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Threat of oil spill in Gulf of Finland and SYKE new technology to deal with

Abstract

Oil transport in the Gulf of Finland is now more than five times bigger than ten years ago (1995-2004; from 20 to 110 million tons) and may be over 190 million tons per year already in 2010, when Russian new port projects will be accomplished. The capabilities to response to spillages of oil and other harmful substances, and other emergency capacities have to increase accordingly.

Within the framework of the Helsinki Convention (HELCOM) the nine Baltic Sea states have agreed on a common policy for response to pollution incidents threatening the marine environment. It defines among other things criteria for national capabilities to respond to spillages of oil and other harmful substances, emergency towing, fire fighting and lightering capacities, minimization of the use of dispersants in operations and criteria for aerial surveillance. Finland fulfils mostly these requirements for national oil response capabilities. Also the bilateral agreements between Finland and Russia and between Finland and Estonia as well as the Copenhagen Agreement between the Nordic Countries are important for an efficient joint response.

Finland has thirteen Government owned ship-size vessels with an oil recovery system fitted permanently inside vessel and two such vessels under construction in years 2005-2006. The governmental ship-size vessels are situated along the coast so that theoretically most of the places can be reached by one of them within six hours from start from their homeport. Municipalities have 97 oil spill response boats of a length of 7-20 metres and a couple of hundred smaller boats. The municipality boats fulfil the two hour demand of HELCOM on all coastal waters in ice free conditions. 31 of those municipal boats have an oil recovery system.

Also new precautionary measures against accidents should be fostered in the Gulf of Finland and also in all the Baltic Sea area. These measures include among others the requirements of double hull for oil tankers, adequate winter navigation

requirements, VTMIS and AIS systems for vessel traffic guidance and surveillance and also an obligation of escort towing big oil tankers in fairways.

Finland continues to develop techniques of oil recovery for adverse weather and ice conditions and aims to construction of multipurpose response ships with oil recovery, emergency towing and fire-fighting capability. This paper gives an overview about the recent situation.

1. GENERAL

1.1 GEOGRAPHY

Finland as one of the Scandinavian countries in northern part of Europe is situated by the Baltic Sea, the largest brackish water basin in the world. It is located between Russia and Sweden and its neighbouring countries include also Estonia and Norway. The response area of Finland covers a significant part of the Baltic Sea, the northern side of the Gulf of Finland, the northern part of the Baltic Proper and the eastern side of the Gulf of Bothnia. The total length of the Finnish coastline without taking into account islands, capes and bays is about 1,200 km. Due to the thousands of islands and the broken shoreline, the total length of the shoreline that can be affected in oil spills is about 16,000 km. The narrow fairways, which make navigation difficult especially in wintertime and in high sea conditions, are also significant to Finnish waters. About 80% of Finnish exports and imports are carried by marine transport, and all Finnish harbours can freeze in the winter. Therefore safe navigation routes and routines, adequate ability to respond oil and chemical spills even in winter conditions and good cooperation with neighbouring countries in this respect, is a necessity for Finnish authorities.

1.2 INTERNATIONAL COOPERATION AND NATIONAL ORGANIZATION IN FINLAND

Finland is a signatory to five major international conventions relating to marine pollution:

- The Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention)
- The agreement on mutual assistance between Finland, Norway, Denmark, Sweden and Iceland (Copenhagen Agreement). Under the terms of this convention, the Nordic countries will take joint action in the event of accidental spill in the marine environment.
- The Finnish-Soviet cooperation agreement for the recovery of oil and other hazardous chemicals in accidents affecting the Baltic Sea area. Finland and Russia have agreed bilaterally to honour this agreement in practice for the present.
- The Finnish-Estonian agreement on the cooperation in combating against pollution incidents at sea.
- The 1990 International Convention on Oil Pollution Preparedness, Response and Co-operation (IOPRC). While this Convention outlines the same basic duties and responsibilities as the multilateral agreements listed above, its scope is global.

Bilateral agreements and the Copenhagen Agreement are consistent with and complementary to the Helsinki Convention. They are forums to handle matters of regional importance in responding to maritime pollution incidents.

The European Community is also actively participating in international co-operation activities. The European Community plays a central role between Member States as a contracting party to all major regional conventions and agreements covering regional seas around Europe, such as the Helsinki Convention.

In Finland the Ministry of the Environment (ME) has the supreme responsibility for the management and supervision of the oil pollution response. The Finnish Environment Institute, SYKE, operating under the Ministry, is the competent government oil and chemical pollution response authority. It is in charge of measures against pollution incidents at open waters and whenever severity of an incident so necessitates. SYKE is also the nationally appointed competent authority, that is empowered to request and give international assistance in combating marine pollution caused by oil or other harmful substances. Other authorities are obliged to assist oil spill response within their abilities. Each municipality shall in its own area take care of oil pollution preparedness and response. Besides the owners of different kind of facilities handling big amounts of oil shall have a limited oil spill response ability of their own.

