

FRENCH KNOW-HOW IN THE PREVENTION AND FIGHT AGAINST ACCIDENTAL OIL SPILLS

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ABSTRACT: *As the victim of several oil spills caused by oil tanker accidents along its coasts during the 1970s, France has created a specific organization, including a research and documentation center, and developed all necessary means to prevent further major pollution and to protect its coastline.*

The French program is unique in the fact that it is first of all concerned with the prevention of accidents. In addition, French know-how is characterized by the establishment of intervention plans (POLMAR plans, sea and land) which are designed to prepare for and coordinate the fight against accidental water pollution at sea and on the coastline.

An antipollution operation also relies on the existence of the necessary means to carry it out, as well as specialized equipment which is ready to be put to work at sea as well as on the coastline by competent authorities. In the case of oil spills occurring in other countries, France is prepared to share its experience and know-how thanks to its groups of experts such as those of CEDRE and of the port of Marseilles.

On March 16, 1978, the *Amoco Cadiz* sank off the Breton coast and its cargo of 223,000 tons of oil was spilled into the sea, polluting more than 300 km of coastline.

At that period, the national provisions for the prevention and clean-up of accidental oil spills were insufficient to deal with a pollution accident of that magnitude. Shortly thereafter the French Government took action to reinforce existing ways and means in all areas in order to be better prepared in case of pollution and to better minimize its effects.

Today, national policy is oriented toward prevention of pollution, but antipollution operations are in no way neglected.¹ Eight years after the *Amoco Cadiz*, this national policy has proved its effectiveness, especially during the accidental oil spill of the ship *Tanio* in March 1980.

Prevention of accidental oil spill pollution

After being the victim of a number of oil spill incidents, France has elaborated a rigorous prevention policy relying on European and international legislation, both reinforced by national measures.

Security of maritime navigation. The measures are essentially designed to ensure improvements in four areas as follows.

1. Inspection procedures have been strengthened in order to enforce the rules for construction, equipment, and use of sea-going vessels.

During inspection, the Centres of Security of Maritime Affairs verify whether a vessel conforms to the security legislation of international conventions, notably the MARPOL 73/78 convention.

The Memorandum of Understanding on Port State Control, signed in Paris on January 26, 1982, enabled a standardization of inspections for foreign vessels in the European countries which were cosigners. The Administrative Center of Maritime Affairs centralizes information regarding inspected vessels and puts this information at the disposal of the cosigners of the agreement.

2. The information available to the authorities regarding maritime navigation along French coasts has been improved. A decree of March 24, 1978 instituted a system for identifying tankers transporting petroleum products when they enter French territorial waters or when they have an injury at less than 50 nautical miles from the French coastline. This law has been reinforced by Protocol I of MARPOL 73/78, which, since October 1983, provides that any event which causes or could cause a pollution accident will be reported to the proper authorities.

3. Vessels carrying potential pollutants now must stay at a greater distance from the French coastline. Navigating within seven (7) nautical miles of the coast is forbidden to these tankers, except in specially-listed channels and estuaries which give access to ports.

With the French initiative, the traffic separation scheme of Ushant was modified by the International Maritime Organization (IMO) in January 1979 in order to push back the tanker traffic of hydrocarbons and dangerous substances to waters further than 27 miles from the coastline.

4. Penalties for maritime traffic violations and for oil spill pollution accidents have been strengthened. A 1983 law has permitted sanctions for an offense against laws forbidding oil dumping at sea, as defined by MARPOL 73/78, committed by French or foreign vessels in territorial waters or in the Exclusive Economic Zone, as well as carelessness, negligence or non-conformity to laws which results in an accident at sea causing pollution in territorial waters.

Monitoring of maritime navigation. The necessary means for applying preventive measures have been reinforced. Two complementary organizations have enabled this role to be assured:

Five Maritime Rescue Coordination Centers (CROSS), equipped with military personnel, can coordinate sea rescue operations, insure the monitoring of maritime navigation (notably in the traffic separation schemes), and monitor pollution. Related to the Secretary of State for the Sea, these centers are responsible to the Maritime Prefect for their operational missions (Figure 1).

Sixty-five semaphores of the French Navy ensure optical monitoring and radar coverage of the French coastline.

