IPIECA

International Association of Oil & Gas Producers

Oil spill responder health and safety

Good practice guidelines for incident management and emergency response personnel

IPIECA

The global oil and gas industry association for environmental and social issues

Level 14, City Tower, 40 Basinghall Street, London EC2V 5DE, United Kingdom
Telephone: +44 (0)20 7633 2388 Facsimile: +44 (0)20 7633 2389
E-mail: info@ipieca.org Website: www.ipieca.org

International Association of Oil & Gas Producers

London office
Level 14, City Tower, 40 Basinghall Street, London EC2V 5DE, United Kingdom
Telephone: +44 (0)20 7633 0272 Facsimile: +44 (0)20 7633 2350
E-mail: reception@iogp.org Website: www.iogp.org

Brussels office
Boulevard du Souverain 165, 4th Floor, B-1160 Brussels, Belgium
Telephone: +32 (0)2 566 9150 Facsimile: +32 (0)2 566 9159
E-mail: reception@iogp.org Website: www.iogp.org

IOGP Report 480

Date of publication: December 2012

Oil spill responder health and safety

Good practice guidelines for incident management and emergency response personnel

Photographs reproduced courtesy of the following: pages 6, 7, 9, 12, 13, 16, 17 (bottom), 18, 20, 21, 22, 23, 24 (bottom), 26 and 33: Oil Spill Response Limited; page 15 (bottom): BP; front and back covers, and pages 10, 11, 17 (top), 19, 25, 27, 28, 31 and 32: ©Shutterstock.com; page 24 (top): ©2012MediaBakery.

Preface

This publication is part of the IPIECA-IOGP Good Practice Guide Series which summarizes current views on good practice for a range of oil spill preparedness and response topics. The series aims to help align industry practices and activities, inform stakeholders, and serve as a communication tool to promote awareness and education.

The series updates and replaces the well-established IPIECA 'Oil Spill Report Series' published between 1990 and 2008. It covers topics that are broadly applicable both to exploration and production, as well as shipping and transportation activities.

The revisions are being undertaken by the IOGP-IPIECA Oil Spill Response Joint Industry Project (JIP). The JIP was established in 2011 to implement learning opportunities in respect of oil spill preparedness and response following the April 2010 well control incident in the Gulf of Mexico.

The original IPIECA Report Series will be progressively withdrawn upon publication of the various titles in this new Good Practice Guide Series during 2014–2015.

Note on good practice

'Good practice' in the context of the JIP is a statement of internationally-recognized guidelines, practices and procedures that will enable the oil and gas industry to deliver acceptable health, safety and environmental performance.

Good practice for a particular subject will change over time in the light of advances in technology, practical experience and scientific understanding, as well as changes in the political and social environment.

Contents

Introduction

When an oil spill occurs, the issue of health and safety, both for the public and oil spill responders, is a serious consideration. It is recognized that health and safety are managed in many different ways around the world, with highly regulated prescriptive regimes which legislate actions in some countries and risk-based systems in others. It would be inappropriate to develop a document that attempted to prescribe a standardized approach to safety or health, as it would not succeed in meeting the expectations of at least some part of the community. Instead, this document will concentrate on identifying the principal issues when an oil spill occurs, their degree of severity, and the practical steps that can be taken to minimize the impact of the spill.

Many spills have been cleaned up safely in the past. Because clean-up activities are usually conducted in the open air, the hazards from vapours and gases are relatively low, and simple protective clothing can reduce contact with oil and minimize any chance of harm. Nevertheless, the oil and the working environment do introduce other hazards. The key is to recognize the risks from all sources and to be prepared to act accordingly. Another major issue is liability. Health and safety management systems are used to manage the liabilities that may arise as a result of an accident, and this document focuses on the practical and technical safety considerations that need to be dealt with when responding to an oil spill. However, the potential for future litigation should be borne in mind and scrupulous record keeping should be undertaken.

Those with well-developed health and safety regimes will have the procedures in place but should find value in the practical guidance provided in this document. Those that do not have such advanced systems should find this guide useful in developing plans to deal with the issues that are raised.

Although this document is primarily intended to address oil spills on water, it may also be of use in the event of an inland spill.

This document is divided into eight broad categories, each of which needs to be addressed. They are:

- management control;
- risk assessment;
- oil and response clean-up chemical safety issues;
- the working environment and safety during response operations;
- personal protective equipment (PPE);
- site facilities;
- decontamination; and
- management of volunteers.

Each organization will need to establish its own strategy to ensure that health and safety is incorporated into its own spill response provisions. These strategies should be reviewed periodically, taking into account experience and lessons learned.

Management control

The safety of the general public and responders is assigned the highest priority during spill response operations. A response management system, with safety and health as its core elements, should start from the top and penetrate to all levels within the organizations participating in response activities.

The management team should appoint an individual and, if necessary, a supporting team, with the skills to undertake responsibility for safety and health management. Responders can often become too involved in operations and not be able to take an overall view of the situation. The responsible individual needs to be able to step back from the operation and consider wider issues such as monitoring and maintaining awareness of active and developing situations, assessing hazardous and unsafe situations and developing measures to assure personnel safety. These measures include:

- An initial site assessment with documented processes for: hazard identification; risk assessment; selection of responders, including local labour; provision of controls (e.g. zoning, specialized equipment and PPE); assessment of training needs, and identification of decontamination areas. Competent personnel, i.e. those appropriately trained and experienced in the issues surrounding spill safety, should be used to manage and supervise the response.
- Developing and implementing a Site Safety and Health Plan (SSHP). Information to develop the plan can be obtained from competent health and safety professionals, the risk assessment process and environmental monitoring. The SSHP should be reviewed regularly with regard to the safety and health implications of the activities proposed or in progress.
- Participation in planning meetings to identify health and safety concerns inherent in the operation's daily work plan, and to emphasize the need to communicate the hazards and mitigation measures to all personnel.
- Correcting unsafe acts or conditions through the regular line of authority, although the responsible individual should be authorized to exercise emergency authority to prevent or stop unsafe acts when immediate action is required. They should also ensure that any accidents or exposures occurring in the course of the spill response are investigated.
- Establishing first-aid stations and medical facilities in accordance with the SSHP.

It should be borne in mind that, in some locations, the local coastguard would assume management control, jointly if not singly.

Site Safety and Health Plan (SSHP)

The responsible individual should ensure the preparation and implementation of the SSHP in accordance with local and national plans and regulations. The SSHP should, ideally, address the following elements:

- health and safety hazard analysis for each site, task or operation;
- risk assessment;
- comprehensive operations work plan;
- personnel training requirements;
- task-specific fitness requirements;
- personal protective equipment (PPE) selection criteria;
- site-specific health surveillance requirements, bearing in mind local legislation and the likelihood of exposure to health hazards;
- individual and area air monitoring;

- site control measures;
- confined space entry procedures, if needed;
- pre-entry briefings (initial/daily/pre-shift);
- pre-operations health and safety conference for all incident participants;
- quality assurance of SSHP effectiveness;
- decontamination; and
- management of data relating to all of the above.

Site layout plans may help with making people aware of the risks and the location of key safety elements. These should be prepared and displayed at the site command post. A copy should be retained at the incident command centre and should be revised as conditions at the site change.

Health and safety briefing and communication

One of the key methods of managing safety and health is by the use of briefings (Appendix 1). Ideally, briefings should be held before the start of each shift to pass along all information necessary to ensure safety on the site. All contractor supervisory personnel should attend these briefings to pass information to their own teams. A method of rapid communications with all field sites should be included in the briefings. The information passed should be pitched at the correct level to suit the audience; for example clean-up crews will require a different content and style of briefing to the personnel in the command centre. The briefings should address:

- work zone characteristics;
- hazard information on the spilled product;
- control measures (e.g. PPE);
- evacuation routes;
- assembly points;
- first-aid post locations;
- location of staging areas;
- command post locations; and
- how to respond to other emergencies that may arise.

Briefing the response team prior to a day's operations

Risk assessment

An overall risk assessment should be conducted at the start of a spill.

The first task that should be undertaken when preparing to conduct oil spill response operations is a comprehensive hazard analysis and risk assessment. The management team will firstly need to carry out a high-level risk assessment of the overall situation as soon as possible to ensure that oil spill responders or the wider population are not in danger. The initial approach should be to answer such questions as:

- Is there a potential gas cloud and therefore an explosion risk?
- Should people be evacuated or excluded?
- Is the environment safe for people?
- Will oil enter water systems that may affect people?

This initial assessment may lead to the establishment of safety or exclusion zones while the area is monitored in more detail. This may include the use of monitoring equipment to detect flammable or toxic gases and materials. These types of hazards usually persist for a short period only, but this issue is more significant with the more volatile oil types and in calm weather conditions. Monitoring should continue until it can be established that the risk has reduced to acceptable levels. Once the overall situation has been stabilized from a safety point of view, the work of responding to the oil spill can begin. In normal circumstances responders are not likely to be exposed to areas in which there is an explosion or toxic vapour risk. Specialist source control teams, who are trained and equipped to work within these high-risk areas, are the ones most likely to enter these environments.

