Cedre Information
BULLETIN

Feature

Pollution caused by *flooding in Île-de-France in 2016*

STUDIES

Case summaries and statistics for spills in inland waters in 2017

N° 38 - October 2018

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Cedre Information BULLETIN

Centre of Documentation,
Research and Experimentation
on Accidental Water Pollution

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EDITORIAL

Waters with good status, in well functioning natural environments, form part of the heritage of our land. For all inhabitants, this offers a high quality living environment, and for the municipality, ecological services that generate inestimable savings.

In the Loire-Brittany catchment area (28% of the surface area of mainland France, but 40% of its coastline), today only 30% of the watercourses have good or very good status. The target for 2021 is to bring this up to 61%.

The Water Agency is an active partner for all water stakeholders in an institutional environment that is undergoing a profound transformation in terms of water and aquatic environment management. The agency supports municipalities during this period of transition which, although delicate, is essential to achieve consistent water policies.

Investments by municipalities and economic players to restore water quality have never been higher. In 2017, the agency injected over €470 million into projects for water and aquatic environments in the Loire-Brittany catchment area.

Improving the quality of surface, ground and inshore waters remains a high priority, with over half of the financial support granted going to this issue. This involves reducing and treating pollution at the source, whether occasional or diffuse, emanating from agricultural, domestic, industrial or artisanal practices.

Considerable progress remains to be made with regard to the reduction of micropollutant emissions and to limiting rainfall-related pollution which currently constitute major concerns. Primarily, the causes of such pollution must be addressed, rather than their consequences. The agency's responsibilities have also been expanded to encompass marine environment monitoring.

The 11th programme (2019 - 2024) for the French water agencies (6 agencies across mainland France) will be a powerful driver (€2.1 billion per year) for achieving the objectives of the water management master plans (SDAGE) and meeting the commitments of the Water Framework Directive by implementing, through concrete measures, the priority guidelines issued by the Ministry, such as reducing the erosion of biodiversity, adapting to climate change and preventing environmental impacts on health.

In 2019, we shall work together with our partners to build the projects of the future and to guarantee water quality for human health, aquatic life and different uses.

For over 40 years, the teams at the Water Agency and at Cedre have fostered the same values of expertise for the protection of the environment.

Martin Gutton,
Director General of the Loire-Brittany Water Agency

FEATURE

Pollution caused by flooding in Île-de-France, in 2016

When flooding triggers pollution

In late May 2016, France was widely affected by heavy precipitation. Several days of exceptional rainfall in the areas of Île-de-France, Picardy, Burgundy and Centre led to swollen rivers and severe flooding. These events caused oil and chemical pollution across extensive geographical areas, in several regions of the country. Three departments which were particularly badly hit requested assistance from Cedre: Seine-et-Marne, Yonne and Essonne.


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Pollution caused by flooding in Île-de-France in 2016

Context

A wide variety and large number of facilities were affected, including oil storage facilities (both new and waste oil) and fuel tanks. The pollutants spread across vast areas of flooded land and travelled along many rivers in spate. Natural areas, infrastructures and residential buildings (individual houses and blocks of flats) were contaminated, including underground parts (garages, cellars...). The local authorities and fire and rescue services – already heavily mobilised to mitigate the damage and risks generated by these exceptional events – also had to handle this "diffuse" pollution issue.

Cedre was called out on 5th and 6th June and rapidly sent team members on site. Requests came from various parties: the Seine-et-Marne Fire and Rescue Service, the Evry Prefecture in Essonne and the city council of Charny Orée de Puisaye in Yonne. These missions lasted from a few days to a few weeks. In addition to attending meetings, the agents from Cedre handled many requests for support in the field.

Conducting an on-water survey

Surveys and situation assessment

The first requests were for assistance in assessing the situation. In the Yonne area, one main source of pollution was identified, although flooded cellars with overflowing heating fuel tanks were also reported. Elsewhere many scattered sources were identified and were often difficult to locate. Certain sites or homes were closed off or shut down, others were difficult to access due to the flooding.

The pollution had spread very widely, carried by the flood waters as the water levels rose then fell. Helicopter overflights were conducted to monitor its spread along the watercourses, observe the containment systems deployed (mainly floating booms) and recommend alterations to optimise the set-up. Very soon, these investigations were further supported by surveys conducted on land, or even by boat when the streets were flooded. New recommendations on containment techniques and equipment were issued to support emergency response operations. In particular, they included advice on setting up custom-made barriers and filter systems, as conventional booms were unsuitable for certain sites.

Aerial surveys

Many individual homes were affected by the oil, meaning that "door-to-door" visits had to be organised to obtain an accurate estimation of the extent of the pollution and to define *ad hoc* technical recommendations. These surveys were conducted jointly with the city councils and local authority staff, fire brigade personnel and other services.

On land surveys

FEATURE

Pollution caused by flooding in Île-de-France in 2016

Polluted house walls and gardens

The situation assessment took several weeks and mobilised up to 4 Cedre agents at a time. In total, over 70 sites were surveyed in Seine-et-Marne, and more than 20 in Essonne and Yonne. In Seine-et-Marne, Cedre drew up a daily note for the Fire and Rescue Service, the civil protection and defence service and certain State services. This note reported the surveys and observations made and suggested priority actions for the following day.

The pollutants observed were mainly light fuels, in particular diesel or home heating oil, as well as both new and used engine oil. Many other products present in cellars, sheds or workshops had also been released, although the exact type or quantity could not always be determined. Seveso-classified sites were protected and did not appear to have suffered any leaks or significant damage.

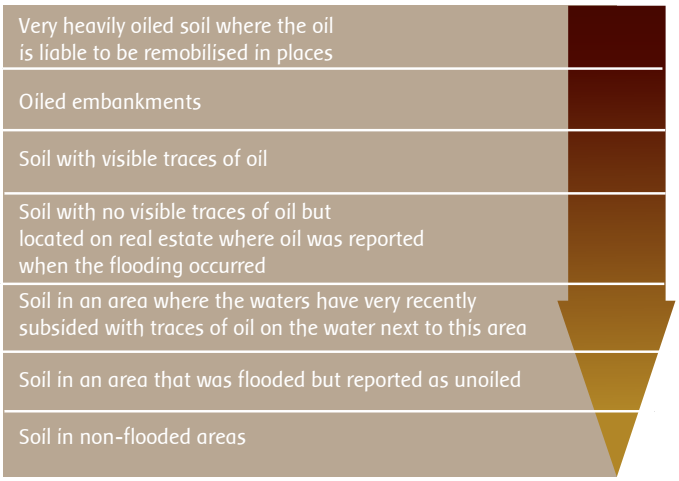
Response in flooded cellars and underground carparks

Another urgently needed action was to pump the large volumes of contaminated water out of flooded sites (cellars, underground carparks). Cedre assisted the Seine-et-Marne Fire and Rescue Service in designing and building makeshift filtration systems made of bins with a perforated base and filled with loose sorbent. These systems were used to evacuate the water from these sites and release it into the natural environment. Technical datasheets were also produced by Cedre and distributed.

