ANNEX 2

World Maritime Day 2009

Climate change: A challenge for IMO too!

Background paper

Introduction

There is general agreement among the world's leading meteorological experts that the surface temperature of the earth has risen by around 0.6°C over the past 100 years. The relevant organs of the United Nations Framework Convention on Climate Change (UNFCCC) estimate that the average temperature of the earth's surface has risen by as much as 0.74°C since the late 1800s and that, unless action is taken, it will increase by another 1.8°C to 4°C by the year 2100 – a change which it characterizes as "rapid and profound". Even if the minimum predicted increase takes place, it will be larger than any century-long trend in the last 10,000 years.

The overwhelming balance of scientific evidence clearly states that we need look no further than the effects of a century and a half of industrialization to find the principal reasons for this alarming phenomenon. The burning of ever-greater quantities of fossil fuels, mainly oil and coal; the cutting down of forests, and the widespread practice of intensive farming methods, together with industrial processes, have all spiralled during the industrial era, and they have all served to increase the amount of so-called greenhouse gases (GHGs) in the atmosphere, especially carbon dioxide, methane, and nitrous oxide.

Such gases occur naturally. Indeed, they are critical for life on earth, as they keep some of the sun's warmth from reflecting back into space; without them the world would be a cold and barren place. But, in the increasing quantities now being observed, they are pushing the global temperature to artificially high levels and altering the climate that sustains the ecosystems we have depended upon for thousands of years and the way of life we have come to know. Even if all GHG emissions ended today, the long-term effects of the gases already emitted would last for hundreds of years.

The climate does not respond immediately to external changes but, after 150 years of industrialization, global warming now has momentum, and it will continue to affect the earth's natural systems for hundreds of years even if GHG emissions are reduced and levels of GHGs in the atmosphere stop rising. To introduce a maritime analogy, climate change is like a giant oil tanker, in that, to stop it, or even to alter its course, not only takes a massive force but also a considerable amount of time – which means that, already, climate change is inevitable, as a result of past and current emissions of GHGs.

Evidence and effects

The evidence for, and the effects of, global warming and the resultant climate change are well documented and the facts are overpowering. Some of these effects are already upon us, some are predicted; some are already inevitable, some might be averted if prompt and concerted action is taken now.

Numerous plant and animal species, already weakened by pollution and loss of habitat, are not expected to survive the next 100 years. Human beings, while not threatened in this way, are likely to face mounting difficulties in the way we conduct our lives. People in developing countries will be hardest hit due to their lack of resources in general and, in particular, a lack of resources they can bring to bear on alleviating the effects of climate change.

Higher temperatures cause the volume of water in the oceans to expand, and melting glaciers and ice caps add more water. As a result, during the 20th century, the average sea level rose by 10 to 20 cm, and an additional increase of 18 to 59 cm is predicted by the year 2100. If the higher end of that scale is reached, the sea could overflow the heavily populated coastlines of low-lying countries, resulting in tens of millions of displaced humans. The predicted sea-level rise could cause the disappearance of some nations entirely (such as the island State of the Maldives), foul freshwater supplies for billions of people in low-lying areas, and also spur mass migrations.

Agricultural yields are expected to drop in most tropical and sub-tropical regions – and in temperate regions, too – if the temperature increase is more than a few degrees.

Computer models have predicted more frequent "extreme weather events" and recent severe storms, floods and droughts appear to show that they are on target. The Rhine floods of 1996 and 1997, the Chinese floods of 1998, the East European floods of 1998 and 2002, the Mozambique and European floods of 2000, and the monsoon-based flooding of 2004 in Bangladesh (which left 60 per cent of the country under water), are all examples of recent extreme rainfall.

By contrast, the drying of continental interiors could cause disruptions in land use and food supply, while the range of diseases such as malaria may expand. In Africa's large catchment basins of Niger, Lake Chad, and Senegal, total available water has decreased by 40 to 60 per cent, and desertification has been worsened by lower average annual rainfall, runoff, and soil moisture, especially in southern, northern, and western Africa.

