



# Risk assessment associated with shipping operations in UK waters

September 2003

## RATIONALE

The UK has over 15,000 kilometres of coastline, which is exposed to the potential hazards associated with shipping operations. The Department for Transport (DfT) states that 95% of the UK trade by weight leaves or arrives by sea. DfT statistics also show that in 2001 there were 154,434 ship arrivals at UK ports, with many additional ships in transit around UK waters. Between 1999 and 2003 - 39 collisions, 43 groundings and 33 fires on vessels over 100 gross tonnage occurring in UK waters were reported to the Marine Accident Investigation Branch (MAIB) of the UK government. Recent statistics from the Maritime Coastguard Agency show that in 2002 there were 846 ship related oil pollution incidents in UK waters, which accounted for 16 percent of ship related incidents. This is a cause for public concern.

As a consequence there is widespread recognition that sensitive parts of the coastline need to be identified as areas of high-risk and offered special protection from shipping impacts. By conducting a risk assessment exercise of coastlines or areas of coastline it is possible to identify areas of high vulnerability and sensitivity, and to consequently take appropriate steps to minimise risk to these areas. Shipping designations such as Particularly Sensitive Sea Areas (PSSAs) and the introduction of Marine Environmental High Risk Areas (MEHRAs), coupled with specific associated protective measures (APMs), consequently provide an important suite of tools to achieve this aim and urgent action is needed.

## Definitions of shipping designations

The International Maritime Organization's (IMO) Resolution A.927(22): Guidelines for the Designation of Special Areas under MARPOL73/78 and Guidelines for the Identification and Designation of Particularly Sensitive Sea Areas defines a Particularly Sensitive Sea Area (PSSA) as:

“An area which needs special protection through action by IMO because of its significance for recognised ecological or socio-economic or scientific reasons and which may be vulnerable to damage by maritime activities.”

The Donaldson Report (1994)<sup>[1]</sup> defined MEHRAs as:

“Comparatively limited areas of high sensitivity which are also at risk from shipping. There must be a realistic risk of pollution from merchant shipping.”

The definition of MEHRAs therefore introduces the concept of ‘realistic risk’.

## RISK ASSESSMENT AND SHIPPING

Risk assessment is a process that evaluates how likely it is that a set of hazardous circumstances will arise and estimates the potential consequences. Risk management will then determine the tolerable level of risk and consider how it can best be avoided or controlled. In ‘Guidelines for Environmental Risk Assessment and Management’ (2000)<sup>[2]</sup> the UK government drew on definitions of hazard and risk produced by the Royal Society as follows:

Hazard:	a property or situation that in particular circumstances could lead to harm
Consequence:	the adverse effects or harm as the result of realising a hazard which causes the quality of human health or the environment to be impaired in the short or longer term
Risk:	a combination of the probability or frequency of occurrence of a defined hazard and the magnitude of the consequence of the occurrence
Risk estimation:	the outcome or consequence of an intention [risk impact], taking into account the probability of occurrence
Risk evaluation:	determining the significance of estimated risks for those affected
Risk assessment:	consists of risk estimation and risk evaluation
Risk management:	the process of implementing decisions about accepting or altering risks based on assessment of various costs and benefits.

The methodology is really only appropriate to shipping management when considering low frequency/high impact events such as major spills associated with collisions and groundings rather than smaller more frequent operational incidents.

Shipping hazards (what can go wrong and why) are particularly related to:

- The number, type and size of vessels passing and the nature of their cargoes;
- Crew competency;
- The distance of the usual shipping lanes from the shore;
- Any circumstances giving rise to an increased risk of collision such as a significant amount of traffic going across the normal flow;
- Hydrological conditions relevant to safe navigation, such as lack of safe anchorages; and
- Prevailing meteorological and tidal characteristics.

The level of likelihood of these hazards causing incidents (frequency) must be drawn from historical records, incident reports and statistics, traffic patterns and expert advice supported by technical judgement of conditions affecting safety of navigation. Safety research has shown that human factors account for some 80% of marine incidents, with busy ports and choke points, such as seaward approaches recording the highest incident rates.