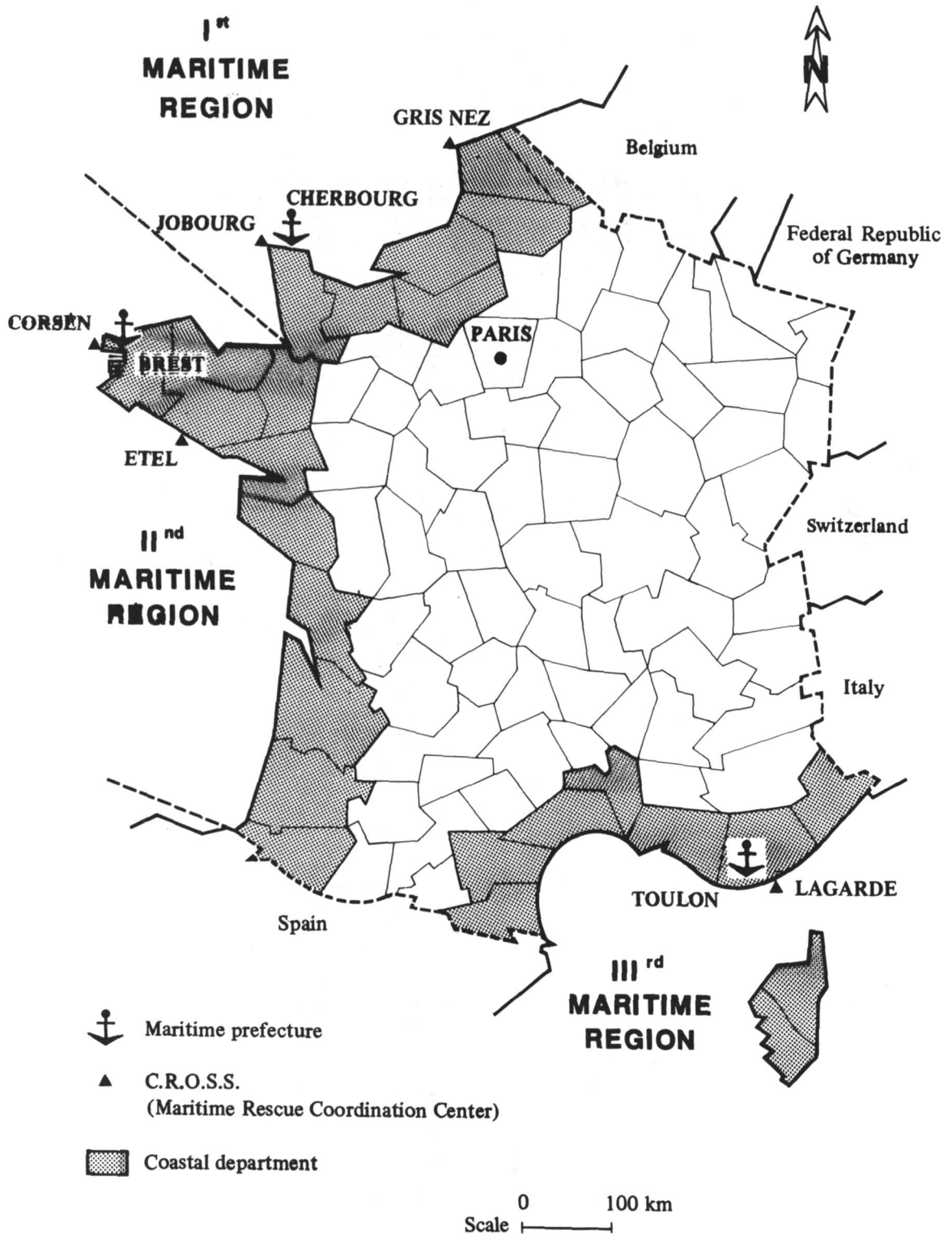


Figure 1. French administrative organization

The missions of the CROSS centers related to monitoring navigation were significantly enlarged after the *Amoco Cadiz* accident. Three of the centers ensure the particularly careful monitoring of maritime traffic and the traffic separation scheme for the English Channel (Figure 2). Created recently, their means of transmission and detection are extremely up-to-date.

Intervention at sea in the case of a pollution threat. In each maritime

region, specific ways and means have been installed in order to assist a vessel in difficulty.

