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SUSTAINABLE DEVELOPMENT FOR PORTS

Report by the UNCTAD secretariat

CONTENTS

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INTRODUCTION

1. For years, one of the major objectives of port managers has been to achieve both efficient economic performance and ecological sustainability, as well as social equity. However, it is only over the last decade that the international community has formally examined all these issues in a comprehensive and coherent manner.

The work of the United Nations

2. The World Commission on Environment and Development in its 1987 report, **Our Common Future**, defined sustainable development as development that "meets the needs of the present without compromising the ability of future generations to meet their own needs." Thus economic growth was linked to environmental protection. One of the main achievements of the United Nations Conference on Environment and Development (1992) may have been to reach agreement on the need to ensure that development takes place in a way that the environment is properly considered and protected. However, the same priorities are not allocated to environment protection and economic development in every country. There are cases where economic development problems are so acute that most efforts go towards dealing with them, although this cannot be interpreted as lack of interest in environmental protection. There are other cases where environmental problems are so acute that they also require total mobilization of efforts, although this cannot be interpreted as lack of interest in economic development. Environmental costs are also costs to be borne by someone. Development requires taking all costs into account. When appropriate measures to protect the environment are taken in the early stages of economic activities, their costs, which are not necessarily high, are usually more rapidly offset than later when accidents and other forms of environment deterioration begin to occur. In addition, developing countries should be aware that most international financial institutions, including the World Bank, have adopted policies to give financial support only to projects which will not cause severe or irreversible environment deterioration or contravene any international environmental agreement.

The work at UNCTAD

3. At UNCTAD's eighth session, the Conference recognized that the most important development challenges for the 1990s are the elimination of poverty and the acceleration of economic growth and social development on a long-term basis. The Conference also recognized the need for all countries to make economic growth and environmental protection mutually supportive. The Conference reaffirmed the need for UNCTAD's intergovernmental machinery and the secretariat to continue to integrate the concept of sustainable development and its environmental dimension into their respective programmes of work. The orientation relating to the environment and sustainable development should be guided by the following objectives, taking into account the work in other forums: (i) to contribute within its mandate to innovate thinking relative to the establishment of a framework for coexistence between environmental measures and international trade rules, thus aiming at preventing the use of environmental measures for protectionist purposes; (ii) to contribute to the exploration of all possibilities of providing developing countries with additional resources for environmental protection and development, notably through the improvement of existing financial

mechanisms such as the Global Environment Fund (GEF); (iii) to explore and promote policies aimed at generating, adapting and disseminating environmentally sound technologies; (iv) to foster the sound management of natural resources, taking into account the special conditions and development requirements of developing countries, through enhanced international cooperation, and to complement and support their national policies and efforts, respectively.

Consequently, UNCTAD is pursuing an extensive programme of research into the developmental implication of different methods of integrating environmental costs in decision-making. In the context of this particular paper, special reference can be made to the study "Fair Principles for Sustainable Development." 1/ It explores how formal principles which increasingly guide policies in this field, like the "polluter pays principle" can be applied with advantage to development policies.

Ports, environment and development

4. How is sustainable development linked to ports? Ports are strategically located at the interface of sea and land. They are busy commercial, industrial and transport nodes playing a key role in the economic development of their countries. However, there are risks of environmental deterioration to sea, land and air in most ports, resulting from possible accidents occurring in the port area, or even from the day-to-day port operations and port development activities: effluent and water discharge, garbage, noise, dust, maintenance, dredging, etc. In addition, most ports have fuelled the development of neighbouring cities, which in turn contribute to environmental deterioration: sewage, air pollution, traffic, noise ...

IMO legislation

5. IMO has developed a strategy for the protection of the marine environment, along with a Global Programme for the Protection of the Marine Environment, financially supported by a number of member States. This programme provides expertise and assistance to developing countries. The three main international conventions affecting ports, prepared under the auspices of IMO, are the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Dumping Convention - in force since 1975), which covers materials dredged from rivers and harbours, the Convention for the Prevention of Pollution from Ships (MARPOL 73/78 - in force since 1983), which covers facilities for receiving wastes in ports and the Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC90 - in force since 1990), which makes it mandatory for ports to have oil pollution emergency plans coordinated within a national contingency arrangement. In addition, IMO has developed activities and contributed to the preparation of international conventions, the implementation of which will contribute to the protection of the port environment, particularly in the following fields:

- Civil liabilities and compensation for oil-pollution damage.

- Construction modalities and maintaining, manning and operating ships.

- Transport, handling and storage of dangerous substances in port areas.

Ports and their neighbouring areas are dramatically affected by many of the maritime casualties causing severe damage to their environment. Therefore, they are directly concerned with the implementation of the norms set by these conventions.

6. **AGENDA 21 of the Rio Conference**, adopted by the Plenary at the United Nations Conference on Environment and Development (UNCED) in 1992, is a plan of action for the global community. Issues directly affecting ports are mainly to be found in chapter 17, which particularly concerns the protection and sustainable development of the marine and coastal environment and its resources. It includes, for instance, the following points:

- Preventative and precautionary approaches are to be applied in project planning and implementation, including prior environmental impact assessment and systematic observation of the impacts of major projects;

- Establishment of port reception facilities should be facilitated for the collection of oily and chemical residues and garbage from ships and promoting the establishment of smaller-scale facilities in marinas and fishing harbours;

- Development of contingency plans for oil and chemical spills, including provision of spill response material, training of personnel and, where necessary, establishing regional oil/chemical spill response centres;

- Make systematic observations to record the state of the marine environment;

- Conduct workshops on environmental aspects of port operation and development.

Legal and technical non-governmental organizations

The analytical studies and intergovernmental activities of United Nations organizations dealing with environment protection, and in particular the port environment, are benefiting from work carried out by the major international maritime and port associations, namely:

- CMI (Comité Maritime International), who in September 1992 organized a seminar on the various aspects of liabilities and "indemnification" relative to marine pollution.

- PIANC (Permanent International Association of Navigation Congress), whose next meeting in GDANSK (June 94) has included environmental issues in its agenda.

- IAPH (International Association of Ports and Harbours), which is particularly active in this field and has established a Subcommittee on Port, Ship, Safety and Environment and Construction (COPSSEC).

7. IAPH undertook a survey of member ports and asked them to rank various environmental concerns. From the 183 replies received, the main concerns for ports were dangerous materials, water pollution and dredging and dumping of dredging waste. IAPH has also prepared a draft charter on environmental policy for ports which includes seven points:

- drafting of an environmental impact analysis for port development;
- risk prevention for major accidents (vessel movement control, dangerous goods procedures, emergency plans);
- limiting of water pollution from ship, land and dredged materials;
- limiting of atmospheric pollution (dust, noise);
- limiting of waste and discharge through recovery, collection, recycling and supervised disposal areas;
- creation of quality areas (green spaces, screens, clean-up areas);
- working to create enforceable regulations against polluters.

The role of UNCTAD

8. What role can UNCTAD play in this domain? At the meeting of the Standing Committee on Developing Services Sectors dealing with shipping, held in November 1992, the Committee requested the UNCTAD secretariat to undertake a comparative analysis of the port sector and related policies in different countries, with a view to determining the factors which can contribute to better management, efficiency and **sustainable development** of ports and related port services.

9. The present study has been prepared to implement the mandate received. In order not to duplicate the work already carried out in this field, it has been decided to summarize and build on the technical work already carried out by other organizations and, in particular, the IAPH. By way of a supplement, an analysis of the issues involved will be made from an economic point of view. Chapter I will present the environment deterioration which may result from port development and operations. Chapter II will examine the economic aspects of environmental issues. Chapter III will provide guidelines on policies and strategies aiming to achieve sustainable development. In Chapter IV the conclusion will be presented. Chapter V will illustrate through a number of case studies how selected ports of different locations and sizes have taken steps to combine their economic development with the protection of their environment.

10. It is hoped that circulation of the present study will be of interest not only to governmental officials, port authorities and port operators of developing and developed countries, but also to port users or port partners:

consultancy firms, public-works firms, including dredging companies, and many other persons or organizations involved in transport and trade activities. In this way the study will contribute to a better understanding of sustainable-development issues, including a strengthening of environment protection in the port area.

In addition, it is expected that the continued efforts of the United Nations and other organizations involved in this field will lead to better and quicker results among these specialized bodies, as well as to an increased number of ratifications/adherences to the relevant international conventions.

CHAPTER I

TECHNICAL ISSUES IN THE ENVIRONMENTAL MANAGEMENT OF PORTS

11. Ports are nodal points where various modes of transport come together and where cargo is transferred from one transport mode to the other. In many ports the arriving cargo is not immediately transferred, but value is added to that cargo before it is transported to its final destination. This may involve refining in the case of crude oil, or the storage and blending of chemical products, etc. Storage and distribution also come under this heading, adding value in the port area. Value-added activities have a tendency to increase. The concentration of these various types of activities in a relative small area may pose a threat to environmental quality. The environment may be affected by day-to-day activities, incidents or accidents, and infrastructural activities linked to port expansion or infrastructural modification.

12. In this chapter, prepared in cooperation with the International Association of Ports and Harbours (IAPH), a presentation will be made of these technical issues. For this purpose, work carried out by the IAPH will be used. In effect, the IAPH, through its Subcommittee on Port, Ship, Safety and Environment and Construction (COPSSEC) has made an in-depth analysis of the corresponding issues. Guidelines have been set forth in "Environmental issues 1991-1992" and on "Environmental Planning and Management in Ports and Coastal Area Development (1989)."

13. Two of the numerous publications issued in this field which have been used for preparing this study, deserve to be quoted:

- "Environmental Considerations for Port and Harbour Developments" by the World Bank, Technical Paper No. 126/1990 by John D. Davis, Scott MacKnight, IMO staff and others.

- "Assessment of the Environmental Impact of Port Development" ESCAP publication prepared for the IMO/ESCAP seminar on "Environmentally-sound Port Development and Management" (31 August- 4 September 1992 Yokohama).

Environmental impact of port activities

In this section, the various types of structural operational or accidental pollutions of the water, soil, atmosphere and other components of the port environment will be examined.

A. Pollution from ships

14. Ship movements, for entering the port and berthing, present a potential danger. Ship collisions or groundings may have serious consequences in terms of obstructing other ships and their cargo, together with fuel oil or waste being discharged into the water. These type of accidents should be prevented at all times due to their potentially severe and unpredictable consequences, in some cases beyond the normal combating capacity of a port community. Vessel traffic management is an essential tool in this sense, but further details are beyond the scope of this document.

15. Under the "International Convention for the Prevention of Pollution from Ships of 1973 with Protocol of 1978" (MARPOL Convention 73/78), drawn up by the International Maritime Organization (IMO), ships are restricted with regard to waste discharge at sea. Five Annexes are attached to the MARPOL Convention dealing with the following wastes:

Annex 1 - OIL - (in force)
Annex 2 - Noxious liquid substances in bulk - (in force)
Annex 3 - Harmful substances in packaged form - (in force)
Annex 4 - Sewage (not yet in force)
Annex 5 - Garbage - (in force)

A sixth annex regarding noxious solid substances in bulk is under discussion. As a consequence, when a ship arrives in a port that has implemented the MARPOL Convention, its waste products must be discharged into a port reception facility. The most common waste products are dirty ballast water and residues from tanks which previously contained cargo, sludge from the filtering of fuel oil, oil-contaminated bilge water and household refuse (garbage). The financial consequences of discharge into a reception facility, or the fact that such facilities cannot be provided in the port, may tempt shipmasters to illegally discharge these substances in the port waters or at sea. As a result, soil and water pollution may occur, in severe cases leading to contamination of the port infrastructure (quay walls, slopes, etc.) which require expensive cleaning by specialized companies. Part of the contamination may dissolve in the water and part may become attached to silt particles. Since many ports need to regularly dredge their port basins and fairways to maintain sufficient depth, the result is that contaminated silt is dredged which can neither be dumped at sea nor used for infrastructural purposes on land. Costly storage depots appear to be the only answer at the time, since cleaning techniques, although available, are extremely expensive and only practical when small amounts are involved.

16. Accidental oil pollution dealt with by the "International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990" (OPRC 90), also drawn up by IMO. Parties are required to establish a national system for responding to oil pollution incidents and to ensure that authorities or operators in charge of sea ports and oil handling facilities, have oil pollution emergency plans or similar arrangements. The plans should be coordinated with the national systems.

17. The discharge of warm process water from ships may harm the aquatic life. Also the discharge of "clean" ballast water, i.e., ballast water which has not been in contact with any product or other substance, may cause unwanted effects due to the presence of pathogens and foreign organisms. There were cases where the bacteria in discharged "clean" ballast water had an adverse effect on the micro-biological ecosystem in the port of discharge. The discharge of sanitary waste is a less harmful activity since it concerns biodegradable components, although it should be prohibited in ports in order to avoid becoming a nuisance to the surrounding area.

18. Other sources of pollution generated by ships include exhaust-gas emissions to the air (auxiliary engines, boiler, etc.), noise from ship engines and emission of cargo vapours from tanks.

B. Pollution from cargo handling

1. Bulk cargoes

19. Bulk cargoes are usually transported in large ships requiring sufficient water depth. As a result handling of these cargoes takes place close to the port entrance, where this depth is available. A distinction should be made between dry and liquid bulk cargo, since the potential impact on the environment is different. Dry bulk cargo, such as grain, coal, ore, etc., may cause dust when it is being handled. Dust can be very detrimental to certain activities (e.g., commodities, cars, etc., stored in the vicinity) and can aggravate and cause health problems for the inhabitants of nearby living quarters. There are indications that dust from loading phosphates has damaged coral reefs. There appears to be a widely accepted principle that 1 per cent of a traffic flow is lost in the process of transportation from producer to end destination. Obviously, loss of product is most likely in those places where the product is physically stored and handled, e.g., in ports. Not only does this mean a loss in financial terms, it also means an environmental threat, since most of the lost product will end up in the port environment. The 1 per cent principle means that the parties concerned are not particularly concerned by this loss of product - it is an accepted course of events. Consequently, there will be little or no attention focused on the prevention of these types of events when the port authority does not require it. Considering the vast amounts of dry bulk products being shipped all over the world, 1 per cent represents an enormous amount. It is clear that abandoning acceptance of the 1 per cent principle should be advocated, thus contributing to the improvement of environmental conditions in ports. In many ports, the terminal operations of dry bulk products have applied technical measures to prevent dust emissions including sprinkling devices, spraying vehicles, verges around the terminal, etc.

20. Liquid bulk products are usually petroleum derivatives, and may vary from crude oil to chemical products. Petroleum products have varying properties, but most of them are flammable and toxic to humans. Virtually all petroleum products are harmful to the environment when released. However, when handled properly, release should be rare and consequently the effect on the environment will be nil to minimal. The only effect worth mentioning is the emission of cargo vapours from tanks when products are transferred from one containment area to another.

21. A more serious threat to the environment concerns operational incidents during cargo handling, resulting in release of product. This may be due to the rupture of a connection hose or pipeline, the bursting of a valve or manifold or the failure of the coupling between ship and shore. Due to the high pumping rates, the amounts which are released in these incidents can be considerable. Depending on the time elapsed before the failure is noticed, action taken and valves closed, several hundred cubic meters of product may be spilled. The minimal amount of released product can be estimated by determining the amount that is pumped in a period of two minutes. (Taking into account a minimum personnel reaction time of 30 seconds, it will then take another 90 seconds for all valves to be closed.) When handling a product at a rate of 100 m^3 per hour, the amount released, in case of rupture of the ship-shore connection, could easily be over 3,000 litres. Apart from the pollution entailed by these types of incidents, they cause an additional risk

in terms of immediate danger to health and/or risk of fire and explosion in the vicinity of the spilled product. The size of the threatened area may obviously vary with the properties of the product handled; distances of 100 metres and more from the spill should be reckoned with. Another consequence of a spill is usually the smell of the product. Most products have an irritating smell, even at extremely small concentrations. This means that over large distances downwind from the site of the spill, people will be confronted with its odorous consequences. Although the danger is usually limited to the area near the spill, the effect of the bad smell can be very disturbing and frightening to the general public. Moreover, the visual effect of spills (e.g., oil washed ashore), not to mention the effect on small animals or seabirds, should be considered. Again, the relation between the port and residents of the surrounding city may consequently deteriorate. Such an incident involving a crude oil carrier discharging at a rate exceeding 5,000 tonnes per hour would release a considerably larger quantity of more persistent oil, requiring extensive clean-up operations over a wider area.

