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UNITED NATIONS ENVIRONMENT PROGRAMME

PREVENTING MARINE POLLUTION

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InternationaL Maritime Organization

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PREVENTING MARINE POLLUTION

1. THE ENVIRONMENTAL THREAT

During the last twenty-five years the pollution of the world's oceans has become a matter of increasing international concern. Most of it comes from land-based sources and includes the by-products of industry, run-off from agricultural pesticides and herbicides and effluents discharged from urban areas.

Nevertheless a very significant amount of pollution is caused by shipping and maritime activities generally. The substances involved vary enormously in quantities transported and their potential harm to the marine environment. The following paragraphs summarize the pollution-control situation insofar as the main types of shipping activity are concerned.

Oil

In tonnage terms, the most important pollutant resulting from shipping operations is oil. The National Academy of Sciences of the United States estimated in 1980 that as much as 3.54 million tons of oil entered the sea every year, some 1.5 million tons of which resulted from the transport of oil by sea (the remainder came from land-based activities and included industrial waste[illegible] run-off and natural seeps).

World oil consumption in 1983 was nearly [illegible] million barrels per day - less than the record 64 million barrels of 1979 but still a substantial increase on the 31 million barrels consumed daily in 1965.

The world tanker fleet is smaller than it was a few years ago and much of the tonnage is laid up; but the tonnage of the world tanker fleet is still more than 280 million deadweight tons compared with

64 million tons in 1960.

The ships themselves have also changed dramatically in size; in the 1950s ships of 30,000 dwt were regarded as very large; today tankers of 250,000 dwt are commonplace and a number have been built with twice that tonnage.

The best known cause of oil pollution is that arising from tanker accidents. Although this may contribute a comparatively small percentage of the total oil entering the sea in a year, the consequences of an accident can be disastrous to the immediate area, particularly if the ship involved is a large one and the accident occurs close to the coast. The wrecks of the Torrey Canyon (1967) and the Amoco Cadiz (1978) are examples. The NAS estimates that about 390,000 tons of oil a year enter the sea from this source. Collisions and groundings account for 83 per cent of major spills.

The most common pollution incidents occur during terminal operations when oil is being loaded or discharged - perhaps as many as 92 per cent of oil spills, according to figures published by the International Tanker Owners' Pollution Federation. Because they occur close to shore and often in a confined area, such as ports, their environmental damage to the immediate vicinity can be considerable. But in tonnage terms such accidents provide only a small proportion of the total - about 20,000 tons, according to the NAS.

A much great quantity of oil enters the sea as a result of normal tanker operations, usually associated with the cleaning of cargo residues (clingage) which takes place when the ship is returning from the port of discharge to take on another cargo of oil. The amount of clingage normally amounts to about 0.4 per cent of cargo-carrying capacity - about 800 tons on a 200,000 dwt crude oil carrier. During ballasting and cleaning as much as half of this can be lost overboard unless slops are retained on board. In tonnage terms, this is still probably the biggest source of oil pollution from ships - about 700,000 tons a year, according to the NAS - but it has declined considerably in recent years.

Other causes of oil pollution include dry docking (30,000 tons); bilge and fuel oil (from dry cargo ships as well as tankers (300,000 tons); and non-tanker accidents (20,000 tons).

Noxious substances and dangerous goods

Although most public concern about marine pollution has concentrated on problems associated with oil, many of the chemicals carried by sea are far more dangerous to the marine environment. Some of them are so poisonous that even a tiny amount can kill fish and other marine life. They can build up in the food chain until they are present in large enough quantities to present a danger to human health. Some are so persistent that they can last for tens or even hundreds of years. Tainting of fish so that the catch is unsuitable for human consumption can have serious commercial repercussions for fishermen.

Fortunately, perhaps, the amount of noxious substances carried at sea is only a fraction of the amount of oil transported each year. Many are carried in bulk form in tankers especially designed for the purpose. The chemical tanker fleet amounted to 2.7 million dwt in 1973 and had risen to 7 million dwt by 1982 (some 275 ships), according to figures issued by Drewry Shipping Consultants Ltd.

The ships themselves are generally much smaller in size than oil tankers, ranging from 500 grt to about 40,000 grt. They are, however, often extremely complex (and hence expensive) to build. Not only must the cargo be given maximum protection, but the ship may also carry many different products at the same time - each one of which may have particular properties and require different handling.

Other chemical products, including liquid substances, are carried in packaged form, such as in drums or specially constructed containers. Again, the environmental threat which some of these substances represents bears no relation to the size of the unit in which they are carried. As an example, polychlorinated biphenyls (PCBs) are potentially so harmful that IMO has recommended that their carriage in bulk form by ship should be banned.

Many of these substances are not only a pollution threat - they can also be extremely hazardous both to ships and equipment and, more

importantly, to people.

