行政院所屬各機關因公出國人員出國報告書

（出國類別：研習

參加「中法環保合作計畫－海洋污染講習觀摩計畫」
出國報告書

服務機關：行政院環保署
出國人 職　稱：技　正
姓　名：孫鴻玲

出國地點：法國巴黎、布雷斯特、馬賽
出國期間：民國九十一月六月八日至六月二十四日
報告日期：九十一年六月二十七日

行政院研考會/省（市）研考會
編號欄

I5/C09102779

參加「中法環保合作計畫－海洋污染講習觀摩計畫」

出國報告

時　　間：九十一年六月八日至六月二十四日

地　　點：法國巴黎、布雷斯特、馬賽

出國人員：孫鴻玲技正，行政院環境保護署水質保護處

報告日期：九十一年六月二十七日

壹、報告摘要：

「中法環保合作計畫－海洋污染講習觀摩計畫」係配合法國已有二十五年歷史 INFOPOL 計畫主辦單位設備運輸暨住屋部（DTMPL）的邀請，並透過中法環保合作計畫由我方派員出席。該活動共有來自阿爾及利亞（Algeria）、沙烏地阿拉伯（Saudi Arabia）、智利（Chile）、象牙海岸（Ivory Coast）、法國（France）、黎巴嫩（Libanon）、馬爾他（Malta）、摩洛哥（Morocco）、卡達（Qatar）、辛納給亞（Senegal）、突尼西亞（Tunisia）及我方等十二個國家參與。

INFOPOL 計畫（海洋污染講習觀摩計畫）主要在促進各國分享有關海洋污染防治的最新國際趨勢（政策）、處理科技及經驗，並提昇國際間對海洋油污染災害的重視，希望藉由技術及經驗交流，共同保護海洋環境。各國參與學員大多為海事部門、港務單位及海軍等單位的官員代表，僅少部分為環境保護官員、石油公司代表、及大學教授；多由法國透過外交管道邀請各該等國海洋污染應變單位派員參與，並由法方支付受訓期間所有費用；其中來自民間石油公司代表，則需自費參與；我方則由行政院環境保護署水質保護處孫鴻玲技正代表參與，連續十多日的共同學習過程中，也拓展了與各國海洋污染應變體系各權責機構代表的溝通管道。

本次活動除了吸取法國海洋污染（包括油及化學品）體系設備及技術資源、海洋污染國際公約外，還觀摩布雷斯特（Brest）法國海軍的海上油污應變演練及港

灣油污演練，並參觀其海污器材倉儲（stockpile）、馬賽港港務局及消防隊在海洋污染工作的努力、廠商的海污應變器材操作介紹。由於法國的污染防治體系與我國非常類似，其海洋污染應變指揮分為海上及岸際兩大系統進行應變，應變方式也是利用各相關部會所長，將暨有資源進行整合，並補充不足之部分。其體系已發展二、三十年之久，很多整合及應變的經驗很值得國內主管海洋各項業務的單位多派員赴法國觀摩，並參與 INFOPOL 計畫。

貳、目錄

參、行程

六月八日(星期六)　啟程

21:00 抵達桃園中正國際機場長榮航空櫃檯辦理登機

BR：CMQAHG；　　AF：ZMS6AR

23:00 搭乘長榮航空 BR 75 班機由台北飛往荷蘭阿姆斯特丹　（波音 747-400，航程 16:40）

中途停靠泰國曼谷機場（BKK）候機

六月九日 (星期日) 啟程

09:40 抵達荷蘭阿姆斯特丹機場（AMS）

13:25 由阿姆斯特丹機場搭乘法國航空 AF 1441 班機由荷蘭阿姆斯特丹飛往飛往法國巴黎（空中巴士，航程 1:10）

14:35 抵達法國巴黎戴高樂機場（CDG）　搭車前往住宿飯店 Residence Richemont
17 rue Jean Colly, Paris 13 eme
Tel:　002-33 1 45 82 84 84;
Fax:　002-33 1 45 82 88 80;
Email: hotel.residence.richemont@wanadoo.fr

六月十日～六月二十二日

參加「海洋污染講習觀摩」活動

六月二十三日(星期日)　　返程

09:20 法國巴黎戴高樂機場（CDG）登機

19:30 搭乘法國航空 AF 2570 班機由法國巴黎飛往倫敦希斯洛機場（波音 737，航程 1:20）

19:50 抵倫敦希斯洛（LHR）機場

20:10 英國倫敦希斯洛（LHR）長榮航空櫃檯辦理登機

21:30 搭乘長榮航空 BR 班機 68 由英國倫敦希斯洛（LHR）飛返台北（波音 747，航程 16:30）

六月二十四日（星期一）　返程

21:00 抵達桃園中正國際機場

肆、觀摩內容

六月十日(星期一)

08:00 離開飯店 Richemont Hotel

17, rue Jean Colly 75013 Paris

Tel: 002-33 (1) 4582 8484

Fax: 002-33 (1) 4582 8880

09:00 開幕：Mr. Gille，Director，海事運輸港口暨海岸司（ＤＴＭＰＬ，Department of Maritime Transport, Ports and the Coast），設備運輸暨住屋部(Ministry of Equipment, Transport and Housing)

22, rue Monge 75005 Paris, Conference Room L406

09:15 代表團報告

Mr. Weizmann，計畫經理，國際合作

ＤＴＭＰＬ，設備運輸暨住屋部

10:00 法國有關污染應變的一般政策

Mr. Silverstre，海洋部門秘書長

11:15 有關意外污染事件船東的責任及損害賠償

Mrs. Odier，法律部門主任，法國船東協會（ＣＣＡＦ，French Shipowners Association）

12:30 午餐，由ＤＴＭＰＬ提供

14:00 法國政府在岸際污染事件的責任及活動

Mr. Vernier，海岸及公共海事室主任

ＤＴＭＰＬ，設備運輸暨住屋部

15:00 ＩＯＰＣ基金及賠償系統

Mr. Herbert，法律事務部門，經濟財務暨工業部（Ministry of Economy, Finances and the Industry）

16:00 MARPOL 73/78 公約－附錄一（待續）

Mr. Weizmann，計畫經理，國際合作

ＤＴＭＰＬ，設備運輸暨住屋部

17:00 離開前往 Paris-Orly-West 機場

18:50 離開前往 Brest（搭乘 AF 7370）

20:35 抵達 Brest，轉往飯店

Mercure – Continental Hotel

Square de la Tour, d'Auvergne 29000 Brest

Tel: 002-33(0)2 9880 5040

Fax: 002-33(0)2 9843 1747

六月十一日(星期二)

08:00 搭乘巴士離開飯店

09:00 開幕致詞暨 Cedre 報告

Cedre：水污染意外研究暨實驗文件中心，Center of Documentation Research and Experimentation on

Accidental Water Pollution

Mr. Girin，Director，Cedre

Mr. Rosseau, 應變準備部門主任，副經理，Cedre

Mr. Peigne, 應變部門主任，副經理，Cedre

09:40 污染應變領域的未來展望

Mr. Girin，Director，Cedre

10:10 中場休息

10:30 海洋及岸際污染應變的原則與策略

Mr. Rosseau, 應變準備部門主任，副經理，Cedre

11:30 法國政府在海洋污染事件的責任及活動

Mr. Velut，法國海軍

12:30 午餐

13:45 Cedre 技術設備的導覽

14:15 離開前往ＰＯＬＭＡＲ倉庫

14:30 導覽

15:45 離開前往 CROSS CORSEN 海難救援協調中心

16:15 導覽

18:00 回飯店

19:00 雞尾酒會，Cedre 提供

六月十二日(星期三)

08:30 搭乘巴士離開飯店

09:00 除油劑：應用的方法

在海洋與海岸帶使用除油劑的政策

Mr. Merlin，研究與發展部門主任，Cedre

10:20 中場休息

10:40 海洋及岸際圍堵及回收的策略觀－在 Erika 污染事件海上的國際合作

Mr. Peigne, 應變部門主任，副經理，Cedre

12:00 午餐

13:45 週四上午展示及佈施應變設備的介紹

Mr. Pinlou，法國海軍

14:15 「海洋應變/岸際應變」論壇

本論壇將著重於案例介紹，並討論油污染應變替代方案的預期效益，這些方案的建議及最近之科技發展，Erika 及 Ievoli Sun 災難：污染過程及應變操作過程

14:15 - 15:15 救援及救難操作，Claden 船長，'Abeille Flander' tug Master

15:15 - 15:45 Erika 溢漏油：海上應變

Mr. Cabioc'h - Cedre

15:45 - 16:30 Erika 漏油：海岸應變的組織與管理

Mr. Kerambrun - Cedre

16:30 - 17:00 Erika 及 Ievoli Sun 擱淺之應變操作

Mr. Pinlou

17:00 - 17:30 廢棄物管理, Cedre

18:00 回飯店

六月十三日(星期四)

08:30 搭乘巴士離開飯店

09:00 海上應變：演練／展示

法國海軍

12:00 離開海軍

12:30 午餐

14:00 代表團的報告

15:00 ＳＹＣＯＰＯＬ（污染應變設備廠商公會，Association of pollution response equipment constructors and service providers）

15:00 Erika 事件的經驗回饋

15:45 應變設備的報告與展示

19:00 雞尾酒會，ＳＹＣＯＰＯＬ提供

20:30 回飯店

六月十四日(星期五)

08:30 搭乘巴士離開飯店

09:00 岸際清理技術：效力與限制【多乾淨才算乾淨？】

Mr. Kerambrun，污染監測部門主任，Cedre

10:00 中場休息

10:20 危害及危險物質：行徑及風險

化學品溢漏的應變

Ievoli Sun 案例

Mr. Le Floch，應變小組，Cedre

12:00 午餐

13:30 災難管理的介紹

Mr. Rousseau

15:00 暫停

19:00 晚餐，Cedre 提供

22:00 回飯店

六月十五日(星期六)

09:30 離開飯店前往 Brest 機場

10:50 前往馬賽（Marseilles）(搭機ＡＦ 7365，經巴黎)
於 Paris-Orly 機場轉機，Paris 搭機ＡＦ 6056 起飛

13:50 抵達 Marseille-Marignane 機場，搭車前往飯店

Mercure Euro Center Hotel

1, rue Neuve Saint-Martin, 13001 Marseilles

Tel: 002-33 (4) 9617 2222;

Fax: 002-33 (4) 9617 2233

下午自由活動

六月十六日(星期日)

09:30 搭乘巴士離開飯店

馬賽區（Marseilles）觀光

於 Cassis 午餐

六月十七日(星期一)

08:30 搭乘巴士離開飯店

09:00 開幕致詞

Mr. Brassart, 馬賽港管理科長(Managing Director)

09:15 港內海洋污染意外應變的組織－港灣主管機關的任務, 馬賽港務長（Marseilles Harbour Master）Moysan 船長

10:10 中場休息

10:30 污染意外：災難及資訊管理－Ievoli Sun 案例

Mr. Denis，IFREMER（法國海洋研究與探勘機構，French Institute for Research and the Exploitation of the Sea）

11:35 案例報告

12:30 午餐

14:00 案例之小組工作

19:00 雞尾酒會，馬賽港提供

六月十八日(星期二)

08:30 搭乘巴士離開飯店

08:45 MARPOL 公約（結論）

危險物品的運輸（the carriage of dangerous goods）

IMDG Code（International Maritime Dangerous Goods，國際海事危險品編號）

Mr. Weizmann

10:30 中場休息

10:45 有關煉製場環境保護設備所採取的行動

Mrs. Dura Nd-Pinchard，BP 環境部門主任

11:45 固體廢棄物處理

12:30 午餐

14:00 馬賽港安全管制, Myosan 船長

15:00 清除化學污染醫療部門

移動式質量光譜儀（Mass spectrometry unit）

馬賽海洋消防部門（Marseilles Marine Fire-Fighters; BMPM）

17:30 本日課程結束

六月十九日(星期三)

08:30 搭乘巴士離開飯店

馬賽海洋消防部門年度演練

12:30 午餐

下午自由活動

六月二十日(星期四)

08:30 搭乘巴士離開飯店

09:00 Bonnex Alpha 案例：海上遺失貨櫃

Mr. Weizmann

10:15 貨傳載運危險液體物質之裝貨與卸貨（管制與安全）, Mr. Brouchery，船舶稽核調查(Shipping Audit Survey)

11:00 中場休息

11:15 Fos-Lavera 駁油港例行性的安全

Mr. Pemartin，西港港務長(Harbour Master, Western Harbour)

12:00 馬賽港訓練所介紹（Marseilles Harbour Training Institute）

12:30 午餐

14:30 參觀

- 遙測飛機（The French Customs POLMAR remote sensing aircraft）
- 油污應變小組（Fast Oil Spill Team）

六月二十一日(星期五)

08:30 搭乘巴士離開飯店

09:00 代表報告實際案例

10:00 案例研究的報告

11:00 中場休息

11:15 研討會的評估

13:00 午餐，馬賽筏船俱樂部

14:30 離開前往 Marseilles-Marignane 機場

16:30 搭機ＡＦ 6037 前往 Paris-Orly 機場

18:00 抵達 Paris-Orly 機場，搭巴士前往飯店

Richemont Hotel

17, rue Jean Colly 75013 Paris

Tel: 002-33 (1) 4582 8484

Fax: 002-33 (1) 4582 8880

六月二十二日(星期六)

整理觀摩研習報告資料

六月二十三日(星期日)　　返程

09:20 法國巴黎戴高樂機場（CDG）登機

19:30 搭乘法國航空 AF 2570 班機由法國巴黎飛往倫敦

19:50 抵倫敦希斯洛（LHR）機場

20:10 英國倫敦希斯洛（LHR）長榮航空櫃檯辦理登機

21:30 搭乘長榮航空 BR 班機 68 由英國倫敦希斯洛

六月二十四日（星期一）　返程

21:00 抵達桃園中正國際機場

伍、觀摩紀錄

六月十日一早由法方安排專車將各國代表接至設備運輸暨住屋部，並於該部舉行開幕儀式，由海事運輸港口暨海岸司科長G氏（Mr. Alain Gille）致詞歡迎，並介紹法國舉辦INFOPOL計畫，已有二十五年的歷史，本次共有來自阿爾及利亞（Algeria）、沙烏地阿拉伯（Saudi Arabia）、智利（Chile）、象牙海岸（Ivory Coast）、法國（France）、黎巴嫩（Libanon）、馬爾他（Malta）、摩洛哥（Morocco）、卡達（Qatar）、辛納給亞（Senegal）、突尼西亞（Tunisia）及我方等十二個國家參與；國際合作計畫經理W氏（Mr. Weizmann）介紹法國主辦海洋污染講習觀摩計畫主要在促進各國分享有關海洋污染防治的最新國際趨勢（政策）、科技及處理經驗，並提昇國際間對海洋油污染災害的重視，希望藉由技術及經驗交流，共同保護海洋環境。開幕致詞之後，則依座位順序由參與學員一一自我介紹；學員組成大多為海事部門、港務單位及海軍等單位的官員代表，僅少部分為環境保護官員、石油公司代表、及大學教授；多由法國透過外交管道邀請各該等國高級官員參與，並由法方支付受訓期間所有費用；其中來自卡達（Qatar）兩位石油公司代表，則是自費（每人需支付三千五百歐元整）參與。

「法國有關污染應變的政策」由海洋部門秘書長S氏（Mr. Silverstre）說明：在一九六九年十一月二十九日Torrey Canyon 海上漏油事件發生之後，法國當局曾經考慮過要成立一個海岸防衛隊（French Coast Guard），但基於污染防治主要是中央政府的責任，這個構想因過於簡

單及不足而沒被採用。經過一系列的方案分析，法國有中央與地方行政結構，各自都能在其主管範圍內有效率的運作，因此可採用各自的專長及知識，有效的打擊污染。一九七八年三月九日公佈了海上動計畫，將海洋污染應變納入，一個月後發生了 Amoco Cadiz 海上漏油事件，法國當局在這個災難中很快的得到經驗。一九九五年十一月二十二日法國成立了海上跨部會委員會（Secretariat General de la Mer），由總理（the Primer Minister）直接授權，負責有關海上及岸際行動的行政協調，委員會不具操作的功能，但是對於動員、協調行政結構、甚至是國際合作共同打擊污染等，都能很有效率的達成。一九九七年十二月十七日打擊海洋污染的詳細措施及應變計畫架構出爐，共分為海上油污染計畫（POLMAR-Mer）及陸際油污染計畫（POLMAR-Terre）；海上油污染計畫（POLMAR-Mer）係依海域的分區為應變範圍（共計三個海事轄區），陸際油污染計畫（POLMAR-Terre）則依地方轄區為應變範圍（地方轄區共計有九十六的郡）。當發生海上漏油污染時，在中央由設備運輸暨住屋部的公共安全署運作中心（CODISC，Center Operationnel de la Securite Civile）負責，並與海上跨部會委員會（Secretariat General de la Mer）密切合作；在地方則由海事主管及相關地方政府主管負責實際操作，並由 Cedre（水污染意外研究暨實驗文件中心，Center of Documentation Research and Experimentation on Accidental Water Pollution）提供必要的協助。

「有關意外污染事件船東的責任及損害賠償」係由法國船東協會（CCAF）法律部門主任O氏（Mrs. Francoise Odier）介紹，值得一提的是本次學員S氏（Mr. Ambroise Sarr，Senegal）在二十年前曾參加過ＩＮＦＯＰＯＬ計畫，而且也在那計畫中聽過由O氏講授的課程，間接也說明她是船東法律顧問專家界的翹楚。本次講授內容偏重於在國際法中，有關對於船東的處罰及求償的演變，她強調自一九六七年 Torrey Canyon 號油輪在英吉利海峽附近觸礁洩油，造成英、法海岸嚴重遭受污染以來，每次有重大油污染事件發生，就會促使國際規則的演化。從一九六九年在布魯塞爾制定的ＣＬＣ公約（International Convention on Civil Liability for Oil Pollution Damage,1969；一九六九年關於油污損害民事責任國際公約）至一九七一年的ＩＯＰＣ　ＦＵＮＤ公約（International Convention on the Establishment of an International FUND for Compensation for Oil Pollution Damage,1971；一九七一年設立油污損害國際賠償基金國際公約）；都是在建立一個機制，考量船東的賠償能力並保證受害者能得到較充分、快速的賠償。一九九二年議定書（Protocol pf 1992）之後，開始針對較小船隻的船東賦予賠償責任。二ＯＯ三年歐聯（ＥＵ）外交會議將討論對ＩＭＯ施壓，以促使現有的賠償機制有利於受害的一方。

「ＩＯＰＣ基金及賠償系統」由經濟財務暨工業部（Ministry of Economy, Finances and the Industry）法律事務部門H氏（Mr. Federick Herbert）介紹，他同時也是法

國在ＩＯＰＣ的代表。ＩＯＰＣ基金是由各會員國派遣的大使成立執行委員會（executive committee）以決定基金的運作，係屬政府間國際組織，基金則來自於石油公司。有關污染求償的法律原則，係與責任(responsibility and liability) 者（who）、賠償範圍及舉證者有關，自一九九二年里約（Rio）會議後，新的國際公約開始將環境考量的相關費用內部化（internalized the cost of environmental concerned），包括船舶本身在意外發生前是否採取了污染預防的措施、防止污染的方法及污染的損害，而損害賠償則包括直接（例如：清理）及間接（例如：經濟損失）兩部分，有關環境損害賠償，則需要考量應賠給誰（Who is entitled for compensation?）。ＩＯＰＣ只針對石油及油輪，一般貨櫃船並不包含在內；而「1996 HNS Convention」則可針對化學品的船及製造廠。

「法國政府在岸際污染事件的責任及活動」由設備運輸暨住屋部海事運輸港口暨海岸司(ＤＴＭＰＬ) 海岸及公共海事室主任Ｖ氏（Mr. Emmanuel Vernier）介紹，他強調法國的系統是基於自己國家的政治運作體系及文化發展出來的，所以每個國家的系統不需要是一樣，但是一定要是可以運作的。法國在岸際污染意外的應變的責任及活動，主要係根據「海洋污染陸地應變計畫(POLMAR-Terr Plan)」來運作的，當油團油海上飄到岸際時，由省長來決定是否啟動海洋污染陸地應變計畫，一旦計畫被啟動，各個成員的政府部門就需各司其職，例如：設備運輸暨住屋部就要負責提供或購買應變設備。

「一九七三／一九七八防止船舶油污染國際公約

(International Convention for the Prevention of Pollution from Ships,1973 as modified by the Protocol of 1978 relating thereto, 以下簡稱 MARPOL 73/78 公約)」由設備運輸暨住屋部海事運輸港口暨海岸司(D T M P L)國際合作計畫經理W氏（Mr. Weizmann）介紹，該公約係由聯合國專司海事之國際海事組織（I M O）負責秘書處的作業，該公約共有六個技術附錄，會員國必須接受附錄一及附錄二之規範，其它附錄則採自願性方案。各附錄重點為：

（一） 附錄一（Annex I）：防止油污染，一九八三年十月二日生效，規範有關油輪操作性之油排放量、排放率及離岸距離等；根據本附錄規定，會員國必須提供廢油（oily waste）之收受設施，而目前備有廢油收受設施的港口遠低於實際需求，造成實際執行上的困擾。因此，在一九九五年國際海事組織的海洋環境保護委員會（IMO's Marine Environment Protection Committee）第三十七次會議(MEPC 37)時決定重新檢討，以尋求提供港口收受設施財務之最佳機制，並修訂及簡化附錄一及附錄二，預計於二ＯＯ二年完成。

（二） 附錄二（Annex II）：防止有害液體（noxious liquid substances）污染，一九八七年四月六日生效，規範有關貨輪載運有害液體排放標準及污染控制措施，公約附錄所列規

範的有害液體共有二五Ｏ種，該等物質止渴排放於收受設施（reception facility），直到符合所訂濃度狀況下才可排放；該等物質共分為 A、B、C、D 及其它液體物質等五類（catagories），依國際貨船化學碼（International Bulk Chemical Code）分類則共計有三百多種；目前正由安全及污染危害評估小組（ESPH, the Working Group on the Evaluation of Safety and Pollution Hazards）研擬簡化成三類，依據液體物質之污染及裝載需求的特性，併入預防措施的考量以確保貨運安全及保護海洋環境，預計二ＯＯ二年底前可完成評估工作。

（三） 附錄三（Annex III）：防止包裝的有害物質（harmful substances in packaged form）污染，一九九二年七月一日生效，包含有害物質種類清單、包裝及貨櫃；其所指有害物質主要是依據國際海事有害物質碼（IMDG Code, International Maritime Dangerous Goods Code），共分九類物質，是影響該附錄最主要的部分；IMDG Code 是由海洋環境保護科學專家聯合小組（GESAMP, Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection）負責評估及修訂，曾多次修訂最近一版為二ＯＯ一年一月一日生效。

（四） 附錄四（Annex IV）：防止防止船舶廢污水（sewage from ships）污染，禁止船舶於離陸四浬處排放任何未處理之船舶廢污水；離陸四至十二浬處，船舶廢污水應先消毒後才可排放。該公約雖已有七十五個國家批准，佔全球百分之四十三左右的船隻總噸位，但仍未能達到生效條件（全球百分之五十以上的船隻總噸位），最主要因素是因為會員國都必須提供收受設施（reception facilities）目前國際海事組織（ＩＭＯ）的相關小組（Corresponding Group）正在研擬如何將國際海事組織（ＩＭＯ）及國際標準組織（ＩＳＯ）的廢水處理場標準一致化。

（五） 附錄五（Annex V）：防止船舶垃圾（garbage from ships）污染，一九八八年十二月三十一日生效，規範不同種類的垃圾、離岸之距離、及棄置方式，最重要的是此附錄完全禁止塑膠品的海拋。

（六） 附錄六（Annex VI）：防止船舶空氣（Air Pollution from Ships）污染，一九九七年九月通過，迄今尚未生效。本項主要係因應一九九七年京都議定書（the Kyoto Protocol），針對船舶二氧化碳排放的控制，發展相關執行規範，包括：船舶燃料使用採樣規範、氮氧化物監測、及紀錄設

備規範等。

未來國際海事組織（ＩＭＯ）的重點，將包括推動一九九一年壓艙水規範（Guidelines for Preventing the Introduction of Unwanted Organisms from Ship's Ballast waters and Sediment Discharges 1991），負責推動所有船旗國及港口國落實 MARPOL 公約的要求（requirements）。

所有參與學員在法方安排於六月十日傍晚搭乘飛機前往布雷斯特（Brest），六月十一日起所有活動以水污染意外研究暨實驗文件中心（Cedre，Documentation Research and Experimentation on Accidental Water Pollution）為主，進行相關課程講授、參觀其他單位及除污器材與技術之展示。六月十一日一早，由 Cedre 主任Ｇ氏（Mr. Michael Girin）致歡迎辭，並介紹 Cedre 組織結構上為一協會（association）而非機構（agency），共有五位部長於其董事會（board）上，是一個科學性的專業組織，可提供海洋及陸上水污染意外之主管當局每日二十四小時的技術諮商服務，具有研究發展以引導新解決方案的功能，目前主要與歐洲建立合作關係，近年來也逐漸擴展其合作關係至智利、新加坡及日本等國，具有二十四年水污染應變各方面的經驗，包括提供國際海事組織（IMO）及ＩＯＰＣ基金等國際組織有關風險評估及賠償之建議。目前 Cedre 還辦理訓練、演練、研討會、手冊、評估文件、月刊、雙年報、並設有網站。Cedre 副經理暨應變準備部門主任Ｐ氏（Mr. Gorge Peigne）接著補充介紹 Cedre 的全職為因應應變計畫、改善及提昇應變技術及設備、及提供資訊。Cedre 可在接到有關開放

海域、港口及河川之水污染意外事件電話後四十分鐘內，提供顧問服務，平均一年處理六十多件的案例，並曾參與美國 Exxon Valdez、義大利 Haven、英國 Sea Empress、法國 Erika 及 Ievoli Sun 等多件國際大型海洋油污染案例的經驗。對於應變的準備工作包括：資訊及建立文件、評估應變手冊、評估及改進海上與現場應變技術及設備、污染物行徑與風化、溢油軌跡模式、空中調查及遙測、海上貨櫃艙的遺失、擱淺物的棄置、油使用消散劑的技術及實際操作手冊、保護敏感地區、內陸水域、海岸線的清理、廢棄物棄置、自然資源損害評估、緊急應變計畫及應變團隊的訓練。

「污染應變領域的未來展望」由 Cedre 主任 G 氏（Mr. Michael Girin）介紹，污染應變本身涉及不同的考量、規則及組織，而大眾的敏感度及需求增加，且希望更快的獲得資訊，因此每一次主管當局必須作得比上次更好，但是沒有一次事件會是相同的。每發生一次大型油污染事件之後，都會為一連串的改變開啟一扇大門；政客與一般大眾的夢想是「希望不會再有下一次」，納稅人的夢想是「讓污染者付費」，法律專家的夢想是「讓不小心的國家付費」，受害者的夢想是「證明所需費用獲得補償」…，在操作管理上也走向更好、更便宜的趨勢，因此排訂優先順序是必須的。正確的規劃工作包括：有效的將應變裝備預先就位或移位、具備正確油團風化及飄移的預測、高效能的倉儲（stockpiles）及專業的協助、一開始盡全力打擊油污後再調整變方式、預防原則、修復環境損害、快速及完全的處理殘骸及廢棄物、調度除

污船舶、尋求志工、建立及散佈科學資訊、建立合理的方法、聯絡財務賠償的管理、與資訊進行時間戰。對於媒體則有一三角關係，即比媒體先知、及時通知媒體、提供可信資料；目前面臨更大的挑戰，就是與網際網路賽跑，很多資訊應直接放於網路上。因此必須為不可能發生的事做好準備，它可能明天就會發生。就像船長手上的海圖一般，一旦發現海圖或航行錯誤，就要看有核可用的方式，也許可藉由衛星系統矯正，但是當事者必須快速因應，而且必須已建好系統；若沒有該系統，則要能夠對媒體解釋為何沒有該系統。當一個諮詢顧問的武器就是要有實際的經驗（solid experiences），尋求有共識，協助決策者採取可被大家接受的措施（measure）。

「海洋及岸際污染應變的原則與策略」由 Cedre 副經理應變準備部門主任 G 氏（Mr. Arnaud Guena）介紹，由於沒有一次污染事件會是相同的，當我們面對不管是發生在海洋或岸際的污染意外時，必須考慮到：法律上應變的組織、訓練有素的人員、緊急應變計畫及應變策略、聯絡人的網路（network）、可信賴及具有彈性的應變設備。應變的方法即緊急應變計畫的應用包括：警報（alert）及啟動緊急應變計畫、緊急介入、污染物鑑定、狀況評估、操作規劃、溢油污染應變、處置及處理收集之油污、回覆受污染地區、操作結束／報告／計畫更新。

課程中 Cedre 還安排位於布雷斯特（Brest）「海洋污染計畫倉庫（POLMAR　Stockpiles）」的參觀活動，該倉庫是在 Erika 事件後於一九七０年成立，以因應啟動海上油污染計畫（POLMAR-Mer）或陸際油污染計畫

（POLMAR-Terre）時由該倉庫運送所需之除污器材。一般該倉庫出借除污器材是不收費的，但是如有毀損則需付修補費用。該倉庫所需經費由設備運輸暨住屋部負責編列（包括購置設備及維修的經費），主要的設備包括除污船、攔油索、汲油器、防護衣、...等，此外該倉庫也參與大型演練，並參與訓練的活動。該倉庫曾因一九九九年十二月的 Erika 事件，倉儲內的設備幾乎掏空；設備運輸暨住屋部海事運輸港口暨海岸司(ＤＴＭＰＬ)於二ＯＯＯ年二月緊急向政府間委員會申請獲得四仟萬法郎，並於二ＯＯＯ年十二月底補齊倉庫的設備與器材。為確保倉儲之設備及器材可於緊急需要時可迅速運達需要的地點，已與當地相關處理及公共事務訂定契約，準備隨時的支援。法國的「海洋污染計畫倉庫（ＰＯＬＭＡＲ　Stockpiles）」共計十三個倉儲，八個在法國本土，五個在海外；其中最大一個倉儲位於馬賽（Marseilles）。

參觀「海難救援協調中心（CROSS CORSEN）」係屬設備運輸暨住屋部，其主要任務包括：協調海上救援、監測污染、監測漁業、監測航運、發布海象資訊等五項。全法國共有五個海難救援協調中心，由於法國有油輪及貨櫃輪的分行制度，各中心有一塔台可利用衛星每二小時接收法國領海內所有漁船的訊息；另該中心也裝有監測污染的雷達，接收海上排除壓艙水相關訊息，但是目前該雷達裝置尚無法進行夜間污染監測，據該中心統計捉到違法排放廢污水的船隻機率只有百分之一。

「油分散劑（dispersant）的應用及方法」與「油分散劑在海洋與海岸帶使用油分散劑的政策」由 Cedre 研

究與發展部門主任M氏（Mr. Merlin）負責解說，使用油分散劑的目的在於協助油在水體（water column）中分散，以加速海水中微生物的分解速率。由於油分散劑是化學品，多多少少具有毒性性；一般在海上使用油分散劑的原則，是要降低油污染對海洋生態的危害，而不應加重海洋生態的危害。除了毒性的考量外，油分散劑的使用亦有其限制，並不是每一種油品都是可以用油分散劑分散的；此外，油進入海上後的風化情形，也會影響油分散劑的效力，一般油進入海面十小時後，就不太適合再使用油分散劑，但是也有例外；其中油品及其風化產物的粘滯性（viscosity）是影響效力的主因之一。一般油品及其風化產物的粘滯性大於 2000cSt 後，油分散劑的效力就會不佳，但有些則可用於 20000cSt 左右；因此，一般使用分散劑之前，可以先倒一點在油團（slick）上作一試驗，如果油團有變色表示有效，再進行正式噴灑。當面對油污時，要迅速作成是否噴灑油分散劑的決策的時間壓力，因此必須有一快速決策的方案：（一）污染物種類的資訊：應用油分散劑是否可能？可行？（二）決策關鍵（粘滯性是否大於 2000cSt）：應用油分散劑是否可能？可行？（三）空中監測（確定污染位置）： 環境考量上是否可接受油分散劑的使用？（四）油量？（五）可使用的油分散劑、噴灑工具及後勤支援是否足夠？當我們噴灑油分散劑時，必須確定我們這樣做是對的，如果會使情況便得更糟，也許做好讓油團上岸後的處理工作是一個較好的選擇。國際海事組織與聯合國環境規劃署也於一九九五與二ＯＯ一年分別出版有關使用油分散劑的的指南（IMO/UNEP Guideline on Oil Spill Dispersant

Application, 1995 ed.； Including Environmental Consideration, Nov, 2001 ed.）。

「海洋應變/岸際應變論壇」著重於Erika溢漏油案例介紹，並討論海上應變、海岸應變的組織與管理、擱淺之應變操作、廢棄物管理、油污染應變替代方案的預期效益、這些方案的建議及最近之科技發展，有關Erika及Ievoli Sun災難污染過程及應變操作過程、救援及救難操作由Claden船長負責介紹。

有關「海上污染應變的演練展示」由布雷斯特（Brest）海軍基地負責展示，本日的操作演練活動也邀請了當地的記者一起參加，演練的結果還上了當地次日的報紙。學員團到達基地後，搭乘海軍船艇置港外觀摩除污船、外海型攔油索與汲油器的佈施，雖然當時海風淩冷天空飄著細雨，八個操作人員仍井然有序的將一段一段的攔油索充氣並由船尾的平台放入海中，佈施工作則由機械操控攔油索一端至船翼手臂遠端，攔油索另一端則由船上三至五個人以繩索拉至至船翼手臂近船身的一端，等攔油索圍成U型，再用起重機把汲油器放置於U型攔油索底端，整個過程約需三十分鐘。整個展示令人印象深刻的是船隻的設備與除污設備的機具是互相搭配的，這對於佈施工作操作的流暢是非常重要的；本日所展示的船隻是艘專業除污船，同時也兼搜救的工作，整艘船、除污設備及除污人員都是私人公司所有。該地區海上除污所需船隻、除污設備及除污工作是由海軍外包給私人經營的專業公司運作，以契約方式每年付費；法國採用此模式最主要的原因是，開始建立海洋污染緊急應變系

統（POLMAR-mer）時，海軍本身並無除污船隻，因此當時就採租賃方式僱用私人專業公司執行海上除污，該運作模式大約已有二十至二十五年的歷史。

法國污染應變設備承包商及服務協會（SYCOPOL）也在本次課程中以投影片、錄影帶、設備參觀及操作展示方式介紹 SYCOPOL 廠商在海洋污染應變的貢獻，同時也介紹他們所提供的產品及服務，值得一提的是所有的參展廠商的產品、及設備操作演練都是在 Cedre 內進行，Cedre 除了主要行政大樓（辦公室、圖書室、教室及理化分析實驗室）外，在停車場後面還有一個很大的倉庫，是本日 SYCOPOL 廠商介紹及展示產品的地方，產品除了可放置腳架上外，整個設計還可以提供照片、海報、錄影帶等展示方式的運用，該倉庫採光良好參觀時並不需另外開燈。參展 LE FLOCH DEPOLLUTION 公司的昆耶先生（Mr. Pierre Le Tellec）還曾受大翰海事公司的僱用，赴墾丁待了四個月，負責以高壓清洗方式清理龍坑的油污，對於國人在該事件的努力工作及友善的態度，留下深刻的印象。面對展示倉庫外的是機具操作展示池，本日共有攔油索、汲油器、高壓噴洗器、高壓熱水噴洗器、海陸兩用除污船廠商參與，展示池共分為兩處，每一池都有不同功能的設計，除了本日的機具展示外，最大的功能應該是用於除污機具的效力試驗。經過這個設備參觀及操作展示的收穫，除了是那些除污機具的功能外，最令人印象深刻的是整個 Cedre 是個功能與設備完整的海洋除污專業機構，除了有經驗的專家、完整的資料庫，硬體的展示及試驗設備也相當完整。

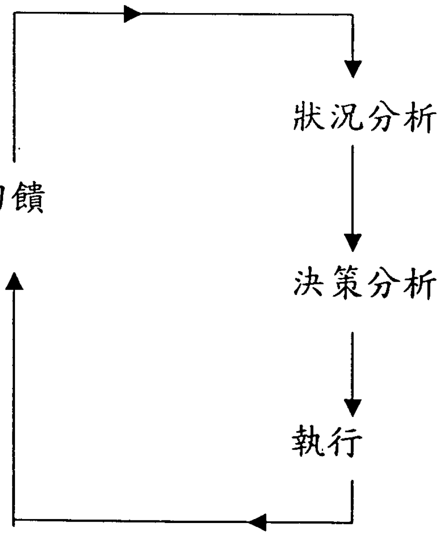
「岸際清理技術」是由 Cedre 污染監測部門主任 Mr. Kerambrun 解說；在法國並沒有相關清理程序的法令，雖然有清理技術，但必須是可供使用的，且必須要有一個已準備好的計畫，來調用現有的設備。岸際清除方案選擇應考量下列四個因素：（一）污染的特徵，例如：污染量、粘稠度、持久性、是否伴隨垃圾…；（二）遭受污染地點的特徵，例如：受污染海岸的使用方式、是否為生物敏感區或水產養殖區…；（三）可採用的工具及後勤支援，例如：從當地或鄰近地區可調用的資源、現有設備是否需要電力供應…；及（四）人力資源，例如：可組織實際工作的主管當局及專家等。岸際清理工作又可分為清除大量油污及最後的修飾工作兩個階段，針對沙灘、沿岸、紅樹林的清理則各有不同的方式及其優缺點，當面對清理工具及不同清理方案選擇時，有一個很重要的原則，就是「不要讓清理的工作，對環境生態造成更大的傷害」；因為很多時候如果只是考慮到要快速去除岸際上面可見的油污（例如：以怪手拖車等機械方式），其結果常是對該受污染地區的植被與棲息地產生二次傷害；很多時候，專家們會建議主管當局不要採取任何行動，但是這可能會引起社會大眾及媒體的不諒解，甚至是造成很大的社會及政治壓力；因此，專家必須提供足夠的資訊給主管當局，以便向社會大眾及媒體說明，相關的監測工作應同時進行，以確認污染狀況對當地生態的衝擊可隨著自然的復育而逐漸改善。有關岸際清理有四件必須知道的事情，稱為四“R”規則（4R Rules）：正確的人，在正確的地方，於正確的時機，採用正確的設備（the right people, at the right place, at the right moment, with the right equipment）；因此，我們需要有一個緊急應變計畫，計畫內的人員需要加以訓練，要預先準備，可多方適應且資源要多元化。有關岸際清理工作的決策，則來自共識，它是根據岸際不同季節的使用狀況以及污染的特徵而定，在這其中必須考量到（一）生態、經濟、及政治對污染的耐受程度；（二）可運用的技術、財政及生態與清理的可行性。

「危害及危險物質的行徑及風險」是由 Cedre 污染監測部門主任 Mr. Fanch Cobioch 解說；當貨櫃船在海上發生化學品溢漏時，必須先了解船上有些什麼化學品？化學品在海洋的行徑（Behavior）取決於化學品的成分，而海洋環境的狀況也影響著化學品對海洋環境的衝擊。在海上應變的第一要件，是必須先知道船上有些什麼東西？也就是你所要處理的是什麼？一般可向船長或船東取得化學輪或是貨艙裝載物品的基本資料，根據化學品的聯合國編碼代號（UN number）查詢相關手冊（例如：北美洲出版的危害化學物質手冊、MARPOL 73/78 Annex I, 2, 3、IMDG、Fiches），另外也可向製造商取得更細的資料；根據化學品在海上溢漏的特徵分類，可分為：（一）F（漂浮，Floter）；（二）E（蒸發，Evaporater）；（三）D（溶解，Dissolver）；（四）C（沉澱，Sinker）；等四類，通常一個化學品可能同時具有二至三種的特徵；總而言之，最重要的是要在應變前確認所將要處的化學品。環境的影響因素包括：海象（風、波浪、紫外線、巨浪...）及地理位置（近岸、海面、河口則影響著鹽度、洋流）；化學品溢漏到環境之後，他開始產生蒸發、生物

分解、擴散、光氧化、分散、沉澱等老化現象（aging）。因此面對危害及危險物質的溢漏事件時，先蒐集資訊（包括化學品及海象）；這將有助於評估潛伏的衝擊以研擬較好的應變方案。整個決策的路徑可略述為：

意外事件→蒐集資訊→分析→決策→行動→評估→結束行動

「災難管理」Cedre 應變準備部門主任兼副經理Ｒ氏（Mr. Rosseau）介紹，在災難時決策的三大目的包括：解救人命、保護私人財產、及保護環境等。四大決策步驟則是：



以狀況分析階段而言，如何讓決策者在很短的時間內作出沒有錯誤的決策，資訊是非常重要的；決策者也必須要能掌握事情的感覺（get the feel of things），有些問題必須要先釐清的，例如：那些是會影響目前狀況的限制因子（例如：媒體的衝擊）？可被應用的安全措施？可使用方法與器材可能發生的問題（例如：氣候不佳、

意外現場的交通及人口）？在這個階段，必須冷靜研判再進一步研判分析，此時可能需透過現場蒐集、或由當地及其它政府機關蒐集下列有關資料：意外事件本身及相關問題、可能改變現狀的情況、可能的損失（包括：人命、環境及私人財產）、量測、評估及控制的方法（包括：內部及外部的資源）；為釐清問題，有三個因子必須加以考量：意外事件演變的階段、污染物的量及危險性、意外事件中相關化學物質行徑的型態。

六月十五日法方的安排下搭機離開布雷斯特前往馬賽（Marseilles），週日安排全體成員參觀馬賽市區的教堂及附近的卡賽（Cassis），法國在活動安排上極為盡心，不管是餐點或是導覽皆能帶動參與者深入了解法國的文化多樣性與特質，讓人有不虛此行的感動。

六月十七日又是一個新的開始，課程與參觀活動以馬賽港務局（Port Autonome de Marseille）大樓為中心，開幕儀式由港務局局長 B 氏（Mr. Eric Brassart, Director General）致歡迎辭。馬賽港務長（Marseilles Harbour Master）Moysan 船長介紹馬賽港內海洋污染意外應變的組織－港灣主管機關的任務。

「清除化學污染醫療部門」「移動式質量光譜儀（Mass spectrometry unit）」議題係安排至馬賽海洋消防部門（Marseilles Marine Fire-Fighters; BMPM）參觀，清除化學污染醫療係一拖車可載至化學污染現場的次級隔離區（warm zone），當受傷及受污染者由污染意外現場被移至此區時，則於移動式的清除化學污染醫療部門負

責去除污染作緊急醫療後，再進一步送醫，以避免污染範圍擴大。「移動式質量光譜儀（Mass spectrometry unit）」係運用於化學槽車（tanker）溢漏時，以磷原子偵測器（detector）初步快速偵測溢漏品是否具有毒性，化學品的鑑定則可於配備有化學分析實驗車中進行，如果發生分析上的限制無法鑑定出化學品的種類，則需將現場樣品送至實驗室化驗；該等設備及操作不僅可用於海上化學品溢漏時安全官之評估上，亦值得國內化災應變的參考。

觀摩活動中也安排參觀「馬賽海洋消防部門年度演練」，據馬賽海洋消防部門代表解釋，本次參與演練單位大致知道時間及位置，所有細節則須至現場才會有更進一步的資料，各個參與成員需要依據手邊的緊急應變計畫書的分派任務及操作步驟進行。現場指揮中心是由一個箱型車改裝而成的，有一張桌子可共三至四人討論用的，車內則有傳真、電話、海圖、應變手冊等，並未見有電腦及保模式的工具，指揮官的需求均以電話方式向相關單位要求提供；各參與應變單位都各有一個組長，負責向報到的組員說明污染狀況及該組的應變方案及任務，所有器材則由馬賽海洋消防部門（Marseilles Marine Fire-Fighters; BMPM）中心依據現場指揮官的指令負責調配支援送達現場，整個演練包括：報到方式與說明、指揮中心運作、污除機具及人員調配、岸際及海面上攔油索與汲油器佈施、圍堵油污技巧（例如：flushing）…等共進行了將近三個小時才結束，這也是馬賽港首次嘗試以無劇本方式進行演練，以測試其緊急應變計畫書之

可行性及人員平日訓練及傳承成績。

「遙測飛機」是安排至參觀海關的飛機遙測大樓參觀（The French Customs POLMAR remote sensing aircraft），該海關備有專司海污監測海上污染的飛機，飛機上裝有熱感應、雷達及碳氫化合物遙測器、全球定位照相機...等，每台飛機配有駕駛員二名、污染物判讀專家二名，目前該飛機可與塔台直接聯繫但無直接將蒐證照片或影像傳輸至船上或地面的設備，像這樣具有特殊配備的海洋污染偵測專職飛機全法國共有二部，另外也有以外包商業用飛機的契約方式，協助辦理偵測違法污染蒐證工作。

「油污應變小組（Fast Oil Spill Team, FOST）」係屬公司制度，總裁（President）C 氏（Mr. Eric Calonne）親自於倉儲（stockpile）接待我們的參觀，該公司儲備有各式攔油索、汲油器、小艇、油分散劑噴灑器、個人防護應變工具包...等，每項器材均定期由專人護則保養。令人印象深刻的是工具包內的東西除了依個人量身訂作衣物（依各季節氣候有所調整）、三類手套、保護眼鏡、耳塞、手電筒、電池、乳液護脣膏及保護外衣外，還有安全鞋、安全靴、聯絡用的手機...等；因此每份工具包上都標示使用者姓名；另有儲物箱擺置個人不同季節的衣物。最重要的是該倉儲位於機場內，倉庫外亦有泊船處，倉儲中每項器材均以木箱包裝並加以分類及編號，箱子的大小則依據負責運送之貨櫃車、飛機或船舶的規格訂製，可加速應變的速度。該公司有固定二十四個訓練有素的應變專業人員，當接到應變通報徵調時，立即趕赴

FOST 倉儲（stockpile）報到聽取簡報，並領取個人專用的防護應變工具包，穿載完備後再趕往應變現場。因此，該公司在處理應變時，不管在器材、專業人員資源或爭取時效上均可充分掌握。

「案例研究的報告」是由參與學員分法語及英語兩組進行，法語組與英語組各分配一個不同的案例，英語組負責有關 BT 公司槽車於駁油前因撞到接駁橋墩，致使槽車底部洩漏，該槽車被要求停滯於接駁橋墩上，此時各相關成員應如何應變的案例。我方代表參與英語組並獲推擔任紀錄負責該組彙整及報告製作，發言人則由法國海軍 L 氏（Guillaume Lambert）擔任。分組討論時令人印象最深刻的是，由卡達（Qatar）石油公司經理 A 氏（Mr. Abdul Jabbar Saifaldeen）擔任主席，在他說明案例後，參與本組的成員就七嘴八舌的又提了一大堆問題問主席，主席狠狠的看了大家一眼後，斯條慢理的說：「我是主席，我已經說明了我們手上現有的資料了；你們是專家，你們的責任是來提供有用的建議，不是來問問題的。」，之後大家才各依所長，依共同有的有限資料研擬應變方案。來自馬爾他（Malta）的船旗國暨港口國管制官 G 氏（Mr. Albert Grupetta），提出有關港灣處理實際案例的經驗；法國海軍 G 氏（Mr. Guillaume Lambert）提出該國應變程序及法律規定；主席則以石油公司經驗說明私人公司處理的程序及保險問題；我方則提供環保單位及現場指揮官的權責.....很快的，不同經驗與機構代表，很快的在五十分鐘內完成了應變的方案，並由我方代表彙整成報告，內容包括：第一階段的通報及移除污

染源；第二階段則是各相關應變單位依權責分工參與；第三階段則是廢棄物處置、環境監測及檢討等，詳如附件二。

活動最後，則由法方頒與每位參加的成員壹份結業證書（如附件三），並由各學員輪流發表對此項活動的建議。我方代表則被安排為第一個發言，除感謝法國政府提供籌畫良好的觀摩活動及工作人員的辛勞外，也建議法方應可考量於活動前先將講義內容寄給學員，更能增加事半功倍之效，隨後發言英語組的成員也多支持我方提議。十二天的學習觀摩活動雖然在馬賽落幕了，所有的參與學員在法方的安排下，一起飛回巴黎；學員們依依不捨與互約再見之情，正是 INFOPOL 2002 家族延續的開始。

陸、心得與建議

一、法國在海洋污染應變政治體系結構，與我國非常類似。以美國及英國而言，海洋污染應變均責由污染者（肇事之油輪或貨輪公司），政府僅負責監督及必要時介入的責任。法國與我國在處理重大海洋污染事件時，均中央政府成立跨部會委員會負責橫向聯繫，並由總理獲行政院長擔任跨部會委員會主席，負責重要決策；應變則分海上應變及岸際兩大指揮系統，再依海洋污染程度及區域分層由中央或地方政府負責。法國海污應變系統已推廣二、三十年之久，它充分應用了各參與機關暨有的專業技術與人力資源，而各個被指派任務的機關亦能全力配合，並改進自己的應變能力，不管是港務局、消防單位、海軍、設備運輸暨住屋部、海關、海難救援協調中心、...等，經由觀摩及參觀活動中，均能感受到他們各自在其崗位上善盡專長執行海洋污染應變與防治的職責，著實令人感動；而法國的這套應變體制不管是在經濟效益上、或是在政治體系運作上，均值得我國擴大交流層面以吸取經驗。明（九十二）年在辦理海洋污染應變能力養成計畫時，建議以法國為第一優先考量的海外國家。

二、法國水污染意外研究暨實驗文件中心（以下簡稱「Cedre」, Center of Documentation Research and Experimentation on Accidental Water Pollution）係一負責內陸水域及海域污染意外的技術諮詢機構，除了提供二十四小時諮商服務外，任何有關水及海洋

污染意外的疑難雜症只要一通電話，四十分鐘內 Cedre 的專家就可提供立即的技術建議；該機構成員僅有四十人，它的功能包括了：水及海洋污染監測及處理技術的研究開發與驗證、水及海洋污染採樣分析及新分析方法研擬、提供水及海洋污染意外調查及緊急應變技術諮商服務、水及海洋污染文件彙整及資料中心、辦理相關訓練與國際合作...等，Cedre 佔地、的設備、僱員、經費雖然非常精簡，但是其專業人力強、經驗足、硬體設備亦足以搭配，因此 Cedre 在水及海洋污染專業諮商能力，已獲國際肯定。目前我國正在籌畫成立海洋事務部，建議成立類似 Cedre 兼具專業技術諮詢顧問、技術開發、技術驗證、資料中心、訓練及國際合作的獨立單位。

三、在法國當重大海洋污染發生時，應變先決的條件就是要先考慮人員的生命安全、保護人民的財產、及環境生態的保護；因此，船難而產生重大海洋污染發生時，常常都是先搶救船上人員，但基於氣候及海況惡劣的因素，而採取不行動的方案（no action），也就是不能立即進行污染清除工作（因為可能危及負責污染清除工作人員的生命安全），但政府仍需持續保持監測（monitoring），這是國際間均認可的決策原則。然而，這種知識與常識上的落差是不可忽略的負面因素，主管當局在採取不行動的方案（no action）決策時，實需謹慎處理，除了一開始即主動向社會大眾說明外，亦需定期將監測

結果及處理現況資料透過各種媒體及網路系統主動發布。也就是除了技術層面的考量外，必須兼顧政治面的需求。

四、國際間有關海洋污染防治工作已趨預防原則，國際海是組織除透過對船舶設計結構、污染處置設備及紀錄規範外，亦授權港口國採取檢查權利；此外，港口國亦必須提供廢油（oily waste）之收受設施，以有效落實防止船舶油污染的 MARPOL 73/78 公約。在參觀法國南部馬賽港的時候，發現馬賽的港務單位，非常自豪他們已建置有地中海最大的廢油收受設施，代處理業告知目前其處理費用是一噸廢油水收取三百歐元的費用，但是馬賽港不怕因此而失去港口泊船率；因為，二〇〇三年起歐盟將強制於區域內落實 MARPOL 73/78 附錄一及港口國管制制度，由港口國管制督察員，採取臨船登檢；屆時船東必須面臨是否改善船上廢油處置設備、或交由港口的廢油收受設施代處理、或鋌而走險非法排放而致高額罰款的決擇。馬賽港港務單位不僅善盡本分落實港口國管制職責，有位當地保有優美的海岸風景及興盛的觀光業。近年來，我國工業原料及石化產品輸入量之增加，加上亞洲地區經濟成長快速所帶來的航運活動日益頻繁，而我國又位於國際航道上，使得海域遭受國際船舶污染之威脅日益增加；所幸去年年底，國內由港口主管單位大批派員出國接受港口國管制官員訓練，在國家大力栽培下，未來必可為我國海域避免船舶污染注入新的生

力軍，這也是我國避免各國船舶造成我國海域重大污染的第一道也是最重要的防線。

五、根據法國、與本次參與講習觀摩的各國代表表示，與鄰近國簽訂合作協定是重大海洋污染應變很重要的一環，除了與鄰國建立官方協定外，法國也與國外（例如：英國的 OSRL 及 Briggs）的污染應變公司簽有合作契約。對我國而言，日本、香港、中國大陸、新加坡...等，都是我們應優先積極爭取建立合作管道的國家。除透過正式官方管道建立合作協定外，亦應參法國及產油國家以商業契約方式與國際知名的海洋污染應變公司或國際組織建立合作關係；惟需預先克服我國對國際契約行為的法律、經費及應變器材通關的限制。而其中海域與我最密切是中國大陸，建議處理兩岸事務之主管單位應以正面積極的態度處理此一海域環境問題，並促進兩岸即早建立重大海洋污染應變合作協定。

柒、與會者名單

Mise à jour : 04/06/2002 – CO

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捌、觀摩活動文件

DEPARTMENT OF MARITIME TRANSPORT, PORTS AND THE COAST

FRENCH MINISTRY OF EQUIPMENT, TRANSPORT, HOUSING, TOURISM AND THE SEA

INFOPOL 2002

SEMINAR ON ACCIDENTAL MARINE POLLUTION CONTROL

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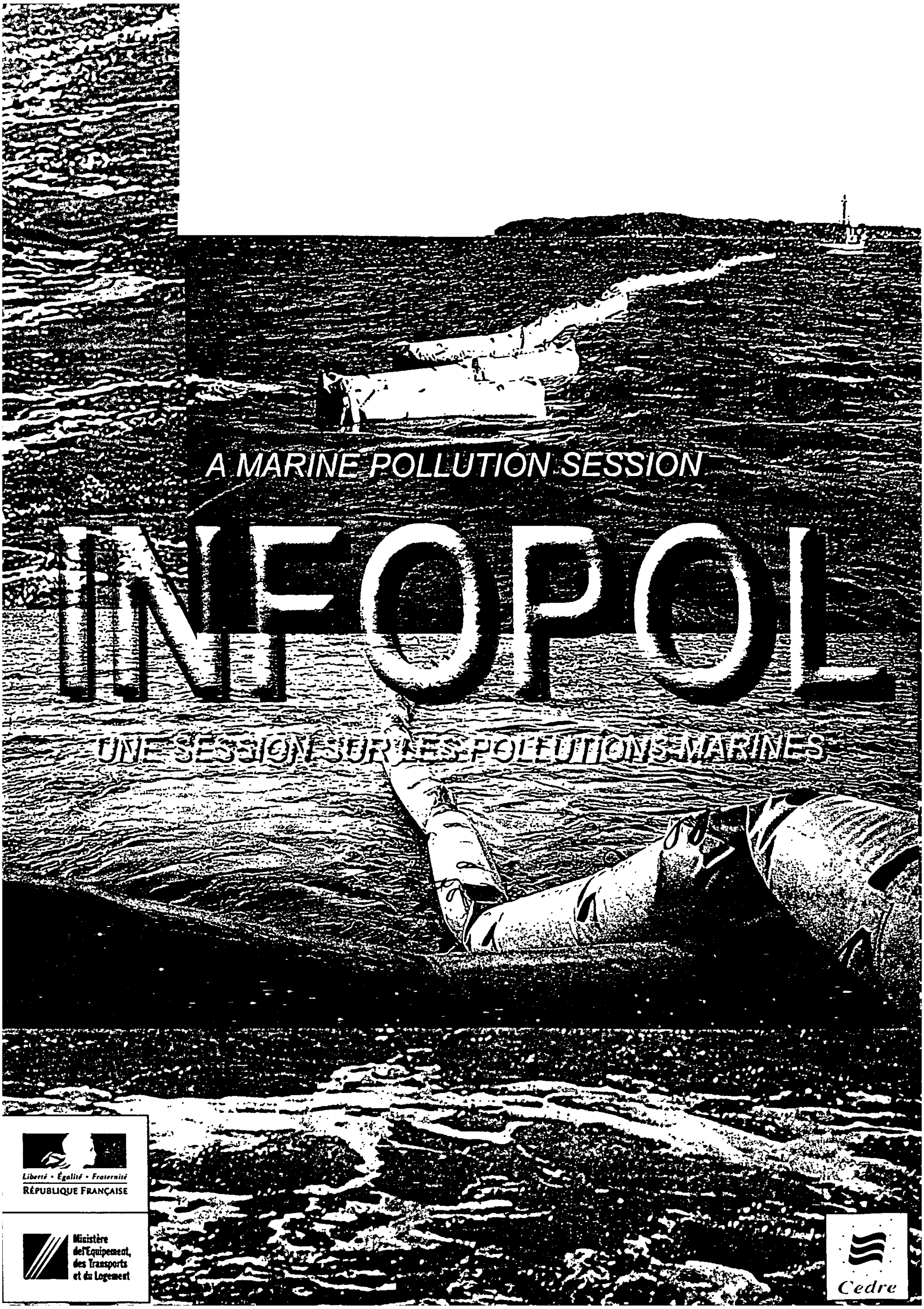
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Ministère de l'Equipement, des Transports et du Logement
Cedre

...AMOCO CAĿA ĿIVIPKĿƆƆ, ĿKIKA...

...ce sont des milliers de tor thousands of tonnes of oil that have
kilomètres de côtes. Aucun pf coastline.
risk of an accident occuring along its
la connaissance idable environment; therefore it is essential
préparation à la ent and control

OBJECTIFS OBJECTIVES

INFOPOL offre une synthèse et ue knowledge acquired and the consideration raised by
les problèmes posés par la polluti biology, oceanography, marine law or the techniques
droit maritime ou les techniques dpills and pollution caused by hazardous substances.
bures et substances dangereuses ed by the existing means, on the precautions required

INFOPOL sensibilise les participai them. It allows attendees to prepare for exercising their
mise en œuvre, l'opportunité de le
sabilités. equently to mutual assistance, thanks to the ties bound

INFOPOL est une source de cont
se tissent au cours des deux sem

PROGRAMME PROGRAMME

Au cours de la première semaimentation, Research and Experimentation on accident-
d'Expérimentations sur les polluti equences of pollution from the scientific, technical and
niques et opérationnels, le dérouls. facilities (regional operational centre for vessel sur-
tions du C.R.O.S.S (Centre Régiried out by the French Navy with the implementation of
tration organisée avec les moyen

La deuxième semaine, qui se dérwill make participants study oil spill control systems by
tir des mesures de prévention et rganisation to be implemented in the event of an acci-
crée, pour l'essentiel, aux questioocuses on issues related to ports, to oil operations and
mesures à prendre en étudiant dd on real fact cases.

Des exercices et présentations dhe Port Authority, the Civil Security and members of the
du Port Autonome, de la Sécuritéonstructors and service providers).
nal des constructeurs d'équipeme

THEMES ABOR ISSUES RAISED

La réglementation internationale International rules
Les principes généraux de l'orga General principles of the French organisation
L'impact des pollutions accidente Impact of oil pollution on the coastline
Les aspects chimiques et biologi Chemical and biological aspects of a pollution
Le pétrole et son évolution sur l'eaviour of oil on water in the event of an accidental spill
L'intervention sur les substances Controlling a chemical spill at sea
Les stratégies de lutte contre les Accidental water pollution control strategies
La cartographie pour la préparati Mapping for contingency plans
La télédétection aéroportée en m Airborne remote sensing at sea
Les systèmes informatisés d'aide Decision aid computer systems
Une démonstration dynamique d Demonstration of dynamic pollution control equipment

ORGANISATION

La Direction du Transport Maritime, des Ports et du Littoral du Ministère chargé de la Mer organise, avec le concours du *Cedre,* du Port Autonome de Marseille, et la participation active de la Marine nationale, de la Direction de la Sécurité Civile, de la société pétrolière Total Fina Elf et du SYCOPOL, ce séminaire de sensibilisation aux problèmes de prévention et de lutte contre les pollutions marines.

INFOPOL s'adresse aux cadres étrangers concernés par les problèmes de pollution marine :

- Responsables portuaires
- Sociétés pétrolières
- Compagnies de navigation
- Environnementalistes
- Administrations...

D'une durée de 15 jours, INFOPOL se déroule tous les ans au mois de juin à Paris, au *Cedre* à Brest, puis au Port Autonome de Marseille.

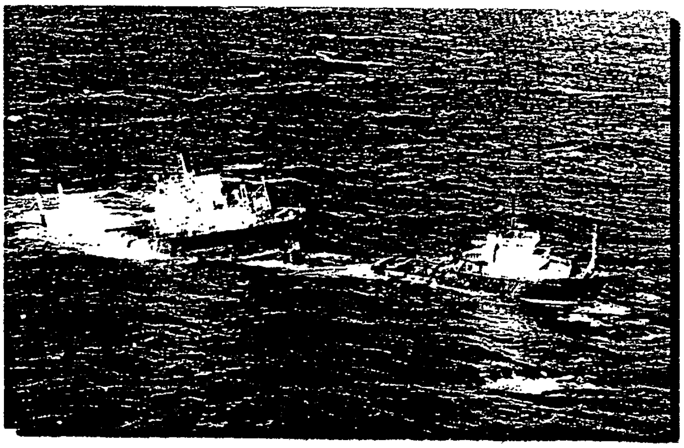
ORGANISATION

The Direction of Maritime Transport, Ports and Coastline, under the Ministry of the Sea, organises this seminar with the assistance of *Cedre*, of Marseilles Port Authority, and the active participation of the French Navy, of the Direction of the Civil Security, of Total Fina Elf oil company and of the SYCOPOL, to make the participants sensitive to the prevention and control of marine pollution.

INFOPOL is intended for foreign executives concerned with the marine pollution problems:

- Port officials
- Oil companies
- Shipping companies
- Environmentalists
- Governmental agencies...

INFOPOL is a two-week seminar held yearly in June in Paris, at *Cedre* in Brest and at the Port of Marseilles.



Crédit photos
page 1 : CEDRE
pages centrales : Port Autonome de Marseille
page 4 : Marine nationale

INSCRIPTION

Auprès de la Direction du Transport Maritime, des Ports et du Littoral ou du *Cedre*.

Les frais d'inscription comprennent l'accueil, le séjour et les transports en France. Le voyage aller-retour Paris est à la charge des participants.

REGISTRATION

Please contact the Direction of Maritime Transport, Ports and Coastline or *Cedre*.

The registration fees include hospitality, living and travel expenses in France. The round trip fare to Paris is at the participants' own cost.

DIRECTION DU TRANSPORT MARITIME DES PORTS ET DU LITTORAL
22, rue Monge - 75005 PARIS - France
Tel. : 33 1 40 81 71 37 - Fax : 33 1 40 81 70 30

CENTRE DE DOCUMENTATION, DE RECHERCHE ET D'EXPERIMENTATIONS SUR LES POLLUTIONS ACCIDENTELLES DES EAUX
Rue Alain Colas - BP 20413 - 29604 BREST CEDEX - France
Tel. : 33 2 98 33 10 10 - Fax : 33 2 98 44 91 38 - E-mail : cedre@ifremer.fr

INFOPOL 2002

LISTE DES MINISTERES ET SOCIETES AYANT PARTICIPE A L'ORGANISATION DE LA SESSION

1 ADMINISTRATION, ETABLISSEMENTS ET ORGANISMES PUBLICS

PREMIER MINISTRE Secrétariat Général de la Mer 16 boulevard Raspail 75007 PARIS Tél. : 01 53 63 41 53 Fax : 01 53 63 41 78	**M. SYLVESTRE**
MINISTERE DES AFFAIRES ETRANGERES 37 quai d'Orsay 75007 PARIS Tél. : 01 43 17 44 13 Fax : 01 43 17 57 45	**M. PUJOLAS** **M. SEILLAN**
MINISTERE DE L'EQUIPEMENT, DES TRANSPORTS, DU LOGEMENT, DU TOURISME ET DE LA MER Direction du Transport Maritime des Ports et du Littoral 22, rue Monge 75005 PARIS Tél. : 01 40 81 71 37 Fax : 01 40 81 70 30	**M. GILLE** Directeur **M. WEIZMANN** Chargé de Mission **M. VERNIER** Chef de bureau
DIRECTION DEPARTEMENTALE DE L'EQUIPEMENT Subdivision Phares et Balises Avenue de Kiel 24801 BREST Tél. : 02 98 33 40 00 Fax : 02 98 33 41 53	**M. LOUARN** **M. LE GOIC**

SERVICE TECHNIQUE DE LA NAVIGATION MARITIME
ET DES TRANSMISSIONS DE L'EQUIPEMENT
Technopole Brest-Iroise – B.P. 05
29280 PLOUZANE

Tél. : 02 98 05 67 51
Fax : 02 98 05 67 67

M. QUINQUIS
Mme FLOCH

MINISTERE DE LA DEFENSE
2 rue Royale
Etat Major de la Marine
00350 ARMEES

Tél. : 01 42 92 17 03
Fax : 01 42 92 17 13

M. CELERIER
Adm. en Chef des Affaires Maritimes
M. DARRAS

Préfecture Maritime Atlantique
Château
29240 BREST NAVAL

Tél. : 02 98 22 10 80

M. MERLE
Commissaire Général

Préfecture Maritime de la Méditerranée
83800 TOULON NAVAL

Tél. : 04 94 24 90 00

M. LAROCHE
Commissaire

CEPPOL

Tél. : 02 98 80 20 41
Fax : 02 98 22 09 91

M. C.F. PINLOU
Président

MINISTERE DE L'ECONOMIE ET DES FINANCES
(DAJ)
Direction Générale des Douanes et des Droits Indirects
23bis rue de l'Université
75007 PARIS
Tél. : 01 44 74 44 33
Fax : 01 55 04 65 94

M. HEBERT
M. BEAUFRERE
Chef de bureau

MINISTERE DE L'INTERIEUR
Direction de la Défense et de la Sécurité Civiles
Bureau des Risques Naturels et Technologiques
87-95 quai du Dr. Dervaux
92600 ASNIERES

Tél. : 01 56 04 74 16
Fax : 01 56 04 76 00

M. LECROC
Lieutenant de Vaisseau

C E D R E
Centre de Documentation, de Recherches et d'Expérimentations sur les Pollutions Accidentelles des Eaux
Rue Alain Colas
B.P. 20413
29604 BREST Cedex

Tél. : 02 98 33 10 10
Fax. : 02 98 44 91 38

M. GIRIN
Directeur
M. GUÉNA
Responsable Service Formation

IFREMER
Institut Français de Recherche pour l'Exploitation de la Mer
Centre de Brest
Technopole Brest-Iroise – B.P. 70
29280 PLOUZANE

Tél : 02 98 22 40 40

M. LE VERGE
Directeur

Centre de Toulon
Laboratoire Côtier – B.P. 330
83507 LA SEYNE Cedex

Tél. : 04 94 30 48 20

M. DENIS

PORT AUTONOME DE MARSEILLE

Capitainerie
23 place de la Joliette
13226 MARSEILLE Cedex 02

Tél : 04 91 39 40 00
Fax : 04 91 39 40 40

Cdt MOYSAN

IFEP
Institut de Formation et d'Echanges Portuaires

Tél : 04 91 39 41 57
Fax : 04 91 39 40 90

M. LE DANTEC

2. GROUPEMENTS PROFESSIONNELS ET ASSOCIATIONS

COMITE CENTRAL DES ARMATEURS DE FRANCE
47 rue de Monceau
75008 PARIS

Tél : 01 53 89 52 52

Mme ODIER
Chef du Service Juridique

SYCOPOL
SYNDICAT FRANÇAIS des constructeurs d'équipement et des prestataires de service de lutte contre la pollution
530, rue Mayor de Montricher
Z.I. Les Milles
BP 291000
13798 AIX-EN-PROVENCE Cedex 3
Tél. +33 (0)4 42 24 57 57
Fax +33 (0)4 42 24 57 76

M. VANBAELINGHEM

Liste des membres du SYCOPOL

ZODIAC
AERAZUR
Division Techniques Elastomères

ZODIAC AERAZUR
Division des Techniques Elastomères
D. ROBERT
4 rue lesage Maille
76320 CAUDEBEC LES ELBEUF
tel : 33 (0)2.32.96.56.81
fax : 33 (0)2.32.96.56.01
Mobile : 33 (0)6 60 23 70 06
mel : DRobert@zodiac.com

Barrages auto-flottants
Barrages gonglables Tourets
Stockages flottants Stockages souples auto-porteurs

AQUAPOLL
S.A.R.L. M. CAVALEC
J. BRONNEC
Rue Joseph le Brix
29260 PLOUDANIEL (FRANCE)
tel : 33 (0)2 98 45 15 27
fax : 33 (0)2 98 83 77 14
mel : MC-AQUAPOLL@wanadoo.fr

Equipements d'écrémage et de nettoyage de plages
Bateaux récupérateurs "SEAPOLL"
Unités amphibies "AMPHIPOLL" de récupération sur eau et sur plages

ARCAD TECHNOLOGIES
J. PARRAVANO
Aéroport - Bâtiment 101
BP13
78117 TOUSSUS LE NOBLE
Tel : 33 (0)1 39 56 78 27
Fax : 33 (0)1 39 56 78 28
mel : arcad.technologies@wanadoo.fr

Nettoyeurs HP
Aspiration industriel triphasé
Pulvérisation des formulations chimiques
SAV

BACOU DEVELOPPEMENT
Y. BOURDET - M. VISINALI
Z.I. de la Pointe Ringale
91250 SAINT-GERMAIN-LES-CORBEILS
Tel : 33 (0)1 69 89 85 40
Fax : 33 (0)1 69 89 12 32
http://www.bacou-developpement.fr

Equipement de protection industrielle

BATAILLE S.A.
X. Barteau & J.M. Douillère
Rue Bertin
76330 Notre Dame de Gravenchon
tel : 33 (0)2.35.38.60.99
fax : 33 (0)2.35.31.47.33
mel : info@bataille-sa.fr
http://www.bataille-sa.fr

Nettoyage industriel
Dépollution maritime, aquatique et terrestre (stock d'intervention)
Transport de déchets liquides et solides
Destruction en décharge agréée
Tel d'urgence 24h/24 : 06.14.31.19.21

CECA S.A.
Gérald Larive
Indusnor Avenue Alfred Nobel
64000 PAU
tel : 33 (0)5.59.92.44.00
fax : 33 (0)5.59.92.44.02
mel : gerald.larive@ceca.elf-atochem.fr
http://www.ceca.fr, produits, matériels

Dispersant
Gélifiant
Produit filmogène
Récupérateurs sous vide
Canons et rampes à dispersant
Récupérateurs à tambour

CFG
Eric Lasne
Avenue Claude Guillemin
BP 6429
45064 Orléans Cedex
tel : 33 (0)2.38.64.38.72
fax : 33 (0)2.38.64.32.83
mel : cfg.orleans@wanadoo.fr

Recherche de fuite sur structures enterrées
Analyse en temps réel par camion laboratoire de matières polluées (sol)

DJET
Gilbert Parcollet
ZI des Pierrelets
45380 Chaingy
tel : 33 (0)2.38.43.44.97
fax : 33 (0)2.38.43.95.47
mel : contact@djet.net

Rampes dispersant
Projetcteurs & récupérateurs d'absorbant
Absorbant
Récupérateurs disques
Tangon
Stock d'intervention
Interventions
Barrages anti-feu

FOSELEV INDUSTRIES - MIM - SIS
J-P Vanbaelinghem - D. Laborde
13270 FOS SUR MER
64150 OS MARSILLON
76340 ST VIGOR D'YMONVILLE
tel : 33 (0)4 42 24 57 57
fax : 33 (0)4 42 24 57 76
mel : info@foselev.com
http://www.foselev.com

Prestations de service : nettoyage HP de zones polluées avec récupération des effluents.
Gestion globale des interventions

GAMLEN
Daniel Desmichels
17, route de Rouen
27950 Saint Marcel
tel : 33 (0)2.32.64.35.35
fax : 33 (0)2.32.51.43.24
mel : ddexport@compuserve.com
stmarcel@gamlen.com
http://www.gamlen.com

Dispersant
Biodégradant
Absorbant
Produit de lavage

GEP - Groupement des entreprises parapétrolières et paragazières
J. BOUVET - V. VACHIER
45 rue Louis Blanc
92038 Paris La Défense Cedex
tel : 33 (0)1.47.17.67.37
fax : 33 (0)1.47.17.67.47
mel : gep@gep-france.com
http;//www.gep-france.com

Le GEP rassemble 150 sociétés, fournisseurs d'équipements et de services à l'industrie pétrolière et gazière internationale. Il a pour but de promouvoir l'image technologique et commerciale de l'industrie française à l'étranger et d'animer le réseau des entreprises établies en France.

HALECO DEPOLLUTION MARINE
Eric BELLON
BP 303
Avenue d'Orange
84706 SORGUES
tel : 33 (0)4.90.39.39.66
fax : 33 (0)4.90.39.39.79
mel : clients@haleco.fr
http://www.haleco.fr

Barrages absorbants
Produits de Biorémédiation
Kit de dépollution
Absorbants polypropylène
Equipement de dépollution

IDRA ingéniérie environnement
Monsieur BERAUD
Avenue Robert Schuman- Ker Lann
35170 BRUZ
tel : 33 (0)2.99.05.50.05
fax : 33 (0)2.99.05.40.90
mel : info@idra-environnement.com
http://www.idra-environnement.com

Gestion des opérations de dragage
Traitement et conditionnement
Réalisation / valorisation des matériaux dragués ou traités
Traitement des hydrocarbures contenus dans l'eau
Gestion des pollutions accidentelles

LE FLOCH DEPOLLUTION
Patrick Le Floch
Z.I. de Keriven
Rue Edouard Branly
29600 Saint Martin des champs
tel : 33 (0)2.98.15.11.13
fax : 33 (0)2.98.15.11.14
mel : leflochdepollution@libertysurf.fr
http://www.leflochdepollution.com

Récupérateurs
Pompes
Laveurs à eau chaude HP
Interventions 24H

MEXEL S.A.
Antoine VANLAER
3 rue Mirabeau
59370 MONS EN BAROEUL
tel : 33 (0)3.28.76.93.20
fax : 33 (0)3.28.76.93.21
mel : info@mexel.fr
http://www.mexel.fr

Traitement de surfaces
Traitement des circuits ouverts
Circuits de refroidissement

REIMS AVIATION
G. ILLIEN
Aérodrome de Reims Prunay
BP 2745
51062 REIMS CEDEX
tel : 33 (0)3.26.48.46.46
fax : 33 (0)3.26.49.18.57
mel : reims.aviation@reims-aviation.fr
http://www.reims-aviation.com

REIMS F406 POLMAR :
Contrôle des pollutions maritimes par avion

REP
Jean-Charles Lavergne &
Nicolas Tramier
40, avenue Jean Jaurès
ZI pétrolière
78440 Issou Gargenville
tel : 33 (0)1.30.98.80.00
fax : 33 (0)1.30.98.82.01
mel : info@rep.fr
http://www.rep.fr

Dispersant
Solvant
Absorbant
Produit filmogène
Desémulsifiant
Effaroucheur à oiseaux
Produits de lavage

RIVARD ABSORBPAL
Michel Galard
4 rue de la Fraternité
49640 Daumeray
tel : (0)2.41.33.68.68
fax : (0)2.41.32.51.70
mel : rivard@wanadoo.fr
http://www.absorbpal.com

Absorbant polymère
Stock d'intervention plan ASAP
Matériel d'assainissement
Pompes haute pression
Barrages flottants

SCHOELLER HOESCH
A GLATFELTER Company

SCHOELLER & HOESCH SARL
Jean Brink
ZI - Rue de la Mazière
F - 67130 Wisches
tel : 33 (0)3 88 47 35 00
fax : 33 (3) 88 47 33 80
mel : jean.brink@schoellerhoesch.fr
info@schoeller-hoesch.com
http://www.schoeller-hoesch.com

Absorbants d'hydrocarbures en microfibres de polypropylène
Barrages absorbants
Kits d'intervention
Essuyage professionnel
Stock d'intervention disponible sous 24 heures

TMB
Techniques Michel BROCHIER

TMB
Michel Brochier
ZI rue des Chartinières
01120 Dagneux Cedex
tel : 33 (0)4.78.06.32.22
fax : 33 (0)4.72.25.98.25
mel : michelbrochier@walter.fr
http://www.tm-brochier.com

Barrages flottants
Barrages gonflables avec tourets
Stockage à terre
Tentes gonflables PC

TOTAL

TOTALFINAELF
J. LELEUX - C. VARESCON
51 Esplanade du Général de Gaulle
La Défense 10
92907 PARIS LA DEFENSE Cedex
tel : 33 (0)1.41.35.22.51
fax : 33 (0)1.41.35.52.90
mel : jerome.leleux@totalfinaelf.com
christian.varescon@totalfinaelf.com
http://www.totalfinaelf.com

Dispersants marins

3. ENTREPRISES

TOTAL FINA ELF

Direction Environnement Sécurité Industrielle Exploration Production — **M. TRAMIER**
Direction Trading — **M. CALONNE**
MLLE MOHR
M. THOUILIN

Tél : 01 41 35 41 39
Fax : 01 41 35 64 45

INFOPOL 2002

Paris, Brest, Marseilles, 10- 21 June 2002

PROGRAMME

Paris, Monday, 10 June

8:00	Bus leaves Richemont Hotel *17, rue Jean Colly 75013 Paris. Telephone: 01 45 82 84 84 – Fax: 01 45 82 88 80*
9:00	Opening address Mr. **GILLE**, Director Department of Maritime Transport, Ports and the Coast (DTMPL) French Ministry of Equipment, Transport, Housing, Tourism and the Sea 22, rue Monge 75005 Paris – Conference room L406
9:15	Presentation of the delegates Mr. WEIZMANN, Project Manager, International Co-operation Department of Maritime Transport, Ports and the Coast (DTMPL) French Ministry of Equipment, Transport, Housing, Tourism and the Sea
10:00	General policy of the French organisation as regards pollution response Mr. SILVESTRE - General Secretariat of the Sea
11:15	Shipowners' responsibility as regards accidental pollution and damage compensation Mrs ODIER, Head of Legal Department - French Shipowners Association (CCAF)
12:30	**Lunch given by DTMPL**
14:00	The IOPC Fund and compensation system Mr. HEBERT - Legal Affairs Department French Ministry of Economy, Finances and the Industry
15:00	Responsibility and activities of the French government in the event of coastal pollution Mr. VERNIER, Head of the Office of the Coast and Public Maritime Domain - DTMPL French Ministry of Equipment, Transport, Housing, Tourism and the Sea
16:00	MARPOL 73/78 Convention - Annex 1 Mr. WEIZMANN
17:00	Departure to Paris-Orly-West airport
18:50	Departure to Brest (flight AF 7370)
20:00	Arrival in Brest. Transfer to Mercure-Continental Hotel, *Square de la Tour d'Auvergne 29000 Brest. Telephone: +33 (0)2 98 80 50 40 – Fax: +33 (0)2 98 43 17 47*

Brest, Tuesday, 11 June

8:00	Bus leaves hotel
8:15	Registration
8:45	Opening speech and presentation of *Cedre* Mr. GIRIN, Director - *Cedre* Mr. PEIGNÉ, Head of Response Department Deputy Manager - *Cedre* Mr. GUÉNA, Head of Training Department - *Cedre*
9:40	Future prospects in the field of pollution response Mr. GIRIN
10:10	***Break***
10:30	Principles and strategies of response to pollution at sea and on the shoreline Mr. GUÉNA
11:30	Responsibilities and activities of the French government in the event of marine pollution Mr. VELUT - French Navy
12:30	***Lunch***
13:45	Visit of *Cedre* technical facilities (Command Centre, flume test, laboratory)
14:15	Departure to the POLMAR stockpile (POLlution MARitime – MARitime POLlution)
14:30	Visit
15:45	Departure to the CROSS CORSEN Marine Rescue Co-ordination Centre
16:15	Visit
17:45	Bus leaves CROSS CORSEN
18:15	Back to hotel
19:00	*Cocktail party given by Cedre*

Brest, Wednesday, 12 June

8:30	Bus leaves hotel.
9:00	Dispersants: methods of application. Policy for using dispersants at sea and in coastal belts Mr. MERLIN, Head of Research & Development Department - *Cedre*
10:20	***Break***
10:40	Presentation of Thursday morning exercise CF PINLOU
11:00	Strategic aspects of containment and recovery at sea and in coastal areas Mr. PEIGNÉ
11:45	**Forum "Response at sea / Response on the coast"**

The forum will focus on case histories to present and discuss the benefits which can be expected from oil spill response alternatives, the advisability of their implementation as well as their most recent technical developments.

"The *Erika* and *Ievoli Sun* casualties: pollution course and response operations progress"

11:45 - 12:15: Erika: response operations at sea
Mr. PEIGNÉ

12:15 ***Lunch***

14:00 - 15:00	*Rescue and salvage operations* ***Captain** CLADEN, "Abeille Flandre" tug Master*
15:00 - 15:30	*Response operations on the Erika and Ievoli Sun wrecks* *CF. PINLOU*
15:30 – 15:50	*Break*
15:50 – 16:45	*the Erika oil spill: organisation and management of coastal response* *Mr. KERAMBRUN, Head of Pollution Monitoring Department - Cedre*
16:45 - 17:15	*Waste management* *Mr. KERAMBRUN*
17:15 - 18:00	*Panel discussion*

18:00 Back to hotel.

Brest, Thursday, 13 June

8:45	Bus leaves hotel.
09:00	Response at sea: exercise/demonstration. **French Navy**
12:00	Departure to *Cedre*
12:30	***Lunch***
14:00	Delegates present case histories
15:00	**SYCOPOL** (Association of pollution response equipment constructors and service providers) *15:00* The *Erika* casualty experience feed-back **Ms LABORDE** *15:45* Presentation and demonstration of response equipment
19:00	Cocktail/barbecue given by the **SYCOPOL**
20:30	Back to hotel

Brest, Friday, 14 June

8:30	Bus leaves hotel
9:00	Shoreline cleanup techniques: effectiveness and limits "How clean is clean?" **Mr. KERAMBRUN**
10:00	***Break***
10:20	Hazardous and Noxious Substances: behaviour and risks Response to chemical spills Case history: the "*Ievoli Sun*" casualty **Mr. CABIOC'H**, Head of Response Department - *Cedre*
12:00	***Lunch***
13:30	Introduction to crisis management. **Mr. ROUSSEAU**
15:00	***Afternoon off*** *19:15* ***Delegates meet in the lobby***
19:30	Dinner given by *Cedre*
22:00	Back to hotel

Brest, Saturday, 15 June

9:30 Departure to Brest airport.

10:50 Departure to Marseilles via Paris (flight AF 7365)

Flights connection in Paris-Orly airport: *arrival from Brest at 12:00*
departure from Paris at 13:35 (AF 6056)

14:50 Arrival at Marseilles-Marignane airport
Bus transfer to the Mercure Euro Centre Hotel, *1, rue Neuve Saint-Martin*
13001 Marseilles. Telephone: 04 96 17 22 22 - Fax: 04 96 17 22 33

Afternoon off

Marseilles, Sunday, 16 June

9:30 Bus leaves hotel.
Sightseeing in Marseilles area.
Lunch in Cassis.

Marseilles, Monday 17 June

8:30	Bus leaves hotel.
9:00	Opening address. **Mr. BRASSART,** Managing Director - Marseilles Harbour
9:15	Organisation of accidental marine pollution response in ports. Harbour Authority general mission. **CPT. MOYSAN,** Marseilles Harbour Master
10:15	***Break***
10:35	Accidental pollution: crisis and information management. The *Ievoli Sun* case history. **Mr. DENIS,** IFREMER (French Institute for research and the exploitation of the Sea)
11:35	Case histories presentation
12:30	***Lunch***
14:00	Group work on case histories.
19:00	Cocktail party given by Marseilles Harbour.

Marseilles, Tuesday 18 June

8:30 Bus leaves hotel.

8:45 MARPOL Convention (concluded).
The carriage of dangerous goods.
IMDG (International Maritime Dangerous Goods) Code
Mr. WEIZMANN

10:30 ***Break***

10:45 Action taken in refineries to meet environmental protection requirements.
Mrs DURAND-PINCHARD, Head of Environment Dpt. - BP.

11:45 Solid waste treatment
Mr. MINGUOZZI – Salamat Merex

Merclean
Mr. BOURHIS

12:45 ***Lunch***

14:00 Marseilles Harbour safety regulations.
CPT. MOYSAN

15:00 Presentation of the chemical decontamination medical unit.
Presentation of the mobile mass spectrometry unit.
Introduction to Wednesday exercise.
MARSEILLES MARINE FIRE-FIGHTERS (BMPM)

17:30 End of day

Marseille, Wednesday 19 June

8:30 Bus leaves hotel.

DELEGATES PARTICIPATE IN MARSEILLES MARINE FIRE-FIGHTERS' ANNUAL DRILL

12h30 ***Lunch***

Afternoon off

Marseilles, Thursday 20 June

8:30 Bus leaves hotel

9:00 The *Bonnex Alpha* case: loss of a container at sea.
Mr. WEIZMANN

10:15 Unloading, loading and/or off-loading of noxious liquid substances carried in bulk (control and safety).
Mr. BROUCHERY - Shipping Audit Survey

11:00 ***Break***

11:15 Safety on a daily basis in Fos-Lavéra oil terminals.
Mr. PEMARTIN, Harbour master in charge of the Western Harbour.

12:00 Presentation of Marseilles Harbour Training Institute.

12:30 ***Lunch***

14:00 Afternoon visits:

- The French Customs POLMAR remote sensing aircraft
- FOST (Fast Oil Spill Team – Total Fina Elf)

Marseilles, Friday 21 June

8:30 Bus leaves hotel.

9:00 The delegates present practical examples.

10:00 Report of the case histories study.

11:00 ***Break***

11:15 Evaluation of the seminar.

13:00 ***Lunch***

14:30 Departure to Marseilles-Marignane airport.

16:30 Departure to Paris-Orly airport (flight AF6037).

