1999

# Impact of the new Annex VI of MARPOL and its entry into force

Nestor O. Perez
*World Maritime University*

**WORLD MARITIME UNIVERSITY**
Malmö, Sweden

# Impact of the New Annex VI of MARPOL and its Entry into Force

By

**Nestor O. Perez**

**Panama**

A dissertation submitted to the World Maritime University in partial fulfillment of the requirements for the award of the degree of

**MASTER OF SCIENCE**

in

**MARITIME SAFETY AND ENVIRONMENTAL PROTECTION**

**(Operational)**

1999

## DECLARATION

I certify that all the material in this dissertation that is my own work, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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20 August 1999

Supervised by:
Name:
Office:

Assessor:

| | |
|---|---|
| Name: | Jan Horck |
| Office: | Lecturer |
| Institution/organization: | World Maritime University |

Co-assessor:

| | |
|---|---|
| Name: | John Ostergaard |
| Office: | Senior Adviser on Marine Pollution<br>Marine Environment Division |
| Institution/organization: | International Maritime Organization |

## ABSTRACT

Title of the Dissertation: **Impact of the New Annex VI of MARPOL 73/78 and its Entry into Force**

Degree: **MSc**

This dissertation is a study of the new Annex VI of MARPOL 73/78, its impact to all the various industries, as well as governmental agencies and the possible impediments for its entry into force.

The first chapter after the introduction is geared to provide enough background information for the proper understanding of the chapters that follow. Information will be provided about air pollution, air pollution caused by ships and MARPOL 73/78.

The annex is then broken down, and analyzed, including a brief background of the annex. The regulations that specifically address the control of various emissions are listed and analyzed. These regulations include ozone depleting substances, NOx, SOx and volatile organic compounds.

The next two chapters deal specifically with the impact that the regulations contained in the annex will have to the different sectors, which leads to the next chapter where the most controversial areas of the annex are singled out and analyzed.

The concluding chapter recapitulates the main points illustrated in the preceding chapters, stresses the impact of the annex and identifies the areas of conflict for the entry into force of the annex. Also, a list of recommendations is included, which could be used by those administrations that are considering the ratification of the annex, but still have some doubts.



**KEYWORDS:** Annex VI, Air Pollution, NOx, SOx, Ozone Depleting Substances

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**Appendices**

## LIST OF ABBREVIATIONS

| | |
|---|---|
| BIMCO | The Baltic and International Maritime Council |
| BSFC | Brake Specific Fuel Consumption |
| C | Carbon |
| CFCs | Chlorofluorocarbon(s) |
| CIMAC | International Council on Combustion Engines |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| CONCAWE | The Oil Companies' European Organization for Environment, Health and Safety |
| EAPPC | Engine Air Pollution Prevention Certificate |
| EGR | Exhaust Gas Recirculation |
| GRT | Gross Registered Tonnage |
| HC(s) | Hydrocarbon(s) |
| HCFC(s) | Hydro-chlorofluorocarbon(s) |
| HFC(s) | Hydro-fluorocarbon(s) |
| HFO | Heavy Fuel Oil |
| HSFO | High Sulfur Fuel Oil |
| IAPPC | International Air Pollution Prevention Certificate |
| ICS | International Chamber of Shipping |
| IMO | International Maritime Organization |
| INTERTANKO | International Association of Independent Tanker Owners |
| ISO | International Standard Organization |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| MDO | Marine Diesel Oil |
| $N_2$ | Nitrogen Gas |
| NOx | Nitrogen Oxides |

| | |
|---|---|
| ODP | Ozone Depletion Potential |
| ODS | Ozone Depleting Substances |
| PCB(s) | Polychlorinated biphenyl(s) |
| PFC(s) | Perfluorocarbon(s) |
| PSC | Port State Control |
| PVC(s) | Polyvinyl Chloride |
| RDS | Residue De-sulfurization |
| SCR | Selective Catalytic Reduction |
| SFOC | Specific Fuel Oil Consumption |
| SECA(s) | SOx Emission Control Area(s) |
| $SO_2$ | Sulfur Dioxide |
| SOLAS | International Convention for the Safety of Life at Sea |
| SOx | Sulfur Oxides |
| UNCLOS | United Nation Convention of the Law of the Sea |
| VEC(s) | Vapor Emission Control Systems |
| VOC(s) | Volatile Organic Compounds(s) |

# CHAPTER I

## Introduction

As we head towards the next millenium, preservation of the environment has become one of the priorities on a global scale. The realization that the harm done to the environment could be irreparable and could affect future generations has led to a worldwide effort to control different sources of pollution.

Among the types of pollution, air pollution is one of the major concerns of the global community due to the its contribution to phenomena like ozone depletion and global warming. These phenomena are of great worry, because they could have such damaging effects that could change the earth as we know it today.

Foreseen the future consequences, the world has come together to take preventive measures that will prevent further deterioration of the environment by air pollution. International conventions and agreements had taken place to curb emissions of damaging gases and to restrict the production of other substances.

Following that trend, the shipping industry has recently become the target for future control of air pollution caused by ships. These controls, which are expected to come into force within a few years are contained in a new annex to the International Convention for Pollution Prevention 73/78 (MARPOL 73/78), which is the most important convention regarding the regulation and control of different types of pollution caused by ships. The entry into force of the new requirements will depend on the ratification of the same, by countries that are party to the MARPOL convention.

The development of these regulations was conducted at the IMO under the close scrutiny of governments, members of the maritime industry, other related industries and environmentalist groups. The development of these regulations took several

years and it was surrounded by controversy due to its economic implications and other political issues.

Even when most people recognize and accept that there is a need to protect the environment, there has been some skepticism to whether the measures that have been taken were appropriate. This is in part because the degree to which ships contribute to air pollution has been very difficult to quantify. In regards to the new annex, some groups think that the regulations are too lenient, while others think that the are too stringent and that the financial implications are too much to bear for the shipping industry and some governments.

As any new set of regulations, they will have an impact on a range of different sectors associated with the maritime industry. The sectors that will be affected the most are: ship operators, engine builders, bunker suppliers and administrations. Being the ships the main focus of these new requirements, ship operators will have to carry most of the burden that arises from the proper implementation of the new regulations, although some other sectors could also be greatly affected.

The aim of this paper is to identify the sectors affected by the new requirements, to analyze the impact to these sectors arising stem from the compliance with the regulations and to identify and analyze the regulations of more impact. This will lead to the final identification of some of the areas that may affect the entry into force of the annex.

To accomplish this, background information will be provided first. This information includes facts about air pollution and how ships contribute to air pollution, also a brief introduction to the MARPOL 73/78 will be provided.

Then, a review of the annex will be conducted, including background information of how the annex was developed. After that, each specific regulation will be matched to the industry or government entity that it affects and its impact will be analyzed.

Once the various sectors that will be affected and how they will be affected have been established, the requirements of greater impact will be isolated. These regulations are the ones that are more likely to create doubts among governments and that may interfere with their decision to ratify this new annex. These requirements will be analyzed more in detail.

The analysis performed and the conclusions and recommendations reached in this paper will provide factual as well as insightful information about the impact of the annex to the various industries and governments. This information could be used by administrations when considering the ratification of the annex.

Due to the fact that the topic selected is current, that annex has not come into force yet, and that real effects will not be seen until the entry into force, the collection of information proved not to be as easy as expected. Because of the lack of published books on the topic, most of the information provided comes from periodicals and conference proceedings. Some of the views expressed in the report are solely the opinion and inferences of the author, which are based on the analysis of the information gathered and knowledge gained while attending the Maritime Environmental Protection Committee and the Conference that adopted the annex.

# CHAPTER 2

# Ships and the Environment

## 2.1 MARPOL 73/78

The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78), has been ratified by 100 countries representing 93% of the world's tonnage of merchant shipping (IMO Acts to Clear the Air, 1997, 47). It is the most important international convention regarding the control of pollution of the seas from ships. The convention contains 6 technical annexes, although only four have come into force to this date.

In the last twenty years the environmental performance of the shipping industry has been greatly improved. This has been accomplished by the widespread implementation of the provisions contained within the IMO MARPOL 73/78 annexes I and II covering the prevention of harm to the environment by reducing pollution by oil and chemicals into the oceans (Setting Environmental Standards for Ships, 1998, 6).

MARPOL was initially developed to reduce the pollution by oil and chemical substances originated from the normal operation of ships or from accidents. In order to accomplish that task, annexes I and II required ships to install equipment to reduce waste generated; to monitor or limit discharges to the sea; to follow operational procedures to minimize waste; to maintain oil and cargo record books for transfers and discharges; to meet design and stability criteria; and to be inspected and certified for compliance (Navigation and vessel inspection circular No. 4-87).

The proper implementation of the regulations contained in these two annexes has always been questioned, especially at an early stage. Even so, one fact that cannot be denied is that these annexes have improved the conditions of the oceans and

coastlines, which could be said that it has been improved by a factor of four (Pattofatto, 1995,4).

The trend to improve the quality of the seas was followed by the development of two annexes covering the discharge of garbage and sewage respectively. Unfortunately, the later is still pending ratification.

The requirements for the control of sewage can be found in annex IV. This annex gives provisions for the adequate discharge of sewage through the use of sewage treatment plants into the ocean. It also requires governments to provide reception facilities for the proper disposal ashore.

The regulations for garbage, contained in annex V of the convention were designed to reduce the amount of garbage being dumped into the sea from ships and to prevent the disposal of non-biodegradable products into the sea. The annex prohibits the discharge of plastics, restricts the discharge of other types of garbage into coastal waters and special areas, and requires governments to provide adequate reception facilities for the discharge from ships.

The latest set of regulations to become part of MARPOL, annex VI, is geared to reduce air pollution caused by ships. Although air pollution is an issue of current importance, most of the existing international agreements made to reduce the amount of damaging emissions into the atmosphere address only land based industries.

The first binding rules of a global nature concerning atmospheric pollution are found in the United Nation Convention on the Law of the Sea (UNCLOS). Under this convention it is stated that states must adopt laws and regulations to prevent, reduce and control pollution of the marine environment from or through the atmosphere. These laws and regulations should apply to the states' air space, and to the vessels and aircraft flying their flag or under their registry. States must also take other

measures, which may be necessary to prevent, reduce and control such pollution (Kiss & Shelton, 1991, 231).

The new annex is the first instrument that establishes specific regulations to control air pollution caused by ships. Under the annex there are restrictions on diesel emissions, refrigerants and fuel quality among others and it also sets new operational requirements for ships, new control measures, and the need for the development of new technology.

As of March 1, 1999, only two countries have ratified the annex, Norway and Sweden, and its entry into force is still pending.

## 2.2 Air Pollution

The problems related with air pollution have increasingly become the focus of attention as we become more aware of its long term damaging effects. Agents that cause this type of pollution have been studied thoroughly to learn how exactly each pollutant affects the environment. Continuous research and monitoring is carried out in order to be able to control the level of these gases in the atmosphere, to find new agents that may also contribute to pollution and to and take preventive measures as necessary.

The sources of air pollution are numerous, and include heating plants, both industrial and domestic, industrial processes, waste incinerators, automobiles and other transport vehicles. The amount of pollutants that are emitted will vary from one area to another, and will depend on the type and concentration of human activities and on the measures that have been taken to reduce emissions (Kiss & Shelton, 1991, 227).

Comparing it to water and soil, where pollutants may exercise long-term effects, the atmospheric medium is more transitory. Most pollutants generally remain a short time, undergo modifications in their composition and are returned to one of the other

environmental sectors. However, even their short term presence pollutes the air and besides, pollutants increase most quickly and travel the greatest distances in the atmosphere (Kiss & Shelton, 1991, 227). Also there are some pollutants that when release into the atmosphere could linger for many years.

Atmospheric pollution has been defined in the Covention on Long-Range Transboundary Air Pollution (1979) as "the introduction by man, directly or indirectly, of substances or energy into the air resulting in deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems and material property and impair or interfere with amenities and other legitimate uses of the environment."

The effects caused by the release into the atmosphere of substances that affect the world's ecology can be categorized into: ozone depletion, green house effect and acid rain.

### 2.2.1 Ozone Depletion

The ozone layer is formed by molecules, which contain three atoms of oxygen instead of the normal two. This layer protects us from the harmful effects of certain wavelengths of ultra-violet (UV) light from the sun. A decrease in ozone will result in an increase of UV radiation, which could in turn result in an increase in skin cancers, suppression of the immune system, exacerbation of eye disorders including cataracts, reduction of plant yields, damage to ocean eco-systems, reduction of fish yields, adverse effects on animals, and damage to plastic materials (Ozone Treaties).

Ozone depletion is caused by the release to the atmosphere of chlorine and bromine compounds, which once in the stratosphere decompose, because of ultra violet radiation, and release the chlorine and bromine atoms. These atoms react with the ozone molecules, causing a reaction that leads to its depletion (Ozone depletion process).

The ozone depletion potential or ODP is a measure of the destructive potential of a particular substance relative to depletion caused by an equal amount of a reference substance. CFC-11 is typically defined as the standard reference compound and is assigned an ODP of 1.0 (Ozone-depletion and chlorine-loading potential of chlorofluorocarbon alternatives). In table 2.1, the ozone depletion potential of some of the most commonly used halons and CFCs can be observed.