2. General cargo

22. The term "general cargo" comprises all cargo not shipped in bulk. In the context of this paper it ranges from breakbulk to unitized cargo. The typical incident that may happen with this type of cargo is an accident during handling of the individual packaging. The causes of this type of incident may be manifold. They vary from negligence on the part of personnel to lack of knowledge and training (even in developed ports). The most common accidents to commodities are falls from cranes and damage by the forks of a forklift truck. When a product container is perforated, the product is spilled. The effects are generally simple to rectify when it concerns dry products. However, when liquids such as chemical products are concerned, the effects can be very disturbing. Flammable products will evaporate and may be ignited, causing a fire or even an explosion.

23. Residue disposal problems can also arise in the event that containerized packages of hazardous substances break free and are damaged in transit. Terminals should be provided with decontamination facilities where cargo residues, damaged packages and harmful spillages can be dealt with under environmentally controlled conditions. These toxic products are a threat to the health and safety of port workers and, depending on the level of toxicity, to people further away. Apart from the danger to health in the vicinity, the released product may penetrate into the soil, causing soil pollution which is costly to rectify. Hosing the product into the drain may create problems in the water-purification system. If there is no such system, the sea may be polluted. The presence of volatile product in sewer systems may also create a safety hazard. Flammable vapours in an enclosed space, such as a sewer pipe, may travel over considerable distances and be ignited at places far away from the original location of spillage. The consequences of such an explosion may easily include fatalities. The possible effects in terms of dust or smell are obvious. Most of the time these are not harmful to surroundings, only an inconvenience.

24. Since general cargo, except containers, is generally transported in smaller ships than bulk cargoes, the required water depth is also less. Consequently, general cargo handling can take place further inland, often in closer proximity to built-up areas. This is even more so when the port has a

long history and has developed over the years into an industrial complex. In such cases, the distance to built-up areas will be relatively small, and even moderate releases from incidents could have a detrimental effect on those who live in these areas. The first generation who went to live in the port vicinity was less informed on environmental matters and therefore less likely to complain about these disturbances than their descendants.

25. The general cargo sector uses pallets, drums and a wide variety of other packaging materials. Depending on the activities taking place in the port area, a certain amount of this material turns into waste. This mix of paper, plastic and timber can create an environmental problem if not treated properly.

26. A side effect from general cargo handling is the traffic it generates. Other than with bulk cargoes, which are generally transported by pipeline, train or inland barges, general cargo is mainly transported by road, rail and to a certain extent by barge. Up till now, road transportation, through its flexible capability of reaching many destinations in the hinterland, seems to be the preferred mode of transport. Road transport causes a number of environmental effects. It requires infrastructure, which means the loss of natural countryside. It causes noise and air pollution as a result of emitted exhaust gases, principally CO_2. Energy consumption by various modes of transport is bound to receive more attention as Governments strive to stabilize CO_2 emissions. Where leaded fuel is used, mostly in passenger cars, pollution of the soil near the roads with lead compounds may occur. In case this land is used to allow cows to graze, lead may turn up in the milk and cause a potential health problem. A well-known effect of road transport is its tendency to cause congestion in the port area, especially during those periods of the day when the workforce goes to work or returns home.

C. Pollution from storage

1. Bulk products

27. Liquid bulk products are stored in tanks, of special design when it concerns liquid gases. However, the majority are ordinary tanks in which the product is stored under atmospheric pressure. The use of floating roofs, which prevents or at least diminishes the emission of product vapours, is not yet common practice. In such cases, product vapour emissions may take place as a result of variations in temperature during the day and night, the so-called breathing of a tank. Maintenance of tanks is crucial, since tiny leaks may otherwise remain undetected for a long time, causing soil pollution. The same applies to pipeline systems. If not properly checked and maintained, leakage remains undetected, especially when lines are underground. Leakage may also occur at pipe or tank connections, e.g. by leaking flanges or inadequate seals. In view of the nature of most liquid products, flammable and/or toxic, the risk of fire cannot be excluded, especially where leakage occurs. During "favourable" weather conditions, no wind and a stable atmosphere, vapours may gather in low-lying places. A simple cigarette butt may trigger a vapour-cloud explosion with an unpredictable domino effect.

28. The storage of dry bulk products takes place in the open air unless otherwise determined by the nature of the product (e.g. cement, sugar and fertilizer). This type of storage affects the environment mainly through dust

and to a smaller extent smell. The dust may cause soil pollution (ore), deteriorate commodities or equipment stored downwind in the open air; when blown into the water, contamination of the seabed and its sediments may result.

2. General cargo

29. General cargo may be stored in sheds or in the open air. The risks to these types of storage are different. With long-term storage in a shed, small leaks as a result of damaged packagings may remain unnoticed during prolonged periods. By the time these leaks are eventually discovered, the product may have penetrated the underlying soil, with resultant soil pollution. Dangerous situations may arise in the case of flammable products: vapour clouds may be formed whose accidental ignition may cause fire and explosion which are extremely difficult to control. In short, long-term storage bears a remote risk of severe harmful effects.

30. Open-air storage is utilized when the cargo is not affected by the climate and is awaiting onward transportation. This type of storage is characterized by the fact that the cargo is handled relatively often in a short period. The accompanying risk is mainly determined by the probability that during these handling operations (in or out of the ship, across the quay, etc.) damage will occur due to faulty handling. The effects of these types of incidents - soil and/or contamination of water or sewer - may be diminished if immediate action is taken. This is logical, because the incident happens when the cargo is physically handled and people are present who can take immediate countermeasures. Particular attention is required for products which become unstable when their temperature increases. These should be stored out of direct sunlight.

D. Pollution from port maintenance

31. Like every piece of equipment, a port and its infrastructure, as well as the superstructure, needs to be well maintained. This process itself bears the risk of pollution or nuisance as a result of these activities which have to be carried out in the open. In the following paragraphs, some typical examples will be given.

1. Maintenance dredging

32. Dredging is an essential activity in many ports, especially in those which are situated at the estuary of a river whose silt is carried downstream, then settles in the port basin. Also as a result of tidal movements, material from the sea bottom is flushed into the port and settles in the basin. Consequently, the water depth decreases and may reach a level that is insufficient for the ships calling at the port - dredging is necessary to correct this situation. Dredging will provide material for transportation and disposal. When the dredged material is of a suitable nature, such as clean granular material, it may be used for reclamation or other civil-engineering purposes. When there is a surplus of clean granular dredged material or due to its composition (e.g. due to its silt or clay content) it is not suitable for use, it will frequently have to be deposited at sea. If disposal at sea is an option, the deposit site must be carefully selected to minimize the environmental impact. Fine-grained materials may give rise to turbidity. If

the silt has become polluted as a result of structural discharges (industry) or accidental spillage (industry and shipping), then the dredged material poses a potential threat to the environment. The dredging operation itself may produce water turbidity due the suspension of small particles that spread far beyond the actual dredging site. In this case, the pollution may be "exported" to areas which were clean before the dredging operation started. Thus the need to control turbidity during dredging operations. Dredged spoil above very low contamination levels may not be discharged at sea, leaving storage on land as the only alternative. If no protective measures are taken, this can cause pollution of soil and ground water due to the leaching out of the silt by precipitation.

2. Maintenance of suprastructure and equipment

33. Bridges and cranes need to be regularly cleaned and repainted. The usual work method is gritblasting and spray-painting, both of which can cause pollution. Gritblasting uses small grit particles which are sprayed under high pressure. Paint particles are released together with the actual grit material, which may either pollute the water and consequently the silt or the soil. When spray-painting, the paint that misses the object falls into the water or onto the soil causing local pollution with evaporating solvents ending up as emissions to the air. The various types of preventive and repair maintenance of port equipment is often done in workshops located in the port area. This generates noise and is a potential source of accidents such as explosions, etc. Workshop soil is often polluted by grease and oil.

3. Maintenance and repair of ships

34. The maintenance of ships carried out in a dry dock or alongside a quay provides similar risks of pollution as described above. With tankers, there are additional risks due to the possible presence of flammable or toxic substances in the tanks. This may either lead to water pollution when released or even to explosions if hot work (welding, grinding, etc.) is carried out on tanks which are not gas free. Tributyl tin (TBT) is used on marine paints because of its anti-fouling properties. It is extremely toxic to marine life and stringent precautions should be taken in dry docks, etc., to contain and prevent TBT paint particles from polluting the marine environment.

4. Maintenance and repair of industrial plants

35. The maintenance of industrial plants bears similar environmental risks as described above. Moreover, when chemical plants are involved there is always the remote risk of fire or explosion due to unexpected events or careless behaviour.

E. Pollution from port development

36. Ports strive for more business; if successful they need to expand their facilities to accommodate the extra flow of traffic. Trends in shipping and cargo handling may also call for modifications of the port infrastructure. The change of a port from a simple transfer point, where cargo is transferred from one mode of transport to another, to a complex nodal point in logistic chains have led to new requirements in the port infrastructure layout. These

civil works, such as deepening of access channels, new building or lengthening of quays, construction of container storage and handling areas, or the constructions of wave-protection structures may affect natural features and lead to the destruction of some parts of the natural environment. Sites so far untouched by commerce or industry may have to be developed to provide the necessary space. Breeding grounds for fish or other valuable marine life may be disturbed and the local marine ecosystem unsettled. The infrastructural changes may result in changes in wave and current patterns, as well as sediment transport. This may affect the natural regime and marine life. In many cases, harbour works cause sheltering of the neighbouring coast from wave action and tidal currents. This may result in the creation of slowly moving eddies which tend to retain fine sediments and pollutants. This may render beaches unpleasant or even unsafe for recreational use.

F. Pollution from port industrialization

37. The previous paragraphs referred to possible environmental effects of industrialized activities located in the port area (dust, noise, etc.). The effects may vary depending on the sort of activity; however, every industrial activity produces environmental risks. Mention should be made of the risk of soil pollution due to inadvertent spillage of compounds. Soil pollution can result in pollution of ground water, especially when the soil is porous, allowing pollution to migrate quickly to lower soil layers. When this water travels underground to locations that supply drinking water, there may even be a risk to human health.

38. Apart from soil pollution, air pollution can be another by-product of industrialization. In spite of the use of new technology, emissions will occur; and although they may have no immediate effect on the immediate surroundings, they will add to the global amount of pollutants in the air. Most industrial processes use water, either as an element of the production chain or for cooling purposes. Process water, if not adequately cleaned in a water-treatment plant, can cause considerable pollution of the surface water, to the detriment of marine life. European rivers (the Rhine, Meuse, etc.) are examples which despite tremendous efforts, show that even modern industries have problems in producing sufficiently clean effluents.

39. The last but certainly not the least environmental effect of industrial activities is noise. Noise is not comparable with other types of pollution that are capable of creating irreversible negative effects on the environment. Noise has a disturbing effect on humans and will spoil the pleasant side of daily life, leading to stress and its consequences. Where industry is located close to living quarters, complaints are bound to arise.

G. Pollution generated at the port city interface

40. The interface between the port and the city is the area where the influences of both activities are most prominent. The influence of these activities can be felt, thus the harmful effects of both are cumulative. If the interface area is built up and inhabited, unwanted or even unacceptable situations may result. Noise levels, although acceptable when considered separately, may exceed permissible limits when added up. Emissions to the air from the city, mostly traffic, combined with those of nearby industrial activities may lead to concentrations which are above generally accepted

limits. Although not an environmental issue in the clear sense of the word, safety is nevertheless relevant to the city/port interface. If distances between industrial port activities and people living in this interface area are short, there is a chance that these industrial activities - being acceptable for an industrial area - will be unwanted or even unacceptable for residential areas. In general, built-up areas between city centres and industrial port activities are in most cases subject to exposure levels which are at the least undesirable.

41. Annex 1 presents a check-list issued by the Asian Development Bank of environmental parameters for ports and harbour projects, with an indication of environmental damages to as well as recommended protection measures. Annex 2 contains the World Bank's check list of environmental impacts for port and harbour projects.

CHAPTER II

ECONOMIC ASPECTS OF ENVIRONMENTAL ISSUES

42. As seen in the previous analysis, there are significant economic implications to activities related to environmental protection. One may argue that the threat to the environment generally comes from the development of economic production; since environmental protection measures always have a cost, the more ports managers invest in environmental protection, the less will be left for the economic development of their port. This is often the main reason why some ports managers, particularly in countries where the resources are very scarce, or environmental deterioration not yet apparent, are reluctant to invest in environmental protection. However, the basic requirement is that the environment be in an acceptable state (i.e. acceptable by those who are affected by it). How costs are allocated between the port authority, the port users and operators, the people living in the vicinity and the national Government, needs to be worked out in light of each party's intentions. There is no reason for the port authority to pay more than its share.

A. Environmental costs

43. Common economic principles apply to environmental protection activities. Measures to protect the environment have a cost. However, the benefits accruing from these measures, if carefully identified, can offset the corresponding costs. In the short run, this is not always easy to achieve. But in the long run, when the environment is protected there are less accidents and pollution and the benefits thus obtained generate sustainability. In this section, an overview will be presented of certain environmental costs - either costs of environment deterioration or of measures taken to protect the environment. The coverage is neither exhaustive nor are the figures presented relevant to all ports. In fact, most of this information has been communicated by large European ports that the secretariat had the opportunity to visit. The figures given are specific to the ports described; and costs for similar activities may be different in other ports.

1. Costs of environmental deterioration

(a) Nature and scope of environmental deterioration costs

44. The costs of environmental deterioration can be classified according to several criteria. First, there are costs corresponding to deterioration which cannot be remedied (e.g. loss of life, commodities, equipment, etc.), and costs corresponding to deterioration which can be reversed (polluted water, soil, etc.). Then there are direct costs, which include the cost of material and goods damaged, time costs when economic activities have been stopped, and indirect costs, such as damage of commercial reputation, bad image of the port, loss of traffic, etc. There are also the costs of deterioration itself, (human and material losses) and the costs necessary to revert to the original state: cleaning-up costs, etc. Finally, there are immediate costs and the costs generated over time, when no action is taken to remedy the deteriorating pollution. In fact, immediate costs generally increase over time. Environmental deterioration is generated by various factors (industries, operators, users) in various areas (land, access channel, etc). The pollution

may occur in the immediate area or extend into the neighbouring area (air, water, soil, etc.). Therefore, the nature and scope of environmental deterioration costs are directly linked to the environment components affected: air, water, soil, etc.

45. **Air environmental deterioration** is attributable to smoke, dust, gases and offensive odours. The range of environmental deterioration costs depends on the wind characteristics and the type of pollution (quantity of particles produced). This type of pollution rises with the increased interest in second-generation ports (with industrialized areas), especially in countries where legislation to prohibit polluting industries has not yet been developed. It is possible to quantify the air deterioration. For instance, SO_2 and NO_2 indicators are used to measure the degree of air deterioration. There are very simple devices to measure these indicators as well as the quantity of dust particles in the air. Data have to be collected on a long-term basis to eliminate bias such as seasonal changes. Therefore, the degree of environmental deterioration of the atmosphere can be estimated. However, quantification in monetary terms of the corresponding direct and indirect costs is generally very difficult. When dust is covering commodities, vehicles, etc., stored in the open air, or vegetables growing in areas neighbouring the port, the cost of cleaning up (whenever feasible) or the replacement cost of the goods lost can be estimated.