When responding to a spill the risks posed by particular operations or locations should be assessed on a case-by-case basis. One way of dealing with this is through the use of a Site Safety Survey Checklist (Appendix 2). When completed by a competent individual from the response team, this can be used to identify the various hazards and determine whether they present a risk.

Once identified, appropriate control measures can be taken to mitigate the risks. Those personnel involved in carrying out risk assessments must have sufficient training and knowledge to understand the potential hazards presented by the operations. The process of risk assessment is intended to identify all of the potential hazards. Once this has been completed, the probability and the severity of any potential incident should be predictable. Those incidents most likely to occur frequently, or those most likely to cause the greatest harm, should be dealt with first. Account must be taken of who might be harmed, and how. There are a number of techniques in common use for the assessment of risk. Some rely on descriptive ranking, while others employ a numerical scoring system to produce an order of priority. Whatever system is employed, it is important that all the assessments are carried out in a consistent manner.

Once the likelihood and severity of risks have been considered, the precautions available should then be examined to determine their effectiveness. If the hazard continues to present a risk then additional measures should be put in place. There is an accepted hierarchy of approach that may be summarized as follows:

1. Prevent access to the hazard
2. Organize the work in a way that exposure to the hazard is reduced
3. Use PPE

The risk assessment should be fully documented and filed. During the conduct of operations the risk from the spilled oil will inevitably change but many of the physical risk factors in the environment will remain constant. As a matter of course, the workplace hazards should be periodically reassessed and the suitability of previously selected hazard controls re-evaluated. The possibility of reviewing previous risk assessments will assist in getting consistency of approach. The Site Safety Survey Checklist shown in Appendix 2 is a means of documenting the hazards at any specific site or those arising from particular operations. In the main, hazards can be seen to arise from a number of specific areas:

- the spilled substance itself and response chemicals;
- the working environment;
- activities during response operations;
- machinery used in the clean-up operation; and
- external factors.

Chemical safety issues during oil spill response and clean-up operations

Responses to oil spills inevitably put responders and chemicals together in the same environment. Potential exposure of personnel should be assessed, monitored, and controlled if health effects are to be avoided. Each type of product, when spilled into the environment, will have its own set of chemical characteristics that will determine the most effective response strategy and, indeed, which techniques are safe to use. It is important to remember that the chemical characteristics of the spillage will usually change over a period of time as a result of what is known as 'the weathering process', i.e. the action of the elements on the substance and its reaction with the surroundings.

The chemical constituents and characteristics of the spilled product will need to be ascertained so that appropriate measures can be taken to protect responders. In the case of a known product this information is presented in a document called a material safety data sheet (MSDS). Each MSDS contains all the information required to complete a risk assessment of the chemical constituents and provide the appropriate first-aid measures. In the case of a leak or spill from an exploration site, urgent analysis of the oil is required to ascertain its properties.

Some spills present specific safety risks.

Oils, whether in the crude state or as refined products, have hazardous properties that may include:

- flammability;
- explosive vapours;
- toxicity;
- displacement of oxygen; and
- slippery nature.

Flammability

Crude oils, condensates and refined products may be ignited if they are exposed to a source of ignition. The period for which oil remains easily ignitable is usually short because of evaporation of the more volatile components and the inclusion of water in the oil if it emulsifies. Whilst the oil is fresh, care must be taken to exclude any potential sources of ignition from an area to minimize the risk of fire. Responders should select intrinsically safe equipment, and smoking, sparking tools, vehicles or any other potential source of ignition should be kept out of the spill area. Access to the spill operations areas should be controlled whilst any danger of ignition persists. Light products, such as gasoline or kerosene, represent a particular hazard and special care should be taken when approaching these spills.

Explosive vapours

When a refined product or volatile crude is spilled, there will be a release of hydrocarbon vapours during the initial stages of the incident. There is potential for this vapour cloud to drift, under the effects of the prevailing winds, into a populated area or to a location where there is a possibility of the vapours being ignited. Safety exclusion zones and air monitoring stations may need to be

established to determine the vapour levels to monitor whether or not they are within explosive limits. The release of vapours may present a specific hazard to internal combustion engines causing them to over-speed uncontrollably if the vapour is sucked into the engine. Internal combustion engines should not be operated in areas where a risk of explosion exists. As a precaution, engines that could be exposed to environments where vapours are present should be protected by the fitting of an air inlet shut-off device that will operate if the engine speed exceeds maximum rated limits.

Toxicity

Although oils contain potentially harmful components, exposure risk can be kept low if appropriate PPE is worn. The potentially most serious exposure exists during the initial stages of a spill, particularly when volatile crude oils, condensates or light refined products are involved. Toxic components can enter the body via the eyes, skin, mouth and lungs. Aromatic compounds, in particular benzene, and hydrogen sulphide (H_2S) from 'sour' crudes and natural gases, are major concerns. Whilst aromatic products usually only persist for a short period of time and will rapidly disperse in the air, they have direct effects on the central nervous system causing dizziness, drowsiness and later unconsciousness and death. Benzene also targets bone marrow and can cause anaemia and cancer. If potential exposure is likely, initial protection should be provided using self-contained breathing apparatus while assessment is carried out. If assessment demonstrates the presence of benzene concentrations above regulatory limits, an appropriate respiratory protection programme should be instituted. Further guidance may be obtained from NIOSH[1], OSHA[2] and HSE[3].

Care must be taken to monitor the levels of benzene in the environment and to protect both responders and the public from exposure. The level of aromatics released will be a function of the specific oil type, the surface area of the spill, the temperature and wind conditions at the time of the release. The risks must be assessed by specialists and controls implemented to reduce their impact to an acceptable level.

The potentially most serious exposure exists during the initial stages of a spill, particularly when volatile crude oils, condensates or light refined products are involved.

1 National Institute for Occupational Safety and Health (USA)—www.cdc.gov/niosh

2 Occupational Safety and Health Administration (USA)—www.osha.gov

3 Health and Safety Executive (UK)—www.hse.gov.uk

The presence of hydrogen sulphide must also be monitored. This gas causes eye irritation and coughing, and is particularly toxic to the lungs and central nervous system. One manifestation of this is that it 'paralyses' the olfactory nerves so that, despite its pungent odour, it cannot be detected by the nose after a few breaths. It can also cause pulmonary oedema (fluid accumulation in the lungs) and death. The NIOSH recommended exposure limit is a 10 minute ceiling concentration of 10 ppm (OSHA standard is a 10-minute ceiling at 20 ppm; HSE STEL is 10 ppm over 15 minutes). Responders should not normally be operating in an environment where the risk of poisoning from gases such as hydrogen sulphide exists, unless they are involved in source control, in which case they should be wearing chemically-resistant impervious gloves and suits, goggles and self-contained breathing apparatus with a full facepiece and under positive pressure.

There can be particular concern for the public if there is a possibility that a gas cloud from an incident could drift into residential or populated areas. If the levels are extremely high, for example due to the 'blow out' of a 'sour' crude well or the release of a large quantity of 'sour' crude oil, evacuation should be considered as a sensible precaution. If the presence of hydrogen sulphide is suspected based on information usually gained from the producer or the shipper of the oil, a monitoring system should be established to determine the levels, including use of H_2S alarms. Once the level of gas present has reduced to acceptable levels, responders should be provided with personal monitoring equipment to monitor their personal exposure, and their working time should be limited so as not to exceed occupational exposure limits.

Oil and some of the chemical compounds used in clean-up operations can have a degreasing effect on skin, leading to irritation and dermatitis, and can also be absorbed through damaged skin causing toxic effects internally. Personal protective equipment in the form of gloves, boots and suits needs to be managed with care; if the inner surfaces of the PPE are contaminated, absorption of the chemical will be enhanced and damage to skin and internal organs exacerbated. Decontamination facilities should be established which permit responders to remove oiled clothing in a controlled environment, and which provide them with access to suitable washing facilities, in particular before meal times when contaminated hands can lead to the ingestion of chemicals.

Personal protective equipment, e.g. gloves, boots and suits, needs to be managed with care to prevent the inner surfaces becoming contaminated.

Displacement of oxygen

Hydrocarbon gases can displace the oxygen (O_2) in an environment, particularly when they collect in confined spaces or trenches that are not adequately ventilated, leading to a risk of asphyxiation for those entering. Oxygen content readings should be taken prior to entering any confined space, trench or area where reduced ventilation may lead to an accumulation of hydrocarbon vapours. Entry should only be permitted if readings in excess of 19.5% O_2 are confirmed unless an independent oxygen source is used. Such areas should be monitored continually, entry by responders controlled using a permit to work system, and the appropriate tank entry procedures implemented.

