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Aerial Surveillance and Information Gathering Systems.

Kill●Spill

Integrated solutions for combating marine oil spills

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1 General Introduction and Background

Kill-Spill is a European funded seventh framework programme project focusing on the development of highly efficient, economically and environmentally viable solutions for the clean-up of oil spills caused by maritime transport or offshore oil exploration and related processes.

The aim of the project is to develop novel biotechnologies with a reduced ecological impact for the clean-up of oil spills, to limit the use of non-environmentally friendly solutions. This encompasses the development of biosensors to monitor hydrocarbon degradation, as well as novel dispersants, absorbents, combined microbial and additives formulations, multifunctional bioremediation agents, and tools for sediments decontamination. The impact and toxicity of the developed products will be assessed, and they will then be validated in mesocosms and on real oil spills.

Work Package 1 (WP-1) is the in depth analysis of current knowledge and identification of technological gaps. WP-1, Task 1.1 is a review of available techniques and technologies.

Task 1.1, Subtask 1.1.1: Aerial Surveillance and Information Gathering System calls for a brief review of the current technologies and methods available to each European Union (EU) member state, European Free Trade Association (EFTA) Coastal Country and Candidate in respect of aerial surveillance, information gathering system and participation in European Maritime Safety Agency's (EMSA) CleanSeaNet. This will include both ad-hoc and dedicated surveillance platforms (satellite, fixed wing and rotary wing) and consider how the information is captured and transmitted to the decision making body. The quality of information and the speed at which it is received is of critical importance when mobilizing the correct and appropriate assets to a pollution incident.

2 Scope

The review covers EU member states, EFTA Coastal Countries, an Acceding EU member, Potential EU Candidates and a state which has applied for EU membership: a total of 28 states.

EU Member States: Belgium, Bulgaria, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Poland, Portugal, Romania, Slovenia, Spain, Sweden and United Kingdom (22)

EFTA Countries: Iceland* and Norway (2). *Iceland is also a Potential EU Candidate.

Acceding EU Member: Croatia – 1st July 2013 (1)

Potential EU Candidates: Iceland*, Montenegro and Turkey (2).

Applied for EU Membership: Albania (1)

Figure 1: European Union Map

3 Method

With regard to aerial (airborne) surveillance each country has been researched to determine the resources available. These countries have been split into countries with aircraft which have specialist marine pollution equipment, trained /experienced crews that fly regular patrols; those countries with aircraft and helicopters readily available with crews with maritime flying experience but probably without specific training or experience in oil observation at sea; those countries that have rotary wing aircraft that regularly fly over the sea in support of offshore exploration and production of oil and gas and finally general / commercial aviation. The data researched for each country is at Annex A.

The current specialist equipment used for marine pollution aerial surveillance has been studied and is detailed at Annex B.

The communications methodology for each country has been determined to establish how pollution reports are transmitted to the authority responsible for response.

Information gathering systems have been considered and documented.

Satellite surveillance and each country's participation in the EMSA's CleanSeaNet has been ascertained and highlighted.

Other information such as participation in international agreements has been included.

4 Aerial Surveillance – Aircraft with marine pollution surveillance equipment with trained and experienced crews that fly regular patrols.

Seventeen (17) of the 28 countries operate aircraft fitted with specialist marine pollution equipment. They have trained and experienced crews / observers and regularly fly patrols.

Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland and Sweden survey the Baltic Sea (8 countries).

Over the Greater North Sea and its wider approaches patrols are undertaken by Belgium, Denmark*, France, Germany*, Netherlands, Norway, Sweden* and United Kingdom (*Denmark, Germany and Sweden also fly over the Baltic) (5 countries).

France**, Spain and Italy fly surveillance over the Mediterranean Sea (**France also flies over the North Sea) (2 countries).

Spain*** patrols the Atlantic Ocean, covering the Spanish North Coast and the Canary Islands (***Spain also fly over the Mediterranean Sea).

It is believed Portugal surveys its maritime area of the Atlantic Ocean with emphasis on the Exclusive Economic Zone (EEZ) and continental shelf. Large maritime areas of the Autonomous Regions of the Azores and Madeira are also patrolled (1 country).

It is understood that Iceland flies regular pollution patrols (1 country).

Figure 2: The Norwegian Administration Beech King Air 350ER

5 Aerial Surveillance – Aircraft and helicopters readily available with crews with maritime flying experience.

All 28 countries have government aircraft and helicopters available at short notice. They are in general for Search and Rescue (SAR); some are maritime patrol and most are part of the coastguard or military. The crews will be use to flying over the sea but may have little knowledge of oil spill observation. However, they should be able to confirm the situation and give outline details of the oil provided they are adequately briefed as to what is required.

6 Aerial Surveillance - Rotary wing aircraft that regularly fly over the sea in support of offshore exploration and production of oil and gas.

The majority of the 28 countries are involved with oil and/or gas production: Belgium, Bulgaria, Cyprus, Latvia, Malta, Iceland and Montenegro are not currently domestic producers of offshore energy. Based on this it is fair to assume that there is helicopter traffic to and from the rigs on a regular basis. This traffic will generally report any oil on the surface to the platform or oil company who will be mandated to report the oil slick to the national authorities.

7 Aerial Surveillance – General / Commercial Air Traffic.

General and commercial air traffic is required to report, through the air traffic system, any sighting of suspected oil pollution on the sea surface. The information is normally within the national 'Air Pilot' document.

8 Specialist Remote Sensing Equipment for Marine Pollution Aerial Surveillance.

The very basic common Marine Pollution Remote Sensing Equipment Suite consists of a Side Looking Airborne Radar (SLAR), for detection; an Infrared sensor (IR) for relative oil thickness measurement and an Ultraviolet sensor (UV) for area measurement. There are cameras to record the detection. The equipment is integrated into a system where the data is displayed and stored with essential information overlaid (position / time / altitude / speed etc). The data can be communicated to responsible authorities via radios or data links. The equipment is detailed at Annex B.