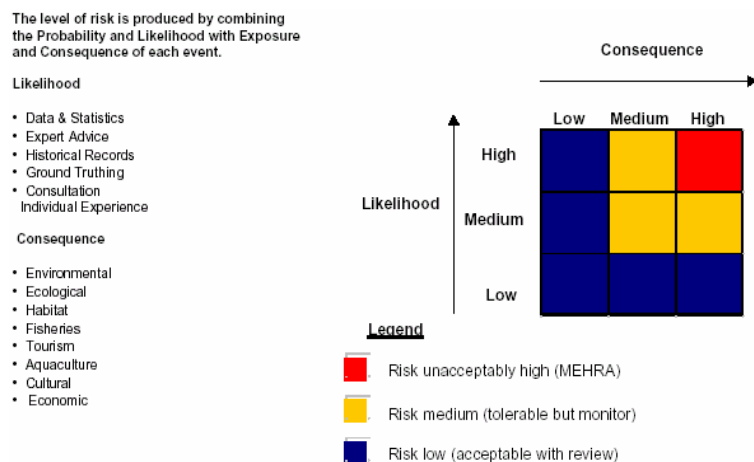
The consequences of shipping impacts, in terms of how much harm can be caused, must be considered in terms of both:

- Ecological vulnerability – high biodiversity, high productivity, presence of endangered and / or unique species etc; and
- Socio-economic vulnerability – fisheries, tourism, marine-related employment, archaeology and other cultural assets

Variability will be introduced according to the volume and nature of pollutants, weather conditions and ease or difficulty involved with remediation. The extent of vulnerable areas, their uniqueness and whether or not they might be able to recover from a pollution incident are important contributory considerations.

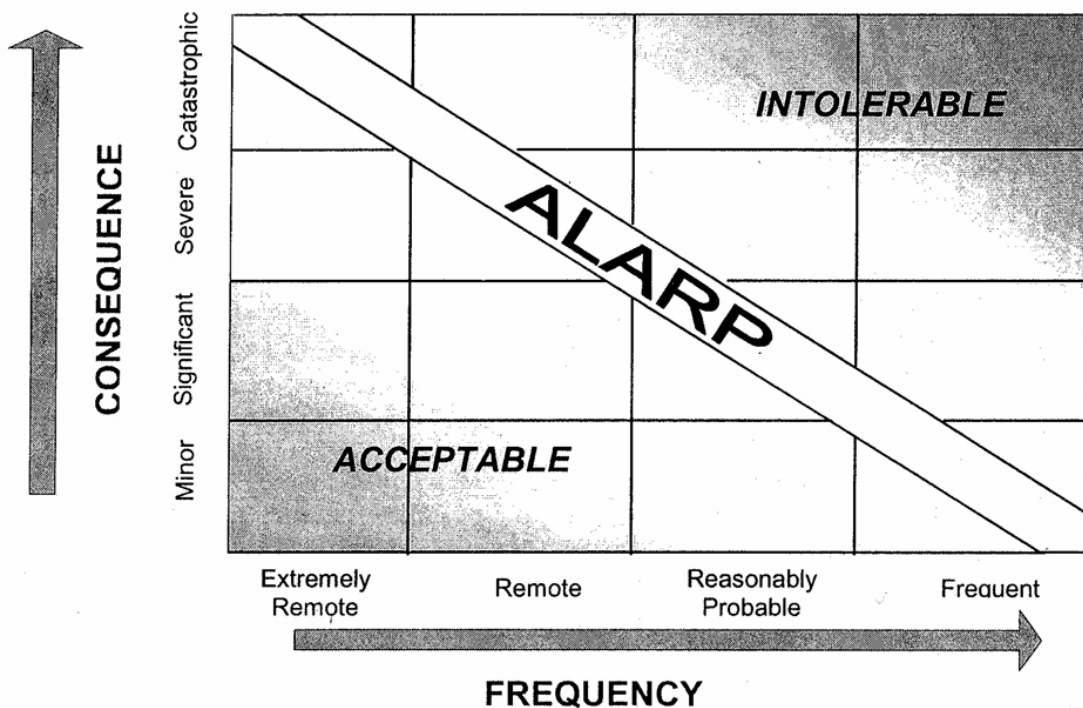
Risk estimation combines hazard probability (or likelihood) and magnitude of the consequence as illustrated in Figure 1 taken from the oil spill risk assessment for the coastal waters of Queensland and the Great Barrier Reef Marine Park (2000)<sup>[3]</sup>

