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Bulk carriers disasters : loading problems and solutions for increased safety at sea

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BULK CARRIERS DISASTERS: LOADING PROBLEMS AND SOLUTIONS FOR INCREASED SAFETY AT SEA

By

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, 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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ABSTRACT

The dissertation propose to study problems causing bulk carriers casualties. These problems are dealt with separately from loading, maintenance, stability, discharging to crew and personnel ashore competency.

The problems related to the cargo and the ship it self are listed and examined. Loading and discharging operations are explored taking into account stability questions. Possible other causes of bulk casualties are then explored to find out how they can affect the safety of the ship and cause serious accidents.

Bulk carriers safety rules and regulations are then enumerated. Problems faced to implement and enforce these instruments are pointed out with some possible solutions.

Possible ways and means to prevent damages to bulk carriers are then explained with an emphasise on how to improve the safety of bulk carriers.

KEY WORDS: bulk carrier, casualty, bulk cargoes, loading and discharging, damage

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List of abbreviations

BC Code	the Code of Safe Practice for Solid Bulk Cargoes
BIMCO	the Baltic and International Maritime Council
COLREG 72	the Convention on the International Regulation for Preventing Collision at Sea, 1972
DSC	Digital Selective Call
ESP	Enhanced Survey Program
FOC	Flag of convenience
FSI	Flag State Implementation
GM	Metacentric height
GMDSS	Global Maritime Distress and Safety System
GRT	gross registered tonnage
GZ curves	Stability cross curves
IACS	International Association of Classification Societies
IAPH	International Association of Port and Harbours
ICS	International Chamber of Shipping
ILO	International Labour Organisation
ILU	Institute of London Underwriters
IMDG Code	the International Maritime Dangerous Goods Code
IMO	International Maritime Organisation
INMARSAT	International Mobile Satellite Organisation
INTERCARGO	International Association of Dry Cargo Shipowners
IOPP	International Oil Pollution Prevention
ISM	International Safety Management Code
ITF	International Transport Workers' Federation
LL 66	the International Convention on Load Line 1966
LSA code	Life saving Appliance Code
MARPOL 73/78	the International Convention for the Prevention of Pollution from Ships, 1973 as amended in 1978
mdwt	million dead-weight
MOU	Memorundum of Understanding
MSC	Maritime Safety Committee
SMS	Safety Management System
SOLAS	the International Convention of the Safety of Life at Sea 1974
SWL	Safe working load
URS	Unified Requirements

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CHAPTER 1
INTRODUCTION

Bulk carriers are among the most anonymous of ships. They usually operate between terminals situated far away from cities and are rarely noticed by the general public. Large bulk carriers are often confused with tankers. When accidents occur, they do not have the same impact on the general public because there is no serious pollution associated. The sinking of bulk carriers often means that some or all crew members are reported dead or missing. In most cases, the causes of these casualties were attributed to "heavy weather" or accepted as unavoidable. The disappearance of many bulk carriers, built to the best knowledge available at this time, was accepted by the industry as a normal fact. Crew members onboard this kind of vessels and their families were amongst the rare persons who are really conscious of this problem.

Fortunately, IMO in co-operation with many other experts mentioning only the Nautical Institute, the International Association Of Classification Societies (IACS), the International Association of Dry Cargo Shipowners (INTERCAGO) and the International Chamber of Shipping (ICS) decide to act to improve the safety of bulk carriers. As a consequence, bulk carrier safety became a matter of great concern for the international maritime community. These joint efforts were axed on loading/discharging problems, structural failures and the human factors. All these factors are interconnected together and can affect the safety of bulk carriers. Firstly there are cargo criteria: density, angle of repose and the stowage factor which have to be considered to decide the amount and distribution of loads. Secondly, stresses to which a bulk carrier is subject have to be monitored and kept within limits approved by classification societies. It is very important to not exceed these limits during loading/deballasting and discharging/ballasting operations. It should be kept in mind that stresses could cause structural failures. Finally when human factors are invoked, crews, shipowners and terminal operators have to remember their obligation to contribute to the ship's safety. Studies carried out shows that not only crew members are to be blamed, when accidents occur, but also shipowners and terminal operators. They have to co-ordinate the cargo handling with ship's crews a safe operation.

Thus, new regulations were adopted concerning crews competency, safe loading and unloading of bulk carriers and guidance on how to carry inspections and what to look for. The management has to be involved in the bulk carriers safety through ensuring quality standards of crew members employed onboard, the safety of ships operated and marine environment protection. These new rules emphasise on inter alia personnel competency for both onboard and ashore, communications procedures during cargo operations and simplified guidance and procedures for improving the safety. Furthermore, an international co-operation between port State control and flag State control is necessary to ensure implementation of and compliance with all international rules and regulations. Most substandard ships are now targeted for detailed inspections and the principle of "no more favourable treatment" is applied to eliminate them.

CHAPTER 2

BULK TRADE AND BULK CARRIER FLEET

The increasing demand for raw material by industrialised countries has developed the world bulk trade and fleet. The reason for this development is that raw material are, in many cases, available far away from where they are needed and the most economical way to transport them is by ships. Many dry cargoes need to be carried by bulk carriers or combined carriers. Bulk carrier is a ship designed primarily to transport dry bulk cargo without bagging or packaging. A combined carrier transports ore/oil or oil/bulk/ore. In this way they have been developed to trade either in bulk or tanker trade.