9 Visual Observation

Visual observation of the pollution provides essential information about the size, appearance and coverage of the slick that can be used to calculate an initial estimate of volume. Remote sensing instruments can provide a clear and unambiguous indication of the pollution on sea surface under normal conditions: but all have limitation and/or have not be proven to work effectively operationally. To confirm the presence of oil and estimate the volume the observer must 'see' the slick; therefore the most important remote sensing sensor is the human eye.

Since the colour of oil itself as well as the optic effects are influenced by meteorological conditions, altitude, angle of observation and colour of the sea water, an appearance cannot be characterised purely in terms of apparent colour and therefore an 'appearance' code, using terms independent of specific colour names, has been developed. The Bonn Agreement Oil Appearance Code is detailed at Annex C.

10 Training

Training in the use of the specialist equipment, data interpretation, visual observation and oil quantification is essential if an accurate picture of the situation is to be available to the relevant authorities. Its importance cannot be over emphasised.

11 Communications

Within the country information at Annex A it can be seen that all 28 countries operate, 24 hour, Rescue Coordination Centres (RCC). In most cases the RCC is a Maritime RCC but occasionally a Joint RCC; they are normally the first point of contact for pollution reports. The RCC staff will be well use to dealing with 'emergency' communications / information that needs priority action from their search and rescue commitment. They will know which authority to contact. An RCC is well equipped with VHF radio, MF radio and telephone (Satellite, Landline and Mobile).

Air assets, surveillance aircraft and SAR helicopters, are able to communicate through Marine Band Radio. Data linking would be via an air base or headquarters.

12 Information Gathering Systems.

All the EU coastal states use both Automatic Identification Systems (AIS) together with Vessel Tracking Services (VTS) and Port State Control (PSC) for information gathering as part of the establishing of the detailed maritime situation picture.

12.1 Automatic Identification System (AIS) and Vessel Tracking Services (VTS)

AIS is an automatic tracking system used on ships and by VTS for identifying and locating vessels by electronically exchanging data with other nearby ships, AIS base stations and satellites. AIS information supplements marine radar, which continues to be the primary method of collision avoidance for water transport.

Tracking vessels outside the range of AIS coastal networks requires the use of satellites. When satellites are used to detect AIS signatures then the term Satellite-AIS (S-AIS) is used.

Member States and EMSA operate SafeSeaNet, the vessel traffic monitoring and information system covering the waters in and around Europe. It acts as a platform for maritime data exchange, linking together maritime authorities from across the continent. It works by tracking AIS radio signals transmitted by ships. These provide identity details, latest positions and other status information in near-real-time for around 17,000 vessels operating in and around EU waters. This data can be enriched with information on hazardous goods; the number of people on board; past positions of ships; ships with high risk profiles; accidents and incidents; estimated or actual arrival and departure times in ports.

One of the main users of SafeSeaNet is the THETIS system. (THETIS is the working name for the system. THETIS was a goddess of the sea). The system supports Port State Control (PSC) inspections. It indicates which ships have priority for inspection and allows results to be recorded and shared. Information on ship arrivals and departures from ports in SafeSeaNet enables inspections to be planned efficiently.

12.2 Port State Control (PSC)

PSC is the inspection of foreign ships in national ports to verify that the condition of the ship and its equipment comply with the requirements of international regulations and that the ship is manned and operated in compliance with these rules.

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. The primary responsibility for ships' standards rests with the flag State - but port State control provides a "safety net" to catch substandard ships.

The International Maritime Organisation (IMO) has encouraged the establishment of regional PSC organizations. Agreements, Memoranda of Understanding (MOUs), have been signed covering all of the world's oceans.

12.3 Long-Range Identification and Tracking (LRIT)

LRIT is a mandatory international system to track ships around the world. Vessels send signals via telecommunication satellites, which are received by data centres in flag States. EMSA operates the EU LRIT Cooperative Data Centre, covering over 35 countries. The Agency also hosts the International Data Exchange, for the exchange of ship positions between Data Centres around the world.

Emerging technologies now enable AIS signals to be received by satellite. This will progressively extend the geographical range of the AIS system.

12.4 General Public

The **General Public** is another vital information gathering system and should never be forgotten or ignored. Recently, reports of dead birds along a coastline and, in the past, tar balls on the beach have been a trigger for response action; as well as an initial indication of oil or chemicals on or below the sea surface. What is required is a well publicised contact / telephone number of the national coastguard or another authority for the populace to report any sighting / findings.

13 Satellite Surveillance Systems.

13.1 CleanSeaNet

EMSA operates the European oil spill and vessel detection service **CleanSeaNet**. The service is based on radar satellite images, covering all European sea areas, which are analysed in order to detect possible oil spills on the sea surface. When a possible oil spill is detected in national waters, an alert message is delivered to the relevant country. Analysed images are made available to national contact points within 30 minutes of the satellite passing overhead.

CleanSeaNet First Generation Report, 16 April 2007 - 31 January 2011, shows that 24 countries received satellite images between 2007 and 2011. Twenty two (22) of the countries are the EU member states given in paragraph 2.1. The other 2 are Norway and Croatia.

The CleanSeaNet has access to 3 polar orbiting satellites with Synthetic Aperture Radar via a network of 5 receiving ground stations throughout Europe, allowing wide areas to be monitored at regular time intervals.

Satellite images are acquired in segments of up to 1400km and swaths of up to 500km. Swath coverage refers to the width of the strip covered by the radar at each overpass. Coastal states order the images they require. These often cover the alert area of another coastal state. On average, one image covers the alerting area of 2.6 Member States. By ordering images centrally, it is possible to significantly reduce the number of images needed to fulfil coastal

states' national coverage requirements. By ordering a large number of images and data via centralised contracts, a reduction of the cost of image licences and of service provision can be achieved.