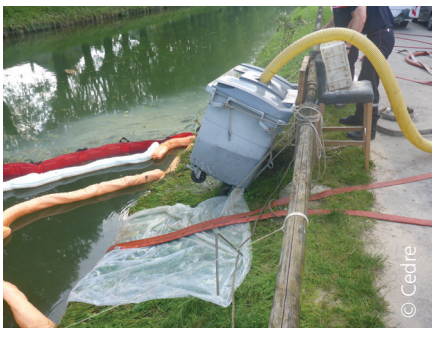
Health concerns rapidly emerged. A memo jointly produced by the Ile-de-France regional health agency (ARS), the Seine-et-Marne authorities, the Seine-et-Marne Fire and Rescue Service and Cedre was released on 8th June for the general public and provided instructions on what to do in case of response actions in flooded and contaminated properties and cellars.

Defining a sampling plan

Cedre helped to define a sampling plan, managed by the Seine-et-Marne unit of the Regional and Interdepartmental Directorate for the Environment and Energy (DRIEE), so as to characterise the main types of pollution observed (see diagram below).



Response in cellars and underground carparks



Booms and sorbents deployed on the water

Pollution caused by flooding in Île-de-France in 2016

Recovery on the water

When the site configuration caused sufficiently thick layers of floating oil to accumulate, this oil was recovered by pumping, sometimes used in combination with skimmer heads. However, in more open areas, the extensive spread of the product at the water surface meant that sorbents were the only viable option.

Booms and sorbents deployed on the water

Sorbent booms were also laid as "sentry" devices, or near to points of pollution resurgence, or else in a protective capacity for certain sites.

Very quickly, the quantity of sorbents required, and their installation, surveillance, renewal and treatment once oiled became an issue in itself. This came in addition to the problem of storing and processing the large quantities of litter and debris, whether oiled or not, generated by the flooding. Improvised storage areas were set up locally, sometimes in very restrictive conditions given the complex circumstances. In certain cases no ground protection was laid, creating a risk of secondary contamination.

Cleaning houses and gardens

In terms of the pollution deposited when the water level dropped, Cedre was questioned on the clean-up techniques to be implemented in homes and gardens, the equipment to be used and the available contractors. These recommendations were used to conduct clean-up, but also as supporting documents for insurance claims.

The techniques recommended for gardens are similar to those used during the "botanical clean-up operations" implemented in oiled natural vegetated areas: scything, selective cutting, scraping, or even removal of a few centimetres of soil. In terms of the clean-up of hard surfaces, the emphasis was on the urgent need to contain, recover and treat washing effluents.

Some of the questions asked did not fall within Cedre's field of expertise, in which case the enquirers were referred to the French geological survey BRGM for probing and sampling polluted soil and the regional health agency ARS for questions relating to health. The main concerns were in connection with:

- the techniques and equipment for cleaning walls and other hard surfaces, according to the material and coating (paint, render, etc.)
- the clean-up of oiled objects, furniture, ornamental or fruit trees
- whether or not fruit and vegetables grown in the gardens (in 2016 and the following years) would be fit for consumption
- whether children should be allowed to play in the gardens, whether barbecues could be lit, etc.

Cleaning up contaminated gardens

FEATURE

Pollution caused by flooding in Île-de-France in 2016

Disparate management of oiled waste

- the health risks posed by oiled basements
- oiled waste management.

Within the limits of its field of expertise in relation to these concerns, Cedre drafted an observation record and recommendations for each site visit. Cedre also produced a general framework memo, intended for mayors in Essonne. This document was rapidly generalised to apply to the other areas affected. This memo included:

- advice and key terms for use by the authorities, explaining the background to the pollution, the behaviour of the products involved and their impacts on soil and vegetation
- recommendations for treating oiled gardens and plant debris, according to the type of site (lawn, trees, vegetable garden, etc.) and the extent of the pollution
- recommendations for treating contaminated cellars.

Cedre completed its field mission at the end of June, but continued to provide remote assistance from Brest to BRGM and the authorities until the end of July, in particular by fine-tuning the initial recommendations made and mapping the visits conducted.

Summary and feedback

The pollution generated by the severe flooding of June 2016 was rather exceptional in several respects: vast geographical areas affected, very high number of sites contaminated (around 90), numerous sources of pollution, different types of pollutants (oil, plant protection products, etc.) all in the context of a natural disaster.

Particular attention had to be paid to responder safety as personnel were required to work in places that were particularly difficult to access such as flooded cellars of houses or areas of marshland. The risks were aggravated by the possible presence of volatile toxic compounds (VOCs, H2S) and submerged hidden hazards (storm drains, branches, various objects, etc.). Another very important aspect which was a major focus for all those involved in the response was the issues relating to the safety of inhabitants as well as the health and hygiene of the homes and gardens affected.

In terms of spill response, original solutions were implemented using the resources available on site. Waste management, for pollutants, contaminated objects and used sorbents, proved complicated due to the extremely high volume of waste involved.

Among the lessons Cedre drew from this response, we note the benefit of the surveys conducted jointly with the Fire and Rescue Service or representatives of the local authorities. This made it easier for Cedre responders to access the various oiled sites, a crucial factor in obtaining a full understanding of the issues at stake and in providing appropriate technical guidance.

Ivan Calvez and
Anne Le Roux, Cedre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Involvement of the Seine-et-Marne Fire and Rescue Service

From 25th May to 6th June 2016, the northern half of France was hit by heavy rainfall, causing many watercourses to burst their banks, in particular in the basins of the Loire and the Seine. The flood of 2016 had several specific features which set it apart:

- exceptionally high water levels – even for flood conditions – aggravated by watercourses, situated far apart, rapidly and extensively overflowing
- a large breach in the Briare canal upstream of Montargis
- significant involvement of the Fire and Rescue Service: widespread mobilisation of personnel and equipment in all fields of specialisation, over and above the usual activity.

Focus on Seine-et-Marne's mobile chemical response unit (UMIC)

The Seine-et-Marne mobile chemical response unit (UMIC) was created in 2002 to respond to risks in the fields of chemical hazards, transport of hazardous substances, biological hazards, spill response, and emerging threats in the Seine-et-Marne area. It has developed several technical and scientific partnerships, in particular with Cedre, the Paris Police Prefecture's central laboratory and several units of the Ministry of the Interior and the Ministry of Defence.

The unit has 7 specialised vehicles, 4 technical advisers, 23 unit leaders, 89 team leaders and 45 team members divided between 5 specialised centres. These fire fighters are also involved in classic fire and rescue services in their fields of specialisation.