The number of different chemicals and other goods of this type is growing all the time as the world becomes more industrialized and industry itself becomes more complex. It has been estimated that up to 15 per cent of all goods carried in conventional dry cargo ships are dangerous to some degree and, if liquid substances carried in chemical carriers or tankers is included, then the total is around 50 per cent.

Garbage and sewage

Garbage and sewage from ships have traditionally been dumped into the sea as a matter of course and in relation to the amount of similar wastes poured into the sea each year from the land the quantities in the past were not considered excessive.

Today, however, the situation is very different. One reason is the growing everyday use of substances such as plastics which are non-biodegradable: once thrown into the sea, they are extremely persistent and potentially harmful if ingested by seabirds and marine mammals. The aesthetic quality of coastlines and beaches has also been devalued by the accumulation of such wastes.

Studies carried out in the United Kingdom by the Keep Britain Tidy Group in 1978-79 showed that most of the refuse washed up on British beaches came from ships. Of some 20,000 items recovered, 42 per cent were plastic (mostly containers of household products such as disinfectants, bleach and washing-up liquid) and 22 per cent metal. Of the latter, more than two-thirds turned out to be drink cans.

The amount of wastes generated by ships can be prodigious. A study carried out by a marine biologist at Newcastle University in 1982 showed that during a 44-days voyage, the 46-members of a merchant ship's crew dumped overboard 320 cardboard or paper boxes; 370 plastic beer-can holders; 162 crisp packets; 19 plastic bags; 2 plastic drums; 240 bottles; 5 glasses; 5,176 cans; and two metal drums. Not surprisingly, perhaps, the same survey showed that of 600 ships entering ports in South Wales in 1977-78 only 13.5 per cent used the waste disposal facilities provided on shore.

Land-generated wastes and solids

In a number of countries quantities of industrial and municipal waste (mainly sewage sludge) generated on shore are disposed of by dumping at sea. Most of these materials are such that they can be assimilated by the marine environment without harmful effects (although the sheer scale of dumping operations has caused concern in some areas). But other materials - such as radioactive wastes - are much more controversial.

Some other materials are so dangerous that their disposal is a major problem. It is difficult to find suitable sites on land and in some cases controlled disposal by incineration at sea is considered to be the best solution. These incineration operations involve very high temperatures so as to ensure virtual total destruction of the waste. They are conducted well away from human habitation on specially constructed ships with a high degree of control and sophisticated monitoring by the flag State.

Account must also be taken of the many harmful substances transported in packaged forms which can have a polluting effect if released into the marine environment. The labelling and stowage of such packages should be such as to minimize hazards arising from shipment.

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No matter what substance is involved, marine pollution is an international problem. The risk of a major tanker accident is greater in some areas than in others but pollution can happen almost anywhere and can affect coastlines which are often many miles away from the incident which caused it.

The world-wide character of the problem means that pollution can only be effectively tackled by the maritime countries of the world combining their resources and acting together. The world's fleet is divided among many different flags. Action by individual countries

can consequently only make a small impact on the problem as a whole and indeed a variety of unco-ordinated national measures could even make matters worse.

It has been recognized for many years that marine pollution from ships, which affects so many nations, can only be satisfactorily tackled through an international marine forum. That forum is IMO.

2. HOW IMO OPERATES

IMO met for the first time in 1959. It is a specialized agency of the United Nations system and is responsible for technical matters affecting shipping. Its primary task is to promote the safety of shipping by introducing standards which are internationally acceptable and implemented by many nations. A secondary function - and one which has grown in importance over the years - is the prevention of marine pollution from ships.

The measures evolved by IMO are normally contained in international treaties known as Conventions. These are developed by representatives of Member Governments meeting in the IMO forum and the resulting convention is then agreed on, or adopted, at a conference of Governments called by the Organization.

The convention then has to be ratified by individual Governments, and only enters into force - that is, becomes legally binding upon those countries which have accepted it - when a specified number of countries have done so. It is important to ensure that the terms of the convention apply not only to as many countries but also to as many ships as possible. In some conventions, therefore, the requirements for entry into force include a tonnage provision.

Since 1959 IMO had adopted nearly 30 treaty instruments covering many aspects of maritime safety and pollution prevention, including such matters as the safety of life at sea; collision avoidance; measures to prevent pollution by oil and other substances; compensation for oil pollution damage; the rights of States to intervene to prevent pollution; crew standards and training; and many more.

The major international conventions dealing specifically with pollution for which IMO is responsible include the following:

1. International Convention for the Prevention of Pollution of the Sea by Oil (adopted in 1954)

Although this convention, which entered into force in 1958, was adopted before IMO came into existence, the Organization assumed responsibility for it in 1959. The convention is concerned with deliberate, or operational discharge of oil at sea, and was amended by IMO in 1962 and 1969. Further amendments were adopted in 1971 but did not enter into force. The convention has been superseded by MARPOL 73/78 (see below) as far as States which have ratified both instruments are concerned.

