Summary and lessons learnt

On 11 November 2007 the weather conditions in the Black and Azov Seas were extreme: a storm wind gusts with a speed exceeding 35 m/s surged waves over 5 meter-high in the rather shallow Kerch Strait waters. Those extremely rough for this shallow area weather conditions lasted no longer than nine hours but eventually resulted in a major disaster.

The storm was devastating and its consequences were catastrophic. As a result five vessels sank (four of them in the Kerch Strait) while thirteen vessels suffered damage and some of them were stranded ashore. Four sailors from the crew of the *Nahichevan* cargo-ship lost their lives and another four went missing forever in the Kerch Strait waters.

The Russian and Ukrainian Search and Rescue (SAR) units were immediately called-up by their respective Ministries. Their work was highly efficient and exemplary under the dangerous and difficult conditions of the strong-wind and heavy-waves. Thanks to their courageous effort, 35 crewmen from four vessels were rescued and hospitalized. The necessary actions were carried out without helicopter support which was not possible due to the prevailing stormy weather conditions. Out of four sunken vessels in the Kerch Strait, three were the dry-cargo carriers loaded with 6726 tons of sulphur, while the broken apart *Volgoneft-139* tanker carried tons of heavy fuel oil (mazut) and about 1300 tons were spilled into the sea in the shipwreck accident.

The referred storm has triggered significant changes in coastal and bottom topography and coastal cliffs shifted inland by 5–7 m in certain places, while the river mouths got partially blocked by pebble bars somewhere. Sandy bottom experienced considerable local modifications in certain areas due to the enhanced sediments shifting discovered later on by the divers. Serious damage was inflicted on the coast protecting constructions and facilities, recreation beaches and sea-front embankments as well as their auxiliary facilities and small-sale outlets. The coastline was affected all along to the West from Sevastopol in Crimea till the Imeretin Lowlands in the Cape of Konstantinovsky (city of Adler) in the East.

The Kerch Strait oil-spill response efforts in its first phase were geared towards arranging water and coast clean-up and ensuring safety of people while not specifically targeting at oiled wildlife rescue The heavy fuel oil from the *Volgoneft-139* stern part, and later oily waters from the bow section were pumped to other vessels and transported to the port of Caucasus for recycling. The stern itself, which went aground, was towed to the port of Caucasus promptly after the accident and booms were installed around it. Oil products floating on the surface were collected both around the stern and bow sections of *Volgoneft-139*. A 400-m long boom to prevent further oil spread to the Taman Bay was installed on 14th of November between the Tuzla Spit and the Tuzla Island. The sunken *Volgoneft-139* bow part remained on the bottom of the Strait till August 2008 when refloating and towing operations were conducted.

Despite of the taken measures, the pollution of the marine environment and coastal zone was among the major consequences of the storm catastrophe and the post storm effects of the greater scale were well expected. The oil polluted Black and Azov Seas subtotal area was estimated around 700 km^2 while the total length of the Eastern Kerch Strait contaminated coastline was about 183 km. Herewith, significant spatial variations in the coastal oil pollution were observed and the most serious contamination levels were detected at the Tuzla Island. In the places like the Tuzla dam, the Chushka Spit and along the Azov Sea coast up to the Kamenny Cape the contamination was less intense though still significant.

At the Ukrainian coast, the Ak-Burun Cape and Arshintsevskaya Spit areas were detected heavily polluted, though not immediately after the *Volgoneft-139* tanker shipwreck, but a week later on 17–19 November. In the areas of the Kerch Bight and the Northern section of the Kerch Strait up to the Hrony Cape no coast contamination with oil was observed except for minor isolated small spots.

Due to heavy clouds covering the skies during and after the oil-spill accident the satellite visual images could not to be taken for a reliable source of information about the surface oil pollution distribution. The Synthetic Aperture Radar (SAR) images were made publicly available later, on 15–16 November the earliest, and they clearly demonstrated that the *Volgoneft-139* tanker bow part was a point-source of oil pollution. The heavily polluted area spread also along the coast stretch from the Tuzla dam to the Western tip where large volumes of heavy fuel oil got washed ashore during the storm. Partially, that heavy fuel oil was transported farther away in the Northern direction to the Chushka Spit and the Taman Bay where it was washed ashore

Various Russian and Ukrainian institutions made predictions of the spreading of oil pollution using mathematical modeling that further contributed greatly to resources mobilization and the efficient clean-up operations. The coast clean-up efforts were started immediately after the accident happened.

In the Russian Federation about 2.5 thousand people from various professional agencies and rescue teams, including the military forces and fire fighters, the Navy Academy cadets and public sector workers from Novorossiysk and other towns and villages, students and teachers from five universities all over the region got engaged with removing the oil spill consequences. Around 300 units of technical equipment were assigned for the on-shore clean-up operations. The local and international organizations, such as the WWF, Greenpeace, Birds International, and the International Fund for Animal Welfare and Sea Alarm joined forces with thousands volunteers and public sector workers from various cities in their effort to clean the coast and save the wildlife.

According to the data provided by the Ministry of Transport of Ukraine more than 500 personnel of the Ministry of the Emergencies of Ukraine, 17 units of machineries and 15 vessels carried out the cleanup operation of the coastal area of the Island of Tuzla by 21 November 2007.

At the Ukrainian coast, the clean-up operation was completed in December 2007 while at the Russian coast they lasted till February 2008. About 40 000 tons of oily garbage — contaminated with fuel oil algae, soil and debris — were collected from the Russian shore to be later utilized. Around 7140 tons of waste, mainly oil and sand mixture, were collected at the Ukrainian coast. The waste was put into bags to be transported to and stored in the Kerch Port enclosed area to ensure that no further leakage happens. Later the waste was processed and transformed into the inert construction material by specially developed technology, and these newly-produced materials were used for road paving.