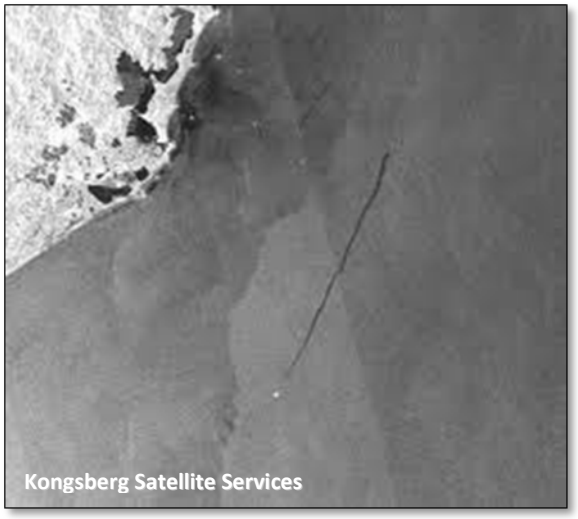

Figure 3: Satellite Synthetic Aperture Radar Image

13.2 Kongsberg Satellite Services (KSAT).

KSAT is a commercial Norwegian company, uniquely positioned to provide ground station and earth observation services for polar orbiting satellites. With three interconnected polar ground stations optimally positioned for access to polar orbits.

The company supports most of the commercial satellites in orbit and can provide timely imagery and data independent of satellite ownership. With a unique ground station network and experienced analysts, 'near-real-time' operational information can often be provided within 30 minutes. KSAT's multi-mission maritime monitoring services have been provided to coastguards, pollution-control authorities and oil companies since 1998; they include oil spill detection, vessel detection plus multi mission rapid response.

13.3 SATHAV

The Norwegian Coastal Administration supports a national satellite program called SATHAV. The aim of this program is to coordinate use of satellite data between governmental users, such as the military, the different pollution authorities, meteorological institutes, research institutes, universities etc. Norway only receives 'high confidence' satellite observations. In 2010, 1500 satellite images were analysed in the Norwegian EEZ.

13.4 SeaU

SeaU is a three-year project, started in February 2011, funded by the European Commission (EC) to develop the next generation satellite based oil monitoring service. The project, led by KSAT, brings together the leading European experts in research and operational services with respect to monitoring of oil pollution with satellites.

The overall aim of the project is to improve the current state-of-the-art methodology for satellite based oil spill detection and to demonstrate how these improvements can contribute to the development of a sustainable downstream service. This will be done by integrating new geoinformation products into innovative methods for oil spill detection.

14 International Agreements

All 28 countries have bi-lateral and or multi-lateral arrangements for support during major incidents. They are all contracting parties to at least one of the following international Agreements, Commissions and Conventions.

The Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area is an international convention encompassing various measures for the prevention and elimination of pollution of the Baltic Sea, from all sources, through intergovernmental co-operation. With regard to aerial surveillance the states endeavour to fly - as a minimum - twice per week over regular traffic zones including approaches to major sea ports as well as in regions with regular offshore activities and once per week over the regions with sporadic traffic and fishing activities. Twice a year, several Baltic Sea states jointly organize surveillance flights (24 to 36-hours) - one covering the southern part of the Baltic Sea, and another flight over waters further north. The contracting parties are Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden and the EC.

The Bonn Agreement is an environmental agreement to ensure mutual cooperation in the avoidance and combating of environmental pollution of the Greater North Sea and its wider Approaches by oil and other harmful substances. Within the framework of the Bonn Agreement close co-operation has been established on airborne surveillance. This is achieved by co-ordination of the national flight plans carried out by the contracting parties themselves; co-operation in areas of mutual interest, for example by means of Coordinated Extended Pollution Control Operations (CEPCO) and setting up special flights, such as Tour d'Horizon, Joint Flights and Aerial Surveillance Exercises. The contracting parties are Belgium, Denmark, France, Germany, Ireland, Netherlands, Norway, Sweden, United Kingdom and the EU.

The Barcelona Convention is a convention to prevent and abate pollution from ships, aircraft and land based sources in the Mediterranean Sea. Signatories agree to cooperate and assist in dealing with pollution emergencies, monitoring and scientific research. The contracting parties are Albania, Algeria, Bosnia Herzegovina, Cyprus, Croatia, Egypt, Spain, France, Greece, Israel, Italy, Lebanon, Libya, Malta, Morocco, Monaco, Montenegro, Slovenia, Syria, Tunisia, Turkey and the EC.

The Convention on the Protection of the Black Sea against Pollution it is the basic framework of agreement. There are three specific Protocols; the control of land-based sources of pollution; dumping of waste and joint action in the case of accidents (such as oil spills). The contracting parties are Bulgaria, Georgia, Romania, Russia, Turkey and Ukraine.

Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) is the mechanism by which the Governments of the western coasts and catchments of Europe, together with the EC, cooperate to protect the marine environment. The area covered includes the Atlantic and Arctic Oceans north of latitude 36°N, east of longitude 42°W and west of longitude 51°E, excluding the Baltic and Mediterranean Seas. The contracting parties comprise the fifteen following governments: Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom, together with the

EU. Finland is not on the western coasts of Europe, but some of its rivers flow to the Barents Sea, and historically it was involved in the efforts to control the dumping of hazardous waste in the Atlantic and the North Sea. Luxembourg and Switzerland are contracting parties due to their location within the catchments of the River Rhine.

The United Nations Environmental Programme (UNEP) Regional Seas Programme provides vehicles for governments to co-ordinate their activities on the prevention of pollution of specific sea areas. More than 143 countries participate in 13 regional seas programmes. The programmes function through an Action Plan. In most cases the Action Plan is underpinned with a strong legal framework in the form of a regional convention and associated protocols on specific problems. The work of programmes is coordinated by UNEP's Regional Seas Branch based at the Nairobi Headquarters. Regional Coordination Units, often aided by Regional Activity Centres oversee the implementation of the programmes and aspects of the regional action plans such as marine emergencies, information management and pollution monitoring.

15 Consideration

Work Package 1 (WP-1) calls for an in depth analysis of current knowledge and identification of technological gaps.