2. International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (1969)

This convention was adopted by IMO as a result of the Torrey Canyon disaster. It deals with the rights of nations to take action to prevent or mitigate the danger of pollution by oil following accidents involving ships outside territorial waters. It entered into force in 1975. A Protocol which entered into force in 1983 extends the convention to other hazardous substances, such as chemicals.

3. International Convention on Civil Liability for Oil Pollution Damage (1969)

This convention was also adopted following the Torrey Canyon incident and is designed to ensure that adequate compensation is available to persons who suffer from oil pollution by placing the liability for compensation upon the owner of the ship from which the oil escaped or was discharged. The convention entered into force in 1975. A Protocol substantially increasing compensation available was adopted in 1984.

4. International Convention for the Establishment of an International Fund for Compensation for Oil Pollution Damage (1971)

The main purpose of this convention is to provide for further compensation to victims of oil pollution. The 1969 Civil Liability Convention puts the burden of compensation on the shipowner, but at

the same time limits the amount of compensation payable. The Fund is made up of contributions by oil importers and enables further compensation to be paid when the limits of compensation payable under the 1969 Convention have been reached. The convention entered into force in 1978. A Protocol substantially increasing compensation available was adopted in 1984.

5. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972)

This convention was adopted at a conference called by the United Kingdom, but IMO has been responsible for duties associated with it since it came into force in 1975. The aim of the convention is to prevent or limit the deliberate disposal at sea of various types of waste materials produced on land.

6. International Convention for the Prevention of Pollution from Ships (1973) as modified by its Protocol of 1978 (MARPOL 73/78)

The parent convention contains five annexes dealing with pollution by oil; noxious liquid substances carried in bulk; harmful substances carried in packaged forms; sewage; and garbage.

A Protocol adopted in 1978 introduced more stringent requirements dealing with the prevention of oil pollution. MARPOL 73/78 contains measures designed to prevent or reduce accidental as well as operational pollution and is widely regarded as the most important instrument of its type so far adopted. It entered into force on 2 October 1983. The first set of amendments were adopted in 1984 and are expected to enter into force on 1 January 1986.

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In addition to conventions, IMO has also adopted literally hundreds of codes and recommendations which are designed to complement the requirements contained in the conventions or to assist their implementation. Unlike conventions, they do not become binding upon

nations but are intended to act as guidance in framing national requirements.

What the IMO measures do

The conventions and recommendations outlined above tackle the problem of marine pollution in a number of ways. They include the following:

1. Preventing operational pollution: (for example, the dumping of oil-water mixtures resulting from tank cleaning directly into the sea). This has been done by introducing anti-pollution measures into the design, equipment and operation of ships.

2. Reducing accidents: this is principally achieved by introducing and enforcing strict standards and navigational procedures on a world-wide basis. While principally designed to make shipping safer these measures have a secondary advantage in that they also help cut pollution resulting from accidents.

3. Reducing the consequences of accidents: measures have been introduced which are designed to lessen the amount of pollution resulting from an accident (for example, by limiting the amount of oil entering the sea in the event of a tanker going aground or being involved in a collision).

4. Providing compensation: the costs of pollution can be enormous. A series of measures have been adopted to enable victims of pollution incidents to be provided with compensation for their losses.

5. Helping implementation.

3. PREVENTING OPERATIONAL POLLUTION

(a) Oil tankers

Tankers carry their cargo in a number of tanks or compartments within the hull of the ship. After the oil is discharged the tanks have to be carefully cleaned and about one third of them have to be filled with sea water so that the ship's propeller is properly immersed and it has correct handling and sea-keeping characteristics. This process is known as ballasting.

In the early days of oil tanker operations it was a common practice to clean tanks by means of jets spraying sea water. The

jets washed the oil residues from the tank surfaces, resulting in a mixture of oil and water which collected at the bottom of the tank and was then pumped overboard. This naturally led to a considerable amount of oil escaping into the sea, and the ballast water, which was pumped overboard to make way for a fresh cargo of oil, was also contaminated.

In the 1950s there were no alternative ways of cleaning tanks. Nevertheless it was recognized that the pollution of coastlines by oil discharged from oil tankers was becoming a serious problem in many areas.

The main aim of the 1954 Convention was to prohibit the discharge of oil or oily mixtures within 50 miles of land. This limit was extended to 100 miles in certain areas which were regarded as being particularly endangered. They include the Mediterranean, the Gulf and Red Sea, the coasts of Australia and Madagascar and some others. The limits were extended by an amendment adopted in 1962.

Governments ratifying the convention also undertook to provide reception facilities at ports at which oily mixtures and oil residues could be discharged.

During the 1960s technical advances made it possible to improve upon the requirements of the convention and in 1969 further amendments were adopted which were designed to make even greater reductions in operational oil discharges.