Figure 1: Risk Assessment Matrix used at Great Barrier Reef Marine Park



In the context of shipping, ‘realistic risk’ is addressed in the Donaldson Report (1994)<sup>[1]</sup>. The shipping industry will always involve some hazards and it is important to define their acceptability. The ‘As Low as Reasonably Practicable’ (ALARP) matrix is a method for assessing acceptability of the frequency and consequence of a particular hazard. It is recognised by IMO guidelines and has been used by the Port of London Authority in their 1999-2001 Operational Risk assessment<sup>[4]</sup>. The ALARP principle reflects there may be a number of risks that should only be tolerated if risk mitigation measures that are in place provide risk reduction.

Figure 2: The ALARP Matrix



Risk mitigation can be achieved, in part, through the designation of PSSAs and MEHRAs and associated protective measure such as areas to be avoided; traffic separation schemes; deep water routes; no anchoring areas; special discharge restrictions; pilotage requirements; mandatory reporting and special innovative measures to address specific problems.

However, the shortcomings of this methodology should also be noted. It relies on comprehensive datasets, the selection of appropriate criteria and overlooks both the majority of operational incidents and many unreported ‘near misses’. A conservative approach should therefore be taken when making assessments. Furthermore, to be effective, risk assessments must be dynamic processes, and will need periodic updating and refining to factor in any changing circumstances and new information such as the most recent incidents.

## RISK ASSESSMENTS AND SHIPPING DESIGNATIONS IN THE UK

Identifying PSSAs and MEHRAs requires the determination of the relative risk between different geographic locations by relating potential for accidents to the value and sensitivity of marine and coastal resources.

### Atlantic Coasts and Channel PSSA

A proposal to designate certain parts of Western European waters as a PSSA was submitted to the IMO in 2003 by six European nations including the UK. Initially two APMs were proposed – banning single hulled tankers carrying heavy oils through the PSSA and mandatory reporting for double-hulled tankers carrying these products. Future additional APMs were also alluded to. The area under consideration covers the Western coasts of the UK, Ireland, Belgium, France, Spain and Portugal, from the Shetland Islands in the North to Cape Vicente in the South, and the English Channel and its approaches. It includes two international Straits – Dover/Pas de Calais and the Fair Isle Channel. WWF submitted supporting information to this proposal and made the case for an extended area to include the Irish Sea, the waters of West Wales, and the east coast of Scotland and England to East Anglia.

The case was made for this candidate PSSA (cPSSA) on the basis of ecological (with particular attention to the presence of deep water corals), fisheries and recreational importance. Vulnerability was established with reference to the most significant concentration of major oil spills over a sustained period (see Annex 1). The proposal was further informed by shipping density analyses plotted by Anatec<sup>[5]</sup> using six months of Voluntary Observing Ships (VOS) data. The area concerned accommodates some 82,000 ships annually, which equates to 230 vessels per day, one of the world's most significant shipping areas by volume. In addition to volume of traffic, cargoes carried, standards of vessels and natural factors contribute to high risk levels. Extensive protective measures are already in place.

The 49<sup>th</sup> session of the Marine Environmental Protection Committee (MEPC) accepted the PSSA proposal in principle with one associated measure, mandatory reporting for certain vessels, but did not include the wider area suggested by WWF. This decision was made following deliberations by an informal technical group, after which the northern boundary of the area was reduced and the proposed single hull carriage ban withdrawn. Questions are also pending at forthcoming Legal and Navigation Sub-Committee meetings. Whilst sufficient consensus was achieved to support the revised proposal, significant concerns were expressed including the potential effect of this PSSA to transfer risk outside the area, economic impacts on adjacent States and problems relating to the area's size and complexity. Strong opposition was voiced by Russia, Panama, Liberia, Argentina and the industry.