**Table 2.1 Ozone Depletion Potential of Halon and CFCs**

| Materials | Chemical Formula | ODP | Remark |
|---|---|---|---|
| CFC-11 | $CFCl_3$ | 1.0 | Coolant Name R-11 |
| CFC-12 | $CF_2$ | 1.0 | Coolant Name R-12 |
| CFC-115 | $C_2F_5Cl$ | 0.6 | Coolant Name R-115 |
| HCFC-22 | $CHF_2Cl$ | 0.04 - 0.06 | Coolant Name R-22 |
| Halon 1301 | $CF_3Br$ | 10.0 | Extinct Gas |
| R-502 | $CHF_2Cl$ /$C_2F_5Cl$ | 0.3 | Mixture R-115 & R-22 |

**Source: Takarada, 1995, page 525**

### 2.2.2 Acid Rain

The major cause of acid rain is the release into the atmosphere of the gases formed when burning fossil fuels. The main two chemicals that contribute to the creation of acid rain are sulfur dioxide (SO2) and nitrogen oxides (NOx). Acid rain usually forms high in the clouds, where sulfur dioxide and nitrogen oxides react with water, oxygen and oxidants. This mixture forms a mild solution of sulfuric and nitric acid. Rainwater, snow, fog and other forms of precipitation containing those mild solutions of sulfuric and nitric acid fall to the earth as acid rain, which can have damaging effects to plants, forests, crops, structures and lakes (Acid from the clouds).

SOx and NOx compounds also fall back to the earth in a dry form in the shape of gases and particles. About fifty percent of the acidity found in the atmosphere gets back to the earth in the form of dry depositions, which are blown into buildings, trees and other surfaces. These particles are sometimes washed off from the trees and other surfaces by the rain. When this occurs, the acids in the runoff water join the acid rain, making the combination more acidic than the rain alone. The combination of acid rain plus dry deposited acid is called acid deposition. (Environmental effects of acid rain)

### 2.2.3 Global Warming

Global warming is an increase in the Earth's temperature caused by too many greenhouse gases. Excess amounts of carbon dioxide, methane, and nitrous oxide into the atmosphere create a layer that results in trapping too much infrared heat from the sun, causing an increase in the Earth's temperature. As the Earth's temperature rises, so does the ocean water level and the ice caps begin to melt, which could lead to mass flooding in low lying areas (What is the greenhouse effect?)

## 2.3 Air Pollution from Ships

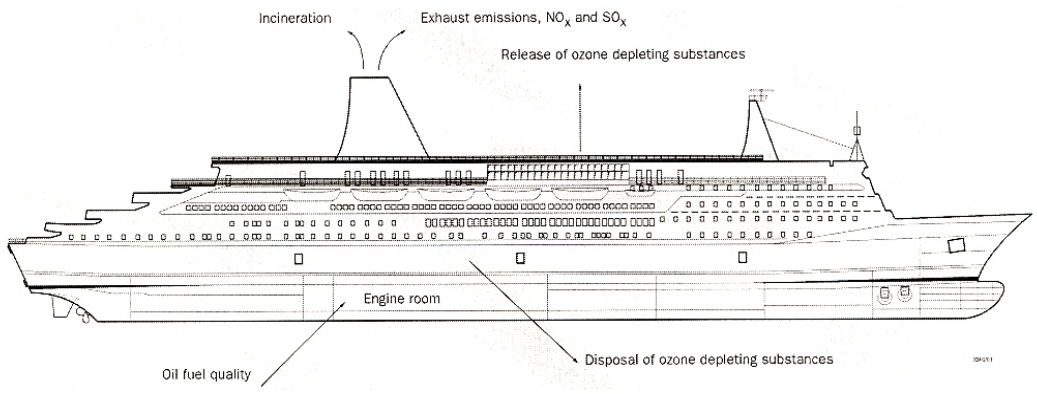
A little over a decade ago, the shipping industry was little concerned about air pollution, and more attention was paid to the problems of oil spills, leakage and other forms of emissions to the sea. Today the industry must take account of the new Annex VI to the MARPOL 73/78 Convention, on Prevention of Air Pollution from Ships, which will control emissions from ships (Evans, 1999). This is the first time the IMO has addressed vessel pollution as a factor in the deposition on land of environmentally harmful substances, such as those causing acid rain, as opposed to those affecting sea pollution.

The requirements of the IMO protocol were created adhering to the precautionary principle of the declaration of Rio. This principle, number 15, states "In order to protect the environment, the precautionary approach shall be widely applied by states

according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

Air pollution from ships is mainly caused by the discharge into the atmosphere of emissions from engines, which is comprised of gases like nitrogen oxides (NOx) and sulfur oxides (SOx). There are other chemicals utilized onboard ships that also contribute to the detriment of the environment, affecting the ozone layer and contribution to the green house effect, like chluoroflorocarbons (CFCs) and halons. In figure 2.1, the areas of a ship that contribute to pollution could be appreciated.

**Figure 2.1 Areas of Pollution Control**




**Source: Controlling Air Pollution from Ships, 1998, page 6**

The amount of pollution for which ships may be held responsible for and its impact to the environment has been a source of debate. Different studies have shown different figures indicating the contribution to air pollution by ships. This is a probable reason why the developments of the requirements regarding air pollution from ships took so long.

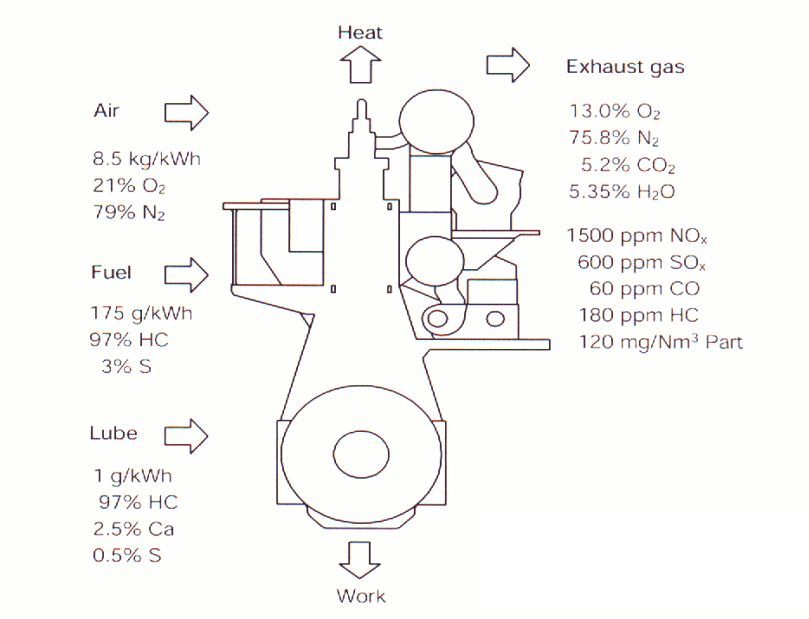
Even if a standard figure could not be attained, it is an undeniable fact that ships do contribute to global and regional air pollution, but how much, is very dependent on where and how the study was conducted. It is also well known that the contribution

of ships to air pollution is less than other means of transport, in terms of emissions released compared to the amount of cargo transported.

Another fact that is also undeniable is that the effects of emissions released from ships have a greater impact to the environment in busier shipping lanes, harbors, ports, and inland waterways. For example, gases that cause acid rain have a minimal impact when released into open seas, since most of the particles will end up in the ocean having very little consequences (The Motorship, 1995, 73).

Exhaust emissions from marine diesel engines largely comprise nitrogen, oxygen, carbon dioxide and water vapor, with smaller quantities of carbon monoxide, oxides of sulfur and nitrogen, partially-reacted and non-combusted hydrocarbons and particulate material, which can be observed in figure 2.2. Of these emissions, SOx and NOx, together with carbon dioxide, are of special concern as threats to human health, flora and the environment.

**Figure 2.2 Typical Emissions from an MC Type Low-Speed Engine**




**Source: Emission Control Two-Stroke Low-Speed Engines, page 2**

The major agents that contribute to air pollution and are a result of the operation of a ship are: chhluorofluorocarbons (CFCs), halons, nitrogen oxides (NOx), sulfur oxides (SOx), volatile organic compounds (VOCs) and carbon dioxide (CO2). Although carbon dioxide is one of the major contributors to global warming, it is not controlled under the provisions of the new annex. Currently, the IMO is working towards the future inclusion of CO2 as part of annex VI and consequently it will not be discussed in this paper.

### 2.3.1 CFCs (Chlorofluorocarbons)

These are non-toxic, non-corrosive and non-flammable chemicals that have been used in great quantity in industry for refrigeration, air conditioning, and in consumer products. Chlourofluorocarbons are used onboard ships for several purposes, such as for ship cargo refrigeration, refrigerated containers, air conditioning, ship domestic refrigeration and insulation for cargo area or containers. A list of equipment that utilizes CFCs onboard ships is provided in figure 2.2.

CFCs and their relatives, when released into the air, rise into the stratosphere, a layer of the atmosphere high above the earth. In the stratosphere, CFC's and their relatives take part in chemical reactions, which result in reduction of the stratospheric ozone layer, which protects the earth's surface from harmful effects of radiation from the sun. CFCs break apart in the atmosphere and releases chlorine atoms, which cause ozone depletion (Ozone Depletion Process).

### 2.3.2 Halons

Halons are low-toxicity, chemically stable compounds that have been extensively used for fire and explosion suppression and enclosure insertion for the past twenty years. Halon 1211 is a liquid streaming agent used mainly in hand held fire extinguishers, and halon 1301 is a gaseous agent used mainly in total flooding systems (Halon-recycling and banking to help protect the ozone layer).

UV radiation decompose halons in the stratosphere, which releases bromine atoms. These bromine atoms react with ozone molecules and contribute to ozone depletion. For this reason, The production of halon was discontinued in January 1994 (Takarada, 1995, 522). A list of the equipment that uses halon onboard ships is provided in table 2.2.

**Table 2.2 Major Equipment Onboard Using Halon and CFCs**

| Equipment | Uses | Major Materials |
|---|---|---|
| Refrigerator | Coolant | HCF-22, CFC-12 |
| Air Conditioning | Coolant | HCF-22, CFC-12 |
| Low Temp. Instrument (Ice Chamber Cooler) | Coolant | CFC-12, R-502 (Mixture CFC-115 & HCFC-22) |
| Heat Insulating Material (Hrad Urethane Foam) | Foaming | CFC-11 |
| Fire Extinguishing Installation (Extinct Gas) | Fire Fight | Halon 1301 |
| Sea Container | Coolant, Insulat. | HCF-22, CFC-11 |
| Paint (Rubber Chloride, Polyolefine Chlorination) | Solvent | Carbon Tetrachloride |

**Source: Takarada, 1995, page 525**

### 2.3.3 Nitrogen Oxides (NOx)

It is a gas, which is produced from burning fuels including gasoline and coal. Some of the NOx formed results from the oxidation of $N_2$, and the rest from nitrogen compounds present in the fuel. They are formed within the sprays of burning fuel during combustion; with temperature and oxygen content being the dominant parameters. Nitrogen oxides are smog-formers, which react with volatile organic compounds to form smog (Emission Control Two-Stroke Low-Speed Diesel Engines, 4). They are also considered major components of acid rain.

### 2.3.4 Sulfur Oxides (SOx)

SOx is the result from the oxidation of sulfur in the fuel when burned in engines or boilers. It is mostly $SO_2$ and about 5% $SO_3$, which forms sulfuric acid at temperatures below their dew point. It can be controlled only by either removing the sulfur from the fuel or partly removing it from the exhaust gas by cleaning (Emission Control Two-Stroke Low-Speed Diesel Engines, 4). The major effect of SOx, is its contribution to the formation of acid deposition.

### 2.3.5 Volatile Organic Compounds

Organic chemicals all contain the element carbon (C). They are the basic chemicals found in living things and in products derived from living things such as coal, petroleum, and refined petroleum products. Volatile chemicals produce vapors readily at room temperature and normal atmospheric pressures. These vapors escape from volatile liquid chemicals. Volatile organic chemicals include gasoline, industrial chemicals such as benzene, solvents such as toluene and xylene, and tetrachloroetylene. Many volatile organic chemicals are also hazardous air pollutants; for example, benzene causes cancer (Clear Air Act Definitions).

# CHAPTER 3
# Annex VI of MARPOL 73/78

## 3.1 Background

The concern about global warning, atmospheric pollution and ozone depletion is of current importance and it keeps on getting more attention, although this has not always been the case. The damaging effects of certain gases released into the atmosphere have only been identified within the last thirty years. When the world first started to realize the consequences of these toxic gases, it caused real concern and serious consideration was given to the problem (Lang, Nehold, Zemanek, 1991, 1). This problem was initially identified by industrialized countries, which had started to see the damaging effects of these gases and have tried to tackle the problem at regional levels.

After the real magnitude and the seriousness of the problem was clearly seen and the fact that it wasn't only a local but a global problem was realized as well, it was then taken to international forums. At first, agreements between nations were very difficult. It was mainly because some of the evidence was only in the form of theories. Problems like global warming by greenhouse gases or the depletion of the ozone layer had not been studied for long enough time and objective evidence was not available.

Even though scientific prove was not available, governments decided to take appropriate action due to the seriousness of the problem and to the transboundary effects of this kind of pollution. Meaning that, pollutants released into the atmosphere in a particular country could not only affect the country itself, but also adjacent countries and even the whole globe.

For this reason, instruments like the 1979 Geneva Convention on Long-Range Transboundary Air Pollution, The 1985 Vienna Convention, The 1987 Montreal

Protocol on Chlorofluorocarbons, and lately the Kyoto Protocol on Greenhouse Gases were established. These instruments tackled the problem by restricting the levels of emissions in countries, limiting the trade of certain substances and banning the production and use of certain agents, but they didn't specifically address the air pollution caused by ships.