One of the most important technical advances was the development of the system known as load-on-top. Under this method, the oily-water mixtures resulting from the decanting of dirty ballast and tank cleaning operations are pumped into a special slop tank on board the ship. During the course of the ship's voyage the oil and water separate. The oil floats to the top of the tank and it is possible to pump the clean water into the sea and to retain the floating oil in the slop tank. At the loading port, oil is loaded into the slop tank on top of the residual oil.

The 1969 amendments limit the amount of oil which a tanker may

discharge on a ballast voyage to 1/15,000 of the ship's cargo-carrying capacity; limit the rate at which oil may be discharged to a maximum of 60 litres per mile being travelled; and ban all discharges of oil from tankers within 50 miles of land.

In 1971 two further amendments were adopted, the first of which was designed to provide greater protection to Australia's Great Barrier Reef, an area regarded as very vulnerable to pollution, by extending the prohibited zone. The second dealt with the size of cargo tanks (see page 18).

Further improvements are contained in the 1973 Convention. The maximum quantity of oil which can be discharged from new tankers is halved from 1/15,000 to 1/30,000 of the cargo.

'Special areas' are established in which intentional oil discharges are completely prohibited (except where the safety of the ship is threatened). The main areas are the Mediterranean, the Baltic Sea, the Black Sea, the Red Sea and the Gulfs Area. All of these seas are almost totally enclosed by land and because of the limited exchange of water with the great oceans, are considered to be particularly vulnerable to pollution.

To ensure that discharge requirements are met, tankers must be fitted with oil-discharge monitoring and control equipment. All ships over 400 tons and tankers over 150 tons must have oil-water separating equipment for the treatment of discharges from machinery space bilges. In some instances a filtering system, sludge tanks, piping and pumping arrangements are also specified.

Oil tankers are required to be capable of operating the load-on-top system or of discharging oily mixtures and residues into shore reception facilities.

An important new requirement is for new tankers of 70,000 dwt and above to be fitted with segregated ballast tanks. This means that sufficient tanks to contain adequate sea water ballast must be provided and used solely for that purpose: they cannot be used for the transport of oil. This measure is designed to eliminate the mixing of oil and

water resulting from the carriage of ballast water. On the laden voyage, these tanks are simply kept empty.

This principle of avoiding the mixture of oil and water was further extended in 1978, when a conference called by IMO adopted further tanker safety and pollution prevention measures.

The latter were included in a Protocol to the 1973 MARPOL Convention. In order to expedite entry into force, it was decided that the Protocol would in effect absorb the parent convention. The annex dealing with oil pollution entered into force on 2 October 1983.

The combined instrument, usually referred to as MARPOL 73/78, extends the requirement for segregated ballast tanks to new tankers of 20,000 dwt and above. For ships carrying refined products (such as petrol) as opposed to crude or unrefined oil, the requirement applies to ships of 30,000 dwt and above.

MARPOL 73/78 also takes into account a new technical development known as crude oil washing. This is an advance on earlier cleaning methods. Instead of using sea water, tank cleaning is carried out by spraying the cargo tanks with crude oil itself. Experience has shown that this is a more effective cleaning agent than water and the process avoids the mixture of oil and water resulting from the previous system. At the same time it benefits the cargo importer, for virtually all the cargo can be delivered ashore, instead of a proportion of it being wasted by becoming mixed with water.

MARPOL 73/78 makes the provision of reception facilities mandatory not later than one year after the entry into force of the convention (i.e. by 2 October 1984). To assist Governments in complying with this requirement IMO has published guidelines for the provision of reception facilities in ports.

(b) Noxious liquid substances

Although these substances are not carried in such vast quantities as oil, the nature of the products poses special problems. The ships which carry them are among the most complex in existence and safety precautions

have to be extremely stringent.

The rapid increase in sea transport of hazardous or noxious chemicals in bulk led to the recognition of the need for international measures to ensure their safe carriage. Accordingly the Organization developed the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk, which became effective in 1972.

The Code was developed to provide an agreed international standard for the safe carriage by sea of dangerous chemicals in bulk by prescribing the constructional features of ships involved and the equipment they should carry.

Some products carried in this way present a fire hazard in excess of petroleum and similar flammable products. They can also possess significant health hazards, including toxicity by inhalation of vapour; by oral ingestion; or by skin absorption; and some are corrosive to the skin. Products which are to be carried in bulk are evaluated for their safety hazards and listed in the Bulk Chemical Code. The Code has been amended ten times to keep abreast of technological developments.

The Code lays down certain restrictions on the siting of cargo tanks in relation to the ship's side and bottom, which afford them a degree of protection from external damage and stipulates the extent to which the ship should be capable of remaining afloat after sustaining a given extent of damage, depending upon the nature of the cargo to be carried.

Three ship types are specified in the Code. Type I is for the most hazardous substances and Types II and III are for substances of progressively lesser hazard.