2.1 MAJOR DRY BULK CARGO

In most material available, the major dry bulk cargoes are iron ore, coal, grain, bauxite and phosphates. The remaining dry bulk cargoes such as agricultural products, forest products, fertilisers, cement, salt, manganese, chrome and nickel are grouped together. Major dry bulk commodities (except grain), as described and defined in the Condensed Chemical Dictionary, are :

Iron ore : The principal raw material of the steel industry. Iron ore has three main varieties, chromite, hematite and magnetite.

The chromite or chrome iron ore is a natural oxide of ferrous iron and chromium, sometimes with magnesium and aluminum present. It is iron-black to brownish-black, streak dark brown or luster metallic to submetallic.

The hematite, called also red iron ore or bloodstone, is the most important ore of iron. However certain varieties are used as paint pigments and for rouge. It is brilliant black to blackish red or brick red mineral with brown to cherry red streak and metallic as dull luster.

The magnetite or lodestone is a black mineral, black streak, submetallic or dull(terne) to metallic luster (eclat). It contains 72.4% of iron and is readily recognised by strong attraction by magnet.

According to Jack Isbester (1993, page 230), iron ore cargoes are carried in one of four different forms:

- ROM is run of mine, which is ore of no special grade, shipped as it comes from the mine.
- Fines are small screening of iron ore. They may be sintered, which is a fusing together of fines with coke breeze, millstone and limestone fines to take lumps, or round pellets formed of very fine high grade ores.
- Lump is ore larger than a certain size.
- Concentrates are obtained when a natural ore has undergone some form of purification by physical separation of undesirable ingredients. Concentrates are like heavy sand.

Exporters: Brazil, Australia, Russia, India, Liberia, South Africa, Sweden, Canada.

Importers: Japan, Western Europe, South Korea, Taiwan, China.

Coal : The second largest of dry bulk cargoes. It is an impure form of carbon, occurring naturally as a stratified sedimentary rock. Usually black in colour but it might also be dark brown. It constitutes a mineralised fossil fuel mined extensively throughout the world and widely utilised as a source of domestic and industrial energy.

The main varieties are soft (bituminous), hard (anthracite), manufactured coal products (briquettes, peas, beans) and patent fuels (mixtures of coals dust and cement). It can be also classified in two categories: metallurgical or cooking coal (processed to become coke prior to being used with iron ore to produce pig iron for the steel industry) and thermal coal (extensively used as fuel to generate heat in power stations)

Exporters: Australia, the United States of America, Canada, Poland, South Africa, the United Kingdom and Colombia

Importers: Japan, South Korea, Taiwan, Hong Kong, Germany, the United Kingdom, the United States of America and Canada

Grain : The term grain covers : wheat, maize , oats, rye, barley, rise, pulses, seeds and flour. The carriage of grain presents a number of challenges for the shipmaster because it is a product which flows freely. It is also perishable and is intended for consumption by humans or livestock. This calls for holds that are very clean and for high standards in avoiding contamination, damage or infestation. The trade of grain is seasonable and fluctuating due to climatic conditions and the market offer and supply. A large amount of grain is not traded but transported as humanitarian aid to some countries which are affected by climatic disasters, epidemics or wars.

Exporters : Argentina, Australia, Canada, the European Community and the United States of America.

Importers : Western Europe, the Russian Federation, the Middle East, Africa and Asia.

Bauxite and Alumina :

The Bauxite is a natural aggregate of aluminum-bearing minerals, more or less impure, in which the aluminum occurs largely as hydrated oxides. It usually formed by prolonged weathering of aluminous rocks. It could be white cream, yellow, brown, grey or red. It is insoluble in water but decomposed by hydrochloric acid. The bauxite is most important ore of aluminum; aluminum chemicals; abrasives; aluminous cement; refractories; de-colorizing and de-odorizing agent; catalysts; filler in rubber, plastics, paints, cosmetics; hydraulic fracturing.

Alumina is a highly porous, granular form of aluminum oxide having preferential adsorptive capacity for moisture and odour contained in gases and some liquids. Granules range in size from powder to pieces about 3.81 cm diameter. It is also the semi-refined product of aluminum. It takes 5.4 tons of bauxite to produce 2 tons of alumina and obtain 1 ton of aluminium at the end of the process.

Phosphate : A natural rock consisting largely of calcium phosphate and used as a raw material for manufacture of phosphate fertilisers, phosphoric acid, phosphorus and animal feeds. The phosphate is also the primary source of superphosphate, prepared by treatment of the pulverised rock with sulphuric acid or by acidifying with phosphoric acid. It is often shipped raw.

Exporters : Morocco, the United States of America, North and West Africa and Jordan.

Importers : Western Europe, Japan, North America and Mediterranean Countries.

Other dry bulk cargoes : If considered separately, they are called minor bulk cargoes due to their modest trade. They are constituted of agricultural products, fertilisers, cement, salt, manganese, chrome and nickel. The agricultural products are composed of cotton, coffee, copra, groundnuts, potatoes, sugar and many other products.

2.2 INTERNATIONAL TRADE OF DRY BULK CARGO

Table 1. World seaborne trade of main bulk commodities 1992-1996 (in million tonnes).

Bulk commodities	1992	1993	1994	1995	1996
Iron ore	334	354	383	402	391
Coal	371	367	383	423	435
Grain	208	194	184	196	193
Bauxite and Alumina	48	51	49	52	55
Phosphate	29	27	29	30	31
Total	990	993	1028	1104	1105

Source Fearnleys: World Bulk Trade 1997 , p: 5

2.3 MARINE POLLUTION THREAT

Most dry bulk cargoes are not very pollutant. However there are many other minor bulk cargoes which are pollutant. Their trade is not important and due to their threat, they are generally transported in packed form. These bulk cargoes are listed in Appendix B of the Code of Safe Practice for Solid Bulk Cargoes (BC Code) and in the International Maritime Dangerous Goods (IMDG) Code.

