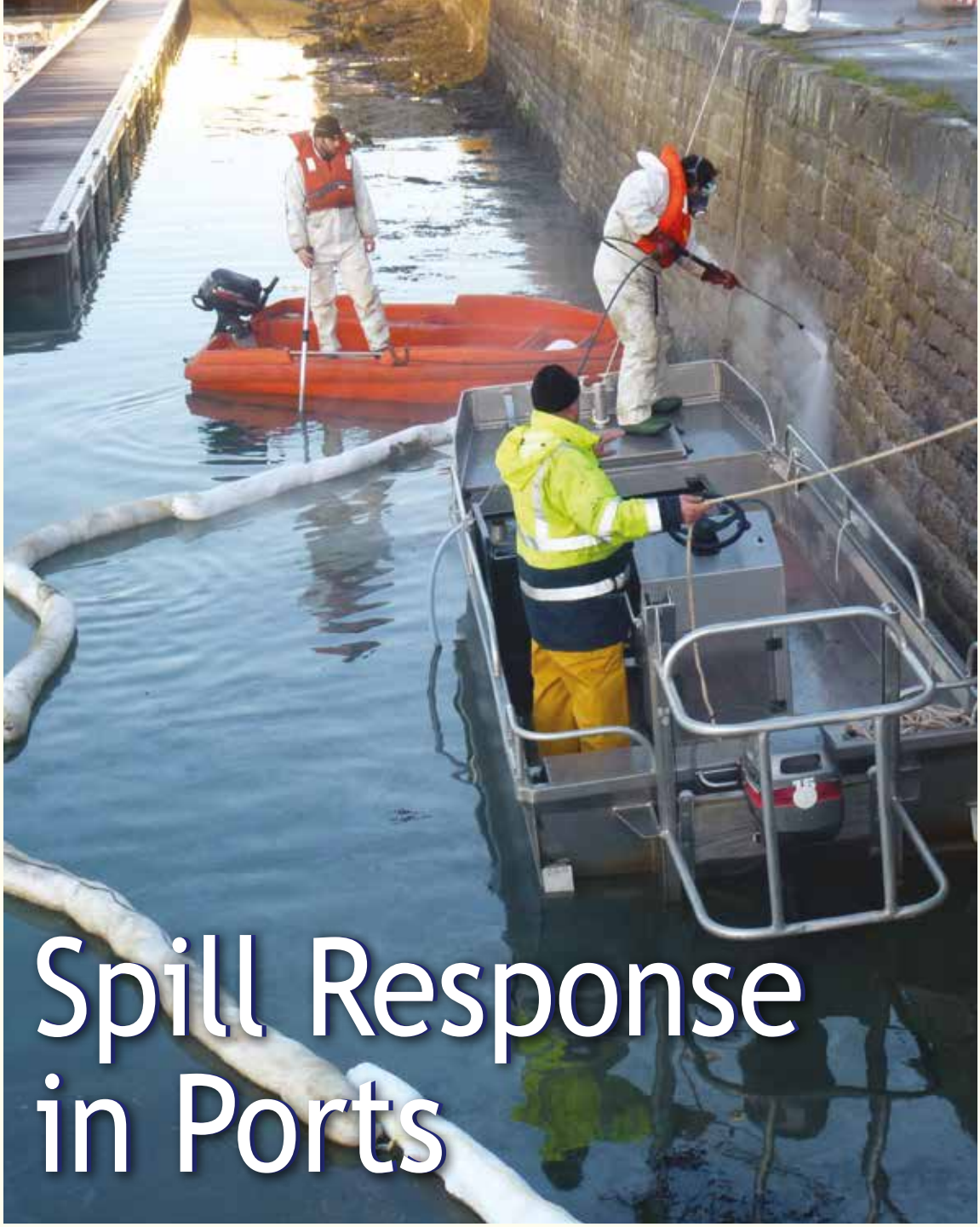

Spill Response in Ports

OPERATIONAL GUIDE

SAFERSEA
Smarter and Eco-friendlier Atlantic area
Interreg Atlantic Area
Co-funded by the European Union
Cedre

Spill Response in Ports

OPERATIONAL GUIDE

Information
Decision-making
Response

Guide produced by Cedre with funding from the Loire-Brittany Water Agency and the French Ministry in charge of ecology.
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Purpose and structure of this guide

Both seaports and inland ports–whether commercial ports, fishing harbours, marinas, cruise ports or military ports–are at risk of spills that can affect their water basin or their infrastructure, temporarily disrupting their operations.

Such spills vary greatly in origin and type. They often result from incidents caused by:

- vessels: spill during bunkering, engine room bilge water discharge, hydraulic fluid loss, collision, fire, etc.;
- port facilities: fuelling station, careening area, pipes, storage facilities, water networks, backfill, etc.;
- activities of port users and operators: sea professionals, pleasure boaters, shipyard, terminal, industrial company, etc.;
- upstream contamination: port outfall, faulty facility, industrial wasteland, etc.;

This guide is designed for port operations and supervision officers and personnel, fire services, military fire-fighters, technical support personnel of ports or local authorities, oil storage facility and terminal personnel, crews of fishing, pleasure, military and commercial vessels, maritime training organisations, etc. It has a two-fold objective: to present the response framework, while providing guidance on spill prevention and on implementing an effective and appropriate response.

This guide is divided into four parts:

- the first section presents the response framework for spills in ports;
- the second section consists of a series of reflex sheets, designed for operational reference on the initial actions to be implemented to respond to the most frequent types of spills;
- the third section is composed of practical datasheets on preparedness and response. It is designed as a toolkit to help operators to conduct spill response tasks;
- the fourth section provides examples of real-life incidents and information on the behaviour of pollutants when spilled.

This guide is at the crossroads between numerous other publications by Cedre, which are referred to and which we encourage you to consult.

Contents

Spill in a port: oil and contaminated seaweed

From preparedness to response

A

Characteristics of spills in ports

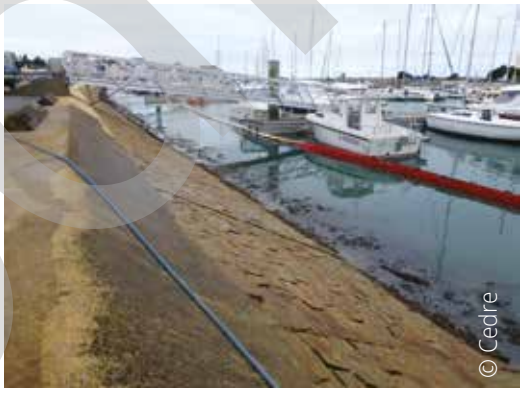
A1

Spills in ports are not uncommon occurrences. Around one third of spills recorded by Cedre for the period 1998-2018 occurred in port waters. In the vast majority of cases, these incidents involve oil. The quantities spilled are relatively low, with a median of around 10 m^3 and approximately 15% of such spills in excess of 100 m^3.

Spills in ports are characterised by five factors:

- the variety of substrates affected: quays/wharves/jetties, riprap, slipways, floating pontoons, etc.;
- the many potential spill sources: vessels, boats, floating gear, pipelines, storage facilities, fuelling stations, sewer systems, etc.;
- the diverse range of stakeholders, making it a sensitive and complex sector;
- the relative proximity of port areas to industrial and urban areas; this is a priority focus for risk assessment and incident management, in particular in relation to safety;
- the near-systematic presence of litter and debris due to activities on or near the water, complicating pollutant recovery and increasing the volume of waste to be managed.

Oiled pontoon



Oiled quay and containment using booms

Large accumulations of washed up litter

Sorbent boom below a wharf

Boom in an industrial area

Recovering oil contained in a drydock

Prevention and preparedness

A2

Prevention

The term "prevention" covers the actions that may be implemented in advance to avoid spills occurring, but also to limit the severity and impact of the spill if an incident does occur.

These actions may focus on:

Infrastructure

- Install oil storage facilities where there is little exposure to waves and wind;
- Set up zones for oil and chemical storage with retention systems and/or standard underground tanks with a leak detection system. Equip these zones with discharge treatment systems;
- Keep the lengths of fuel pipelines to a minimum, limit the quantities of fuel stored and opt for more frequent deliveries;
- Regularly maintain drainage systems (channels + slabs), ensure fuel pipes are oil-tight and that there is no diffuse pollution due to a leaking drainage channel which could contaminate the waste present;
- Prefer quaysides sloping away from the water;
- Design and use fuel transfer and distribution zones with a view to preventing overflow into the environment: leak detection, overflow valve on pump system, regular restarting of pumps, etc.;
- Install oil separators in water drainage systems and buffer storage capacities for run-off in ship repair yards;
- Identify suitable storage areas for contaminated waste (port reception facilities...) and/or hazardous waste;
- Install protection systems for water intakes: upstream oil detection triggering automatic shutoff when high concentrations are detected;
- Systematically complete the necessary formalities to obtain authorisation prior to conducting any work in a port area in order to minimise the risk of damaging pipes.

Personnel

- Raise awareness among port users and personnel to prevent hazardous practices such as storing waste oil directly on port roads;
- Improve loading, unloading and storage procedures.

Equipment

- Organise regular maintenance of equipment for storing and transporting oil and chemicals;
- Provide emergency kits to ensure a quick response in the event of a spill;
- Install permanent systems (booms, drain seals, etc.) and perform regular maintenance to remove accumulations of aquatic organisms or algae that could reduce their efficiency;
- Provide specific, oil-tight containers for vessels' oil filters (mainly fishing vessels).

Certification programmes

Several environmental protection initiatives for ports have been launched in recent years. When implemented, such initiatives have a significant influence on prevention.

- Ports propres: In France, the "Ports propres" (Clean Harbours) certification is a voluntary initiative for marinas to ensure their management addresses environmental issues. It requires harbours to have their practices control by an independent third-party organisation according to a benchmark of 17 criteria established at European level by the CWA 16987 Agreement, *Certification Européenne Ports Propres* (Clean Harbours Guidelines).
- ISO 14 001 certification: ISO 14 001 environmental certification recognises voluntary efforts to reduce environmental impacts. It requires compliances with all the regulations applicable to port activities and a systematic analysis of environmental aspects. In its 2015 version, it can be associated with an ISO 9001 (compliance of products and services) and ISO 45001 (safety) integrated management system.
- Blue Flag: Certified marinas are places where pleasure boaters have access to careening areas with no discharge into the natural environment, retrieval systems for waste water from boats and special waste recovery areas. Blue Flag marinas offer environmental activities to raise the awareness of pleasure boaters and visitors regarding environmental protection.

Contingency planning

Planning is based on the regulations in force and the existing organisation. It covers all actions that can be implemented in advance to ensure a quick and appropriate response in the event of a spill, to mitigate impacts on port users, local inhabitants, the environment, property and socio-economic activities. All these actions are recorded in a contingency plan to prepare decision-makers and operators to handle such an incident.

A contingency plan is an operational document, built on a risk analysis, that enables an appropriate and effective response to oil and/or chemical spills. It must therefore be realistic, easy to use and concise. All people potentially involved in responding to an incident must know of the plan's existence and be familiar with the sections relevant to them. Regular tests, updates and revisions are also required. At a minimum, the contingency plan must outline:

- the alert system and first actions (alert chart, evaluation, notification);
- the emergency organisation: location and operation of incident management units, composition and role of these units, operator mission sheets;
- incident management procedures: command structure, information management, equipment mobilisation, health and safety, internal and external communications, financial management, etc.;
- response sequences (protection measures, response at source, flows and targets, restoration actions): decision support charts, response strategies and tactics associated with spill scenarios,

response sheets and procedures;

- available resources (inventories of available resources and equipment that can be mobilised, experts and specialised back-up personnel);
- the end of operations, demobilisation of resources, record-keeping/archiving, compensation and litigation management, short-, medium- and long-term measures;
- post-incident management (feedback, plan revision, training and exercises, equipment replacement and maintenance).

In port areas, several types of plans can exist simultaneously: Ship Oil Pollution Emergency Plans (SOPEPs), the port's own spill contingency plan, those of industrial sites and those of the authorities. They must however be consistent and compatible with each other.

Contingency plans are very often drafted after a port is built or altered. Studying probable incident scenarios prior to the construction or redevelopment work would undoubtedly help to mitigate the effects and impact of spills. A clear example of this lack of prior analysis is the installation of fuelling stations on a floating pontoon in the middle of a marina.

The port itself can be used as a spill response tool. This is the case for instance when it is chosen as a port of refuge. The organisational and operational implications of such a decision must be laid out in the plan.

Equipment positioning and storage

Spill response equipment is often deployed in an emergency. The position and storage conditions should therefore be defined and adapted to ensure a rapid response and easy deployment, preferably near high-risk sites.

Contingency plans should define the locations that will ensure maximum efficiency in case of deployment. To be as close as possible to the spill, the equipment can be positioned on the deck of a ship, a pontoon, barge, dock or jetty, or in a warehouse.

Ideally, all the equipment required for the operation should be stored together (in a single container, trailer, cradle etc.). For instance, a skimmer should be stored together with a pump, a power pack, a set of hoses, ropes, tools, etc.

Generally speaking, the equipment should be protected from the sun's rays, frost, weather (spray, wind, rain, etc.). In areas where the climate is hot and humid (tropical or equatorial), it is important to make sure that sufficient ventilation is provided to prevent mould from forming and premature deterioration. The equipment should also be protected from rodents.

Training and exercises

The choice of equipment, creation of appropriately sized stockpiles and the optimal positioning of equipment is not the only key to success. Successful response operations in ports also depend on the quality of the organisation in place and how well it matches the risk. It is important that all personnel potentially involved in the response have had prior training and practice. Exercises should be organised regularly, taking into account

staff turnover. For response personnel, exercises are opportunities to "work together" and to better interact in an emergency.

One solution: pooling

In a port, it is fairly easy to share spill preparedness costs: concerted and complementary equipment purchases, joint training courses with shared costs, alternating organisation of exercises (port authority, industry, local authorities, fire and rescue service, etc.).

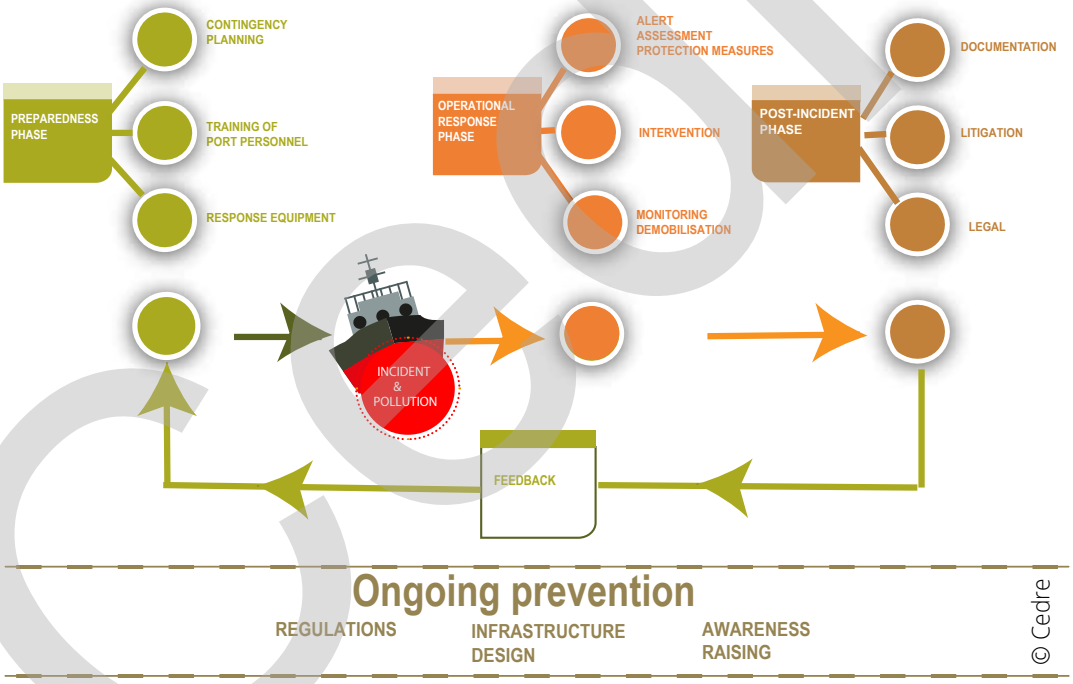
Boom deployment exercise

A3

Response framework

Spill response in ports is not restricted simply to the intervention phase. Although this is the core phase, it can only be carried out once the alarm has been raised, any "reflex" measures have been implemented, the situation has been assessed and information has been gathered on the behaviour and impact of the pollutant, the available response resources, the sea and weather conditions and the protection of response personnel. This information is collected during the assessment stage and is used to define the response strategy.

During and after response operations, the evolution of the situation must be monitored to establish a new assessment to provide a basis for the decision-making process.



Flow chart of the main missions to be conducted

Past experience has shown that response operations in ports generally involve numerous responders from both public and private sectors. However, clean-up operations are more or less systematically contracted out to private specialised contractors.

Generally speaking, the different actions to be assigned to the various responders can be divided into: main actions, secondary actions and complementary actions. The table on page 16 presents the breakdown of these actions.