17:50 Arrival at Paris-Orly airport.
Bus transfer to RICHEMONT Hotel
17, rue Jean Colly 75013 Paris. Telephone: 01 45 82 84 84 – Fax: 01 45 82 88 80

Paris
Monday, 10 June

GENERAL POLICY OF THE FRENCH ORGANISATION AS REGARDS POLLUTION RESPONSE

GENERAL PRINCIPLES OF THE FRENCH ORGANIZATION

Daniel SILVESTRE
General Secretariat of the Sea

PREAMBLE

This paper very broadly describes the French organization for combating pollution. It does not intend to present this organization as a model suitable for other countries where preexisting structures are different. It will describe an approach and present a few reflections on the matter.

1. ADMINISTRATIVE INSTITUTIONS OF THE STATE

1.1. Central administration of the State

France is a centralized State. Therefore the Prime Minister and, within his competence, each Minister, have important responsibilities. For instance, the Minister of the Sea, the Minister of Defence (French Navy), the Home Minister, the Minister of the Environment have their own competence in the field of water pollution. Some of their actions are specifically presented in other lectures.

1.2. Local organization of the State

The administrative organization of the State has been subject to deconcentration and decentralisation measures. Without entering into the details of French legislation and its recent evolution nor mentioning all local structures of the State, we will present those which play an essential role in preventing and combating marine pollution, with a distinction between two areas: land and sea.

1.2.1. On land

The French territory is divided into 96 "departments" (equiv: county) - overseas departments not included. In each department, the Government appoints a "Prefect" who represents the State and leads all local offices of civilian administrations of the State (between 1982 and early 1988, the Prefect had the title of "Commissaire de la République").

The deconcentrated services are specialized according to their technical competence: e.g. the Departmental Bureau of "Equipment" (for public works and construction), or of Agriculture or "Direction Départementale de la Sécurite Civile" (Civil Safety), etc.

The "Conseil Général" is an elected Assembly which takes decisions for matters within the competence of the "department" (by opposition to State competence).

In 1982, many State competences were transferred to the Conseil Général.

1.2.2. At sea

The responsibility of all affairs at sea, including civilian affairs, is given to the "maritime Prefects" who are Admirals depending from the Ministry of Defence. There are three seaboards: the Western coast is divided into two areas: one from Belgium to the Mont St-Michel, with the maritime Prefect in Cherbourg and one from the Mont St-Michel to Spain, with the maritime Prefect in Brest; for the whole French Mediterranean area, Corsica included, the maritime Prefect is in Toulon.

The maritime Prefect co-ordinates all civilian and military administrations of the State for all their actions at sea.

In each maritime Prefecture, Cherbourg, Brest, Toulon, a Bureau is specifically in charge of "Affaires Civiles de la Mer" (civilian affairs of the sea).

A lecture is given in Brest by the officer Head of the "bureau des Affaires Civiles de la Mer", describing his responsibilities.

2. ADAPTATION OF THIS ORGANIZATION TO THE NEEDS RELATED TO FIGHTING ACCIDENTAL MARINE POLLUTION

2.1. The circumstances

Following successive disasters from 1967 (*Torrey Canyon*) to 1988, French authorities gave consideration to the best means to prevent and combat marine pollution.

It had been considered to create a French Coast Guard (or even a European one from Greece to Denmark).

Such a solution might seem attractive and some politicians or some sectors of public opinion regularly raise that question. Such an idea, although tempting because of its apparent simplicity, appeared inadequate for a country like France where pollution control activities are mainly central State responsibilities.

2.2. Solution chosen in France

The solution chosen in the consequences of this analysis: France has central and local administrative structures and each one operates in its field of competence in a very efficient way. Therefore the approach was a pragmatic one: to use and adapt the knowledge of each one in his field of competence to pollution fighting.

Example: daily practice of military of "aeronavale", using customs aircraft for remote sensing, skit of lighthouse authority personnel for laying buoys or other instruments at sea, etc.

But skill and experience are not enough. It is necessary to plan various levels, will act to prevent or face an oil spill.

The measures taken

First measure: a decree of 9 March 1978, organizing the actions of the State at sea, takes into account marine pollution response (this decree was issued one month before the *Amoco Cadiz* disaster!). And very quickly French authorities drew lessons from the disaster.

Second measure: a decree of 22 November 1995 creates the "Secrétariat Général de la Mer" (interministerial mission for the Sea). As its very name shows the Mission is a light structure in charge of co-ordinating the action of the administrations intervening (in a broad meaning) at sea or on the shoreline. The Mission had been put under direct authority of the Prime Minister. Later the Prime Minister delegated his co-ordination powers to the Minister in charge of the Sea. The Mission has no direct operational role but it is very efficient to move and co-ordinate all administrative structures either in the elaboration of preventive measures or to prepare combating operations, as well as a central correspondent for all international co-operation activities pollution combating.

Third measure: an instruction of 17 December 1997 relative to combating accidental marine pollution details the measures to be taken within the framework of the plans POLMAR-Mer (Sea) and POLMAR-Terre (Land). These plans are aimed at defining "in peace time" the measures to be taken in case of an accident creating or likely to create pollution. There is one "POLMAR-Mer" plan for each maritime Region and one "POLMAR-Terre" plan for each department. A general principle governs all of them: co-ordination of existing services to take both preventing and combating measures, at central or local level.

Response at sea*: the maritime Prefect activates the «POLMAR-Mer» plan when he considers it as necessary.

Response on land*: the "POLMAR-Terre" plan is activated by the maritime Prefect of the 6 departments concerned.

** Note: the limit between "sea" and "land" is not the actual limit of water as the protection of beaches or estuaries with booms belongs to "fight on land". The pragmatic reason for this is that, in this context, "sea" stops where naval ships have not a sufficient depth of water to operate.

Co-ordination of plans in case of a major spill

- At central level: it is the responsibility of the CODISC (Centre Opérationnel de la Sécurité Civile - Operational Centre of Civilian Safety Administration) of the Home Ministry in close co-operation with the Mission interministérielle de la Mer.

- At local level: conference between the services of the maritime Prefect and those of the Prefect (s) of the department (s) concerned, who are responsible for carrying out the actual operations, which are all decentralized, with the very able support of CEDRE (Centre de Documentation de Recherche et d'Experimentation sur les Pollutions Accidentelles des Eaux - Centre of Documentation Research and Experimentation on accidental water pollution).

3. MEANS

3.1. Preparation of POLMAR plans

"If you want peace, prepare the war"

3.1.1. Increasing safety

To avoid accidents, efforts are concentrated on safety of navigation and of ships and, in the event of an incident, on a rapid response to prevent pollution.

This means strict application of international Conventions (MARPOL, Brussels 1969, etc.), development of surveillance centres and mainly the CROSS (Centre Regional Operationnel de Surveillance et de Sauvetage - Regional Operational Centre of Surveillance and salvage), multiplying observations by ships and planes, controlling ships in ports, etc.

3.1.2. Administrative organization

The POLMAR-Mer and POLMAR-Terre plans have to be established and organized before an accident occurs.

This means designating people for all headquarters and all co-ordination centres, at every level in such a way that a sector HQ is ready to operate day and night and to take immediate measures:

- information and advice
- evaluation of the pollution
- movement of equipment and personnel, etc.

3.1.3. Preparation of detailed plans

The POLMAR plans must at least include:

- List of the most vulnerable places to be protected as a priority (water intakes, aquaculture, mussel or oyster beds, estuaries, amenity areas, etc.).
- Plans for boom laying.
- Possibility to bring the equipment to the location (by sea or from land).
- Storage of fighting equipment; storage of recovered residues.
- List of heavy equipment available: helicopters, planes, tugs, lorries... Preparing a contingency plan is expensive but absolutely necessary.

3.2. Equipment and other resources

3.2.1. The Ministry of Defence (French Navy) and the Ministry of the Sea (Direction of Ports) finance the acquisition of the equipment which will be based in the various centres (see other lecture).

3.3. Technical assistance for the preparation of the plans and for the percution.

Together with the competent administrations, CEDRE plays an essential role in all the operations: preparation of plans, interventions after an accident, drills, training, research, etc. CEDRE is more and more recognized internationally for its competence. Other bodies, which will be met during the session, also contribute to the research.

3.4. Drills and training

Once the equipment has been purchased, the plans drafted, the list of competent people established, the efficiency of the system has to be tested:

- permanent check of the plans,
- updating,
- checking the equipment conditions,
- replacing the equipment,

  Drills: they are very important and each year they are carried out in 3 or 4 departments together with all the actors of the POLMAR-Mer and POLMAR-Terre plans with the assistance of CEDRE.
- Training of personnel

The personnel of the lighthouse authority, the ports, the Navy, the "Direction Départementale de l'Equipement", etc. competent for safety-environment-pollution follow practical training to learn how to lay booms, clean the shore, use dispersants, etc.

3.5. Money

The cost of pollution response is high and the use of the funds available for personnel and equipment is to be justified and in case of an accident, where victims will be entitled to compensation, the efficiency of the resources and the expenses will have to be detailed.

NOTES

SHIPOWNERS' RESPONSIBILITY AS REGARDS ACCIDENTAL POLLUTION AND DAMAGE COMPENSATION

POLLUTION DAMAGE COMPENSATION

Françoise ODIER

Comité Central des Armateurs de France
French Shipowners' Association

Introduction

The regime of compensation for pollution damage was built up progressively to meet the needs arising from successive accidents.

This regime was originated with pragmatic views after the *Torrey Canyon* spill on November 29, 1969.

The circumstances of its origin resulted in making it very complex from the very beginning.

People in the shipping industry, mainly the shipowners, decided to implement a regime of voluntary and professional compensation in view to avoid an imperative and compulsory solution. This initiative taken by the shipowners paved the way for the product refiners thus resulting in the implementation of a private compensation regime which was doubling the regime that had stemmed from the November 2911969 CIVIL LIABILITY CONVENTION.

This professional compensation regime, initially designed as temporary, and abolished since Autumn 1997, had produced two private funds: TOVALOP, backed by the shipowners, and CRISTAL, backed by the product refiners.

- In spite of existing arguments over the implementation of private funds, IMO, upon the request of English and French governments to conduct a survey, had set up a Committee on this purpose, and from this moment never ceased to question the whole system of shipowner liability.

A scheme was finalised by this Committee and adopted on November 29, 1969, by a diplomatic conference as CIVIL LIABILITY CONVENTION. This Convention was to be further developed and was eventually completed by the Protocol of December 1811971.

The liability regime

The liability of oil tanker shipowners is appraised with regard to the general regime of liability, it is devised as to be added up to the general regime and to transform the basic principles in view to a better indemnification of the victims.

The victims of spill having actually nothing to do with shipping, they will not accept some aspects of the shipowner general liability, the justification of which can be found in the relationship existing between the shipowners but can not be imposed to the land victims.

This recognition of the land victims by the maritime institution is typical of oil spill and does for explaining the inventive scheme implemented, by the CLC of 1969.

I) The liability regime established by the

a) Risk-founded liability whereas the general regime is fault-founded

It was impossible to admit that the indemnification of victims be based on a navigation fault when it is the actual risk generated by oil carriage that should be the founding of the shipowner's liability. Three cases of exemption come to lighten the factual basis of liability, but these cases are more relevant to theory than to practice.

b) Liability assumed by the owner

During the discussions some would have liked to link the liability to the cargo: the idea was dropped as the owner can be more easily apprehended since the ship can always be arrested.

c) Liability tied to a compulsory insurance

This liability insurance entitles the victims to sue directly the insurer. This compulsory insurance is materialized by a certificate which has to be placed onboard. The insurance can be a P&I of any similar guarantee.

d) The liability is limited

In 1969 the liability was amounting to twice as much as the general regime with a maximum ceiling of $ 16,8 million. In the event of a damage this liability must lead to setting up a fund to be added up to the general liability fund and dedicated only to the oil spill damage indemnification of the victims.

II) Developments

a) Protocol *of 18 December 1979*

Establishment of a guarantee fund backed by a taxation upon the cargo (as per ton of oil unloaded) named FIPOL. This Protocol is not settling any liability with the owner of cargo but a participation to the indemnification. The Convention of 1971 brings the ceiling to $ 32,5 million for victims' indemnification. FIPOL covers the shipowner's liability as from $ 10 million.

b) Protocols of 1992

These protocols were adopted after long discussions to merely solve the problems arising from accidental oil spilis which happened after the *Torrey Canyon.*
Extension of the Convention to some types of substances and to tanker bunkers.
Raising of thresholds in order to increase the liability of the owners of small ships. Raising of ceilings.

c) End of voluntary regimes

These regimes had to work as long as the Conventions were not fully applied. Their extinction means that the Conventions of 1969 and 1971 have been widely ratified and can provide for the indemnification of victims.

CONCLUSION

None of these systems are suitable to meet the cost of a disaster of the *Exxon Valdez* type, which is at the root of the OIL POLLUTION ACT and of the principle of shipowner's unlimited liability.

NOTES

THE IOPC FUND AND COMPENSATION SYSTEM

THE INTERNATIONAL OIL POLLUTION COMPENSATION FUND 1992

Explanatory note prepared by the 1992 Fund Secretariat

May 2002

1 Introduction

Compensation for pollution damage caused by spills from oil tankers is governed by an international regime elaborated under the auspices of the International Maritime Organization (IMO). The framework for the regime was originally the 1969 International Convention on Civil Liability for Oil Pollution Damage (1969 Civil Liability Convention) and the 1971 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (1971 Fund Convention). This 'old' regime was amended in 1992 by two Protocols, and the amended Conventions are known as the 1992 Civil Liability Convention and the 1992 Fund Convention. The 1992 Conventions entered into force on 30 May 1996.

Due to a number of recent denunciations of the 1971 Fund Convention, this Convention will cease to be in force on 24 May 2002. Therefore this note deals primarily with the 'new regime', ie the 1992 Civil Liability Convention and the 1992 Fund Convention.

The **1992 Civil Liability Convention** governs the liability of shipowners for oil pollution damage. The Convention lays down the principle of strict liability for shipowners and creates a system of compulsory liability insurance. The shipowner is normally entitled to limit his liability to an amount which is linked to the tonnage of his ship.

The **1992 Fund Convention,** which is supplementary to the 1992 Civil Liability Convention, establishes a regime for compensating victims when the compensation under the applicable Civil Liability Convention is inadequate. The **International Oil Pollution Compensation Fund 1992 (IOPC Fund 1992** or **1992 Fund)** was set up under the 1992 Fund Convention. The 1992 Fund is a worldwide intergovernmental organisation established for the purpose of administering the regime of compensation created by the 1992 Fund Convention. By becoming Party to the 1992 Fund Convention, a State becomes a Member of the 1992 Fund. The Organisation has its headquarters in London.

As at 1 May 2002, 83 States were Parties to the 1992 Civil Liability Convention, and 77 States were Parties to the 1992 Fund Convention. The States Parties are listed in the Annex.

2 1992 Civil Liability Convention

2.1 Scope of application

The 1992 Civil Liability Convention applies to **oil pollution damage** resulting from spills of **persistent** oil from **tankers**.

The 1992 Civil Liability Convention covers pollution damage suffered in the **territory, territorial sea or exclusive economic zone (EEZ)** or equivalent area of a State Party to the Convention. The flag State of the tanker and the nationality of the shipowner are irrelevant for determining the scope of application.

'Pollution damage' is defined as loss or damage caused by contamination. For environmental damage (other than loss of profit from impairment of the environment) compensation is restricted, however, to costs actually incurred or to be incurred for reasonable measures to reinstate the contaminated environment.

The notion of pollution damage includes measures, wherever taken, to prevent or minimise pollution damage in the territory, territorial sea or EEZ of a State Party to the Convention (**'preventive measures'**). Expenses incurred for preventive measures are recoverable even when no spill of oil occurs, provided that there was a grave and imminent threat of pollution damage.

The 1992 Civil Liability Convention covers spills of **cargo or bunker oil** from sea-going vessels constructed or adapted to carry oil in bulk as cargo, and applies thus to **laden** tankers and in certain circumstances also to **unladen tankers** (but not to dry cargo ships).

Damage caused by **non-persistent oil** is not covered by the 1992 Civil Liability Convention. Spills of gasoline, light diesel oil, kerosene, etc, therefore do not fall within the scope of the Convention.

2.2 Strict liability

The owner of a tanker has strict liability (ie he is liable also in the absence of fault) for pollution damage caused by oil spilled from the tanker as a result of an incident. He is exempt from liability under the 1992 Civil Liability Convention only if he proves that:

(a) the damage resulted from an act of war or a grave natural disaster, or
(b) the damage was wholly caused by sabotage by a third party, or
(c) the damage was wholly caused by the negligence of public authorities in maintaining lights or other navigational aids.

2.3 Limitation of liability

Under certain conditions, the shipowner is entitled to limit his liability under the 1992 Civil Liability Convention. The limits are: (a) for a ship not exceeding 5 000 units of gross tonnage, 3 million Special Drawing Rights (SDR) (US$3.8 million); (b) for a ship with a tonnage between 5 000 and 140 000 units of tonnage, 3 million SDR (US$3.8 million) plus 420 SDR (US$533) for each additional unit of tonnage; and (c) for a ship of 140 000 units of tonnage or over, 59.7 million SDR (US$75.8 million)<1>. There is a simplified procedure under the 1992 Civil Liability Convention for increasing these limits.

If it is proved that the pollution damage resulted from the shipowner's personal act or omission, committed with the intent to cause such damage, or recklessly and with knowledge that such damage would probably result, the shipowner is deprived of the right to limit his liability.

2.4 Channelling of liability

Claims for pollution damage under the 1992 Civil Liability Convention can be made only against the registered owner of the tanker concerned. This does not preclude victims from claiming compensation outside this Convention from persons other than the owner. However, the Convention prohibits claims against the servants or agents of the owner, members of the crew, the pilot, the charterer (including bareboat charterer), manager or

<1> The unit of account in the 1992 Conventions is the Special Drawing Right (SDR) as defined by the International Monetary Fund. In this document, the SDR has been converted into US dollars at the rate of exchange applicable on 2 May 2002, ie 1 SDR = US$1.269680.

operator of the ship, or any person carrying out salvage operations or preventive measures. The owner is entitled to take recourse action against third parties in accordance with national law.

2.5 Compulsory insurance

The owner of a tanker carrying more than 2 000 tonnes of persistent oil as cargo is obliged to maintain insurance to cover his liability under the 1992 Civil Liability Convention. Tankers must carry a certificate on board attesting the insurance coverage. When entering or leaving a port or terminal installation of a State Party to the 1992 Civil Liability Convention, such a certificate is required also for ships flying the flag of a State which is not Party to the 1992 Civil Liability Convention.

Claims for pollution damage under the 1992 Civil Liability Convention may be brought directly against the insurer or other person providing financial security for the owner's liability for pollution damage.

2.6 Competence of courts

Actions for compensation under the 1992 Civil Liability Convention against the shipowner or his insurer may only be brought before the Courts of the State Party to that Convention in the territory, territorial sea or EEZ of which damage was caused.

3 1992 Fund Convention

3.1 Supplementary compensation

The 1992 Fund pays compensation to those suffering oil pollution damage in a State Party to the 1992 Fund Convention who do not obtain full compensation under the 1992 Civil Liability Convention in the following cases:

(a) the shipowner is exempt from liability under the 1992 Civil Liability Convention because he can invoke one of the exemptions under that Convention; or
(b) the shipowner is financially incapable of meeting his obligations under the 1992 Civil Liability Convention in full and his insurance is insufficient to satisfy the claims for compensation for pollution damage; or
(c) the damage exceeds the shipowner's liability under the 1992 Civil Liability Convention.

The 1992 Fund does not pay compensation if:

(a) the damage occurred in a State which was not a Member of the 1992 Fund; or
(b) the pollution damage resulted from an act of war or was caused by a spill from a warship; or
(c) the claimant cannot prove that the damage resulted from an incident involving one or more ships as defined (ie a sea-going vessel or seaborne craft of any type whatsoever constructed or adapted for the carriage of oil in bulk as cargo).

3.2 Limit of compensation

The maximum amount payable by the 1992 Fund in respect of an incident is 135 million SDR (US$171 million), including the sum actually paid by the shipowner (or his insurer) under the 1992 Civil Liability Convention. There is a simplified procedure under the 1992 Fund Convention for increasing the maximum amount payable by the 1992 Fund.

3.3 Competence of courts

Actions for compensation under the 1992 Fund Convention against the 1992 Fund may only be brought before the Courts of the State Party to that Convention in the territory, territorial sea or EEZ of which damage was caused.

It is expected that in most incidents to be dealt with by the 1992 Fund all claims will be settled out of court, as has been the case with the 1971 Fund.

3.4 Organisation of the 1992 Fund

The 1992 Fund has an **Assembly**, which is composed of representatives of all Member States. The Assembly is the supreme organ governing the 1992 Fund, and it holds regular sessions once a year. The Assembly elects an **Executive Committee** comprising 15 Member States. The main function of this Committee is to approve settlements of claims.

The 1992 Fund shares a Secretariat with the 1971 Fund (see section 4.2 below). The joint Secretariat is headed by a Director, and has at present 27 staff members.

3.5 Financing of the 1992 Fund

The 1992 Fund is financed by contributions levied on any person who has received in one calendar year more than 150 000 tonnes of crude oil and heavy fuel oil (**contributing oil**) in a State Party to the 1992 Fund Convention.

Basis of Contributions

The levy of contributions is based on reports of oil receipts in respect of individual contributors. A State shall communicate every year to the 1992 Fund the name and address of any person in that State who is liable to contribute, as well as the quantity of contributing oil received by any such person. This applies whether the receiver of oil is a Government authority, a State-owned company or a private company. Except in the case of associated persons (subsidiaries and commonly controlled entities), only persons having received more than 150 000 tonnes of contributing oil in the relevant year should be reported.

Contributing oil is counted for contribution purposes each time it is received at ports or terminal installations in a Member State after carriage by sea. The term **received** refers to receipt into tankage or storage immediately after carriage by sea. The place of loading is irrelevant in this context; the oil may be imported from abroad, carried from another port in the same State or transported by ship from an off-shore production rig. Also oil received for transhipment to another port or received for further transport by pipeline is considered received for contribution purposes.

Payment of Contributions

Annual contributions are levied by the 1992 Fund to meet the anticipated payments of compensation and administrative expenses during the coming year. Each contributor pays a specified amount per tonne of contributing oil received. The amount levied is decided each year by the Assembly.

The Director issues an invoice to each contributor, following the decision taken by the Assembly to levy annual contributions. A system of deferred invoicing exists whereby the Assembly fixes the total amount to be levied in contributions for a given calendar year, but decides that only a specific lower total amount should be invoiced for payment by 1 March in the following year, the remaining amount, or a part thereof, to be invoiced later in the year if it should prove to be necessary.

The contributions are payable by the individual contributors directly to the 1992 Fund. A State is not responsible for the contributions levied on contributors in that State, unless it has voluntarily accepted such responsibility.

Level of contributions

Payments made by the 1992 Fund in respect of claims for compensation for oil pollution damage may vary considerably from year to year, resulting in fluctuating levels of contributions. The following table sets out the contributions levied by the 1992 Fund during the period 1996-2001.

Annual Contributions	Date Due	Total Contribution £	Contribution per Tonne £	Contribution for 1 million Tonnes £
1996	01.02.1997	4 000 000	0.0110440	11 044
	01.09.1997	10 000 000	0.0188066	18 807
1997	01.02.1998	9 500 000	0.0114295	11 430
	Maximum deferred levy	*30 000 000*	*(No deferred levy made)*	-
1998	01.02.1999	28 200 000	0.0400684	40 068
	01.09.1999	9 000 000	0.0134974	13 497
1999	Credit: 01.03.2000	-3 700 000	-0.0056367	-5 637
	01.09.2000	53 000 000	0.0552651	55 265
2000	01.03.2001	49 500 000	0.0545770	54 577
	Maximum deferred levy	43 000 000	*(No deferred levy made)*	-
2001	01.03.2002	41 000 000	0.0428439	42 844
	Maximum deferred levy	21 000 000	0.0188148	18 815

4 The 'old' regime: the 1969 Civil Liability Convention and the 1971 Fund Convention

4.1 1969 Civil Liability Convention

The 1969 Civil Liability Convention entered into force in 1975. As at 1 May 2002, 50 States were Parties to the Convention (as listed in the Annex).

The 1969 Civil Liability Convention was adopted to govern the liability of shipowners for oil pollution damage resulting from spills of persistent oil from laden tankers. The main features of the Convention are the same as those of the 1992 Civil Liability Convention, except on the following points.

Unlike the 1992 Civil Liability Convention, the 1969 Convention is limited to pollution damage suffered in the territory (including the territorial sea) of a State Party to the Convention. Furthermore, it applies only to damage caused or measures taken after an incident has occurred in which oil has escaped or been discharged. The Convention therefore does not apply to pure threat removal measures, ie preventive measures which are so successful that there is no actual spill of oil from the tanker involved.

The 1969 Civil Liability Convention applies only to ships which are actually carrying oil in bulk as cargo, ie normally laden tankers. Spills from tankers during ballast voyages are therefore not covered by the 1969 Convention, nor are spills of bunker oil from ships other than tankers.

'Pollution damage' is defined in the 1969 Civil Liability Convention as loss or damage caused by contamination, without any reference to reinstatement of the contaminated environment.

Under the 1969 Civil Liability Convention, the limit of the shipowner's liability is much lower than under the 1992 Civil Liability Convention, ie 133 SDR (US$166) per ton of the ship's tonnage or 14 million SDR (US$17.5 million), whichever is the lower. There is no simplified procedure for increasing the maximum amount payable under the 1969 Convention.

Under the 1969 Civil Liability Convention, the shipowner may be deprived of the right to limit his liability if a claimant proves that the incident occurred as a result of the personal fault (the "actual fault or privity") of the owner.

Claims for pollution damage under the 1969 Civil Liability Convention can be made only against the registered owner of the tanker concerned. This does not preclude victims from claiming compensation outside this Convention from persons other than the owner. However, the Convention prohibits claims against the servants or agents of the owner. The owner is entitled to take recourse action against third parties in accordance with national law.

4.2 **1971 Fund Convention**

The International Oil Pollution Compensation Fund 1971 (IOPC Fund 1971 or 1971 Fund) was set up under the 1971 Fund Convention, when the latter entered into force in 1978. As at 1 May 2002, 26 States were Parties to the 1971 Fund Convention (as listed in the Annex).

The 1971 Fund pays compensation to those suffering oil pollution damage in a State Party to the 1971 Fund Convention who do not obtain full compensation under the 1969 Civil Liability Convention in cases corresponding to those set out above in respect of the 1992 Fund Convention (section 3.1).

The total amount of compensation payable by the 1971 Fund per incident is much lower than the maximum amount payable by the 1992 Fund, ie 60 million SDR (US$76 million), including the sum actually paid by the shipowner (or his insurer) under the 1969 Civil Liability Convention.

In the great majority of incidents dealt with by the 1971 Fund, all claims have been settled out of court. So far, court actions against the 1971 Fund have been taken in respect of only seven incidents. In these cases, the aggregate amounts claimed greatly exceed the maximum amount payable under the 1969 Civil Liability Convention and the 1971 Fund Convention.

The 1971 Fund has an Assembly and an Executive Committee comprising 15 Member States elected by the Assembly. The main function of the 1971 Fund Executive Committee is to approve settlements of claims against the 1971 Fund. As indicated above (section 3.4), the 1971 Fund shares a Secretariat with the 1992 Fund.

The 1971 Fund is financed in the same way as the 1992 Fund. In addition to annual contributions, however, the 1971 Fund (unlike the 1992 Fund) levies initial contributions which are payable when a State becomes a Member of the 1971 Fund.

Following the denunciation of the 1971 Fund Convention by many States, the quantity of contributing oil received in the remaining Members of the 1971 Fund has been reduced from 1 200 million tonnes to 300 million tonnes. This could result in a significantly increased cost for the oil industry in those States which are Parties to the original Conventions, since the financial burden would be spread among fewer contributors. A new Protocol ('the 2000 Protocol') to the Convention has been adopted to resolve this problem. As a result of the entry into force of this Protocol, the 1971 Fund Convention will cease to be in force on 24 May 2002, when the number of 1971 Fund Member States falls below 25. The Convention therefore will not apply to incidents occurring after 24 May 2002.

The 1971 Fund has taken out insurance to cover its liabilities to pay compensation for pollution damage resulting from any incidents which occur after 1700 hours GMT on 25 October 2000. In this way, the availability of compensation for incidents which occur in the remaining 1971 Fund Member States has been ensured until the termination of the 1971 Fund Convention.

5 Conclusions

The advantages for a State of being a Member of the 1992 Fund can be summarised as follows. If a pollution incident occurs involving a tanker, compensation is available to governments or other authorities which have incurred costs for clean-up operations or preventive measures and to private bodies or individuals who have suffered damage as a result of the pollution. For example, fishermen whose nets have become polluted are entitled to compensation, and compensation for loss of income is payable to fishermen and to hoteliers at seaside resorts. This is independent of the flag of the tanker, the ownership of the oil or the place where the incident occurred, provided that the damage is suffered within a 1992 Fund Member State.

As mentioned above, the 1969 Civil Liability Convention and the 1971 Fund Convention have been denounced by a number of States, and the 'old' regime will cease to be in force on 24 May 2002. Moreover, the 1992 Civil Liability Convention and the 1992 Fund Convention provide a wider scope of application on several points than the Conventions in their original versions, and much higher limits of compensation. For these reasons, it is suggested that Governments might wish to accede to the 1992 Protocols to the Civil Liability Convention and the Fund Convention (and not to the 1969 and 1971 Conventions) and thereby become Parties to the Conventions as amended by the Protocols (the 1992 Conventions). The Protocols would enter into force for the State in question 12 months after the deposit of its instrument(s) of accession.

States which are already Parties to the 1969 Civil Liability Convention are advised to denounce that Convention at the same time as they deposit their instrument(s) in respect of the 1992 Protocol thereto, so that the denunciation of that Convention would take effect on the same day as the Protocols enter into force for that State.

States Parties to both the
1992 Protocol to the Civil Liability Convention and the
1992 Protocol to the Fund Convention

as at 1 May 2002

64 States for which Fund Protocol is in force (and therefore Members of the 1992 Fund)		
Algeria	Germany	Norway
Antigua and Barbuda	Greece	Oman
Argentina	Grenada	Panama
Australia	Iceland	Papua New Guinea
Bahamas	India	Philippines
Bahrain	Ireland	Poland
Barbados	Italy	Republic of Korea
Belgium	Jamaica	Russian Federation
Belize	Japan	Seychelles
Canada	Kenya	Singapore
China (Hong Kong Special Administrative Region)	Latvia	Slovenia
	Liberia	Spain
Comoros	Lithuania	Sri Lanka
Croatia	Malta	Sweden
Cyprus	Marshall Islands	Tonga
Denmark	Mauritius	Trinidad and Tobago
Djibouti	Mexico	Tunisia
Dominican Republic	Monaco	United Arab Emirates
Fiji	Morocco	United Kingdom
Finland	Netherlands	Uruguay
France	New Zealand	Vanuatu
Georgia		Venezuela

13 States which have deposited instruments of accession, but for which the Fund Protocol does not enter into force until date indicated	
Sierra Leone	4 June 2002
Cambodia	8 June 2002
Turkey	17 August 2002
Dominica	31 August 2002
Angola	4 October 2002
Saint Vincent and the Grenadines	9 October 2002
Cameroon	15 October 2002
Portugal	13 November 2002
Colombia	19 November 2002
Qatar	20 November 2002
Brunei Darussalam	31 January 2003
Samoa	1 February 2003
Mozambique	26 April 2003

States Parties to the
1992 Protocol to the Civil Liability Convention
but not to the 1992 Protocol to the Fund Convention

as at 1 May 2002

(and therefore not Members of the 1992 Fund)

5 States for which Protocol to Civil Liability Convention is in force			
China	Egypt	Indonesia	Romania
Switzerland			

1 State which has deposited an instrument of accession, but for which the Protocol to the Civil Liability Convention does not enter into force until date indicated	
El Salvador	2 January 2003

States Parties to both the 1969 Civil Liability Convention and the 1971 Fund Convention

as at 1 May 2002

(and therefore Members of the 1971 Fund)

Note: the Convention will cease to be in force on 24 May 2002

24 States Parties to the 1971 Fund Convention		
Albania	Gambia	Nigeria
Benin	Ghana	Portugal
Brunei Darussalam	Guyana	Qatar
Cameroon	Kuwait	Saint Kitts and Nevis
Colombia	Malaysia	Sierra Leone
Côte d'Ivoire	Maldives	Syrian Arab Republic
Estonia	Mauritania	Tuvalu
Gabon	Mozambique	Yugoslavia
2 States Parties to the 1971 Fund Convention which have deposited instruments of denunciation which will take effect on date indicated		
Djibouti		17 May 2002
United Arab Emirates		24 May 2002

States Parties to the 1969 Civil Liability Convention but not to the 1971 Fund Convention

as at 1 May 2002

(and therefore not Members of the 1971 Fund)

24 States Parties to the 1969 Civil Liability Convention		
Brazil	Equatorial Guinea	Luxembourg
Cambodia	Georgia	Nicaragua
Chile	Guatemala	Peru
Costa Rica	Honduras	Saint Vincent and the Grenadines
Dominican Republic	Indonesia	Sao Tomé and Principe
Ecuador	Kazakhstan	Saudi Arabia
Egypt	Latvia	Senegal
El Salvador	Lebanon	South Africa
		Yemen

RESPONSIBILITY AND ACTIVITIES OF THE FRENCH GOVERNMENT IN THE EVENT OF COASTAL POLLUTION

FRANCE'S COASTAL and INLAND MARITIME POLLUTION PLAN (POLMAR-TERRE)

Emmanuel VERNIER
Department of Maritime Transport, Ports and the Coast (DTMPL)

The POLMAR plans (POLlution MARitime - MARitime POLlution) are highly specific pollution response plans that are used whenever a case of marine oil pollution has to be mitigated. These plans mobilise and co-ordinate previously identified staff and equipment.

There are two types of response plans and they bear different names:

- The **POLMAR-Mer** (POLMAR-Sea) plan that is entrusted to Port Admirals who implement resources belonging to the Ministry of Defence - Navy.

- The **POLMAR-Terre** (POLMAR-Land) plan that covers the coastal section of the country and is entrusted to Departmental Prefects (equiv: Governor, Lord Lieutenant of the County, and so on) who are accountable to the Ministry of the Interior (equiv: Home Office). When a marine casualty involves a very serious and extensive pollution threat, the Prime Minister can appoint one single Departmental Prefect as the C-in-C (Commander in Chief) to co-ordinate matters for a number of territorial departments or in some instances the Prefect who is in charge of the relevant Area of Defence. This POLMAR-Land plan tends to involve a number of Ministries. The Ministry of "Equipment", Transport and Housing is entrusted with the physical preparation, namely the implementation of technical and financial resources required to do the job in addition to providing the appropriate qualifications for the staff who will be involved in the response plan.

Since the sinking of the *Erika*, the Interministerial Committee of the Sea meetings convened on 28 February and 27 June 2000 have ruled that both POLMAR component plans should be merged to afford improved response capability and co-ordination. Government is devising terms of reference for this instrument-to-be in addition to an interministerial instruction that will co-ordinate all matters germane to response plans.

<u>Structures</u>
<u>Stockpiles</u>
<u>Human resources</u>
<u>Priority objectives</u>

Structures

The Department of Maritime Transport, Ports and the Coast (DTMPL) and the Nautical Activities and Coast Bureau (official administrations - Office of the Coast and Public Maritime Domain) is in charge of organising the relevant resources to mitigate pollution and to design preventive action concerning the POLMAR-Land plan.

Accordingiy, DTMPL ensures that local offices of the Ministry of "Equipment" are given the financial and technical resources they need and contributes to designing research programmes in addition to being involved in awareness sparking campaigns.

The CETMEF (Technical, Maritime and River Research Organisation) via its POLMAR subdivision, is involved in advising on matters concerning procurement, manages spare parts and new equipment in addition to training strike and response teams using simulation exercises.

Stockpile and Response Centres

France has thirteen (13) such centres dotted along the seaboard (eight of them are on mainland France and five are in Overseas Departments or Territories). These Centres stockpile and maintain the equipment which must be ready at a moment's notice whenever the plan has to be implemented. The centres are technical and operational centres of competence and cover a number of "Departments" at a time and they each cover a given part of the country which does not prevent other Centres from lending a hand when needed. They are under the orders of the Prefect whenever the POLMAR-Land plan has to be implemented.

POLMAR Officials

From the purely administration point of view, co-ordination and communication are entrusted to the Maritime Bureaux of the Ministry of "Equipment" which are special buries or ones that are a part of the DDE (Departmental Bureau of "Equipment") and run by a person we call RDP, namely the Official in charge of a Departmental POLMAR Plan.

Stockpiles and how they are used

Equipment in the Ministry of Equipment's POLMAR-Land stockpiles

The stockpiles that Prefects had at their fingertips in November 99 were more or less the following before the *Erika* sank:

- 34 kilometres of floating boom, different models, mostly high sea boom
- 85 recovery devices: skimmers, skimmer barges
- 142 pumps
- 443 washing machines for beaches and rocks plus 261 powerpacks
- 573 storage units of all sizes

To ensure rapid transportation of the equipment when needed, contracts have been signed with local handling and public works companies.

It is worth noting that France over the past few years has lent some of the POLMAR equipmént to other countries for dealing with serious cases of pollution (Alaska, Madeira, Wales).

Other stockpiles

Whenever needed, oil company equipment can be used in addition to the resources managed directly by the government. One such example is the Southampton Centre in the UK which is run by a Private Company that includes equipment belonging to 22 oil companies in addition to leading edge equipment including a Hercules transport plane for dispersant spraying which is on permanent lease, specially trained staff, the FOST created by ELF on a contract basis with the City of Marseilles. This system is staffed by local marine fire-fighters that are under contract with City Hall and who provide communications equipment, medical equipment, pollution control equipment (such as dispersants, booms, 2 helicopters, pumps, recuperator barges, and so on) all stored at Marignane airport and that can be implemented very quickly.

Replenishing the stockpiles

Most of the equipment in the POLMAR-Land stockpiles in mainland France was used on the Atlantic seaboard in December 1999 to respond to the massive pollution caused by the *Erika*. Much of the equipment was subsequently deteriorated by the oil and storms and could no longer be used.

That is why DTMPL requested and obtained at the interministerial Committee meeting on 28 February 2000 a further budgetary allocation of 40 million francs. Assisted by CETMEF, orders were placed with suppliers so as to replenish the stockpiles with floating booms in addition to matching operational requirements of the POLMAR stockpile Centres. At the end of 2000 the stockpiles will once again be in a state of complete readiness.

The technical limits of POLMAR equipment

The sinking of the *Erika* was a reminder that given the current state of the art, booms are not very useful during storms or in the event of high waves and the same can be said in areas where currents are strong. At the moment, a number of sensitive areas cannot be protected which only serves to put the onus on prevention.

Human resources

The human resources needed to implement the POLMAR-Land plan and that a Prefect can call on are usually from the Civil Service. First and foremost staff come from local offices of the Ministry of Equipment (DDE, Maritime Bureaux, First aid and Firefighting, Civil Defence, requisitioned military personnel). The role of local authorities is also essential.

Priority objectives

Ever since the very first POLMAR instruction back in 1978, DTMPL has always had three main objectives in mind:

Need to maintain a permanent state of readiness

For the POLMAR Plans to be effective, the equipment has to be ready for use so that maintenance, refurbishing or replenishment, modernisation are all important items as is training the response teams. Priority has always been given to training, budgetary provisions allowing, and this has included simulation exercises, hands-on training and more academic theoretical training for the purposes of better qualifying staff for the job. Prior to the sinking of the *Erika,* France implemented a pluriannual programme with an average of 5 exercises a year covering all of the country's maritime areas.

Accordingly, in 1999, exercises were organised in Northern France, Finistère, Vendée, Guadeloupe and La Réunion.

Furthermore, Head Quarters exercises (no equipment used) were developed in addition to joint Sea and Land exercises.

More research has been done since the *Erika* in a bid to bolster preparedness by refocusing priorities on a simulation exercise to be organised every three years in each " Département " in addition to a joint exercise once a year for each maritime area of which France has three.

Improving preparedness by supporting research

This is being made possible by placing orders with CEDRE (www.ifremer.fr/cedre) that was created in the wake of the *Amoco Cadiz*. CEDRE keeps a very close eye on technological developments world-wide and conducts experiments and research on modernising techniques and expertise.

The Ministry also relies on CETMEF for consulting and assistance services in relation to implementing resources.

Since the sinking of the *Erika*, the need to develop research and promote expertise capable of providing specialist advice during the management of a crisis has been recognised and validated.

Developing co-ordination

An effective response capacity cannot just involve a general mobilisation of the Civil Service which is why the Ministry has always co-ordinated matters with the Civil Defence Bureau of the Ministry of the Interior (joint instructions and training) and local government.

In the aftermath of the *Erika*, stress is mainly being put on sea-land co-ordination in addition to developing contacts with the Navy.

Whenever local POLMAR plans have to be revised or reworked, stress has also to be put on the need to promote much closer co-operation with every single component of local government including the Social and Health Services, DIREN and DRIRE not to mention other government bureaux, local authorities and associations.

NOTES

MARPOL 73/78 CONVENTION

IMO

(Web site: www.imo.org)

MARPOL 73/78

Introduction

The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and updated by amendments through the years.

The International Convention for the Prevention of Pollution from Ships (MARPOL) was adopted on 2 November 1973 at IMO and covered pollution by oil, chemicals, harmful substances in packaged form, sewage and garbage. The Protocol of 1978 relating to the 1973 International Convention for the Prevention of Pollution from Ships (1978 MARPOL Protocol) was adopted at a Conference on Tanker Safety and Pollution Prevention in February 1978 held in response to a spate of tanker accidents in 1976-1977. (Measures relating to tanker design and operation were also incorporated into a Protocol of 1978 relating to the 1974 Convention on the Safety of Life at Sea, 1974).

As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument is referred to as the International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78), and it entered into force on 2 October 1983 (Annexes I and II).

The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes:

Annex I - Regulations for the Prevention of Pollution by Oil

Annex II - Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk

Annex III - Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form

Annex IV - Prevention of Pollution by Sewage from Ships (not yet in force)

Annex V - Prevention of Pollution by Garbage from Ships

Annex VI - Prevention of Air Pollution from Ships (adopted September 1997 - not yet in force)

States Parties must accept Annexes I and II, but the other Annexes are voluntary.

History of MARPOL 73/78

Oil pollution of the seas was recognized as a problem in the first half of the 20th century and various countries introduced national regulations to control discharges of oil within their territorial waters. In 1954, the United Kingdom organized a conference on oil pollution which resulted in the adoption of the **International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL), 1954.** Following entry into force of the IMO Convention in 1958, the depository and Secretariat functions in relation to the Convention were transferred from the United Kingdom Government to IMO.

OILPOL Convention

The 1954 Convention, which was amended in 1962, 1969 and 1971, primarily addressed pollution resulting from routine tanker operations and from the discharge of oily wastes from machinery spaces - regarded as the major causes of oil pollution from ships.

The 1954 OILPOL Convention, which entered into force on 26 July 1958, attempted to tackle the problem of pollution of the seas by oil - defined as crude oil, fuel oil, heavy diesel oil and lubricating oil - in two main ways:

- it established "prohibited zones" extending at least 50 miles from the nearest land in which the discharge of oil or of mixtures containing more than 100 parts of oil per million was forbidden;
- it required Contracting Parties to take all appropriate steps to promote the provision of facilities for the reception of oily water and residues.

In 1962, IMO adopted amendments to the Convention which extended its application to ships of a lower tonnage and also extended the "prohibited zones". Amendments adopted in 1969 contained regulations to further restrict operational discharge of oil from oil tankers and from machinery spaces of all ships.

Although the 1954 OILPOL Convention went some way in dealing with oil pollution, growth in oil trade and developments in industrial practices were beginning to make it clear that further action, was required. Nonetheless, pollution control was at the time still a minor concern for IMO, and indeed the world was only beginning to wake up to the environmental consequences of an increasingly industrialised society.

Torrey Canyon

In 1967, the tanker **Torrey Canyon** ran aground while entering the English Channel and spilled her entire cargo of 120,000 tons of crude oil into the sea. This resulted in the biggest oil pollution incident ever recorded up to that time. The incident raised questions about measures then in place to prevent oil pollution from ships and also exposed deficiencies in the existing system for providing compensation following accidents at sea.

First, IMO called an Extraordinary session of its Council, which drew up a plan of action on technical and legal aspects of the **Torrey Canyon** incident. Then, the IMO Assembly decided in 1969 to convene an international conference in 1973 to prepare a suitable international agreement for placing restraints on the contamination of the sea, land and air by ships.

In the meantime, in 1971, IMO adopted further amendments to OILPOL 1954 to afford additional protection to the Great Barrier Reef of Australia and also to limit the size of tanks on oil tankers, thereby minimizing the amount of oil which could escape in the event of a collision or stranding.

1973 Convention

Finally, an international Conference in **1973** adopted the **International Convention for the Prevention of Pollution from Ships.** While it was recognized that accidental pollution was spectacular, the Conference considered that operational pollution was still the bigger threat. As a result, the 1973 Convention incorporated much of OILPOL 1954 and its amendments into Annex I, covering oil.

But the Convention was also intended to address other forms of pollution from ships and therefore other annexes covered chemicals, harmful substances carried in packaged form, sewage and garbage. The 1973 Convention also included two Protocols dealing with *Reports on Incidents involving Harmful Substances* and *Arbitration.*

The 1973 Convention required ratification by 15 States, with a combined merchant fleet of not less than 50 percent of world shipping by gross tonnage, to enter into force. By 1976, it had only received three ratifications -

Jordan, Kenya and Tunisia - representing less than one percent of the world's merchant shipping fleet. This was despite the fact that States could become Party to the Convention by only ratifying Annexes I (oil) and II (chemicals). Annexes III to V, covering harmful goods in packaged form, sewage and garbage, were optional.

It began to look as though the 1973 Convention might never enter into force, despite its importance.

1978 Conference

In 1978, in response to a spate of tanker accidents in 1976-1977, IMO held a Conference on Tanker Safety and Pollution Prevention in February 1978. The conference adopted measures affecting tanker design and operation, which were incorporated into both the Protocol of 1978 relating to the 1974 Convention on the Safety of Life at Sea (1978 SOLAS Protocol) and the Protocol of 1978 relating to the 1973 International Convention for the Prevention of Pollution from Ships (1978 MARPOL Protocol) - adopted on 17 February 1978.

More importantly in terms of achieving the entry into force of MARPOL, the 1978 MARPOL Protocol allowed States to become Party to the Convention by first implementing Annex I (oil), as it was decided that Annex II (chemicals) would not become binding until three years after the Protocol entered into force.

This gave States time to overcome technical problems in Annex II, which for some had been a major obstacle in ratifying the Convention.

As the 1973 Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument - **the International Convention for the Prevention of Marine Pollution from Ships, 1973 as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)** - finally entered into force on 2 October 1983 (for Annexes I and II).

Annex V, covering garbage, achieved sufficient ratifications to enter into force on 31 December 1988, while Annex III, covering harmful substances carried in packaged form, entered into force on 1 July 1992. Annex IV, covering sewage, has not yet entered into force. Annex VI, covering air pollution, was adopted in September 1997 and has also not yet entered into force.

Annex I: Prevention of pollution by oil

Entry into force: 2 October 1983

The 1973 Convention maintained the oil discharge criteria prescribed in the 1969 amendments to the 1954 Oil Pollution Convention, without substantial changes, namely:

Operational discharges of oil from tankers are allowed only when all of the following conditions are met:

1. the total quantity of oil which a tanker may discharge in any ballast voyage whilst under way must not exceed 1/15,000 of the total cargo carrying capacity of the vessel;

2. the rate at which oil may be discharged must not exceed 60 litres per mile travelled by the ship; and

3. no discharge of any oil whatsoever must be made from the cargo spaces of a tanker within 50 miles of the nearest land.

An oil record book is required, in which is recorded the movement of cargo oil and its residues from loading to discharging on a tank-to-tank basis.

In addition, in the 1973 Convention, the maximum quantity of oil permitted to be discharged on a ballast voyage of new oil tankers was reduced from 1/15,000 of the cargo capacity to 1/30,000 of the amount of cargo carried. These criteria applied equally both to persistent (black) and non-persistent (white) oils.

As with the 1969 OILPOL amendments, the 1973 Convention recognized the "load on top" (LOT) system which had been developed by the oil industry in the 1960s. On a ballast voyage the tanker takes on ballast water (departure ballast) in dirty cargo tanks. Other tanks are washed to take on clean ballast. The tank washings are pumped into a special slop tank. After a few days, the departure ballast settles and oil flows to the top. Clean water beneath is then decanted while new arrival ballast water is taken on. The upper layer of the departure ballast is transferred to the slop tanks. After further settling and decanting, the next cargo is loaded on top of the remaining oil in the slop tank, hence the term load on top.

A new and important feature of the 1973 Convention was the concept of "**special areas**" which are considered to be so vulnerable to pollution by oil that oil discharges within them have been completely prohibited, with minor and well-defined exceptions. The 1973 Convention identified the Mediterranean Sea, the Black Sea, and the Baltic Sea, the Red Sea and the Gulfs area as special areas. All oil-carrying ships are required to be capable of operating the method of retaining oily wastes on board through the "load on top" system or for discharge to shore reception facilities.

This involves the fitting of appropriate equipment, including an oil-discharge monitoring and control system, oily-water separating equipment and a filtering system, slop tanks, sludge tanks, piping and pumping arrangements.

New oil tankers (i.e. those for which the building contract was placed after 31 December 1975) of 70,000 tons deadweight and above, must be fitted with segregated ballast tanks large enough to provide adequate operating draught without the need to carry ballast water in cargo oil tanks.

Secondly, new oil tankers are required to meet certain subdivision and damage stability requirements so that, in any loading conditions, they can survive after damage by collision or stranding.

The Protocol of 1978 made a number of changes to Annex I of the parent convention. Segregated ballast tanks (SBT) are required on all new tankers of 20,000 dwt and above (in the parent convention SBTs were only required on new tankers of 70,000 dwt and above). The Protocol also required SBTs to be protectively located – that is, they must be positioned in such a way that they will help protect the cargo tanks in the event of a collision or grounding.

Another important innovation concerned crude oil washing (COW), which had been developed by the oil industry in the 1970s and offered major benefits. Under COW, tanks are washed not with water but with crude oil – the cargo itself. COW was accepted as an alternative to SBTs on existing tankers and is an additional requirement on new tankers.

For existing crude oil tankers (built before entry into force of the Protocol) a third alternative was permissible for a period of two to four years after entry into force of MARPOL 73/78. The dedicated clean ballast tanks (CBT) system meant that certain tanks are dedicated solely to the carriage of ballast water. This was cheaper than a full SBT system since it utilized existing pumping and piping, but when the period of grace has expired other systems must be used.

Drainage and discharge arrangements were also altered in the Protocol, regulations for improved stripping systems were introduced.

Some oil tankers operate solely in specific trades between ports which are provided with adequate reception facilities. Some others do not use water as ballast. The TSPP Conference recognized that such ships should not be subject to all MARPOL requirements and they were consequently exempted from the SBT, COW and CBT requirements. It is generally recognized that the effectiveness of international conventions depends upon the degree to which they are obeyed and this in turn depends largely upon the extent to which they are enforced. The 1978 Protocol to MARPOL therefore introduced stricter regulations for the survey and certification of ships.

The 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls – and it brought in a phase-in schedule for existing tankers to fit double hulls.

Annex II: Control of pollution by noxious liquid substances

Entry into force: 6 April 1987

Annex II details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk.

Some 250 substances were evaluated and included in the list appended to the Convention. The discharge of their residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with.

In any case, no discharge of residues containing noxious substances is permitted within 12 miles of the nearest land. More stringent restrictions applied to the Baltic and Black Sea areas.

Annex III: Prevention of pollution by harmful substances in packaged form

Entry into force: 1 July 1992

The first of the convention's optional annexes. States ratifying the Convention must accept Annexes I and II but can choose not to accept the other three - hence they have taken much longer to enter into force.

Annex III contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications for preventing pollution by harmful substances.

The International Maritime Dangerous Goods (IMDG) Code has, since 1991, included marine pollutants.

Annex IV: Prevention of pollution by sewage from ships

Entry into force: 12 months after being ratified by 15 States whose combined fleets of merchant shipping constitute at least 50% of the world fleet.

Status: The Annex has been accepted by 75 States whose fleets represent 43.11 percent of world tonnage
The second of the optional Annexes, Annex IV contains requirements to control pollution of the sea by sewage.

Annex V: Prevention of pollution by garbage from ships

Entry into force: 31 December 1988

This deals with different types of garbage and specifies the distances from land and the manner in which they may be disposed of. The requirements are much stricter in a number of "special areas" but perhaps the most important feature of the Annex is the complete ban imposed on the dumping into the sea of all forms of plastic.

Annex VI: Prevention of Air Pollution from Ships

Adopted September 1997
Entry into force: 12 months after being ratified by 15 States whose combined fleets of merchant shipping constitute at least 50% of the world fleet.

Status: See status of conventions

The regulations in this annex, when they come into force, will set limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibit deliberate emissions of ozone depleting substances.
See 1997 amendments

Enforcement

Any violation of the MARPOL 73/78 Convention within the jurisdiction of any Party to the Convention is punishable either under the law of that Party or under the law of the flag State. In this respect, the term "jurisdiction" in the Convention should be construed in the light of international law in force at the time the Convention is applied or interpreted.

With the exception of very small vessels, ships engaged on international voyages must carry on board valid international certificates which may be accepted at foreign ports as prima facie evidence that the ship complies with the requirements of the Convention.

If, however, there are clear grounds for believing that the condition of the ship or its equipment does not correspond substantially with the particulars of the certificate, or if the ship does not carry a valid certificate, the authority carrying out the inspection may detain the ship until it is satisfied that the ship can proceed to sea without presenting unreasonable threat of harm to the marine environment.

Under Article 17, the Parties to the Convention accept the obligation to promote, in consultation with other international bodies and with the assistance of UNEP, support for those Parties which request technical assistance for various purposes, such as training, the supply of equipment, research, and combating pollution.

Amendment Procedure

Amendments to the technical Annexes of MARPOL 73/78 can be adopted using the "tacit acceptance" procedure, whereby the amendments enter into force on a specified date unless an agreed number of States Parties object by an agreed date.

In practice, amendments are usually adopted either by IMO's Marine Environment Protection Committee (MEPC) or by a Conference of Parties to MARPOL.

The 1984 amendments

Adoption: 7 September 1984
Entry into force: 7 January 1986

The amendments to Annex I were designed to make implementation easier and more effective. New requirements were designed to prevent oily water being discharged in special areas, and other requirements were strengthened. But in some cases they were eased, provided that various conditions were met: some discharges were now permitted below the waterline, for example, which helps to cut costs by reducing the need for extra piping.

The 1985 (Annex II) amendments

Adoption: 5 December 1985
Entry into force: 6 April 1987

The amendments to Annex II, which deals with liquid noxious substances (such as chemicals), were intended to take into account technological developments since the Annex was drafted in 1973 and to simplify its implementation. In particular, the aim was to reduce the need for reception facilities for chemical wastes and to improve cargo tank stripping efficiencies.

The amendments also made the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) mandatory for ships built on or after 1 July 1986. This is important because the Annex itself is concerned only with discharge procedures: the Code contains carriage requirements. The Code itself was revised to take into account anti-pollution requirements and therefore make the amended Annex more effective in reducing accidental pollution

The 1985 (Protocol I) amendments

Adoption: 5 December 1985
Entry into force: 6 April 1987

The amendments made it an explicit requirement to report incidents involving discharge into the sea of harmful substances in packaged form.

The 1987 Amendments

Adoption: December 1987
Entry into force: 1 April 1989

The amendments extended Annex I Special Area status to the Gulf of Aden

The 1989 (March) amendments

Adoption: March 1989
Entry into force: 13 October 1990

The amendments affected the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code), mandatory under both MARPOL 73/78 and SOLAS and applies to ships built on or after 1 July 1986 and the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH). In both cases, the amendments included a revised list of chemicals. The BCH Code is mandatory under MARPOL 73/78 but voluntary under SOLAS 1974.

Further amendments affected Annex II of MARPOL - updating and replacing the lists of chemicals in appendices II and III.

The October 1989 amendments

Adoption: 17 October 1989
Entry into force: 18 February 1991

The amendments make the North Sea a "special area" under Annex V of the convention. This greatly increases the protection of the sea against the dumping of garbage from ships

The 1990 (HSSC) amendments

Adoption: March 1990
Entry into force: 3 February 2000 (Coinciding with the entry into force of the 1988 SOLAS and Load Lines Protocols.

The amendments are designed to introduce the harmonized system of survey and certificates (HSSC) into MARPOL 73/78 at the same time as it enters into force for the SOLAS and Load Lines Conventions.

All three instruments require the issuing of certificates to show that requirements have been met and this has to be done by means of a survey which can involve the ship being out of service for several days.

The harmonized system alleviates the problems caused by survey dates and intervals between surveys which do not coincide, so that a ship should no longer have to go into port or repair yard for a survey required by one convention shortly after doing the same thing in connection with another instrument.

The 1990 (IBC Code) amendments

Adoption: March 1990
Entry into force: On the same date as the March 1990 HSSC amendments i.e. 3 February 2000.

The amendments introduced the HSSC into the IBC Code

The 1990 (BCH) amendments

Adoption: March 1990
Entry into force: On the same date as the March 1990 HSSC amendments i.e. 3 February 2000.

The amendments introduced the HSSC into the BCH Code.

The 1990 (Annexes I and V) amendments

Adoption: November 1990
Entry into force: 17 March 1992

The amendments extended Special Area Status under Annexes I and V to the Antarctic.

The 1991 amendments

Adoption: 4 July 1991
Entry into force: 4 April 1993

The amendments made the Wider Caribbean a Special Area under Annex V.
Other amendments added a new chapter IV to Annex I, requiring ships to carry an oil pollution emergency plan.

The 1992 amendments

Adoption: 6 March 1992
Entry into force: 6 July 1993

The amendments to Annex I of the convention which deals with pollution by oil brought in the "double hull" requirements for tankers, applicable to new ships (tankers ordered after 6 July 1993, whose keels were laid on or after 6 January 1994 or which are delivered on or after 6 July 1996) as well as existing ships built before that date, with a phase-in period.

New-build tankers are covered by Regulation 13F, while regulation 13G applies to existing crude oil tankers of 20,000 dwt and product carriers of 30,000 dwt and above. Regulation 13G came into effect on 6 July 1995.

Regulation 13F requires all new tankers of 5,000 dwt and above to be fitted with double hulls separated by a space of up to 2 metres (on tankers below 5,000 dwt the space must be at least 0.76m).

As an alternative, tankers may incorporate the "mid-deck" concept under which the pressure within the cargo tank does not exceed the external hydrostatic water pressure. Tankers built to this design have double sides but not a double bottom. Instead, another deck is installed inside the cargo tank with the venting arranged in such a way that there is an upward pressure on the bottom of the hull.

Other methods of design and construction may be accepted as alternatives "provided that such methods ensure at least the same level of protection against oil pollution in the event of a collision or stranding and are approved in principle by the Marine Environment Protection Committee based on guidelines developed by the Organization.

For oil tankers of 20,000 dwt and above new requirements were introduced concerning subdivision and stability. The amendments also considerably reduced the amount of oil which can be discharged into the sea from ships (for example, following the cleaning of cargo tanks or from engine room bilges). Originally oil tankers were permitted to discharge oil or oily mixtures at the rate of 60 litres per nautical mile. The amendments reduced this to 30 litres. For non-tankers of 400 grt and above the permitted oil content of the effluent which may be discharged into the sea is cut from 100 parts per million to 15 parts per million.

Regulation 24(4), which deals with the limitation of size and arrangement of cargo tanks, was also modified.

Regulation 13G applies to existing crude oil tankers of 20,000 dwt and product carriers of 30,000 dwt and above.

Tankers that are **25 years old** and which were **not** constructed according to the requirements of the 1978 Protocol to MARPOL 73/78 have to be fitted with double sides and double bottoms. The Protocol applies to tankers ordered after 1 June 1979, which were begun after 1 January 1980 or completed after 1 June 1982. Tankers built according to the standards of the Protocol are exempt until they reach the age of **30.**

Existing tankers are subject to an enhanced programme of inspections during their periodical, intermediate and annual surveys. Tankers that are five years old or more must carry on board a completed file of survey reports together with a conditional evaluation report endorsed by the flag Administration.

Tankers built in the 1970s which are at or past their 25th must comply with Regulation 13F. If not, their owners must decide whether to convert them to the standards set out in regulation 13F, or to scrap them.

Another set of tankers built according to the standards of the 1978 protocol will soon be approaching their 30th birthday - and the same decisions must be taken.

The 1994 amendments

Adoption: 13 November 1994
Entry into force: 3 March 1996

The amendments affect four of the Convention's five technical annexes (II III, V, and I) and are all designed to improve the way it is implemented. They make it possible for ships to be inspected when in the ports of other Parties to the Convention to ensure that crews are able to carry out essential shipboard procedures relating to marine pollution prevention. These are contained in resolution A.742 (18), which was adopted by the IMO Assembly in November 1993.

The amendments are similar to those made to SOLAS in May 1994. Extending port State control to operational requirements is seen as an important way of improving the efficiency with which international safety and anti-pollution treaties are implemented.

The 1995 amendments

Adoption: 14 September 1995
Entry into force: 1 July 1997

The amendments concern Annex V. They are designed to improve the way the Convention is implemented. Regulation 2 was clarified and a new regulation 9 added dealing with placards, garbage management plans and garbage record keeping.

The 1996 amendments

Adoption: 10 July 1996
Entry into force: 1 January 1998

One set of amendments concerned Protocol I to the Convention which contains provisions for reporting incidents involving harmful substances. The amendments included more precise requirements for the sending of such reports.

Other amendments brought requirements in MARPOL concerning the IBC and BCH Codes into line with amendments adopted to SOLAS.

The 1997 amendments

Adoption: 23 September 1997
Entry into force: 1 February 1999

Regulation 25A to Annex 1 specifies intact stability criteria for double hull tankers.

Another amendment made the North West European waters a "special area" under Regulation 10 of Annex 1. The waters cover the North Sea and its approaches, the Irish Sea and its approaches, the Celtic Sea, the English Channel and its approaches and part of the North East Atlantic immediately to the West of Ireland.

In special areas, discharge into the sea of oil or oily mixture from any oil tanker and ship over 400 gt is prohibited. Other special areas already designated under Annex I of MARPOL include: the Mediterranean Sea area, the Baltic Sea area, the Red Sea area, the Gulf of Aden area and the Antarctic area.

The Protocol of 1997 (Annex VI - Regulations for the Prevention of Air Pollution from Ships)

Adoption: 26 September 1997
Entry into force: 12 months after being accepted by at least 15 states with not less than 50% of world merchant shipping tonnage (The Conference also adopted a Resolution which invites IMO's Marine Environment Protection Committee (MEPC) to identify any impediments to entry into force of the Protocol, if the conditions for entry into force have not been met by 31 December 2002).
Status: see Status of conventions

The Protocol was adopted at a Conference held from 15 to 26 September 1997 and adds a new Annex VI on **Regulations for the Prevention of Air Pollution from Ships** to the Convention.

The rules, when they come into force, will set limits on sulphur oxide (SOx) and nitrogen oxide (NOx) emissions from ship exhausts and prohibit deliberate emissions of ozone depleting substances.

The new Annex VI includes a global cap of 4.5% m/m on the sulphur content of fuel oil and calls on IMO to monitor the worldwide average sulphur content of fuel once the Protocol comes into force.

Annex VI contains provisions allowing for special "SOx Emission Control Areas" to be established with more stringent control on sulphur emissions. In these areas, the sulphur content of fuel oil used on board ships must not exceed 1.5% m/m. Alternatively, ships must fit an exhaust gas cleaning system or use any other technological method to limit SOx emissions.

The Baltic Sea is designated as a SOx Emission Control area in the Protocol.

Annex VI prohibits deliberate emissions of ozone depleting substances, which include halons and chlorofluorocarbons (CFCs). New installations containing ozone-depleting substances are prohibited on all ships. But new installations containing hydro-chlorofluorocarbons (HCFCs) are permitted until 1 January 2020.
The requirements of the IMO Protocol are in accordance with the Montreal Protocol of 1987, as amended in London in 1990. The Montreal Protocol is an international environmental treaty, drawn up under the auspices of the United Nations, under which nations agreed to cut CFC consumption and production in order to protect the ozone layer.

Annex VI sets limits on emissions of nitrogen oxides (NOx) from diesel engines. A mandatory NOx Technical Code, developed by IMO, defines how this is to be done.

The Annex also prohibits the incineration on board ship of certain products, such as contaminated packaging materials and polychlorinated biphenyls (PCBs).

Format of Annex VI

Annex VI consists of three Chapters and a number of Appendices:

- **Chapter 1 - General**
- **Chapter II - Survey, Certification and Means of Control**
- **Chapter III - Requirements for Control of Emissions from Ships**

Appendices including the form of the International Air Pollution Prevention Certificate; criteria and procedures for designation of SOx emission control areas; information for inclusion in the bunker delivery note; approval and operating limits for shipboard incinerators; test cycles and weighting factors for verification of compliance of marine diesel engines with the NOx limits; and details of surveys and inspections to be carried out.

The 1999 amendments

Adoption: 1 July 1999
Entry into force: 1 January 2001 (under tacit acceptance)

Amendments to Regulation 13G of Annex I (Regulations for the Prevention of Pollution by Oil) make existing oil tankers between 20,000 and 30,000 tons deadweight carrying persistent product oil, including heavy diesel oil and fuel oil, subject to the same construction requirements as crude oil tankers.

Regulation 13G requires, in principle, existing tankers to comply with requirements for new tankers in Regulation 13F, including double hull requirements for new tankers or alternative arrangements, not later than 25 years after date of delivery.

The amendments extend the application from applying to crude oil tankers of 20,000 tons deadweight and above and product carriers of 30,000 tons deadweight and above, to also apply to tankers between 20,000 and 30,000 tons deadweight which carry heavy diesel oil or fuel oil.

The aim of the amendments is to address concerns that oil pollution incidents involving persistent oils are as severe as those involving crude oil, so regulations applicable to crude oil tankers should also apply to tankers carrying persistent oils.

Related amendments to the Supplement of the IOPP (International Oil Pollution Prevention) Certificate, covering in particular oil separating/filtering equipment and retention and disposal of oil residues were also adopted.

A third MARPOL 73/78 amendment adopted relates to Annex II of MARPOL Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk. The amendment adds a new regulation 16 requiring a Shipboard marine pollution emergency plan for noxious liquid substances.

Amendments were also made to the International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code) and the Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (BCH Code). The amendments address the maintenance of venting systems.

The 2000 amendments

Adoption: 13 March 2000
Entry into force: 1 January 2002 (under tacit acceptance)

The amendment to Annex III *(Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form)* deletes tainting as a criterion for marine pollutants from the Guidelines for the identification of harmful substances in packaged form. Tainting refers to the ability of a product to be taken up by an organism and thereby affect the taste or smell of seafood making it unpalatable. A substance is defined as tainting when it has been found to taint seafood.

The amendment means that products identified as being marine pollutants solely on the basis of their tainting properties will no longer be classified as marine pollutants.

The 2001 amendments

Adoption: 27 April 2001
Entry into force: 1 September 2002

The amendment to Annex I brings in a new global timetable for accelerating the phase-out of single-hull oil tankers. The timetable will see most single-hull oil tankers eliminated by 2015 or earlier. Double-hull tankers offer greater protection of the environment from pollution in certain types of accident. All new oil tankers built since 1996 are required to have double hulls.

The revised regulation identifies three categories of tankers, as follows:

1. "Category 1 oil tanker" means oil tankers of 20,000 tons deadweight and above carrying crude oil, fuel oil, heavy diesel oil or lubricating oil as cargo, and of 30,000 tons deadweight and above carrying other oils, which do not comply with the requirements for protectively located segregated ballast tanks (commonly known as Pre-MARPOL tankers).

2. "Category 2 oil tanker" means oil tankers of 20,000 tons deadweight and above carrying crude oil, fuel oil, heavy diesel oil or lubricating oil as cargo, and of 30,000 tons deadweight and above carrying other oils, which do comply with the protectively located segregated ballast tank requirements (MARPOL tankers), while

3. "Category 3 oil tanker" means an oil tanker of 5,000 tons deadweight and above but less than the tonnage specified for Category 1 and 2 tankers.

Although the new phase-out timetable sets 2015 as the principal cut-off date for all single-hull tankers, the flag state administration may allow for some newer single hull ships registered in its country that conform to certain technical specifications to continue trading until the 25th anniversary of their delivery.

However, under the provisions of paragraph 8(b), any Port State can deny entry of those single hull tankers which are allowed to operate until their 25th anniversary to ports or offshore terminals. They must communicate their intention to do this to IMO.

As an additional precautionary measure, a Condition Assessment Scheme (CAS) will have to be applied to all Category 1 vessels continuing to trade after 2005 and all Category 2 vessels after 2010. A resolution adopting the CAS was passed at the meeting.

Although the CAS does not specify structural standards in excess of the provisions of other IMO conventions, codes and recommendations, its requirements stipulate more stringent and transparent verification of the reported structural condition of the ship and that documentary and survey procedures have been properly carried out and completed.
The requirements of the CAS include enhanced and transparent verification of the reported structural condition and of the ship and verification that the documentary and survey procedures have been properly carried out and completed. The Scheme requires that compliance with the CAS is assessed during the Enhanced Survey Programme of Inspections concurrent with intermediate or renewal surveys currently required by resolution A.744(18), as amended.

SUMMARY OF STATUS OF CONVENTIONS
as at 30 April 2001 (* *Source: Lloyd's Register of Shipping/World Fleet Statistics as at 31 December 1999)*

Convention	Entry into force date	No. of Contracting States	% world tonnage
IMO Convention	17-Mar-58	158	98.47
1991 amendments	-	50	69.12
1993 amendments	-	91	83.18
SOLAS 1974	25-May-80	144	98.36
SOLAS Protocol 1978	01-May-81	98	93.87
SOLAS Protocol 1988	03-Feb-00	49	62.49
Stockholm Agreement 1996	01-Apr-97	8	9.37
LL 1966	21-Jul-68	146	98.34
LL Protocol 1988	03-Feb-00	46	62.23
TONNAGE 1969	18-Jul-82	129	98.07
COLREG 1972	15-Jul-77	138	96.79
CSC 1972	06-Sep-77	68	59.66
1993 amendments	-	6	3.09
SFV Protocol 1993	-	7	7.52
STCW 1978	28-Apr-84	136	97.93
STCW-F 1995	-	2	3.05
SAR 1979	22-Jun-85	68	48.25
STP 1971	02-Jan-74	17	22.12
SPACE STP 1973	02-Jun-77	16	20.71
INMARSAT C 1976	16-Jul-79	88	92.75
INMARSAT OA 1976	16-Jul-79	86	92.67
1994 amendments	-	39	32.12
1998 amendments	-	56	64.20
FAL 1965	05-Mar-67	87	54.94
MARPOL 73/78 (Annex I/II)	02-Oct-83	114	94.23
MARPOL 73/78 (Annex III)	01-Jul-92	96	79.39
MARPOL 73/78 (Annex IV)	-	80	43.44
MARPOL 73/78 (Annex V)	31-Dec-88	100	85.98
MARPOL Protocol 1997 (Annex VI)	-	3	8.86
LC 1972	30-Aug-75	78	68.38
1978 amendments	-	20	19.71
LC Protocol 1996	-	14	11.85
INTERVENTION 1969	06-May-75	75	69.53
INTERVENTION Protocol 1973	30-Mar-83	43	43.93
CLC 1969	19-Jun-75	56	8.59
CLC Protocol 1976	08-Apr-81	53	57.68
CLC Protocol 1992	30-May-96	68	86.93
FUND 1971	16-Oct-78	32	4.36
FUND Protocol 1976	22-Nov-94	33	46.88
FUND Protocol 1992	30-May-96	64	82.79
NUCLEAR 1971	15-Jul-75	14	21.35
PAL 1974	28-Apr-87	26	32.99
PAL Protocol 1976	30-Apr-89	20	32.71
PAL Protocol 1990	-	3	0.76
LLMC 1976	01-Dec-86	35	44.87
LLMC Protocol 1996	-	4	7.37
SUA 1988	01-Mar-92	52	47.49
SUA Protocol 1988	01-Mar-92	48	47.18
SALVAGE 1989	14-Jul-96	32	29.21
OPRC 1990	13-May-95	58	48.97
HNS Convention 1996	-	1	1.96
OPRC/HNS 2000	-	-	-

Focus on IMO

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October 1998

MARPOL - 25 years

The International Convention for the Prevention of Pollution from Ships (MARPOL) was adopted on 2 November 1973 following a conference at the London headquarters of the International Maritime Organization, the United Nations agency responsible for the safety of shipping and the prevention of marine pollution.

The adoption of the Convention, 25 years ago, was a crucial stage in an ambitious project to deal with vessel-source pollution. The convention adopted in 1973 covered pollution by oil, chemicals, harmful substances in packaged form, sewage and garbage.

The conference which adopted MARPOL, was held against a background of increased global awareness of the need to protect the environment. The United Nations Conference on the Human Environment held in Stockholm in June 1972 provided a global forum for discussions on the environment. In the same year, a London Conference adopted the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LC), which controls the dumping of industrial and other wastes at sea by ships and aircrafts. [1]

The adoption of MARPOL on 2 November 1973 was clearly a significant move. As the London-based Oil Companies International Marine Forum (OCIMF) wrote in 1974:

"The 1973 Convention represents an historic and major step forward in the prevention of pollution from ships. It extends the existing restrictions upon operational pollution by oil and requires both equipment and design features in tankers and other ships, while also introducing controls against other forms of pollution from ships."[2]

But it was not all plain sailing. The Convention required ratification by 15 States, with a combined merchant fleet of not less than 50 percent of world shipping by gross tonnage, and by 1976, it had only received three ratifications - Jordan, Kenya and Tunisia - representing less than one percent of the world's merchant shipping fleet. This was despite the fact that States could become Party to the Convention by only ratifying Annexes I (oil) and II (chemicals). Annexes III to V, covering harmful goods in packaged form, sewage and garbage, were optional.

It began to look as though the Convention might never enter into force, despite its importance.

"There is no doubt that, were the [MARPOL] convention to come into force and be widely ratified, it would make a significant contribution to reducing pollution from ships. Unfortunately, however, it is making very slow progress at coming into force," wrote lawyer Robin Churchill, in the book "The Impact of Marine Pollution".[3]

In 1978, in response to a spate of tanker accidents in 1976-1977, IMO held a Conference on Tanker Safety and Pollution Prevention in February 1978. The conference adopted measures

[1] IMO took over Secretariat functions for the London Convention when it entered into force in 1975

[2] MEPC II, Inf 10. Position of the Oil Companies International Marine Forum.

[3] Robin Churchill, The Role of IMCO, in The Impact of Marine Pollution, Edited by Douglas J. Cuisine and John P.Grant, 1980, Croom Helm Ltd, London.

affecting tanker design and operation, which were incorporated into both the Protocol of 1978 relating to the 1974 Convention on the Safety of Life at Sea (1978 SOLAS Protocol) and the Protocol of 1978 relating to the 1973 International Convention for the Prevention of Pollution from Ships (1978 MARPOL Protocol).

More importantly in terms of achieving the entry into force of MARPOL, the 1978 MARPOL Protocol allowed States to become Party to the Convention by first implementing Annex I (oil), as it was decided that Annex II (chemicals) would not become binding until three years after the Protocol entered into force.

This gave States time to overcome technical problems in Annex II, which for some had been a major obstacle in ratifying the Convention.

As the 1973 Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument is referred to as the 1973 International Convention for the Prevention of Marine Pollution from Ships, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78), and it finally entered into force on 2 October 1983 (for Annexes I and II).

Annex V, covering garbage, achieved sufficient ratifications to enter into force on 31 December 1988, while Annex III, covering harmful substances carried in packaged form, entered into force on 1 July 1992. Annex IV, covering sewage, has received 71 ratifications (at September 1998), representing 42.50 percent of world shipping tonnage.

In 1997, a new Annex VI on prevention of air pollution from ships was added. IMO's Marine Environment Protection Committee (MEPC) is now drafting mandatory regulations covering the management of ballast water to prevent the spread of unwanted aquatic organisms and the banning of anti-fouling paints that are harmful to the environment.

Despite the number of years it took for MARPOL to enter into force, the 1973 Conference which adopted the Convention laid the groundwork for IMO's future work on environmental issues, and its significance cannot be underestimated.

IMO's work in marine pollution prevention was recognised in 1997, when the Organization was awarded the prestigious Onassis Prize for the Environment.

The MEPC, which meets three times during every biennium, is an important forum for Governments, Inter-Governmental and Non-Governmental Organizations with an interest in protecting the marine environment from pollution by ships.

MARPOL remains a living document and is amended when necessary. More importantly, IMO is also concentrating its efforts on full implementation of MARPOL requirements by all Flag States and Port States.

The development of regulations in the different MARPOL annexes is outlined below.

MARPOL Annex I - Regulations for the Prevention of Pollution by Oil

Background

The world's first oil tankers appeared in the late 19th century and carried kerosene for lighting, but the invention of the motor car fuelled demand for oil. During the Second World War, the standard oil tanker was the T2, 16,400 tonnes deadweight, but tankers grew rapidly in size from the 1950s onwards. The first 100,000-tonne crude oil tanker was delivered in 1959.[4]

The potential for oil to pollute the marine environment was recognised by the International Convention for the Prevention of Pollution of the Sea by Oil, 1954 (OILPOL 1954). The Conference adopting the Convention was organised by the United Kingdom government, and the Convention provided for certain functions to be undertaken by IMO when it came into being. In fact, the IMO Convention entered into force in 1958 just a few months before the OILPOL convention entered into

[4] The first 100,000-tonne crude oil tanker was delivered in 1959 to cover the route from the Middle East to Europe round the Cape of Good Hope (thereby avoiding the Suez Canal which had been temporarily closed following political conflicts in 1956). Shippers saw economies of scale in larger tankers and by the mid-1960s, tankers of 200,000 tonnes deadweight- the Very Large Crude Carrier or VLCC - had been ordered.

force, so IMO effectively managed OILPOL from the start, initially through its Maritime Safety Committee.[5]

The OILPOL Convention recognised that most oil pollution resulted from routine shipboard operations such as the cleaning of cargo tanks. In the 1950s, the normal practice was simply to wash the tanks out with water and then pump the resulting mixture of oil and water into the sea.

OILPOL 54 prohibited the dumping of oily wastes within a certain distance from land and in 'special areas' where the danger to the environment was especially acute. In 1962 the limits were extended by means of an amendment adopted at a conference organised by IMO.

Meanwhile, IMO in 1965, set up a Subcommittee on Oil Pollution, under the auspices of its Maritime Safety committee, to address oil pollution issues.

Torrey Canyon disaster

Although the OILPOL Convention had been ratified, pollution control was at the time still a minor concern for IMO, and indeed the world was only beginning to wake up to the environmental consequences of an increasingly industrialised society..

But in 1967, the **Torrey Canyon** ran aground while entering the English Channel and spilled her entire cargo of 120,000 tons of crude oil into the sea. This resulted in the biggest oil pollution incident ever recorded up to that time. The incident raised questions about measures then in place to prevent oil pollution from ships and also exposed deficiencies in the existing system for providing compensation following accidents at sea.

It was essentially this incident that set in motion the chain of events that eventually led to the adoption of MARPOL - as well as a host of Conventions in the field of liability and compensation.[6]

First, IMO called an Extraordinary session of its Council, which drew up a plan of action on technical and legal aspects of the **Torrey Canyon** incident.[7]

It was still recognized, however, that although accidental pollution was spectacular, operational pollution was the bigger threat (see page 6). In 1969, therefore, the 1954 OILPOL Convention was again amended, this time to introduce a procedure known as 'load on top' which had been developed by the oil industry and had the double advantage of saving oil and reducing pollution. Under the system, the washings resulting from tank cleaning are pumped into a special tank. During the voyage back to the loading terminal the oil and water separate. The water at the bottom of the tank is pumped overboard and at the terminal oil is pumped on to the oil left in the tank.[8]

At the same time, the enormous growth in the maritime transport of oil and the size of tankers, the increasing amount of chemicals being carried at sea and a growing concern for the world's environment as a whole, made many countries feel that the 1954 OILPOL Convention was no longer adequate, despite the various amendments which had been adopted.

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[5]IMO's twin objectives today are stated as "the safety of shipping and the prevention of marine pollution by ships", but marine pollution was not specifically mentioned in the original IMO Convention, adopted in 1948. In 1975, however, the IMO Assembly adopted amendments to the IMO Convention, changing its name from Inter-Governmental Maritime Consultative Organization (IMCO) to IMO and changing Article I by adding to the list of purposes "the prevention and control of marine pollution from ships; and to deal with legal matters related to the purposes set out in this Article." The amendments entered into force in 1982.

[6] The **Torrey Canyon** incident is also seen as the turning point for IMO as an Organization, to the extent that IMO went on to expand its activities in the environmental and legal fields.

[7]An ad-hoc Legal Committee was established, which later became a permanent subsidiary organ of the IMO Council. International Conventions on liability and compensation followed, including the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (INTERVENTION), 1969; the International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969; and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND), 1971

[8] The amendment entered into force in 1978, but was incorporated into MARPOL 1973.

In 1969, the IMO Assembly decided to convene an international conference to adopt a completely new convention, which would incorporate the regulations contained in OILPOL 1954 (as amended). At the same time, the Sub-Committee on Oil Pollution was renamed the Sub-Committee on Marine Pollution, to broaden its scope, and this became the Marine Environment Protection Committee (MEPC), which was eventually given the same standing as the Maritime Safety Committee, with a brief to deal with all matters relating to marine pollution.

The conference was set for October-November 1973, and preparatory meetings began in 1970.

Meanwhile, in 1971 IMO adopted amendments to OILPOL 1954, which limited the size of cargo tanks in all tankers ordered after 1972. The intention was that given certain damage to the vessel, only a limited amount of oil can enter the sea.

1973 International Convention for the Prevention of Pollution from Ships

The 1973 conference in October-November 1973 was attended by representatives from 71 countries and resulted in the adoption of the most ambitious international treaty covering marine pollution ever adopted.

The Convention incorporated much of OILPOL 1954 and its amendments into Annex I, covering oil, while other annexes covered chemicals, harmful substances carried in packaged form, sewage and garbage.

Annex I expanded and improved on OILPOL in several ways. It specified requirements for continuous monitoring of oily water discharges and included the requirement for Governments to provide shore reception and treatment facilities at oil terminals and ports. It also established a number of Special Areas in which more stringent discharge standards were applicable, including the Mediterranean, Red Sea and Gulf, and Baltic Seas. These special areas would be implemented when the littoral States concerned had provided adequate reception facilities for dirty ballast and other oily residues.

An important regulation of Annex I was Regulation 13 which required segregated ballast tanks on new tankers over 70,000 deadweight tonnes. The aim was to ensure that ballast water (taken on board to maintain stability, such as when a tanker is sailing empty to pick up cargo) is never going to be contaminated by oil carried as cargo or fuel.

This regulation was initially opposed by States with large shipowning interests, but ultimately the fact that there was at the time sufficient tonnage to provide capacity for another decade led to the regulation being accepted.[9] However, a proposal strongly pushed by the United States for a requirement for double bottoms was not accepted.[10]

Despite doubts expressed over States' willingness to ratify the Convention, one commentator noted: "The 1973 Conference - especially from an historical perspective - was a landmark in international environmental regulation. For the first time the installation is required of those ship and shore technologies necessary for the retention on board and proper port disposal of oil residues."[11]

As it turned out, there was slow progress at ratifying the Convention (partly due to technical problems in ratifying Annex II) and the non-ratification of MARPOL became a major concern.

At the same time, a series of tanker accidents in 1976-1977, mostly in or near United States waters and including the stranding of the **Argo Merchant**,[12] led to demands for more stringent action to curb accidental and operational oil pollution.

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[9] Pollution, Politics and International law, Tankers at Sea. R. Michael M'Gonigle and Mark W. Zacher. University of California Press. 1979. p. 114.

[10] Double hulls were introduced in the 1992 amendments to MARPOL following the **Exxon Valdez** disaster.

[11] Pollution, Politics and International law, Tankers at Sea. R. Michael M'Gonigle and Mark W. Zacher. University of California Press. 1979. p. 120.

[12] The **Argo Merchant** ran aground off Massachussetts in December 1976. It was a small tanker, carrying 27,000 tons of oil, but caused huge public concern as the oil slick threatened New England resorts and Georges Bank fishing ground.

The United States took the lead in asking the IMO Council, in May 1977, to consider adopting further regulations on tanker safety. The Council agreed to convene a Conference in February 1978 - the Conference on Tanker Safety and Pollution Prevention.

A working group met in May, June and July, and a combined MSC/MEPC met in October, to prepare basic documents for the Conference.

1978 Conference on Tanker Safety and Pollution Prevention

The Conference, in February 1978, was attended by delegates from 61 States, observers from three States and representatives from 17 international organizations - a total of 451 people.

The Conference adopted a protocol to the 1973 MARPOL Convention, absorbing the parent Convention and expanding on the requirements for tankers to help make them less likely to pollute the marine environment.

The Protocol expanded the requirements for segregated ballast tanks to all new crude oil tankers of 20,000 dwt and above and all new product carriers of 30,000 dwt and above. The Protocol also required segregated ballast tanks to be protectively located, in other words, placed in areas of the ship where they will minimise the possibility of and amount of oil outflow from cargo tanks after a collision or grounding.

New tankers over 20,000 dwt were required to be fitted with crude oil washing system. Crude oil washing, or COW, is the cleaning or washing of cargo tanks with high pressure jets of crude oil. This reduces the quantity of oil remaining on board after discharge.

The Protocol also called for existing tankers over 40,000 dwt to be fitted with either segregated ballast tanks or crude oil washing systems; while for an interim period, it also allowed for some tankers to use clean ballast tanks, whereby specific cargo tanks are dedicated to carry ballast water only.

Additional measures for tanker safety were incorporated into the 1978 Protocol to the International Convention for the Safety of Life at Sea (SOLAS), 1974. These included the requirement for inert gas systems (whereby exhaust gases, which are low in oxygen and thus incombustible, are used to replace flammable gases in tanks) on all new tankers over 20,000 dwt and specified existing tankers. The SOLAS Protocol also included requirements for steering gear of tankers; stricter requirements for carrying of radar and collision avoidance aids; and stricter regimes for surveys and certification.

In order to speed up implementation of MARPOL, the Conference allowed that the Parties "shall not be bound by the provisions of Annex II of the Convention for a period of three years" from the date of entry into force of the Protocol, so that countries could accept Annex I and have three years to implement Annex II.

Both the 1978 MARPOL and SOLAS Protocols were seen as major steps in raising construction and equipment standards for tankers through more stringent regulations. Furthermore, a number of nations, such as the United States, made clear their commitment to pushing through the legislation to make the regulations mandatory and this was seen as a help in spurring on other maritime nations, keen to protect their shipowners' competitiveness, into ratifying the Convention.