The unit is called out around 100 times a year, in 40% of cases for spill response operations, generally involving oil.

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Seine-et-Marne CODIS crisis room activated during the flooding

FEATURE

Pollution caused by flooding in Île-de-France in 2016

Timeline of the natural disaster

Spring 2016 saw particularly heavy rainfall (+130% in relation to mean annual rainfall) causing the soil to become water-logged and an extremely rapid reaction by watercourses in the case of heavy rain.

Saturday 28th May: a yellow flood and rainfall warning was issued for the Seine-et-Marne department. Nearly 300 calls were recorded by the Fire and Rescue Service, resulting in almost 150 call-outs.

Sunday 29th May: heavy rainfall continued and requests for emergency assistance flooded in, in particular in the Cély-en-Bière area.

Monday 30th May: water levels had risen, in particular in the Seine-le-Loing and the Grand Morin. All the Fire and Rescue Service units activated their incident response units around the clock.

Tuesday 31st May: an orange storm and flood warning was issued for the department. As the situation escalated, a red warning was issued for the Loiret department. The Seine-et-Marne Fire and Rescue Service was called on to provide back-up to the Loiret Fire and Rescue Service in order to evacuate the occupants of a retirement home. Meanwhile, the Grand Morin exceeded its maximum flood level. The neighbourhood of Almont in Melun required numerous evacuations using rowing boats. The operational fire and rescue centre (CODIS) organised the relocation of the Moret-sur-Loing emergency response centre to Champagne-sur-Seine.

Wednesday 1st June: the severe weather warning for Seine-et-Marne was raised to a red storm and flood warning. The rise in water level continued faster than anticipated and the first inhabitants were evacuated in Souppes-sur-Loing during the night, mobilising a large number of fire-fighters. In municipalities located downstream, the local authorities together with fire-fighters as well as police forces informed the population, via a variety of channels, of the high flood risk and asked residents to leave their homes. The evacuation of several thousand people began in the centre of Nemours on 1st June. The events attracted considerable media coverage.

Thursday 2nd June: red warning maintained for the department. The flood wave from the Loing spread into the Seine, and the water levels rose drastically in particular in the areas close to the confluence of the Loing and the Seine. The fire brigade's incident response units were strategically positioned to cover and organise actions across the geographic basins. Back-up from civil protection military forces arrived, as well as equipment from the civil protection operational and logistic support establishment (ESOL). Population evacuation procedures continued but were limited in the Seine catchment area to the confluence with the Loing. Evacuation procedures then began in Crécy-la-Chapelle, with far less media coverage than the major evacuation of the centre of Nemours and fears related to the rise in water levels in Paris.

Friday 3rd June: the flood waters began to subside except on the Seine which remained at a stable level. The response organisation consisted in the establishment of four incident response units. Despite the receding waters, no concrete pumping actions could yet be implemented. As the waters subsided, other major issues became apparent, in particular in terms of pollution. Slicks of fuel, oil and other hydrocarbons became visible in the watercourses, streets, businesses, homes and gardens. This pollution mainly came from tanks of heating fuel in the cellars of individual houses. Certain major releases also came from industrial sites in particular related to the automotive industry. Cedre was called upon to provide technical support alongside the Seine-et-Marne mobile chemical response unit.

Saturday 4th June: this date marked the beginning of a rather intense period in terms of operational management. Water removal actions in the field were not yet possible but surveys and containment actions for many pollution incidents were launched.

Sunday 5th June to 14th June: the operational organisation in place remained unchanged. The flood waters had greatly subsided, allowing water removal and clean-up operations to take place. These operations were implemented according to the priorities established at interservice meetings. The activities conducted by onsite incident response units were gradually reduced over the following days to be completely deactivated on 14th June in favour of local management of the remaining operations.

Interactions between the Seine-et-Marne Fire and Rescue Service and Cedre

The Seine-et-Marne Fire and Rescue Service mobilised vast quantities of equipment to respond to the flooding and the Seine-et-Marne fire brigade's mobile chemical

Filter bins (Cedre - Fire and Rescue Service) on 8th June 2016

The mobile chemical response unit in action

Pollution caused by flooding in Île-de-France in 2016

The flooding: fast facts

For the Seine-et-Marne Fire and Rescue Service as a whole:

- 4,428 rescue calls
- 6,700 vehicle mobilisations for 2,900 operations
- 8,000 people evacuated or taken to safety
- 2,200 fire-fighters deployed (300 per day at the height of the disaster)
- 4,000 meals prepared by the Fire and Rescue Service and served to rescue workers on site

14th June: end of rescue operations but mobile response unit mobilised until 21st June

For the mobile chemical response unit in particular:

- 140 pollution response operations, including 95 in cooperation with Cedre
- 15 specialists/day across the different operations

Technical support from Cedre for operation monitoring (5 specialists/day including 2 liaison officers)

response unit was faced, in late May 2016, with the largest spill response operation since its creation. The flooding caused pollution at over 70 sites distributed across around 50 km.

The mobile chemical response unit's specialists, together with Cedre's team, were confronted with a multitude of pollution incidents, in addition to having to deal with councillors and inhabitants distraught by this multifaceted disaster. The mobile unit's technical advisers (RCH4) worked in pairs with Cedre's engineers to:

- survey and map the pollution and determine clean-up priorities
- assist the State services, in particular with contaminated soil sampling
- draft field recommendation sheets for the local inhabitants
- monitor emergency clean-up sites.

Clean-up operations were conducted either by the mobile chemical response unit's fire-fighters, with support from their non-specialist colleagues, or by private contractors. A brief report was drawn up for the operational fire and rescue centre (CODIS) each day. This was used as a basis for the daily brief at the Prefecture. Waste storage rapidly became problematic.

Given their heavy involvement, both in terms of the duration of this mission and the vast number of sites to be treated, the members of the unit particularly appreciated the technical support provided by Cedre in the field.

This long-standing partnership ensured a perfect symbiosis between the mobile unit's officers and the engineers sent on-site. From the very first aerial survey, views on the objectives to be established and priority sites to be defined naturally converged.

The confidence exhibited by Cedre's engineers in the response capacity of the Fire and Rescue Service's specialists together with our knowledge of Cedre's know-how reinforced the interoperability of the forces deployed in the field. Cedre's engineers were thereby able to fully concentrate on their role in examining and assessing the situation prior to response actions and the fire service's specialists were able to focus their efforts on the sites where the resources were most effective.

This experience is remembered, by each and every member of the mobile chemical response unit, as a personally enriching experience. It was the opportunity for us not only to witness Cedre's trainers in operation, but also to build strong working relationships which provided an excellent footing for handling the emergency in the best possible conditions, despite the pressure of events and the quite understandable distress of victims confronted with what was an unparalleled disaster for this region.