Among the initial actions, the table specifies the need to check the accuracy of the information received. Then, the first measure to be taken by the port authority consists in conducting a survey, which will be used to define a safety zone, identify the sites affected, qualify the pollution (oil or bulk product, packages, containers, stranded wildlife...) and assess its extent.

In terms of response priorities, these assignments can be divided into 3 phases:

- **Emergency phase**

The aim during this initial phase is to ensure human safety, then to protect the environment and property. Meanwhile, as much information as possible on the pollutant should be gathered and the authorities and port users should be alerted as early as possible. Starting from this initial phase, the port authority will be responsible for gathering pollution reports and justifying each decision, with a view to subsequently compiling a compensation or litigation claim.

- **Response phase**

Once the necessary safety measures have been taken, the Incident Commander will direct the response and manage the incident over time. They will need to manage all operational, media-related, legal and financial aspects simultaneously. Throughout clean-up operations and up until the worksites have been closed down, the stored waste must be removed and sent to the most appropriate treatment channels to allow the site to return to its normal usage as quickly as possible.

- **Post-spill phase**

Monitoring must be implemented to determine whether it is relevant and feasible to conduct further operations. Following the incident, all the information collected from the outset, i.e. from the initial alert, must be compiled and sorted with a view to preparing for litigation and legal proceedings, but also to serve as a basis for the feedback process. This process aims to draw lessons for the future and improve the contingency plan or emergency procedures.

Key points on response

Chemical dispersion and in-situ burning are two techniques that should never be used in a port environment. Most of the time, response efforts will focus on containing and recovering the spill, cleaning contaminated surfaces and managing waste.

Main actions	Secondary actions	Additional actions
Alert raised by the polluter or a witness, or spill report/observation	→ Stop, close, plug at the source as soon as possible → Set up a safety area	→ Begin to record the information → Activate the contingency plan if there is one → Inform port users
Identification/search for origin/cause/source	→ Identify the pollutant precisely → Assess risks and possible evolution of the situation → Alert the authorities and responders → Estimate the volume/surface area → Adjust the safety area on shore and on the water	→ Seek polluter and give legal notice if identified → Collect samples, evidence, photos → Have a formal report established (by a qualified officer)
Reduce or stop the spill spreading towards the water	→ Onshore actions: protection, dyking, pumping, sorption, collection, storage, clean-up, waste treatment, shutoff measures...	→ Probable intervention of port's technical services, fire service and specialised contractors
Reduce or stop the spill spreading on the water	→ Actions on the water: containment, trawling, sorption, protection	→ In principle, intervention of the fire service, or alternatively the polluter or company contracted by the polluter or the authorities in charge of operations → Probable intervention of a specialised company or the port's technical support services
Recover the pollutant from the water	→ Actions on the water: sorption, concentration/thickening and pumping of the slick	→ Probable intervention of a specialised company or the port's technical support services
Store/transfer the pollutant for subsequent treatment	→ Waste characteristics → Elimination via appropriate channels	→ Minimise the quantities produced to reduce the need for subsequent treatment
Restore the site	→ Clean up oiled structures and hulls → Treat affected ground	→ Prepare the legal case, assess response costs and damages for submission to the polluter or their insurer
End of intervention	→ Resume operations	→ Inform port users
Documentation and feedback	→ Update plan → Restore equipment and replace used consumables	

Different possible actions during spill response

Reflex sheets: What to do in the case of...

These sheets illustrate the reflex measures for the selected response method according to the pollutant. They address the four following points:

- reflex measures;
- safety aspects;
- response strategies and techniques;
- summary data on product behaviour.

The pollutants covered in these sheets represent the products that are most frequently spilled in ports. They can be grouped into four main types:

- heavy oils: heavy crude oil, IFO 180 and 380, lubricating oil, often in the form of waste oil... ;
- light oil products:
  - diesel and similar products such as marine diesel (light marine diesel and MDO), home heating oil, biodiesels;
  - petrol and similar products such as light crude oils, Super Unleaded petrol, Super 95 and 98, kerosene, Jet A-1 or Super petrol;
  - Low Sulphur Fuel Oils (LSFO), currently little known;
- chemicals:
  - transported in solid form: raw ores (bauxite, rock phosphate, iron, manganese oxide and mineral salts) or organic ores (ammonium nitrate, pesticides, insecticides...);
  - transported in liquid form: petrochemicals (methanol, benzene, styrene...), corrosive substances (acids, caustic soda...), vegetable oils (palm oil, copra oil...), gases (natural gas, ammonia, chlorine...);
- organic matter such as foodstuffs (rice, wheat, molasses, etc.), tank slops or wastewater treatment plant discharge, etc.

Spills of heavy oil

Heavy crude oil, IFO 180 or 380, lubricating oil...

B1

Reflex measures

→Relay the alert.
→Implement the necessary safety measures at the facility or vessel at the origin of the spill.
→If it is possible and safe to do so, stop the spill at its source.
→Assess the situation and report the information to the harbour master.
→Determine exclusion zones and safe areas on the shore and on the water.
→Record the pollution: have an official report drawn up, take photographs and samples.
→Launch response operations along the route taken by the spill and/or on the water.
→Notify the fire and rescue service, harbour master's office and Cedre.

Operator safety

→As far as possible, stay upwind of vapours while taking into account any current.
→Ensure there are no heat or ignition sources in the vicinity.
→Wear oil-resistant Personal Protective Equipment (PPE) to prevent contact with the skin and possible inhalation of vapours.

Response strategies and techniques

If the spill is onshore

→Stop the slick from spreading using a containment system composed of sorbents or by constructing a bund.
→Protect storm drains, gutters and other outlets as a precautionary measure.
→In the case of large quantities of pollutant, recover the spill by pumping. In the case of small quantities of pollutant, recover the spill using sorbents.

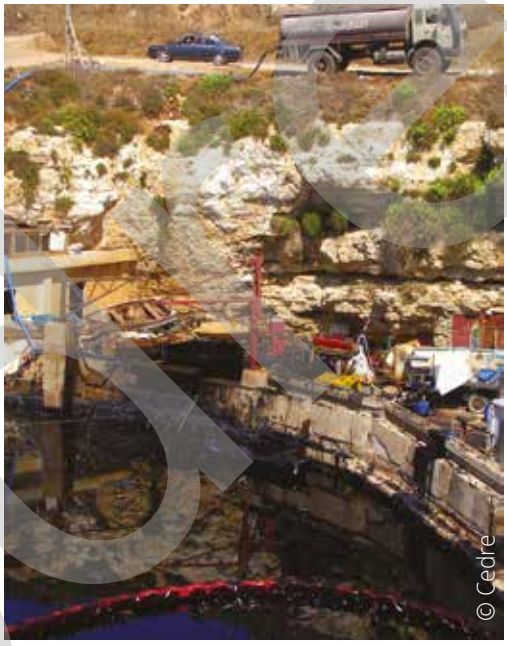
If the spill is on the water

The use of chemical dispersants in ports is strongly discouraged. Due to natural containment of the water in harbour basins, it is difficult or even impossible for the dispersed pollutant to quickly dissipate in a large volume of water. Furthermore, dispersants have little effect on very viscous products.

→Contain the polluted area or the source of pollution by surrounding or isolating the slick on the water surface with a floating boom and ensure that the system is watertight by also using sorbent booms. If necessary, herd and contain the slick at the surface by creating a flow at the surface using a fire hose with a solid jet. Avoid directly spraying the slick.
→Recover the spill using a weir skimmer or pump it from the water surface using a simple large-diameter suction nozzle (given the product's viscosity) connected to a vacuum truck.
→If the polluted area is very large, concentrate and thicken the slick by trawling the surface with a small curtain boom.

→Protect sensitive areas and structures from the pollution: water intakes, riprap, difficult access areas under piled wharves, natural sensitive areas such as marshes or mudflats, other areas such as shellfish breeding areas or pontoons for pleasure boats.
→Organise subsequent cleaning of oiled structures and hulls. Any washing agents used should be insoluble so that they can be recovered at the same time as the washing effluents.
→Organise rehabilitation of oiled wildlife.
→Manage all waste collected.

Pumping oil and storing it onboard a barge



Pumping oil and storing it in a tank

Product behaviour

Heavy oils are characterised by a high viscosity and density compared to petrols and diesels. With the exception of bitumen, they float, spread and can form slicks up to several centimetres thick in the case of a large spill. Their density close to that of freshwater or even seawater reduces their buoyancy. Combined with a high content of suspended matter, this can cause slicks to become submerged.

Their viscosity is generally high, reducing the effectiveness of packaged sorbents, but pumping or mechanical recovery operations are still feasible. If the water body is agitated, heavy oils may form an emulsion, further reducing the effectiveness of sorbents and complicating pumping operations. Heavy oils adhere to the rocks and concrete of port structures as well as ships' hulls, making subsequent clean-up operations of oiled surfaces more complex.

Spills of diesel or similar

Diesel, light marine diesel, marine diesel oil (MDO), domestic fuel oil, biodiesels...

Reflex measures

→Relay the alert.
→Implement the necessary safety measures at the facility or vessel at the origin of the spill.
→If it is possible and safe to do so, stop the spill at its source.
→Assess the situation and report the information to the harbour master's office.
→Determine exclusion zones and safe areas on land and on the water.
→Report the pollution: have an official report drawn up, take photographs and samples.
→Launch response operations along the route taken by the spill and/or on the water.
→Notify the fire brigade, port authorities and Cedre.

Operator safety

→As far as possible, stay upwind of vapours while taking into account any current.
→Ensure there are no heat or ignition sources in the vicinity.
→Wear oil-resistant Personal Protective Equipment (PPE) to prevent contact with the skin and possibly inhalation of vapours.
→In high temperatures and/or if the spill occurred in a contained area, beware of the fire hazard.

Response strategies and techniques

If the spill is onshore

→Stop the slick from spreading using a containment system composed of sorbents or by constructing a bund.
→Protect storm drains, gutters and other outlets as a precautionary measure.
→In the case of large quantities of pollutant, recover the spill by pumping. In the case of small quantities of pollutant, recover the spill using sorbents.

If the spill is on the water

The use of chemical dispersants in ports is strongly discouraged. Due to natural containment of the water in harbour basins, it is difficult or even impossible for the dispersed pollutant to quickly dissipate in a large volume of water.
Protect sensitive areas and structures from the pollution: water intakes, riprap, difficult access areas under piled wharves, natural sensitive areas such as marshes or mudflats, other areas such as shellfish breeding areas or pontoons for pleasure boats.
→If large pollutant accumulation areas form naturally, use a skimmer coupled to a vacuum

truck. The pollutant may be concentrated by using a water jet to create a flow in front of the slick, but not directly on it as this may cause the diesel to emulsify.

→If the slicks are scattered, place sorbent pads on the surface and renew them when saturated. Store used sorbents in leakproof containers or skips. If the polluted area is very large, trawl the slick at the surface using sorbent booms.

→Organise subsequent cleaning of oiled structures and hulls if the environment's natural cleaning capacity (tides, waves, etc.) is insufficient.

→Organise rehabilitation of oiled wildlife.

→Manage all waste collected.

Diesel sheen

Recovering oil using sorbent booms and pompoms

Product behaviour

The behaviour of diesel or a similar product spilt in water depends on the exact nature of the product which can vary in composition, density and volatility. Diesel always floats, as it is much lighter than water (its density is usually between 0.82 and 0.87).

In ports, which are generally calm and relatively sheltered from the wind, natural dispersion is low, even in quite strong winds. Diesel therefore mainly spreads and evaporates (20 to 40%).

Spills of petrol or similar

Petrol, light crude oils, Super Unleaded petrol, Super 95 and 98, kerosene, Jet A-1, Super petrol...

Reflex measures

→Avoid/remove any sources of heat or potential point of ignition.
→Relay the alert.
→Implement the necessary safety measures at the facility or vessel at the origin of the spill.
→If it is possible and safe to do so, stop the spill at its source.
→Notify the fire and rescue service, harbour master's office and Cedre.
→Evacuate the area and wait for the fire and rescue service or port firefighters to handle the incident, given the risk of fire and explosion.

Operator safety

→Switch off engines and motors (vessels, vehicles on land...), ban smoking, do not start up electrical or electronic equipment.
→Always stay upwind, while taking into account any current.

Response strategies and techniques

Response strategies and techniques should only be implemented by the fire and rescue service or by trained, drilled and fully equipped firefighters. Once safety aspects have been managed, given the behaviour of petrol, no major response operations can be conducted, as the pollutant will have entered the atmosphere and the water column.

Product behaviour

When spilled in a harbour basin, petrol and similar products float, spread and evaporate rapidly. 75-85% of a petrol slick generally evaporates within the first hour and almost all of the pollutant will evaporate within the first six hours following the spill.
With a density of around 0.75, they are very light and low-viscosity products.
The risks posed by a significant spill are particularly high for the general public and for response personnel. The flash point of this type of product is lower than ambient temperature and the risks of fire and explosion are therefore high.
From an environmental point of view, a spillage of such a product generates the presence of toxic molecules in large quantities in the water column. In turbid waters, these molecules will become combined with matter in suspension and will then settle. Most additives present in petrols are also toxic.

Protecting a building with a water curtain sprayed by a water shield

Spills of bulk or containerised chemicals

Raw ores, petrochemicals, corrosive substances, vegetable oils, gases...

B4

Reflex measures

→Position yourself upwind and at a distance to quickly assess the main risks (explosion, toxicity, ignition) by gathering essential information such as the UN number, the BIC code and/or the hazard class pictogram on the package or container, the presence of a leak, smoke, etc.
→Take cover using collective protection or evacuate the area.
→Implement the necessary safety measures at the facility or vessel at the origin of the spill.
→Activate the preventive safety systems (safety valves, loading arms, emergency shutdown, etc.) if they have not been activated automatically.
→Take into account the information provided by surveillance devices (cameras, sensors, alarms).
→Notify the fire and rescue service, harbour master's office and Cedre.

Operator safety

→In the case of an unknown, flammable or explosive product, eliminate any fixed or mobile ignition sources in the risk area.
→Always stay upwind, while taking into account any current.
→Do not attempt to respond to the spill or handle the container.
→Only the fire and rescue service or trained, drilled and fully equipped firefighters should implement intervention.
→If the substance has not been identified, it should be considered hazardous by default.

Response strategies and techniques

Response strategies and techniques should only be implemented by the fire and rescue service or by trained, drilled and fully equipped firefighters.

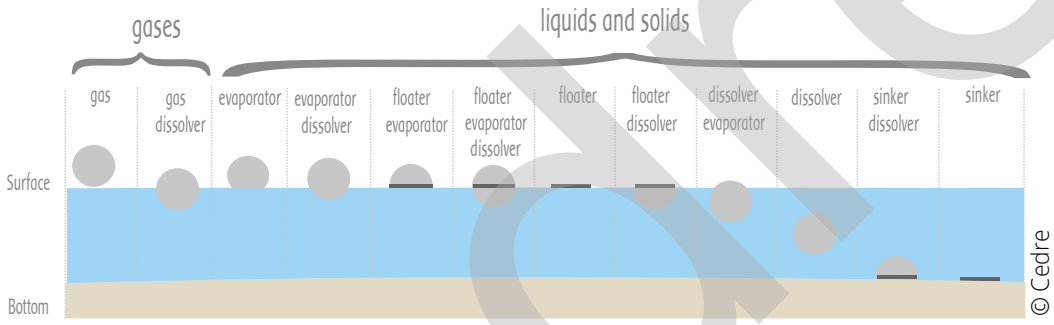
Recovering vegetable oil using a weir skimmer

Installing a drain seal mat on the ground

Product behaviour

It is essential to predict the behaviour of a chemical substance spilled in the aquatic environment in order to provide an appropriate response. For every chemical, a simple but rapid assessment of its behaviour can be made based on some of its physico-chemical properties: state, solubility, density, etc. The overall behaviour of a substance is thus determined and listed in the Standard European Behaviour Classification (SEBC).

The different types of behaviour are presented below, but it is important to note that environmental conditions (especially weather conditions) may influence this behaviour.



The different types of behaviour of spilled substances according to the SEBC classification

Spills of Liquefied Natural Gas

B5

Reflex measures

→Check that the automatic protection measures are activated.
→According to the severity, activate the appropriate alert procedure (shelter-in-place or evacuation).
→Activate the preventive safety systems (dry-break or emergency shutdown) if they have not been activated.
→Take into account the information provided by surveillance devices (cameras, sensors, alarms).
→Take cover using collective protection or evacuate the area.
→Notify the fire and rescue service, harbour master's office and Cedre.

Operator safety

→Eliminate any fixed or mobile ignition sources in the risk area.
→Always stay upwind.
→Only trained, drilled and fully equipped operators should implement intervention. If the spill spreads outside of the port boundaries, leave the fire and rescue service to coordinate and implement the response.
→If the substance has not been identified, it should be considered hazardous by default.

Response strategies and techniques

Response strategies and techniques should only be implemented by the fire brigade or by trained, drilled and fully equipped firefighters.

Product behaviour

LNG is colourless and odourless. The liquid's density relative to water is between 0.42 and 0.50. The gas's density relative to air is 0.60. Its flammability limits are between 5 and 15% when the product has evaporated.
LNG in contact with water or any other liquid at ambient temperature will vaporise instantly. Depending on the spill kinetics, vaporisation can be violent (Rapid Phase Transition). The sudden increase in the volume of the LNG can generate a "cold explosion" shock wave, i.e. a sudden generation of overpressure, without combustion.
The vapours generated during a significant LNG spill may travel a long way to a distant ignition source and produce a flashback. The cloud may be white (condensed water vapour), but the colour will rapidly dissipate while the risk of fire or explosion remains.