Later on, in 2008, several cases of coastal pollution by petroleum hydrocarbons were detected that were, as assumed, rather related to fresh operational pollution or illegal discharges than to the November 2007 oil-spill accident. However, special investigations to attribute these pollution cases to a definite source were not carried out.

Though the response effort was prompt and efficient and diverse pollution combating practices were applied for collecting heavy fuel oil from the sea surface and the Kerch Strait shoreline, in particular, the common expectation was that the environmental and socio-economic consequences of the November 2007 oil-spill disaster would remain significant and be felt for a number of years on. Regardless of the effort taken the Kerch Strait accident was recognized as an ecological catastrophe and one of the worst in the region and the gravest since the *Nassia* tanker tragic incident in 1994 taken into consideration the specific features of the Kerch accident area and its importance for the Sea of Azov and the Black Sea.

In order to substantiate the negative ecological and social impacts and determine damages for the local ecosystems to be eventually compensated commercially the sound scientific investigations were carried out. Accordingly, the Governments of the Russian Federation and Ukraine initiated the necessary activities and provided financial support to a number of institutions and agencies. As a result, in 2008–2009 about 60 research expeditions to the Kerch Strait and adjacent marine and coastal areas for assessing the state of their environment after the oil-spill accident were carried out.

Depending on the studied parameters the field investigations were performed onboard the large research vessels, sailing boats, small motor and rubber boats as well as by the divers and on the coast. The research was targeted not only at the oil pollution: a wide range of environmental parameters including abiotic and biotic components of the environment were studied. Articles, reports, brochures and books were published. Thus, the Kerch Strait incident has become one of the best ever-studied oil spill in the Black Sea region comparable to the extensive research studies of the Chernobyl catastrophe.

The comparison of the long-term data provided by the ongoing (since 1981) monitoring observations with the data collected after the 11 November 2007 storm has revealed no significant increase of the average levels of total petroleum hydrocarbons anywhere in the oil-spill impacted area. Still, their elevated levels were observed during a short period of roughly one month after the spill. Later, oil concentrations in water decreased significantly approaching the baseline levels for the region of

0.05 mg/l. Of course, the 2008–2009 maximal recorded levels of petroleum hydrocarbons differed significantly from the average values. Still, extremely high concentrations, exceeding 30 times the threshold of Maximum Allowable Concentrations of Pollution (1 MAC = 0.05 mg/l, MAC List, 1999), were occasionally registered after the catastrophe while the TPHs significant deviations from the MAC were periodically detected in the Kerch Strait long before the oil-spill accident of November 2007.

The high variability of the temporal and spatial distribution of the petroleum hydrocarbons in the Kerch Strait is rather typical for the region. The petroleum hydrocarbons high baseline levels along with the maximal values observed in the waters since 1980s have suggested an existence of permanent and long-lasting sources of this kind of pollution in the Kerch Strait. Apart from traditional industrial and municipal waste water discharges (land-based sources of pollution) ship-borne pollution may have be a case: for instance, small-scale spills produced by the ships at berth as well as at the anchorage in six special locations in the Kerch Strait Southern section used as a transshipment complex. The petroleum hydrocarbons pollution might originate during the decades from the ongoing oil leakages at berths and in the transshipment area where oil products are constantly reloaded or pumped from the river-sea tankers to the sea-going fuel carrying tankers or it might be the illegal waste waters discharges from the cargo vessels during awaiting and in the process of cargo-handling operations.

It is known that the bottom sediments pollution by petroleum hydrocarbons was rather high before the November 2007 oil spill generally exceeding the Permissible Concentrations by 10 times (Warmer H., van Dokkum R., 2002). After the oil spill accident and within two months after the devastating storm, two institutions, YugNIRO and MHI, recorded high TPHs concentrations exceeding the norm by almost 60 times. Since May 2008 TPHs concentrations in the Kerch Strait sediments have decreased significantly and varies between the minimal and the about 10–20 permissible concentrations (500–1000 μg/g) levels.

Final conclusion would be the same, as for the waters: high levels of chronic or long-term petroleum hydrocarbon pollution of the Kerch Strait bottom sediments were recorded whereas the oil spill impact in the Kerch Strait was relatively short-term. Certain areas, such as the Kerch Bight, were found highly polluted by petroleum hydrocarbons though clearly unrelated to the Kerch Strait oil spill since it never impacted them.

High concentrations of sulphur, released from three sunken cargo-boats loaded with 6726 tons of that granulated product continued remaining in the Kerch Strait bottom sediments long after the shipwreck occurred. In 2008 sulphur average concentration kept exceeding the norm while its observed maximum reached 18 permissible levels (2.87 mg/g). Nevertheless, no negative impact on the biota was recorded since November 2007, and this was most probably due to sulphur low toxicity.

Comprehensive investigations of the trends of various chemical substances in the affected adjoining areas were carried out by different institutions and agencies in the frameworks of the complex monitoring programs. Particular attention was given to the trace metals spatial distribution and temporal variations in the water and bottom sediments. Historical data were compared with the data collected after the November 2007 disaster.

Measurements made straight after the Kerch Strait oil-spill accident, i. e. in December 2007 and March 2008, revealed patchiness in the trace metals distribution both in the water and sediments. Hence, the maximal levels of chromium, cobalt, zinc and nickel present in the sediments came to about 0.7–1.6 PC, while the much lower average values were calculated. A year later in July 2009, only copper, chromium and nickel concentrations were occasionally detected slightly above 1 Permissible Concentration while other (Cd, Co, Hg, Pb, Zn, As and Al) concentrations were substantially lower the permissible level. At the same time the results obtained for the Kerch Strait waters showed that their metal concentrations, as tested on 8 July 2009, were less than 1 maximum allowable concentration (approximately ten times lower). Some increase of metals presence in the bottom sediments was recorded in December 2009 when maximal concentrations of chromium and nickel were slightly exceeding 1 PC and those of cadmium, mercury, cobalt, copper, zinc and arsenic were slightly less than the norm. In general, the metal presence in the Kerch Strait area before and after the November 2007 catastrophe remained at the geochemical background level and exceeded the norm just occasionally.