In colder climes, the evidence for climate change is perhaps even more pronounced. Average temperatures in the Arctic have increased at almost twice the global rate in the past 100 years. Temperatures at the top of the permafrost layer have generally increased, since the 1980s, by up to 3°C. Buildings and infrastructure have collapsed because permafrost under their foundations has melted.

In mountainous areas, glaciers and snow cover have declined and, as already mentioned, widespread decreases in glaciers and ice caps have contributed to sea level rise. Almost all mountain glaciers in non-polar regions retreated during the 20th century. This is a dramatic change, as glaciers are the main source of water both for households and irrigation in large parts of the world, often far from the glaciers themselves. As an illustration, the overall volume of glaciers in Switzerland has decreased by two-thirds and the same trend may be observed in all regions of the world.

As if all this were not evidence enough, there are also numerous examples of changing phenomena in the plant and animal kingdoms that point clearly to global warming.

In the European Alps, for example, some plant species have been migrating upward by one to four metres per decade, and some plants previously found only on mountaintops have disappeared. The growing season for many plants has lengthened by several days.

Elsewhere in Europe, mating and egg-laying of some bird species has occurred earlier in the season; butterflies, dragonflies, moths, beetles and other insects are now living at higher latitudes and altitudes, where previously it was too cold to survive.

Acidification of the oceans, a related phenomenon, also represents a potentially gigantic problem. There is an equilibrium between atmospheric CO_2 and the CO_2 dissolved in seawater: as atmospheric levels increase, so do the levels of CO_2 dissolved in the ocean waters, especially in the surface waters where most ocean life flourishes. The dissolved CO_2 reacts with the seawater to form carbonic acid (H_2CO_3), increasing the acidity of the water – to the point where many of the marine species we rely on for food could well disappear.

Climate change and shipping

The environmental credentials of every country and industry are now under sharper scrutiny than ever before. The pressure is mounting for every potential polluter, every user of energy and every conspicuous contributor to global warming and climate change to clean up their act and adopt greener practices. The transport industry is no exception to such scrutiny and pressure; and environmental concerns are now high on the agenda in all of its sectors, including shipping.

There is no avoiding the fact that the modern world has become utterly dependent on motorized transport systems that run largely on fossil fuels: an engine burning fossil fuel will, inevitably, emit a quantity of GHGs, principally CO_2 – emissions that are now widely accepted as being significant contributory factors towards global warming, climate change and ocean acidification.

In terms of CO_2 emissions per tonne of cargo transported one mile, shipping is recognized as the most efficient form of commercial transport. Yet the enormous scale of the global shipping industry, which is responsible for the transportation of the overwhelming majority of world trade, means that it produces around three per cent of global manmade GHG emissions.

The most authoritative figures for the impact of shipping on GHG emissions are to be found in the Second IMO GHG Study, 2009 – an update of the original IMO study, dated 2000. The 2009 study reaches a number of significant conclusions:

- Shipping is estimated to have emitted 1,046 million tonnes of CO_2 in 2007, which corresponds to 3.3 per cent of the global emissions during that year. International shipping is estimated to have emitted 870 million tonnes, or about 2.7 per cent of the global emissions of CO_2 in 2007.

- Exhaust gases are the primary source of emissions from ships. Carbon dioxide is the most important GHG emitted by ships. Both in terms of quantity and of global warming potential, other GHG emissions from ships are less important.

- Mid-range emission scenarios suggest that, by 2050, in the absence of reduction policies, ship emissions may grow by 150 per cent to 250 per cent (compared to the emissions in 2007) as a result of the growth in world trade.

- A significant potential for reduction of GHGs through technical and operational measures has been identified. Together, if all measures are implemented, they could increase efficiency and reduce the emissions rate by 25 per cent to 75 per cent below the current levels, on a tonnes/miles basis, depending on the ship type and actual trade and operating pattern.

- Shipping has been shown, in general, to be an energy-efficient means of transportation compared to other modes. However, not all forms of coastal and short-sea shipping are more carbon efficient than all other forms of transport.