If the world needed further reminder of the need for strict regimes to control oil pollution, it got it just one month after the 1978 Conference, when the **Amoco Cadiz** ran aground off Brittany, giving France its worst oil spill ever. The tanker, filled with 223,000 tons of crude oil, lost its entire cargo, covering more than 130 beaches in oil. In places, the oil was up to 30 cm thick.

Sufficient States had ratified MARPOL by October 1982, and the MARPOL 1973/78 Convention entered into force on 2 October 1983.

Estimate of oil entering the oceans in 1979

(Metric tonnes per annum)

Vessels	**1,500,000**
Accidental	257,000
Operational/deliberate of which: Deballasting and tank washing - Load on Top Deballasting and tank washing - non-Load on Top Tank washing before maintenance Bilge pumping Bulk/oil carriers Other ships	**1,243,000** 105,000 529,000 360,000 23,000 46,000 180,000
Off-shore operations	
Accidental	80,000
Operational/deliberate	insignificant
Other Sources	
Tanker terminal operations	70,000
Refinery effluents	300,000
Pipelines and handling spillage	40,000
Discarded lubricants	1,300,000
Total	**3,290,000**

Source: The Impact of Marine Pollution. Douglas J. Cuisine and John P. Grant. CroomHelm Ltd. London 1980.

The 1984 amendments

While MARPOL Annex I had entered into force, there was still work to be done in reviewing the Convention and ensuring it was being implemented.

The first amendments to MARPOL 73/78 were adopted in 1984, entering into force in 1986. They were designed to improve and strengthen existing provisions, such as Regulation 25 concerning subdivision and stability - intended to ensure that tankers can survive assumed damage. Certain provisions were waived, or relaxed, for example carriage of ballast water in cargo tanks was now permitted in certain circumstances, based on studies presented to the MEPC showing that this was appropriate.

In 1991, further amendments to Annex I, which entered into force in 1993, introduced a new chapter, requiring oil tankers and other ships[13] to carry a shipboard oil pollution emergency plan detailing the procedure to be followed in reporting an oil pollution incident, authorities to be contacted in the event of an oil pollution incident, a description of the action which must be taken and the procedures and point of contact on the ship for co-ordinating shipboard actions with national and local authorities.

But it was another tanker accident which led to one of the the most important changes to be made to the Convention since the adoption of the 1978 Protocol.

In March 1989, the Exxon Valdez, loaded with 1,264,155 barrels of crude oil, ran aground in the northeastern portion of Prince William Sound, spilling about one-fifth of its cargo. It was the largest crude spill, to date, in US waters and - probably the one which gained the biggest media coverage to date. The U.S. public demanded action - and duly got it.

[13] Applies to oil tankers of 150 gross tons and above and ships other than tankers of 400 gt and above

The United States introduced its Oil Pollution Act of 1990 (OPA 90), making it mandatory for all tankers calling at U.S. ports to have double hulls.

The United States also came to IMO, calling for double hulls this time to be made a mandatory requirement of MARPOL. The implications of the **Exxon Valdez** spill were not lost on IMO Members, and the MEPC began discussions on how the U.S. proposals could be implemented.[14]

As on previous occasions[15], there was some resistance on the part of the oil industry to double hulls being made mandatory, due mainly to the cost of retrofitting existing tankers.

At the same time, several of IMO's Member States said that other designs should be accepted as equivalents and that measures for existing ships should also be contemplated. In 1991 a major study into the comparative performances of the double-hull and mid-height deck tanker designs was carried out by IMO, with funding from the oil and tanker industry.

It concluded in January 1992 that the two designs could be considered as equivalent, although each gives better or worse outflow performance under certain conditions.

Eventually, the MEPC agreed to make mandatory double hulls or alternative designs "provided that such methods ensure the same level of protection against pollution in the event of a collision or stranding". These design methods must be approved by the MEPC.

1992 amendments - prevention of oil pollution in the event of collision or stranding

The amendments introducing double hulls (or an alternative) were contained in Regulation 13F, adopted in March 1992 and entering into force in July 1993.

Regulation 13F applies to new tankers - defined as delivered on or after 6 July 1996 - while existing tankers must comply with the requirements of 13F not later than 30 years after their date of delivery.

Tankers of 5,000 dwt and above must be fitted with double bottoms and wing tanks extending the full depth of the ship's side. The regulation allows mid-deck height tankers with double-sided hulls, such as those developed by Japanese and European shipbuilders, as an alternative to double hull construction.

Oil tankers of 600 dwt and above but less than 5,000 dwt, must be fitted with double bottom tanks and the capacity of each cargo tank is limited to 700 cubic metres, unless they are fitted with double hulls.

The MEPC also adopted Regulation 13G, concerned with existing tankers, which makes provision for an enhanced programme of inspections to be implemented, particularly for tankers more than five years old.

Regulation 13G also allowed for future acceptance of other structural or operational arrangements - such as hydrostatic balance loading (HBL)[16] - as alternatives to the protective measures in the Regulation.

It was anticipated that many older tankers which could not be brought up to the new standard economically, would be scrapped and the MEPC adopted a resolution recommending that Member Governments take initiatives in co-operation with the shipbuilding and shipping industries, to develop scrapping facilities at a world-wide level, to promote research and development programmes and to provide technical assistance to developing countries in developing ship scrapping facilities.

The MEPC also adopted amendments to MARPOL drastically reducing the amount of oil which can be discharged into the sea as a result of routine operations, by forbidding non-tankers to discharge oily wastes if the oil content exceeds 15 parts per million (an amount which is virtually

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[14] Another consequence of the **Exxon Valdez** disaster was the adoption in 1990 of an International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), to provide a global framework for international co-operation in combating major incidents or threats of marine pollution.

[15] The United States had called for double hulls to be made mandatory at both the 1973 and 1978 Conferences

[16] Hydrostatic balance loading (HBL) is based on the principle that if a hull is breached, the pressure from outside would be greater than that from the oil inside so seawater would flow in, pushing the oil upwards through non-return valves into ballast tanks; rather than an outflow of oil into the sea.

undetectable), and permitting tankers to discharge oily mixtures only at a rate of 30 litres per nautical mile (and only outside special areas).

The 1994 amendments - implementation

In November 1994, the MEPC adopted amendments to MARPOL aimed at improving implementation of the Convention, by making it possible for ships to be inspected when in the ports of other Parties to the Convention, to ensure that crews are able to carry out essential shipboard procedures relating to marine pollution prevention.

The amendments, which entered into force on 3 March 1996, also applied to Annex II, which is concerned with pollution by noxious liquid substances (such as chemicals); Annex III, containing regulations for the prevention of pollution by harmful substances in packaged form; and Annex V, which deals with garbage.

Similar amendments were made to the International Convention for the Safety of Life at Sea (SOLAS), 1974 in May 1995. A number of IMO Conventions contain provisions for port State control inspections but previously these have been limited primarily to certification and the physical condition of the ship and its equipment.

Extending port State control to operational requirements was seen as an important way of improving the efficiency with which international safety and anti-pollution treaties are implemented.

The 1997 Amendments - intact stability and special areas

In September 1997, the MEPC adopted a new Regulation 25A to Annex 1, specifying intact stability criteria for double hull tankers. The amendments, which enter into force on 1 February 1999, were deemed necessary after experience had shown that a small number of double hull tankers were being constructed without enough bulkheads to maintain stability. The regulation, which is technical in nature, defines the criteria for achieving intact stability for double hull tankers.

Another amendment makes the North West European waters a "special area", thereby prohibiting discharge into the sea of oil or oily mixture from any oil tanker and ship over 400 gt in the North Sea and its approaches, the Irish Sea and its approaches, the Celtic Sea, the English Channel and its approaches and part of the North East Atlantic immediately to the West of Ireland, from the time when littoral States have made provision for adequate reception facilities.

The countries concerned, informed the MEPC in April 1998, that reception facilities were adequate and that the North West European Waters special area should take effect as from 1 August 1999.

MARPOL Annex I - achievements

In 1990, the National Research Council Marine Board of the United States credited MARPOL 73/78 with making "a substantial positive impact in decreasing the amount of oil that enters the sea".

A study carried out by the Board showed that in 1981, some 1,470,000 tons of oil entered the world's oceans as a result of shipping operations. Most of it came from routine operations, such as discharges of machinery wastes and tank washings from oil tankers (the latter alone contributed 700,000 tons). Accidental pollution contributed less than 30% of the total. [17]

By 1989, it was estimated that oil pollution from ships had been reduced to 568,800 tons. Tanker operations contributed only 158,000 tons of this.

Moreover, although the 1978 Protocol did not enter into force until 1983, many of its requirements were already being implemented. The "load on top" system, for example, had been implemented since 1978 and was installed on many tankers because it reduced the amount of oil wasted during routine operations (and thereby increased profits). The "new ship" and "new tanker" definitions included in the original 1973 Convention and the 1978 Protocol also meant that all tankers built after those dates already complied with MARPOL 73/78 requirements.

Today, tankers transport some 1,800 million tonnes of crude oil around the world by sea including 50 percent of U.S. oil imports (crude oil and refined products). Most of the time, oil is transported quietly and safely.

MARPOL measures introduced after major accidents have contributed to the fact that today a tanker is more likely to be a well constructed, well operated ship.

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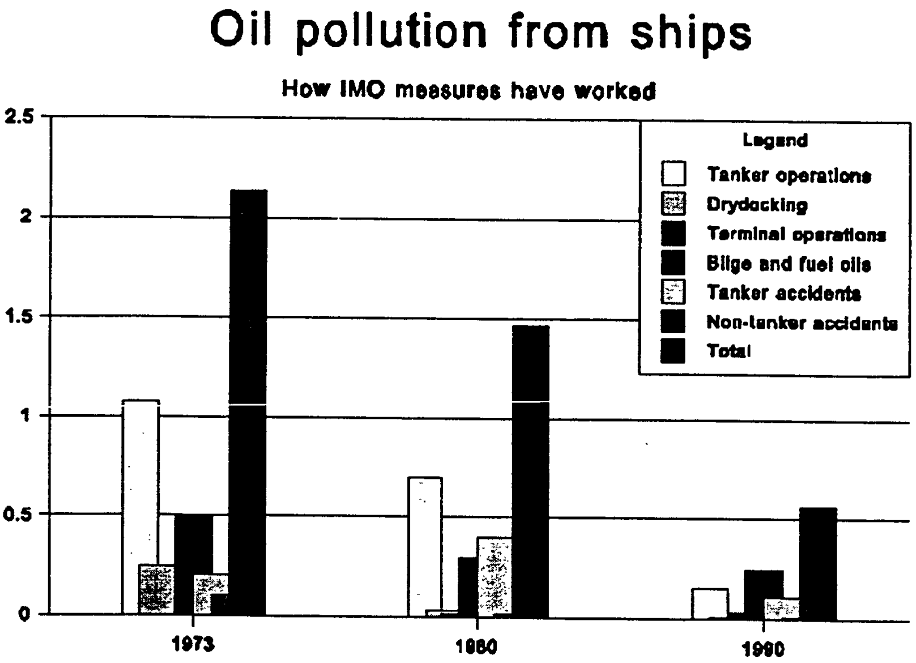
[17] See Focus on IMO - MARPOL

The fact that MARPOL measures have essentially been disaster-led is not necessarily a bad thing. The impact of the public outcry over oil slicks or tar balls on beaches has been to ensure that the oil majors who transport crude oil around the world are willing to invest in safety and pollution prevention features - because an accident, apart from its costs in human life or physical terms - could cost them dearly in bad publicity.



Annex I issues
Annex I of MARPOL is generally considered "complete". Nonetheless, IMO Member States continue to approach IMO where they feel there is room for improvement. For example, there is currently a debate on whether to speed up the phase-in period for double hulls on existing tankers for certain sizes of oil and product carriers.

But there is still concern over the fact that a number of important oil producing and exporting nations have so far failed to ratify MARPOL.

One reason may be that these countries would be obliged to provide reception facilities for oily wastes. The costs of doing so could be great, since most tank cleaning operations take place during the ballast stage of the tanker's voyage: the reception facilities required at an oil loading port, therefore, are much greater than those needed elsewhere.

All of this makes life very difficult for tanker owners and crew. MARPOL greatly limits the discharge of wastes into the sea and in some areas bans it completely: but if the ports fail to provide the reception facilities the captain of the ship has to dispose of the wastes in some other way. The temptation is to do this illegally - and hope that no one finds out.

IMO is addressing the problem of inadequate reception facilities and the MEPC is currently looking at the best mechanisms for financing port reception facilities. It is also involved in a number of technical co-operation projects to help developing countries implement MARPOL requirements.

Review of Annex I
With the aim of facilitating more effective implementation of Annex I, the MEPC agreed to review all the provisions of the Annex, and a General Action Plan for the Revision of Annexes I and II was prepared at MEPC 37 in 1995. The revision aims at simplifications of present requirements, adaption to technical progress and identification of inconsistencies with Annex II, including editorial amendments. It is expected that the revision work will be completed by 2002.

Annex II - Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk

Background

The transportation by sea of liquid chemicals in bulk developed in line with the increasing number of by-products being produced by the petroleum refineries.

Chemical tankers have developed alongside the growth in the chemicals industry since World War II. At first, oil tankers were adapted to carry liquid chemicals, by installing special tanks, double bottoms and structural and piping arrangements.

But as the range of products from the chemicals trade increased, so chemical tankers became more complex. In the early 1960s, the first purpose-built chemical tankers made their appearance - designed to offer maximum protection to the cargo and to the crew, because of the nature of the chemicals involved. Chemical tankers are generally smaller in size than oil tankers, ranging from 500 gross tonnage to 40,000 gross tonnage, and are often of extremely complex construction, being designed to carry many different substances at the same time, each with different properties and requiring different handling.

The main chemicals carried in bulk include heavy chemicals; molasses and alcohols; vegetable oils and animal fats; petrochemical products; and coal tar products (see page 17).

Chemical tanker safety

The issue of chemical tanker safety was first raised in the IMO forum in the mid-1960s and resulted in the formation of a new Sub-Committee on Ship Design and Equipment, which was asked to "consider as its initial task the construction and equipment of ships carrying chemicals in bulk". [18]

The new sub-committee held its first session in January 1968 and agreed to prepare a code to cover the design criteria, construction and equipment of chemical tankers. As an initial measure, however, it drew up an interim recommendation for existing chemical tankers which was issued as an MSC circular in 1970.

In October 1971, the IMO Assembly adopted the Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (BCH Code)[19], which set out agreed international standards for the carriage and equipment requirements for such cargoes. The Code applied to ships built on or after 12 April 1972, although it was at the time only recommendatory in nature. However, several countries with a significant number of chemical tankers in their fleet went on to implement the Code into their national legislation.

The Code set out requirements on ship capability for surviving damage and cargo tank location, according to the type of products carried: type I ships would be designed to carry products requiring maximum preventive measures to preclude escape of cargo; type II for products requiring significant preventive measures; and type III covered products requiring a moderate degree of containment. The code gave a list of more than 100 chemicals with the appropriate recommended ship type - based on the evaluation of those chemicals according to a list of specified hazards, including flashpoint, of the chemical and health hazards.

The Code did not tackle the pollution aspects of the transportation of chemicals in bulk: IMO's Sub-Committee on Marine Pollution[20] was already beginning to prepare regulations on the control of discharges from chemical tankers, to be incorporated into the planned new convention on marine pollution.

1973 MARPOL Convention

While the BCH Code addressed the construction and design of chemical tankers to ensure safe carriage of these substances, Annex II of the 1973 MARPOL Convention was concerned with preventing or minimising the operational discharge and accidental release of these substances into the sea.

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[18] MSC 15 March 1967; see Focus chemicals at Sea 1986

[19] Assembly Resolution A.212(VII)

[20] The sub-committee became the Marine Environment Protection Committee in 1973

The regulations were the first to address operational discharges of chemicals from operations such as tank washing. However, the regulations required Governments to ensure reception facilities would be available to receive chemical residues - and this was seen as a sticking point even as States at the 1973 Conference adopted the Convention.

Commenting on the Annex II regulations in 1974, the Oil Companies International Marine Forum (OCIMF) said:

"The provisions of Annex II for control of noxious liquid substances in bulk represent an entirely new set of requirements for previously uncontrolled discharges which may well cause Governments concern as to their ability to comply with its requirements. However, the essential shipboard requirements are operational in character and were developed largely by specialists in the operation of chemical tankers. Therefore it is believed that the procedures needed to assure a high degree of compliance may be evolved in a relatively expeditious fashion.

Perhaps the most difficult aspect of compliance will be concerned with the collection and eventual disposal of residues from reception facilities which must be created for this purpose. As contrasted with the reception facilities required for tankers and other ship residues, the facilities required in the chemicals trade may initially be relatively small in number and volume but they represent a much more difficult technical problem."[21]

While Annex I was based on the premise that all oils are harmful substances and should be prevented from entering the sea, Annex II recognized the wide diversity in physical and biological properties of the substances it covered. As a result, the substances were divided into four categories graded A to D, according to the hazard they present to marine resources, human health or amenities.

(a) **Category A** - Noxious liquid substances which if discharged into the sea from tank cleaning or deballasting operations would present a major hazard to either marine resources or human health or cause serious harm to amenities or other legitimate uses of the sea and therefore justify the application of stringent anti-pollution measures. Examples are acetone cyanohydrin, carbon disulphide, cresols, naphthalene and tetraethyl lead.

(b) **Category B** - Noxious liquid substances which if discharged into the sea from tank cleaning or deballasting operations would present a hazard to either marine resources or human health or cause harm to amenities or other legitimate uses of the sea and therefore justify the application of special anti-pollution measures. Examples are acrylonitrile, carbon tetrachloride, ethylene dichloride and phenol.

(c) **Category C** - Noxious liquid substances which if discharged into the sea from tank cleaning or deballasting operations would present a minor hazard to either marine resources or human health or cause minor harm to amenities or other legitimate uses of the sea and therefore require special operational conditions. Examples are benzene, styrene, toluene and xylene.

(d) **Category D** - Noxious liquid substances which if discharged into the sea from tank cleaning or deballasting operations would present a recognizable hazard to either marine resources or human health or cause minimal harm to amenities or other legitimate uses of the sea and therefore require some attention in operational conditions. Examples are acetone, phosphoric acid and tallow.

The Annex also listed "other liquid substances" deemed to fall outside Categories A, B, C or D and therefore representing no harm when discharged into the sea from tank cleaning or ballasting operations. These substances included coconut oil, ethyl alcohol, molasses, olive oil and wine.

A list of some 250 noxious liquid substances, with categorization, was given in Appendix II to the Annex.

The way in which these substances can be discharged varies according to the hazard they present. Category A substances can only be discharged into reception facilities - not even residues resulting from tank cleaning can be discharged into the sea. This is permitted for other categories, but only under strict controls: Category B substances, for example, can never be discharged in

[21] MEPC II/Inf.10 page 12

quantities greater than one cubic metre. No discharge of residues containing noxious substances is permitted within 12 miles of the nearest land in a depth of water of less than 25 metres. Even stricter restrictions apply in the Baltic Sea and Black Sea. Parties to the Convention were obliged to issue detailed requirements for the design, construction and operation of chemical tankers which contain at least all the provisions of the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (The 1985 amendments made the Code mandatory - see below.)

Operations involving substances to which Annex II applies must be recorded in a Cargo Record Book, which can be inspected by the authorities of any Party to the Convention.

The 1978 Conference

As some observers had predicted, the requirements in Annex II were making it difficult for some Governments to ratify the Convention. As a result, the 1978 Conference on Tanker Safety and Pollution Prevention agreed that Annex II would become effective three years after Annex I entered into force. This encouraged Governments to ratify the Convention, which entered into force on 2 October 1983 - giving parties to the Convention until 2 October 1986 to implement the regulations.

However, it soon became clear that Annex II was not only outdated in some respects but also still presented considerable difficulties as far as implementation was concerned.

A major problem with the implementation of Annex II arose from the original premise on which it was drafted, namely that the quantity of Category B or C chemicals remaining in a tank after unloading could be calculated using vertical and horizontal surface areas and the relevant physical properties of the substance at the temperature concerned, e.g. specific gravity and viscosity.

Providing this calculated quantity was less than the upper limit established by the Convention this residue could be discharged into the wake of the ship with the proviso that the resultant concentrations in the sea did not exceed a certain limit. The application of the latter criteria required further calculations to establish a suitable speed and the under-water discharge rate for the chemical concerned.

But this meant that the operation of a chemical carrier with parcels of different chemicals and considerable variability of physical properties and ambient temperature conditions would mean that a member of the ship's crew would be employed virtually full-time in computing residue quantities and ascertaining discharge parameters.

Experience indicated that this complicated procedure described above could be circumvented if the efficient stripping of tanks to a relatively insignificant residue level during unloading was made mandatory. Those smaller quantities of residues could then be discharged overboard without limitation or rate of discharge, etc.

Another major problem of Annex II concerned reception facilities, the provision of which was crucial to the effective implementation of the regulations. Reception facilities for chemicals are more expensive and complicated than those designed for the reception of oily wastes, since the wastes they are required to deal with are much more varied. There is also little opportunity for recycling them (as can be done with some oily wastes). As a result, governments and port authorities were reluctant to provide such facilities, particularly as the Convention itself was ambiguous as to whether the facilities should be provided in loading or unloading ports.

Some other aspects of implementation were also of concern, such as developing monitoring equipment to ensure that chemicals are properly diluted before being discharged into the sea. Therefore certain operational procedures had to be developed to limit the discharge rate to minimize harm to the environment.

In October 1982, the last ratification required for entry into force of the 1978 MARPOL Protocol was deposited with the IMO Secretary-General, and the Convention entered into force on 2 October 1983. This meant that Annex II would become binding for Parties three years later, on 2 October 1986 and made it even more imperative that something be done quickly to ensure that the Annex could actually be implemented.

In 1983, the IMO Assembly had adopted procedures and arrangements for the discharge of noxious liquid substances which are called for by various regulations of Annex II and these were applied on a trial basis by a number of IMO Member States. These trials showed a number of difficulties in implementing Annex II, mainly associated with the problems already outlined in the previous paragraphs. They included:

1. The requirements were too complex and put a heavy burden on the crew of the ship.
2. Measures of control were very limited and compliance with the standards depended entirely

upon the willingness of the crew.

3. There was a general lack of facilities for the reception of chemical wastes. Although provision of facilities themselves did not present great difficulties because the amount is small compared with oily wastes, treatment of wastes and ultimate disposal was a problem.

IMO consequently, prepared a number of important changes to Annex II which were formally adopted at an "expanded" meeting of IMO's Marine Environment Protection Committee in December 1985.

The 1985 amendments

The 1985 amendments were designed to encourage shipowners to improve cargo tank stripping efficiencies, and included a number of specific requirements to ensure that both new and existing chemical tankers reduce the amount of residues to be disposed of.

At the same time, the amendments made it possible to adopt simplified procedures for the discharge of residues.

The amendments were also aimed at reducing the quantities of B and C substances that were discharged into the sea by introducing a new regulation 5A on *Pumping, piping and unloading arrangements*, which called for new ships (built after 1 July 1986) to be provided with pumping and piping arrangements such that the residue left after emptying a tank would be cut to a specified minimum. Ships constructed before 1 July 1986 also had to ensure pumping and piping arrangements restricted the amount of residue to specified limits.

As a result, the 1985 amendments were designed to bring about a significant reduction in the generation of wastes resulting from shipboard operations, thereby reducing marine pollution by noxious liquid substances from ships as well as cutting drastically the environmental problems ashore involved with the treatment and ultimate disposal of wastes received from ships. In addition, the amendments provided for improved possibilities for executing effective port State control, thus ensuring full compliance with the provisions of the Annex.

It was also decided in 1985, that the implementation date of existing Annex II (originally set as three years after entry into force of MARPOL 73/78 as a whole) should also be deferred until 6 April 1987, the date of entry into force of the 1985 amendments. If this had not been done, the Annex would have entered into force in October 1986 only to be changed in crucial aspects, including the Certificate and Cargo Record Book, barely six months later. This would have imposed a considerable burden on Administrations and the shipping community.

Another important feature of the 1985 amendments to Annex II was to make mandatory the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code). This Code was developed to improve and update the existing Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code) and had been made mandatory under the International Convention for the Safety of Life at Sea (SOLAS) through amendments to that Convention adopted in 1983.

The IBC Code applies to chemical tankers constructed on or after 1 July 198622, while chemical tankers constructed before that date had to comply with the requirements of the existing BCH Code.[23]

The 1985 MARPOL amendments also brought survey and certification requirements into line with Annex I (regulations 10-12); introduced a scheme for the mandatory pre-washing of cargo tanks (regulation 8); added a new regulation dealing with oil-like noxious liquid substances (regulation 14); revised the list of noxious and other substances appended to the Annex; and updated the form of the Cargo Record Book (regulation 9).

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[22] This was the date of entry into force of part B of chapter VII of SOLAS 1974 contained in the 1983 amendments to the 1974 SOLAS Convention.

[23] The purposes of each of these Codes is to provide an international standard for the safe transport by sea in bulk of liquid dangerous chemicals, by prescribing the design and construction standards of ships regardless of tonnage involved in such transport and the equipment they should carry so as to minimize the risks to the ship, its crew and to the environment, having regard to the nature of the products carried.

Annex II implementation
Annex II of MARPOL (with the 1985 amendments) became binding for Parties on 6 April 1987.

The Annex contained the following provisions for controls on discharges:

Pollution Category	Maximum discharge quantity allowed from any one tank Existing ships	New ships
A	None	None
B	300 litres	100 litres
C	900 litres	300 litres
D	Unrestricted (but discharge allowed only under certain conditions, including not less than 12 nautical miles from nearest land)	Unrestricted (but discharge allowed only under certain conditions, including not less than 12 nautical miles from nearest land)
Other	Unrestricted	Unrestricted

Categorization of products for Annex II
The categorization of noxious liquid substances for Annex II was based on evaluations carried out by a special Working Group on the Evaluation of Harmful substances (EHS), set up by the joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP)[24].

The EHS Working Group has evaluated substances according to a range of properties, including bioaccumulaiton, tainting, acute aquatic toxicity, human health effects and potential damage to living resources. This evaluation procedure results in a GESAMP Hazard Profile for individual substances - which is used as a basis for defining pollution categories (and ship types) for substances transported under Annex II.

A revised list of chemicals in Annex II and in the International Bulk Chemical Code and the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk were adopted in the March 1989 amendments to MARPOL, which entered into force on 13 October 1990.

Review of Annex II
In 1992, the MEPC agreed to review all the provisions in Annex II, with the aim of simplifying the requirements to encourage more widespread implementation of the Annex. At the same time, it agreed to review the categorization system.

The decision to completely review the Annex was influenced by a number of developments.

Firstly, improvements in ship technology meant that stripping of tanks had improved to the extent that only very minimum amounts of residues would be left in tanks after unloading and consequently the limits on the discharges of substances could also be drastically cut.

As improvements in technology have enabled IMO to reconsider the amount of discharge permitted to enter the marine environment, they have also provided an opportunity to reconsider the number of defined pollution categories.

Another issue was increased understanding of the environmental impact of chemicals on the marine environment. In the existing product categorization, Annex II placed considerable emphasis on acute aquatic toxicity, tainting of fish and bioaccumulation with associated harmful effects, but it was being recognized that other properties were equally important - such as chronic aquatic toxicity, and the effect on wildlife or seabed of substances that would sink or persistently float on the surface.

The 1992 UNCED Rio Conference is also influencing the review of Annex II. Chapter 19 of Agenda 21 adopted by the Conference included a programme on harmonization of classification and labelling of chemicals and the United Nations Committee of Exerts on the transport of Dangerous Goods and the Organization for Economic Cooperation and Development (OECD) have been acting as clearing houses for the development of harmonized hazard classification systems covering the physical and biological properties that affect safety and protection of the environment.

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[24] GESAMP includes experts from various United Nations agencies, including IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP

The work of these organizations in developing harmonized classification systems has a bearing on the work of the GESAMP Evaluation of Hazardous Substance working Group - and on the work of the Working Group on the Evaluation of Safety and Pollution Hazards (ESPH) - a working group of the IMO Sub-Committee on Bulk Liquids and Gases (BLG), which reports to the MEPC and MSC. The ESPH working group is dealing primarily with the assignment of pollution categories and carriage requirements for products in order to ensure their safe carriage and protection of the marine environment.

Revision of categories towards three-category system

As instructed by the MEPC, the ESPH working group is considering whether the existing five product category system in Annex II (categories A, B, C, D plus "other liquid substances") could be simplified into a three-category system.

The MEPC at its 40th session in 1997, agreed that it was inappropriate to make any decisions related to re-categorization until it had all the facts before it, including environmental, economic, practical and administrative considerations. As a result, the MEPC agreed to continue with the work in developing alternative categorization systems along with all the resultant pros and cons of introducing such systems

The three-category system is based on the premise - in line with the development of the so-called precautionary approach[25] - that no product should be permitted to enter the sea in unlimited quantities, as is the case with Category D and "other liquid substances" under Annex II. Therefore these two categories could be combined, creating a category for substances with limited restrictions.

A second category could combine current categories B and C, since ship technology now makes it easier for all ships to achieve minimum residue levels of 100 litres per tank - so there is no need to differentiate.

The third category would be equivalent to the existing Category A - in other words, substances considered highly environmentally hazardous and which should not be discharged at all.

The ESPH working group is continuing work on refining alternative systems including the three-category system.

It is envisaged that the complete revision of Annex II will be completed by 2002. By then, hazard profiles for all noxious liquid substances carried in bulk on ships which come under MARPOL Annex II will have been re-evaluated and re-categorized. This is a mammoth task - some 300 substances are listed in the International Bulk Chemical Code.

The MEPC is also looking into the whole issue of reception facilities and how to ensure adequate reception facilities are provided at ports.

[25] The precautionary approach was introduced into the 1996 protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LC), and is based on the premise that unless a substance can be proved to be harmless, it should not be dumped in the sea. Previously, the onus has been to prove something is harmful, to get its dumping banned.

Noxious liquid substances carried in bulk - examples[26]	
Heavy chemicals	Those substances produced in large quantities, for example: **sulphuric acid** - among the cheapest of all acids and can be produced from sulphur, air and water. It is also very versatile, being used for the production of phosphate fertilizer, explosives such as TNT, plastics such as rayon, purifying petroleum and removing oxides from metals and in storage batteries; **phosphoric acid** - used for the production of superphosphates and various other products, including detergents, paints, and foodstuffs: **nitric acid** - a basic ingredient of explosives, nitrate fertilizers and many dyes, and plastics; **caustic soda** is also shipped in solution; **hydrochloric acid** - used in steel reduction process and ore reduction; **ammonia**.
Molasses and alcohols	**Molasses** comes from either sugar beet or sugar cane and can be fermented into alcohols such as rum. Many **alcohols** are produced by the petrochemical industry, but some can also come from the fermentation of starch, such as ethanol. Alcohols of this type, including ethyl, methyl and propyl, are used in industrial. processes (for examples to make cellulose acetate, which is a thermoplastic moulding compound used in the manufacture of telephones, buttons, films and many other products). **Wines and some beers** also come into this category and are being increasingly carried at sea in bulk quantities on ships which are in fact specialized chemical tankers.
Vegetable and animal fats and oils	**Edible vegetable oils** are derived from soya beans, groundnuts, cottonseed, sunflowers, olives, rape and other seeds. **Coconut and palm oil** can be used for cooking and also in the production of soap. **Industrial oils** come from linseed and castor seed. Some fats are extracted from animals including lard and fish oils.
Petrochemical products	The most complex and probably the most versatile group of chemicals carried in bulk - all are carbon compounds basically derived from oil or gas. They are extensively used in the production of fibre, artificial rubber and plastics and many are carried on liquefied gas carriers. Substances carried in chemical tankers include aromatics, such as benzene, which nowadays are derived mainly from oil but can be produced from coal. Other important petrochemicals include xylenes (used in the production of polyester fibres); phenol (previously known as carbolic acid) and styrenes.
Coal tar products	Coal tar is derived from the carbonization of coal. It can be converted into numerous products, many of which can also be produced from oil (oil and coal are both fossil fuels composed of hydrocarbons). Coal tar derivatives include benzene, phenol (used for the production of Bakelite, the first 'plastic'), naphthalene and many more. Common products which are derived from coal include nylon, aspirin, antiseptics and herbicides.

[26] Each individual product is evaluated according to the hazards it presents.

Annex III - Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form

The objective behind the regulations contained in Annex III of MARPOL was to identify marine pollutants so that they could be packed and stowed on board ship in such a way as to minimise accidental pollution as well as to aid recovery by using clear marks to distinguish them from other (less harmful) cargoes.

The rules on discharging harmful goods was straightforward: "Jettisoning of harmful substances carried in packaged form shall be prohibited, except where necessary for the purpose of securing the safety of the ship or saving life at sea". [27]

The Annex also called for "appropriate measures based on the physical, chemical and biological properties of harmful substances shall be taken to regulate the washing of leakages overboard, provided that compliance with such measures would not impair the safety of the ship and persons on board."[28]

The Annex applies to all ships carrying harmful substances in packaged form, or in freight containers, portable tanks or road and rail tank wagons. The regulations require the issuing of detailed standards on packaging, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications, for preventing or minimizing pollution by harmful substances.

However, implementation of the Annex was initially hampered by the lack of a clear definition of harmful substances carried in packaged form. This was remedied by amendments to the International Maritime Dangerous Goods Code (IMDG Code) to include marine pollutants.

The IMDG Code was first adopted by IMO in 1965 and lists hundreds of specific dangerous goods together with detailed advice on storage, packaging and transportation. The amendments extending the Code to cover marine pollutants, which entered into force in 1991, added the identifier "marine pollutant" to all substances classed as such. All packages containing marine pollutants must be marked with a standard marine pollutant mark.

Annex III of MARPOL was also amended at the same time, to make it clear that " 'harmful substances' are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code)."

Annex III was optional under the terms of the 1973 Convention which meant that States who had signed up to MARPOL 73/78 were not required to adopt the Annex at the same time. The optional Annexes (Annexes IV and V were also optional) would enter into force 12 months after not less than 15 States with combined merchant shipping tonnage of more than 50 percent of the world fleet had ratified them.

Annex III received sufficient ratifications by 1991 and entered into force on 1 July 1992. It has been ratified by 87 States, representing 79.13 percent of world merchant shipping (at 1 October 1998).

Annex III today

The main changes affecting Annex III today relate to the IMDG Code, rather than to any developments in the Annex itself.

The MSC in May 1998 adopted Amendment 29 to the IMDG Code, which is aimed at bringing the Code into line with the tenth revised edition of the United Nations Recommendations on the Transport of Dangerous Goods, set to come into force on 1 January 1999, with a transitional period to 1 July 1999.

Amendment 29 also includes a revised classification of marine pollutants, based on the work carried out by GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection) on hazard profiles.

Meanwhile, the IMDG Code is being reformatted to make it more user-friendly and easily understandable. The present Code appears in four volumes, but the reformatted Code will appear in two volumes: one covering the general introduction, with information about the nine classes of dangerous goods, packaging and portable tanks; the second incorporating the list of substances plus index.

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[27] MARPOL Annex III, Regulation 7 (1)

[28] MARPOL Annex III, Regulation 7 (2)

The final draft of the reformatted Code is expected to be adopted during 1999 with entry into force scheduled for 1 January 2001.

Annex IV - Prevention of Pollution by Sewage from Ships

The discharge of raw sewage into the sea can create a health hazard, while in coastal areas, sewage can also lead to oxygen depletion and an obvious visual pollution - a major problem for countries with large tourist industries.

The main sources of human-produced sewage are land-based - such as municipal sewers or treatment plants.

It is generally considered that on the high seas, the oceans are capable of assimilating and dealing with raw sewage through natural bacterial action and therefore the regulations in Annex IV of MARPOL prohibit ships from discharging sewage within four miles of the nearest land, unless they have in operation an approved treatment plant. Between 4 and 12 miles from land, sewage must be comminuted and disinfected before discharge.

Governments are required to ensure the provision of adequate reception facilities at ports and terminals for the reception of sewage.

The Annex, which is optional, will enter into force after being accepted by 15 states where merchant fleets represent 50 percent of world tonnage. By October 1998 it had been accepted by 71 countries with 42.50 percent of world tonnage.

The Annex, when it comes into force, will apply to new ships (built after the date of entry into force of the Annex) of 200 gross tonnage and above or carrying more than 10 persons. It will apply to existing ships (built before the date of entry into force of the Annex) 10 years after date of entry into force.

Annex IV today

Although the Annex has not come into force, many countries have imposed regulations which are in line with its requirements, on ships visiting their coastlines to avoid the damage to health and amenities from the discharge of sewage. In practice, evidence suggests that all cruise ships and large passenger ships already have sewage treatment plants on board, so that ships are not seen as a major source of sewage pollution.

Meanwhile, an IMO Correspondence Group is working on reviewing the regulations in Annex IV with a view to updating and revising them where necessary, to encourage further ratifications.

The obligation for Parties to provide reception facilities is seen as one issue hampering ratification, which could be resolved by requiring all or most ships to have sewage treatment plants. Another issue being considered is the size of ships to which the regulations should apply: one proposal is that they should apply to larger passenger ships only.

The Correspondence Group is also working on harmonizing IMO standards on sewage treatment plants with those being developed by the International Standards Organization (ISO).

Annex V - Prevention of Pollution by Garbage from Ships

Garbage from ships can be just as deadly to marine life as oil or chemicals. The greatest danger comes from plastic, which can float for years. Fish and marine mammals can in some cases mistake plastics for food and they can also become trapped in plastic ropes, nets, bags and other items - even such innocuous items as the plastic rings used to hold cans of beer and drinks together.

It is clear that a good deal of the garbage washed up on beaches comes from people on shore - holiday-makers who leave their rubbish on the beach, fishermen who simply throw unwanted refuse over the side - or from towns and cities that dump rubbish into rivers or the sea. But in some areas most of the rubbish found comes from passing ships which find it convenient to throw rubbish overboard rather than dispose of it in ports. One estimate in the early 1980s suggested that more than six million cans and 400,000 bottles were being dumped into the sea from ships every day.[29]

For a long while, many people believed that the oceans could absorb anything that was thrown into them, but this attitude has changed along with greater awarenes of the environment.

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[29] Lloyd's List 24/12/82

Many items can be degraded by the seas - but this process can take months or years, as the following table shows:

Time taken for objects to dissolve at sea	
Paper bus ticket	2-4 weeks
Cotton cloth	1-5 months
Rope	3-14 months
Woollen cloth	1 year
Painted wood	13 years
Tin can	100 years
Aluminium can	200-500 years
Plastic bottle	450 years

Source: Hellenic Marine Environemnt Protection Association (HELMEPA)

The 1973 MARPOL Convention sought to eliminate and reduce the amount of garbage being dumped into the sea from ships. Under Annex V of the Convention, garbage includes all kinds of food, domestic and operational waste, excluding fresh fish, generated during the normal operation of the vessel and liable to be disposed of continuously or periodically.

Annex V totally prohibits of the disposal of plastics anywhere into the sea, and severely restricts discharges of other garbage from ships into coastal waters and "Special Areas". The Annex also obliges Governments to ensure the provision of facilities at ports and terminals for the reception of garbage.

The special areas established under the Annex are the Mediterranean Sea, the Baltic Sea Area, the Black Sea area, the Red Sea Area, the Gulfs area, the North Sea, the Wider Caribbean Region and the Antarctic Area - areas which have particular problems because of heavy maritime traffic or low water exchange caused by the land-locked nature of the sea concerned.

Although the Annex was optional, the Annex did receive sufficient number of ratifications to enter into force on 31 December 1988.

Provisions to extend port State control to cover operational requirements as regards prevention of marine pollution were adopted as a new regulation 8 to the Annex in 1994 (entering into force on 3 March 1996). Like similar amendments adopted to the other MARPOL Annexes, the regulation makes it clear that port State control officers can inspect a foreign-flagged vessel "where there are clear grounds for believing that the master or crew are not familiar with essential shipboard procedures relating to the prevention of pollution by garbage".

Implementation, and enforcement, was also the focus of a further new Regulation 9, adopted in 1995, which requires all ships of 400 gross tonnage and above and every ship certified to carry 15 persons or more, and every fixed or floating platform engaged in exploration and exploitation of the seabed, must provide a Garbage Record Book, to record all disposal and incineration operations. The date, time, position of ship, description of the garbage and the estimated amount incinerated or discharged must be logged and signed. The books must be kept for a period of two years after the date of the last entry.

This regulation does not in itself impose stricter requirements - but it makes it easier to check that the regulations on garbage are being adhered to as it means ship personnel must keep track of the garbage and what happens to it. It may also prove an advantage to a ship when local officials are checking the origin of dumped garbage - if ship personnel can adequately account for all their garbage, they are unlikely to be wrongly penalised for dumping garbage when they have not done so.

Regulation 9 came into force for new ships from 1 July 1997 but from 1 July 1998 all applicable ships built before 1 July 1997 also have to comply: all ships of 400 gross tonnage and above and every ship certified to carry 15 persons or more, and every fixed or floating platform engaged in exploration and exploitation of the seabed.

The Regulation also requires every ship of 12 metres or more in length to display placards notifying passengers and crew of the disposal requirements of the regulation; the placards should be in the official language of the ship's flag State and also in English or French for ships travelling to other States' ports or offshore terminals.

Despite the entry into force of Annex V in 1988, even recent surveys carried out in the United States each year have produced up to 10 tons of garbage per mile of coastline, a record that can probably be matched in may other parts of the world. Plastic forms the biggest single item found.

Persuading people not to use the oceans as a rubbish tip is a matter of education - the old idea that the sea can cope with anything still prevails to some extent but it also involves much more vigorous enforcement of regulations such as Annex V.

Wider Caribbean project

In 1993, IMO, in co-operation with the World Bank, began a major project to solve the garbage disposal problems in the Caribbean - called the Wider Caribbean Initiative on Ship-generated Waste (WCISW) Project.

The Wider Caribbean region was chosen a a focus for this project as it is a magnet for the increasingly popular cruise shipping industry. Cruise liner passengers like to visit a different port each day and a cruise ship with 3,000 people or more on board generates as much garbage as a small town: figures show that each person on a passenger vessel generates more than 2.5 kilograms of garbage per day. On a ship carrying 3,000 passengers and crew, that means more than seven tonnes of garbage per day.

In theory, the ship should be able to dispose of this when it reaches port - but in practice the island States of the Caribbean do not have the resources to cope with such a deluge. When the project started in 1993, many of them had not ratified Annex V of MARPOL because they were unwilling to provide reception facilities for cruise ships' rubbish when the cruise ships themselves do not make a great contribution to local tourism income.

Yet, if ships cannot dispose of their rubbish in ports the danger is that some of them will be tempted to do so - illegally - at sea. And this could lead to immense damage being caused to the pristine environment that attracts tourists to the Caribbean in the first place.

The result of the project was that six more countries ratified MARPOL and it is anticipated that all 29 countries in the area will have done so by 2001. The next stage will be ensuring the infrastructure is actually in place (i.e. reception facilities) to meet the "special area" status of the region.

Annex VI - Prevention of Air Pollution from Ships

Background

The issue of controlling air pollution form ships - in particular, noxious gases from ships' exhausts - was discussed in the lead up to the adoption of the 1973 MARPOL Convention. However, it was decided not to include air pollution at the time.

Meanwhile, air pollution was being discussed in other arenas. The 1972 United Nations Conference on the Human Environment in Stockholm marked the start of active international cooperation in combating acidification, or acid rain. Between 1972 and 1977, several studies confirmed the hypothesis that air pollutants could travel several thousand kilometres before deposition and damage occurred. This damage includes effects on crops and forests.

Most acid rain is caused by airborne deposits of sulphur dioxides and nitrogen oxides. Coal and oil-burning power plants are the biggest source of sulphur dioxides while nitrogen oxides come from car, truck - and ship - exhausts.

In 1979, a ministerial meeting on the protection of the environment, in Geneva, resulted in the signing of the Convention on Long-range Transboundary Air Pollution by 34 governments and the European Community. This was the first international legally binding instrument to deal with problems of air pollution on a broad regional basis.

Protocols to this Convention were later signed on reducing sulphur emissions (1985); controlling emissions of nitrogen oxides (1988); controlling emissions of volatile organic compounds (1991) and further reducing sulphur emissions (1994).

During the 1980s, concern over air pollution, such as global warming and the depleting of the ozone layer, continued to grow, and in 1987 the Montreal Protocol on substances that Deplete the Ozone Layer was signed. The Montreal Protocol is an international environmental treaty, drawn up under the auspices of the United Nations, under which nations agreed to cut consumption and production of ozone-depleting substances including chlorofluorocarbons (CFCs) and halons in order to protect the ozone layer. A Protocol was adopted in London in 1990 - amending the original protocol and setting the year 2000 as the target completion date for phasing out of halons and ozone-depleting CFCs. A second Protocol was adopted in Copenhagen in 1992, introducing accelerated phase-out dates for controlled substances, cutting short the use of_transitional substances and the introduction of phase-out dates for HCFCs and methyl bromide(a pesticidal gas which depletes the ozone layer).

CFCs have been in widespread use since the 1950s as refrigerants, aerosol propellants, solvents, foam blowing agents and insulants. In shipping, CFCs are used to refrigerate ship and container cargo, insulate cargo holds and containers, air condition crew quarters and occupied areas and refrigerate domestic food storage compartments.

Halons, manufactured from CFCs, are effective fire extinguishers used in portable fire extinguishers and fixed fire prevention systems. [30]

IMO and air pollution

At IMO, the MEPC in the mid-1980s had been reviewing the quality of fuel oils in relation to discharge requirements in Annex I and the issue of air pollution had been discussed. In 1988, the MEPC agreed to include the issue of air pollution in its work programme following a submission from Norway on the scale of the problem.[31] In addition, the Second International Conference on the Protection of the North Sea, held in November 1987, had issued a declaration in which the ministers of North Sea states agreed to initiate actions within appropriate bodies, such as IMO, "leading to improved quality standards of heavy fuels and to actively support this work aimed at reducing marine and atmospheric pollution."[32]

At the next MEPC session, in March 1989, various countries submitted papers referring to fuel oil quality and atmospheric pollution, and it was agreed to look at the prevention of air pollution

[30] MEPC 29/Inf 9 from FOEI

[31] MEPC 26/25 para 24.3

[32] MEPC 26/24 Annex page 2

from ships - as well as fuel oil quality - as part of the committee's long-term work programme, starting in March 1990.

In 1990, Norway submitted a number of papers to the MEPC giving an overview on air pollution from ships. The papers noted:

Sulphur emissions from ships' exhausts were estimated at 4.5 to 6.5 million tons per year - about 4 percent of total global sulphur emissions. Emissions over open seas are spread out and effects moderate, but on certain routes the emissions create environmental problems, including English Channel, South China Sea, Strait of Malacca.

Nitrogen oxide emissions from ships were put at around 5 million tons per year - about 7 percent of total global emissions. Nitrogen oxide emissions cause or add to regional problems including acid rain and health problems in local areas such as harbours.

Emissions of CFCs from the world shipping fleet was estimated at 3,000-6,000 tons - approximately 1 to 3 percent of yearly global emissions. **Halon emissions** from shipping were put at 300 to 400 tons, or around 10 percent of world total. [33]

Discussions in the MEPC and drafting work by a working group, led to the adoption in 1991, of an IMO Resolution A.719(17) on ***Prevention of Air Pollution from Ships***.

The Resolution called on the MEPC to prepare a new draft Annex to MARPOL 73/78 on prevention of air pollution.

The new draft Annex was developed over the next six years - and was finally adopted at a Conference in September 1997. It was agreed to adopt the new Annex through adding a Protocol to the Convention, which included the new Annex. This enabled specific entry into force conditions to be set out in the protocol.

The Protocol of 1997 (Annex VI)

The Protocol and new Annex VI to MARPOL 73/78 will enter into force 12 months after being accepted by 15 states with not less than 50% of world merchant shipping tonnage.

The Conference also adopted a Resolution which invites IMO's Marine Environment Protection Committee (MEPC) to identify any impediments to entry into force of the Protocol, if the conditions for entry into force have not been met by 31 December 2002.[34] This proviso was aimed at ensuring that any problems in ratifying the annex could be ironed out to avoid excessive delays in the Annex coming into force.

Annex VI on Regulations for the Prevention of Air Pollution from Ships, when it comes into force, will set limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibit deliberate emissions of ozone depleting substances.

The annex includes a global cap of 4.5% m/m on the sulphur content of fuel oil and calls on IMO to monitor the worldwide average sulphur content of fuel once the Protocol comes into force.

Annex VI contains provisions allowing for special 'SOx Emission Control Areas' to be established with more stringent controls on sulphur emissions. In these areas, the sulphur content of fuel oil used onboard ships must not exceed 1.5% m/m. Alternatively, ships must fit an exhaust gas cleaning system or use any other technological method to limit SOx emissions. The Baltic Sea Area is designated as an SOx Emission Control area in the Protocol.

Annex VI prohibits deliberate emissions of ozone depleting substances, which include halons and chlorofluorocarbons (CFCs). New installations containing ozone depleting substances are prohibited on all ships. But new installations containing hydro-chlorofluorocarbons (HCFCs) are permitted until 1 January 2020.

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[33] MEPC 29/18/4

[34] The Conference also adopted a Resolution which invites the MEPC to identify any impediments to entry into force of the Protocol, if the conditions for entry into force have not been met by 31 December 2002.

Annex VI also sets limits on emissions of nitrogen oxides (NOx) from diesel engines. A mandatory NOx Technical Code,which defines how this shall be done, was adopted by the Conference under the cover of Resolution 2.

The Annex also prohibits the incineration onboard ship of certain products, such as contaminated packaging materials and polychlorinated biphenyls (PCBs).

Current status

Annex VI has to date (October 1998) been ratified by two countries.

Meanwhile, the MEPC has drawn up a programme of follow-up action towards implementation of Annex VI.

The Sub-Committee on Ship Design and Equipment (DE) has been instructed to develop guidelines relevant to implementation of the Annex VI, including, as a high priority, guidelines on sampling of fuel delivered for use onboard ships and guidelines for onboard nitrogen oxide monitoring and recording devices.

The Sub-Committee on Fire Protection (FP) is to review the use of perfluorocarbons (PFCs) in shipboard fire-extinguishing systems, in line with a conference resolution calling for their use to be prohibited. The FP Sub-Committee will seek to identify what uses of PFCs, if any, are essential for fire-extinguishing systems on commercial surface vessels, commercial submersibles and offshore platforms. In the Arctic and Antarctic sea areas, alternatives may not be suitable for use in sub-zero conditions.

The issue of carbon dioxide emissions from ships, and how to control them, as requested by the Kyoto Protocol of 1997 to the United Nations Framework Convention for Climate Change, is being discussed at MEPC, with a view to developing guidelines relevant to implementation of the Annex VI, including, as a high priority, guidelines on sampling of fuel delivered for use onboard ships and guidelines for onboard nitrogen oxide monitoring and recording devices.

Possible future Annexes to MARPOL 73/78

IMO's Marine Environment Protection Committee is currently working on two further issues which affect the marine environment. Draft regulations are being drawn up to prevent the spread of unwanted aquatic organisms in ballast water and to prohibit the use of toxic anti-fouling paints. Both issues may be dealt with by adding new Annexes to MARPOL 73/78 - although the MEPC may decide to propose that they are dealt with by independent Conventions.

Unwanted aquatic organisms in ballast water

Ballast water is used to stabilise ships when they have discharged their cargo and are sailing to pick up cargo at the next port. Over the years, ships have unwittingly carried hundreds of species across the oceans. Discharged into their non-native habitat, these species can cause havoc to the local ecosystem.

Examples include the European goby fish, which has been introduced into the Great Lakes in North America a voracious and aggressive fish which is damaging local native fish stocks. Kelp is farmed in Japan - but outside its native habitat it can choke coral and devastate the local ecosystem.

Dinoflagellates - microscopic organism - can cause paralytic shellfish poisoning in humans. South-east Asian dinoflagellates have been introduced into Australian waters, harming local shellfish industries.

The problem of alien species in ballast water was recognised in the early part of the 20th century, but it was not until the 1970s that it really began to be recognised as a problem.

The 1973 conference which adopted the first MARPOL Convention, adopted a Resolution which noted that "ballast water taken in waters which may contain bacteria of epidemic diseases, may, when discharged, cause a danger of spreading of the epidemic diseases to other countries". The Resolution requested IMO and the World Health Organization to "initiate studies on that problem on the basis of any evidence and proposals which may be submitted by governments". [35]

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[35]Final Act of the International Conference on Marine Pollution 1973, Resolution 18

In the next decade, more and more alien species were being introduced - and being noticed - around the world. In the late 1980s, Canada and Australia were among countries experiencing particular problems with unwanted species, and they brought their concerns to the (MEPC).[36]

Ballast water guidelines 1991

In 1990, the MEPC at its 31st session set up a working group on ballast water, which developed guidelines on addressing the problem of alien species. An MEPC Resolution MEPC 50 (31) - ***Guidelines for Preventing the Introduction of Unwanted Organisms and Pathogens from Ships' Ballast Waters and Sediment Discharges*** - was adopted in 1991.

The Guidelines were aimed at providing Administrations and port State authorities with information on procedures to minimize the risks from the introduction of unwanted aquatic organisms from ships' ballast water and sediment.

The Guidelines were subsequently adopted as an Assembly Resolution A.774(18),while a revised version was adopted in 1997 as A.868(20). The revised version incorporates further recommendations on tackling the problem, including how to lessen the chances of taking onboard harmful organisms along with ballast water.

The recommendations include informing local agents and/or ships, of areas and situations where uptake of ballast water should be minimized, such as areas with known populations of harmful pathogens or areas near to sewage outlets. Ships should operate precautionary practices, through avoiding loading ballast water in very shallow water or in areas where propellers may stir up sediment. Unnecessary discharge of ballast water should also be avoided.

Procedures for dealing with ballast water include exchange of ballast water at sea and discharge to reception facilities, while the Guidelines note that in the future treatment using heat or ultraviolet light could become acceptable to port States.

The MEPC and Maritime Safety Committee have already approved guidance on safety aspects relating to the exchange of ballast water at sea, which outlines procedures for exchanging ballast water and point out safety issues which need to be considered, such as avoidance of over and under pressurization of ballast tanks and the need to be aware of weather conditions.

In March 1998, the MEPC approved a programme of work for the ballast water working group, which includes developing draft Regulations on ballast water management, expected to be adopted at a Conference of Parties to MARPOL 73/78. The Conference is scheduled to be held in the year 2000.

The Regulations will probably make it compulsory for ships to choose between exchanging their ballast water in mid-Ocean, where they are less likely to pick up sea life, discharging ballast water into special reception facilities or using some other method to kill off any alien life forms carried in the ballast water.

Toxic anti-fouling paints

Antifouling paints are used to coat the bottoms of ships to prevent sealife such as algae and molluscs attaching themselves to the hull - thereby slowing down the ship and increasing fuel consumption. In the early days of sailing ships, lime and later arsenic was used to coat ships' hulls, until the modern chemicals industry developed effective antifouling paints using metallic compounds.

But underwater marine life can be harmed by these products. The compounds slowly "leach" into the sea water, killing barnacles and other marine life that have attached themselves to the ship . But studies have shown that these compounds persist in the water, killing sealife, harming the environment and possibly entering the food chain. One of the most effective antifouling paints, developed in the 1960s, contains the organotin tributyl tin (TBT), which has been proven to cause deformations in oysters and sex changes in whelks.

MEPC's interest in the anti-fouling paints issue goes back to 1988, when at its twenty-sixth session, the Paris Commission requested IMO to consider the need for measures under relevant legal instruments to restrict the use of tributyl tin (TBT) compounds on seagoing vessels in order to

[36] A sub-committee of IMO's Maritime Safety Committee was set up following the **Torrey Canyon** disaster of 1967 to deal with environmental issues, but in 1975, the 9th Assembly adopted resolution A.358(IX) which formally established the Marine Environment Protection Committee (MEPC). The MEPC deals with all aspects of marine pollution and has the same status as the MSC. It is open to all IMO Member States and is usually attended by a number of environmental non-governmental organisations which have consultative status with IMO.

supplement the measures that had been taken in other fora to eliminate pollution from such compounds.

By this time there was unequivocal evidence worldwide that TBT and other organotin compounds were harmful to aquatic organisms. Based on the results from organotin assessment studies, a number of Governments either individually or under regional agreements adopted measures to reduce the harmful effects of the use of TBT based anti-fouling paints.

It was recognized, however, that, in order to tackle this problem, an international measure to regulate the use of anti-fouling paints would need to be developed. In April 1990, the Third International Organotin Symposium held in Monaco recognized that the IMO was the appropriate body to regulate the use of organotin compounds internationally.

In 1990, the MEPC adopted a resolution (MEPC.46(30) which recommended that Governments adopt measures to eliminate the use of antifouling paint containing TBT on non-aluminium hulled vessels of less than 25 metres in length and eliminate the use of antifouling paints with a leaching rate of more than 4 microgrammes of TBT per day. Some countries, such as Japan, have already banned TBT in antifouling paint for most ships.

In the sessions that followed, the MEPC was presented with TBT monitoring study results which reconfirmed the toxicity of these compounds to marine organisms and highlighted the effectiveness of control measures in reducing the concentration of TBT in both the water column and tissues of aquatic organisms. The Committee was also presented with information on existing alternative anti-fouling paint systems, including their effectiveness and the risk posed to the aquatic environment by these systems.

As a result, the MEPC in 1996 established a Correspondence Group which reviewed current research and looked into the possibility of drafting regulations to phase out the use of TBT acting as a biocide in anti-fouling systems.

In March 1998, the MEPC agreed to establish a Working Group to begin drafting mandatory regulations to ban TBT in biocides in anti-fouling systems. It is likely that these regulations would be adopted at a Conference after the year 2000.

Alternatives to TBT paint include copper-based coatings and silicon-based paints, which make the surface of the ship slippery so that sealife will be easily washed off as the ship moves through water. Further development of alternative anti-fouling systems is being carried out. Underwater cleaning systems avoid the ship having to be put into dry dock for ridding the hull of sealife, while ultrasonic or electrolytic devices may also work to rid the ship of foulants.

MARPOL 73/78 - Conclusions

The adoption of the MARPOL Convention in 1973 was an important step in focusing the shipping industry's attention on the environment. It was no longer enough just to ensure goods and people were transported safely - consideration for the environment was now on the agenda.

In part, this reflected greater awareness worldwide of the impact of an increasingly industrialised world on the environment - and it is clear that the Convention was also in a sense a global political response to incidents such as the **Torrey Canyon** disaster.

In 1973, the Convention was extremely ambitious - and time showed that some of its aims did prove to be technically difficult to achieve and to convert into practicable regulations that Parties to the Convention could implement into their national legislation.

After the 1978 conference on Tanker Safety and Pollution Prevention, which both strengthened provisions for tanker safety and removed the obstacles that were preventing the entry into force of the Convention (mainly related to technical provisions in Annex II), the twin aims of "Safer shipping and cleaner oceans" became the dual objective of IMO's work.

When MARPOL 73/78 entered into force in 1983 it proved that countries were prepared to implement measures to protect the marine environment.

Today, MARPOL is recognised as the most important set of international regulations for the prevention of marine pollution by ships and figures show that marine pollution has declined over the years.

According to the environmental group Greenpeace, 77 percent of all polluting substances in the marine environment come from human land-based activities, while shipping and dumping at sea are thought to contribute to the remainder. [37]

There are still concerns over pollution entering the world's oceans - and the key to preventing this is implementation of IMO Conventions.

IMO is focusing on this through its Committees and Sub-Committees, and through its Technical Cooperation programme, which aims to assist developing countries in developing the infrastructure and trained personnel necessary to achieve ratification and implementation of the international regulations.

Besides MARPOL, IMO's safety related Conventions are also crucial elements in helping prevent accidents - and therefore helping prevent marine pollution.

These include:

International Convention for the Safety of Life at Sea (SOLAS), 1974
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978
International Convention on Load Lines (LL), 1966
Convention on the International Regulations for Preventing Collisions at Sea (COLREG), 1972
International Convention on Salvage (SALVAGE), 1989

Other conventions which relate to pollution concerns include:

International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (INTERVENTION), 1969
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LDC), 1972
International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990
International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND), 1971
International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (HNS), 1996

[37] Greenpeace Report on the World's Oceans. See LC\20\8-1 p2

Other important contributions to preventing marine pollution include port State control, the introduction of the International Safety Management Code and the 1995 amendments to the 1978 International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)

Port State control

Many of IMO's most important technical conventions contain provisions for ships to be inspected when they visit foreign ports to ensure that they meet IMO requirements. These inspections were originally intended to be a back up to flag State implementation, but experience has shown that they can be extremely effective, especially if organized on a regional basis. A ship going to a port in one country will normally visit other countries in the region before embarking on its return voyage and it is to everybody's advantage if inspections can be closely co-ordinated.

This ensures that as many ships as possible are inspected but at the same time prevents ships being delayed by unnecessary inspections. IMO has encouraged the establishment of regional port State control organizations in many parts of the world including Europe and North America, Asia and the Pacific, Latin America, the Indian Ocean the Mediterranean, and the Caribbean. Ultimately it is expected that all regions will be covered, perhaps leading to the creation of a global system which will make it virtually impossible for sub-standard ships to escape detection.

The ISM Code

the International Safety Management Code became mandatory for passenger ships, oil and chemical tankers, bulk carriers, gas carriers and cargo high speed craft of 500 gross tonnage and above on 1 July 1998 and is extended to other ships in 2002.

The Code is aimed at ensuring that ships are properly managed and operated - the objectives, stated clearly in the Code, are to "ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment and to property".

The shipowner or other person with responsibility for the operation of the ship must develop, implement and maintain a safety management system, which includes a safety and environmental-protection policy and ensure compliance with mandatory rules and regulations.

The ISM Code is not intended to be just paperwork - if it is properly implemented onboard a ship then procedures will be in place for every eventuality. If an incident does occur, everyone onboard will be prepared for it and loss of life and damage to the environment will be minimised.

The ISM Code is an example of the shift in emphasis towards what is sometimes called the human factor. If the people operating and managing a ship follow the rules, then there should be no deliberate polluting of the marine environment. Operational pollution - such as from bunkering operations - should not happen if all procedures are followed correctly.

If an accident does occur - then its effects will be minimised if the people involved are prepared for that eventuality.

STCW Convention

The human factor is also being addressed by the 1995 amendments to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). These amendments, which updated and completely revised the Convention, entered into force in February 1997. By 1 August 1998, all Parties to the Convention had to submit documentation to IMO showing that their training institutions complied with the requirements of the revised Convention.

IMO is now reviewing the information, with the help of competent person nominated by Parties to the Convention, and a list of countries in full compliance with the Convention will be published. This is significant, because it is the first time that IMO has been given the role of verifying compliance with a Convention.

NOTES

CONVENTION ON LIABILITY AND COMPENSATION (CLC)

IMO

(Web site: www.imo.org)

LIABILITY AND COMPENSATION

International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969

Adoption: 29 November 1969
Entry into force: 19 June 1975

Note: The 1969 Convention is being replaced by its 1992 Protocol as amended in 2000

Introduction

The Civil Liability Conventiowho suffer oil pollution damage resulting from maritime casualties involving oil-carrying ships.

The Convention places the liability for such damage on the owner of the ship from which the polluting oil escaped or was discharged.

Subject to a number of specific exceptions, this liability is strict; it is the duty of the owner to prove in each case that any of the exceptions should in fact operate. However, except where the owner has been guilty of actual fault, they may limit liability in respect of any one incident to 133 Special Drawing Rights (SDR) for each ton of the ship's gross tonnage, with a maximum liability of 14 million SDR (around US$18 million) for each incident. (1 SDR is approximately US$1.28 - exchange rates fluctuate daily).

The Convention requires ships covered by it to maintain insurance or other financial security in sums equivalent to the owner's total liability for one incident.

The Convention applies to all seagoing vessels actually carrying oil in bulk as cargo, but only ships carrying more than 2,000 tons of oil are required to maintain insurance in respect of oil pollution damage.

This does not apply to warships or other vessels owned or operated by a State and used for the time being for Government non-commercial service. The Convention, however, applies in respect of the liability and jurisdiction provisions, to ships owned by a State and used for commercial purposes. The only exception as regards such ships is that they are not required to carry insurance. Instead they must carry a certificate issued by the appropriate authority of the State of their registry stating that the ship's liability under the Convention is covered.

The Convention covers pollution damage resulting from spills of persistent oils suffered in the territory (including the territorial sea) of a State Party to the Convention. It is applicable to ships which actually carry oil in bulk as cargo, i.e. generally laden tankers. Spills from tankers in ballast or bunker spills from other ships.

The International Convention on Civil Liability for Oil Pollution Damage (CLC) was adopted to ensure that adequate compensation is available to persons tankers are not covered, nor is it possible to recover costs when preventive measures are so successful that no actual spill occurs. The shipowner cannot limit liability if the incident occurred as a result of the owner's personal fault.

The Protocol of 1976

Adoption: 9 November 1976
Entry into force: 8 April 1981

The 1969 Civil Liability Convention used the "Poincaré franc", based on the "official" value of gold, as the applicable unit of account. However, experience showed that the conversion of this gold-franc into national currencies was becoming increasingly difficult. The 1976 Protocol therefore provided for provides for a new unit of account, based on the Special Drawing Rights (SDR) as used by the International Monetary Fund (IMF). The exchange rate for currencies versus the SDR fluctuates daily. However, in order to cater for those countries which are not members of the IMF and whose laws do not permit the use of the SDR, the Protocol provides for an alternate monetary unit – based, as before, on gold.

The Protocol of 1984

Adoption: 25 May 1984
Entry into force: 12 months after being accepted by 10 States, including six with tanker fleets of at least 1 million gross tons.
Status: Superseded by 1992 Protocol

While the compensation system established by the 1969 CLC and 1971 Fund Convention had proved very useful, by the mid-1980s it was generally agreed that the limits of liability were too low to provide adequate compensation in the event of a major pollution incident.

The 1984 Protocol set increased limits of liability, but it gradually became clear that the Protocol would never secure the acceptance required for entry into force and it was superseded by the 1992 version.

A major factor in the 1984 Protocol not entering into force was the reluctance of the United States, a major oil importer, to accept the Protocol. The United States preferred a system of unlimited liability, introduced in its Oil Pollution Act of 1990. As a result, the 1992 Protocol was drawn up in such a way that the ratification of the United States was not needed in order to secure entry into force conditions.

The Protocol of 1992

Adoption: 27 November 1992
Entry into force: 30 May 1996

The Protocol changed the entry into force requirements by reducing from six to four the number of large tanker-owning countries that are needed. The compensation limits are those originally agreed in 1984:

- For a ship not exceeding 5,000 gross tonnage, liability is limited to 3 million SDR (about US$3.8 million)
- For a ship 5,000 to 140,000 gross tonnage: liability is limited to 3 million SDR plus 420 SDR (about US$538) for each additional unit of tonnage
- For a ship over 140,000 gross tonnage: liability is limited to 59.7 million SDR (about US$76.5 million).

The 1992 protocol also widened the scope of the Convention to cover pollution damage caused in the exclusive economic zone (EEZ) or equivalent area of a State Party. The Protocol covers pollution damage as before but environmental damage compensation is limited to costs incurred for reasonable measures to reinstate the contaminated environment. It also allows expenses incurred for preventive measures to be recovered even when no spill of oil occurs, provided there was grave and imminent threat of pollution damage.

The Protocol also extended the Convention to cover spills from sea-going vessels constructed or adapted to carry oil in bulk as cargo so that it applies apply to both laden and unladen tankers, including spills of bunker oil from such ships.

Under the 1992 Protocol, a shipowner cannot limit liability if it is proved that the pollution damage resulted from the shipowner's personal act or omission, committed with the intent to cause such damage, or recklessly and with knowledge that such damage would probably result.

From 16 May 1998, Parties to the 1992 Protocol ceased to be Parties to the 1969 CLC due to a mechanism for compulsory denunciation of the "old" regime established in the 1992 Protocol. However, for the time being, the two regimes are co-existing, since there are a number of States which are Party to the 1969 CLC and have not yet ratified the 1992 regime - which is intended to eventually replace the 1969 CLC.

The 1992 Protocol allows for States Party to the 1992 Protocol to issue certificates to ships registered in States which are not Party to the 1992 Protocol, so that a shipowner can obtain certificates to both the 1969 and 1992 CLC, even when the ship is registered in a country which has not yet ratified the 1992 Protocol. This is important because a ship which has only a 1969 CLC may find it difficult to trade to a country which has ratified the 1992 Protocol, since it establishes higher limits of liability.

The 2000 Amendments

Adoption: 18 October 2000
Entry into force: 1 November 2003 (under tacit acceptance)

The amendments raised the compensation limits by 50 percent compared to the limits set in the 1992 Protocol, as follows:

- For a ship not exceeding 5,000 gross tonnage, liability is limited to 4.51 million SDR (US$5.78 million) (Under the 1992 Protocol, the limit was 3 million SDR (US$3.8 million)
- For a ship 5,000 to 140,000 gross tonnage: liability is limited to 4.51 million SDR (US$5.78 million) plus 631 SDR (US$807) for each additional gross tonne over 5,000
  (Under the 1992 Protocol, the limit was 3 million SDR (US$3.8 million) plus 420 SDR (US$537.6) for each additional gross tonne)
- For a ship over 140,000 gross tonnage: liability is limited to 89.77 million SDR (US$115 million) (Under the 1992 Protocol, the limit was 59.7 million SDR (US$76.5 million)

Special Drawing Rights Conversion Rates

The daily conversion rates for Special Drawing Rights (SDRs) can be found on the International Monetary Fund website at http://www.imf.org/

International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND), 1971

Adoption: 18 December 1971
Entry into force: 16 October 1978
Note: The 1992 protocol replaces the 1971 Convention

Introduction

Although the 1969 Civil Liability Convention provided a useful mechanism for ensuring the payment of compensation for oil pollution damage, it did not deal satisfactorily with all the legal, financial and other questions raised during the Conference adopting the CLC Convention.

Some States objected to the regime established, since it was based on the strict liability of the shipowner for damage which they could not foresee and, therefore, represented a dramatic departure from traditional maritime law which based liability on fault. On the other hand, some States felt that the limitation figures adopted were likely to be inadequate in cases of oil pollution damage involving large tankers. They therefore wanted an unlimited level of compensation or a very high limitation figure.

In the light of these reservations, the 1969 Brussels Conference considered a compromise proposal to establish an international fund, to be subscribed to by the cargo interests, which would be available for the dual purpose of, on the one hand, relieving the shipowner of the burden by the requirements of the new convention and, on the other hand, providing additional compensation to the victims of pollution damage in cases where compensation under the 1969 Civil Liability Convention was either inadequate or unobtainable.

The Conference recommended that IMO should prepare such a scheme. The Legal Committee accordingly prepared draft articles and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage was adopted at a Conference held in Brussels in 1971. It is supplementary to the 1969 Civil Liability Convention.

The purposes of the Fund Convention are:

- To provide compensation for pollution damage to the extent that the protection afforded by the 1969 Civil Liability Convention is inadequate.
- To give relief to shipowners in respect of the additional financial burden imposed on them by the 1969 Civil Liability Convention, such relief being subject to conditions designed to ensure compliance with safety at sea and other conventions.
- To give effect to the related purposes set out in the Convention.

Under the first of its purposes, the Fund is under an obligation to pay compensation to States and persons who suffer pollution damage, if such persons are unable to obtain compensation from the owner of the ship from which the oil escaped or if the compensation due from such owner is not sufficient to cover the damage suffered.

Under the Fund Convention, victims of oil pollution damage may be compensated beyond the level of the shipowner's liability. However, the Fund's obligations are limited so that the total payable to victims by the shipowner and the Fund shall not exceed 30 million SDR (about US$41 million) for any one. In effect, therefore, the Fund's maximum liability for each incident is limited to 16 million SDR incident (under the 1971 convention - limits were raised under the 1992 Protocol).

Where, however, there is no shipowner liable or the shipowner liable is unable to meet their liability, the Fund will be required to pay the whole amount of compensation due. Under certain circumstances, the Fund's maximum liability may increase to not more than 60 million SDR (about US$82 million) for each incident.

With the exception of a few cases, the Fund is obliged to pay compensation to the victims of oil pollution damage who are unable to obtain adequate or any compensation from the shipowner or his guarantor under the 1969 Convention.

The Fund's obligation to pay compensation is confined to pollution damage suffered in the territories including the territorial sea of Contracting States. The Fund is also obliged to pay compensation in respect of measures taken by a Contracting State outside its territory.

The Fund can also provide assistance to Contracting States which are threatened or affected by pollution and wish to take measures against it. This may take the form of personnel, material, credit facilities or other aid.

In connection with its second main function, the Fund is obliged to indemnify the shipowner or his insurer for a portion of the shipowner's liability under the Liability Convention. This portion is equivalent to 100 SDR (about US$128) per ton or 8.3 million SDR (about US$10.6 million), whichever is the lesser.

The Fund is not obliged to indemnify the owner if damage is caused by his wilful misconduct or if the accident was caused, even partially, because the ship did not comply with certain international conventions.

The Convention contains provisions on the procedure for claims, rights and obligations, and jurisdiction.
Contributions to the Fund should be made by all persons who receive oil by sea in Contracting States. The Fund's Organization consists of an Assembly of States, a Secretariat headed by a director appointed by the Assembly; and an Executive Committee.

The Protocol of 1976

Adoption: 19 November 1976
Entry into force: 22 November 1994

The 1971 Fund Convention applied the same unit of account as the 1969 Civil Liability Convention, i.e. the "Poincaré franc". For similar reasons the Protocol provides for a unit of account, based on the Special Drawing Right (SDR) as used by the International Monetary Fund (IMF).

The Protocol of 1984

Adoption: 25 May 1984
Entry into force: 12 months after being accepted by at least 8 States whose combined total of contributing oil amounted to at least 600 million tons during the previous calendar year.
Status: Superseded by the Protocol of 1992

The Protocol was primarily intended to raise the limits of liability contained in the convention and thereby enable greater compensation to be paid to victims of oil pollution incidents.
But as with the 1984 CLC Protocol, it became clear that the Protocol would never secure the acceptances required for entry into force and it has been superseded by the 1992 version.

The Protocol of 1992

Adoption: 27 November 1992
Entry into force: 30 May 1996

As was the case with the 1992 Protocol to the CLC Convention, the main purpose of the Protocol was to modify the entry into force requirements and increase compensation amounts. The scope of coverage was extended in line with the 1992 CLC Protocol.

The 1992 Protocol established a separate, 1992 International Oil Pollution Compensation Fund, known as the 1992 Fund, which is managed in London by a Secretariat, as with the 1971 Fund. In practice, the Director of the 1971 Fund is currently also the Director of the 1992 Fund.

Under the 1992 Protocol, the maximum amount of compensation payable from the Fund for a single incident, including the limit established under the 1992 CLC Protocol, is 135 million SDR (about US$173 million). However, if three States contributing to the Fund receive more than 600 million tonnes of oil per annum, the maximum amount is raised to 200 million SDR (about US$256 million).

From 16 May 1998, Parties to the 1992 Protocol ceased to be Parties to the 1971 Fund Convention due to a mechanism for compulsory denunciation of the "old" regime established in the 1992 Protocol.

However, for the time being, two Funds (the 1971 Fund and the 1992 Fund) are in operation, since there are some States which have not yet acceded to the 1992 Protocol, which is intended to completely replace the 1971 regimes.

IMO and the IOPC Fund Secretariat are actively encouraging Governments who have not already done so to accede to the 1992 Protocols and to denounce the 1969 and 1971 regimes. Member States who remain in the 1971 Fund will face financial disadvantages, since the financial burden is spread over fewer contributors. For both the 1971 and 1992 Funds, annual contributions are levied on the basis of anticipated payments of compensation and estimated administrative expenses during the forthcoming year.

The 2000 Amendments

Adoption: 18 October 2000
Entry into force: 1 November 2003 (under tacit acceptance)

The amendments raise the maximum amount of compensation payable from the IOPC Fund for a single incident, including the limit established under the 2000 CLC amendments, to 203 million SDR (US$260 million), up from 135 million SDR (US$173 million). However, if three States contributing to the Fund receive more than 600 million tonnes of oil per annum, the maximum amount is raised to 300,740,000 SDR (US$386 million), up from 200 million SDR (US$256 million).

The IOPC funds and IMO

Although the 1971 and 1992 Funds were established under Conventions adopted under the auspices of IMO, they are completely independent legal entities.

Unlike IMO, the IOPC Funds are not United Nations (UN) agencies and are not part of the UN system. They are intergovernmental organisations outside the UN, but follow procedures which are similar to those of the UN.

Only States can become Members of the IOPC Funds. States should consider becoming Members of the 1992 Fund, but not of the 1971 Fund which will be wound up in the near future.

To become a member of the Fund, a State must accede to the 1992 Civil Liability Convention and to the 1992 Fund Convention by depositing a formal instrument of accession with the Secretary-General of IMO. These Conventions should be incorporated into the national law of the State concerned.

See the IOPC Funds website at http://www.iopcfund.org/

Special drawing rights

The daily conversion rates for Special Drawing Rights (SDRs) can be found on the International Monetary Fund website at http://www.imf.org/

Winding up of 1971 fund

Contracting Parties to the 1971 International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (IOPC Fund) on 27 September 2000 signed a Protocol allowing for the early winding-up of the 1971 Fund, which was established to provide compensation to victims of oil pollution from ships carrying oil as cargo.

The 2000 Protocol was signed following a Diplomatic Conference held from 25 to 27 September 2000.

From 16 May 1998, Members of the 1992 Fund ceased to be Members of the 1971 Fund Convention due to a mechanism in the Protocol which established the 1992 Fund allowing for compulsory denunciation of the "old" regime. However, with the departure of these States, the total quantity of contributing oil on the basis of which contributions to the Fund are assessed has been dramatically reduced. The effect of this reduction in the contributions base is two-fold.

In the first place, a considerably increased financial burden will fall on the contributors in those States which remain Members of the 1971 Fund if a major oil spill occurs in any of those States, since the contributors will be legally responsible for the funding of the total amount of compensation due from the 1971 Fund.

In addition, as long as the 1971 Fund remains in existence, the concern remains that it will face a situation in which an incident occurs where the 1971 Fund has an obligation to pay compensation to victims, but where there are no contributors in any of the remaining Member States.

In such a situation, if a tanker spill should occur, the remaining 1971 Fund Member States would not have the financial protection which they would expect under the provisions of the 1971 Fund Convention.

Under Article 43.1 of the 1971 Convention, the 1971 Fund ceases to exist when the number of Contracting States falls below three. In order to allow the Convention to terminate sooner, the Conference agreed to amend Article 43.1 so that the Convention ceases to be in force:

(a) on the date when the number of Contracting States falls below twenty-five; or

(b) twelve months following the date on which the Assembly notes that, according to the information provided by the Director on the basis of the latest available oil reports submitted by Contracting States in accordance with article 15, the total quantity of contributing oil received in the remaining Contracting States by those persons who would be liable to contribute pursuant to article 10 of the Convention during the preceding calendar year falls below 100 million tonnes, whichever is the earlier.

The 2000 Protocol will be brought into force by the tacit acceptance procedure, whereby it is deemed to have been accepted six months from the date of its adoption unless objections are received by not less than one-third of the Contracting States.

Convention on Limitation of Liability for Maritime Claims (LLMC), 1976

Adoption: 19 November 1976
Entry into force: 1 December 1986

Introduction

The Convention replaces the International Convention Relating to the Limitation of the Liability of Owners of Seagoing Ships, which was signed in Brussels in 1957, and came into force in 1968.

Under the 1976 Convention, the limit of liability for claims covered is raised considerably, in some cases up to 250300 per cent. Limits are specified for two types of claims claims for loss of life or personal injury, and property claims (such as damage to other ships, property or harbour works).

In the Convention, the limitation amounts are expressed in terms of units of account. Each unit of account is equivalent in value to the Special Drawing Right (SDR) as defined by the International Monetary Fund (IMF), although States which are not members of the IMF and whose law does not allow the use of SDR may continue to use the old gold franc (referred to as "monetary unit" in the Convention).

With regard to personal claims, liability for ships not exceeding 500 tons is limited to 330,000 SDR (equivalent to around US$422,000). For larger vessels the following additional amounts are used in calculating claims:

- For each ton from 501 to 3,000 tons, 500 SDR (about US$640)
- For each ton from 3,001 to 30,000 tons, 333 SDR (US$426)
- For each ton from 30,001 to 70,000 tons, 250 SDR (US$320)
- For each ton in excess of 70,000 tons, 167 SDR (US$214)

For other claims, the limit of liability is fixed at 167,000 (US$214,000) for ships not exceeding 500 tons.

For larger ships the additional amounts will be:

- For each ton from 501 to 30,000 tons, 167 (US$214).
- For each ton from 30,001 to 70,000 tons, 125 SDR (US$160)
- For each ton in excess of 70,000 tons, 83 SDR (US$106)

The Convention provides for a virtually unbreakable system of limiting liability. It declares that a person will not be able to limit liability only if "it is proved that the loss resulted from his personal act or omission, committed with the intent to cause such a loss, or recklessly and with knowledge that such loss would probably result".

Protocol of 1996

Adoption: 3 May 1996
Entry into force: 90 days after being accepted by 10 States.
Status: See status of conventions.

The Protocol will result in the amount of compensation payable in the event of an incident being substantially increased and also introduces a "tacit acceptance" procedure for updating these amounts.

For ships not exceeding 2,000 gt, liability is limited to 2 million SDR (US$2.56million) for loss of life or personal injury and 1 million SDR (US$1.28 million) for other claims.

Liability then increases with tonnage to a maximum above 70,000 gt of 2 million SDR (US$2.56 million) + 400 SDR (US$512) per ton for loss of life or personal injury and 1 million SDR (US$1.28 million) + 200 SDR (US$256) per ton for other claims.

Special Drawing Rights

The daily conversion rates for Special Drawing Rights (SDRs) can be found on the International Monetary Fund website at http://www.imf.org/

International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (HNS), 1996

Adoption: 3 May 1996
Entry into force: 18 months after the following conditions have been fulfilled:

- 12 States have accepted the Convention, four of which have not less than two million units of gross tonnage.
- Provided that persons in these States who would be responsible to pay contributions to the general account have received a total quantity of at least 40 million tonnes of contributing cargo in the preceding calendar year.

Status: See status of conventions

Introduction
Limits of liability
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HNS and the CLC/Fund Convention
Special drawing rights

Introduction

The Convention will make it possible for up to 250 million SDR (about US$320 million) to be paid out in compensation to victims of accidents involving HNS, such as chemicals.

The HNS Convention is based on the two-tier system established under the CLC and Fund Conventions . However, it goes further in that it covers not only pollution damage but also the risks of fire and explosion, including loss of life or personal injury as well as loss of or damage to property.

HNS are defined by reference to lists of substances included in various IMO Conventions and Codes. These include oils; other liquid substances defined as noxious or dangerous; liquefied gases; liquid substances with a flashpoint not exceeding 60°C; dangerous, hazardous and harmful materials and substances carried in packaged form; and solid bulk materials defined as possessing chemical hazards. The Convention also covers residues left by the previous carriage of HNS, other than those carried in packaged form.

The Convention defines damage as including loss of life or personal injury; loss of or damage to property outside the ship; loss or damage by contamination of the environment; the costs of preventative measures and further loss or damage caused by them.

The Convention introduces strict liability for the shipowner and a system of compulsory insurance and insurance certificates.

The unit of account used in the Convention is the Special Drawing Right (SDR) of the International Monetary Fund (IMF).

Limits of liability

For ships not exceeding 2,000 units of gross tonnage, the limit is set at 10 million SDR (about US$12.8 million). For ships above that tonnage, an additional 1,500 SDR is added for each unit of tonnage from 2001 to 50,000; and 360 SDR for each unit of tonnage in excess of 50,000 units of tonnage. The total possible amount the shipowner is liable for is limited to 100 million SDR (US$128 million).

States which are Parties to the Convention can decide not to apply it to ships of 200 gross tonnage and below, which carry HNS only in packaged form and are engaged on voyages between ports in the same State. Two neighbouring States can further agree to apply similar conditions to ships operating between ports in the two countries.

In order to ensure that shipowners engaged in the transport of HNS are able to meet their liabilities, the Convention makes insurance compulsory for them. A certificate of insurance must be carried on board and a copy kept by the authorities who keep record of the ship's registry.

HNS Fund

It has generally been agreed that it would not be possible to provide sufficient cover by the shipowner liability alone for the damage that could be caused in connection with the carriage of HNS cargo. This liability, which creates a first tier of the convention, is therefore supplemented by the second tier, the HNS Fund, financed by cargo interests.

The Fund will become involved:

- because no liability for the damage arises for the shipowner. This could occur, for example, if the shipowner was not informed that a shipment contained HNS or if the accident resulted from an act of war.
- because the owner is financially incapable of meeting the obligations under this Convention in full and any financial security that may be provided does not cover or is insufficient to satisfy the claims for compensation for damage.
- because the damage exceeds the owner's liability limits established in the Convention.

Contributions to the second tier will be levied on persons in the Contracting Parties who receive a certain minimum quantity of HNS cargo during a calendar year. The tier will consist of one general account and three separate accounts for oil, liquefied natural gas (LNG) and liquefied petroleum gas (LPG). The system with separate accounts has been seen as a way to avoid cross-subsidization between different HNS substances.

As with the CLC and Fund Conventions, when an incident occurs where compensation is payable under the HNS Convention, compensation would first be sought from the shipowner, up to the maximum limit of 100 million SDR (US$128 million).

Once this limit are reached, compensation would be paid from the second tier, the HNS Fund, up to a maximum of 250 million SDR (US$320 million) (including compensation paid under the first tier).

The Fund will have an Assembly consisting of all States which are Parties and a Secretariat headed by a Director. The Assembly will normally meet once a year.

HNS and the CLC/Fund Conventions

The HNS Convention excludes **pollution damage** as defined in the International Convention on Civil Liability for Oil Pollution Damage and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, to avoid an overlap with these Conventions.

However, HNS covers other damage (including death or personal injury) as well as damage caused by fire and/or explosion when oils are carried.

NOTES

Brest
Tuesday, 11 June

FUTURE PROSPECTS IN THE FIELD OF POLLUTION RESPONSE

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PRINCIPLES AND STRATEGIES OF RESPONSE TO POLLUTION AT SEA AND ON THE SHORELINE

PRINCIPLES AND STRATEGIES OF RESPONSE TO POLLUTION AT SEA AND ON THE SHORELINE

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PRIOR TO RESPONSE: PREPARATION

Whatever the importance of the problem encountered, pollution response in marine or fresh waters will be successful only if well planned and organised, carried out by trained staff with available adequate equipment. Late or inappropriate response will lead to irremediable loss of pollutant in the environment, a majoration of the area already contaminated, of the length of littoral oiled, extra difficulties in oil containment, recovery and dispersion, as well as a considerable increase in the global response cost. Response preparation phase is therefore fundamental. It takes several steps: contingency planning, equipment, staff training. Here, we shall only deal with a few points that highlight international trends.