Chlorinated pesticides of the HCH and DDT groups were detected in the Kerch Strait waters and bottom sediments. The maximal concentration of pesticides in water very seldom exceeded the established 1 MAC in water and rather often 1 PC in the bottom sediments. High spatial and temporal variability of concentrations were typical for the water column and sediments. The distribution of chlorinated pesticides in the bottom sediments was patchy resulting from the bottom conditions and particles size spectrum while in general, those pollutants were present in low concentrations. The same patchiness was found for polychlorobyphenyls the concentrations of which ranged from analytical zero to the norm exceeding levels, both in the water and bottom sediments.

The results of the several expeditions proved the necessity of applying a unified regional methodology for sampling and analytical procedures in contamination studies, in particular organic pollutants, in order to assure comparability of data from different sources. Highly recommendable would be the constant inter calibration exercises to ensure quality assurance of the chemical analytical procedures.

The local sources of the Kerch Strait long-lived radionuclides were not detected. Hypothetically, the traced to the Kerch Strait bottom sediments source of the long-lived anthropogenic radionuclides ^{137}Cs and ^{90}Sr were the large-scale atmospheric nuclear weapon tests conducted prior to 1963 and the Chernobyl Nuclear Power Plant disaster in April 1986. In December 2007, the ^{137}Cs radiation levels varied in the Kerch Strait bottom sediments from 18 Bq/kg to 54 Bq/kg and were substantially lower as compared with the Dnieper and Danube Rivers estuaries levels. The ^{90}Sr radiation level detected was negligible.

Soon after the Kerch Strait accident, density of bacteria and virus-like particles was detected maximal in the central part of the Kerch Strait nearby the Tuzla Spit and in the Taman Bay. The oil oxidizing bacteria were present in relatively high concentrations both in the water and bottom sediments thus reflecting the ongoing active processes of petroleum hydrocarbons biological degradation, especially in surface waters and the sediments upper layer. However, bacterioplankton development was rather limited by the low water temperature. Consequently, concentrations of heterotrophic bacteria recorded in December 2007 were several times lower than in August 2009, when no Kerch Strait accident post-disaster effects were traceable anymore, yet natural factors were assumed favorable for bacterioplankton proliferation. In 2009 the concentrations of oil oxidizing bacteria present in the bottom sediments of the Kerch Strait were confirmed to be hundred times higher than in the sediments of conditionally pure water area. That was recognized not as related to the Kerch Strait pollution incident, but as resulting from the long-going discharges of the petroleum hydrocarbons of the different Kerch Strait sources.

The investigations of phytoplankton communities did not disclose any significant difference in conditions existing prior to and after the Kerch Strait oil-spill accident. Variability of algae abundance and biomass, and the species succession were found rather well dependant on the Kerch Strait eutrophication level than on the oil pollution.

The structure of mesozooplankton communities studied in December 2007 was found traditional for the area. The dead plankton organisms in relatively high number were recorded. The increased mortality of zooplankton was most probably related to the rapid changes of water temperature and salinity during and after the November 2007 storm. The 2008–2009 further investigations did not reveal significant changes in the zooplankton structural characteristics as compared to the data collected prior the Kerch Strait oil-spill accident.

The quantitative parameters of macrozoobenthos communities and species composition observed in the Kerch Strait before and after the accident did not differ significantly. However, the Kerch Strait benthos is typical for the areas affected by anthropogenic activities for decades. Shortly after the accident, the filter-feeding zoobenthos species were recorded in low numbers and the general diversity was assumed poor, while variety of species indicating a high organic pollution were present and the habitats were considered unstable. At the November 2007 shipwreck site, the zoobenthos biomass was recorded respectively minimal compared to the other investigated areas in the Kerch Strait. In June–July 2008 no specific post-disaster effects on the Kerch Strait bottom organisms were registered. The state of the *Rapana*, *Pontogammarus*, *Anadara*, *Mytilaster* and other populations of the benthic organisms was recognized as typical for the area and similar to the levels observed prior to the catastrophe. Yet, any pollution level increase in the area would have negatively influenced benthic communities and further deteriorated the Kerch Strait habitats.

The most important phytobenthos species of *Zostera marina* eelgrass form a wide meadow in the Taman Bay and is a highly important structural component of the bay ecosystem. Nowhere else in the Kerch Strait the eelgrass is well presented. Very few macroalgae, mainly ectokarpus and cladofora, are found in the Kerch Strait due to the lack of stable substrates vital for algae development. Zostera dead leaves usually form small floating ‘islands’ on the water surface and those numerous ‘islands’, highly polluted with heavy oil, were collected at the coast after the Kerch Strait oil-spill incident. In 2008, no phytobenthos visible changes were encountered as compared with observations carried out prior to the incident.

In the end of November 2007 the ichthyoplankton survey showed the lower than normal abundance of eggs and larvae of certain fish species common for the area while more than 75 % of sampled pelagic fish eggs were discovered dead. All the dead eggs found had abnormalities of development, and such a high number of dead eggs at the last stages of development suffering abnormalities and the detected low number of larvae evidenced presence of unfavorable for their survival conditions. In December 2007, i. e. one month later, neither eggs nor larvae present in the ichthyoplankton samples were found. However, in summer 2008 the state of the ichthyoplankton community was discovered satisfactory and not revealing any visible signs of oil-spill impact on fish spawning in the Kerch Strait waters as compared with the previous periods.