46. **Water environmental deterioration** is a major source of environmental problems at ports. The source of water pollution can be divided into two main categories according to whether it originates from land-based installations or from ships and cargo handling. Some land-based installations produce effluents which contain contaminating substances. These effluents, even when purified, still contain some contaminants because cleaning installations cannot remove all of them. As a rough estimate, the cost of an average purification installation for a medium-size city is approximately US$ 30 per inhabitant (i.e. the average amount of contaminated water produced per capita). Ships and cargo handling may represent yet another hazard. Ships produce waste products when being operated. The Marpol Convention (The International Convention for the Pollution from Ships of 1973 with Protocol of 1978, MARPOL 73/78) has made it much more difficult for ships to dispose of these wastes at sea. Consequently, ships must discharge their waste in ports, where port reception facilities should be available. It is important that waste products from ships not be mixed, because this makes further treatment much more difficult and costly. Bunker oil spills are frequent mishaps in ports, at a substantial cost. The moderate spill of several cubic metres into water will cost approximately US$ 7,000 in a European port to clean up (remove from the water by mechanical means). Chemical spills can be even more harmful, either since their properties may cause a dangerous situation (hazard to health due to toxic vapours, or fire/explosion hazard due to flammable vapours) as well as environmental pollution. Their toxic properties may cause additional problems when trying to remove them from the water surface. Water soluble chemicals, as a result of that property, cannot be removed and thus remain in the aquatic system.

47. Water pollution has an immediate effect on the quality of the silt. Depending on the level of contamination, dredging raises the problem of disposing of the polluted dredged material. Storage in special depots is expensive and has physical limits. The present cost of cleaning contaminated

silt in Europe is approximately US$ 50 per metric ton. A large river port in Western Europe has to cope with two million cubic metres of contaminated silt each year. There are indicators to measure the degree of water pollution, mainly with regard to oil, suspended solids, heavy metal and pesticides, dissolved oxygen, concentration of hydrogen sulphide with temperature, etc. As an example of the cost of restoring water quality, the case of the Kitakyushu Port - Dokai Bay (Japan) is worth mentioning. A survey conducted by the Environmental Agency in 1971 found the following concentration of polluted materials in sludge from the bay (the figures in brackets are the criteria for harmful bottom sediments in Japan, Environmental Agency, 1990):

cadmium (Cd)	468 ppm	(0.1 ppm)
lead (Pb)	1,869 ppm	(1.0 ppm)
cyanogen (CN)	30 ppm	(1.0 ppm)
arsenic (As)	395 ppm	(0.5 ppm)
chromium (Cr)	917 ppm	(0.5 ppm)
copper (Cu)	995 ppm	(3.0 ppm)
total mercury (T-Hg)	29.5 ppm	(0.005 ppm)
phosphorus (P)	5.9 ppm	(1.0 ppm)

Restoration of water quality was coordinated by the city through the Dokai Bay Clean-Up Project, a three-pronged attack that sought to control industrial effluents, to control household effluents and to dredge polluted sludge. The amount of sludge to be dredged was 350,000 cubic metres at an approximate cost of US$ 6 million (in 1972 prices). A special treatment pond was prepared for the dredged sludge, which was then covered with sand. As a result of the project, water quality in the bay has improved considerably - COD went from 38 ppm in 1970 to 3.6 ppm in 1991. Fish and shell fish have returned to the bay. In order to have a full picture of the cost of water environmental deterioration, it is also necessary to take into account the modification caused by the construction of port facilities on coastal hydrology, including tidal changes, current speed and direction, etc., as they affect sediment transport. In one African country, the creation of a port altered this sediment transport regime to the point where the access of a neighbouring lagoon to the sea was almost closed, to the detriment of the bio-regime of fish and shrimp which were the main livelihood of the local population. Losses were huge. It was decided to build an expensive dam to re-establish the original water communication between the lagoon and the sea. Such an investment represented the cost incurred for the area to revert to its original state.

48. **Soil environment deterioration** is another possible effect of industrial port activities. Apart from the apparent accidents which impregnate the soil with polluting substances, unnoticed pollution caused by operational processes presents a serious risk. The amount of environmental damage will depend on the composition of the soil. Rocky and clay type soil will have a tendency to prevent the pollution from spreading; however, sandy soil will allow contaminants to migrate at high speed both horizontally and vertically. The cleaning of contaminated soil is a complex procedure, even more complicated and costly when buildings and other infrastructure components are present. There are also indicators to measure the degree of soil and bottom contamination (heavy metals, harmful substances, etc). In order to establish the need for a cleaning operation for a suspect piece of land, a so-called nil-study is required. This study, which involves soil sampling and

laboratory tests, will indicate whether pollutants are present. If this is the case, a full-scale study is necessary to precisely locate the polluted areas, their size and depth, etc. The cost of a nil-study varies with the size of the area. In western Europe, it may range between US$ 8,000 for a maximum area of 1 hectare to US$ 40,000 for an area of 20 hectares. The full-scale study is more expensive, from US$ 12,000 to US$ 120,000 for the same range of areas (1-20 hectares). Typical cost figures for actual cleaning activities in Europe are as follows: excavating to a maximum of 4 metres, additional cleaning or dumping US$ 140-195 per M^3; excavating over 4 metres deep, additional cleaning or dumping US$ 170-250 per M^3; on-site cleaning US$ 85-140 per M^3.

(b) Measurements of costs

49. A distinction has to be made between accidental and structural costs. **Accidental costs** are the costs related to accidents which may occur at any time. These are unwanted harmful events which can have very serious consequences on the environment of the port area and therefore on its activities and economic life. Fires, explosions, major spillages, etc., are examples of these accidents. It is more difficult to evaluate the costs of accidents, for they rarely occur. This is why it is even more difficult to convince port managers to take action and allocate resources against these "possible" damages. The number of accidents may be small, but the damage in the long term can be very great. The risks are thus huge. This kind of accident can temporarily paralyse port operations and cause tremendous economic losses.

Structural costs are other costs of environmental deterioration which occur constantly with daily operation. These are events which may have minor direct consequences when taken individually; when they occur constantly, however, they become as dangerous as the occasional big accident. Examples of structural costs include dust generated by bulk terminals, smoke generated by industrial plants, etc.

The total deterioration costs are therefore the accidental and structural costs incurred during a certain period of time (e.g. one year, or throughout the life of protection measures)

(c) Risks

50. An examination of the economic consequences of environmental deterioration cannot be made without analysing the risks linked to the environmental deterioration. Risks are composed of two factors: probability or frequency, and effects or consequences. The analysis of risks is a measurement and combination of these two elements.

Frequency - it is generally very difficult to estimate accurately the probability of accidents in ports. This is not only because of the complexity of the port operation, but also because of the constantly changing sources of accidents, such as ships, vehicles, commodities, etc. Nevertheless, based on the past experience of the port and that of other ports with similar activities and geographical characteristics, a rough frequency rate can be worked out in relation to some particular accidents.

Consequences - There are cases where the harmful consequences of an accident can be quantified in monetary terms. However, there are other cases where these consequences cannot be quantified other than by ranking them according to a stair-step scale based on past experiences. It is neither possible nor advisable to establish international standards of possible consequences for each kind of accident, since the effect will vary greatly from port to port according to the particular physical features and situation of the port. Each port can make its own judgement accordingly.

Level of risk: The degree or level of risk is a combination of the above two accident factors. It is possible that a minor accident, albeit one with a high level of probability of happening has the same degree of harmfulness as an accident which rarely happens but has very great effect when it does. To simplify the analysis, the level of risk can be expressed by the figure obtained when multiplying the level of frequency by the magnitude of pollution/deterioration.

LEVEL OF RISK = FREQUENCY x MAGNITUDE OF POLLUTION

2. Cost of protecting the environment

(a) Nature and scope of environmental-protection costs

51. Protection against environmental deterioration involves various actions ranking from very simple legal measures to investing in huge programmes. All these actions have a cost. Therefore environmental protection of these costs can be defined as "the costs and consequences of all actions taken to protect the port against environmental deterioration". These costs can also be divided into direct and indirect costs. Direct costs are mainly human and capital investments which include personnel recruiting and training, infrastructure building and equipment purchasing, operating and maintenance, the creation of laws and regulations, etc. Indirect costs result from protective measures such as delays in port activities and traffic and productivity zones, because of environmental-protection requirements, or commercial loss, additional expenditure or time delay resulting from environmental protection, legislation and regulations. There are countries where the environmental clearance process of major port investments have delayed economic development of the port for several years. It should be noted that international norms or recommendations allow some of the costs to be borne by port users rather than by the port authority. The "polluter pays" principle states that the polluter should in principle bear the costs of pollution prevention and clean-up as determined by the public authorities, reaffirmed by the Rio declaration (Principle 16). The same categorization applies for the costs of environmental deterioration.

52. Water environmental protection requires equipping the port with specialized boats and devices. In one European port, an investment of US$ 1 million was made over a two-year period to acquire specific devices for controlling water pollution. A major port in Australia has invested US$ 1.9 million to acquire three cleaning units, one harbour-cleaning vessel and beach-cleaning vehicles. The harbour-cleaning service costs US$ 0.2 million per year to operate. In one European port, since the contaminated silt could neither be used on land for reclamation, nor dumped at sea, a large storage depot was built with a capacity of 150 million

cubic metres to accommodate the 10 million cubic metres of polluted silt dredged out every year. Reception facilities for ship waste are required to comply with the MARPOL Convention. The same type of facilities can receive waste generated on shore. These installations would include a tank park and specific facilities for separating different types of waste pending further treatment. Experience has shown that the cost of providing such a station is small although operating costs are high. An agreement should be reached between the port authority and port users on how these costs are to be shared.

53. Air environmental protection may take various forms. Apart from the installation of equipment capable of filtering the polluted industrial smoke in port areas, the measures taken to eliminate dust resulting from the storage and handling of bulk goods are one of the major protective actions, especially when the port is located close to residential areas. Coal for example, is stored in the open air in piles. Air pollution is caused by the wind which dries the particles, sweeps them away and deposits them elsewhere. In this case, measures should be taken to keep the coal wet, i.e. to install sprinkling devices or to provide vehicles equipped with spraying devices, etc. The effect of the wind can be reduced by constructing verges around the terminal. Some quick-growing, large-leafed trees, such as poplar can also be planted. In case of long-term storage, the coal piles can be sprayed with special products. As far as the handling of dust-creating cargo is concerned, a number of mechanical appliances may be used to reduce the generation of dust. If the conveyor belt is used, it is advisable to cover the belt. The cost of this equipment or measures can generally be quantified. Equipment costs and operating costs include maintenance. Terminals handling volatile chemicals in bulk can be equipped with vapour return systems, for which IMO has drawn up guidelines.

B. Benefits of environmental protection

54. Since most environmental-deterioration costs originate from accidents occurring in the port area, the corresponding issues should be analysed in terms of risk coverage as is done in the field of insurance. Ports cannot afford to wait for accidents to happen. The logic of insurance is to pay a smaller cost to avoid suffering from an eventual bigger cost relating to an accident. Knowing the effects, consequences and probable frequency, a corresponding degree of risk can be estimated for each kind of environmental deterioration. Covering risks implies taking corresponding measures of environmental protection. When there are no commercial insurance companies willing to cover environmental-deterioration risks, then the port has to be its own insurer. While the normal method of insurance involves spreading risks over a large number of insured parties, each paying a relatively small amount of money to cover bigger risks over a short period of time, the only way for the port to cover its own risks is to spread the costs over a relatively long period of time.

55. Most protection measures have a cost. One principle should apply when taking the decision: the protection costs (A_2), including investments and operation costs, should always be less than total deterioration costs (A_1). In other words, the amount paid to cover a cost should never be bigger than the cost itself. If an activity in the port (for example, traffic) bears a big environmental risk (cost C) and if in protecting itself against this risk the port would end up paying more than cost C, then the port should give up

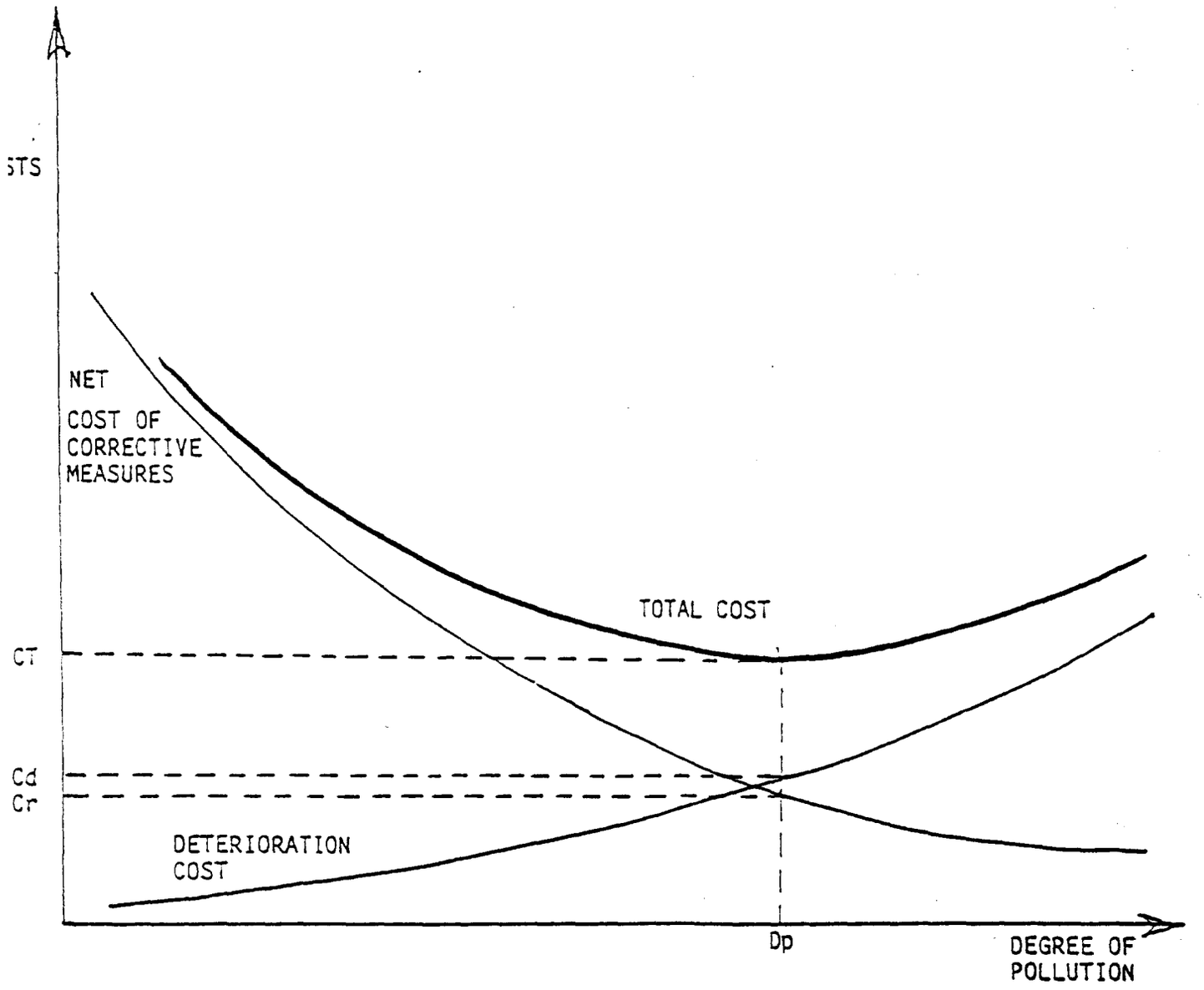
this activity rather than pay the protection cost. The major benefits that can be drawn from environmental protection stem from the fact that by spending a relatively small amount of money on environmental prevention and protection, the port can avoid a much bigger loss caused by environmental deterioration. It should be remembered that in some cases costs can be covered by charges.