Slipperiness

The most common form of accident encountered during spill operations results from slips, trips or falls. Many of the products encountered are, by their very nature, slippery. Slips, trips and falls on oiled surfaces are some of the main causes of injury, and awareness of these hazards should be raised. Responders can also find it difficult to handle equipment when wearing oily gloves, increasing the time taken to complete familiar tasks and making some more complicated tasks impossible without decontaminating the equipment first.

Spill response chemicals and cleaning agents

A number of chemical materials, such as dispersants and solvent-based cleaners, are used when responding to oil spills and special care must be taken when handling them. Most products are provided with guidance notes on the risks, use and handling of the material, and this information should be made available to all those handling the product. When handling dispersant chemicals, gloves, goggles and protective clothing should be worn and prolonged contact with the skin avoided, as many of the materials are hydrocarbon based and can cause dermatitis. Similar precautions should be taken when handling solvent chemicals used for cleaning, as these can contain more aromatic components. Special care should be taken in the use of respiratory protection with the appropriate filter cartridges. A full discussion of the safety implications of dispersant use is provided under 'Dispersant Response Operations' on page 23).

Air monitoring equipment and record keeping

Conducting air monitoring in the vicinity of the spill site

Air monitoring to determine potential exposures can be conducted through the use of a range of environmental and personal monitors. The type, level and frequency of monitoring should be based on the particular circumstances and be guided by an environmental or industrial hygiene specialist. An example of an air monitoring record is shown in Appendix 3.

It is essential that accurate records of air quality are kept to inform protective measures necessary for personnel and to provide evidence to defend future claims.

The working environment and safety during response operations

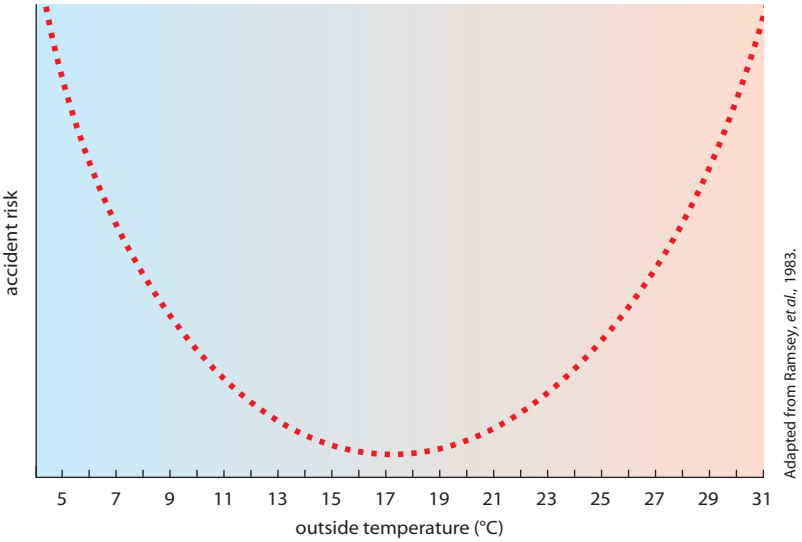
The working environment

Oil spills can occur in practically any type of environment, and under all climatic and meteorological conditions. This poses a number of challenges to responders and has an overriding influence on the response options available. Some aspects of the working environment (such as site layout, security, working shifts) may be controlled by the responders themselves. Others, including the weather and the terrain, must be given consideration and accommodated when response targets are set. In every working environment, safety must remain the top priority, and measures to control any risks put in place.

Weather

Extremes of temperature, humidity and precipitation all place considerable strain on human performance (IOGP-IPIECA, 2008). In the case of heat, work performance declines especially where the task requires coordination, alertness or vigilance, and results in an increased risk of accidents. In the case of cold, by reducing comfort, cold may lead to reduced performance as well as reduced safety (see Figure 1). The effects of cold on mental performance seem to be caused mainly by distraction. Studies show a clear relationship between skin temperature and manual performance (see Table 1). As a first response to the cold, heat loss is reduced by a reduction of blood flow to the peripheral areas of the body, causing discomfort in the hands and feet. When muscles are cold they are less efficient. With progressive lowering of tissue temperature, manual dexterity is lost and numbness is produced.

Figure 1 *Accident risk based on temperature*



Health problems due to extreme heat and humidity include muscle fatigue and fainting (heat syncope). Skin problems can occur due to excess sweating and salt loss, together with irritation and rubbing of clothing leading to minor cuts and abrasions. Prickly heat, sunburn and windburn can occur, and increased sweating and humidity can lead to skin infections. More serious heat-related conditions are heat cramps, due to salt depletion, and heat exhaustion. Symptoms of the latter include headache,

Table 1 *Effects of cold on manual performance*

Hand skin temperature (°C)	(°F)	Effect on performance
32–36	89–97	Optimal hand and finger function
27–32	81–89	Effects on finger dexterity, precision and speed
20–27	68–81	Impaired performance in work with small details, reduced endurance
15–20	59–68	Impaired performance of gross finger work
10–15	50–59	Reduced gross muscle strength and coordination, pain sensation
<10	<50	Numbness, manual performance reduced to simple gripping, pushing, etc.

fatigue, dizziness, confusion and collapse. Heat exhaustion is more likely to occur in the dehydrated, the unfit, the elderly and those with high blood pressure, emphasizing the need for careful selection and training of responders and volunteers. The most serious condition, heat stroke, occurs when the body's coping mechanisms are overwhelmed and core temperature rises rapidly. This is a medical emergency and requires urgent specialist paramedic and physician treatment.

Health problems due to the cold include chilblains, trench foot, often occurring when wet socks are worn for long periods, painful fissuring of the fingertips, frostnip of the ears, nose and cheeks, and more seriously frostbite. This is the freezing of deeper as well as superficial tissues, and usually affects the fingers, toes, nose, cheeks and ears. All these conditions can be prevented by care in the training of responders and provision of protective clothing, together with robust provision of first aid. The most serious condition due to cold exposure is hypothermia, chilling of the body's core temperature below 35°C (95°F). This again is a medical emergency and requires specialist paramedic and physician intervention.

In all weather extremes, suitable and sufficient control measures need to be provided and might include:

- Provision of communications equipment and accurate weather forecasting.
- Environmental controls:
  - in hot climates, shade from the sun whenever possible and always during break periods, together with air cooling when feasible;
  - in cold conditions, provision of heated shelters and shielding from the wind.
- Work practices:
  - a buddy system is useful for work in extreme climates so that each member of a pair can watch out for early warning signs of excessive heat or cold stress in the other person.
  - Monitors—people trained in the recognition and management of heat stress and the early symptoms of cold are particularly useful.
  - Sensible work scheduling and breaks are essential not only for preventing ill health but also for increasing productivity.
  - Mechanical assistance where possible in heat helps to reduce the physical requirements of the job and subsequent internal heat generation.
  - Job rotation and frequent breaks, together with access to cool fluids in the heat and warm energizing drinks in cold conditions all help.
  - Allowing longer to complete work in extreme climates reduces the risk of health problems.
- Acclimatization—this is a gradual physiological adaptation that improves an individual's ability to tolerate heat stress, but does not remove the need to have heat exposure controls in place. It takes about a week to become 90% acclimatized to high heat levels and is done by starting at a reduced pace on the first day and gradually increasing the amount of work and duration of exposure to heat each day for the first week. This has implications for how rotations are organized as some acclimatization is lost during leave or absence due to illness.