After the Kerch Strait oil-spill accident, no significant changes were detected in the structure of coastal fish communities inhabiting the Kerch Strait proper and the Azov Sea in its vicinity. The population structure, abundance and physiology of the Kerch Strait area commercial fishes, i. e. the European anchovy, herring, gray mullet, goby, red mullet, horse mackerel, flounder, whiting, sprat, sea-fox and spur dog, remained stable and within the range of natural annual variations observed prior to the accident.

The parasitological studies conducted right after the accident recorded mass mortality of the girodaktilyus type fish parasites found on the skin of the fishes caught in the Kerch Strait. Those parasites mortality may be well attributed to absorption of petroleum hydrocarbons by the fish skin mucus. However, studies of the monogeneans species composition and their emergence on the fish skin conducted in May 2008 did not reveal any change in their condition status in comparison to observations conducted in May 2007, i. e., prior to the Kerch Strait accident. It may be concluded that ectoparasites population quickly recovered from the accident to its baseline parameters.

Bird population was severely damaged by the oil-spill accident. Because of oil contamination, the sea and shoreline birds kept perishing and in total 5487 dead birds were collected. Also, 244 birds were gathered alive and 111 of them were later fully rehabilitated and released back to the wild.

No evidence was found of deceased cetaceans as no signs were detected of mass cetacean stranding happening due to heavy fuel oil spillage after the 11 November 2007 storm. Neither dead animal were found along the Kerch Strait Ukrainian coast within ten days following the catastrophe. At the same time two dead animal bodies were found at the Chushka Spit of the Russian coast that had been most probably washed ashore before 11 November 2007.

The overall impact of the Kerch Strait accident in comparison to the Kerch Strait baseline conditions may be concluded as follows:

1. The Kerch Strait was chronically polluted by petroleum hydrocarbons and other chemical elements long before the Kerch Strait November 2007 catastrophe largely due to its intense traffic and frequent transshipment operations within the water area. The oil spill accident contributed, though not much, to the baseline pollution level of the Kerch Strait.

2. The oil spill in the Kerch Strait impacted the Strait water quality as well as its sediments and the biota for a short period of time lasting no longer than a month or two.

3. Birds and people suffered the most from the catastrophe.

4. Certain areas of the Kerch Strait coastline were badly contaminated, nevertheless, clean-up operations were quite efficient and no long-term damage to the coastal environment was observed.

5. Bacteria, phytoplankton, zooplankton and fish well survived through the Kerch Strait accident and generally revealed no significant change in their composition and quantitative parameters but a rather traditional for the area seasonal dynamics of these communities. The macrozoobenthos habitats in the Kerch Strait were found quite vulnerable and unstable however the oil-spill accident was not considered to be their major cause and a chronic anthropogenic pressure on the Kerch Strait ecosystem was believed rather to be the cause. The further increase of pollution in the bottom sediments could critically affect the state of the bottom communities.

Therefore, the observed catastrophe effects in the Kerch Strait were short in time and minor by scope. On the other hand, for decades the Kerch Strait waters, sediments, and the biota were continuously exposed to the pressures by sea vessels and land-based sources pollution. In terms of shipping the degradation experienced by the Kerch Strait ecosystem was primarily related to operational ship-borne pollution and illegal discharges from the ships, and to a lesser extent — to accidental spills. Hence, the real Kerch Strait calamity has not resulted from the accidents, and this is common understanding. The oil pollution originated from the tanker accidents is relatively minor comparing to all other sources of pollution though its concentration levels and high media attention make it a something *MAJOR* regardless of how much oil got spilled, and how serious the problem is that must be addressed. In the world the tanker operational discharges account for 22% of all oil pollution, municipal wastes — for 22%, tanker accidents — for 12%, and natural seepage, bilge and fuel oil — for 44%[1]. Thus, approximately by 88% oil pollution is not produced by the tanker accidents, and the Kerch Strait oil-spill accident has been no exception in this sense. However, the potential of a spillage during a tanker accident to cause a long-lasting environment disaster increases exponentially when the oil is spilled into a small area which is the case of the enclosed Black and Azov Seas.

It has been always believed that the ship-builder mission should be designing boats strong to withstand the rough marine environment. Presently, the main concern has seemed to become an ability of ensuring environment protection from the boats. An urge is becoming increasingly apparent that the coastal states should safeguard their seas from environmental disasters originating from substandard, high-risk prone or carelessly operated vessels.

Many similarities were found between the natural conditions and effects observed on 11 November 2007 and later during the Kerch Strait accident, and the *Globe Acimi* tanker shipwreck at the Klaipeda harbor on the Baltic Sea on 21 November 1981. Similarly, during the Klaipeda accident the heavy fuel oil (mazut) was spilled over while low atmospheric and water temperatures coupled with strong wind led to the outbreak to the coast of substantial part of the 16 000 tons of the spilled oil. Investigations conducted in 1982–1983 after the accident at the Klaipeda port revealed a serious damage to sand beaches by oil contamination; however, the water environment damage was identified as short term and minor (Andrjustchenko V. V. *et al.*, 1986, Simonov A. I., 1990). Scientists came to a similar conclusion about the Kerch oil spill accident having carried out numerous investigations of its consequences.

Lessons learnt and weaknesses of the Oil Spill Preparedness and Response (OPR) systems currently operational in the Black Sea region

The Kerch Strait accident has focused attention of decision-makers, scientists and broad public on various shortcomings and gaps existing in oil-spill prevention and preparedness systems in the Black Sea region, including apparent insufficiencies in the current national and regional monitoring systems and lack of proper cooperation to ensure a realistic post-disaster assessment.