WP-1, Task 1.1, Subtask 1.1.1: Aerial Surveillance and Information Gathering System requires a brief review of the current technologies and methods available to each EU member state, EFTA Coastal Country and Candidate in respect of aerial surveillance, information gathering system and participation in EMSA's CleanSeaNet. This should include both ad-hoc and dedicated surveillance platforms (satellite, fixed wing and rotary wing) and consider how the information is captured and transmitted to the decision making body.

Subtask 1.1.1 has been completed and is documented in this paper.

15.1 Aerial (airborne) Surveillance

The data collected shows that at least 17 of the 28 countries, more than 60%, have aircraft fitted with specialist remote sensing marine pollution surveillance equipment; flown by trained and experienced aircrews and observers.

All the remaining 11 countries have government maritime / SAR aircraft and/or helicopters flown by experienced aircrews. Most of these aircrews and other observers are unlikely to have had any marine pollution visual observation with oil quantification training. However they will be experience in flying over the sea in all kinds of weather condition (sometimes very rough). They are well able to assess a situation and can provide an invaluable insight into what is happening on scene by describing what they can 'see'. With training, what they 'see' would be qualified and more readily accepted. **Whilst not a technological gap there is a definite need for oil spill surveillance, visual observation and quantification training.**

There is a significant amount of air traffic supporting offshore industries in the majority of countries. Nearly 80% of states have involvement with oil / gas production. This air traffic provides a substantial additional aerial surveillance capability in sea areas which are more liable to pollution and can be prone to accidents (Piper Alpha, Deep Water Horizon), particularly as installations age.

General and commercial flights rarely report sightings of sea disturbances but is has been known and there is a mechanism for reporting through the air traffic control system.

Overall it is considered that there is 'good' aerial surveillance coverage within the area. The Baltic, the Greater North Sea, the Atlantic and Western Mediterranean are well resourced. In the Eastern Mediterranean and Black Sea there is a number of assets available that are capable of responding to oil spill detections and / or incidents: however there is a real need for marine pollution aerial surveillance, visual observation and oil spill quantification training in this region.

The current remote sensing sensors have been used successfully for a long time and it is understood that there are no new instruments in development. Those instruments that identify and quantify oil appear to have limitations when used operationally; which is why visual observation is essential.

15.2 Information Gathering Systems

Information Gathering Systems as described are used by all parties to build up a 'good' surface picture overall, regionally and within national sea areas. Experience with the integration of systems and use of information is being gained and will be used to develop / improve the support to the European vessel traffic monitoring community.

Information from other sources, particularly the general public, is an invaluable complement to other systems and will normally provide the first indication of a problem or incident.

15.3 Satellite Surveillance Systems

Satellite Surveillance Systems for pollution monitoring are well established and are commonly used throughout the area. The CleanSeaNet is now well into the second generation; it can provide a satisfactory and timely service to an expanding community.

15.4 Data and Visual Reporting - Communications

Data capture, storage and dissemination are an essential part of all surveillance and information gathering systems. Those aircraft fitted with a remote sensing suite automatically annotate the recorded data sets. The information, together with the observers report, can be transmitted to operation centres via the myriad communications, including satellite communications, available today.

Those aircrews and observers of government or contracted aeroplanes / helicopters (normally maritime and SAR) and other platforms with visual reports to make will be very familiar with the global maritime SAR system of coordination centres and radio stations around every coastline. The emergency services, normally coastguard or military, are highly experienced at handling urgent messages and relaying them to the relevant authority in a timely fashion. In most cases the national coastguard / coordination centre is the main point of contact for 'pollution' reports.
Analysed satellite images are made available to national contact points within 30 minutes of the satellite passing overhead.

It is considered that the information, data and visual reports, can be captured and transmitted to the decision making body with a quality and speed that enables the mobilization of the correct and appropriate assets to a pollution incident.

15.5 International Agreements – Mutual Support

Mutual support is available to all parties, and has been used to good effect, through agreements and conventions. They are an essential part of any contingency plan.

ANNEX A To
DL 1.1. Aerial Surveillance
And Information Gathering

National Data Collected

EU Member States

BELGIUM

Management Unit of the Mathematical Model of the North Sea (MUMM) and the Directorate General Environment of the Federal Public Service Health, Food Chain Safety and Environment are the two Belgian authorities competent for the aerial surveillance of marine pollution above Belgium's zone of responsibility in the North Sea.

MUMM plans, directs and controls the surveillance missions using a Britten Norman Islander (OO-MMM) aircraft fitted with SLAR, IR/UV and camera systems. The aircraft is operated by MUMM and flown by Belgian military pilots. The remote sensing equipment is handled by an operator from MUMM. During aerial surveillance patrols, the aircraft retains state aircraft status.

The Directorate-General Environment complements MUMM's surveillance activities with a fast response service using private stand-by helicopters certified for a broad range of operations above the sea (including hoisting). A helicopter can be scrambled at any time for verifying reported information on possible marine pollution. The helicopter on duty is equipped with a purpose-build portable video system with day and night capabilities. This system is operated by the agent of the Directorate-General Environment leading the mission on board of the helicopter.

Belgium has a Coast Guard with an MRCC at Ostend. The MRCC is the first point of contact for incidents at sea and coordinates rescue.

The Coast Guard does not own any vessels, aircraft or helicopters; these are provided by the cooperating ministries and authorities working together in the Coast Guard.

SAR duties along the Belgian part of the North Sea are executed by the Belgian Air Component from its Koksijde Air Base; it operates 5 Westland Sea King Mk.48 helicopters.

BULGARIA

The Bulgarian Maritime Authority is responsible for the prevention and response to pollution in the marine environment.

There is an MRCC at Varna. Radio Varna ensures 24-hours surveillance of maritime radio frequencies and voice communication with vessels.

SAR duties are carried out by the Bulgarian Navy using AS 565 MB 'Panther' helicopters. The Bulgarian Air Force operates AS 532 'Cougar' and AS 565 helicopters.

 CYPRUS

The Department of Fisheries and Marine Research is responsible for detecting and combating pollution in the territorial waters of Cyprus. For this it co-operates closely with the Coast Guard; marine or airborne.