- Training—this should take place at induction and then as needed throughout the response. It should involve the basics of body temperature physiology, hazards related to sunlight and alcohol, the importance of food and water, clothing requirements, the recognition of temperature-related symptoms and signs and the potential for other illnesses to impact on tolerance ot extremes of heat and cold.
- Specialized clothing (PPE):
  a) Clothing for the heat: this should be loose fitting with a layer of air between skin and clothing to aid evaporation of perspiration. Clothes should be light in weight, and also light in colour as this reflects heat, while dark clothes absorb the heat. Clothes made of thin cotton fabrics are ideal as they help evaporate the sweat by picking it up and bringing it to the surface. Most synthetic fibres increase sweating, interfere with evaporation and increase the risk of fungal infections. Protection of the head, ears, nose and back of the neck from direct sunlight, and the use of good quality sunglasses, are a must. Chemical suits, gloves, hats and respirators all diminish heat loss via evaporation and increase the risk of heat stress so account must be taken of this when designing work schedules and rest breaks.
  b) Clothing for the cold: well-designed clothing is a major survival factor and a balance should be struck between the use of PPE, including the use of specialized clothing, and allowance of extra time to perform tasks due to the encumbrance of extra layers. During periods of high activity and excess heat production, problems may arise due to sweat production and evaporation processes. Sweat accumulated in garments during work may result in cold stress due to either the reduced insulation value of damp clothing or evaporation of the accumulated sweat after cessation of work or exercise. In cold conditions where accumulation of sweat in clothing is difficult to avoid, it is preferable that the sweat accumulates as far from the skin as possible. Multi-layered clothing is ideal, with an inner layer (underwear) for moisture absorption and transport, a middle layer (shirt, sweater) for insulation and moisture transport, and an outer layer (wind breaker, arctic clothing, rain gear) for protection against the external environment

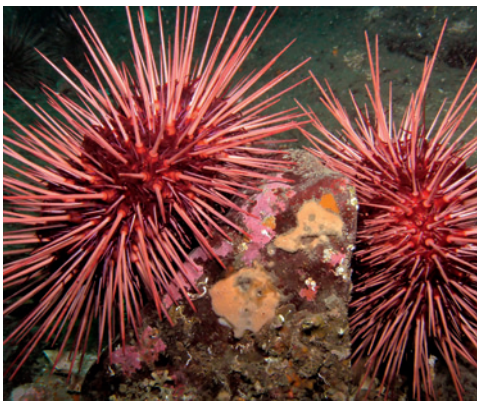
and for moisture transport. As in the case of heat, head and neck protection is necessary, but in this case to prevent heat loss. Hand protection against the cold needs to be chemically resistant if it is intended for use in spill response operations, and the lack of manual dexterity due to wearing gloves should also be borne in mind. Shoes should be large enough to allow insulation by trapped air, and should also be of materials that allow ventilation of water vapour. Socks should provide insulation and facilitate transport of sweat as far from the skin as possible (e.g. wool, alone or in combination with polypropylene).

- Health assessment for fitness to work: it is easier to survive in extreme heat or cold when medically fit and in good health. Selection of people for work in extremes of temperature requires a health assessment by a doctor with knowledge of the working conditions and requirements of the job. The same standards as those applied to work on offshore rigs or remote locations (IOGP-IPIECA, 2011) should be applied to determine a responder's fitness to work in the heat or cold. Potential contraindications to work in extremes of temperature include respiratory or cardiovascular problems, severe obesity, alcohol abuse, pregnancy and some medications, but in all cases it is essential that an individual risk assessment is undertaken to avoid needlessly excluding someone from work for which they are qualified.

The natural environment

The environment in which a spill can occur can range from exposed shorelines to rugged and remote mountains in the case of pipeline spills. Safe access and egress must be arranged for vehicles and pedestrians with account being taken of shoreline type (mud, cliffs, mangroves etc.) and tidal patterns and ranges. Care must be taken that workers and equipment are not cut off by rising tides when working on shorelines. In the case of inland spills, each locality will present its own unique set of challenges that must be overcome, including accessibility, gradients, watercourse flow rate and depth, and water table characteristics.

Although indigenous flora and fauna are often an important ecological and environmental resource, they can present a very real safety issue. Poisonous plants and dangerous animals need to be identified, and their appearance publicized to the responders along with information on how to deal with the threat they present. Of greater concern are those creatures that may actually attack humans both in the sea and on dry land. Where these possibilities exist, expert advice must be obtained and adequate protection provided.



Expert advice should be obtained where there is the possibility of being harmed by indigenous species.

Night operations

Night operations present particular risks for workers. Unless adequate lighting can be guaranteed to ensure that responders can have safe and secure access to the worksite, and that an acceptable level of operational efficiency can be guaranteed, night clean-up operations should be avoided. It is difficult to see oil in low light conditions and the risk of slips, trips or falls increases dramatically. Worker fatigue will increase through night working and the operational benefits of this work need to be assessed. A balance will need to be struck in very hot environments in which the only comfortable time to work may be after sunset. Offshore application of surface dispersants, particularly from aircraft is not recommended during night time conditions as there are inherent safety and operational efficiency issues.

Slips, trips and falls

As mentioned previously, the most common hazard to responders is the danger from slips, trips or falls. Oil spills can occur in locations where access to the work site is difficult. The problem is compounded when the surface is coated with oil, but rocky shorelines can be naturally slippery due to seaweed, wet rocks or mud. Safe and secure access must be provided for the workforce to prevent the possibility of injury. When working on the shoreline, it is advisable for responders to keep clear of cliffs or rocky shorelines until a safe means of access has been provided, either in the form of access bridges or guide ropes. Clean-up crews should be warned of the hazards of any particular site access and be given information on the safest access routes. Slips, trips and falls are also an issue when working on vessels involved in offshore operations. Responders should beware of falling into the water and must wear personal flotation devices at all times. Decks can become extremely slippery when coated in oil. Towing lines and equipment hoses add to the potential trip hazards. Good seamanship to maintain clean and tidy decks is an important factor in reducing the hazard.

Providing safe access to the worksite is critical to reducing the risk of accidents.

Manual handling and use of lifting equipment

Care must be taken by responders when lifting recovered waste bags or equipment. Where possible lifting equipment should be used. If manual handling is required, the loads should be restricted to manageable proportions and persons instructed in the proper lifting techniques. When using lifting equipment, responders should be provided with safety helmets and only those trained in the operation of the equipment should be permitted to use it.

Transport of materials/waste disposal

When oil is recovered it is usually stored in temporary pits on the shoreline. These pits should be cordoned off from the public. Safe and secure access should be provided for vehicles delivering or removing material. The pits should be well marked with suitable signage to warn any person against accidentally falling into them.

Oil spills require significant logistics support with regard to the transportation of equipment, and the use of specialist vehicles and personnel transport. To prevent degradation of local roads, care must be taken to avoid secondary contamination beyond the initially oiled areas. Transport cleaning stations will need to be established to prevent oil being transferred into public areas and causing potential safety hazards.

Temporary storage tanks must be clearly marked, and secondary pollution should be avoided.

Right: there are potential risks from the use of heavy machinery in public places.

Box 1 *Transport tips*

- Vehicle cleaning stations should be provided at shoreline access points.
- Vehicles must meet road licencing requirements.
- Responders must not be transported on vehicle load beds or on the back of pick-up trucks.

Clean-up operations generate large quantities of solid waste and liquids that must be stored, sorted and disposed of through an approved process or procedure. The transport of materials will often require specialized vehicles. In most cases, licences will need to be obtained from the local authorities to allow on-site storage, transportation and disposal of oily waste.

Fatigue

Fatigue Management Plans (FMPs) are becoming increasingly common in the oil and gas industry (IOGP-IPIECA, 2007). An FMP is a framework designed to enable operational and employee concerns regarding fatigue to be addressed in a preventative manner. The aim of an FMP is to maintain, and when possible, enhance safety, performance and productivity and manage the risk of fatigue in the workplace.

FMPs typically include the following fundamental components (Baker and Ferguson, 2004):

a) Policy
   A document formally outlining the approach, commitment and accountability, including a requirement for internal and external auditing processes.
b) Training
   A training and education programme to enable employees and managers to identify the signs and symptoms of fatigue, and to adopt coping strategies in and outside the workplace.
c) Tracking incidents: metrics
   A programme for the tracking and understanding of all incidents, accidents and near misses. These events should be plotted for time of day, day of roster, hours of prior wakefulness and sleep length in order to determine the role that the roster and sleep loss may have played in the event.
d) Support
   Medical and well-being support that includes diagnosis of sleep disorders and other health problems causing sleep disturbance, treatment of sleep problems and, where necessary, referrals to general practitioners, psychologists, counsellors and sleep clinics.

Other risks

There are other risks that need to be considered, especially when dispatching responders internationally. Some parts of the world have their own inherent dangers and these must be assessed on a case-by-case basis. Professional advice from embassies and government departments, or from specialist security and medical companies, will need to be sought in order to make an informed judgement on how to proceed. Support and advice should be sought from the in-country staff as to the actual risk conditions on the ground at the spill location. Issues to be considered include:

- travel arrangements (routes, visas, couriers);
- airline safety;
- accommodation;
- food hygiene;
- exposure to endemic diseases (e.g. malaria, yellow fever) and the need for any protective measures;
- language; interpreters, translation of documents;
- risk of hijack or kidnap;
- any country-specific risks such as terrorism, civil war, unexploded ordnance; and
- evacuation.

The extent and potential threat of these issues must be taken into account before committing responders to any particular activity. If there is a risk, suitable and appropriate countermeasures and plans should be established, communicated and tested.

Health-related activities during response operations

The arduous nature of response activities increases the risk of illness and injury to responders. Often they are undertaking difficult tasks, under pressure and in unfamiliar surroundings. Preventative measures need to be taken to protect responders from infectious diseases and from other health effects of the oil-contaminated environment. The responsible individual must ensure that competent advice is available to determine fitness and vaccination needs before personnel are deployed and requirements for first aid, medical staffing and facilities, and medical evacuation once they are in the response area. There should be designated first-aiders, appropriately trained, in each location, and access to emergency medical technicians (EMTs), paramedics, nurses and physicians should be facilitated as appropriate. The company may need to provide such personnel themselves or use community professionals and facilities; whatever the case there should be seamless communication and working between the two.