Since traditionally the IMO is the entity who regulates the maritime industry, it was up to them to create the legislation regarding the emissions from ships. It wasn't until the mid-eighties when the first talks about air pollution by ships took place at the Marine Environmental Safety Committee (MEPC).

The first submission to the IMO was made by Norway, which had already been experiencing some of the effects of this kind of pollution, like acid rain (De Bievre). After it was introduced to the IMO, it was then made part of the work program in 1990 and the work was started. At the time, developing new requirements for air pollution was uncharted territory for the IMO.

In 1991 through Resolution A.719 (17), on Prevention of Air Pollution, instructions were given to start the drafting of a new annex to MARPOL. Work was carried out in the Air Pollution working Group of the Sub-Committee on Bulk Chemicals with the expertise of some of the northern European countries, which had already started to take action through recommendations of the Helsinki Commission. Other countries like the United States, which had done extensive research in the area, also contributed to the development of the annex.

The work was done in the IMO spirit using the existing international conventions or agreements on air pollution as framework conventions. The process to develop a set of requirements to prevent air pollution from ships took about six years. After all those years of work, on September of 1997, an International Conference of parties to MARPOL 73/78 was convened and the new Annex VI to reduce air pollution from ships was adopted.

The Conference, which adopted the new Annex, was quite a difficult one. Member countries could not come to an agreement on several of the provisions, in particular the sulfur content of fuel oil. Negotiations took place until the night before the end of the Conference, at which point the Conference faced the possibility of failing. Member countries finally came to a compromise and the new annex through the protocol of 1997 was made part of MARPOL 73/78, which currently consists of five technical annexes containing measures to prevent pollution by oil, chemicals, harmful substances in packaged form, garbage and sewage.

## 3.2 General Review

The new annex will come into force 12 months after a number of at least 15 member states with a combined fleet of 50% of the world's merchant fleet have ratified the annex. If by December 31st 2002, enough countries to make it come into force haven't ratified the annex, the IMO will initiate as a priority matter a review to identify the impediments for the entry into force.

The Annex applies virtually to all ships in both domestic an international trade setting limits on sulfur oxide and nitrogen oxide emissions from ships exhausts and prohibits the deliberate emission of ozone depleting substances. The Annex VI consists of three Chapters and five Appendices.

### 3.2.1 Chapter I - General

This chapter specifies that it is applicable to all ships regardless of the trading area, except where expressly provided otherwise. It also states that the annex will no apply to those emissions that are necessary for the purpose of securing the safety of a ship or saving life at sea or to any emission resulting from damage to the ship or its equipment, provided that all possible precautions have been taken and there is no intent to cause damage.

### 3.2.2 Chapter II – Survey, Certification and Means of Control

This chapter covers the requirements for surveying ships and the intervals for surveys, in order to ensure that they comply with the provisions of the annex. It requires that all ships from 400 GRT and above should have an Air Pollution prevention Certificate, which is necessary to demonstrate that the ship is in compliance with all the requirements, including the prescriptions of the NOx Code. It also covers the operational requirements for port state control, including provisions for the detection of violations and for its enforcement. It also states that Administrations may establish alternative measures that are appropriate to ensure that vessels under 400 GRT comply with the requirements of the annex.

### 3.2.3 Chapter III – Requirements for Control of Emissions from Ships

This chapter sets out the specific requirements for the prevention of air pollution from ships, as regards to ozone depleting substances, nitrogen oxides (NOx), sulfur oxides (SOx); and volatile organic compounds. It also covers requirements for shipboard incineration; provision for reception facilities, fuel oil quality, and requirements for drilling rigs and other platforms.

### 3.2.4 Appendixes

The Annex contains 5 appendixes:

Appendix I - Form of the International Air Pollution Prevention Certificate

Appendix II - Test cycles and weighting factors for verification of compliance of marine diesel engines with the NOx limits

Appendix III - Criteria and procedures for designation of SOx emission control areas

Appendix IV - Type approval and operating limits for shipboard incinerators

Appendix V - Information to be included in the bunker delivery note

### 3.2.5 Resolutions and Further Work of the IMO

The Conference also adopted a number of resolutions. These resolutions were created to:

- adopt the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines;
- invite the MEPC to develop guidelines for monitoring the worldwide sulfur content of residual fuel oil supplied for use onboard ships;
- invite the MEPC to develop a harmonized system of survey and certification;
- invite the MEPC and the Maritime Safety Committee (MSC) to consider measures to restrict the use of perfluorocarbons on board ships;
- invite the MEPC to consider strategies to reduce carbon dioxide emissions from ships

Of particular importance is the development of a systematic monitoring of the worldwide average sulfur content of residual marine fuel oils, since many delegates expressed that it was needed and that it should be adopted. The monitoring mechanism will be geared towards inducing stricter compliance with a global cap, which will result in a future lowering of the figure of 4.5% as a mean to counter any sulfur changes in bunker oils. Currently, the IMO is working as a priority matter in developing guidelines for the monitoring of the world sulfur content average of bunkers.

Also, the Maritime and Environmental Protection Committee has given instructions to the Sub-Committee on Ship Design and Equipment to work on:

- Guidelines on representative samples of the fuel delivered for use on-board ships.
- Guidelines for on-board NOx monitoring and recording devices
- Guidelines on equivalent methods to reduce on-board NOx emissions
- Guidelines on on-board exhaust gas cleaning systems
- Guidelines on other technological methods verifiable or enforceable to limit SOx.

## 3.3 Control of Emissions

While Chapter II sets the grounds for the proper control and enforcement of the annex, Chapter III enumerates the specific requirements that must be followed to

control air pollution caused by ships. These requirements are comprised in 8 regulations. The control measures established, range from controlling the discharge of ozone depleting substances to the quality of fuel. Although the annex contains a wide range of regulations to control pollution in five different areas, its main aim is on restricting NOx and SOx emissions.

To have a better understanding of the provisions of the new annex, an analysis of the regulations included in chapter II will be made:

### 3.3.1 Regulation 12 - Ozone Depleting Substances

The deliberate emissions of ozone depleting substances as defined in the Protocol of Montreal, like halons and chlorofluorocarbons (CFCs) are prohibited under the provisions of the new annex. Deliberate emissions include those that may occur in the course of maintaining, servicing, repairing or disposing of systems.

New installations of ozone depleting substance are prohibited except for hydro-chlorofluorocarbons (HFCs), which could be used on board until January 1st, 2020. When removed from ships, ozone-depleting substances must be delivered to appropriate reception facilities.

CFCs

New installations of fixed refrigeration plants, fixed air conditioning plants and insulation containing CFCs, the ozone-depleting potential of which is more than 0.05 should be prohibited as from 6 November 1992 (The Motorship, 1995, 30).

Halons

Under the provisions of the SOLAS Convention, halons 1301, 1211 and 2402 were used as fire-extinguishing agents, although most of the ships used halons 1301 and 1211. New installation of halon fire-extinguishing systems onboard ships except those falling in the category of “essential use” as defined in the Montreal Protocol should be prohibited as from 1 July 1992. Full-scale tests of halon fire-extinguishing

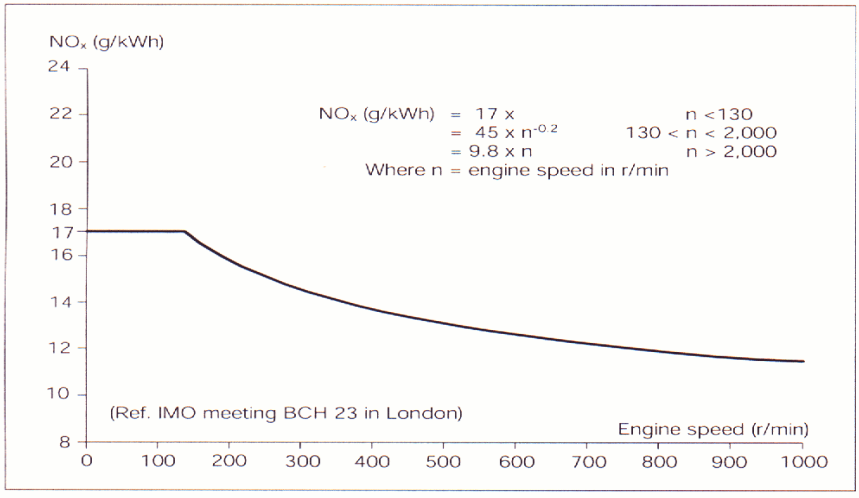
systems onboard ships should be prohibited as from January 1992 (The Motorship, 1995, 30)

### 3.3.2 Regulation 13 - Nitrogen Oxides (NOx)

Provisions for reduced emissions of NOx will apply only to engines of 130 Kw or more installed in ships built on or after 1 January 2000 or engines of 130 Kw or more converted after this date. There would not be any retrofitting requirement for existing ships. Under this regulation, engines installed on ships engaged solely in domestic trade may be exempted, if the Administration applies alternative NOx measures. Emergency diesel engines, lifeboat engines and any equipment intended to be used solely in case of emergencies are also exempted from this regulation.

The mandatory NOx Technical Code lays down the specific requirements for the technical specifications of the engines, which limits the emissions according to engine speed (See figure 3). The Code establishes mandatory procedures for the testing, survey and certification of marine diesel engines which will enable engine manufacturers, shipowners and Administrations to ensure that all applicable marine diesel engines comply with the relevant limits for emission values of NOx.

**Figure 3 Target Emission Levels of IMO**




**Source: Emission Control Two-Stroke low-Speed Engines, page12**

### 3.3.3 Regulation 14 - Sulfur Oxides (SOx)

The control of sulfur oxides was the most delicate and most political issue in the whole new Annex. Member governments agreed that bunkers delivered to ships should have sulfur content of no more than 4.5% by weight. Since the global cap established was not satisfactory for all parties the annex has provisions for the creation of local SOx Emission Control Areas where the sulfur content in bunkers will be much lower than the cap. The only emission control area identified by the new annex is the Baltic Sea. However, Northern European countries have already announced their intention to propose a similar status for the North Sea.

The provisions allowing for SOx Emission Control Areas were set to establish more stringent control on sulfur emissions. In these areas, the sulfur content of fuel oil used on board ships must not exceed 1.5%. As an alternative, ships can fit an exhaust gas cleaning system or use any other technological method to limit SOx emissions.

### 3.3.4 Regulation 15 - Volatile Organic Compounds

This regulation requires that terminals that will control volatile organic compounds must inform the IMO, when they have in operation on-shore receiving Vapor Emission Control Systems (VECs). Three years after this announcement has been made, each tanker calling the terminal must have vapor recovery lines.

The IMO through MEPC/Circ.345 requires Governments to provide a list of ports within their jurisdiction that have implemented vapor recovery systems. This list will then be circulated to owners so they have up to date information and can plan accordingly.

When ports stipulate the use of tanker VECs, primarily to limit the discharge of volatile organic compounds from cargo during loading, these are to be designed in accordance with IMO MSC/Circ.585 standards. The system is designed to control vapor from hazardous cargoes during loading or ballasting operations and to reduce

air pollution in harbor areas and to reduce the risk of explosion and fire (Controlling Vapour Emissions from tankers, 1993, 13).

### 3.3.5 Regulation 16 - Shipboard Incineration

Incineration on board ship of certain products, such as contaminated packaging materials and polychlorinated biphenyls (PCBs), is prohibited under the Annex.
Onboard incinerators must be designed and built in accordance with IMO resolution MEPC 76(40) on Standard Specification for Shipboard Incinerators. Also, incinerators must be type approved under the responsibility of the Administration.

In addition, there will be operational controls and exclusions on the incineration of certain materials, which could result in toxic emissions. The substances that will be prohibited are the following:

- annex I, II and III cargo residues of MARPOL
- polychlorinated biphenyls (PCBs)
- garbage containing more than traces of heavy metals
- refined petroleum products containing halogen compounds

### 3.3.6 Regulation 17 - Reception Facilities

The annex calls for appropriate reception facilities for the disposal of ozone depleting substances. These reception facilities will have to comply with the provisions of the Montreal Protocol, which regulates ozone-depleting substances.
It also calls for appropriate facilities for the disposal of wash from exhaust gas systems, if installed onboard ships.

### 3.3.7 Regulation 18 - Fuel Quality

Apart from limiting sulfur content in fuel oil, there will also be controls to prevent the incorporation of potentially harmful components, particularly waste chemicals. Suppliers will also have to provide ships with a delivery note, giving details of the fuel including its sulfur content, together with a truly representative fuel sample.

Also, governments through the proper authority must keep a registry of all the bunker suppliers under their jurisdiction. This will be necessary for proper control and enforcement of the provisions.

### 3.3.8 Regulation 19 - Platforms and Drilling Rigs

Emissions that arise from the exploration and associated offshore processing, of seabed mineral resources are exempted from the provisions of the annex. These emissions include:

- emissions that are a result of incinerating substances that are the result of the exploitation and related processes of the seabed,
- gases and volatile compounds entrained in drilling fluids and cuttings,
- emissions associated with the handling and storage of minerals from the seabed,
- emissions of diesel engines that are associated with the exploitation and processing of seabed minerals.

Also, the requirements for fuel quality will not apply if the fuel that is used is produced on site. This will apply if the Administration accepts this arrangement.

# CHAPTER 4

# Impact on Different Industries

## 4.1 Engine Manufacturing

The engine manufacturing industry has been characterized for their continuous work through development and research to improve the performance of their engines by making them more energy efficient and easier to maintain. Environmentally friendliness of the engine has not always been a priority in the list of engine designers and it wasn't taken into consideration until lately. They have traditionally strived to put to the market a better product, that will be more appealing in terms of fuel efficiency, which in turn will allow ship operators to run a much more cost efficient ship.