Four powerful civilian tug boats, chartered by the French Navy and put at the disposal of the Maritime Prefects are continually prepared to assist any vessel in difficulty. This assistance may be deemed necessary by the Maritime Prefect if he so judges. Also, thirty-two towing exercises (on September 30, 1986) of large vessels have taken place

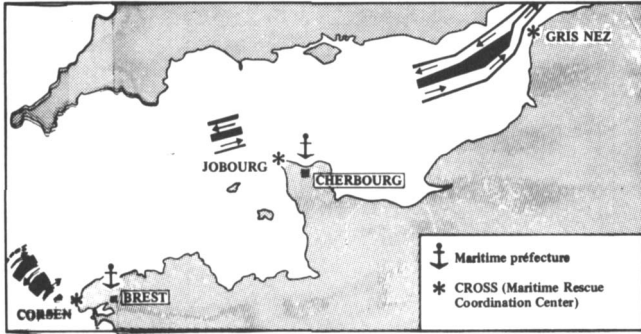


Figure 2. Navigation monitoring of the English Channel and location of maritime authorities

under diverse weather conditions. These exercises, as well as numerous interventions at sea, have enabled verification of the effectiveness of the existing antipollution organization.

Evaluation and intervention teams can be placed on board the damaged vessels by helicopter. Composed of military personnel who are competent in various shipboard functions, their role is to evaluate the danger, to inform the Maritime Prefect, and eventually to undertake any necessary immediate actions on board (such as preparation for towing, short-term repairs, or preparation for ship evacuation).

Evaluation of the measures for preventing pollution accidents at sea. The preventive measures initiated by the French government have already proven their worth. Respect for traffic laws in the plan of traffic separation has continued to improve: 15,729 offenders were counted in 1979, whereas there were ten times fewer in 1985. Furthermore, thanks to all the preventive measures which were taken since the *Amoco Cadiz* accident, France has not had a major pollution problem since the *Tanio* shipwreck of March 7, 1980. Finally, increased conformity of the vessels to the norms imposed by international conventions, notably MARPOL 73/78, has led to a real lessening of petroleum spills at sea.

The affidavits of pollution infraction have consequently followed the same downward curve (Figure 3).

Fight against accidental oil spill pollution

The effectiveness of a national prevention policy cannot totally eliminate the risk of a pollution accident. Large efforts have been made in order to reinforce the national plan of readiness for an accident in all its aspects: improving existing response programs, and increasing the response potential in both trained personnel and equipment.

The national intervention policy against accidental pollution. The first directives organizing the fight against pollution were enacted in 1970 after the *Torrey Canyon* accident. The experience gained from other accidents has improved the concepts regarding the antipollution organization which was totally modified in a new directive of October 12, 1978 organizing the POLMAR Plan² which takes into consideration what has been learned from the *Amoco Cadiz* experience.

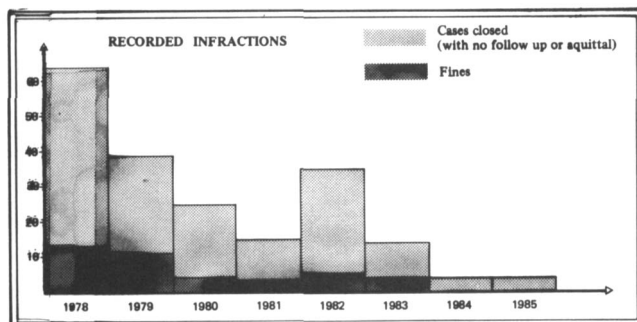


Figure 3. Evolution of pollution infractions affidavits from 1978-1985



Figure 4. Lightening of a vessel in difficulty

At sea, the responsibility to prepare for and conduct antipollution operations is given to the Maritime Prefect, a general Navy officer who possesses large military and civil responsibilities and with whom resides the authority of the government at sea.

In each maritime region, the Maritime Prefect has established, in connection with the local elected authorities and the various users of the marine environment, an intervention plan for offshore pollution (plan POLMAR-MER) which inventories all the means available for a pollution response operation. In the event of a maritime accident, the Maritime Prefect directs the POLMAR-MER (POLMAR-SEA) plan. If the magnitude of an accident justifies the use of the POLMAR-MER plan, the Maritime Prefect sets the plan in action. In doing so, he has access to the Intervention Fund which is the responsibility of the Minister of the Environment, and which provides for any exceptional expenditures.