The challenge of reducing carbon emissions is, therefore, undoubtedly a critical issue for the shipping industry. As the industry's regulator, IMO shares this concern and is heavily engaged in efforts to pursue the limitation and reduction of greenhouse gas emissions from ships. Indeed, the Organization has adopted "*Climate change – a challenge for IMO too!*" as the theme for this year's World Maritime Day, in recognition of the intense focus this topic is receiving throughout the Organization and the global community in 2009.

IMO's work to regulate GHG emissions from shipping

IMO's work on this hugely important topic stems from the genuine concerns of its Member States for the environment. Moreover, the Kyoto Protocol to the United Nations Framework Convention on Climate Change provides that the limitation or reduction of emissions of greenhouse gases from ships must be pursued through IMO.

To that effect, IMO has established an ambitious but achievable action plan and is working towards the development and adoption of a robust regime that will regulate shipping at the global level and, thus, contribute to the deceleration of climate change.

Significant progress has been made in developing a package of measures, most notably an Energy Efficiency Design Index for new ships, an Energy Efficiency Operational Indicator for all ships and guidance on best practices for the entire shipping industry. An advanced draft of each of these, and other measures, was presented to the 59th session of IMO's Marine Environment Protection Committee (MEPC 59), in July 2009, which agreed to their circulation.

The first of these, the Energy Efficiency Design Index for new ships, is a formula to determine a ships' use of energy in transporting the cargo it is intended for, at the intended speed. The index figure for each ship will be determined at the design stage and possibly be verified at the sea trial. A better index figure for a ship may be obtained by including more sophisticated systems in the design that can, for example, reduce resistance, reduce the required propulsion energy or use the energy more efficiently, e.g., improved hull shape or air lubrication systems to reduce hull resistance through the water, improved engines, propellers and the use of diesel-electric systems as well as wind-assisted propulsion power or solar energy to provide lighting, or waste heat recovery systems and shaft generators to improve the efficiency of the fuel used.

The Energy Efficiency Operational Indicator is a rating of how efficiently a given ship is operated – i.e. how much cargo it moves for the fuel used. It works by calculating cargo, fuel and distance for each voyage leg, averaged over a period (usually 12 months). As it will provide a standardized way of communicating a ship's energy performance in operation, it may be used by ports to differentiate their fees (green ports), and be used by charterers or cargo owners in connection with energy efficiency branding or in negotiating sub-contracts.

It has been available in interim form since 2005, since when IMO has received results from hundreds of trials conducted, over several years, allowing the compilation of a huge volume of CO_2 data and leading to the observation that identical ships in seemingly similar trades may produce different results depending on different operation patterns or weather conditions. Operational differences concerning the specific utilization of individual ships involved in the trials may lead to significant variations; parameters, such as the length of time spent waiting in port areas, the length of ballast voyages, whether a ship is fully laden or not, can also produce different results.

The wide range of operational measures that affect GHG emissions from shipping mean that the involvement of stakeholders, other than the shipowner (e.g., ports and port operators/authorities, charterers, cargo owners and other authorities), is beneficial. IMO has, therefore, developed guidance for the entire shipping sector for the best possible energy-efficient operation of ships, to raise awareness, and to understand and explore possibilities.

Despite the current economic downturn, international trade is projected to continue growing and, with it, international maritime transport. Recognizing that technical and operational measures may not be sufficient to reduce the desired amount of GHG emissions from international shipping, market-based mechanisms have also been considered over recent years. A market-based mechanism would serve two main purposes: off-setting growing ship emissions in other sectors and inciting the industry to invest in more fuel-efficient ships and to operate them more efficiently. In addition, a market-based mechanism could generate considerable funds that could be used for purposes such as adaptation and transfer of technology into developing countries. The two market-based instruments that have received most attention are a maritime emissions trading scheme and an international GHG fund, based on contributions made in proportion to fuel consumption.