56. The various measures taken to protect the environment do not have the same cost efficiency. There are very simple low-cost measures, such as adopting regulations in conformity with international standards, which can prevent major deterioration. Other measures are sometimes expensive to take, for instance buying specialized equipment or launches. However, their costs are amortized over several years, during which the protection is ensured. If A_1 is the deterioration cost which has been avoided, and A_2 the protection cost, the following formula is worth considering since it shows the degree of protection cost efficiency (coefficient α)

$$\alpha = A_2/A_1$$

Since almost all environmental protection action should be taken by the port community itself, it is very important to know the major economic features of the various protection measures. This includes the following question: How many resources are required for each of the protection measures and what is the impact of such measures on the environment, or what is the effectiveness of the different measures? The above equation can, in this sense, serve as a tool for the relevant decision-making process.

57. The more one strives for "zero pollution", the more expensive it becomes. Therefore, for every pollution situation, there is an optimum point for the corrective measures to be taken. Up to this optimum, the benefits to be expected from the measures taken are worth the corresponding costs. Beyond such an optimum, the measures become more and more sophisticated and expensive and the efforts made to come back to a "zero pollution" situation are disproportionate to the additional benefits obtained. In each country/port, the authority should define such an "acceptable degree" of pollution, and in particular they should determine the "acceptable" standards of pollutants in the air, soil and water. In the following graph, calculated for one type of pollution, three curves are shown. Two represent the total deterioration costs, and the total cost of corrective measures ("clean-up" costs). The third curve is the total of the two other costs. The optimum is reached when the total cost is minimum (Ct). This corresponds to an acceptable degree of pollution (Dp), for which the cost of corrective measure is Cr and the total deterioration cost is Cd. This graph takes no account of an important element: revenue. In so far as it is possible to charge users or polluters, revenue will be generated and will affect the cost curves. Firstly, the net cost of corrective measures is reduced, and secondly, charges may encourage users generating pollution to adopt different methods with lower deterioration costs.


COSTS
NET
COST OF
CORRECTIVE
MEASURES
TOTAL COST
CT
Cd
Cr
DETERIORATION
COST
Dp
DEGREE OF
POLLUTION

C. To find the balance

58. In order to decide between measures to protect the environment within the port area, it is suggested that the following approach be adopted which is illustrated by the following table. First, all possible environmental deteriorations should be listed under two headings, "Accidental", or "Structural". In both cases, these deteriorations should be classified (air, water, soil), and an estimation of their deterioration costs, both direct and indirect, made. Whenever possible, the costs should be quantified; otherwise, they should be ranked according to their magnitude (1: very low, 2: low, 3: middle, 4: high, 5: very high). Whenever it is impossible to assess and quantify deterioration costs, indicators should be worked out showing the degree of environmental deterioration. (For instance, the degree of dust pollution can be measured with accuracy). Finally, the probability (or expected frequency) of the accidental deterioration should be calculated. Then, for each environmental deterioration, possible protection measures should be listed and costed. Whenever it is possible, a comparison should be made over a period of time, for one type of pollution, between the expected total deterioration costs and the total protection costs of possible measures. Then an efficiency indicator can be worked out for each measure. The higher the indicator, the more cost-effective the protection measure will be.

59. With limited resources, which is most often the situation in developing countries, ports can find the best and most effective balance between development and environmental protection by identifying and putting to use the most cost-efficient protection measures with the highest ratio. In practice, it would be advisable to examine all possible pollution characteristics as shown in the table to select those areas where protection measures should be taken. For instance, it may appear that a very simple measure (e.g., regulation) can eliminate structural pollution (e.g., smoke). At the same time, other more expensive measures could be selected in view of their high degree of cost efficiency in reducing the risk of major pollution. Such an analysis can help in prioritizing the port environmental-protection programme and in adopting a policy and strategy in this field. When accurate cost determinations cannot be made, often the case with certain environment deterioration costs, then ranking or pollution indicators should be used to choose among alternative protection measures. As far as ranking is concerned, it may be convenient to take into account the nature and intensity of complaints by those affected. The comparison of these measures with those which can be cost determined is more difficult and cannot be done with accuracy. Nevertheless, the available information is useful to prioritize different measures for guarding against environmental deterioration. Other factors such as the need to comply with national/international standards should also be taken into account. The lack of quantitative figures should by no means be an obstacle leading to inactivity in the field of environmental protection.

Evaluation of Environmental Protection Alternatives (Year ----)

	Deterioration costs				**Protection costs**				**efficiency indicator = A1/A2**
	direct costs	indirect costs	frequency	total deterio-ration costs (**A1**)	direct costs	indirect costs	total protection costs (**A2**)		
Accidental									
air:									
water:									
soil:									
Structural			n.a.						
air:			n.a.						
			n.a.						
water:			n.a.						
			n.a.						
			n.a.						
soil:			n.a.						
			n.a.						
			n.a.						

1 = very low; 2 = low; 3 = middle; 4 = high; 5 = very high; n.a. = not applicable

D. Port environment pricing principles

60. Port pricing is a strategic tool normally available to the port management for implementing policies on port revenue, port investment and port operation. There are cases where the regulations are such that they hamper the full utilization of such a tool. This is the case when any alteration of the port-tariff structure and/or level cannot be done without lengthy discussion with the supervising bodies. This is also the case when only a fixed percentage of the tariff level is authorized, every year or so, irrespective of its impact on the traffic and level of asset utilization. Environmental protection generates costs, requires investments and has a bearing on port operations. Therefore, it might be subject to specific pricing schemes, to recover costs and improve port operations. In practice, this leads to the implementation, either separately or concurrently, of the following basic pricing schemes:

61. The Polluter Pays Principle constitutes the basis for allocating costs of pollution prevention and control measures introduced by the public authorities. It means that the polluter should bear the expenses of carrying out the measures to ensure that the environment is in an acceptable state. Details on these principles can be found in "Fair Principles for Sustainable Development", Annex 1 and 2. For instance, if the dust generated by coal storage is responsible for damages to other traffic, the owner (or its insurers) will have to pay the cost incurred. In case it is decided to install specific devices to keep the coal wet and avoid dust, the owner will have to bear the cost. In general, port authorities are in favour of such a principle which has been endorsed by the International Association of Ports and Harbours (IAPH). A study 2/ sponsored jointly by IMO INTERTANKO, ICS and the EEC on mechanisms for the financing of port reception facilities also favoured this principle, suggesting that special funds could be generated by charges on ships from which investments in facilities could be taken.

62. The free service principle is based on the philosophy that the environment will be better protected if all the facilities and services created to prevent accidents, incidents or even pollution (such as waste-reception facilities) are provided by the Port Authority or another official body free of charge to users. Then the port can recover the corresponding costs from other sources, including from an increase of other charges imposed on its users. In general, the main "potential" polluters such as the representatives of oil-tanker owners or operators are in favour of such a principle. 3/ Some countries have adopted this principle (for instance Sweden, in the early 1980s). However, results have been mixed. The argument that ships should not be incited to discharge their waste at sea for economical reasons seems to be no longer valid since there is now more consciousness on board ships and more surveillance than 20 years back. Ship officers and crews do not have the same interest in the economy of the ships and they will not assume the risk of being sentenced for an unlawful discharge. Shipowners have also included these costs in their freight calculation. Another aspect is that the ports have become aware of the importing of waste that otherwise should have been discharged to other ports. Therefore, regulations have been adopted to limit these practices.

63. Incentive pricing schemes are based on the concept that port charges should be designed in such a way as to encourage (or at least not penalize)

users who have made efforts to comply with environmental protection requirements. It is in this spirit that IMO resolution A 388(X) was adopted in 1977 to recommend the exemption of the segregated-ballast type of oil tanker from port dues and charges which are generally based on vessel size (GRT, WRT or volume). The IAPH, in its 18th conference in SYDNEY (1993), adopted a resolution recommending that IAPH members encourage the use of safe technology by tankers via tariffs and fee adjustments. The operative paragraph reads as follows:

> "RESOLVES that as an initiative in pursuit of the goal of sustainable economic and operational development of ports, the members of IAPH should consider incentives toward that end, which might include adoption of a Scheme in which environmentally friendly equipped and operated ships are encouraged in the structuring of port tariffs and fees."

There is no doubt that such a resolution is worth considering (and implementing) by all ports, since it is in line with the desirable objective; however, without jeopardizing the port management's ability to use its pricing scheme, according to the requirements of its other policies on revenues, investments and operation.

64. Finally, it should be emphasized that in order to attract traffic, under no circumstances should the argument be used directly or indirectly, that there are no port charges nor other costs to the user relative to protecting the environment. In other words, the lack of environment protection should not be used to keep port costs down and attract traffic.

E. Port management information systems on environmental issues

65. Practically all ports have now established information systems and efficiency indicators to monitor their operational, financial and administrative performance. These systems should be extended to include environmental aspects. The first step is to design a system in order to measure the degree of pollution of the air, soil and water. For this purpose, it is suggested to consult the ESCAP report "Assessment of the Environmental Impact of Port development", where chapter 3 deals with "environmental indicators and criteria".

66. The main indicators of water quality are the Chemical Oxygen Demand (COD), the Biochemical Oxygen Demand (BOD), Dissolved oxygen (DO), the degree of acid/alkaline (ph), coliform bacteria and oil content. ESCAP is preparing a table showing the permissible limits of these indicators in India, Indonesia, Japan, Malaysia, Philippines and Thailand. Similar indicators are presented for air quality, noise, odour and harmful bottom sediments.

67. All ports, including those located in developing countries, should establish similar indicators, adapted to their specifity. At the beginning, only a few simple indicators could be established and monitored. This is the only way to obtain the data necessary for defining the policy of the port in this field and to follow its implementation.

CHAPTER III

POLICIES AND STRATEGIES FOR SUSTAINABLE DEVELOPMENT IN PORTS

68. The goal of sustainable development cannot be achieved in an ad hoc manner. It requires a carefully-managed process based on a well-defined policy which takes into account the local situation. In the previous chapter, suggestions were proposed on how to analyse the various components of such a policy, on the basis of economic and other types of information. Once the policy is adopted, the port should develop and adopt a strategy for implementing it. Such a strategy should be supported by all parties concerned - industry, individuals and authorities. Variations in local situations will result in different policies and strategies for different ports. Yet, some basic elements will be applicable to every port.

A. Defining a policy for the sustainable development of a port

1. Objectives

69. In terms of action, environmentally sensitive port development involves a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations. It is this balancing process - which ensures harmony, safeguarding the short-term commercial performance of the port and its industry, yet aiming at viability in the long term - that requires the most attention. In other words, the focus should be on sustainability of performance. This provides the guarantee that the port will remain in business, earning money to be able to invest and thus support sustainable development. When considering sustainability in environmental terms, one may look at the different environmental components, such as water, air, land, etc. It may be argued that only those components are important that have a direct bearing on the functioning of the port. Such an approach implies that air pollution is hardly of any interest, since it "disappears" into the atmosphere. This is different in the case of soil pollution, which affects only the area in question and thus has a direct effect on the functioning of that particular area of the port. However, this is a misguided environmental approach - air pollution must also be taken into account, because it affects the global quality of the air and thus indirectly that of the port area.

70. The objectives of a port in the field of environment protection and sustainable development should be incorporated into the mission statement of the Port Authority and other organizations or firms concerned. Within the port authority and the other bodies working in the port area, there should be specific and quantitative sub-objectives or targets assigned to each organization or unit and addressing the components of environmental protection. For instance, the operational department of the port authority may have as a sub-objective or target for the next year, to comply with Annex V of the MARPOL Convention; the firm X which is importing coal in bulk may have as a target the installation over the next two years of a specific permanent device to limit dust production on storage areas, etc. The objectives of protecting the environment in a limited geographical area, like a port, cannot be compartmentalized by each of the various actors working in

this area. Coordination is required inside the port community in order to achieve results. Objectives and sub-objectives or targets should be prioritized, according to the cost and frequency of possible environmental deterioration as well as the cost of preventive measures required. In the previous chapter, suggestions were given on how to establish priorities.

2. Preparation and adoption of the policy

71. For efficiency reasons it is necessary to initiate and coordinate efforts from a central point. It seems only logical that this central point should be the port authority, in view of its direct interest in and influence on everything going on in the port area. There are cases where the port authority only marginally participates in the actual functioning of the port since it has a managerial role. The actual port activities are carried out by private companies. As a consequence, the port authority will not be able to physically contribute to efforts aimed at sustainability. Its role is that of defining overall policies and introducing them to the port industry and port users so as to obtain their consent and commitment. In other countries where the port authority is involved in the operations, its role will be stronger. In all cases, there should be a focal point in the port to deal with and coordinate environmental matters. This can take the form of a specific unit (or person) in the port authority. A coordinating committee involving all concerned may also be established. What is essential is to make known that for any environmental matter there is one person to contact in the port and that a consultative mechanism exists where all interested parties can present their views and obtain information on what is going on in this field.

72. The port authority should communicate with all actors in its port, discussing and assessing the required objectives. In doing so, the port authority should take into account national government policy. There is little use in developing a policy which is not in line with that of national authorities. Clear goals should be set, which should be compared with the possibility that the port community will reach them. This comparison should be the basis of establishing action to be taken. In this process the balancing of environmental necessities and practical (economic) possibilities should take place. In view of the necessity of staying in business and the need for sustainable performance, action should be carefully selected. Once the practical approach is established, in terms of action, the way in which this action should be carried out can be determined. It is essential that all participants in this process be committed to this mutual goal. In this context, it cannot be stressed enough that the basis of the whole exercise is, that in the end, only a clean and safe port will be able to survive. This is not a condition which can be reached by simply setting rules. The real power behind the drive towards sustainability is the common willpower of those participating in the port processes. The port authority should make it clear that sustainable development is in the interest of the whole port community. It should be stated that the time when environmental protection could be ignored, or treated as a marginal issue, is over. Environmental protection actually starts with the implementation of sound day-to-day good housekeeping principles. Interest in protecting the environment is also the direct concern of those who are dependent on the economic benefits generated by the port. This latter category is not limited to those actually working in or for the port. As said earlier, the economic impact of ports reaches much farther than the immediately involved area and may even be of national importance. This

means that ports should be entitled to support from their Governments as they strive for sustainability. It is in the interest of these Governments that their countries have ports which are in a position to contribute on a long-term basis to the national income and to the welfare of the people.

73. Efforts to reach common goals should not be imposed, but instead agreed upon in intensive consultation processes. In these processes the port authority should explain the risks of not striving for sustainable development. In spite of the fact that it is usually very difficult to quantify the cost of environmental deterioration, it may be less difficult to quantify the cost for cleaning operations following pollution. An excellent means to communicate the dedication to a clean port to the general public, and if necessary to other authorities such as the national Government, is an environmental policy statement. There are ports which have adopted an "Environmental Charter" or an "Environmental Code of Practice". For instance, the British Port Federation has adopted an "Environmental Code of Practice". In the foreword, the Chairman states that the Code should encourage greater awareness (of the environment) on the part of both port employees and users. It should also contribute to maintaining the principle of working towards a better environment while maintaining efficient port services. The BPF environmental statement is presented, (Annex 3). The following sections should be dealt with in an environmental policy statement:

- Environmental management systems
- Monitoring the environment
- Preparedness Plan
- Compliance with legislation
- Consultations
- List of current legislation
- List of environmental consultants

74. In this type of document, which should be drawn up and supported by all actors in the port, a description can be given of the goals the port has set for itself in the environmental field and the means it has identified of reaching these goals. Such a document will clearly illustrate the determination of the port community and may be an effective tool in convincing national and other authorities to render support in order to reach the described objectives.