On shore, in each of the 26 coastal departments, the Prefect (Commissaire de la République) representing the French Government within the department prepares a POLMAR-TERRE (POLMAR-LAND) plan in connection with locally elected officials, users of the marine environment, associations for protection of the environment, and scientific experts.

The POLMAR-TERRE plan comprises a number of elements such as an inventory of zones to be protected and their priority, plans for installing booms designed to protect these areas, inventory of antipollution equipment both publicly and privately owned, and a list of storage sites and treatment centers for recovered products.

Begun at sea, the cleanup operations may be continued on the coast. Small-scale incidents can be treated by the coastal communal authorities directly affected, but in the case of an exceptional pollution accident, the above-mentioned Prefect can put the POLMAR-TERRE plan into action and direct the antipollution activities under



Figure 5. Sirene 20 recovery device



Figure 6. The flexible floating tank, Pollutank

the authority of the Minister of the Interior. As with incidents at sea, for exceptional expenses on land, the Prefect can ask for assistance from the Intervention Fund of the Minister of the Environment.

Coordination of antipollution activities. Since 1978, the coordination structures have been reinforced. At the central level, all maritime problems of this nature are periodically examined, if necessary by the Interministerial Committee of the Sea, whose work is prepared by the Interministerial Mission for the Sea. In this way, in March 1986, all the existing national antipollution provisions were reviewed.

If a pollution accident is of an exceptional magnitude and if there is a necessity to coordinate the POLMAR-TERRE and MER operations, this coordination falls under the authority of the Minister of the Interior who meets with a staff of directors in the operational center of the Direction of Civil Defense and Security (CODISC).

At the local level, a regional maritime conference with representatives of the various administrations involved in maritime questions, will verify coherence between the preparation of the POLMAR-MER and POLMAR-TERRE plans.

If cleanup operations are simultaneously taking place at sea and on the coastline, the coordination of activities will be supervised by a permanent conference with representatives from the Maritime Prefect and the Commissaire de la République (Prefect) of the particular department concerned.

Appeal to specialized organizations. Antipollution operations at sea and on land need specialized knowledge. To meet this demand, the POLMAR instruction has created a Center of Documentation and Research and Development on Accidental Water Pollution (CEDRE). The principal role of CEDRE is an improvement of antipollution techniques and a documentation of the techniques.³ CEDRE also assists government agencies in preparing intervention



Figure 7. Coastal oil tanker equipped with Sirene 20 and ESCA recovery devices

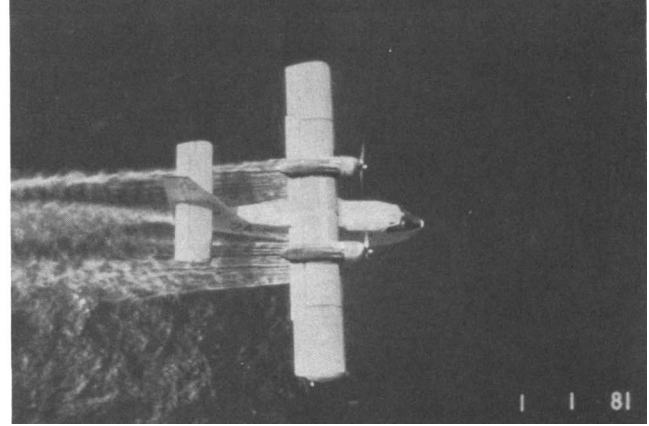


Figure 8. Fire combating plane adapted to dispersant spraying

plans. In the event of a pollution incident, CEDRE provides technical advice to those responsible for antipollution activities.

In addition, the French Navy has created a Commission for Practical Antipollution Studies (CEPPOL) in order to meet its specific needs; the Minister of the Interior (Directorate of Civil Defense and Security) possesses, at the heart of the civil security units, response sections which have specifically designed antipollution equipment; and French authorities may require advice from research centers such as IFREMER (Institut Français pour l'Exploitation de la Mer) and IFP (Institut Français du Pétrole).