Different organizations are liable to assist SYKE in pollution response actions. These organizations include: Governmental authorities like the Finnish Maritime Administration, Finnish Frontier Guard, Defence Forces (especially the Navy), Institute of Marine Research and local oil spill response authorities. Private companies like oil companies, ports, salvage and shipping enterprises are also liable to assist with resources at their disposal. Special regional contingency plan is made for each of three coastal sea areas and for one inland watercourse area. The Ministry of Environment confirms such a plan after having heard the SYKE about it.

Among other things SYKE purchases and develops governmental oil spill response equipment and decides which response methods are to be used. Mechanical removal of pollution is strongly preferred and more controversial methods like use of chemicals for oil spill response requires an advance approval of any applicable chemical and a decision of the SYKE on case by case basis.

Locally each municipality is responsible for arranging the combatting of oil spills in its sea and land area and shall have a plan. Such plans are subjects to the approval of the Regional Environment Centre. In municipalities oil spill response has normally been a task of the local fire-fighting and rescue brigade. From the beginning of year 2004 Finland has 23 Rescue Services Districts. According to the *Rescue Act* (468/2003), the Rescue Services District is responsible -among other things- for maintaining for all the municipalities in the district an organization to carry out the duties of rescue services. That will partly apply to oil spill response too. A local Response Commander leading an oil spill response action will come from the Rescue Services District in which the accident or dangerous situation began. A Rescue Services District will make a joint oil contingency plan for all municipalities in its area. That plan will replace the previous plans of the municipalities and will also be a subject to the approval of the Regional Environment Centre.

Finland has national Oil Pollution Compensation Fund for purchasing of equipment and financing oil spill response costs. The capital for the fund is raised by a 0.50 € levy on each ton of oil imported to or transported through Finland. The Customs submits collected charges to the fund. The Fund is administrated by the Ministry of the Environment but the fund is independent from the Ministry and has its own Management Board making the decisions on compensations.

Municipalities have legal right to get compensation from the fund for purchases of the equipment that is mentioned in its approved contingency plan. Also the governmental authorities are entitled to reimbursement of equipment from the fund, but the compensation is a subject of consideration.

2 HELCOM POLICY AND NATIONAL ABILITY

2.1 POLICY

Following the HELCOM recommendation 22/2 (March 2001) on *Restricted use of chemical agents and other non-mechanical means in oil combatting operations in the Baltic Sea area* is largely based on mechanical recovery methods, since the ecosystem of both the Baltic Sea and its coastal archipelago is highly sensitive. The principal strategy is to collect the oil from the water surface as quickly and completely as possible, so the oil can be reused or destroyed in an appropriate manner.

Other methods may be considered only if circumstances require; the responsible authorities may consider options such as burning or the use of chemical dispersants. These alternatives may be considered if weather conditions prevent the use of mechanical recovery, or if the oil spill presents an immediate threat to an area with significant natural value. In some Baltic Sea States the use of dispersant is not allowed or out of question in practise. Intentional sinking of oil is generally prohibited.

2.2 NATIONAL ABILITY TO RESPOND TO SPILLAGES AND MARITIME EMERGENCIES

Helsinki Commission has set criteria for national capabilities to combat spillages of oil and other harmful substances. HELCOM Recommendation 11/13 (1990) *Development of national ability to respond to spillages of oil and other harmful substances* recommends among other things adequate response measures and readiness times for them. It also encourages the Contracting Parties for research and development activities to develop suitable techniques.

The former Combatting Committee of the Helsinki Commission (its successor is the Response Group) worked out guidelines (1990) for applying the said recommendation. It emphasizes some planning factors like spill spreading velocity, realistic skimmer performance and need of booms to contain a specific amount of oil at sea. The minimum requirements of the guidelines for capacities to recover various persistent oil types are :

1. 2000 metres high sea booms

2. 2,5 square kilometres of sweeping performance per day. The calculated area is based on a working speed of 1-2 knots of the sweeping or skimming vessels. A sweeping area of 4,5 square kilometres has to be fulfilled by those countries, which mainly use autonomous driven skimmer ships.
3. 6 high performance sea skimmers
4. sufficient storage tank capacity at sea for continuous operations

2.3 FINNISH APPROACH AND PREPAREDNESS

METHODS

Especially Finland's northern geographical location places special requirements on recovery and clean-up methods. Development efforts have focussed on improving operational efficiency at low temperatures and in icy conditions. In practice, the ability to recover high-viscosity oil is a basic requirement. Cleanup operations often take place in temperatures that are below the point at which oil becomes a solid. In these cases, conventional surface skimming equipment designed for the recovery of light oil is inadequate.