B. Strategy for implementing the policy

75. The previous section dealt with the development of a policy which will have the widest possible support. During that phase the areas of concern should be identified, in order to form the basis of the strategy to implement the policy. In this section, the contents of such a strategy and the practical implications will be discussed.

1. Preventive measures

76. As stated earlier, one of the cornerstones of a successful policy is an effective combination of preventive measures.

The establishment of a legal framework

77. The objective of this activity is to develop regulations to ensure that standards and quality objectives are made clear to all concerned and that they are implemented. It is recommended that internationally agreed-upon recommendations be followed, rather than developing one's own specific rules, unless absolutely necessary. The three main IMO Conventions, (MARPOL, the London Dumping Convention and OPRC) and other legal instruments and resolutions/recommendations should be studied and if possible adopted and implemented. At the outset, it is worth noting that some issues are better dealt with by national legislation and others by port regulations. Similarly in some cases, government services are better placed to monitor and enforce the rules adopted. In each particular case, the port authority needs to consider whether to adopt its own regulations or to press for an appropriate national law. In each country, a list of the relevant international/regional and national legislation should be established. Implementation of other recommendations adopted by non-governmental organizations (e.g., IAPH) should be reviewed and implemented if appropriate. National regulations should preferably be in line with those applicable in neighbouring countries or regions. This calls for close coordination with the relevant authorities. In setting up regulations, care should be exercised in order to ensure that they are clear and easily understood. The regulations are primarily meant for those working in the port, not for highly-experienced legal experts. A complex regulation which is not understood by those who have to abide by it will prove to be utterly ineffective. The total set of regulations can best be compiled in a set of port regulations or by-laws.

Enforcement and control

78. When regulations are issued, it is essential that they be enforced in order to ensure that they are implemented. Regulations must be understandable by those who have to abide by them. This is also important for those involved in the enforcement of regulations. If too complex or unclear, effective enforcement is not possible. Enforcement should be carried out by qualified persons with adequate knowledge of their area of responsibility. In this context port authorities should consider the usefulness of civil liability as a means for allocating responsibility for the costs of environmental restoration in cases when both the legislative framework and enforcement have failed to avoid environmental damage. Civil liability is a legal and financial tool used to make those responsible for causing damage pay compensation for the cost of remedying that damage. By requiring those responsible to pay the costs of the damage they cause, civil liability also has the important secondary function of enforcing standards of behaviour and preventing people from causing damage in the future. This particular item is presently on the environmental protection agenda of the European Community.

79. An example of the control measures exercised by countries is the Memorandum of Understanding on Port-State Control, which is an agreement between the maritime authorities of fourteen European countries, 4/ aimed at

the establishment of a harmonized and efficient system of port-State control. The Memorandum came into effect on 1 July 1982. The grounding of the Amoco Cadiz and the resulting oil spill was a major incentive for the Commission of the European Communities to start work on a directive concerning the enforcement, in regard to shipping using Community ports, of international standards for shipping safety and pollution prevention. Improved enforcement of the Memorandum would reduce substandard tonnage. Under the Memorandum, each authority will maintain an effective system of port-state control to ensure that foreign merchant ships visiting its ports comply with the standards laid down in a number of international conventions and their amendments (IMO and ILO). There will be no discrimination as to flag. Each country will have to achieve an annual total of inspections corresponding to 25 per cent of the estimated number of individual foreign merchant ships which entered the ports of its State during a twelve-month period. Each authority will consult, cooperate and exchange information with the other authorities. The authorities will do everything to avoid undue detention or delay to a ship. In case deficiencies are found which are clearly hazardous to safety, health or the environment, the hazard must be removed before the ship is allowed to proceed to sea (in the case of detentions, the flag State will be notified as soon as possible). If such hazardous deficiencies cannot be remedied in the port of inspection the authority may allow the ship, under certain conditions, to proceed to another port.

Education, training and public awareness

80. The objective here is to change behaviour, improve skills and involve the whole port community in the achievement of a green port objective. This will help create an environment of self-regulation. Education and training programmes need to be developed which are geared to the specific activities carried out in the port. An important side effect of properly trained people is that knowledge of the tasks being carried out will also enhance motivation. This in itself has a positive effect on the quality of performance and the sense of responsibility, particularly true in the handling of dangerous goods. Improper handling cannot only lead to loss of cargo, but will also create dangerous situations for the people involved and those in the vicinity. Education is not only necessary for those working in the port. The general public also needs to be aware of the activities which are going on in the port. Especially when activities pose certain risks it is essential that the public be informed of these risks and the measures taken to minimize them as much as possible. Information can be disseminated through the local media such as newspapers, radio or TV. Accordingly, the port authority should consider measures to make the port accessible to the general public. This may be done by providing observation towers with information on the activities which can be seen from there. All this will increase community involvement and avoid unnecessary confrontations between the port and the community through better understanding.

81. The Port of Sydney provides an excellent example of community involvement in cleaning up the port. 8 January 1989 was instituted as Clean Up the Harbour Day. The day was planned and organized by a committee of volunteer workers, with a full-time organizer and public-relations consultant working on an honorary basis for two months leading up to the day. Most goods and facilities were donated and the media gave complete support to the event, utilizing community service airtime to run the media and radio advertisements

that had been produced by two Sydney advertising agencies. This public-awareness, education and action campaign attracted 40,000 Sydney residents who volunteered to donate a Sunday to cleaning up the garbage and litter pollution in Sydney Harbour. The organizers had estimated that perhaps 100 tonnes would be collected. In fact, it was over 5,000 tonnes. The event was a tremendous and unparalleled success.

Incentive measures

82. The environmentally-friendly behaviour of individuals and companies can be influenced by incentive measures, aimed at rewarding proper behaviour. Rewards can be found in terms of preferential tariffs or preferential treatment. As already mentioned, at its 1993 Conference in Sydney, the IAPH adopted a resolution along these lines for ships. The text of the crucial paragraph of this resolution reads as follows (for the full text see Annex 4):

> "Resolves that as an initiative in pursuit of the goal of sustainable economic and operational development of ports, the members of IAPH should consider incentives towards that end, which might include adoption of a scheme in which environmentally friendly equipped and operated ships are encouraged in the structuring of port tariffs and fees."

A similar approach could be developed towards the land-based companies, e.g., by rewarding environmentally-friendly behaviour by (extra) subsidies, tax benefits, credit facilities, etc.

Infrastructural measures

83. Infrastructural measures in terms of lay-out of terminals etc. can contribute to the prevention of accidents endangering the environment. Typical activities in this field will depend on the local situation. In order to illustrate the thinking behind this suggestion, an example is given. General cargo terminals are very busy places where a large number of activities are carried out simultaneously. Ships are loaded and unloaded, cargo is transported to and from storage areas, road and rail vehicles circulate, etc. By properly organizing the traffic flow, accidents can be prevented. Work will also be executed more efficiently and consequently at lower cost. A traffic-flow programme should as much as possible separate different traffic flows, such as those for internal transport and external transport means. The area where ship-related operations take place, using fork trucks etc., should be a restricted area with no road transport allowed, unless it is required for delivering cargo to the ship or receiving cargo from the ship. The introduction of one-way traffic lanes is another method for structuring the traffic flow at a terminal.

B. Corrective measures

84. Corrective measures are necessary for both the structural and the accidental deterioration of the port environment. In the former case, the nature, origin and impact of pollution can be identified and studied. There is usually enough time to work out and implement technical, administrative and financial measures to stop or reduce pollution to an acceptable level and share the clean-up and other costs according to the principles adopted by the public authority. The situation is completely different in the case of

accidents, since corrective measures must be implemented without delay; they consequently must be carefully prepared well in advance of their implementation. Basically, this requires three components: plans, people and equipment.

Emergency plans

85. An analysis of all activities going on in the port will enable the port authority to select a number of possible accidents for which the port should be prepared to react. In principle the possible accidents can be divided into four main categories:

- incidents involving general cargo;
- incidents involving bulk liquids, spillages;
- fire or explosion;
- nautical incidents such as collisions and groundings.

After establishing the most likely accidents to be prepared for, detailed plans should be prepared, in close cooperation with other interested parties such as the fire brigade, the police, ambulance services and supporting organizations such as laboratories. It is important that the plans contain a clear command structure. Emergency operations will be frustrated when it has not been established who is in command. The plans should also describe the equipment required and where this equipment is stored. The description of the communication process and procedures during emergency activities is essential. Ignoring this will render actions ineffective and may even lead to dangerous situations for personnel involved in the emergency operations. In order to avoid confusion, communication channels selected for use during emergencies should not be used for other purposes. Communication procedures need to be rehearsed regularly to enable personnel to be familiar with them and to ensure that, even under the strain of emergency operations, procedures are followed. Plans should be regularly checked and updated if and when required. They should also address the way in which the general public is kept informed. It is recommended that contacts with the press to this effect be maintained by one designated person who is kept informed about actual developments.

86. For proper and quick action it is essential that authorities be immediately notified in case of an incident. Notification should preferably be made by a competent person employed by the party involved in the incident. However, reports from passers-by, patrolling police, etc. may also be very useful. In order to quickly assess the situation, which is required for initiating the proper counter-action, the notification should comprise the following at a minimum:

- time
- location
- ship and/or company name
- name of contact person

- nature of incident; fire, explosion, leakage, etc.
- dangerous substances involved? If yes, name of substance(s)
- estimate of quantities involved

Besides this basic information, data on climatic conditions are required. Wind direction, for example, is important in determining the area likely to be affected by the incident: smoke, dangerous vapours, etc.

Emergency personnel

87. Personnel for emergency activities will usually be drawn from the normal workforce in the city, the port and the port authority. These people should be carefully trained and instructed. They should be familiar with the emergency plans and all relevant procedures. Training should not be merely an exercise on paper - training in the field, using the actual equipment is essential. The latter includes fire extinguishers, self-contained breathing apparatus, measuring devices, etc.

C. Planning port development

88. Port development is an essential part of the responsibilities of a port authority and may be considered as the third cornerstone of a successful port policy aimed at sustainability. As demands change and markets evolve, the infrastructural assets of a port may need alterations from time to time. These may vary from minor changes involving quays and harbour basins to large-scale expansion of the port area. In most cases, these changes will have environmental effects; it is therefore necessary to study these effects carefully and adapt plans so as to minimize them. The Environmental Impact Assessment (EIA) is a powerful tool in the process of port planning. It enables the identification of all environmental aspects of planned changes. This inventory can serve as a basis for the development of plans to mitigate harmful effects. It is important that port planning not be carried out in isolation but rather in close cooperation with those responsible for city planning. Thus, the requirements of the port and the city can be balanced. In fact, the major aim of the EIA process is to identify possible conflict situations in the early stages of the project preparation so corrective measures can be introduced before any harm is done.

89. The following figure illustrates how to carry out the planning process correctly. It can be seen that contrary to standard practice some 10 or 20 years ago, the examination of the environmental impact relative to envisaged port investment is done in the early stage of the project and rather than at the end, as was often the case in the past.

Planning Process

1960s	1990s
1. Project Objectives	1. Project Objectives
2. Pre-Feasibility Study	2. **Prefeasibility Study of Initial Environmental Assessment**
3. Feasibility Study	3. Feasibility Study And **Environmental Impact Assessment**
4. Formulation	4. Formulation
5. **Examination of Environmental Impact**	5. Adoption
6. Adoption	6. Implementation
7. Implementation	7. Monitoring/Evaluation
8. Monitoring/Evaluation	

90. The ESCAP study "Assessment of the Environmental Impact of Port Development" (1992), presents the issues involved fully. In particular, the major impacts identified by a letter in the following table are examined in the study.

Major Impacts of a Port Development Project on the Environment

Facet of the environment	Location of port	Construction and dredging	Port operation	
			Ship traffic and discharges	Cargo operations and waterfront industry
	(A)	(B)	(C)	(D)
Water quality (1)	A1	B1	C1	D1
Coastal hydrology (2)	A2	B2	-	-
Bottom contamination (3)	A3	B3	-	D3
Marine/coastal ecology (4)	A4	B5	C4	D4
Air quality (5)	-	B6	C5	D5
Noise and vibration (6)	-	B7	-	D6
Waste management (7)	-	B8	C7	D7
Visual quality (8)	A8		-	D8
Socio-cultural impact (9)	A9		C9	D9

Environmental indicators and criteria are then examined. Finally, survey and prediction methods are presented as well as methods for pollution-free dredging and reclamation. Many institutions, other than financial ones are now requesting EIA studies. The following table shows that specific EIA legislation is now being requested in many countries.

Status of EIA Requirements for Port and Harbour Development Projects

Country/Area	Status of EIA requirements			
	A	B	C	D
Australia	*			
Bangladesh				*
Brunei Darussalam			*	
Fiji				*
Hong Kong		*		
India	*			
Indonesia	*			
Japan	*			
Malaysia	*			
New Caledonia				*
New Zealand	*			
Pakistan				*
Papua New Guinea	*		*	
Philippines		*		
Republic of Korea		*		
Singapore		*		
Solomon Islands			*	
Tahiti				*
Thailand		*		
Tonga			*	
Viet Nam		*	*	

Type of EIA legislation

A: Specific legislation on EIA

B: Administrative requirements from a government agency for particular projects.

C: No local requirements for EIA but through the request of international funding agencies such as the World Bank or Asian Development Bank.

D: No particular requirement for EIA

Source: Summary of "Questionnaire on Environmental Impact Assessment in your port(s), April 1991" TACD, ESCAP

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

91. The issue of protecting the environment and achieving sustainable development of ports is not a temporary aspect of our present period, nor is it a "luxury" and a point of major concern among only the developed countries. It is an irreversible trend that all involved in port activities should progressively understand and eventually support. We have to take care of environmental health exactly as if we were taking care of our own health. The first straightforward consequence of this attitude is the need for those who understand the nature and extent of the stakes involved to inform and sensitize their colleagues. In this respect, the role of the port manager is crucial. Managers should convince all their staff, through awareness campaigns or similar activities that all port personnel in their day-to-day activities must take care of environmental health. The second issue to be dealt with in this field is the adoption of a policy defining objectives to be reached, identifying and prioritizing of required activities and allocating part of the resources available to the port. Such a policy and its associated strategies have to be coordinated and implemented by the port community as a whole rather than through ad hoc measures taken separately by the various port actors. In this study, guidelines have been provided on how to identify and analyse the environmental issues with specific emphasis on economic aspects. Practical suggestions have been formulated on how to set priorities among the various measures to protect the environment, and consequently on how to define and implement policies and strategies in this field. There is not one single model which can be implemented at every port. However, there are basic principles to be followed in order that environmental protection, efficient operations, harmonized development and a good social climate may be jointly attained.

92. To assist in the implementation of these principles, the following practical recommendations are worth mentioning:

(a) In all ports, a focal point should be established for environmental protection in order to collect and disseminate information (accidents, data, publications, laws, conference, etc.). Such a focal point should contribute to the formulation of the port environmental policy in such a way that international instruments or recommendations are taken into account as well as national interests and regulations.

(b) Incentives to encourage environment protection should be supported, with the understanding that it is up to the port management to decide in conformity with the decisions taken by the Government on the timing and nature of the incentive, bearing in mind port operations, development and financial requirements. In this respect, the Resolution adopted by IAPH in 1993 in Sydney on Ship's Port fees is an example of a good balance between environmental and economic considerations.

(c) In addition, the focal point should be instrumental to implementation of the adopted policy. A coordination mechanism such as an Environmental Committee should be created to coordinate action, inform all interested parties and give them the opportunity to present their views and obtain their support. This Committee should consist of representatives of

relevant national authorities, the port operator, port users, and people living in the vicinity of the port. The Committee should be fully aware of the constraints set by international standards. Environmental statements, codes of conduct, or charters should be adopted as well as environmental management information systems.