Experimental phase: releasing methane in the Cedre Experimentation Column

Experimental phase: releasing methane in the Cedre's deep-water test tank

Spills of organic matter

Foodstuffs (rice, wheat, molasses, etc.), tank slops or wastewater treatment plant discharge, etc.

B6

Reflex measures

→Floating pollution (e.g. animal fat – filleting waste from oily fish): rapidly set up containment (booms, etc.) to avoid accumulation on port structures (slipways, ladders and quay walls, ships' hawsers).

→Dissolved pollution or plumes of suspended matter: notify the port authorities in order to suspend any potentially affected activities (seawater pumping, etc.) and/or take action at the source of the spill (vessel, technical port installation, etc.)

→Identify the spill source. Notify network operators and authorities (shellfish farms, bathing areas, etc. in the vicinity).

Operator safety

→If the substance has not been identified, it should be considered hazardous by default.

→In the case of discharge via port outfalls, priority should be given to removing all residues from quay ladders and walls, and slipways, as it may make them slippery and hazardous (for users and responders). If necessary, block off access to port facilities (berths, slipways, etc.) for the duration of the clean-up operations.

Response strategies and techniques

→In the case of recurrent organic pollution such as oily fish waste from port networks, recovery/pre-treatment/treatment facilities suited to the effluents (fine sieving, flotation, etc.) must be set up and comply with the regulatory requirements applicable to production facility operators.

→Regular maintenance of port discharge treatment facilities helps to prevent incidents caused by overflow (wastewater) or pollutant discharge (careening areas, etc.).

Product behaviour

The concept of organic pollution covers several types of discharge into the sea. It includes direct discharge of organic matter (effluents from port facilities, black water/grey water from vessels), cargo residues (cereals, seafood, etc.) but also organic pollutants that collect in vessel maintenance facilities (careening sludge, bilge water, etc.). The behaviour of the products/pollutants, their potential effects and the response strategies will therefore be diverse and specific to each situation.

Fish fat released in a port outfall, with deposits and accumulations on a slipway

Scattered release of organic matter (fish processing wastewater)

Practical datasheets

Inventory of possible pollution sources and port structures

Objectives

To draw up a prior inventory of the different possible sources of pollution and of the port structures in place in order to simplify and facilitate the initial actions to be implemented in the event of a spill, through better prior knowledge of the risks.

Procedure

List the possible sources of pollution

- Map (for the"catchment area" of the port in question) the sites where oil and/or chemicals are handled or transferred (fuelling stations, bunkering facilities, industrial sites...) as well as shipyards and port waste reception facilities.
- Map existing storage sites and associated pipelines (for example all storage sites with a capacity greater than 10 or even 5 m^3) including buried storage facilities for home heating oil.
- Up-to-date map showing the course of any pipelines (aerial, buried or underwater) in the port area.
- Detailed map of networks: urban sewer system, industrial site outfalls, rainwater drainage systems, port trench drains, streams, etc.
- Precise definition of network shutoff, containment of outfall discharges, etc.
- All other information (documents or maps) which may be used to list potential sources of pollution or understand the routes taken by liquid pollution within the port boundaries.

Inventory the different port structures and vulnerable points

- Quays and wharves. Piled wharves are liable to be polluted underneath, sometimes depending on the tidal range and the rising and falling tides.
- Structures designed to act as a breakwater (e.g. riprap, tetrapods, embankments, jetties, underneath quays) and through which only a small volume of water can pass.
- Slipways, pontoons and locks are sensitive sites as they are essential elements for the use of the port, including during pollution response operations.
- Water intakes (fish markets, industrial sites, aquariums, etc.).
- Recreational areas (fishing, bathing, watersports, etc.).

Produce a simplified map of the port and, if possible, integrate the data compiled in a Geographic Information System (GIS).

Integrate the data contained in the local authority contingency plan and/or the port contingency plan where these documents exist.

Precautions

A liquid spill on the surface of a watercourse or near the shore will be likely to strand in natural areas of accumulation where litter and debris regularly wash up. When pollution is detected, it is often advisable to visit these generally well-known sites to check for the presence of liquid pollution, and begin clean-up where necessary.

Illustrations

Oiled riprap and wharf pilings

Oiled harbour basin and pipes

Lock gate

Drafting a contingency plan

Objectives

Drafting a contingency plan means designing an operational document that enables the operator and authorities to effectively respond to a spill. Such a document must be clear, precise, concise, known to all stakeholders and regularly updated.

Procedure

Before drafting the plan

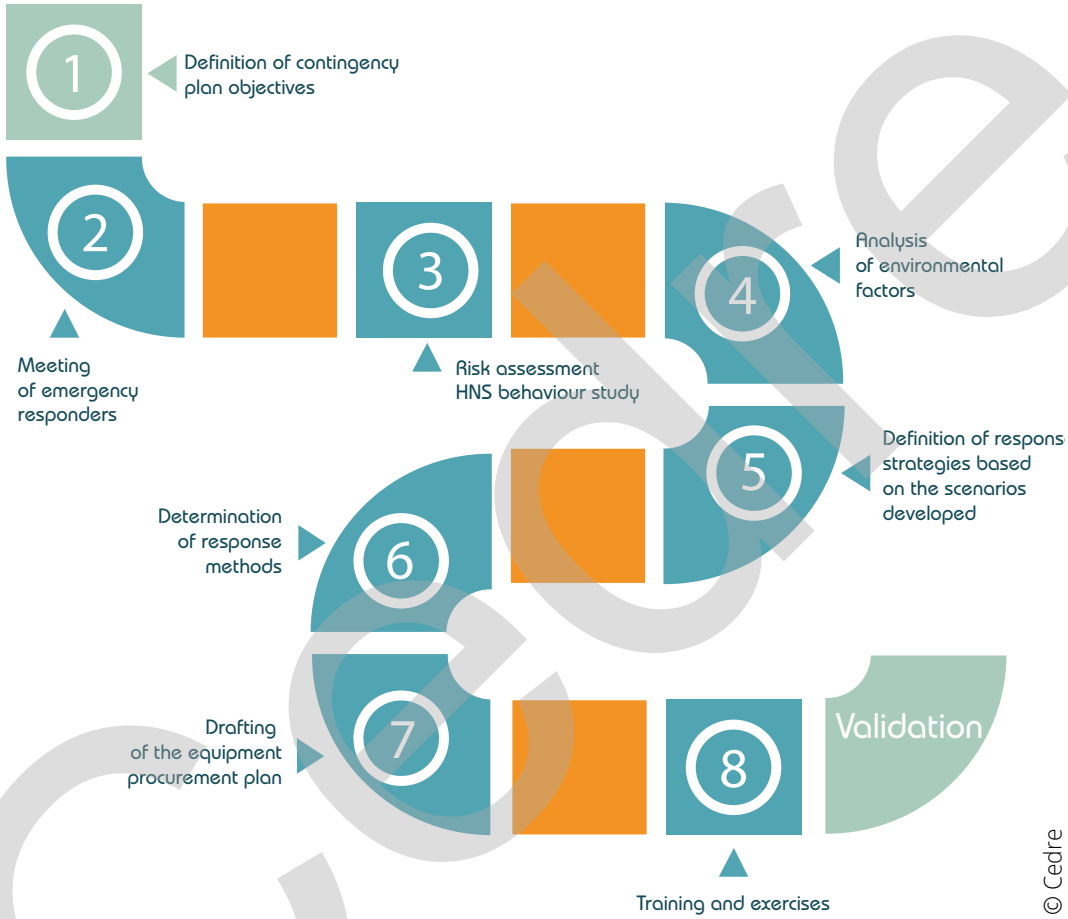
- Assess the spill risks, identify the products liable to be spilled and the potential causes of a spill (tank rupture, pipe leakage, collision between two vessels, etc.).
- Carry out an environmental analysis to anticipate the trajectory of the product spilled in the environment, its behaviour in this type of environment and the areas it may impact.
- Identify all stakeholders that may be involved in the management of the spill and their responsibilities and resources.
- Define effective and realistic prevention measures.

In the plan

- Describe the alert system and initial actions (assessment, notification, protection).
- Define the crisis organisation: location and operation of incident management units, composition and role of these units, operator mission sheets, interfacing with other plans.
- Draft incident management procedures: command structure, information management, resource mobilisation, health and safety, communications, financial management.
- Describe the response sequences: decision support charts, response strategies and tactics associated with spill scenarios, response sheets and procedures.
- Review available resources: inventory of available resources and equipment that can be mobilised, experts and specialised back-up personnel.
- Outline aspects relating to ending the response: termination of operations, demobilisation of resources, record-keeping and archiving, compensation and litigation management, short-, medium- and long-term measures.
- Describe post-spill management: feedback, plan revision, training and exercises, equipment replacement and maintenance.

Precautions

- The spill contingency plan may be incorporated in a local authority contingency plan and/or in a port contingency plan.
- The spill contingency plan must be regularly tested through exercises in order to ensure it remains relevant and ensure that the personnel liable to be mobilised are well practised in its implementation. It should be regularly updated, particularly following an incident, a change in organisation or new protection or response measures.



Main steps in drafting a contingency plan

Equipment recommendations

Objectives

To propose a typical allocation of equipment according to the type and volume of pollutant spilled. These suggestions do not take into account the layout of the harbour basins which can vary greatly from one site to another, or the complexity of an incident which can in certain cases require further response means.

Procedure

For response on land
- Drain covers.
- Inflatable plugs.
- Containment system for use on the ground.
- Universal sorbents.
- Brooms, brushes, spades, buckets.
- Watertight skips, drums or bins to store used sorbents.
- Personal Protective Equipment (PPE).
- Equipment for marking out the area and ensuring its safety.

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For response on water - Case of a 1,000-litre spill of heavy oil or diesel
- Sorbent booms, preferably with a skirt (twenty 3 m sections), for containment
- Mooring and anchoring equipment.
- Vacuum truck fitted with an appropriate skimmer head.
- Bulk or pompom sorbents (1 to 2 m^3) for recovery.
- 1 motor boat to work on the water, to deploy booms and recover sorbents.
- Watertight skips, tanks, barrels or bins and landing nets or boat hooks to recover and store the pollutant and used sorbents.
- PPE.
- Equipment for marking out the area and ensuring its safety.

For response on water - Case of a 10,000-litre spill of heavy oil or diesel
- Floating fence boom of sufficient length (double the width of the water body).
- Sorbent booms: 40 extra 3 m sections (60 sections in total).
- Mooring and anchoring equipment.
- 1 motor boat to work on the water.
- Vacuum truck equipped with a self-adjusting mechanical weir skimmer with suction hoses fitted with floaters.
- Watertight skips, tanks, barrels or bins and landing nets or boat hooks to recover and store used sorbents.
- PPE.
- Equipment for marking out the area and ensuring its safety.

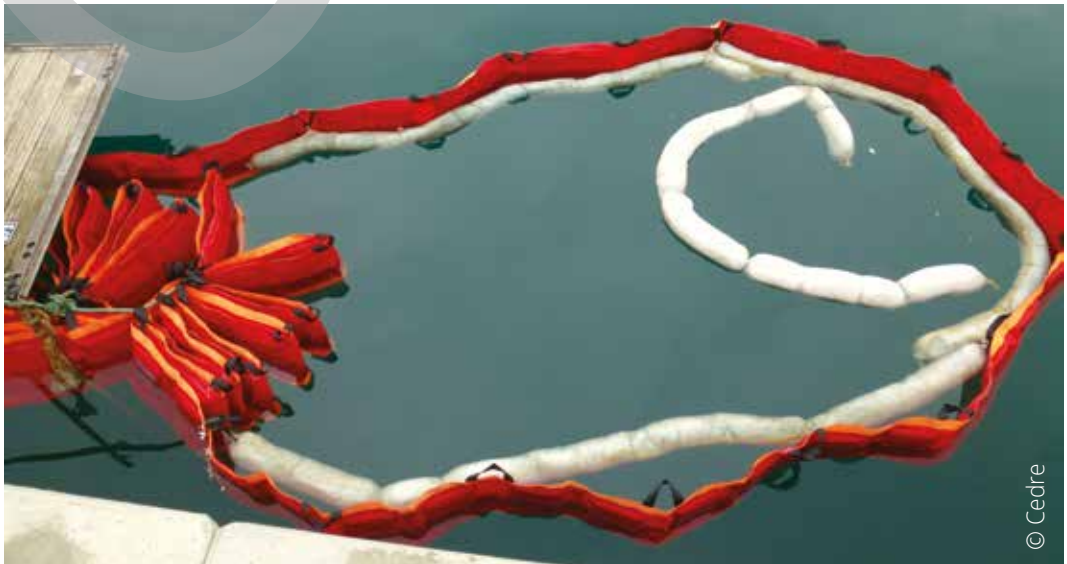
Precautions

- Any process involving spill response equipment procurement, structure development or the selection of a service provider must be initiated by precisely defining the needs: conditions of use (exposed and sheltered areas, accessibility, logistical equipment, etc.), type of pollution (nature of the pollutant, behaviour of the pollutant, compatibility of materials, etc.) and response scenarios.
- The indirect costs associated with equipment procurement or structure development should be identified (list all accessories, training, maintenance, etc.) and, according to the budget, pooling options may be chosen.
- When consulting manufacturers, it is important to check that the performance claims will hold true in the expected usage conditions.
- The use of dispersants in ports and harbours is not a technique recommended in this guide as it requires a very large volume of water for the complete dissipation of the dispersed pollutant. However, ports are composed of protected or confined bodies of water, and therefore rarely offer this possibility.
- The use of sorbents can be considered as expenditure on consumables. Certain suppliers offer a service involving the supply of new products and the removal of used products. The type of sorbent should be carefully chosen, drawing upon the lists published by Cedre on its website (wwz.cedre.fr/en/Analysis-Research/Dispersant-and-sorbent-testing).
- Ensure the necessary power sources and fluids are available prior to response operations.

Illustrations

Drain cover

Boom moored to the wire of a tidal compensator



Containment system composed of a fence boom and a sorbent boom

Conducting exercises

Objectives

- To drill emergency management personnel and/or field teams in spill management.
- To test the spill response procedures and systems and validate the contingency plans.

Procedure

Exercises can be carried out at different levels, depending on pre-identified needs. They may consist in a half-hour alert simulation, a practical exercise lasting a few hours on a particular aspect of response, or a crisis management exercise designed to test the entire response organisation in the event of a spill, which may last one to two days.

Analysing needs

- Define the port's priorities in relation to the risks identified.
- List the personnel liable to be involved in spill response and their skill level, then identify training courses (for example those run by Cedre, see wwz.cedre.fr/en/Training) through which they can acquire any skills that may be lacking.
- Define a training plan, comprising training courses and exercises, that may vary in length according to regulatory obligations and the available budget.
- Define the type of exercise and its objectives.

Preparing an exercise

- Appoint an exercise coordinator in charge of organising and subsequently assessing the exercise.
- Define the site in the case of a field exercise.
- Define the duration according to the established objectives.
- Draw up specifications.
- Prepare a credible spill scenario consistent with the objectives of the exercise based on the identified risks.
- For crisis management exercises only:
  - → Set up a facilitation team with a lead coordinator;
  - → Prepare assignment sheets for each facilitator;
  - → Develop the general synopsis (expected reactions according to objectives);
  - → Define a timeline for the exercise;
  - → Identify and mobilise participants: players, observers, evaluators;
  - → Prepare messages for the facilitation team;
  - → Define the conventions to be used for the exercise (real or fictional weather forecasts, real or accelerated time, communication methods);
  - → Produce an exercise directory (phone numbers for players and facilitators);
  - → Prepare evaluation sheets for the evaluators.
- Schedule in an evaluation phase just after the exercise, whose duration should be proportional to that of the exercise.
- Prepare a procedure and a schedule for feedback, which should take place a short while after the exercise.

Conducting an exercise

- The aim of the exercise itself is to immerse participants in a realistic incident management situation.
- In the case of a crisis management exercise, the facilitation team, lead by its coordinator, is responsible for running the exercise and encouraging participants to play an active role in accordance with the established objectives. To do so, they regularly inject different types of messages. The evaluators' role is to analyse the progress of the exercise. Observers do not take part in any phases of the exercise. Observers and evaluators must be readily identifiable (badge/pass, armband, etc.).

Evaluating an exercise

- The evaluation phase is crucial to determine whether the objectives set have been achieved. It highlights the positive points as well as the areas for improvement. An initial feedback session should be organised immediately after the end of the exercise.
- In the case of a crisis management exercise, the immediate debrief should be followed up by a second session a short while later. This may require work groups to be set up on organisational topics or specific techniques.
- Update procedures or the contingency plan and identify training needs.