The mentioned accident has revealed that Russia and Ukraine have not yet adopted effective instruments for conducting bilateral actions in the Kerch Strait in case of

[1] Lee, R. Operational pollution prevention programs for loaded tankers transiting coastal waters: http://www.iosc.org/papers/01584.pdf

emergency. Respectively, they have not joined forces in SAR and oil-spill response operations after the catastrophe on 11 November 2007, acted individually with no timely coordination of strategy and efforts. A major gap was also the lack of joint Russian-Ukrainian monitoring conducted after the Kerch accident which would allow to carry out an assessment of the scale of damage by unified methodology and models and to use the agreed results for the calculation of the economic losses based on their national systems of payments.

In both countries, apparent are the policy and legislation deficiencies, lack of capacity to efficiently mitigate accident's consequences and protect the environment as well as inadequacies of the existing monitoring systems to specifically trace post-disaster effects and absence of procedures for preparing a realistic economic assessment required for applying for compensation.

1. Pollution prevention and preparedness for oil spills

Prevention is better than cure'

Notwithstanding the breakthrough accomplished in the oil pollution clean-up technology, the practice continues remaining largely inefficient, costly, and strongly weather-dependant, as was observed during the Kerch Strait accident rescue efforts. The oil-pollution response equipment stops functioning if the waves exceed a meter, chemical dispersants have their own toxicity limit, and mix in the water column together with oil. Oil, when close to the shore, penetrates inside coastal sediments, cobble and boulder beaches and becomes difficult to fully remove.

Thus, it is much better to make arrangements for pollution prevention from the very beginning, and it could be largely achieved through comprehensive, efficient and workable pollution prevention programs. This would mean a return to the prudent and safe navigation founding principles and operational procedures that would effectively reduce as well an accident risk thus making clean-up and contingency plans largely redundant. Efficiently managed, monitored, and supplemented by education effort and public awareness campaign that program would have a potential to eventually ensure, if patience is angelic, impressive results of fruitful cooperation in marine environment on-going protection. The effort would pay back by such long-term dividends, as good public relations, healthy environment, predictable schedules, safety regardless of weather conditions, marketable performance, etc. Savings should not be made at the expense of nature well-being. A famous Indian proverb is most explicit about this:

Only after the last tree has been cut down,
Only after the last river has been poisoned,
Only after the last fish has been caught,
Only then will you find that money cannot be eaten.

However, prevention mechanisms are still poorly addressed in the Black Sea region and no integrated pollution prevention programs are operated in the Black Sea countries. The Black Sea region preparedness to combat operational and accidental pollution, as well as the countries capacity to control illegal discharges, remain far from perfect, especially when a large oil spill occurs.

The Russian and Ukrainian Black Sea borders and correlated responsibilities are relatively well understood[2]. However, responsibilities are not so clear in regard to the Kerch

[2] Note: However, areas of response during accidents are not yet officially agreed in the Black Sea.

Strait and the Azov Sea where demarcation of border between the two states is not agreed. It is widely believed that lack of clearly defined borders presents a possibility for tax evasion through oil and other products reloading and discharging in the Kerch Strait. As a result, the Kerch Strait suffers from high pollution level having a tendency for increase in time while the situation as a whole remains not manageable in terms of ensuring the protection of marine ecosystems in the Black and Azov Seas.

As for the Kerch Strait oil spill, the storm to result in shipwreck was forecasted beforehand by the Ukrainian agencies and the senior vessel personnel was duly given the information along with instructions to shelter in port. Most of the boats in the Kerch Strait followed instructions and retreated to safe areas while a few vessels apparently did not respond promptly enough that eventually resulted in shipwrecks and oil discharge into the water environment.

The Kerch Strait is an area of trafficking with constantly increasing boat transportation turnover: According to the Ukrainian Ministry of Transport, approximately 1000 boats per month pass through the Kerch Strait mostly carrying coal, sulphur and crude oil aboard. It is estimated that the open water oil transfers account for around 7 ml tons per year (UNEP, 2008) while chronic pollution from the Kerch Strait oil spills remains a key threat to the environment. A few years ago the total oil shipped through the Black Sea accounted for roughly 700 ml barrels and a significant future growth was expected[3]. An increased maritime activity standing at up to 40 vessels per day implies a higher risk presence in the Kerch Strait which contributes to the likelihood of hazardous substances discharge into marine environment. However, no regional Automatic Identification System, AIS server functions in the area that could have allowed a better safety of navigation, hence improving the shipping environment safety aspects is available.

The constantly increasing levels of crude oil production and intense Black Sea shipping continue to present the key threats to human health and the major risk for the environment, thus reminding relentlessly about the need to apply the proper and up-to-date management procedures, as well as the best available practices in all Black Sea countries in order to prevent oil pollution and respond to its threat. The careful planning is essential for any successful operation preparation, especially in an emergency situation.

A three-tier approach was applied by Russia in developing its contingency plans, CP. The Russian Federal Plan for Oil Spill Prevention and Response at Sea was adopted by the Ministries of Transport and Natural Resources, and by EMERCOM[4]. In July 2003, the plan was reviewed, presently it is updated and expected to be enforced in 2011. A regional plan for oil spill prevention and response at the Azov and Black Seas was adopted in 1999, updated in 2003, passed almost all approval procedures in 2010 and is expected to be formally approved in 2011. As well, Russia plans to adopt the Black Sea regional CP (BS RCP) in 2011. Russian ports are provided with oil-spill response equipment, while the Russian fleet operates antipollution, survey, multipurpose and skimming vessels, as is described in Annex 4[5] of

[3] International Tanker Owners Pollution Federation, Summary of oil spill risks and the state of preparedness in UNEP Regional sea regions, 2003.