Contingency planning

The aim of plans is to organize tasks and divide efforts, thus reducing improvisation as much as possible. The current trend consists in defining in plans the objectives that should be reached in terms of response levels. These response levels are expressed:

either with regard to the volume spilled:

Level 1 $\leq$ 10 m^3 of oil
10 m^3 < Level 2 < 4 – 5,000 m^3
Major pollution level

or with regard to geographic or organizational criteria:

Level 1 - local response (oil terminal, oil refinery, loading-buoy)
Level 2 - national response
Level 3 - regional or international response.

A precise definition of these levels will subsequently help specifying operational procedures, identifying required or available means and planning staff training.

Resources

They must fit the response level foreseen. Procurement, maintenance and immobilisation are expensive. Technical criteria to take into account regarding means acquisition will be treated in the following chapters. In general, beyond efficiency, complementarity within equipment and between equipment and the existing stocks on a local, national and international scale should be aimed at primarily.

Staff

Large international projects for optimizing the response preparedness level showed considerable needs in staff training. Technical training of field staff, and also training of the managerial staff to handle emergency situations in order to prevent any incident turning into a crisis; which would prove very expensive for the company.

RESPONSE STRATEGY: MAIN OBJECTIVES

Oil activities mainly include exploration, production and transportation. The accidental pollution they create annually represent an average total input of oil in the marine environment of 300,000 to 500,000 tonnes. The potentiality of incidents being known, their consequences are predictable and, as response methods and techniques have been developed, every spill must be subjected to monitoring and response, when feasible, and considering the local prevailing conditions.

Slick monitoring has two main objectives:

- monitor its motion (speed and direction), in order to determine which areas of the coastline might be exposed to a massive stranding of oil,
- check the slick weathering, that can reduce its volume (evaporation, dilution and natural dispersion) or enlarge it (emulsification).

The main objective of the response itself will be to prevent or (at least) minimize the arrival of oil on the coast. Any method likely to help reaching this aim may be used, provided it has no « perverse effects », such as the « concealment » of the slick (e.g. massive transfer of the slick from the surface to the bottom by « sinking down » of the slick) or toxic effects, especially in shallow waters and areas rich in living resources. Such curative methods apply to the pollutant when it is spilled into the environment. They allow, respectively, the oil to be removed from marine environment (containment + pumping), or diluted and dispersed into the whole water column (chemical dispersion). Nevertheless, other response methods are available, either deterrents (lightening) or curative measures (in-situ burning), and particularly those to implement when, in spite of all efforts at sea, the shoreline needs protection or cleaning.

LIGHTENING

Although rarely implemented, lightening of disabled vessels is, in the event of an incident, the option that should be first considered. It essentially consists in transferring, by pumping, all or part of a vessel (not necessarily a tanker) cargo or bunkers. It sets important safety problems (fire and explosion hazard). Incidents that occurred in the latest years have shown the interest of such a technique:

- lightening of 160,000 tonnes for *Exxon Valdez* for 40,000 tonnes spilled,
- lightening of 140,000 tonnes for *Khark V* for 70,000 tonnes spilled,
- lightening of 58,200 tonnes for *Sea Empress* for 72,000 tonnes spilled.

The operation is mostly appropriate in the case of a stranded vessel or hull damage, or both (*Exxon Valdez, Sea Empress*). The *Sea Empress* case showed, once more, that this type of operation can only be carried out efficiently by specialists. There are few of them around the world.

RESPONSE OPTIONS

A marine oil spill activates combating means and techniques. The most common method consists in deploying a boom in order to contain the slick for easier recovery. Another method rests on the acceleration of the oil natural degradation processes with the help of a chemical dispersant. Nevertheless, in spite of the response, oil frequently reaches the coastline. Clean-up and waste collection are then necessary. Most often, these methods have to be implemented successively or simultaneously. In addition to these three response options:

- open sea containment and recovery,
- chemical dispersion,
- shoreline protection and clean-up.

is the « do-nothing », or « leave alone » option which consists in monitoring slicks drift as well as letting natural elements work when the use of chemical and mechanical means is considered inopportune. But, prior to any tactical choice, it is essential to gather the following data:

- volume of oil spilled,
- oil characteristics,
- weather and sea conditions over 24, 48 and 72 hours,
- slicks drift forecast over the same periods.

Contingency planning must also give indications on response global strategy and provide the whole of operational procedures covering all pre-defined risks and combating tactics and methods fitting the risks.

BEHAVIOUR OF THE SLICK AT SEA

The oil slick will evolve according to both its own physico-chemical properties and prevailing weather and sea conditions at the time and on the site of the spill. This evolution can be summed up in two words:

- slicks drift,
- hc weathering.

The movement of the slick is due to its spreading and splitting up but mainly to its drift. This drift can be defined as (vectorial) addition of 100 % of the current and 3 % of the wind.

Weathering occurs under the influence of numerous factors, of which only those which are significant in the first hours of the spill are of interest for this presentation of the response principles. They are evaporation, natural dispersion, emulsification and viscosity increase that results from these three evolutions of oil. Experimental devices (test flume) have been designed in Norway, in the USA, and, more recently, in France. Thus, since 1997, *Cedre* is able to study, on request, the weathering process of particular crudes.

VARIATION OF POLLUTION VOLUME FROM THE RELEASE TO RECOVERY OF THE POLLUTANT ON THE SHORE

Slick volume will first vary with the evaporation of the crude oil lighter fractions. Most of this process will happen within the first 24 hours of the spill and will affect, depending on the crude spilled, up to 40 % of the initial volume. In the event of pollution involving refined products, this proportion can raise, e.g. for gasolene, kerosene... or drop, even get non-existent, for heavy crude oils such as bunker fuel.

In the example (see figure 1), evaporation represents 30 %, that is 300 tonnes out of the 1,000 tonnes of crude oil initially spilled. Chemical dispersion represents 200 tonnes and recovery 100 tonnes. Residual slick will then be 400 tonnes.

If the mixing, due to the state of the sea, is important, a major process in the weathering of the slick may then occur. It is the emulsification of the crude, which leads to the formation of a « water-in-oil » emulsion, the proportion of water being sometimes up to 80 %. The slick could then reach 1,500 tonnes.

At last, in spite of all efforts and response operations, this slick will probably strand on the shoreline. Depending on the quality of oil/waste segregation during collection, the amount of collected products will increase again, and our example numbers its total weight at 3,000 tonnes.

OPERATIONAL CHOICES

The range of operational choices is, at the same time, much and little in the way that each option is limited by numerous factors, the response time and the state of the sea being the most important.

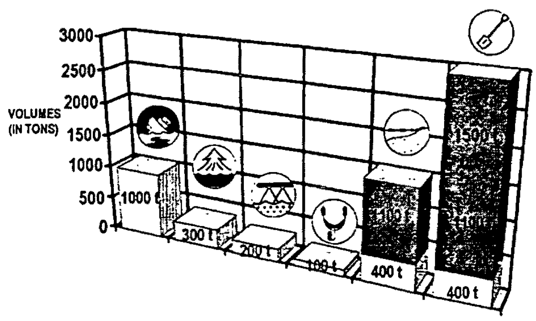


Fig. 1 : Operational choices

These choices may be brought together into response fields:

- **Operations carried out at the source or by the source**
  - stop the spill,
  - **contain at source and recover,**
  - disperse at source,
  - lighter, in the case of a vessel or a barge,
  - eliminate by in-situ burning, if the hazards of such a method are acceptable, or even non-existing.

- **Operations carried out in the first phase of the slick drift (at high sea)**

  - contain with booms and recover with pumps or skimmers,
  - trawl using a skimmer-boom or vessels equipped with coupled means, « sweeping arm » for instance,
  - spread sorbents on the slick, and recover with the help of surface trawls or other means accepting non-liquid waste,
  - **disperse chemically (massively if needed).**

- **Operations carried out in the second phase of slick drift**

  - **protect sensitive areas of the shoreline,**
  - deflect drifting slicks towards less sensitive areas,
  - contain and recover,
  - treat with small quantities of dispersant, under ecological monitoring, taking into account the possibilities of mixing up dispersed oil in a large volume of water.

- **Operations carried out on the shoreline**

  - hold back the slicks on contaminated sites in order to avoid the extension of polluted areas,
  - **set up recovery and clean-up sites, taking into account the whole waste treatment process,**
  - avoid increasing damage by inopportune actions in highly sensitive sites, such as saltmarshes.

OPERATIONAL CHOICES: THE LIMITS

Beyond the need for adequate equipment and trained response staff or personnel, each option is characterized by a dominant criterion and several secondary criteria.

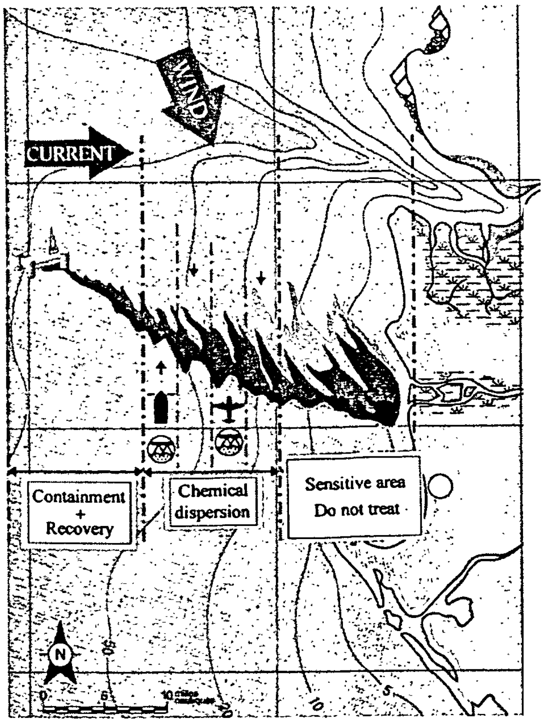


Fig. 2: Operational choices: limits

- The first response option, containment-recovery is, first, limited by the state of the sea. It mainly applies to:
  - **the source**
  - **coastal areas**

- The second option is chemical dispersion. A high sea, this method is limited by the oil viscosity, which, above 2,000 cSt, makes it inefficient. On the other hand, in coastal areas, it is limited by the need for sufficient dilution.

- The last one of the three options shown on this view, shoreline clean-up, is neither conditioned by the delays nor by local meteorological conditions, or, if so, in a small extent. Nevertheless, on sensitive sites, the use of heavy techniques may increase damage instead of reducing it, especially in saltmarshes and other fragile zones to which access is difficult.

In those cases, the "leave alone" option is often the most efficient one in the long term.

DECISION CHART

Considering all pre-cited elements, and particularly the knowledge of the main response options, it is important to bear in mind a simple decision plan, to which one will refer almost by reflex, should an incident happen. This plan can be represented under the form of an organization chart which starting point is the spill, and that guides the decision with the help of yes/no questions.

This decision chart includes the most common and most efficient techniques used nowadays. Of course, it could be completed, if the development of these techniques allows it, by such response options as slicks in-situ burning, hydrocarbons biodegradation, or even sites bioremediation.

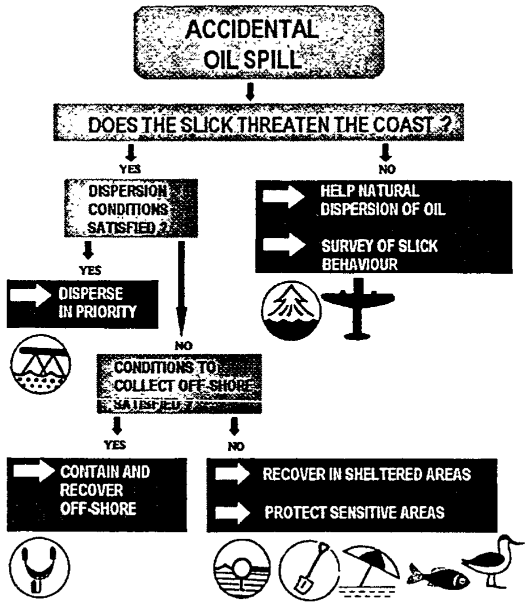


Fig. 3: Decisional chart

DISPERSION: IN WHICH CONDITIONS?

The aim of dispersion is to split a slick up into very fine droplets in order to achieve the oil mixing up and dispersion in a large volume of water. The limits of the technique are now known. They mainly include viscosity, which must be as low as possible, and in all cases lower than 2,000 cSt, and sufficient turbulence of the water for dilution to occur. Nevertheless, even if these criteria are fulfilled, dispersion operations are not always desirable.

In the first place, one should know, or check, whether there are possibilities of mixing the oil up in a large quantity of water, these possibilities being obtained either by important depths, over 50 m at least, or by currents likely to wash the dispersed oil towards the open sea.

A condition as important as the previous ones, that is to say the oil/dispersant mixture toxicity, must of course, be acknowledged before any crisis, and induce a systematic assessment of treating or leaving a slick heading for a zone which is known as rich in sensitive living resources. The conditions and criteria of dispersion being all fulfilled, there are, schematically, near the coast, two limits:

- within the first limit, defined considering all the elements cited above, any dispersion will be forbidden, the importance and sensitivity of living resources being too high regarding the risks due to the oil/dispersant mixture toxicity;

- beyond the second limit, if dispersion is technically possible, a massive use of this method may be allowed;

- finally, between the two limits, the appreciation of risks, considering the movements of dispersed oil following the wind and currents, will be preponderant in the choice of this response method.

THE DISPERSION CHAIN

Besides any strategic choice, it is essential to have equipment to do the job. The notion of "weak link" in a chain or of "bottleneck" appears here. Regarding the use of dispersants, the chain is roughly the following:

- important volumes of dispersant considering the volume of the slick, defined by risk analysis,

- means for detecting, and especially locating and marking the slick at sea,

- spraying equipment (aerial or naval) of the right size and suitable for:
  - slick area and volume,
  - volumes of dispersant to be sprayed,
  - distances/time necessary to reach the slicks from the means starting point.

It is also important that:
  - the dispersion chain be suitable for the type of operations to be carried out,
  - the elements of this chain be suitable to one another.

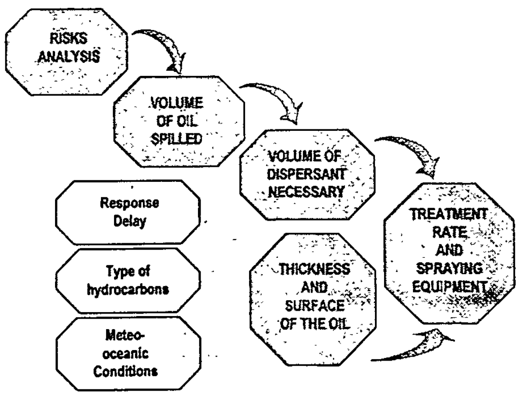


Fig.4: Dispersion chain

CONTAINMENT AND RECOVERY

The aim of containment and recovery operations is to remove the pollutant from the surface of the sea before it reaches the coast, either in the open sea or near the shoreline.

In open seas, these operations, limited by the state of the sea, depend upon the types and quantity of the means available.

On the other hand, in coastal areas, several particular risks and choices appear and must be discussed successively in a crisis time. These risks are related, in particular, to the different types of coast and their own sensitivity. Schematically, we have classified these coastlines in three categories:

- LITTORAL A: very sensitive shorelines, due to the nature of the ground itself (sand, mud, marsh...) or to the fact that they are rich in living resources.

- LITTORAL B: sensitive coasts, less rich than type A shoreline, or to which pollution would cause lighter perturbation.

- LITTORAL C: not very sensitive shorelines, due to the nature of the ground (rocks, cliffs) or exposed to self-cleaning by a high energy sea, or sheltering few living resources.

According to this scheme, containment and recovery operations will then have more precise objectives and will be dedicated to the protection of the most sensitive areas:

- specific recovery of the slicks heading for littorals A and B, diversion of these slicks towards a type C shoreline, sacrificed, if their containment is not possible due, for instance, to the wind and current.

- containing and holding the slicks on sites already contaminated, in order to avoid the spreading of the pollution.

The notion of "sacrificed site" now clearly appears. Nevertheless, the choice of such sites is always difficult if all areas are sensitive. This means that the priorities of site protection must be defined very precisely before the incident happens.

THE RECOVERY CHAIN

Following the same logical process, and with the same care as for dispersion, you must properly adjust all the links in the containment and recovery chain. Besides lack of equipment in the recovery chain itself, most failures appear during at-sea storage, transfer to the shoreline, and entry in a retreatment process.

This recovery chain includes the following elements:

- **containment devices,**
- **naval means**, for setting the devices up,
- **aerial means**, to locate the slick and guide vessels,
- **skimmers,**
- **at-sea storage capacities,**
- **on-land treatment chain.**

The capacity of each element must take into account the fits and starts of this response method, especially regarding storage capacities, above all if the operations are carried out far from the shoreline, thus inducing both important transfer times and rapid filling of these capacities.

If allowed by technical possibilities, each link should be bigger than the previous one in the containment/recovery chain.

STORAGE
AT SEA

CONTAINMENT
MEANS

TERRESTRIAL
DISPOSAL
CHAIN

RECOVERING
MEANS

NAUTICAL MEANS
GUIDED BY AERIAL VECTORS

Fig. 5 :Recovery chain

SHORELINE PROTECTION AND CLEAN-UP

When, in spite of recovery operations at sea, it is obvious that the oil will reach the coastline, any measure aimed at **minimizing the impact** of this pollution and **accelerating the return to former state** must be considered/set up:

- **minimize the impact** by protecting, as a priority, the most sensitive areas (saltmarshes, mudflats),
- **accelerate the return to former state**, by adapting clean-up and waste collecting operations to the particular sensitivity of each site.

WASTE: FROM THE SHORELINE TO FINAL TREATMENT

At-sea operations, in open seas or in sheltered coastal areas, and clean-up operations do not represent the whole response to the pollution. These operations produce important volumes of liquid, pasty and solid wastes that will enter treatment or re-use processes.

Whatever collection and recovery techniques are used, either manual or mechanical, the waste "produced" must be stored, then transferred to treatment sites.

The global scheme of waste processing can be summed up as follows:

- **recovery and collection**, manual or mechanical,
- **intermediate storage**, on the backshore,
- transport towards a temporary storage,
- collection from temporary storage and transport to a treatment site (incineration, use as refinery feedstock, stabilisation with quicklime...),

transport towards a final storage or re-use site (land reclamation and road construction for instance).

Following the same methodology as for the containment/recovery chain, each element of the waste process must be bigger than the previous one, in order to be able to accept the "production" fits and starts.

THE "LEAVE ALONE" OPTION

Every antipollution intervention has its own restraints, depending, mostly, upon local environment. Moreover, some techniques have efficiency or yield limits that may be lower than the natural evolution of the pollution, under the simple influence of the sea energy or the prevailing meteorological conditions. These elements must be taken into account when making a decision about interfering or not.

The following general cases can be considered as examples:

- rocky coast, much exposed to the open sea, and undergoing strong self-cleaning due to the action and energy of the waves,
- saltmarsh or mudflat, rich in living resources, and quite sheltered from marine energy,
- slick heading for the open sea.

In this case, if chemical dispersion can be considered in order to enhance the natural evolution of the oil slick, this operation is not a priority and "do nothing" is an option to be considered. Of course, "leave alone" does not mean giving up all activities. Response teams will carry on with monitoring the oil slick drift as well as the evolution of the pollution on the impacted sites.

AFTER THE INCIDENT: RESPONSE AND PROTECTION

As part of response options that ensue from tactical and strategic choices, some elementary crisis management principles can be stated regarding response specific problems:

Personnel safety and protection

Hazards due to oil toxicity and flammability must be taken into account, particularly in the detection of these hazards and also the protection of response teams.

Limitation of the incident extent

As a rule, fast response will afford limiting the consequences of an incident thus reducing the potential impact of pollution on the coast (e.g. lightening operations on a damaged vessel).

Quickness of response

The evolution of oil spilled at sea rapidly limits some response options by altering some characteristics (oil viscosity, slick volume, emulsification...). The search for quick response possibilities, especially the use of aerial means, is fundamental.

"Do not do more harm than good"

This somewhat obvious principle may be difficult to comply with in crisis periods. This is particularly true in case of response in saltmarshes, which destruction will only show months after operations termination.

Apprehend and carry response out with technicity and methodology

Pollution response must be carried out methodically and techniques should be earned through practical drills and hands-on training. By following these operational principles when setting up the options previously exposed, you will be able to make them more efficient by reducing associated hazards.

Think about the post-crisis phase

From the beginning of an operation, the collection of data in order to assess the situation to help operational decision making will have to be systematically coupled with a record-keeping process for regulation and contentious purposes. Oil combating operations, possible damages, in the broad sense of the term, resulting from a pollution, can lead to huge expenses.

All technical and financial elements likely to justify choices or expenses, any data concerning the state of the environment, of fisheries or mariculture in the affected zone before, during and after the incident, must be collected, classified, stored. They will build the basis of the post-accident juridical and contentious file.

THE COST OF POLLUTION

Accidental marine pollution causes various short, medium and long-range damage affecting wide geographic areas and numerous operators. In the public's mind, it all comes down to "THE POLLUTER PAYS". But, beyond this assertion, reality is much more complex... Up to the seventies, the main part of the cost of such pollution corresponded to the expenses involved in the fighting operations and the cleaning of the damaged sites and properties. Compensation was then mostly restricted to the expenses engaged during the crisis directly following the incident.

In the seventies and eighties, other expenses, more important, arouse; they are expenses for economic loss related to sea-related activities (particularly tourism, fish farming). The will of Breton people and the *Amoco Cadiz* trial played an important part in this evolution. But, above all, several dozens of incidents in Asia progressively established standards for these types of damage.

Today, after the deep revision of the American jurisprudence generated by the *Exxon Valdez* incident (Alaska, 1989), some jurisprudences have integrated a third category of damage, of much wider implications than the previous ones: ecological damages. These damages affect the physical and biological heritage. Their assessment raises three main questions: how to value wild plants and animals or a natural habitat of no commercial or industrial value? who is entitled to compensation? and for what purpose?

This evolution towards the acknowledgement of new types of damages has generated considerable financial flows together with the creation of new professions and complex jurisprudence in constant evolution. Today, when the media spotlights are turned off, when pollution fighting and clean-up operators have returned home, when fishing bans or seafood sales bans are lifted, a new battle begins, more discreet than the first one, but no less difficult nor less bitter. This new battle is longer and the amounts involved are getting more and more important. Pollution fighting and clean-up operators can no longer consider it as no concern of theirs. Months or years after the pollution, what was done or written in the emergency will be thoroughly analysed and weighted by experts and lawyers, leading to financial decision fraught with consequences.

THE COST OF POLLUTION

- *Amoco Cadiz*, France, 1979
  200,000 tonnes: 600 US$ dollars / tonne

- *Exxon Valdez*, USA, 1989
  80,000 tonnes: 25 000 US$ dollars / tonne

- *Kuangoon 5*, Korea, 1993
  1,100 tonnes: 110 000 US$ dollars / tonne

NOTES

RESPONSIBILITIES AND ACTIVITIES OF THE FRENCH GOVERNMENT IN THE EVENT OF MARINE POLLUTION

Wednesday, 12 June

DISPERSANTS: METHODS OF APPLICATION
POLICY FOR USE AT SEA AND IN COASTAL BELTS

THE USE OF DISPERSANTS

Mr. François MERLIN
Cedre

INTRODUCTION

Oil spill response techniques aim at:

- containing and recovering the oil by mechanical means,
- dispersing the slicks in order to increase the rate of oil degradation in the sea and thus prevent large quantities of oil from being washed up on the shore.

Dispersion, a technique which often takes precedence over the others, if weather conditions permit, requires the use of dispersant products. Many contradictory opinions have been expressed regarding these products. This report is intends to summarise the current problems met when using dispersants, and to enable response teams:

- to understand the limitations in the use of dispersants,
- to properly use the means which are presently available,
- to be more able, should the need arise, to explain the immediate action they will be called upon to take in the event of an oil spill.

It is obviously impossible to cover such a complicated and controversial subject in a few pages. It is a field where a wide disparity of viewpoints still exists, despite the extensive research effort which has been undertaken over the past years, mainly in France, UK, USA, Canada and Norway.

WHAT IS THE PURPOSE OF USING DISPERSANTS?

Dispersants have been perfected for use at sea, in order to achieve two main objectives:

- **Prevent oil spills from being washed up on a shore**

  Dispersed in the water column, the treated slicks will be less affected by prevailing winds.

- **To condition oil slicks**

  When mechanical methods of containment and skimming prove ineffective, consideration is often given to accelerate natural dispersion of oil in the sea. This may be done with the help of dispersants. However, this procedure must only be used when the natural degradation processes are sufficient to eliminate the oil dispersed in this way, with no major risks for the ecological equilibrium of the marine environment.

The elimination processes are:

- physical : evaporation of the lightest and most toxic substances
- chemical : degradation, oxidation
- biochemical : biodegradation

The effectiveness of these processes will closely depend on the contact surface between the oil and the surrounding environment. It is therefore advantageous to break down the slicks into fine droplets and thereby considerably increase the contact surface.

The use of dispersants for this purpose has the following results:

- the slicks are broken into countless oil droplets,
- rapid recoalescence of the oil droplets into a surface film is prevented.

The final aim of treatment at sea is therefore to condition the oil in order to encourage natural degradation.

IHOW DO DISPERSANTS WORK?

a) Principles

Dispersants contain surface-active mixtures which reduce the interfacial tension between water and oil. This will enhance the spreading and the breakdown of the surface oil film into tiny droplets which are then carried down into the water column by means of mechanical and/or natural agitation.

Some components in the dispersants are able to prevent a recoalescence of the oil droplets which could lead to the creation of a new oil film.

b) Environmental conditions

The products and application methods which are currently available enable oil slicks to be correctly treated (see the following sections) if certain environmental conditions are present. An effective dispersion can be obtained only if:

- a large dilution is possible following dispersant's application,
- natural agitation is sufficient to avoid a rising and resurfacing of the oil droplets.

Treating slicks in confined areas, or in calm waters, will only result in a more or less compact oil film being recreated.

c) The products

The two main components of dispersants are:

- a solvent which conditions the active component and enables its diffusion in the oil and water,
- one or more surface-active agents dispersing the oil in tiny droplets.

There are three general categories of dispersants:

- **First generation products**: marketed from 1960-1970, they are composed of solvents rich in aromatic compounds and relatively highly toxic surface-active agents. Their use should be forbidden.

- **Second generation products** which are "diluted" or "conventional", marketed after 1970: composed of only slightly toxic components in normal doses, mainly non-ionic surface-active agents and non-aromatic oil solvents.

- **Third generation or "concentrated" products**: composed of non-ionic surface-active agents and water soluble solvents. Generally containing larger amounts of surface-active agents than second generation products, these concentrated dispersants can be used neat or prediluted in water.

Remarks

- **The distinction between second generation and concentrated products is not clear: dispersants exist which contain a high proportion of active components in an oil solvent.**

- **The concentrated products lose some of their effectiveness when prediluted in water. Application of neat products from a ship requires specific equipment.**

- **In order to treat viscous oil or inverse emulsions, the presence of an oil solvent will increase penetration within the layer of oil to be treated.**

THE LIMITATION OF DISPERSANTS EFFECTIVENESS

Dispersants were formulated to treat oil pollution and the following data are not applicable to other pollutants (e.g. vegetable oils). The results of dispersant treatment will be determined according to two main properties of the oil to be treated: pour point and viscosity.

Pour point

At a temperature lower than the pour point, the paraffins crystallise and the oil coagulates.

When temperature raises to become close to the pour point, a rapid decrease in viscosity is observed; then, variation follows a semi-logarithmic law. An oil slick cannot be correctly treated when ambient temperatures are a few degrees below the oil's pour point. Table I presents the pour points of commonly transported crude oils.

Viscosity

The second consideration for effective dispersion is the oil's viscosity. The straight lines in Figure 1 demonstrate the considerable variations in viscosity according to temperature for several crudes and common fuel oils (French specifications).

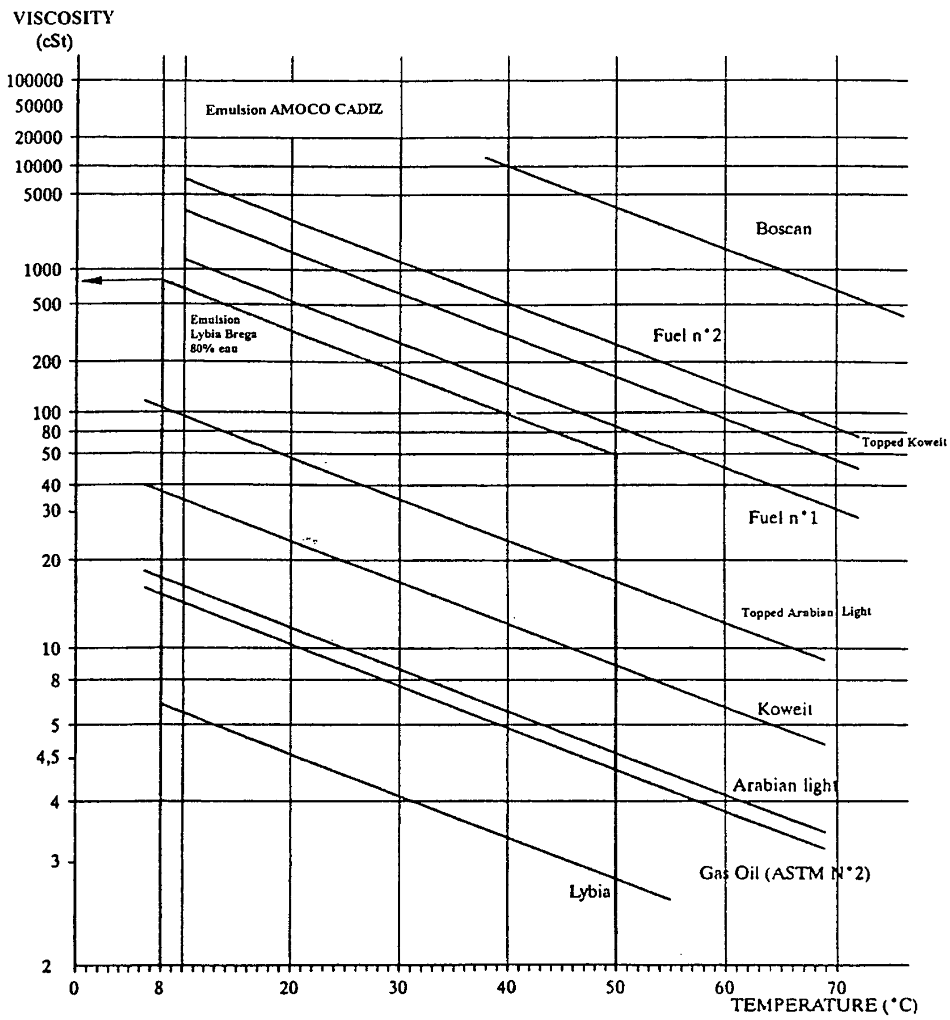
From viscosity values at 20°C, 50° C and 100° F (cf. Table I) it is possible to approximate the viscosity at treatment temperature using a logarithmic chart (cf. Figure 1).

Almost all fuel oils have viscosities close to the upper limit of French specifications (Table II) and the lines drawn (Table I) correspond to this limit. The law of viscosity variation is not applicable to the oils at low temperature, but the measured values are close to or higher than the line's extension if the pour point is at some distance from the line.

TABLE I: PROPERTIES OF CRUDE OILS

CATEGORY	COUNTRY	TYPE	SPECIFIC GRAVITY	VISCOSITY cSt	POUR POINT
				at 38 °C	
1 HIGH PARAFFIN CONTENT	EGYPT	* El Morgan	0.874	13	13
	GABON	* Gamba	0.872	28.5	30
	LIBYA	* Es Sider	0.841	5.7	9
	NIGERIA	* Nigerian Light	0.844	3.6	21
				at 10°C	
2 AVERAGE PARAFFIN CONTENT	QATAR		0.814	4.5	- 18
	CEI	* Romaskinskaya	0.859	20	- 4
	ALGERIA	* Zarzaitine	0.816	9	- 15
	LIBYA	* Brega	0.824	6.3	- 18
		* Zueitina	0.808	5	- 12
	IRAN	* Iranian Light	0.854	20	- 4
		* Iranian Heavy	0.869	30	- 7
	IRAQ	* Northern Iraq	0.845	9	- 15
	ABU DHABI	* Abu Dhabi	0.830	6.2	- 18
		* A.D. Zakum	0.825	5	- 15
		* A.D. Umm	0.840	6.5	- 15
	NORWAY	Shaif	0.847	9	- 4
		* Ekofisk			
				at 10°C	
3 LOW PARAFFIN CONTENT	ALGERIA	* Hassi	0.802	3	< - 30
		Messaoud	0.809	4.3	< - 30
	NIGERIA	* Arzew	0.907	60	< - 30
		* Nigerian	0.872	13	< - 30
	KUWAIT	Medium	0.869	30	- 18
	SAUDI	* Nigerian export	0.851	12	< - 30
	ARABIA	* Kuwait	0.874	29	- 15
		* Arabian Light	0.887	80	< - 30
	IRAQ	* Arabian	0.847	13	- 13
	OMAN	Medium	0.861	25	- 8
	VENEZUELA	* Arabian Heavy	0.900	70	< - 30
		* Southern Iraq			
		* Oman			
		* Tia Juana			
		Medium			
				at 38°C	
4 VERY LOW PARAFFIN CONTENT	VENEZUELA	* Bachaquero	0.978	1.280	- 7
		* Tia Juana	0.980	2.980	- 3

FIGURE I: OIL VISCOSITY VARIATION ACCORDING TO TEMPERATURE



$$\text{Viscosity in centistokes} = \frac{\text{Viscosity in centipoises}}{\text{Density}}$$

Viscosity variation at sea

Oil spilled at sea is subject to a rapid transformation which depends largely on its initial composition, the quantities spilled and local conditions. In the first few hours following a spill, an increase in viscosity is noted for all crudes, due to evaporation or dissolving of most of the lighter fractions and also due to the creation of inverse emulsions.

TABLE II: FUEL OIL VISCOSITY (French specifications)

Domestic fuel oil	Light fuel oil	9 to 15 cSt at 50
Engine diesel oil	Heavy fuel oil n°1	15 to 110 cSt at 50° < 9.5 cSt at 20°
Marine diesel oil	Heavy fuel oil n°2	110 to 380 cSt at 50°

Evaporation is the main phenomenon which leads to increased viscosity. Table III gives some values for a Kuwait crude which shows that most of the light fractions are evaporated within a few hours. The resulting increases in viscosity are shown on Figure 1 giving the straight lines corresponding to topped Kuwait at 200°C and to topped Arabian Light at 100°C (BAL 150).

TABLE III: AGEING OF A KUWAIT CRUDE

Duration (hours)	:	1	2	4	12	24	72	168
BOILING POINT °C	:	100	125	140	165	180	205	215

The fractions of the oil which are liable to dissolve in water are mainly the light ones and especially the aromatic ones which are the most soluble. Inverse emulsions are formed, due to gradual incorporation of water under the form of fine droplets, and these emulsions result in a considerable increase in viscosity. In the laboratory, emulsions of varying stability are obtained, with a viscosity between 1,000 and 50,000 cSt, according to the type of crude oil, its weathering, and the conditions under which the emulsions are formed. The asphaltene content of the crude and the amount of energy used are the two dominant factors in emulsion formation.

Inverse emulsions may be formed at sea even with crudes containing very little asphaltene (Ekofisk) if there is an intensive mixing. The emulsions are, however, less persistent. An Ekofisk slick can be rapidly broken down (in about 20 hours) into particles of 5-10 mm in diameter. The following table gives information obtained from real incidents.

TABLE IV: FORMATION OF INVERSE EMULSIONS

	Time in hours	% water	Viscosity (cSt)
Ekofisk	1.5 7	72 83	- 1,000
Amoco-Cadiz	350	75	15,000

In Figure 1, the values at 20°C were reported for the Libya Brega and the Amoco-Cadiz (points 1 and 2).

Effectiveness of dispersants as a function of the viscosity of the oil to be treated

Tests in the laboratory and at sea demonstrated the ineffectiveness of dispersants on viscous products, confirming the observations made on many occasions when treating oil slicks at sea. Although this experimental work is still being carried out, it is necessary to decide on an upper viscosity limit beyond which it is preferable not to use dispersants, since their effectiveness is nil.

The following table gives some information on the quantities of dispersant necessary, in relation to the oil, in order to obtain effective dispersion, according to the viscosity of the oil to be treated. Additional information obtained during tests at sea (PROTECMAR) and in port areas should enable us to reduce the cut off levels given below, which are very approximate. However, these viscosity limits are being revised in the light of technical improvements either in the dispersant formulations either in the application techniques.

TABLE V: PERCENTAGES OF DISPERSANT/OIL NECESSARY AS A FUNCTION OF THE VISCOSITY OF OIL TO BE TREATED

	Dispersant dosage (% in relation to oil)		
VISCOSITY (cSt)	< 1,000	1,000 – 5,000	> 5,000
CONVENTIONAL (2 nd generation)	30 - 50 %	Up to 100 % low efficiency	Inefficient
CONCENTRATED (3 rd generation) applied diluted 10 % in water *	5 - 10 % **	Inefficient	Inefficient
CONCENTRATED (3 rd generation) applied neat	5 - 10 %	10 % - 15 %	Inefficient

NB: *** Dispersant dilution must not be less than 10%**
**** Meaning 50-100% of "dispersant + water" solution**

Inverse emulsions

The viscosity of "chocolate mousse" is often over 1,000 cSt, but dispersant treatment in the initial stages may result in the emulsion beginning to break up, and therefore in a reduction in viscosity. This may justify the use of dispersants on fresh emulsions with an average viscosity and, in this case, we recommend using neat concentrate or second generation dispersants. Recent studies suggested two-stages treatments to disperse fresh emulsion: a first application of dispersant (or possibly demulsifier) in order to break the emulsion and reduce viscosity, followed by a second application of dispersant. However, in the case of very viscous, or weathered, emulsions which have remained at sea for several days and have a high water content (70-80%), treatment by dispersants is considered to be useless.

EFFECTIVENESS OF DISPERSANTS IN TERMS OF WATER SALINITY

Almost all dispersants available were designed for use in salt water (at sea). These same products, when used in fresh or only slightly salted water, have often given poor results. Several manufacturers designed dispersant formulas that are effective in freshwater.

USING DISPERSANTS IN ESTUARIES

a) Estuaries

An estuary is geographically defined as the bed of a water-way which is periodically flooded by tidal waters. This characteristic of tidal flooding will confer that area of a river or stream which is flooded with particular hydrological, biological or sedimentary qualities.

The currents appear to be alternating. The salinity of the water is variable according to the height of the tides, the flow rate of the river and the distance from the sea. The animal and plant life which develops will be especially adapted to withstand variations in physico-chemical conditions (notably salinity or water temperature). Also, sedimentary phenomena related to an intense microbial activity are observed.

Salt marshes are often located in estuaries. The marshes, or bogs, are the site of a biological productivity that, even in temperate zones, is equal to the biological production of a tropical forest. The large production of organic matter is used in situ by local fauna (birds and especially fish) or will be exported to the sea in the form of organic waste which is transformed and absorbed by marine organisms.

b) Consequences of the use of dispersants in estuaries

The disadvantages of using dispersants in estuaries can be studied:

- in terms of the physico-chemical evolution of the treated oil in the environment,
- in terms of environmental consequences.

Physico-chemical considerations

The main disadvantages of using dispersants are related to physico-chemical modifications of the oil which is treated.

These modifications will affect:

- the adhesion of the dispersed oil to the mineral particles suspended in the water column likely to settle, later on, on both the banks and bottom of the estuary,
- the possibility of recovering the oil.

a) Adhesion of the oil to suspended particles

The suspension of the oil in the water column promotes the possibility of oil meeting with and sticking to solid materials such as suspended particles, estuary bottom and banks sediment. More, oil stuck to mineral particles forms aggregates that can deposit. To some extent, treating oil in an estuary can lead to its transfer from the surface to the mud plug on the bottom, or on the riversides. However, in most cases, this transfer process will lead to a significant dilution of the oil on a wide surface and recent studies showed that oil biodegradation could go faster when oil is linked to clay particles than when loose if, of course, there is no special limitation in oxygen.

The problem of dispersion in estuaries is quite complex and the fate of dispersed oil must take into account the behaviour of the mud or suspended material present in the estuary:

- What is the actual mineral load in the estuary?
- What are the locations where mineral particles settle? Are there any sensitive items?
- Is there oxygen availability for oil dispersion?
- Once a year, when the river is in spate, is the mud present in the estuary or flushed out to sea?

b) Difficulty in recovering treated oil

Oil which is even partially treated with dispersants will be mixed with surface-active agents. The droplets can resurface in long stringy or granulated slicks in areas where the water is calm. The presence of surface-active agents will reduce the effectiveness of recovering the slicks by pumping, scraping, shovelling, etc. An increased penetration within some sediments will necessitate the use of more complicated equipment than if the oil had merely settled on sediment before being treated.

Toxicity and deciding on the use of dispersants

a) Toxicity of dispersants and of treated oil

An argument against the use of dispersants has often been that the toxicity of the pollution will increase. The intrinsic toxicity of a dispersant is generally less than that of a fresh crude oil. The toxicity of a mixture of oil and dispersant is often greater. The following table gives the toxicity (LD 50) for oil, dispersants and a mixture of the two:

- crude oil : 100 - 1,000 ppm
- topped oil used as a reference : 10,000 ppm
- neat dispersant : 1,000 - 10,000 ppm
- mixture dispersant/oil : a few hundred ppm

Generally, ecological systems can withstand a short-term toxic effect due to the oil/dispersant mixture. Nevertheless, some limits have been defined. This is the reason why approval for using a particular dispersant will not be granted unless it toxicity has been tested, the oil/dispersant mixture toxicity, its effectiveness and its biodegradability.

Toxicity measures are carried out through laboratory tests and lethal concentrations for some representative organisms in the marine ecosystem are defined. In this way, a lethal dose (LD 50) is determined for each reference organism and for each dispersant. At LD 50, 50% of the animals under consideration will be killed after a given length of time. This concentration is expressed in ppm (either milligrams/litre or grams/tons).

b) Biodegradability and toxicity of oil

Natural removal and elimination of an oil spill is essentially related to a biodegradation process leading to a mineralization of the oil. Such process will never enable removal of all the oil compounds: breakdown of the linear alcanes is rapid, while that of the isoparaffins and polycyclic aromatics takes a longer time period. Some polycyclic alcanes, the polyaromatics having 6 or more cycles, the resins and asphalts are especially resistant to the phenomena of biological breakdown.

To begin with, we should remember that under optimal conditions about 30 % of the oil will not be able to be biologically broken down and will therefore remain in the environment. Obviously, this percentage of remaining oil can vary according to its initial make-up. Thus, for fuel n° 2, a total of 40 to 50 % of the oil will probably remain in the environment.

On the other hand, in terms of acute or immediate toxicity, it appears that the most easily biodegradable compounds (short chained linear alcanes, concentrated aromatics) are also the most dangerous ones. The compounds which are the least biodegradable also appear to be the most neutral ones. Nevertheless, in the case of a large oil spill accumulation, it can not be excluded that these seemingly harmless compounds could also have a toxic effect on the environment.

It is necessary to keep in mind that the biological breakdown (biodegradation) of oil is an aerobic phenomena which takes place in the water/oil interface, and is very sensitive to any gas exchange (arrival of oxygen, elimination of the metabolic elements).

Finally, it should also be remembered that biodegradation can be inhibited if the oil is found in over-abundant amounts (toxic effects on the metabolic elements).

c) Consequences of toxicity for the use of dispersants in estuaries

Dispersion is designed to break down the oil so it can be eliminated by micro-organisms. Spreading a slick over a larger water surface or mixing droplets within the water column will increase:

- the probability of contact of the oil with living organisms (fish, shell fish...) and, at the same time, the probability of contact between the pollutant and the banks or bottom of an estuary (and therefore a contact with animal life in these areas, notably crustaceans, mollusques, worms...).

the toxic effects of a dispersed oil will increase:

- with the decreasing size of the oil particles,
- with an increase in the quantity of animal life which exists in a relatively closed area.

The concentrations measured under the water surface after dispersants are applied on oil slicks at sea are observed to become inferior to the lethal concentrations very soon after the products have been used. Several hours after a dispersant application, the concentration of dispersant/oil is just a few ppm. Under these conditions, it seems that the decision to use dispersants in certain areas is more related to the ecological characteristics of an area than to the actual toxicity of a dispersant or of a dispersant/oil mixture. In fact, it is prudent to avoid using massive amounts of dispersants in an estuary unless the area is such that there is very little probability of the dispersed oil coming into contact with the bottom or with filtering organisms.

GEOGRAPHICAL LIMITS FOR USING DISPERSANTS

Around 1980, *Cedre*, with the assistance of other technical and scientific organisations, established a geographical limit along the French coast beyond which it was possible to consider using dispersants without major risks to the marine environment. This had been defined to allow the naval authorities to perform treatment in these zones without any loss of time by consulting with the scientific organisation concerned. This boundary had to be considered as valid during the first hours of treatment of a given spill until the nature and extent of the pollution could be better assessed. Then, thanks to complementary information, *Cedre* could have to modify this limit or even recommend that dispersant treatment should be stopped.

These boundaries took into account the possibility of dilution according to the ocean currents and depth, as well as marine life productivity. The basic rules were: minimum depth 20 m in the Atlantic ocean and 50 m in the Mediterranean sea, minimum distance to the shore: 1 nautical mile. These limits had been drawn for a quite large spill (around 10,000 t). This limit concept has been reviewed in 1995. Taking into account the possibilities of dilution of the dispersed oil related to the total volume of the pollution, it has been decided to establish 3 limits corresponding to pollutions of 10, 100, 1,000 t.

0.5 NM for 10 t.
1.0 NM for 100 t.
2.5 NM for 1,000 t.

The limits have been drawn considering a minimum distance to the land to prevent the pollution from reaching the shore still undispersed, and a minimum depth. Some special coastal zones such as estuaries, closed bays, roadsteads, have been excluded from this work because they are too specific and need particular studies. These limits have been extended in the vicinity of particularly sensitive areas such as seafarms, fisheries, natural resources, etc.

PROCEDURE FOR SELECTING DISPERSANTS

The dispersants should be tested and approved before use: many countries have established procedures for selecting dispersants. Selection procedures will result in:

- dispersants being classified either into recommended (or approved) and non-recommended (or forbidden) dispersants,
- dispersants being ranked according to their effectiveness. If the results of the approval methods are similar, there are still differences in the area of classifying among the various products themselves.

There is a wide range of testing methods used in different countries. Several contacts have been made in order to establish some agreement between the different existing procedures. In the best case, common lists of products have been set up, but no consensus has been obtained concerning the best methods to be used for a selection of products: the EC tried to elaborate a general ranking taking into account the results of the different testing procedures. Nevertheless, the lists of properties which are verified are not very different: the two main criteria, ***effectiveness*** and ***toxicity***, are evaluated in every approval procedure. ***Biodegradability*** and several ***physical properties*** are also mentioned by several countries.

In France, dispersants have been tested and a list of recommended products is published by *Cedre*. This list includes only concentrated dispersants.

Based on results obtained during offshore trials, the selection procedure was revised in 1987 to include effectiveness, toxicity and biodegradability tests.

DECISION TO TREAT AN OIL SPILL

TYPE OF OIL	DECISION TO TREAT
- **Light refined products** Example: gasoline/diesel fuel/kerosene	Treatment possible, but useless in most cases (disappearance by evaporation and natural dispersion)
- **Viscous oil spills *: ≤ 5,000 cSt** Light and medium crudes, little weathered (Arabian Light type) Light and medium fuel oils, little weathered (50/50 type)	Dispersion possible with a priority for use of 3rd generation products
- **Oil spills with viscosity *: > 5,000 cSt** Weathered light and medium crudes Heavy fuel oils (e.g. Bunker C) Heavy crudes (e.g. Boscan, Venezuela) Slops	Low efficiency
- **Waxy crudes with higher pour point** (e.g. Bu Attifil, Libya)	Dispersion is impossible

- **NB viscosity at sea water temperature**

DISPERSANT APPLICATION

Equipment for applying dispersants

For a treatment to be effective, the dispersant must be spread on the oil:

- in correct quantities to limit product losses,
- by spraying to obtain a good dispersant/oil contact.

Effectiveness will be achieved only by using well-maintained specialised equipment, previously inspected. The quantity of concentrated dispersant necessary is proportional to that of the pollutant to be treated: the dispersant/oil ratio is about 10%*. However, it is very difficult to determine the quantities of oil to be treated, since oil slicks vary considerably in thickness: from a few microns to millimetres. As a general rule, a suitable treatment dose is about 100 litres/hectare, corresponding to an average oil thickness of 0.1 mm. The treatment dose may be modified around this value in function of oil thickness, by varying certain treatment parameters (e.g. dispersant flow-rate on adjustable equipment or the treatment rate speed...).

*** NB: with conventional dispersants, the required rate is 30 to 100% according to the pollutant's viscosity.**

The fineness of a spray should be adjusted to obtain an even distribution and a maximum dispersant-oil contact:

- drops of dispersant which are too large pass through the oil slick and are lost in the subjacent water,
- drops which are too fine are deflected by the wind and the oil.

Between these two opposite effects, drops with an average diameter of 400 to 700 mm are usually recommended. Dispersants may be sprayed either from aircraft (aeroplanes, helicopters) or ships:

- Although aircraft and helicopters can be set to work relatively quickly, they do not always offer a satisfactory treatment quality due to uneven application (up to 100% variation in the amount of dispersant applied) and due to the considerable amount of dispersant which is lost (from 20 to 50%).

- Ships are slower to be set in operation, but their use on site may be more flexible especially on small areas of pollution: treatment is selective with the possibility of modulating the treatment doses and application rate in function of the quantities of oil found.

TREATMENT FROM AIRCRAFT

Undiluted, concentrated dispersants are used in aerial treatment. The dispersants are sprayed by means of equipment based on the systems used in agriculture for crop spraying. The means always consist of a pump and spray units equipped with nozzles or calibrated holes for dispersant distribution. However, the regularity and uniformity of the treatment depend on flight conditions met during spraying:

- the wind direction should be identical with the flight path,
- the altitude of the aircraft should be as low as possible.

Equipment adapted for helicopters

This usually consists of self-contained compact assemblies (dispersant tank, motor-driven pump and spray units) suspended by a sling from the helicopter: "bucket" type equipment. This system has the advantage of not requiring any modification to the aircraft and its easy use means that the same unit can be used with different helicopters according to their availability. It will only be necessary that the carrying capabilities of the helicopter be compatible with the tank capacity of the equipment which may range from 500 to 3,000 litres of dispersant according to the model. On the other hand, the carrying capabilities offered by helicopters will be limited by the distance of a spill, which means their use will be restricted to coastal zones or to areas near a heliport. Under usual flight conditions, treatment rates vary from 80 to 200 1/ha over a width of about 15 to 20 m.

Equipment adapted for aircraft

This type of equipment is built into the aircraft: the dispersant tank and pump are positioned in or under the fuselage and the spray units are fixed on the wings or the tail.

a) Single-engined aircraft

They are small planes, originally designed for agricultural purposes, which have been converted for dispersant spraying. They are very flexible in use (rudimentary airport), suitable for spraying because of their ability to fly at low speeds (about 100 to 200 km/h) and at low altitudes (a few metres). On the other hand, their capacity is limited (0.5 to 1.5 t of dispersant) as is their range of operation, which restricts them to missions near the coast.

Rates of about 50 to 100 1/ha over widths of 15 to 20 m can be attained.

b) Multi-engined planes

Most of them are large, with substantial dispersant capacity (5 to 13 t), capable of carrying out missions at great distances from the coast (several hundred kilometres) with the security offered by more than one engine.

On the other hand, their speed is high (200 to 400 km/h) and they fly at higher altitudes during spraying (10 to 30 m), which is prejudicial to the precision of the treatment. Finally, they often require an airport with a long runway (1,000 to 1,500 m).

The treatment rates usually obtained are about 50 to 100 l/ha over effective widths of 20 to 40 m.

Small twin-engined planes have recently appeared upon the scene. They offer the flexibility of use of the single-engined planes described above, but with a wider range and greater safety.

The present trend is to increase the treatment rates for the planes with large carrying capabilities to allow them to treat thick patches of oil (about 1 mm instead of 0.1 mm).

Initially, concentrated dispersants were applied to the oil after predilution in sea water*. Various studies have shown that this method is less effective (especially on pollutants with viscosity greater than 500 cSt), and the present trend is to use undiluted dispersants.

Treatment with concentrated dispersant prediluted in sea water

By means of an eductor

The dispersant may be diluted in sea water by using an eductor connected to the ship's fire main; at the downstream end of the circuit, the product is sprayed onto the pollutant from spray units or special offset projection nozzles. The dilution of the dispersant in the water must not fall below 10%, in order that the product may be acceptably effective, as the operation of an eductor is very sensitive to any disturbance (pressure variation, dirt...).

In this system, the water and dispersant flow rates are constant and the operator has the choice only of stopping or continuing the treatment by closing or opening the dispersant feed. Generally, two 5 m spray units or offset projection nozzles with a similar range are mounted after the eductor, and the vessel has to adapt its speed (often between 4 and 6 knots) in function of the installation flow rate in order to obtain a suitable treatment rate of about 100 1/ha.

With self-contained equipment

Other types of self-contained equipment with their own pumps have been developed in a number of countries. They consist of two pumps (one for sea water, the other for dispersant) which supply the sprayers.

The application rate of most of these units may be adjusted between certain limits, by modification of the dilution rate (from 10 to 30%) by adjusting the dispersant pump delivery. This faculty is very useful as it allows some adaptation of the treatment rate in terms of the quantity of oil to be dispersed (e.g. variations of the dispersant rate between 100 and 250 1/ha).

*** NB: Conventional dispersants are used undiluted and require independent equipment consisting of a pump and spray units similar to those mentioned in paragraph B1.**

These systems usually operate with two spray units varying from 5 to 10 m in length according to the model, and the speed of treatment may vary between 4 to 8 knots. Mixing devices (mixing panels, plastic chains) may be mounted downstream of the sprayers to provide the energy necessary to break up the oil once the dispersant has been applied.

Finally, care must be taken with regard to the bow wave which pushes the pollutant far away from the ship, possibly beyond the spray units. In order to avoid this disadvantage, the present trend is to place the equipment at the bow of the vessel, and apply the dispersant to the oil before the bow wave passes, using the mixing energy provided by the wave to break up the oil.

Treatment with concentrated dispersants applied undiiuted

This treatment may be carried out by means of an air blast sprayer, or by modified spray unit systems.

Air blast sprayers

In this system, the dispersant is injected into the powerful air flow from an axial fan, which thus ensures accurate diffusion onto the pollutant, with a range of about 20 to 25 m.

This light and compact system, without spray units projecting on both sides of the vessel, is convenient to use. According to the quantities of dispersant injected into the fan, it is easy to vary the spraying rate in function of the thickness of the various regions of the slicks. However, as in the case of aerial spraying, the distribution of a dispersant on the oil is very uneven and variations in rate exceeding 100% must be expected.

Spray unit system

These systems are composed of a pump supplying a pair of spray units generally located in the bow of the ship, in view of the presence of the bow wave mentioned above. However, in this case, a much smaller volume of dispersant is spread. The jets from the spray nozzles are weaker and therefore more likely to be deflected by the wind. To avoid any wind-drifting, particular attention must be paid to the spraying parameters (pressure, type of nozzle...) so that the droplets are not too fine. The position of the nozzles above the water must also be as low as possible.

These systems generally have a single delivery rate, with a correspondingly constant treatment rate determined by the size of the nozzles used. The associated spray units may be as long as 15 m (on the largest models).

Finally, some systems use a number of nozzles of various sizes, supplied by independent circuits allowing variation of the dispersant delivery rate with the number and type of nozzles simultaneously in service. The treatment dose may then be modulated as a function of thc quantity of oil to be treated (e.g. from 50 to 350 l/ha at 7 knots).

THE USE OF SORBENTS

Cedre

Using floating sorbents to fix and agglomerate oil and other pollutants in the event of an incident is an effective technique currently implemented for recovering small spills on calm waters and in harbours. When the oil is runny, using sorbents will facilitate the action of the skimmers. It is possible, temporarily, to resort to makeshift materials such as straw, saw dust... These products, often used, may constitute a good choice provided they do not get in contact with water before or during the absorption process.

On water, it is preferable to use more suitable materials corresponding to low density products which, put in contact with water and oil, have the property of preferencially fixing oil (oleophilic property) instead of water (hydrophobic property) and to retain it within their pores. These products act through adsorption (on the surface) and absorption (in the bulk of the material) phenomena. They are found under various forms:

- in bulk (powders, fibers, shavings, fine particles...);
- packaged (pillows, sheets, rolls, booms...).

BULK SORBENTS

A large range of products is available on the market. It includes powders or short fibers of mineral origin (treated materials: expansed perlite, vermiculite), vegetable origin (materials treated or not: saw dust, peat...) or synthetic origin (polymers: polyurethane, polypropylene, polystyrene, epoxy...).

- In practice, the treatment requires that the volume of sorbent be at least twice the volume of oil to be recovered. For this reason, and considering their cost as well as technical and logistical difficulties linked to the properties of the products and their implementation, bulk floating sorbents can only be used to recover small amounts of oil. In this respect, you must keep in mind that sorbents complicate the recovery chain: uneasy application and incompatibility between flocculating products and oil pumps.

There are several ways of applying bulk sorbents:

- manually: this kind of application hinders regular distribution and can only be used on small spills,
- with the help of a hydro-ejector (foam hose for instance): this kind of use has the drawback of affecting the sorbent properties of the product, since it is in contact with water,
- with the help of an air-gun: in such case, the product is applied dry and has much better performances.

Fig. 1: Air gun set onboard inflatable dinghy

Nota: in all cases, sensitivity to the wind and irritating properties of products require staff protection (masks, goggles).

- After application on oil, agglomerates appear, somewhat thick according to the nature of the products, the type of oil and the degree of agitation of the water-surface.
- Sorbents may be used on viscous oils (several thousands cSt), but then the absorption time depends on the oil viscosity. In the case of high density pollutants, close to 1 (inverse emulsion of water on the surface for instance), oil/water contact is difficult to achieve, because of a water film at the surface of the slick.

PRE-SHAPED FLOATING SORBENTS

Pre-shaped sorbents, easier to handle than bulk sorbents, are expensive and will therefore be used on very small spills or to finish cleaning after the oil has been recovered by other means.

Pillows and booms

Such products, which sorbent material is pre-shaped in a bag highly permeable to oil come in the form of pillows of small dimensions (< 1 m) or booms several meters long cylinders (without skirt).

Despite their designation as "booms", these products only have poor performances regarding their containment possibilities: due to their very small draught (no skirt), they cannot actually contain an oil slick, except in particularly smooth conditions (no current nor chop). They should therefore be only considered as big sponges able to soak up water. They are much more convenient to handle manually (implementation and recovery) than bulk sorbents but are more expensive. Their thorough impregnation will be possible only when in contact with a runny oil. For these reasons, they are particularly adapted to small spills occuring in harbour facilities or sheltered zones, to recover slicks already contained within a standard boom, or downstream from recovery sites to trap possible oil leakage.

Sheets and rolls

Pre-shaped in thin sheets (several millimeters to several centimeters thick), these sorbents are sturdy enough to be handled as they are. Sheets are usually square, less than one meter long, whereas rolls can be several meters long. They are most often made of non-woven fibers (felt-like). Like pillows and booms, they are easy to handle (installation and, above all, manual recovery). Moreover, on low and medium (150 to 2,500 cSt) viscosity oils, these products offer a much higher permeability, due to their extensive surface providing a good contact with the pollutant. On the other hand, they are not fit for viscous oils, which are hardly absorbed.

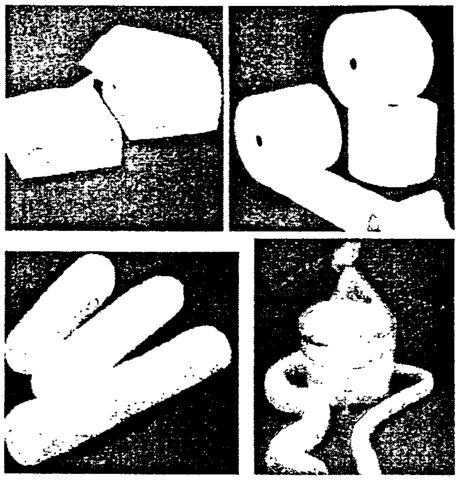


Fig. 2: Sorbent sheets, rolls, pillows and booms

Some manufacturers suggest that these products be re-used several times after being wrung to squeeze off the pollutant; however, in practice, they should rather be considered as single-use products. They can be used on partly contained, small spills, or, in the case of rolls, to recover a continuous leakage on a low current stream (< 0.25 m/s).

Mops

The sorbent material comes in flexible strings, creating a light and very open structure, suitable for viscous oil recovery (mops can, for instance, be made of a few dozens of long fibers - 10 to 40 cm - tied together at one end). These products, seldom employed, are used manually, like floorclothes, mainly to recover thick oil, stranded or trapped within crevices.

The fixation mode is no more absorption of oil into the fibers, but rather a rough trapping between the fibers, making them suitable for heavy oils.

CHOOSING A SORBENT

Cedre publishes and keeps up-to-date a non-exhaustive list of floating sorbents which were tested, containing products offering good absorbent properties and being hydrophobic enough to be used on water. This kind of document aims at helping on-scene staff to select sorbents.

Among choice criteria that must be considered, you will first focus on the price per liter of oil trapped (which is a good comparison criterion between products, computed considering the retention capacity (in weight) and the price of the product), then the product absorption capacity (in weight), the product absorption capacity in volume, its compatibililty with implementation (ex: projection) and recovery means, and its chemical nature (to plan after-use disposal).

Cedre

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PRODUITS CLASSES SELON LA PROCEDURE EN VIGUEUR DEPUIS LE 01.01.88
SELECTED PRODUCT ACCORDING TO THE NEW FRENCH CLASSMENT PROCEDURE VALID SINCE JANUARY 1988

Mise à jour/*updated* : Février/*February* 2002

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BIOREICO R93	Ste REICO	13, rue de la Libération BP 8 - 28210 VILLEMEUX SUR EURE F	33(0)2 37 65 80 69	33(0)2 37 65 87 01	
COREXIT 9500	ONDEO Nalco Energy Services Ltd	P.O. Box 123, 4600 Parkway, Solent Business Park Whiteley, Fareham, PO15 7AR United Kindgom 3, rue des Chardonnerets – 69680 CHASSIEU F	44/1489 880880 33(0)4 72 05 30 91 06 08 63 27 01	44/1489 880990 33(0)4 72 05 37 40	http://www.ondeo-nes.com
DASIC SLICKGONE NS	DASIC International Ltd	Winchester Hill Romsey. Hants. SO51 7YD England	44/1794 512419	44/1794 522346	
DISPEREP 8	Ste REP International	40, avenue Jean Jaurès ZI Pétrolière 78440 ISSOU GARGENVILLE F	33(0)1 30 98 80 00	33(0)1 30 98 82 01	http://www.rep.fr
DISPOLENE 36S **DISPOLENE 38S**	Ste SEPPIC - Division Industrie Ste DJET	75, quai d'Orsay – 75321 PARIS Cédex 07 ZI des Pierrelets- 45380 CHAINGY F	33(0)1 40 62 58 74 33(0)2 38 43 44 97	33(0)1 40 62 56 60 33(0)2 38 43 95 47	http://www.djet.net
EMULGAL C-100	AMGAL CHEMICAL PRODUCTS	2 Hachrash St.NESS-ZIONA 74031 ISRAEL	972/8 9401440 224	972/8 9401439	
FINASOL OSR 52	TOTALFINAELF Département Fluides Spéciaux	51, Esplanade du Général de Gaulle 92907 PARIS LA DEFENSE Cédex F	33(0)1 41 35 22 74 33(0)1 41 35 59 93	33(0)1 41 35 33 50 33(0)1 41 35 51 34	http://totalfinaelf.com
GAMLEN OD 4000 (PE 998)	GAMLEN Industries SA	17, Route de Rouen - 27950 SAINT-MARCEL F	33(0)2 32 64 35 35	33(0)2 32 51 43 24	http://www.gamlen.com
INIPOL IP 80 **INIPOL IP 90** **INIPOL IPC**	CECA SA	La Défense 2 Cédex 54 DPCP 92062 PARIS LA DEFENSE F	33(0)1 47 96 90 90 33(0)1 47 96 92 91	33(0)1 47 96 92 33	http://www.ceca.fr
NEUTRALEX C	SOCIETE INDUSTRIELLE DE DIFFUSION	2, rue Antoine Etex – 94020 CRETEIL F	33(0)1 45 17 43 00	33(0)1 43 99 98 65	http://www.sid.m.fr
NU CRU	GOLD CREW PRODUCT AND SERVICES - Division of ARA CHEM, Inc.	Box 5031 SAN DIEGO CALIFORNIA 92165-5031	1-619/286 4131	1-619/444 7256	
OCEANIA 1000	Ste HENKEL Division Industrie	Buroparc – Bâtiment B, 3, allée Emile Reynaud 77200 TORCY F	33(0)1 60 17 02 02 33(0)1 60 17 66 40	33(0)1 60 17 32 91	
PETROTECH 25	PETRO BIOTECH Distributeur FRANCE Ste EDIA	CH 6304 ZUG SWITZERLAND 144, avenue des Champs Elysées 75008 PARIS F	41/0796050636 33(0)1 43 59 01 08	41/417101648 33(0)1 53 76 07 53	
O.S.D-2B	Ste C.A.M.I.	1ère avenue n°44 Z.I. 13127 VITROLLES F	33(0)4 42 89 18 50	33(0)4 42 89 63 49	http://www.cami-international.com

L'inscription au tableau d'un produit est effectuée sans préjudice des procédures prescrites au titre de la loi n°77-771 du 12.07.77 modifiée par la loi n°82-905 du 21.10.82 relative au contrôle des produits chimiques et de ses textes d'application.
This procedure of approval is carried out without prejudice to the procedures prescribed under the French law n°77-771 of 12 July 1977, as amended by French Law n°82-905 of 21 October 1982 relating to the control of chemicals and its implementary provision.

12/04/02- Service Recherche et Développement

Cedre

Centre de Documentation de Recherche et d'Expérimentations sur les pollutions accidentelles des eaux
Association Loi 1901, sous tutelle du Ministère de l'Environnement
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UTILISATION DE DISPERSANTS EN EAU DOUCE
USE OF DISPERSANTS IN FRESH WATER

Produits préconisés par le CEDRE dans l'attente d'une procédure d'agrément de dispersants en eau douce
Draft list of the products recommanded by CEDRE (awaiting a full approval procedure for fresh water dispersant)

Mise à jour/*updated* : Février/*February 2002*

Produit *Product*	**Fournisseur** *Producer*	**Adresse** *Address*	**Téléphone** *Phone*	**Télécopie** *Fax*	**SITE INTERNET**
DASIC FRESH WATER	DASIC INTERNATIONAL LTD	Winchester Hill. Romsey. Hamps - e S051 7YD UK	44/1794 512419	44/1794 522346	
DISPEREP 8	Société REP International	40, avenue Jean Jaurès ZI Pétrolière 78444 ISSOU GARGENVILLE	33(0)1 30 98 80 00	33(0)1 30 98 82 01	http://www.rep.fr
ENERSPERSE 1037	DARCY INDUSTRIES LTD	Riversdale Mill, Hacken Lane - Darcy Lever Bolton BL3 1 SJ, UK	44/1204 33965	44/1204 394271	
INIPOL IPF	CECA SA	La Défense 2, 12 place de l'Iris - Immeuble Iris DPCP 92062 PARIS LA DEFENSE Cédex	33(0)1 47 96 90 90 33(0)1 47 96 92 91	33(0)1 47 96 92 33	http://www.ceca.fr
GAMLEN OD 4300 **GAMLEN OD 4500**	GAMLEN INDUSTRIES	17 route de Rouen 27950 SAINT MARCEL	33(0)2 32 64 35 35	33(0)2 32 51 43 24	http://gamlen.com

Ces produits ont fait l'objet d'un contrôle d'efficacité et de toxicité
These products have been tested for efficiency and toxicity

L'inscription au tableau d'un produit est effectuée sans préjudice des procédures prescrites au titre de la loi n°77-771 du 12.07.77 modifiée par la loi n°82-905 du 21.10.82 relative au contrôle des produits chimiques et de ses textes d'application.
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Updated: February 2002

CHARACTERISTICS OF FLOATING SORBENT TO BE USED AT SEA AND IN INLAND WATERS
ACCORDING TO AFNOR NFT 90-360

SORBENT TYPE A - BULK SORBENT

The table below gives a non-exhaustive list of sorbent products tested by CEDRE's laboratory) measured using crude Arabian Light, topped at 110°C (viscosity 42-45 cP at 20°C) for their efficiency and specifies:

- the sorbent capacity which allows a comparison of the products performances.
- the nature of the sorbent material, which is an essential element to define the storage conditions and the disposal of the product (eg: incineration).

Only products which meet to the following criteria are listed below:
① **sorbent capacity:** sorbent capacity in weight higher than 5
or
sorbent capacity in volume higher than 0,5 (calculated according to the apparent density of the product)
② **hydrophobia:** retention capacity of water/retention capacity of oil equal or below 0,25
③ **stability:** the product must stay stable and un-friable for keep its properties

NAME OF THE PRODUCT	NATURE OF THE MATERIAL	ASPECT	ABSORBENT CAPACITY BY WEIGHT	SUPPLIER
ABSORLENE N	fiberglass	yellow fiber	28.6	ISOVER
ABSORBPAL loose	phenolic foam	purple flake	64,1	RIVARD
BLACK GREEN	phenolic foam	pink flake	72,0	Groupe CAL-X
CANSORB	vegetal fiber (peat)	brown fiber	7,9	ACANTHE Sarl
DIPSORB T	polyurethane	granulate	19,0	SAITEC SA
ELCOSORB	vegetal fiber (peat)	brown fiber	7,8	DIPTER
ERGON	polypropylene	white « spaghetti »	10,6	ERGON / GEMADIS
FIBERPERL	perlite and cellulose	brown fiber	6,2	TEES
MEPOXAB	epoxy powder	white powder	19,0	M.S.M.
MICROSORB	polypropylene	white flake	13,7	SCHOELLER & HOESCH
REPSORB SPAGHETTI	polypropylene	white fiber	9,0	REP
SPC 27	polypropylene	white fiber	11,0	SICSA
SORBICAN	vegetal fiber (peat)	brown fiber	8,3	CITIS
VERDYOL SORBENT	vegetal fiber	cream-coloured fiber	12,5	VERDYOL INTERNATIONAL

NOTE ABOUT THE USE OF DATA OF TABLE

The sorbent capacity in weight in the table, is the retention capacity when the sorbent is saturated, with oil (crude Arabian Light, topped at 110° C). For each product, it is possible to determine the theoretical price per treated liter, by combining the retention capacity in weight (sorbent capacity) with the price of the sorbent.
The price per treated liter of oil is a good criterion to compare the efficiency of various sorbents from an economic point of view.
Beyond this criterion, for obvious operational reasons, it is important to evaluate the sorbent capacity in volume, which is the volume of sorbent needed to recover a given volume of pollutant. This can be calculated by taking into account the apparent density of the product in its packaging, available from the supplier, and the sorbent capacity in weight.
<u>note</u>: some manufacturers might modify the composition or the nature of the sorbent they market; in case of doubt, do not hesitate to consult CEDRE which keeps a sample of each product that is tested ; this will allow, at least, a visual comparison to be made.
Additionally it is always possible to order a control test of the product.

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Updated: February 2002

CHARACTERISTICS OF FLOATING SORBENT TO BE USED AT SEA AND IN INLAND WATERS ACCORDING TO AFNOR NFT 90-360

TYPES B & C - SHEETS, ROLLS or MAT

The table below gives a non-exhaustive list of sorbent products tested by CEDRE's laboratory) measured using crude Arabian Light, topped at 110°C (viscosity 42-45 cP at 20°C) for their efficiency and specifies:

- the sorbent capacity which allows a comparison of the products performances.
- the nature of the sorbent material, which is an essential element to define the storage conditions and the disposal of the product (eg: incineration).

Only products which meet to the following criteria are listed below:
① sorbent capacity: sorbent capacity in weight higher than 5
② hydrophobia: retention capacity of water/retention capacity of oil equal or below 0,25
③ stability: the product must be sufficiently strong to be manipulated as it is without tearing

NAME OF THE PRODUCT	NATURE OF THE MATERIAL	ASPECT	ABSORBENT CAPACITY BY WEIGHT	SUPPLIER	
ABSORLENE B	fiberglass	yellow fiber	31.3	ISOVER	ORGEL SA
AQUASORB 100	polypropylene	white	14.0	REICO	
AQUASORB 200	polypropylene	white	14,5	REICO	
OIL BUOY OB 100	polypropylene	white	13,6	BIG 'O'	
ERGON	polypropylene	white	11.6	ERGON	GEMADIS
MICROSORB 200 g/m²	polypropylene	white	14,5	SCHOELLER & HOESCH	
MICROSORB 400 g/m²	polypropylene	white	14,0	SCHOELLER & HOESCH	
VF240	polypropylene	pale green	14.6	HALECO	
VF240W	polypropylene	pale green	11.2	HALECO	
POROIL	polyester polypropylene	brown	8.7	ENAC	SICAM
POWERSORB HP 156	polypropylene	white	16.5	3M	
POWERSORB T 156	polypropylene	white	13.9	3M	
PROGRESS 200 g/m²	polypropylene	white	14,5	EXO POLL	
PROGRESS 400 g/m²	polypropylene	white	14,0	EXO POLL	
REPSORB FEUILLE (sheet)	polypropylene	green	11,0	REP	
SPC 150 (roll)	polypropylene	white	9.2	SISCA	

The sorbent ability in weight in the table, is the retention capacity when the sorbent has reached on point, measured using crude Arabian Light, topped at 110° C. For each product:
It is possible to determine the theoretical price per treated liter, by combining the retention capacity in weight (sorbent ability) with the price of the sorbent.
The price per treated liter of oil is the only criterion by which the efficiency of the various sorbents can be compared from an economic point of view.

Some manufacturers may modify the composition or the nature of the sorbent they market; in case of doubt, do not hesitate to consult CEDRE which keeps a sample of each product that is tested; this will allow, at least, a visual comparison to be made.
Additionally it is always possible to request a product test from CEDRE.

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Updated: February 2002

CHARACTERISTICS OF FLOATING SORBENT TO BE USED AT SEA AND IN INLAND WATERS
ACCORDING TO AFNOR NFT 90-360

TYPES D & E - PILLOWS or SOCKS and BOOMS and TYPES G – SPECIAL PRODUCTS

The table below gives a non-exhaustive list of sorbent products tested by CEDRE's laboratory) measured using crude Arabian Light, topped at 110°C (viscosity 42-45 cP at 20°C) for their efficiency and specifies:

- the sorbent capacity which allows a comparison of the products performances.
- the nature of the sorbent material, which is an essential element to define the storage conditions and the disposal of the product (eg: incineration).

Only products which meet to the following criteria are listed below:
① sorbent capacity: sorbent capacity in weight higher than 10
② hydrophobia: retention capacity of water/retention capacity of oil equal or below 0,25
③ stability: the product must stay stable and un-friable for keep its properties

NAME OF THE PRODUCT	NATURE OF THE MATERIAL	ASPECT	ABSORBENT CAPACITY BY WEIGHT	SUPPLIER
TYPES D & E - PILLOWS or SOCKS and BOOMS				
AQUASORB	polypropylene	white	23,0	REICO
EXOBAR (boom)	polypropylene	white	23,0	EXO POLL
MICROSORB (boom)	polypropylene	white	23,0	SCHOELLER & HOESCH
SANCOSORB	polyethylene	white	17,0	SANERINGKONSULT
SORS 1001	processed cotton	white	23,0	SANERINGKONSULT
SPILCAT	urea-formaldehyde resin	white	29,2	NORDIN CELLULOSE
TYPE E 810	polypropylene	white	7,4	GEMADIS
TYPE G - SPECIAL PRODUCT				
BLOCKS – RIGID PLATE				
ABSORBPAL sheet	phenoplast	mauve foam	62,8	RIVARD
MAXORB.SID	phenoplast	mauve foam	62,8	Ste Industrielle de Diffusion

The sorbent ability in weight in the table, is the retention capacity when the sorbent has reached on point, measured using crude Arabian Light, topped at 110° C. For each product:
It is possible to determine the theoretical price per treated liter, by combining the retention capacity in weight (sorbent ability) with the price of the sorbent.
The price per treated liter of oil is the only criterion by which the efficiency of the various sorbents can be compared from an economic point of view.

In the case of a boom, the results of tests apply to the constituant material of the boom and not to the boom itself; the performances of booms may vary slightly according to the state of compression of the material within the boom.

Some manufacturers may modify the composition or the nature of the sorbent they market; in case of doubt, do not hesitate to consult CEDRE which keeps a sample of each product that is tested; this will allow, at least, a visual comparison to be made. Additionally it is always possible to request a product test from CEDRE.

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NOTES

STRATEGIC ASPECTS OF CONTAINMENT AND RECOVERY AT SEA AND IN COASTAL AREAS

OIL CONTAINMENT AND RECOVERY AT SEA AND IN COASTAL WATERS

Georges PEIGNÉ
Cedre

INTRODUCTION

Oil containment and recovery at sea and in coastal waters involve collecting most and, if possible, all of the oil spilled as a result of a marine casualty before it reaches the coast and causes catastrophic damage both to the environment and the economy.

Not so long ago recovery at sea was almost unanimously and essentially regarded as a showcase for the media and the public and which depended more on the influence politicians can have on a response Command Centre than on reasoned technical choices.

Things began to change with the *Exxon Valdez* spill in 1979: taking advantage of fair weather and sea conditions, every available boom and barge on the US West coast operated for weeks, recovering over one tenth of the 40,000 tonnes spilled and thereby beating prior records. Seven years later (1996), the *Sea Empress* casualty in Wales reinforced public feelings that it was worth trying to recover oil at sea. The spill was a case in point because it taught response professionals a number of things about a spill lasting several days, the shifts in wind and current patterns herding large slicks towards the high sea, the spill location itself which was close to the home ports of recovery vessels available in Europe and so on. Five vessels or containment and recovery systems of very different design, including the French Navy vessels Ailette and Elan, were engaged on an average of ten days each. Four thousand tonnes (4,000) of emulsion were recovered thus sparing hundreds of thousands man-hours in shoreline clean-up and the recovery and treatment of at least tens of thousands of tonnes of oily waste. The *Erika* spill, in December 1999 off the French Atlantic seaboard, confirmed both the feasibility and merits of oil recovery at sea. Actually, despite extremely adverse weather and sea conditions that allowed operations to take place for only three days in a period of three weeks, despite the high fuel oil viscosity that rendered pumping operations particularly difficult, over 1,100 tonnes of oil were recovered, which is a remarkable result considering the duration and cost of cleanup of areas subsequently impacted by the rest of the cargo. Such an achievement was the outcome of excellent co-operation on the part of countries that pooled their resources as provided for by regional agreements which had already been activated to deal with the Sea Empress spill.

These examples illustrate that containment and recovery at sea are more than a showcase. Moreover they imply that response officials are expected to do even better in future response operations.

Response operations conducted near exposed coastlines is comparable to response at sea. In sheltered areas, special equipment may be deployed to contain and recover drifting slicks before they impact sites of particular importance to the environment or the economy.

In addition, it is essential for two reasons. First, it prevents oiling of considerable volumes of debris, seaweed, pebbles, sand and other beach materials which would subsequently require expensive collection and treatment. Secondly, it has a significant impact on the public who appreciate the efficiency (a slick is contained in time) or the inefficiency (the slick could have been contained) of response officials which could be swiftly hyped by the media.

Although setting the target is easy, achieving success is a challenge. In addition to purpose-built systems such as booms and skimmers, oil containment and recovery at sea and in coastal waters require the implementation of a number of resources in order to succeed every step of the operation from oil containment to pollutant transfer to the seashore. Success depends on having a coherent range of resources geared to the problem at hand.

The choice of strategy and appropriate resources require an accurate assessment of the situation and information concerning available equipment.

RESPONSE FRAME

Decision-making criteria for the optimal use of equipment or for setting up procurement policies are listed in Table 1 overleaf.

Table 1
Decision-making criteria for oil containment and recovery at sea and in coastal waters

1. Type and volume of oil
a) type of oil ▪ density ▪ viscosity ▪ pour point ▪ degree of emulsification ▪ flash point (flammability) b) volume of oil (instantaneous spill or continuous release)
2. Characteristics of the location of the spill
a) distance ▪ from the coast ▪ from a major port ▪ from a land-based storage site for recovered pollutants b) weather and sea conditions ▪ swell or choppy sea ▪ wind ▪ surface currents ▪ air and sea temperatures
3. Characteristics of the threatened shore
a) sensitivity ▪ ecologically and economically sensitive areas ▪ areas where containment and recovery at sea are feasible ▪ foreshore that can be cleaned up easily ▪ accessibility by land or by sea b) weather and sea conditions ▪ exposed shore (to swell and breaking waves) ▪ tidal range and currents
4. Available resources
a) specifically designed pollution response equipment ▪ floating booms ▪ skimmers ▪ floating storage tanks ▪ pumps and fittings b) vessels, handling equipment and storage capacities for recovered oil c) staff (skilled or inexperienced) d) aerial guidance resources (helicopters, aircraft)

There are two major types of accidental spill at sea depending on the source of the pollution: spills related to oil tankers and those resulting from offshore oil production. The latter are "easier" to handle because the following information is known in advance:

- type of oil,
- location of potential pollution sources,
- usual weather and sea conditions in the area,
- sensitivity of the potentially threatened coastline.

Moreover, dedicated pollution response resources (vessels, staff) are probably stockpiled and available nearby.

Conversely, accidental oil or other hc-related spills from vessels involve unpredictable factors such as:

- the type of oil involved, which requires readiness for response operations on a crude - heavy or light - a refined light oil or a highly viscous substance. Furthermore, in the event of an incident, information on the characteristics of the spill should be rapidly available.

- the spill location, which requires readiness for response anywhere along shipping routes and permanent information on the weather and sea conditions in these areas.

Moreover, most accidental releases from ships occur in severe sea conditions that hinder response operations and may even preclude them since containment and recovery systems are ineffective in waves higher than 2.5 m (sea state 4). The *Erika* spill was a cruel reminder of just how well equipment can perform yet recognised as particularly effective at sea in addition to the conditions that response teams can safely operate in.

The ***physical properties*** of oil must be considered when selecting recovery equipment, the effectiveness of which varies according to oil density, viscosity and pour point. When the pour point is close to air and water temperatures, oil behaves almost like a solid and as such is extremely difficult to pump. That was the case for the heavy fuel oil spilled by the *Erika* which was very sticky, hardly fluid and that could hardly float.

The physical properties of oil also affect the decision to recover or not. For safety reasons, light volatile oil will not be recovered and, more generally, when possible, it is preferable to let the environment eliminate oil from the sea surface. Remarks on fire hazard mainly apply to incidents resulting from offshore oil production. In case of a time-limited spillage from a damaged ship, response time allows lighter oil fractions to evaporate and fire risk is mitigated when operations begin. In every instance, it is more than advisable to ensure that there is no risk to response teams by knowing exactly what the flash point is at the time of a spillage in a bid to manage it effectively over time.

The ***volume*** of spilled oil affects the amount of pollutant to be recovered, slick size and thickness. Containment-recovery systems (booms, skimmers) and storage capacities should be provided accordingly. Such operations require extensive equipment and are deemed worthy only for volumes of at least several dozens or even several hundreds of tonnes. In the event of very minor pollution (a few dozen tonnes) recovery is justified only when it can be reasonably expected to recover almost all of the spilled oil. The same can be said for protecting sensitive areas (laying mooring lines, deploying inordinate numbers of boom sections).

Spill location affects the decision to recover at high sea and, if such decision is taken has an effect on the logistics needed to mitigate the effect of the distance to the nearest port on response time and on the transfer of recovered pollutants to land-based storage facilities. The closer the pollution source is, the shorter the response time is going to be before oil strands on the coastline. But then transfer-induced idle times are shorter. When a spill happens far off shore, response times are longer and the storage and transfer of recovered pollutants or waste are major problems which can be overcome by providing large storage capacities at sea (e.g. oil tanker).

Moreover, except when recovering at source, permanent aerial guidance is required to ensure that recovery systems are treating the thickest patches. Helicopters can be used when the source is close to shore, or when a near-by platform can be used as a landing / refuelling pad. Aircraft are less hampered by distance but reconnaissance accuracy is poorer unless the spotter aircraft are fitted with remote sensing equipment.

Off shore pollution sources allow more time for deploying equipment to protect sensitive areas; yet, if at the same time winds shift, a bigger section of coastline is likely to be impacted unless increasing numbers of protection systems or response teams swing into action rapidly depending on the extent to which slick drift has been either forecasted or reported. This is the type of situation shoreline protection supervisors had to face during the *Erika* spill.

Other points for consideration when opting for a strategy concern either the operating conditions of the equipment or the need for additional equipment needed to run the containment-recovery systems. All of which will depend on the main types of boom or recovery system described below.

SPILL CONTAINMENT BOOMS

General

In the armamentarium of equipment used for pollution response, booms are a key element of shoreline protection even though they do not perform well in every situation. They are also a useful, or even an essential part of recovery. In either case, the quicker booms are deployed the more effective they will be. There exists a wide range and variety of models and yet booms have their limits but that we can improve providing they are deployed appropriately. Different locations call for different techniques and require sound environmental knowledge and skilful handling that can only be gained through realistic hands-on practical exercises.

Booms are designed to prevent oil and floating debris from spreading. Containment allows thickening or deflecting slicks towards calmer waters for easier recovery. The generic term "booms" always refers to commercially available booms. Nevertheless, improvised barriers made from local materials are helpful in minor spills, particularly in sheltered areas and on inland waters, or while awaiting the arrival of purpose-built equipment.