Brush technology is a very good oil clean-up method at low temperatures and for heavy oil. In this method, oil-laden water is running through rotating brush units and oil is swept up by brushes. Floating oil and tar balls adhere to the brushes, which are scraped clean. The oil is then pumped into the vessel's holding tanks. Besides its high capacity for mechanical recovery, this method collects only small quantities of water, normally less than 5%, which is an important advantage. There are various mounting options: the recovery units can either be fitted permanently inside the vessel or installed at the front or on both sides of the vessel using hook attachments. Even if permanently mounted, these units take up relatively little space, so that the vessel can be in normal use when it is not needed for clean-up operations or oil spill response exercises.

A rotating brush with a pump inside of a bucket has been developed to be used in icy conditions and for cleaning up oiled shores. The Oil Recovery Bucket is operated by a crane of a vessel or by a typical excavator. There are also other devices developed in Finland to be used by ice strengthened oil recovery vessels for recovery of oil in ice conditions.

MATERIAL AND TEMPORAL PREPAREDNESS

HELCOM Recommendation 11/13 (1990) *Development of national ability to respond to spillages of oil and other harmful substances* recommends among other things the adequate response measures and readiness times for them. The Contracting Parties should be able to respond to spillages of oil and other harmful substances

"(i) to keep a readiness permitting the first response unit to start from its base within two hours after having been alerted;

(ii) to reach within six hours from start any place of a spillage that may occur in the response region of the respective country; to ensure

well organized adequate and substantial response actions on the site of the spill as soon as possible, normally within a time not exceeding 12 hours,"

The first responders in Finland for open sea incidents are the out guardian vessels of the Finnish Frontier Guard. There is normally an out guardian vessel patrolling at each sea area. These vessels are able to start measures needed to secure a casualty against further harms like sinking, leaks or fire and can also make the first booming around it. One of the out guardian vessels, MERIKARHU is also an oil recovery vessel and is able to take some measures needed in case of a chemical spill, too.

In coastal waters and in ice-free conditions the first response ability is based on resources of municipalities. They have 97 oil spill response boats of a length of 7-20 metres and a couple of hundreds smaller boats, whose readiness fulfils two hours demand. Their main task is to restrict spreading of oil with oil booms in order to win time for ship-size oil recovery vessels, so that the polluted area would be as small as possible when the ship-size recovery vessels arrive. In many areas the boats can start also oil collection. 31 of those boats have an advancing type of stiff-brush oil collecting system and in 17 of those boats the system is fitted permanently inside vessel. However, their recovery capacities are relatively small, when compared to capacities of oil recovery ships and thus the boats apply better to collecting smaller amounts of oil drifting towards shore.

Class	Oil recovery equipment	lenght	number
F-class	with oil recovery equipment	13-20 m	27
F-class	no oil recovery equipment	13-15 m	11
E-class	with oil recovery equipment	11-14 m	4
E-class	no oil recovery equipment	10-18 m	29
D-class	no oil recovery equipment	7-10 m	26
TOTAL			**97**

Table 1. Finnish municipal oil recovery boats in size range from 7 to 20 metres

Further the Baltic Sea countries should respond to major oil spillages

"(iii) within a period of time normally not exceeding two days of combatting the pollution with mechanical pick-up devices at sea;"

In Finland there are thirteen Government owned ship-size vessels. The vessels are situated along the coast so that theoretically almost all of the places can be reached by one of them within six hours from start from their homeport. That geographically coverage will be still better in 2005 and 2006, when two additional oil recovery vessels are taken into use. Then one of the most important shortcomings will be the lack of one heavy-duty multipurpose vessel for emergency towing, fire-fighting and and oil recovery ability even in ice conditions in the Gulf of Finland.