[4] The Ministry for Civil Defenses, Emergencies and Elimination of Consequences of Disasters (EMERCOM of Russian Federation).

[5] Annex4 of the RCP: Directory of response personnel and inventory of response equipment, products to be offered as assistance of activation of the Regional Plan for Co-operation.

the BS RCP (http://www.blacksea-commission.org/_table-legal-docs.asp). The Russian Federation has approved two programs designed for modernization of its safe-and-rescue vessels operated by the Ministry of Transport. Herewith, the Transport System Modernization, 2002–2010 and the Development of Russian Transport System, 2010–2015 federal programs jointly with the Marine Transport subprogram provide for technical development of specialized rescue vessels belonging to a new generation and their construction at the Russian ship-yards. The timetable for new fleet delivery to the Novorossiysk Salvage Department subordinated to SMPCSA (State Marine Pollution Control, Salvage & Rescue Administration of the Russian Federation) is as follows.

2010: road diving boat — 1; rescue boom boat — 1; multifunctional salvage and rescue vessel of 4 MW power — 1;
2011: road diving boat — 2; multifunctional diving vessel — 1;
2013: rescue boom boat — 1, multifunctional salvage and rescue tug of 2.5–3 MW power — 1;
2014: seagoing platform — 1;
2015: multifunctional salvage and rescue tug of 2.5–3 MW power — 1.

In Ukraine, the national system of oil-spill preparedness and response measures is an integral part of the overall system of preparedness and response to the emergency situations. A specialized national CP (NCP) to address marine pollution has been developed and is in a process of approval by the Parliament. The BS RCP will come for consideration after the NCP is approved. According to the Ukrainian legislation each port on the coast of Ukraine must have a local contingency plan and does possess necessary response-support equipment, such as booms, sorbents, and dispersants. However, the capacity of local contingency plans could deal with small oil spills only, also known as the Tier-1 spills. The larger oil spills require coordinated request for equipment from other Ukrainian port (s) or international assistance as in the most of the Black Sea ports.

The provisions as set out in Decree 1567 cover a broad range of emergencies without specifying particulars of an oil-spill emergency situation. Decree 1567 is broad-scoped and the specifics required for addressing oil spills in marine context are set up in the local contingencies plans of ports. The currently practiced system of dealing with environmental emergencies in Ukraine is highly centralized and renders highest authority to the Cabinet of Ministers, Special Commission, and the Central Executive Ministries in case of the major incidents and incidents with transboundary implications in coordinating the activities of the regional authorities and securing necessary resources.

A national information system to improve maritime safety in the Black Sea basin is in process of development in Ukraine since 2009 (see http://spill.sea.gov.ua/index.php). UkrSCES is the developer-institution working with the assistance of OSCE (Organization for Security and Cooperation in Europe, http://www.osce.org/). The planned electronic reporting and information system, to become operational in 2011, follows the best practices of SafeSeaNet (http://www.emsa.europa.eu/safeseanet-in-action.html) with the aim of enhancing the efficiency of port logistics and safety of maritime traffic. It will assist the response of Ukrainian authorities to incidents, accidents or potentially dangerous situations at sea and will contribute to improved prevention and detection of pollution by ships. Based on monitoring AIS (radio) broadcasts from ships, this Vessel Traffic Monitoring System contains applications on oil-spill modelling supplemented by decision-making tool, archive of oil spills, risk assessments, and others. The system will be linked to CleanSeaNet (http://cleanseanet.emsa.europa.eu/) and to the Black Sea Regional Information System which is under development in the frames of the MONINFO project. Similar national system is expected to be developed in Russia as well.

No doubt that since the November 2007 oil spill, Russian and Ukrainian governments have been making progress in improving the shipping environment safety aspects. For instance, an important initiative has become an introduction of restrictions applicable for sub-standard vessels passing through the Kerch Strait. A bilateral working group jointly established by Russia and Ukraine proposed on 18 February 2008 that vessels should be allowed entrance to the Azov Sea ports through the Kerch Strait only in case of their compliance with the provisions of:

- The International Convention for the Prevention of Pollution From Ships, 1973, as modified by the 1978 Protocol (MARPOL 73/78); and
- The International Convention for the Safety of Life at Sea (SOLAS), 1974.

The recently announced by Russia single-hull tankers fleet decommissioning in order to be replaced with the double-hull oil tankers operational in the Kerch Strait, would significantly reduce the acute oil-spill risks. However, it was found out that only two out of thirty Black and Azov Seas ports regularly loading and discharging oil products possess the necessary means to conduct a tanker screening at their port terminals. The procedure is strongly recommended to all Black Sea countries, in regard to the high-risk vessels in particular, for increasing the regional shipping environment safety.

A well-publicized and conspicuous aerial surveillance program, if possible, proceeded by satellite surveillance combined with AIS and back-tracking of potential polluters, is highly advocated to be developed for the traffic routes associated with regulatory pollution sanctions for enhancing environment safety for shipping in the Black Sea region. Call to court, vessels delay, charging the clean-up expenses and fines are all strong weapons in prosecuting offenders world-wide. On their side, the countries should definitely provide for adequate port reception facilities, acceptable service fees, transparent and prudent operational practices, safe chartering and terminal operations.

Satellite SAR imagery is a valuable tool that complements other remote sensing and visual resources and mathematical models (simulations), helping to better organise oil-spill response operations and to tackle illegal discharges. However, satellite monitoring and surveillance are not in place at the national level both in Russia and Ukraine. In Russia, SCANEX (http://www.scanex.ru/en/) sporadically provides services to the Maritime Administration of the Port of Novorossiysk[6]. However, there is no aerial surveillance for verification of the satellite images delivered[7], no system integrating AIS information with back-tracking similar to CleanSeaNet

[6] The use of satellite imagery in combating illegal discharges should be treated as a single step in the gathering of evidence. Without supporting evidence, and the validation of the interpretive results of the data, the use of satellite images to prosecute offenders, is very limited. SAR images themselves are not an evidence in court, but their contribution in the legal process can be an important one when used properly.