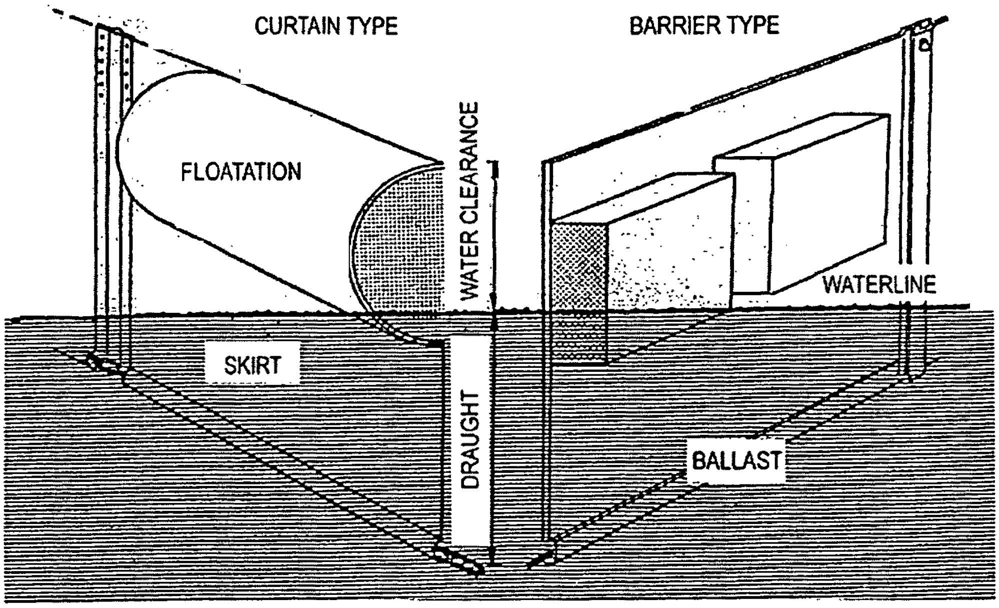
Commercially available booms

With a few exceptions, booms developed significantly after the *Torrey Canyon* spill in 1967. The rubber industry joined hands to present equipment likely to be approved by the authorities. Boom technology has improved over the past thirty years and a number of models are now commercially available.

There are two types of floating boom:

- ***Curtain booms*** have floatation chambers of circular cross-section and are generally inflated; a weighted skirt hangs below.
- ***Fence booms*** have a rigid or semi-rigid screen that is kept upright in the water by side floatation chambers filled with air or expanded foam.

Both categories have their advantages and disadvantages which vary according to spill conditions and implementation.



Curtain boom **Fence boom**

Containment booms generally have three operating components. These are:

FLOATATION CHAMBER (inflatable or self-inflatable floats filled with air or expanded foam).

SCREEN OR SKIRT made of rubber or synthetic material. The skirt usually hangs under the float providing a barrier to contain the oil.

BALLAST, generally a chain, attached to the bottom of the skirt. Ballast helps to keep the skirt upright.

Booms can be subjected to horizontal (axial) tension which is vectored by tension lines or by vertical boom components. Tension members affect the behaviour of booms in water.

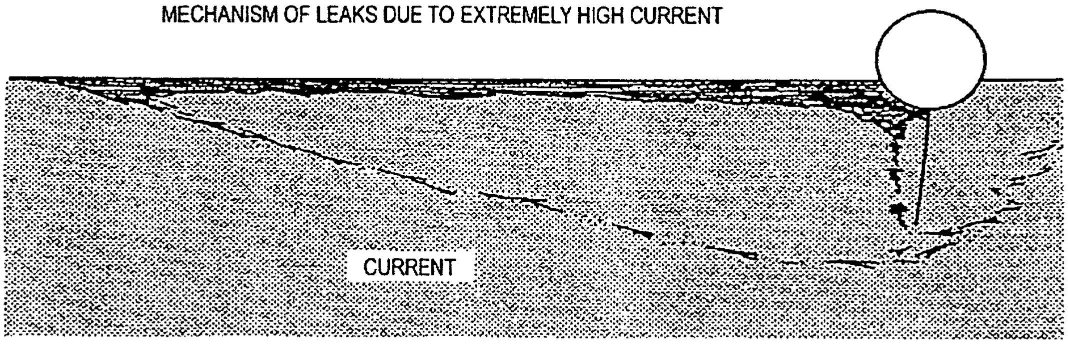
Booms are mainly made of plastic coated oil-resistant materials.

Scope of use

In an environment one can rarely manage, precautions have to be taken to foster boom efficacy, particularly deployment which should be commensurate with spill conditions.

Current velocity is one of the main causes of boom failure. Oil remains quite stable if currents are slow moving. But when velocity increases, oil accumulates and the slick thickens which leads to splashover once "critical velocity" has been reached then exceeded. Oil escape can also result from turbulence along the boom. Critical velocity varies with viscosity and density in addition to slick thickness and other boom characteristics. It is generally agreed that critical current velocity ranges from 0.7 to 1 knot for a boom deployed at right angles to the current. In shallow waters (less than five times the draught) higher current velocity may cause oil escape well before the critical threshold is reached.

MECHANISM OF LEAKS DUE TO EXTREMELY HIGH CURRENT



Wind combined with currents may also cause splashover. The shape of the boom may thus influence its behaviour and retention capacity. In rough seas, the flexibility of the constituent parts of a skirt boom will enable it to follow the waves but if sea conditions worsen booms will have a tendency to dive. This is when the point of no return is met because in worsening sea conditions booms simply cannot cope or even survive.

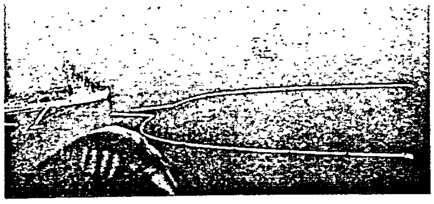
How to use booms

A boom is the first link in a chain of mechanical systems comprising recovery equipment, transfer pumps, storage capacities and vehicles required for transferring pollutant to recycling or treatment plants. Since the conditions governing boom implementation have already been well defined, they should be used accordingly depending on location and response equipment they are going to be used with.

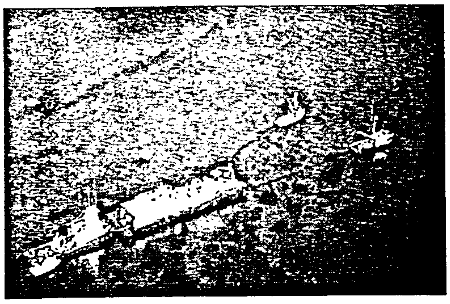
At high sea

When oil is accidentally spilled at sea, containment equipment should be deployed rapidly in order to reduce the quantity of oil that will inevitably reach the shore and oil areas that can often be hard to reach. Booms are used along with the requisite recovery equipment and storage capacities.

Booms can be used in stationary mode and be deployed at right angles to the current in order to recover drifting pollutants in the pocket though they are mostly used in dynamic mode and are towed by two vessels. Maximum manoeuvrability at low speeds is essential for vessels to tow the boom at the maximum speed consistent with oil retention (boom speed relative to drifting slicks must always be below effective boom trawling speed). Booms can be towed in U or V configurations depending on whether the collection system is placed inside the boom or towed. During recovery operations, boom shape will change according to vessel co-ordination, especially since they often have to alter course.



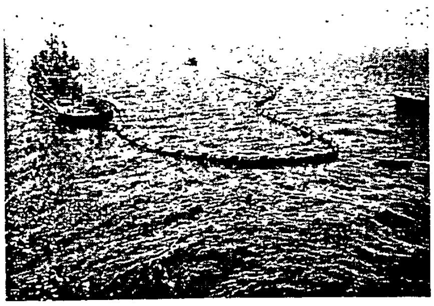
U configuration



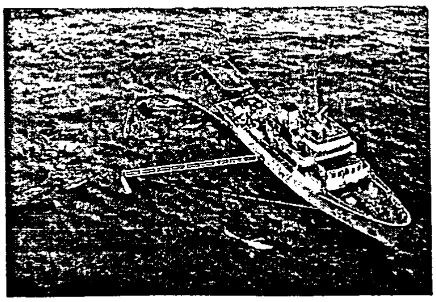
V configuration

Three vessels are required for trawling booms in U and V configurations. The pocket may be redesigned for towing in J configuration with 2 vessels. Vessel 1 tows the boom while vessel 2 carries the collection system and eventually provides storage for the recovered pollutant. The French Navy prefers J configuration trawling in response operations at sea (successfully achieved during the *Sea Empress* spill) and during regular training exercises. During the *Erika* spill, the French Navy attempted to use containment booms but the weather and sea conditions were unfit and the slicks proved to be thick enough for direct recovery.

Another solution consists of using one vessel for trawling the boom that is fitted to a sweeping arm and that is deployed so as to encounter the slick as a vessel moves forward through it. Such a system would be booms that recover the oil while containing it (e.g.: the Sirene 20 boom) and would also be the corralling system used by the French Navy (e.g.: the Dacama system). In this event, the boom encounter width or aperture would be no more than 20 metres. Yet this system can still be optimised even further by deploying a second boom trawled in front of the first one and that would then act as a funnel and deflect oil towards the recovery unit.



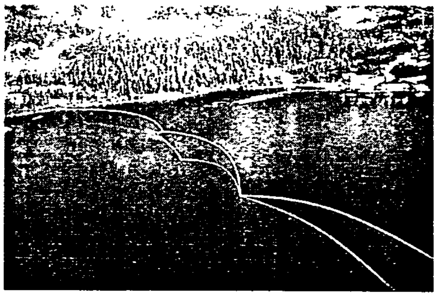
J configuration



Recovery boom associated to vessel

In estuaries and coastal areas

As we learned with the *Erika* spill, such locations are often exposed to wind, current and breaking waves. On exposed coastlines, it is essential to identify sensitive areas requiring protection and those where recovery sites can be implemented.



Protection of sensitive sites

Sensitive areas are protected by setting up booms which when placed slightly offshore can deviate slicks towards other less sensitive coastline areas. Heavy duty booms are anchored, moored or fastened in position and may remain so for several weeks on end. Booms should be reusable and resistant to damage from adverse sea conditions. Laying moorings is a skilled job that has not yet been fully mastered. With wind and water movement, mooring lines can shift despite the presence of concrete blocks (called sinkers) weighing as much as 6 tonnes. Permanent mooring locations should always be provided for places requiring priority protection. In estuaries, booms can deflect oil towards a recovery area accessible by land.

Tides can sometimes generate variations in current velocity of more than 3 knots and in such conditions, given the current state of the art, it is senseless to expect that you will be able to prevent the slick from spreading. At best it can be deflected, at least part of it, towards a recovery system. But local populations will not easily accept the idea and even less the decision to give up booming a sensitive area. The *Erika* spill has afforded a number of examples and particularly of oyster farms located in estuaries. Whence the importance of taking prior measures whilst in the preparatory phases of devising a pollution response plan (called a Contingency Plan) which by necessity has to comprise a section on how to protect sensitive areas.

In France the most sensitive areas from the ecological and economic point of view have been mapped by coastal authorities and provided with boom laying and maintenance plans as laid down in the Polmar rules that date back to 12 October 1978. These rules, moreover, have been included in a more recent ministerial decree dated 17 December 1997. Sensitive location protection plans use current and tidal data in addition to maps that indicate how to access sensitive areas when recovery systems have to be deployed.

However, using them during regular exercises or pollution response operations is a reminder that such plans must not be over-ambitious but as realistic as possible. Otherwise, response and logistics equipment unsuited to the location will be mobilised whereas they could be used to better avail elsewhere.

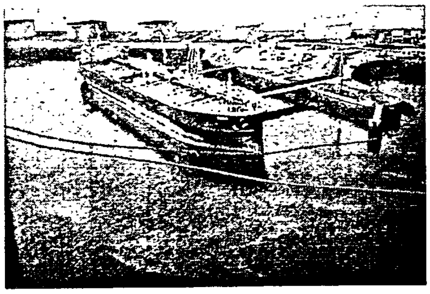
Floating booms belong to the Ministry of Transport and are entrusted to the care of the Department of Maritime Transport, Ports and Coastal Affairs which is in charge of selection and procurement. Stockpiles are managed by the Technical, Maritime and River Research Organisation which also delivers hands-on training. In the national boom stockpiles of mainland France there are 30 kms of floating boom. These stockpiles are in Dunkirk, Le Havre, Brest, Saint-Nazaire, Le Verdon, Sète, Marseilles and Ajaccio (Corsica). More than two thirds were used for months on the Atlantic seaboard during the *Erika* spill. Over a half of them were damaged by bad weather.

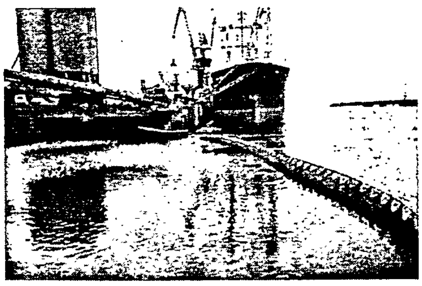
Light duty manoeuvrable booms are needed for cleaning up and containing spills and are deployed on the waters' edge to collect oil that runs off rocks that are being cleaned by beach response teams or that seeps up through the sand on polluted beaches, otherwise the oil tends to float back offshore and drift to some other part of the coast and pollute it. Weather permitting, sorbent booms will be advocated.

In ports

In high risk areas such as oil terminals, permanent booms may be installed or stored under cover on reels or in other ways that will facilitate rapid deployment.

Ports are, generally speaking, areas where currents are low. Boom deployment and use will be commensurate with surface and recovery conditions. Average size booms are suitable for time-limited use when manoeuvrability is sought (e.g. corralling slicks with small boats). Bubble barriers can in some instances be a viable solution when permanent use is sought. Fire booms can be used in harbours or near coastal refineries.





Other instances

Sorbent booms

Sorbent booms made of natural or synthetic materials are « sausage » shaped and used for absorbing hc. They have not been designed as primary response booms. Rather, they are generally used to provide the finishing touches to an operation or for cleaning locations that are hard to get to for skimmers. They are not very robust and as such are never recommended for use alone in currents but can be used as a back-up to standard floating booms. Their absorption capacity is as much as 3 to 6 times their own weight.

Bubble barriers

Bubble barriers afford a way of countering surface currents and preventing slick drift. A pipe or hosepipe is laid on the seabed and air bubbles then rise up through the water column to the surface to form a curtain of bubbles that increase in size as they rise to the surface and form a barrier in a bid to mitigate slick drift.

The final decision on the efficacy of bubble barriers is still pending. They are mainly used in oil terminals or fishfarms etc. Installation can be costly but implementation is immediate and does not hinder shipping.

MAIN TYPES OF OIL SKIMMERS FOR USE AT SEA

General

In order to afford optimal oil recovery whilst at the same time ensuring fast transfer or recovered materials to waste treatment plants ashore, sea operated oil recovery systems are designed to meet the main criteria for efficiency, which are:

- the oil encounter rate (or amount of water surface swept per unit of time),
- the throughput efficiency (which is the amount of oil that is effectively recovered compared to the amount of oil encountered),
- the oil recovery rate or selectivity (which is the percentage of oil contained in the total water/oil mixture skimmed off the water surface and recovered).

Experience has shown that all three results cannot be achieved simultaneously because an increase in encounter rates always involves a drop in selectivity. Most system manufacturers attempt to reach a compromise depending on how their recovery system is to be deployed. This applies to design and operating criteria that will be commensurate with spill type and the equipment needed to respond to it. In the event of a minor spill and if the response vessels only have limited storage capacity, selectivity of course will be of the essence. Conversely, in the event of a major spill and if « Strike Command » has plenty of storage capacity, the onus is going to be on encounter rates. In which case, selectivity and throughput efficiency will be impaired.

Types of skimmer

Operating principles

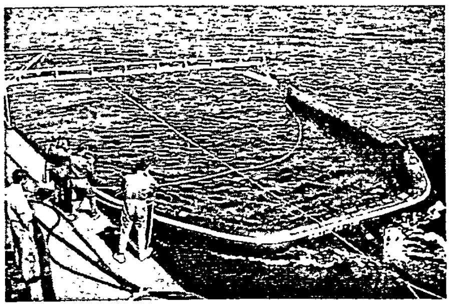
As a general rule, oil recovery systems for use at sea include a number of features which promote buoyancy, recovery of oil from the water surface and the transfer of the pollutant to storage capacities. Prior to recovery, oil is generally contained by part of the skimmer itself or by a boom, as mentioned previously. Two main types of skimmers are used for recovering oil on the water surface:

- ***mechanical skimmers*** which use the fluid proprieties of oil/water mixtures and the difference in density of oil and water;

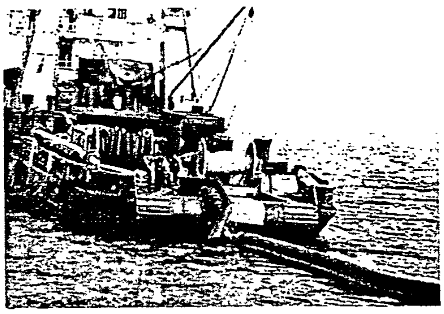
- ***oleophilic skimmers*** which use the adherence capacity of certain materials in relation to oil.

MECHANICAL SKIMMERS

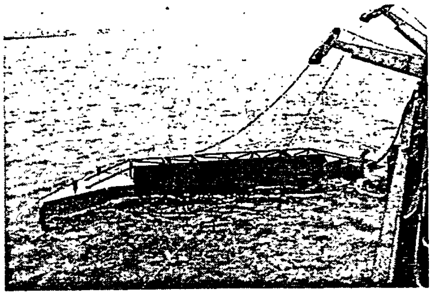
Most mechanical skimmers for use at sea are ***boom skimmers***, which means that they include a boom-type element to concentrate oil before it is skimmed by a system placed in front of the boom or that is an integral part of it. This system generally comes with a pump that serves also as a transfer pump with the suction head being placed in a weir so as to control oil. thickness before it is skimmed Booms with integral skimmers have been developed in France (Sirene 20), in the USA (Sock, Skimming Barrier), in Great Britain (Weir Boom, Vikoskim), in Denmark (Roskim), in Holland and Germany (Sweeping Arm), and in Norway (Ro-Fi Oil Trawl). Most weir skimmers used for offshore operations come from Norway (Transrec), Sweden (Foliex TDS), Denmark (Desmi Terminator and Tarentula) and the UK (Cascade, Pharos GT).



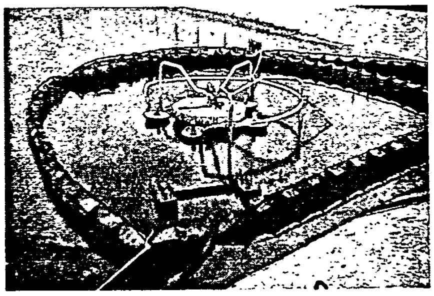
Sirene 20



Weir Boom



Sweeping Arm

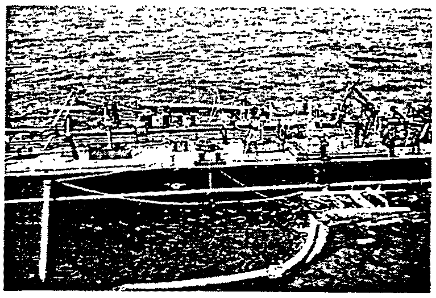


Transrec

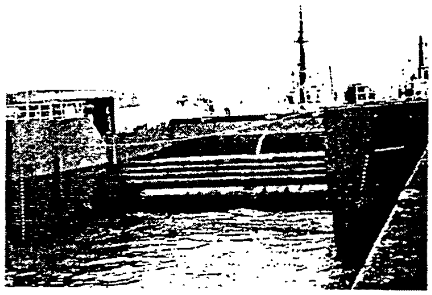
Boom skimmers offer many advantages such as a high encounter rate as such booms concentrate thin oil patches into thick ones thereby enhancing recovery rates and good wave-following capacities in addition to being able to hook them up to powerful pumping systems capable of pumping even viscous materials.

However, in order to prevent splashover or oil escaping beneath the boom, towing speeds are limited to 1 or 2 knots, which requires the use of specialised vessels with good manoeuvrability at low speed (supply vessels). A single-ship recovery system could be preferred to a more complex two or even three ship system since maintaining the correct trawling configuration requires simultaneous movement. But even this solution can be hampered by sea conditions. Since most boom skimmers afford poor selectivity, ample storage capacity must be available to allow for oil/water separation once the pollutant has been pumped.

Let us now compare skimmer booms and surface oil recovery to systems that are designed to recover oil directly in the tanks of a support vessel via an aperture in the hull. Such an arrangement would be positioned at wave height (Soopres, Norway or Svetlomor, Russia) or even a few metres below it and would in this case comprise a hosepipe fitted to a weir skimmer such as the ESCA high sea recovery system, France or suction dredges connected to an appropriate skimming system by a sling/towline such as the Dredge Skimmer, Holland.



High sea Esca system



Westensee

The advantage of skimming barge systems compared to boom skimmers described previously is that no pumping unit is needed and they can be used successfully on light or very viscous oils or solids. However, they should to be used with vessels offering large storage capacities (oil tankers, trawlers, large barges) that are purpose-built or sometimes designed for use on a recovery system (eg Thor and Bottsend, Westensee, Germany)

Another type of mechanical skimmer is the vortex skimmer which concentrates oil prior to pumping it from the vortex. They are advancing skimmers (Cyclonet, France) or stationary skimmers (Walosep, Sweden) with poorer encounter rates and wave-following capacity than boom skimmers. However, in calm sea, vortex skimmers are far more selective.

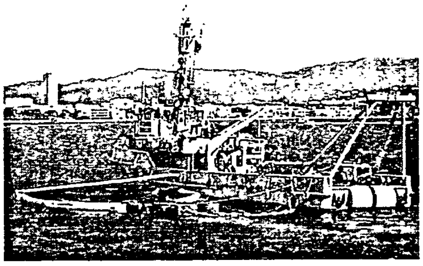
Lastly, yet another type of skimmer has been developed in Norway recently and comprises a rotating drum with palettes, called the Highwax that has been specially designed for recovering viscous and/or near-solid pollutants. The recovery performance of the system is due to the palettes that concentrate the pollution and an Archimedean screw type pump that works well on viscous materials and an in-line ring water injector on the delivery side of the pump. It can be said that other recovery systems comprise such an injector that is well known in the oil industry as it was validated by Cedre and the IFP in France well over 15 years ago.

EOPHILIC SKIMMERS

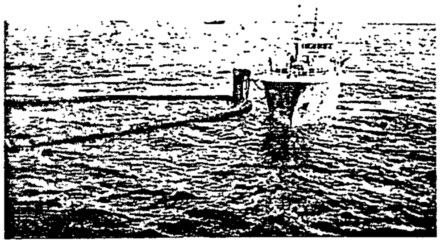
Oleophilic skimmers designed for use at sea are grouped under three main headings according to the shape of the oleophilic surface: disc, drum, rope or brush.

Disc skimmers, unlike the systems previously described, are designed for operation in near-stationary mode and it is only their size as well as the possibility of operating them from a vessel that allows to consider them as skimmers for use at sea. The best known models are the Vikoma Seaskimmer from Great Britain, the Discoil from Italy and the Rodisc from Denmark. They should be used with a containment boom. For most of them effectiveness is enhanced by a weir that improves recovery rate performance on thick slicks but to the detriment of selectivity shared by all oleophilic oil recovery systems.

Two *drum skimmers* have been developed for use at sea: the Stopol (France) and the Magnum (USA). This system was originally designed for use by supply vessels on oil fields and its operating principle is more akin to that of a boom skimmer than an oleophilic disk skimmer. Drum skimmer encounter rates are slightly lower, as they cannot be trawled at more than 1 knot. But they afford better selectivity and their effectiveness increases with oil viscosity.



Stopol



Foxtail

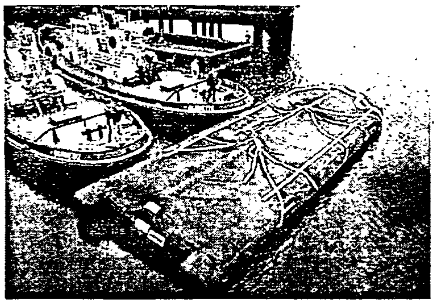
Oleophilic rope skimmers are designed for use at sea. The FORCE 7 from Great Britain is a poor performer due to its operating principle which is intermittent: ropes are dragged on the water surface then hauled onboard and the oil is squeezed off by rollers. On the other hand it is very selective and hardly sensitive to waves. Foxtail (Norway) and Seamop (Denmark) skimmers have the advantage of having a continuous mode of operation but on the other hand they must be operated in stationary mode with a boom.

Operating skimmers at sea

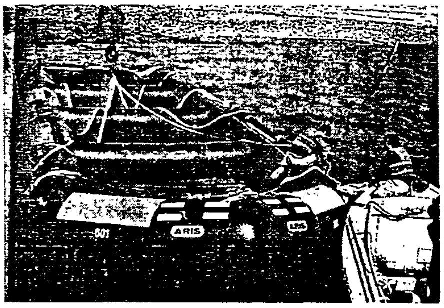
Selecting and adjusting skimmers does not provide optimum efficacy in recovery operations at sea. Most important of all is to devise a strategy and implement available equipment. Recovery rates will increase substantially if skimmers are used for longer periods of time rather than by seeking to optimise skimmer operating principles. Longer periods of operation will mean finding solutions to issues such as the following: locating the slick, when aerial reconnaissance is not available, working at night or in poor visibility conditions, operating skimmer skilfully, transporting pollutants, which assumes an effective and seamless transfer chain geared to the recovery system being used by the strike teams.
Since most skimmers have poor storage capacities additional spaces must be provided either onboard support vessels or towed by them.

Storage tanks can be fitted only on large trawlers, some dredgers and coastal tankers most of which lack manoeuvrability at low speed and therefore can hardly operate recovery systems.

Towing floating rubber (pillow) tanks or barges may be considered as the easiest alternative. However, floating tanks offer low capacity, which increases transfer rate to intermediate storage. Moreover, closed tanks (Dracone, Great Britain, RoTank, Denmark, or Caiman, France) are difficult to empty particularly when the pollutant is extremely viscous. This can be overcome by using tanks with a removable top (Pollutank and Aristock, France – Lancer, New Zealand).



Pollutank



Aristock

These remarks emphasize the importance of having adequate logistics. In effect, it is more a matter of using an entire recovery system than simply implementing a skimmer. Two different concepts stand out and are based on the additional vessels needed to do the job and are highlighted in ***table 2***.

Decision to recover oil at sea

Though oil recovery at sea is the best response to an accidental spill, it is also the most difficult to achieve since it requires extensive specific equipment and additional naval logistic support. However, oil skimming at sea should be considered as the priority pollution response, though subject to fair sea conditions, when the amount of oil spilled justifies such large scale operations. The choice of commercially available equipment depends above all on the type of spill. Success relies more upon effective organization than on theoretic skimmer performance. Therefore, skimmers should be easy to operate and personnel be trained during regular exercises and drills.

Moreover, after the *Sea Empress*, the *Erika* spill was a reminder of the advantages to be gained from readiness even though, at the beginning, sea conditions do not allow containment and recovery. Swift mobilisation of national and foreign resources for response at the first lull, for a limited cost, is worthwhile when officials know the oil will remain long enough at sea depending on the location of the spill and the type of pollutant involved (persistence). It is a different matter when, as for the *Braer* (Shetlands), the spill occurs on the coast and the oil is naturally dispersible.

OIL RECOVERY IN COASTAL AREAS

General

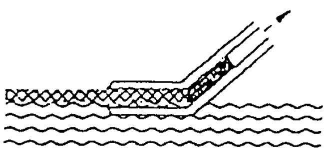
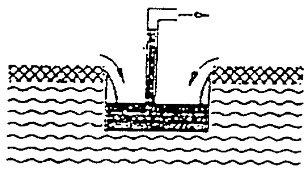
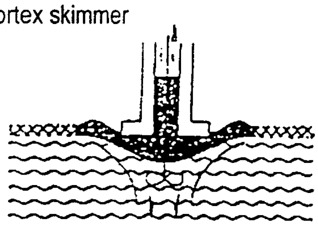
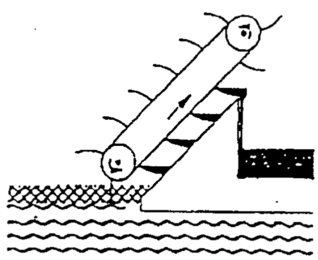
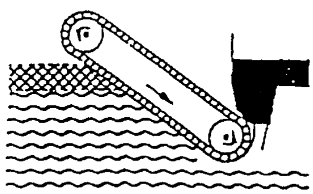
In accidental spills at sea expectations should not run so high as to suppose that all the oil will be recovered before it beaches on the coast. Thus, although recovery at sea will be a main priority, coastal response should not be overlooked. Moreover, many accidental spills occur on the coast, particularly in ports.

Recovery aims at removing floating oil from the sea surface for transfer to an intermediate storage on the shore or a pillow tank. Techniques for recovering floating oil in coastal areas call for specially designed equipment. Skimmers come with inherent features such as size and attendant operating conditions. Since each spill is different, all skimmers will perform differently (effectiveness, deployment) and this must be considered before purchase.

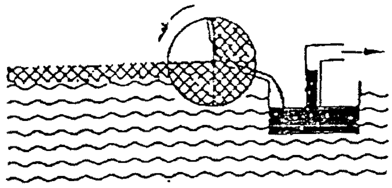
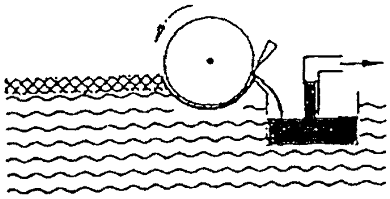
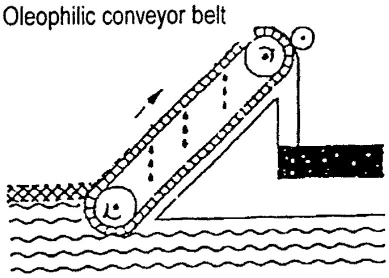
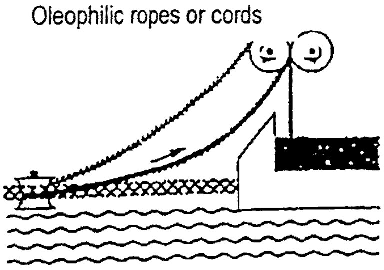
Main types of skimmers for use in coastal areas

There are different types of skimmers and they all have characteristic features (size, operating principle). Typically, skimmer size will be a determining factor for use at sea, along the coastline or in harbours or inland waters, and each location will require one specific kind of skimmer. The main types of skimmers, their advantages and disadvantages are listed in **table 1**. Moreover, some systems implement several operating principles depending on the spill to be managed.

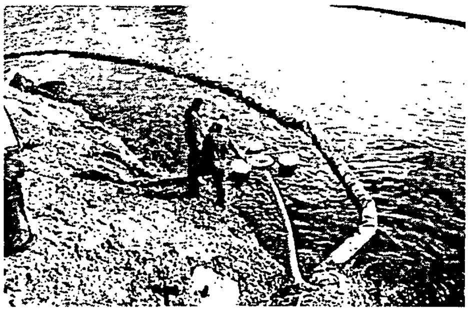
MECHANICAL SKIMMERS

Direct suction skimmer 	A nozzle fitted to a suction head skims the surface of the water. This skimmer is very simple and very practical for use in shallow water or on river banks. Vacuum pumps are used with these skimmers that are not very selective but are widely used especially on small spills.
Weir skimmer 	A subsurface weir is adjusted so as to (in principle) skim only the pollutant, which is then collected in a small tank and then pumped to a storage capacity. These skimmers are very easy to use and are more elaborate when compared with the previous type and are thus more selective and will be more effective still if used with the right kind of pump. There are many models available and all of them work well on sheltered waters.
Vortex skimmer 	Oil is lighter than water and as such collects naturally in the middle of a vortex thus affording selective pumping. They work best on fluid pollutants and in calm waters.
Conveyor belt skimmer 	A belt fitted with paddles conveys a pollutant to a storage-settling tank. These skimmers are used on very viscous pollutants and are rather selective as they combine recovery with settling. As a rule they are self-propelled and have been used very effectively on major spills occurring along the French coastline.
Submersion skimmer 	A pollutant is recovered by a belt that pulls the oil below the surface and into a storage tank from which it is pumped into a storage capacity. This skimmer works well on light oils, is reasonably selective and operates well in slow currents that the skimmer has been designed to produce if required.

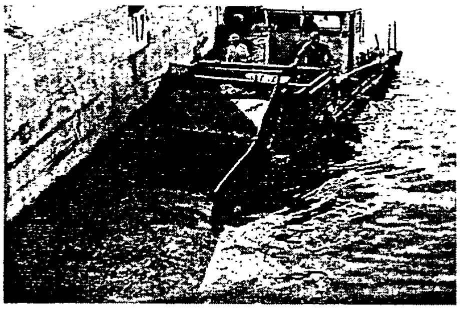
OLEOPHILIC SKIMMERS

Disk skimmer 	Disks mounted on an axle rotate counterclockwise in the slick and scrapers remove the oil from the disks. These skimmers are highly selective and their recovery rate is low but when combined with a weir can afford better recovery rates. There are many models of varying sophistication which are very suitable for recovering small spills.
Drum skimmer 	A drum coated with oleophilic material rotates counterclockwise in a slick and recovers the oil which is scraped off into a small tank located behind the drum and from there the oil is pumped into a storage capacity. These skimmers are also highly selective and their throughput increases as a function of pollutant viscosity. Performance will be much better if the skimmer is used in dynamic mode rather than static mode.
Oleophilic conveyor belt 	A permeable belt recovers the oil, water drips through the belt and oil is squeezed off the belt by a ringer located at the top end of the belt. These skimmers are very selective and perform well on viscous pollutants..
Oleophilic ropes or cords 	A motorised pulley and a return pulley are used to operate this recovery system. Two large ringers squeeze the oil off the rope which then returns to the slick for recovery. These systems are very selective and are the least affected by waves. The system is not very mobile and as such is rather recommended for use on inland waters.

We now need to mention skimmers that are specifically designed for recovering solid waste and debris. Most are self-propelled and address the particular issue of chronic pollution, of major concern in ports, and may be used for recovering highly or almost solid oil. Some may be equipped with optional systems allowing selective recovery.



Skimming operation



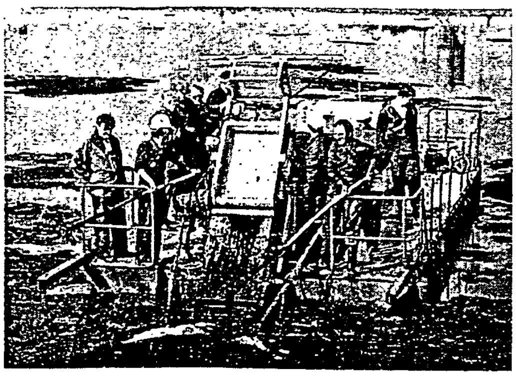
Solid waste recovery

Selecting a skimmer

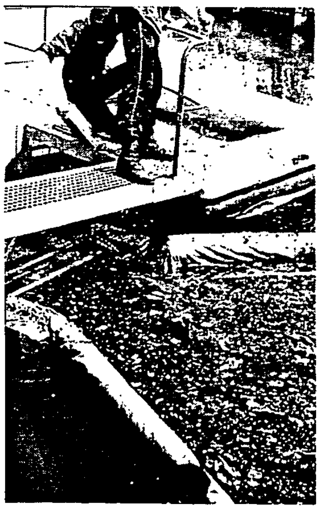
As for recovery at sea, the selection of a skimmer is determined by the conditions in which it will be used: type and volume of pollution; type of site polluted, ancillary equipment available to enhance skimmer effectiveness.

Type and volume of pollution

Very **viscous** oil is difficult to pump and hardly flows on the water surface. Very few skimmers are capable of recovering such materials and particular attention must be paid to choosing the right pump for delivering the waste. However, increased viscosity may improve the effectiveness of some skimmers such as those with conveyor belts, which take advantage of slick thickness. The only problem still pending as seen during the *Erika* spill, is stripping the oil from the belt.



Egmopol barge



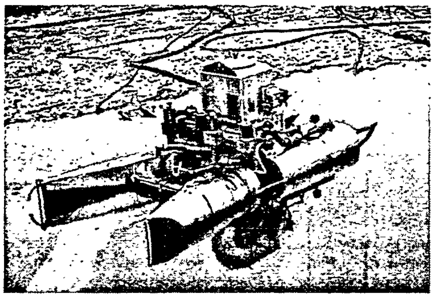
Solid Waste

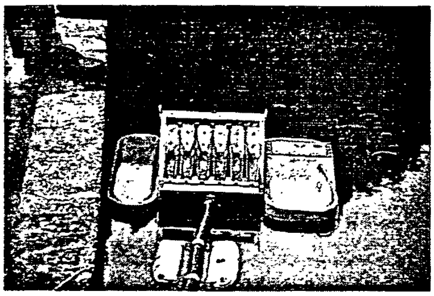
Solid waste hinders the flow of pollutant into the skimmer. Some designs are fitted with coarse screens that may be rapidly clogged with seaweed, floating wood, etc. On other systems, debris may block the intake valve or some other vital part of the pump. Debris may also prevent disc or cord rotation on oleophilic skimmers. In order to avoid such problems netting systems should be placed in front of the skimmer, provided they are themselves regularly cleaned.

Finally, attention must be paid to potential oil ***flammability.*** Operations must be carried out in compliance with safety requirements using non-sparking equipment. Such a problem is mainly encountered in ports. Danger is mitigated when oil remains at sea for a while before washing up on the coast.

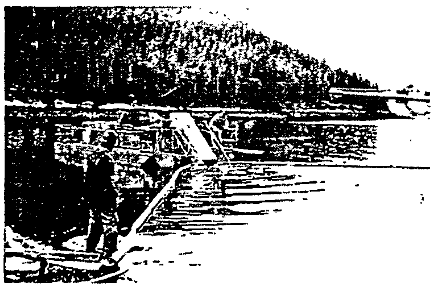
Pollution volume affects recovered waste quantities, recovery rates, storage capacities and slick thickness.

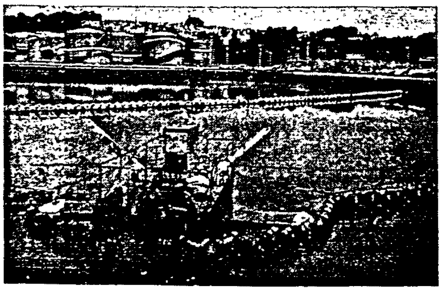
Selective systems (oleophilic skimmers or mechanical weir skimmers) should be preferred in the event of minor spills and thin slicks in order not to have to recover and store large quantities of water, provided other spill characteristics do not hamper this method. Another advantage is that these systems are often lighter and as a result an entire strike team can be required to deploy them.





On the other hand, heavy-duty systems with higher recovery rates are more effective on thick and large slicks provided large storage capacities are available. To reduce shoreline contamination, operations should be carried out as fast as possible to avoid oil emulsionning or weathering and slicks drift along the coast when boom containment is impossible.





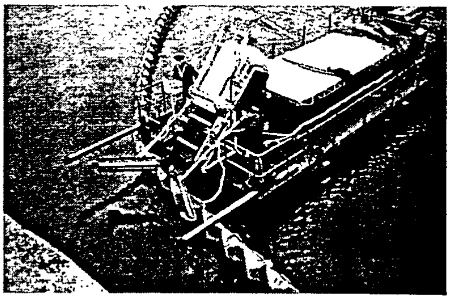
Types of spill locations

In some areas pollution response operations can only be carried out from the sea using self-propelled skimmers or skimmers that can be towed by a shallow draft vessel. When immediate transfer of the recovered pollutant to the shore is not possible, skimmers should have integral storage tanks or be used with a barge or a floating pillow tank. As these capacities usually fill up in the space of an hour or so, temporary storage should be organised nearby, either on land from a wharf as landing place for the system, or at sea where the water depth allows anchoring larger storage capacities. Temporary storage should be as close as possible to the recovery area in order to avoid losing time in transfers.

If land access is easy, honey wagons may be used down by the edge of the slick to directly pump the oil. The intake valve can be fitted with a flattened hose (buoyant or otherwise) to reduce the water content of the recovered waste.

With most skimmers shallow waters will preclude using them close to beaches and only direct suction systems can be implemented. If necessary, they may be fitted either with a hose or with a ***shallow draft*** weir.

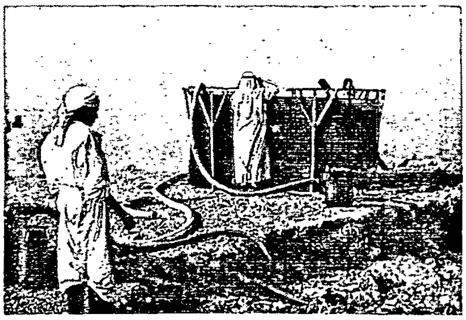
In harbours, water depth is less of a problem but pumping from wharfs is a difficult proposition. This can be overcome by placing the pump on the water or by using a self-propelled skimming barge.

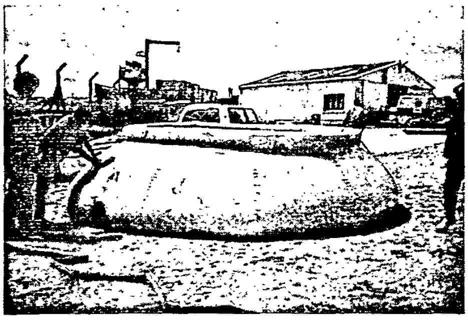


Whenever possible, a location's ***natural containment features*** should be used to prevent oil from spreading and concentrate it in an attempt to enhance recovery effectiveness.

The exposure of the location to ***swell*** or ***choppy seas*** should be taken into consideration when selecting a skimmer or operating it. Recovery operations cannot take place in areas exposed to swell and breaking waves because, in addition to the difficulty of operating skimmers in turbulent waters, waves and rocks accelerate emulsification thereby impairing skimmer performance.

Intermediary ***storage*** of recovered materials after skimming and prior to being transferred to processing facilities can involve either floating storage facilities such as those used offshore or flexible or rigid tanks and road tankers. Floating storage facilities are only used if land access is a problem.





Techniques that facilitate oil recovery

Oil recovery will always require a transfer chain which, if it is to be as effective as possible, will necessarily have to process high oil content materials. Timely oil recovery techniques will therefore be based on the ***aggregation principle*** and the main item that enhances this is the floating boom.

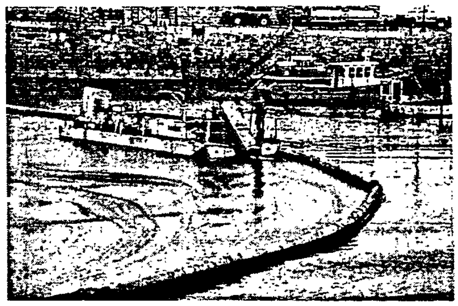
At high sea, near estuaries or opposite beaches, slicks can be shifted with a skimmer in the pocket of a boom trawled in a U-configuration. Alternatively, a deflector boom can be used to increase encounter widths if a skimmer is used with a sweeping arm for instance. In such cases, storage capacities will have to be an integral part of the recovery system on board the response vessel (dredger, barge, small coastal tankers, etc.) or a pillow tank can be used and be towed either by the recovery system or be on board the response vessel.

Items that are going to decide on the choice of a skimmer which is the very core/hub of the entire recovery system will be the size of the spill and prevailing sea conditions.

In calm seas, small spills (a few cubic metres) will be recovered with skimmers that have their own storage capacity and will almost always be of the self-propelled type. The skimmer will be located in the pocket of a U-shape configuration and be trawled at a speed not in excess of 1 knot.

In choppy seas, the skimmer boom will be preferred as it offers less resistance to waves and be fitted to a response vessel that has its own storage tanks. Also, if the spill is extensive a further deflector boom will be used if the average slick thickness is slight. If the spill is smaller but involves shallow waters two shallow draught vessels can tow a skimmer boom in U-configuration providing their rated horsepower is sufficient. In this event, one of them will also be entrusted with towing the pillow tank.

Oil thickness can also be enhanced by containing the oil between the boom and the coastline. Depending on the quantity and the type of oil to be recovered, the recovery technique may involve a light-duty skimmer placed on the landward side of the boom or alternatively the oil can be skimmed by approaching the slick from the seaward side of the boom. As skimmers do not concentrate oil patches, the boom has to be regularly tightened around the skimming head which will mean placing and keeping the barge outside the boom so as to avoid patches of thick oil coming between the barge and the boom. If the spill location is subject to tides, skimmers must never be allowed to beach. In this event, the recovery technique will involve self-propelled barges or skimmers that can be deployed from a vessel.

Long, regular swell is not a problem and in any event much less problematical than choppy waves. When wave height reaches 50 cms, skimmers become inoperative and if weir skimmers are being used they will not longer be effective if wave heights are even less than 50 cms and the same applies to direct suction skimmers and vortex skimmers in addition to some kinds of oleophilic skimmers

Slow currents will be beneficial for most skimmers providing they can be used to herd the oil toward the skimmer or promote slick thickening. But, when currents exceed 1 knot oil can either splash over the booms or dive under and appear on the other side of the boom unless of course the skimmers are self-propelled and can move at an appropriate operational speed. Some skimmers require relative speeds for them to operate correctly and if not they will tend to remain motionless if the currents are too strong (current speeds of 1 or 2 knots will be enough to prevent direct suction skimmers from advancing particularly if the suction heads are fitted with floats. Prior knowledge of currents is essential when deciding where to locate recovery sites.

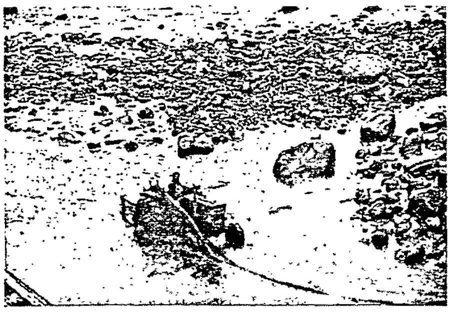
Additional equipment

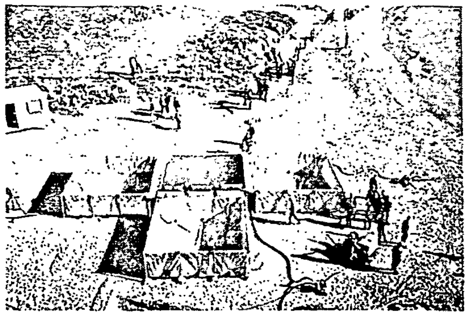
As a rule, skimmers do not offer adequate storage capacity and additional equipment is needed to transfer the pollutant to other storage units. Efficacy and throughput will largely depend on the right choice of equipment.

The main component of waste ***transfer*** is a pump that may be part of the skimmer or, as in most cases, associated to it. But, when skimmers are specific systems, pumps are not usually designed to resist oil or corrosion. This should be borne in mind when selecting the equipment.

The risk of explosion must be considered in the event of a light crude. Rather than the pump itself, it is the power pack that must be carefully considered. The pump power pack should be kept at a distance from slicks and hydrocarbon vapours.

Pumping very viscous materials (heavy fuel oil or water-in-oil emulsions) is an other critical item. Few pumps are capable of delivering viscous products over ten or twenty meters even if they show low tolerance to debris. Therefore, as far as possible, materials to be pumped should be free of debris.





The ***settling system*** as part of the overall response armamentarium will also be important. It is a fact that skimming is seldom perfect except when using oleophilic skimmers because many skimmers sometimes recover large quantities of water that have to be separated in order to make best use of storage capacities. Some kind of separation process will be required and require a slop tank for instance. The handiest system may be a tank with a drain valve beneath to bleed the water after a short settling period.

Sorbents improve skimming by forming agglomerates which can be mechanically skimmed, recovered with pumps used for viscous oil or removed using shovels and nets. Sorbents also prevent oil adherence on some surfaces (plants in salt marshes, walls, etc.). Packed in sheets or pillows, sorbents are particularly suited for selective recovery of small quantities of oil.

Organising recovery sites

A recovery site will be designed with skimmer efficiency in mind, not to mention skimmer delivery speeds and how quickly recovered pollutants can be evacuated to storage areas nearby. Intermediary storage units will have to be chosen accordingly so as they can be used as a buffer capacity and for settling (water and waste) between the production site and the evacuation system.

A recovery site has to comprise a team of skilled technicians capable of troubleshooting the equipment and who can also advise strike team members how to use the equipment.

A recovery site will be set up by skilled staff used to operating the equipment and who thereafter can train others « on the job ».

A recovery site will be deemed to have been organised suitably when all the additional logistics required to operate the equipment have been provided, including but limited to equipment deployment units and storage capacities.

Staff or personnel training

Recovering oil in coastal areas or in harbours will require equipment that will perform suitably in such locations not forgetting that implementation techniques will also have an effect on the end result. Such techniques are based on simple principles such as aggregating slicks and therefore will require equipment such as floating booms that have to easy to handle. Regular training exercises and drills will be needed to ensure that response equipment and entire recovery systems can be deployed and operated quickly and effectively in the event of a spill.

NOTES

WASTE MANAGEMENT

WASTE TRANSPORT, STORAGE AND DISPOSAL

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In the event of accidental oil spill, waste is generally removed in three stages:

- recovery in the polluted area, by pumping or collecting the pollutant,
- removal of waste from the polluted area to the treatment plant,
- treatment and actual disposal of the waste.

The amount handled in each of these stages depends on the extend of the pollution and the effectiveness of equipment used : correct operation of the whole treatment chain therefore requires the use of buffer storage facilities between each phase.

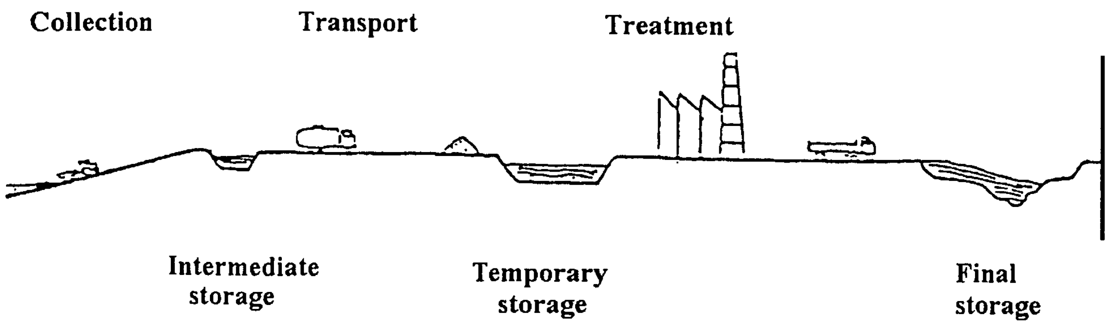
DEFINITIONS

In each pollution disposal chain, we shall consider :

- *as **intermediate***, the land-based storage generally located at the back of a beach or on the bank of a river which ensures continuity between coastal collection operations and the transport of waste to the treatment plant ; the intermediate storage will reduce the repercussions in the entire treatment chain between the various rates of coastal waste collection or skimming and the rates of waste removal. It will also enable a settling period for the skimmed oil which will improve the waste transport and disposal.

- *as **temporary***, storage of the pollutant before being disposed of in treatment plants. This type of storage will insure a regular transport of waste to the treatment centers ; however the temporary storage area should be well designed and constructed as it is possible that the waste will remain a relatively long time before being treated.

- *as **final***, dumping the treated waste. In some cases, the sand collected has such a low level of pollution that it does not warrant treatment and can be taken directly to the dumping ground. It is to be used exclusively for solid waste which presents no threat of contamination to surface or underground water, and no long term harm to the living species in the vicinity.



WASTE

Waste recovered during cleaning operations contains oil and various other elements in variable proportions :

- water trapped in an oil/water emulsion, or trapped in the sediment, or removed simultaneously with the oil or sediment,
- oil/sediment agglomerates, or sediment removed simultaneously with the oil,
- various debris such as plants (seaweed), or macro-wastes (plastic packing material, wood, various flotsam and jetsam, etc.).

The proportions of the various components that are recovered will lead to a distinction between pumpable and non-pumpable waste. The waste recovered at the conclusion of skimming operations on water or after pumping operations is generally considered as being a liquid waste. Collection and recovery on land concerns "solid" waste.

1. LIQUID WASTE

The extreme end of the spectrum of possible recovered waste is when we are able to collect oil in the same condition under which it was accidentally released (a massive spill directly on the coast, for example). In most cases however, the skimmed oil will contain some fraction of water. Also, solid components can be recovered during pumping operations, especially if vacuum pumps are used. The solid fraction removed during pumping may be as much as 25% of the so-called "liquid" waste.

2. SOLID WASTE

Recovering oil spills by other ways and means rather than by pumping is usually not very selective. For this reason, the oil collected in this manner has a high percentage of solids (from 60 to 85 %). Solid waste can be further differentiated into two categories : pasty waste and dry waste.

2.1 - Pasty Waste

This type of waste contains from 5 to 50% oil and from 20 to 30 % water. An initial value of 50% oil is only able to be achieved by means of highly selective skimmers which are used on a viscous spill. The pasty character of the waste may be enhanced by the presence of plant debris. This waste is visibly very polluted, since oily water or pure oil is seen draining off the waste. Precautions should be taken when handling this type of waste in order to avoid any subsequent oil releases.

2.2 - Dry Waste

These solid waste products have a water content of 15 to 20% and an oil content of 1 to 5 %. Dry waste can be heaped into piles, and there is no visible oil/ oily water run-off.

COMPONENTS FOUND IN WASTE	LIQUID WASTE	SOLID WASTE PASTY	DRY
Oil	10 - 100 %	5 - 50 %	1 - 5 %
Water	0 - 90 %	20 - 30 %	15 - 20 %
Solids	0 - 25 %	30 - 75 %	75 - 85 %

After long storage, oil content will rarely exceed 5 %, since any oil which was found above this percentage will have been removed from the pasty waste due to gravity caused run-off.

Table 1: waste components

Note : During the collection and recovery operations, it is important to keep the three types of waste separate. Each type of waste has its own appropriate treatment operations.

WASTE TRANSPORT

As storage, waste transportation can take place at different moments in the chain of cleaning/recovery/treatment operations following an oil spill.

Transporting waste involves:

- the transfer of a pollutant between the area from where it was recovered (during pumping operations, skimming, manual collection, etc.) to areas of intermediate storage, which can be temporary and/or definitive,
- carrying waste to treatment centers.

1. EQUATING THE MEANS OF TRANSPORTATION TO THE MEANS OF OIL RECOVERY

The logical relationship between these two phases will affect the entire recovery chain of action (from the early collection of the oil waste on a polluted site up to the final storage or treatment of the recovered waste).

There are numerous possibilities for the chain of action to break down. This breakdown in the recovery/treatment chain of action can lead to two possible outcomes :

a) The means of transportation is able to fill the gap in the chain of actions because of its autonomy and pumping capabilities;

   This will be true for sewage trucks equipped with pumps, agricultural honey wagons, or bucket loaders which are intended to transport the waste between the waste collection site and the intermediate storage area.

b) The means of transportation cannot respond to a breakdown in the chain of actions:

either because the transportation vehicles cannot pump or otherwise remove the collected waste (for example, tank trucks, tank trailers, dump trucks, trailers, agricultural tractor platforms...),

or because the means of transport is ineffective in terms of the type of waste to be handled (too viscous, too heavily loaded with solids...), such as the case of a sewage truck equipped with a pump for a fluid waste product which is expected to be effective in contact with a dry or pasty waste.

In the second case, it will be necessary to plan on additional equipment:

pumps for transferring liquid or pasty waste,
loading apparatus for transferring solid waste or bags of debris (hydraulic lift, etc.).

2. EQUATING THE MEANS OF TRANSPORTATION FROM THE SITES AND TO THE DISTANCE TO BE COVERED

These two parameters will affect the performance and the cost of transportation operations ; on beaches, it will be preferable to have equipment adapted for an unstable terrain such as agricultural equipment or heavy machinery with low pressure tyres.

If there are any long distance routes to be travelled, and in terms of the economic considerations, the transportation means should be rapid and have a large carrying capacity, such as : sewage trucks, tank trucks, dump trucks. Any long distances (more than 50 - 100 km) should be covered by rail road transportation or by maritime or river transport (if appropriate facilities are available).

Nevertheless, vessels should be used with caution. Ships must be adapted to the required job: especially, solid or pasty waste may release liquids which are dangerous for the equilibrium of a vessel not designed for this type of transport. Also, it will be necessary to take into consideration the unloading possibilities: depth of tanks, available handling means, etc.

A few recommendations can be given for success in the phase of transportation operations:

- Settling the recovered waste is vital before transport in order to increase the amount of actual oil that can be carried.

- In the event of inverse emulsions, demulsifiers should be used during the pumping operations to lower the viscosity and break-down the emulsion, thereby improving the performance of the entire chain of action.

- Storing the waste within the transportation vehicles themselves is not recommended in the event of a massive spill since it will prove costly to immobilize the transport means, and because the evolution of the stored waste may cause additional handling difficulties. It is preferable to place the waste in intermediate storage areas. However, in certain cases (small scale pollution of a port) direct storage of the pumped oil may simplify operations and avoid the need for an intermediate storage.

- Preference should be given to transportation carriers which are easily cleaned : for example, it is wise to use tank trucks which can be wide opened (sewage trucks). Also, tanks equipped with a heating system will assist in the unloading phase of the operation.

- All precautions should be taken to avoid a second spill inland. For this reason, it is advisable to transport liquid waste in closed tanks, and to make dump trucks leakproof by means of a plastic sheet installed in the dump bin's interior. In addition, if the organization of a cleaning site permits, it is better to have long-distance transportation carriers different from those working on the site. Installing an intermediate storage area will fill the gap between the two modes of transport.

3. RECOMMENDATIONS FOR TRANSPORT ON BEACHES

Channel and reduce the traffic to a minimum in order to avoid damaging the dunes. To avoid the trucks becoming bogged down in the sand, use metal plates such as are employed by the military (take off PSP type plates). If possible, use low pressure tyres on the sand (to avoid getting bogged down). In general, channel the traffic and regulate the circulation in order not to plug or damage the road-ways leading to and from the site.

STORING WASTE

1. INTERMEDIATE STORAGE

The reasons for having an intermediate storage are :

a) to play the role of buffer in the waste removal/storage/treatment chain of actions ; in other words, reduce the repercussions related to the supply of waste coming from the recovery site and the supply of waste able to be further transported, which will enable each link in the chain to work at its maximum speed without slowing down or speeding up the other parts of the system.

b) to allow for a first settling period for the recovered substances. An intermediate storage will also improve the performances for the transportation and treatment aspects of the operation :

- By allowing the waste to be pre-selected in terms of its consistency (liquids, solids, pasty or dry).
- By relating the storage operations to tefirst steps in a waste treatment operation by :
  - "sifting" the liquid or pasty wastes using filter baskets which are placed over the storage tanks as they are filled. This first stage of filtering will reduce the problems of pump clogging when the wastes are transported a second time.
  - treating wastes containing inverse emulsions which viscosity will otherwise make pumping very difficult and will not permit a rapid settling of the solid phases from the liquid phases. Nevertheless, it is preferable to treat the wastes with demulsifiers at the time they are fist pumped if at all possible.

Systematic inventories of the storage tank contents (viscosity, percentage of water and oil, etc.) will enable an evaluation of the effectiveness of the recovery operations, and allow an improvement in the methods used if the performance is judged ineffective.

2. STORAGE AS A TRANSPORTATION BUFFER

When the removal (evacuation) operations call upon large scale means of transportation such as the railroad or maritime vessels, it is sometimes necessary to create storage areas at the loading zones. This may be considered as an intermediate storage due to its length of time, and to the role played by the storage areas, or may be considered as a temporary storage due to its location and capacity.

3. TEMPORARY STORAGE

Wastes are usually stored before being treated and eliminated in treatment plants, and in this case, the storage is considered as being temporary. This type of storage enables a non-stop supply of waste to the treatment plants. Such temporary storage areas should be built carefully if the waste is likely to remain there a quite a long time.

If the treatment of pasty waste is to take place directly on the coast, the temporary and intermediate storage centers may be one and the same. In this case, the capacities of the storage installations should be the size necessary for a temporary storage rather than that intended for an intermediate storage.

4. PERMANENT STORAGE

This is the ultimate storage center for waste, where it can be eventually returned to the environment. Permanent storage will only be possible for solid wastes which present no dangers of potential pollution for surface or subterranean waters, and absolutely no hazards, even in the long run, for neighbouring populations.

This type of storage can be used either after treatment, or with no treatment, depending on the site and the type of waste to be stored. In the case when no treatment has been done before storage, this final dumping place may be considered as a type of treatment in itself. It will be necessary to undertake complete on-site studies for each possible case, in order to know exactly how each of the final storage areas should be built, and what types of precautions need to be taken to avoid possible environmental contamination.

It is advisable to limit the number of permanent storage areas in order to better manage and survey the ones which exist.

CHOICE OF SITES AND DESIGN OF STORAGE AREAS

The storage areas should be designed in a way which reconciles the operational needs and the environmental constraints, which are often contradictory. The functional, operational needs consist of :

- rapid availability of storage sites which are as close as possible to the collection site or the treatment site, in order to reduce the circulation of the collection or transportation equipment ;

- pits built to correspond to the size of the transportation means coming to and leaving from the storage sites.

The environmental factors must consider first of all potential pollution risks to the underground water and the hazards or disagreeable aspects of the storage site for any populations living close to the area.

These constraints will be more or less important in terms of whether the storage area is an intermediate site at the back of a beach, a temporary storage area inland, or a permanent dumping site. The solutions will be distinctly different according to whether the wastes to be stored are liquid, pasty, or solid, and to whether they are in bulk form or in packages.

1. INTERMEDIATE STORAGE

1.1. Choice of the storage site

The length of time a substance is to be stored in an intermediate storage area is limited to the first stage of the beach cleaning activities (pumping or collection) which means just a few weeks : due to the relatively short storage period, the underground water will not be seriously threatened by any risk of pollution.

Also, the operational necessity of having sites which are as close to the cleaning sites as possible will result in building the intermediate storage areas in coastal regions which are not usually areas of potable water exploitation (brackish water).

In general, the intermediate sites are installed in the coastal region found between the high-tide line and the coastal residential areas, along side a road leading to the cleaning site which is accessible for large trucks : if necessary, a quick-built, temporary roadstead could be constructed by means of gravel, or PSP plates, for example.

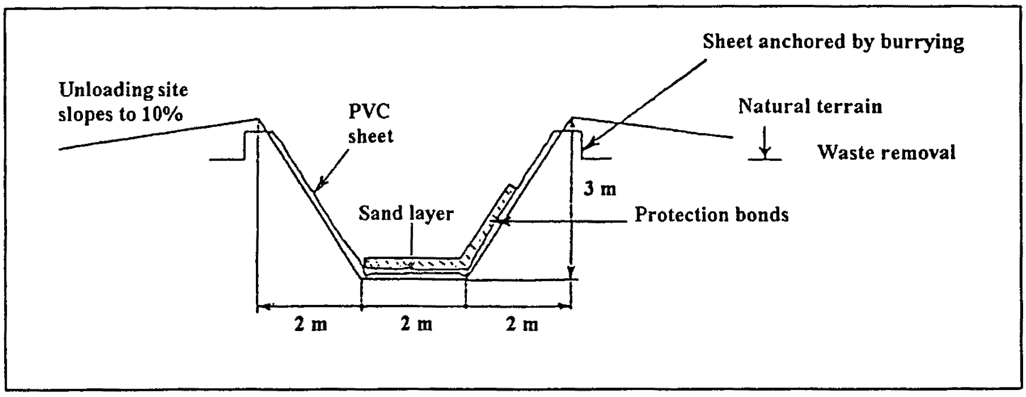
1.2. Design

- Pits for storing liquid or pasty waste

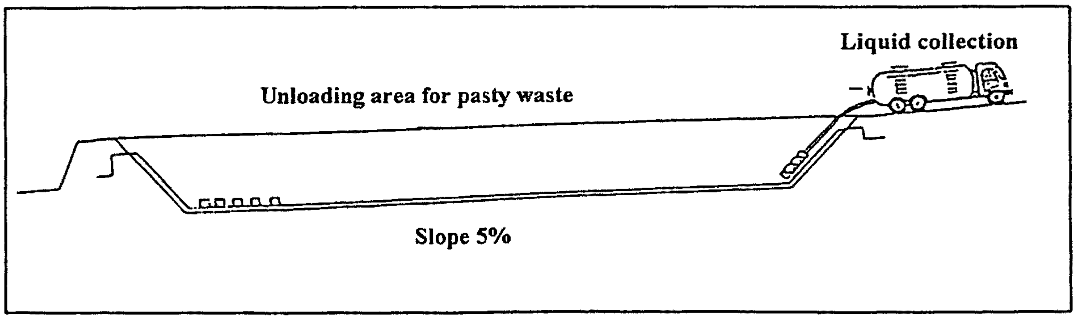
In unstable terrain, the most rapid and economic solution for storing liquids or pasty waste consists in digging pits, which may also have raised borders. The pits capacity will depend on the means used to collect the oil on the site : in general, it will be necessary to plan on 100 to 300 m^3 for each collection site, and to remember that it may be impossible to further remove the waste before the transportation/evacuation chain is in place for moving the wastes to a treatment site.

To enable an easy handling of the waste, using commonly available public works equipment, it is advisable to limit the depth of the pits to 3 meters, and their width to 4 or 5 meters.

A typical design of one of these intermediate storage pits is presented in the figure below :



a) Transversal cross section



b) Longitudinal cross section

Figure 1 : Design of a storage pit for liquid or pasty waste

In general, the high viscosity of the recovered waste will preclude the need for making these intermediate pits leakproof : nevertheless, it is often preferable to line the pits with a plastic sheet in order to reduce the amount of earth to be treated at the conclusion of the intermediate storage site's usefulness when it has been permanently emptied, and to provide a better stability for the walls of the trench.

- Liquid waste storage in tanks or pools

When it is impossible to dig pits or to build dikes on the coast in order to store black tide wastes (such as near quays, parking lots, in urban areas, in protected areas, or in the case of an oil spill on an inland water body, for example), it will be necessary to provide autonomous storage capacities which can be brought to the site.

The number of tanks or basins necessary in the event of a massive black tide in a given area of the French coastline, and the areas otherwise reserved for digging storage pits are generally designated on the Departmental POLMAR Contingency Plans.

The current availability of rigid basins in the private sector is believed to be sufficient for departmental needs in the event of a massive accident.

In addition, we can also use inflatable pools, or non-rigid plastic pools with a tubular superstructure, in order to hold the liquid wastes pumped from the water surface. Setting up this type of equipment available from the Technical Services in the Lighthouse/Buoys Department of Public Works should be done in order to improve the performance of the skimmers used in a recovery site, and have a skimming/pumping chain which is the most effective possible, and more quickly able to be operational.

- Storing solid waste

In coastal areas, dry solid waste can be piled up, usually without taking any special precautions, on a inclined platform which will allow any liquids trapped in the waste to drain off.

In terms of intermediate storage, this design can be simplified : since the platforms are installed at the rear of a polluted beach, it will not be necessary to use plastic sheets to make the system leakproof.

If the fleet of dump trucks is sufficient, the intermediate storage site can be eliminated, except for polluted seaweed which is better left to age at the rear of the beach, so it can release a maximum amount of its water content.

The stored waste should be deposited :

- in piles 2 to 3 meters high, and at least 5 - 6 meters in diameter,
- on surfaces which can withstand the traffic of the heavy transportation vehicles intended to remove the waste to the treatment centers (eventually, PSP plates can be used to solidify the ground).

The platform can be made leakproof if necessary by means of a plastic sheet which is attached to the base of the construction, or by treating the ground cover of the platform with a cementing agent such as quick lime in order to obtain a relatively waterproof area.

- Particular case of plastic bag storage

When the coast to be cleaned is not accessible for mechanical means, the waste must be transferred to an accessible area by means of bags. The packaged waste must be then removed, stored, and treated in a manner which differs from bulk waste. Confusion between the two methods of removing the waste will result in confusion in the methods used to treat the polluted material : the bags must be torn open before any treatment takes place.

In terms of intermediate storage, a comparable set-up to that used for solid waste should be designed, but it must be made leakproof since some of the bags containing waste will inevitably be torn, and the contents will spill out. A plastic sheet spread over the platform will avoid any risk of seepage should a bag (which could contain pure oil or a sand which is practically oil free) be split open and allowed to leak out its contents.

The storage space necessary will be an average of 20 m^2 per collection day and per kilometre of beach, and the platform should be equipped with a border dike 50 to 70 cm high in order to avoid any risks of oil drainage.

1.3. Equipping the storage areas

One of the advantages of an intermediate storage could be to improve the entire chain of subsequent removal and waste treatment if the wastes are able to be separated according to their type and their liquid contents.

It is also very important to separate the vehicles working on the beach from those expected to further transport the polluted waste in order to avoid any further pollution on land at some distance from the shore.

2. TEMPORARY AND PERMANENT STORAGE AREAS

At the present time, the coastal departments in France have an inventory of the storage sites first developed in 1980 under the guidance of the Ministry of the Environment : the up-to-date capability of the sites listed in this document will require a further investigation by the authorities of the departments involved, especially in terms of the work needed on the sites themselves. According to the local policies of land-acquisition of each community, it may be necessary to reserve the land chosen in the zoning documents or to revise the inventories in order to reconsider the use for the listed areas.

2.1. Temporary storage

- Choice of sites

  Temporary storage for waste awaiting treatment can last as long as one year.

  Liquid waste, which is oil-rich, can be directly carried to the deballasting stations where the oil can be recycled : these deballasting stations are usually able to store the waste before it is treated.

  Solid waste, both pasty and dry, should be stored close to the treatment plant, if it exists, or should be stored close to or on the site itself of the final permanent storage area if the treatment site needs to be constructed.

  In order to avoid useless transportation, it is desirable that the sites chosen be less than 50 km from the collection/recovery sites they are to serve, which means there will be a minimum of 2 - 3 sites in the event of a massive oil spill.

  Considering the length of time involved in the temporary storage phase, the sites chosen should guarantee that the underground water table will not be contaminated by any liquid oil contained in the waste : if the sites do not provide this type of security, the chosen sites will require a minimum of installation at the time of emergency. No matter which sites are pre-chosen, any work done before they are needed should be fairly superficial since if the sites are well prepared too far in advance of their being needed, they will quickly become uncontrolled dumping areas and be useless when needed for polluted waste storage.

- Design

  The temporary storage should be designed as a unit able to handle up to 3,000 tons of waste per day and a total of about 50,000 tons for the entire treatment operation. The time available for preparing the storage areas is limited since pits able to hold up to 5,000 m3 must be built in just a few days.

  The pits, reserved for storing solids with a high oil content (pasty waste), should adhere to the dimensions imposed by the handling equipment available on site for moving the waste into the treatment center. In terms of current possibilities, it is best to limit the depth of the pits to 4-5 meters and their width to 10 or 12 meters.

For solid waste with a lower oil content ("dry" waste), slightly inclined leakproof platforms-equipped with a drainage catch basin for the drained off liquids are preferable to storing the waste in pits where rain water could increase their liquid content, which will complicate the final treatment of the waste, and which will increase the risk of underground water pollution, should the rainwater seep into the ground.

2.2. Permanent Storage

- Choice of sites

Permanent storage areas are used for dumping dry waste containing very little oil, as well as waste previously treated with quick lime : this material is physically stable, and can be used as land fill. The best types of permanent storage sites are those which can be re-used for other purposes afterwards, where depressions are filled in the local topography. Thus, topographic dips or depressions are the best choice of areas for the land fill.

In terms of what is available in a given area, the treated waste can be used for land fill in constructed areas (parking lots, pleasure parks, roads or highways). In the event of an oil spill, it will be advisable to look around for a construction site which could eventually handle the treated waste land-fill which is to be eliminated.

- Design

The amount of treated material to be stored (a total of 150,000 m3, for example, in the framework of the POLMAR contingency plan for the AMOCO CADIZ accident), will result in significant topographic changes, which can have an effect on the surrounding environment : total restoration of a site should be taken into consideration from the moment of its design since this will influence the type and characteristics of the dumping area.

The plan and size of the storage area will also be affected by the type of waste treatment to be undertaken before the final dumping. A lime treatment can be done in a plant close to a temporary storage site in the case of waste which will be subsequently moved to another dumping area, or can be done directly on beds of oily waste when the waste is to be permanently stored in the same area.

To reduce any seepage into underground water, it is best to cover up the final dumping area with a sloped surface (to reduce the effect of rain water seeping into the waste) and cover the surface with a relatively impermeable substance and even further cover the entire site with agricultural soil for growing purposes.

CHOICE OF TREATMENT TECHNIQUES

Eliminating waste is the final phase in the entire pollution clean-up operation. The goal of treatment is to render the waste compatible with a return to the environment without any subsequent danger of pollution or other disagreeable aspects, or even to re-cycle the waste.

The techniques usually employed for the elimination of domestic garbage, or industrial waste, can be used as guides for the process of oil pollution waste disposal, however any wastes recovered following an oil spill are often quite different from industrial waste, and may be of varied quality in terms of the time and place of their recovery. Considerations of a waste's consistency, its oil content, and the type of oil contained in the waste, will lead to different types of treatment. A careful pre-selection of the waste from the moment it is recovered will improve the final elimination process. We can distinguish between the liquid, pasty or dry wastes. The criteria for choosing a specific treatment technique will depend on :

- its performance : the elimination rate is the first and foremost consideration because this will influence the size necessary for the temporary storage site,

- investment and functioning costs,

- a technique's ability to treat variable qualities of waste: procedures used for "pumpable" waste are not well adapted to the presence of any dry waste,

- constraints concerning the waste's eventual return to the environment : in certain cases, slightly oiled waste may be disposed of without any previous treatment, if the dump area is well managed,

- possibilities of setting up treatment sites close to the polluted areas : this will reduce the high cost of waste transportation, so any techniques which could be used in these areas should be carefully considered.

The following paragraphs will expose several techniques for eliminating oil waste which were used during previous oil spills as well as certain techniques which have been studied or tested experimentally. A table at the conclusion of this chapter will summarize the conclusions and the characteristics of all the techniques.

SEPARATION OF LIQUID WASTES

Liquid waste contains enough oil to justify its treatment by separation, and the removed oil can be recovered and eventually recycled. The separation will take place in deballasting stations by a static, settling process at temperatures close to 90°C. The settling process may be helped along by means of demulsifiers.
In some cases, refineries can handle liquid wastes, but the specifications concerning any solid debris trapped in the waste are much stricter.

Separation in a centrifuge (hydro-extraction) requires continuity in the quality of waste to be treated, and has a very low performance rate (less than 10 t/h). Any solid debris must be small and be found in only small amounts. The use of centrifugal force to treat/separate liquid waste is unsuitable for treatment on a large scale.

INCINERATION

The three main drawbacks of incineration are :

- its cost (if done in a permanent installation),
- the waste is not often well-adapted to this method since it has a low oil content, or a high water content, which will require the massive use of additional fuel,
- the low speed of the treatment.

Incineration can take place at the recovery/collection site, or in specialized treatment centers.

1. ON-SITE INCINERATION

Using small-sized, mobile incinerators on the recovery site is one method for eliminating plant or plastic waste. It is a possible method if the site is isolated (islands, for example). In this case, the cost of the incineration technique needs to be weighed against the high transportation cost of otherwise removing the debris.

2. INCINERATION IN TREATMENT CENTERS

The cost of incineration, no matter how it is accomplished, is high. In the case of a small-scale spill, injecting the polluted waste into a local incinerator (such as is used for domestic garbage) may avoid the high cost of transporting the collected waste to a deballasting center.

Therefore, the solution of incineration should always be considered as a means of eliminating oil spill waste, and should be weighed against the other possibilities for each case.

STABILIZATION OF PASTY AND DRY WASTE USING PHYSICO-CHEMICAL PROCESSES

The procedures involved in this method do not intend to eliminate the oil, but are intended to "trap" the waste in a mineral structure which, after compacting, will prevent oil seepage towards the underground water table and improve the mechanical characteristics of the treated material.

If this method is used on organic or ligneous material, the results are not satisfactory. In this case, it will be necessary to mix the waste within a sedimentary matrix before other stabilizing chemicals are applied. This is especially true for recovered, powdered sorbents which must first be mixed with large-grained sand before any treatment is undertaken.

1. CHOICE OF REACTIVE AGENTS

The following reagents can be used.

1.1. Hydraulic binding agents (cement)

The resulting material is a pseudo-mineral, which can be found in a solid block form or can be powdered. Wastes treated in this manner are nearly undissolvable and are very physically, chemically, and mechanically stable. The disadvantage of this treatment is the time lapse before the oil-waste/binding agent is hardened, and this will increase the time necessary before the treated material can be used for land-fill.

1.2. Quick lime

Treatment with quick lime is inspired by treatments used for stabilizing silt. The ways and means used are identical in both cases. Lime will not cause a hydraulic binding, however, it will give the treated waste a water-repellent characteristic. In the most usual cases, sandy waste with a 5% oil content is treated with a 10 % (weight percent) amount of lime. It is not advised to over-dose the lime treatment since this will make the treated product less mechanically stable, and may result in an increased permeability. Using an agent to slow-down the hardening will not improve the treatment results.

1.3. Quick Lime and dry, airborne flue dust

Filtering the smoke coming from coal-fired electric power plants recovers a fine-grained ash which will form a cement in the presence of water. Associating quick lime + dry, coal smoke ash will add the water-repellent and drying capacities of the quick lime to the cementing possibilities of the dust.

The amount of reagent necessary is the same as what is necessary for a simple quick lime treatment, and we can add the coal smoke ash up to amounts not exceeding the amount of lime (lime/coal ash = 1). When used on waste with a 10 % oil content, this technique gives satisfactory results whereas a treatment with only quick lime used alone would be more expensive and more difficult to achieve. Adding the coal smoke ash will require a longer time lapse before the material can be compacted, due to the increased hardening time, however this fact will be offset by the reduced treatment cost.

2. TREATMENT METHODS

Waste treatment by stabilization can be done in three ways.

2.1. Intermediate storage pits

Since the reagent is mixed with the waste by means of a steam shovel the mixing job is only a rough one.

There will be large concentrations of quick lime which will raise the temperature of certain areas (steam sprays) and cause the lime to be scattered about. For these reasons, it is not advisable to treat waste in this manner in urban areas.

This type of treatment should be considered as a pre-treatment method before transporting solid waste. For only slightly oiled waste, this method is not recommended (except for small scale spills). Should quick lime be used at the same time as the coal smoke dust, only the quick lime should be applied in the intermediate pits; the coal smoke ash will be applied in the final storage area.

2.2. In a treatment center

In this case, the reagent is mixed with the waste by means of a mixing drum. The installation will include :

- a sifting screen on the waste intake system,
- a bag opener (which can be avoided if all the waste is treated in bulk),
- a mixing drum (with waste and reagent supply systems),
- two reagent storage silos (or four in the case of the use of quick lime + coal smoke ash),
- removal conveyor system for dumping the treated waste in piles.

If the treatment involves both quick lime and the coal smoke ash, an intermediate storage buffer area for about 1 week will be necessary before the ash starts to react and harden the waste.

Using a treatment plant allows for more efficient treatments sites and facilitate the management of required reagent.

However, this technique requires that equipment be installed in a permanent plant or will use the facilities of a privately owned plant which will be installed on site, meaning a delay of several weeks before treatment operations can begin.

The amount of waste which can be treated in this manner is limited : the plant in Brest can handle 20 t/hour.

2.3. In beds

This method is often used in conjunction with road building. The basic tools include :

- a bulldozer
- a spreader
- a mixer (powder mixer)
- leveller (road grader)
- compactor (steam roller)

Treatment is done in 30 cm thick layers. The advantage of this technique is the fact that it can be used directly on the site of permanent storage and will therefore reduce waste handling operations. The rate of treatment can reach 700 t/day.

A disadvantage of this method is related to the meteorological conditions and to the reaction time of the binders. The time lapse may be a handicap if quick lime/coal smoke ash are used in order to obtain beds which are rapidly able to be compacted.

DUMPING (FINAL, PERMANENT STORAGE)

Only solid, slightly polluted waste can be dumped. Dumping may be considered as a treatment method if the site chosen is without danger for the environment, and if the contents of the dumping site are well managed.

The use of domestic garbage dumps may be a solution for slightly oiled waste collected during a small scale spill. It is advisable not to exceed a daily amount of polluted waste equal to 10% of the daily total of domestic garbage carried to the dump.

Managing an oil spill dump site is much the same as managing a dumping site for industrial waste. Until the waste is covered by a waterproof layer, systems for collecting or deviating rain water run-off should be set-up.

WASHING

In theory, washing polluted waste should be considered as the most logical method for treatment, but in reality, several practical difficulties exist.

In fact, although it is relatively easy to wash damp sand and to return a pollution free sediment to the coast, a mixture of dry sand and oil that has been left exposed to the sun for several days (such as the case of the back beach areas) is very difficult to clean. Any washing operations should be done with hot water and well adapted cleaning products. In addition, any equipment used should take into consideration the granulometry of the sand to be cleaned.

Washing is impossible for mud sediment.

Before the final washing, it may be possible to have a pre-wash in the intermediate storage pits in order to release the maximum amount of oil before any waste transportation takes place.

To accomplish the pre-wash operations, fire-hoses can be used but it will also be necessary to have a good sized storage area, and a settling system, in order to recover the released oil.

A final wash will require a plant equipped with :

- a sifting system (for large size macro-waste mixed in with the sand),
- an intake system (conveyor belt and elevator),
- mixing system for mixing the sand to be cleaned with the cleaning products (mixing drum),
- a separator for the solid and liquid phases(e;g : hydrocyclone),
- a water treatment zone (settling, floculation),
- optional material : heater for washing water.

The products used to facilitate waste washing are especially adapted mixtures of petroleum cuts and tensio-active agents which are compatible with the final treatment of the used wash water.

Initially designed for washing oiled sand, the washing plant will also enable pebbles and beach stones to be cleaned, as was seen during an experimental stone washing operation in the Bay of Audierne following the Amazzone accident in February, 1988. A prototype of the mobile sand/stone washing plant is currently located in the POLMAR stock in Brest.

In the event of an accident, existent sand washing plants can be adapted to the conditions at hand.

LANDFARMING

The procedure consists of enhancing the natural biodegradation of oil by spreading thin layers of waste on agricultural soil, and completing the operation by agricultural tilling methods and crop replantation on the terrain.

The biodegradation is accomplished by a bacterial flora adapted to oil. The technique can be improved if fertilizer is added to the soil.

This method is used by certain oil companies to eliminate their refinery sludge. It is not possible to adapt this process to a large scale spill.

The planting is sometimes hindered by the mixed types of waste involved in an accidental spill recovery, and by the presence of lumps or miscellaneous debris.

Landfarming remains, therefore, a solution which can only be considered for any polluted soil which has to be recovered, especially in the case when an oil spill occurs on otherwise arable soil.

CONCLUSION

To resolve the problem of eliminating recovered oily waste, a variety of techniques are possible.

The choice of a particular procedure will depend on the amount of polluted waste to be eliminated, the technical means existing in the area for certain processes, the eventual possibility that the waste could be disposed of through already existent local ways and means.

It is preferable to analyse the various parameters involved, and the potential choices available, before it becomes necessary to call them into action due to an oil spill accident.

TABLE SUMMARIZING THE VARIOUS TREATMENT PROCESSES

PROCESS	TREATABLE WASTE	PERFORMANCE EFFECTIVENESS	POSSIBILITY OF IN-SITU TREATMENT	RESIDUAL POLLUTION	POSSIBILITY OF RECYCLING	INCONVENIE - DURING - AFTER
Separation	Essentially liquid	Variable, depending on stability of emulsion 100 T/day	Primary separation only	• Water : discharge possible • Oil : can be recycled • Solids : to be treated later	• Oil : can be recycled • Solids : complementary treatment	• None • Water and so to be treated
Incineration	Liquid to dry	Low : a few tons per day	Yes, but operation difficult and low performance	None	Often reddish sand usable only as land fill	Smoke
Stabilization treatment	Pasty to dry	• On beds 1000 m^3/day • In treatment plants : Much lower performance (100 T/day)	Yes, directly in intermediate storage pits	No effect on oil content but oil trapped No risk of seepage after compacting	Landfill material	Scattering of li treatment in ex beds
Dumped with-out treatment	Dry, low oil content	• Continuous addition of materia		No degradation. Site to be chosen with care	No	Poor psycholo impact : smells Site requires f or constructior landscaping
Wash + lime treatment of residual sludge	Liquid to solid	Approx 100 T/day	Semi-mobile installation	Solid waste Complementary treatment of settled sludge	• Oil recycled • Sand returned to beach or for landfill • Treatment of sand bars.	Inconvenience storage and h
Land farming	liquid to solid	Acceptable only for small quantities of sand with low oil content or for the in-situ treatment of polluted farmland.				

NOTES

Thursday, 13 June

SYCOPOL: THE ERIKA CASUALTY EXPERIENCE FEED-BACK

NOTES

Friday, 14 June

SHORELINE CLEANUP TECHNIQUES: EFFECTIVENESS AND LIMITS
"HOW CLEAN IS CLEAN?"

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As was seen for pumping operations, the choice of the collection method to be used is made in function of the amount of oil to be recovered (either directly washed up on the shore, or found deposited as a secondary effect of operations previously carried out) and the morphology of the polluted site.

The amount of oil will correspond to the thickness of the deposits at a given point. There are three major types of oil deposits:

- massive deposit, thick and homogeneous layer over the sand's surface;
- ribbons, small patches, tar balls, tar cakes or other soiled material which is more or less scattered over the sand's surface;
- various polluted debris (seaweeds, shells, etc.).

The impacted area is:

- localized, if the spill has only affected a site with a relatively small, well-defined area such as a beach no more than a few kilometers long for example,
- generalized, if the spill has affected a larger sector (such as several different beaches with a total length exceeding a few tens of kilometers).

There are four types of situations:

- -small deposit covering a limited area
- -small deposit covering a large area
- -large deposit covering a large area
- -large deposit covering a limited area

The best type of response for each situation are summarized in the following table:

GEOGRAPHIC AREA COVERED	**QUANTITY OF POLLUTION**	
	SMALL AMOUNT	**LARGE AMOUNT**
LOCALIZED	Manual intervention	Manual or mechanical intervention
GENERALIZED	Manual or mechanical intervention	

The choice of a type of response is further affected by the concepts of accessibility, displacement and the dimensions of a given site.

In light of these possibilities, it will be necessary to respond to a cleanup with the techniques and the equipment best adapted to each situation, under the best possible conditions, in order to remove the greatest quantity of pollutant in the shortest possible time (notion of performance), and with the least amount of sand removed at the same time (notion of selectivity).

TYPE OF COLLECTION	PERFORMANCE	SELECTIVITY
Manual : bulk bagged	2m^3/person/day 1m^3/person/day	5 - 10 % 5 - 10 %
Mechanical (loader) Seattered oil concentrations Continuous layer with direct collect	100 m^3/loader/day 180 m3/loader/day	1 - 3 % 1 - 3 %
Specialized equipment	20 - 25 m^3/hour	10 - 30 %

Table comparing the performance of various collection techniques

The cost of manual collection is much higher than the cost of mechanical collection. Nevertheless, this fact must be weighed with the fact that the amount of waste recovered manually is lesser than what is collected mechanically (we may estimate the waste to be four or five times more when mechanically collected) and this will influence the cost at the next stage of the intervention operation (i.e. waste removal and treatment).