(d) Regional cooperation among ports in the field of environmental protection should be encouraged in order to adopt harmonized measures, share costs, experience and expertise.

(e) There should not be any competition between ports based on the lack of protection of the environment. For this purpose, pollution norms, environmental pricing systems, etc., should be harmonized on a subregional basis taking into account the specific and technical/financial capacities of each port. Such an item should be on the agenda of the regional association of ports. On occasion, government support may be indispensable in achieving this kind of harmonization.

CHAPTER V

CASE STUDIES

Case No. 1: Autonomous Port of Abidjan (Côte d'Ivoire)

A. Organization

93. The Autonomous Port of Abidjan became a government enterprise in accordance with Decree No. 92-940 of 23 December 1992. Article 6 of the Decree states that the territorial limits of the Port of Abidjan are defined by the Port Delimitation Plan. The Port and surrounding areas are estimated at 1,950 hectares, composed as follows:

1,000 hectares of water area;

950 hectares of land area, including 800 hectares of industrial area and 26 hectares of open storage yards.

Some 155 of the 240 authorized enterprises identified by the environment services in the city of Abidjan are established in the industrial area of the Port of Abidjan. They discharge 30,000 m^3 of wastewater per day.

94. In view of this situation, the Port of Abidjan set up the Environment Department to protect the port environment from damage resulting from polluting activities of port enterprises. The Department implements and monitors the implementation of the environmental regulations, measures and standards that govern matters such as air and water pollution, waste management and industrial hygiene.

B. Standards

95. The acceptable standards in the Port of Abidjan are those defined in the National Plan.

(a) Maximum discharge levels for water:

pH	5.5 - 8.5
Temperature (°)	40° C
Suspended matter	30 - 40 mg/1
COD	120 - 150 mg/1
BOD	40 - 80 mg/1
Hydrocarbons	20 mg/1
Phenol compounds	1 mg/1
Cr6+	0.05 mg/1

Pb	0.1 mg/1
Kjedhal N	50 mg/1
Nitrates	0.5 mg/1
Nitrites	30 mg/1
Phosphates	10 mg/1
Fluorides	1.5 mg/1
Cd	0.5 mg/1
Hg	0.001 mg/1
Sulphides	5 mg/1

(b) Air: 150 mg/l of dust

(c) Noise: 60 dB: 7 a.m. - 8 p.m.

50 dB: 10 p.m. - 6 a.m.

55 dB: 8 p.m. - 10 p.m. and 6 a.m. - 7 a.m.

On holidays and Sundays, 50 dB are allowed.

(d) Land use is regulated. Industries are divided into two groups: those requiring an authorization and those requiring a declaration. Industries in the first group are established in the industrial areas and those in the second group are established not far from residential areas.

(e) Waste management depends on the type of waste. Some wastes are allowed in public dumps, while others are specially treated by the producing industry.

C. Regulations

96. With regard to the environment, the Port of Abidjan has its own legal powers in cases of the pollution of port waters by hydrocarbons. In other cases of environmental pollution, it shares power with other authorities, such as the Service for the Inspection of Classified Installations in the Ministry of the Environment, Building and Urban Management. Côte d'Ivoire is one of the countries of Africa south of the Sahara, apart from South Africa, that is best equipped for environmental protection, for which it has national regulations. Within its territory it also applies the provisions of the conventions to which it is a party. There are local regulations which apply to the Port of Abidjan.

D. Recent problems

97. The implementation of all this legislation has not prevented cases of pollution and environmental stress in the Port of Abidjan:

Pollution of the lagoon by hydrocarbons in 1985;

Pollution of the lagoon by discharges from canneries;

Unauthorized construction of dwellings in the port area;

Dust discharges by cement factories;

Ammonia fumes from SIVENG vats (hydrochemicals);

Rapid silting up of the base of quays;

Organic pollution.

E. Environment Department

98. The Environment Department is very young and does not yet have very many resources. It works together with the Service for the Inspection of Classified Installations, which carries out periodic checks of factories and enterprises. It also works to increase environmental awareness.

99. In 1984, it was urged that industrial pollution should be reduced to an acceptable level by 1995. A recent evaluation shows that this objective is far from having been achieved. It may, however, be said that one enterprise (CAPRAL NOVALIM) has made genuine efforts in connection with waste reclamation and the reduction of air pollution. Two factories, PFCI and SCODI, have also made substantial progress in reducing waste.

F. Costs

100. The Autonomous Port of Abidjan has just set up a department to propose improvements to the port environment and combat environmental stress in the port area. This department does not yet have all the data it needs to evaluate the cost of environmental protection. It may, however, be stated that most environmental funding is the responsibility of the Government and local communities. In cases of clearly identified pollution, whether accidental or deliberate, the polluter pays. The free collection of garbage from ships costs the Port about CFA 1,000 million (US$ 350,000) per year.

G. Means

101. The Port has its own means of combating oil pollution. The analysis of the water to determine the type of pollution is done by CIAPOL, which is also in charge of combating floating plants. The Port has given authorizations to five companies for the free recovery of oil waste from vessels calling at the Port of Abidjan.

102. Means of pollution control in the Autonomous Port of Abidjan include:

A 200 m oil boom divided into four 50 m sections and two pumps for spreading dispersant;

600 l of second-generation dispersant.

CIAPOL has much more equipment, which has been provided by Denmark:

An oil boom;

A water analysis laboratory;

Dispersants;

A photography laboratory.

Case No. 2: The Port of Rotterdam

A. Organization

103. Rotterdam is a municipal port. The Rotterdam Municipal City Council has allocated responsibility of the port areas, the port basins and the adjacent industrial sites to the Rotterdam Municipal Port Management (RMPM). This makes RMPM the landlord of the port industry. RMPM does not carry out any port activity itself. It provides the port infrastructure, builds the quay and delivers the site ready for building to the port industry, which provides its own suprastructure. Sites are leased to customers. RMPM is divided into three directorates, each charged with one of the three core tasks:

> The Directorate of Shipping, which regulates shipping traffic in the port, enforces the Port By-Laws and national laws regarding dangerous goods and the environment. Officials in this directorate are authorized to issue summons which are presented to the public prosecutor.
>
> The Directorate of Commercial Development is charged with commercial activities. It leases out sites, acquires new business and is responsible for port dues.
>
> The Directorate of Port Planning is responsible for long-term developments, research in relevant fields and strategic development.

The directors form the Management Board. Each directorate has its own safety and environment department. Their activities are coordinated by a coordination group which answers to the management board. Environmental plans of the individual directorates require approval of the coordination group before they are presented to the board for final approval. RMPM's main objective is to promote economic activity in the port area. This requires a clean and safe environment: only a clean port will be able to survive in the long run. Environmental care is therefore an essential condition for reaching the main objective, rather than being a goal in itself.

104. The relevant environmental standards are set by the national Government. RMPM has little authority. However, RMPM has its own policy regarding the two main areas of interest: water quality, and a related matter, the quality of the silt and soil at industrial sites. The very strict national legislation regarding noise has created some problems which require RMPM's attention. Air quality is governed by national law, RMPM is barely involved.

B. Water and silt quality

105. Due to water pollution caused by upstream and local industry and shipping, silt is contaminated as well. Frequent dredging is required to maintain sufficient water depth. Each year, 23 million m^3 is dredged, of which 10 million m^3 is contaminated to such an extent that it cannot be dumped at sea nor deposited on land. A 150 million m^3 depot has thus been built, the Slufter, which has sufficient capacity to operate to approximately the year 2002. By that time, the silt should be clean enough so that it may be dumped at sea or used on land. This requires a reduction of pollutants of 70-90 per cent. A variety of activities are being deployed to reach that

goal. Agreements on reductions with upstream industries are being made. If these agreements fail to have the expected result, RMPM stands a fair chance that a legal action against polluters will succeed. A similar approach in cooperation with the relevant governmental departments is being followed with local industry, which is being urged to agree to reductions beyond legal requirements. Shipping is approached in a different way. Guidelines have been produced on the prevention of spillage of dry bulk cargo residues. Since bunkering of ships proved to be a frequent pollution cause, the use of a bunkering checklist has been made mandatory. A ship/shore checklist with the same aim for loading or unloading bulk liquids was introduced a number of years ago. A project is presently under way which is aimed at the promotion of proper discharge of ship waste products: bilge water, sludge, wash water, etc. Recently a plan has been launched that will enable RMPM to reward ships which are environmentally-friendly equipped and managed. This Green Award System is aimed at attracting environmentally-friendly ships. Further contacts with potential polluters are planned, such as ship repair companies, stevedores, cleaning companies, etc. Apart from the above activities, port supervision has been intensified. The port has facilities for the reception of waste products from ships according to the Marpol Convention which has been incorporated into Dutch national law. Oily and chemical waste as well as garbage can be discharged into reception facilities. This may be done directly or through barge services which collect the waste from the ships. In a cooperation programme with governmental departments and the province, RMPM is engaged in a project which is aimed at monitoring this process in order to support the enforcing of legislation addressing these activities. In spite of all these preventive measures, RMPM is prepared for accidents that may happen. Spills of hazardous products must be reported immediately and equipment is available within the municipal organization to allow speedy clean-up, whose cost is borne by the polluter. Computer models are available to calculate the possible endangered area resulting from the release of dangerous products. This enables the maintenance of safe working conditions for those involved in the counteraction. People in the vicinity of the accident can if necessary be warned in order to evacuate the area.

C. Soil pollution

106. Many of the industrial sites have become more or less polluted over the years. RMPM is currently taking action to rectify the situation by encouraging industry to embark on voluntary clean-up operations. The goal is to make all sites suitable for their particular use with no environmental or health restrictions within about one generation (30 years). There are two lines of approach: preventive and curative. The preventive approach includes special clauses in the lease contract, stating that the lessee must return the site in the original condition upon expiry of the lease contract. Furthermore, any accidental pollution during the lease period must be reported immediately and removed without unnecessary delay at the lessee's expense. At present RMPM has signed contracts with industry regarding voluntary clean-up operations. Regarding the curative approach, the goal is that in principle sites should be cleaned up to the level of multi-functionality, which means that the sites should be suitable for any use. This is not always possible due to physical restrictions. Therefore RMPM allows so-called functional cleaning, in that sites can be cleaned to a level which makes them suitable for their particular use. Since a certain amount of contamination is allowed, and the site consequently loses value, this loss of value will be financed by

establishing a special fund to which all the lessees contribute through a slight increase in their lease price. In other words, should the situation arise whereby a site must be cleaned completely due to a change in its use, finances are available to pay for the cleaning operation.

D. Noise

107. The Netherlands has enacted a law on noise nuisance. This law provides very strict regulations regarding the noise levels to which houses, etc., may be exposed due to industrial activities. Especially for port industrial areas in the proximity of living areas, this leads to situations which are in contradiction with legal requirements. Isolating measures are relatively ineffective, since most of the noise sources are located at elevated levels, e.g., the engine rooms of (container) cranes. In order to be able to comply with the legal requirements and avoid costly remedies such as relocating present living quarters, RMPM has started a research programme aimed at the development of cranes with a much lower (minus 10 dB) noise level than presently available on the market.

E. Emergency plans

108. RMPM realizes that in spite of all efforts aimed at preventing accidents, things do go wrong from time to time. The human factor is difficult to control. For that reason, emergency plans have been developed. Four main categories of accident and their required counteraction have been described in detail:

- spillages
- fires/explosions
- general cargo accidents
- nautical accidents such as groundings, collisions, etc.

As stated previously, the spillage scenario incorporates a computer programme which can predict the hazardous situation following the release of dangerous substances and its effects over a period of time. This model enables RMPM to take proper action in case of these incidents: to warn endangered areas, to close off shipping channels, to evacuate areas, etc.

F. General

109. RMPM is presently preparing an environmental policy statement. This statement is meant to communicate the port management's ideas and approaches relative to environmental issues to all those concerned with the port and its future: citizens, industry, labour unions and other authorities. The Sandoz disaster in 1987 has prompted the Dutch national Government to develop guidelines for stevedoring companies in order to avoid massive water and soil pollution in case of accidents involving dangerous substances. The guidelines comprise specific measures such as liquid-tight floors, as well as procedural measures such as supervision, education and training. RMPM has participated in drawing up these guidelines, presently being implemented for new activities. Existing companies must comply by 1995. Since safety and

environment are linked, mention should be made of the zoning system used for the handling of dangerous goods. The basic principle of the system is to prevent a minor accident from developing into a life-threatening situation in nearby living quarters. For all dangerous goods (drums, cylinders, tanks, etc.) calculations are made of the potentially endangered area following accidental damage to the packaging. These distances are used to determine the locations where a particular substance may be handled. The system is incorporated in the Port By-Laws. RMPM has issued its outlook for the year 2010, in a plan describing the possible development of the port as well as the infrastructural and environmental consequences. The plan is presently being worked out in close cooperation with all parties concerned. One requirement is that the port must be able to grow while at the same time improving the environment. Many projects have been identified to guarantee that the development process will stay on course.

110. RMPM is firmly opposed to the situation that ports can compete with each other on the basis of less environmental legislation. Competition is fine, as long as it is based on quality of services. For that reason, RMPM has taken the initiative of internationalizing a number of environmental port problems. At a recent (March 1993) workshop, representatives of some 17 European ports discussed mutual problems and possible solutions. Supported and sponsored by the European Commission, the project known as ECEPA (Environmental Challenges for European Port Authorities) is presently preparing detailed plans of action. The aim is to realize these projects with the support of the European Commission and with subsidies from European research programmes. A second workshop is planned for spring of 1994. The results obtained will then be discussed in light of new areas of collaborative approach identified. The problems which are solved in this manner will contribute to a cleaner environment in European ports and will enable the development of legislation which is applicable to all ports due to the availability of adequate solutions to yet unsolved environmental issues.

G. Environmental cost

111. A question frequently asked is what RMPM spends on environmental care. This question cannot be answered. Environmental care is an integral part of the total managing process and therefore it is impossible to identify individual environmental components. The only figures available and which are directly attributable to environmental protection are the salaries for the approximately 20 staff members who are employed in the environmental departments. The cost figures of research projects could be mentioned. Moreover, some 700 operational personnel are also involved in the process: they enforce RMPM policy and are the eyes and ears of the RMPM, while conveying policy to the port users. Looking at the port as a whole, individual companies spend large sums to improve their installations. Even if these new investments are primarily aimed at increasing efficiency, they also have a positive effect on environmental risks.

Case No. 3: Autonomous Port of Le Havre (France)

A. Organization

A.1 Organization, authority and staff

112. The Autonomous Port of Le Havre (PAH) is a Government enterprise responsible for managing and developing the Port of Le Havre and the industrial area adjacent to the port basins. France has signed the MARPOL and London Conventions and the Autonomous Port of Le Havre implements the provisions of these Conventions. As far as the environment is concerned, PAH is organized and equipped and has defined its short-term and medium-term objectives. A six-person department composed of three engineers and three supervisors works full time on environmental protection problems, including prevention, pollution control and protection of wildlands in the Seine estuary. The following equipment has been made available and PAH either helps manage it or manages it directly:

An air quality monitoring and warning system in the event of sulphur dioxide build-up; in this case, industries are requested to burn low-sulphur content fuel;

A dump for non-reclaimable wastes;

A centre for the collection and destruction of solid and liquid industrial wastes;

Collection of wastes from quays and open storage yards; sweeping (MARPOL Convention, annex V);

Equipment to combat accidental water pollution: oil booms, skimming and collection platforms, dispersants and tugs equipped to fight fires and disperse oil slicks. Port industries are also equipped to combat accidental pollution.