The shipping industry is a very competitive one, where profits are marginal. For this reason, vessel designers, owners and builders have always paid very careful attention to such matters as prime mover's first cost, horsepower and dimensions, fuel, lube and spares consumption, maintainability and similar factors (The Diesel Dilemma).

With the new annex, engine manufacturers face a new challenge. They have been entrusted with the task to develop the technology to make engines compliant with the annex requirements, and at the same time to maintain engine performance. The industry has already stated in various reports, that with the current technology there will be no problems to meet the current NOx emission limits set by the IMO.

The real challenge will be to develop the technology to meet future projections on tougher NOx limits, without affecting specific fuel consumption (SFOC). The NOx emission limit established by the IMO is just a starting point. The aim of the IMO is to gradually progress to a reduction of the NOx emissions released by diesel engines, which will entail further development in this area by engine manufacturers.

Maintaining fuel efficiency is not only a matter of driving operating costs down. It too, has a pollution-reduction dimension: the less fuel that is burned, the less carbon dioxide greenhouse gas is emitted into the atmosphere, which contributes to global warming (The Diesel Dilemma).

Further reductions in the NOx emission limits may affect the market for marine engines. Future marine engines built to the requirements of the NOx Code may not be sufficiently simple to operate and the engines may not be able to operate on commonly obtainable fuel (Air Pollution).

### 4.1.1 Certification of Engines

With the entry into force of the new requirements, reduction of emissions has moved to the top of diesel engine designers' priorities. Manufacturers will not only be burden with developing the technology, but also with the certification procedure. This procedure must be done in order to obtain a certificate that states that the engine is in compliance with the provisions of the Technical Code.

It will be the manufacturers' responsibility to undertake the necessary tests, engine by engine, and provide the authorities of the Flag State with the required documentation, in order to obtain the approval and the Engine Air Pollution Prevention (EAPP) certificate. The documentation to be submitted should provide details about the limit values, measurement and assessment procedures for new installations. The measures used during the lifetime of the engine to prove that its emissions comply with the limit values should also be described (German research project).

The industry believes that the process necessary to ensure IMO engine certification will introduce added complexity to the final stages of engine preparation in the workshops, and that it will carry the risk of delays in testbed trials. Predicting the added complexity, the industry warns that shop tests will be more time-consuming

and costly than before, because of the procedures that will be necessary to obtain certification (Tinsley, 1998).

Also, each engine that is delivered must contain a technical file specifying all the components considered to influence the engine's emission level. It should include the entire fuel injection system, the injection and exhaust valve cams and timing, the cylinder cover, the piston with piston rod and shims, the conrod and the turbochargers. This file also must include adjustment data and tolerances for performance parameters, in addition to the detailed results of the emission measurements carried out at the workshop trial stage. Engines must be re-certified every five years and the technical file must follow the engine throughout its life (Tinsley, 1998).

Even though the annex has not come into force, and it is not foreseen to come into force until around 2002 - 2003, engines built and delivered or converted after January 1, 2000 will have to meet the requirements of the Technical Code when the annex enters into force. For this reason, the engine manufacturing industry will be the first one to experience the effects of the new regulations.

To meet the annex requirements by the 2000 applicability date, engines produced from around the middle of 1999 will have to obtain a document of compliance from the administration. This is a temporary measure while the annex comes into force, to then obtain the required EAPP certificate. The granting of the ship's International Air Pollution Prevention Certificate (IAPCC) will be dependent on the EAPP certificate being provided with the engine.

### 4.1.2 NOx Reduction Methods

The engine manufacturing is now in a position that is not very enviable. They don't only have to meet the current engine requirements, but also to continue doing

research to meet future foreseeable restrictions of engine emissions. In order to meet these future standards and at the same time maintain fuel efficiency of the engine, they are currently working to find an optimal solution.

Utilizing current technology, the industry is working on various methods and combination of methods that could lead to meet their objectives. Methods currently used to meet the requirements without sacrificing too much efficiency include the balancing of factors such as the fuel injection pressures and spray patterns, compression ratios and combustion temperatures (More Consolidation in Medium Speed Diesel Market).

To develop engines that will comply with IMO's NOx emissions limit, the engine manufacturing industry have conducted tests using primary and secondary methods of NOx reduction. Primary methods of reduction are generally sufficient to satisfy IMO's speed-dependent NOx emission limits, but more intensive cutbacks proposed globally or imposed at regional levels will most likely have to be met by secondary methods or a combination of primary and secondary (The Green Diesel, February 1997, 16).

Primary methods aim at reducing the amount of NOx formed during combustion, but they affect the engine combustion process directly. The actual degree of reduction depends on the engine type and the specific reduction method, but it varies from 10% to more than 50% and has a direct impact on the performance of the engine (Coming Clean on Exhaust Gas Emissions, 1999, 20).

Secondary methods aim at removing NOx from the exhaust gas by downstream treatment without affecting the engine performance from its optimal setting, using equipment that does not form part of the engine itself. A reduction of up to 95% can be achieved utilizing this method. (Emission Control Two-Stroke Low-Speed Engines, 5)

#### 4.1.2.1 Primary Methods

Firing Pressure Influence: Reducing the firing pressure via injection retardation will lower the peak temperature and thus reduces NOx, but it also inevitably leads to higher fuel consumption (Low Speed Diesel R&D Priority: Meeting Stricter Emission Standards).

Air Quality Control: The ratio between oxygen and nitrogen can be changed by the use of exhaust gas recirculation (EGR). Using this method NOx emissions can be reduced by 69% with an EGR rate of 28% with a very small raise in smoke and fuel consumption. The use of EGR (appendix 1) on board a ship has a drawback, as the effluent from the cleaning contains sulfur in a non-disposable form as well as unburned hydrocarbons, soot and ash (Low Speed Diesel R&D Priority: Meeting Stricter Emission Standards).

Fuel Nozzle Adaptation/Fuel Injection: Fuel nozzle adaptation is used for the verification of performance at different layouts. Different nozzle types have a significant impact on NOx as well as the intensity of the fuel injection. With this method a NOx reduction potential of about 20% can be accomplished at a fuel penalty of 3.5 % (Emission Control Two-Stroke low-Speed Engines, 6).

Water Emulsification: This method leads to significant reduction of the NOx, with no effect on maintenance costs. The influence of water emulsification varies with the engine type, but generally 10% of water reduces NOx by 10%, with an increase of 2% in fuel consumption. (Options for Reducing Emissions, 1997, 22). A layout of a water emulsification system can be found in appendix 2, and alternative water system in appendix 3.

#### 4.1.2.2 Secondary Methods

Selective Catalytic Reduction: In selective catalytic reduction (SCR) systems (appendix 4), the exhaust gas is mixed with ammonia before passing through a layer

of a special catalyst at a temperature between 300 and 400 C. Using this system, NOx is reduced to the harmless waste products nitrogen and water vapor. In addition some of the soot and hydrocarbons in the exhaust are removed by oxidation in the SCR reactor. Also, the system has the capability to be bypassed through a valve that will allow the engine to be operated without NOx control by the SCR system, when the vessel is trading in areas where the restrictions are not that stringent (Coming Clean on Exhaust Gas Emissions, 199, 23).

Selective Catalytic Reduction systems have the problem that it takes up expensive shipboard real estate and it introduces another level of technology, maintenance burdens and capital expenditure. They should only be used where very strict individual rules are enforced (Low Diesel R&D Priority: Meeting Stricter Emission Standards).

1

The typical cost for a SCR system, including control devices ranges from US$ 40 to US$ 120/Kw. The actual price will depend on the size of the unit (Options for Reducing Emissions, 1997, 23).

## 4.2 Shipping Industry

The shipping industry, meaning mostly ship operators, will be affected the most by the entry into force of this new annex. With the new annex, they will have to incur in expenses regarding the fitting of new equipment and will also incur an increase in operating costs. To see exactly how each regulation will affect ship owners, an analysis will be made for each aspect area that will have an impact.

### 4.2.1 Ozone Depleting Substances

Most of the requirements regarding ozone depleting substances (halons and CFCs) are not new to the industry. The phase out scheme for halons and some refrigerants has already been implemented, thus limiting the impact of the new annex regarding

these substances. Nevertheless, shipowners will have to incur in expenses to retrofit some of the existing systems and will have to make provisions for new buildings.

Regarding halon, which is commonly used in fixed fire extinguishing systems in engine rooms, pump rooms and cargo spaces intended solely for the carriage of vehicles which are not carrying any cargo as allowed by SOLAS there are other systems as alternatives. These alternatives include CO2, foam and water systems. Existing vessels that use halon as an extinguishing medium do not have to incur in the expenses of retrofitting, since there is no requirement in the annex.

In respect to CFCs, existing installations that use this refrigerant will continue to be able to use them. Even though the production of CFCs has been banned, supplies are still available, coming in part from recycling, but at an increased cost and at a reduced availability. An alternative is the use of HCFCs which are allowed to be used until the year 2020, although at regional level they may be phased out sooner. The major drawback is that systems will have to be retrofitted and that HCFCs are also in line to be phased out, which will lead to restrictions to the amounts available. (Green Refrigerants Growing Cool in Current Climate, 1997, 32).

Other alternatives with 0 ODP has also being developed. Alternatives like ammonia are also being used, which although it is not an ozone depleting substances it is toxic. There are also under development other alternatives that will have an less of an impact to the ozone layer.

The main implication of this regulation is the in the operational part of the vessel. Shipboard personnel will have to establish control and monitoring measures to prevent the discharge of ozone depleting substances into the atmosphere. Also owners may face the problem when the discharge of these substances is required, they will be dependent on the port, which is required to provide reception facilities.

A question, which arises here, is what will happen if a ship is required to discharge ozone depleting substances and the port does not have the capability? And, if these results in discharge to the atmosphere, will they still be held responsible? These questions will need to be addressed to prevent any future conflicts.

### 4.2.2 Engine NOx Emissions

Under this regulation, engines of 130 kW or more will have to comply with the provisions of the NOx technical Code. The parameters regarding allowable levels of NOx emissions are included in the Code.

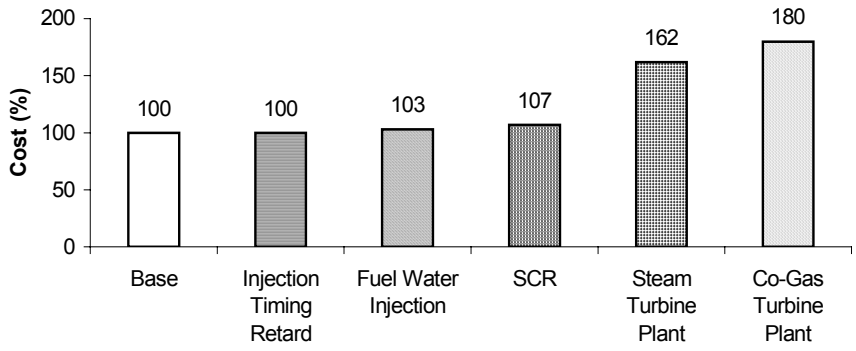
For compliance with this requirement, shipowners will have to rely on the technology developed by engine manufacturers. Currently, engine manufactures will meet the current limits by the use of primary methods, which implies an increase of the cost of the engine. Engine manufacturers have talked about a possible of 8% in the cost of the engine when primary methods are used. The increase of capital cost will be compounded with the cost increase derived from lost fuel efficiency, which is almost inevitable, since there is an inverse relationship between nitrous oxides generation and fuel consumption. It has been estimated that a 25% cut in nitrous oxides output causes a 5% increase in fuel usage (Osler, 1999).

In the event that a SCR is used to meet the requirements, additional investment in equipment will be necessary. Also the need for significant amounts of ammonia or urea introduce and additional costs and operational considerations.

Another alternative that shipowners have in order to comply with the requirements of regulation 13 is the use of alternate propulsion systems. There are other prime movers like gas turbines and steam turbines, which tend to have very low emissions of NOx compared to a diesel engine of the same output (Coming Clean on Exhaust Emissions). These engines will easily meet IMO's NOx requirements, and even more

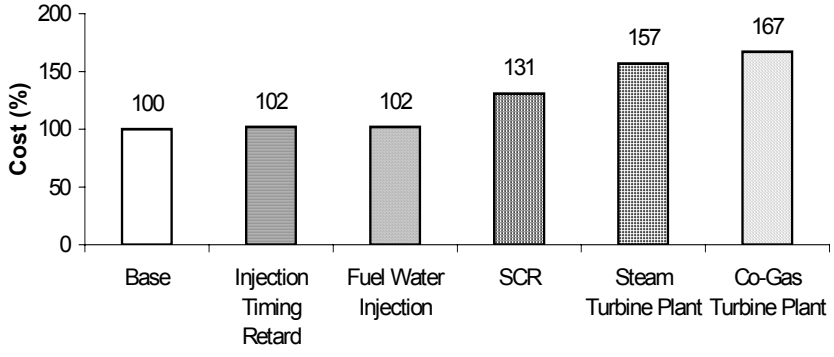
stringent requirements. The only problem is that these alternatives derive a higher capital and operational cost as it could be seen in figures 4.1 and 4.2.