The shipping industry – taking responsibility

While IMO works to produce a regulatory regime for the international shipping industry, the industry itself has not been slow to understand its own responsibilities with regard to GHG emissions. In recent years, not only has it contributed through its industry organizations to the technical and regulatory process at IMO, it has also been responsible for generating its own technical and operational developments to help reduce GHG emissions from ships.

Carbon emissions and fuel efficiency are directly linked. In simple terms, the less fuel burned, the smaller the volume of carbon emissions. In recent decades, led by its marine engineers, shipping has developed more efficient propulsion systems and propeller designs that have yielded considerable reductions in fuel consumption. Engine technology has evolved to the extent that modern main propulsion systems for ships consume about 10 per cent less fuel than their predecessors installed some ten years ago, but with the same power output. Naval architects, too, have made their contributions; significant improvements in hydrodynamics and in vessel hull design have brought reductions of between two and four per cent in fuel consumption.

Based on the industry's continuous endeavours to achieve better results, additional improvements in hull, engine and propeller design can be expected, in the future, to produce further reductions in fuel consumption and there may also be possibilities for better utilization of waste heat. However, while work in these complex technical areas is ongoing, and some of these improvements may possibly materialize on board new ships within the short to medium term, it might be very difficult to apply these new technologies to existing ships. The solution for the existing fleet may, therefore, lie in improving the efficiency of certain aspects of their operation.

These are complex issues. Travelling at slower speeds, for example, might help reduce emissions; but it might also mean that more ships will be needed to transport the same quantity of cargo – not to mention that steaming at slower speeds would also have implications in the timely delivery of goods, such that receivers who have grown accustomed to a world of "just in time" delivery, and calculated their inventories of raw materials, components and other products accordingly, may need to make some adjustment in this regard.

Larger ships, while offering undoubted economies of scale, also have implications for port capacity and facilities, which would need to increase to accommodate them. They might also need to be supported by expanded networks of "feeder services", using smaller ships. Clearly, detailed studies of the net environmental benefits of such initiatives and practices are still needed.

Marine engineers are also actively conducting research into a number of alternative fuel sources and new energy sources such as solar, wind and fuel cells in order to help reduce carbon emissions.

For example, due to its lower carbon content, liquefied natural gas (LNG) can be used as an alternative clean fuel containing no sulphur and almost eliminating the emissions of particulate matter; moreover, nitrogen oxide emissions are reduced by up to 90 per cent. There are technical and safety challenges related to the use of LNG as a marine fuel, in particular as it requires three times the storage space of liquid fuels and, in general, it will only be feasible for newbuildings.

The potential CO_2 reduction from the use of LNG is about 25 per cent but, due to an increase in the emissions of methane (CH_4), with current technology, this benefit is reduced to about 15 per cent, although the full potential may, nonetheless, be achieved by new technology in the future.

The lack of LNG infrastructure and availability in bunkering ports, together with the challenges related to long-term storage, indicates that it might be more suitable for implementation by ships on fixed routes and short-sea shipping.

Fuel cells, too, may be a possibility for new ships in the long term. Although they are currently too limited in range to offer a viable solution, significant development work is going on. Small passenger ferries are being used for full-scale tests and fuel cells are also being tested on board vessels for auxiliary power generation.

Nuclear propulsion is technically feasible, although the costs associated with the support infrastructure could be a serious drawback to its more general use in merchant ships.

Biofuels might, conceivably, provide a possible alternative although there is, of course, considerable public debate about the net environmental benefits and the social effects of their wider utilization due to the production method of the so-called first generation of biofuels. Their use by shipping is currently seen as uneconomic, with uncertainty about sustainable availability in the large quantities that would be required, given the high demand anticipated from land transport. There are some technical challenges related to the storage and use of biofuels on board ships that need further studies but, in general, it is the uncertain net environmental benefit, as well as the price, that constitute the main obstacles.

It is evident that, while renewable energy sources, such as solar power, may have their place in helping to meet some ancillary requirements (such as lighting) on board ships, they are not considered as practical alternatives when it comes to providing primary propulsion power. Current solar-cell technology is sufficient to meet only a fraction of the auxiliary power requirements of a tanker, even if the entire deck area were to be covered with photovoltaic cells. Wind-assisted power, on the other hand, has a promising potential for fuel-saving in the medium and long term but, as present-day trial experiences of these technologies on board large vessels is limited, it is difficult to assess their full potential and further trials and development should be encouraged.