Lieutenant-Colonel Françis Comas,
Western unit chief - Seine-et-Marne Fire and Rescue Service

Survey by the Fire and Rescue Service and Cedre in Nemours on 6th June 2016

Around the world

The flooding and resulting pollution which affected France in June 2016 were not a one-off occurrence. A few similar cases are outlined below.

2018 — Cienfuegos, Cuba

On 28th May, Cuba's largest refinery, located 250 km south-east of Havana, suffered damage following flooding caused by heavy rainfall from subtropical depression Alberto. The site's crude pumping plant was flooded and the waste treatment facility was partially destroyed. 12,000 m^3 of oil and contaminated water were released into the environment. Between 60 and 70 % of Cienfuegos Bay, i.e. a surface area of 65 to 78 km^2, was affected. The joint action of unions, entities from different provinces and the Armed Forces stopped the spill from spreading and helped to improve the cleaning and sanitation of the waters. 3,000 metres of boom were deployed and detergents were used. Some dead fish and oil-spotted birds were observed.

The assessment of environmental damages cannot be finalised until the waters recover their transparency so as to inspect the seabed. The State has emphasised the need to update response plans for pollution hazards related to such situations generated by natural disasters.

2017 — Texas, United States

From 1st to 4th August, Hurricane Harvey caused heavy rainfall (up to 155 cm) in the region of Houston (Texas). Numerous oil and chemical facilities were affected. 46 chemical plants and refineries released a total of 2,000 tonnes of emissions, mainly due to emergency shutdown procedures, leaks and explosions. The contaminated San Jacinto River Waste Pits were damaged and released dioxins into the surrounding area. A damaged tank at a refinery released over 100 tonnes of benzene, toluene and other volatile organic compounds. Nearly 1,700 m^3 of petrol from two storage tanks in Galena Park, along Houston Canal, was released into the flood waters. 40 water treatment plants became inoperable or were destroyed.

The Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA) worked together within the Natural Disaster Operational Workgroup (NDOW) to assess the situation and organise the response to hazardous substances. 266 spills were identified, listed and responded to. 51 contaminated industrial waste sites were visited and samples taken. Only one, the San Jacinto River Waste Pits, required the contaminated waste to be removed.

2017 — Amuay, Venezuela

On 31st October 2017, a storage tank at Amuay refinery in the north-west of Venezuela overflowed due to heavy rainfall. An estimated 32,800 m^3 of oil, including petrol and diesel, was released into the nearby bay. The Paraguaná Refinery Complex immediately activated the local contingency plan which stated that containment booms should be laid and the oil recovered using sorbents and vacuum trucks.

2013 Colorado, United States

In September 2013, following unprecedented flooding in Colorado, thousands of square kilometres were threatened with contamination by oil and chemicals. The affected area comprised a large number of oil and natural gas wells. 1,900 wells were very quickly shut down by their operators. Inspectors from the Colorado Department of Natural Resources were sent into the field to conduct surveys, but their progress was slow as many roads remained inaccessible. Over and above the oil pollution risk, the authorities were concerned by the tanks of toxic wastewater and chemicals used in drilling or extraction processes which might be damaged. These sites also contained a complex network of pipes which could potentially fracture. In October, the Colorado Oil and Gas Conservation Commission (COGCC) indicated that a total of 168 m^3 of oil had been released into the environment due to ruptured pipelines and containment systems. Some 100 m^3 of wastewaster from oil refining was also released into the flood waters. Furthermore, the Colorado Department of Public Health and Environment announced that many water treatment facilities had been affected by the flooding, leading to a spill of 75,700 m^3 of untreated wastewater and 568,000 m^3 to 1,000,000 m^3 of partially treated wastewater.

2007 Kansas, United States

On 2nd July 2007, while the Coffeyville Resources refinery in Kansas was undergoing an emergency evacuation following a storm and heavy rain warning, a pump malfunction occurred at a crude oil storage tank. The incident went on to cause the tank to overflow following heavy rainfall, contaminating Verdigris River with some 270 tonnes of oil. The flooding and subsequent flooding of the land caused the pollution to spread as far as Oklahoma. The city and the refinery remained flooded for several days, making spill response difficult to implement. In such cases, the number one priority is naturally to save lives. While it was feared that the slicks would affect Oologah Lake in Oklahoma, the pollution appeared to have dispersed before reaching it, thus saving it from significant damage.

Pollution observed in Onion Creek, Kansas, 2007

STUDIES

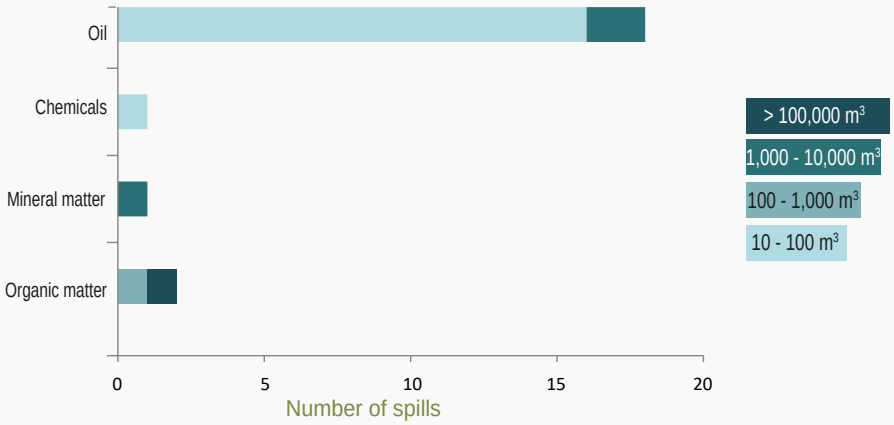
Spills in inland waters around the world in 2017

Statistical data

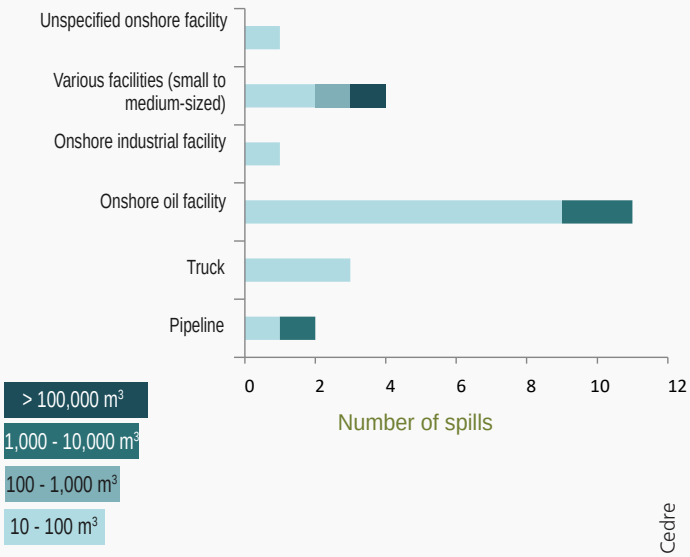
The data presented below has been obtained from an inventory of incidents around the world, made known to Cedre as part of its day-to-day activities, and having resulted in an oil or HNS spill in inland waters. This inventory is therefore by no means exhaustive. The incidents selected for analysis are those for which sufficient information is available to be entered into a database and which involved a spill (or spills) in excess of 10 tonnes.