**Figure 4.1** **Comparison of Investment Cost**




**Source: The Marine Engineering Society in Japan (1995), 87**

**Figure 4.2** **Comparison of Running Costs**




**Source: Source: The Marine Engineering Society in Japan (1995), 87**

In order to maintain engine compliance with the NOx emission requirements, careful attention will have to be paid to the operation, maintenance and overhaul of the engines. This is necessary so the parameters established by the manufacturers, to meet the emission standards are not affected, which could possibly change the NOx emission level of the engine

### 4.2.3 Sulfur Cap

Under this regulation, owners will have to comply with a global sulfur cap of 4.5%, meaning that the fuel used onboard must not have more than this percentage of sulfur content per weight. In practical terms, the figure of 4.5% is just symbolic and it will not be a burden to shipowners, since less than 2% of today's deliveries of bunker fuel exceed this limit (Bunkering, 1998). The problem may arise, if this cap is lowered in the future. This is very likely to happen because it is the IMO's goal to use the 4.5% cap as a reference point to then monitor the average sulfur content of residual fuels worldwide, and gradually lower the cap.

By further reducing the allowable content of sulfur in fuel, shipowners will be facing an increase in operating costs because the price of fuel varies with its sulfur content. The lower the sulfur contents the higher is the price of fuel. A decrease of 1% sulfur in fuel leads implies an increase of fuel cost of US$ 10 to 20 per ton (Options for Reducing Emissions, 1997, 23). This will definitely have an impact, since fuel is one of the major expenses of running a ship.

Price for residual fuel ranges from about US$ 95 to US$110 per ton and a ship that burns about 90 tons a day will accumulate a fairly large fuel bill (Bunkers and fuel emissions-an inseparable problem?,1996, 32). It could be estimated that the cost derived from fuel consumption, which depends on age of vessel, engine performance, and oil price, is about 47% of the voyage cost (Stopford, 1997, 167).

As restrictions on sulfur content become more stringent, the availability of lower sulfur fuels will tend to become more limited, since certain areas of the world tend to produce fuels with a higher sulfur content and currently do not have the refinement capacity to put to the market lower sulfur fuels. As the availability becomes restricted prices will tend to go up, as the prices tend to change with demand. If this was to happen, the ship operator will ultimately have to assume the price differential.

### 4.2.4 SOx Emission Control Areas

The main area of concern within this regulation, is the creation of special emission areas, which calls for a 1.5 % sulfur cap when navigating in the area. To meet this requirement owners will either have to use two different kinds of fuel, the easier solution, or to use alternative reduction methods like scrubbers, which raises questions about its friendliness to the environment.

The Baltic and International Maritime Council (BIMCO) have voiced their concern about the establishment of SOx emission control areas. They believe that problems may arise due to the need for special low sulfur fuel and the expected bureaucratic enforcement procedures. The shipping industry is worried about the possibility to face new complicated procedure in order to present evidence that may satisfy authorities that the requirements have been complied with (Air Pollution).

Also, other organizations that represent shipowners like the International Chamber of Shipping (ICS), have criticized the impracticalities of forcing ships trading in different areas to fall back on dual fuel arrangements without the benefit of improved global air quality (De Bievre). During the process of adoption of the annex VI the shipping industry voted in favor of a uniform global cap of 3.5%.

#### 4.2.4.1 Dual Fuel Systems

The establishment of special emission areas will have serious effects on the ways ships are operated. Considering the present requirements, this will mean that ships

may to return to carrying two types of bunkers, heavy (HFO) and light (MDO). Modern ships are designed for heavy fuel operation throughout, both for main propulsion and auxiliary power plants. The new legislation will mean a need for segregation of fuel onboard involving separate tanks, pipelines, fuel conditioning and delivery systems. Engines may have to be adapted to take dual fuel and some vessels may be obliged to fit catalytic reactors in the exhaust system (Fuels & Lubes, 1997, 22).

In addition, vessels using dual fuel system will face changes to onboard operating procedures. Vessels using separate fuel oils in order to comply with the requirements of the impending regulations, will have to allow sufficient time for the fuel oils service system to be fully flushed of all bunkers exceeding 1.5% sulfur content, prior to entering a SOx emission control area. The volume of low sulfur fuels used for this event contained in each tank, in addition to the date, the time and position of the vessel when any fuel changeover as operation is completed, is to be recorded in a log as prescribed by the relevant Administration (Fuels & Lubes, 1997).

The compliance with these requirements will lead to an increase in the initial and/or operating cost of any vessel calling ports in these specified areas. This is of great significance because of the competitiveness of the shipping industry, where carriers find it at times difficult to break even.

The impact of this regulation is not limited to the economic aspect. It can also affect the operation of the ship. As stated before, the most viable option to comply with this regulation will be to use low sulfur oil. The drawback is that not all bunker suppliers can provide the required low sulfur fuel oil. This will affect the flexibility of the operation of a ship because they will have to plan their schedule if low sulfur content will be needed to avoid ending in a situation where the low sulfur fuel is not available.

#### 4.2.4.2 Exhaust Gas Treatment

The use of exhaust gas treatment systems is advocated by certain people in the industry. For SOx removal, the most promising technique is seawater scrubbing (appendix 5). Trials have been conducted on a number of ships with basically encouraging results, although, some operational problems of heat exchanger fouling and corrosion have been reported. Using this method, the sulfur discharge from the vessel is not actually reduced, it is simply re-routed from the funnel to the sea (The Motorship, 1995, 77). Water washing the gas in a scrubber leaves sulfuric acid in the wash water, which must be neutralized chemically, creating a disposal problem (Low Speed Diesel R&D Priority: Meeting Stricter Emission Standards).

The technique has a number of major disadvantages. The system is bulky and will not be easy to retrofit to existing vessels. It also has high operating costs because of the urea or ammonia consumption and the catalyst replacement. Even when designed from new, it will still cost the equivalent of about $25 extra per ton of fuel consumed and fuel consumption itself is increased by about 3% (Options for Reducing Emissions – A Difficult Decision for the Shipowner, 1997, 22).

Lastly, and probably most important, the long term ecological impacts of pumping concentrated acidic and toxic water into the sea are not known. Whether this is more acceptable than gaseous emissions, particularly in enclosed, relatively shallow locations such as ports, harbors and sensitive waters, is open to debate (The Motorship, 1995, p 77).

### 4.2.5 Fuel Quality & Bunker Delivery Note

Under this regulation, bunker deliverers will have to provide a bunker delivery note whenever they supply bunkers to a ship, and it must be kept onboard for a period of at least three years. Also a representative sample of the fuel must accompany the bunker delivery note and should be kept onboard at least until the fuel has been consumed, but in any case for a period of at least twelve months.

The requirement of a bunker delivery note could be of benefit for ship operators. The delivery note is a certification that the bunker delivered onboard meets the desired specifications, and that it complies with the requirements for fuel quality set in annex VI of MARPOL.

The new requirements for fuel quality may help reduce the number of claims to bunker suppliers for the delivery of bad quality fuel. Although it may help control the quality of fuel delivered which, is a problem of great concern because of variations of fuel quality in different areas of the world (Fuels and lubes, p 26), it could also have some drawbacks.

The major drawback will the control they will be subject under Port State Control. As it is known, the shipping industry is burdened with all sorts of regulations, inspections and control measures. With the introduction of this regulation crews will have to deal with again another control, which is not in itself a bad thing, since it is for the improvement of safety and the environment. The problem raises when crews, which keep on getting smaller, are burdened with all these paper exercises, which leave less time for the safe operation of the ship.

Another aspect to take into consideration is the need to provide a certified copy of the bunker delivery note to the competent authorities of the port. This in itself should not be a problem. But we run into the scenario, where every country may have different procedures to meet this requirement. Delays to the ship could be faced, depending on the bureaucracy level of the country.

### 4.2.6 Vapor Emission Control Systems

Under the new annex, the requirement for vapor emission control systems is dependent on the ports. The annex only gives the standards that must be met in case the system is installed, and gives instructions to governments to notify to the IMO,

which ports have emission control systems. Under this regulation vessels, in particular tankers, will be at the mercy of the ports that decide to install the system. When a port has a vapor emission control system, all tankers calling that port must install onboard a system for proper discharge of the volatile organic compounds.

By not having a uniform standard, and leaving it up to the port, ships could face competition disadvantages, since the installation of the systems is burdensome. The capital investment for the installation of this system is also considerable.

There are several sources that provide information about the actual cost for installing these systems onboard. One such source is The International Association of International Tanker Owners (INTERTANKO), which claims that the cost of installing a vapor emission control system is about US$ 1 million (Environment Aspects of Tanker Operations).

Another source is the Oil Companies' European Organization for the Environment, Health and Safety (CONCAWE), who has produced a detailed study about what would entail to install such system onboard tankers. According to the CONCAWE report, in order for vapors to be collected and passed to a shore-side emission control system, seagoing vessels will need to have vapor collection pipework onboard. The cost to fit this depends on tankers being equipped with closed loading and/or inert gas systems during loading (Cost-effectiveness of Marine Vapour Emission Controls).

They say that the costs of modifying sea-going vessels vary considerably. The costs reported by their study consider both actual retrofits and projected estimates. These costs are:

- for a vessel without inert gas: US$275 000
- for a vessel with inert gas: US$130 000

Considering the difference in figures, if we average the information provided by INTERTANKO and the one by CONCAWE, we realize that the capital cost for the installation of vapor recovery systems onboard ships could be in the order of 600,000 US$, which is a considerable amount of money.

Besides the cost implications, there will also be some changes in the operational procedures when unloading cargo associated with the safe operation of the vapor recovery systems. Crew will have to be familiar with the system and with the safety precautions associated with the use of the system.

### 4.2.7 Reception Facilities

Although the requirement to install adequate reception facilities for the discharge ashore of ozone depleting substances falls under the responsibility of coastal states, it can also affect the operation of ships. Ships that require the service of a reception facility, for example to change refrigerants, can face the much too real possibility that these facilities are not available in the area where the ship trades. Owners will face the problem of finding a viable solution to properly dispose of these substances, which could have added costs.

Another scenario is that those ports that do have the facilities may charge for the use of the facility or may incorporate port surcharges even if the facility is not used. This is becoming a widespread practice, and will obviously have an increase the operating costs of a ship.

### 4.2.8 Incinerators

Incinerators installed onboard ships on or after January 1st, 2000, will have to comply with the provisions of the new annex. The annex calls for compliance with resolution MEPC 76(40) on Standard specification for shipboard incinerators, and with the operating limits set in appendix IV to the annex. All incinerators installed after

January 1, 2000, will have to meet these standards regardless of the date of construction of the vessel.

For most of merchant vessels with small crews that spend most the time at sea, the selection of an incinerator is still important to properly dispose of the waste that is generated and that requires storage. To meet the IMO current requirements, currentlythere are two main systems in use: cyclonic and double chamber or combination of both. (Burning Question, 1997, 94)

### 4.2.9 International Air Pollution Certificate

The entry into force of annex VI implies the burden of another certificate, the International Air Pollution Certificate. In a time where the shipping industry is saturated with new requirements and all types of certifications and surveys, the requirement of a new certificate will only add complexity to the operation of the ship. The certificate will be valid for a period not exceeding five years, and it is subject to annual surveys and to an intermediate survey.

The implication of a new certificate is the extra cost that will be imposed to the operator. The cost is not only limited to the cost of the certificate and subsequent surveys, but also to the extra time that the ship will need to be out of service for the inspections to verify compliance with the requirements of the annex.

### 4.2.10 Control Measures

With the entry into force of the new annex, the shipping industry will face new control measures to verify compliance by both flag and port state. Extra documentation will be required as well as approval for several equipment installed onboard, like incinerators and diesel engines.

Ships will have to keep documentation when going into SECAs, including logbook entries for change of fuel operation, to demonstrate compliance. Also bunker

delivery notes and fuel samples will likely be targeted by port state control for inspections.

Another area is the verification of NOx emissions, which will require a monitoring and recording system. The main problem with this requirement is that the guidelines are still being developed by the IMO. The expected completion date is after the targeted date for entry into force of the annex, which could cause operational problems. Also, the emission records will become part of the additional documentation to be inspected.

## 4.3 Bunker Suppliers

The bunker supplying industry will be mostly affected by the requirements of the new annex regulating the quality of the fuel and the regulations controlling the sulfur content of the fuel, which is one of the major contributors to acid deposition.

### 4.3.1 Sulfur Content

Two regulations in the new annex control the amount of sulfur that could be present in fuels used onboard ships. The first one is a 4.5% sulfur content global cap and the second is a 1.5% sulfur content requirement for vessels operating within designated special emission control areas.

The current requirement of a 4.5% sulfur global cap will not have a significant impact to the bunker supply industry, since the current world average sulfur content of the fuels supplied to ships is well below that average. It has been stated earlier that only about 2% of the world's supply of fuel do not meet the 4.5% cap. The real concern of the bunker industry is the future lowering of this cap and the proliferation of SECAs, which has an availability implication (and hence a cost implication) for the 1.5% maximum sulfur fuel that accounts for less than 4% of today's bunker fuel deliveries (Bunkering, 1998, 7).

The sulfur content of crude oil varies considerably greatly and can range from as little as 0.1% to, in few cases over 4%. From a marine viewpoint, it is an unfortunate fact that when crude oils are distilled and processed at refineries, the vast majority of the sulfur is contained in the residue fractions, and it is the residue which forms the main constituents of all marine fuel oils (The Motorship, 1995, 78)

There are two ways in which bunker fuels with low sulfur content are produced. One is by using low sulfur residues obtained from selected low sulfur (sweet) crude oils, and the second is by de-sulfurization of high sulfur residues.(The Motorship, 1995, 77).