The choice of the method to be employed must always take into condideration the entire chain of waste treatment. For example, if the following criteria are met:

- beach not subject to erosion
- easy access
- waste disposal site sure and with sufficient dimensions, located close to polluted area
- availibility of public works equipment

it may be advisable to use public works equipment instead of more specialized pollution cleanup equipment, even if the amount of sand removed is significantly higher.

The following conditions

- small beach with fragile equilibrium
- no disposal site close to polluted area

may encourage us to use manual collection techniques to reduce the cost involved in damaging the geomorphology of the polluted beach.

ƆIL COLLECTION

MANUAL COLLECTION

The work is selective (the waste has a 5-10% oil content), but performance is poor (1-2 m^3/day/person).

This technique is best adapted to cases of small, localized pollution. For a small but generalized pollution, it is also possible to intervene using manual collection techniques, if there is enough personnel and time to do the job. In both cases, the collection should be preceded by a period where the pollutant is concentrated in order to increase the effectiveness of the collection operation.

For a large amount of pollution localized in a small area, the manual collection may again be the prefered technique since it is highly precise. We must also use this method when mechanical collection is impossible for sites that have :

- difficult access
- an unusual nature (rocks, pebbles, salt marshes etc) or reduced dimensions that make moving around difficult.

Concentrating a pollutant

The concentration of a pollutant disseminated over a given surface is accomplished using shovels or scrapers which are raked over the sandy surface. The scraper is, by far, the most effective tool to concentrate the oil patches.

If there are soiled debris (plants or other debris), the use of pitchforks is advisable. Floating wastes or debris should systematically be recovered since they can move away and cause more pollution in adjacent areas, and could hinder pumping operations. The collected waste is piled on the beach in strips or piles according to the collection methods which are to follow. If the oil is not too viscous, it can be concentrated in pits or trenches dug for this purpose and pumped later on.

Collection operations

The piles or rows of wastes are removed using shovels or pitchforks according to the type of material removed. When the beach is accessible to public works equipment, and when it is vital to finish the job quickly, collection can be done by loaders ; however, the amount of sand removed at the same time really increases.

Evacuation

If it is impossible to remove the collected waste by a mechanical mean, for problems of accessibility, manoeuvrability or site protection, it will be necessary to do it manually. The waste must be put in plastic bags or buckets which can then be carried by hand or on the back of the personnel. Precautions should be taken for transporting wastes to a storage area in order to avoid tearing the plastic bags, or creating a subsequent spill.

MECHANICAL COLLECTION

Agricultural equipment, public works machinery or especially designed equipment can be used.

- **Mechanical collection with public works equipment**

  This type of equipment will be used in the case of a generalized or localized large amount of pollution.

  The performance of the work accomplished is greater than in the case of manual collection (10 times greater), but there is reduced selectivity : 1 - 3% oil in the recovered material.

  A major disavantage in using this equipment is the damage caused by the repeated passage of the heavy machinery : more sand is polluted by the wheels and this leads to more waste removal, treatment, etc, in the entire chain of operations.

- **Collection with specifically designed equipment**

  An effort has been made to develop machinery which is highly effective in terms of selectivity and performance. Several types of beach cleaning machines have been perfected in order to deal with the variety of types of oil pollution which is likely to wash up on the shore.

Concentrating the pollutant

In the case of a large amount of pollution, or when there is a small amount of generalized pollution and a lack of man power for manual collection methods, we can use mechanical means to insure the preleminary phase of concentrating the pollutant before it is actually collected. The performance of the mechanical means is assured, but the selectivity is reduced.

The concentration phase involves raking the surface layer of the beach while trying to remove the least possible amount of sand. The machine best adapted is the grader. There is no need to say that if the beach has an uneven surface, it will be difficult to concentrate the pollutant as precisely as one would wish.

It is also possible to use an agricultural scraper or a loader whose dumper is equipped with a board or a rubber edge.

The concentration can be made in one or more rows along the beach. In order to double the row's width, two graders can work simultaneously in the same direction with their blades orientated with different angles.

Collection

This can be accomplished with:

Agricultural machinery

This type of equipement is used to collect the soiled wastes. The best device is the tractor with a fork-lift or a mesh bucket. It will reduce the amount of sand which is removed at the same time as the wastes. The set up is readily available (fork-lift for manure) and can be used under any conditions.

Specialized equipment

This equipment has been especially designed to clean up beaches covered with macro-wastes. Working on the principle of differences in granulometry (in raking or sifting), the machines can only collect very consistant oil wastes (very viscous, aged or agglomerated) such as : soiled debris, tar balls, tar cakes. These machines can be used without any previous concentration of the pollutant since they are highly selective. Nevertheless, they are less available than the public works equipment. Generally, this type of machinery is owned by coastal communities or unions of smaller towns, as well as by the public works departments in some regions.

Some of the specialized equipment can empty their receiving drums into a truck used for transporting the wastes to a storage or treatment area, while other machines will simply empty their drums onto the ground which will necessitate a second pick-up by a loader, with all the accompanying difficulties previously cited. It is preferable to continually load trailers with the collected material by means of a system of conveyor belts.

A belt system makes part of the ROLBA 150 D machine which is specifically adapted for collecting solid, aged oil or soiled debris. The performance of the set-up is about 4 to 5,000 m^2 per hour, or even more in some situations, since the sifted wastes can be removed continuously (at a speed of 50 m^3 per hour). A roller which will selectively remove fresh oil has been developed for work involved with fresh, recent oil washing up on the sand.

Evacuation

It can be accomplished by means of:

Loaders

The loaders can be put to work after a manual collection : the waste is loaded manually in the loaders, either in bulk form (shovelled) or packaged in bags (hand loading). Buckets can also be emptied that way. In the case of a mechanical collection, the loader could be both the collector and the means of removal from the site.

The loader can carry its contents towards an intermediate storage area if it is located close by, or transport the waste to a larger carrier if the distance to the storage area is important and if the type of collected waste will enable it to be carried in a dump truck.

Carriers which can be loaded directly (manually) or by means of conveyor belts or by means of loaders (see above).

They are agricultural trailors or platforms pulled by a tractor which can be loaded by shovels for bulk waste, by hand for packaged waste or garbage pails. If the zone is easily accessible, 6x4 dump trucks or tractor-trailer trucks could be loaded by means of the public works machinery.

N.B. : during the collection/recovery operations, it is necessary to keep the various types of waste separated : liquids, pasty waste, solid waste. In fact, each type of waste will require a different type of treatment in the chain of disposal.

The restoration operations are only undertaken when oil slicks or deposits are no longer washing up on the shore. The final phase of cleanup is intended to complete the job either by means of natural cleaning processes which take place at a given site, or by means of specific techniques. First stage, generalized oil collection and removal are usually not enough to give rise to a total restoration of a coastal area : the sand may have been oiled up to a certain depth, and the rocks and man-made structures along the shore were probably tarred in the area of the black tide. If, for some zones, the natural washing action of the waves may be sufficient to complete the clean-up work begun with the first stage of collection and removal, in sheltered areas it will be necessary to undertake additional cleaning activities, especially in zones having a touristic interest.

The techniques employed are intended to:

- use the natural action of the sea and encourage sediment mixing and draining;
- substitute cleaning methods for sea natural action in areas where sea energy is reduced.

In all cases, we will attempt to recover all the oil removed from where it was originally deposited.

1. SAND AND PEBBLE BEACHES CLEAN UP

This is the next step after the first phase of generalized oil collection and removal is completed.

IN TIDAL AREAS EXPOSED TO THE ACTION OF THE SEA

Two phenomena will function according to the tides:

- when the **tide is going out**, water percolating through the sediment will carry the oil along with it,
- when the **tide is coming in**, waves breaking on the sediment will simultaneously cause the sediment to be mixed and free trapped oil.

Thus, the following techniques are applicable for sand beaches.

Outgoing Tide

The percolation effect will carry down the oil-laden water which can then be confined and skimmed.

The technique consists in digging trenches along the open beach area using shovels or ploughs. These furrows, which are dugs, parallel to one another and at a 90° angle to the sea, will be filled with the percolating water which can then be channelled to an area where it will be pumped or skimmed.

At the end of the trenches, a cross-ditch (with its border higher on the sea side) will collect the water carried down in the smaller furrows and channel it to a collection pit where it can then be pumped.

Remarks

- If the drainage is difficult or slow, the beach soil should be broken up with a roto-tiller. The water will then be able to flow more freely, and the trapped oil will be somewhat released from the sediment.

- The trenches can be replaced by pits. The percolating water will fill the pits and the oil will be confined by the dirt placed on the seaward side of the hole, like a dam towards the sea.

- The oil can be recovered from the water's surface by means of pumping (a honey wagon is particularly adapted for the job). The vacuum tanks will need to be frequently emptied, since a great deal of water will be pumped up at the same time as the oil. The recovered waste is then allowed to settle in larger tanks with a capacity of several cubic meters, where the settled water can be easily removed from the bottom of the tanks. Using flat vacuum heads (carp-tail types) or floating sorbants will improve the pumping operation's selectivity.

Incoming Tide

The incoming water will push the oil into pits located just behind the tide line. Mixing will free some of the oil which may be trapped in the sand which has been removed to dig the trenches, etc. This newly freed oil will not be able to be collected : its dispersion in the marine environment will be favorized.

The techniques for an incoming tide can be used independently of the methods used for outgoing tides if there is only a small amount of water percolation in the sand. In this case, the pollutants are moved towards the breaker area.

The incoming tide technique is also well adapted to the cleaning of a shingle or pebbles beach. In fact, stony beaches are very porous and the spaces between the stones or pebbles are excellent traps for oil. It is necessary to mix up the rocks or shingle wherever the sea's energy can be put to work.

This work should be done as quickly as possible because when the oil ages, it changes the shingle and oil into a solid mass, and the coast will become extremely vulnerable to the subsequent breakers since the beach stones can no longer dissipate the sea's energy. Nevertheless, stones removal will also reduce the protection offered to the coast by this type of beach. For this reason it should be done with full awareness of the consequences. The stones should be removed only as long as necessary for cleaning, or before a black tide to avoid them being oiled, then they should be returned to the site as soon as possible.

These techniques require heavy, strong, mobile machinery : rubber tire wheeled dumpers or loaders.

IN AREAS OF LOW ENERGY

The natural mixing and draining can be induced artificially by means of water sprays aimed directly at the sand which is to be cleaned.

Under water

The water pressure of the spray is the major parameter. The freed oil is held in suspension in the water and can then be confined and skimmed from the surface. This technique is especially effective on sand beaches but is more difficult on muddy sediment when a large quantity of oil will remain adhered onto the fine particles which are themselves held in suspension.

Out of water

The oil is freed and carried by water sprays to where it can be contained and skimmed within a confining boom or in a sand dam collection pit built down slope from the treated area.

The water flow rate should be sufficient to enable a good down flow. The pressure can vary according to the sensitivity of a site. In salt marshes, it is recommended that pressure not exceed 2-3 bars.

This technique is used on sand and muddy sediment as well as on shingle beaches where the stones cannot be removed (due to a fragile equilibrium of the tidal area). The water spray down flow can be improved by digging furrows which follow along the site's main downslope line. These furrows can be made either manually (lack of availability of public works machinery) or by means of mechanized steam shovels or ditch-diggers.

The techniques which can be used in sheltered areas will present serious logistical problems since a great deal of equipment will be required : spray hoses, pumps and, if possible, skimmers, fresh water storage tanks, waste storage tanks, booms, etc.

IN TIDELESS SEAS

In the Mediterranean sea, where there are virtually no tides, it is impossible to use the sea's actions and to create drains to channel oil towards collection/recovery points. Thus, we can only use the techniques recommended for areas with a low level of energy.

This technique consists in releasing the trapped oil by means of a jet spray mixing under water. The freed pollutant will rise to the water's surface and be trapped by floating sorbants before being recovered.

The water spray pressure is again the major parameter to be considered for a given operation: if it is too weak the oil cannot be freed from where it is trapped in the sediment or between the beach stones. The flow rate also needs to be strong enough to carry the freed oil down to the sea surface. Right water pressure should be determined in function of the sensitivity of each site as well.

2. ROCKS, PEBBLES AND COASTAL STRUCTURES CLEAN-UP

WHEN AND WHY ROCKS AND COASTAL STRUCTURES SHOULD BE CLEANED

Operations for cleaning rocks and man-made walls are especially justified when:

- natural cleaning is insufficient (protected rocky areas,harbor quays and sea walls, etc.);
- when quick restoration is necessary (just before the summer season);
- in areas close to beaches to avoid chronic pollution;
- in all areas if the pollutant is a heavy product which is only slightly degradable.

The results of such cleaning operations are variable

Operations range from superficial wash, where the thin remaining oil film is left to be cleaned by natural processes, to a complete cleaning where the structure is totally cleaned. Often, superficial wash is necessary in order to avoid a hardening of thick layers of oil on the spot during the aging process. A time lapse of several months will be necessary before the natural cleaning processes are able to complete the job.

The methods employed for a complete cleaning are relatively harsh for the environment (hot water, high pressure sprays, cleaning agents...) thus it is wise to assess the need for such a treatment along with the consequences.

Fine cleaning of the structures can be undertaken when there is no more threat of massive re-oiling.

When aging oil becomes hard and methods which are increasingly harsh for the environment will be necessary to obtain a good cleaning performance. So, a rapid wash should be given in the early days of a pollution to avoid that thick layers of oil accumulate and harden, especially in the fissures between rocks.

WASHING TECHNIQUES

We should distinguish between the operations related to washing the oiled surfaces and operations related to collecting the oil which has been washed off.

Mechanical washing

The choice of washing methods will be made in terms of the desired objectives or, in other words, in terms of the desired amount of cleaning to be obtained regarding to the condition of the oil which is attached to the surface to be cleaned.

Rough washing

For newly deposited oil, a superfical washing can be accomplished by means of low pressure water sprays (with a pressure between 3 to 10 bars).

The equipment used should be robust (such as traditional firefighting equipment), lightweight and simple to use, in order to enable quick interventions in areas requiring for the equipment to be frequently moved around.

This type of equipment should be able to work with sea water if several precautions are taken during its use; however, experience has shown that the use of sea water can be problematic in some areas because pumping up, for washing the rock faces or man made structures, is difficult during low tide.

The partial washing technique will allow to release a major portion of the oil trapped in the crevices and hollows of rocky areas.

Disadvantages of the technique

- ineffective on highly adherant oil,
- after washing, a thin film of oil still remains.

Advantages of the technique

- cold water and low pressure sprays will considerably reduce the negative effects of the cleaning on flora and fauna. Safe for the personnel.
- equipment easily available.

Fine washing

a) Cold water, high pressure sprays

The pressure needed varies between 60 to 250 bars.

The pumps to be used can generally work with sea water (same remark as above concerning the use of fresh water). The most commonly available equipment is the water flush sewage cleaning truck.

Disadvantages of the technique

- the pressure is not always sufficient to enable fine cleaning
- ineffective on weathered oil
- the pressure will cause oil splashing all around the clean-up area (use flat sprays rather than hose sprays)
- the equipment is expensive

Advantages of the technique

- affords superficial washing
- the equipment is readily available

b) Cold water, very high pressure sprays

The equipment can work under a pressure as high as 1000 bars. The best pressure is 400 bars.

Disadvantages of the technique

- high pressure sprays are dangerous for the personnel. Therefore, only specialists will be involved in the operations.
- the pressure of the spray may break up the mortar between the stones in a masonry wall (remark: on older quays this problem may arise even when using lower water pressure sprays);
- the equipment is expensive and relatively scarce.

Advantages of the technique

- effective on aged oil deposits
- affords removing weathered oil to be removed and the surface to be completely cleaned

c) Washing with hot water or steam sprays

The temperature varies between 95°C and 140°C, and the pressure varies between 20 to 150 bars. Above 100°C, washing will be done by means of steam so a maximum pressure cannot be obtained. Setting the temperature at 95°C along with the maximum pressure is generally the most effective way of using the equipment.

The equipment requires a maintenance/repair team on site (3 people required to put a machine to work, and 1 full time maintenance person for every 10 machines). All these pumps are not autonomous and will need a source of energy (electric generator). For a wide scale massive oil spill, it is preferable to concentrate the machines on a few sites rather than to have them scattered over a large area. In this manner we can achieve a rapid cleaning of each site, and also a better maintenance of the machines. This technique is effective on moderately aged oil. The performance of this technique can be improved if cleaning agents are employed, and cleaning agents become indispensable if the oil is more than 2 months old.

Disadvantages of the technique

- usually the machines are designed to work with fresh water ; drinking water is preferable in order to avoid mineral deposits since the equipment is fragile, and intended for industrial use rather than for use in the field ; occasionally, the machinery can be used with sea water, on islands which do not have a source of fresh water, however it will be necessary to periodically rinse the machines with fresh water during their operation

- the use of hot water and steam will require a training for the operative personnel, and a minimum of protective clothing (gloves, slicker jacket and trousers, protective glasses)
- the totally destructive effect of the spray on flora and fauna in the area where the sprays come into direct contact decreases dramatically
- cleaning agents are necessary on oil that has weathered for more than 2 months

Advantages of the technique

- hot water washing is the most effective for cleaning off aged oil;
- the adequate devices are readily available on the market.

Recovering the removed oil

Recovering and treating the removed oil goes hand in hand with the cleaning operations. There are several techniques for recovering the removed oil depending on where it has been allowed to go once removed from the surface where it was first deposited.

<u>On sand</u>

In sediment which is not saturated with water, the wash water run off will infiltrate the sand at the foot of the rocks. The oil will then separate from the wash water, and most of it will be deposited in the sand's surface layer. We must then content ourselves by removing this layer (either manually or mechanically).

Disadvantages

Some of the oil is removed, however the rest will infiltrate the sand or run down the beach to the sea, therefore, this method is to be avoided on large grained sand beaches.

<u>On water in trenches</u>

When the sediment is saturated with water, and if the terrain will permit, oil recovery trenches should be dug to a depth of about 40 cm. Mechanized machinery is highly recommended to dig the trenches which should be placed as close as possible to the washed area (in order to avoid the oil's infiltrating the sand). The water/removed oil mixture is trapped in the trenches which also serve as settling gutters. The floating oil is then pumped or skimmed, or other wise removed, even by means of sorbants.

Disadvantages

if the wash water flow off rate is high, the trenches will fill up very quickly, and will rapidly overflow (plan for a pumping or gravity recovery system to remove the settled water)

- the percentage of oil collected in the trenches is small and its removal is difficult : by means of pumping, a great deal of water is collected as well, and if recovery is to be accomplished by means of shoveling, the oil will be only partially removed

- if the washing pressure is high, the oil is splattered all over (especially if the surface to be cleaned is not flat) and will be likely to be splashed outside the trenches

On water by skimming (or pumping) within floating booms

If surfaces to be washed are partially submerged, or close to the sea at low tide, we can allow the water/oil mixture to run into the sea into an area enclosed by a lightweight, floating boom. The oil trapped by the boom can then be removed by a skimmer.

Remark : In the Mediterranean where tides are small, oil can be collected by pumping from behind a boom placed around the area to be cleaned in order to isolate the cleaning site and prevent oil escapes.

Use of cleaning products or sorbents

Their use allows to:

- facilitate the freeing or unsticking of oil
- facilitate the oil's dispersion in the environment if it is impossible to recover
- facilitate a subsequent recovery of the oil freed by the washing operations.

Cleaning products

Using cleaning agents is necessary after the oil has aged about 1 month after it was deposited on the rock faces.

The products which are most effective are those containing petroleum cuts : among the most effective agents, there are some products whose toxicity is so low that they can be used along the shore.

The best method for employing these cleaning agents consists in spraying them onto the surface to be cleaned about 15 to 30 minutes before the washing operations, in a dose of about 1 volume cleaning agent for 3 volumes of oil. An increased contact time will favorize the cleaning formula's action, but should not exceed 2 to 3 hours since the agent's solvant will then evaporate.

Certain products have a tendency to emulsify the removed oil and are therefore considered to be likely to increase the oil's dispersion. In reality, this dispersion is only partial and temporary. The use of such cleaning agents should be reserved for exceptional cases where it is impossible to otherwise recover the removed oil.

Floating sorbents

These substances have no effect on the speed with which oil is removed from rocks.

Used on a cleaning site, they are intended to absorb or trap the removed oil floating on water. This step will help in the oil's collection, since it will increase the selectivity of the subsequent collection operations, more so than if a thin oil slick would be pumped from the water's surface. Once the washing operations are finished, the best method of using the sorbants is to spread them over the surface of the floating oil, either in the trenches, or within the confining booms in the water body.

Recovery can be accomplished either using specialized shovels with holes which are easily made on the spot, or with nets or skimmers.

The mixture oil/sorbant that cannot be recovered, but which is also never very extensive, is dispersed along the water edge and will not reoil rocks. Eventually, it will mix with sand and will be brushed and mixed within the water column with tide mouvements.

CONCLUSION

Less spectacular than the general, first step recovery due to the small amounts of oil which are removed, the final cleaning of polluted surfaces is, nevertheless, an operation which is expensive and time consuming. A choice of sites to be restored is indispensable, while keeping in mind that the amount of cleaning perfection to be attained will be a function of the economic, esthetic, or biological value given to a particular site.

NOTES

HAZARDOUS AND NOXIOUS SUBSTANCES: BEHAVIOUR AND RISKS

RESPONSE TO CHEMICAL SPILLS

CASE HISTORY: THE IEVOLI SUN CASUALTY

THE BEHAVIOUR OF ACCIDENTAL CHEMICAL POLLUTION AND OPTIONS OF COMBAT

Michel MARCHAND

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Part 1 : **Short term behaviour of chemical substances accidentally spilled at sea**

Part 2 : **Responses to chemical spills**

Part 1

SHORT TERM BEHAVIOUR OF CHEMICAL SUBSTANCES ACCIDENTALLY SPILLED AT SEA

1. INTRODUCTION

Dangerous chemical substances are defined as such because of their inherent properties which are harmful to human health, property and the environment. They differ from hydrocarbons, as stated in the International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL Convention 73/78).

Compared to oil spills, the spills of dangerous chemical substances are less frequent and quantities spilled in the marine environment are often lower (tons to hundreds of tons). On the other hand, the risks involved are much more varied, according to the diversity of the products transported.

Of the 60 000 chemical substances commonly used, approximately 2 000 are mainly transported by road, rail and sea. The results of world-wide studies, carried out over a period of twenty years, concerning dangerous chemical substances spilled at sea have shown :

- most accidents concern two types of products : flammable liquid substances and corrosive substances;
- one or two major accidents can be predicted each year;
- there are as many accidents in « bulk » as in « package goods » shipments.

Date	Ship	HNS	Quantities	Type of accident
1917	Mont-Blanc	Explosives	2 600 tons	Explosion
1944	Fort Stickene	Explosives	1 400 tons	Fire and explosion
1974	Cavtat	Tetraethyl Lead	150 tons 120 tons	Collision and sinking
1976	René 16	Ammoniac	180 tons	Hose rupture
1979	Sinbad	Chlorine	50 barrels	Loss at sea due to bad weather
1984	Brigitta Montanari	Vinyl chloride	1 300 tons	Sinking
1987	Cason	Diverse packed products	1 800 tons	Fire and grounding
1988	Anna Broëre	Acrylonitril Dodecylbenzene	547 tons 500 tons	Collision and sinking
1991	Alessandro Primo	Acrylonitrile Dichloroethane	550 tons 500 tons	Sinking
1992	Pugliola	Methyl Alcohol	6 300 tons	Fire
1994	Tus	Caustic soda	4 200 tons	Sinking
1995	Chung Mu	Styrene	310 tons	Collision

Table 1 **: List of a number of accidents caused by ships transporting dangerous substances**

The consequences of chemical pollution depend on the nature of the spill, local conditions and the properties of the pollutant. To protect human life, to choose the most appropriate methods of response action, to evaluate the impact of such pollution on the environment, it is important to evaluate both the immediate reactivity of the spilled substances and their behaviour in the aquatic environment. It is, therefore, necessary to be aware of the physical, chemical and toxicological properties of chemical substances. Many books, dictionaries, monographs, and data banks are available on the subject.

Because of the great diversity of chemical substances, many different systems of classification have been developed. Systems useful in the particular domains in which we are concerned are:

- classification by transport
- classification by physical hazard
- classification as marine pollutant
- classification by reactivity
- classification by short term behaviour

The lecture is centred around the reactivity and the short term behaviour of chemical substances involved in accidental spills, but other methods of classification will first be examined.

2. CLASSIFICATION BY TRANSPORT

There are several regulations concerning the transport of dangerous substances. The MARPOL Convention of 73/78 (MARPOL, 1991) has established several types of regulations for the prevention of pollution by ships carrying:

- oil (annex I)
- noxious liquid substances (annex II)
- dangerous substances transported in packs (annex III)
- waste water (annex IV)
- waste products (annex V)

In the same way, there are also many codes which provide recommendations but which do not have any legal status. The main codes concerning the shipping of dangerous substances are as follows :

- IBC-Code (International Bulk Chemical Code), a code used for the construction and the equipment of ships transporting dangerous substances in bulk.
- IGC-Code (International Gas Carried Code), a code used for the construction and equipment of ships transporting liquefied gas in bulk.

- IMDG-Code (International Maritime Dangerous Goods Code), a code used for the transportation of packed substances. The main aim of the IMDG code is the safety of the ships and the crew on board and not the protection of the marine environment.

3. CLASSIFICATION BY PHYSICAL HAZARD

The system of classification given in detail in the International Convention for Safety at Sea (SOLAS 1974) and which can be found in the IMDG Code, has the aim of insuring safety during the transport and the handling of transported substances. This classification system places chemical products in 9 levels of risk with sub-classifications *(table 2)*. This allows for an initial analysis of the situation in cases of dangerous substance spills. The risks defined by the classification system are as follows:

- combustibility
- explosion
- toxicity
- reactivity
- radioactivity
- corrosion

4. CLASSIFICATION AS MARINE POLLUTANT

In the framework of the MARPOL Convention of 73/78, a group of GESAMP experts has established a risk profile of liquid substances transported in bulk by sea, taking into account four types of possible risks involved in accidental spills at sea :

- marine resource damages
- risks to human health
- reduction of amenities
- interference with other sea users

This has led to the defining of a risk profile for each substance, according to five columns *(table 3)* :

A : Bioaccumulation
B : Damage to living resources : acute toxicity
C : Risks to human health by oral intake
D : Risks to human health by skin and eye contact or inhalation
E : Reduction of amenities.

Class 1:	**Explosives**	
	Division 1.1	Substances and articles with a risk of mass explosion
	Division 1.2	Substances and articles with a risk of projection but without risk of mass explosion
	Division 1.3	Substances and articles with a fire risk and a slight risk of explosion or projection or both, but no risk of mass explosion
	Division 1.4	Substances and articles of no particular risk
	Division 1.5	Insensitive substances with a risk of mass explosion
Class 2 :	**Compressed gases, liquefied or dissolved under pressure**	
	Class 2.1	Flammable gases
	Class 2.2	Non-toxic flammable gases
	Class 2.3	Toxic gases
Class 3 :	**Inflammable liquids**	
	Class 3.1	Low flashpoint group (a flashpoint < -18°C, in a closed cup test)
	Class 3.2	Average flashpoint group (flashpoint equal to or > -18°C and < 23°C, in a closed cup test)
	Class 3.3	High flashpoint group (flashpoint equal to or > 23°C and < 61°C, in a closed cup test)
Class 4 :	**Inflammable solid substances**	
	Class 4.1	Flammable solids
	Class 4.2	Spontaneously flammable solids
	Class 4.3	Substances which in contact with water emit flammable gases
Class 5 :	**Oxidising substances (agents) and organic peroxides**	
	Class 5.1 :	Oxidising substances (agents)
	Class 5.2	Organic peroxides
Class 6 :	**Toxic and infectious substances**	
	Class 6.1	Toxic substances
	Class 6.2	Infectious substances
Class 7 :	**Radioactive materials**	
Class 8 :	**Corrosives**	
Class 9 :	**Miscellaneous dangerous substances and articles**	

Table 2 : **Classification of transported chemical substances (OMI (IMDG -International Maritime Dangerous Goods Report)**

Column A -	*Bioaccumulation and tainting*	
+	Substance bioaccumulated to a significant extent and known to present a risk to aquatic life or human health.	
Z	Bioaccumulated with a risk to aquatic organisms or human health, but with a brief persistence of one week at the most	
T	Liable to taint sea foods	
O	No evidence to support any of the above-mentioned degrees of risk (+, Z,T).	
Column B -	*Risks to living resources*	
		DL_{50} (96-h)
4	Highly toxic	< 1 mg/l
3	Moderately toxic	1 - 10 mg/l
2	Slightly toxic	10 - 100 mg/l
1	Practically non-toxic	100 - 1000 mg/l
0	No risk	> 1000 mg/l
D	Substance likely to form deposits on the sea bed	
DBO	Oxygen biochemical demand	
Column C -	*Risks to human health (if taken orally)*	
		DL_{50} (laboratory mammals)
4	Highly dangerous substance	< 5 mg/kg
3	Moderately dangerous	5-50 mg/kg
2	Slightly dangerous	50-500 mg/kg
1	Practically without danger	500-5 000 mg/kg
0	No risk	> 5 000 mg/kg
Column D -	*Risks to human health (by inhalation and skin contact)*	
II	Dangerous substance (severe irritation, strong sensitizing, cause of lung damage, toxic skin contact, carcinogenic or other specific long term adverse effects on health)	
I	Slightly hazardous (mild irritation, slightly sensitizing)	
0	No risk (non-irritant, non-sensitizing).	
Column E -	*Reduction of amenities*	
XXX	Very dangerous substance because of its persistence, its odour or its toxic or irritant characteristics; this can result in beaches being closed ; symbol also used when it is known that the substance is carcinogenic to humans or likely to have other specific, serious, long term, adverse effects on human health.	
XX	Moderately harmful, because of the aforementioned characteristics, but only with short term effects which could temporarily interrupt the use of beaches; symbol also used when it is known that it is a substance carcinogenic to animals but where there is no actual proof that it causes cancer to humans, or when laboratory studies lead to the belief that it could be the source of specific, serious, long term, adverse effects on health	
X	Slightly harmful, no risk to the use of beaches	
O	No problem	

***Table 3* : Criteria adopted by GESAMP for the evaluation of risks**

The MARPOL regulations of 73/78 accorded a hierarchy to the nature of the damage caused to the marine environment by accidental chemical spills, based on a classification of substances into five categories, defined according to the profile risks of the substances, as defined by GESAMP. The MARPOL categories are listed from A to D according to the risk involved *(table 4)*.

Risk Profile (GESAMP)				ANNEX II (MARPOL) Category of Pollution
A	B	C	E	
+	-	-	-	Category A
-	4	-	-	
T	3	-	-	
Z	3	-	XXX	
T	-	-	-	Category B
Z	-	-	-	
-	3	-	-	
-	2	-	XXX	
-	2	-	-	Category C
-	1	4	XX	
-	1	3	XX	
-	1	-	-	Category D
-	-	4	-	
-	-	3	X	
-	-	-	XXX	
-	-	-	XX	
-	D/BOD	-	-	

Table 4 **: Relation between risk profile and MARPOL category**

Remarks:

1. There may be some unintentional ambiguity between the Marpol classifications (categories A,B,C,D) and the risk profile of substances (columns A,B,C,D,E).
2. It is to be noted that the Marpol classification is not used in column D of the risk profile concerning risks to human health by inhalation and risks which are without direct effect on water pollution.

The IMDG code classifies chemical substances transported in packs, as «marine pollutant» in two groups :

•P : sea pollution •PP : severe marine pollutant

The differentiation between (P) and (PP) is based on the GESAMP risk profile as in *(table 5):*

GESAMP Risk Profile		**IMDG Code**
A	B	
+	-	
-	4	P
T	-	« marine pollutant »
Z	-	
+	4	
-	4	PP
	(<0.01 ppm)	« severe marine pollutant »

Table 5: **Classification as «marine pollutant» for packed chemical substances (IMDG code)**

5. CLASSIFICATION BY REACTIVITY

Chemical substances can be highly reactive. The importance of chemical reactivity has already been evoked in the classification of transport (see IMO regulations). Reactivity signifies the capacity of a substance to change chemically by additional or substitutional reactions, or decomposition. Chemical reactions can be endothermic or exothermic.

In cases of accidents involving the transportation of dangerous chemical substances, risks linked to the reactivity of the substances affect the ship and its crew as well as the immediate environment. It is, therefore, important to be able to evaluate the reactivity of substances being transported in order to define a possible means of intervention in the event of an accidental spill in an aquatic environment. The reactivity of the substances can be divided into 4 categories :

- reaction with oxygen in the air
- self-reaction
- water reaction
- reaction with other substances.

5.1. Reaction with oxygen in the air

Combustion is the reaction of a substance with oxygen leading to a release of heat and sometimes an explosion. The differences between fire and explosion are in the intensity of the oxidation reactions. To start a combustion, a substance must be ignited. In this way, a fire or an explosion depends on the stoechiometric reaction of substance to air (or oxygen) and the strength of the source of ignition. There are various sources of ignition (fire, friction, heat, sparks, radiation, noise). Ships and aircraft are potential sources of ignition and when a liquid gas escapes the risk of ignition is high.

At present, it is well known that many chemical products contain functional explosive groups. Many of them are nitrogen or ester nitrogen compounds. Other compounds containing peroxide groups are unstable, explosive as a result of the reaction of peroxides with oxygen in the air. Some substances (ex. di-isopropylic ether, vinylidene chloride, di-vinyl acetylene, potassium amide and sodium amide) oxidise easily in air, forming explosive peroxides. For this reason peroxide forming substances must be transported with anti-oxidants to inhibit the formation of the compounds.

When a substances escapes into the atmosphere as a gas or vapour, an explosion may occur if the concentration of the substance is between the upper and lower explosion limits (UEL and LEL). There is no danger of explosion or fire if the maximum concentration of the substance in the gas cloud is under the lower explosion limit (LEL). The quantity of heat developed is insufficient to ignite the neighbouring gas.

The reaction stops itself because of a too « poor » reactive mixture. In contrast, over the upper explosion limit (UEL) the oxygen concentration is too low to maintain the combustion of the substance.

	% in air volume LEL - UEL	
	LEL	UEL
Methane	5.7	13.2
Ethane	3.1	10.7
Ethylene	5.7	17.5
Acetylene	3.0	60.0
Hydrogen	9.5	66.5

Table 6 **: Lower explosion limits (LEL) and upper explosion limits (UEL) of some gases**

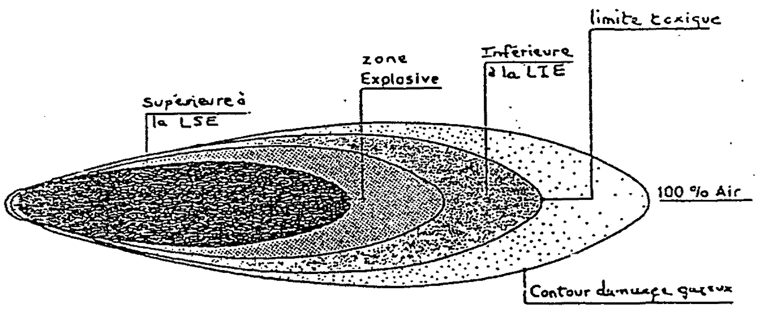


Figure 3 **: Risks of explosion related to the extent of an explosive cloud of gas**

To assess the risks of igniting a volatile substance, reference is normally made to the flashpoint. The flashpoint of a combustible liquid is defined as the lowest temperature (°C) at which the vapour released into the atmosphere forms a flammable mixture in the air. IMO uses this criteria to classify the maritime transport of flammable liquids *(table* 2). Three sub-groups are defined on the basis of their flashpoints : -18°C, 23°C and 61°C. The substances in the first sub-group (flashpoint < - 18°C) are the most hazardous in the fire risk plan, while substances with the flashpoint above 61°C are not considered as flammable.

5.2 Self-Reaction

Polymerisation is the additional reaction of small molecules (monomers) to form larger molecules (polymers, macromolecules) such as polystyrene, polyisopropane, polyacrylonotrile. The reaction of polymerisation can rapidly become uncontrollable. To avoid this type of reaction during transport and storage, low concentrations of polymerisation inhibitors are added. This applies to some twenty chemical substances such as styrene, acrylonitril, and acrylate compounds.

Other chemical substances decompose at the surrounding temperature if exposed to light or low heat. Above a certain temperature certain substances may decompose, as is the case of substances of the OMI 4.1 class («flammable solids ») and the OMI 5.2 class (« organic peroxides »). For example, sodium cyanide decomposes in humid air releasing cyanhydric acid which is a toxic gas.

5.3 Reaction with water

Certain substances react to water, either by a reaction of hydration or hydrolysis. This type of reaction becomes extremely serious in cases of accidental spills in water and the fact that water is commonly used in fire-fighting on board ships. Products resulting from these reactions can ignite or explode, be toxic or have corrosive effects on materials. There are numerous reactions with water :

- reactions of **decomposition with water**, such as the hydrolysis of acetic anhydride to acetic acid. Some of these reactions are explosive (example : chlorosulphonic acid). Other reactive products are corrosive : solid ferric chloride ($FeCl_3$) reacts with water (exothermic reaction), releasing chlorhydric acid vapour (HCl). Substances of the OMI 4.3 class (hazardous matters in humidity) emit flammable gases when in contact with water. This applies to alkalis such as sodium, potassium and lithium, calcium carbide, magnesium compounds etc.

$$Na + H_20 \xrightarrow{\text{oxidation}} NaOH + 1/2H_2$$

$$CaC_2 + 2\ H_20 \longrightarrow C_2H_2 + Ca(OH)_2$$

- **Combination reactions** such as hydration. Generally, these reactions are exothermic. Oleum ($H_2SO_4 + SO_3$) reacts violently with water: it dissolves, releasing a large quantity of heat. Chlorine forms hydrates (Cl_2H_2O) and a corrosive solution of HCl and ClOH dissolves in water. It must also be noted that certain products are very active when in contact with humidity in the air : they can then ignite spontaneously. This is the case of white phosphor, alkalis, some organometallic compounds and metallic hydrures.

5.4 Reaction with other substances

The mixing of chemicals, in the event of an accident, can result in violent chemical reactions. Such reactions may generate fires or explosions, or produce toxic gases dangerous to the ship, the crew and intervention teams.

The International Maritime Organisation (IMO), on the basis of reactions between products, has proposed tables of separation : non-compatible products must be stocked separately. A large number of chemical combinations are incompatible. This information can be found in dictionaries or specialised guides.

6. CLASSIFICATION BY BEHAVIOUR

This classification is based on the affinity of chemical substances in reaction with air, the water surface, the water column or the seabed. In classifying chemical substances into different groups, it becomes easier to develop more appropriate and more specific methods to combat pollution. The European classification system of accidental chemical spills divides substances into 4 main groups :

- evaporators (E)
- floaters (F)
- dissolvers (D)
- sinkers (S)

As the substances can have various types of behaviour, sub-categories must also be defined. For example, a chemical product can float on the surface of the water and at the same time evaporate and dissolve.

Physical properties which are used in this classification are as follows :

- the state of the substance : gas, liquid, solid
- density compared to sea water
- vapour pressure
- solubility
- the density relative to air can also be included

6.1. Classification criteria

- **The state of the substances** is chosen at 20°C. The evaluation of the 300 most transported chemicals in the North Sea shows that there is no noticeable difference over a temperature range of between 5 and 20°C.

- **Density** in relation to sea water determines whether a substance floats. The density of sea water is given at 1.03 kPa at 20°C.

- **Vapour pressure** is taken at 0.3 kPa. It is admitted that at a lower vapour pressure a substance does not evaporate. In comparison, the criteria for a rapid evaporation (disappearance of 1 000 m3 in one hour) is fixed at 3 kPa (23 mm Hg). Substances which have a vapour pressure of over 100 kPa (760 mm Hg) are, by definition, gases.

- **Solubility.** The criteria adopted differ according to the state of the substance. Liquids with a solubility lower than 0.1 % are considered insoluble. With a solubility higher than 5% there is a predominant dissolution process. For solids, the criteria adopted as whether to neglect or, on the contrary, to accord more importance to the dissolution process are 10% and 100% respectively.

- **Density relative to air.** Gases or the vapour phases with a higher density than air will stay on the surface of the water. The density of air is 1.29 g/l at 20°C.

6.2 Flow Chart

Figure 4 shows the flow chart of the European system of classification of the behaviour of accidentally spilled chemicals in water (12 groups for gases, liquids or solids). *Table 7* and *figure 5* show the 12 groups of behaviour. Another presentation of the flow chart is based on the state of the substance spilled (gas, liquid or solid) (*figure 6*).

6.3 Gases

Some substances are transported in a pressurised or refrigerated state. Dangerous substances belonging to the same category, such as butane and vinyl chloride, evaporate rapidly at an ambient temperature. A distinction is made between gases which do not dissolve or dissolve slowly in water and gases which dissolve in water (GD) (Criteria of solubility 10%).

Group		Properties	Examples
Immediate Evaporation Gases	G	Immediate evaporation	propane, butane, vinyl chloride
	GD	Immediate evaporation and dissolution	ammonia
Evaporators (Rapid evaporation)	E	rapid evaporation	benzene, hexane, cyclohexane
	ED	rapid evaporation and dissolution	methyl-t-butyl ether, vinyl acetate
Floaters	FE	floating and evaporation	heptane, turpentine, toluene, xylene
	FED	floating evaporation dissolution	butyl acetate, isobutanol, ethyl acrylate
	F	floating	phthalates vegetable oils animal oils dipentene isodecanol
	FD	floating and dissolution	butanol butyl acrylate
	DE	rapid dissolution and evaporation	acetone monoethyl amine propylene oxide
Dissolvers	D	rapid dissolution	acids and bases certain alcohols glycols amines methyl ethyl ketone
	SD	sinking and dissolution	dichloromethane 1.2 - dichloroethane
Sinkers	S	sinking	butyl benzyl phthalate chlorobenzene creosote tetra ethyl lead, tetra methyl

***Table 7* : 12 behaviour groups of chemical substances in the event of accidental spills**

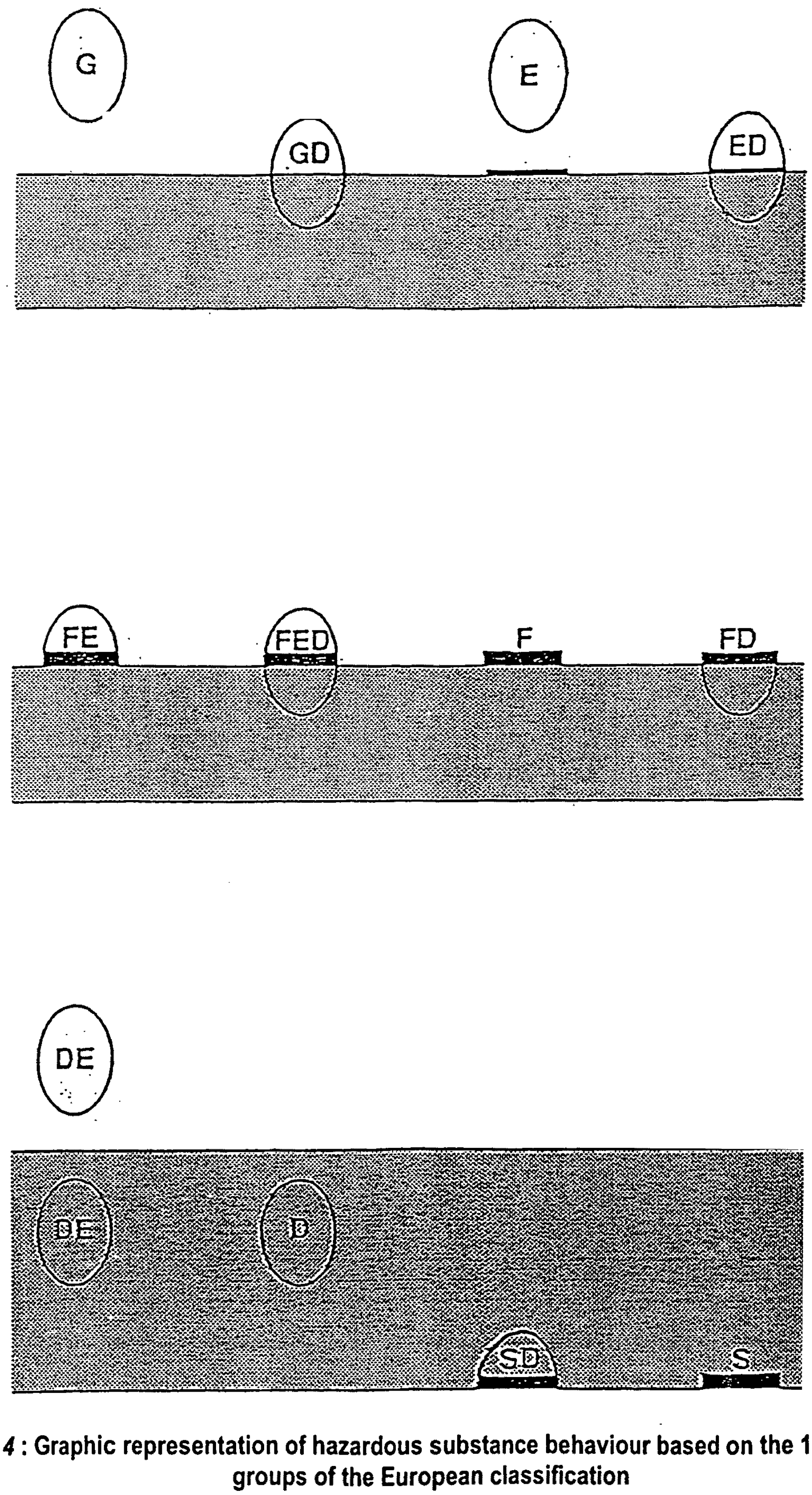


Figure 4 : **Graphic representation of hazardous substance behaviour based on the 12 behaviour groups of the European classification**

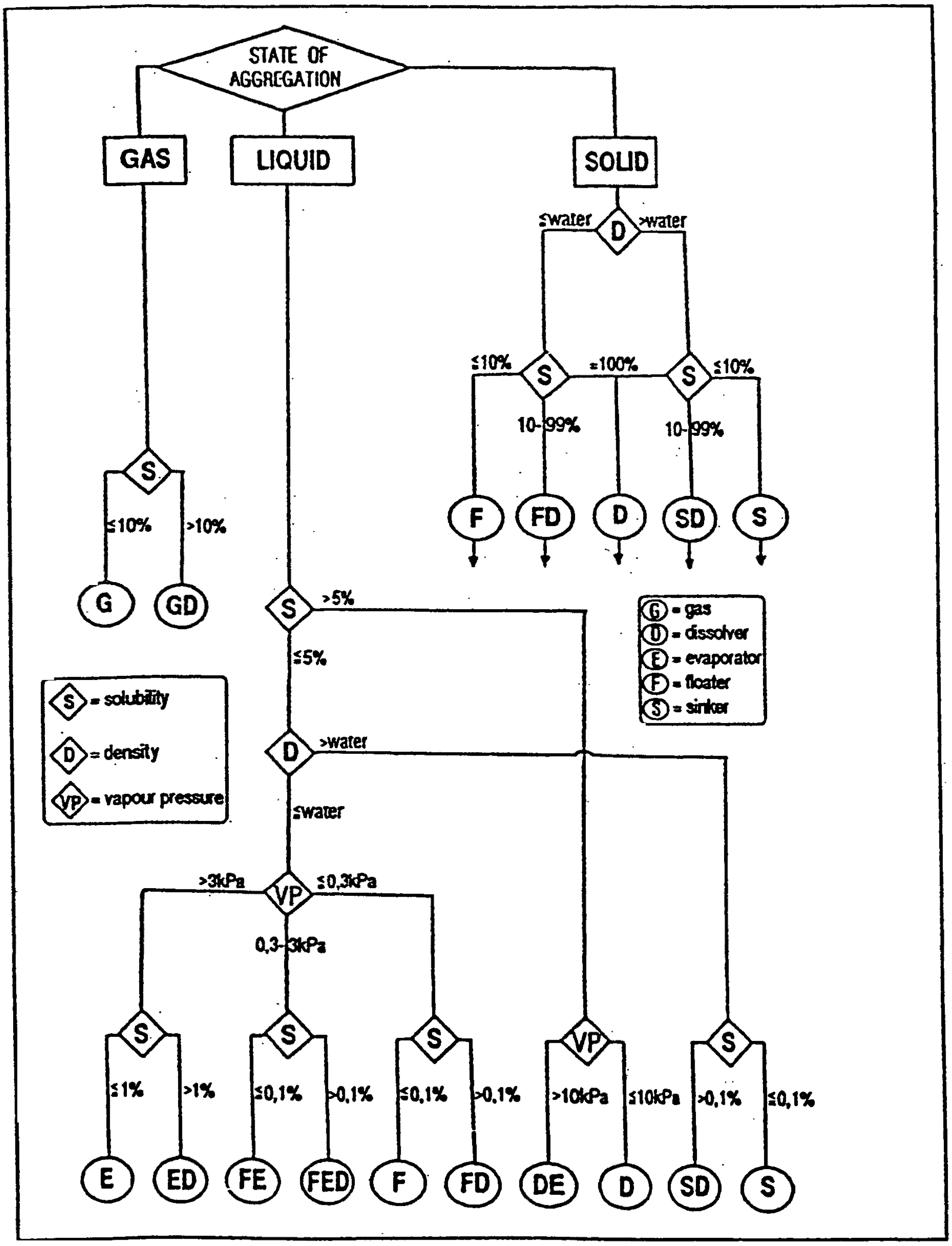


Figure 5 : Graphic representation of the behaviour of dangerous substances based on the 12 behaviour groups of the European classification

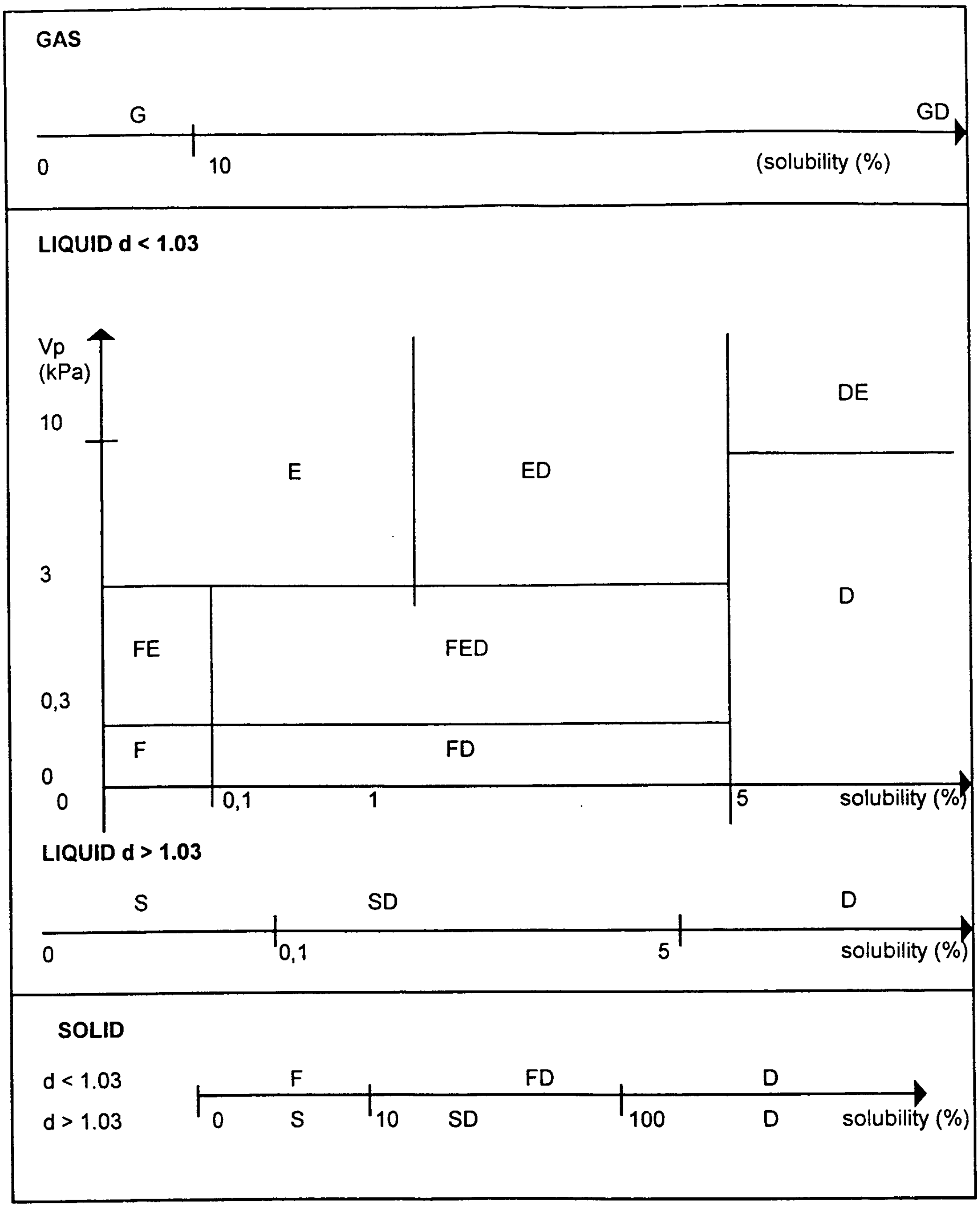


Figure 6 **: Behaviour of chemical substances in accidental spills according to their state and physical properties**

6.4. Solids

Two parameters (density and solubility) are used to define the five different behaviour groups : floaters (F), (FD), sinkers (S), (SD) and dissolvers (D).

6.5. Liquids

The types of behaviour of liquid substances transported in bulk vary during accidental spills in water. The three physical properties (density, vapour pressure and solubility) must be considered when defining the behaviour groups or sub-groups. A first distinction can be made according to the density, in order to differentiate sinkers (S), (SD) from other groups (floaters, evaporators and dissolvers). When density is lower than that of water, parameters of both the vapour pressure and the solubility must be taken into account when characterising the evaporators (E), (ED), floaters (F), (FE), (FD) (FED) or dissolvers (D), (DE).

6.6 Examples of particular behaviour

Ammonia spills (GD)

Liquefied ammonia boils rapidly and violently when in contact with water. Its behaviour depends on the quantity spilled and if the spill takes place on the surface or in the water column. Globally, it is estimated that 60% of ammonia is dissolved if the spill is on the surface and 90% if it occurs in the water column.
Dissolved ammonia undergoes a chemical reaction with water to form ammonium.

$$NH_3 + H_2O \rightleftharpoons NH_4^{+} + OH^{-}$$

Non-ionised ammonia NH_3 has toxic effects on aquatic organisms. The rate of dissociation depends on pH and the water temperature.

	NH_3 (%) in water			
	pH			
Temperature	7.0	7.5	8.0	8.5
10°C	0.19	0.59	1.8	5.6
15°C	0.27	0.86	2.7	8.0
20°C	0.40	1.2	3.8	11.0
25°C	0.57	1.8	5.4	14.0

Table 8 **: Dissociation of ammonia in water**

- Substances which solidify when in contact with water.

The process of solidification depends not only on the solidification point (fusion point f.p.) and ambient temperature, but also on the solubility. A fusion point combined with a low or light solubility, will facilitate the process of solidification of the substance when in contact with water. Such substances show a solubilisation or late evaporation behaviour, which makes it easier to recuperate the product with adapted material than to leave it to the values of vapour pressure solubility.

	Behaviour Group	Water temperature		Fusion Point (°C)	Solubility (%) (10°C)	Vapour Pressure (kPa) (10°C°)
		0°C	10°C			
tallow oil	F	(X)	(X)	-10/+30	10↓≥	10↓≠
tallow	F	X	(X)	+ 30/+50	10↓4	10↓4
tallow acid fat	F	X	(X)	+35	10↓″	10↓≥
vegetable oils	F	(X)	(X)	-20/+50	10↓″	10↓≥
benzene	E	X		+6	5 10↓″	6
cyclohexane	E	X		+7	5 10↓≥	6
creosote	S	(X)	(X)	-6/+41	10↓″	10↓≠
phtalic anhydride	S	X	X	+131	0.3	10↓4

X solidification
(X) partial solidification

Table 9 **: Solidification of certain substances in water**

- Substances which react with water

As previously shown, certain substances may react with water. Their behaviour no longer corresponds to the flow chart of the European classification system. Some examples will given to show this type of behaviour for substances usually transported by sea:

- methyl chloride is a fuming liquid which reacts violently with water and decomposes into hydrochloric acid and acetic acid;
- calcium carbide is a solid which sinks and reacts with water forming acetylene, a highly flammable gas;
- sodium and potassium are alkaline metals which float and react violently to contact with water forming a flammable hydrogen gas which may form explosive mixtures in the air;
- sulphonyl chloride is a fuming liquid which reacts violently to water and decomposes into sulphuric acid and hydrochloric acid;
- toluene isocyanate is a liquid which sinks and reacts slowly with water forming carbonic gas and a plastic polymer (polyisocyanate).

7. CONCLUSION

In classifying dangerous substances into different sectors of transport, physical risk, marine pollutant, reactivity and behaviour, it is possible to obtain certain relative information which will provide not only a selection of appropriate means of response but also a better understanding of the harmful effects of substances spilled on the marine environment. The European classification system allows for the determining of the short term behaviour of substances spilled in water, according to the main physical properties (density, solubility and vapour pressure).

According to their properties, the hazardous substances can persist in the environment over long periods of time. The problem of accidental spills then gradually changes and eventually becomes a problem of chronic pollution. On a long term basis, other abiotic and biotic processes must be considered in order to evaluate the distribution and transformation factors of polluting substances in the aquatic environment, such as Henry's law of constant octano/water coefficient, data concerning the reactions of photlysis, hydrolysis and biodegradation.

Part 2

RESPONSES TO CHEMICAL SPILLS

1. GENERAL CONSIDERATIONS

Response options to intervene after accidental pollution correspond to the means available to minimise the risks created in an emergency, to protect people, the environment and property, and to return the affected zone to its pre-emergency conditions.

Means of combating accidental oil spills have developed greatly over the last twenty years. As a result, it is now known how to combat accidental oil pollution, which is extremely useful when having to deal with the less frequent chemical spills. The means of combat and the organisation structure are essentially the same, with specific particularities concerning the type of hazard caused by the chemical substances.

Faced with chemical pollution, three reactions are possible :

- no intervention possible
- non-intervention
- intervention

1.1. No intervention possible

➔ due to delay: the means of combat must be taken from storage (generally on land) to the site of the pollution. Added to the time of transporting the material is the time necessary to observe and study the pollution and to decide on and to establish the necessary intervention logistics. It is estimated that in optimal conditions, a minimum of 24 hours is necessary before beginning combat operations at sea. The delay is increased by the actual time of intervention (approx. 12 hours minimum). As a result, it is necessary, in cases of pollution at sea, that the chemical pollutant persists for at least 36 hours in the environment before considering any intervention. In a coastal zone the beginning of response options is not considered suitable if the pollutant does not persist for more than 24 hours, or more than 12 hours in ports.

➔ due to pollutant behaviour.: There are some properties to be considered in determining the behaviour of a product and in foreseeing an opportunity of intervention :

- **colour :** chemical products are often colourless or only slightly coloured making the possibilities of intervention difficult, as the means of combat depend on the visualisation of the pollutant.

- **density** : this parameter defines the floating character of the pollutant and consequently the choice of the response option (solubility and vapour pressure must be low);

- **solubility :** no intervention will be made if the chemical dissolves rapidly in the water mass

- **vapour pressure** : as in cases of solubility, intervention will be unnecessary if the pollutant evaporates immediately.

- **viscosity** : the value is generally lower in floating chemical products than in oil. A low viscosity leads to a high « self-dispersion » of the pollutant in the environment. If natural agitation is sufficient (waves, wind, swells and currents), a practically insoluble pollutant could disperse rapidly in the water mass and therefore be impossible to confine.

- **reactivity between the chemical product and the response option used.** Aggressive properties of a product, related to the basic materials used in response equipment, pose a problem of pollutant/material incompatibility during an intervention, whether during confinement operations, recuperation or storage. Intervention necessitates the availability of materials which are adapted and compatible to the nature of the pollutant.

1.2 Non-intervention

Compared with oil, chemical products present numerous risks : fire, explosion, air toxicity, water toxicity, bioaccumulation, etc. People who approach the pollution zone should do so with the full knowledge of the risks involved.

The responsible authorities may have to take a decision of non-intervention:

- when intervention may endanger intervention teams
  - risks of fire or explosion (awareness of the chemical's flashpoint),
  - risks of intoxication by skin contact or inhalation (if the intervention team does not have adapted protective clothing at its disposal),

- when the name of the spilled product or products is unknown : as a precautionary measure the most penalising conditions are adopted. For bulk transport, the name of the products is generally soon known, but this is not always the case when dealing with packed goods.

1.3. Intervention

Intervention can be undertaken in the following conditions :

- when the pollutant persists for a sufficiently long period, on the water surface or on the seabed, to allow for at least a partial recuperation;
- when the pollutant is naturally confined (e.g. in a port zone or trapped on the seabed or on the coast)
- when risks to man and the environment are low and allow for team intervention;
- when there is enough equipment available and when recuperation sites are under control;
- when containers are beached or drifting.

Only responses for a spill from a ship which spreads over the immediate environment will be dealt with. Before considering external combat, all efforts should first be made on board ship, to limit the release of spills. This study will initially deal with response options on-board ships, then consider the reactions of responses adapted to the behaviour of the spilled products (substances which evaporate, float, dissolve or sink).

2. ON-BOARD INTERVENTION

Understanding the characteristics and properties of hazardous substances can prevent accidents as well as help to define the type of intervention necessary in an accidental spill. The possibility of carrying out combat action directly on-board a ship depends on the nature and the level of risk involved : extent of damage to the ship, amount spilled, characteristics of the spilled products (volatility, toxicity, flammability...).

The personnel involved in the emergency operations must be fully protected and aware of any dangers involved when handling the products. The IMO publication, « *Emergency Procedures for Ships Carrying Dangerous Goods - Group Emergency Schedules* » offers a general outline of emergency procedures for personnel on board ships at sea. The IMDG Code also provides information concerning the handling of dangerous substances.

2.1. Pollutant reduction

- The releasing of gases on-board ship can generate the presence of toxic, corrosive or flammable vapours. The movement of the ship, according to the spill and meteorological conditions, can facilitate the scattering of noxious vapours. On-site intervention in zones of suspected leakages must be carried out by teams equipped with self-contained breathing apparatus and protective clothing. Inert gases, usually considered as non-toxic and inflammable, can create oxygen-deficient air in confined zones. Moreover, ventilation to disperse leaking gases may prove to be ineffective to gases heavier than air. With gases or flammable vapours, sources of ignition must be strictly avoided.

- In the event of a liquid spill, the washing of the bridge, with large quantities of water, is the most common safety recommendation. There are, however, certain limitations. Firstly when the substances react to water, secondly when the water used for washing the bridge risks causing a heavy pollution of the natural environment (shallow water, drinking water supply zones...).

2.2. Intervention on the ship and its cargo

Many techniques can be envisaged on the bases of experience in oil pollution, taking into account that such options must be found to be technically possible before being carried out on chemical pollutants.

- Lightening the ship in difficulty involves the transfer of the cargo to another ship. Limitations of such a procedure depend on the means available and the safety of the intervening personnel with regards to the transported products (fire, explosion, toxicity), the position and condition of the ship and the surrounding environment.

- Theoretically, other options could be foreseen such as the voluntary sinking of a ship (impossibility to tow or to lighten the ship, risks to the population due to explosive or toxic products in the air), the burning of the cargo (this has never yet been done when dealing with the transport of chemicals) or the accelerating of the spill into the sea (to avoid a discontinuous or too slow a spill, to encourage a spreading in the environment, to recuperate products floating after a shipwreck...).

3. INTERVENTION ON POLLUTANTS

Intervention on pollutants spilled in the environment signifies three types of action:

- the forecasting of pollution displacement (F) (1)
- the monitoring of environmental contamination (M)
- combating methods (C)

Forms of intervention vary according to whether the chemical pollutant is an evaporator, a floater, a dissolver or a sinker.

3.1. Gases and Evaporators

EXAMPLES	
ammonia chlorine propane	vinyl chloride methane butane

Forecasting

The movement of a cloud of gas (G, GD) in the atmosphere can be roughly estimated according to the method shown in *figure 1* and *table 1*. Such estimations must be treated with care and necessitate confirmation on the site.

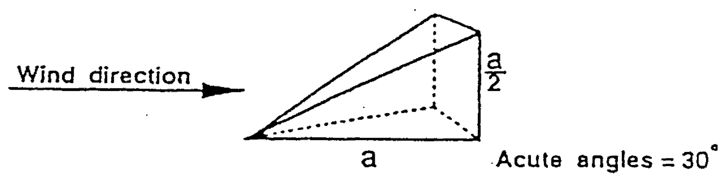


Figure 1 **: Simplified provisional model of the movement of a cloud of gas in the atmosphere**

SPILL	HEALTH RISKS		FIRE / EXPLOSION RISKS
Compounds	ammonia, vinyl chloride chlorine	GNL, GLP ethylene buylene butadiene	ammonia vinyl chloride GNL, GPL ethylene butylene buadiene
Tons	(a) km	(a) km	(a) km
0.1	1	0.2	0.2
1	2	0.4	0.4
10	5	1	1
100	10	2	2
1000	20	4	4

Table 1 **: Impact of gas clouds in the atmosphere**

For flammable and/or toxic liquid substances which evaporate (groups E, ED, FE, FED, DE), the dispersion of vapours in the atmosphere can be roughly estimated by multiplying the values given in *table 1* by coefficient VP/100, VP being the vapour pressure of the liquid substance (represented as kPa) if inferior to 100 at ambient temperature.

Monitoring

The monitoring of hazardous gas contamination in the atmosphere (fire, explosion, toxicity) is very important for the evacuation of people who are non-protected and for the protection of intervention teams. Low concentrations of gas can be detected by various instruments : gas detector tubes, photo-ionizers, IR trace gas detectors. In zones of high concentration of flammable gases, it is necessary to use explosimeters to allow intervention teams to operate in maximum security. Follow-up operations of contamination must be carried out by trained teams equipped with safety equipment (breathing apparatus, protective clothing).

Combating

Water Spray on the pollutant which is evaporating allows for two complementary actions :

the water curtain plays a protective role for the intervention team, limiting the risks of fire or vapour explosions;

in cases of soluble gases (GD) water droplets dissolve and draw the pollutant's vapours into the water column: e.g. ammonia *(figure 2).*

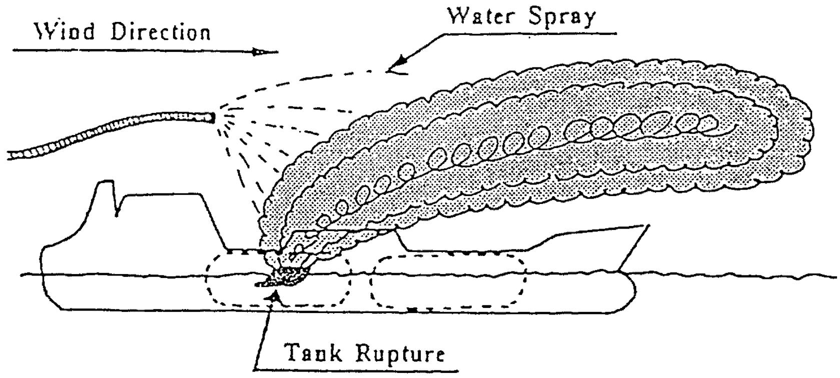


Figure 2 : **Combat technique in cases of soluble gas leakage**

Foams, normally used for fire-fighting, can also be used for chemical spills. They can limit the evaporation of a floating liquid chemical, creating an isolating film (a surfactant film as the foam contains a tensio-active element) between the pollutant and the air. Distinctions should be made between apolar chemicals (hydrocarbons, chlorine solvents) and polar chemicals (alcohols, ketones, aldehydes, ethers, amides, amines ...) before using foams. Certain foam/pollutant incompatibilities, which can lead to the degradation of certain products, must also be taken into account. Foam manufacturers can provide a list of chemicals or groups of chemicals which can be covered with each type of commercialised foam.

3.2. Floaters

EXAMPLES	
amyl acetate	butyl acetate
butanol	butyl acrylate
cyclohexanone	butyl phthalate
octyle phthalate	dipentene
fish oil	heptane
hexanol	isodecanol
olive oil	oil (tape seed)
turpentine	toluene
	xylenes

Forecasting

The drifting of a floater (F, FE, FED, FD) can be estimated according to the same principles as for hydrocarbons, using the vectorial sum of the sea's current (100% its speed) and the wind (3% of its speed). It must be noted that most floaters (except those in group F) disappear progressively, dissolving and/or evaporating within ten hours after the spill.

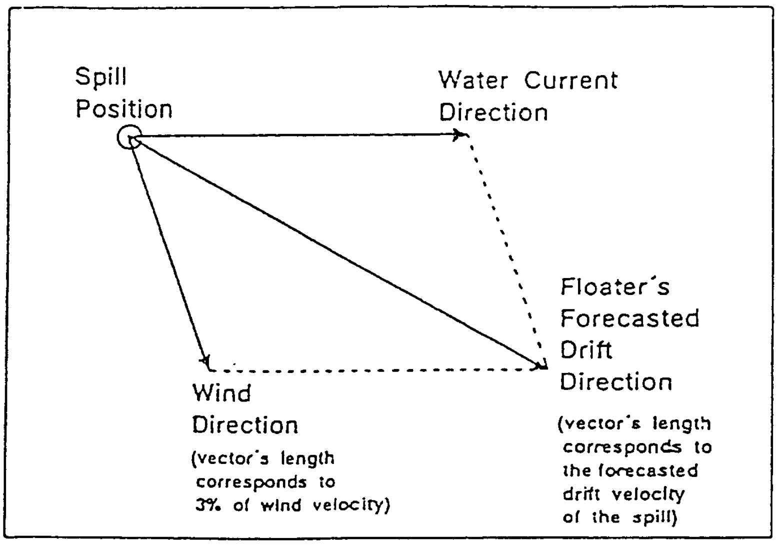


Figure 3 **: Calculations of the drifting of a slick using a vector diagram**

Observations

The location of a slick generally presents two difficulties related to the chemicals' characteristics, on one hand because most chemicals are colourless, hence difficult to see with the naked eye, on the other hand because their viscosity is often low (< 10 cSt) and the slick spreads rapidly.

Chemical markers of pollutants have been tested (ex. red organol), but until now experiments have not provided any techniques applicable in the event of an accidental spill.

Buoy markers may facilitate intervention by limiting the most polluted area. This technique can also be useful when following the pollutant's drifting movement caused by the winds and currents.

Remote sensing detection is a technique widely-used at present, installed on planes or satellites, giving the image of a floating slick as well as providing complementary information concerning the thickness and the type of pollutant. The technique uses two types of sensor : passive or active sensors. Both are often used, as each one has its advantages and disadvantages (*Table* 2).

PASSIVE SENSORS	U.V.L.S. (Ultra Violet Line Scanner	Reflection properties of the sun's UV rays
	I.R.L.S. (Infra-Red Line Scanner)	I.R. radiation whose intensity provides information on the thickness of the slick
	M.W.R. (Micro-Wave Radiometer)	Reception of wavelengths (between 0.3 and 3cm), providing an estimation of the pollutant's volume
	L.L.L.T.V. (Low Light Level Television Camera)	Work in an UV and visual domain, allowing work in dull weather.
ACTIVE SENSORS	S.L.A.R. (Side-way Looking Airborne Radar)	Reflection of micro-waves, giving the image of agitation on the water's surface
	S.A.R. (Synthetic Aperture Radar)	Functions as SLAR + computer analysis.
	Fluorimetric Laser	Florescence emitted by the pollutant under the impact of a laser beam

***Table 2* : Principle techniques used in remote sensing detection**

Combating

Combating techniques can be used on liquid products and floating solids which do not evaporate or dissolve (group F). Certain response options are usually used when dealing with hydrocarbon pollution :

- confinement using floating booms
- recuperation of the chemicals
- treatment by absorbents

- **Confinement** with the help of floating booms limits the spreading of the slick, stopping it from drifting (especially when threatening a sensitive zone) and moving it towards a more favourable recuperation zone. Numerous booms are available and commonly used. Each one corresponds to a certain type of environment (port, coastal area, high sea) and meteo-oceanic conditions. There may be problems of incompatibility between the chemical pollutant and the material of the booms. After a 40 000 m³ spill of condensate (the « Juan A. Lavalleja » shipwreck in 1979), the « Balear » type glue used on the boom, was dissolved in a few hours by the condensate, causing a complete dislocation of the boom.

- **Recovery** necessitates equipment specially made for use on water, to skim off the chemicals on the surface and to pump and transfer them to temporary storage containers. The floating products may, however, be difficult to recuperate if their viscosity is too low (1 - 2 cSt) as they will have a tendency to spread rapidly and form thin films on the surface. Recovery is easier for chemicals which have been pre-treated by sorbents.

- **Floating sorbents** are used for small spills (approx. 10 m^3), to fix and agglomerate the pollutant. These are oleophilic and hydrophobic products which fix the pollutant while remaining on the surface of the water. They are treated minerals (volcanic ash), treated plants (sawdust, peat) or polymers (polypropylene). Sorbents are sold in bulk (powder, chips, granules) in the form of pillows and booms, flat sheets or rolls.

  Spreading the bulk products can be done by an air or water-spray applicator. The sorbents are not totally water-resistant and will lose some of their effectiveness when in contact with water, before reaching the pollutant. On average it is estimated that 1 to 2 volumes of bulk sorbent are needed to absorb 1 volume of the pollutant. Recovery of a spill can be either very simple or very complicated : for small spills, a hand-net for manual recovery (approx. m3), a drag-net on the surface, tugged by two boats (recovery of 2 to 8 m^3 of agglomerates) or a V-shaped boom which guides the spill into the net.

  Figures 4 and *5* show examples of sorbents in sheet or boom form.

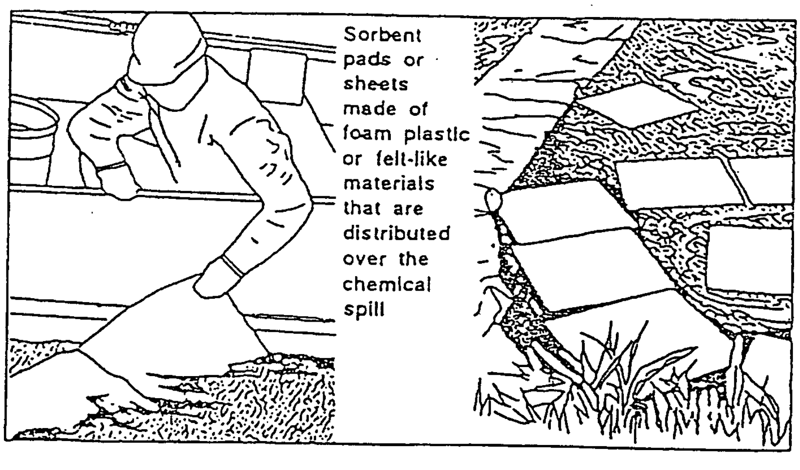


Figure 4 **: Treatment using sorbent sheets or pads**

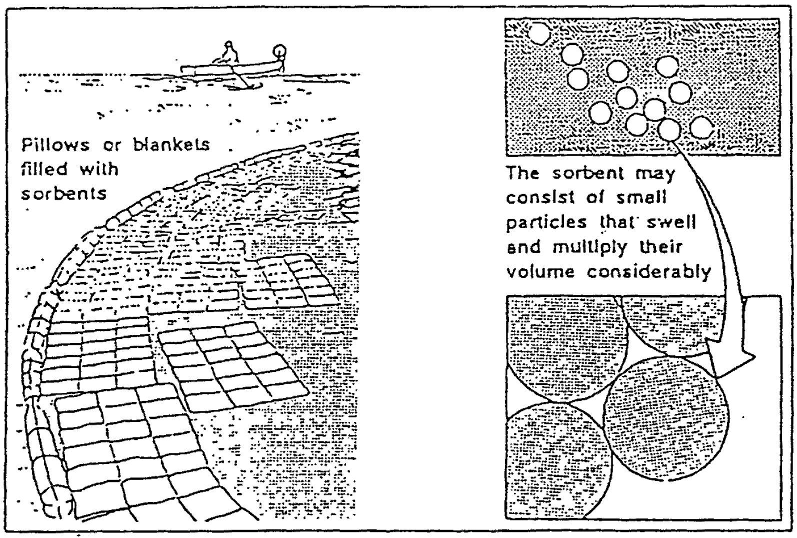


Figure 5 : **Treatment using blanket or boom form powdered sorbents**

3.3. Dissolvers

EXAMPLES	
acetone	phosphoric acid
ethanol	glycol
isopropanol	methanol
methyl	ethyl ketone
amine monoethyl	soda
propionic acid	propylene oxide
sulphuric acid	acetic acid

Forecasting

The spreading of pollution in the water column (group D) can be calculated according to *figure 6* and *table 3*, if the movement of the water mass is relatively slow. This method cannot be applied either to stagnant or turbulent water.

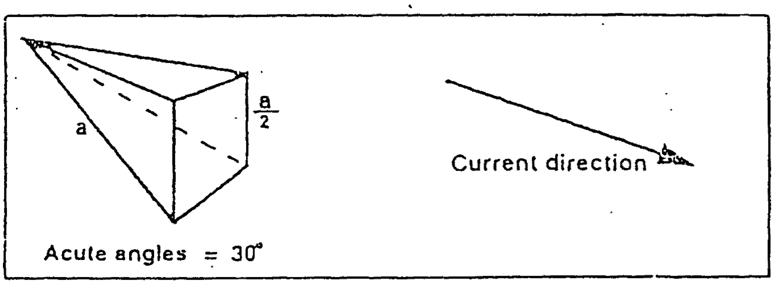


Figure 6 : **Simple forecasting model of the dispersion of a soluble pollutant in water**

Spill (tons)	Concentration (mg/l) a (km)	Concentration (mg/l) a (km)
1	0.5	5
10	1	10
100	2	20
1000	4	40

Table 3 : **Dispersion of a soluble product in water related to the amount spilled**

Combating

The treatment of a soluble product supposes a remaining high concentration in the environment and relatively small mass of water to be treated. For these two reasons, a response option for this type of pollution must not be decided upon if it is impossible to isolate the contaminated water mass.

Two types of techniques are possible : neutralisation techniques for the release of acids or bases, and purification techniques which use a wide variety of treatment agents (flocculation agents, gelling agents, activated carbon, complexing agents, ion exchangers).

- ***Neutralising agents*** are used in cases of acid or chemical based spills in a confined zone. Two neutralising agents are commonly used to neutralise pH variations and to return it to its initial state (pH 7.8 to 8.2 for sea water)

  - sodium bicarbonate ($NaHCO_3$) for acids
  - sodium di-hydrogen- phosphate (NaH_2PO_4) for base spills

- ***Purification techniques*** can be used when the polluted water mass can be isolated (enclosed basin). The following technical principles are used :

  - an adsorption process allows for the fixing of pollutants on the adsorbents (clays, zeolites, activated carbon...) which can later be recuperated by filtering or settling;
  - ionic exchangers (cationic or anionic resins) can fix pollutant ions contained in water;
  - oxidising or reducing agents which may lower the pollutant's toxicity;
  - flocculation agents may mix with the pollutant to form a precipitate that can also be recovered by filtration or settling.

3.4. Sinkers

Location and observation

The spillage of a sinker can strongly contaminate the sediments. Moreover, after a certain period of time, hydrodynamic conditions, as well as the behaviour of the chemical, will gradually cause the dispersion of the pollutant in the aquatic environment. The dispersal factors are :

- action of the currents and tide,
- effect of a sloping seabed
- low viscosity pollutant which favours the formation of more easily spread small droplets,
- progressive dissolution of the pollutant in the water column.

It is, therefore, necessary to act rapidly to confine the pollutant to a restricted area. Intervention must be carefully planned when dealing with the decontamination of the polluted environment and the final clean-up of contaminated sediments.

Observation of the contaminated area can be done using an echo-sounder. A more detailed cartography can be made by divers or submersible apparatus. The spreading of the pollution must be supervised by monitoring the contamination of waters adjacent to the pollution site in order to be able to evaluate environmental risks (fisheries, aquaculture, recreation areas, drinking water...).

Combat

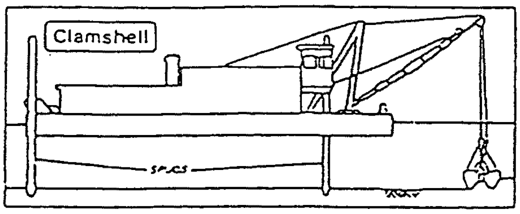
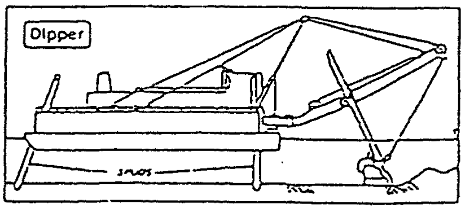
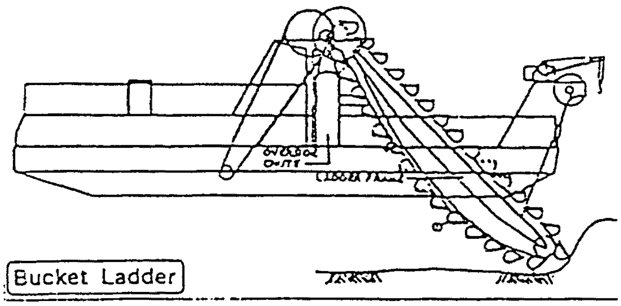
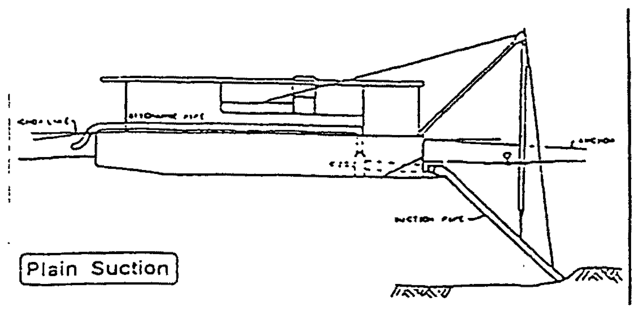
Dredging techniques can be used to recover sinking chemicals. The dredging includes « shovelling up » or « sucking up » the pollutant and part of the sediment in contact with the pollutant. The choice of the dredging technique depends on many factors such as:

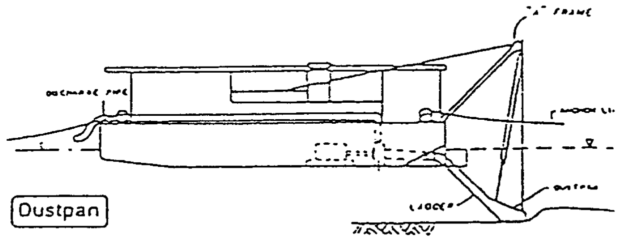
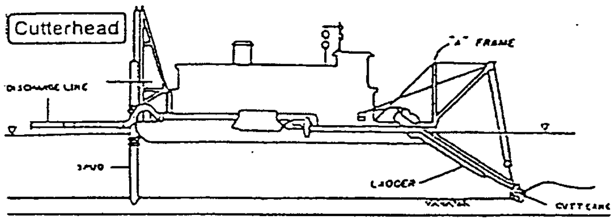
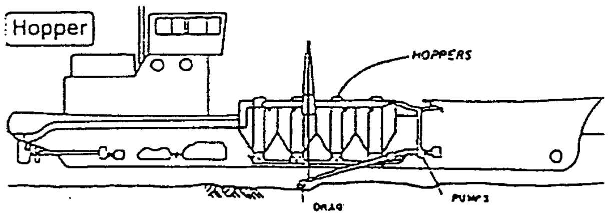
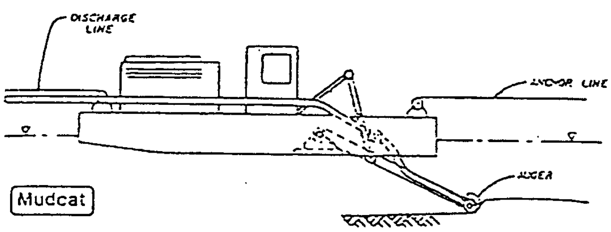
- the size of the spill
- the location of the spill (port, basin, coastal zone...)
- the state of the pollutant (liquid, solid, absorbed in the sediments)
- the environmental conditions (meteo-oceanic conditions, water depth).

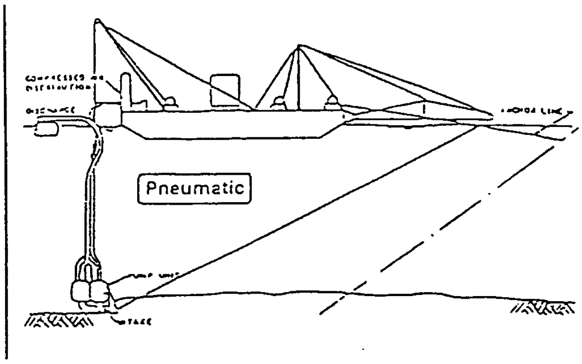
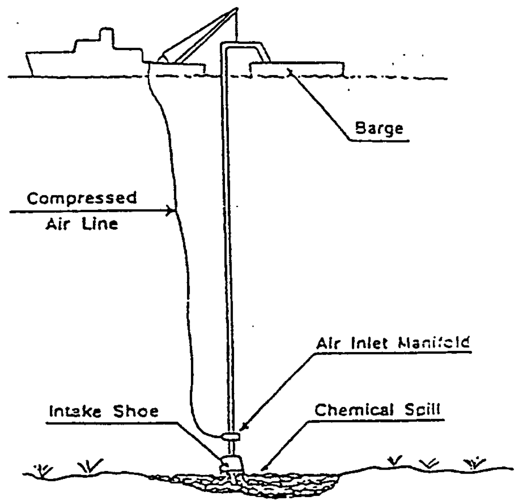
Each type of dredging is suitable for each particular job, according to specific conditions. There are three types of dredges :

- mechanical dredges
- hydraulic dredges
- pneumatic dredges

The equipment's main characteristics and functioning are as illustrated :

Mechanical dredges	
Can recover solids spilled on the seabed and pollutants absorbed in the sediment	*Figure 10* : **Clamshell Dredge** 
The most commonly used dredges are the dipper, the clamshell, and the bucket ladder.	*Figure 11* : **Dipper Dredge** 
Recovery in shallow waters : 15m (dippers), 45m (clamshells, bucket ladder). Slow rate of flow < 500 m3/h Limited selectivity	*Figure 12* : **Bucket ladder** 
Hydraulic Dredges	
Can pump non-dissolvant solids or liquids	**Figure 13 : Plain suction dredge** 

Technique guided by a diver	**Figure 14: Dustpan dredge** 
High recovery rate : 1 500 - 7 500 m³/h	**Figure 15 : Cutterhead dredge** 
The dredge's suction force limits its use to shallow waters	***Figure 16*** **: Hopper dredge** 
	Figure 17 **: Mudcat dredge** 

Pneumatic Dredges	*Figure 18* : Pneumatic dredge
Hydraulic systems of pipelines using compressed air.	
The sediment is brought up to the surface by compressed air. This type of dredge is relatively more effective that those previously mentioned (i) there is no depth limit (ii) because of the pneumatic force of the dredge the product brought up does not necessarily have to be liquid	*Figure 19* : **Small pneumatic dredge (airlift)** 

4. CONCLUSION

In the event of an accidental chemical spill at sea, it is rarely possible to recover the pollutant. It is usually preferable to let the pollutant spread into the air and water, as the majority of chemicals transported in bulk (with the exception of certain chlorinated solvents) do not persist in the environment. This avoids intervention teams having to take possible risks (fire, explosion, respiratory intoxication) and also avoids the deterioration of combat material used against pollution and problems of transport, storage and waste treatment.