Illustrations

Deploying a boom from a slipway during an exercise

Containment exercise around a fishing vessel

Table-top training exercise

Immediate action chart within the administrative boundaries of a port

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** The Master of a ship involved in a discharge or probable discharge of oil, or noxious liquid substances must report the incident without delay to the nearest coastal State (IMO RESOLUTION A.851(20))*

*** The harbour master's office includes the harbour master, port officer, assistant port officer, port supervisor, and supervisory support staff*

Standard notification form

ALERT RECEIVED	DATE AND TIME OF CALL
Contact details of caller Name: Department/position: Tel.: Fax: Email:	Contact details of receiver Name: Department/position: Tel.: Fax: Email:

EVENT DESCRIPTION	
Date and time of the event:	Location: (basin, wharf, quay, pontoon...)

Description (pollution, accident, fire, explosion, toxic emission...):

Source (vessel, container, industrial site, vehicle, undetermined):

Product involved (1): Quantity (units):
Where relevant, other product involved (1): Quantity (units):

(1) if product is undetermined, specify: presence of hazard label, colour, viscosity, appearance, perceptible smell.

INITIAL ASSESSMENT

Exact situation at time of call (people injured, fire under control, in progress...):

Evolution, possible short term risks (resources at risk, targets):

INFORMATION CONFIDENCE LEVEL	Action to be taken
☐ Doubtful (to be confirmed) ☐ Reliable but inaccurate ☐ Definite (already confirmed)	

Conducting a survey

Objectives

- To confirm or reject the alert message.
- To identify the areas affected, characterise the pollution (type of pollutant, estimation of volume and length of affected shoreline, etc.) and provide initial information for decision-making.
- To monitor the evolution of the pollution by establishing successive situation assessments.

Equipment

- Clothing: Appropriate PPE according to the pollutant, the site (proximity to the water, lifting equipment, etc.), weather conditions, etc.
- Communication equipment: VHF or mobile phone, chosen according to risks (e.g. ATEX).
- Note-taking: notebook, blank site survey forms, protective folder in case of rain, port map or digital tablet with necessary files.
- Imagery: camera, video camera or phone: ensure battery is fully charged and sufficient storage space is available.
- Observation and quantification: binoculars, watch, tide tables, decameter, GPS.
- Appropriate means of transport that is authorised on site: light watercraft, port vehicle, etc.
- According to the context, use a drone or even a helicopter for an overall view of aerial images, ensuring compliance with the regulations in force.

Procedure

Before travelling to the site

- Adapt safety measures according to the suspected product (PPE, approach route remaining upwind of the spill, etc.).
- Select the sites to be visited first according to the alert data and ensure that you have the necessary access permission.
- Schedule the time of the survey according to external factors (tide times, etc.) where relevant.
- Gather the necessary equipment and organise logistics.

During the survey

- Use the standard pollution assessment form to gather as much information as possible to detail the incident, adapt safety measures and define an appropriate response strategy.
- Take photos and/or films.
- Depending on the context and surveyor's capacity (judicial police officer), take samples.

After the survey

- Send a copy of the survey form (including images) to the appropriate authority and retain/archive the report.
- According to the context, send samples to the designated laboratory for analysis.

Illustrations

Aerial survey of a spill in a port

Boat-based survey: binoculars and note-taking

Boat-based survey under a piled wharf

Boat-based survey along a quay wall

Standard pollution assessment form

This form should be completed with as much information as possible. The correct assessment of the problem and possible pre-mobilisation of additional resources will depend on its accuracy.

AUTHOR	RECIPIENT
Name: Position: Phone n°: Fax n°: Email:	Name: Position or organisation: Phone n°: Fax n°: Email:
Date:	Number of pages:

PART 1: SITE CONCERNED & INCIDENT DESCRIPTION	
Incident source	Vessel ☐ Wharf ☐ Pipe ☐ Discharge ☐ Other (specify) ☐ Name: Exact location / Position in relation to an easily identifiable point of reference
Cause of incident	
Time of occurrence	

Current status
Place where spill occurred if different from facility location:
Spill start time: Discontinuous spill ☐ or continuous spill ☐
Spill under control: yes☐ /no ☐ If not, indicate estimated leak rate:
Pollution: Water body ☐ Port facilities ☐ Nearby roads☐ Other (specify)
Estimated quantity spilled (volume in m^3):
Survey conducted ☐ / scheduled ☐ (specify time:)

Product characteristics	Name: Density: Flash point: Viscosity:..... cSt at .....°C Odour: Colour:
Product behaviour	Evaporates ☐ Floats☐ Disperses ☐ Dissolves ☐ Sinks ☐
Possible risks:	Fire ☐ Explosion ☐ Explosivity measurements: Yes ☐ No ☐ Location: Acidic or basic product: Yes ☐ No ☐ pH:
State of the slick	Emulsion ☐ Bands ☐ Thick patches ☐ Sheen ☐ Other ☐
Weather conditions	Sunshine/cloud cover: Rainfall: Wind speed (knots): Direction wind coming from: Water temperature: Air temperature:
Conditions on water body & sea state	Current: Direction: Speed (knots): Wave height: Visibility: Tide (coefficient, range):

PART 2: EVOLUTION OF THE SITUATION		
Weather forecast (specify data source)	Wind (estimated direction): Directly threatened areas:	Estimated speed:
Risks of worsening (specify tide times and directions)		
Facilities in danger and areas at threat	By order of priority	
	1.	2.
	3.	4.
	5.	6.
	7.	8.

PART 3: RESPONSE ASSETS		
Harbour master's office informed: yes ☐ / no ☐		Any other contact(s):
VHF channel for boats involved:		
On-site command post: yes ☐ / no ☐ Name and contact details of chief: Operational command post: yes ☐ / no ☐ Name and contact details of chief:		Other useful contact details:
Resources deployed	Personnel:	Equipment:
Resources available	Personnel:	Equipment:
Needs	Personnel:	Equipment:

Identifying the pollutant and associated hazards

Objectives

To determine the type of product spilled in order to define the safety measures to be adopted, the level of protection for responders and the response strategies to be implemented to mitigate the impact of the pollution and promote a return to normal.

Procedure

To identify the pollutant

- Consult the shipping document, the dangerous cargo manifest (for container ships only) and the information on the container, where applicable, in order to obtain the scientific name, trade name, UN number, Chemical Abstracts Service (CAS) number and/or manufacturer's information.
- Contact the previous port of call or the port of loading where applicable.
- Use the observations made during surveys (colour, viscosity, odour, behaviour, etc.).

To characterise the hazards for humans and the environment

- Consult the product's Safety Data Sheet (SDS) provided by the manufacturer, importer or retailer.
- Take note of the information on the container, where available (owner's number and serial number of the container, hazard pictogram).
- Search for information in the various international transport codes and agreements: IGC, IBC, IMDG, IMSBC and ADN.
- Contact organisations offering operational expertise such as Cedre, Ineris...

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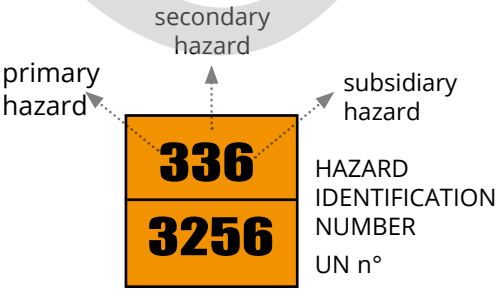
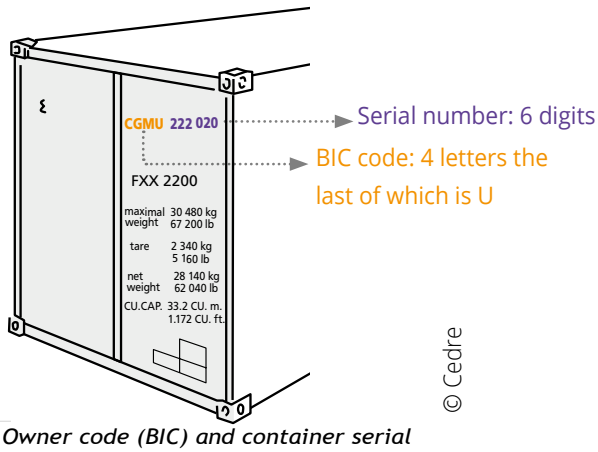
Precautions

- All products spilled or washed up should be considered potentially hazardous.
- It is important to set up a data collection network in advance, to ensure quick access to reliable and accurate information from the outset.

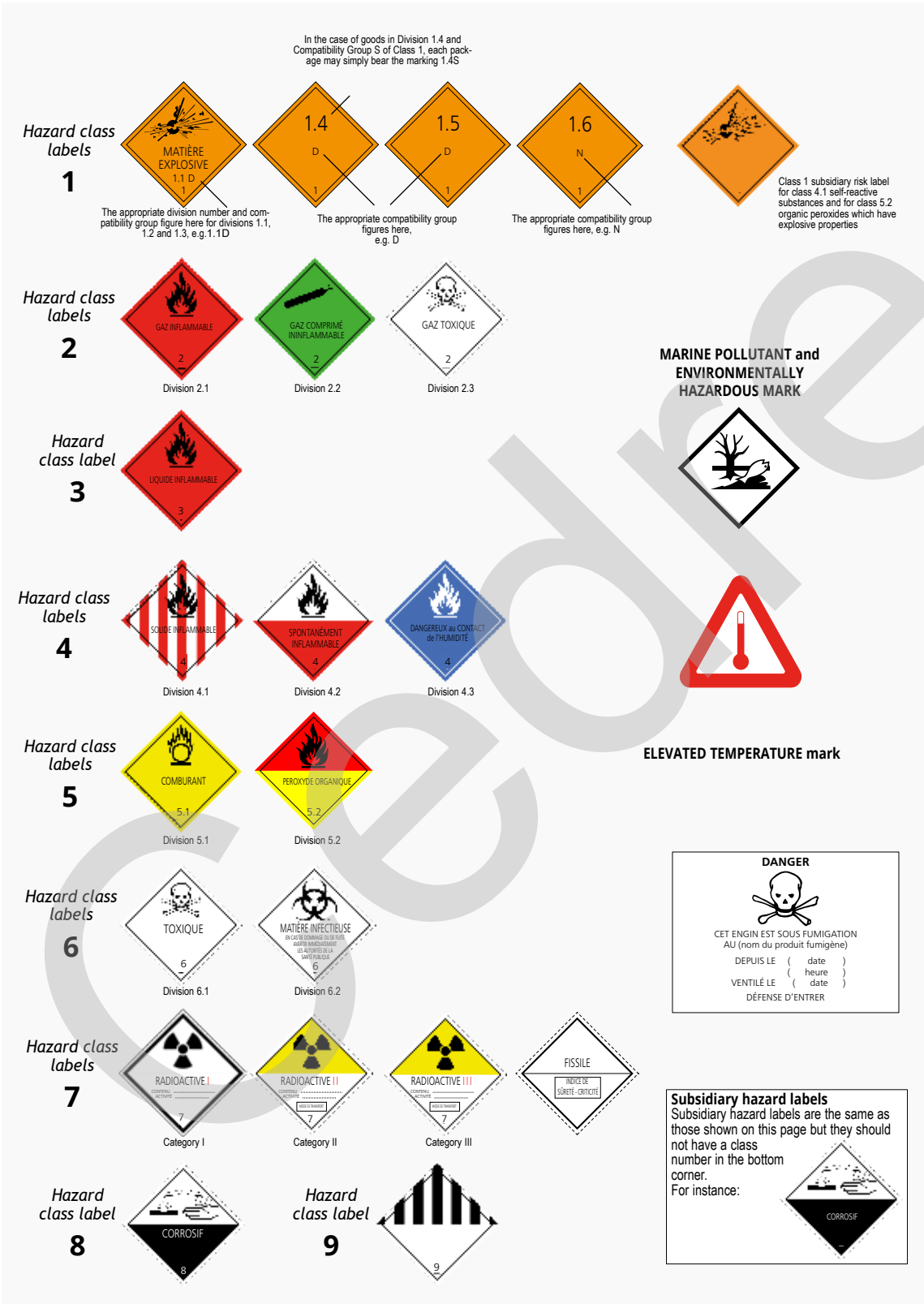
Illustrations



Product's UN number



Owner code (BIC) and container serial number



Hazard classes

1: Explosives | 2: Gases | 3: Flammable liquids | 4: Flammable solids | 5: Oxidising agents & organic peroxides | 6: Toxic & infectious substances | 7: Radioactive substances | 8: Corrosive substances | 9: Miscellaneous dangerous goods

Taking an oil sample

Objectives

- To analyse the physico-chemical characteristics of the pollutant for operational or scientific purposes (flash point, water content, pollutant composition, toxicity, evolution...).
- To identify the pollutant for administrative or legal purposes by characterising the distribution of certain components of the pollutant in relation to a reference sample.

Equipment

Sampling

- Flexible oil-resistant gloves (nitrile or neoprene), possibly a protective suit, a filter mask and goggles.
- Glass bottle, fitted with a metal lid lined on the inside with aluminium foil or a white or brown wide-neck glass bottle fitted with a lid or a Teflon seal.
- Stainless steel spatulas and spoons.
- Aluminium box and foil.
- Labels and indelible marker.
- Gloves, mask.
- Paper towels.
- Bin bag.

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Collecting samples for analysis

- Pollutant at the surface: stainless steel spoons and spatulas or a trowel, sorbent (pads), polyurethane sponge, Teflon film.
- Pollutant in the ground: trowel or core sampler.
- Labels, water-resistant marker pen, paper towels, bin bag.

Storage

- Wide-neck glass bottles, with caps and Teflon seals.
- Glass jars with a lined metal lid.

Procedure

For identification

- The required minimum amount of pure pollutant is 5 grams. In practice, the pollutant will be mixed with other elements, so care must be taken to ensure that the sample is large enough so as to contain the minimum required amount. Quantities of around 100 grams should therefore be sampled.
- In order to determine the pollutant's water content, flash point and viscosity, a 500 ml sample will be required.

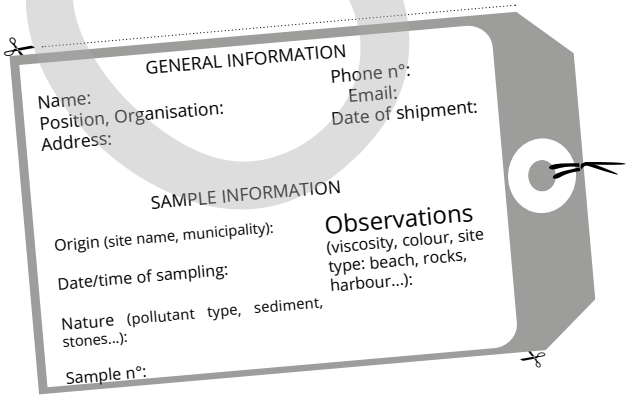
For sampling and storage

- Use containers that are suitable for the type of sample: glass flask or bottle for samples of loose sediment, aluminium sheet or box for pebbles, etc. When sampling small quantities, use a sorbent material, polyurethane sponge or Teflon film that will trap the pollutant.
- Only use inert and non-contaminating materials (glass, Teflon, stainless steel, aluminium), otherwise the sample may be unusable.
- Wash containers and utensils prior to use.
- Where possible, use brown glass bottles that will protect the sample from photo-oxidation. When using glass jars with a plastic or metal cap, insert a sheet of aluminium foil between the cap and jar to insulate the sample. If no inert recipients are available, wrap the sample in aluminium foil and transfer to an adequate recipient.
- Identify the samples using a standardised label (see illustrations).
- Store at cold but positive temperatures (between 0 and 10°C).
- Transfer samples as soon as possible, if possible in less than 8 days. Samples required for administrative purposes will be sent to the appropriate certified laboratories with the necessary skills and analysis equipment (GC/MS, high resolution gas chromatography coupled to mass spectrometry). The list and contact details of these laboratories are available from Cedre. Samples required for legal purposes must be taken in triplicate by a court-appointed expert and sent to an accredited laboratory (in France, LASEM).

Precautions

- Never use plastic to sample or store organic compounds (oil, pesticides, pharmaceutical products, etc.), as it can contaminate samples. Only use non-contaminating materials: glass, Teflon, stainless steel, aluminium. Inorganic compounds on the other hand (dissolved metals, sulphates, nitrates, etc.) should be sampled in special plastic bottles. If necessary, ask a laboratory or Cedre for further information.

Illustrations



Label template

Taking an oil sample

Collective, environmental and property protection

Objectives

- To protect the local population, port users, but also first responders.
- To mitigate the impact of the pollution on the environment, in particular in sensitive areas.
- To facilitate clean-up operations.

Procedure

For collective protection

- Divide up the affected area according to the hazard level and the risks liable to be encountered, taking into account the origin and rate of release; wind direction and force; population distribution and density; spill kinetics (slow or fast) which, depending on the manoeuvring time, will affect the response team's actions; the potential situations determined based on a methodological approach. Three zones are thus defined: an exclusion zone, a control zone and an uncontaminated support zone.
- Mark out the three zones.
- Restrict access to the exclusion zone to trained response personnel wearing encapsulating suits. Evacuate unequipped responders, port users and local inhabitants from the exclusion zone. If evacuation is not possible, implement shelter-in-place.
- Restrict access to the control area to trained personnel equipped with self-contained breathing apparatus and lightweight personal protective clothing. Evacuate unequipped responders, port users and local inhabitants from the control zone. If evacuation is not possible, implement shelter-in-place.
- Prepare an information notice and display it in the harbour master's office, and at port entrances and access areas.
- Establish and display by-laws where necessary.