### UK MEHRAs

In 1993 the *Braer* spilled 85,000 tonnes of oil resulting in the death of an estimated 32,000 seabirds and compensation payments of £52 million. Oil settled in the sediments and badly polluted the Fair Isle Channel closing the langoustine fishery. Lord Donaldson's report (1994), in response to this incident, made detailed recommendations intended to improve safety and

environmental protection. These included the identification and further protection of relatively small but sensitive areas, such as the entrance to Strangford Lough in Northern Ireland, as MEHRAs. Such areas would be identified on the basis of a combination of environmental sensitivity and vulnerability (level of tanker activity, navigational difficulties, hazardous cargoes) to shipping impacts.

A press release from the House of Commons highlighted the lack of any action to further the concept of UK MEHRAs and attributed it to the UK Government's ratification of the 1989 Salvage Convention and accession to protocols increasing liability and compensation limits. Public emotions were further raised by the *Sea Empress* disaster in 1996, with a further set of recommendations, implementation of which has been painfully slow<sup>[6]</sup>. Eventually in 1999 a DfT commissioned risk assessment, produced by Safetec UK<sup>[7]</sup>, identified a proposed methodology to establish MEHRAs in the UK. The analysis identified main pollutant groups (based on MARPOL categories of pollutants), and their source (based on shipping traffic and recognised accident models, calibrated against historical accidents in UK waters) and the sensitivity of UK waters in terms of environment and socio-economic factors (wildlife, landscape, amenity/economy, geology, fisheries). This information was then used to give a rationale as to why some areas are more vulnerable than others. Limitations and assumptions were acknowledged. For example, operational pollution was not considered and the traffic database used did not include non-routine traffic such as naval vessels, fishing vessels, pleasure craft or offshore traffic transiting to mobile drilling units. Potential MEHRA sites were identified which, as recommended by the Donaldson Report, total no more than 10 percent of the UK coastline.

Consultation was undertaken on the methodology of this analysis but not the potential location of MEHRAs. NGOs responded to the consultation highlighting concern regarding the results, particularly with respect to inadequate representation of those areas of the highest environmental and amenity value. The criteria used were objective but crude. In particular the Computer Assisted Traffic database (COAST) used nature conservation designations to denote wildlife importance, rather than considering ecological sensitivity or resilience to pollution. The importance of archaeological features, fundamental tidal characteristics and the effects of pollution on benthic communities, fish spawning areas, sea mammals, seabirds at sea and the sensitivity of estuarine environments was omitted.

Following this consultation an inter-departmental government group have considered additional traffic surveys and reviewed potential routeing measures aimed at moving vessel traffic away from potential MEHRA sites. Potential measures include Traffic Separation Schemes, Deep Water Routes, areas to be avoided, greater use of tugs and available salvage vessels located at key coastal points, the availability of more oil pollution response equipment and promulgation of educational materials for mariners. Concerns remain that MEHRAs without any of these measures or investment in the additional resources they demand will merely be considered as 'paper tigers'. Furthermore, there has been no debate on how MEHRA 'designation' will be communicated to the shipping community.

In parallel with the 1999 Safetec UK report complementary work by Cardiff University<sup>[8]</sup>, commissioned by TWT and WWF, evaluated a risk assessment of shipping in four environmentally sensitive areas in UK waters. The vulnerability of each area was established

and results incorporated into a risk assessment for shipping. The report considered West Wales, North West Scotland, The Shetland Islands and North East England. It rated West Wales and North West Scotland as highest on the risk sensitivity scale as illustrated in the following case studies.

## CASE STUDIES

### South West Wales

The West Wales area can claim high environmental sensitivity. It supports high marine and coastal biological diversity with varying habitats such as estuaries, reefs, shallow inlets, rocky shores, mudflats, saltmarshes and vegetated cliffs. Marine waters support harbour porpoise and resident bottle-nosed dolphin populations as well as lesser known species of corals, jewel anemones and sea fans. There are many Sites of Special Scientific Interest and the area is a major migratory flyway between the Arctic and the African, Mediterranean and southwest European coasts. It includes the Pembrokeshire Coast National Park, as well as marine nature reserves located on Skomer Island and Special Areas of Conservation in Cardigan Bay, Camarthen Bay and Pembrokeshire marine area. It is a popular recreational sailing area and is fished extensively.