However, in certain cases, such as coastal and port zones, it would be possible, even preferable, to recover the pollutant. The use of combat techniques in these cases is studied case by case according to the nature of the product and its behaviour, the environmental factors and the available means of combat.

INTRODUCTION TO CRISIS MANAGEMENT

INTRODUCTION TO CRISIS MANAGEMENT

The systematic, or disciplined, approach to an emergency response is a technique of information-gathering and decision-making which has been perfected in order to assist those responsible in running a complicated emergency situation, in a logical and methodical manner.

Inspired by the reasoning methods used in the tactical study courses of the French Naval Academy, this technique has been adapted by the chemical industry for its own needs. This can be explained by the increased complexity of pollution response interventions involving chemical accidents. The factors contributing to an increased difficulty are mainly linked to the technological advances of the past few years, and to the growing number of individuals involved in the event of an incident.

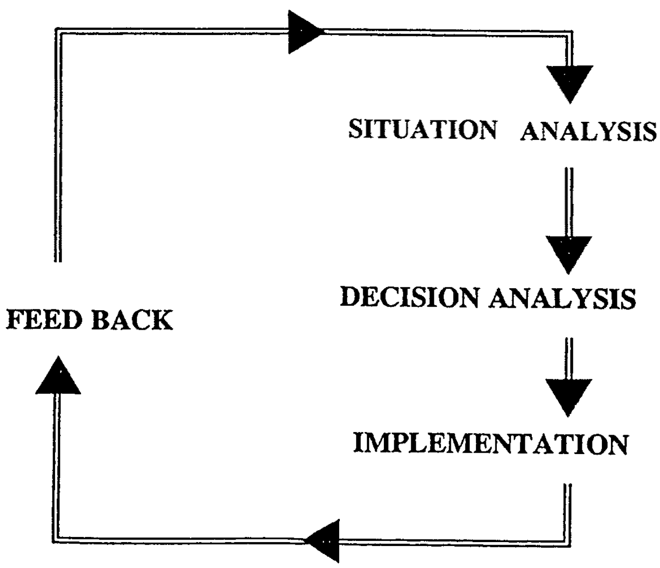
Therefore, it has now become necessary to have a decision-making process which can integrate a great number of factors in an effective manner, and in a way which can be properly understood by all the people involved in an operation.

The method can be summarised by three objectives and takes place in four phases.

The three main objectives of the decision-making approach method are listed below in order of importance:

- saving human lives
- protecting private property
- protecting the environment

The four basic phases which occur in the method and their relationship are shown hereunder.



The process begins by the gathering of information concerning the incident. This takes place in the SITUATION ANALYSIS phase. Then, the information is interpreted by the decision-making authority in order to make the correct decisions concerning during the second phase: ANALYSIS OF THE DECISION. Once the decisions have been made, the phase of executing them by means of the appropriate strategies and tactics will occur. The fourth and final phase, which also serves to close the system, is the phase of reconsidering the entire intervention analysis and decisions in light of the continuing evolution of the situation. This phase is called the FEED BACK phase.

Lets take a closer look at the four phases.

I. Situation analysis

a) Getting a feel for the situation

"No matter where he finds himself, in a comfortable office several kilometres away from the incident, with only a telephone to communicate, in an operational command post, or on site, the potential decision maker must first envision which information is necessary, and must be able to imagine the real situation which is taking place."

The basic material he needs in order to make a decision is information.

A preliminary analysis will enable him to determine what type of information is needed. If the information is not available, it must be sought out, without any error, and with the least possible loss of time.

The decision maker must "get the feel of things" and his first investigations should give some answers, even partial, about:

- the general constraints which are likely to affect a situation (media impact...),
- the security and safety measures to be applied,
- finally, the problems involved in using some methods or material (population or traffic circulation in the accident zone, difficult weather conditions).

At this stage, it is necessary to remain fairly generalised and to get some idea of the areas needing a more detailed, exhaustive analysis.

b) Detailed analysis

A detailed evaluation of a situation will require that a great deal of circumstantial and resident data be collected. This information can be related to:

- the problem or the incident itself,
- conditions which could alter the situation,
- potential losses,
- measuring, evaluation and control methods.

Three factors must be considered in order to define the problem. They include the stage of evolution of the incident, the quantity and dangerous nature of the pollutant, and the type of behaviour of the substances involved in the incident.

The potential losses are determined by evaluating the human lives, the environment, and private property which could be exposed to real or potential dangers.

Finally, the control measures concern the internal or external resources (national or international) in personnel, means (technical, financial, legal), resident data, emergency plans which can be called upon in an intervention. This information can be collected:

- on site for the data regarding the specific circumstances of the situation,
- from various government agencies for resident data.

The information collected should be verified, tallied and, if necessary, added to. Also, it is very important that the decision-making authority be able to use and directly exploit the data (be careful to avoid jargon, and overly technical vocabulary...). In the event of a major incident, one or more members of the crisis staff could be specifically responsible for collecting information and making this information usable for the rest of the group.

A correct interpretation of the information assumes that the vocabulary involved is clearly understood by all the people involved.

II. Analysis of the decisions

The decision-making authority has collected information concerning:

- the state of the ship and its cargo,
- the behaviour of the chemicals involved,
- the type of risk involved,
- the extent of the zone or area which could be involved,
- the probable length of time a risk is possible,
- the conditions likely to have an effect on the critical situation, such as weather conditions, the location of the accident, etc.

After considering all the information available, the decision-making authority will decide whether or not a pollution response intervention should take place.

It must also be decided whether or not an intervention is possible, and in order to determine the possibility of intervention it will be necessary to consider:

- what objectives are to be attained,
- what actions are possible,
- decide which actions are best adapted to the situation and to the desired objectives,
- evaluate the possibilities of intervention.

Only after the proposed or planned ways and means of an intervention are compared to the available ways and means can a decision to intervene be made, and only then it will be possible to define the priorities.

a) Defining objectives

Before a choice is made concerning the ways and means to be used, the goals or objectives of the intervention should be clearly defined. At this point, we need to know what the desired overall objective is and what means are necessary to achieve it.

It must always be kept in mind that saving human lives, protecting property and preserving the environment are, generally speaking, the priority objectives. If these primary goals are achieved, we should be able to see a more or less rapid return to a "normal" situation.

b) Identifying possible actions

In order to deal with a critical situation such as those maritime authorities have been confronted with in the past, these authorities have the potential of putting a certain number of actions into effect. Once an inventory of all the possible actions has been listed, the decision-making authority must then evaluate the various possibilities in terms of the given situation.

Inventory of possible actions

The Bonn Agreement Working Group on the Operational Technical and Scientific Aspects of Pollution (BAWG-OTSOPA) have presented a list of possible actions which can be carried out at sea in the event of a critical situation on board a vessel transporting hazardous chemical substances. These actions are listed below according to three main categories:

- actions on board the vessel (figure 1)
- actions concerning the cargo (figure 2)
- actions on a substance accidentally released at sea (figure 3)

For each type mode of action, various ways and means for accomplishing the action are proposed on the following tables.

Figure 1. Actions on board the vessel

TYPE OF ACTION	WAYS/MEANS OF ACTION
Extinguish a fire	CO2 Foam Dry powders Halon Sand Water Saw dust Steam
Reduce the spreading of the fire	Spray down the deck Spray down the tanks Separate the burning compartments Eliminate heat sources
Move the ship	To high sea To a safe port To a safer mooring Strand the ship
Sink the ship	
Do nothing	

Figure 2. Actions on the cargo

TYPE OF ACTION	WAYS/MEANS OF ACTION
Move the cargo	Move the cargo on board the vessel Transfer the cargo by lightening at sea Remove the containers
Stop the spill	Gel the cargo Polymerise the cargo Close the valves Stop the leaks Deviate or trap a leak Cut the hoses
Protect the cargo	Cooling Heating Reduce pressure by releasing the gas in the air Remove cargo from a heated or burning hold area Jettison burning cargo Control vapour with a water spray Treat the cargo using chemical agents Add inert gas
Destroy the cargo	Sink the cargo Jettison the cargo Explode the cargo Burn the cargo
Immobilise the cargo	Bury the packages or the chemicals Anchor the containers or packages to moorings
Accelerate the biological degradation of the cargo	Using aerobic stimulants Using anaerobic stimulants
Neutralise the cargo	Using acids on bases and vice-versa
Do nothing	

Figure 3. Actions on a substance released at sea

TYPE OF ACTION	WAYS/MEANS OF ACTION
Dispersion	Similar to those used for oil spill pollution
Chemical treatment	Make a substance soluble Solidify a substance Mark a substance (cloud or slick) so it becomes visible Gel a substance
Confinement and recovery	Using traditional methods and means as for oil spill response ; reverse osmosis systems Sorbents Demulsifiers

Evaluating the modes of action

In order to help decision-making, the possible types of action for each situation should be carefully analysed and evaluated. In order to evaluate the types of action, each possibility will be given a grade of 1 or 0 on the basis of whether or not the action can be accomplished during a scenario involving several parameters (type of incident, risks related to the behaviour of a chemical, weather conditions...). The actions to be undertaken which can be evaluated as being the most appropriate are those whose total sum equals 1 or whose total sum is the highest of all the possibilities considered.

Example: containers filled with a radioactive substance are washed overboard during poor weather conditions close to a coastline vessel in distress:

First operation: list the parameters involved.

Type of incident	1 - Collision 2 - Grounding 3 - Loss of containers 4 - Leaking cargo 5 - Fire 6 - ....
Type of risk	1 - Radioactivity 2 - Toxicity 3 - Explosion 4 - ....
Type of substances	1 - Floaters 2 - Sinkers 3 - ....
Weather conditions	1 - Good 2 - Poor 3 - Bad weather expected 4 - ....
Location of Incident	1 - On the open sea 2 - Near a coastline 3 - ....

Second operation: list all the actions which could conceivably be undertaken.

A - Recover the containers lost at sea
B - Tow the vessel out to sea
C - Destroy the cargo

Third operation: evaluate the actions listed according to the method described above.

Actions	Incident 3	Risks 1	Substance 1	Weather 2	Location 2	Product	Total
A	1	1	1	0	1	0	4
B	1	1	1	1	1	1	5
C	0	0	0	0	0	0	0

According to the above table, among the three actions listed, measure B (towing the vessel out to sea) is, under the given circumstances, the best action to be undertaken. It is obvious that since a situation will evolve, the table must be constantly updated in terms of new developments.

Preparing such tables in order to better manage crisis situations will enable the decision-making authority to chose a number of possible actions taking into account their effects on various parameters such as:

- the number of victims
- the damage to property
- the damage to the environment

Example:

Number of victims	-	1	2	0	+
Damage to property	-	2	1	0	+
Damage to the environment	-	2	0	1	+

0 : Do nothing
1 : Action 1
2 : Action 2

Note : some computerised systems for help in decision-making, such as the SEABEL system, may suggest which type of action should be undertaken according to a given situation.

c) Evaluation of the intervention capabilities

An evaluation of the intervention capabilities will take place in two phases:

1. A quantitative and qualitative estimate of the necessary ways and means for every possible action.

2. A quantitative and qualitative estimate of the various ways and means which could be used for every possible action.

It is obvious that these estimates must also consider which ways and means (personnel and equipment) are available for use at the time they are needed.

Weighing the possibilities

First, a consideration of what ways and means are both necessary and available will give us an idea of the possibilities of an intervention strategy. In this way, if the available ways and means are much less than what is needed, the decision-making authority may be forced to:

- postpone the intervention and wait for reinforcements,
- cancel the intervention.

This analysis of the available and necessary ways and means is constantly evolving. There must be a constant updating of the facts in terms of whether or not:

- the critical situation increases its dimensions,
- the type of critical situation is changed.

Ways and means that can be used

Local resources	Navy Firefighting departments
National resources	Navy Defence department resources Civil defence department resources
International resources (experts, equipment)	European Community

Once the list of available or expected means is completed, the decision-making authority can define the intervention strategy and the various priorities of action.

d) <u>Definition of strategies and tactics</u>

Generally, a spill of hazardous substances implies a propagation of chemical pollutants in the air as in the water.

Response operations purpose is to stop or at least reduce this pollution:

- by limiting or stopping the spill,
- by avoiding future spills,
- by extinguishing sources of fire or explosion,
- by recovering toxic chemicals floating on the water surface,
- by neutralising the chemicals spilled...

These actions can be grouped under three main headings:

1. Preventive measures which aim to avoid any extension of the critical situation.

2. Corrective measures which aim at concluding the critical situation.

3. Restoration measures which attempt to bring the marine environment back to its original condition.

It should always be kept in mind that the first two groups of measures are generally implemented from the ship, while the third group is usually undertaken on the shore. The three groups of measures or actions are also completed by a monitoring of the situation.

III. Implementation

The implementation phase consists in setting up and putting into action, in order of their priority, the various preventive or corrective strategies designed to put an end to a critical situation.

We must emphasise that protecting human lives is always the first and foremost priority. This includes protecting the population as well as the personnel involved in the intervention. The various techniques and tactics which will be presented during the training programme fit any chosen strategy.

IV. Feed back

This systematic approach to an emergency intervention is a dynamic method which is well used in the face of a chemical threat since any chemical threat is, by its very definition, a situation in constant evolution. Feed back is the last but far from least of the four phases of the approach system. This final phase requires a constant re-evaluation of the entire process, in order to make sure that nothing new has occurred that might necessitate a change in the response plans.

This permanent evaluation cannot be achieved unless the "monitoring measures" have been well fixed. We need to measure and evaluate not only the substances involved, but all factors and parameters likely to alter the situation (weather conditions, ways and means availability, actions which have been undertaken, personnel fatigue, etc.).

This continuous control of the situation means that the decision-making approach method is constantly functioning, examining, re-examining, re-evaluating.

Even before any real change occurs in a situation, the responsible authorities should try to anticipate any evolution which might take place in the present circumstances.

CONCLUSION

a) Measuring the efficiency of the method

According to various publications specialised in the field, we have selected 7 major criteria which enable us to determine whether the procedures for decision-making are of good quality. The decision-making authority must be able to accomplish the following, if his decision is to be the best possible:

1. Seek out a large field of alternative actions.

2. Take into consideration all the possible objectives in order to satisfy them, as well as to satisfy the underlying values implied in their choice.

3. Carefully estimate, in so far as possible, the costs and the risks, as well as the positive and negative consequences which could be the result of every conceivable action.

4. Seek out new, pertinent information concerning a future evaluation of the alternatives.

5. Make out properly any new piece of information and take it into consideration, even if it does not corroborate the initial intervention strategy.

6. Before making a final decision, re-examine the positive and negative consequences of every alternative, including those initially considered as unacceptable.

7. Ascertain that the chosen plan of action is fulfilled.

b) <u>Advantages of the method</u>

The main advantage of this type of disciplined approach method is to unite the various decision-making organisations around a common objective. The method provides a series of actions for decision-making which will reduce the risks of conflicts related to the choice of priorities, to different opinions concerning the way in which a situation is managed.

If this method is used during a real or test situation, its advantages are clearly seen, such as:

- if all the intervention personnel use the same method, there will be a better understanding of the vital decisions which are made,

- the simple, logical approach of the method is easily understood and easily used by all the intervention personnel,

- the use of lists which continually recapitulate the situation guarantees that the pertinent facts will be taken into consideration and none of them will be forgotten,

- the system is a great help in establishing priorities,

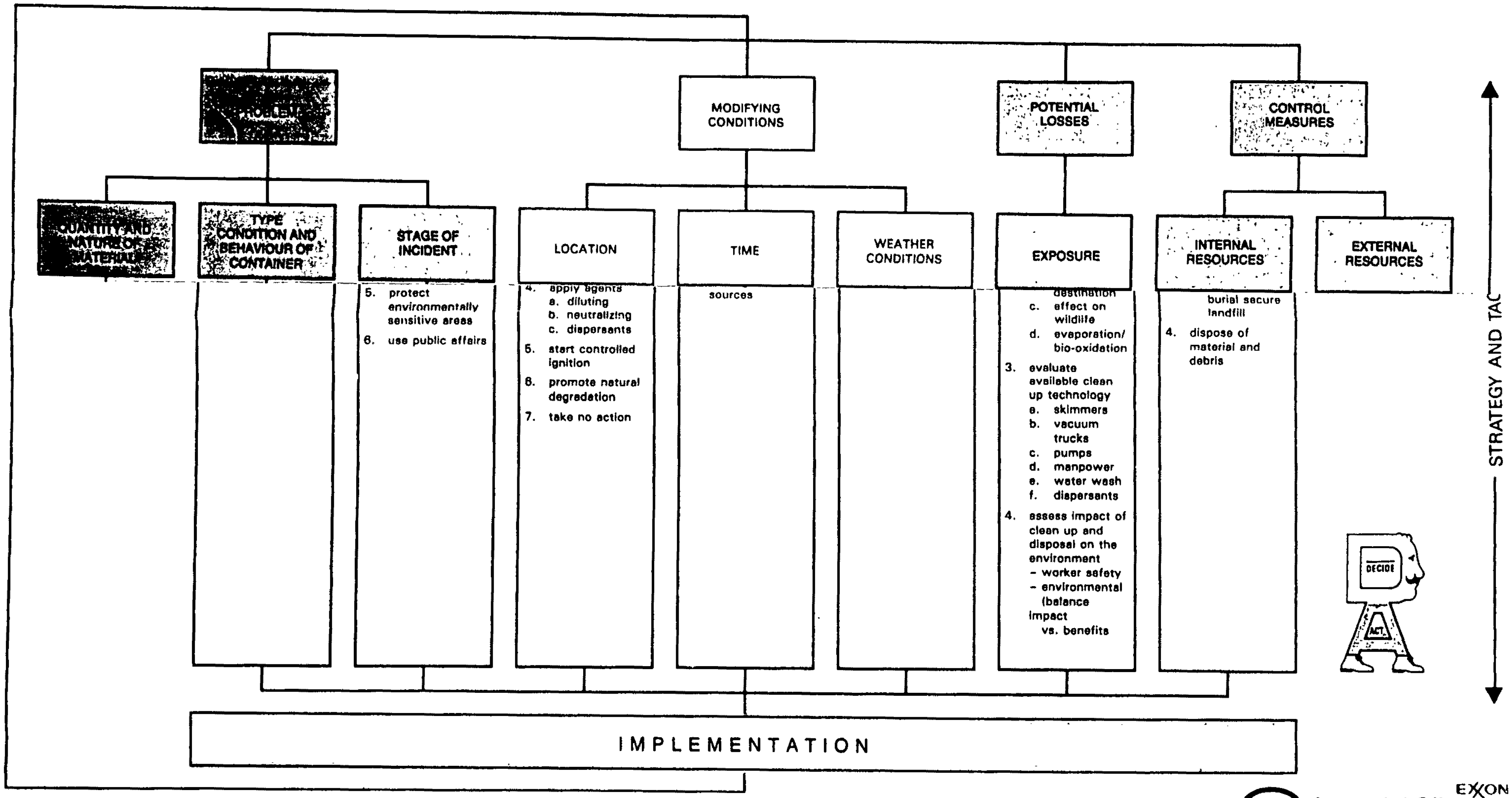
- the method enables the response means to be used to their best advantage,

- finally, the method increases the safety of the intervention teams and the general public.

A systematic approach to an emergency intervention requires that those who use the method have open minds, a good sense of humility, and a great deal of discipline.

A Disciplined Approach to Emergency Response

(A process to help protect lives property and the environment in an efficient manner)



Developed by Imperial Oil Limited Canada. Slight modification for application worldwide made by Exxon Chemical International Inc.

Esso Imperial Oil EXXON CHEMICAL

NOTES

Marseilles

ACCIDENTAL POLLUTION: CRISIS AND INFORMATION MANAGEMENT
CASE HISTORY: THE IEVOLI SUN CASUALTY

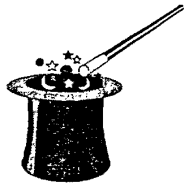
NOTES

ACTIONS TAKEN IN REFINERIES TO MEET ENVIRONMENTAL PROTECTION REQUIREMENTS

NOTES

LES PROBLEMES, LES TECHNOLOGIES ET LES PERSPECTIVES DE DEMAIN

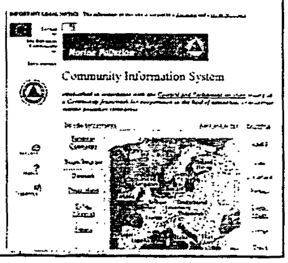
PROBLEMS, TECHNOLOGIES AND PROSPECTS OF TOMORROW



INFOPOL, Brest, May 2002

Des préoccupations, des règles, des organisations différentes

Different
- *Concerns*
- *Rules*
- *Organisations*



Un point commun : la sensibilité et la demande du public augmentent

A Common Point : Public Sensitivity and Demand increase

Une clé : chaque accident majeur ouvre la porte à un flux de changements

A key : each major accident opens the door to a flow of changes

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CHANGEMENT

=

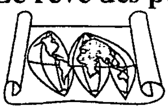
Rêve ou cauchemar ?

CHANGE

=

Dream or Nightmare ?

Le rêve des politiques et du public : plus jamais ça !



The dream of the politicians and public : never again !

- **des mesures de sécurité absolues,**
- **des coûts de pollution dissuasifs**

- ***Absolute safety measures,***
- ***deterrent pollution costs***

Le rêve du contribuable : que les pollueurs payent

The taxpayer dream : make polluters pay

- A travers une responsabilité solidaire de tous les acteurs de la chaîne conduisant à une pollution
- *Through a joint responsibility of all parties in the chain of events leading to a pollution*

Le rêve des juristes : faire payer l'Etat imprudent

The Lawyers Dream : make the careless State pay

- De préférence l'Etat du pavillon, mais aussi celui du port
  (= poche profonde des contribuables)
- *Preferably the Flag State, but also the Port State*
  (= taxpayers deep pocket)

Le rêve des écologistes : le dommage environnemental

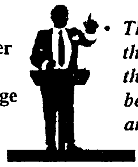
The Dream of Ecologists : Environmental Damage

- En argent ou en mesures de restauration ?
- Jusqu'où et au bénéfice de qui ?
- *In Monetary Value or in Restoration Measures ?*
- *Up to what Point and for Whose Benefit ?*

Le rêve des victimes : retourner la charge de la preuve

The Dream of Victims : reversing the Charge of the Proof

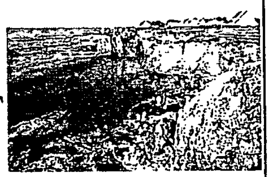
- Que ce soit au pollueur de prouver l 'absence de lien entre mon dommage et sa pollution

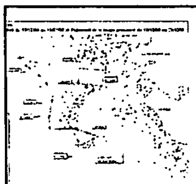


- *That I would be for the polluter to prove the absence of a link between my damage and his pollution*

LES TENDANCES DE LA GESTION OPERATIONNELLE
Mieux, moins cher

TRENDS OF OPERATIONAL MANAGEMENT
Better, cheaper



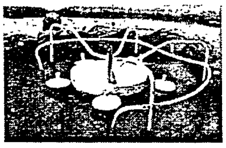


Une planification et des prévisions précises
Accurate Planning and Predicting

- Un prépositionnement et des mouvements de moyens parfaits
- Grâce à une prévision de dérive et d'évolution sans faille

- Ideally prepositioning and moving response means
- With Fully accurate slick drift and weathering prediction

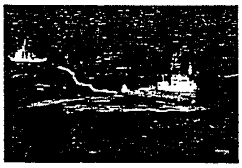
Stocks performants et assistance mutuelle
High Performance Stockpiles and Mutual Assistance



- Chez les opérateurs privés et publics
- Partager est une force, pas une faiblesse

- ***At Private and Public Levels***
- ***Sharing is Strength, not Weakness***

Frapper fort, puis ajuster les moyens
Striking hard first, then adjusting Means



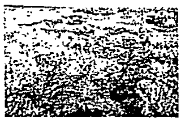
- **Une nécessité face à la demande du public**
- **Une source de conflit majeur avec les payeurs**

- ***A Need in Front of Public Demand***
- ***A Major Source of Conflict with the Payers***

Le principe de précaution : fermer ou détruire si nécessaire
The Precautionary Principle : Close or Destroy if needed

Interdire des lieux, des récoltes, des ventes, avec des justifications valables

- ***Forbidding Access to Places, Sales, Harvests, with proper Justification***

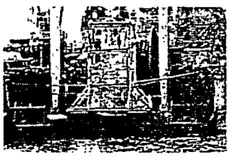


Réparer le dommage environnemental
Repairing Environmental Damage

- Accélérer quand c'est possible la restauration naturelle,
- Payer la perte
- Et en profiter pour faire un peu mieux qu'avant ?

- *Accelerate when Possible Natural Restoration,*
- *Paying the loss*
- *And using the Opportunity to improve Things a little ?*

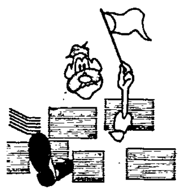
Traiter les épaves et les déchets vite et complètement
Treating wrecks and waste fast and fully



- Pour ne pas laisser des problèmes complexes et coûteux à ceux qui viendront après

- *To avoid leaving complex and costly Problems to Those who will come after*

LES NOUVELLES MISSIONS IMPOSSIBLES



THE NEW IMPOSSIBLE MISSIONS

Où diriger un navire endommagé ?

Pas vers ma côte, pas vers mon port

Where to take a stricken vessel ?

Not to my coastline, not to my port

Apprendre à gérer les bénévoles

Où ils veulent, quand ils peuvent

Learning to make use of Volunteers

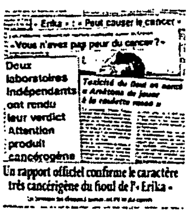
Where they want, when they can

Etablir et faire connaître la vérité scientifique

Qui est en danger de cancer ?

Establishing and disseminating scientific evidence

What about Cancer Hazard ?



« Erika » : « Peut causer le cancer »

« Vous n'avez pas peur du cancer ? »

Deux laboratoires indépendants ont rendu leur verdict Attention produit cancérogène

Un rapport officiel confirme le caractère très cancérigène du fioul de l'« Erika »

Etablir la « mesure raisonnable » acceptable par tous

Establishing the « Reasonable Measure » acceptable by all

Parvenir à une gestion coordonnée de l'indemnisation
malgré les divergences d'intérêts

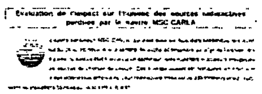
Reaching a Coordinated Management of the Financial Compensation
in spite of diverging interests

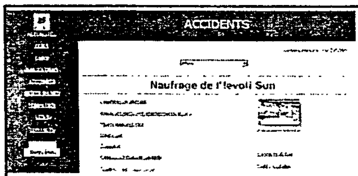
LA BATAILLE SUR LE FRONT DE L'INFOR-MATION

BATTLING ON THE INFORMATION FRONT

Le triangle impossible : savoir avant la presse, l'informer à temps, en être cru

The impossible triangle : know before the press, inform it in time, be believed





Le nouveau défi : gagner la bataille sur Internet

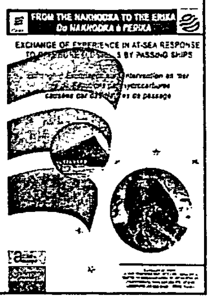
The new challenge : winning the battle on the Internet

VOTRE DEVOIR : être prêt pour l'impossible, il arrivera demain !

YOUR DUTY : being ready for the impossible, it will happen tomorrow !

VOS ARMES :

Une solide expérience au service d'une recherche de consensus



YOUR WEAPONS :

Solid Experience serving a Consensus Search

ERIKA OIL SPILL

Shoreline response :

organisation & management

loïc Kerambrun
Cedre

ERIKA OIL SPILL

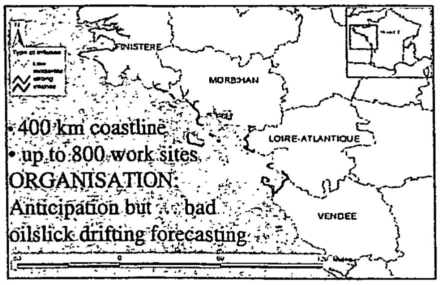
summary

- General context
- organisation (command scheme)
- response (steps)
- resources involved
- innovation (management)
- cleanup (main issues)
- Waste management
- ecological impact
- results

The pollutant : FO6

- about 20 000t spilled in extreme sea conditions, during several days
- *30 to 40 000 t of emulsion onshore*
- dispersibility and biodegradation : poor
- *viscous & persistent*

Oil on the shoreline



• 400 km coastline
• up to 800 work sites
ORGANISATION:
Anticipation but : bad
oilslick drifting forecasting

Shoreline Response Context

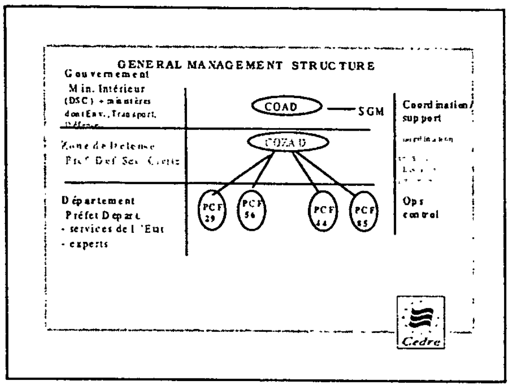
crisis (december 2000)

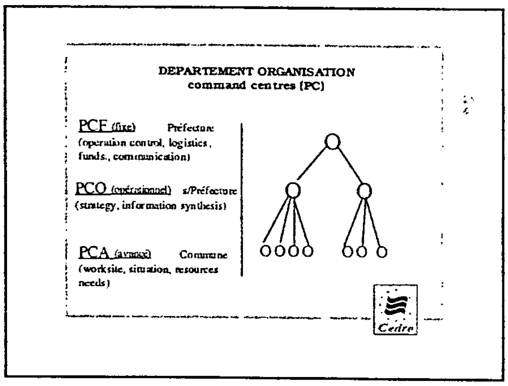
- End of the year : Xmas / Y2K bug
- meteo
  severe conditions (floods, storms)
  winter (daylight / temperature)
- pollutant

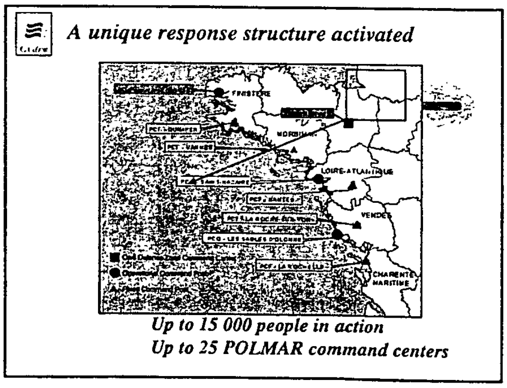
(viscous / unceassant oil arrivals)

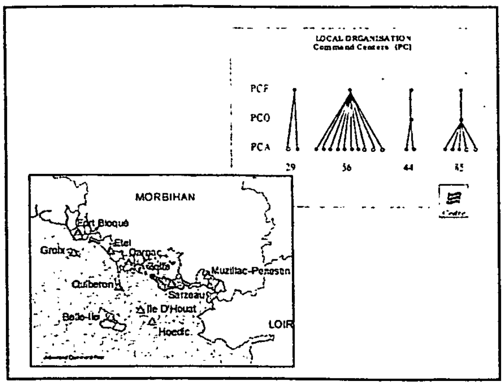
Shoreline Response Organisation

- instruction Polmar du 17/12/97
- a hierarchical command and coordination structure


GENERAL MANAGEMENT STRUCTURE
Gouvernement
Min. Intérieur
(DSC) + ministères
COAD
SGM
Coordination support
COZA D
Département
Préfet Départ.
- services de l'Etat
- experts
PCF 29
PCF 56
PCF 44
PCF 85
Ops control
Cedre


DEPARTEMENT ORGANISATION
command centres (PC)
PCF (fixe) Préfecture
(operation control, logistics, funds., communication)
PCO (opérationnel) s/Préfecture
(strategy, information synthesis)
PCA (avancé) Commune
(worksite, situation, resources needs)
Cedre


A unique response structure activated
FINISTERE
MORBIHAN
LOIRE-ATLANTIQUE
VENDEE
CHARENTE MARITIME
Up to 15 000 people in action
Up to 25 POLMAR command centers



Command Centre / organisation

Informations	Operations	Logistics
Health	Human Resources	Finances
Relations	Equipment resources	Wildlife Environment

Shoreline response: Steps

A long 4-step story :

- December -January 2000 : crisis
- Feb- mid July 2000: planified response
- Summer 2000: beach openning
- Autumn '00 - Summer '02: final cleaning

A long story : why?

- Type of oil : viscosity and persistance
- Type of pollution : successive arrivals of fuel
- Bad meteorological and sea states conditions

- Awarding public contract procedures in the frame of European market

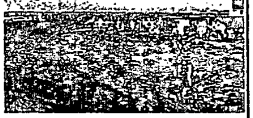
Shoreline response Phase 1

Dec. 99 - end Jan.

OIL REMOVAL

- + Prep. Phase 2
  - general cleaning plan (needs) / worksites definition (priorities)
  - protocole Etat - TotalFina (cleanup / waste)

Large mobilization of human resources



Shoreline Cleanup Phase2

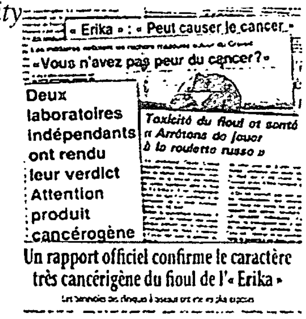
Feb. 2000 July 2000

Oil REMOVAL + CLEANING

- beach clean and safe in time
  - Polmar human means (firefighters, Army, Civil Security Corps),
  - volunteers
  - private sector
- Threat Wreck (repollution)
- wildlife (huge bird toll : > 60 000 oiled birds collected)

Fuel toxicity

Fighting the "they are hiding the real danger" (i.e. cancer)


« Erika » : « Peut causer le cancer »

« Vous n'avez pas peur du cancer? »

Deux laboratoires indépendants ont rendu leur verdict Attention produit cancérogène

Toxicité du fioul et santé « Arrêtons de jouer à la roulette russe »

Un rapport officiel confirme le caractère très cancérigène du fioul de l'« Erika »

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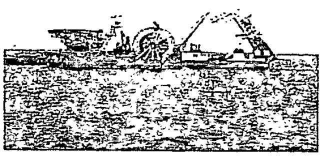
summer 2000 : - slowdown of beach cleaning - wreck pumping

- Wrecks sunk on fishing grounds, at 120 m deep. =12 000t pumped in 2 months.

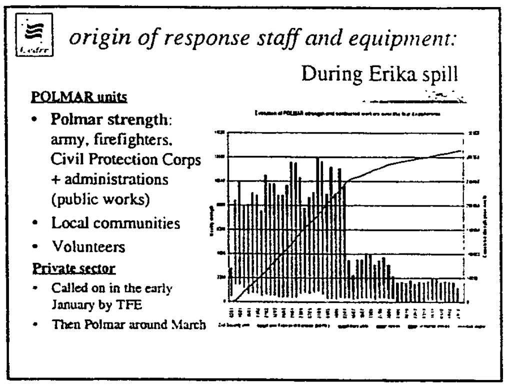


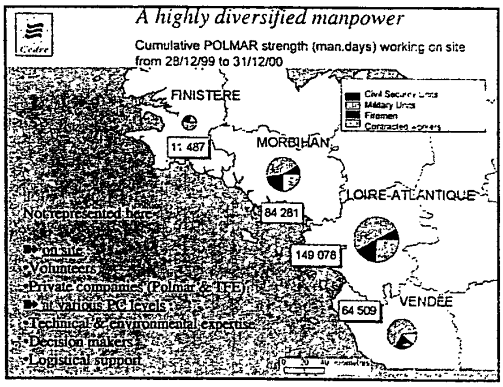
Shoreline Cleaning Phase2

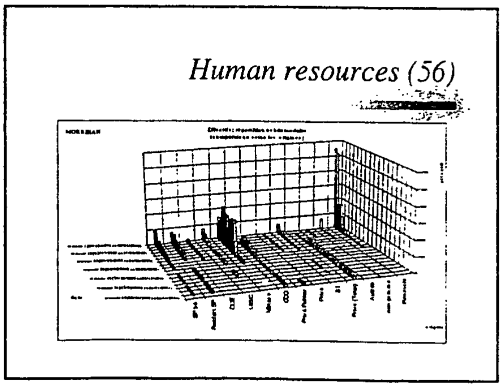
Sept. 2000 - Jun. 2002

Removal of new arrivals and high pressure cleanup

- Polmar ressources decreasing
- Private oil spill response companies


origin of response staff and equipment:
During Erika spill
POLMAR units
• Polmar strength: army, firefighters, Civil Protection Corps + administrations (public works)
• Local communities
• Volunteers
Private sector
• Called on in the early January by TFE
• Then Polmar around March


A highly diversified manpower
Cumulative POLMAR strength (man.days) working on site from 28/12/99 to 31/12/00
FINISTERE
MORBIHAN
LOIRE-ATLANTIQUE
VENDEE
84 281
149 078
64 509
Military Units
Firemen
Not represented here:
on site
•Volunteers
•Private companies (Polmar & TFE)
at various PC levels
•Technical & environmental expertise
•Decision makers
•Logistical support


Human resources (56)
MORBIHAN

Human Resources
(constraintes)

- Military / Firefighter support
  - availability (meteo, fires, fund)
  - short stay / relieve without overlap
  - accomodations / restauration
- volonteers
  - responsability ?
  - delicate management (reception, accomodation, rest.)
  - supervision / efficiency / impact ?
- private companies
  - not numerous
  - local engaging sometimes difficult

Equipment Resources
(origin)

- Stock Polmar
- Polmar Funds
  - purchase (spécific equipment : NHP, beach cleaners ; clothes, tools and ancillary equip.)
  - contract (heavy equipment)
  - requisitionning (maritime transport)
- TotalFina purchase (NHP, pump, beachcleaner)
- communes
- private gifts (beachcleaner, quads)

Logistics

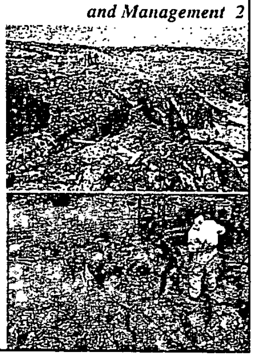
- equipment : DDE / firefighters / CG
  (Communes)
- *constraints*
  - supplying (fabrication time)
  - transport towards islands
  - maintenance / repairing
  - requests (fabricants, « inventeurs »)
- waste
  - DDE : evacuation / intermediate storage
  - TotalFina : heavy storage /treatment-disposal

Innovations in the Response Organization and Management 1

- **Involvement of the freighter in the cleanup.**
- **Creation of short-term jobs**
- **Recourse to private companies**
- **Field Training**

Innovations in the Response Organization and Management 2

- **Environmental Evaluation Commission**
  - DIREN experts (botanists, geomorphologists, and biologists)
  - representatives of nature protection associations,
  - *Cedre* experts,
  - state administration representatives,
  - elected representatives,
  - professionals in marine activities.
- **Technical field instruction**
  field theoretical and practical training (*Cedre*)



Innovations in the Response Organization and Management 3

- **Cleanup evaluation and termination team**
  - *Cedre* expert,
  - DIREN expert,
  - elected representative,
  - a member of the POLMAR Advanced Command Post
  - ITOPF, IOPC
  - TotalFina
- **Procedure for opening public beaches**
  - Department of Social and Sanitary Affairs,
  - same as cleanup evaluation

Beach Cleanup june- july 2000

Saving the summer season

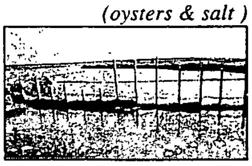
- Making so that beaches are safe and clean in time
- Convincing the public that they are and will remain so

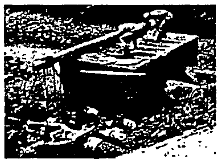
Global strategy for the cleanup

- **Three objectives:**
  - protection of marine cultures
  - limitation of the ecological impact of the spill
  - salvage of the tourism season

- **Main difficulties:**
  - marine culture
    intertidal mud flats
    fast tidal current channels
  - ecologically sensitive, natural protected areas
  - difficult access
  - oiled vegetation
  - buried oil
  - underwater oil slicks

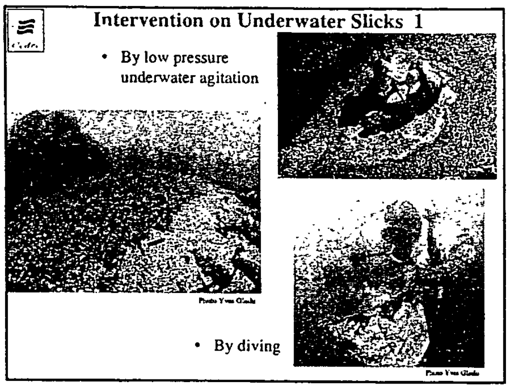
Protection of marine culture (oysters & salt)

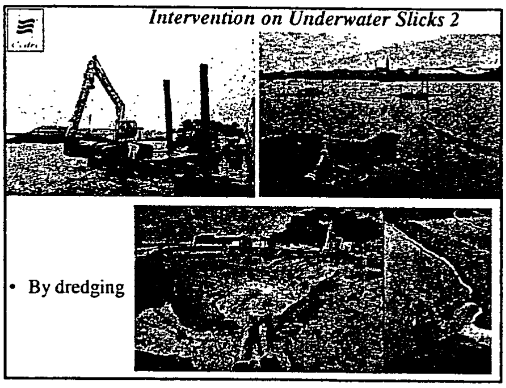


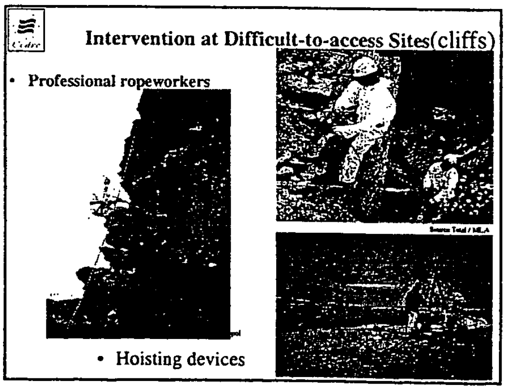


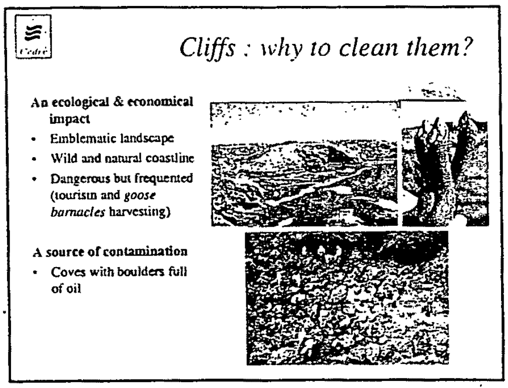
•Filtering barriers in high current creeks

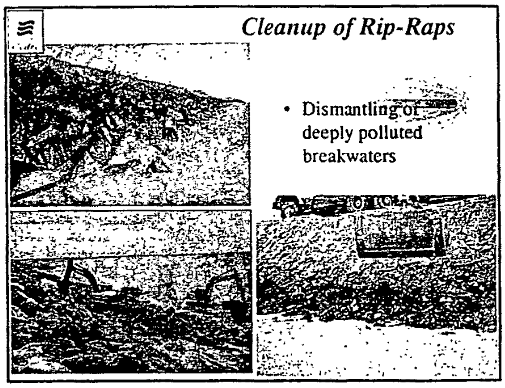
•Filtering devices for water intakes

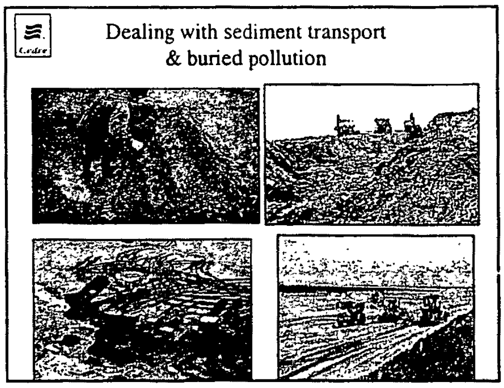

Intervention on Underwater Slicks 1
• By low pressure underwater agitation
• By diving


Intervention on Underwater Slicks 2
• By dredging


Intervention at Difficult-to-access Sites(cliffs)
• Professional ropeworkers
• Hoisting devices

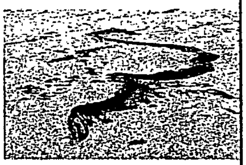

Cliffs : why to clean them?
An ecological & economical impact
• Emblematic landscape
• Wild and natural coastline
• Dangerous but frequented (tourism and goose barnacles harvesting)
A source of contamination
• Coves with boulders full of oil


Cleanup of Rip-Raps
• Dismantling of deeply polluted breakwaters


Dealing with sediment transport
& buried pollution

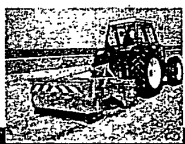
Cleanup of Sand and Pebbles 1

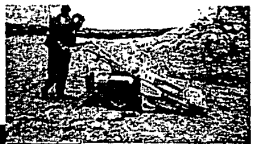
- Surf washing in the high-energy wave-breaking zone
- Anchored nets for fuel recovery



Cleanup of Sand and Pebbles 2

- screening machines





- Pebble cleaning in concrete mixers

Cleanup of Rocks and Other Hard Surfaces

- Use of Geotextile sheets:
  - protection,
  - filtration and recovery of the effluent
- low pressure/ hot water

Intervention in Ecologically Vulnerable Areas

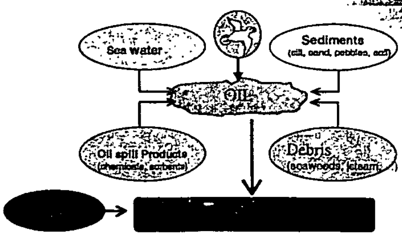
- Traffic canalization:
  - Geotextile sheets
- Damage limitation
  - low-pressure tyres vehicles

Cleanup of Oiled Vegetation

Botanical worksites

Helping vegetation recovery

WASTE COMPONENTS depend of: polluant, sites/substrates, techniques and means used



STORAGE SITES - AIM

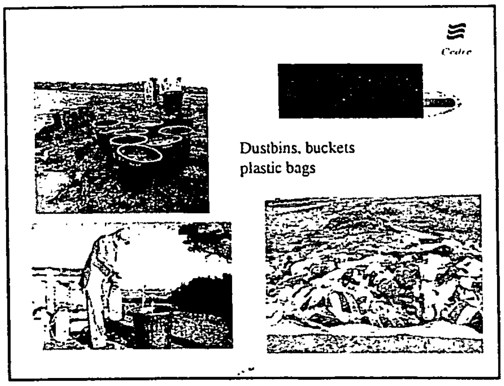
- GATHERING
- SORTING
- PRE-TRAITEMENT
- RE-PACKAGING
- PREPARING OF TRANSFERT

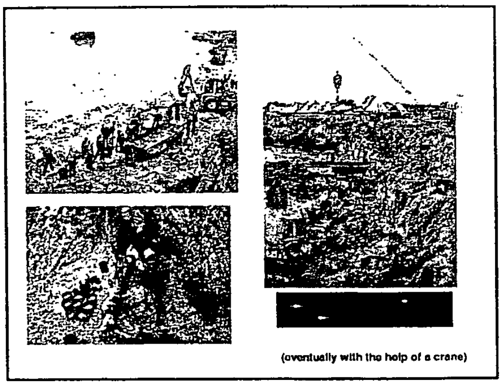
STORAGE SITES - TYPES

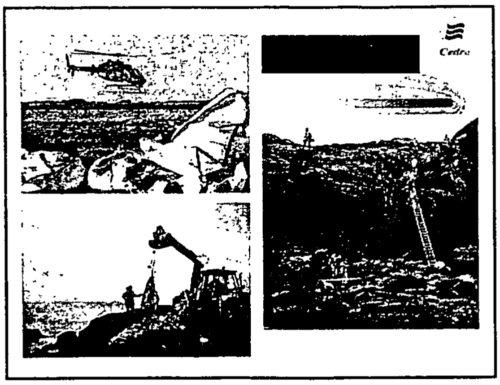
• PRIMARY STORAGE	• small size • near the beach • short life
• INTERMEDIATE STORAGE « buffer » storage	• bigger size • longer life
• « HEAVY » STORAGE	• potentially huge site and of long duration

ORGANIZING THE STORAGE & TRANSFERT PROCEDURES

- DEFINE AS SOON AS POSSIBLE THE NECESSARY AND APPROPRIATE MEANS ACCORDING TO :
  - *LOCAL AVAILABILITY : RISK ASSESSMENT, NEARNESS, ACCESSIBILITY*
  - *RECOVERED WASTE : TYPE AND VOLUME*
  - *WORKSITES : NUMBER, RECOVERY DEBIT*
  - *TRANSFERT MEANS : AVAILABILITY, CAPACITY, DEBIT, TRAFFIC*
  - *FURTHER SITES : STORAGE CAPACITY, TREATMENT RATE*


Dustbins, buckets
plastic bags


(eventually with the help of a crane)



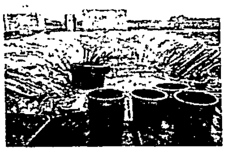
[redacted]

- Guédel - - Belle-Ile

[redacted]

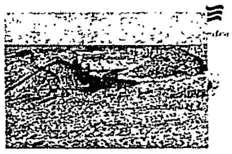
STORAGE SITE MANAGMENT

- *CONTROL OF POTENTIAL LEAKS AND CONTAMINATION (WATERPROOFNESS, DRAINAGE)*
- *SEGREGATION OF WASTE*
- *ORGANIZATION OF TRAFFIC*
- *CONTROL OF THE UNLOADING*
- *RECORDING (DAILY VOLUME, TYPE, ORIGINE OF WASTE)*
- *CLEAN AND RESTRICTED AREA*



waterproofing

sorting



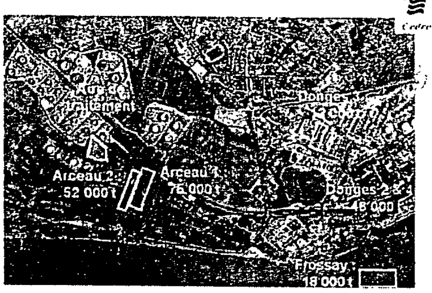
Wild or uncontrolled deposit

No sorting

What to avoid

Due to :
- *saturation,*
- *lack of storage capacity*
- *negligence,*
- *no signposting,*
- *no surveillance*

' HEAVY ' STORAGE



[redacted]

ERIKA / ECOLOGICAL IMPACT

- *OIL*
- It is not the Amoco Cadiz Oil Spill : no heaps of carcass of dead benthic animals washed ashore
- an impact limited to the deposit sites (smoothering) , no dispersion in the water column (low toxicity) = possible recruitement from the edges
- but HECATOMB among SEA BIRDS
- *RESPONSE OPS*
- « Unavoidable », but « relatively limited » impact considering the duration of the response and the numerous worksites

•sites opening : access
•worksites setting up
•waste storage sites
•sediment removal

ERIKA BILAN

Effectifs (hxj)

- 29 : 11 000 *(31/12/00)*
- 56 : 150 000 *(15/04/01)*
- 44 : 170 000 *(31/03/01)*
- 85 : 65 000 *(31/12/00)*

total: 400 000 h x j

- Déchets (t)
- 29 : 1 100 *(07/12/00)*
- 56 : 25 000 *(15/04/01)*
- 44 : 135 000 *(07/12/00)*
- 85 : 42 000 *(07/12/00)*

total: 200 000 t

ERIKA : operation in progress

➪ cleaning worksites

- Finistère (over / mid- 2001)
- Loire Atlantique (over / end of 2001)
- Vendée (over / early 2002)
- *Morbihan (till june 2002)*
  Belle-Ile (cove + underwater slicks)

➪ Restauration operations

➪ Ecological monitoring

On 12th December 1999 the "Erika", carrying 31,000 tons of heavy fuel oil, broke up in the Bay of Biscay approximately 60 miles off the Brittany Coast. She caused some of the most extensive oil pollution ever seen in Europe, affecting 400 kilometres of the French Atlantic Coastline. This video is an account of the spill and of the intensive clean up which followed it.

Produced in association with

The Steamship Mutual Underwriting Association (Bermuda) Ltd.

and

STEAMSHIP

Steamship Insurance Management Services Ltd.

In co-operation with

The International Tanker Owners Pollution Federation Ltd (ITOPF)

with thanks to

The International Oil Pollution Compensation Funds.

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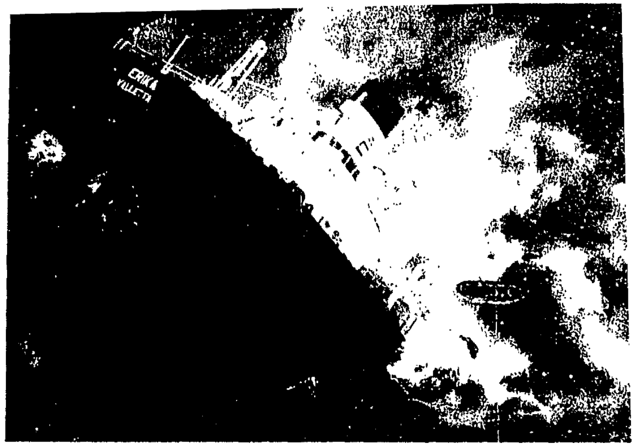
Running Time approx. 30 minutes. Stereo 4:3

STEAMSHIP

ERIKA

The Black Tide



ERIKA
The Black Tide

Presented by Edward Stourton

Figure 1: Numbers of spills over 700 tonnes

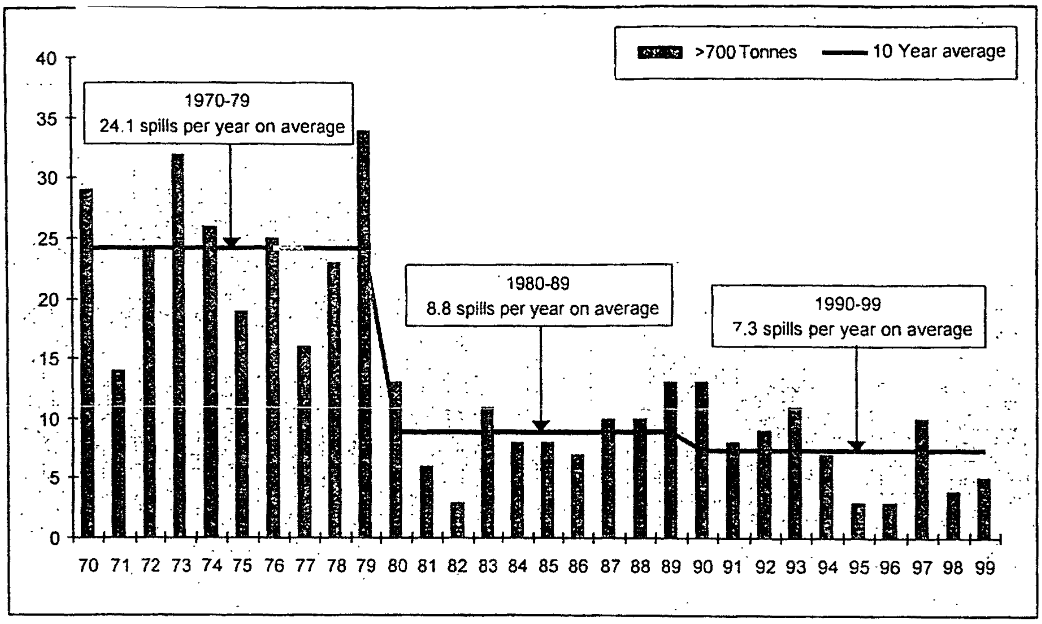
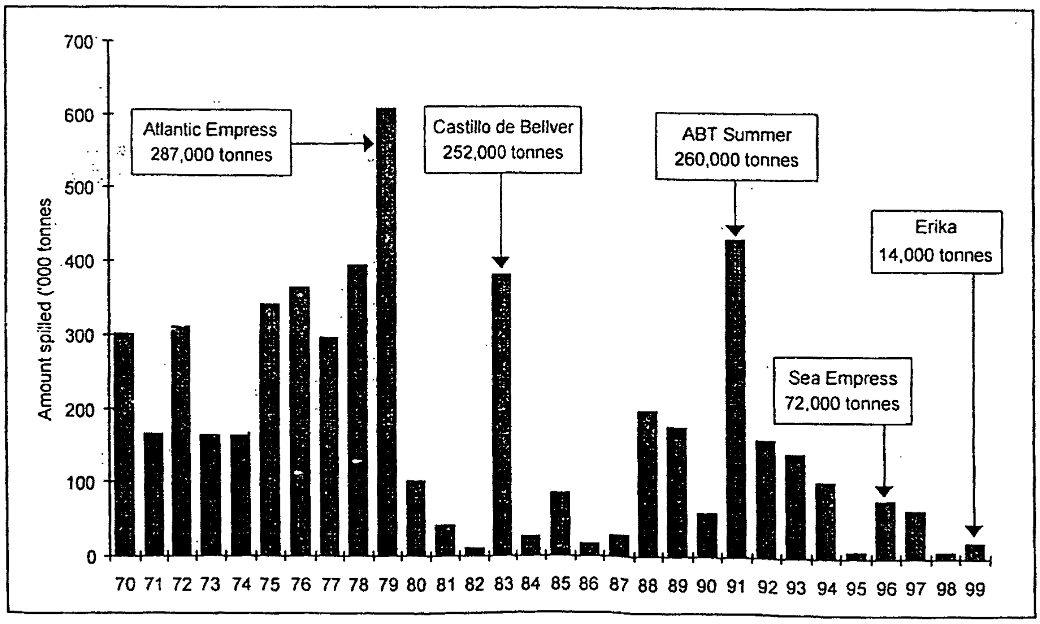
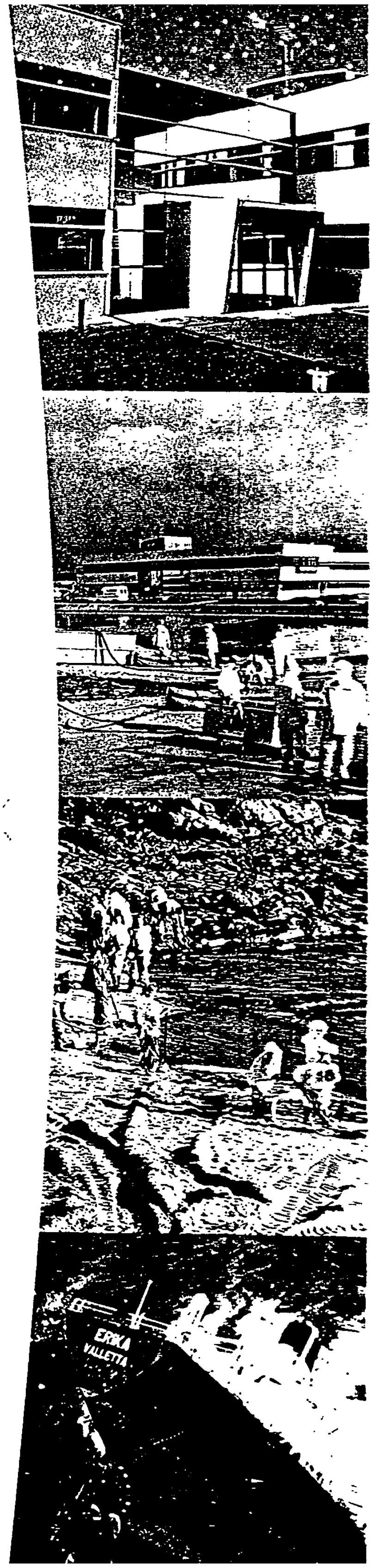


Figure 2: Quantities of oil spilt



Cedre



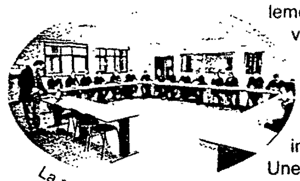
CENTRE DE DOCUMENTATION DE RECHERCHE ET D'EXPERIMENTATIONS SUR LES POLLUTIONS ACCIDENTELLES DES EAUX

CENTRE OF DOCUMENTATION, RESEARCH AND EXPERIMENTATION ON ACCIDENTAL WATER POLLUTIONS

Le *Cedre* a été créé en 1978 dans le cadre des mesures prises suite au naufrage du navire pétrolier "*Amoco Cadiz*" pour améliorer la préparation à la lutte contre les pollutions accidentelles des eaux et renforcer le dispositif d'intervention français.
Il est responsable, au niveau national, de la documentation, de la recherche et des expérimentations concernant les produits polluants, leurs effets, et les méthodes et moyens spécialisés utilisés pour les combattre.
Sa mission de conseil et d'expertise englobe aussi bien les eaux marines que les eaux intérieures.
Son financement est assuré par des subventions et des contrats publics et privés.

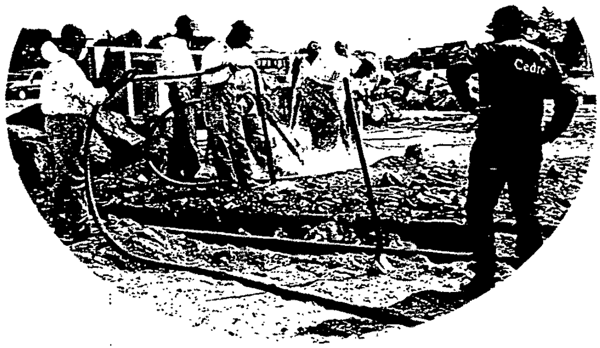
Cedre was created in 1978 within measures taken after the wreckage of the oil tanker "Amoco Cadiz", to improve preparedness against accidental water pollution and strengthen the national response organisation.
It is responsible, at national level, for documentation, research and experimentation on pollutants, their effects and the response means and tools to combat them.
Its expertise encompasses both marine and inland waters.
Its budget comes from contracts and public and private subsidies.

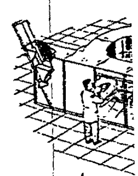
TRAINING


La salle de conférences

Un site comme celui du *Cedre* n'existe nulle part ailleurs. Il est spéci lement conçu et aménagé pour entraîner les personnels d'inte vention à la lutte contre les pollutions accidentelles du littoral des zones portuaires. Ce site permet des déversements rée de polluants sur une plage artificielle de 6 000 m2 et dans u bassin profond de 4 000 m3 pour les engins flottants. U large panoplie de matériels et produits de lutte complète c installations.
Une équipe de formateurs professionnels organise régulièreme des stages généraux ou spécialisés, en français ou en anglais, qui pe mettent aux personnels concernés de se confronter à une gamme exce tionnelle de situations réelles, dans les meilleures conditions.

Our site is unique and especially designed and equipped to train response personn for accidental pollution on the shoreline and in ports. It allows real spills of pollutan on a 6.000 square metres artificial beach and in a deep-water basin of 4.000 cub metres to carry out experiments on floating devices with a complete set of respons equipment and products. A team of professional traine organises general or specialised courses, in Frenc or in English, allowing the personnel concerne to confront with an exceptional range of re situations, under the best conditions.




Le pollu

PRÉPARATION À LA LUTTE

RESPONSE PREPAREDNESS

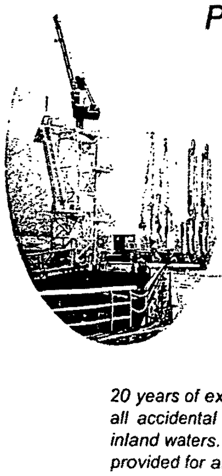
INFORMATION COMMUNICATION

INFORMATION COMMUNICATION

Le *Cedre* fournit de l'information écrite e photographique par l'intermédiaire de s documentation, de son site Internet et e publiant une lettre, un bulletin et des guide opérationnels.


La documentation

Guides, reports photographs, monthly news letter and half-yearly bul letin are availa ble at Cedre's library and from its website.



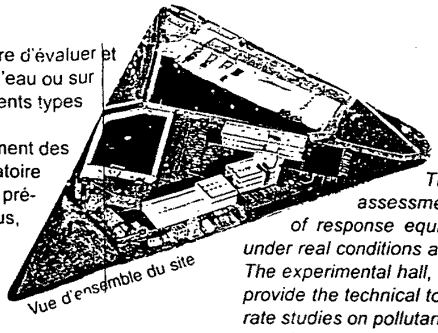
AUDITS PLAN

AUDITS PLANS

20 années d'expérience internationale ont permis au *Cedre* de mettre au point une méthodologie d'analyse de tous les risques de pollutions accidentelles. Cette expertise s'applique aussi bien à des sites industriels, à des façades littorales, à des ports qu'à des bassins versants. Elle permet d'établir des plans d'intervention et de préconiser des équipements parfaitement adaptés.

20 years of experience at international level enable Cedre to elaborate risk analysis methods for all accidental spills. This expertise applies to industrial plants, harbours or coastal areas and inland waters. Audit service for emergency response plans and equipment recommendations are provided for any situation.

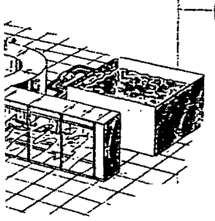
Sur son plateau technique, le *Cedre* est en mesure d'évaluer et de mettre au point tous les matériels de lutte sur l'eau ou sur le littoral, dans des conditions réelles et sur différents types d'hydrocarbures.
Le hall d'expérimentations, l'anneau de vieillissement des hydrocarbures en ambiance contrôlée et le laboratoire offrent tous les services nécessaires à une étude précise des polluants ou des produits de lutte. De plus, le *Cedre* et ses partenaires conduisent régulièrement de larges expérimentations en mer.

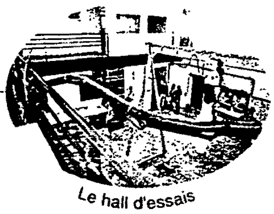


Vue d'ensemble du site

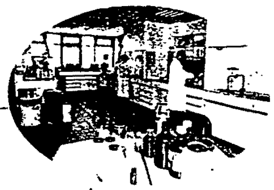
The technical facilities allow the assessment and development of all types of response equipment on water and shoreline under real conditions and with different types of oil. The experimental hall, the flume test and the laboratory provide the technical tools necessary to carry out accurate studies on pollutants or response products. In addition, Cedre conducts extended experiments at sea, with its partners.

RECHERCHE ET DÉVELOPPEMENT
RESEARCH & DEVELOPMENT

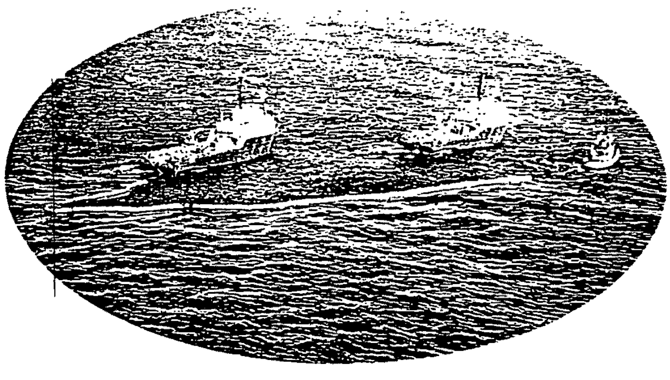




Le hall d'essais



Le laboratoire



SUIVI DES POLLUTIONS
POLLUTION MONITORING

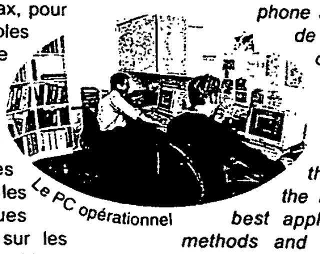
Connaître et faire savoir ce qui se fait ailleurs, tirer des enseignements sur les plans technique et écologique des accidents qui surviennent en France et à l'étranger, suivre l'après-accident : veille technologique et retour d'expérience font aussi partie des missions du Cedre.

To know and let know what is done elsewhere, to learn lessons, at technical and ecological levels, from the incidents which occurred in France and abroad, to follow-up the situation after an incident: technological development monitoring and experience feedback are also part of Cedre's mission.

LUTTE ET OYENS DE LUTTE
RESPONSE ꝫ RESPONSE MEANS

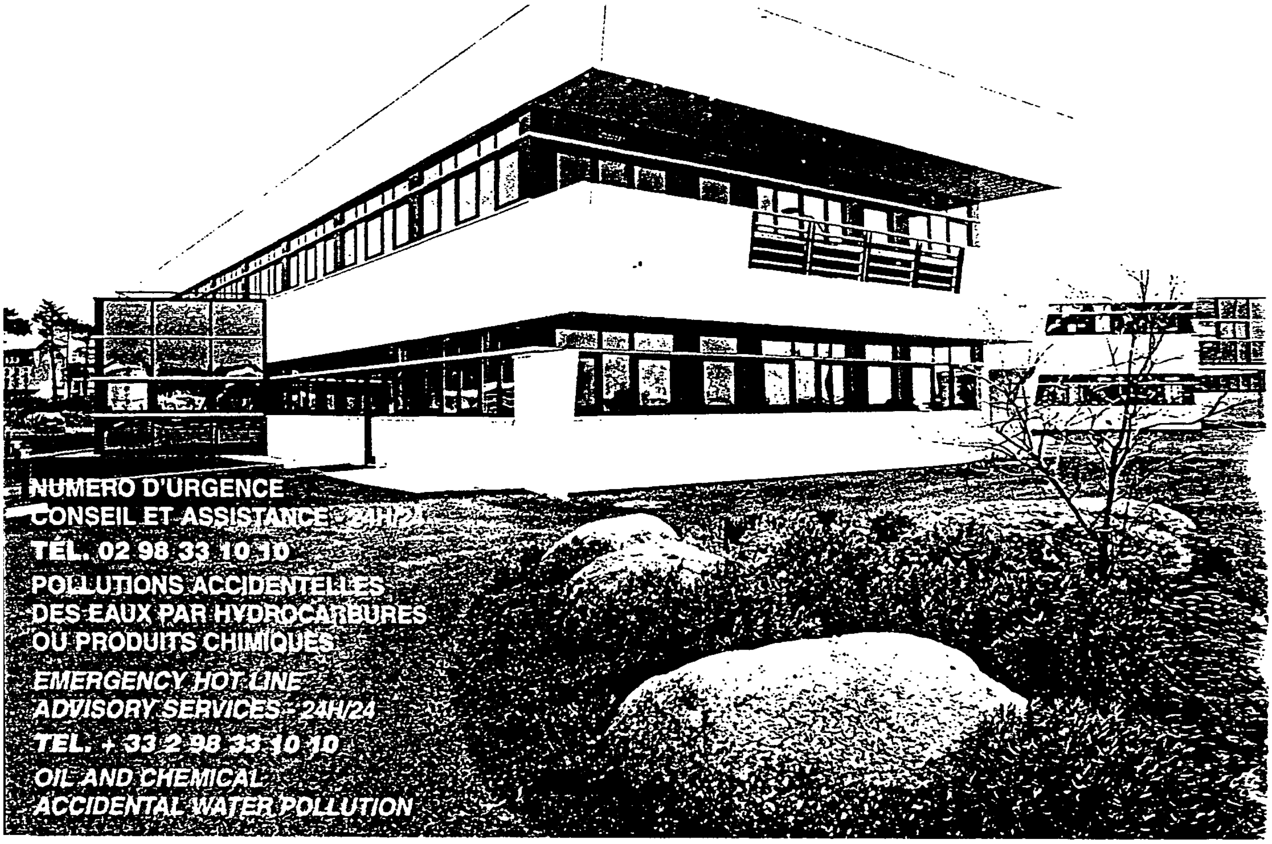
INTERVENTION
EMERGENCY

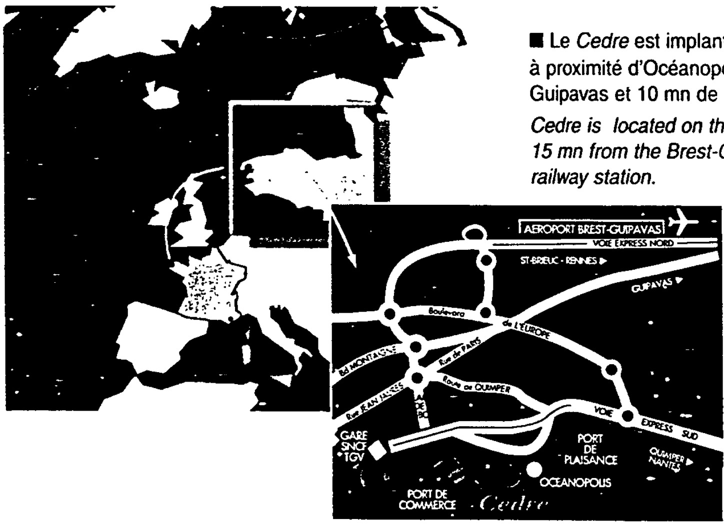
ıe composante essentielle de la ssion du *Cedre* est une permance opérationnelle 24h/24, accesıle par téléphone et fax, pour nseiller les responsables la lutte contre toute llution accidentelle s eaux. Ce conseil rte sur les polluants, ır évolution, leur venir et les risques ils représentent, sur les ıthodes et techniques plicables, ainsi que sur les tériels et produits utilisables.



Le PC opérationnel

An essential component of the mission of Cedre is a 24h/day advisory service, available by phone and fax, to provide those in charge of response to any accidental water pollution with information on the pollutants, their behaviour, the related risks, the best applicable response methods and techniques, the products and equipment to use.





■ Le *Cedre* est implanté sur la zone portuaire de Brest. rue Alain Colas. à proximité d'Océanopolis, à 15 mn de l'aéroport international de Brest-Guipavas et 10 mn de la gare S.N.C.F. de Brest.

Cedre is located on the port of Brest, rue Alain Colas. close to Oceanopolis. 15 mn from the Brest-Guipavas international airport and 10 mn from the Brest railway station.

■ La délégation du *Cedre* pour la Méditerranée est installée sur la base IFREMER Méditerranée à Toulon.

Cedre delegation for the Mediterranean Sea is located on the IFREMER Mediterranean base. at Toulon.

Zone Portuaire de Brégaillon - BP 330 - 83507 La Seyne Mer Cedex
Tél. + 33 (0) 4 94 30 49 93 - Fax. + 33 (0) 4 94 30 13 72

Cedre

Centre de Documentation, de Recherche et d'Expérimentations sur les Pollutions Accidentelles des Eaux
Centre of Documentation, Research and Experimentation on Accidental Water Pollutions
Rue Alain Colas - BP 20413 - F 29604 BREST CEDEX
National : Tél. 02 98 33 10 10 - Fax 02 98 44 91 38
International : Tel. +33 2 98 33 10 10 - Fax +33 2 98 44 91 38
E-mail : cedre@ifremer.fr - Internet : http://www.ifremer.fr/cedre

Cedre

CENTRE DE DOCUMENTATION DE RECHERCHE ET D'EXPERIMENTATIONS SUR LES POLLUTIONS ACCIDENTELLES DES EAUX

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Tél. 33 (0)2 98 33 10 10 - Fax 33 (0) 2 98 44 91 38 - E-mail : cedre@ifremer.fr - Internet : http://www.ifremer.fr/cedre
Association régie par la loi de 1901, sous tutelle du Ministère de l'Environnement - SIRET: 315 429 142 00039 Code APE 731 Z

Création

La création du *Cedre* a été décidée en Conseil des Ministres le 5 juillet 1978, à la suite du naufrage, le 16 mars 1978, du navire pétrolier *Amoco-Cadiz* sur la côte Nord du Finistère (Bretagne). Cette pollution majeure a amené l'Etat français à renforcer considérablement le dispositif de prévention des accidents au large de nos côtes ainsi que l'organisation et les moyens de lutte contre les pollutions accidentelles en mer et le long du littoral.

La mise en place effective du *Cedre* est intervenue le 25 janvier 1979, en application d'une circulaire et d'une instruction du Premier Ministre du 12 octobre 1978, dans le cadre du plan Polmar (journal officiel du 14 octobre 1978).

Creation

The creation of the Cedre was decided on July 5th, 1978 by the Council on Ministers, following the wreckage of the oil tanker Amoco-Cadiz on the north coast of Finistère (Brittany), on March 16th, 1978. This major oil spill induced the French government to significantly reinforce its system for preventing accidents off the French coastline and to improve the organization and methods of pollution response in the event of an accidental pollution at sea or along the shore.

The actual setting up of the Cedre took place on January 25th, 1979, in pursuance of a circular and a directive from the Prime Minister of October 12th 1978 within the framework of the Marine Pollution (Polmar) contingency plan.

Les installations du Cedre depuis mai 1999

Cedre's premises since May 1999

Statut et partenaires

Le *Cedre* est une association régie par la loi de 1901, placée sous la tutelle du Ministère chargé de l'Environnement.

Assurant une mission de service public, le *Cedre* dispose d'un Conseil d'Administration regroupant trois collèges :

- **l'Etat** : représenté par le Secrétariat Général de la Mer et les Ministères chargés de l'Environnement, de la Défense, des Transports et de l'Equipement, de l'Intérieur, de l'Industrie, de la Recherche Scientifique et Technique, de la Pêche et des Cultures Marines ;
- **des Représentants d'organismes publics ou professionnels** : l'Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER), les Agences de l'Eau, l'Institut Français du Pétrole (IFP), l'Union Française des Industries Pétrolières (UFIP), le groupe Rhône Poulenc, le Comité National des Pêches Maritimes et des Elevages Marins, Météo-France ;
- **des membres élus pour 2 ans représentant le littoral français et les autres membres de l'assocation.**

Le *Cedre* est actuellement présidé par Pierre Maille, Président du Conseil Général du Finistère.

L'orientation, le suivi et l'évaluation des activités techniques du *Cedre* sont confiés à un Comité Stratégique. Ce comité est composé de plusieurs collèges représentant :

- **l'Etat et les organismes impliqués dans la protection de l'environnement ;**
- **les activités à risques : les industries pétrolières, les industries chimiques et le transport maritime.**

Le comité stratégique est actuellement présidé par Bernard Tramier, directeur Sécurité-Environnement du groupe TotalFina Elf.

Statut and partners

The Cedre is a non-profit association regulated by the law of 1901, under the supervision of the Ministry responsible for the Environment.

Holding a public service mission, the Cedre has a Board of Directors, composed of three parties :

- ***the French Government** : represented by the Secrétariat Général of the Sea and the Ministries responsible for the Environment, Defence, Transports and Infrastructure, Interior, Research, Industry, Fisheries and Mariculture ;*
- ***representatives of public or professional organizations** : the French Research Institute for Exploitation of the Sea (IFREMER), Regional Water Agencies, the French Petroleum Institute (IFP), the French Union of Petroleum Industries (UFIP), Rhône-Poulenc group, the National Committee for Marine Fisheries and Mariculture, Météo-France ;*
- ***elected members representing the population living along the French coastline and others members of the association.***

The Cedre is at present presided over by Pierre Maille, President of Finistère County Council.

The Monitoring and evaluation of the Cedre's technical activities are the responsibility of a Strategic Committe. This committee includes representatives of :

- ***the French Government and organizations involved in the protection of the environment ;***
- ***Sources of high risks : oil industrie, chemical industries and maritime transport.***

The strategic committee is at present presided over by Bernard Tramier, Safety and Environment Manager of the TotalFina Elf group.

Les missions du Cedre

Le *Cedre* a pour mission de conseiller et d'assister les autorités chargées de lutter contre les pollutions accidentelles des eaux marines dans le cadre de la circulaire et de l'instruction du Premier ministre du 17 décembre 1997, relative à la lutte contre la pollution du milieu marin et aux plans de secours spécialisés Polmar. Son rôle s'étend aux eaux douces par l'instruction relative aux pollutions accidentelles des eaux intérieures annexée à deux circulaires interministérielles du 18 février 1985.
Cette mission intègre une permanence opérationnelle 24 heures sur 24 (tél. : 02 98 33 10 10) pour le compte des autorités chargées de la lutte antipollution.

De manière permanente, le *Cedre* assiste les autorités en matière :

- d'élaboration et de mise à jour des plans de secours spécialisés (ex : plans Polmar Mer et Terre) ;
- d'information sur les politiques et moyens de lutte antipollution ;
- d'amélioration et d'évaluation des techniques et équipements de lutte ;
- d'homologation des produits de traitement des polluants ;
- de préparation de guides d'interventions (ex : sur navire pétrolier en difficulté, ou face au risque chimique) ;
- de formation des personnels d'état-major et des équipes d'intervention (ex : Marine nationale, Directions départementales d'incendie et de secours, Directions départementales de l'équipement, compagnies pétrolières...) ;
- d'organisation d'exercices de lutte antipollution.

Lors d'accidents, le *Cedre* assiste les autorités en matière :

- d'évaluation des risques liés aux pollutions en cause ;
- de choix des techniques et moyens de lutte à utiliser, d'organisation des opérations ;
- d'évaluation des conséquences de la pollution et de la lutte.

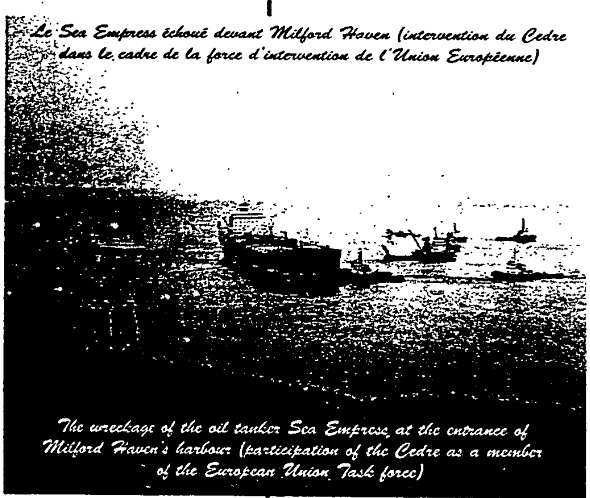
Cette assistance est apportée depuis le *Cedre* et au niveau des états majors de crise ou sur le terrain (ex : aux P.C. avancés ou à bord des navires d'intervention).

Le P.C. du *Cedre* participe à plus de cent interventions par an, en France et à l'étranger. Des spécialistes interviennent sur le terrain 10 à 15 fois par an.

Le *Cedre* participe à la force d'intervention de l'Union Européenne :

Depuis 1987, il fait partie des experts de cette force, chargés d'assister les autorités nationales dans leur lutte contre les pollutions accidentelles. Il a participé dans ce cadre à la majorité des grands accidents de pollution en Europe et à plusieurs interventions hors d'Europe.

Il est, par ailleurs, expert auprès de la Direction Générale Environnement de l'Union Européenne, pour le contrôle des pollutions par hydrocarbures et autres produits chimiques.



Le Sea Empress échoué devant Milford Haven (intervention du Cedre dans le cadre de la force d'intervention de l'Union Européenne)

The wreckage of the oil tanker Sea Empress at the entrance of Milford Haven's harbour (participation of the Cedre as a member of the European Union Task force)

Cedre's missions

The purpose of the Cedre is to advise and assist the authorities in charge of accidental pollution response. Its role in the field of water pollution is specified in the Polmar circular of December 17th 1997 and the interministerial circular directive on accidental inland pollution of February 18th 1985. This includes a 24 hour operational availability to authorities in charge of pollution response (phone : +33 2 98 33.10.10.).

The Cedre permanently provides assistance to the authorities as regards :

- *design and update of response plans (e.g. : sea and land Polmar contingency plans) ;*
- *information on pollution response policies and techniques ;*
- *improvement and evaluation of pollution response means and techniques ;*
- *approval of pollution treatment agents ;*
- *preparation of emergency guides (e.g. for assisting an oil tanker in distress, for response in case of a chemical spill) ;*
- *training of response teams (e.g. teams from the French Navy, the Fire Brigades, the Department of Public Works, oil companies) ;*
- *organization of pollution response drills.*

During an accident involving pollution, the Cedre assists the authorities as regards :

- *assessment of risks due to the pollution in question ;*
- *the choise of the best ways and means to deal with the pollution and the organization of operations ;*
- *assessment of consequences of both the pollution and the response.*

Aid is provided from the crisis office at the Cedre or on site (e.g. : on-site command centre, on board response vessels).

The Cedre provides help in more that a hundred interventions a year, in France and other countries. Its specialists are mobilised on site 10 at 15 times a year.

The Cedre Participates in the European Union Task Force :

Since 1987, it has been a member of the group of experts which have the role of assisting the E.U. and foreign Governments in their response to accidental pollutions. As a member of that Force, the Cedre has participated in most of the major spills in Europe as well as several EU assistance operations outside Europe.

The Cedre also serves as an adviser to the European Commission's Directorate of the Environment, for pollution response to oil and other chemical spills.

Les moyens du Cedre

Les contacts privilégiés du *Cedre* avec les responsables opérationnels et les centres d'informations opérationnels de nombreux pays lui permettent de rassembler rapidement des informations sur les circonstances d'un accident, les produits en cause, les risques pour l'homme et l'environnement, l'équipement de protection à utiliser, les techniques et moyens de lutte à mettre en oeuvre.

Il peut être consulté, pour toute pollution accidentelle des eaux. En cas de déclenchement du plan Polmar, il met ses moyens et son personnel à la disposition des autorités responsables de la lutte afin de leur apporter aide et conseils.