To stop or divert the spread of a floating slick

- Ensure that boom deployment is compatible with the weather and sea conditions and the hazardous nature of the product.
- Determine the length of boom required according to the area to be protected.
- Adapt the vessels' towing power to the size of the booms to be towed.
- Preventively set up moorings (mooring buoys + blocks or anchors/piles + buoys) following the predetermined boom laying plan then mark out the mooring points.
- Place the protective boom in the water from the shore or water body (if stored on a barge).
- Position it on the water by towing it with a light craft at low speed. During towing, additional small boats may be used to hold the boom in place, assist in its positioning and perform mooring operations.
- Connect the boom to intermediate mooring points using the connectors provided.
- For the final section, a small boat may be used to pass the rope ashore. If necessary, pass the mooring line through a pulley and tighten by pulling with a 4x4 vehicle or a tractor. A block and tackle or winch can also be used.

To protect water intakes

- Set up a protective system for water intakes, for instance pneumatic plugs, nets or filter cartridges.

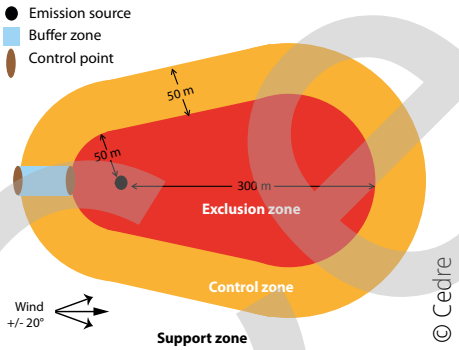
To protect property

- Prohibit entry to and circulation around the port, close locks.
- If possible, remove or move boats at risk. In the case of pollution of the water body, advise owners against going onboard, as oil floats and swaying or loading down the boat will widen the polluted band on the hull. Set up a cleaning area.
- Create a water flow along stone walls and/or slipways to prevent the pollution from sticking to structures.
- Protect piled wharves using booms as a preventive measure.

Precautions

- Inhabitants living in the risk area should be informed, as a precautionary measure, about what to do in case of an incident. This is not the case in an area with a non-sedentary population (e.g. tourist area) or an area where no major risk has been identified.
- An evacuation area should be defined with a minimum radius of 50 metres around the spill source. It should take the form of a uniform circle around the spill source in the case of an explosion risk. In the example illustrated in the diagram below (20° angle in relation to the wind direction, minimum length of 300 m), the exclusion zone takes the form of an emission cone for all risks of toxic, flammable or explosive vapours being produced.
- In the case of seaports, the sensitivity atlas of the relevant contingency plan should include maps of areas identified as sensitive.

Illustrations



Example of zoning

Laying a boom as a preventive measure to protect quays

Sign prohibiting port access

Laying a boom in a chevron arrangement at the port entrance

Operator protection

Objectives

- Select Personal Protective Equipment (PPE) according to the risks related to the environment (weather conditions, low or high temperatures, tide predictions, wind force, etc.), the specific characteristics of the worksite (use of heavy machinery in the immediate vicinity, dock height, fall hazards, etc.) and operations (handling of a pollutant, live components, etc.).
- Ensure that responders are fully aware of the risks and safety rules to be applied.
- Ensure responders' comfort and good working conditions.

Equipment

- Protective suit chosen according the pollutant involved: protection against splashes of irritant chemicals (type 6); air-borne solid particles (type 5); spray (type 4); liquid chemicals (type 3); gases and liquid chemicals (types 1 and 2).
- Waterproof clothing according to weather conditions and/or when using pressure washers.
- Work gloves or chemical-resistant gloves.
- Safety shoes or boots.
- Safety goggles to protect against pollutant spray or fragments of rock.
- Respiratory protection which, depending on the vapours generated by the pollutant or spray produced during clean-up operations, may be a cartridge mask or self-contained breathing apparatus.
- Earplugs or earmuffs.
- Safety helmet (hard hat) in case of risk of falling rocks, or slip hazards in riprap.
- Life jacket (minimum 100 Newton) if working on or near water.

C12

Procedure

Safety

- Identify the risks associated with the response and prioritise operator safety over clean-up.
- Continuously monitor changes in the prevailing weather conditions.
- Conduct a safety brief for operators every morning before the start of operations.
- Permanently remind responders of the safety instructions and in particular that Personal Protective Equipment is mandatory.
- Regularly inform responders of the specificities of each area.
- Specify the alert method used to stop operations and the assembly point location.
- Never leave an operator alone. Have operators work in pairs.
- Provide feedback on any incident (at the latest during the brief the following morning).

Health and safety

- Adjust the pace of work according to operator fatigue and organise breaks when necessary.
- Provide hot or cold drinks according to weather conditions.

- Provide appropriate PPE and renew it regularly.
- Provide equipment in good condition suited to the tasks in hand.
- Provide decontamination areas at clean-up site exits to clean reusable protective clothing and tools to avoid spreading oil outside of the clean-up area.

Rescue

- Identify trained first aiders.
- Specify the location for first aid equipment.
- Have a communication device to alert the emergency services.

Precautions

- Personal Protective Equipment (PPE) is mandatory.
- The majority of PPE is subject to manufacturing standards defined according to the type of risks to which the operator is exposed (oil, falls, drowning, etc.). These standards must be followed wherever the working conditions could lead to these risks.

Illustrations

Operators wearing PPE

Operators wearing PPE on board a vessel during a quay clean-up operation

Worksite organisation

Objectives

- To organise all activities in order to ensure that the whole of the worksite is correctly run throughout its duration.
- To optimise the response.

Equipment

For signposting and site access
- Materials required to regulate access and to mark out a traffic system: safety barriers, stakes, barricade tape, traffic cones, posts, signs, nails...
- Scaffolding, walkways, etc.
- Slipway, lifting equipment (crane, lifting arm, etc.).

For decontamination areas
- Flat or slightly sloping open area (> approx. 30 m2)
- Geotextile, plastic tarpaulin.
- Boot bath with a cleaning agent that is harmless to humans, cloths, sponges.
- Bins to dispose of used oiled equipment.
- Tank with a capacity of 1 to 2 m3 containing a washing agent to soak small tools.
- High-pressure washer and sorbents for decontaminating machinery.

For waste sorting and storage areas
- Geotextile, plastic tarpaulin.
- Storage capacities: tanks, cubitainers, skips, big bags, buckets, bins, bags, etc.

In the case of long-lasting operations
- Prepare an area for offices (documents, first aid kit) and communications.
- Spill response equipment storage area (e.g. warehouse).
- Base camp for operations (changing rooms, toilets, showers, covered eating area, etc.).

Procedure

Organise the overall response
- Brief responders on the organisation of clean-up operations.
- Ensure overall consistency in operator flows, waste flows and the reception of logistical support.
- Draw up a daily report of operations using a daily worksite record sheet.

Organise the worksite
- Mark out the response area, a waste sorting and storage zone (barge, slipway with lifting equipment nearby), a decontamination area and a worksite management area (first aid kit, communications, administrative documents or even a base camp). If possible, sacrifice a section of the port: deflecting the pollutant towards an area suitable for natural containment and recovery.

- Prepare access routes (slipway).
- Identify mooring sites for workboats.
- Protect quays/pontoons and exposed ground (geotextile, water curtain).
- Prepare the decontamination area: ground protection, skips, big bags, etc.
- Identify workboat decontamination method.

Regulating access

- Ensure operators are well aware of the boundaries of the exclusion zone and display by-laws.
- Define and mark out navigation routes and traffic routes (vehicles, pedestrians).
- Control access to quays/pontoons (prohibit public access, PPE mandatory).
- If necessary, organise site surveillance outside of working hours.

Precautions

- Every worksite should have a clearly identified manager who is responsible for the safety and application of response techniques recommended by the response authority.
- Identify the worksite manager, the Quality, Health, Safety & Environment (QHSE) manager and first aiders with armbands.
- Ensure the health and safety of responders working on the site throughout operations (life jackets, PPE, etc.).
- If weather conditions endanger the safety of personnel, suspend operations.
- Choose waste storage sites according to metocean conditions (probable drift of the pollutant, concentration area) and the site layout.
- Take into account tidal variations and currents in tidal areas.

Illustrations

Logistics area adjacent to a clean-up site

Ground protection

Walkway and logistics area

Temporary waste storage

Containment and recovery on land

Objectives

- To stop a spill from spreading across the ground, by containing it as close as possible to the source.
- To protect gutters, manhole covers, drains and outlets to water systems to prevent their contamination.
- To restrict infiltration of the pollutant into porous soils and confine polluted soils within a trench.
- To recover contained pollutant and contaminated sediment where applicable.

Equipment

- Sand bags, tarpaulins.
- Drain seals.
- Universal sorbents (bulk, pads or booms).
- PPE, brushes, shovels, pickaxes.
- Waste storage capacity.
- Vacuum truck.

Procedure

C14

Case of a spill on impermeable ground

- Block off the flow by building a bund composed of sandbags covered with a tarpaulin.
- Protect gutters and drains using sorbents to prevent contamination of the drainage network.
- Seal off drains and manhole covers using drain seals.
- In the case of a large spill, first pump up any slicks.
- In the case of a small spill, apply sorbents to the spill, promote sorption using a broom, then recover.

Case of a spill on the deck of a vessel

- Close the scuppers.
- In the case of a large spill, first pump up any slicks.
- In the case of a small spill, apply sorbents to the spill, promote sorption using a broom, then recover.

Case of a spill on porous ground

- Block off the flow by building a trench with a bund, and if possible line with tarpaulin.
- Pump up large accumulations.
- Isolate contaminated soil in a trench to contain run-off.
- Recover any supernatant by pumping or using sorbents.
- Evacuate the contaminated materials and soil by scraping the surface to prevent any subsequent release.

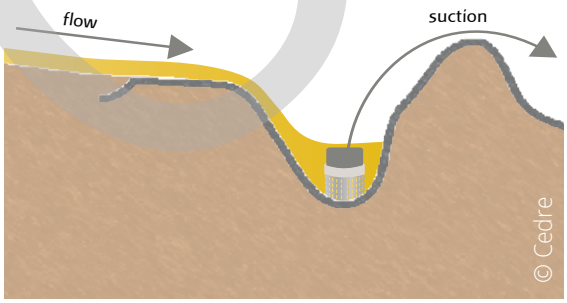
Precautions

- Find out about the characteristics of the pollutant and the potential risks associated with this response option.
- Check that the sorbents are compatible with the substance spilled.
- Cover the spill on the ground or in trenches with a carpet of foam if evaporation is a safety concern.
- Evacuate and treat collected waste.

Illustrations

Applying bulk sorbents

Containment on land



Trench with bund

Containment and recovery in gutters and water networks

Objectives

- To restrict the gravity flow of the pollutant and prevent it from spreading outside of the response zone by containing the spill in an accessible area for recovery operations.
- To recover the spill.
- To clean-up facilities to prevent subsequent releases.

Equipment

- PPE.
- Sorbents.
- Inflatable plugs.
- Vacuum trucks.
- Waste storage capacities.

Procedure

- Block the flow of the pollutant using sorbents or filter cartridges. These devices have the advantage of allowing water drainage while recovering the pollutant.
- It is also possible to contain pollutant in gutters and pipes using inflatable plugs. These devices should be selected according to the diameter of the pipe and have the advantage of being completely watertight. However, as they block the entire flow, they cause a rise in the upstream network which must be anticipated.
- Recover the pollutant using sorbents or by pumping. If the pollutant is miscible with water, pump out all the contaminated water and evacuate it.
- Clean up contaminated gutters and drains liable to release pollution.

Precautions

- Find out about the characteristics of the pollutant and the potential risks associated with this response option. Beware of toxic or flammable vapours in the case of accumulations of a volatile substance. In this case, apply a carpet of foam, if necessary, in accessible gutters and check the ambient air quality prior to any intervention in closed or buried pipes.
- According to the type of gutter/network, finish operations with a ground pollution survey, particularly in the case of porous surfaces, and treat if necessary. Set up a network of piezometers for monitoring/control.

Illustrations

Packing a drain with sorbents

Recovering pollutant using bulk sorbents

Plugging a manhole

Containment at an outfall

Objectives

- To prevent pollution from the stormwater system or any watercourse passing through an outfall from reaching the water body by installing a device designed to retain the pollutant while letting water flow through.
- This sheet can also be used for containment at water intakes.

Equipment

For containment
- Inflatable plug.
- Fine mesh net, sorbents, staples, rope.
- Wooden planks, PVC pipes, tarpaulin, stakes, clamps, wire.
- Permanent boom.

For filtration
- Wire or plastic mesh/netting.
- Straw, sorbents.
- Wooden or metal stakes, rope, wire.

For all operations
- PPE.
- Waste storage capacity.

C16

Procedure

Containment by complete obstruction of the outfall. This option is possible regardless of the pollutant's behaviour.
- Use an inflatable plug. To do so, place the plug inside the pipe and inflate.
- Install a stopper. To do so, build a cone by folding and stapling fine mesh netting, fill it with sorbents, tie it closed with rope and position it in the pipe.
- Whatever the system used, manage the rise in water level upstream.

Containment by partial obstruction of the outfall. This option is suitable for floating and sinking substances.
- For prevention purposes, it is possible to install a permanent boom before any incident occurs.
- Build a dam using wooden planks allowing for overflow if the pollutant sinks or underflow if the pollutant floats. To do so, dig slots in the bank to insert the planks for the dam. Cut the planks to this width. Drive piles into the ground on each side of the outfall to hold the planks in place. Position the planks to allows for overflow or underflow. Reinforce the dam with clamps and cover the planks with tarpaulin for waterproofing.
- Build a bund with angled pipes. To do so, cut pipes to the length required to pass diagonally through the bund that will be built. Lay rows of bags of rubble or sediment until they emerge above the water surface, but not above the banks. Cover with a tarpaulin for waterproofing. Lay the pipes on top of the bags, through a hole pierced in the tarpaulin. Hold the pipes in place by adding another row of bags on top. Perform this operation across the entire width of the outfall.

Filter the water column. This option is possible regardless of the pollutant's behaviour. It is particularly suitable for viscous products.

- Install a filter cartridge. To do this, lay out the cartridge casing (chicken wire, oyster bags...) on the ground and fill it with sorbent material (straw, sorbent...). Close the casing using wire or staples. Drive in piles in front of the outfall. Attach the cartridge to the piles. If the outfall is too wide and the flow rate low, bales of straw, possibly bagged in a geotextile, placed on the bed of the watercourse can form a first filter barrier.
- Install skirted sorbent booms. To do so, connect up each boom section tightly until the whole boom is long enough. Moor the boom to several piles placed across the outfall.

Precautions

- Find out about the characteristics of the pollutant and the potential risks associated with this response option.
- Avoid complete obstruction for extensive periods of time.
- Use water-resistant wood: choose plywood over chipboard.
- Filtration devices can be positioned in series for better efficiency.
- The filtration devices described in this sheet require intensive maintenance.
- Evacuate and treat collected waste.

Illustrations

Using an inflatable plug

A permanent boom installed at an outfall

Containment and water level management with a dam made of bags of rubble

A filter cartridge installed at an outfall

Containment around a vessel and between a vessel and the quayside

Objectives

To stop a spill from a vessel or a quay, in particular during bunkering operations, from leaving the water body created between the vessel and the quayside, or between two vessels during ship-to-ship transfer.
To surround the breach or the damaged vessel using a boom to contain the spill and allow recovery operations to be carried out.
To deploy a floating system as a preventive or curative measure in order to create a containment area close to the quayside and allow recovery operations.

Equipment

- Pre-positioned means as a preventive measure: permanent booms, attachment/mooring systems in place...
- Floating spill response boom. There exist small booms that are specially designed for this configuration:
  - → H-shaped inflatable boom whose lateral sections are wedged against the quayside and against the hull of the vessel, or against the hulls of the two vessel in the case of a ship-to-ship transfer;
  - → foam-filled curtain boom.
- Mooring system (buoy, concrete block, magnetic device, anchor, chains and ropes...) and towing system.
- Boats: mooring craft, semi-rigid boat, barge, tugs, etc.
- PPE and explosimeter where appropriate.
- Communication system (VHF) to coordinate manoeuvres.

C17

Procedure

Set up permanent systems that are particularly well suited to piled wharves
Deploy booms

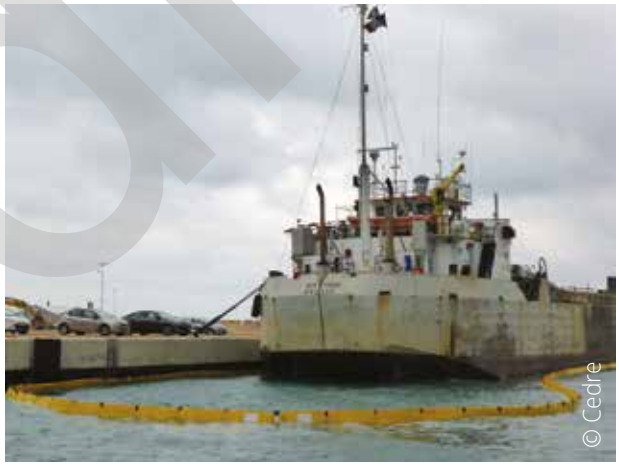
- Specialised booms are light and compact enough to be deployed by one or two operators from the quay or a vessel.
- For non-specialised booms:
  - → prepare two separate sections of the required length;
  - → place them in the water and tow them or load them onboard a workboat;
  - → position one section between the bow and the quayside and the other between the stern and the quayside.
- Attach the end of the boom directly to the hull using a magnetic anchoring system and/or by passing ropes onboard the vessel.
- Attach the other end to an onshore anchoring point.
- If necessary, connect the boom to intermediate mooring points.