The Cyprus Port and Marine Police is the civilian Coast Guard wing of the police.

There is an MRCC at Larnica.

The Cyprus Police Aviation Unit operates two Agusta Westland 139 helicopters for SAR as well as other maritime tasks.

 DENMARK

The Danish Armed Forces are responsible for the state maritime environmental surveillance and enforcement, and marine pollution control at sea.

Admiral Danish Fleet (ADF) receives all reports on matters concerning the marine environment and is responsible for the direction and coordination of the total employment of the state resources at sea, including assistance from involved external authorities. ADF decides on the extent of the effort in connection with established pollution, and organises the allocated national resources.

The Royal Danish Air Force operates 3 Challenger aircraft which are equipped with SLAR, IR/UV line scanners, video/photo cameras with annotation of navigational data and a belly mounted retractable FLIR turret; a SAR and an AIS installation are planned.

Airborne surveillance comprises 500 hours' annual flying performed by specially equipped aircraft from the Air Force's inspection flying structure. The airborne surveillance is carried out over Danish territorial waters, including Danish international straits, and over the Danish EEZ.

There is an MRCC at Arhus.

The SAR forces in Denmark are equipped with 8 EH-101 and 1 or 2 Lynx, helicopters

 ESTONIA

Responsibility for marine pollution lies with the Ministry of Internal Affairs. In practice the responsibility for coordination is delegated to the Estonian Border Guard (EBG).

Estonia flies regular marine pollution aerial surveillance within the Baltic Sea area.

There is a JRCC at Tallinn.

For SAR the EBG has 3 AW139 helicopters.

 FINLAND

The Ministry of the Environment has overall responsible for the management and control of oil and chemical spill response

Finnish Environment Institute (SYKE), operating under the Ministry, is the competent governmental pollution response authority. It is in charge of measures against pollution incidents in open sea and whenever severity of an incident necessitates.

The Finnish Border Guard (FBG) operates has 2 Dornier 228 -12 which fly regular marine pollution patrols in the Baltic Sea area. There FBG also operates a number of helicopters for SAR.

There is an MRCC at Turka.

 FRANCE

France has not formed a single multi-purpose force to combat accidental pollution in the marine environment. The Maritime Prefect is responsible for organising and directing operations at sea within the boundaries of his own region. When a disaster or a threat of disaster is of such gravity or complexity that response by ordinary means is not possible, the Maritime Prefect sets in motion the POLMAR Plan (Sea).

Several aircraft within the customs organisation perform routine flights over the sea and carry out pollution surveillance. Two F406 are equipped with remote sensing systems: both have SLAR, IR/UV, AIS and SATCOM. One aircraft is equipped with MWR and the other with a LLL TV.

There are MRCCs at Etel, Gris Nez, Jobourg, Corsen and La Garde.

The French Navy has numerous SAR and maritime helicopters and several Atlantique II Maritime Patrol aircraft

 GERMANY

The Central Command for Maritime Emergencies (CCME), Section 2, Maritime Pollution Control / High Sea plans directs and controls the aerial surveillance missions.

The Federal Waterways and Shipping Administration owns two Dornier Do 228-212 LM aircraft. The aircraft are operated by the Naval Airwing 3 based in Nordholz.They are equipped with SLAR, IR/UV, MWR, LFS and FLIR / CALI system. For documentation purposes, a video system, a nadir camera and photo cameras are on board.

The German Federal Coast Guard is a civilian law enforcement organisation whose primary missions include maritime environmental protection.

The German Navy has numerous helicopters for SAR and maritime. They also operate P-3C Maritime Patrol aircraft

There is a MRCC at Bremen.

 GREECE

The Hellenic Coast Guard Force is currently under the authority of the Ministry of Civil Protection. One of its main activities is the protection of the marine environment and response to marine pollution incidents.

The Coast Guard operates a small fleet of fixed wing aircraft based at Tatoi (Dekelia) Air Base; including a maritime patrol Cessna 406 Caravan II. Its four AS.332 Super Puma SAR helicopters are operated by the Hellenic Air Force 384 Squadron, based at Elefsis Air Base (LGEL), with mixed Air Force and Coast Guard crews. The Air force also has maritime patrol aircraft

There is a MRCC in Piraeus and the Emergency Radio Communications Station SXE at Aspropyrgos.

 IRELAND

The Irish Coast Guard (IRCG), part of the Department of Transport, is responsible for pollution response in the marine environment. The MRCC in Dublin coordinates all pollution control in the Irish EEZ.

The IRCG operate 6 Sikorsky helicopters for SAR.

The Air Corps operates two CASA CN235, maritime patrol, aircraft in support of the fishery protection. These long-range aircraft patrol throughout the Irish exclusive fishery limits.

 ITALY

The overall responsibility of spills rests with the Ministry of the Environment. The Central Service of Sea Defence, a part of the Ministry of the Environment, is responsible for coordinating response.

It is understood that regular pollution patrols take place.

The Corps of the Port Captaincies is the Coast Guard of Italy and is part of the Italian Navy under the control of the Ministry of Infrastructure and Transport. One of its missions is the protection of marine resources.

The Coast Guard has a number of fixed wing maritime patrol aircraft including an ATR 42. For SAR there are up to 13 Augusta helicopters.

There is an MRCC in Rome and numerous sub stations around the country.

The Italian Navy has many maritime helicopters and the Air Force operates Atlantique, Maritime Patrol aircraft.

 LATVIA

The **Latvian Coast Guard Service**, under the authority of the Ministry of Defence, has national responsibility for dealing with spills of oil in Latvian marine waters.

There is an MRCC at Riga.

The Latvian Air Force operated Mi-8 Hip helicopters for SAR.

 LITHUANIA

In Lithuania control of the EEZ and territorial waters is the joint responsibility of the Lithuanian Air Force and the Lithuania Navy.

Helicopters and the aircraft of the Lithuanian Air Force are used to detect areas of oil product or hazardous substances spills.