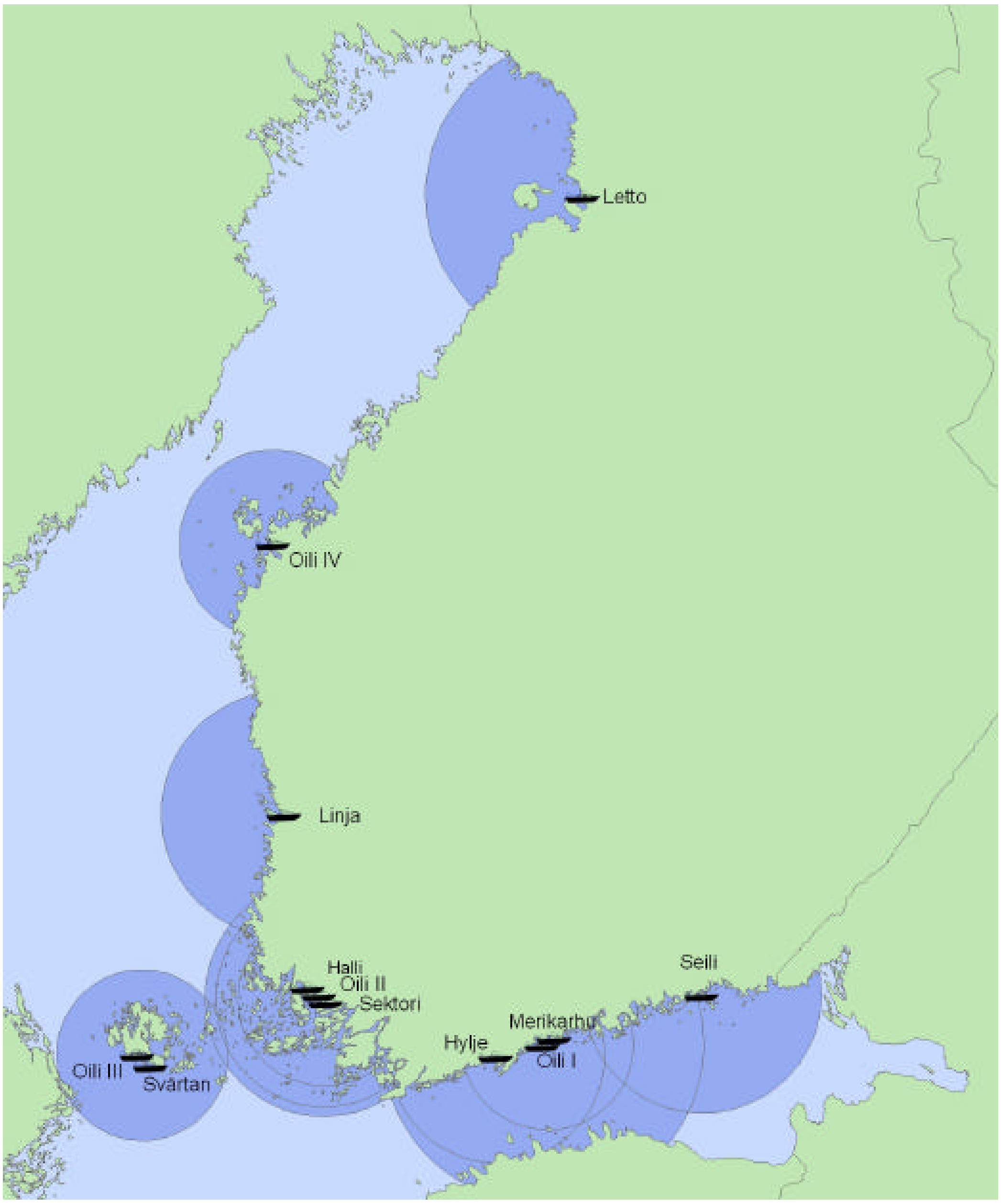
Because of long distances it takes three days before all of those vessels could be on the same place anywhere in the Finland's response region. Before that, within 12 hours one of those vessels will quite likely start response measures in the Gulf of Finland, in the Archipelago Sea or in the Gulf of Bothnia. Then, in general it is quite likely that there is at least one vessel within 24 hours and two vessels within 48 hours in use anywhere on the Finland's response region. Finally, after three days the total sweeping performance of government owned oil recovery vessels would be about 7,6 km²/day (1 knot velocity during 12 hours) and exceeds well the requirement of HELCOM guidelines (4,5 sqkm/day). Total sweeping capacity will rise up to 9 km²/day in 2006, when two additional recovery vessels (Tursas and Uisko) will be in use.

VESSEL`S NAME	OWNER	LENGHT [m]	BREADTH [m]	SWEEPING BREADTH [m]	TANK VOLUME [m³]	SWEEPING AREA [km²/ 12h]	RECOVERY CAPACITY [m³/h]	MAX LIFTING CAPACITY OF BRUSHES [m³/h]
Halli	**NAVY**	60	12,5	40	1400	0,9	74	450
Hylje	**NAVY**	54	12,5	35	800	0,8	65	400
Merikarhu	**FFG**	58	11	32	40	0,7	59	378
Tursas*	**FFG**	61,3	10,2	30	100	0,7	56	300
Uisko*	**FFG**	61,3	10,2	30	100	0,7	56	300
Oili I	**SE**	24	6,6	21	80	0,5	39	250
Oili II	**SE**	24	6,6	21	80	0,5	39	250
Oili III	**SE**	24	6,6	21	80	0,5	39	250
Oili IV	**SE**	19	6,5	19	30	0,4	35	250
Kummeli	**SE,Saimaa**	28	7,9	24,9	70	0,6	46	250
Sektori	**SE**	33	7,9	24,9	108	0,6	46	250
Linja	**SE**	35	9	23	77	0,5	43	278
Letto	**SE**	43	12,2	30	43	0,7	56	306
Seili	**SE**	50,5	12,2	30	196	0,7	56	300
Svärtan	**ÅG**	24	6,6	21	52	0,5	39	250
TOTAL					3256	9,0	746	4461