Fitness for work of both responders and volunteers can be a major issue when potentially hundreds of individuals are joining every day. Baseline health information should be collected wherever possible and linked to fitness requirements where local legislation permits. In complex environments with multiple activities and potential exposures, follow-up health studies become important. Appropriate collection of baseline data including contact details is essential, and an assessment on completion of the work assignment is recommended. Electronic methods of data collection, e.g. portable tablets, should be considered. Health records must be kept on any responder or volunteer who undergoes a fitness assessment or who receives emergency advice or treatment.

Safety during response operations

Shoreline response operations

The majority of response activities occur on shorelines. The proximity to water presents its own set of hazards which give rise to increased risks, particularly among inexperienced or unfamiliar responders. Notably, tides, currents and waves contribute to creating a dynamic environment that can catch out the unwary and therefore need constant monitoring and reassessment.

Shoreline deployments require extensive management.

The nature of shoreline deployments often poses problems in terms of communications, access and movement of heavy equipment, together with the provision of adequate first aid and evacuation resources. Cliffs, mud and treacherous terrain increase the difficulties in providing these arrangements.

Unless access to spill sites and contaminated areas is properly controlled, the local population can be exposed to

Box 2 *Shoreline response safety tips*

- Test for poisonous or explosive gases, establishing exclusion zones where necessary.
- Create safe access and egress—slips and falls on large boulder fields are a significant cause of injuries.
- Ensure adequate manpower to achieve the task safely.
- Ensure adequate safety briefings (see Appendix 1) and supervision.
- Be aware of tidal conditions.
- Provide shelter, rest periods and nourishment for responders.
- Employ a buddy system to avoid lone working.
- Never permit entry into excavations; always clearly mark storage pits on shorelines.
- Reassess operations if weather deteriorates, especially if a heavy sea is running.
- Ensure adequate first aid, medical response and medical evacuation arrangements are in place.
- Maintain good communications to further minimize risks.

risks from which they are not protected. Additionally, vehicles and persons entering the spill area may generate secondary contamination and possibly cause unnecessary damage to sensitive environmental resources.

It is essential that shoreline responders are trained to recognize the hazards present in their working environment, and are provided with adequate means to control the risks.

Shoreline clean-up operations need to be managed carefully to prevent accidents.

Offshore response operations

Offshore working can take place either on fixed installations or on vessels. These environments have their own special practices and procedures that should be followed in order to remain safe. Inexperienced or uninitiated responders are at increased risk when operating offshore and, where possible, regular local workers acting as safety escorts should accompany them. A personal flotation device must be worn by all responders working offshore and in vessels, because swimming ability is impaired by clothing such as boots and helmets. Vessels engaged in offshore response work should be suitably sized and equipped to deal with the environment. Adequate and suitable safety and communications equipment should be installed on the vessels. Crews should be trained and competent in the operation of the vessels and responders should be trained and fully briefed on their responsibilities.

High seas conditions can make vessel operation hazardous.

It cannot be overstressed that the hazards faced in the offshore environment multiply as a result of poor weather, oiled decks and equipment, and congested work areas. Lines and chains used for lashing and towing have the potential to cause serious injuries and must be checked periodically, especially in high seas. A communications system should be established to permit all vessels working offshore to be able to report any emergencies and provide operations status reports. A system of notifying craft of any adverse weather reports should be established as a precaution, and is particularly important when small craft are engaged in nearshore response operations.

Box 3 *Offshore response safety tips*

- Test for poisonous or explosive gases, establishing exclusion zones where necessary.
- Lines and chains used for lashing and towing have the potential to cause serious injuries and must be checked periodically, especially in high seas.
- Keep the decks as clean as possible—hazards faced in the offshore environment multiply as a result of poor weather, oiled decks and equipment, and congested work areas.
- Ensure that all responders are familiar with the equipment to be used.
- Ensure that all responders are familiar with the vessel emergency procedures.
- Deck operations always carry the hazard of drowning so a personal flotation device must be worn.
- Ensure adequate safety briefings (see Appendix 1) and supervision.
- Secure equipment with tag lines when lifting using deck cranes
- Maintain good communications between the bridge and the deck to further minimize risks.
- Provide shelter, rest periods and nourishment for responders.
- Reassess operations if weather deteriorates, especially if a heavy sea is running.
- Ensure adequate first aid, medical response and medical evacuation arrangements are in place.

Operations involving the surface application of dispersants

The use of dispersant chemicals to treat spilled oil brings with it a number of health and safety issues that must be addressed. Specifically, the chemicals can pose a hazard to health and the methods of application can leave unprotected responders open to various modes of exposure. It is essential that any dispersant chemicals selected have a material safety data sheet with advice on protective measures and first aid, and that the advice given is followed. Modes of exposure include:

- **Breathing aerosol mists:** when operations present this risk, appropriate respiratory protective equipment (RPE) (see the section on PPE on pages 26–30) must be worn by all responders during spraying operations, whether spraying from vessels or operating aircraft systems. On vessels, all normal doors and windows should remain closed during spraying operations, to protect crew members located within the accommodation, inside the engine room or on the bridge. On larger vessels, there is the potential for dispersant mist to enter the forced air engine room ventilation. In this case, it is advisable for engine room personnel to use deck operations PPE during spraying operations. Dispersant mist may also have a detrimental effect on engines if sucked into air inlets. Special care should be taken to protect all personnel when spraying is conducted in windy conditions.
- **Ingestion:** respirators should be used to prevent swallowing of any dispersant mist. Personal hygiene practices must be rigorously applied to prevent the possibility of dispersant ingestion during meal breaks.
- **Absorption through the skin:** dispersant is readily absorbed by the skin and can cause irritation or organ damage. Protective clothing is required during loading and transfer operations and for boat spraying. Hand protection is also required when coupling/disconnecting dispersant hoses during the operation of fixed-wing aircraft systems.
- **Splashes to the eyes:** chemical goggles are required where splash risk exists, e.g. during loading and transfer operations, both for boat and fixed-wing aircraft operations. If dispersant is splashed into the eyes it should be washed out immediately and then medical attention sought. Eye wash bottles should be provided wherever there is a risk of splashes into the eyes.

Box 4 *Dispersant response operation safety tips*

- Assess the routes of possible exposure to dispersant chemical.
- Provide PPE to guard against each and every route, ensuring that all PPE is compatible and fits the wearer.
- Keep decks clear and dispersant free by regular washing.
- Head spray vessels into wind where possible.
- Make sure that the PPE is resistant to the dispersant in use.
- Avoid uncontrolled releases of dispersant.
- Always refer to the Material Safety Data Sheets.

Appropriate PPE must be worn by all responders during spraying operations, whether spraying from vessels or operating aircraft systems.

Controlled in-situ burning

As with dispersant response operations, controlled in-situ burning also brings with it a number of health and safety issues, for example when using igniters and towing ignited slicks, and during burning operations where there is the potential for inhalation of particulates (ARPEL, 2006).

Below: the health and safety risks associated with the in-situ burning of an oil slick cannot be understated.

Box 5 *Controlled in-situ burning safety tips*

- Establish a thorough health and safety plan before the operation begins.
- Monitor the operation continuously to determine any need for a reassessment of the burn situation.
- Consider the use of both aerial surveillance for increased visibility, and surveillance from a larger vessel capable of carrying additional monitoring and firefighting capability.
- Try to anticipate potential difficulties in a burn operation (e.g. encountering thick slicks that could burn out of control) so that these situations may be avoided from the outset.
- Carefully assess the properties and characteristics of the oil to be burned in order to avoid serious injury caused by vapour flashback.
- Do not attempt to burn a slick that could flash back to the source (e.g. a tanker) or a populated area.

Aviation operations

Response strategies often include the use of aircraft. This may be for reconnaissance, transport or for dispersant spraying. Aircraft operations, airfields, and indeed aircraft themselves, present numerous hazards that must be identified and controlled. Briefings should be provided to passengers by the aircrew on the safety aspects of the specific aircraft type and the location and use of safety equipment. Care must be taken by personnel whilst on the airport not to enter areas in which aircraft are operating without first gaining the necessary permission from the airport staff or aircrew.

Aircraft can play a significant role in response operations.