[7] For the operational use of satellite imagery, it is recommended that each country avail itself of an aerial surveillance program that will complement and validate satellite detection so as to have all the necessary information to prosecute offenders. There are no legal barriers to satellite SAR images as evidence in court for illegal ship discharges when used in conjunction with aerial photographs.

(http://cleanseanet.emsa.europa.eu/) in Europe. Nevertheless, detailed inspection of the suspected ships (potential polluters in cases of illegal discharges) often takes place in the Port of Novorossiysk. Upon finding the deficiencies aboard the suspected vessel the detention is imposed. The vessel can only make money when it is sailing, and the detention becomes a serious prosecution.

2. Response to oil spills

Indisputably, Russia and Ukraine have substantial capacities for eliminating the oil-spill accidents consequences.

A. Policy

Russian oil-spill mitigation policy could be described as follows: the Tier 1 spills are to be treated mechanically, if the weather conditions permit, while for the Tier 2 and 3 accidents all the available treatment is permitted to include dispersants and in situ booming. Still, applying of dispersants and booming require prior approval of the Natural Resources and Healthcare Ministries, as well as the Fisheries Committee.

In Ukraine, no concrete oil-response policy has been adopted. In all marine ports, including five oil-export terminals, local contingency plans for combating the operational and incidental pollution are functional. Mechanical clean-up equipment is available at the ports. Upon authorization of the Ministry of Environmental Protection the Ecodin, domestically-produced dispersant, may be used to bind, sink and bio-remediate the oil spilled in the water.

B. Waste management

It remains an issue, how to arrange storage and recovery of wastes from an accident, since specialized storage facilities do not exist in the Black Sea region, but for Turkey. The national contingency plan adopted by Turkey lists inter alia private companies licensed for collection, transportation, storage and recovery of wastes resulting from the accident. The rest of the Black Sea countries still have to follow this practice and amend their adopted contingency plans accordingly.

In Ukraine, it is the Ministry of Environmental Protection that is responsible to grant licenses for waste management though the Ministry of Transport and Communications is involved in the waste management process as well at the Kerch Port. Still, a data base for the best available and cost effective technologies for processing of the oily wastes should be created in Ukraine. When it became clear that all wastes after the Kerch accident were collected on 18 February 2008, a specially created working group discussed various options for the utilization of these wastes, including storage of waste mixture in the lime pits. The practical recommendations how to use biosorbents were also developed and the proposals for utilization of collected mixture were considered. Later, a special Governmental Commission, established by decision of the Ukrainian Cabinet of Ministers of 19 March 2008, by its decision No 496 approved application of technology proposed by Ecocenter from Kirovograd (http://www.ecocenter.com.ua/index_e. htm) by its decision No 496. As a follow up the Ministry of Environmental Protection of Ukraine signed an agreement with Ecocenter to finance the waste utilization from the State Environmental Fund of Ukraine. That has proved to be the most efficient solution.

To facilitate prompt transportation, storage and utilization of wastes, a proper waste strategy definitely needs to be developed by all Black Sea countries having designated facilities or locations for influx of waste generated by environmental emergencies. The mentioned strategy could also recommend for application, depending on circumstances, concrete cleaning technologies and should be made broadly available to render support to decision-makers in the waste management issues.

In Ukraine the additionally required oil-spill response resources and capacities for contingency plans implementation are currently in the process of evaluation. As mentioned above, Ukraine does not currently have sufficient domestic means and resources available to develop and implement efficient and cost effective contingency plans for oil spills, and is obviously in need of assistance in this field.

C. Oil recovery

Facilities for oil recovery are available. However, it would be probably realistic to assume that no more than 15 % of spilled oil is recoverable under the best possible conditions[8].

3. Monitoring of incidental pollution

Current national and regional monitoring systems are not duly adapted to trace the accident effects and substantiate the post-disaster assessments, or contribute to pollution prevention.

The national monitoring systems of the Black Sea countries have some provisions for emergency monitoring. In Ukraine the local hydro-meteorological stations of the Ministry of Environmental Protection, responsible for the routine monitoring (see Chapter 1), immediately started measurements of pollution levels and information about these levels was uploaded and made public at the website of the Ministry on a daily basis since the very beginning of the Kerch Strait accident. However, these stations do not monitor biological parameters. The effect of the Kerch oil spill on biota was studied basically by scientific Institutions, which are not part of the national monitoring system of the Ministry of Environmental Protection (such as IBSS-Sevastopol and YugNIRO-Kerch).

Under the regional Black Sea Integrated Monitoring Program (BSIMAP, http://www.blacksea-commission.org/_bsimap. asp) the available and functioning instruments are mainly aimed at long-term continuous and complex observations for fulfilling national reporting obligations of the countries, Parties to the Bucharest Convention. Hence, the current integrated monitoring is intended to prepare data and information on pressures, state of the Black Sea environment, impacts, response and the ecosystems recovery in the long-term run. The Black Sea Contingency Plan, however, contains the provisions for emergencies monitoring and for establishing Task Forces in case of maritime incidents. This particular part of monitoring when developed shall become an integral part of BSIMAP.