Response techniques and methods for oil spills

The antipollution effort which resulted from the *Amoco Cadiz* shipwreck used specific equipment which France developed after the *Torrey Canyon* accident, and, to a large degree, nonspecific equipment. Significant effort has been made in designing and testing equipment, in order to be well prepared for pollution response operations,^{7,8} and testing dispersants as well as sorbents and other products adapted to oil spill treatment.^{5,6}

Aware of the limitations imposed by each method of cleaning up pollution, as well as the variety of types of pollution which could be encountered, the French authorities as well as the research centers have not designated any particular antipollution technique. Thus, research and development on means of combating pollution has been carried out, primarily by CEDRE, in close association with the manufacturers concerned with antipollution activities. In particular, research and experimentation have concerned the following aspects of pollution response.



Figure 9. Heavy helicopter (Super-Frelon) equipped with dispersant spraying equipment



Figure 10. Balear boom

Lightening a vessel in difficulty. The French Navy and the port authorities have access to heliportable pumping devices. The effectiveness of these pumps being greatly reduced in the presence of viscous hydrocarbons, research has been oriented toward methods for pumping viscous products. Figure 4 shows the lightening of a vessel in difficulty.

Confinement and recovery at sea. It is in this field that the French strategy has most advanced during the past few years.

The first approach which was chosen was very pragmatic. Priority was given to the perfection of existing equipment in order to incorporate it in units adapted to the naval capabilities of the French Navy. The basic recovery device was chosen to be the Sirene 20, a direct suction skimmer integrated with an inflatable boom (Figure 5), which has proved to be effective in moderately choppy sea. This device has been tested on numerous occasions, towed by two vessels as well as by one vessel with a jib-boom.⁹

The storage and transportation of the recovered products at sea are accomplished by means of floating tanks having capacities of 100 to 200 cubic meters. CEDRE offered its services to the industry for the study and creation of a tank with a removable roof, the Pollutank (Figure 6). Concurrently, it also helped the French Navy in testing the emptying and cleaning of another flexible tank (Dracone).

It soon became obvious that despite their limitations it was necessary to study specific devices for recovery in high seas, capable of recovering and storing large amounts of pollutant. But the studies which were undertaken on specialized vessels did not produce enough convincing data.

For these reasons, another approach has concentrated the research on the use of existing vessels with large storage capacity which can be used as supports for recovery devices. Two vessels seem best adapted

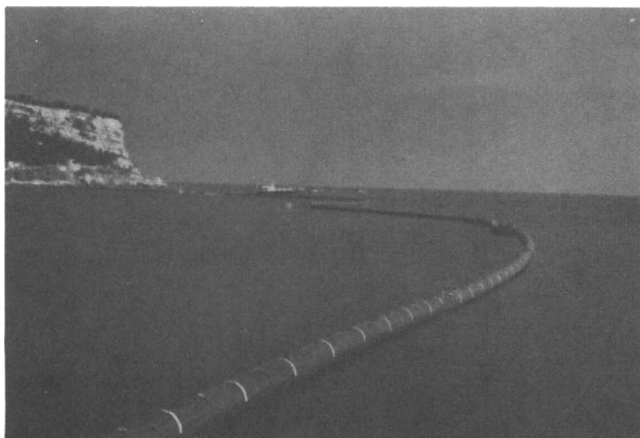


Figure 11. TMB boom

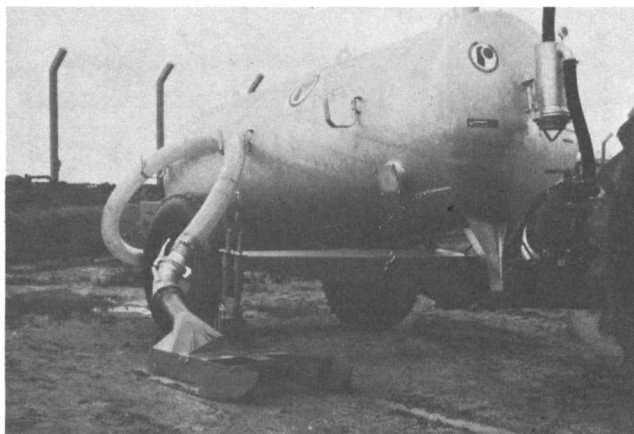


Figure 12. Polluge—suction head adapted to a vacuum tank trailer

to this work: the pumping dredgers and the small coastal oil tankers. CEDRE has studied a recovery device which has been designed specifically to be used on an oil tanker, the high sea ESCA (Figure 7).

Although the use of booms in high seas has generally met with skepticism, during the Castor tests which were done with the Navy, CEDRE was able to verify that under certain conditions the use of booms can be undertaken. This could be to encircle a localized source of pollution or to increase an area which is swept by a recovery device.