Box 6 *Aviation safety tips*

- Never walk across airfield aprons without an escort.
- When approaching or leaving aircraft, care must be taken to avoid the intakes, exhausts, propellers and rotor blades.
- A rotating helicopter blade may pass near to the ground particularly when idling: personnel should always crouch when approaching or departing from a helicopter with turning rotors, and should proceed in the direction advised by the aircraft crew.
- Approach to an aircraft should only be made when directed by the pilot or crew, and the route should remain in the pilot's field of view.
- Briefings must be provided to passengers by the aircrew on the safety aspects of the aircraft and the location and use of the exits and life saving equipment provided.
- Particular attention should be paid to hearing protection and the wearing of high visibility garments when working on airfields.
- Loose objects pose a threat to aircraft safety and should be controlled. This includes litter, nuts and bolts, packing cases and hats.

Personnel responsibility

Whatever the working environment, safety can be considerably improved if personnel watch out for each other as well as for themselves. The working environment in a spill situation changes constantly, and responders need to be able to adjust to the changing conditions to mitigate any potential injury or loss.

Along with physical and chemical factors, other factors also affect the working environment. Working long hours under hot and dry, humid, or cold, damp and windy conditions along with extended periods away from home can quickly lead to fatigue. As fatigue sets in the ability to exercise good judgement and decision making decreases rapidly. Equipment operation and working on deck becomes more dangerous as fatigue becomes more pronounced. Personnel injuries, unexpected environmental discharges, and property damage potentially can all result from fatigue. Safe working is dependent upon the experience and training of the involved personnel and the continued close attention to safety procedures.

Safety can be considerably improved if personnel watch out for each other as well as for themselves.

Personal protective equipment

Personal protective equipment (PPE) is defined as any equipment which is to be worn or held by a person at work and that is designed to protect that person against one or more risks to their health or safety. It ranges from simple gloves requiring the minimum of instruction in use to sophisticated breathing apparatus where medical selection and training is required. It is vital to emphasize that use of PPE is not, in itself, the only risk control method, but rather the last item in the hierarchy of control measures. However, in most oil spill circumstances it is inevitable that personnel will come into close contact with the oil and/or dispersants and PPE will be a necessity. The proper selection and use of PPE requires skill and experience.

A properly-equipped and well-motivated team is a major asset.

The following points should be taken into consideration when selecting the appropriate PPE:

- the expected working conditions and hazards;
- the activities to be performed;
- the person(s) being exposed; and
- the compatibility of the equipment—each item of PPE should be capable of performing effectively without hindering the proper operation of other items.

Consideration should also be given to the nature of the task and the demands placed on the worker, including:

- the physical effort required to do the job;
- the methods of work involved;
- how long the PPE will need to be worn;
- the need for adequate vision and communications whilst wearing the items;
- whether high-cost, durable equipment or lower-cost disposable items be selected; and
- whether the task is critical to the overall clean-up.

Selection of the correct type of personal protective equipment is critical.

The working environment will often dictate the PPE selection criteria. For example, cold weather environments require the use of thermally-insulating clothing. This type of clothing can be rendered unusable if it comes into contact with liquid oils, hence a robust and well-sealed impermeable layer should be worn above the cold weather clothing. Conversely, in hot climates, impermeable clothing will exacerbate any heat-related health problems. Workers should therefore be given adequate rest breaks and liquids to assure their welfare, or an acceptable compromise should be reached in the type of PPE that they wear.

PPE should not be issued without information and training in its use, limitations, maintenance and when it should be replaced. Without this, its effectiveness will be severely reduced. Proper decontamination and cleaning facilities should be provided so that the equipment remains in a good condition for as long as possible. Without these facilities PPE supplies will be wasted, straining supply lines and reducing cost-effectiveness. Where possible, systems should be established to ensure that workers remain responsible for the condition of their own PPE. Simple systems which require workers to hand in used PPE before new stocks are issued will assist in the control of waste. Separate disposal facilities for used PPE should be established to segregate the waste. It is important to ensure that suitable replacement PPE is always readily available.

By taking an activity-based approach to PPE selection, a response organization is able to set some working parameters. These should include mechanical protection, the elements/climate, and hazardous substances. The safety manager and/or an industrial hygienist can determine the most suitable type of PPE, bearing in mind manufacturers and suppliers' instructions. Records should be kept of selection, maintenance and testing of PPE.

Protection for specific areas

Eyes

- **Hazard:** chemical or metal splash, dust, projectiles, gas and vapour, radiation.
- **PPE:** safety spectacles, goggles, face shields, visors, all specific to the hazard involved.

Head

- **Hazard:** impact from falling or flying objects, risk of head bumping, hair entanglement.
- **PPE:** a range of helmets and bump caps.

Body

- **Hazard:** temperature extremes, adverse weather, chemical or metal splash, spray from pressure leaks or spray guns, impact or penetration, contaminated dust, excessive wear or entanglement of own clothing.
- **PPE:** conventional or disposable overalls, boiler suits, high-visibility clothing and specialist protective clothing, e.g. for chemical exposure. Manufacturers' charts will specify which product is recommended for which chemical. The type of PPE used must be suited to the climatic conditions. Personal flotation devices will be needed by boat crews and any responders working in water.

Hands and arms

- **Hazard:** abrasion, temperature extremes, cuts and punctures, impact, chemicals, skin infection or contamination.
- **PPE:** gloves, gauntlets. Gloves differ in design, material and thickness. No glove material will protect against all substances and no gloves will protect against a specific substance forever. Glove manufacturers' charts will show how well their gloves perform against different substances.

Feet and legs

- **Hazard:** wet, slipping, cuts and punctures, falling objects, chemical splash, abrasion.
- **PPE:** safety boots and shoes with protective toe caps and penetration-resistant mid-sole, gaiters, leggings, spats. Some chemicals penetrate leather easily. Manufacturers' information will help determine what material the footwear or boots should be made from.

Hearing

- **Hazard:** noise at levels of 85 dBA or more
- **PPE:** ear defenders (hearing protection devices) in the form of plugs or muffs, with an element of personal selection

Any compulsory hearing protection zones should be marked clearly and responders trained in the use and care of their defenders. These should be suitable for the working environment and compatible with other PPE, e.g. masks, helmets and eye protection.

Respiratory protective equipment (RPE)

RPE is designed to protect the wearer against inhalation of hazardous substances in the air (see Box 7 on page 29). There are two main types of RPE:

- **Respirators (filtering devices):** these use filters to remove contaminants in the workplace air. They should never be used for protection in situations with reduced oxygen levels.
- **Breathing apparatus (BA)**: this requires a supply of breathing quality air from an air cylinder or compressor and is used for protection in situations with reduced oxygen levels.

Both types of RPE are available with a range of different facepieces:

- Masks are tight-fitting facepieces (filtering facepieces, half and full face masks) and rely on having a good seal with the wearer's face. They can be part of both respirators and BA, and fit testing must be carried out. Masks become uncomfortable to wear for periods over an hour.
- Hoods, helmets and suits usually have loose-fitting facepieces which rely on enough clean air being provided to the wearer to prevent contaminant leaking in. They are only used on fan-powered respirators and/or air-fed equipment.

Box 7 *Types of hazardous substances*

Substances can exist as solids, liquids or gases:

- Particulate solids include aerosols, dusts, smokes and fume. Fumes are generated by vaporization of solids and condensation into fine particles. Smokes are formed by the incomplete combustion of materials. If the solid particulates are very fine, they can behave like gases and vapours and move with air currents. In this way, they can be transported quite a long way from the source of emission.
- Liquids can exist as droplets or as finer sprays and mists in air or other gases.
- Gases behave in the same way as air; vapours are the gaseous forms of substances which normally exist as a solid or liquid at room temperature.

Any items of headwear, spectacles with side arms or facial hair can interfere with the seal to the face when wearing tight-fitting facepieces, and can lead to leakage. If this cannot be eliminated, a loose-fitting facepiece should be considered.

Air-purifying respirators (see Box 8) must be fitted with a filter, of which there are three main types:

- **Particle filters:** these trap and hold particles from the air flowing through them. They do not trap gases or vapours including organic liquid mists and sprays, or give any protection against oxygen-deficient atmospheres.
- **Gas/vapour filters:** these are designed to remove gases or vapours, as specified by the manufacturer. They do not protect against particles or oxygen-deficient atmospheres, and their capacity for removing gases and vapours is limited.
- **Combined filters:** these provide protection against particles, gases and vapours.

If oxygen deficiency is possible, only breathing apparatus should be considered.

Box 8 *Air-purifying respirator tips*

Always:

- Ensure the complete device is in good working order before putting it on, even when new.
- Make sure the mask fits and a good seal between the mask and the face is achieved before starting work, including the wearer being clean shaven if appropriate.
- Make sure the filters are the right ones for the work and replace them when used or damaged.
- Use all the straps provided, making sure they are correctly positioned and adjusted.
- Follow the manufacturer's instructions.
- Fit two identical filters to a twin-filter mask.
- Clean and store the mask properly—pay special attention to the valves.

Never:

- Use the mask to protect against lack of oxygen or gases/vapours.
- Use it to protect against particles, unless a particle filter is incorporated.
- Use it if dirty, damaged or incomplete.
- Leave the mask lying around in the workplace—dust will get inside and will be inhaled next time the mask is used.