In 2017, 23 incidents followed by significant spills were identified in inland waters. The vast majority of the incidents involved oil. The spill source was predominantly onshore oil facilities. Around 70% of incidents reported in 2017 were due to holes, breaches or ruptures in various structures.

FREQUENCY OF SPILLS BY PRODUCT



NUMBER OF SPILLS
BY SOURCE STRUCTURE TYPE



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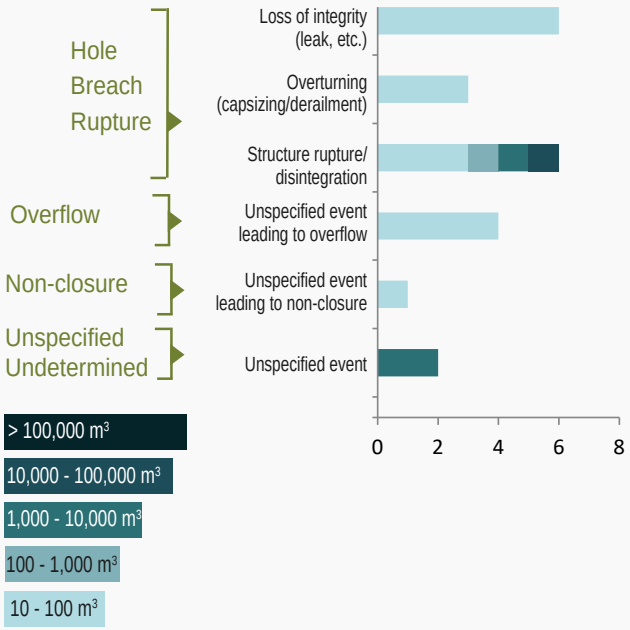
NUMBER OF SPILLS
BY INCIDENT TYPE



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7 major incidents

1 Stark County, Ohio, US

In April, an estimated 7,500 m³ of bentonite-based drilling fluid was spilt in wetlands near Tuscarawas River in Stark County (Ohio, US). The incident occurred during the construction of an over 1,000 km-long gas pipeline, from south-east Ohio to southern Michigan. The operator stated that an unexpected backflow of fluid had occurred during horizontal drilling operations. In November, another such spill, although minor, occurred in a watercourse in the same State. Although these spills involved a non-toxic mineral, as highlighted by the Ohio Environmental Protection Agency, they nevertheless violated the State's pollution control regulations. A series of similar cases between April and September led the Attorney General to file a lawsuit against the pipeline owner and operator.

2 Brittany, France

On 8th April in France, on a pig farm in Brittany (Côtes d'Armor), a pit wall collapsed, instantaneously releasing 600 m³ of slurry. While makeshift barriers (bales of straw) on the ground, in areas of accumulation, helped to reduce the contamination of the stream at the foot of the farm, an estimated 400 m³ flowed into the stream and spread into the Jaudy river. Fish mortality was observed along a 13-km stretch, affecting various species (sculpins, loaches, eels, lampreys, minnows, trout, and salmon), some of which are protected under the inventory of "Eaux et Rivières de Bretagne" and 2 fishing associations. Despite a pumping station in Pontrieux being momentarily shutdown, the incident did not affect the water supply.

3 Culberson County, Texas, US

In early August, in Culberson County (Texas), a gathering line at a well ruptured, spilling almost 2,800 m³ of oily water, affecting Delaware River, a tributary of the Pecos River. The operator and its contractors responded to the spill by implementing containment operations using booms and recovery operations with sorbents.

4 DeWitt County, Texas, US

On 29th and 30th August, again in Texas, at least 4 oil facilities in DeWitt County were submerged following the passage of cyclone Harvey and the subsequent flooding from the Guadalupe River. Following crude oil spills, due to the submersion of storage facilities, of quantities estimated at between 10 and 60 m^3, Guadalupe County was polluted with a few dozen cubic metres of oil and somewhere around 15 m^3 of oily water. Given that these spills occurred against the backdrop of a natural disaster, spill response actions were greatly impeded, or in some cases completely prevented, due to the need for the authorities to wait until the flood waters had subsided to assess the situation and the necessary actions.

5 Red Earth Creek, Alberta, Canada

On 20th November, in the Canadian province of Alberta, a pipeline rupture near Red Earth Creek, around 400 km north of Edmonton, resulted in the release of just under 100 m^3 of oily water, contaminating areas of muskeg (acidic peat bogs). No impact on wildlife or neighbouring watercourses was apparently observed. We have no information on any response actions implemented in the wetlands, an environment which is generally characterised by poor access, a low load-bearing capacity and sensitivity to trampling and vehicles.

6 Libreville, Gabon

In mid-December, some 150 km south-east of Libreville, the failure of a pump seal, in a separator at a well, caused a crude oil leak estimated by the operator at 80 to 90 m^3. The oil reached River Ezanga then Lake Ezanga, with the strong flow in the watercourse hampering the effectiveness of the booms deployed.

7 Harjavalta, Finland

On 21st December, at a power plant near Harjavalta, a connection failure on a hose between a tanker truck and a storage tank caused around 50 m^3 of diesel to spill from the tank. The diesel ran into Kokemäki river through storm drains. While ice in the river slowed the spread of the oil, it also hindered the assessment and, to a greater extent, the response, which required the mobilisation of boats, booms and vacuum pumping equipment by a specialised contractor.

Ivan Calvez, Cedre

Testing the Current Buster 2 in dynamic mode with a single boat

Response equipment for use in strong currents

The containment and recovery of pollutants in areas of strong currents are generally confronted with two main issues: boom deployment difficulties and the very limited capacity of booms to contain slicks in such conditions. In an attempt to provide a suitable containment solution for this scenario, various systems have been specifically developed by the spill industry over recent years. Since 2013, Cedre has been evaluating such systems in the natural environment.

Context

The question of oil containment and recovery in areas characterised by strong currents is a recurrent issue, particularly in rivers and estuaries where fast-flowing water is often found. There are generally two types of problems raised by such configurations:

- the difficulty in deploying containment booms in strong current, due to the extremely strong pull forces exerted by such currents,
- these booms' very limited capacity to contain oil in such conditions.

