards for the levels of protective equipment required for the workforce. However, there are many examples of good practice of protective equipment and safe systems of working (such as published by the U.S. National Institute for Occupational Safety and Health (NIOSH) [13] following the Deepwater Horizon incident).

3.3 Public health hazards in the area surrounding the affected site

Following the release of oils of all types, three generic components are released: volatile organic compounds (VOCs), aliphatic hydrocarbon compounds, and residual products that can include heavy metals and sulphur compounds. Crude oils usually contain a certain quantity of sulphur containing hydrocarbons, dissolved hydrogen sulphide gas, and elemental sulphur. It is reasonable to assume that the dissolved hydrogen sulphide had been largely removed from this oil before it was supplied to the generating barge in accordance with standard international practice.

The range of problems associated with contact or exposure to these materials more remotely from the immediate operational area have been well described in other accidents and include distress from the unpleasant smell, eye and respiratory tract irritation (including exacerbation of long standing respiratory disease – especially reversible airways disease e.g. asthma). This is associated with the volatile organic compounds and hydrogen sulphide (if present). Also upon skin contact inflammatory conditions associated with the remaining aliphatic / long-chain hydrocarbon components can occur. All of these conditions are normally reversible, and are usually reported to subside within 7-10 days of removal of exposure to the hazard (or removal of the population from the vicinity of the hazard).

As noted above, certain chemicals contained in the oil are considered potential carcinogens. Moreover, concerns have been expressed in media reports about the possibility of cancer and aplastic anaemia. Such risks, however, are only likely to be a consideration where there are prolonged exposures, as might occur in occupational settings. There is no evidence to suggest that the general public, whose exposure to the chemicals released in this spill has been at low concentrations over a relatively short period of time, will have any of these long-term health risks. Workers involved in managing the oil spill have, so far, been exposed to these chemicals for a relatively short period of time, although at higher concentrations. Provided, however, that measures are taken, as recommended in this report, to minimise exposure to the extent possible through the use of appropriate health protection measures, these workers should not have any detectable increase in disease rates, including cancer and aplastic anaemia.

3.4 Measures to protect the public

Given the duration of the discharge and local temperatures, it is reasonable to assume that the volatile organic compounds (VOCs) component has evaporated and dispersed. Normative assumptions for VOCs are that 75% of VOCs evaporate from cruder oil fractions within 24 hours of release into open atmospheres and are effectively fully dissipated within 72 hours and that public hazard associated with VOCs is therefore of declining concern. As long as the oil is continuing to leak from the barge, however, there will continue to be some air contamination.

The remaining materials are aliphatic compounds, very long chain hydrocarbons and bound environmental materials. These have become distributed along the shoreline outside of the immediate control area. They constitute a residual low-risk contact hazard. The appropriate public health measures are warning against uncontrolled collection and cleaning and ensuring that the programme of restoration includes measures to remove this material safely in due course.

Ingestion hazard is a theoretical pathway of exposure to all of the oil components should there be evidence of contamination of water courses or abstraction aquifers. Second order ingestion pathways through food stuffs are unlikely to generate significant exposure in the short term

[12] Respiratory protective equipment is only required for certain type of operations during the recovery of such a vessel, such as working in closed spaces where anoxic atmospheres may be encountered (requiring self-contained breathing apparatus), or during oil-mist generating operations, such as power washer use (general consensus is that P100 respiratory protection is required for such operations).

[13] U.S. National Institute for Occupational Safety and Health (NIOSH) Interim Respiratory Protection Recommendations for Deepwater Horizon Response Workers http://www.cdc.gov/niosh/topics/oilspillresponse/pperecsumm.html

(although might be unpleasant and cause a degree of nausea). Direct contamination of water abstractions is unlikely given the location of the accident in a heavily tidal coastal location; however, a proper environmental survey ought to be undertaken to give full re-assurance.
A more foreseeable mechanism of hazardous contact with contamination from the accident may be through improperly stored recovered materials. Correct, secure, storage and disposal of recovered materials is essential.
Main public health concerns are direct contact with oil bearing materials, physical injury hazards posed by the debris being removed from the site, and the potential fire hazard associated with the increasingly large amount of oil soaked wooden debris that is being collected on the site. These concerns have been significantly reduced by the evacuation of the population housed / sheltering along the shoreline adjacent to the incident site by the Iloilo authorities.