Precautions

- The initial priority is to deploy the boom alongside the quay to prevent the oil from sliding under the structure. Take into account the position of fenders attached along the quayside.
- Adapt boats (engine power) according to the equipment to be deployed to prevent damage to the equipment and to ensure adequate manoeuvrability.
- Remove as much floating litter as possible.
- Avoid having too large a containment area to ensure selective recovery.
- Recover the pollutant before the containment capacity becomes saturated (to avoid leakage), especially if weather conditions are forecast to deteriorate, the tide is due to turn or the wind direction is expected to change.
- To improve the oil-tight seal, sorbent booms can be used or a surface current created using fire hoses.

Illustrations

Permanent boom attached to a wharf



Containment around a berthed vessel

Boom deployed as a precautionary measure

Magnetic anchoring system attached to vessel hull

Recovery by pumping using a skimmer

Objectives

In the case of a major spill, to skim and pump accumulations of floating pollutant, from a port structure or a vessel, following containment.

Equipment

- Containment equipment (see sheets C14 to C17).
- Skimming and pumping equipment: skimmer, associated pump, hoses and associated connection fittings, hydraulic power pack according to equipment.
- Storage resources: 2 self-supporting tanks (1 recovery tank and 1 settling tank).
- 3 to 4 operators trained in recovery and storage.
- PPE and communication system.

Procedure

- Contain the slicks (see sheets C14 to C17), removing as much floating litter as possible.
- Use a floating pontoon or barge to get up close to the contained slick.
- Connect the skimmer and hoses to the pump to discharge the recovered oil into two self-supporting tanks used alternately for storage and settling.
- Position the skimmer at the water surface (using a rope or lifting equipment if available) in the middle of the slick to be pumped and move it around as required.
- Leave ropes attached to the skimmer, in order to easily direct it from land, in case it needs to be moved around the containment area (change of wind and/or current direction).
- Start the pump and check flow.
- Push the pollutant continually towards the skimmer by creating a water flow using motor pumps connected to fire hoses.
- Set the pump rate in order to optimise the selectivity of recovery (in particular according to the viscosity of the pollutant).
- Optimise storage/settling times, if need be by stopping recovery operations.
- Discharge settling water from the storage tanks into the containment area.
- Organise the emptying of storage capacities.
- At the end of operations, hoist the skimmer out the water with the pump still running.
- Rinse the skimmer and the suction and discharge hoses with freshwater while the pump is still running.
- Switch off the pump and repack the equipment.
- Recover any residual oil using floating sorbents.

C18

Precautions

- Select the skimmer according to the type and quantity of pollutant, the site configuration and the sea and weather conditions. Weir skimmers are less selective and more sensitive to debris than oleophilic skimmers, but offer a higher recovery rate.
- Immediately provide settling tanks (equipped with valves in the lower section) and do not underestimate the quantities of waste that will be recovered.
- Organise the emptying of storage capacities.
- Only implement this type of operation where trained, specialised personnel, for example port response teams or private contractors, are available to conduct it.

Illustrations

Recovering oil from a slipway with an oleophilic skimmer

Recovering vegetable oil with a weir skimmer

Recovery by pumping using a vacuum truck

Objectives

In the case of a major spill, pump up contained slicks of floating pollutant using pumping equipment (vacuum truck, slurry tanker) equipped with a suction head. This operation can be relatively easy to implement however it offers low selectivity.

Equipment

- Containment equipment.
- Recovery and pumping equipment: flat skimmer head and hose connected to a vacuum truck, slurry tanker or gully emptier.
- PPE.

Procedure

- Check the tidal range and ensure that the maximum quay height is compatible with the suction capacity.
- Contain the slicks. The smaller the containment area, the greater the selectivity will be.
- Manually remove debris (using scoop nets for example) to prevent it from hindering recovery, or attach a mesh screen around the suction head.
- Connect the suction head and hose to the vacuum tanker.
- Position the skimming head on the water surface (using a rope if necessary to lower the device into the water, reposition it and retrieve it).
- Start up the vacuum tanker and check flow circulation.
- Push the pollutant continually towards the skimmer by creating a water flow using motor pumps connected to fire hoses.
- Selectively recover the oil by adjusting the pump rate and by thickening the slicks as much as possible. Gradually reduce the size of the containment area.
- At the end of the operation, remove the suction head from the water, with the pump still running.
- Switch off the pump and repack the equipment.

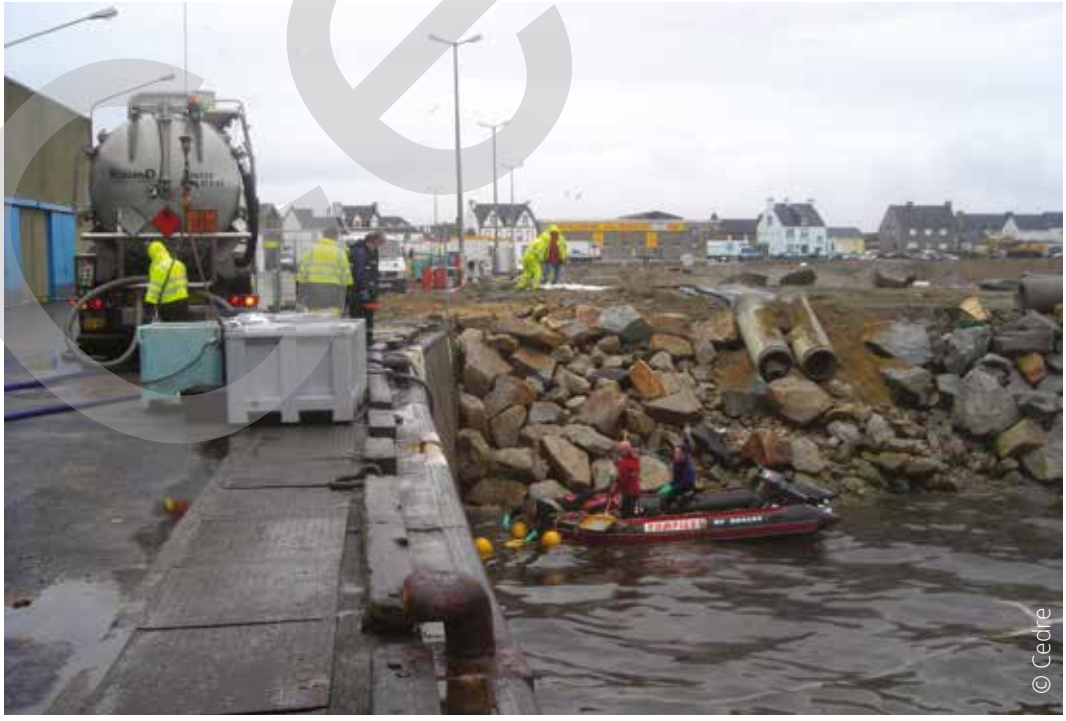
Precautions

- Mobilise several trucks if necessary as this operation generates large quantities of liquid waste (water + pollutant).

C19

Illustrations

Recovery from a dock



Recovery from a dock

Dynamic recovery on the water

Objectives

To collect small slicks of pollutant or sheen drifting in harbour basins that are liable to affect port facilities and sensitive areas or to leave the harbour. This operation consists in sweeping the polluted water body using suitable boats towing a containment or sorbent boom. A single boat equipped with a side beam can also be used.

Equipment

- Floating containment boom, boom + trawl net.
- Skirted sorbent boom, sorbent socks, sorbent rolls.
- Towing system.
- Spacer beams or spars.
- Boats: mooring craft, barge or semi-rigid boat.
- PPE and communication system.
- If necessary, use aerial means to locate slicks (drones, helicopter).

Procedure

Trawling with a single vessel

- Use one or two spacer beam systems and position the containment or sorbent boom so as to create a containment area.
- Such systems can be set up in series to break up the surface current and reduce the vortex effect on the skirt of the boom. Sorbent rolls can also be attached to the beam and at the apex of the containment area to increase the surface area in contact with the water.
- Keep the boat's speed very low. The slower the speed, the more efficient recovery will be.
- Align the system with the slicks' drift as far as possible. Let the slicks drift into the booms to recover as much surface pollutant as possible.
- Use sorbent pads to recover the pollutant collected. Recover the pads by bringing the beam and sorbent booms alongside the hull or from a second boat using scoop nets.
- Position appropriate, leakproof containers (big bags, bins) on board the boat for the contaminated sorbents.

Trawling by a pair of vessels or a vessel and a paravane

- Prepare boom deployment from the quayside. Adjust the boats' towing power according to the type of containment boom and the sea and weather conditions.
- Place the boom in the water and take it in tow, in an aligned or feathered position.
- Near the slick, take up the free end of the boom with the second boat and adopt a U- or J-formation.
- Coordinate the boats from a high vantage point overlooking the water body and communicate by VHF.
- Ensure the system is oil-tight and adjust speed to prevent leaks at the apex of the containment area. Trawl at low speed (< 1 knot) or wait until the slicks enter the system.
- Once the containment area is full, tow it at low speed (< 1 knot) to shore and skim the pollutant collected by the boom.

Precautions

- Remove as much floating debris as possible before beginning the operation.
- When trawling with a pair of vessels, the use of a perpendicular mooring line is recommended to prevent the boats from edging too far apart.
- The slower the speed the boats travel at, the more efficient recovery will be.

Illustrations

Trawling with a side beam system comprising sorbent booms arranged in series

Recovery in an estuary using a recovery boom system in strong current

Using sorbents on land

Objectives

To absorb and recover a small quantity of pollutant, whether hydrophobic or not, spilled on the ground, using “universal” sorbents.

Equipment

- Loose sorbents (type A), pads (type B), rolls (type C), pillows (type D), booms (type E), pompoms (type F); (see the Cedre operational guide on the "Use of Sorbents for Spill Response”).
- Recovery equipment: shovels, scrapers...
- Storage capacities for contaminated sorbents.
- PPE.

Procedure

For liquid pollutants

- Leak from machinery: place pillows (D) under the leak, possibly pads (B), rolls (C) or a boom (E) around the machinery.
- Run-off on the ground: stop run-off using booms (E) or pillows (D). Possibly apply loose sorbent (A) uphill, to reduce penetration into the ground.
- Thin puddle: spread loose sorbent (A) on the puddle, then scrape after sorption or apply pads (B) or rolls (C).
- Small pool: use pillows (D) or booms (E).
- Accumulations in crevices: sponge the pollutant using pads (B). Possibly use loose sorbent (A), for preference with a coarse granule size to facilitate recovery after sorption.

For viscous pollutants

- Leak from machinery: use loose sorbent (A) or sorbent pompoms (F) that may need to be mixed with the pollutant to promote sorption. If unavailable, use pads (B) or mats (C).
- Run-off on the ground: stop run-off using sorbent pillows (D) or sorbent booms (E). Spread bulk sorbent (A) or pompoms (F) uphill. Mix the sorbent with the pollutant to promote sorption.
- Large puddle or small pool: spread loose sorbent (A) on the puddle then scrape after sorption, possibly use pompoms (F). Mix the sorbent with the pollutant to promote sorption.
- Accumulations in crevices: scrape roughly then sponge the pollutant using pompoms (F).

C21

Precautions

- Prior to sorbent use, check that the chemical characteristics of the pollutant are compatible with the sorbent.
- If the pollutant is liquid, the sorption process will be rapid (a few seconds to a few minutes), but retention is lower. There is therefore a risk of release.
- If the pollutant is viscous, sorption is very slow, but retention is higher and the risk of release is low. However, beyond a certain viscosity, recovery is ineffective and there is a risk of the sorbents sinking.
- Pay particular attention to sorbent pads to ensure they are not blown away.
- In the case of sorbent pads, do not forget to turn them over to maximise their sorption capacity.

Illustrations

Sorbent pads and peat in a trench to contain an oil spill

Recovering washing effluents using sorbent pads, pompoms and booms

Using sorbents on the water

Objectives

To absorb and recover a small quantity of pollutant floating on the water, using “oil-only” sorbents.

Equipment

- Loose sorbents (type A), pads (type B), rolls (type C), pillows (type D), booms (type E), pompoms (type F) (see the Cedre operational guide on the "Use of Sorbents for Spill Response”).
- Boats: semi-rigid boat, barge, mooring craft.
- Recovery equipment: large scoop nets, boat hooks...
- Oil sorbent storage capacities (leakproof big bags, crates...).
- PPE.

- Floating slicks (uncontained) in open water (no current): apply loose sorbent (A) to slicks using a blower and recover using nets, possibly after containing the slick. In the case of small spills of light refined products (e.g. diesel), sheen or slicks may be contained and recovered using a sorbent mat (C) strengthened with a rope.
- Floating slicks pushed downstream by the current in a river:
  → In the case of a wide river, follow the instructions for floating slicks in open water but let the sorbent be carried by the current. Otherwise, deflect the pollutant using a floating containment boom towards a sheltered collection area, where the pollutant is either pumped or recovered in the same way as for contained floating slicks.
  → In the case of a low current (< 0.2 m/s) and small quantities of pollutant, the pollutant can be trapped in the water using a sorbent mat (C) placed across the current. To do so, hold the mat in place using a rope. Depending on the circumstances, consider the dynamic recovery option using a sorbent mat towed on a spacer beam.
- Contained floating slicks: apply loose sorbents (A) and recover after sorption using scoop nets, a vacuum tank or a pump (if the texture of the sorbent allows it); or sorbent pads (B) or pillows (D) and recover using a scoop net or boat hook.
- Slicks pushed by the wind or current against a straight bank: use loose sorbent (A), sorbent pads (B) or pillows (C) and possibly protect the bank using a sorbent boom (E), ballasted if possible, or a sorbent boom with a ballasted skirt. If the water body is very calm and the pollutant is a light refined oil, recover with reinforced sorbent rolls fitted with a rope.
- Slicks pushed by the wind or current against an uneven bank: protect the bank using a sorbent boom (E), or a roll (C), or else, if the depth allows it, using a conventional floating boom. Recover the pollutant on the water, preferably using loose sorbent (A) or sorbent pads (B).

Precautions

- Prior to sorbent use, check that the chemical characteristics of the pollutant are compatible with the sorbent.
- If the pollutant is liquid, the sorption process will be rapid (a few seconds to a few minutes), but retention is lower. There is therefore a risk of release.
- If the pollutant is viscous, sorption is very slow, but retention is higher and the risk of release is low. However, beyond a certain viscosity, recovery is ineffective and there is a risk of the sorbents sinking.
- Pay particular attention to sorbent pads to ensure they are not blown away.
- In the case of sorbent pads, do not forget to turn them over to maximise their sorption capacity.

Illustrations

Sorbent pads in a containment area

Recovery using a sorbent boom and a makeshift beam

Managing a leak from a storage tank or fuel facility

Objectives

- To control the pollution source as quickly as possible in order to limit the drift of the spill on the water and the oiling of boats and port structures, which will subsequently require laborious handling and clean-up operations.
- To mitigate the impact of the pollution on the environment.
- To maintain the port's good image.

Equipment

- Sorbent pads (type B), booms (type E), mats (type C).
- Fence boom in the case of a major leak.
- Equipment for recovering oiled sorbents, e.g. scoop nets.
- Leakproof storage capacities: big bags, bins, small containers, etc.
- Storage box for first line response equipment placed nearby.

Procedure

C23

In the case of a leak of diesel or waste engine oil

- Identify leak source.
- Stop the leak if it is still ongoing.
- As soon as possible, contain the slicks and sheen with a boom.
- Apply sorbent pads in the containment area. Leave them long enough to soak up the oil.
- Recover the oiled sorbents and place them in leakproof storage capacities.
- Ensure the waste is evacuated and disposed of appropriately.
- Monitor the area to check for any reccurent pollution.

In the case of a leak of super unleaded petrol

- **Do not intervene. Contact the fire brigade**.

Illustrations

Fuelling station equipped with a storage box containing first line response equipment

Creation of a containment area around pontoons using sorbent booms

Cleaning oiled port structures

Objectives

To clean up oiled structures using appropriate techniques according to the characteristics of the pollution and the site, and balancing ecological and economic priorities.

Equipment

For initial clean-up

- Slurry tanker, vacuum truck, gully emptier, public works equipment.
- Spill response equipment: spill response boom, skimmer head, skimmer, storage tanks.
- Motor pumps, fire hoses.
- Scrapers, masonry trowels, scoop nets and sorbents, etc.
- PPE.
-

For final clean-up

- Spill response equipment: spill response boom, skimmer head, skimmer, sorbents, storage tanks.
- Motor pumps, fire hoses, high pressure washers, etc.
- PPE.

C24

Procedure

Conduct initial clean-up

- Remove the bulk of the pollutant and heavily oiled materials (sediment, litter, seaweed...) as quickly as possible to prevent the stranded oil from being washed back into the sea and thus spreading further, and to mitigate the impact of the pollution by reducing the time during which it is in contact with the environment and by facilitating a return to normal within a reasonable timeframe.
- Throughout clean-up operations, pay particular attention to creating containment areas to recover washing effluent.