It is generally accepted that leaks of oil are liable to appear under the boom when facing into currents exceeding a theoretical value of around 0.35 m/s (approximately 0.7 knots), which is a relatively low current. This critical speed greatly reduces the efficiency of containment and trawling operations using conventional booms in areas of strong current. In an attempt to provide a suitable containment solution for this scenario, various systems have been developed by the spill industry over recent years. Cedre has identified several such systems which have received positive feedback and has been conducting trials at a natural site with strong currents in the Loire estuary since 2013. To do so, Cedre works in partnership with Cerema (the French centre of studies and expertise on risks, environment, mobility and land-use planning), the French Directorate of maritime affairs, Total, FOST (Fast Oil Spill Team), the Nantes-Saint-Nazaire maritime port, the group SEA-Invest and the Loire-Atlantic subdivision of "Phares et balises". Manufacturers loan the equipment to be evaluated and provide assistance for its deployment.

Equipment tested

NOFI Current Buster 4 and 2

This system is composed of two air-filled chambers, similar to those of an inflatable boom, which form a funnel shape to collect the oil at the water surface. These two chambers join together to form a tapered channel which accelerates the flow. A skimming device is placed at the end of this channel to remove the surplus water in the incoming flow, thus concentrating the oil. The oil then flows into a wider unit with a flexible base, which has the two-fold function of separating the oil and temporarily storing it. A skimmer can be deployed in this temporary storage area to remove the concentrated oil. The system can be towed by a single vessel using a BoomVane.

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Response equipment for use in strong currents

DESMI Speed Sweep

This system is composed of a conventional boom in a U-shape across which several rows of netting are attached facing into the current to slow the speed of the oil as it travels towards the apex of the boom. This allows the system to operate at high towing speeds and offers high oil encounter rates, without however compromising the containment performance. As the Speed Sweep does not have an integrated storage capacity, the collected oil must be continuously evacuated. An integrated pump at the apex or a floating skimmer can be used to discharge the oil to the towing vessel. The system can be towed by a single vessel using a Ro-Kite paravane.

LMOS Sweeper 15

This system is composed of a deflective structure combining several rows of deflector booms which channel the oil towards a floating flow reduction channel which feeds into a collector pool. Given this system's very limited storage capacity, the collected oil must be continuously evacuated. An integrated pump at the apex or a floating skimmer can be used to discharge the oil to the towing vessel. The system can be towed by a single vessel with beams or a Sea-Foil paravane.

Resources used

Port facilities

The Nantes-Saint-Nazaire maritime port (GPMNSN), as a partner in these trials, provided its Donges workshop and its personnel to receive, store and repair the equipment. Lifting equipment (crane and telescopic handler) and transport equipment (flatbed trailer) were also mobilised to set up the system to be tested on the dockside then to retrieve it from the water. The group SEA-Invest, which operates at the port's agri-food terminal, provided the section of wharf used for deployment and folding as well as for the static trials.

Water body

The area selected for the dynamic trials is located in the Loire estuary, near to Montoir de Bretagne and Donges. It offers several useful characteristics for testing response equipment in strong flow, with currents often over 1 knot, nearby infrastructures and a suitable size of water body.

Vessels

Three vessels and their crews were mobilised for these trials:

- the *Bonne Anse*, 2 x 175 hp, provided by the Saint-Nazaire subdivision of "Phares et Balises", which was used for the launch and retrieval of the systems as well as for all the dynamic trials either alone or with a second vessel. Its hydraulic crane was used to transfer the equipment from the dockside.
- the *FOST 1*, 225 hp, provided and equipped by FOST, which was involved in towing operations by two vessels then alone, as well as during pumping trials. Its clear deck and its manoeuvrability were also very useful for handling the different equipment on the water.
- the *Armor 2*, 115 hp, which belongs to Cedre and was used for all observations and photography on the water, as well as to release pollutant simulants and to take current measurements.

Spill simulation

For environmental reasons, no oil could be released in the Loire estuary during the trials. Popcorn and oranges were used to visualise the behaviour of a floating pollutant in the systems tested. When released onto water, popcorn floats, simulating a slick, for long enough to carry out the necessary observations. Popcorn is biodegradable and was considered to have a negligible environmental impact in the trial conditions.

Slick simulation: releasing popcorn from Cedre's boat

Trials conducted

Dynamic trials with two boats

The aim of the first series of dynamic trials was to assess the manoeuvrability and collection capacity of each system when towed by a pair of vessels.

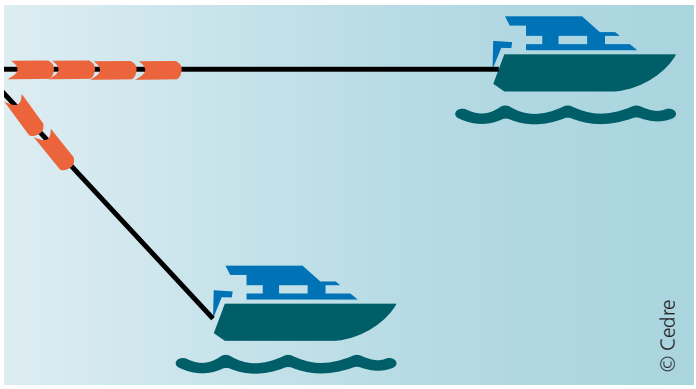


Diagram illustrating deployment by a pair of boats

Dynamic trials with a single boat

The aims of this second series of trials consisted in assessing the manoeuvrability and collection performance of each system towed by a single boat assisted by a paravane equipped with vertical wings which force the paravane to move away from the vessel, while keeping the towing wire taut.

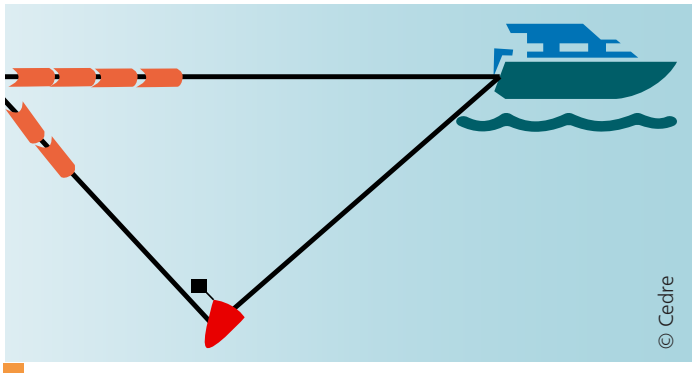


Diagram illustrating deployment by a single boat

Static trials with reversal at the turn of the tide

One of the specificities of estuary areas resides in the change in flow direction after each turn of the tide. A specific protocol was therefore defined to accommodate this particularity in the assessment of equipment in static mode. The trials were designed to determine the deployment conditions of each system from a fixed point with a paravane as well as the feasibility of the reversal manoeuvre of the whole system at the turn of the tide. The trials also aimed to validate the specifications of the vessels required to deploy the system and hold it in position. The viability of the continuous evacuation operation with a pump positioned on the dockside was also assessed.