If the ship is intended to transport more than one substance, the requirements for ship survival correspond to the most dangerous substance, but the cargo containment requirement need only conform to the specified minimum requirements for the chemicals taken individually.

Requirements depend on the hazards of the prodocts and their physical and chemical characteristics, and various requirements are laid down for each product.

The Code is not yet mandatory; it is a recommendation on which governments can base their national regulations. But in 1983 IMO adopted an amendment to Chapter VII of the International Convention for the Safety of Life at Sea (SOLAS), 1974 to make the Code mandatory. This amendment is expected to enter into force on 1 July 1986 when the International Bulk Chemical Code (IBC Code) will become a requirement for ships built after that date. The IBC Code is basically the existing Bulk Chemical Code revised to bring its provisions into line with the International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (IGS Code) and to include an extension of the list of products covered by the Code.

Further requirements covering the carriage of noxious liquid substances are contained in Annex II of MARPOL 73/78, which is scheduled to enter into force on 2 October 1986. Noxious liquid substances are evaluated for their hazards to the environment and grouped into Categories A, B, C and D. Different discharge criteria apply to those categories according to the hazard they present to the marine environment if discharged operationally. The Regulations will apply to all ships engaged in the carriage of noxious liquid substances whether international or domestic trades.

An appendix to Annex II contains a list of some 150 Category A, B, C and D substances. It is expected that when Annex II of MARPOL 73/78 enters into force, the list will be extended to include many noxious liquid substances which can be transported by sea in bulk. A draft list now being prepared contains 313 substances and the environmental hazards of further 56 substances are under investigation.

(c) Packaged goods and non-liquid substances

Chapter VII of the SOLAS Convention contains requirements covering the carriage of dangerous goods by sea which divide goods of this type into nine different classes. These are explosives; gases; flammable liquids; flammable solids; oxidizing substances and organic peroxides; poisonous substances; infectious substances; radioactive substances; corrosives; and miscellaneous substances.

These classes are also used in the International Maritime Dangerous Goods Code which was first adopted by IMO in 1965 and is updated annually. Although the main concern of Chapter VII and the IMDG Code is safety, many of the substances listed can also cause pollution and consequently its successful application benefits the marine environment as well as maritime safety.

Annex III of MARPOL 73/78 deals with pollution by harmful substances carried in packaged form. It applies to all ships carrying harmful substances in packaged forms, or in freight containers, portable tanks or road and rail tank wagons. The annex requires the issuing of detailed standards on packaging, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications, for preventing or minimizing pollution by harmful substances.

To help implement this requirement the IMDG Code will eventually incorporate these pollution prevention aspects.

(d) Sewage and garbage

These are covered by Annexes IV and V respectively of MARPOL 73/78.

Ships are not permitted to discharge sewage within four miles of the nearest land unless they have in operation an approved treatment plant. Between four and 12 miles from land sewage must be comminuted and disinfected before discharge.

As far as garbage is concerned, specific minimum distances have been set for the disposal of the principal types of garbage. Perhaps the most important feature of the Annex is the complete prohibition placed on the disposal of plastics into the sea.

Annexes III, IV and V of MARPOL 73/78 are optional and several countries which have ratified the convention have opted not to apply some or all of these annexes. As a result they are not yet in force.

(e) Dumping

The main instrument regulating the deliberate disposal of land-based

waste into the sea from ships is the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (The London Dumping Convention). This was adopted in 1972 at a conference convened by the United Kingdom and entered into force in 1975. Secretariat functions were then transferred to IMO. Meetings of Contracting Parties are normally held annually at IMO Headquarters.

The convention defines dumping as any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or man-made structures at sea, or the disposal of vessels, aircraft, platforms or man-made structures.

It bans or regulates the dumping of wastes depending on their danger to the environment. Among those whose dumping is banned (Annex I) are crude oil, mercury, cadmium, high-level radioactive wastes, plastics and some others. An addendum to Annex I of the Convention contains regulations for the control of incineration of wastes at sea.

Materials listed in Annex II require a special permit before they can be dumped. They include such substances as arsenic, lead, copper, fluoride, zinc, pesticides etc.

The dumping of all other wastes requires a prior general permit issues on the authority of a Contracting Party.

At the 7th Consultative Meeting of Contracting Parties held in 1983 a resolution was adopted calling for the suspension of the dumping at sea of radioactive materials (including low-level wastes) pending presentation of a report by a group of scientific experts. This report is expected to be considered at the 9th Consultative Meeting in 1985.

4. PREVENTING ACCIDENTAL POLLUTION

IMO's major function is to make shipping of all types safer, including tankers and chemical carriers. The measures incorporated in the numerous safety conventions and recommendations therefore apply to these as well as other ships - and the safer a ship is, the less likely is it to be involved in an accident.

The measures involve such matters as construction; equipment; navigational procedures; communications; and crew standards.