*** RENOVATION TO OIL RECOVERY VESSELS IN 2005 ja 2006**
NAVY= NAVAL FORCES, FG=FRONTIER GUARD, SE=SHIPPING ENTERPRISE (OF THE STATE), ÅG=ÅLAND´s GOVERNMENT

TABLE 2. Finnish Government's vessels with a permanently fitted brush oil recovery system. Sweeping area has been calculated with one-knot velocity of the vessel and recovery capacity with an oil layer thickness of one millimetre.

PICTURE 1. Theoretical operation radius of six hours for the Finnish ship-size oil recovery vessels. Kummeli (in Saimaa Lake area) is excluded from the picture.



Finland fulfils also other minimum requirements of the guidelines for Recommendation 11/13 for capacities to recover various persistent oil types. For instance it has 7200 metres high sea booms and 24 high performance sea skimmers and those vessels have together 3056 m^3 storage tank capacity (will rise to 3256 m^3 in 2005-2006).

Finland's ability to respond to spillages of harmful substances other than oil bases on two specialized vessels, MERIKARHU and TELKKÄ and on the chemical spills response capabilities of municipal fire brigades, mainly. There is urgent need of a vessel with some liquid chemical cargo lightering capacity and some special equipment containers. Underwater technology has been an item of research and development activities, and some technical readiness exists to recover sunken chemicals from the sea bottom.

Finland continues development and improvement of the response capability, taking into account special factors especially the length and configuration of the coastline, ice conditions, vulnerable ecological areas, probability of adverse weather conditions etc. One priority in recent R&D projects has been to develop better methods for oil recovery in icy conditions. As a result the first device, the "Ice bow" was taken into use in 1991. Later two different kinds of special devices for oil recovery in ice conditions, "Oil Recovery Bucket" and "Oil-Ice separator" were developed and are in operational use in recovery vessels.

Mechanical collection of oil and handling of oil on the accident site has traditionally been facilitated by means of various absorbing materials. At the present, bulk absorbing materials are being replaced by the use of mats and other objects, which are easier to handle. Use of absorbing materials as such increases the amount of oily waste. In the open sea, it is not allowed to use any sinking materials, and mostly only absorbing booms to remove thin oil films are allowed.

For ensuring adequate national emergency capacity a lot of work has to be done. In Finland there is enough capacity available for emergency towing in winter only, when icebreakers are in work. Two new escort tugs of an oil company made situation better. Appropriate fire-fighting ability is still missing. Lightering capacity is based on availability of tankers mostly. The current government aims in its program to delivery of a multipurpose icebreaker with oil recovery, emergency towing and fire-fighting ability.

MULTIPURPOSE ICE BREAKER

The Finnish Maritime Administration and Finnish Environment Institute, SYKE together have in January 2005 notified the shipping industry, via the EU Official Journal, that they it wish to contract on "Services of an ice-breaking oil and chemical spill recovery vessel" by this year. Tendering documents are for applying from the The Finnish Maritime Administration. Deadline for offers is April 25, 2005.

The orderers, The Finnish Maritime Administration requires the services of an ice breaker during the winter season and Finnish Environment Institute requires a year-round service for the recovery of oil and chemical spills.

DEVELOPING METHODS

All development is based on a general principle, that prevention of environmental accidents at sea is successful when no harmful materials end into the sea. Success is halfway when such material is collected from the sea. If the material remains in the nature or if it is collected from the shore, the operation can be considered nearly as a failure.

Enormous amount of manpower and manual work is still needed in clean up of oil polluted shoreline. To address this problem SYKE has developed an a self propelled amphibian excavator that was modified and equipped with a rotating brush to collect oil at shoreline or in difficult attainable wetland (“Oil Recovery Bucket”). Also a remote operated vehicle originally build for forest industry has been modified and can be used to clean up oiled shorelines.