Current Buster 4 and 2

The trials demonstrated the collection and concentration potential of these systems for floating oil, including at current speeds of over 0.7 knots. In the case of the Current Buster 4, deployment and retrieval are feasible, although tricky, in lateral current with a boat with high drift resistance, a bow thruster and a 350-hp engine. As for the Current Buster 2, a boat of a similar size to a pilot boat was able to deploy the system. This approach could result in a very short mobilisation time near to port areas.

The trials in dynamic mode showed that towing is far easier and more efficient with one vessel together with a BoomVane than with two vessels. Collection operations were conducted on a simulated spill and given the systems' manoeuvrability, they were able to make successive passes through the slick to collect almost all of the slick visible at the water surface. The behaviour of the system was satisfactory up to a speed of 3.5 knots for the Current Buster 4 towed by a single vessel (50 to 70 cm high waves and low wind) and up to 3.6 knots for the Current Buster 2 (20 to 40 cm high waves and low wind). The pollutant pumping trials in the separation and storage tank of the Current Buster 2 were successful.

The trials in static mode validated the viability of deployment from a fixed point using the BoomVane to tow apart the two arms of the Current Buster facing into the current. Although preferable, the mobilisation of a vessel exclusively to maintain the system in a static position facing into the current is not necessary. It is however essential during launching, retrieval and reversal phases.

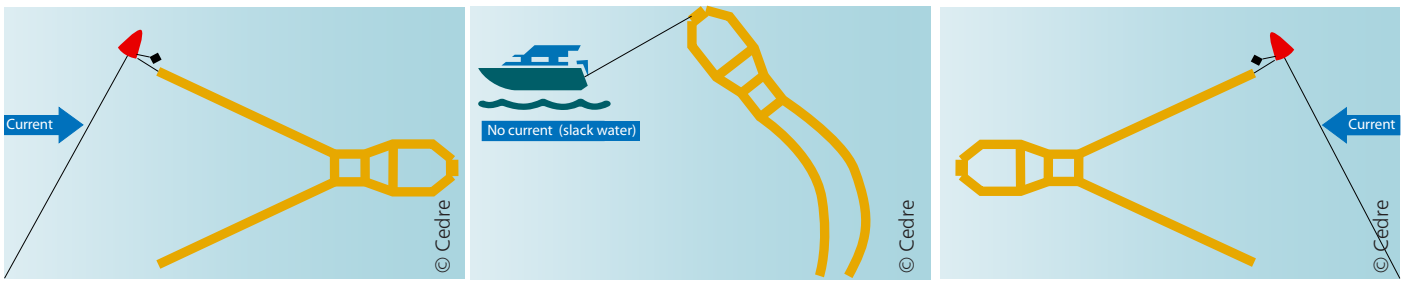


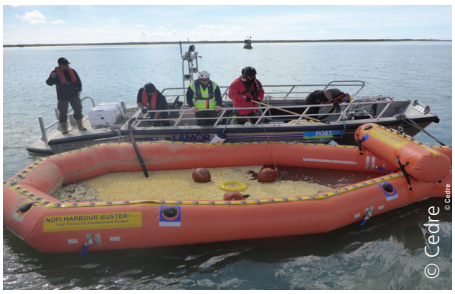
Diagram illustrating the reversal manoeuvre at slack water

Response equipment for use in strong currents

Operating the Current Buster 4 in dynamic mode with two boats

Correct configuration of the Current Buster 4 facing into the current after reversal at the turn of the tide

Testing the Current Buster 2 in dynamic mode with a single boat



Skimming the simulated spill in the apex of the Current Buster 2 and transfer to the floating storage capacity

Speed Sweep and LMOS Sweeper 15

These two systems gave good results in terms of decreasing the flow rate in the collector pool, meaning that they are able to work effectively well beyond the limits of conventional booms, at around 3.1 knots in optimal conditions for the Speed Sweep and 3.5 knots for the LMOS Sweeper 15. The efficiency of these systems will therefore tail off at just over 3 knots, a current speed frequently encountered in estuaries.

Dynamic configurations, with or without a paravane, were shown to be satisfactory, allowing a certain degree of flexibility in their deployment. The Ro-Kite paravane used during the trials however raised certain difficulties given its large dimensions and the strong towing force it exerts.

The trials were also the opportunity to validate the technical feasbility of continuous pumping from the dockside when the system was used in static mode (the maximum height tested between the dockside and the water surface was approximately 5 m). The paravanes provided a good opening width at speeds from around 0.7 knots (Ro-Kite) to 1 knot (Sea-Foil).

These systems are however far more demanding than traditional booms when comparing equivalent sizes. Relatively powerful vessels are required, and small pilot boats are insufficient, unless an adaptation could be devised with smaller paravanes. They also require a certain degree of technical expertise, in terms of knowledge and deployment of the equipment, but also seamanship skills. Initial in-depth training together with regular drills would appear necessary to ensure the operational implementation of such equipment. Nevertheless, these systems ultimately raise the limits of conventional containment systems from 0.7 knots to around the 3-knot mark.

In addition to assessing critical speeds, these trials have provided considerable operational information on these systems, leading to a fuller understanding of the specificities of their use (deployment, handling, etc.).

Dynamic trial on the Speed Sweep with 2 boats

Using the Speed Sweep in a static configuration with the Ro-Kite

Dynamic trial with the LMOS Sweeper 15 with two boats

Dynamic trial with the LMOS Sweeper 15 with a single boat

Julien Guyomarch and
Mikaël Laurent, Cedre

Success of the event *Amoco Cadiz*, 40 years of change(s)

The two-day event marking the 40 years of progress since the sinking of the *Amoco Cadiz* was greatly appreciated by those who attended. Cedre would like to thank its partners and in particular: Brest métropole, Océanopolis, the *Préfecture maritime de l'Atlantique* and the University of Western Brittany. The day of discussions held on 16th March began with a speech by Patricia Charlebois, Deputy Director of the Marine Environment Division of IMO, focusing on current and future global challenges. Vincent Bouvier, Secretary-General for the Sea, then emphasised the importance for France to fit within a European and international perspective. To illustrate these keynote addresses, Christophe Rousseau, Cedre's Deputy Director, gave a detailed presentation of the *MT Sanchi* incident in the East China Sea. The rest of the day was organised into a series of panel sessions on four themes: prevention, preparedness, ecological impacts and restoration. The statements and discussions between panelists were rich and of high quality. A printed publication and video are set to be released soon.