Treatment of oil spills by dispersants. Although a recovery at sea is preferable, unfavorable weather conditions and an emergency situation may make it necessary to spray dispersant products. The French point of view is a compromise between the two extreme solutions, which are on one hand the refusal to use any dispersants and on the other hand using them as a privileged response method.⁵

The dispersants approved in France are mildly toxic, and their massive use in coastal areas may have dangerous consequences for the environment. A geographical limit at sea has therefore been determined, beyond which it is possible in any case to use large amounts of dispersants without a major risk to the environment.

A program of tests at sea (PROTECMAR operations), directed by the French Petroleum Institute (IFP) has given essential data on the effectiveness of treatment methods, the behavior of treated oil, and on operational problems. It has been noted that the proper spraying of dispersants is a fundamental element in the effectiveness of their use. The spraying equipment which already exists on planes and light helicopters has been improved, and equipment better adapted to use with heavy helicopters (such as the Super-Frelon) and to shipboard application have been designed (Figures 8 and 9).

Use of sorbents and other products. If the research and investments have been oriented toward intervention in the case of a major inci-



Figure 13. Rolba—adapted screening machine for beach cleaning



Figure 14. Egmolap land scraper

dent, the recovery of small oil slicks also has been studied. A significant study program by CEDRE and the French Petroleum Institute has investigated the recovery of agglomerated slicks by trawling.

Laboratory tests and tests at sea have identified a selection of floating sorbents, perfected dissemination systems for the sorbents, and developed the SEYNIP trawl nets, several units of which were purchased by the French Navy. In the case of an oil spill, these means will be put into action by fishing vessels which are accustomed to installing trawl nets.

In the same way, field and laboratory experiments have enabled an assessment of other antipollution products such as gelling agents, demulsifiers, and sinking agents.

Confinement and recovery in a coastal area. Protection of particularly sensitive areas is a priority. French authorities have at their disposal more than 35 km of booms to ensure this protection. Technical specifications which define the qualities and expected performances of the coastal protection booms have enabled the selection of three types of booms: the Balear 335 filled with expanded plastic foam (Figure 10), the self-inflating TMB Offshore (Figure 11), and the inflatable boom Polluguard.

Numerous exercises which are systematically carried on along the French coastline with the assistance of the Technical Service of the Lighthouses and Buoys have enabled verification of the validity of the boom deployment plans and training of the antipollution personnel in installing the protective booms.

However, a protection program without a simultaneous recovery program is an inefficient operation. In the field of coastal recovery, a national effort has enabled the improvement of two existing devices, the Egmopol and ESCA barges, and the use of the Sirene 20 towed by coastal vessels or anchored in rivers or big estuaries subject to



Figure 15. Selective oil recovery roller



Figure 16. Portable vacuum tank VIP

currents. In addition, studies have been conducted for pumps adapted to viscous products (such as the EGMO W. pump).

Finally, as we previously mentioned for the treatment of oil spills at sea, products such as sorbents could also be used in coastal areas. Research has indeed been done in selecting the most efficient sorbents and in improving the conditions under which they are used, especially to protect zones which are ecologically sensitive such as coastal salt marshes.

Oil recovery on shore. The coastal cleaning operations which were done after the *Amoco Cadiz* and *Tanio* accidents were able to show the limits of traditional techniques based on manual recovery and the use of agricultural or public works equipment. A priority has been given to the development of new collection equipment which is more productive and more selective, therefore limiting the quantity of waste products.^{4,6}

The study of the problem took two directions: (1) improvement of existing pumping and collection equipment through design of a suction head which could be adapted to an agricultural vacuum tank trailer (Polluge, Figure 12), and adaptation of screening for beach cleaning machines (Rolba, Figure 13) for continuous removal of old oil products; and (2) designing specific equipment such as a device adapted to a front-end loader which permits to scrape up oil on the sand or in water, and to separate it from water (Egmolap land scraper, Figure 14), and the perfection of a selective roller which is hitched to a tractor and which can pick up the oil deposited on sand (Figure 15).

Furthermore, the efficiency for collecting oil in hardly accessible zones has been improved thanks to the design of light-weight, easily maneuvered and easily carried equipment such as the individual vacuum tank VIP (Figure 16).