Currently most of the low sulfur oil, which is generally produced by using low sulfur crude, is destined for the land base industry, which have stringer requirements for emissions. The current supply of low sulfur fuel oil (LSFO) is adequate for the the present demand. If the shipping industry would require this type of fuel, they will have to compete with inland users for the relatively small amounts available, which could have a serious impact to the bunker market (CIMAC, 1998a, 333).

Dr. Liddy, Technical Manager of British Petroleum, explains that the price premium between LSFO and high sulfur fuel oil (HSFO) has oscillated between $2/tonne and $43/tonne. The price differential is very sensitive to demand, and if additional demand arises by the requirements from the shipping industry to burn LSFO fuel in SECAs, the premium is likely to rapidly escalate to the upper end of the range (CIMAC, 1998a, 333). The magnitude of the demand will be governed by the number and extent of SECAs.

If further restrictions on sulfur content arise, refineries will have no choice but to invest substantially in upgrading plants in refineries or will have to use a different choice of crude oil feedstocks, which will become greatly restricted and difficult to

obtain. Both approaches will definitely increase costs and a tightening of bunker fuel availability (Bunkering, 1998, 7)

To see the additional cost, both in terms of investment and in terms of the product, close attention should be paid to table 4. In table 4 the results of a study conducted by CONCAWE on the financial consequences of RDS in Western European Refining Industry is shown. The figures obtained are for a total European bunker requirement of 30 million tons and an average "input" fuel of 3.5% sulfur.

**Table 4 Financial Consequences of RDS**

| Target Bunker Fuel Oil Sulfur Content (%wt) | Investment required US $ billion | Additional cost $/ton |
|---|---|---|
| 2 | 4.2 to 6.4 | 35 to 52 |
| 1.5 | 5.6 to 8.2 | 46 to 68 |

**Source: The Motorship, 1995, 78**

### 4.3.2 Fuel Quality & Bunker Delivery Note

The requirement of a bunker delivery note from the fuel supplier, is a burden that the bunkering industry must deal with in order to comply with the annex VI. The purpose of the bunker delivery note is not only to ensure that specifications and established standards for fuel are met, but also that they are free of organic acids, waste products and other undesirable substances like ash, water, aluminum and silicon.

In addition to the bunker delivery note, bunker suppliers will have to register with the appropriate local authorities, which will conduct spot-checks to make sure they are meeting the requirements regarding fuel quality. This requirement aims at achieving a world standard regarding the quality of fuels (Pattofatto, 1995, 4). When the annex comes into force, a tight control is likely to take place, which should affect in

particular those areas where there are more variations on the quality of the bunker delivered.

Of great concern is the requirement for governments to control their bunker suppliers and to notify the IMO, of those that do not comply with the requirements. If this information is then passed on to other governments it could have a serious impact to the bunker suppliers of the first country.

## 4.4 Ship Construction

The ship construction industry is a very competitive one, where shifts have taken place from traditional maritime countries to a selected group of countries in the Far East. The shipyard is where it all comes together. They have to work in conjunction with ship operators, flag Administrations and in some instances port state control to develop a safe and environmental sound ship.

Their job is to ensure that the ship delivered will meet all applicable international and national regulations and any special request of the owner. The new provisions of the annex VI of  will be no exception.

Environmental consciousness has also taken its toll in the ship construction industry. In order to keep up with the times, the industry will not only have to meet the environmental requirements for the ships they build, but also their whole operation will have to be more environmentally friendly.

With the new regulations for air pollution for ships, shipyards will need to have the adequate technology to meet these requirements. The technology to comply with environmental requirements is not readily available to some countries and the countries that do have it have started to use it as marketing tool to attract more business to their shipyards. With the new environmental requirements with which

they are faced, they will have not to only promote speed of delivery, efficiency or cost, but also their technology to comply with the ever more stringent environmental regulations as it is the case with the new annex of .

Countries involved in the ship construction industry will have to keep up with the times and acquire the technology in order to stay competitive. This is will be necessary, since countries like Japan have already started to use their environmental technology to compete against rivals in South Korea and other areas (Japanese Shipbuilders Win Orders for Low Emission Levels).

Another aspect that shipbuilders and ship designers will have to keep in consideration when designing and building a new ship is the flexibility of the equipment installed onboard. They must design shipboard systems, so they can be easily modified and adapted for existing and future environmental regulations. An example is the fuel oil system, which should allow for the usage of two different types of fuel for vessels that operate in SOx emission control areas. When designing the ship consideration must be given to allow the vessel to work on a dual fuel system, including pumps, pipes, equipment and storage tanks.

The overall impact to the ship construction industry is very limited, since any cost increase they might have to face to comply with the new requirements will be passed on to the shipowner. The main implication will be that they will have in a way, to predict the future by making provisions and arrangements to ensure that their vessels can comply with upcoming environmental requirements.

# CHAPTER 5
# Impact to Governmental Agencies

## 5.1 Maritime Administrations

The role of the Maritime Administration or Flag State is paramount when dealing with the implementation of any new convention. Under all different conventions, including MARPOL 73/78, they have the primary legal obligation to ensure the compliance of their ships with the convention requirements to ensure safety at sea and prevent pollution.

When a government decides to ratify the new annex, they take on the responsibility to ensure that the provisions of the annex are complied with. They must not only make the annex part of their national legislation but they must also regulate it and enforce it.

### 5.1.1 Legal Framework

The process of making international regulations, like the annex VI of MARPOL into domestic laws, is extremely important since it gives the country the legal ground to enforce the requirements. The task to convert an international regulation into domestic regulations or laws is not always an easy one. The amount of work that it entails depends on the type of system that the country has. In some countries laws require the approval of the Congress or Parliament, and in others they just need ministerial ordinances or notifications. (The Society of Naval Architects of Japan 1995, 842)

To properly implement the new annex VI, Administrations need a legal framework that will enable them to legally and effectively implement the provisions of the annex. The framework should include: instructions for implementation, designation of responsibilities, provisions for investigations, sanctions, allocation of resources and procedures for certification, among others.

### 5.1.2 Enforcement

After it has become part of domestic legislation, the most important thing is the enforcement of the regulations. Although keeping a ship in good condition is ultimately the responsibility of the manager or owner of the vessel, the duty of ensuring those standards is up to the flag state.

Who is going to monitor and enforce compliance with the regulations and what resources are needed in order to monitor and enforce compliance are very important questions that must be dealt with by Administrations. The answers should be included in the legal framework.

#### 5.1.2.1 Certification and Surveying

Administrations will have to certify that all vessels under their flag comply with the requirements of the new annex. This will be accomplished through the survey of vessels to finally issue the International Air Pollution Certificate (IAPP).

The IAPP is required for all ships of 400 GRT engaged in voyages to countries party to the protocol, and platforms and drilling rigs that are engaged in voyages to waters under the jurisdiction of countries party to the protocol. Ships constructed, before the entry into force of the Protocol will require an IAPP Certificate not later than the first scheduled dry dock after the entry into force and in no case later than 3 years after the entry into force of the Protocol. The IAPP Certificates cannot be issued to vessels flying the flag of countries that are not party to the Protocol.

The certificate shall be valid for a period not exceeding five years, and it will be subject to an initial survey, periodical surveys not exceeding five years, unscheduled surveys and at least one intermediate survey. In the event that the Administration decides to perform mandatory annual surveys, there will be no need for unscheduled surveys.

With the addition of this new certificate to the list of certificates that must be issued to ships by the Administration, the allocation of resources, including more personnel, will most definitely be needed. Those Administrations that do not count with the adequate resources to perform the verification themselves will have to entrust this task to classification societies or other recognized organizations.

By delegating this function to private organizations, the Administration will have to ensure that the work carried by these organizations is carried properly, and measures for verification should be established as required by the IMO. The increasing number of surveys that must be performed to ships tend to decrease the effective control that Administrations can have over their ships, specially those Administrations that do not have enough resources and that have to rely heavily on private organizations.

#### 5.1.2.2 Type Approval

Under the new annex the Administration will be responsible to approve equipment that is required under the annex. This approval is necessary to attest that the equipment meet the technical specifications that are set in the annex and other IMO instruments. The approval of the Administration is required in order to be able to install the equipment onboard ships flying its flag.

Engines that fall under regulation 13 of the annex must be certified by the Administration for compliance with the NOx Technical Code. The certification of the engine will lead to the issuance of the EAPP certificate. In the transitional period, while the annex enters into force, Administrations should issue compliance documents to the applicable engines.

There are also other equipment under the annex that require type approval, namely incinerators, exhaust gas cleaning systems for NOx and SOx and alternative methods for compliance with provisions of the annex. These approvals are necessary in order to be able to issue the IAPP.

With this requirement, Administrations will need to have qualified personnel as well as resources to conduct proper and timely approval, for these equipment. Due to the very technical nature of the approvals, some Administrations may not count with the expertise necessary, and will have to utilize the services of classification societies for this purpose.

#### 5.1.2.3 Vessels under 400 GRT

Under the annex vessels under 400 GRT do not require an IAPP certificate, but they still have to comply with the requirements of the annex, unless expressly provided otherwise. It will then up to the Administration to develop legislation to properly control these vessels.

For some Administrations, the development of these national regulations may prove to be difficult. Some Administrations do not count with the expertise necessary to develop such technical requirements.

A problem that arises here is when these vessels are subject to port state control. Since there is no specific requirement for a certificate, how will port state control verify compliance? Also, there is the possibility that the requirements established by the Administration will not be satisfactory to port state. In these cases, ships under 400 GRT will be controlled by port state requirements and not by flag's state.

#### 5.1.2.4 Vessels in Domestic Trade

Due to the transboundary effects of air pollution, vessels trading in domestic waters are still subject to the provisions of the annex. There is a provision where Administrations may exempt vessels from the requirements of regulation 13 (NOx emissions) if they are engaged in domestic trade only, provided that they provide alternative measures for controlling NOx emissions. If Administration desire to exempt domestic vessels from the compliance of regulation 13, then they will have to develop alternate measures, which again will require expertise and resources.

#### 5.1.2.5 Delegation to Classification Societies

Classification societies have become be an important link for the enforcement of requirements. Countries that do not have enough resources to conduct the surveying and certification of ships under their flag have relied on the services of classification societies.

Due to the infrastructure and resources available for most classification societies, Administrations have tended to rely more on them, which poses a serious problem. While classification societies are the ones that conduct the surveys and certify the ships, they do it under the authority of a government, which is ultimately responsible for the ship.

By having this function delegated to class societies, it becomes more difficult to exercise an effective control over the ships under their jurisdiction. In some instances, Administrations hardly ever have any contact with the ship, allowing for loopholes.

While it is true that some classification societies perform a good job, there have been instances where ships are found to be “rust buckets”, with all the certificates are valid without any remarks. In these cases, the Administrations are still responsible even when they did not certify the vessel themselves.

For this reason the IMO has set resolutions A.739(18) and A.789(19), which calls for Administrations to conduct screenings and proper control over classification societies and other recognized organizations. The problem here is that these are the same Administrations that did not have the resources to conduct the surveys in the first place. Now, how are they going to exercise proper control over this organizations?

### 5.1.3 Investigation of Violations

Under the annex, Administrations assume the responsibility to investigate claims by other governments regarding the violation of the provisions of the annex by ships flying their flags

Upon receiving information that a ship under its flag is violating the provisions of the annex, the Administration shall look into the matter as soon as possible. They should obtain more evidence from the Party that reported the violation if they esteem that the information provided is not adequate.

Actions shall be taken in accordance with the provisions of domestic laws. This should be done as soon as possible, and notification of the action should be given to the party, which has reported the alleged violation, as well as to the IMO.

In order to comply with this requirement, the Administration should have procedures established to properly conduct investigations. Also, they should count with sufficient personnel to follow up the matter, as well as trained individuals in case a physical investigation is needed. Resources should also be available, in case travel and other expenses are necessary.

### 5.1.4 Sanctions

For proper enforcement, Administrations must impart sanctions to those ships that violate the provisions of the annex. After conducting an investigation that proves a ship guilty from illegal discharges or other violations, legal sanctions must be applied.

These legal sanctions should be severe enough to deter the ship from recurring and to send out a message to shipowners about the seriousness of the matter. The sanctions should be given according to national legislation. For this reason, it is very important

that when the annex is converted into national regulations, provisions are made for these sanctions, scaled for the severity of the violation. Also it is important that Administrations have a legal department to properly impart the sanctions

## 5.2 Port State Control

The port state control regime arose from the need of coastal states to protect their waters from substandard ships that were a threat to the safety of navigation, property and the environment. The role played by Port State Control has gained more importance in the last few years. The last decade has seen a major shift of the world tonnage, from traditional maritime countries to the proliferating open registries or so called 'flags of convenience'. This trend has led traditional maritime countries that have faced a reduction of their national fleet, and an increase of foreign ships navigating in their waterways and calling their ports to develop a stricter port state control regime.

Port state control has become a very active and integral part of the maritime scheme. Memoranda of Understanding on port state control have developed in different areas of the world. These memoranda strive to apply uniform standards for control at regional levels, which provides for a more efficient regime.

Ships are required to hold a certificate in accordance with the provisions of the annex. While in the ports or offshore terminals under the jurisdiction of a Party, this ships are subject to inspection by officers duly authorized by that party.

Any such inspection shall be limited to verifying that there is onboard a valid certificate, unless there are grounds for believing that the condition of the ship or its equipment does not correspond substantially with the particulars of that certificate. Or when there are clear grounds for believing that the master or crew is not familiar with essential shipboard procedures.

In these cases, or if the ship does not carry a valid certificate, the Party carrying out the inspection shall take such steps as will ensure that the ship shall not sail until it can proceed to sea without presenting an unreasonable harm to the marine environment.