The following day, on 17th March, Cedre's partners and the general public were invited on the trail of the *Amoco Cadiz*. The event was attended by 307 visitors, who were given a crash course in spill response. How can we determine and predict the behaviour of a pollutant when spilt at sea? What response equipment or product should be used? How is clean-up organised if the shoreline is hit? What actions can be carried out post-spill? Cedre's staff provided answers to these questions and many more, adapting their answers for younger visitors, and brimmed with creativity in the workshops and activities on offer. Our thanks also go to Anne-Laure Dugué from the *Ligue pour la Protection des Oiseaux* for running a stand and to Pierre-Yves Dupuy from the French Naval Hydrographic and Oceanographic Service (SHOM), Eric Thiébaud from the "Station biologique de Roscoff" and Christophe Rousseau from Cedre for the talks given.

Participation in Interspill 2018

The international conference Interspill 2018 and the associated spill response equipment exhibition were held from 13th to 15th March at ExCeL London (UK). Between the opening and closing plenaries, over sixty presentations were given, organised into 16 thematic sessions addressing various aspects of response preparedness (organisation, joint initiatives between public authorities and the private sector, benefits of new remote sensing technologies, etc.). We note an interesting a debate over certain current issues relating to chemical dispersion, notably questioning the implications of the conclusions of scientific studies conducted following the *Deepwater Horizon* blow-out and in particular their potential effect on the perception of this technique during future spills. In addition to giving a presentation during the "Effective Preparedness" session and chairing the "Making Training Work" session, Cedre, as a member of the Interspill Committee, organised 4 science workshops jointly with ITOPF, in the Exhibition Floor Theatre. The themes chosen for these workshops were: Shoreline Survey, Response in Cold Environments, HNS Pollution and Marine Pollution Impacts. Cedre chaired the two latter workshops. Finally, over 100 specialised service providers and equipment suppliers and distributors were represented in the exhibition hall, where a French pavilion featured several companies which are members of SYCOPOL together with Cedre's own stand.

New equipment

To enhance our training sessions on chemical spills, our technical facilities now feature a standard 10-foot container. Placed on our man-made beach, it recreates a commonly encountered situation: a container lost overboard that washes up on the shore. This container can be used to simulate a range of different situations.

From a training perspective, it can serve to raise trainee's awareness of the survey phase (marking and signposting), risk assessment using gas detectors or a thermographic camera, as well as the establishment of a safety zone. Manoeuvres involving the container can also be organised, in association with the fire brigade or navy fire-fighters, to illustrate the variety of scenarios and difficulties encountered during an HNS spill. These partners use this container for their chemical risk training and handling exercises, which enables us to regularly update our knowledge of the most suitable operational procedures and techniques and subsequently share this knowledge with our trainees.

CONTAINERS

SHOWROOM

Our 300 m² exhibition hall has been entirely renovated and reorganised to showcase the different types of response equipment. In addition to the pre-existing section devoted to oil spills, it now includes a section on chemical spills.

This showroom constitutes a valuable complement to the theory lectures provided by Cedre's trainers and offers the huge advantage of exhibiting at a single location all the most commonly used spill response equipment: Personal Protective Equipment (PPE), portions of booms, mechanical and oleophilic skimmers and the relevant pumps, trawlnets, sorbents, walk-behind sand screeners, waste storage tanks, etc. In this vast area, the optimal conditions of use and maintenance, advantages and limitations of each of the systems can be presented in concrete terms.

Cedre's latest publications

Technical Newsletters

Our technical newsletters are a gold mine of information, offering a summary of our technology intelligence activity on accidental pollution in marine and inland waters. They also include data on past incidents, a review of operational discharges in mainland France, information on response preparedness, and the response techniques and equipment implemented. Information on recent publications in the field of spill response is also featured.

→ Full collection available free of charge at cedre.fr, Resources section

→ Cedre Information Bulletin
Amoco Cadiz, 40 years of change(s)

Issue number 37, released in June 2018, takes on a special format with a very comprehensive 26-page feature on the changes since the *Amoco Cadiz* spill in the fields of pollutant studies, preparedness, response, damage assessment and communication. A 9-page section is then devoted to a look back over the 40 years since Cedre was created.

New recruits

Gérald Falc'hun

Gérald trained as an agronomic engineer with a specialisation in environmental engineering. He joined Cedre in early April, where he is in charge of Quality, Hygiene, Safety and Environment (QHSE) as well as of developing and implementing the equipment and infrastructure investment strategy.

Annaïg Londres

With a Masters 1 in Business and Administration Management and a Masters 2 in SME International Management, Annaïg has solid management experience in a wide range of sectors. She joined Cedre in 2017 where she is Assistant to the Production Manager and the Technical and Scientific Coordinator. Her core missions are the organisation of Strategy Committee meetings, tender management and the administrative and financial management of European projects.

Camille Lacroix

Camille obtained a Masters in biochemistry and molecular biology from Chimie ParisTech, before going on to complete a PhD in marine biology. She first started at Cedre in 2015, working on issues relating to HNS, oil and marine litter and has been involved in national and international projects devoted to understanding the fate and impacts of contaminants in the marine environment. She became a permanent member of staff in late 2017 as a Study Engineer in the Research Department with a specific focus on marine litter and ecotoxicology.

Laurence Saleun

Qualified in accounting and management, Laurence has 20 years of experience in positions of increasing responsibility within various structures. She was recruited by Cedre in May 2018 as Chief Accountant. She is in charge of the payroll and social security contributions, social and tax declarations, accounts receivable and accounts payable, research tax credit, drawing up financial statements and personnel training.

New horizons

Martine Marc

After obtaining a secretarial diploma, Martine started her career with the "Centre Océanologique de Bretagne-CNEXO", now Ifremer. In 1980 she was recruited by Cedre, in its very early days, as a steno-typist. For the majority of her career she belonged to the Research and Development Department, and became PA to Deputy Director Georges Peigné. When the Strategy Committee was set up in 1995 she was placed in charge of its organisation and invested much time and energy in this task. We wish her a happy retirement.

Martine Marc is replaced by Annaïg Londres (see above).

Karine Ropars

Karine was hired by Cedre in 1993 as an accounting secretary. In 2008 she joined the Spill Preparedness Division as a Quality/ Environment Assistant and was a keystone of our quality management system. Her career path has led her on towards new horizons and we wish her every success.

Marc Lavenant

After starting his career with the Ministry of Agriculture in rural engineering, then working for an international consultancy firm in marine aquaculture, Marc was seconded to Cedre in 1996 by the Ministry of Agriculture, Fisheries and Food. He went on to become Manager of the Planning and Audits Department and a Safety and Environment Engineer. In addition to managing his team, producing public and private contingency plans, conducting audits and implementing spill response assignments, he was also placed in charge of infrastructure and building work. He is largely to thank for the high-performance technical facilities and pleasant working environment we enjoy today, as well as for our ISO 14001 certification. As a passionate golfer, we wish him many happy rounds.

Marc Lavenant is replaced by Gérarld Falc'hun (see above).

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Cedre Information BULLETIN

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