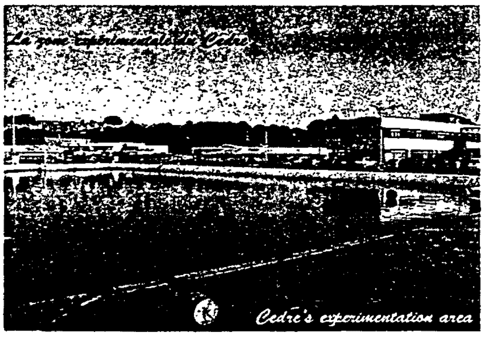
Il gère un budget propre annuel d'environ 17 million de francs. Un peu plus de la moitié consiste en subventions ou contrats passés avec des services de l'Etat ou des organismes publics et professionnels. Le reste consiste en contrats de services signés avec des entreprises, des collectivités territoriales, l'Union Européenne, des Etats.

Il dispose d'une équipe pluridisciplinaire de plus de 40 personnes, ingénieurs scientifiques, techniciens et autres, dont un cinquième mis à sa disposition par ses partenaires.

Sa documentation est conçue pour permettre la réponse immédiate aux questions urgentes. A côté d'une **documentation générale**, recueil de toutes publications, documents, données concernant les pollutions, elle intègre **une documentation opérationnelle :**

- plans Polmar (Mer et Terre), plans de secours en eaux intérieures, fichiers des pétroles bruts et produits chimiques, catalogue de matériels (stocks disponibles dans les administrations et dans les stocks privés en France ou à l'étranger, description technique) ;
- documentation relative aux impacts, méthodes de lutte, zones sensibles... ;
- banques de données sur disques optiques recensant les propriétés de 300 000 produits chimiques et près de 400 pétroles bruts et raffinés ;
- connexion Internet permettant un accès aux centres de recherche mondiaux traitant de la pollution des eaux ;
- modèles prévisionnels et systèmes d'aide à la décision.

Un laboratoire équipé d'un anneau d'essais en ambiance contrôlée permet d'effectuer des analyses sur les hydrocarbures et produits chimiques et des travaux de recherche ou d'homologation.



Cedre's experimentation area

Une zone expérimentale originale, unique au monde, offre la possibilité de tester de nombreux équipements d'intervention et d'assurer la formation pratique des personnels.

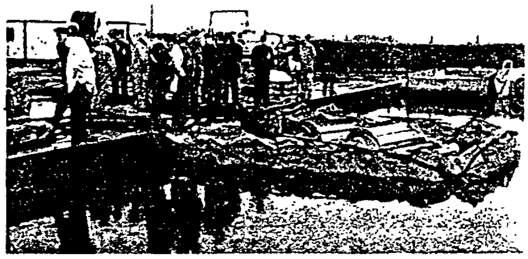
Le soutien logistique (moyens navals) nécessaire aux expérimentations en mer est fourni par la Marine Nationale.

Cedre's means

The preferential contacts of the Cedre with operational response officers or operational information centres from numerous countries allow it to quickly gather information about the circumstances of an accident, the products involved, human and environmental hazards, protective gear to be used, techniques and means to be implemented.

The Cedre may be consulted for help for any accidental water pollution. In the event of implementation of the Polmar Contingency plan, it puts its means and personnel at the disposal of the authorities in charge of the response, to advise and counsel them.

Expérimentation de matériel



Testing of equipment

The Cedre operates an annual budget approx. 17 million French francs. Just over half comes from subsidies or contracts and from public and professional bodies. The rest comes from contracts with companies, cities, local and national authorities, the European Commission, the International Maritime Organisation and Development Banks.

*Bringing together private and public skills, the Cedre represents a **team of over 40 personnel,** including biologists, oceanographers, chemists, geologists, engineers and others, a fifth are put at the Cedre's disposition by its partners.*

***Its documentation is designed to give an instant response to urgent questions** with **a general documentation**, collection of all data dealing with pollution, and **an operational documentation** with :*

- *Polmar contingency plans, handbooks on crude oils and chemicals, equipment inventories and indexes ;*
- *data banks on impacts, response techniques, sensitive areas ;*
- *an Internet connexion with international research centres dealing with water pollution ;*
- *predictive models and decision support systems.*

***The laboratory and a controlled environment flume test** allow rough analyses of hydrocarbons and chemicals, and research and testing works.*

***A unique experimentation area,** (with an artificial beach and port pool), the only one of its kind in the world, is used for the testing of response equipment as well as practical team training.*

***A logistic backup** is provided by the French Navy (ship and aircraft support) for at-sea experiments.*

Les points marquants

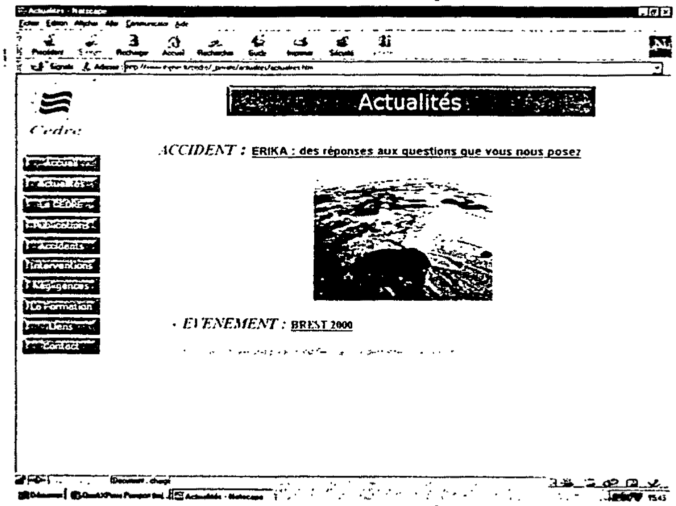
Dans le cadre de sa mission nationale, hors situation d'urgence, le *Cedre* fait progresser l'état de l'art en permanence. Il :

- développe des systèmes d'aide à la décision ;
- **évalue et améliore les techniques et moyens de lutte** contre les pollutions accidentelles, par hydrocarbures et produits chimiques, en mer et en eaux intérieures ;
- **participe à la mise à jour des plans Polmar terre et mer ;**
- **édite des guides et manuels spécialisés ;**
- **forme des équipes d'intervention** (100 stagiaires/an) à la lutte contre les pollutions par hydrocarbures et le risque chimique ;
- **réalise des expertises** en France et à l'étranger à la demande de l'Etat Français ;
- **informe** ses partenaires par une lettre mensuelle, un bulletin semestriel et une journée d'information thématique annuelle ;
- **renseigne** le public grâce à son site Internet régulièrement mis à jour.

En prestations de services, le *Cedre* valorise son expertise par :

- **des audits de plans d'intervention** pour des industries, des services publics et des Etats ;
- **des formations** à la lutte contre les pollutions accidentelles, en mer et en zone littorale ou portuaire (plus de 1 000 jours-stagiaires par an) ;
- **des expertises,** dans le cadre de pollutions accidentelles à la demande des opérateurs concernés.

Site Internet



Internet Site

Stage de formation

Training course

Le *Cedre* est enfin le **point de contact national** de l'Union Française des industries chimiques en cas d'accident à l'étranger.

Significant actions

Erika : chantier de lutte

Erika : clean-up operations

In the framework of its national responsibilities, the Cedre continually progresses the state of the art. It :

- *develops systems for help in decision-making ;*
- *tests and improves the ways and means of dealing with an oil or chemical spill at sea or in freshwater ;*
- *participates in updating the Polmar Contingency plans ;*
- *trains response teams (100 trainees a year) to deal with oil spills and chemical spills ;*
- *publishes specialized guides and manuals ;*
- *provides expert services in France and abroad at the request of the French authorities ;*
- *informs its partners, by a monthly letter, a half-yearly bulletin, a yearly thematic information day ;*
- *informs the public through a permanent internet site.*

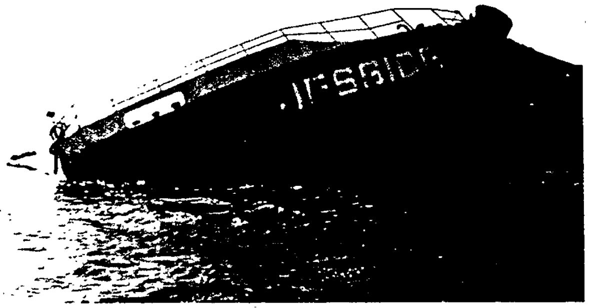
In the framework of service contracts, the Cedre increases its experience through :

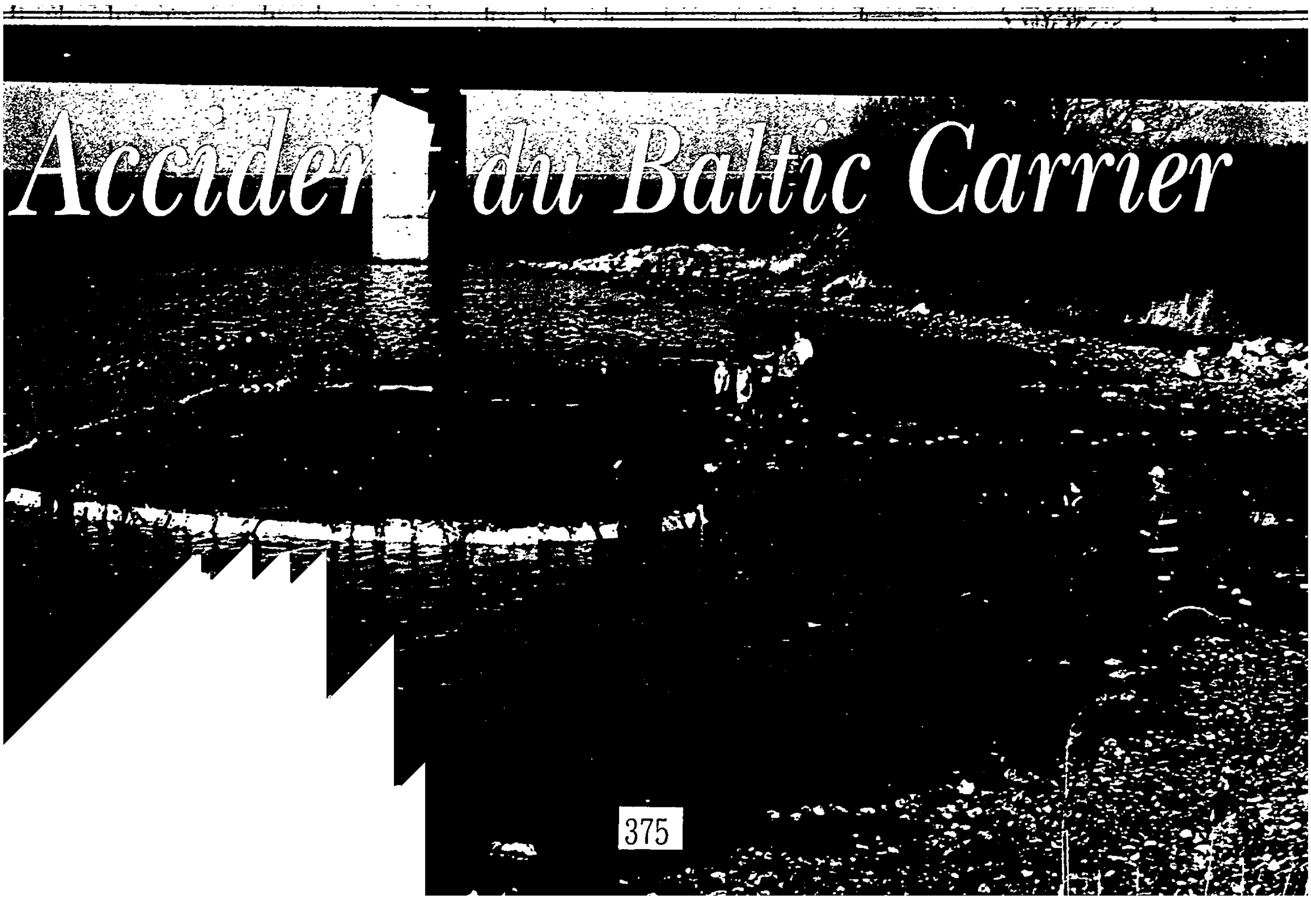
- ***reviewing and improving intervention plans**, in France and abroad for industries, port authorites and States ;*
- ***training for accidental pollution response** at sea and in coastal zones (more than 1 000 days x trainees a year) ;*
- ***consultancy services**, in the framework of accidental pollution, at the request of the operators concerned.*

*The Cedre is the **national contact point** for the French Union of chemical industries in case of a pollution incident abroad.*

ET D'EXPÉRIMENTATIONS SUR LES POLLUTIONS ACCIDENTELLES DES EAUX

Bulletin d'information du Cedre





Bulletin d'information du *Cedre*

Photos de couverture :
Pollution du Baltic Carrier : confinement d'une nappe
Le Jessica

Bulletin d'Information du *Cedre*
Environnement et techniques de lutte antipollution

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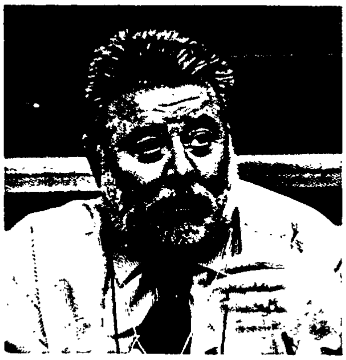


Alessandro Barisich,

Chef de l'unité Protection Civile et Urgences Environnementales de la Commission Européenne (jusqu'au 31 octobre 2001)

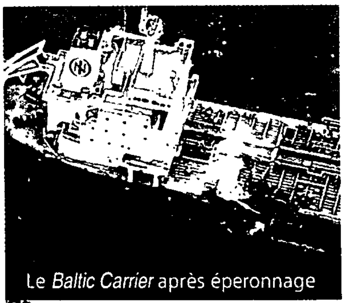
Pendant dix-huit des trente-cinq années passées au service de l'Europe, j'ai eu à traiter les questions liées aux pollutions marines accidentelles. C'est ainsi que j'ai établi naturellement des relations avec le Cedre. En effet, dès 1983, nous avons travaillé ensemble sur le système Communautaire d'Information sur les pollutions marines. Ensuite, ce fut la période des projets-pilotes et enfin, depuis le début des années 90, la formation et la Task Force communautaire. Cette dernière est d'ailleurs très présente dans ce numéro du bulletin : les accidents de l'Erika, du Ievoli Sun et du Baltic Carrier ont fait l'objet d'une intervention de la Task Force communautaire et, dans les trois cas, le Cedre y a joué un rôle majeur. Mais il y a un autre dossier, ouvert depuis quelques années, que je souhaite évoquer : il s'agit d'Eurocedre. L'idée de créer un centre européen ou un réseau européen de centres ou organismes similaires au Cedre a été débattue à plusieurs reprises. Des courriers ont été échangés, mais la dynamique nécessaire pour lancer un tel projet n'a pas été créée. Il a été notamment considéré que dans aucun autre Etat-membre il n'y a un centre équivalent au Cedre. Ceci est exact. Mais d'autres organismes, bien que différents, ont des activités qui recoupent celles du Cedre. Et, en Europe, bâtir sur la diversité est souvent aussi enrichissant que de bâtir sur les similarités. C'est seulement plus difficile et demande davantage d'imagination. La création d'un tel réseau n'est pas un but en soi : l'objectif serait de mettre à la disposition des Etats-membres confrontés à une pollution majeure le savoir-faire et les expériences qui existent en Europe. Ma longue expérience dans le secteur m'a appris qu'une grande marée noire se traduit toujours en une crise nationale. Ses effets dévastateurs sur des communautés locales - souvent basées sur la pêche, le tourisme et l'artisanat - deviennent vite ingérables. Le cadre communautaire de coopération en matière de pollution marine, adopté en décembre 2000, ainsi que le mécanisme communautaire concernant les interventions en cas de situations d'urgence, adopté en octobre 2001, permettent désormais aux Etats-membres de s'entraider de plus en plus efficacement en cas d'accidents de pollution : un réseau Eurocedre contribuerait sur le plan technique à cette entraide. Pour terminer, au moment où je quitte le service européen, je voudrais souhaiter à tous ceux qui jouent un rôle en matière de lutte contre les pollutions et au Cedre en particulier de poursuivre et d'accroître leur coopération. Les 370 millions de citoyens européens manifestent de plus en plus leur désir que dans des situations d'urgence l'ensemble des énergies et du savoir-faire européens soient mobilisés.

Alessandro Barisich

Accident du Baltic Carrier Mer Baltique (Danemark) 29 mars 2001

Stéphane Le Floch, Cedre

Dans la nuit du 28 au 29 mars 2001 vers 0h30, alors que la tempête fait rage en mer Baltique (vent de force 9 Beaufort, mer très formée), le cargo *Tern* entre en collision avec le pétrolier *Baltic Carrier* à la limite des eaux allemandes et danoises à environ 16 nautiques dans le sud-est des îles danoises Falster et Møn (localisation de la collision : 54°43 N / 12°35 E). Le cargo, battant pavillon chypriote, vient de Cienfuegos à Cuba et se rend en Lettonie avec une cargaison de 5 037 tonnes de sucre brut. Le pétrolier, enregistré aux îles Marshall, transporte 30 000 tonnes de fuel lourd. Il vient d'Estonie et se dirige vers Göteborg en Suède pour faire des soutes. Sa destination finale est Milford Haven au Pays de Galles.

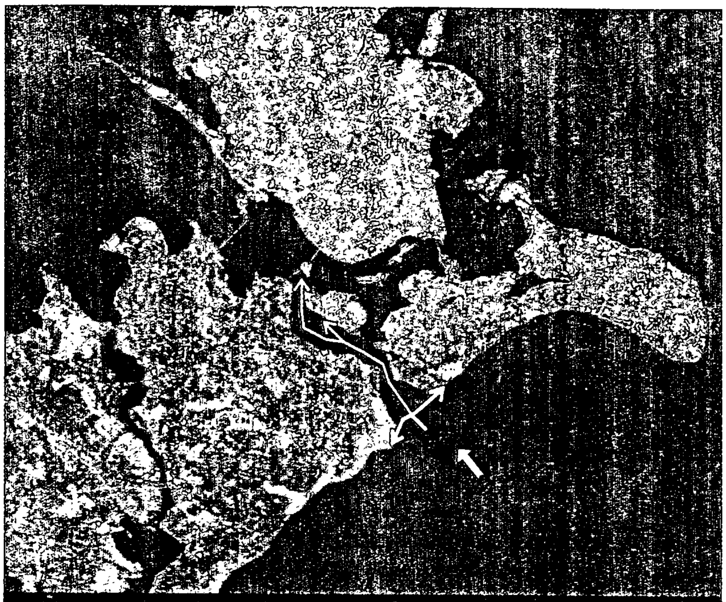

Le *Baltic Carrier* après éperonnage


Brèche au niveau de la cuve n°6

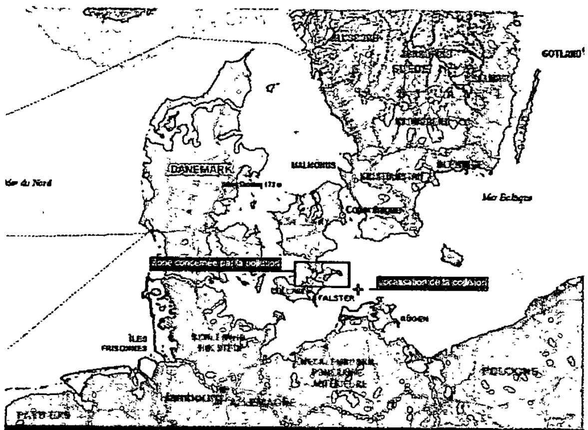
En percutant le pétrolier, qui vient de virer devant lui suite à une avarie de barre, l'étrave du *Tern* occasionne une large brèche à tribord, devant le château, au niveau de la citerne n°6. Le *Tern* gagne par ses propres moyens le port allemand de Rostock.
La quantité de fuel lourd perdue en mer, initialement évaluée par le commandant du pétrolier entre 1 500 et 1 900 tonnes, a ensuite été corrigée à 2 700 tonnes (capacité de la citerne n°6).
Les premiers jours suivant l'accident, les conditions météorologiques rendent difficiles les opérations de lutte en mer conduites par la garde-côtière danoise. Quinze navires danois, suédois et allemands interviennent pour chercher les nappes en mer ou faire de la récupération. Compte tenu de la viscosité élevée du produit, des pelles mécaniques sont tout aussi utiles que des récupérateurs classiques. Le dimanche 1er avril, 940 tonnes sont récupérées en mer. Une surveillance aérienne et satellitaire est maintenue depuis le début des opérations. A la différence de ce qui s'était passé pour l'*Erika*, les conditions météorologiques ont permis aux satellites de "voir" cette pollution et des images ont été fournies par l'Agence Spatiale Européenne.
Malgré la tendance de ce pétrole à former une émulsion inverse stable le rendant visqueux, son séjour en mer fut de courte durée et il est resté pompable. Le lundi 2 avril, deux navires allègent le *Baltic Carrier* qui est ensuite remorqué, le 4 avril, vers un chantier naval pour réparation. En mollissant (force 4), le vent passe secteur sud-ouest, poussant les nappes vers les eaux danoises et les îles Falster et Møn.

Le 29 mars à 17h30, les premières nappes arrivent au niveau du détroit de Grønesund et s'é-:houent sur les îles de Bogø, Mon et Fal-ster polluant un linéaire côtier d'environ 50 km. Dès le 30 mars, la Protection Civi-le danoise est sur zone, installant son PC dans la ville de Stubbekøbing et mettant en place 8 chantiers de collecte où envi-ron 210 personnes prennent part aux opé-rations de nettoyage.

A la demande des autorités danoises, la Task Force de la Communauté Européen-ne est mobilisée. Une équipe de trois per-sonnes (Gilles Vincent de la Commission Européenne, Stéphane Le Floch et Ber-nard Le Guen dépêchés par le *Cedre*) est immédiatement envoyée sur zone. Du 1er au 5 avril, les experts procèdent à une reconnaissance des sites touchés par la pol-lution et à un inventaire des techniques de lutte mises en œuvre.


Dérives des nappes de pétrole

Nettoyage, récupération d'hydrocarbure visqueux
Oiseau mazouté



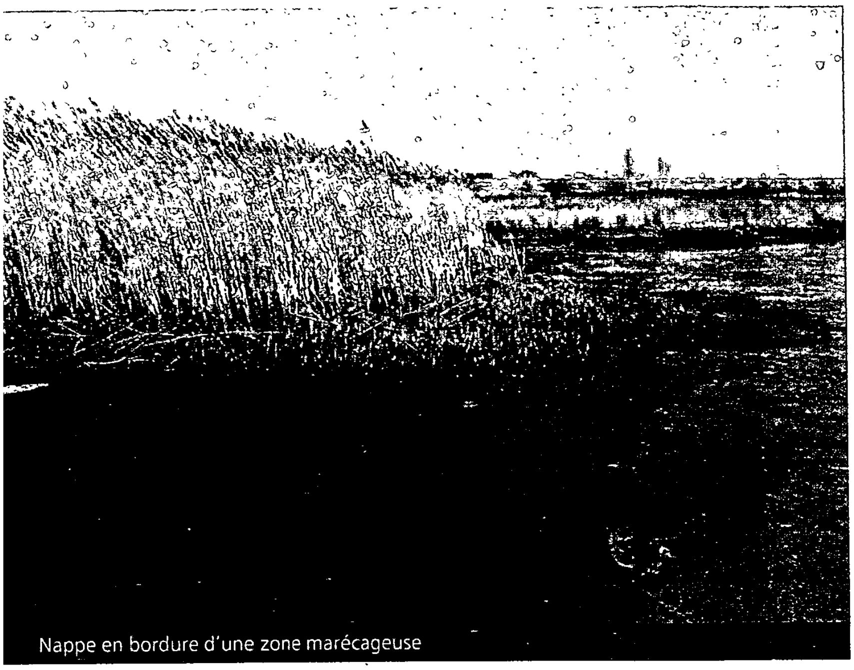
Localisation de la collision entre les 2 navires

Le nettoyage de première urgen-ce s'est effectué sous la respon-sabilité de la Protection Civile danoise qui a opté pour des inter-ventions à l'aide d'engins lourds, matériels réquisitionnés auprès des entreprises locales, notam-ment de Travaux Publics (pelle-teuses, bulldozers, camions bennes, hydrocureuses). Il est important de souligner que, si ces moyens ont permis de récupérer en un temps relative-ment court des quantités consé-quentes d'hydrocarbures (2 000 tonnes dès le 3ème jour), ils ont eu un impact physique considé-rable sur les parties hautes de l'estran ainsi que sur les berges. Cet impact est d'au-tant plus marqué que de nombreuses berges sont de type "haut schorre", c'est-à-dire particulière-ment sensibles. La détérioration de ces sites aurait pu être moindre si des opé-rations de pompage avaient été mises en place, d'autant plus que les conditions météorologiques étaient particulière-ment favorables lors de la phase de lutte à terre.

Les experts de la Task Force ont évalué que la pollu-

NAVIRE

Nom	BALTIC CARRIER
Construction	Hyundai MIPO DOCKYARD CO. (Corée) 2000
Type	Pétrolier et Chimiquier
Port en lourd	35 000 tonnes
Citernes	12 citernes et 2 slops-tanks
Longueur	182,55 m
Tirant d'eau	10,85 m
Moteur	MAN-B2W - 17 497 chevaux à 127 tr/min
Capacité commerciale	42 538 m³
Soutes	1 154 m³ IFO 180
Diesel marine	177,4 m³
Pavillon	Iles Marshall
Armateur	Interorient Navigation co. Ltd, Hambourg
Société de classification	DNV Det Norske Veritas

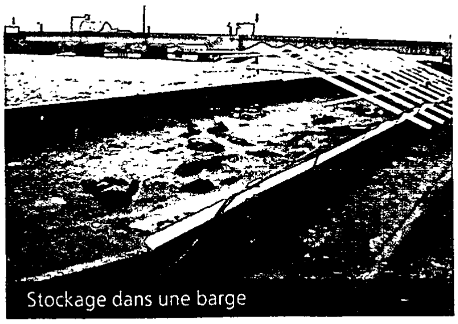


Nappe en bordure d'une zone marécageuse

tion s'étalait sur un linéaire côtier d'environ 50 km avec, par endroits, des accumulations très importantes en pétrole (petites criques). Ce linéaire est pour l'essentiel constitué de plages de galets et de zones marécageuses. Les interventions sur les plages ont consisté à retirer au bulldozer les galets contaminés puis à les transférer par camions sur une aire de lavage (carrière désaffectée). Après un nettoyage à l'eau additionnée de tensio-actifs, les galets ont été redéposés sur leur site de provenance.

En ce qui concerne les marais, le déploiement des moyens d'intervention a été plus délicat et long à mettre en œuvre. Ces zones, d'une grande sensibilité, sont classées réserves naturelles car elles constituent un sanctuaire pour les oiseaux. La présence de zones de nidification explique le nombre important d'oiseaux mazoutés dès les premiers jours de la pollution. Il est à préciser que les autorités danoises ont opté pour l'élimination systématique des oiseaux pollués plutôt que pour l'ouverture de centres de traitements et de soins.

Site de stockage à terre



Stockage dans une barge

Nettoyage d'un véhicule d'intervention

La mission de la Task Force s'est achevée le 4 avril par une réunion à Copenhague dans les locaux de la Protection Civile danoise. A cette date, les quantités de pétrole récupérées se répartissaient de la façon suivante :

- 250 tonnes retrouvées dans le bulbe du *Tern* : la violence du choc a entraîné un transbordement de cette quantité de pétrole ;
- 965 tonnes récupérées directement en mer : 15 navires de nationalités danoise, suédoise et allemande ont participé à des opérations de pompage de nappes flottantes ;
- 920 tonnes collectées sur le littoral durant la période du 31 mars au 3 avril 2001.

Ayant achevé le nettoyage grossier, les 200 intervenants de la Sécurité Civile quittent la zone le 10 avril. Ils ont récupéré 3 950 tonnes de déchets pollués. Les autorités locales et régionales prennent alors le relais et récupèrent 6 800 tonnes supplémentaires (juillet 2001). Les déchets comprennent une grande quantité de sable (sans algues ni macro-déchets) et sont évacués sur le site de Nykobing. Le reste est incinéré dans le centre chimique de Nyborg. En ce qui concerne les oiseaux, 2 500 cadavres seront ramassés en mer et sur le littoral.

CONCLUSIONS ET RECOMMANDATIONS

Dans son rapport de retour d'expérience sur l'accident du *Baltic Carrier*, la *Danish*

Intervention des pelleteuses

Hydrocureuse en action (détail : tête d'apiration de l'hydrocureuse)

mergency Management Agency tire des
nclusions et propose des recommanda-
ons en matière de sécurité maritime en
er Baltique mais également en matière
'organisation, d'équipement et de for-
ation. A la lecture de ce rapport il appa-
ît notamment que la coopération entre
s différents services impliqués a réelle-
ent fonctionné malgré des conditions de
ilotage des opérations loin d'être opti-
ales. L'engagement et la disponibilité des
ersonnels impliqués a largement contri-
ué à l'obtention de ce résultat. Ceci est
'autant plus évident que le matériel dis-
onible n'était pas adapté à la récupéra-
on d'hydrocarbures lourds et visqueux.
urant toute l'opération, des efforts permanents furent consentis pour trouver des solutions techniques alternatives. A l'avenir, l'optimisation des conditions d'intervention sur ce type de produit nécessitera une profonde réévaluation des matériels disponibles.

IFO 380 (M-100)*
FUEL LOURD DU BALTIC CARRIER

Densité à 15°C	0,9753
Viscosité à 50°C	611 cSt
Point d'éclair	128°C
Point d'écoulement	+ 18°C
Naphtalène (hydrocarbure aromatique)	4 %

* M-100 correspond à une terminologie russe s'appliquant au fuel lourd. Un fuel lourd classique IFO 380 présente une viscosité de 380 cSt à 50°C

Une autre grande leçon de cette opération porte sur la haute priorité qui doit être accordée à la formation et à l'entraînement des personnels d'Etat-major en matière de coordination des tâches lors d'opérations complexes ou de longue durée. Cette pollution des îles danoises a également mis en évidence la nécessaire cohérence des plans de lutte antipollution. Il semble en effet rationnel qu'un plan général soit établi au niveau national, décrivant les différentes missions et étapes de la gestion d'une opération de cette ampleur ; la coordination des plans locaux, départementaux et régionaux s'insérant dans ce cadre général.

Déploiement de barrage pour confinement au niveau d'un marais

ABSTRACT

In the morning of the 29th of March 2001 at 0h30, the cargo "MS Tern" and the tanker "Baltic Carrier" collided in the Baltic sea at the position 54°43N and 12°35E. The bulk carrier "MS Tern", with Cyprus flag, carrying sugar from Cuba to Latvia by way of Rostock in Germany, ran into the tanker "Baltic Carrier", under Marshall Island flag, carrying 30.000 tons of Heavy Fuel Oil's produced by UK Texaco, from Estonia to Milford Haven, UK, via Göteborg, Sweden for bunkering. The bulb of the cargo struck sharply the tanker at the level of the tank 6 that contained some 2 700 tons of oil.

On Friday 30th of March, the Danish Environmental Protection Agency arrived in Stubbekøbing area in order to organise the collection of the oil that was stranded on beaches. Four days after the accident, the oil collected at sea was estimated around 940 tons with 15 vessels involved in the operations. The amount of oil collected on the shoreline was estimated around 630 tons ; 220 persons participated in the cleaning operations.

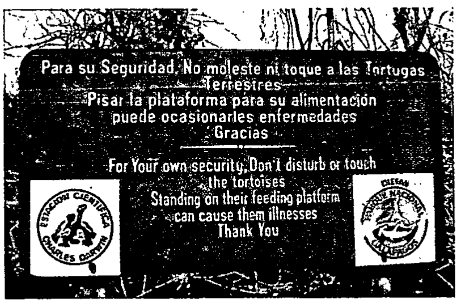
Following a request from the Danish authorities, the European Commission decided to send the European Task Force (from 1st to 5th of April) in order to help the Danish authorities to define the best means of minimising the damage of the spill and to ensure the recovery of affected areas. ■

Galets contaminés

Naufrage du Jessica aux Galapagos (Equateur) 16 janvier 2001

Claudine Le Mut Tiercelin, Cedre

Le 16 janvier 2001, le pétrolier *Jessica* s'échoue, dans la tempête, à l'entrée du port de Baquerizo Moreno dans la baie des Epaves (Wreck bay) sur l'île de San Cristobal, Galapagos. Le navire, construit en 1971, d'un port en lourd de 2 000 tonnes, transportait environ 600 tonnes de gasoil et 300 tonnes de fuel intermédiaire (IFO 120). Le gasoil devait être livré à la station de distribution de l'île Baltra et le fuel au navire de plaisance "Galapagos Explorer".



L'archipel des Galapagos, classé Patrimoine Mondial de l'Humanité, Parc National et Réserve naturelle marine, comprend une douzaine d'îles, s'étend sur 450 km et possède une faune endémique unique au monde.

CIRCONSTANCES

Le *Jessica* a été affrété en remplacement d'un autre pétrolier, en panne, le *Doris*. Le capitaine du navire n'a pas la qualification nécessaire pour un voyage jusqu'aux Galapagos avec un navire de cette taille. Il reconnaît, le 26 janvier, devant la commission d'enquête, avoir commis une imprudence : ayant vécu 10 ans à Baquerizo Moreno, mais n'y étant pas retourné depuis 7 ans, il a négligé de vérifier sur les cartes les changements intervenus dans le balisage des approches du port.

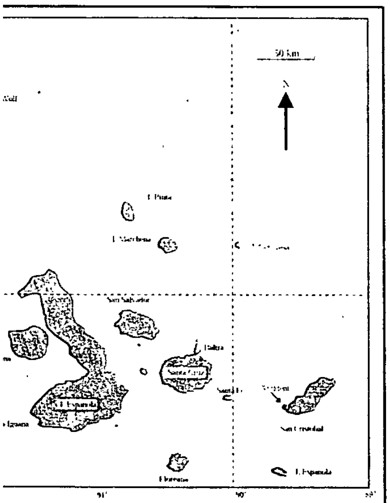
NAVIRE	
Nom	JESSICA
Construction	NISAII DOCK CO LTD - ISE (JAPON) 1971
Type	Pétrolier
Port en lourd	2 000 tonnes
Citernes	10 cuves
Longueur	68 m
Tirant d'eau	4,5 m
Moteur	Daïkatou - 1 500 chevaux
Soutes	71 tonnes
Pavillon	Equateur
Armateur	Iles Marshall
Propriétaire	Aestramar

.a fuite débute le 20 janvier. Aussitôt le ersonnel du Parc National des Galapagos, a Marine nationale, les pêcheurs et des olontaires s'organisent pour tenter de onfiner et récupérer le polluant à la surace de la mer.

.e littoral de l'île de Cristobal est touché rès rapidement. Des nappes se mettent à lériver vers l'ouest en direction de l'île de ;anta Fé qui abrite des colonies de lions le mer (*Zalophus californianus wollebaeki*) :t d'iguanes marins (*Ambryrhynchus cristaus*). Ces nappes menaçent les îles de Sana Cruz et d'Isabela, où vivent en outre des :olonies de pélicans (*Pelecanus occidentalis*).

VIESURES PRISES ET ASSISTANCE :XTÉRIEURE

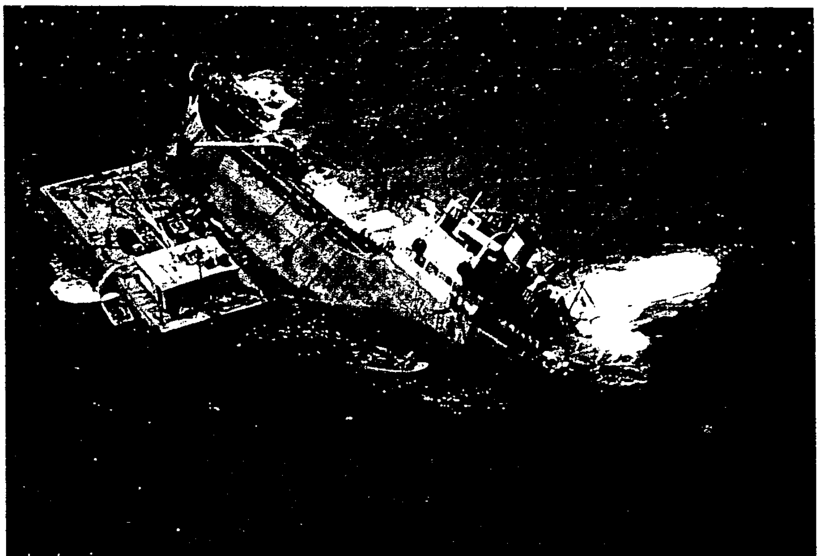
mmédiatement un plan d'urgence est mis :n place. La conduite des opérations est :onfiée à la Direction Générale de la Marie Marchande, avec la participation du Parc National des Galapagos et du Ministère de



calisation de l'accident dans l'archipel des pagos

l'Environnement. Le gouvernement équatorien mobilise une première enveloppe de 2 millions de dollars pour faire face aux frais de lutte et lance un appel à l'aide extérieure pour limiter les impacts sur la faune et la flore. Des survols aériens permettant de localiser les nappes et leur dérive (informations nécessaires pour les prises de décision) sont organisés.

Malgré l'intervention immédiate des autorités locales assistées par des bénévoles, le manque de moyens antipollution adaptés et la position du bateau, couché sur bâbord, ne permettent pas de contenir la pollution. Les nappes commencent à dériver vers



Le *Jessica*

l'ouest nord-ouest sous l'effet des vents et des courants, contaminant légèrement les îles de San Cristobal et de Santa Fé et quelques oiseaux et lions de mer. Des équipes d'assistance de l'*US Coast Guard* (USCG) et de la *National Oceanic and Atmospheric Administration* (NOAA) arrivent le 21 janvier avec des équipements de lutte.

Après une prise de contact avec le gouvernement équatorien, la Commission Européenne fait partir, le 24 janvier, en mission d'évaluation des besoins, une équipe de trois spécialistes de la lutte antipollution : un Espagnol, un Britannique et, avec le soutien du Ministère français de l'Aménagement du Territoire et de l'Environnement, une Française, ingénieur du *Cedre*.

Malgré des dépêches des agences de presse internationales extrêmement alarmistes quant à l'impact de la pollution sur la faune, annonçant "une catastrophe écologique"

Barrage absorbant

qualifiée de "sans précédent" pour diverses espèces d'oiseaux de mer, d'iguanes marins et de tortues marines, aucun dommage grave n'est constaté. Seules quelques nappes dérivant au sud de l'île Isabela ainsi que quelques irisations et boulettes éparses sont observées sur les plages des îles de l'archipel, 10 jours après l'accident.

L'analyse établie dès le 23 janvier par l'institut Charles Darwin est confirmée par les observations des experts européens :

Stockage des hydrocarbures

"Les impacts de cette marée noire sur l'écosystème des Galapagos ne devraient pas présenter de caractère de gravité. La taille modérée du déversement, les mobilisations nationale et internationale, les vents et les courants ont contribué à éviter une catastrophe".

A l'issue de leur mission, des recommandations ont été émises par les experts européens. Elles portent en particulier sur le besoin de formation de personnels à la lutte contre un déversement accidentel d'hydrocarbures. Enfin, lors des discussions avec le Ministère équatorien de l'Environnement, la nécessité d'un plan d'urgence adapté fut mise en évidence. ■

Le traitement de l'épave du Ievoli Sun

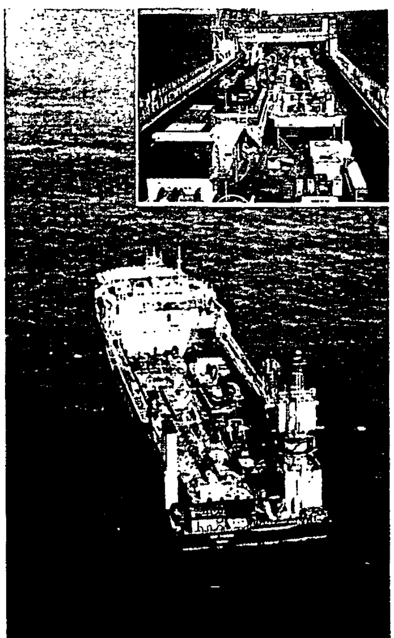
Capitaine de Frégate Pierre Pinlou, Président de la CEPPOL

Le 31 octobre 2000 à 9h00, le chimiquier *Ievoli Sun* sombre au large des côtes françaises (20 nautiques du cap de la Hague) près de l'île anglo-normande d'Aurigny (cf article sur le naufrage dans le Bulletin d'information du *Cedre* n°14). Un dialogue approfondi, piloté par le Secrétaire Général de la Mer, est engagé entre experts nationaux et experts de l'armateur, sur les solutions techniques de traitement du risque représenté par cette épave. Après accord des autorités anglaises et françaises, l'armateur et son P&I Club passent un contrat avec Smit Tak Co, le 10 avril 2001, en vue d'intervenir sur la cargaison du *Ievoli Sun*.

ENVIRONNEMENT DE L'OPÉRATION

L'épave est posée sur le côté bâbord avec un angle de 120° à 90 m sur un fond de sable et petites roches dans une zone de fort courant.

DÉFINITION DES MOYENS DE TRAITEMENT



Le *Smit Pioneer* et son pont de travail

La technique de traitement de la cargaison a été validée par le Ministre des Transports après les propositions faites par le Secrétaire Général de la Mer.

Les différentes propositions faites par les assureurs ont été examinées par un comité d'experts composé de représentants des Ministères chargés des Transports et de l'Environnement, du *Cedre* et de la CEPPOL.

La durée prévue du traitement de l'épave est de 6 semaines. L'opération est conduite depuis un seul bâtiment : le *Smit Pioneer*. La surveillance de l'environnement est effectuée à partir de l'*Ailette* (bâtiment armé pour la lutte antipollution, affrété par la Marine nationale).

LE SMIT PIONEER

Le bâtiment multi-fonctions (longueur : 156 m) de type dock ouvert sur un grand pont de travail appartient à la flotte de la société SMIT INTERNATIONAL.
Le pont de travail d'une surface de 2 700 m² comprend deux "moon pools" (espace permettant d'accéder directement à la mer pour immerger les robots sous-marins en eaux calmes). Sur ce pont sont entreposées deux barges de récupération des produits pompés : une barge de 2 000 m³ pour le styrène et une barge de 370 m³ pour l'IFO 180.

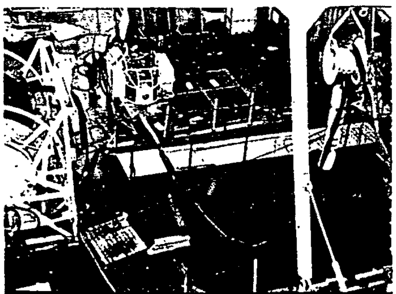
CARGAISON ET SOUTES

Nature	Quantité (en tonnes)
Styrène	3 998
Méthyl Ethyl Cétone (MEC)	1 027
Alcool Iso Propylique (IPA)	996
Fuel (IFO 180)	160
Diesel marine	40

ÉTAPES DU POMPAGE

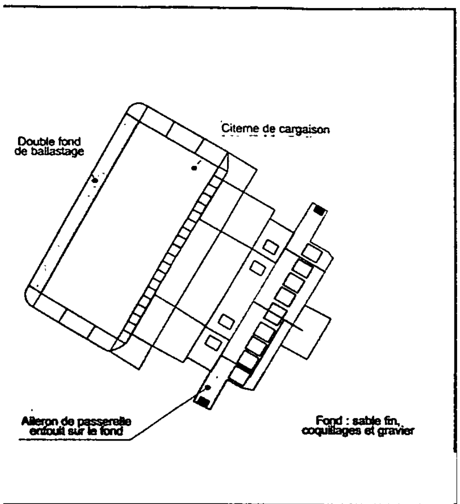
Le pompage s'est déroulé en six phases :

1) Repérage des soutes ;
2) Pose des plaques de base et perçage de la première coque ;
3) Examen de l'espace entre les coques ;



Un moon pool

384



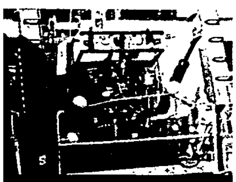
Positionnement de l'épave sur le fond

) Perçage de la deuxième coque et traitement de la cargaison ;
) Transfert de la cargaison sur un chimiquier ;
) Contrôle final de l'épave et de la zone de travail.

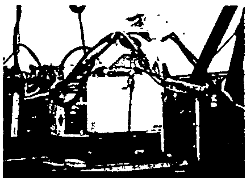
ΛATÉRIEL MIS EN OEUVRE

es opérations 2 et 4 sont effectuées par ıntervention simultanée du ROV et du OLS puis du ROV et du DBT.

OV : Remote Operated Vehicule
OLS : Remote Off Loading System
EC : Pulse Eddy Current
ΙBT : Double Bottom Tool



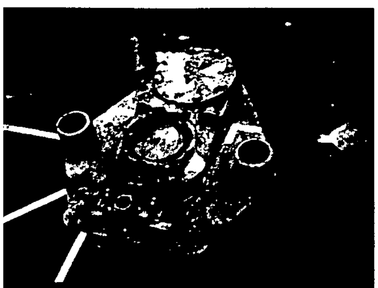
ROV équipé du PEC



ROLS

DBT

a limite d'emploi des robots est liée au ɔurant. Au-delà de deux noeuds, ils ne euvent plus travailler en sécurité.



Plaque de base

REPÉRAGE DES SOUTES

Un examen complet de la coque a permis de faire un état des lieux afin de vérifier si celle-ci avait bougé depuis les dernières inspections effectuées au mois de novembre.
Pour repérer les soutes, un ROV est équipé d'un PEC (système à émission de courant qui permet de repérer les couples et les lisses, grâce à la variation du signal liée aux surépaisseurs de métal).

POSE DES PLAQUES DE BASE ET PERÇAGE DE LA PREMIÈRE COQUE

Sur les 18 soutes contenant des produits ont été fixées des plaques de base. Ces plaques ont deux rôles :

- supporter et guider l'appareil de perçage,
- supporter la plaque obturatrice.

Sur chaque soute on trouve deux plaques : l'une, en partie basse, pour l'introduction d'eau afin d'assurer l'équilibrage en pression de celle-ci ; l'autre, en partie haute, pour le pompage.

EXAMEN DE L'ESPACE ENTRE LES COQUES

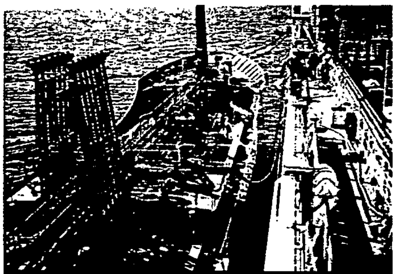
Cette opération permet de contrôler à l'aide d'une caméra l'espace compris dans la double coque, de détecter les éventuelles déformations des soutes et de mesurer la température au droit des soutes de styrène (l'élévation de température est un indice de début de polymérisation).

PERÇAGE DE LA DOUBLE COQUE

A la suite du perçage des soutes d'Alcool Iso Propylique et de Méthyl Ethyl Cétone, un relâchement direct des produits est opéré à débit contrôlé. Pour les soutes de styrène, une pompe associée à la machine de perçage refoule celui-ci vers la barge de récupération située sur le pont. Le critère de fin de pompage est la présence de moins de 5% de styrène dans l'eau pendant 15 minutes. La récupération du fuel se fait par pompage direct car il n'y a pas de double coque au droit de ces soutes. Le stockage se fait dans une barge sur le pont.

TRANSFERT DE LA CARGAISON

Le styrène pompé, auquel est ajouté un inhibiteur de polymérisation, est stocké dans une barge sur le pont du *Smit Pioneer*. Le transfert du produit entre la barge et le chimiquier *Angela* est effectué dans une rade abri du sud de la Grande-Bretagne.



Transfert de la cargaison entre le *Smit Pioneer* et le chimiquier *Angela*

CONTRÔLE DE LA ZONE

Une reconnaissance par ROV est réalisée autour de l'épave afin de repérer d'éventuelles fuites et de faire un bilan des opérations avant de quitter le chantier.

BILAN

Les opérations débutent le 12 avril 2001 par l'arrivée du *Smit Pioneer*. Elles permettent le largage contrôlé et sans conséquence mesurable pour l'environnement de la Methyl Ethyl Cétone et de l'Alcool Iso Propylique ainsi que le pompage des 3 012 m³ de styrène et de fuel lourd restant dans le navire. Les travaux s'achèvent le 31 mai, après 51 jours d'intervention entièrement réalisée par robots et dans des conditions de mer et de courants difficiles.

Cette intervention est très riche en retour d'expérience et doit conduire à des réflexions approfondies sur la faisabilité du traitement de cargaisons chimiques plus complexes. ■

Ievoli Sun - Comportement des produits et contamination d'espèces marines

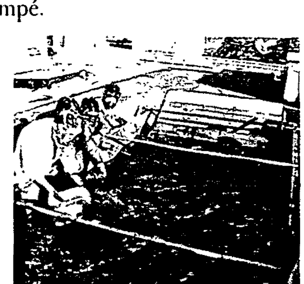
Stéphane Le Floch, Romain Suaudeau - Cedre

A l'initiative du comité national d'experts mis en place par le Ministère de l'Aménagement du Territoire et de l'Environnement, plusieurs expérimentations ont été engagées dans les installations du *Cedre*. Elles ont permis d'appréhender le devenir du styrène à moyen terme face au risque de polymérisation, d'évaluer la faisabilité d'un relargage contrôlé de la Méthyl Ethyl Cétone (MEC) et de l'Alcool Iso Propylique (IPA) et, en parallèle, d'étudier l'exposition d'organismes marins au styrène.

POLYMÉRISATION DU STYRÈNE

Quatre cuves en inox de 160 l ont été immergées dans le grand bassin extérieur du *Cedre*. Ces cuves simulaient différentes conditions de contact du styrène avec l'eau de mer. Des prélèvements hebdomadaires ont été réalisés et la polymérisation du monomère mesurée selon des protocoles communiqués par Shell chimie.

Ces expérimentations ont montré que le monomère n'a pas tendance à polymériser spontanément dans des conditions simulant, autant que possible, celles présentes au niveau de l'épave (absence de lumière, d'oxygène et température de l'ordre de 10°C). Toutefois, il est apparu que l'inhibiteur de polymérisation (pTBC) a fortement tendance à se dissoudre dans l'eau de mer et donc qu'il est nécessaire d'ajouter du pTBC au styrène qui sera pompé.



Déversement de styrène dans un bac à clapot

GC-FID* : chromatographie en phase gazeuse à détecteur à ionisation de flamme.
GC-SM** : chromatographie en phase gazeuse couplée à un spectromètre de masse.
OMS *** : Organisation Mondiale de la Santé.

COMPORTEMENT DE LA MEC ET DE L'IPA

Afin d'évaluer le comportement de la MEC et de l'IPA en cas de relargage contrôlé, les cinétiques de dissolution de ces produits ont été étudiées dans une colonne en plexiglas de 3,5 m de hauteur et de 16 cm de diamètre remplie d'eau de mer, spécialement conçue à cet effet. Les produits ont été injectés à l'aide d'une pompe à des profondeurs et des débits variables. Afin de visualiser le comportement de ces produits, un colorant (le rouge d'organol) leur a été additionné.

Il est apparu que l'IPA est un produit qui se solubilise immédiatement dans l'eau de mer sans présenter de danger particulier. La MEC est également classée comme produit soluble, mais les résultats obtenus montrent que le relargage doit être effectué à faible débit. En effet, il n'est pas possible d'exclure la formation d'une nappe en surface, ayant potentiellement un impact sur l'environnement et sur les intervenants.

EXPOSITION D'ORGANISMES MARINS AU STYRÈNE

L'objectif de cette étude était de savoir si des organismes marins exposés au styrène présentent une odeur et, dans ce cas, à partir de quelle valeur l'odeur est-elle identifiable ? Les organismes étudiés furent des tourteaux (*Cancer pagurus*), des moules (*Mytilus edulis*) et des huîtres (*Crassostrea gigas*).

L'expérimentation, mise en place avec le soutien de l'IFREMER, s'est déroulée en deux étapes, à savoir une phase d'exposition au styrène suivie d'une phase de décontamination. Les analyses ont porté sur le suivi de la teneur en styrène dans l'eau par GC-FID* au laboratoire du *Cedre* et de la teneur en styrène dans les tissus biologiques par Purge and Trap et GC-SM** au Laboratoire Municipal et Régional de Rouen. Les tests olfactifs ont été réalisés par l'Institut de Protection et de Sûreté Nucléaire. Le seuil de détection d'odeur chez les crabes a été établi à 5 000 µg/kg, et à 1 000 µg/kg pour les moules. A titre indicatif, la Dose Journalière Admissible (OMS***) est de 7,7 µg/kg de poids corporel/jour pour un individu.

Bac de décontamination

CONCLUSION

Les résultats de ces travaux furent directement appliqués lors des opérations conduites sur l'épave du *Ievoli Sun*. De façon plus générale, cette étude illustre la nécessité d'avoir une bonne connaissance des caractéristiques et du comportement dans l'eau de mer des produits chimiques transportés afin d'intervenir efficacement et en toute sécurité en cas d'accident. ◻

,e Comité d'Etudes Pétrolières et ⁄arines - CEP&M

lippe de Panafieu, délégué permanent du CEP&M

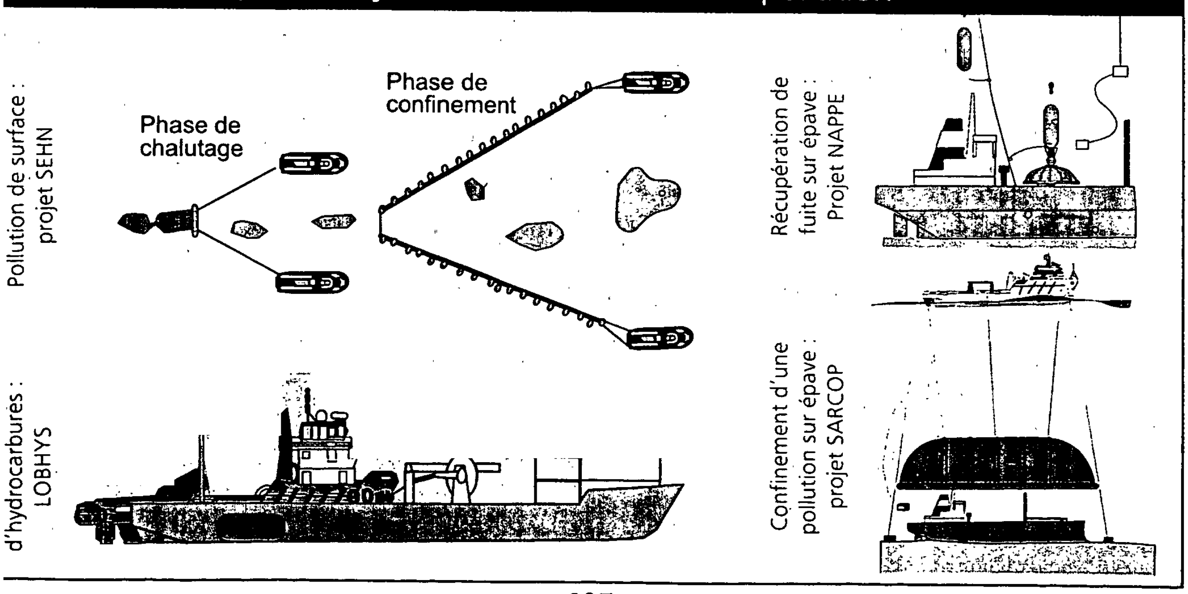
e Comité d'Etudes Pétrolières et Marines (CEP&M), organisme consultatif auprès de la Direction Hydrocarbures et des Matières Pre- res (DIMAH), a été créé en 1963 pour rdonner les actions de recherche et :loppement dans le domaine de l'ex- ation-production des hydrocarbures.

Sa mission principale est de donner des avis sur les programmes susceptibles de faire l'objet d'une aide au titre du Fonds de Soutien aux Hydrocarbures, FSH (compte spécial du Trésor). Les procédures du FSH permettent d'allouer aux entreprises des aides à la recherche remboursables.

Parmi les 147 projets soutenus par le FSH en 2000, une douzaine porte sur la lutte contre les pollutions marines accidentelles (tableau). En 2001, un treizième projet (MARIE) leur a été ajouté. Les résultats de ces projets de recherche sont attendus entre fin 2001 et fin 2002.

ıforcement de la capacité française de prévision de dérive de nappes d'hydrocarbures	*Cedre* - Météo-France
IN "SEcurisation et récupération d'Hydrocarbures visqueux flottant en Nappe"	Créocéan - IFREMER - IFP - *Cedre* - LeDREZEN-Abeilles International
BHYS - Barge polyvalente pour intervention sur zones de pollutions (hydrocarbures chimiques)	D2M, Géocéan, Abeilles International
ıire dépollueur de Grande Capacité	Doris-Chantiers de l'Atlantique, *Cedre*
ıires de récupération de produits pétroliers flottants et installation mobile utilisant de navires de récupération	Technip France, CMD, ENSIETA, *Cedre*
ıire Ecrémeur Haute-mer	BOS-SOFRESID, D2M, MN
PPE - NettoyAge des Produits Pétroliers sur Epaves	Géocéan - IFP
idification du produit dans une épave par combustion pour permettre son pompage	Challenger, Doris, Stolt Offshore
RCOP - Sécurisation Active et Rapide de CargaisOns Polluantes	Géocéan, Doris
TA - Véhicule d'Inspection Sous-marine Télé-piloté par Acoustique	Cybernetix - IFREMER
ıire écrémeur convertible haute mer	Bouygues Offshore
ge polyvalente de lutte antipollution	D2M Consultants
RIE - Moyen Autonome de Reconnaissance et d'Inspection d'Epaves	IFREMER - ECA, COMEX - *Cedre*

Projets Géocéan de lutte antipollution



Le programme de suivi Erika
Le programme Liteau

Bernard Baudot, Directeur de l'Eau, Ministère de l'Aménagement du Territoire et de l'Environnement

Lors du premier Comité Interministériel d'Aménagement et de Développement du Territoire qui s'est tenu après le naufrage de l'*Erika*, le 28 février 2000, diverses mesures ont été prises, pour remédier aux conséquences de la marée noire. Dans ce contexte, le Ministère de l'Aménagement du Territoire et de l'Environnement a été chargé de mettre en place des actions qui concernent plus particulièrement :

- le suivi des conséquences écologiques et écotoxicologique, comportant, d'une part, les études d'impact sur les milieux et les espèces et, d'autre part, un réseau de suivi scientifique des conséquences écologiques et écotoxicologiques ;
- l'intensification de la recherche.

LE SUIVI DES CONSÉQUENCES ÉCOLOGIQUES ET ÉCOTOXICOLOGIQUES

Ce programme de suivi a été mis en place et est coordonné par le Ministère de l'Aménagement du Territoire et de l'Environnement. Il est co-animé par l'INERIS et l'IFREMER. Il a pour objectif de connaître les effets à long terme de la marée noire sur les milieux et les espèces et s'intéresse en particulier aux conséquences écologiques de l'arrivée des nappes de fuel sur les écosystèmes côtiers et sur l'évolution des biocénoses touchées par les nappes. Les travaux engagés permettront de mieux connaître la toxicité à long terme des polluants issus des produits pétroliers, vis-à-vis du milieu marin. Ils pourront suggérer de nouveaux indicateurs de pollution pour la flore et la faune benthiques, indicateurs qui pourraient ensuite être intégrés au Réseau National d'Observations de la qualité du milieu marin (RNO), géré par l'IFREMER pour le compte du Ministère.

Sur une cinquantaine de projets reçus, 29 font actuellement partie de ce programme pour un budget prévisionnel de 4,57 millions d'Euros. Ces études sont réparties en quatre volets :

- étendue spatiale et temporelle et répartition dans les milieux de la contamination chimique ;
- transformation et biodisponibilité des hydrocarbures ;
- impacts (écologiques et écotoxicologiques) sur les organismes vivants (espèces et communautés) ;
- suivi de la restauration des milieux et des biocénoses et évolution du trait de côte.

Il est encore trop tôt à ce stade pour faire un premier bilan de ces études.

LES RECHERCHES SUR LES CONSÉQUENCES DU NAUFRAGE DE L'*ERIKA*

Le volet "recherche" mis en place a pour objectif de combler les lacunes de connaissances liées à un événement catastrophique. Il comprend deux mesures :

- structurer un réseau de recherche et d'innovation technologique sur les pollutions marines accidentelles (RITMER) (cf article suivant) ;
- renforcer les recherches en cours au Ministère de l'Aménagement du Territoire et de l'Environnement avec un financement additionnel de 0,76 million d'Euros, en appui au dispositif de suivi des conséquences de la marée noire.

Le programme Liteau sur la gestion durable du littoral (appel à proposition en mars 2000, évaluation et animation en cours) a servi tout naturellement de cadre d'accueil pour les études sur l'impact de la marée noire de l'*Erika* : celles-ci constituent un thème spécifique dans le programme Liteau, sur la gestion d'une pollution accidentelle.

Sur les 34 projets ou lettres d'intention reçus, 8 ont été retenus. On retrouve les mêmes sous-thèmes que pour le suivi.

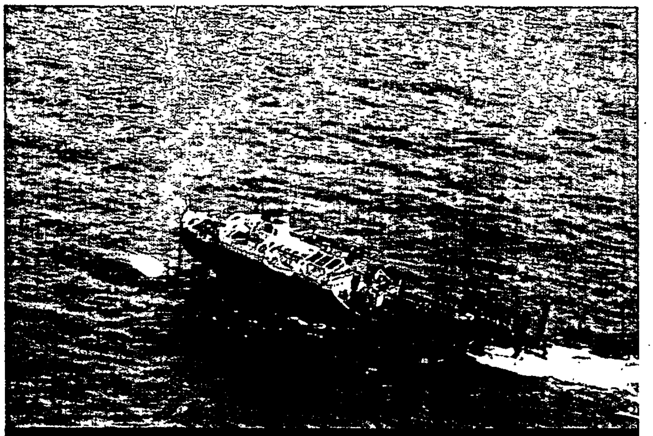
1) Connaissance et comportement des polluants HAP*. Les 2 projets retenus concernent la modélisation 3D de la dérive par rapport au modèle opérationnel et son devenir, en particulier sa biotransformation par voie microbienne (communautés présentes dans les tapis microbiens).
2) Plusieurs projets concernent l'écotoxicité et l'accumulation des composés dans les mollusques (moules) ou l'impact sur l'écophysiologie ou la pathologie des bivalves. Un projet aborde le transfert jusqu'à l'homme de la contamination et la toxicité des polluants par la voie alimentaire.
3) Une autre thématique aborde l'effet plus global de la marée noire sur l'écosystème marin (zone intertidale) et sur les populations d'oiseaux marins, en étudiant plus particulièrement la conservation génétique des populations de guillemots de Troïl.
4) Un dernier projet étudie les conséquences économiques de l'*Erika*, illustrées par la perte d'aménité des résidents se consacrant à la pêche à pied. □

HAP* : Hydrocarbure Aromatique Polycyclique.

Le réseau de Recherche et d'Innovation Technologique - RITMER

Michel Huther, bureau Veritas et Jean Croquette, IFREMER

Dans le cadre des mesures prises par le CIADT à l'issue de la marée noire consécutive au naufrage de l'*Erika*, le Ministère chargé de la Recherche a proposé de créer un Réseau de Recherche et d'Innovation Technologiques (RRIT) sur le thème "Pollutions Marines Accidentelles et conséquences écologiques sur le littoral : prévention et remédiations". Ce réseau complète les dispositifs de suivi de l'*Erika* et le programme Liteau mis en place par le Ministère de l'Aménagement du Territoire et de l'Environnement.



La partie arrière du *Tanio*

Le champ d'action du réseau RITMER, dans ses limites actuelles, débute après l'événement, accidentel ou même délibéré (naufrage, déballastage...) provoquant une marée noire ou autre pollution. Le réseau s'intéresse, d'une part, au repérage, à la caractérisation et au suivi des nappes de polluants dans l'espace et le temps ; d'autre part, à la protection et à la réhabilitation des écosystèmes littoraux et marins. L'étude des pollutions chimiques, voire des pollutions par macro-déchets, d'origine accidentelle pourra être envisagée.

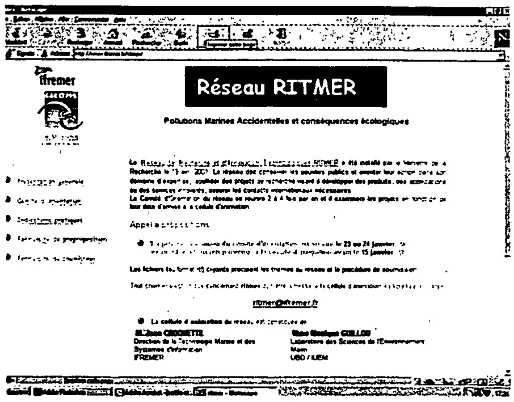
Le réseau RITMER associe des représentants des équipes de recherche publique, des acteurs industriels ainsi que des opérateurs et gestionnaires publics et professionnels de la mer. Il a pour objectif d'être à l'écoute de la demande socio-économique, d'identifier les besoins prioritaires dans le domaine et de susciter et soutenir par labellisation des actions de recherche coopératives en vue d'accroître les capacités de réponses technologiques. Des collaborations internationales pourront être recherchées et mises en œuvre. Le champ d'action du réseau défini par le Comité d'Orientation couvre 8 thématiques :

1) La caractérisation des produits transportés ;
2) Les technologies de repérage et de suivi des polluants (en mer, sous l'eau, dans le sable...) ;
3) La récupération et le traitement des polluants en mer et à terre ;
4) La gestion des épaves ;
5) La gestion des risques vis-à-vis des écosystèmes ;
6) Les technologies de protection et de réhabilitation des sites et écosystèmes sensibles ;
7) Les technologies de traitement des déchets collectés (passage du déchet aux produits ultimes) ;
8) Les méthodes de gestion des risques.

Les actions de recherche et développement labellisées seront soutenues par des crédits incitatifs de l'Etat, des collectivités locales... Des recherches technologiques peuvent également être soutenues par les fonds publics dans le cadre des programmes du Comité d'Etudes Pétrolières et Marines (Ministère de l'Economie, des Finances et de l'Industrie).

Suite à l'ouverture des soumissions de projets en mai 2001, 15 propositions ont été reçues sur lesquelles 12 correspondant aux thématiques ont été retenues et soumises à évaluation pour labellisation en septembre 2001.

En complément, le réseau RITMER conduira des actions de transfert technologique, de communication, de valorisation des résultats, en suivant les axes définis par son Comité d'Orientation. □



Pour en savoir plus : http://www.ifremer.fr/ritmer et http://www.recherche.gouv.fr

L'Observatoire des marées noires

Christine Jean, chargée de mission - Observatoire des marées noires

L'Observatoire des marées noires, qui rassemble pour l'essentiel des associations de protection de la nature et de l'environnement, a vu le jour le 8 avril 2000. L'association entend apporter sa contribution à l'amélioration de la prévention, du traitement et du suivi de l'impact des marées noires.

Pour ce qui concerne le programme de recherche post-*Erika*, l'Observatoire des marées noires a effectué une synthèse des études proposées par Bretagne Vivante-SEPNB et la Ligue pour la Protection des Oiseaux (LPO) pour évaluer l'impact de la marée noire sur les populations d'oiseaux. Celle-ci a été adressée au Ministère chargé de l'Environnement en juillet 2000.

Les populations d'oiseaux marins ont été particulièrement affectées par la marée noire de l'*Erika*. Le naufrage et la dérive des nappes de fuel sont intervenus dans une zone importante pour l'hivernage des oiseaux. Ce sont 63 606 oiseaux qui ont été recueillis vivants ou morts par les associations et les bénévoles dans les 13 centres de soins. Sur ce total, plus de 61 400 sont morts. En outre, tous les oiseaux échoués n'ont pas été recensés et l'on sait, depuis l'*Amoco Cadiz*, que de nombreux oiseaux morts n'atteignent pas les côtes. Compte tenu de ces éléments, on estime aujourd'hui à plus de 200 000 le nombre d'oiseaux morts des suites de la marée noire de l'*Erika*, ce qui constitue un record international.

Les populations d'oiseaux marins font l'objet de quatre études pilotées par Bretagne Vivante-SEPNB :

- Bilan des échouages et de la mortalité des oiseaux : il s'agit de recueillir toutes les informations disponibles sur les échouages d'oiseaux morts et vivants, pour retracer de manière aussi détaillée que possible le cours des événements après le naufrage de l'*Erika* et d'affiner le bilan des mortalités. L'étude s'achèvera en septembre 2001.
- Suivi des populations d'oiseaux nicheurs : pendant 3 à 5 ans, les colonies de reproduction de guillemot de Troïl (*Uria aalge*), de cormoran huppé (*Phalacrocorax aristotelis*), d'eider à duvet (*Somateria mollissima*), de mouette tridactyle (*Rissa Tridactyla*), de goélands

Guillemots de Troïl

(*Laridés*) et de gravelot à collier interrompu (*Charadrius alexandrinus*) sont recensées annuellement, pour mesurer l'impact des mortalités sur les effectifs. Le financement du suivi des guillemots de Troïl, dont les

Guillemot de Troïl mazouté

colonies d'origine sont situées sur les côtes de Grande-Bretagne et d'Irlande, n'est toujours pas assuré. Cela pose problème dans la mesure où cette espèce a été la plus touchée par la marée noire (environ 82% des oiseaux recueillis morts ou vivants dans les centres de soins).
- Analyse des reprises/contrôle de bagues et squelettochronologie : les deux études ont pour objectif d'identifier les colonies d'origine et les classes d'âge des oiseaux affectés par la marée noire.

La LPO réalise par ailleurs, en partenariat avec l'université de Rennes, un suivi des populations d'oiseaux d'eau hivernant (Anatidés et Limicoles), celles-ci étant inféodées, à certaines périodes de l'année, à des milieux comme les baies et les estuaires qui ont été très touchés par la marée noire.

Enfin, la LPO a publié, début mars 2001, le bilan du Plan National de Sauvetage des Oiseaux Mazoutés. Ce bilan sert actuellement de base à l'élaboration de préconisations pour les plans POLMAR et à la rédaction d'un guide méthodologique des soins aux oiseaux mazoutés.

L'Observatoire s'intéresse également à l'impact de la marée noire sur les milieux naturels et est intervenu, dans le cadre du comité de pilotage du réseau de suivi écologique et écotoxicologique pour que ceux-ci soient mieux pris en compte. ◘

Déballastages et oiseaux de mer

Gilles Bentz, Ligue pour la Protection des Oiseaux - LPO

Les oiseaux sont souvent pris comme indicateurs de l'état de santé des milieux naturels. En s'échouant sur les côtes, les oiseaux de mer témoignent des pollutions par hydrocarbures provoquées au large.

UN BAROMÈTRE DES POLLUTIONS PAR HYDROCARBURES

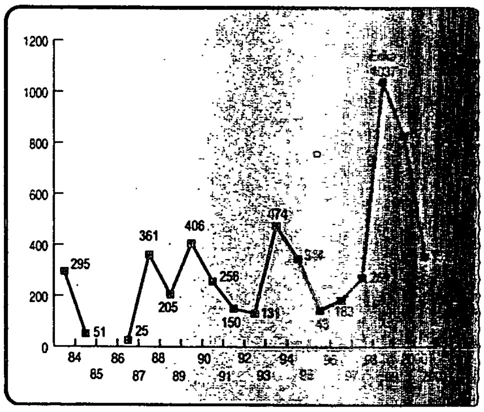
La Ligue pour la Protection des Oiseaux a créé en 1984 la station LPO de l'Ile Grande, à Pleumeur-Bodou (Côtes d'Armor), à quelques encablures de la réserve naturelle des Sept-Iles. Cette station recueille et réhabilite les oiseaux mazoutés. Créé après les marées noires de l'*Amoco Cadiz* (1978) et du *Tanio* (1980), le centre de soins, affilié à l'UNCS*, traitait jusqu'en 1999 une moyenne de 300 oiseaux mazoutés par an. En l'absence de marée noire, l'origine de ces oiseaux était nécessairement imputable aux déballastages. Recueillant des oiseaux échoués sur les côtes bretonnes, grâce à un réseau de points-relais, la station LPO joue le rôle d'"observatoire" des pollutions marines et ce, en dehors bien sûr de tout incident majeur.

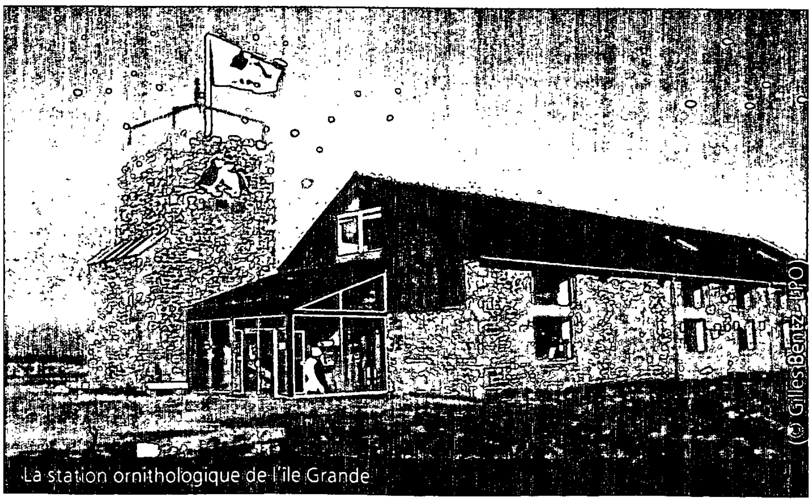
Guillemot de Troïl mazouté, après lavage dans le bassin de réhabilitation de l'Ile Grande

Ce "bruit de fond" des pollutions marines laisse imaginer ce qu'est réellement l'étendue des dégâts, étant entendu qu'une infime partie des oiseaux touchés est retrouvée.

Le nombre d'oiseaux mazoutés recueillis à la station LPO de l'Ile Grande (Côtes d'Armor) a augmenté de façon significative en 1999 et en 2000. Pendant la marée noire de l'*Erika*, la station a recueilli 1 351 oiseaux mazoutés, dont 430 provenant de la côte nord de la Bretagne. L'arrivée à la LPO de ces 500 oiseaux n'était donc pas liée à la marée noire, mais à des déballastages.

* 352 = total provisoire au 30/07/2001





La station ornithologique de l'île Grande

LES DÉBALLASTAGES DE PLUS BELLE

La marée noire de l'*Erika*, gravissime pour les oiseaux - entraînant l'échouage d'au moins 60 000 oiseaux - a masqué l'effet déballastage de l'hiver 1999/2000. Un an après, la LPO a jugé intéressant de réaliser un recensement des échouages d'oiseaux mazoutés. Pour cela, elle a réactivé le réseau associatif mis en place dans le cadre du Plan National de Sauvetage des Oiseaux Mazoutés de la marée noire de l'*Erika*. Ce recensement a également reçu le concours de plusieurs PC POLMAR encore en activité. La période de collecte des oiseaux mazoutés a été particulièrement longue, s'étalant du début du mois de novembre 2000 au début du mois de mai 2001. L'opération a permis de comptabiliser un total de 2 557 oiseaux mazoutés, un record pour une période sans accident pétrolier. Ce dénombrement ne prétend cependant pas être exhaustif.

UN AN APRÈS, ENCORE L'*ERIKA* !

Toutefois, le naufrage de l'*Erika* n'est pas tout à fait étranger à ce chiffre. L'aspect

* Union Nationale des Centres de Sauvegarde de la faune sauvage.

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Pingouin au lavage

(© P. Delhoume - LPO)

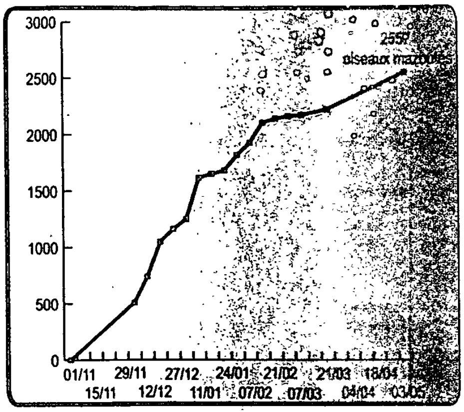
Laboratoire de la station ornithologique de l'île Grande

(© G. Bentz - LPO)

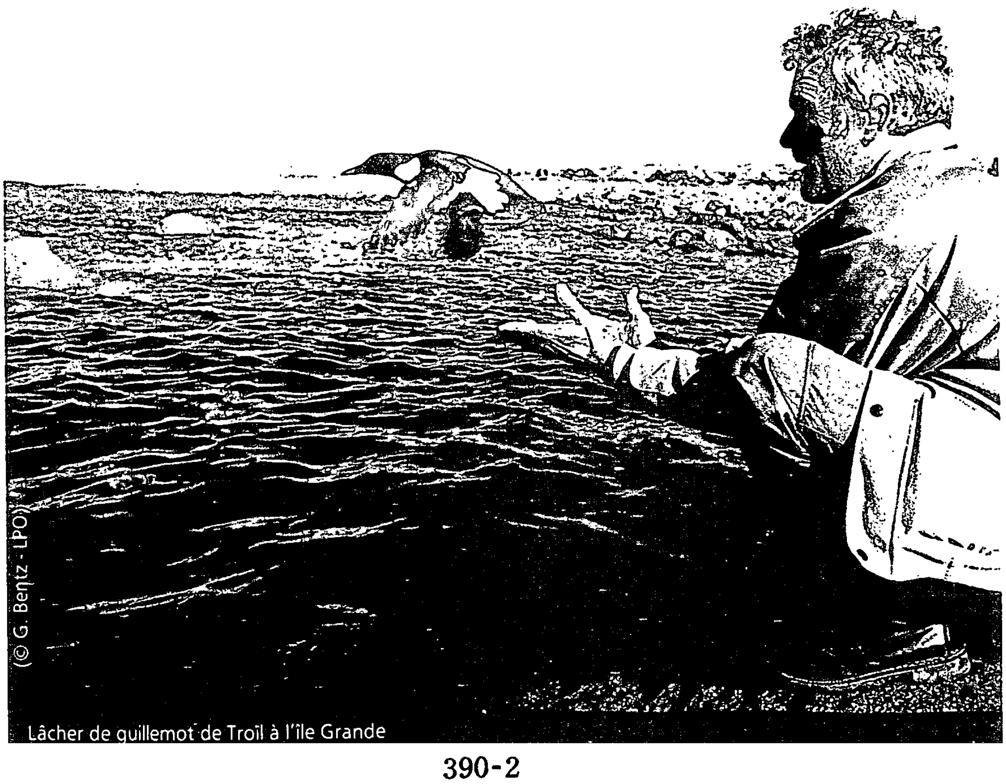
de l'hydrocarbure, engluant complètement certains oiseaux, n'était pas sans rappeler le fuel n° 2 de l'*Erika*. Des analyses ont été demandées au *Cedre*. Sur 36 échantillons prélevés, 12 présentaient de fortes similitudes avec le fuel de l'*Erika*. Ces oiseaux s'étaient échoués sur le littoral de Vendée, de Loire-Atlantique, du Morbihan et du Finistère sud.

"L'ÉROSION" DES COLONIES D'ALCIDÉS

Il reste que la majorité des oiseaux retrouvés a été victime de déballastages. Deux "vagues" d'échouages d'oiseaux mazoutés ont eu lieu. La première, la plus importante, a surtout touché des guillemots de Troïl (*Uria aalge*), mais aussi des fous de Bassan (*Sula bassana*), principalement sur le littoral Atlantique. La seconde, plus tardive, a touché des pingouins torda (*Alca Torda*) sur le littoral nord de la Bretagne. En avril, les alcidés (pingouin torda, guillemot de Troïl et macareux moine - *Fratercula arctica* -) sont installés sur les colonies bretonnes, principalement en Côtes d'Armor (Réserve naturelle des Sept-Iles et Cap Fréhel). Cent vingt huit pingouins mazoutés ont été recueillis à la station LPO de l'Ile Grande pour ce seul mois d'avril. Si les victimes sont essentiellement des jeunes, originaires des iles britanniques, certains de ces oiseaux étaient probablement des représentants de la toute petite population française de pingouins (24 à 27 couples en 1999). Gravement menacée, cette population est plus que jamais vulnérable.



Echouages d'oiseaux mazoutés, morts et vivants, sur les côtes de l'Atlantique et de la Manche (de la Gironde à la Somme) durant l'hiver 2000 - 2001 (du 1er novembre 2000 au 3 mai 2001), un an après la marée noire de l'*Erika*.



Lâcher de guillemot de Troïl à l'île Grande

(© G. Bentz - LPO)

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Publications du Cedre

- **Utilisation des dispersants pour lutter contre les déversements en mer** : Manuel de traitement des nappes par **bateau** -1987, 28p.
- **Utilisation des dispersants pour lutter contre les déversements en mer** : Manuel de traitement des nappes par **voie aérienne** 1991, 28p. *Comment agit un dispersant ? Quand peut-on disperser ? Comment appliquer un dispersant et en quelle quantité ? Comment évaluer l'efficacité du traitement ? Précautions d'emploi.*
- Manuel pratique d'**utilisation des produits absorbants flottants** - 1991, 40p.
Comment agissent les absorbants ? Quelles quantités doit-on employer ? Quels sont les types d'absorbants ? Comment éliminer les absorbants souillés ? Critères de sélection. Mode d'utilisation.
- Manuel pour l'**observation aérienne des pollutions pétrolières** - 1993, 36p.
Comment préparer la mission ? Comment se présentent les nappes d'hydrocarbures ? Comment observer une pollution ? Comment cartographier ? Comment évaluer les quantités de polluant ? Comment guider un navire opérant sur une pollution ?
- **La lutte contre les pollutions marines accidentelles** - Aspects opérationnels et techniques - 1995, 23p.
Synthèse sur les techniques de lutte, les différents produits de traitement, le transport, le stockage et l'élimination des déchets, l'évaluation des risques et les recommandations pratiques sur les actions à entreprendre en cas d'accident.
- **Conteneurs et colis perdus en mer** - Guide opérationnel - 2000, 82p.
Approche méthodologique en 5 phases : alerte - notifications - premières mesures ; évaluation de la situation ; prise de décision ; intervention ; suivi de l'évolution.
- **Reconnaissance des sites pollués par les hydrocarbures** - Guide opérationnel - 2000, 31p.
Méthodologie de reconnaissance du littoral : caractéristiques de la pollution ; du site pollué ; accessibilité...
- **Actes de colloques "From the *Nakhodka* to the *Erika*"** :
exchange of experience in at-sea response to offshore oil spills by passing ships - Conference proceedings - Brest 2000 - 21 communications - 162 p.
- **Le décideur face à une pollution accidentelle des eaux** - Guide opérationnel - 2001, 41p.
Gestion de la lutte et de la remise en état des sites et des biens affectés : qui assume, qui fait, qui paye ?
- **Miniguides d'intervention et de lutte face au risque chimique** : 61 guides vendus en lot ou séparément.

Contact : service documentation - Tél : 02 98 33 67 45 (ou 44)

Le décideur face à une pollution accidentelle des eaux

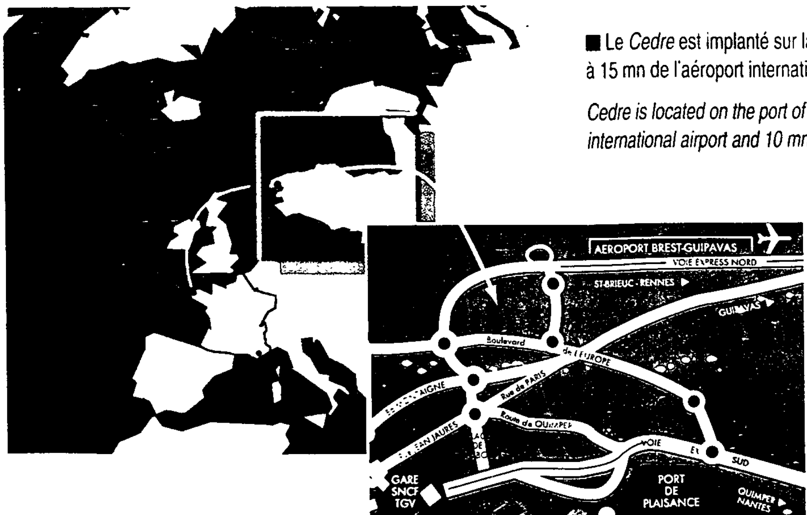
Brusquement propulsés en position de décideurs par les circonstances et les textes, nombre de responsables font là leur première expérience de ce type d'urgence, dans des conditions peu favorables à un bon apprentissage. Ce guide s'adresse donc à tous les responsables français susceptibles de se trouver un jour dans la situation de prendre des décisions en réponse à une pollution accidentelle des eaux. Il a été construit principalement pour le responsable public dont les fonctions amènent à prendre en charge la coordination de la réponse à une telle pollution. Mais les autres décideurs, du secteur public comme du secteur privé, pourront y trouver matière à réflexion sur leur intervention.

Formations 2002

INTITULÉ	DURÉE	DATES
Lutte sur le littoral, avec phases pratiques	4,5 jours	25-29/03
Journées d'information sur le nettoyage du littoral	2 jours	23-24/04
Lutte sur le littoral et en zone portuaire, avec phases pratiques	4,5 jours	27-31/05
INFOPOL 2002 - Séminaire international d'initiation à la lutte antipollution	12 jours	10-21/06
Lutte en eaux intérieures, avec phases pratiques	4,5 jours	24-28/06
Lutte sur le littoral et en zone portuaire, avec phases pratiques	4,5 jours	09-13/09
Journées d'information sur le nettoyage du littoral	2 jours	17-18/09
Lutte en zone portuaire, avec phases pratiques	4,5 jours	07-11/10
Observation aérienne des pollutions en mer	3 jours	21-23/10
Observation aérienne des pollutions en mer	3 jours	04-06/11
Gestion des pollutions accidentelles des eaux en zones de défense	4 jours	10-13/12

Hormis pour le stage INFOPOL, les personnels des services déconcentrés de l'Etat et des collectivités territoriales peuvent bénéficier de places subventionnées par le *Cedre* pour lesquelles seuls restent à charge les frais externes de transport, d'hébergement et de restauration.

Contact : Christine Ollivier - Tél : 02 98 33 67 42



■ Le *Cedre* est implanté sur la zone portuaire de Brest, rue Alain Colas, à proximité d'Océanopolis, à 15 mn de l'aéroport international de Brest-Guipavas et 10 mn de la gare S.N.C.F. de Brest.

Cedre is located on the port of Brest, rue Alain Colas, close to Oceanopolis. 15 mn from Brest-Guipavas international airport and 10 mn from Brest railway station.

■ La délégation du *Cedre* pour la Méditerranée est installée sur la base IFREMER Méditerranée à Toulon.

Cedre's delegation for the Mediterranean Sea is located on the IFREMER Mediterranean base, in Toulon.

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■ La délégation du *Cedre* aux Caraïbes est installée sur la base base Navale de Fort Saint-Louis en Martinique.

Cedre's delegation for the Carabbian is located on the Naval base of Fort Saint-Louis in Martinique.

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