The area is vulnerable to shipping given that it is one of the windiest coastlines in the UK, with a strong tidal stream running at two knots. Oceanographic conditions in the area can make navigation difficult and whilst various traffic management measures have been put into place to attempt to reduce shipping impacts, crossing traffic and high speed ferries create added problems.

Milford Haven was one of the first ports to accept oil tankers, and has suffered from attendant environmental problems, most notably the grounding of the *Sea Empress* in 1996. The Cardiff report identified West Wales as having the highest number of tanker incidents and the second highest number of reported oil spills each year of its four case studies. The vulnerability statistics, combined with the environmental value criteria, support the case for this area to be a candidate MEHRA and/or to be within the Atlantic Coasts and Channel cPSSA. Within the Cardiff Report APMs were put forward for consideration, included an ATBA around Skomer and Ramsay extending to the TSS, an extension of compulsory pilotage further offshore, mandatory reporting and adoption of Pilotage Passage Plans by Milford Haven Port Authority.

### North West Scotland

Northwest Scotland is one of the least industrialised and most pristine areas in the UK. It is recognised for its extensive natural beauty and scientific interest and supports fish and shellfish farms that are vital to the local economy. It contains 270 named islands only 41 of which are permanently inhabited. The highly indented coastline exhibits many small sandy bays, cliffs and beach platforms, tidal flats, estuaries, shallow bays, sea lochs, fresh water lochs and lagoons, which support high levels of biodiversity. Important ecological species include seabirds, shorebirds, seals, otters, rare lichens and flowering plants. The almost unique Machair dunes are found in the area.

This area includes the St Kilda World Heritage Site and the Biosphere reserves of Loch Druidibeg, Rum and St Kilda. There are two RAMSAR Sites and nine Specially Protected Areas. There are also 18 proposed Special Areas of Conservation, 121 Sites of Special Scientific Interest and National Nature Reserves. It is an area of high cultural heritage that is extensively used for recreation and tourism as well as education and scientific research.

The area is on the preferred navigational route from Shetland or Norway to Milford Haven and is often used as a short cut by vessels rather than taking the Deep Water Route to the west of the Isle of Lewis. In 1993 the UK government proposed that no tankers over 10,000gt should use the Minch (a proposal subsequently adopted by IMO). However, this is not compulsory, the effects of this voluntary measure have yet to be evaluated, and it remains a recognised route lacking regulatory measures to control shipping movements. Hazards include poor visibility, strong tidal streams, high and turbulent seas, irregular depths within Little Minch and areas outside the Deep Water Route remain incompletely surveyed. Pollution is difficult to remediate as the area's waters have a very long residence time caused by maximum tidal rates of one knot.

The Safetec UK study showed this area as having the highest density of 'very high' and 'high' environmental sensitivity amongst the coastal and sea cells identified, yet it failed to meet the study's MEHRA test due to lack of shipping traffic. But information provided in the Cardiff report<sup>[7]</sup> showed that 691 tankers transit the North West Scotland areas annually with an incident ratio of 1:1146 and an oil spill ratio of 1:30, usually caused by stranding or groundings. When compared to the statistics from West Wales, whilst the incident ratio is lower, there is a higher risk of an oil spill. Thus the Minches has a low number of tankers and a low number of incidents, but a high number of oil spills with one occurring for every 30 vessels.

On this basis northwest Scotland is also considered to be a key candidate PSSA/MEHRA location. APMs proposed for consideration by the Cardiff report were to make the Inner Minch an ATBA for all vessels above 10,000gt, compulsory pilotage and mandatory reporting.