In practice, the know-how has been applied in many incidents like

- Localization of waste barrels thrown into sea over decade ago and covered by bottom mud (Dragsfjärd barrels 1993), and lifting them without leakages (1994) with a special box-corer device.
- Collection of oil from an oil tanker lying on the ground (MT "Kihnu" in the Estonian coast 1993): 1,070 tons of heavy and light fuel oil was transferred ashore by means of a hose carried by a helicopter.
- Pumping of oil out from broken bottom tanks of a dry cargo carrier lying on the ground (MS "Pamisos" in the open sea north of Åland 1992, carrying 23,000 tons of fertilizers): 320 tons of heavy fuel oil were preheated and removed by vacuum suction through the air pipes. Later similar cases of MS "Fin Master" and MS "Oihonna" in Kotka 1995: heavy fuel oil was removed from broken bottom tanks before docking.
- Divers assisted removing of heavy fuel oil from a wreck: altogether 410 m^3 of oil was pumped in several stages during years 1994-2000 from the 1947 sunk S/S "Park Victory".
- Remote controlled oil removal using underwater robots in 1996 from the wreck of 1994 sunken passenger ferry "Estonia": 230 m^3 of light and heavy oils were removed from 15 tanks. Two of the tanks were behind two walls. All walls were penetrated by the "hot tap" method, doing connections in a closed way. The wreck was laying deeper than 60 metres.
- Preventing the casualty from sinking by using an emergency pump system carried on board by a helicopter (MS "Transgermania" in Utö 1990 was saved from sinking: leakage from MS "APJ Karan" north of Åland 1991 was under control).
- Collection of oil from the water in the open sea (MT "Volgoneft" outside Karlskrona, Sweden, 1990): nearly all leaked waste oil was collected from the sea, over 80% of the total of 1,000 tons by using Finnish made “brush oil recovery systems”. The oil recovery vessel “Halli” which arrived last to the casualty collected most of the oil, 240 tons.
- Collection of oil from the water on the coast (the lighter system "Finn- Pusku" capsized and was later turned around in Hanko 1991): two oil recovery vessels collected heavy fuel oil leaked into the sea.
- Oil recovery in ice conditions (the container carrier “Janra” capsized 1999 and was turned around in Åland 2000 inside heavy open sea booming, oil among ice was recovered from sea. On Spring 2003 oiled ice area was cleaned near

Kalbodagrund. Both works were done with a special equipment “Oil Recovery Bucket”, that has been developed in SYKE).

- 1999 a rail tanker with Russian crude oil cargo derailed at Vainikkala. An excavator with an “Oil Recovery Bucket” recovered spilled oil.
- Collection of oil from the water at the bay and in the port of Muuga in Estonia 2000. Finnish oil recovery vessel "Oili 1" recovered heavy fuel oil, which leaked out from M/T "Alambra".
- Since March 1987, oil pollution protection safeguarding in connection with sea salvage operations of altogether 80 casualties none of which resulted in big amounts of oil waste to be collected from the shore. (1 March 1987 - 29 December 2004).
- Material assistance in the oil spill response operations in Alaska (MT "Exxon Valdez" 1989), in the Persian Gulf (war l991), in France (MT “Erika” 1999-2000) and in Spain (MT “Prestige” 2002-2003).
- Register of dangerous wrecks (about 500 wrecks registered in 1996), a risk classification of the wrecks in the register (1998) and investigation of wrecks posing an environmental risk.
- Two Dornier Do 228 surveillance airplanes with modern remote sensing equipment for control of illegal oil discharges and mapping oil spills. The planes have, besides routine control duty, participated regularly joint international surveillance operations (so called CEPCO flights) and also in oil mapping after the "Prestige" case at the Bay of Biskaja in France 2003.

TRAINING ACTIVITIES

An international conference on oil pollution response in ice conditions took place in Finland in the end of 1992 and another one seminar “Combatting Marine Oil Spills in Ice and Cold/Arctic Conditions” on November 2001.

A practical "Oil in Ice" exercise for Baltic Sea countries was arranged in Oulu in early spring 1994. In September 2003 Finland arranged the annual HELCOM oil response exercise, so called BALEX DELTA in the Gulf of Finland outside Helsinki. Total of 16 response vessels from five different countries participated in the exercise and besides them, about the same number of municipalities boats participated the exercise.

Besides the HELCOM Balex Delta exercise, Finland participates annually joint Finnish-Estonian-Russian trilateral and Finnish-Swedish bilateral equipment exercises.

3 APPLICATIONS OF TECHNOLOGY TO USE

3.1 ASSESSING RISKS

HELCOM project “Updated Assessment of the Risk for Oil Spills in the Baltic Sea Area" aimed to a harmonized method to assess the oil spill probabilities within the Baltic Sea area and their impacts, by use of risk zones at sea and on coastlines, including a scaling of the impacts. Valuable information can be obtained to define high-risk areas to be used when assessing the adequacy of existing oil spill contingency planning and the need to address further maritime safety issues. As a result of the project a GIS data bank called “MARIS” (Maritime Accident Response Information System) has been compiled by SYKE in 2003.