For the assessment of the long lasting effects of pollution and respective assessment of economic losses after the Kerch Strait accident, the countries concerned had first to decide which of the institutions engaged with monitoring and surveillance would do the post-disaster monitoring. Secondly, they had to promptly build programs to conduct this concrete monitoring in order to provide proper reflection of the Kerch Strait accident impact, to evaluate the damage incurred and to calculate the compensation

[8] Vendermulen, John. 1990, Oil and the Environment, Canada Department of Fisheries and Oceans. Bedford Institute of Oceanography.

required. As a result of lack of available agreements and programs, as was mentioned above, Russian government during the period of two-three years after the accident spent incredible money financing activities of different institutions and agencies that often duplicated each other observations, instead of complimenting them. The Ukrainian Government had developed monitoring program adjusted to the specific features of the accident and financed its implementation giving the coordinating role in this activity to the Ukrainian Scientific Center of Ecology of Sea. However, duplication of efforts was also in place, as well as difficulties with financing and delays in the participation of the UkrSCES itself, which revealed problems in the implementation of the mentioned program.

Unfortunately, the Russian and Ukrainian long-term monitoring and on-going scientific programs for the Kerch Strait were found to have many gaps, while not being duly carried out for providing information on background and baseline conditions and it created difficulties for analyzing the changes experienced because of the Kerch Strait oil-spill accident. The water and bottom sediments sampling has been carried out irregularly for years due to the lack of funds, boats and equipment required. Chemical analyses were made for the easily measurable parameters only, such as total petroleum hydrocarbons, while the list did not include many important pollutants. Above all, no regular observation stations in the Kerch Strait Russian section were installed, while just limited number of stations at the Kerch Strait Ukrainian side was envisaged by the monitoring program. As well, national monitoring programs did not cover biological components that were not incorporated therein therefore. No national criteria for bottom sediment quality were established and adopted. Commonly used is the classification system of the «Netherland's Lists», which was developed for the North Sea and needs verification for the conditions of the Black and Azov Seas.

Certainly, Russian and Ukrainian national monitoring programs require substantial improvement and basically need to be supplemented with installation of sampling stations along the vessel routes, at the ports and sites close to the vessels at bunkering, as well as in the areas of dredging and dumping.

Comparison of information and data on various pollutants obtained in the result of expeditions carried out by different institutions has indicated a need for harmonization of methodologies applicable for sampling and analytical procedures, for data quality control and the quality assurance systems development and promotion. Development of relevant guidelines, inter-calibration and inter-comparison exercises are highly recommended to be conducted on a regular basis in the Black Sea region.

For pollution prevention and efficient control over operational and accident pollution and illegal discharges, application of remote-sensing observations on a regular basis is extremely important and highly recommendable.

4. Post-disaster assessments

In view of scarce information available right after the Kerch Strait accident, the different economic assessments were often made based on the assumptions; hence, some unrealistic figures and numbers were published in the mass media.

The UNEP calculations of the total damage cost were mainly derived from the fishery and tourism losses. Their damage estimations did not cover the economic value of a clean beach and its potential impacts on tourism as well as the cost of certain required activities, such as digging out of contaminated sediments around the wreckages. This assessment also did not take into account national system of payments for environmental pollution and remedial measures.

The economic assessments of the accident damage were made by Russian and Ukrainian scientists as well. The preliminary assessments highly overestimated the post-disaster effects while further investigations established that the main source of expenditures was the clean-up operations and the oily garbage final utilization cost as was properly reflected by the Ministry of Transport of the Russian Federation assessment (Booklet, 2009). As mentioned previously the utilization was the most difficult part of the pollution response, since no established standards and easily applicable technologies or appropriate facilities were present.

The total amount of economic losses from pollution of the environment of Ukraine was estimated as 1150526938 USD. By the time of the Kerch accident, Ukraine has been neither a Party to the 1992 Civil Liability Convention nor to the Fund Convention. The economic losses from the Kerch accident in Ukraine were calculated in accordance to the national size of fines for environmental pollution (approved by the Resolution of the Cabinet of Minister of Ukraine dated 03.07.1995 №484).

The Inter-governmental Working Group on the Preparation of the Appeal of Ukraine on the Compensation of Losses was formed according to the Procedure of Implementation of the Protection of the Rights and Interests of Ukraine During the Settling the Conflicts, Trial in the International Judicial Bodies the Cases with Participation of Foreign Entity and Ukraine (approved by the Decree of the President of Ukraine on 25.06.2002 №581).

The Russian Federal Service for the Supervision in the Sphere of the Use of Nature (Rosprirodnadzor) submitted a claim to the IOPC (International Oil Pollution Compensation) Funds based on a method which produces an abstract quantification of damages. This was challenged by the Fund as being in contradiction with Article 1.6 of the CLC (1992 Civil Liability Convention) and therefore was not admissible for compensation in the requested form. The Arbitration Court of Saint Petersburg and Leningrad Region has confirmed the Fund's position. Rosprirodnazdor has not appealed the Court finding and will revise the claim.

The insurer of the Volgoneft-139 tanker pleaded in defense before the Arbitration Court of Saint Petersburg and Leningrad Region that the oil spill had resulted from natural phenomenon of an exceptional, inevitable and irresistible character and that the ship owner and his insurer were therefore not liable for the pollution damage caused by the spill. If this line of defense were successful then the 1992 Fund would have been liable to pay compensation to the victims of the spill from the outset. At a hearing in September 2010 the Arbitration Court decided that the ship owner and his insurer had not provided the evidence that the oil spill resulted from an act of God, exceptional and unavoidable. The Court concluded that the Master having had all the necessary storm warnings had not taken all the required measures to avoid the incident and that therefore the incident was not inescapable for the vessels. The Court also concluded that the storm was not unique since the data on comparable storms in the area were available. In its verdict the Court decided that the spill had not resulted from natural phenomenon of an extraordinary or inevitable character and that the ship owner and his insurer were therefore liable for the pollution damage caused by the spill.