Despite all this excellent and encouraging "blue sky thinking" from academia and the industry, it seems inevitable, however, that fossil fuels will probably continue to be the predominant source of power for the majority of the shipping industry for the foreseeable future.

And, while it is very difficult, at this stage, to make detailed predictions about the improved fuel efficiencies that might be achieved in the future for individual ships – not least because these will vary significantly between ship types and trades – it has been suggested that, by 2020, a combination of regulatory, design and operational measures might possibly deliver a reduction of around 17 to 32 per cent in the fuel consumed by ships per tonne/mile of cargo transported. However, it is important to stress that work on these complex issues is still continuing, that more efficient and sophisticated ships will be more expensive and that many measures may not be cost-effective for a range of ships and trades.

What should always be remembered is that the size and activity level of the world fleet is, ultimately, governed by consumer demand, and this will remain the most significant driver for emissions from ships. Other important factors are distance and technology. The volumes transported will depend on developments in trade, locations of factories, consumption of raw materials and other factors, while the distance will be affected by issues such as changing trade patterns or possible new sea routes.

Thus, while it may be possible to reduce GHG emissions per tonne/mile in a moderately significant way (perhaps by 15 to 25 per cent in the next 5 to 15 years, as mentioned above, with new, more fuel-efficient and bigger ships eventually bringing additional improvements), it would be almost impossible to guarantee any absolute reduction by shipping as a whole, due to the projected growth in demand for shipping worldwide arising from the growing world population and global economy.

On the other hand, shipping companies themselves have a very strong incentive to reduce their fuel consumption and thus reduce their GHG emissions. Bunker fuel costs represent a significant proportion of ships' operational expenses, having increased by significant amounts in recent years. The escalating cost of bunker fuel burned by ships (expected to increase further due to the imminent requirements for fuels of lower sulphur content) means that further improvements in efficiency are a matter of enlightened self-interest for shipowners.

As an interesting aside, fuel costs are already having an impact on the competitiveness of certain maritime trades. For example, short-sea and coastal shipping are often in direct competition with land transport modes. This is where "big picture" thinking is so important; the danger that efforts to reduce GHG emissions from shipping actually result in a modal shift to other, less carbon-efficient forms of transport, clearly needs to be avoided.

The global regulatory situation

During the 1960s and 1970s, the scientific community first began to observe evidence that concentrations of carbon dioxide in the atmosphere were increasing and that, as a result, the phenomenon that we now know as global warming was underway. Climatologists and others pressed for action but it was not until 1988 that the Intergovernmental Panel on Climate Change was created by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP). This group issued a first assessment report in 1990 which reflected the views of 400 scientists. The report stated that global warming was real and urged that something be done about it.

The Panel's findings spurred Governments to develop the United Nations Framework Convention on Climate Change (UNFCCC). By the usual standards for international agreements, negotiation of the Convention was rapid. It was ready for signature at the 1992 United Nations Conference on Environment and Development – more popularly known as the "Earth Summit" – in Rio de Janeiro, Brazil.

Most of the world's countries have since become party to the UNFCCC and, under its umbrella, have to consider both what can be done to reduce global warming and how to cope with whatever temperature increases are inevitable.

In 1997 when the Parties to the UNFCCC met in Japan, a number of nations approved an addition to the treaty, called the Kyoto Protocol, which has more powerful (and legally binding) measures. This second, more far-reaching international treaty on climate change, entered into force on 16 February 2005.

Recognizing that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere, as a result of more than 150 years of industrial activity, the Kyoto Protocol places the obligation for emission reductions on developed nations under the principle of "common but differentiated responsibilities".

The major distinction between the Protocol and the Convention is that, while the Convention encouraged industrialized countries to stabilize GHG emissions, the Protocol commits them to do so. It sets binding targets for industrialized countries for reducing GHG emissions. These amount to an average of five per cent against 1990 levels over the five-year period 2008-2012.