MARIS is a tool used to map oil spill risk caused by oil transport as well as other ship traffic and the readiness for oil spill response in the Baltic Sea and Kattegat area. Mapping is done by compiling together among others the following datasets, many of which had already been collected by HELCOM, Baltic Sea Countries and Nordic Countries:

1. Present and estimated amounts of tanker and other maritime traffic in the Baltic (VTT 2001-2002).
2. Geographical distribution of statistical risk of oil spills corresponding distribution of the oil transport and other ship traffic (based on the SSPA´s earlier works and the updated data on ship movements).
3. Oil spill drifting analyses in the routes of main oil transport (in different parts of the Baltic and in different meteorological and hydrological conditions, based on Professor Ovsienkos analyses).
4. Areas especially sensitive to oil spills (HELCOM, Cowi, Bird Life etc., protected areas).
5. Locations and amounts of national oil combating resources (HELCOM Manual, Strike teams, oil recovery vessels, sea booms) and emergency towing vessels (Sweden, HELCOM SEA 3/2001, etc.).
6. The records of shipping accidents in the Baltic Sea area (Latvia, HELCOM SEA 2/2001, 3.1/6).
7. Necessary base maps for these datasets (coastline, administrative boundaries and zones, drainage etc.).

The material is in digital format so that different datasets can be viewed and combined upon each other on a digital map. MARIS became an official HELCOM tool for assessing and visualizing oil spill risks and response capabilities and its is available in internet in HELCOM website: www.helcom.fi/maris.html

3.2 EVALUATION OF ACCIDENT SITUATION AND CONTROL MEASURES

At sea, planning the oil spill response operation requires follow-up and forecasting of the spreading of oil. Close-range tracking is done by vessels and helicopters, and the more extensive surveying can most effectively be done from a special surveillance aeroplane. Very large scale overview can be obtained from satellite images.

The spreading of oil can be forecasted by using different computerized mathematical models. There is for instance in Internet a program for forecasts and presentation of the spreading of oil, chemicals and substances in water in the Baltic Sea, so called “Seatrack Web”. It has access to current fields of the 3-dimensional HIROMB model. HIROMB gives new 48 hours forecast every morning. The grid is 3 nautical miles and the model covers the whole Baltic Sea out to the North Sea. The model is maintained by SMHI (Svenska Metereologiska och Hydrologiska Institutet). There are also national local models with smaller grids.

In order to salvage the casualty and her cargo and to prevent environmental damage caused by the accident, it is vitally important to find out what exactly are the damages of the casualty and in what condition the cargo is, to understand their effect on the behaviour of the casualty and on the leakages, and to select and take appropriate measures. All cases are different but there are certain common features and needs.

If the casualty lies on the rock, she has to be refloated without being capsized or sunk and without oil leakages. When afloat, leakages into the casualty have to be controlled to stabilize the casualty and to prevent oil leakages during transportation.

The casualty's damages can initially be judged on board of the casualty mainly by sounding the tanks and by surveying accessible spaces. Next, divers can inspect the breaches and indents in the bottom. If the casualty is grounded, the inspection under the water can be done only for those parts where the bottom can be seen. Movements of the casualty (effect of swell, changes in the casualty's position) may restrict diving surveys as the safety aspect has to be considered. More detailed survey of the bottom is possible when the casualty is afloat but, even then, pumping may expose the divers to the risk of being stuck.

Most of oil leakages take place immediately after the accident. The casualty's own fuel tanks, which are wholly under the water line, leak into the casualty if broken. Major outward leakages are caused by large cuts in the bottom tanks, vertical tanks reaching over the water line and seldom to the bottom, or by leaking cargo tanks of tankers. In case of grounding, the situation usually becomes stable so fast, normally within one hour, that it cannot be influenced by any means. As soon as the tanks are in balance, no considerable leakages out take place, except if the position of the casualty changes, water level is lowered, or heavy sea rises. The only task is to prevent these leakages as the casualty is re-floated and transported to a safe place.

Not only oil but also other cargo may cause a risk of environmental damage and complicate the salvage of the casualty.

Sometimes it is possible to survey systematically and exactly enough the broken tanks of a casualty, which is floating free. For necessary strength calculations, the insurance companies and classification societies require that the bottom surveys are done in an adequate manner by a diver approved by the classification societies. If permitted by the circumstances, the broken bottom tanks are temporarily patched before transportation. Wooden wedges are traditionally used for small holes and durable carpets sheets or even different underwater hardening materials. Patching of big tears requires welding cover plates over holes and dented areas surrounding tears. If this is not possible, the casualty is towed to a safe harbour with minimal speed.