The BC Code lists, in its Appendix B, the bulk materials possessing chemical hazards. It defines their properties, the loading and transport conditions to be observed and the segregation, stowage and other special requirements.

The IMDG Code stipulate the transport conditions, marking, packing and labelling requirements of dangerous goods.

2.4 FLEET SIZE

The bulk fleet is composed of both combined carriers and pure bulk carriers. The development of their fleet by size since 1990 is given the two tables below.

2.4.1 Combined carriers : They were developed to trade between markets, wet and dry, rather than to trade alternate cargoes. This was because, for any given period of time, one market tends to be stronger and so provides greater opportunities for profit than the other. However as shown in Table 1, the combined carriers fleet has decreased from 278 ships in 1990 to 173 in 1997 with a total 18.15 million dead-weight (mdwt).

Table 2. Evolution of combined carriers fleet 1990-1997.

Size in '000 dwt	1990 January	1994 January	1995 January	1996 January	1997 January
10 - 25	3	2	1	1	1
25 - 50	18	16	15	14	13
50 - 100	93	101	98	95	84
100 - 150	101	85	76	70	51
150 - 200	39	31	27	24	15
200 - 300	20	16	12	10	5
300 +	4	4	4	4	4
Total	278	255	233	218	173

Source Fearnleys: World Bulk Fleet January 1997 , p: 5

2.4.2 Bulk carriers : In 1990 the number of bulk carriers was 4730. Due to a continuous development of bulk carriers fleet during the nineties, the total number of bulk carriers in January 1997 is 5317 totalling 255.3 mdwt.

Table 3. Evolution of bulk carriers fleet 1990-1997.

Size in '000 dwt	1990 January	1994 January	1995 January	1996 January	1997 January
10 - 25	1302	1253	1251	1263	1280
25 - 50	2301	2356	2401	2498	2576
50 - 100	807	864	910	967	984
100 - 150	203	225	222	229	232
150 - 200	86	121	137	160	199
200 - 300	30	40	41	40	44
300 +	1	2	2	2	2
Total	4730	4861	4964	5159	5317

Source Fearnleys: World Bulk Fleet January 1997 , p: 5

2.5 FLEET AGE AND RELATED PROBLEMS

The two following tables of existing combined carriers and bulk carriers by size and age distribution show that :

- 75% of the bulk fleet is more than 10 years old
- 50% of the bulk fleet is more than 15 years old
- 20% of combined carriers and 28% of bulk carriers are more than 20 years old

The problems with this type of ship are :

- Corrosion of the hull caused by sea water and which can be accelerated by the effect of carrying some cargoes
- General fatigue of the ship's structure
- Inadequate maintenance of important equipment such as hatch covers

Table 4. Combined carriers fleet: size age distribution

Size in '000 dwt	-1976	1977-81	1982-86	1987-91	1992-96	Total
10 - 25	-	1	-	-	-	1
25 - 50	2	1	6	4	-	13
50 - 80	6	18	30	2	4	60
80 - 100	-	5	3	4	12	24
100 - 150	19	21	6	-	5	51
150 - 200	5	-	1	6	3	15
200 - 300	2	2	1	-	-	5
300 +	-	-	1	3	-	4
Total	34	48	48	19	24	173

Source Fearnleys: World Bulk Fleet January 1997 , p: 14

Table 5. Bulk carriers fleet: size age distribution.

Size in '000 dwt	-1976	1977-81	1982-86	1987-91	1992-96	Total
10 - 25	496	389	226	51	118	1280
25 - 50	681	487	836	192	380	2576
50 - 80	204	161	228	136	206	935
80 - 100	16	8	12	4	9	49
100 - 150	53	53	41	32	53	232
150 - 200	15	7	43	38	96	199
200 - 300	7	-	11	20	6	44
300 +	-	-	1	-	1	2
Total	1472	1105	1398	473	869	5317

Source Fearnleys: World Bulk Fleet January 1997 , p: 14

CHAPTER 3

LOADING PROBLEMS

Bulk carriers, the horse-workers of the sea as they are used to be called, are subject to a very hard regime of work. This is due to:

- The wide range of cargo stowage factors which vary from 0.18 m3/t for the ferrochrome to 3.25 for the pumice
- Cargo properties such as shifting, liquefying, chemical hazards content, self-heating or sustaining exothermic decomposition
- Short stay in ports made possible by cargo purpose built vessels, modern cargo handling equipment and purpose built berths
- Some cargo handling equipment which may damage the structure of the ship especially during the end of a discharging operation

In order to avoid these problems great attention should be paid to cargo operations, and ship stresses and stability both in ports and at sea.

3.1 LOADING

The loading, the first operation for a designated voyage, has to be well planned. This plan should include many operational steps in order to ensure ship's safety. Many different criteria related to the cargo itself, the cargo equipment and the ship have to be carefully considered.

3.1.1 Cargo criteria: These criteria are related to the properties of the cargo and can be resumed to:

Stowage factor: As stated before, this factor vary considerably from one cargo to another. It is a very important tool for deciding the cargo quantity to be loaded and for its distribution. For low density materials, it is desirable to share the total amount of cargo between the holds in order to ensure ship's stability, low shear forces and bending moments. However for high density materials, a proportional sharing of the cargo between holds or alternate loading of holds is better. The ship's officer, in charge of the loading operation, also has to check that the amount allotted to each hold is not greater than permitted by the ship's classification society.

Angle of repose: This information is essential to be known for granular materials in order to avoid cargo shifting during the voyage and also used to determine trimming conditions.