Port State shall also cooperate in the detection of violations and the enforcement of the provisions of this annex by using all appropriate and practicable measures of detection and environmental monitoring, adequate procedures for reporting and accumulation of evidence. If such violations are found, they must notify the flag of the vessel found in violation.

With the future coming into force of the Annex VI of MARPOL, Port State Control needs to take measures to develop an efficient system to verify the compliance of the annex when vessels call into their ports. This task will imply the use of resources to develop guidelines to be provided to inspectors to properly verify the requirements without causing undue delay to the ship. Training of inspectors will also be necessary.

Another issue that Port State control has to deal with is the use of phrases like "to the satisfaction of the Administration" or "alternate measures established by the Administration", which are used in several conventions. This term just helps to make things more complex. What is satisfactory to one Administration may not necessary be to another, thus creating variations of standards.

In the case of annex VI, there are several provisions that allow Administrations to opt for alternate arrangements. These are mainly SOx reducing methods, and SOx and NOx control and verification methods. The problem is how will port state control go about the verification that these are in reality alternate methods, and that

they comply with the provisions of the annex? Will they go further and ask for technical data? These are questions that should be considered.

When a vessel arrives to a port that is in a Special Emission Control Area, Port State control will have to verify the record that must be kept onboard for the fuel changeover procedure that should have taken place prior entry into the port. This record must be in the form of a log book approved by the Administration and must contain information regarding the fuel changeover (to 1.5% sulfur fuel) operation.

Another item that will most likely be targeted by port state control is the bunkering delivery note and the fuel sample. If they have any doubts about the quality of the fuel, the can ask for the copy of the bunker delivery note. If they still have any doubts, they can contact the Administration which should have a copy of the delivery note in file and could attest for its veracity.

One last thing, is that under the annex waste streams from the use of exhaust gas cleaning systems are not allowed to be discharged into enclosed harbors and estuaries unless it can be thoroughly documented by the ship that such waste streams have no adverse impact on the eco system of the area.

It will be then responsibility of the port state to determine whether this discharge is allowable. For this, the port state will have to conduct studies to determine if the discharge of such waste will affect or not their eco system, and then notify their findings to the IMO.

## 5.3 Port Authorities

Ports, which are an integral part of the shipping industry, will also be faced with some requirements under the new Annex. Port operators find themselves on both sides of the environmental fence. They are custodians of the Environment of their

port, being responsible for water quality, the prevention of noxious emissions, the environmental behavior of their tenants and the ships in their water (Operations embrace environmental 'Audits', 1991, 24).

### 5.3.1 Receptions Facilities

The most outstanding item affecting ports is the requirement to provide adequate reception facilities for the proper disposal of ozone depleting substances and residues from exhaust gas cleaning, which will add to the current requirements under MARPOL for facilities for oily water, noxious substances and garbage.

The issue of reception facilities is of constant debate. While shipping operators complain that the lack of facilities makes it harder for them to comply with MARPOL provisions, some ports claim that the expenses to install such reception are too high. This statement holds especially true in less developed areas of the world, although lack of reception facilities have also been reported in ports of the industrialized world Environmental Aspects of Tanker Operations).

Some port operators have stated that they don't think it is viable to invest in this type of facilities if they don't see there are enough ships that will utilize them. On the other hand ship operators say that they will utilize them if they were available. This brings us to one of the oldest dilemmas, which one is first, the chicken or the egg?

In this same respect there is another aspect that plays an important role. Since a good number of ports operate privately, some Port Authorities say that it will be very difficult for them under the national legislation to demand the installation of these facilities. This reminds us that the industry is international in nature, and that legislation can vary substantially from country to country.

One particular problem with reception facilities for ozone depleting substances, besides the economic factor is that some countries may lack the technical expertise to

properly install these facilities. Up to this date there are no guidelines by the IMO with detailed specific requirements for this type of facilities, which will have to comply with the prescriptions of the Protocol of Montreal that regulate ozone depleting substances.

### 5.3.2 Vapor Emission Control Systems

Another aspect of the annex that affects ports is the installation of vapor recovery systems for the control of volatile organic compounds. Although this is not mandatory under the annex, if ports decide regulate the emissions of volatile organic compounds, they must do so under the provisions of the annex. Under the annex, the system to be installed in the port must comply with the requirements of MSC/Circ.585 on Standards for Vapor Emission Control Systems.

In a study conducted by CONCAWE, it was estimated that the cost of installing a vapor emission control system for loading gasoline onto sea-going vessels could vary significantly at sites with similar product loading rates because of specific issues in each site. Reported costs for sites with loading rates typical of a large refinery, range from 4 to 20 million US$ (Cost-Effectiveness of Marine Vapour Emission Controls).

The parameters used in the CONCAWE study to determine the costs of vapor emission control systems, which are very dependent on site-specific issues, are the following:

- the number of loading berths connected to the system;
- the distances between the berths and the shore line;
- the length of vapor line to the location of the emission control facility;
- the need for blowers to assist vapor flows over long distances;
- the number and level of redundancy of measurements, alarm and safety systems; and
- whether additional gas is added to the vapor to reduce the risk of ignition propagation along the vapor collection lines.

### 5.3.3 Bunker Suppliers

Lastly, under the annex contracting parties to the annex will have to ensure that the proper authorities keep a register of local bunker suppliers. This responsibility could be imposed to the port authority, since they could have better control over suppliers that operate in their ports.

In the event that the port authority is entrusted with this task, they will have to make sure that suppliers keep copies of the bunker delivery note for at least three years, and ensure that suppliers deliver the proper quality of fuel. They should also take appropriate action when suppliers are not found in compliance. A system will have to be developed to allow port state control verify the veracity of the bunker delivery note. The system should be available at all times for access and verification by the port state control.

# CHAPTER 6
# Areas of Concern

## 6.1 General

The entry into force of the new annex is still pending ratification by enough member states (at least 15) that will have a combine gross tonnage of at least 50% of the world's merchant fleet. Due to the nature of the provisions of the new annex, where interests from several sectors of the maritime industry are at stake, the fear that the annex will not come into force is present among a number of member states and other organizations, in particular environmentalist groups. The prove that the timely entry into force of the annex is questioned, can be found in a resolution created during the Conference that adopted the annex. This resolution says that if by 31 December 2002, the annex has not come into force a review will be conducted by the IMO as a priority matter.

The possibility that the annex will not come into force at least by the expected date is very real. There are precedents like Annex IV on Sewage, that after more than 10 years of its adoption still hasn't come into force. The IMO is currently conducting a review to find out the reasons why it hasn't come into force yet.

The issue regarding the provisions for entry into force of the annex was very controversial during the Conference that adopted the annex. Some countries, fearing that the annex will not enter into force asked for a reduction of the percentage of tonnage required for the entry into force. Various proposals were submitted suggesting that an increase of number of states could compensate for the reduction of tonnage.

These proposals arouse from the concern of some countries that the annex will not come into force. This concern was mainly because most of the world tonnage belongs to open registries, which are mostly developing countries and that are not

characterized by their safety and environmental consciousness. In table 6, we can appreciate that to most of the world tonnage is in the hands of few countries, which puts them in such position that if they don't ratify the annex, its entry into force will be jeopardized.

**Table 6 Top Ten Flags According to Gross Tonnage**

| Country | Gross Tonnage | Percentage |
|---|---|---|
| 1. Panama | 79581000 | 16.84% |
| 2. Liberia | 58137000 | 12.30% |
| 3. Greece | 27184000 | 5.75% |
| 4. Bahamas | 23873000 | 5.05% |
| 6. Cyprus | 23081000 | 4.88% |
| 7. Norway | 21089000 | 4.46% |
| 5. Malta | 19058000 | 4.03% |
| 8. Singapore | 16393000 | 3.47% |
| 9. Japan | 17570000 | 3.72% |
| 10. China, PR | 15785000 | 3.34% |
| **Total** | | **63.85%** |

**Source: Shipping Statistics Yearbook 1998**

The ratification of the annex will depend, in countries feeling that the benefits obtained outweigh its impact and in their ability to comply with these regulations, rather than for altruistic reasons. It is a well-known fact that financial implications take an important role when making the decision to ratify an international legal binding instrument.

Due to the complexity of the current industry and the different roles played by countries, the impact that the annex will have to a particular country differs greatly from country to country. Countries that are major flag states, will focus more on the impact that the new regulations will have to their fleet, while countries that are affected by pollution will focus on the great benefit from reduction of air pollution in their coastal area. Also, countries that are neither port state or flag states have other interests like the impact to their oil industry.

In chapters 4 and 5 an analysis was performed to determine how very sector of the maritime industry will be affected by specific regulation contains in the annex, which was reviewed in chapter 3. From the analysis, it can be inferred that even though, all regulations contained in the annex, will have an impact in one way or another, there are regulations whose impact is far greater. These regulations are the ones that are subject of controversy.

Using the above facts as a reference and using the information contained in the analysis on the impact to the various sectors, we can identify some of those areas contained in the annex that could somehow have an impact when countries are deciding to ratify the annex.

## 6.2 Sulfur Cap

As it was mentioned before, this is one of the most controversial provisions of the annex. The actual global cap established by the IMO will have almost no effect to the shipping or bunker industry.

The concern arises in the future lowering of this cap. With the lowering of the cap, the demand for lower sulfur fuel, which currently is mostly derived from low sulfur crude will affect countries that produce crude with higher sulfur contents. Countries that produce HSFO will face difficulties, since there might not be a market for this type of fuel. The majority of these countries do not count with the infrastructure to reduce the sulfur content of their crude by themselves, which needs the allocation of a lot of resources that are not available in most of these countries.

Widespread production of LSFO by removing sulfur at the refinery using a number of residue de-sulfurization (RDS) processes is not very likely. Even though the basic technology is fairly well established, the process is not widely used and only a few such plants exist (The Motorship, 1995, 78).

It is important to note that the sulfur does not magically disappear. It is left as a solid residue, which requires disposal, creating another problem. RDS involves treating the residue at high temperatures and pressures, using hydrogen and a catalyst, necessitating an investment in a high capital cost plant. For a unit of 20,0000 barrels/day, studies have indicated a cost in the range $350-650 million (The Motorship, 1995, 78).

These cost implications are of real concern for many oil producing countries in the developing world, which may not have the resources (Dust Settling, 1997). Also, arising from this investments in capital, an increase in the fuel price for the buyers will be inevitable. This increase is expected to be between US$ 25 and US$48 per ton (World Fleet Demand for Low Sulphur Fuel will Push Prices to the Peak, 1993, 20)

Within this category, there are countries like Mexico and Venezuela, whose economy relies heavily in the production of oil, and that will be greatly affected by future restrictions on sulfur content (Ninaber, 1998). Prove of this concern, was seen in their active participation during the Conference that adopted the annex to voice their concerns about the sulfur cap.

To illustrate the possible economic impact if the sulfur cap is reduced further, submissions from the oil industry to the IMO show that the estimated global investment cost associated with a 3.5% global sulfur cap would be between US$ 1.4 and 2.0 billion. If a 1.5% sulfur cap on a worldwide basis was established, it is estimated to be US$ 20 billions (The Motorship, 1995, p36).

## 6.3 Fuel Quality

Fuel quality is measured by performing a range of chemical analyses on a fuel sample. Such analyses are difficult to do accurately and are normally performed in

specialist laboratories. These days most of the fuel buyers use a reputable agency to perform the laboratory analysis. The test results decide whether a specific fuel is usable or not. The use of these laboratories has become a widespread practice among owners to make sure they get what they asked ordered.

Currently, the International Standard Organization (ISO) has in place standards for marine fuel oils, which are the standards being used by the industry. These standards are the basis for most the bunkers delivered worldwide, which has kept the sulfur content below 5% and also an acceptable quality of fuel. To keep in line with IMO's fuel quality requirements, the ISO has included the provisions of regulation 18, by means of a note, in their revisions of ISO 8217, which sets standards for marine fuel quality (Fuel Standards Attempt to Prevent Bunker Disputes But…, 1997, 29)

Since the days of the first use of heavy fuel oil in diesel engines, there has been an inherent compromise in opting to use such fuel: the acceptance of a fuel quality which is less than ideal for a diesel engine, in order to access a relatively low-cost fuel. Such a fuel is of course a by-product, rather than the primary product, of the refining process (CIMAC, 1998a, p 335). Most propulsion systems were developed to perform efficiently using these types of fuel.

The goal of the shipping industry has been to have access cheap fuel, but this is achieved only if specifications are set at a level which does not necessarily restrict availability, given the sort of refinery process and crude oil slates common in the industry. To date the correct balance seems to be achieved, but this might change with the imposing of the new requirements (CIMAC, 1998a, p 335).

Further restrictions on fuel quality could only lead to changes to the industry, as we know it today. By further restricting quality requirements, the bunker supply industry may have to invest to ensure that the bunker delivered complies with the set

standards. The inherent costs to produce such fuel will be passed on to the shipowners.

This regulation also has some other implications. The first is the added complexity to the bunkering procedure, which as mentioned before will depend on the bureaucracy level of each country. Also, the added control measures that shipowners will have to face, by having to "prove", through documentation and sampling that their fuel meets the established standards.

Lastly, this regulation also has some political implications. Governments will be responsible to ensure that bunker suppliers in the area are compliant with this regulation. Not only that, but also they should report to the IMO those companies that are not meeting the requirements. This puts governments in a delicate position. By informing the IMO, this information will be passed on to other countries, which could ultimately affect their local market.