Restoration of polluted zones. In order to eliminate pollution which

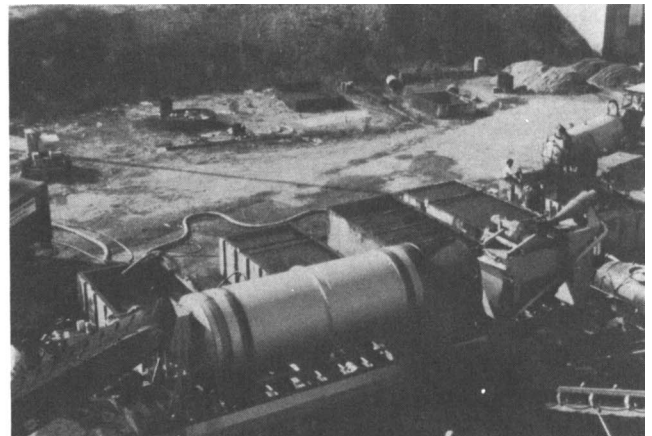


Figure 17. Mobile cleaning unit for polluted sand

remains in the sand after the cleaning operations, diverse techniques such as underwater polluted sand washing have been tested with success.

In addition, rock cleaning operations which were done during the *Amoco Cadiz* and *Tanio* cleanups permitted tests of cleaning techniques (cleaning with high pressure hot water jets) and improvements in the use of these techniques.¹⁰ Several tests, conducted since 1980, also permitted a selection of efficient cleaning products with low toxicity.

Storage of polluted waste. Studies regarding intermediate storage of waste have led to more rational techniques, and better adapted equipment has been designed such as flexible storage basins.

Criteria that have to be taken into consideration for a choice of temporary storage sites have been defined, and used in determining a national inventory of sites at which recovered waste could be dumped.

Waste treatment. The spills which have occurred on the French coastline have given a good basis for study of waste treatment and in particular the improvement of a quicklime treatment for solid residues.

A mobile polluted sand washing unit (Figure 17) which can be moved close to the beach, was designed and tested in 1985. This equipment enables return of the washed sand to the beach, avoiding transportation costs.

The policy of stockpiling pollution products and equipment. Development, adaptation, and evaluation of antipollution equipment has enabled the selection of equipment best suited to the desired goals. The French Government is involved in a comprehensive acquisition program for this equipment in order to respond more quickly and more efficiently to major oil spills. For this reason two types of stockpiles have been created (Figure 18).

- Stocks of products and equipment for antipollution interventions at sea are created and managed by the French Navy in each Maritime Region. They are composed of lightening equipment, high sea and port recovery devices, booms, floating tanks and dispersants, sorbents, and sinking agents as well as the necessary equipment for their application.
- The management of the products and equipment for a land antipollution intervention is under the responsibility of the Direction of

Table 1. Antipollution equipment stored by French authorities

Means stored by the French Navy (as of March 1, 1986)	Means stored by the Secretary of State for the Sea (as of April 15, 1986)
<ul style="list-style-type: none"> • 5,305 m of booms • 16 flexible floating tanks • 4 coastline recovery devices • 16 high sea recovery skimmers • 2,155 m³ of dispersants • 229 tons of hydrophobic chalk • 195 tons of sorbents 	<ul style="list-style-type: none"> • 36,085 m of floating booms • 36 recovery devices • 19 storage tanks • 5 beach cleaning machines • 521 hot water pumps • 4 cold water pumps • 98 emptying pumps • 250 m³ of dispersants • 94 tons of sorbents

Ports and Maritime Navigation by the Secretary of State for the Sea. The equipment is distributed along the coastline in: eight storage centers for the booms, bringing the total length to more than thirty-five kilometers (as opposed to less than fifteen in 1980) and enabling a rapid protection of zones exposed to pollution; and two centers for land cleaning operations (recovery devices, hot water pumps, small scale equipment) in Brest and Marseilles.

Table 1 shows the importance of the equipment stored in the above mentioned stockpiles.

During the antipollution operations, consignment of this equipment to a polluted zone is decided on a central level by the Direction of Defense and Civil Security of the Ministry of the Interior, after approval by the Direction of Ports and Maritime Navigation.

In addition to this equipment there is also that which belongs to the local communities (such as beach cleaning machines), to the petroleum companies with coastal installations, and to other private enterprises.