Moisture content: In order to carry safely the cargo, the moisture content has to be less than the transportable moisture limit. To ensure this cargo condition, the master should not only rely on the certified value from the declaration by the shipper but also through his own cargo inspection before loading. The cargo can be wetted or moistened during the production, transport or storage phases. It is not unusual that the cargo is stored on the quay when it is raining and for long periods.

Chemical hazards: These are defined in Section 9 of the BC Code in accordance with the IMDG Code. Hazards are classified in nine sections:

1. Flammable solids
2. Substances liable to spontaneous combustion
3. Substances which, in contact with water, emit flammable gases
4. Oxidising substances
5. Poisonous (toxic) substances
6. Infectious substances
7. Radioactive materials
8. Corrosives
9. Miscellaneous dangerous substances and articles

Hazards may affect the safety of the ship by causing:

- damage to the ship it self by generating explosion, fire and corrosion of the ship's structure
- injury to crew members.

Consequently, the ship's master has to be provided with cargo's chemical hazards in order to take necessary actions and measures to ensure safe handling of the cargo and the safety of his ship.

3.1.2 Handling facilities criteria: Loading facilities are generally of the following types:

- Pipes from silos for bulk grain, animal feeds and oil seeds and for mineral material with high values or dusty characteristics
- Conveyor belt or rope way transportation system when stockpile is far away from the port
- Shiploader or reclaimer if the stockpile is within the port
- Ship- or shore-cranes with grabs which transfer cargo from the stockpile directly to the ship

In general loading equipment rarely cause damage to the ship. However the risk still exist and can occur through contact between the loader arm and the ship's structure or droppings of cargo from grabs. The other possibility of risk is caused by bad manoeuvring of the loading equipment. Therefore the ship's master or the officer in charge of the loading operation have to watch how the operation is performed by the stevedores. In addition any damage to the ship has to be reported, monitored and repaired especially if it affects the safety of the ship. It is not uncommon that equipment on the deck and hatch covers, coamings or sealing are damaged due to improper operation of loading equipment.

3.1.3 Ship's criteria: To ensure safe loading operation, the ship's master has to prepare loading plans in conformity with the ship loading manual. In that order, the Nautical Institute has prepared a "Cargo Operation Control Form" which includes a programme for the safe loading whilst keeping stresses within the permitted limits throughout the process (J.Isbester, 1993). This form has to be completed before the commencement of the loading and is used during the operation as a working document both ashore and onboard. The loading operation includes many simultaneous tasks to be performed by the ship's personnel:

- Deballasting which has to be planned and monitored during the loading. Ballast should be discharged in a time shorter than the time allowed for the loading and from a position close to the hold taking cargo. This ensures that the ship stresses and bending moments are kept within the permitted limits

- Monitoring the delivered amount of cargo. Nowadays loading rates in many ports are very high. This monitoring can be done by means of loadicators or loading computers, if available, otherwise through manual calculation and draft monitoring. Loadicators are computers made only for loading calculations while loading computers can perform, in addition, a variety of other tasks

- Ensuring effective communication system between the ship and the terminal throughout the operation. This link has to be established and among other agreements should contain procedures on how to stop cargo operations or to provide the ship's master with the loaded cargo weight at frequent intervals and the reporting of any ship's damage from the cargo operation

- Ensuring symmetric cargo hold distribution so that potential stresses are avoided.

During the sea voyage, the crew has to plan regular inspections of:

- hatch covers, their water-tightness and locks. Additional attention has to be taken in case of rough weather
- ballast tanks in order to detect abnormal levels. Regular sounding has to be recorded so that unexpected increase or decrease of typical values of tanks levels are detected
- cargo lashing and securing devices in case of timber or logs on deck and steel coils carried below deck
- holds' temperature which should be monitored and recorded to avoid heating of cargoes like coal and grain or moisture content in the case of materials of particularly vegetable origin.

3.2 DISCHARGING

As for the loading/deballasting programme, the discharging/ballasting operation has to be carefully planned to avoid stresses and bending moments of the ship. Unlike the loading operation, the discharging operation is a real threat to the ship structure. Several equipment being used cause damages to the hold coating or the ship's structure particularly side shell frames, end brackets, inner bottom plates and transverse bulkheads. For continuous unloading systems, the use of pneumatic hoses, Archimedes' screw or bucketweel did not present risk of damage to the ship unless there is contact between the system and the ship's structure. This is not the case of hydraulic equipment used to free and clear the cargo, grabs and bulldozers where the risk of damage is very high. The contact between this type of equipment and the ship's structure and holds' coating is unavoidable particularly during the end of the operation. Using the ship's gear presents the same problem as for grabs specially when the gear is operated by shore drivers. The reason is the lack of attention, responsibility and care from stevedores. This skill and mentality of care have to be applied in order to minimise damage to the ship. As stated for the loading, concerning damage to the ship, the same procedure is applied to the discharging operation.

After discharge, a detailed inspection of the ship is carried out to detect damages of the interior of the holds, hatch coamings, hatch covers or any other ship's structure. Additional inspection of the deck equipment is also carried out to discover any damage which would affect the safety of the ship.