Box 9 *Supplied-air breathing apparatus tips*

Always:

- Ensure the complete device is in good working order before putting it on, even when new.
- Ensure that there is an adequate supply of clean breathing air.
- Anchor the hose inlet in clean air.
- Look after the supply hose during use.
- Clean and store the equipment properly, paying special attention to valves.

Never:

- Use the device without training, fit testing or medical clearance.
- Use it if dirty, damaged or incomplete.
- Use the equipment without the waist belt.
- Keep working if the flow rate drops—leave the work area immediately.
- Place the inlet near to potential sources of contamination, e.g. vehicle exhausts.
- Leave the equipment lying around in the workplace as any contamination will be breathed in the next time it is used.

Special considerations for RPE (see Box 9)

- **Visual clarity:** for discerning fine detail, half-mask RPE or scratch-/mist-resistant designs may be necessary.
- **High temperatures or humidity:** wearing RPE increases heat stress, sweating and discomfort. Using fan-assisted or compressed supplied-air BA can help; proprietary cooling devices are available from RPE manufacturers.
- **Extreme cold:** air flow associated with fan-assisted or compressed air-supplied BA can cause chilling; proprietary heating devices are available from RPE manufacturers.
- **Communication:** all RPE affects communication and specialist devices may be necessary.
- **Mobility over large areas:** trailing hoses can drag, snag or be a trip hazard.
- **Potentially explosive atmosphere:** intrinsically safe, light-alloy free and antistatic RPE is required.
- **Relevant medical conditions:** for example claustrophobia, heart disease, asthma.

Summary issues

- Is PPE appropriate for the risks involved and the conditions at the place where exposure to the risk may occur?
- Does it prevent or adequately control the risks involved without increasing the overall level of risk?
- Can it be adjusted to fit the wearer correctly?
- Has the state of health of those who will be wearing it been taken into account?
- What are the needs of the job and the demands it places on the wearer? For example, consider the length of time the PPE needs to be worn, the physical effort required to do the job and the requirements for visibility and communication.
- If more than one item of PPE is being worn, are they compatible? For example, does a particular type of respirator make it difficult to get eye protection to fit properly?

Because PPE is the last resort after other methods of protection have been considered, it is important that users wear it all the time they are exposed to the hazard. Where possible, choose equipment where the different forms of protection required are integrally combined (e.g. eye, face, head and respiratory protection provided by a fan-assisted helmet respirator).

Site facilities

Food and water

The quality of food should be guaranteed, from its source, through transport, storage, and the cooking or preparation process. If ambient temperatures are high, extra vigilance is necessary to avoid deterioration or infection. Extra calories are required while working in extreme cold. Heavy work in both hot and cold climates may lead to dehydration due to heavy sweating and responders should be encouraged to drink enough non-alcoholic fluids to make urine colourless. Potable water should be readily available. (See IOGP-IPIECA, 2009.)

The five keys to safer food[4] are:

1. Keep clean: wash hands, surfaces and equipment and protect kitchen areas from pests and animals.
2. Separate raw and cooked food.
3. Cook thoroughly.
4. Keep food at safe temperatures.
5. Use safe water and raw materials.

Sanitation and personal hygiene facilities

Potable water, non-potable water, toilets and personal hygiene facilities should be readily available. The disposal of sewage and rubbish must be designed to protect the health of humans as well as the environment. A high ambient temperature or humidity increases the risk of contamination from flies and other potential infectious agents.

Details of the location of hygiene facilities should be contained on the site layout plan.

Decontamination

Decontamination procedures

Contaminated personnel, equipment and vehicles or vessels should be decontaminated in accordance with a decontamination plan which should include:

- a description of the location and layout of decontamination stations for the facility;
- a list of the decontamination equipment needed;
- the appropriate PPE for persons carrying out the decontamination;
- appropriate procedures for specific materials that may be encountered;
- methods and procedures for preventing secondary contamination of clean areas;

[4] WHO—www.who.int/foodsafety/consumer/5keys/en

- methods and procedures for minimizing worker contact with contaminants during removal of PPE, and the provision of effective means of containment, recovery and storage of contaminants and used contamination liquids;
- safe disposal methods for clothing and equipment which are not completely decontaminated; and
- revisions whenever the site conditions change, or the facility hazards are re-assessed based on the new information.

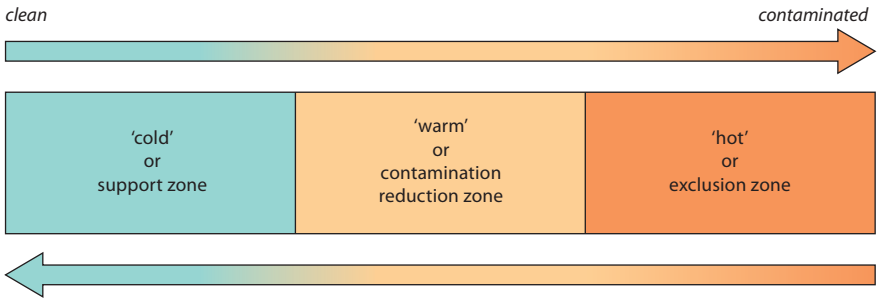
Decontamination facilities

Decontamination is best performed in a specific sequence to reduce levels of contamination on personnel, PPE, equipment or transport until no contaminant remains. Facilities should be established to deal with the waste from cleaning stations so it can be disposed of in an approved manner to prevent secondary pollution.

Movement of personnel and equipment through the decontamination stations should be carefully coordinated to reduce the possibility of cross-contamination.

Decontamination stations should take personnel and equipment from the 'hot' contaminated zone through a 'warm' cleaning zone to the 'cold' exit point from the operations area. Movement through these zones should be coordinated to reduce the possibility of cross-contamination.

Figure 2 *Contamination zones*



Management of volunteers

Volunteers will frequently offer their services to assist, either as part of the clean-up team or to assist with wildlife rescue. Volunteers are often inexperienced and untrained in spill response activity, so this resource can be both an asset and a liability if their use is not controlled and insufficient care is given to safety and welfare. For this reason, safe use of volunteers needs careful thought and planning.

In some areas of the world, volunteers are prohibited from becoming involved in the response activity unless they can demonstrate that they have undertaken formal safety training. In other countries it has proved impossible to prevent the public from becoming involved in the clean-up, and certain countries positively encourage such assistance. Whichever philosophical approach prevails, the key is to ensure safety, adequate communication and, where possible, control of the effort.

If volunteers are used in a response activity, it should be in such a way that their safety is assured. Wherever possible, volunteers should be used in activities that avoid or minimize direct contact with the oil. A specific training programme should be provided, identifying the risk and hazards, and how to avoid injury. Volunteers should also be provided with appropriate PPE and integrated into the overall command structure to ensure that they have the benefit of safety information briefings.

Volunteer activities must be properly coordinated, and safety aspects managed to assure the safety of the volunteers.

Volunteer coordination

Management of volunteers can be difficult as they can be focused on either their own local environment or their own specific issues. To get the best out of a volunteer workforce a volunteer coordinator can be included as part of the response management team. The volunteer coordinator should be responsible for managing and overseeing all aspects of volunteer participation, including recruitment, induction, training and assignment.

A volunteer coordinator would:

- coordinate with the response organization to determine where volunteers are needed;
- identify the local skills that are available that can be usefully employed;
- identify any necessary skills and training needs;
- verify minimum training required, as necessary, with safety manager or units requesting volunteers (if special skill is required);
- activate, as necessary, standby contractors for supplementary training needs;
- coordinate nearby or on-site training as part of the deployment process;
- identify and secure other equipment, materials and supplies;
- provide induction safety training for volunteers;
- activate pre-registered volunteers if needed;
- assess, train and assign volunteers to specific tasks;
- coordinate with the logistics section for volunteer housing and meal arrangements; and
- assist volunteers with other special needs.

Volunteer responders

If volunteers are to be used during the clean-up, they will need to have attained an acceptable level of competence in clean-up techniques and safety. Training and supervision will be needed from experienced personnel that can be drawn from either the response team or from local organizations.

Wildlife volunteers

Often, members of the public are distressed by the reports and sights of oiled wildlife, and will volunteer to assist. To minimize distress to the animals concerned, oiled wildlife often needs special handling by trained personnel. In some parts of the world professional organizations are available to treat and clean oiled wildlife. Ideally, before volunteers are included in the response, they should receive professional training and should be supervised during animal collection or subsequent cleaning operations.

Logistics volunteers

Some volunteers may offer to become involved in the logistics operation supporting the spill response. Their training needs will depend upon the role in which the volunteer is engaged. Some support activities would not expose the volunteer to the risks associated with the clean-up and therefore only basic training in the management structure of the response organization will be required. These types of activities include:

- logistics (e.g. procurement, purchasing, inventory control);
- transportation (e.g. carpools, trucking); and
- personnel services (e.g. lodging, laundry).