Spill response is centred on the MRCC of the Lithuanian Naval Force at Klaipeda.

The Lithuanian State Border Guard Service, Aviation Unit, operates 4 twin engine helicopters.

 MALTA

Transport Malta is the competent national authority with overall responsibility for oil pollution response at sea.

For maritime patrol the Armed Forces of Malta (AFM), Air Wing, operates 2 BN-2B-26 Islanders and 2 Beechcraft B200 King Airs'. The King Airs' are fitted with RDR-1700B Maritime Surveillance and Imaging Radar. They also operate helicopters for SAR and coastal patrols.

AFM operates the Malta RCC.

 NETHERLANDS

The Minister for Transport, Public Works and Water Management is the coordinating Minister for North Sea activities. The Minister is also responsible for policy in maritime accidents. However, the Director of the Netherlands Coastguard is in charge of coordinating the response operations.

The Ministry of Defence, represented by the Netherlands Coastguard, operates two Dorniers 228-212. The aircraft are equipped with SLAR, FLIR, video camera and digital photo cameras. A data downlink is part of the system. These aircraft fly regular marine pollution surveillance patrols.

The Royal Netherlands Navy is responsible for operational command of the Netherlands Coastguard Service.

There is a MRCC at Den Helder.

The Navy flies the SAR and utility version of the Lynx maritime helicopter. The Royal Netherland Air Force (RNLAF) has a specialized SAR unit which is equipped with Agusta-Bell AB 412s and based at RNLAF Leeuwarden.

 POLAND

The Ministry of Infrastructure delegates the responsibility for planning, conducting and coordination pollution combating operations to the Director of the Maritime Search and Rescue Service.

There is a MRCC at Gdynia and a number of coastal rescue stations.

The Border Guard of the Republic of Poland, Maritime Regional Unit, is tasked with surveillance of the Polish Maritime Area.

The Border Guard's has an M28 Skytrack aeroplane which regularly flies over the Polish EEZ. They also have other fixed wing aircraft and a number of helicopters.

 PORTUGAL

The Maritime Authority Directorate General (DGAM) coordinates the response to marine pollution at sea.

There is a MRCC at Lisbon and Ponta Delgardo.

Portuguese Air Force operates the Augusta Westland AW101 Merlin helicopter for SAR.

Other air assets that can be called on including P-3, C-130, C-295, Falcon 50 fixed wing aircraft and Allouette III helicopters. Of these aircraft the P-3 (5) and C-295 (5) are maritime patrol aircraft.

It is understood that the CASA C-295MPAs have a marine pollution surveillance suite.

 ROMANIA

The Romanian Naval Authority (RNA) takes the lead role for at sea response to oil spills and operates an MRCC at Constanta to coordinate of the activities for the prevention, investigation and response to pollution.

The Romanian Naval Force and Air Force operates the IAR 330 Puma helicopters. The Navy Pumas are operated from frigates for SAR, medevac and maritime surveillance missions.

 SLOVENIA

The Slovenian Maritime Administration working within the Ministry of Infrastructure and Spatial Planning carries out a wide range of tasks encompassing all aspects of maritime activity including pollution prevention and search and rescue at sea.

There is an MRCC at Koper.

One of the main tasks of the Slovenian Air Force and Air Defence is SAR. They have a number of helicopters.

 SPAIN

The Spanish Maritime Safety Agency (SASEMAR), the operations branch of the Maritime Authority General Directorate of the Merchant Marine, controls the aerial surveillance missions. SASEMAR owns three, fully equipped, CASA CN235-300s. One patrols the Mediterranean and the other two the Atlantic, covering the Spanish North Coast and the Canary Islands respectively. SASEMAR operates a fourth light aircraft Beechcraft B-55 Baron, equipped with digital photo camera in the Mediterranean. The aircraft, based in Santiago de Compostela, Galicia, patrols the Spanish North Atlantic Coast. It is fitted with specific antipollution sensors: SLAR, IR/UV, MWR, LFS, and with other equipment: FLIR/CALI, video recorder, digital photo camera, AIS and data link. The system is managed by two operators placed in two mission consoles. The data is analysed in the Mission Support Centre.

Helicopters can support the marine pollution aerial surveillance; taking samples from the sea. SASEMAR owns eight helicopters AW139 (three in the Spanish North Atlantic Coast), and operates three S-61N (one in the Spanish North Atlantic Coast), equipped with FLIR, video recorder and digital photo camera.

Spain has 21 MRCCs around the coast.

 SWEDEN

The Swedish Coast Guard has the responsibility for maritime environmental protection, which includes the response to oil and other harmful substances in the territorial waters, the EEZ and in the larger lakes.

The Coast Guard operates 3 Dash 8 Q-300, all fully equipped with remote sensing systems, for routine operations in the Skagerrak and North Sea. The three aircraft have a total flying time of approximately 3000 hours per year.

The Coast Guard also has a number of Sikorsky S76 SAR helicopters on standby.

There is an MRCC Goteborg.

 UNITED KINGDOM

The United Kingdom, Maritime and Coastguard Agency (MCA), Counter Pollution Branch, plans, directs and controls regular surveillance flights using two marine pollution surveillance aircraft. The aircraft, a Cessna 404 and a Cessna 406 are equipped with SLAR, IR/UV, Video and digital cameras, night identification equipment and a data transmission system.

The Coast Guard has a number of SAR helicopter around the coast. The Royal Air Force and Royal Navy also have helicopters on short notice at military bases.

There are a number of MRCCs around the coast.

EFTA Countries

 ICELAND

The Icelandic Coast Guard (ICG) is tasked with pollution monitoring.

The ICG has Bombardier DHC-8-Q314 for maritime surveillance and three x Aérospatiale AS-332L1 Super Puma helicopters for maritime surveillance and SAR operations**.**

Regular pollution patrols are undertaken.

There is an MRCC Reykjavik.

 NORWAY

The national responsibility for dealing with acute pollution on Norwegian territory, in the territorial sea and at Svalbard rests with the Ministry of Fisheries and Coastal Affairs.