Personnel training and antipollution exercises. In order to obtain peak effectiveness, the various antipollution agencies on land and at sea have undertaken training programs for personnel who would be involved in pollution operations.

Personnel training can also be achieved while testing an intervention plan during exercises simulating real examples of pollution. In this way, every year the coastal booms from the storage centers of POLMAR equipment are put at the disposal of other services in the framework of an exercise program intended to implement departmental protection plans for the coast.

Also, the conditions for a simultaneous implementation of the POLMAR-MER and -TERRE plans are re-verified every year during the INTERPOLMAR exercises, jointly organized by the Third Maritime Region, and the Prefects of one or several Mediterranean coastal departments.

Finally, let us remember that the various field experiments at sea or on the coastline performed in order to assess and improve the ways and means of an antipollution offensive are also occasions for training antipollution intervention personnel.

Conclusion

Eight years after the *Amoco Cadiz* shipwreck and six years after that of the *Tanio*, France now has a large task force at its disposal in the field of combating accidental oil pollution.

The strength of France's antipollution effort is based first and foremost on the prevention of accidents, thanks to the powerful means of towing which have been installed by the French Navy, and also to the personnel of the CROSS and semaphores who constantly monitor the entire coastline to ensure that the rules of navigation are respected, especially by the vessels transporting petroleum products or dangerous chemical substances.

In addition to the prevention of accidents, an organization for combating major pollution, both at sea and on land, has been established.

This organization takes shape when the POLMAR-MER and -TERRE plans are set into motion in the case of a foreseeable disaster; the efficiency of the plans is systematically reviewed during appro-

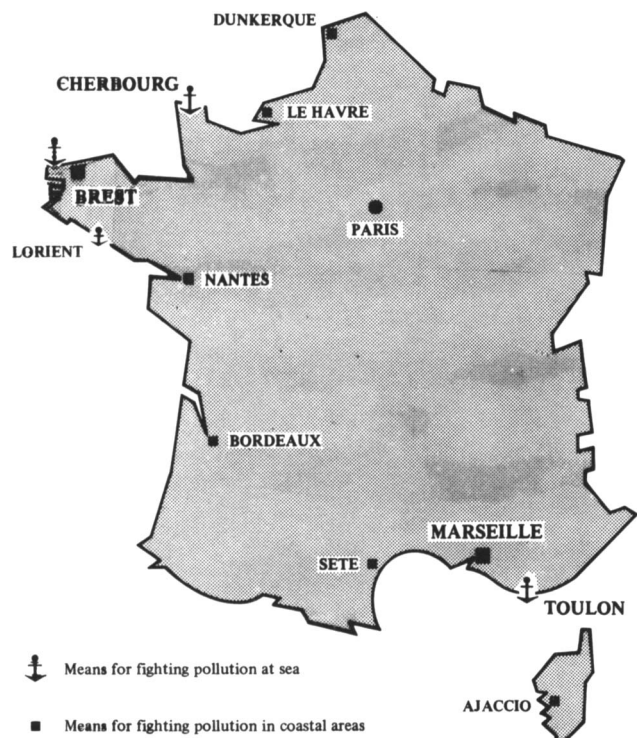


Figure 18. Location of French antipollution equipment storage centers

priate tests. At the heart of the antipollution organization there is a stock of specialized equipment. This equipment is provided to deal with all the aspects of an antipollution response and is to be used by trained personnel. The equipment has been, in most cases, designed, tested and evaluated by CEDRE in close cooperation with French industry.

If the research which deals with equipment is continuing, notably in the field of lightening petroleum tankers and in dispersant spraying techniques, it is also to be noted that efforts are being made in the field of technological awareness.

This suggests that the large research program carried out by CEDRE and its partners during the past eight years has practically achieved its goals and from now on will be focused on the conditions for optimal use of the material and on training of skilled antipollution personnel, to be organized by the appropriate French authorities.

Despite the imperfections of the French organization and technology in the antipollution field, on an international level it seems that the French program is in an excellent position.

This fact is without a doubt related to the already long and unhappy history of our country in dealing with accidental oil spills. As a result of experience, France has developed an exceptional competence and know-how in preventing maritime accidents and in combating pollution.

It is this particular "savoir-faire" which France wishes to make known on an international level and, if necessary, share with other countries.

Acknowledgments

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