The most important of all conventions adopted by IMO is probably the International Convention for the Safety of Life at Sea (SOLAS). The first IMO version was adopted by the Organization in 1960 and came into force in 1965. An improved version adopted in 1974 came into force in May 1980, and its requirements have already been strengthened by a Protocol adopted at the 1978 Conference on Tanker Safety and Pollution Prevention (TSPP), which came into force in May 1981. Further amendments adopted in November 1981 entered into force in September 1984 while other amendments adopted in 1983 will enter into force on 1 July 1986.

Where appropriate, the convention includes special requirements for tankers. Fire safety provisions, for example, are much more stringent for tankers than ordinary dry cargo ships, since the danger of fire on board ships carrying oil and refined products is much greater.

It is not just fire which is dangerous to tankers - in certain circumstances a single spark can cause a disaster, for even tanks which contain no oil are filled with flammable gas which can explode unless proper procedures are followed. The normal method is to fill these tanks with inert gas, that is, a gas which is non-explosive. This is usually done by using the gas from the ship's boiler flue: it is cleaned and then pumped into the empty tanks, or into the spaces left above the oil in loaded tanks. An inert gas system is required on all new tankers and most existing tankers of 20,000 dwt and above, including combination carriers - that is, ships which are designed to carry oil or bulk cargoes, such as ores or grains.

The 1978 Tanker Safety and Pollution Prevention Conference led to the adoption of further measures designed to make tankers safer, which were incorporated in a Protocol to the 1974 SOLAS Convention.

All new crude oil carriers and product carriers of 20,000 dwt and above must be fitted with an inert gas system. So must all tankers which are fitted with a crude oil washing system.

The SOLAS Protocol also strengthens existing provisions concerned with equipment. All ships of 1,600 to 10,000 gross register tons (including tankers) must be fitted with radar, while larger vessels must have two radars, each capable of operating independently, so that if one breaks down the other can still be used. Steering gear control systems must also be duplicated on tankers of 10,000 grt and above.

Other safety conventions which are particularly relevant include the International Regulations for the Prevention of Collisions at Sea, 1972, which contain special provisions for ships such as tankers which, by virtue of their draught) have a reduced ability to manoeuvre: and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, several of whose requirements are designed specifically for those working on tankers.

5. REDUCING THE CONSEQUENCES OF POLLUTION

Other measures adopted by IMO are designed to limit the damage which can be caused to the marine environment following an accident.

In 1971 IMO adopted amendments to the 1954 Oil Pollution Convention which limit the size of tanks which can be installed on oil tankers. By making tanks smaller (the maximum size is 40,000 cubic metres) the amount of oil which can escape into the sea if the tank is damaged is correspondingly reduced. These requirements are also included in MARPOL 73/78.

MARPOL 73/78 also stipulates that new tankers must meet certain requirements regarding subdivision and stability, which are intended to ensure that, in any loading conditions, the ship can survive after being involved in a collision or stranding.

The 1978 MARPOL Protocol introduced a further element. This is the concept known as protective location of segregated ballast tanks. It means that the ballast tanks (which are empty on the cargo-carrying leg of the voyage and only loaded with water ballast for the return leg) are positioned where the impact of a collision or grounding is likely to be greatest. In this way the amount of cargo spilled after such an accident will be greatly reduced.

The Intervention Convention of 1969 is designed to enable Governments to take action when the threat occurs outside their territorial waters. Until the adoption of this convention there were considerable legal difficulties involved in taking such action, since countries have always been prevented from acting against ships of other countries operating on the high seas. It was widely recognized by Governments, however, that it was essential to act as soon as possible in the event of a major accident threatening pollution, and the convention was designed to enable them to do so.

But the adoption of internationally-agreed standards is only part of the battle. Legislation alone cannot prevent accidents occurring. For this reason IMO has initiated various procedures which are designed to help nations fight pollution if and when it takes place.

One step has been to prepare a comprehensive Manual on Oil Pollution designed for the use of Governments in preparing anti-pollution measures, which is periodically revised.

The Organization has also encouraged and assisted nations to establish emergency arrangements for dealing with oil pollution emergencies. The need for devising such procedures was stressed by the IMO Council as long ago as 1967 and in 1968 the Assembly adopted a Resolution concerning regional co-operation in dealing with significant spillages of oil.

Several regional plans have since been developed, including the Bonn Agreement of 1969 between various North Sea countries and the Manche Plan which is concerned with the English Channel.

In 1976 the United Nations Environment Programme organized a Conference of Mediterranean Governments which adopted a Protocol concerning co-operation in cases of emergency in combating pollution in the Mediterranean Sea by oil and other harmful substances. One result of this Protocol was the establishment in Malta of the first ever Regional Oil Combating Centre. UNEP has an overall co-ordinating role for the entire Mediterranean project, with IMO acting as executing agency for the Malta Centre.