A sunken wreck may require urgent measures because of oil leakages or some other reasons, too. Then similar technic as used for oil removal in groundings is applicable there too. Besides equipment and method for penetrating walls and other obstacles for pipe connections are needed ("PARK VICTORY", 1994-2000 tanks were emptied through "hot tap" connections. In the "ESTONIA" case, 1996, two deep heavy fuel tanks on the tank top were connected through the bottom plate and through double bottom by aid of so called "double bottom tools").

Oil removal from sunken wrecks is feasible to do with divers down to 60 metres depth. Deeper than that special, so-called saturation diving technique is needed. Divers are pressurized for a working stage, for instance one week's time. Because of big pressure chambers, diving bells or submarines and a special base ship, system is very expensive. Then an alternative is to use remote control technic for oil removal ("ESTONIA" 1996).

4 FUTURE PROSPECTS

4.1 METHODS

There are plenty of weak points in the oil spill response technology, still. Darkness, adverse weather conditions, ice, oil's tendency to spread rapidly at water surface and to stick fast to rigid materials are main challenges, perhaps. Work still needs to be done to develop methods to be used in submersible renovation work, oil spills in fast ice field conditions, oil transfer pumping at sea and bioremediation.

For many reasons, it is quite likely that an oil spill occurred at sea will become a disaster ashore. Therefore we should now look at possibilities to develop cleaning methods for shorelines too. If there would be such mechanical devices, which would recollect efficiently enough main amount of oil on various types of shoreline types without harming the environment, a remarkable amount of handwork and money would be saved.

The outstanding development of computer and communication technology offers many applications to oil spill response too. Satellite based positioning and communications, computer aided navigation, wireless image transfer and different remote sensing techniques give possibility to have real time positions of strike teams and even of oil and displaying them on one screen.

Although the mechanical recovery of spilled oil is the method, that is most unanimously accepted, it is not always feasible. All other methods may be more controversial, but they can often fulfil the caps, outside of the reach of mechanical collection methods. For instance a bioremediation is always the final cure by nature to the environment. In what extent that or other controversial methods like dispersing or burning shall be applied, varies case to case, inevitably. Therefore, little by little we will have more knowledge from research to be able to select optimal tools to overcome oil pollution.

4.2 KEEPING CASUALTY FIGURES LOW

With the fast growth of sea traffic also the probability of oil spills may increase likewise, if the level of precautionary measures against accidents stays as it has been. However, it very difficult to estimate how often oil spills will occur, really. If the occurrence of oil spills in the Gulf of Finland would be the same as it was estimated in a HELCOM study in 1995 and 1997 for the Baltic (0,35 spills/1000 journeys), it means that after the year 2004 there might be annually average 14 accidents causing oil spills in the Gulf of Finland. Main amount of those spills would be some tens of tons of bunker oil of any type of vessel. Maximum size of those bunker oil spills would be 100-200 tons. Probability of a cargo oil spill would be 1-2 per year. Size of cargo oil spills would vary from some hundreds of tons to thousands of tons of oil.

Other kind maritime pollution incidents would be quite rare when compared with oil spills. A chemical cargo leak from a tanker could occur once per six year in the Gulf of Finland. Chemicals in packages would go over board about twice per year, but a serious accident of a ship carrying such a cargo would happen once per two years only.

The said estimations seem very high when compared with the near past occurrence of pollution incidents in the Gulf of Finland or in Finland. In the reality oil spills of magnitude over 30-40 tons occurred in Finland one such an oil spill every 39 months - four oil spills in Finland during 13 years. HELCOM studies were based on an old statistic from era before nineties, when spills were of a higher occurrence than later in the Baltic Sea.

Why the spill occurrence in the Baltic Sea and especially in Finland has been so little? Broken and shallow coastal zone in the northern and western coasts and sometimes difficult weather conditions require a comparatively high level of maritime safety. Long fairways through the archipelago are well build and marked. Land based radar network covers the coast and use of the pilotage service is obligatory. Merchant vessels are quite new and with a modern navigation equipment. Tankers are mostly at least with double bottom. In spite of all that casualties like groundings occur frequently, but consequences of them have not usually been very bad. Because of the generality of casualties the authorities and private companies get often practise and keep trained to overcome practical difficulties. Salvage and pollution response are initiated promptly and in order to prevent all leakages during refloating.

Maritime conditions for some of new planned ports are quite challenging ones. The growth of transport emphasizes need of precautionary safety as well as an efficient preparedness for salvage and pollution response. Escort service for big tankers in fairways and emergency towing and fire-fighting capacities are some important ways to keep casualty and spill figures low in the Gulf of Finland in the future, too.

Additional information can be found from Internet:
http://www.environment.fi/oil