3.3 STABILITY AND CARGO SHIFTING

A stable ship is a ship that will return to its initial position when inclined by an external force. An unstable ship is one which tends to heel still further when inclined to a small angle. Thus it is very important that the ship at any condition has an adequate standard of stability. In that order the Regulation II-1/22.1 of the International Convention of the Safety Of Life At Sea (SOLAS) 1974, as amended, requires ships which are subject to this Convention to be provided with a stability information booklet. This booklet represents simplified stability information contained in diagrams or tables which enable the ship's master to calculate the ship's stability for the planned voyage. The calculation has to be done for two different conditions. The first one is the port condition where the ship is in sheltered waters but subject to shear forces and bending moments due to loading/deballasting or discharging/ballasting operations. The second condition is the at-sea condition where the ship is subject to higher shear forces and bending moments due to the load of the ship and accentuated by the weather conditions which could be encountered during the voyage. Even when the ship is adequately loaded, the cargo well trimmed and the openings and deck equipment secured, the weather encountered during the voyage could increase the risk of loss stability due to the ship movement in the seaway. The ship could endure very difficult situations due to:

- springing or flexing which can be generated by waves or swell when the ship is inadequately loaded for these weather condition. This situation can be corrected by an alteration of the course or the planned route or a change of the ship's speed or a ballast change.
- hogging and sagging which are situations where the ship's load is concentrated respectively in the forward and after and near amidships. In case of hugging the drafts forward and aft are greater than the midships draft while in the case of sagging the situation is completely opposite. Due to the fact that cargo spaces are located near amidships, the ship often will be more sagged than hogged. Under any condition the shear stresses exist and are minimised when the ship is sagged.
- flooding which can occur accidentally and reduce stability of the ship due to free surface effect. Some compartments can be flooded but for a loaded hold the effect of free surface can occur only when the water surface rises above the level of the cargo.
- sloshing which is the violent movement of liquid within a compartment as a result of the ship's motion in a seaway.

The in-port condition values are often higher than the at-sea values. Thus before leaving the port, the shipmaster has to reduce the in-port values to the at-sea values to ensure that the ship remains safe throughout the voyage. All provisions related to the stability of the ship are required by the International Convention on Load Line (LL), 1966 which calls for an assessment of the ship's stability through amongst others the calculation of the value of the metacentric height (GM) and bending moments and the use of stability cross curves (GZ curves) . An approximate indication of the ship's stability can be obtained from the metacentric height (the GM). The value of the GM can be calculated easily by the shipmaster or the chief officer supposing that all the weights and their position onboard are known with a relative accuracy. However the value of the GM has to be corrected for free surface effect to obtain the fluid GM. The value of the fluid GM gives an idea about the behaviour of the ship at sea. If its value is large, the ship will be very stable or "stiff" which means that she will roll violently and rapidly. This condition, even if it is uncomfortable, is common aboard bulk carriers when they carry high density cargo such as heavy ores and steel. On the other hand, a bulk carrier carrying low density cargoes will have a small fluid GM and consequently be less stable, be inclined more easily and will roll more slowly. This condition is known as a tender condition. Thus the maritime authority has to refuse the departure of a ship for the voyage in an unstable condition unless adjustments to improve the stability condition are made. These adjustments to increase the positive stability could be :

- repositioning weights lower in the ship,
- the addition of weights such as bunkers or ballast low in the ship,
- the removal of weight from high in the ship,
- the rearrangement of the contents of bunker and ballast tanks in order to reduce free surface effect, and otherwise
- the reduction of the amount of cargo accepted

In addition the ship's loading guidance and stability manual will provide details of the calculation required. The stability manual also states the minimum permitted values for areas under the statical stability curve for the righting lever and for the fluid GM (J. Isbester, 1993). The BC Code, in the section 2.1.3. states conditions to aid stability inter alia the carriage of high density materials and the obligation for the shipmaster to calculate the stability for the anticipated worst conditions during the voyage as well as that on departure and show that the stability is adequate. Some other criteria related to cargo properties have to be taken into account. These criteria affect the initial stability of the ship and particularly the stability during the voyage are:

- asymmetric cargo distribution
- cargo shifting
- material with high moisture content and which can thereby act like liquids

In addition to the BC Code, there are special requirements for the carriage of grain and timber deck cargoes. The I M O Grain Rules stipulate the minimum level of acceptable stability for the carriage of grain in term of initial metacentric height, angle of heel due to assumed grain shift and residual dynamic stability. These rules stipulate also requirements for the strength of grain fittings and securing of partly filled compartments. The Code for Safe Practice for Ships Carrying Timber Deck Cargoes provides recommendations for the safe carriage of timber deck cargo and under-deck stowage of logs. It contains:

- general provisions for the carriage of timber deck cargo;
- methods for calculating the stability of the ship at all times;
- conditions for the stowage of timber deck cargo;
- guidance and minimal requirements for the securing devices;
- advice for ensuring the ship's safety when handling the cargo and during the voyage; and
- general guidelines for the under-deck stowage of logs.

3.4 HANDLING FACILITIES

It is common only for handy-sized and mini-bulkers to be geared. It is uncommon for large bulk carriers to be equipped with gears. The cargo is then handled by the shore equipment which can load or discharge cargoes faster and with more flexibility.

Geared vessels use their handling equipment when they have to visit poorly equipped ports and anchorages. The majority of terminals now are well equipped so that bulk carriers use their gears only when the shore-based equipment fail. The most common ship's gears are composed of derricks, cranes and munck gantries which provide a base for cranes. The munck gantry consists of an horizontal span supported on two pairs of legs resting on rails which run the length of the deck. A lifting head is situated at the lower ends of the wires which can be used with a grab or hook. The munck gantry can move longitudinally on the rails along the deck and have a transverse movement through the top platform beneath the span.