The Norwegian Coastal Administration has under contract a Beech King Air 350ER Maritime Patrol and surveillance Aircraft with SeaHunter 8000. The aircraft flies regular pollution patrol.

The Norwegian Coast Guard is a military force and is part of the Royal Norwegian Navy.

There are MRCCs at Stavanger and Bodoe

The SAR helicopters are operated by the Royal Norwegian Air Force who have 12 Westland Sea Kings. The Norwegian Sea Kings are due to be replaced by 2020. They also have maritime patrol aircraft.

MRCC Stavanger MRCC Bodoe

Acceding EU Member: Croatia – 1st July 2013

 CROATIA

The principle pollution control authority is the ministry of the Interior. Response at sea is the responsibility of the Ministry of Maritime Affairs, Transport and Communications.

The Coast Guard is a division of the Navy.

There is an MRCC at Rijeka and a number od sub centres along the coast.

The Coast Guard has at its disposan several Pilatus PC-9 aircraft and Mil Mi-8 helicopters of the Croatian Air Force.

Potential EU Candidates

MONTENEGRO

The Maritime Safety Department of Montenegro, Division for the Prevention of Pollution from navigable vessels, performs activities connected with the prevention of pollution from navigable vessels (combating, minimizing and eliminating consequences of pollution).

There is an MRCC at Bar.

The Montenegrin Air Force operates Gazelle and Mil Mi-8 helicopters.

TURKEY

One of the objectives of the Ministry of Environment and Forestry Turkey, is to prevent every type of pollution.

The Coast Guard, under the command of the Turkish Interior Ministry, is responsible for controlling the maritime areas, coasts and fighting all kind of illegal action in the area. Turkish Coast Guard is also the main SAR Coordination Authority and has an MRCC at Ankara.

The Turkish Coast Guard operates CASA CN-235 aircraft and Augusta Bell AB-412 helicopters.

The Armed Forces and police have other aircraft and helicopters that can be called on.

Applied for EU Membership

ALBANIA

Under the Ministry of Public Works, Transport and Telecommunication one of the objectives of Albanian Maritime Transport Infrastructure Development is to protect maritime environment from pollution. The Maritime Transport Policy Directorate is the point of contact; Tirana.

There is a JRCC at Tirana

The Albanian Air Force operates a number of helicopters of various types.

ANNEX B To
DL 1.1. Aerial Surveillance
and Information Gathering

Specialist Remote Sensing Equipment for Marine Pollution Aerial Surveillance

1. Remote Sensing

Remote sensing is the detection and identification of phenomena at a distance from the object of interest using human capabilities or special sensors. Modern remote sensing instruments are normally based on optical, electronic or, sometimes, chemical techniques.

2. Sensors – General Requirements

To be of use in dealing with (oil) pollution incidents, remote sensing instruments have to provide the capability to a clear and unambiguous indication of the pollution on sea surface from a reasonable distance under normal conditions. In addition it is desirable to have means to identify the type of pollution and the source the pollution originates from as well as means for estimating the volume.

It is recommended that all sensors are integrated into one operating system with the data and annotation presented in real time. The recorded data can be analysed in a ground processing station as required.

Sensors fall into broad categories according to their mode of operation – active and passive.

Active sensors emit a signal, and measure some feature of the interaction of the signal and the target – usually by analysing the return echo. Radar Systems and Laser Fluorimetry are examples of active sensors. In general, active scanners can operate at any time of day or night and to some extent can penetrate cloud.

Passive sensors do not emit a signal, but rely instead on emissions from the target – usually the reflection or transmission of ambient electromagnetic radiation. Ultra Violet and Infrared scanners as well as Microwave Radiometers are examples of these types of sensors. Passive sensors will only be functional when there is sufficient ambient radiation, and this usually means during daytime.

3. Side Looking Airborne Radar (SLAR)

The SLAR measures the roughness of the sea surface. Microwaves in the region of 3 centimetres are transmitted in pulses and the reflection from the surface is used to build up a radar picture on both sides of the aircraft. Capillary waves on the sea surface tension resulting in a dampening of the capillary waves, will show up against the surrounding clear water.

SLAR is the most common device in use at present. Under normal conditions, between wind forces 1 up to 7 Beaufort; the system will cover an area of up to 40 kilometres on either side of the aircraft. When flying undisturbed at an altitude along a straight track the image building up will cover a total area of 80 kilometres in width although there is a gap directly under the aircraft corresponding with

1.5 times the altitude. Within the area covered the presence of, even thin layers, surface pollution can be detected, provided that there is sufficient roughness at sea surface.

The spatial resolution of SLAR on the average lies around 20 metres, which means that when two objects at the same distance from the antenna should have a separation of at least 20 metres to be detected as two objects. For oil detection the polarisation of the system is vertical and for ice detection often horizontal polarisation is used.

The main disadvantage of the SLAR, that is the same for all radar systems, is that it responds to any phenomena that suppress capillary waves. For example certain current patterns, ice and surface slicks associated with biological activity can all produce falls targets. Conclusively it is emphasised that though SLAR is the primary long range detection sensor the only information obtained is an indication that "something" is floating at the surface probably requiring further investigations.

4. Synthetic Aperture Radar

Synthetic Aperture Radar used on satellites systems; is similar to the SLAR in how it detects oil on the sea surface. However, from a technical point a view there are some important differences. Where the SLAR uses a fixed antenna length the synthetic system can define the antenna length by sampling echo's over a period of time. The mechanical part of the antenna is very small. The advantage of the synthetic radar is its improved spatial resolution that remains the same over the entire area covered.

Operational use of synthetic radar in aircraft with the objective to detect oil is not yet common.

5. Ultra Violet (UV)

Surface pollution, especially oil, is a good reflector of the ultraviolet component of sunlight. An ultraviolet scanner or camera is a passive device detecting reflected ultraviolet with a wavelength of about 0.3 micrometers. The sensor is mounted vertically in the belly of the aircraft and can build up a continuous image of an entire slick, even the extremely thin areas, as the aircraft passes over the slick. It cannot distinguish between types of pollution or different layer thickness. The application of the sensor is limited to daylight conditions.