Food preparation and distribution

Any volunteers offering to help with, or being assigned to, food preparation and distribution should receive specific food handler training, or should provide certificated evidence of having undergone such training.

First-aid squads

Any volunteers offering to join first-aid squads must produce certificated evidence of training in first aid; without appropriate training, it is possible that they may do more harm than good.

Additional information will be available in the IPIECA-IOGP Technical Document on volunteer management.

Conclusions

The cleaning up of spilled oil is important, but not as important as ensuring the safety of those who are involved, or who may be affected by the spill. The health and safety of the public and the responders is a critical aspect of a successful operation. The problem may not be a particularly complex one if numbers are small, but, if multiple sites, different legislative areas and hundreds or thousands of responders are involved, robust planning and management is essential.

The risks are well known, and arise for the most part from the natural environment in which the operations are conducted rather than from the product itself, particularly as the oil weathers and the lighter fractions evaporate.

Conducting a risk assessment is essential when preparing for the safe clean-up of oil following a spill, and should take into account the various operations and the different working environments that may be encountered. Response managers and supervisors should be trained in the use of risk assessments and have the necessary safety training to be able to determine the hazards and put appropriate control measures in place.

Responders should be provided with appropriate training and briefings to ensure that they are aware of the risks and how to deal with them. Communication of health and safety issues is vitally important, as is the provision of appropriate PPE to workers.

Considering potential scenarios before an oil spill occurs, and using accident and illness information from previous spills, will enable companies to plan response operations in advance. It would also be prudent to set up relationships with appropriate responder organizations as well as with catering and medical contractors.

This report identifies the key issues surrounding responder health and safety, and is intended to provide guidance regarding the options available for carrying out safe clean-up operations. Hopefully it will assist in the establishment of an effective response management system to protect responders, volunteers and the general public.

References and further reading

ARPEL (2006). *A Guide to In-situ Burning of Oil Spills on Water, Shore, and Land*. ARPEL Environmental Guideline. Regional Association of Oil and Natural Gas Companies in Latin America and the Caribbean (ARPEL), November 2006.

Baker, A. and Ferguson, S. (2004). *Work Design, Fatigue and Sleep. A Resource Document for the Minerals Industry*. Minerals Council of Australia, 2004.

IPIECA (2002). *Oil spill responder safety guide.* IPIECA Oil Spill Report Series Volume 11 (Reprinted in 2005).

NIOSH (2011). *Health Hazard Evaluation of Deepwater Horizon Response Workers.* (Final Report, August 2011).

IOGP-IPIECA (2007). *Managing fatigue in the workplace: a guide for oil and gas industry supervisors and occupational health practitioners.* IOGP report 392.

IOGP-IPIECA (2008). *Health aspects of work in extreme climates: a guide for oil and gas industry managers and supervisors.* IOGP report 398.

IOGP-IPIECA (2009). *A guide to food and water safety for the oil and gas industry.* IOGP report 397.

IOGP-IPIECA (2011). *Managing health for field operations in oil and gas activities*. IOGP report 343.

OLF (2012). *Deepwater Horizon: Lessons learned and follow-up.* Section 4.4, 'The working environment and chemical exposure. Norwegian Oil Industry Association (OLF), June 2012.

Ramsey, J.D., Burford, C.L., Beshir, M.Y. and Jensen, R.C. (1983). Effects of workplace thermal conditions on safe work behavior. *Journal of Safety Research*. 14:105-114.

Appendix 1:
Example site safety briefing sheet

Incident: _____ **Project Code:** _____

Site Name: _____ **Location/Map Ref.:** _____

Date: _____ **Time:** _____

Briefing Conducted by: _____

Topics Covered:

- Weather conditions ☐
- Injuries and illnesses ☐
- Corrective actions/precautions ☐
- First aid ☐
- Site emergency plan ☐
- Site hazards ☐
- Oil/chemical hazards ☐
- PPE to be worn ☐
- Decontamination procedures ☐
- Other topics (list below) ☐

Comments:

Appendix 2:
Example site safety survey checklist

1. SITE:

2. DATE: **3. TIME:** **4. INCIDENT:**

5. PRODUCT(S): _____ (Attach MSDS)

6. Site Characterization (tick all relevant boxes):

6a. Area:	☐ Ocean	☐ Bay	☐ River	☐ Saltmarsh	☐ Mudflats
	☐ Shoreline	☐ Sandy	☐ Rocky	☐ Cliffs	☐ Docks
6b. Use:	☐ Commercial	☐ Industrial	☐ Farming	☐ Public	☐ Government
	☐ Recreational	☐ Residential	☐ Other		

7. Weather: ☐ Ice/frost ☐ Snow ☐ Rain ☐ Wind ☐ Sun

Temperature _____

8. Site Hazards:

☐ Bird handling	☐ Fumes, vapours, gases	☐ Pumps and hoses
☐ Boat safety	☐ Heat	☐ Slips, trips and falls
☐ Chemical hazards (to skin)	☐ Helicopter operations	☐ Steam and hot water
☐ Cold	☐ Humidity	☐ Tides
☐ Drum handling	☐ Insects/animals	☐ Trenches, excavations
☐ Electrical hazards	☐ Lifting	☐ UV radiation
☐ Endemic diseases	☐ Manual handling	☐ Visibility
☐ Equipment operations	☐ Motor vehicles	☐ Weather
☐ Fatigue	☐ Noise	☐ Work near water
☐ Fire, explosion, in-situ burn	☐ Overhead/buried utilities	☐ Other (specify overleaf)

9. Air Monitoring:

☐ O_2 ☐ LEL ☐ Benzene ☐ H_2S ☐ Other (specify overleaf)

10. Personal Protective Equipment:

☐ Foot protection	☐ Coveralls	☐ Head protection
☐ Impervious suits	☐ Eye protection	☐ Personal flotation
☐ Ear protection	☐ Respirators	☐ Hand protection
☐ Other		

11. Site Facilities Required:

☐ Sanitation ☐ First Aid ☐ Decontamination

12. Emergency Plan Requirements:

☐ Alarm system ☐ Evacuation plan

13. Contact Details Required:

☐ Fire ☐ Doctor ☐ Ambulance ☐ Police ☐ Hospital ☐ Other (specify overleaf)

14. Date Plan Completed: _____ **15. Plan Completed by:** _____

Continued …

Site Name:
Location/Map Reference:

Include work zones, first-aid locations, primary and secondary escape routes, assembly points, staging area and command post locations. Also include notes to entries marked 'Other' on the previous page.

Appendix 3
Example gas testing record sheet

Location:										
	Equipment used	**Acceptable limits**	**Initial test**		**Follow-up tests**					
			Results	Date/ time	Results	Date/ time	Results	Date/ time	Results	Date/ time
Gas Test % O_2		Limits >19.5%<22%								
% LEL		<10%								
H_2S (STEL)		Refer to current industry practice								
Benzene (TWA)		Refer to current industry practice								
#1										
#2										
#3										
#4										
#5										

O_2 = Oxygen LEL = Lower explosive limit H_2S = Hydrogen sulphide STEL = Short-term exposure limit TWA = Time weighted average

Tests completed by	**Initial test**	**1st Follow up**	**2nd Follow up**	**3rd Follow up**
Name				
Signature				

Acknowledgements

We are very grateful to the following organizations for their contributions to this document:

- American Petroleum Institute (API)
- Australian Marine Oil Spill Response Centre (AMOSC)
- International Tanker Owners Pollution Federation (ITOPF)
- Oil Spill Response Limited (OSRL)
- UK Health and Safety Executive (HSE)
- UK Maritime and Coastguard Agency (MCA)
- US Department of Labor Occupational Safety and Health Administration (OSHA)
- US National Institute for Occupational Safety and Health (NIOSH)
- US National Oceanic and Atmospheric Administration (NOAA)

IPIECA

IPIECA is the global oil and gas industry association for environmental and social issues. It develops, shares and promotes good practices and knowledge to help the industry improve its environmental and social performance; and is the industry's principal channel of communication with the United Nations. Through its member led working groups and executive leadership, IPIECA brings together the collective expertise of oil and gas companies and associations. Its unique position within the industry enables its members to respond effectively to key environmental and social issues.

www.ipieca.org

International Association of Oil & Gas Producers

IOGP represents the upstream oil and gas industry before international organizations including the International Maritime Organization, the United Nations Environment Programme (UNEP) Regional Seas Conventions and other groups under the UN umbrella. At the regional level, IOGP is the industry representative to the European Commission and Parliament and the OSPAR Commission for the North East Atlantic. Equally important is IOGP's role in promulgating best practices, particularly in the areas of health, safety, the environment and social responsibility.

www.iogp.org.uk