These equipment have to be kept in good condition in order to ensure their safe operation. They must be greased, lubricating oil in sumps must be topped up as necessary and signs of contamination by water must be sought (J. Isbester, 1993). The safe working load (SWL) of each item of the gear must be clearly marked and the condition of the wire ropes has to be inspected regularly. The limit switches, if provided, have to be frequently checked, tested and reset to their designated limits. After any dismantling for maintenance, the gear has to be inspected and carefully handled when reassembled. Finally a special attention has to be made when the vessel's gear are operated by shore personnel who might be less familiar with the equipment. Naturally the safe working limits have to be respected.

Shore equipment vary considerably. This type of equipment are very sophisticated and have high work performance in order to reach very high loading or discharging rates.

The most common loading equipment are:

- Conveyor which is one of the easiest ways to transport bulk cargoes. Its length depends on the situation of the stockpile which can be in the port or in some cases in the factory or even as far as the mine. It is often linked to a reclaimer which is a machine using bucket wheel or a scrapper belt to remove cargo from stockpile or a stacker which is an arrangement of conveyor belts and booms similar to a shiploader.
- Stacker/reclaimer which could be very useful in the case where the mine is adjacent to the loading berth
- Mechanical shiploader used principally for dusty cargoes. It is composed of a conveyor belt contained within a suitable boom framework and able to move on rails along the quay. The cargo is brought by the conveyor over the ship and then directed through a boom or an arm directly into the hold.
- Grab, crane or munck gantry which are also very common in bulk terminals.

Some of these equipment are also used for discharging. This is the case of grabs, cranes and munck gantries. With slight modifications some other equipment are also used for the discharging operation. This is the case of the mechanical shiploader and the loading pipe which are respectively replaced by the continuous unloader and the suction unloader. Additionally equipment are used to discharge dry bulk cargoes :

- Vacuvators as described in Bulk Carrier Practice (J. Isbester, 1993) are self-contained mobile suction units powered by diesel motors and usually weighting 3-5 tonnes. Their use is most common in berths where bulk cargoes are not regularly handled and in under-developed regions. They are generally used to discharge grain and similar cargoes.
- Cavaletto is a portable gantry which is lifted on board the ship. It can move on beams plac-ed on strengthened hatch coamings. The cavaletto system is used a lot in some Italian ports.

Most of the damages that the ship endure during discharging operations are related to bad manipulation of the cargo handling equipment. The equipment only damages the ship if an accident occurs. However the stevedores' work have to be continually controlled and supervised. At the end of the cargo operation, any damage to the ship is reported to the stevedoring company. These damages soonest have to be repaired in order to avoid that the ship sails in any hazardous condition.

3.5 SHIP STRESSES

Bulk carriers are built to be subject to varied regimes of work during their life time due to the wide variety of cargoes they carry. Consequently their design should take into account this particularity so that the structural integrity is maintained. They have to withstand the expected static and dynamic forces to be experienced during their future service time. The static forces are due to weights of the ship's structure, out-fittings, equipment, machinery, cargo carried, bunkers and ballast and buoyancy forces acting on the hull. The dynamic forces are generated by the action of the waves and the effect of the resultant ship motion (i.e. pitching, heaving, rolling, wind, acceleration forces, slamming and sloshing). All these forces cause the ship to be subject to shear forces and bending moments which vary considerably throughout the length of the ship. The shear forces and bending moments have to be calculated before any operation of loading or discharging of cargo, ballasting and bunkering.

According to a study carried out by the International Association of Classification Societies (IACS) members showed that a 5% overload placed in various holds could increase the still water bending moments by up to 15% and the shear force by up to 5% while a 10% overload could increase the still water bending moments by up to 40% and the shear forces by up to 20%. This overload could be caused by five to eight minutes delay in stopping a conveyor belt with a capacity of 16,000 tons an hour (IMO, 1998).

Consequently the stresses to which the ship's structure is subject in high seas will depend on the loading and particularly the weather conditions. As defined in ship stability (D. R. Derrett, 1996), a stress is the mutual action between the parts of a material to preserve their relative position when external loads are applied to the material. Thus, whenever external loads are applied to a material stresses are created within the material. The stresses in the hull section caused by theses shearing forces and bending moments are carried by continuous longitudinal structure members. These structural members are the strength deck, side shell and bottom shell plating and longitudinals, double bottom girders and topside and hopper tank sloping plating and longitudinals, which are generally defined as the hull girder (IACS, 1998). These stresses are accentuated by the large hatch openings which reduce the torsional resistance of the hull. Accordingly, it is very important that the stresses values should not exceed the allowable ones otherwise the ship may suffer during the voyage and in the worst cases breakdown. The factors which may generate ship's stresses have to be monitored exceptionally when the bulk carrier is carrying cargo in alternate holds. In such conditions, the structure suffers greater stresses on frames, girders and inner hull components which is acceptable for a new ship but not for an old ship. The classification societies provide normally the ship with maximum allowable values of stresses to which the ship can be subject. Nowadays and with the help of computers, all necessary calculations can be easily performed at any time and as quickly as possible.

CHAPTER 4
BULK CARRIER CASUALTIES

The number of accidents where bulk carriers were involved has been fluctuating during the last years. This fact was rarely noticed by the general public because there was no pollution to attract the media or the environmentalists. Fortunately, the maritime community became seriously concerned about this problem because of the important number of serious casualties where bulk carriers were involved and lives lost in these accidents. In that order some studies and investigations were done to find out the major causes of the latest accidents and the problems related to the increase of bulk carriers casualties. Frequently these accidents cause the loss of the ship, her cargo and many losses of life. These investigations were carried out to:

- collect data on bulk carriers casualties; and
- find out the causes of major accidents.