Its purpose is to promote and integrate regional and national anti-pollution measures and ensure that assistance is provided where necessary. Another important task is to help governments carry out training programmes connected with the combating of oil pollution resulting from maritime incidents.

It is intended that this Centre will become the forerunner of similar projects in other parts of the world where oil pollution is a major threat: the Mediterranean is particularly vulnerable because of the land-locked nature of the sea and because exchange of water with the Atlantic Ocean takes so long. In 1983 governments participating in the Kuwait Action Plan established the Marine Emergencies Mutual Aid Centre (MEMAC) in Bahrain. Regional plans are also being developed in other areas, including the Red Sea and Gulf of Aden; the Caribbean; West and Central Africa; East Africa; East Asian Waters; the South East Pacific; the South West Pacific and South Asia.

6. COMPENSATION FOR POLLUTION

Although the prevention of marine pollution is IMO's primary concern, the Organization has also taken steps to ensure that adequate compensation is paid to those who suffer when pollution does occur. In the past, pollution incidents have had serious effects upon bird and marine life, including fisheries and shell-fish. Beaches have been heavily coated with oil with disastrous consequences for the tourist trade. And the cost of cleaning up oil spills has often run into many millions of pounds.

The purpose of the 1969 Civil Liability Convention is to put the onus of paying compensation on the shipowner. The 1971 Fund Convention extends additional liability to oil importers, who pay into a central Fund an amount which depends upon the amount of oil they import.

The joint system works in the following way: under the Civil Liability Convention, those affected by oil pollution are able to claim damages from the shipowner whose ship is judged to be responsible for the pollution. But the shipowner is able to limit the amount of compensation payable to about US $14.6 million or US $140 per ton of the tanker. This is so that he can obtain insurance cover: if there were no limit on the

amount of compensation payable, the shipowner would not be able to insure himself, and a major claim could prove financially disastrous. In practice, such a system would prove impracticable.

But it was recognized that the US $14.6 million limit could very well prove to be inadequate if the pollution incident were a major one. It was also felt that the oil importers should shoulder their share of the burden. Thanks to the creation of the International Oil Pollution Compensation Fund, victims of oil pollution can claim additional compensation, beyond the US $14.6 million payable under the Civil Liability Convention up to about US $47 million. Contributions to the Fund are paid by oil importers.

Since the two conventions were adopted, inflation and other factors have made even these sums inadequate to pay compensation in the event of a major disaster. In May 1984 the liability limits in the two conventions were increased.

Under the Protocol to the 1969 CLC ships up to 5,000 gt will be able to limit their liability to $3.12 million. For ships above that future the liability limit will increase in proportion to their tonnage to a maximum of $62 million for ships of 140,000 gt and above.

When the damage exceeds the limit of the shipowner the Fund Protocol will provide an additional source of compensation. The basic coverage (including the liability under the CLC Protocol) will limited to a maximum of $140 million (£101 million). But when the total quantities of contributing oil received in three Contracting States equals 600 million tons or more, the limit of compensation will be increased to a maximum of $208 million.

The 1984 conference also considered a draft convention on liability and compensation for incidents involving hazardous and noxious substances. In the event the issues proved so complex that the delegates were unable to come to a consensus and the draft was referred back to IMO for further consideration.

7. MORE EFFECTIVE IMPLEMENTATION

The measures introduced by IMO during the last 25 years have provided a framework for reducing marine pollution from ships. It could certainly be argued that if all of these measures were rigorously applied the problem would already have been virtually eliminated.

Unfortunately the problem is still with us and it is apparent that the most important requirement now is not to adopt new measures but to ensure that those which have already been adopted are implemented as rapidly and as effectively as possible.

The IMO Assembly - the Organization's governing body - has adopted a resolution which in effect calls for a slow-down in the adoption of new instruments and amendments to enable governments to concentrate on the more effective implementation of existing legislation.

IMO has taken steps to bring this about. The inspection and certification requirements contained in various conventions have been strengthened and further improvements are now being planned. These requirements, by enabling Government inspectors to carry out checks on vessels more frequently than in the past, help ensure that shipowners, crews and other parties actually do implement convention requirements. Provision is also being made for port states to take stronger measures against ships from other countries which are found guilty of infringing requirements.

IMO has also built up an effective programme of technical assistance which is designed to help governments enforce conventions and other instruments. For where shortcomings do exist it is not because of lack of will or support for IMO measures. Their value and need is recognized throughout the maritime community but many Governments, particularly in the developing world, do experience some difficulties in putting those requirements into force.

In many cases they lack financial resources. It is expensive setting up maritime training academies, which are needed to produce properly trained officers and crews. It also costs money to build reception

facilities for oil and other wastes. Other items also involve a great deal of expense.