4 Recommendations

1) Precautionary measures for local residents

Awareness raising with local residents should be undertaken on precautionary measures such as:

- People should avoid direct skin contact with the oil – they should not enter contaminated water, and if handling contaminated debris they should wear thick rubber nitrile gloves, and boots.
- If skin gets contaminated with oil or tar balls, the skin should be washed off with soap and water.
- Clothing contaminated with oil can be washed in the usual way, however, if clothing is heavily contaminated it should be discarded.
- Fishing and collection of shellfish in affected areas should be suspended, and sales of seafood from the affected areas prohibited, until the spill has been cleaned up or has fully dispersed and this has been confirmed by the testing of food samples.
- Fish or shellfish caught or collected in contaminated areas, or that taste or smell of oil, should not be eaten.
- If contamination of a drinking-water source is possible then water extraction from that source should be suspended and the water quality monitored. If necessary and alternative water supply should be provided until the water quality returns to established norms.
- Residents should be advised not to consume water that tastes of oil.
- Care should be taken to avoid spreading fire: residents should be advised not to have open flames, e.g. use kerosene lamps, light fires, smoke or discard cigarettes, close to contaminated areas since the oil is flammable.
- Since burning bunker oil produces toxic and polluting smoke, residents should be advised not to burn debris (for example, soiled waste or driftwood) contaminated with oil, or burn oil on the water surface.

2) The **protection of the workforce** is currently inadequate, or inappropriate, and **must be strengthened immediately**.

- Of most concern is the manual recovery of oil from open water which should be stopped immediately.
- People who are working on the clean-up of an oil spill should be given appropriate training and personal protective equipment such as disposable nitrile gloves (to be worn under work gloves), protective suits, rubber boots and goggles. Respiratory protection with a P100 particulate filtering face piece respirator should be provided if there is a risk of inhalation of aerosolized oil mist e.g. through the use of pressure hoses[14].

[14] U.S. National Institute for Occupational Safety and Health (NIOSH) Interim Respiratory Protection Recommendations for Deepwater Horizon Response Workers http://www.cdc.gov/niosh/topics/oilspillresponse/pperecsumm.html

- Official statutory oversight of health and safety issues on site is urgently required.
- It is imperative that the poor occupational practices on the recovery site are immediately addressed by:
  a. the defining of an appropriate safe system of working, stratified by work theme;
  b. the provision of appropriate PPE/RPE;
  c. training on, and supervision of adherence to, the safe system of working and use of PPE;
  d. strict site security;
  e. Immediate cessation of open water manual oil recovery.
- That a proper reasoned review of hazards, risks and their mitigation on behalf of the workforce and affected public is shared and promulgated.
- That an environmental hazard pathway and risk management / mitigation report is commissioned.

3) <u>Mitigation measures and clean-up</u>

- All efforts must be taken to stop the leaking from the source (barge).
- Determine the remaining volume of bunker residing in each tank of the power barge and arrange for a method of transfer and storage of the remaining product.
- Take all efforts to control migration of oil (e.g. install more booms with higher capacity, lay a second row of booms outside and around the existing booms to prevent/reduce spreading of oil, prevent twisting of booms).
- Utilize mechanical removal (e.g. oil skimmers) where free phase product is still present.
- Develop containment strategies preventing further movement of product into mangroves.
- Collected oil, contaminated sand and debris should be disposed of according to the national regulations for handling hazardous waste.
- Undertake an environmental assessment of the oil spill along the coast south of Estancia. Begin segmentation and assessment of impacted shoreline and shoreline at risk. Consider the use of the proven 'Shoreline Clean-up Assessment Technique'[15].
- Prioritise the assessment results according to environmental sensitivity and resources at risk.
- Begin efforts to try and flush bunker oil from the roots of impacted mangroves. Do not use chemicals. The use of chemical agents can further damage the root system of the mangroves.
- Consider implementing an appropriate command and control structure such as the Incident Command System (ICS), which allows for effective coordination between planning and operational capacities across various jurisdictions and functional agencies, both public and private.[16]
- If shoreline washing agent available, consider bench testing the agent on a sample section of shoreline to determine efficacy in removal of bunker from rock and manmade shorelines. Toxicity testing should also be considered before approval is given to ensure no adverse impacts result on the local flora/fauna.
- A strategy to manage tar balls and submerged oil may need to be considered as the product weathers and is exposed to various sea states.
- Monitor for wildlife at risk of becoming oiled. If birds are present in the region of the incident consider developing a strategy to mitigate the risk of oiling.
- Wildlife already oiled should be managed appropriately. If resources exist consider developing a strategy to collect oiled wildlife, clean and rehabilitate.
- Consider developing a strategy to monitor quality of sea foods.

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[15] U.S. National Oceanic and Atmospheric Administration (NOAA), Ocean Service, Office of Response and Restoration: Shoreline Clean-up and Assessment Technique (SCAT) http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/shoreline-cleanup-and-assessment-technique-scat.html

[16] For more information on the Incident Command System: http://training.fema.gov/EMIWeb/IS/ICSResource/JobAids.htm

- Begin considering cleanup endpoints. When should the contractor stop cleaning one segment of shoreline and begin the next. Endpoints may differ depending on the end use of the shoreline and the type of shoreline.

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Annex

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