4.1 OVERVIEW OF CASUALTIES

After any kind of accident, it is very important to find out its causes. This study is also primordial to learn lessons from previous accidents and to decide the way to avoid them in the future. This is not always possible due to the fact that many bulk carriers were lost without any trace of neither the ship nor the crew. Many have sunk so quickly that even distress messages have not been sent and there was no time for the crew to use life boats.

The Baltic and International Maritime Council (Bimco), in their Special Bulletin 1998 on bulk carrier safety shows that from 1991 to present days:

- the number of serious casualties of bulk carriers, generating the total loss of the vessel, is fluctuating with a trend to decrease during the last three years. In 1991 there were fifteen total losses as in 1992. In 1993 fortunately there was a significant decrease of fatalities to ten which was not the case of 1994 when seventeen bulk carriers were lost. In 1995, there was an important decrease to only six very serious accidents which was also the case of the year 1997. Unfortunately, for the year 1996 an important increase of the number of fatal accidents was noticed to reach thirteen.

- The causes of theses casualties are varied but the number of accidents due to bad weather condition is noticeable due to the fact that in major cases it is the highest one. In such case it is difficult to carry search and rescue operations and consequently some of the ships sunk without leaving any trace and there was no survivals from the crew. The investigations were not carried out due to among other factors the weather conditions or the depth of the sea where the ship sunk. Adding the fact that in some cases the crew has no time to launch life boats or even to send an emergency message, consequently the cause of such disaster was attributed to weather conditions which might not be. It could be other causes such as structural failure, cargo shifting, flooding of some holds and compartments or capsizing of the vessel which were accentuated by the weather conditions.
- Bulk carriers which were totally lost were flying different flags and under all classification societies. Their age vary from three to twenty eight years old. That's mean that ship's which are three years old have been constructed according to the latest development of ship's design and with the help of the most powerful computers. The best steel quality was used for their construction and computerised calculations were made to strength the vessel's structure where needed and to make savings in other parts.
- Their size vary from 1485 gross tonnage (GRT) to 96, 039 GRT. The interesting in this statistic is to notice that some bulk carriers sunk while they were not loaded and the cause of their sinking was also attributed to weather conditions.

On the other hand, statistics available from different documents of the Sub-Committee on Flag State Implementation (FSI) of IMO, give clear data on the number of serious casualties where bulk carriers were involved. Many vessels were broken up after the accident due to the fact that they have suffered too much damage and the repair costs would be too high.

According to these documents (IMO, 1993 ; IMO, 1994 ; IMO, 1995 ; IMO, 1996 ; IMO, 1998), the number of serious casualties where bulk carriers were involved since 1991 to 1996 are given in the table below:

Table 6. Bulk carriers casualties 1991-1996.

YEAR	1991	1992	1993	1994	1995	1996
Average age of ship	19.3	19.1	15.3	19.6	16.6	18.0
Number of casualties	30	25	10	60	38	69
Number of total losses	21	12	07	17	09	19
Percentage of total loss	70	48	70	28	24	27

The table above shows, for bulk carriers involved in serious accidents, that:

- Their average age is always above fifteen years and exceeds nineteen in three cases. For this reason, bulk carriers are considered to be so vulnerable when they reach fifteen year old
- The number of serious casualties is oscillating between 10 for the year 1993 and 69 for 1996. This is due to the weather conditions because one typhoon can cause a considerable number of accidents such as grounding, capsizing or flooding. One other interesting observation is that for the year 1993 when there had been only 10 serious accidents, seven of them were totally lost which means 70 per cent and that in 1996 when the number of casualties reached 69, nineteen of them were lost which represents 27 per cent only.

4.2 CAUSES OF MAJOR ACCIDENTS

The loss of a bulk carrier is a matter of great interest and concern to the seamen who serve in that class of ship. They need to know the lessons which have been learnt from all the bulker casualties which have occurred in recent years in the hope that they can profit from the mistakes which have been made in the past (J. Isbester, 1993) . Some bulk carriers casualties were further investigated to determine the causes of these accidents and to avoid them in the future. Unfortunately the causes of many casualties remain not clarified due to the fact that the ship sank, all the crew died and there was no investigation. In such cases the flag state did not want or can not carry out an investigation.

During the last years, a serious concern about this subject was manifested by the International Maritime Organisation (IMO), IACS and many other concerned institutions mentioning only the Institute of London Underwriters (ILU), the International Chamber of Shipping (ICS), BIMCO and the International Association of Dry Cargo Shipowners (INTERCARGO). The international community is also combining all efforts to improve the safety of bulk carriers. This could be done by identifying firstly the causes of these accidents and secondly the means to avoid them. The Canadian and the Norwegian government agencies are therefore investigating the wrecks of the two bulk carriers "Flare" and "Leros Strength".

The causes of major accidents can be attributed to:

Extreme weather conditions: This is a major cause of fatal accidents where bulk carriers were totally lost. Weather can be the direct cause and generate the capsizing, grounding, stranding or flooding. In some other cases, it has been proven that the weather can accentuate an existing critical situation of cargo overloading, instability, machinery problems or structural failure of a bulk carrier. Consequently, it is very important to collect data before and during the voyage about the weather conditions in order to make the right decisions at right time. The data to be collected are:

- Direction and force of the wind
- Direction and state of sea and swell
- Atmospheric conditions and visibility
- State and height of the tide
- Direction and strength of tidal and other currents

However, the collection of data and information is not sufficient to ensure a safe voyage because the weather issues are too complex and not completely available for the master. Receiving and using the weather forecasts are not sufficient because the user must understand their weakness on a seasonal or regional basis particularly for a transoceanic voyage. In addition, adjustments to the planned route should be made according to weather warnings that are broadcast.