113. Various members of the staff of PAH departments and outside service companies are involved in pollution and nuisance control:

PAH officials: harbour master's office, dredging service;

Staff of outside service companies: beacons and buoys, tugs, pilots, firemen;

Specialized industry staff.

A.2 Responsibilities of PAH

114. PAH is responsible for monitoring port basin water and managing the port industrial area; it organizes campaigns for the control of water quality and the physical and chemical characteristics of water. Under the MARPOL Convention, PAH also offers desludging services for chemical and oil shipping. It has no authority over the operating procedures adopted by industries, but it is aware of the quality of the liquid waste these industries discharge into port basins.

A.2.2 The port area

115. PAH manages an area which belongs to the Government and is let out to industries and port clients according to the rules authorizing temporary use. PAH sets the rental rate for plots of land in the port area and occupants are under an obligation to comply with the rules authorizing temporary use set out in the specifications published by PAH.

A.2.3 Industries

116. Each port industry may organize itself as it wishes in order to comply with the specifications referred to in section A.2 above and the rules adopted by the Regional Industry, Research and Environment Department (DRIRE) relating to means of determining the quality of discharges into the water and air.

B. Environmental quality

117. PAH has prepared a development plan, as well as an Environment Charter.

B.1 Development plan

118. The main objective is to develop the Port Industrial Area (ZIP) while guaranteeing the safety of the industrial and urban population and to channel the port's development while maintaining stable options that are compatible with industrial projects:

Absence of dwellings in the ZIP;

Quality of sea, river and land access;

Simplicity of the design of road and rail access.

119. As a result of the reservation of technical corridors for water, electricity, gas and oil networks, the development plan meets the above requirements. An important role has been assigned to the petrochemical industry and to port activity, which create the most jobs. In addition to the major order-issuing industries, there are plans to expand areas for small and medium-sized sub-contracting enterprises. Labour-intensive activities are kept away from potentially dangerous industries in the north eastern part of the ZIP. These industries which are not very polluting are thus located preferably near the most sensitive sites. The plan also provides for measures to combat industrial nuisances; PAH either adopts these measures on its own or takes part in implementing them:

Monitoring of industrial and port liquid wastes; quality of water areas;

Monitoring of air pollution;

Destruction of liquid wastes;

Operation of the dump for ordinary solid wastes;

Treatment of toxic wastes dumped into the Seine (phosphate gypsum, titanium gypsum).

120. The plan also describes the major landscaping programme for the ZIP. More than 180 hectares of landscaped areas have been created since 1974 and are being carefully tended. In addition, there are 3,000 hectares of protected wildlands in the southern part of the ZIP. In order to protect the wildlands as long as possible, however, the ZIP will be developed from west to east (except for technical reasons or because of an industrial client's choice). This ecological concern makes economic sense because the most fully serviced plots of land are located in the western part of the ZIP.

B.2 The Environment Charter

121. While the main objective of the plan is to make economic development compatible with the protection of the population, that of the charter is to protect the local environment. The charter defines the rules of conduct to be followed and the areas to be protected:

Increased attention to the environment in major port development projects through impact studies; strengthening of action to combat and prevent industrial nuisances;

Conservation of wildlands;

Improved management of wildlands in the ZIP;

Increased cooperation with ecology associations and scientific experts;

Strengthening of the green-belt policy for the ZIP;

Environmental training for PAH staff members.

122. In specific terms, the following work is planned or has already been carried out:

Updating of biological studies;

Audit of accidental water pollution;

Quality objectives for port basins;

Expansion of a dump, together with stronger environmental measures;

New dump for building site rubble;

Monitoring network for soil and subsoil quality;

Development of wildlands;

Ecological management of rangeland and marshland;

Landscaped areas for new industries;

Landscape master plan for the ZIP;

Plant screen on the northern edge of the ZIP;

Environmental training for staff members, including lectures, field trips and practical exercises in combating accidental pollution.

123. This work was carried out in close cooperation with local communities, State agencies, industry, management and labour, and associations. When an industry moves in, waste quality objectives are specified in the authorization for its establishment and DRIRE ensures that waste standards are met. The industry has to follow increasingly European rules relating to the quality of liquid and gas discharges and destroy or neutralize wastes which do not meet effluent standards in specialized plants. Depending on its quality, industrial solid waste is either incinerated or dumped in ad hoc installations whose operation is supervised by the Port. Quality objectives are based on national and international objectives. PAH (for water monitoring) and DRIRE (for industry inspection) are working to implement the regulations in force.

C. Administrative powers

124. The recent problems of this kind were caused by the expansion of the Port in harmony with the protection of wildlands in the Seine estuary:

Phosphate and titanium gypsum discharges into the estuary (a solution is being found);

Fill from dredgings from Port expansion work sites (Paris Convention);

Establishment of a non-toxic industrial waste storage centre and an industrial waste destruction plant.

D. Environmental monitoring

125. Campaigns to increase the awareness of all persons working in the Port area were launched by PAH as a result of an audit by a specialized office (CEDRE) of risks of accidental water pollution. The Port plays a leading role in the industrial waste collection centre and ensures that Port industries and activities always have the necessary waste collection and destruction facilities. In the event of accidental water pollution, PAH (harbour master's office, dredging services), industries, service companies (tugs, pilots) and urban services (fire department, SAMU) work together to contain the damage and halt the pollution: alarm, setting up oil booms, recovering pollutants, using dispersants, etc. In the event of an accident of this kind, the role of the harbour master's office is to get clean-up operations under way.

E. Environmental protection - costs

126. PAH and the port industries have invested and continue to invest in environmental protection:

Rubbish bins and waste collection on port quays and storage yards; sweeping; cost to the Port in 1992: FF 5.2 million (MARPOL, annex V);

Equipment to combat water pollution: oil booms, skimming and cleaning platforms, dispersants; FF 5 million purchase plan over two years: oil cleaning platform and anti-pollution booms;

Tug equipment, fire-fighting equipment and use of dispersants; investment: 2 x FF 4 million;

Air quality monitoring and warning system; PAH participation: FF 0.1 million/year;

Establishment of a dump for industrial waste and a centre for the destruction of some of this waste; planned investment: FF 100 million in the first stage;

Desludging station:

FF 0.15 million contribution by the Port of Le Havre for desludging before ship repairs;

FF 5 to 10 million for desludging; service offered by the Industrial Shipping Company;

Landscaped areas in the Port Industrial Area in 1992: FF 2 million invested in 1992; maintenance: FF 2.54 million.

128. Special efforts have been made by port industries with regard to the treatment of air and water pollution and the prevention of technological risks. The most recent investments and decisions are:

Thann and Mulhouse, sulphuric acid treatment plant; entry into service: May 1993; FF 450 million;

TRD Total France, sulphur gas treatment plant; entry into service: 1993; FF 105 million;

Chevron Chemical, H_2S treatment plant; entry into service: 1993; FF 28 million;

Lafarge, improvement of the dust treatment plant, entry into service: July 1993; FF 10 million.

129. Le Havre is now more and more convinced that environmental protection is necessary for the city and the Port and that everyone must be involved.

Notes

1/ "Fair Principles for Sustainable Development" by E. Dommen, Editor - Aldershot, Edward Elgon Publishing.

2/ Study by P.G. Sadler and J. King (University College of Wales, Cardiff) submitted to thirtieth session of IMO's Marine Environment Protection Committee (see document MEPC 30/INF32).

3/ See "Port Reception Facilities and Discriminatory Port Taxation on SBT Tankers" by Y. Nighizana, Japanese representatives to the International Association of Independent Tanker Owners. Proceedings IMO/ESCAP Seminar on Environmentally-Sound Port Development and Management Yokohama, 1992.

4/ Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden and the United Kingdom.

ANNEX 1

ASIAN DEVELOPMENT BANK (ADB)

ADB CHECK LIST OF ENVIRONMENTAL PARAMETERS
FOR PORTS AND HARBOURS PROJECTS

Actions Affecting Environmental Resources and Values	Damages to Environment	Recommended Feasible Protection Measures
A. Actions Affecting Coastal Marine Ecology		
1. Location of harbour in fisheries reproduction	1. Loss of fisheries reproduction	1. Consider relocation of harbour site
2. Location of harbour in fisheries capture zones	2. Displacement of fishermen families	2. Relocation of fishing zones
3. Disposal of dredging spoils into fisheries reproduction zones	3. Loss of fisheries reproduction	3. Proper spoils disposal
4. Disposal of dredging spoils into coral beds	4. Loss of fragile/precious marine ecology	4. Proper spoils disposal
5. Oil spills/leakage within harbour which escape harbour area	5. Damage to marine ecology (fisheries/corals)	5. Improved routine and emergency control of oil leakage/spills
6. Oil spills from tankers on way to and from harbour	6. Damage to marine ecology (fisheries/corals)	6. Improved routine and emergency control of oil leakage/spills
B. Actions Affecting Recreational/Resort/ Beach Areas along Coastal Zone	B. Depreciation of Recreation Areas by:	
1. Location of harbour too close to recreational areas	1. Visible turbidity or discolouring of beach waters	1. Consider relocation of port or of resort
2. Escape of liquid and solid wastes from harbour area, especially floatables	2. Silt deposition along shoreline	2. Extraordinary attention to liquid/solid waste management
3. Air pollutant emissions from harbour ships/facilities	3. Visible floatable wastes	3. Extraordinary attention to air pollution control
4. Disposal of dredging spoils which reach along shoreline	4. Waste deposition along shoreline	4. Proper spoils disposal
5. Oil spills/leakage within harbour which escape harbour area	5. Oil firms on beach waters and shoreline	5. Improved spill/leakage control and improved emergency oil-spill clean-up
6. Oil spills from tankers on way to and from harbour	6. Contamination of beach waters (pathogenic hazard)	6. Improved emergency oil spill clean-up

Actions Affecting Environmental Resources and Values	Damages to Environment	Recommended Feasible Protection Measures
C. Actions Causing Unacceptable Sanitation Conditions in Harbour Area	C. Unsanitary Harbour Environment, including:	
1. Inadequate provision of water supply to port facilities and ships	(a) Unacceptable environmental activities	1. Extraordinary attention to water supply
2. Inadequate management of waste emissions from port facilities	(b) Health hazards to port and shipworkers	2. Extraordinary attention to waste management from shore facilities
(a) Liquid sanitary and industrial wastes	(c) Destruction of harbour fishery/ecology	3. Extraordinary attention to management from ships
(b) Solid sanitary and industrial waste	(d) Hazards for pollution of coastal areas by escape of wastes from harbour	4. Improved routine and emergency controls of oil leakages and spills
(c) Gaseous emissions from shore industries	3. Similar to A (1) (2) (3) (4) above	
3. Inadequate management of wastes from ships	4. Similar to A (1) (3) (4) above	
(a) liquid wastes, especially floatables including bilge waters		
(b) solid wastes, especially floatables, including garbage		
4. Escape of oils within harbour		
D. Handing of Hazardous Cargoes Within Harbour especially	D. Similar to A (1) (2) (3) (4)	D. Extra Careful Attention in Design/ Operations
1. Dust emissions (for example handling of coral and cassava dusts)	1. Air pollution and explosion hazards	1. Proper air pollution control
2. Hazardous materials (inflammables, explosives, toxic substances)	2. Health and safety of workers and nearby residents	2. Proper control of hazardous materials
E. Handling of materials to and from Habour		
1. Traffic congestion	1. Air pollution and explosion hazards	1. Proper air pollution control
2. Hazardous material spills (inflammables, explosives, toxic)	2. Health and safety of workers and nearby residents	2. Proper control of hazardous materials

Actions Affecting Environmental Resources and Values	Damages to Environment	Recommended Feasible Protection Measures
F. Actions Affecting Local Socioeconomics		
1. Inadequate housing for new population	1. Hazards for creating slums	1. Planning to prevent slum problems
2. Inadequate health precautions during construction (especially malaria)	2. Communicable disease hazards	2. Proper planning of construction worker facilities
(a) Communicable disease hazards from imported workers/carriers	(a) Proper precautions during construction	(a) Spraying of workers' camp for anopheline mosquito control
(b) Inadequate water supply and sanitation for workers	(b) Provision of adequate facilities	(b) Provision of adequate facilities
3. Changes in land use patterns:	3.	3.
(a) Displacement of agriculture	(a) Loss of agricultural values	(a) Appropriate resettlement
(b) Displacement of villages	(b) Displacement of villages	(b) - ditto -
4. Excessive noise from harbour operations	4. Health of harbour workers and nearby residents	4. Adequate noise control
G. Actions Affecting Terrestrial Ecology		
1. Adverse impacts on local forest	1. Similar to A (1) to A (6) above	1. Similar to A (1) to A (6) above
2. Adverse effects on wildlife from loss in forest habitat	2. - ditto -	2. - ditto -
3. Adverse effects on estuarine lagoons (fisheries, wildlife)	3. - ditto -	3. - ditto -
H. Actions Caused by Changes in Coastal Hydrology	H. Physical Damage to Coastal Facilities/Ecology	H. Careful Project Design with Respect to Hydrology, plus protection facilities
1. Deposition along nearby coastal areas	1. Damage to Resources	1. Proper engineering to avoid problems
2. Erosion along nearby coastal areas	2. - ditto -	2. - ditto -
I. Actions Affecting Precious Historical/ Cultural/Religious Monuments/Sites	I. Loss or Damage to Resources	I. Relocation or Protection Measures
1. By Displacement on submergence		
2. By alternations in coastal zone hydrology/shoreline		
J. Hazards from Access Roads/Traffic Leaving Harbour	J. Collision/Spill Hazards to Ships	J. Proper Design for Harbour Access
K. Navigation Hazards from Ships Entering or Leaving Harbour		

Source: Environmental Guidelines for Selected Infrastructure Projects, Office of Environment, ADB, 1990

ANNEX 2

WORLD BANK CHECK-LIST OF ENVIRONMENTAL IMPACTS FOR PORT AND HARBOUR PROJECTS

(Source: Environmental Considerations for Port and Harbour Developments, World Bank Technical Report No. 126, 1990.)

1.0. WATER-RELATED IMPACTS

1.1. Impacts caused by dredging

1.1.1. Dispersal and settlement of resuspended sediments:

Toxic, harmful substances in water column. Reduced available oxygen, sunlight penetration. Smothering bottom biota. Silt curtains to restrict dispersal. Relative impact of dredging methods. Knowledge of tidal and river flows.

1.1.2. Effects of blasting:

Compression effects. Indirect effects on fisheries. Damage to shorezone and bulkhead structures.

1.1.3. Results of altered bathymetry:

Influence on tidal and river flows. Altered salt wedge intrusion. Accelerated natural sediment deposition. Attraction of desirable or undesirable fisheries. Altered bottom biota.

1.1.4. Effects of changing shoreline configuration:

Change in current patterns. Shorezone and beach erosion. Accelerated sediment deposition - shoaling.

1.1.5. Loss of bottom habitat, shellfisheries, fishery food resources:

Exposed subsurface materials unconducive to recolonization. Lost attachment potential for aquatic biota. Current pattern changes.

1.1.6. Altered groundwater flows:

Salt water intrusion. Accelerated groundwater flow to estuary. Undermining of land-edge sediments. Salt water intrusion to potable water supplies.

1.2. Impacts of dredged material disposal

1.2.1. Selection of appropriate disposal site:

Disposal on land. Disposal in water. Desired character of disposal areas. Methods of dredging and dredged material transfer and related disposal impacts.

1.2.2. Unique Characteristics of Dredged Material

1.2.3. Disposal Methods

1.2.4. Disposal on land:

Drainage. Loss of vegetation. Disposal of contaminants (toxins). Slumping. Revegetation. Aquifer contamination. Leaching of salt, etc.

1.2.5. Disposal in water - harbour/river or at sea:

Dredged material transport and dumping methods. Loss of bottom biota. Biological recolonization rates. Potential or requirements for capping. Alteration of current patterns. Accelerated shoaling. Use of artificial islands.