Conduct final clean-up, if necessary

- Implement techniques with a varying degree of sophistication to remove residual pollutant that is detrimental to the uses of the affected port sites: pollutant trapped in riprap, near a quay used by cruise ships, on the underside of a piled wharf... In certain cases, it may be necessary to build walkways and call upon professional rope access technicians. These operations are generally implemented by specialised companies.

Restore sites

- Remove signage and markings.
- Clean up storage area.
- Take rehabilitation measures if necessary.

Precautions

Conduct a prior study, if necessary consulting specialists such as Cedre

- Select appropriate techniques according to the characteristics of the pollution and the site to avoid causing greater environmental damage than that caused by the pollutant itself. In some cases (sites exposed to waves), it is sometimes preferable to "do nothing" and leave nature to do the clean-up work.
- Define the level of clean-up to be achieved by balancing what is deemed acceptable in terms of pollution from an ecological, economic and political point of view with what is technically and financially feasible in terms of clean-up.
- Anticipate possible slick movements in the port by deploying booms to protect areas that would be difficult to clean or liable to trap pollutant (piled wharves, porous structures).

Illustrations

Pressure washing a wall and riprap

A rope access technician cleaning walls, recovery of washing effluents with sorbents

Cleaning oiled hulls

Objectives

To clean up the hulls of vessels having taken part in response operations or having been affected by the pollution, while limiting the transfer of the pollution to the water body by setting up a containment area for the recovery of washing effluents. According to the type of pollutant, the extent of contamination and the type of vessel, this area may created simply by deploying a containment boom on the water body (case of clean-up of vessels' waterlines) or else by an onshore platform on which the vessel can be handled (careening area or ramp).

Equipment

For the containment area
- On the water: spill response boom, skimmer head, skimmer, storage tanks, sorbent booms, sorbent pads.
- Onshore: geotextile, tarpaulin, earthen bund, straw bales, pumps and settling/storage tank for oily effluents recovered, sorbents.
- PPE.

For cleaning
- Washing agent free of surface active agents suited to the pollutant and the hull material.
- Sprayers, hot water pressure washers, fire hoses, motor pumps, etc.
- PPE.

For lifting
- Crane, lift slings, handling trailer, etc.
- PPE.

C25

Procedure

For a containment area on the water
- Lay a sorbent boom to separate off a containment area for washing effluents.
- Collect these effluents with a skimmer, a skimmer head and sorbent pads.

For an onshore containment area
- If the port does not have a dedicated careening area, choose a relatively flat area and/or grade it using machinery or manually so as to obtain a slightly sloping surface with a trench at the lower end to collect washing effluent.
- Lay one or two layers of geotextile to prevent the liner from being pierced and then lay the liner.
- Cordon off the decontamination area with barricade tape and stakes driven into the ground.

Cleaning vessels

- In the case of oil weathered oil, soften oil by spraying it with a washing agent (dearomatized petroleum fraction such as Ketrul) and leave it for 15 to 30 minutes max.
- Clean the surface of the oiled equipment with water. On slightly adhesive products, use fire hoses and pressure washers with cold water. On adhesive products, use pressure washers on the following settings: 80°C, 100 bars, nozzle 40 cm from the surface to be cleaned. On very adhesive products, use high pressure washers with the same settings as previously and add a washing agent that does not contain surface active agents.
- Leave the hull to drip-dry before returning it to the water.
- Check that the antifouling paint is still effective.

Precautions

- In all cases, conduct a preliminary washing test on a small surface area to check that the washing agent is comptable with the paint and the hull material (aluminium, steel, polyester...).
- Do not use a dispersant for cleaning.
- Implement a cleaning chain from dirtiest to cleanest.
- Inform owners of the risk of damage to the hull coating due to the use of washing agent and pressure washing.
- Protect lift slings with sorbent pads where they are liable to touch the oiled part of the hull. This will prevent recontamination of the hull when lowering the boat into the water.
- Remember to clean mooring ropes and fenders if oiled.

Illustrations

Oiled hull of a pleasure boat

Containment area set up on shore to clean a response vessel

Storing recovered waste

Objectives

To coordinate the pooling of oil and oiled waste collected from one or more clean-up sites within the port area, before evacuating it to an intermediate storage site or a treatment unit. At this daily transfer platform, waste is roughly sorted by type (protective clothing, oiled litter, plastics) and may possibly undergo rough pre-treatments (compacting, settling, etc.).

Equipment

For storage capacities

Storage method	Waste type	Implementation	Observations
Storage on the water (ship's tanks, floating storage bladder, pontoon with tanks...)	Liquids, solids		
Self-supporting flexible tanks	Liquids	Choose flat surfaces and place on pallets Group together the same type of waste in a single storage area equipped with retention systems	May be used for initial settling
Cubitainer	Liquids		Simplified handling
Skips	Solids Debris		May be crane-lifted if watertight
Big bags	Pastes, solids		May be air-lifted if watertight
Buckets, bins, bags	Pastes, solids	Place buckets, bins and bags on a oil-tight platform	
Bulk	Solids	Protect the area with a leakproof liner Build bunds or dig a furrow to collect run-off Pile the waste on the covered surface	

For leakproofing storage capacities

- High Density Polyethylene (HDPE) and polypropylene (PP) geomembranes are the most oil-resistant. It is also possible to use polyvinyl chloride (PVC) membranes that are recommended by certain manufacturers for storing heavy fuel oil.
- Polythene sheeting or tarpaulins are more flexible, less costly and more readily available (agricultural cooperatives, material wholesalers) than geomembranes. They are however less resistant to puncturing, cutting and pulling.

Procedure

Choose the site

- Flat platform with a sufficient surface area, a good load-bearing capacity and situated outside of floodable areas.
- Proximity to and accessibility from clean-up sites and road network.
- Reasonable distance from sectors of activity such as areas used by the general public, offices, etc.

- In industrial ports, wherever possible use existing storage sites or unused areas (e.g. concrete basins, disused and dried up pond, former oil storage facility, etc.).

Prepare the site by artificially protecting the ground and subsoil

- When the aim is simply to form a contamination barrier under oil-tight containers, lay down an ordinary plastic sheet, after having prepared the ground. Lay geotextile to prevent puncturing.
- For bulk storage of pastes, strips of plastic sheeting can be laid, without being joined or stuck together, and should be quadruple-layered by folding two sheets over each other. To achieve a less slippery surface, geotextile can be added along pathways.
- Prepare safe access for trucks to transfer waste.

Organise waste transfer

- To avoid polluting new areas and to optimise the spill response waste treatment process, the loading and transfer means should be chosen according to:
  - → the type of substance to be transported (liquids, pastes, solids)
  - → their packaging (in sacks, skips, drums, in bulk...)
  - → the specificities of the storage site (accessibility, sensitivity, manoeuvrability, load-bearing capacity and ground condition...)
  - → the distances to be covered (sometimes several hundred kilometres).
- To prevent excessive damage to the ground around the clean-up site, channel waste transportation.

Evacuate waste

- Treat and immediately quantify waste.
- Prioritise short treatment and disposal chains for certain fractions:

→ liquids pumped into tanks: refinery,
→ fermentable waste: composting unit or biocentre,
→ plastics and sorbents: household waste incineration plant, subject to necessary authorisations.

- Evacuate waste from the site on a daily basis to prevent bottlenecks.

! Precautions

- In France, for storage areas of over 100 m^3, the regulations for classified installations apply.
- Do not underestimate the risks of leakage or run-off which may contaminate the natural environment.
- To prevent the perforation of plastic sheeting or tarpaulins, use several layers or lay geotextile underneath.
- At the end of operations, clean and restore the site.

Illustrations

Waste storage site

Labelling bags of waste prior to evacuation

Transporting and disposing of waste

Objectives

According to the extent of the spill and the availability of treatment units, transport waste directly to treatment centres or to a storage site.
Transport and treat waste contaminated by oil or chemicals as hazardous waste and ensure it is dealt with by a specialised contractor.

Equipment

Mode of transport to be chosen according to spill characteristics and available equipment
- "Light" vehicles: small caterpillar trucks, quad bikes (with trailers).
- "Heavy-duty" vehicles: loaders, vacuum trucks, dump trucks, slurry truck with a tractor...
- Transfer from difficult access sites: helicopter, crane, zipline, boats (barges, landing craft...).

Packaging materials
- Sacks, buckets, bins, leakproof big bags, drums, watertight skips, leakproof containers....
- Waste transport and disposal should be laid out in the relevant contingency plan.

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Procedure

- Identify companies able to collect and transport waste as well as those able to treat it (incineration plants for hazardous waste, cement works, physico-chemical treatment plants...). Note that there are also companies which deal with waste from collection through to disposal.
- Ask for a quote from the companies identified on the basis of the volume to be treated, its composition and its packaging.
- Contact the selected companies.
- If the polluter has been identified, negotiate the coverage of waste storage and treatment costs with their insurer.

Precautions

- Systematically keep all supporting documents for the operations implemented.
- Waste traceability must be implemented, providing evidence that the waste has indeed been treated or recycled.
- As companies able to treat this type of waste are not always available locally, transport costs can be high. A compromise must therefore be reached between what is technically feasible and what is financially acceptable.

Illustrations

Loading big bags onto a truck

Hazardous waste treatment plant

Funding the response

Objectives

In view of the "polluter pays" principle, the costs of pollution prevention and response measures are the polluter's responsibility. Whatever the environment in question, this principle applies in the case of a spill. However, the application of this principle requires two fundamental conditions: the polluter must be identified and a direct causal link must be established between the incident and each instance of damage.

Procedure

- Identify the polluter
  If the pollution source is an onshore industrial facility
  Many industrial firms have Environmental Liability Insurance (ELI). Such policies include different guarantees that can be selected by the firm, but none cover ecological damage. Certain industrial firms are their own insurer for environmental damage and directly cover the costs.
  If the pollution source is a vessel
  Shipowners take out insurance with P&I (protection and indemnity) clubs. P&I clubs cover the shipowner's liability for loss or damage resulting from pollution caused by an oil spill. However, there is a limit on the amounts paid out by P&I clubs. If the expenses exceed this limit, the international compensation regime will cover additional expenses:
  → if the pollution is caused by an oil tanker, the International Oil Pollution Compensation Funds (IOPC Funds) provide compensation.
  → in the case of a bunker fuel spill, the Bunkers Convention applies, although with a far lower maximum amount than that of the IOPC Funds.
  → for chemical spills, there is as yet no international compensation regime.

- Ensure the polluter or their insurer covers all possible costs and compensation
  The polluter or their insurer can directly finance response measures, but the public authorities must validate the technical choices proposed by the firm's experts or their insurer, control the operations carried out in the field and validate the termination of operations. The polluter can limit their liability to the reimbursement of expenses subsequently judged justified and reasonable, leaving the public authority to advance the costs of response efforts. Compensation claims will be made for all expenses that have not been directly covered; every spill response expense incurred must be justified.

- Record, justify and retain all details in order to be able to claim reimbursement of all response costs that are not directly covered as well as the economic impact of the pollution.

Precautions

- Port authorities are advised to establish a pollution report from the very first day of the incident and to request that a police report is drawn up.
- Prepare in advance by drafting contract templates (in compliance with public contracts regulations and using the specific provisions for procurement in an emergency).

Standard pollution report

Port logo

Following the contamination of the port area within the municipality of ..... due to marine pollution on ..... (date), I, the undersigned, ..., Harbour Master of the Port of ..... (name of port) as a port officer, establish today at .....:..... (time), a detailed report of observations.

1. OUTLINE OF OBSERVATIONS

Briefly outline the origin of the alert (port officer, industrial firm, general public...), the time of the first evaluation/confirmation and whether measures have already been implemented by the port or a third party.

2. DESCRIPTION OF THE POLLUTION

Locate and number on a map all the sites mentioned and append this map to the report.
For each port zone (quay, wharf, basin...) affected by the pollution:

- indicate the place name (quay, basin) and the exact time of the site visit by the port officer
- describe the site: structure type, extent of the site
- describe the type of pollutant observed: oil, chemical...
- describe the extent of the pollution: quantity, percentage cover...
- attach date- and time-stamped photographs of the observed pollution
- specify whether a port closure order has been established (if so, take a photograph of the display board)
- specify whether operations have been or are being conducted. If so, describe them briefly
- specify whether there are any injured parties and/or damage to equipment.

Signed in ....., on .....
For all legal intents and purposes.

The Harbour Master
Signature + stamp

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Preparing a compensation claim

Objectives

To optimally prepare a compensation claim during and after the incident.

Procedure

During the incident

- Draw up an observation report, take photos.
- Contact the polluter/shipowner's representative and their insurer to discuss the response techniques adopted, obtain advice and keep them informed of the progress and costs of operations.
- File a complaint and, as far as possible, if the shipowner is known and represented, negotiate the coverage of clean-up costs with them directly.
- Keep a log book which lists all events and operations conducted from the very beginning of the incident.
- Keep a record sheet for each worksite, updating it at a frequency consistent with the type, frequency and extent of the pollution. Compile and retain these record sheets. Calculate costs on the basis of these record sheets (personnel and equipment).
- Gather and archive:
  - → evidence demonstrating the reality of the pollution: survey forms, observation reports, expert reports, samples, analyses, photographs and videos.
  - → proof of expenses: purchase orders, invoices, pay slips, time sheets for personnel involved, employment contracts for temporary staff, etc.
  - → documents providing evidence of careful management of the incident and justifying the choices made: meeting minutes, decision sheets, situation reviews, expert assessment reports, municipal by-laws, etc.
  - → press articles and, where available, video imagery (news broadcasts, etc.)
  - → Maintain active links with other local authorities affected as well as with State services.

After the incident

- Obtain the compensation form from the insurer and complete it. It should include the following information: the spill source (e.g. vessel name); the name of the claimant, their legal representative and their address; a summary of the claim explaining how the port was affected; a list of the amounts claimed.
- Include the following with the form: a presentation of the port; the log of events; a table of contents for the different supporting documents for each category of costs (invoices, worksite record sheets, personnel time sheets, pay slips, equipment used, etc.); photographs (dated and with location and legend) and press cuttings collected.
- If several local authorities are affected by the pollution, contact the other local authorities and services/agencies affected or involved to ensure the consistency and coordination of claims and costs.
- Submit the claim, in principle, to the shipowner's P&I club.

Precautions

- Prior to any incident, it is advisable to gather recent photographs and documents describing the port's specific sites in order to have a "baseline status" of the structures.
- Port authorities are advised to establish a pollution report from the very first day of the incident and to request that a police report is drawn up.
- Record costs using appropriate forms. Present these elements rapidly to the organisation in charge of processing them.
- Have the most important document signed by the different stakeholders to give them an official status.
- Appoint a claims officer who will work together with the technical managers and the port authority throughout the incident. To support the claims officer, provide for the possibility of contracting one or more experts to prepare the compensation claim, if justified by the extent of the pollution, and identify, prior to any incident, the people or networks liable to provide this expertise.
- In the case of oil pollution covered by the IOPC Funds, the claim must be addressed to the IOPC Funds within 3 years of the date on which the damage began. For hazardous substances, as the 2010 HNS Convention has not yet entered into force, the timeframe is set out by national law. The documents compiled will provide a basis for compensation claims that may be addressed to the State and court, especially if the shipowner is unknown.

Feedback

Objectives

To methodically and carefully analyse the management of an incident so as to draw lessons for the future.
To create an opportunity to share, learn and progress for all those involved in the crisis.

Procedure

- Appoint a facilitator who may be: the harbour master, "hazardous materials" officer, member of port staff or port's QHSE officer in charge of managing the incident. To ensure objectivity, the facilitator should be assisted by an external agent, if possible experienced in incident management (such as a fire officer or police officer).
- Invite all those involved in managing the incident, whatever their rank or status, including managers within local authorities, private companies, experts, etc.
- Collect all information required to chronologically reconstruct the order of events.
- Conduct individual interviews with those involved to supplement this chronology with witness accounts.
- Draft a joint account of events, dividing the management of the spill into sequences and analysing for each one: the context of the situation, the hypotheses considered, the decisions and actions taken, the resulting effects and consequences.
- Organise a review meeting.
- Draw up an action plan and revise the port emergency response plan if one exists.

Illustration

Group interview

Post-spill monitoring and restoration

Applicability

- ☐ Commercial port
- ☐ Fishing port
- ☐ Marina
- ☐ Sea
- ☐ Estuaries
- ☐ Rivers
- ☐ Lakes

Objectives

To determine whether it is necessary, relevant and feasible to implement additional clean-up operations, rather than letting natural processes take their course.

Procedure

Set up a working group composed of the different interested parties.

Assess the extent of the zone still affected after clean-up operations.
- Conduct surveys.
- Take atmospheric measurements and conduct analyses on water and sediment samples.
- Collect and count individuals of indicator species (flora and fauna).

Decide on the most appropriate and effective strategies.
- Leave natural processes to take their course.
- Boost natural processes by phytoremediation and/or bioremediation.
- Treat the pollutant.

Mobilise sufficient and appropriate resources.

Set up monitoring so as to determine whether to pursue or stop restoration operations.
- Implement physico-chemical monitoring of the water and sediments.
- Conduct monitoring of the restoration of plant and animal communities.