An even greater problem is lack of expertise. However anxious a Government may be to implement IMO requirements, it is difficult for it to do so, even if finance is no problem, if it does not possess the trained and experienced manpower required. This applies on board, for ships are becoming more and more sophisticated every year and their operation requires even higher educational standards and experience. It is also true on shore, for an efficient fleet and maritime industry needs to be properly managed if it is to be successful - and safe.

IMO is helping to overcome these difficulties through its technical assistance programme, which now operates right round the world and is one of the fastest growing activities within the Organization.

The Organization has appointed a number of advisers and consultants in various fields, such as maritime training and marine pollution prevention, whose task is to assist Governments in implementing requirements.

Through the United Nations Development Programme and other sources, including donor countries, IMO also helps to provide financial assistance for individual projects - such as the establishment of maritime training academies, which is generally felt to be the best long-term solution to the shortage of skilled manpower.

Where proper training cannot be provided at home, IMO also helps to arrange for training to be given in centres in other countries, through its Fellowship programme. The Organization also advises Governments on the purchase of specialized equipment and helps to secure funding.

A major new development in this connection is the World Maritime University which was opened in Malmö, Sweden in 1983. Its aim is to provide high-level training for key administrators and others, primarily from developing countries. Marine pollution prevention is one of the subjects on the University syllabus.

8. THE IMPACT OF IMO MEASURES

It is difficult to state precisely how effective IMO's measures have been in reducing marine pollution. But the evidence does indicate that oil pollution is now less serious than it was a decade ago.

Ten years ago the United States National Academy of Sciences made its first estimate of the amount of oil entering the sea, using data relating to 1971. It showed that about 2 million tons of oil entered the sea that year as a result of marine transportation. The figures for 1980 quoted at the start of this paper indicate that there has been a considerable improvement since then, especially since the amount of oil carried by sea has increased in the meantime.

The improvement is even more marked if one considers what might have happened if no action had been taken to prevent oil pollution from ships. It has been estimated that as much as 8 to 10 million tons of oil would be entering the sea each year as a result of pumping oil-contaminated tank-cleaning and ballast water straight into the sea, without taking into account accidental pollution.

There are many reasons for this improvement. One is the greater use of load-on-top and latterly crude oil washing on tankers. These techniques, coupled with other measures adopted by IMO, have led to a great reduction in the amount of pollution caused by routine tanker operations such as tank cleaning.

Similarly, the increased availability of reception facilities in ports and improved cleaning techniques have led to a substantial reduction in the amount of oil emptied into the sea by ships going into dry dock (in the earlier NAS study it was estimated that in 1971 one half of tankers arrived for drydocking without tank washing residues).

The improvements achieved so far have resulted mainly from the reduction in operation pollution. But pollution resulting from accidents has also fallen sharply in recent years.

For the last few years the IMO Steering Group on Casualty Statistics has been preparing and analysing statistics on casualties involving tankers, chemical carriers and combination carriers (ships which are designed to carry oil or bulk cargoes such as ores). The statistics go back to 1968 and show that during this period the serious casualty rate per hundred tankers at risk has averaged 2.29 per year. In 1981 the rate rose to 2.84 per year but in 1982 fell to 1.84. This improvement was maintained in 1983 when the rate was 1.87 per cent.

Statistics from other sources support the view that the position is improving. The International Tanker Owners Pollution Federation reported that it dealt with eight oil spills in 1983 compared with five in 1981 and 1982, 12 in 1980 - and an average of 26 a year for the previous eight years.

There is reason to hope that this improvement can be maintained in the years to come as more stringent controls become internationally mandatory and implementation becomes more effective.

MARPOL 73/78 entered into force on 2 October 1983. It greatly strengthens measures to prevent oil pollution from ships and, for the first time, will introduce international controls concerning other forms of pollution. The annex dealing with pollution from chemicals - potentially the most dangerous pollutants of all - is expected to be implemented from 2 October 1986.

These measures will be further strengthened when the International Code for the Construction and Equipment of Ships Carring Dangerous Chemicals in Bulk (IBC Code) becomes mandatory on 1 July 1986, when the 1983 SOLAS amendments enter into force. In the near future the scope of the Code is likely to be widened to take pollution into account. This will ensure, for instance, that the chemicals posing the most serious pollution hazard will only be carried in chemical tankers equipped with the most stringent containment systems.

Amendments to SOLAS 1974 which were adopted in November 1981 entered into force in September 1984. They include measures to give even greater protection against fire and explosion.

Other measures will also have a beneficial effect. The STCW Convention entered into force on 30 April 1984. It is regarded by many as second in importance only to SOLAS as far as maritime safety is concerned and it is equally crucial to the success of anti-pollution measures, for despite all the technical advances of the last few decades the human element remains the most important component of all in shipping.

The outlook, then, is encouraging. The means for making further reductions in marine pollution from ships exist and are having an impact. But it would be a mistake to assume that the battle is already won. The measures so carefully worked out during the last two decades depend for their effectiveness on the way they are implemented. And that depends not just on IMO but on everybody concerned.