## CONCLUSIONS

Risk assessments provide an opportunity to take an objective, holistic overview of the environmental impacts of shipping and can therefore contribute to an ecosystem-based approach to marine management. Inevitably an element of 'expert judgement' is involved in risk estimation but an adaptive and flexible approach is needed, resulting in proactive informed decisions based on hard evidence and responding appropriately to public expectation. Prevention must replace clean up, not least because long-term effects of pollution are poorly monitored and damage to the sea-bed is largely unknown. Risk assessment should drive proposals for APMs, thus creating location specific solutions. In this respect the UK would do well to draw from international experience e.g. Great Barrier Reef (GBR) wide-ranging review of existing measures and associated risks.

The candidate Atlantic Coasts and Channel PSSA has been defined on the basis of succession of past accidents. Trans-boundary inter-governmental proposals of this nature are an appropriate use of PSSA designation and could serve to co-ordinate pan European contingency planning. However, the EU collective proposal to ban single hulled tankers was in particular a reaction to

irrevocable damage inflicted by the 21 million gallons of fuel oil spilled by the *Prestige* and will be pursued as a separate agenda. Previously proposed APMs have not been ship type specific but have been directed at potential impacts of shipping per se.

Key environmental areas within UK territorial waters remain at risk following a decade of procrastination since the Donaldson Report. Disagreement over weightings and a lack of any critical analysis of the Safetec UK risk assessment by the government is cause for concern. This methodology has under-rated local environmental interests and more complex, port specific situations. Failure of the methodology to identify some of the most sensitive and least protected marine areas casts further doubt on its validity. Why protect only 10% of the UK coastline if more is at risk? An independent study highlights West Wales and NW Scotland (Minches) as urgent priority areas both within and outside *cPSSA* but the DfT are likely to focus on east-coast sites that fall outside the *cPSSA* rationale.

UK political commitment to MEHRAs is welcomed but action is long overdue. Proposals for operating and monitoring MEHRAs as well as delineation need collective resolution and there is a need to debate protective measures at the earliest opportunity. It is likely that some proposed MEHRAs will already have comprehensive APMs, but designation will at least signal vulnerability/sensitivity. The current level of uncertainty reinforces a need to match attendant measures to specific needs. Thus further consideration of risk reduction through emergency response coverage, identification of vessels through AIS transponders, routing advice and information for insurers and charter crews, combined with proper inspection of older vessels is essential.

#### Recommendations

- Risk methodology must be credible and based on up-to-date inclusive data. Protection should be based on the size and needs of the ecosystem.
- The Atlantic Coast and Channel *cPSSA* requires significant further refinement. This includes more work to substantiate key areas of biological and socio-economic importance and to review boundaries. There is a further need to re-establish what the *cPSSA* can achieve given that major APM has been dropped, and scope exists for additional APMs. In short a detailed technical and scientific review is required. Within this further consideration should also be given to WWF's recommendation for a comprehensive risk map recognising the special characteristics of discrete areas within the *cPSSA*, supported by appropriate cost-benefit studies.
- Uncertainty about the effectiveness and timescale for implementation of the *cPSSA* places even more urgency on plans to establish MEHRAs at strategic locations around the UK coastline. These must be in the most vulnerable areas at highest risk. Limited consultation on any government proposals will devalue this initiative and may lead to a sub-optimal solution. Thus NGOs must maintain pressure to be allowed to make an informed input. More work is needed to substantiate the economic advantages of added protection. This requires research into contingent valuation of site specific coastal and marine assets such as fish farms and important tourist beaches.

- IMO endorsement of any APMs in MEHRAs should be sought. In this respect MEHRAs provide an opportunity to be innovative. Thus, for example, the UK should consider stricter standards as a condition for entry for ships calling at ports within MEHRAs as permitted by UNCLOS article 211.3. APMs could include discharge restrictions, cargo transfer requirements, and seasonal closure of routes to protect migrating mammals. Links should be made to the nature conservation agenda established by Habitats Directive that requires Special Areas of Conservation to be maintained in 'favourable status'. Enabling the establishment effective stakeholder partnerships within MEHRAs, as has been achieved in UK estuary areas, is also a priority.