Precautions

- Seek information, if available, to establish the baseline status of the port prior to the incident.
- Seek a consensus with the relevant parties on what is considered an acceptable level for ending response operations and entering the post-spill phase.

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Further information

Examples of past incidents

1998, RIO GRANDE, BRAZIL

On 24th August 1998, the chemical tanker *Bahamas* entered the port of Rio Grande in Brazil loaded with 19,000 tonnes of 95% sulphuric acid. Due to technical errors, the machine room was flooded with a mixture of water and acid. This very corrosive mixture created serious problems for the vessel's structure.

On 30th August, the vessel was listing heavily and the acid reached the main generators. The crew then evacuated the *Bahamas* due to the risk of explosion. Sprays of the acid and water mixture were seen coming from the tanks and the pump room. An operation to pump the cargo to shore was ordered by the shipowners and conducted by a private contractor. However the mixture of acid and water was too corrosive and destroyed the pump hose.

Three response issues can be pinpointed: The first is the high risk of explosion due to the formation of hydrogen. The second is the absence of a tank on shore to transfer the corrosive water and acid mixture into. The third is the fact that it was impossible in practice to neutralise such a large quantity of acid. Furthermore, corrosion of the vessel's structure was liable to cause leaching of heavy metals in the environment.

Two months after operations began, the decision was made to slowly discharge the cargo at falling tide, into the port, while constantly monitoring the pH. The pumping operation lasted more than eleven days, without ever exceeding the pH limits agreed on and without the leaching of ferrous compounds from the hull. Finally, the vessel was scuttled in international waters on the orders of the maritime authorities.

2008, DONGES, FRANCE

On 16th March 2008, a pipe leak caused a spill of an estimated 400 tonnes of heavy fuel oil during the loading of a vessel at Donges Refinery, Loire-Atlantique, France. Initial surveys revealed pollutant on the water in the form of sheen, patches and trails, from the Loire estuary as far as 10 km upstream of Donges. On the shoreline, certain wharves in the port of Saint-Nazaire were affected. Constant winds pushed the oil towards infrastructures and protection structures in the port of Paimboeuf.

On 17th March, the French Navy response vessel *Argonaute* was mobilised to recover the oil at sea. As a precautionary measure, fishing and shellfish harvesting bans were issued. Based on the results of sampling campaigns, the bans were lifted on 17th April.

Recovery operations on the water proved relatively inefficient: most of the oil recovered was collected on the shoreline. Onshore clean-up operations were in full swing. In March, nearly 1,000 operators were involved per day (civil protection, fire brigade, contractors).

Given the wide variety of polluted substrates, appropriate response techniques were required. Clean-up of port structures (quays, wharves, riprap) began with low and high pressure washing. Certain heavily oiled riprap and pebbles were removed and washed at a nearby location, the riprap at a temporary washing facility and the pebbles in a concrete mixer. Professional rope access technicians were required to clean lock gates, drydocks and pipes. Clean-up operations ended in early July 2008. The waste collected was pooled at a specially prepared pretreatment area inside the refinery. Each type of waste was channelled to an appropriate treatment facility according to its type and its degree of oiling.

2011, SAINT-PIERRE, SAINT PIERRE AND MIQUELON

On 30th May 2011, a handling error at the island's oil storage facility led to the release of around 100 m^3 of heating oil. The leak occurred in a closed hut; oil filled the hut then overflowed out of the door and windows, and ran down the slope and into the sea at the port's deep-water dock.

The POLMAR correspondent was rapidly alerted by the operator and arrived on site, notified the POLMAR stockpile and mobilised a buoy tender to assess the extent of the pollution. The modelling results pointed to a potential drift towards Newfoundland and the Canadian authorities were informed of the spill.

The first containment boom was laid two hours after the alert. Pumping began in the afternoon, after it was clear that containment was effective. The equipment and personnel involved were from the POLMAR stockpile and the beacons service. The polluter directly managed the waste collected and agreed to reimburse the costs of response operations by State services and of the consumables used.

Meanwhile, the Canadian authorities conducted aerial surveys. On the day after the incident, a leak from the containment area was spotted and the pollution was seen to be spreading within the port. However the quantities involved were low. One day later, the system was reinforced with sorbents.

After once again observing a small leak, that was however visible on the water around the foot of the riprap, the authorities issued a ban on pumping water and fishing in the port of Saint-Pierre one week after the initial incident. These bans were lifted on 24th June and 10th August respectively. On 8th June, the authorities gave legal notice to the storage facility operator to take the necessary measures to stop the leak. A specialised company was contracted for clean-up and waste treatment. The water supply to fish and shellfish tanks was replaced with seawater from the nearby area.

In total, 12 m^3 of fuel oil was recovered by pumping. This proved to be an important point as the archipelago, given its remote location, had a limited capacity to rapidly replenish its stockpile of sorbents.

2011, ETEL, FRANCE

During the night of 15th to 16th December, the *TK Bremen* was caught in a storm and ran aground on the coast of Morbihan in Brittany, south of the mouth of the Ria d'Etel. The cargo vessel's bunker tanks contained an estimated 190 tonnes of intermediate fuel oil (IFO 120) and 40 tonnes of diesel at the time. Two and a half hours later, the POLMAR contingency plan was activated and an operational command post composed of the local services and stakeholders involved in the incident management was set up in Erdeven early in the morning. The first surveys confirmed the presence of floating oil in the Ria d'Etel, with a risk of it reaching Etel marina.

Completely barring the ria with containment booms was not a feasible option due to the strong currents at this site. A static chevron configuration was therefore adopted, composed of floating booms combined with sorbent booms. The system was moored to the quayside of Etel harbour and to a 6-tonne concrete block. Laid using an oyster barge, this was the main protective system in case of a sudden leak from the wreck or in case the oil on the badly affected beaches downstream was washed back out to sea. This system was left in place until the end of response operations and intercepted a share–although only a very small quantity—of the oil and oiled debris that entered the mouth of the ria and was drifting upstream.

From the outset, in addition to the manual recovery of clusters of oil and heavily oiled seaweed, the majority of operations within the Ria d'Etel consisted in pressure washing hard surfaces (rocks and port structures). The final shoreline clean-up operations were completed by mid-March 2012. Meanwhile, a washing area was set up for pleasure boats in an area adjacent to the marina: a few dozen boats were taken out of the water for cleaning by a specialised contractor between March and April.

2012, BREST, FRANCE

On 29th October 2012, a 4 m^3 spill of soybean oil was reported in one of Brest's harbour basins. The leak occurred during a loading operation onto a vessel. Initially, the harbour master's office set about obtaining information on the behaviour of vegetable oil in water in order to check that the response actions requested of the shipping agent—consisting in the use of containment booms and mechanical recovery—were consistent with the type of product.

The weather conditions that day were favourable as the prevailing westerly wind effectively contained the spill at the back of the harbour basin, next to riprap. After validating the chosen technique, the pollutant was pumped up by a vacuum truck. This operation was first conducted from the bank, then on the water using a weir skimmer provided by Cedre and operated by coasting pilots.

By the end of the day, a significant share of the soybean oil spilled had been recovered. During the night, the wind dropped and the remainder of the oil was dispersed by the ebb tide. The following day, no traces of oil remained in the harbour basin.

2015, CHERBOURG, FRANCE

On 15th October 2015, a marine work barge, working together with another barge in the Cherbourg roadstead, struck the bottom and lost between 40 and 60 m^3 of marine diesel.

Spill response teams were mobilised together with the firefighting response vessel operated by the naval firefighters at the Cherbourg naval base and tugs, pumping equipment and floating booms. Both floating and sorbent booms were deployed around much of the perimeter of a nearby fish farm.

Three hours after the incident, an initial overflight conducted by the French Navy showed that the spill had spread widely to the eastern side of the roadstead. The slick was mainly in the form of silvery grey sheen. Two further overflights were conducted. Clearance divers also provided support by inspecting the hull of the work barge. The vessel was then towed to the quayside and the contents of its bunker tanks were pumped out by a specialised contractor.

A temporary ban on fishing and navigation was issued for the affected area. As a precautionary measure, the temporary closure of water intakes was also implemented. Monitoring was conducted through sampling and analysis.

An incident command post was set up in Saint-Lô, at the Prefecture. On 16th October, a situation review was organised with the various stakeholders involved. Nautical and aerial surveys were scheduled and regulatory protective measures to be implemented for the following days were defined by by-laws. Shellfish harvesting and watersports were banned and vigilance on the use of water intakes was maintained.

The survey conducted by boat on 16th October showed that the situation was evolving as expected in terms of the behaviour and fate of the marine diesel given the high renewal rate of the water masses in the Cherbourg roadstead. Small accumulation areas may have remained a little longer in sheltered areas with lower water renewal rates, inside the port for instance. In terms of environmental impacts, this incident caused low, temporary exposure of certain marine organisms which decontaminated naturally.

Pollutant behaviour

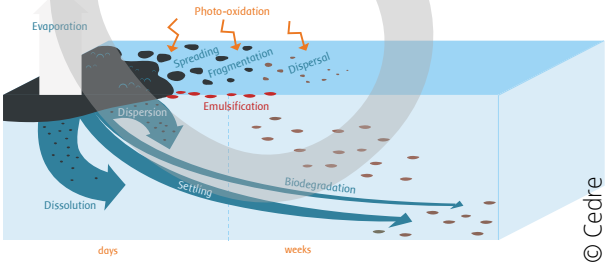
When spilt in water, oil and chemicals are subjected to the prevailing conditions (air and water temperature, wind, current, agitation of the water surface...) and transform at varying rates. This phenomenon is known as weathering.

During the first few hours, the volatile parts of the product spilled may evaporate and the substance may float and spread out to form a film of varying thickness, dissolve or sink. However, nearly all refined oils float, spread and evaporate to a varying extent. Dissolution of such products remains limited. They can quite frequently sink and be deposited on the bottom after adsorption by matter in suspension present in the water in ports and harbours. A few rare oil oils, heavier than water, can also sink as soon as they are spilt. In the case of chemicals however, their behaviour varies greatly and can only be studied on a case by case basis, as many chemicals dissolve, float, sink or evaporate, or combine several of these properties (see SEBC).
Over and above the very nature of the product, external elements may also promote evaporation, including the wind speed and the air and water temperature. Agitation of the water surface depends on exposure to the wind and the wind force, and can cause natural dispersion of the pollutant in the water column or on the other hand lead to the formation of a water-in-oil emulsion (also known as an inverse emulsion) between the product and the water, according to the type of pollutant.

Secondary transformations include oxidation and biodegradation. These processes are slow and need only to be taken into consideration after several weeks.

As the floating pollutant weathers, it drifts on the water surface and is subject to the action of winds and currents. The prevailing sea and weather conditions can cause it to accumulate against quays, vessels, riprap or embankments. When it has dissolved or dispersed in the water column, it is only affected by the current.

D2



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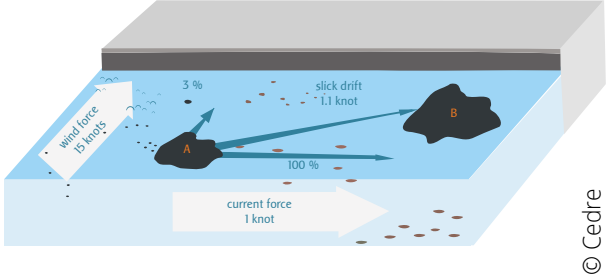
Evolution/weathering of a pollutant spilled in water



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Drift and spreading of a pollutant on a water surface, influenced by wind and current (as a rule of thumb, a slick will drift at 3% of the wind speed and 100% of the current speed)

Additional resources from Cedre

OPERATIONAL GUIDES

Since 1982, Cedre has been publishing operational guides for decision-makers and operators to provide them with access to necessary, practical information in case of accidental water pollution. All of Cedre's knowledge and expertise, gained since its creation in 1979, are used to produce these summary documents. The themes addressed are wide-ranging. In the case of port pollution, the following guides are recommended:

- Sorbents
- Custom-Made Barriers
- Manufactured Booms
- Containers and Packages Lost at Sea
- Aerial Observation
- Surveying
- Skimmers
- Hazardous and Noxious Substances.

These guides are available at: cedre.fr, Resources section, Publications subsection, then Operational Guides.

RESPONSE RESOURCES DATABASE

Cedre regularly updates its database of response resources which comprises information on:

- equipment and products that can be used to respond to oil spills, HNS spills and litter;
- equipment manufacturers and suppliers, and services providers specialised in protection, recovery, storage, clean-up, etc.

This database is accessible free of charge at cedre.fr in the Resources section.

D3

CEDRE TECHNICAL NEWSLETTERS

Drawing on Cedre's technological monitoring activity in the field of spills in the marine environment and inland waters, Technical Newsletters are released on a twice yearly basis. They are available in both French and English at cedre.fr
They are available in the Resources section, Publications subsection, then Technical Newsletters.

LIST OF TESTED RESPONSE PRODUCTS

Cedre publishes on its website cedre.fr a list of sorbents, dispersants and washing agents tested in its laboratory that meet current standards. This list is available in the Analysis & Research section, Dispersant and sorbent testing subsection.

Glossary and acronyms

ADN: European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways.

Adsorption: retention, adherence or accumulation of a solid, liquid or gas at the surface of some other substance. Adherence of a floating pollutant, in suspension or in solution in the water, to the surface of a solid such as sediments or other matters in suspension in the water.

ATEX: equipment suitable for use in explosive atmospheres, in compliance with national and European regulations.

BIC code: number attributed by the Bureau International des Containers (BIC) to identify the owner of a container. It is composed of 4 letters, that last of which is U.

Biodegradation: breakdown of certain substances, such as hydrocarbons, by living organisms.

Bunker Convention: International Convention on Civil Liability for Bunker Oil Pollution Damage.

CAS: unique numerical identifier assigned to a chemical by the US Chemical Abstracts Service for inclusion in its database, which includes chemicals, polymers, biological sequences and alloys.

CODIS: French Departmental Operational Fire and Rescue Centre.

Containment: act of stopping the migration or drift of floating liquid or solid pollutants away from a site by deploying a boom.

Debris: solid materials of all kinds, in various forms, deliberately discarded or accidentally lost onshore or offshore, litter from onshore transported into the marine environment by rivers, drainage and sewage systems or carried by the wind.

DG: Dangerous Goods.

Dispersant: liquid chemical used to place oil in suspension in the water mass and promote its dispersal, in order to accelerate break down by the natural environment.

Effluents: waste waters or liquid waste discharged into the water during clean-up operations in pollution response.

Emulsification: process through which an emulsion is produced.

Emulsion: incorporation of water in oil, due to agitation or the addition of active compounds, to create a heterogeneous mixture.

Flash point: lowest temperature at which a liquid ignites in the presence of a heat source: flame, spark.... If the heat source is removed, burning ceases.

HHO: Home heating oil.

HNS: Hazardous and Noxious Substances.

Hydrophobic: property of a substance whereby it has no affinity for or does not easily combine with water.

IBC Code: International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk.

IGC Code: International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk.

IMDG Code: International Maritime Dangerous Goods Code.

IMO: International Maritime Organization.

IMSBC Code: International Maritime Solid Bulk Cargoes Code.

IOPC Funds: International Oil Pollution Compensation Funds.

ISO: International Organization for Standardization.

LASEM: French Navy laboratory (*Laboratoire d'Analyse, de Surveillance et d'Expertise de la Marine*).

LMD: Light marine diesel.

LNG: Liquefied Natural Gas.

MDO: Marine Diesel Oil.

MRCC: Maritime Rescue Coordination Centre.

Oleophilic: which has an affinity for fats, absorbing them selectively.

ORSEC: French maritime emergency response system (O*rganisation de la Réponse de Sécurité Civile*).

OSC: On-Scene Commander.

PA: Port Authority.

POLMAR-Terre: French contingency plan for marine pollution on the shoreline.

PPE: Personal Protective Equipment.

PW: Public works.

QHSE: Quality, Health, Safety & Environment.

SEBC: Standard European Behaviour Classification. Classification used to determine the theoretical behaviour of a substance according to its physical and chemical properties, and to classify it into one of five main families: Gas, Evaporator, Floater, Dissolver, Sinker.

Settling: gravity separation of immiscible products (i.e. that do not mix), of which at least one is liquid.

Skimming: selective recovery of oil on the water surface using a skimmer.

SOPEP: Ship Oil Pollution Emergency Plan.

Sorbent: natural or synthetic solid product designed to absorb a liquid spilt in water in order to facilitate its recovery.

SPBA: Société Pétrolière du Bec d'Ambès.

Surfactant: or surface active agent, product used in the composition of dispersants that reduces the repulsion that two substances may have towards each other. Surfactants promote the suspension of an oily liquid in water.

Trawling: increasing the concentration and thickness of a slick of pollutant spread out over a water surface using a boom towed in a U-formation by two boats at a speed of less than 1 knot.

UIISC: French civil protection unit (*Unité d'Instruction et d'Intervention de la Sécurité Civile*).

UN number: 4-digit number that identifies hazardous materials for international transport.

Upwind: expression used to locate an object in space indicating that it is situated towards the direction from which the wind is blowing, in relation to an object of reference. The wind therefore reaches the object in question before the object of reference.

VHF: Very High Frequency communication system.

Water column: a volume of water in a real or imaginary vertical tube.

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