With this first commitment period due to end in 2012, the international community is now working to establish a strong multilateral framework to ensure that there is no gap between the end of the Kyoto Protocol's first commitment period in 2012 and the entry into force of a future regime. An initial plan for the development of a post-Kyoto regime was agreed at the United Nations summit in Bali, in December 2007, at which IMO was represented. This post-Kyoto regime will be adopted at a major UN Conference on climate change in Copenhagen, Denmark, in December 2009, to which IMO will report the progress it has made on the issue through the MEPC.

A responsibility shared

It is widely acknowledged that global warming almost certainly will be unfair in the way it affects people. Those who have done most to cause it will not be those who suffer its consequences most acutely. According to the UNFCCC, the industrialized countries of north America and western Europe, along with a few other States, such as Japan, are responsible for the vast bulk of past and current GHG emissions. Large emerging economies have also become major emitters.

Yet, those who will suffer most from climate change will be in the developing world. They have fewer resources for coping with storms, with floods, with droughts, with disease outbreaks, and with disruptions to food and water supplies. They are eager for economic development themselves, but may find that this already difficult process has become even more difficult because of climate change. The poorer nations of the world have done virtually nothing to cause global warming yet are most exposed to its effects.

Climate change will, of course, affect everybody. No one can be immune to it. By the same token, responsibility for finding the solution cannot, realistically, be laid at the door of any particular country or group of countries, any particular region or continent. We are, perhaps as never before, all in this together. Successfully addressing climate change will be far from easy; but the consequences of failing to do so are far too dire to contemplate.

United Nations Secretary-General Ban Ki-moon accurately summed up the situation, speaking in February 2009, at a meeting of industry leaders in India, when he said, "Industrialized countries bear a great deal of responsibility for the state of the planet today. And they must bear their share of the burden when it comes to paying for solutions. But, at the same time, countries that did not contribute as much to global warming still have a responsibility to address it. I don't think this is the time for finger pointing".

The message is clear: to succeed in combating climate change, we must all play our part with the seriousness that the circumstances demand. If the problem pays no heed to man-made borders, then neither can the solution. We all have a responsibility to take bold, comprehensive and coordinated action that not only jump-starts recovery of the planet but also launches a new era of serious and meaningful engagement to prevent a crisis, like the one we are presently facing, from worsening or recurring. Working together, with a sense of responsibility for future generations, the agreements made in Copenhagen later this year can have genuine and lasting value.

Humankind is on the horns of a dilemma. For, whether we like it or not, our collective way of life has become unsustainable and we need to do something about it – and soon. The choices we have made about the way we lead our lives have been slowly eating away at the very support system that enables us to live and breathe. This cannot go on. We need to make some tough decisions, we need to make them now and we need to act on them with total commitment – now and in the future. Faced with facts we cannot argue against, we need to consider our priorities and accept that we have to make certain sacrifices; we need to start putting "life" ahead of "lifestyle".

If we are serious about tackling, comprehensively and effectively, the complex and multi-faceted issues of global warming, climate change and ocean acidification, we must pursue "borderless strategies" and be prepared to think, and act, "outside the box".

Despite the inertia that characterized mankind's initial reaction to the early wake-up calls concerning global warming, it is encouraging that, albeit belatedly, we have now come to acknowledge that increases in global temperatures are altering the complex web of systems that allow life to thrive on earth: cloud cover, rainfall, wind patterns, sea levels and ocean currents and the distribution of plant and animal species are, to various degrees, all being affected.

From the human perspective, difficult issues such as poverty, disease, uneven economic development and population growth are additional factors that serve to exacerbate and complicate the problem. Secretary-General Ban Ki-moon, in his address to the UN Conference on Climate Change in Bali, in 2007, branded climate change and our response to the multi-faceted problems it represents as "the defining challenge of our age". Let there be no doubt that, as the 2009 World Maritime Day theme proclaims, climate change is a challenge for IMO too!

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