## 6.4 Reception Facilities

The problem of adequate reception facilities is one that has been around for a long time. Currently, under MARPOL 73/78, states are required to provide reception facilities for the discharge of oily water mixtures, noxious substances and garbage. Member Governments claim that reception facilities are in place, but complaints keep coming to the IMO about the inadequacy, the insufficiency or the lack of these reception facilities.

The provision of adequate reception facilities ashore so that ships can land their oily slops and wastes, tank washing, sewage, garbage and now ozone depleting substances and washing from exhaust gas washing has long been recognized as one of the most important aspects of pollution prevention. As far back as the 1954 Oil Pollution Convention, which is the predecessor of MARPOL, there were requirements for reception facilities to be provided for oily ballast water and tank

washings from vessels other than tankers (Environmental Aspects of Tanker Operators).

So, for all these substances which cause pollution to the marine environment, a legislative regime is internationally in force and in theory there should be no reason why a ship should have any difficulty. The problem that it is two different things to produce an international agreement on the provision of reception facilities for pollutants, and to actually translate these international convention requirements into domestic laws. And even more difficult, is to convert laws into the provision of suitable facilities at ports (Operators Embrace Environmental 'Audits', 1991).

Even if it is clearly required by domestic law that facilities are to be provided, the installation is certainly not cheap and the legal requirements make no mention of how they are to be paid for, although the IMO has come up with some guidelines on this matter. It is easier for the port authority to just note that no such facilities are currently available and to require ships to keep their wastes onboard an take it elsewhere (De Bievre, 1998).

A reason for the lack of facilities, could be the proliferation of private ports. After privatizing their ports, some governments may find themselves in the position that they don't have the legislation to impose the requirement for reception facilities to these private ports. Leaving it to the port operator to decide whether or not to install the reception facility.

The main problem is that ports are faced with further problems in the commercial operation of their reception facilities. They will like to recover the capital and operating costs of the installations, but they must remain keenly aware that if the pricing is wrong, ship operators may elect not to use it. Faced with this dilemma, some ports have effectively hidden the charges for their reception facilities in their general charging schedule and encouraged their used. Some have tried to make more

modest charges for the use of the facilities, while others have merely avoided their responsibility, hoping that the rest would merely take up the burden (Ports Feel the Squeeze, 1990).

Under the new annex, states will be required to provide reception facilities for the proper disposal of ozone depleting substances. These facilities will have to comply with the requirements of the Protocol of Montreal, which regulates the handling of these types of substances. A major concern is that if governments cannot cope properly with the adequacy of reception facilities for oily mixtures, noxious substances and garbage, how are they going to cope with reception facilities for ozone depleting substances and washing from exhaust gas?

Also, on the same line of thinking, what is and adequate reception facility for ozone depleting substances is not defined. While most of the industrialized countries have been dealing with the technology for a long time, and it wold not be likely for them to face difficulties, it would not be the case for a lot of developing countries.

## 6.5 Emission Control Areas

The designation of SOx emission control areas is of great concern, due to the need for special low sulfur fuel to be used in such areas or alternative methods to reduce SOx emissions and the expected bureaucratic enforcement procedures. The shipping industry may face new complicated procedures in order to present evidence that may satisfy authorities that requirements have been complied with.

Another aspect is that there are sectors that believe that SOx emission control areas will not provide any real benefit for the environment, as without enforcement through sampling of all types of fuel oil the value of regulations will be doubtful. The shipping industry has continued to stress that SOx emission control areas are unwanted and they question the possibility of practical policing (Air Pollution).

The designation of special areas is one that goes beyond affecting the operating costs of shipowners. By creating special emission areas and by establishing procedures to designate such areas, the IMO is promoting to a certain extent regional standards as oppose to an international standard, which is the ultimate goal of the organization.

Another fear that has been voiced by the shipping industry is the likelihood of the proliferation of special areas. If this was to happen, it would introduce complexity to the operation of ships because of the need to carry two types of fuel, the procedures to change fuel before entering the area and the control measures they will be subject to, not mentioning the cost implication to have low sulfur fuels.

Another possible effect of establishing special areas is the effect it could have to the trading patterns in the area. Increased operating costs could eventually lead to increases in freights, but most importantly it could also divert them for going to these ports. To call the least number of ports in the area, ships may decide to deliver their cargo to hubs. From these hubs, the delivered cargo will have to be transported to its final destination by other means of transport. This could signify an increase of the transport of goods by land, which will in turn increase the emissions from the land based transportation mode and diminish the benefits from the reduced pollution from ships.

The cargo flows and the existing trade patterns should to be taken into account when considering potential areas for future restrictions on air pollution from ships. Locally different environmental pressures and inadequate reduction measures at single places or areas might influence the existing traffic pattern or could possibly lead to an environmentally unwanted change in the transport means being used, which could finally result in a negative impact for the local and global environment.

Changes in the total traffic pattern could have environmentally unwanted effects, and could finally result in a negative impact for the local and global environment. Consideration should be given to the complete transportation chains of the various goods, including international shipping and further marine distribution systems like feeder services and inland waterways (The Motorship, 1995, p 9).

# CONCLUSIONS AND RECOMMENDATIONS

## Conclusion

The problems related with air pollution, namely global warming, ozone depletion and acid rain are currently a top priority on a global level. As described more in detail in Chapter 2, the impact that these phenomena could have to our eco-system if the appropriate measures are not taken is not quantifiable. For this reason the world is looking for solutions that will prevent us from causing further damage to the environment. The creation of the Annex VI to MARPOL, which controls air pollution caused by ships arouse as a solution that through its proper implementation, will make the shipping industry become part of the global effort to reduce the effects caused by air pollution. The development of the annex was surrounded by controversy and skepticism and the final test, its entry into force, has a long way to become a reality.

Since the annex has already been adopted, it is now the responsibility of countries that are party to the MARPOL convention to ratify it for its timely entry into force. After almost two years after the adoption of the annex, only two countries have ratified it. This raises serious doubts to whether it will come into force. These same doubts led to the development of this paper, which hopefully will serve to have a better understanding of the impact that the annex will have to the maritime industry.

As already described in Chapter 3, the annex is divided into three chapters: General; Survey Certification and Means of Control; and Requirements for Control of Emission. It covers the control of a range of emissions, which include ozone depleting substances, engine emissions, volatile organic compounds and emission from incinerators. The annex also makes mandatory the NOx technical code, that establishes the standards that must be met in order to comply with NOx emission limitations. These regulations will have a great impact to several sectors of the maritime industry, including private industries and governmental agencies.

Chapter 4 identifies the private industries that will be affected the most in conjunction with the regulations that will affect them. These industries are the shipping industry (ship operators), the bunker supplying industry, the engine manufacturing industry and the ship construction industry.

The shipping industry as expected will be affected the most. The burden that these regulations will have on the shipping industry will be manifested in the form of increased capital and operating costs as well as changes in operational procedures. The regulations that could impact ship operators the most are the restrictions on the sulfur content on bunkers, including the creation of SOx Emission Control Areas and the limits on NOx emissions.

Engine manufacturers will be affected mostly by the onus that was put on them to develop the technology to meet the new engine emission requirements. They will also be facing operational changes, since the procedure to certify an engine for compliance with the NOx Technical Code will complicate the procedure for the delivery of the engine.

The bunker supply industry could be greatly affected by further reduction of the global sulfur cap and the proliferation of SOx Emission control areas, which will require the additional production of lower sulfur fuels. The current supply of low sulfur fuels is adequate for the existing demand, and an increase in the demand could put the bunker industry in a position where desulfurization methods may be needed. If this was to happen, the capital investment will be very high and not every country will be able to afford it, causing a possible distortion of the fuel market.

Shipbuilders will have to keep up with the environmental technology in order to stay competitive. Also, their ship designs will have to be more flexible in order to

accommodate new requirements, like the need for dual fuel when vessels operate in SOx emission control areas.

Regarding governments, the agencies that will be affected by the entry into force of the annex include maritime administrations, port state control and port authorities. The implications to these agencies are covered in Chapter 5.

Maritime Administrations will have to translate the requirements of the annex into national legislation in order to properly implement and enforce the requirements. Also, they will have to develop the mechanisms for the adequate control of the ships under their flag, which will entail allocation of resources.

The Port State Control Regime will have to include the provisions of the annex into their current list of items that must be checked by their inspectors, whom will have to be informed and trained to verify compliance. New documents like the bunker delivery note and the IAPP, will become the subject of scrutiny by port state officials.

The major impact for port authorities is that of the requirement for installing reception facilities for ozone depleting substances and washing for exhaust gas. This will have obvious financial implications. Also, they may be designated as the authority responsible for the monitoring of bunker suppliers.

After the impact that the annex will have to the different sectors was identified in chapter IV, the areas that could be considered as controversial were singled out and analyzed. This analysis was conducted in Chapter 6. The specific regulations that have been debated the most and that pose a threat to the entry into force of the annex, include sulfur cap, emission control areas, reception facilities and NOx control measures.

The sulfur cap established does not pose a threat to the industry. The problem may arise if further reductions take place when availability of the fuel and inherent cost increases could become an issue. This will affect both ship operators and bunker suppliers.

The issue of reception facilities has been on the agenda of the IMO for a long time. The lack or the inadequacy of reception facilities in certain ports is a problem that affects the proper implementation of the MARPOL provisions by ships. The main problem as stated by port authorities is the capital cost involved.

The control of fuel oil quality is one that is actually beneficial for shipowners, although it adds complexity to the operation of the ship. In respect to bunker suppliers, it will impose pressure to the industry to deliver good quality fuel.

SOx emission control will lead to higher operating costs to the operator, due to the need of lower sulfur fuels. Also, the proliferation of these areas could affect the bunker market. Another possible impact will be changes in trading patterns with possible effects to freight rates, if the emission control areas become too extensive.

In general, it will be acceptable to say that most countries are aware of the consequences related to air pollution. Even so, not every country is in the position to conform with the established measures to reduce the air pollution. For developing countries, where the impact of pollution is not as noticeable and where most of the citizens of the country live in poverty, the allocation of resources and the proper implementation of this requirements may prove difficult, if not impossible in some cases.

A prove of this fact is that many IMO members states from outside Europe and North America have stated that they are environmentally responsible but cannot afford the kind of reduction in ship's emissions desired by highly industrialized nations. They

also feel that it is not fair to impose extra costs on shipping while atmospheric pollution arising from the offshore exploration, exploitation and processing of sea mineral resources is exempt from similar international regulations (Dust settling, 1997).

Shipowners have expressed similar concerns. They feel they are merely being selected for new environmental constraints because they are an easier target for governments to tackle than shoreside industry or road vehicles, with all their associated votes and political clout (Dust settling, 1997). The validity of this argument may be debatable, but one fact that remains is that their views do carry some weight.

Recapitulating the information contained in this report stated above and trying to be as objective as possible, we can arrive to the following conclusions:

- The annex will affect the shipping industry the most, although it also affects bunker suppliers, engine manufacturers and shipyards.
- Most of the world tonnage is under open registries, which will play a major role in deciding whether the annex will come into force or not.
- Most countries accept the need for environmental controls, but not all of them find themselves in the economic situation to properly enforce these requirements.
- Every country has a different role in the maritime industry and their interests vary between flag states, port states and coastal states.
- Flag states main concern is the fleet under their jurisdiction and the impact it will have to them. Also they are concerned about the need of resources and control measures that are necessary to properly enforce the new requirements. The financial implications to the shipping industry are considerable and it could be a factor that some flag administrations my take into account when deciding to ratify the annex.
- Port State is more concerned about the effective implementation of the annex to prevent illegal discharges to their eco- system and to ensure that flag states are

assuming fully their responsibility. This would lead to the allocation of new resources to properly cope with the technical aspects to properly verify compliance. Also they will need to establish a scheme to impose penalties to those ships violating the emission discharge requirements.

- The interests of coastal states are divided among industrialized countries that are looking for a reduction of pollution and those developing countries that are more worried about the economic implications and the effect it could have to their industries, like the bunkering supply industry.
- The entry into force of the annex will depend on the willingness of those countries that are affected by the economic burden to make a sacrifice for the benefit of the environment, which in the long run will benefit all of us.
- The untimely entry into force of the annex could lead to unilateral or regional actions to control emission from ships that could have a bigger impact to the maritime industry, by causing an unbalance in the market and creating unfair competition.

## Recommendations

Due to the political nature of International Conventions and to right that every country has to decide which conventions they should ratify, it is not easy to tell administrations what they should do. Even the IMO, which regulates the maritime industry don't play much of a role at this stage of the game. Their status as an Inter-Governmental Organization is limited to the issuance of recommendations.

Keeping this in mind the following are the recommendations that may be of some help for a timely entry into force of the annex:

- The industries that will be affected should establish communication with their governments to voice any concern thy may have regarding the provision of the annex.

- Governments should conduct a detail analysis of the annex to determine exactly how it will affect them and analyze their ability to implement it.
- Governments should weight the economic impact against the long term benefits of protecting the environment. If the predictions are accurate,
- Governments that may face financial problems, could approach international organizations that could help with the funding necessary to adopt the requirements
- Governments should manifest their concerns, as soon as they arise to the International Maritime Organizations so they can start looking into the matter and finding solutions.
- Governments should open channels of communication with all the sectors that will be involved, and get their feedback. This will also help the industry to start making the necessary provisions for compliance well in advance and not wait until it has come into force.
- Governments should start looking into arrangements that ways that will make the application of some of the requirements be self-funding. For example, reception facilities could be funded by a user fee system.
- The IMO should take more of an active role. They should exhort governments to ratify the annex and to report any reasons that may stop them from ratifying the annex. It is better to start now, than to wait until the year 2003.

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