6. Infrared (IR)

The IR is very similar in operation to the UV and the two are very often combined in a UV-IR line scanner.

The sensor detects infrared radiation with a wavelength in the band of 8-12 micrometers emitted from the oil. These layers of oil radiate more slowly than the surrounding clear sea and shows up as variations in grey levels (or in defined colours). Thicker layers (greater than about 0.5 millimetres) will absorb sunlight more rapidly than the surrounding sea and show white on the display.

The IR sensor provides information on the relative layer thickness of oil slicks on the water surface. The sensor does not penetrate the water. It is not as sensitive to oil as the UV and so comparison of the outputs from the two sensors, especially when presented real time parallel to each other on the display, will show the thicker parts of the slick. This information is essential when combating

activities are executed, as the combating vessels should concentrate on these thicker parts. Other temperatures-related effects, such as cooling water discharges, can mislead the IR sensor. The IR is used in both daylight and darkness however; it needs clear field of view to the surface pollution. Clouds and fog will hamper the functionality of the sensor.

7. Microwave Radiometer (MWR)

The MWR detects microwave radiation with wavelengths between 0.3 and 3 centimetres. Oil always appears to be at higher temperatures than seawater in the microwave region; the temperature depends on the thickness of the oil layer. The relationship is not a simple one, but by careful selection of operating wavelengths and detailed analysis of the results the system can provide a relatively accurate account of the volume of oil in the slick.

A minimum layer thickness of 0.1 millimetre of oil is required to make proper use of the system.

Recognising that operational discharges according the MARPO regulations or even much higher will not result in layer thickness over 0.1 mm.

8. Laser Fluorosensor (LFS)

LFS is an active sensor emitting an intense beam of coherent light, generated by a laser; to the sea surface immediately blow the aircraft. The receiving apparatus is designed not to respond to the direct reflection of the beam, but to detect and to analyse the fluorescence of the pollution resulting from the laser strike. Currently the laser has been operationally tested and can provide information on the type of pollution; however, the experience is limited so far.

9. Photographic Camera (PHOTO)

Conventional photography provides a valuable, simple and readily understood record of the scene of an incident or operational discharge. When vertically mounted in the aircraft the camera contributes to the evidence to an official statement. Oblique photography in general satisfies the public and the Courts as part of the evidence rather than the more complex imagery from the other sensors. It is recommended that cameras are an integrated part of the remote sensing system and that on the photographs data annotation is printed.

11. Video Camera (VC)

Much the same applies to video recordings as to photography. The advantage of video is that it provides a more instant record and of course a moving picture. After landing the crew can immediately present an overview of the situation at sea, provided required equipment is available.

12. Low Light Level Television Camera (LLLTV)

The LLLTV can be filtered to operate in the ultraviolet region and so provide an ultraviolet analogue to the thermal imager. When used in the visible region, LLLTV can provide the possibility of imaging ship's names or other identifying features in near darkness.

12. Night Identification System

Detection of discharging ships during hours of darkness is possible by using the SLAR or SAR. Identification of the ship is a necessity with respect to gathering of evidence. There are a number of Night Identification Systems available using a variety of sensors, LLLTV with IR / Laser illumination for example. The main requirement is to be able to read and record the ship's name in darkness.

ANNEX C To
DL 1.1 Aerial Surveillance and Information Gathering

The Bonn Agreement Oil Appearance Code

The Theory of Oil Slick Appearances

The visible spectrum ranges from 400 to 750 nm. Any visible colour is a mixture of wavelengths within the visible spectrum. White is a mixture of all wavelengths; black is absence of all light.

The colour of an oil film depends on the way the light waves of different lengths are reflected off the oil surface, transmitted through the oil (and reflected off the water surface below the oil) and absorbed by the oil. The observed colour is the result of a combination of these factors; it is also dependant on the type of oil spilled.

An important parameter is optical density: the ability to block light. Distillate fuels and lubricant oils consist of the lighter fractions of crude oil and will form very thin layers that are almost transparent. Crude oils vary in their optical density; black oils block all the wavelengths to the same degree but even then there are different 'kinds of black', residual fuels can block all light passing through, even in thin layers.

The Bonn Agreement Oil Appearance Code

Since the colour of the oil itself as well as the optic effects is influenced by meteorological conditions, altitude, angle of observation and colour of the sea water, an appearance cannot be characterised purely in terms of apparent colour and therefore an 'appearance' code, using terms independent of specific colour names, has been developed.

The Bonn Agreement Oil Appearance Code has been developed as follows:

- In accordance with scientific literature and previously published scientific papers,
- Its theoretical basis is supported by small scale laboratory experiments,
- It is supported by mesoscale outdoor experiments,
- It is supported by controlled sea trials

Due to slow changes in the continuum of light, overlaps in the different categories were found. However, for operational reasons, the code has been designed without these overlaps.

Using thickness intervals provides a biased estimation of oil volumes that can be used both for legal procedures and for response.

Again for operational reasons grey and silver have been combined into the generic term 'sheen'.

Five levels of oil appearances are distinguished in code detailed in the following table:

CODE	**APPEARANCE**	**QUANTITY - m^3 / km^2**	**THICKNESS µm**
1	SHEEN (SILVERY / GREY)	0.04 - 0.3	0.04 – 0.3
2	RAINBOW	0.3 – 5.0	0.3 – 5.0
3	METALLIC	5.0 – 50	5 – 50
4	DISCONTINUOUS TRUE OIL COLOUR	50 – 200	50 – 200
5	TRUE COLOUR	200 - > 200	200 - > 200

The appearances described cannot be related to one thickness; they are optic effects (codes 1 - 3) or true colours (codes 4 - 5) that appear over a range of layer thickness. There is no sharp delineation between the different codes; one effect becomes more diffuse as the other strengthens.