1.3. Construction of piers, breakwaters and other waterside structures (new or extension/replacement of existing structures)

1.3.1. Filling or excavation covers/removes bottom biota and habitat:

Shellfisheries. Fishery food resources lost or displaced.

1.3.2. New habitats formed by structures (especially pilings and breakwaters): Desirable, undesirable species introduced.

1.3.3. Filled structures (including breakwaters):

Alter currents. Sediment deposition accelerated. Scouring increased. Change required in harbour maintenance dredging practices. New navigation routines. Protection of submerged pipelines.

1.3.4. Disturbance from pile driving, other construction activities:

Temporarily displaced fisheries and other mobile marine/estuarine resources.

1.3.5. Dispersal of suspended sediments:

Smothering of bottom biota. Reduced light penetration. Displaced fisheries.

1.3.6. Piling-supported structures - effects:

Shade bottom. Change habitat. Attract desirable or undesirable species. Accelerated sediment deposition. Increased berth maintenance dredging. Increased nearby bottom scouring.

1.3.7. Release of preservatives from installed wood structures:

Prevent borer establishment. Contaminate fisheries. Release heavy metals to surrounding waters.

1.4. Alteration of harbour/port ship traffic patterns

1.4.1. Changes in channel, anchorage and turning basin locations:

Dredging and dredge material disposal. Increased frequency of maintenance dredging (See Section 1.1.).

1.4.2. Relocation of navigation markers, moorings:

Assurance of location precision. Designation of channels for arrival/departure traffic.

1.4.3. Addition of new channels, anchorages, turning basins requiring improvement dredging. (See Section 1.1.).

1.4.4. Improved procedures for vessel traffic control (VTS) systems. Requirements for collision avoidance systems. Radar. Shore-based radar reflectors. LORAN-C, GPS, DECCA, etc. Requirements for ships using facility. Pilotage.

1.4.5. Increased provision for vessel handling and servicing:

Additional tugs, lighters, service vessels. Vessel repair facilities. Dry docks. Graving Docks.

1.5. Ship discharges - oily ballast; bilge water; sewage

1.5.1. Promulgation of regulations controlling cleaning procedures, limitations on release of cargo and machinery space residues. Discharge limitations - examples cited. Need for facilities to receive waste from ships. Means of storage and ultimate disposal of residual wastes.

1.5.2. Environmental sensitivity to discharges from ships. Importance to fishery resources. General water quality of rivers, bays, harbours. Effects if requirements not imposed or regulations not enforced.

1.5.3. Development of shore facilities for receiving ship generated sewage and garbage waste. Sanitary treatment facilities - connection to special or municipal systems. Transfer and pumping facilities. Ultimate disposal of these wastes.

1.5.4 Effects of antifouling paints:

Relation to ships in dock. Ships in repair. Repair and maintenance practices allowed, not allowed. Effects on biota in water, fisheries. Types of antifoulants - tibutyl-tin, copper based. Vessels berthed in shallow water.

1.6. Spills: detection and clean-up of spills

1.6.1. Type of Spills:

Oils, lubricants, hydraulic oils. Fuels. Liquid and solid chemicals. Behaviour in water. Likely causes of spills. Frequent spill sources - equipment, faulty practices.

1.6.2. Resources at risk:

Identify areas subject to spills. Aquatic resources most likely in jeopardy. Spill-prone areas. Shellfish resources. Fishery resources. Aquaculture operations.

1.6.3. Spill clean-up measures:

Regulations. Clean-up equipment available, to be added. Spill retention measure equipment, emergency procedures. Spill detection routines.

1.6.4. Dry cargo releases:

Fugitive emissions. Dust control. Enclosed loading and unloading systems. Smoke density and effects.

1.6.5 See also hazardous cargoes.

1.7. Waterfront industry discharges - sanitary and non-sanitary

1.7.1. Sanitary wastes:

Sources. Volumes. Special contaminants. Produced by project. Not produced by project.

1.7.1.1 Sanitary treatment facilities:

Existing. Planned. Proposed. Capacity of each. Locations. Discharge water quality - actual and designed. Ability to handle shipping.

1.7.2. Non-sanitary wastes.

Sources. Volumes. Important contaminants (toxins). Produced by project. Not produced by project.

1.7.2.1. Discharge/treatment procedures.

Capacities. Piping systems. How discharged/treated. Discharge limitations - imposed, actual. Residuals - actual, designed.

1.7.2.2. Discharges reaching harbour/river waters.

Behaviour in water, sediments. Dispersion. Settling tendencies. Chemical reactions in water. Effects on biota, aquaculture.

1.7.2.3. Possible needed retention and treatment systems:

Feasibility. Costs. Cost effectiveness. Possible resource recovery.

1.7.2.4. Non-sanitary spillage from non-ship related activities:

Types of spills. Frequency. Volumes. How handled. Retention/recovery systems. Emergency routines.

1.7.2.5. Non-sanitary discharges/releases from ship repair:

Paints. Paint compounds. Other chemicals - hydraulic fluids, etc. Antifoulants. Ship refuse.

1.7.3. Heated process water discharges:

Electricity generation. Industrial processes. LNG condensation. Port/harbour hydrography. Tidal prisms. Effects of heated water on biota. Use in aquaculture. Definition of mixing zones. Potential for blocking fish passage.

1.7.4. Brine from desalinization plants:

Efficiency of mixing. Salinity of receiving waters. Port/harbour hydrography. Tidal prisms. Efficiency of diffusion. Effects on biota, aquaculture.

2.0. LAND-RELATED IMPACTS

2.1. <u>Excavation for fill (rock and aggregated)</u>

2.1.1. Loss of upland-vegetation:

Cropland. Windbreaks. Degradation of upland appearance. Soil cover. Prevention of erosion. Mudslide potential. Flooding potential.

2.1.2. Damage from shore sand/gravel excavation:

Coastal dunes. Destabilization of shorezone. Acceleration of inland dune migration. Increased sandstorm frequency.

2.1.3. Dust (fugitive emissions):

From drilling. Truck traffic and construction equipment. Wind velocity, direction. Dust control and suppression measures.

2.1.4. Blasting and its effects:

Control of debris. Danger from inadequate blast zone coverage. Work area restrictions. Safety regulations. Damage to aquifers. Noise. Dust. Threats to livestock.

2.1.5. Requirements for land restoration:

Pre-construction assessment of land appearance. Aesthetics. Restoration techniques. Landscaping. Constructive use of restored land cover. Need for selection criteria for filled lands to avoid nearshore storm surge inundation.

2.2. Wetland damage and filling

Discussion of needs. Purpose.

2.2.1. Ecological value of wetlands:

Agricultural use. Waterfowl use. Use by domestic animals. Use by other fauna. Unique vegetation. Food source for aquatic or non-aquatic biota, irrigation water source.

2.2.2 Flood plain functions:

River flooding retention capacity. Tidal flooding capacity. Water retention intervals. Flooding related to irrigation source capacity.

2.2.3. Watershed/groundwater source quality:

Groundwater recharge function. Groundwater discharge function. Relation to used aquifer(s). Source of surface streams. Flow rates.

2.2.4 Run off (long term) from developed areas (including ports and harbour facilities). Receiving function for natural surface run off. Receiving area for development area run off - municipal, industrial. Existing contamination input. Contaminant build-up rates. Present background contaminant levels.

2.3. Loss of usable uplands to expanding waterfront/industrial areas

2.3.1. Types of land areas likely lost to industrial or waterfront use. Farmlands. Residential areas. Market centres. Commercial areas.

2.3.2. Extent to which relocation compensates for lost land use:

Extent of involuntary resettlement. Residential relocation. Replacement farmlands. Other replacement/relocation needs. Requirements for associated needs - water, sewer, electricity, roads, fuel, etc.

2.4. Noise from ports and harbourside industry

2.4.1. Planning for possible strategic location of noise sources. Determination of existing background. Prediction of noise addition. Buffer zones. Designation of special high noise areas. Control of construction noise. Suppression, muffled equipment.

2.5. Effects of dust and other airborne emissions

2.5.1. Dust and other non-combustion particulates:

Sources - industrial, construction. Raw material storage. Intensity. Periodicity. Wind rose indication of most likely affected areas. Smothering of shorezones and coral reefs. Screening by vegetation, windbreaks.

2.5.2. Smoke and other combustion products:

Sources - ships, traffic, industry. Emission composition (toxins). Control equipment in place, required. Regulatory requirements/limits. Wind rose data to indicate probable impact areas.

2.6. Traffic burden projections

2.6.1. Existing traffic load:

Roadway network. Traffic load. Accident data. Types of traffic. Periodicity. Weight loading. Pavement damage. Axle load limits, etc.

2.6.2. Projected traffic increases:

Needed roadway additions/improvements. Important routes. Traffic loads - commercial construction. Destinations. Needs for traffic control.

2.7. Handling and disposal of solid shore generated wastes

2.7.1. Important sources:

Ships. Waterfront industrial areas. Residential areas.

2.7.2. Means of transport/transfer:

Ship-to-shore. On shore. Vehicle types. Compactors. Intermediate collecting sites.

2.7.3. Disposal methods.

2.7.3.1. Incineration:

Proper siting. Possible recycling. Possible emissions (toxins, etc. - see Section 2.5.2.). Disposal of residual ash. Energy generation.

2.7.3.2. Landfills

Proper siting. Aquifer/groundwater protection. Need to protect shoreline from erosion, etc. Site preparation. Surface water control - run off. Proximity to water supplies - surface and subsurface, farmlands. Materials, deposited, including incineration ash. Avoid placement in nearshore areas subject to erosion. Use of filter cloths and silt fences.

2.8. Run off from raw material storage

2.8.1. Nature of materials:

Salt. Sulphur. Metal ores. Refined concentrates. Potential for toxic releases.

2.8.2. Exposure effects:

Typical storage conditions. Locations. Storage time. Weathering effects - rain, wind, sun. Health menace to workforce. Need for containment of run off. Protection of groundwater. Need for enclosure, cover. Grain spillage - measures to prevent/control.

2.9. Waterfront drainage

2.9.1. Drainage components:

Contaminants (toxins). Volumes. Oils (hydraulic, etc.).

2.9.2. Drainage collection systems:

Extent of existing systems. Pavement "watershed". Collection conduits. Means of disposal. Cleaning/skimming for oil separation.

2.9.3. Biological effects of disposal:

Effects if directed to rivers, streams, wetlands. Effects if directed to harbour, bay. Effects on fisheries, aquaculture.

2.10. Industrial liquid wastes not discharged to harbour

Possible hazardous/toxic.

2.10.1. Storage and handling methods:

Storage sites. Containment structures and materials. Proper placement and management. De-toxification options. Recycling possibilities.

2.11. Visual impacts - location. Aesthetics

Structure. Painting. Attempts to blend with surroundings.

3.0. AIR-RELATED IMPACTS

3.1. Important background information

3.1.1. Meteorological Data:

Prevailing winds. Seasonal weather patterns. Storm tracks, frequency and severity. Rainfall records. Wind rose data. Identify probable downwind impact areas.

3.1.2. Background data on prevalence of present airborne substances:

Individual carrying/travel capacities. Chemical reactions while airborne. Chemical reactions with water.

3.1.3. Identify sensitive areas:

Farmlands. Forests. Grazing lands. Residential areas. Water reservoirs.

3.2. Fugitive emissions (see also Section 2.5.)

3.2.1 Sources and control measures:

Dust - types, sources. Wetting and other control measures. Enclosed conveyor loading systems for ships loading dry cargo. Construction activities.

3.3. Gases, smoke and fumes

3.3.1. Sources, components, controls:

Industrial contributions. Ships. Residential background. Vehicle emissions. Background from other areas. Control measures. Regulatory limits. Health-threatening toxins. Threats to agriculture and fisheries.

4.0. HAZARDOUS MATERIAL/CARGOES

4.1. Categories - gases, liquids, solids:

Examples. Hazardous rating. Condition - required for industrial processes, waste products, finished products.

4.1.1. Key considerations:

Identity of materials. Volumes/quantities usually on hand. How stored. Location of storage areas - segregation. Shipping and handling procedures. Bunding and other containment precautions associated with bulk storage and tank farms. Disposal of any hazardous wastes generated.

5.0. SOCIO-CULTURAL IMPACTS

Tribal, cultural, ethnic, historical, religious aspects likely impacted by changes, including consequences of modernization and industrialization. Landscape factors integrated with culture, traditions, etc. How affected. Possible measures easing transition. Preserving traditions with minimum loss and disturbance. Removal of graveyards, etc.

6.0. REVIEW OF EXISTING AND PROPOSED REGULATIONS AFFECTING THE PROPOSED PORT OR HARBOUR DEVELOPMENT AND ITS CONSTRUCTION

Environmental. Safety. Financial. Criminal. Export-import. Labour. Foreign consultant/labour use. Laws, regulations tied to socio-religious traditions, etc.

7.0 NEED FOR CONSTRUCTION OR FACILITY OPERATION ENVIRONMENTAL MONITORING

Basis - Most Sensitive Environmental Considerations. Programme Planning. Management and Regulation Enforcement. Programme termination.

ANNEX 3

BRITISH PORTS FEDERATION ENVIRONMENT

CODE OF PRACTICE

BPF ENVIRONMENTAL STATEMENT

Each member of the British Ports Federation, pledges to:

1. Abide by environmental legislation and internationally agreed conventions, directives and resolutions intended to protect the environment which are supported by the United Kingdom Government.

2. Act within the spirit of the law and other agreements, according to the ethic of environmental protection.

3. Take voluntary steps to consider wherever possible and appropriate the improvement of environmental standards beyond those currently required under statute.

4. Nominate a member of staff from a senior management position to take responsibility for coordinating policy and action on the environment.

5. Establish an Environmental Management System (EMS) to introduce environmental protection as an integral part of the business and management practice. The EMS seeks to:

   - Promote the environmental ethic to others within the port and those associated or connected with it, and promote, if necessary by means of introducing a training scheme, the importance of individual responsibility toward the implementation of the EMS.

   - Promote good public relations which should encompass where necessary consultation with local communities, local authorities, and relevant environmental agencies.

   - Establish plans of preparedness to counter any potential incidents in the port area liable to cause environmental harm.

   - Make regular reviews and reappraisals of the Environmental Code of Practice and the EMS to take account of the latest advice resulting from the findings of the most recent research relating to the environment, the dynamics of trade, the economy and legislative and social trends.

6. Make available where possible appropriate resources to support research into environmental issues associated with the industry's activities.

ANNEX 4

INTERNATIONAL ASSOCIATION OF PORTS AND HARBOURS

18th WORLD PORTS CONFERENCE

Resolution No. 2

Ships' Port Fees

Whereas, Resolution No. 4A, adopted by the 17th IAPH Conference in May 1991 recommended that IAPH members encourage the use of safe technology for tankers by tariff and fee adjustments;

Whereas, since that time the United Nations Conference on Environment and Development in Rio de Janeiro in 1992, has urged the full and active participation of all major groups, including IAPH, to enhance the sustainable development while protecting the environment including that of our port areas;

Whereas, the objective of a clean port environment would be advanced by encouraging the presence of safe ships of all types in our ports as well as the good management of the ship in port; and

Whereas, different reward systems can be of use to promote such environmentally friendly equipped and operated ships.

Now therefore, IAPH whilst acknowledging that implementation of such initiatives is a local responsibility, acting at a plenary session of the 18th Conference hereby:

RESOLVES that as an initiative in pursuit of the goal of sustainable economic and operational development of ports, the members of IAPH should consider incentives toward that end, which might include adoption of a Scheme in which environmentally friendly equipped and operated ships are encouraged in the structuring of port tariffs and fees.

SYDNEY (AUSTRALIA)

23 APRIL 1993.