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**Annex 1: Extracted from Identification and Protection of Special Areas and Particularly Sensitive Sea Areas document (MEPC 49/8/1 (Annex 2))**

**MAIN MARITIME ACCIDENTS HAVING CAUSED ENVIRONMENTAL DAMAGE  
IN THE WESTERN EUROPE MARITIME AREA**

	Date	Location	Circumstances	Quantity spilled	Consequences or marine environment
Anne Mildred Brovig (Norway)	20/02/1966	Germany		16 800 tons of oil	
Torrey Canyon (Liberia)	18/03/1967	Sorlingues Island (English Channel)	grounding	119 to 121000 tons of oil	Oil spills polluted Cornwall coasts and French coasts of North Brittany
Jacob Maersk (Denmark)	29/01/1975	Portugal		44 000 tons of oil	
Olympic Alliance (Liberia)	12/11/1975	English Channel		10 000 tons of oil	
Olympic Bravery	24/01/1976	Ushant (West Channel)	Grounding	1200 tons of oil	Pollution of Ushant island shores 400 tons removed from the wreck by pumping
Urquiola (Spain)	12/05/1976	Spain		101 000 tons of oil	
Boehlen (Germany)	15/10/1976	Sein Island (West Channel)	Wreck in bad weather	7 000 tons of oil	Sein Island polluted 2500 tons removed from the wreck by pumping
Amoco Cadiz (Liberia)	16/03/1978	North Brittany (France)	Steer failure	230 000 tons of oil	360 km of shores polluted in West and North Brittany 260 000 tons of marine species and sea birds killed in the few months following the spillage 6 to 7 years have been needed to fully restore the marine environment damages assessment : 534 millions Euros
Eleni (Greece)	06/05/1978	North Sea		5 000	
Andros Patria (Greece)	31/12/1978	Off Cape Finisterre (Spain)		47.000 tons of oil	
Peter Sif	15/11/1979	Ushant (France)		102 000 litres of oil	130 000 litres of oil removed from the wreck in 1998
Gino (Liberia)	28/04/1979	Off Ushant (France)	Collision with merchant vessel	41.000 tons of oil	
Tanio (Madagascar)	7/03/1980	Off North Brittany (France)	Hull break in bad weather	6 000 tons of oil	150 km of shores polluted 65 millions Euros of indemnities granted
Cason (Panama)	5/12/1987	Cape Finisterre (Spain)	Grounding	1100 (chemical goods)	
Amazone (Italy)	31/03/1988	Ushant (France)		3 000 tons of oil	
Sea Spirit (Cyprus)	8/8/1990	Straits of Gibraltar	Collision with gas carrier	8000 tons of oil	Moroccan shores polluted
Nordfrakt	1992	Wreck due to cargo slipping			Wreck and cargo refloated
Aegean Sea (Greece)	12/03/1992	In the vicinity of La Coruna (Spain)	Grounding when in port manoeuvres	80.000 tons of oil	200km of shores polluted
Sherbro	1993	English Channel	88 containers lost at sea	188 000 packs of toxic substances	Three containers with toxic goods dismantled and their cargo were removed on the coast for several months
Braer (Liberia)	5/01/1993	Shetlands Islands	Engine failure	85.000 tons of oil	Shetlands Islands shores polluted
Allegra	1997	Off Guernsey Island	Collision with merchant vessel (fog conditions)		12 tons of oil came on shores
Sea Empress (Liberia)	15/02/1996	Close to Milford Haven port (the United Kingdom)	Human error when in port manoeuvres	73 000 tons of oil	
Erika	12/12/1999	West Brittany (France)	Hull Break in bad weather	20 000 tons of oil.	400 Km of French coasts polluted 60 000 seabirds died 11 000 tons of hydrocarbons removed from the wreck
Ievoli Sun (Italy) Chemical tanker	31/10/2000	Off Guernsey Island (Central Channel)	Hull Break in bad weather	6.000 tons of chemical goods	
Balu (Malta) chemical tanker	20/03/2001	Bay of Biscay	Wreck	8000 tons of chemical goods	
Prestige (Bahamas)	13/11/2002	Off cape Finisterre (Spain)	Hull Break in bad weather	15 000 tons of oil	Pollution of French coasts
Tricolor		Détroit du Pas-de-Calais	Collision with merchant vessel		Pollution of French and Belgian shores