Precisely because the ultimate responsibility for the safe manning of the ship lies with the master, it is essential that he base his decisions on the best information available. Thus, the assistance of an experienced marine weather professional could prove invaluable for the critical decisions that will lead to greater bulk carrier safety (Carlsgaard and Wilson, 1998).

Grounding/stranding: In most cases, a ship runs aground as a result of bad weather conditions and sometimes ships are stranded deliberately to save the vessel, the crew and the cargo. Moreover, this could be due to:

- Effect on compass by magnetic cargo, electrical disturbance or local attraction
- Bad performance of the radar handling and information interpretation
- The use of uncorrected charts, sailing directions and relevant notices to mariners and no observance of the warnings they contain
- Irregular depth soundings taken
- No correction of the ship's draught
- Engine or steering failure
- Anchors not ready or dragging

Fire/explosion: They are always attributed to human errors because they are generated by:

- Leakage particularly in the machinery space
- Cargo chemical hazards namely flammable solids, spontaneous combustion or emission of flammable gases
- Insulation of pipes containing heated materials
- Defection of fire detection and other alarm sensors

What has to be stressed in these cases is that regular inspections, good monitoring systems and awareness of the crew to all the mentioned problems could minimise the risk of fire or explosion.

Foundering: Caused primarily by heavy seas or the alteration of the tightness of the ship's openings. For these reasons, the crew has to check before the departure of the and inspect regularly, if bad weather is encountered, the:

- Stability of the ship if respected
- Ship's seaworthiness if altered by detecting damage to the ship's structure during cargo operations. Any damage has to be monitored and repaired as soon as possible
- Watertight integrity of hatches, scuttles, ports and other openings

Machinery problems: The safety of the ship, while having machinery problems , is ensured by:

- Keeping the bridge informed about these problems
- Having the anchor ready and effective
- Monitoring the weather conditions while the ship has machinery problems
- Requesting assistance depending on the situation and at adequate time
- Maintaining the machinery according to the manufacturer's instructions and avoiding any departure with a failure which may affect the safety of the ship

Collision/contact: The respect of the Convention on the International Regulation for Preventing Collision at Sea, 1972 (COLRE 72) is the best way to avoid collisions which can be done by considering:

- The local or other rules for navigation
- Any obstruction to manoeuvring, e.g. by third vessel, shallow water, beacon or buoy
- The conditions of visibility (fog) and audibility, e.g. state of the sun, dazzle of shore lights, strength of wind and shipboard noise
- The radars used: number and range used on each one
- The look-out conditions and adequate number of persons

4.3 PROBLEM RELATED TO SHIPS CREWS

Inexplicable bulk carrier losses at sea have been attributed to many causes, including poor weight distribution and overloading, high loading rates, shifting of cargo, structural corrosion and weakness, heavy weather, ballasting operation, and damage during loading/discharging operations. A lack of awareness within the industry, particularly on ships operated by crews who have little or no previous experience in operating large bulk carriers , is also a point of concern (Muirhead, 1998). The ideal of course is to have very experienced crew members. Unfortunately, this is not so easy because of unavailability of skilled seafarers. On the other hand, it is primordial to train new people in order to ensure the continuity of the profession. For this reason, the shipowner and the master have to ensure a balance between highly and less qualified crew members.

Moreover, experience is not the only problem concerning the crew. The fatigue and communication between crew members are also very important factors affecting their performance. Fatigue of crew members occur when they are subject to a hard regime of work. The problem of fatigue is well described by Schager (1998), "We all know that when people become tired, their ability to concentrate suffers. We know that forgetfulness is a fact of life". The Flag State Administration has to ensure a minimum number of crew members in order to ensure safe operation of the ship. Periods at sea should not be too long so that the seafarer did not gets tired and bored. Crew condition has to be monitored by the master of the ship and any case of fatigue or even other psychic situation citing only stress, boredom, monotony, day-dreaming and strong emotion, has to be reported to the shipowner who has to plan his replacement as soon as possible. Consequently, in order to reduce human errors, the human nature and its limitations has to be considered. Education, training and experience are also other keys to minimise the risk of errors.

The problem of communication between crew members is present when the crew is multinational. It can easily be cured by continuous use of the English language onboard or by offering preparatory courses in the language normally used. The international maritime community is now emphasising the use of English as an international seafarers language of communication similar to in the airline industry. Furthermore, to have the opportunity for a job in other international companies nowadays, it is preferable that seafarers demonstrate their ability of communication in English.

Human errors onboard ships are also directly affected by all involved in the loading, carriage and unloading processes. In the chain of carriage of solid bulk cargoes matches also the involvement of shore-based personnel. Training programs involving also shore-based personnel are created to achieve a better understanding of the hole operation. They are offered in institutions or also through distance learning programs for:

- Shipowners and shippers: operational problems of bulk carriers are presented and the various ways to avoid them. The top management of a shipping company should also be aware of safety and pollution prevention problems in parallel with economic considerations. They have to ensure that crew members, who navigate the ship, are continuously physically and mentally fit to do the job properly
- Terminal operators and stevedores: their bad practice during cargo operations and damages they can cause, particularly during discharging, are demonstrated to them. Communication problems with the ship and their repercussions are also explained. During loading, a good system of communication with agreed procedures for the stoppage of the operation, avoid overloading of certain holds is needed. During discharging, similar procedures could minimise risks of damage to the ship's holds, coatings, hatch covers and other equipment on deck.

Surveyors of the Maritime Authority or the Classification Societies have also to make detailed inspections of bulk carriers. Theses inspections have to be more meticulous if the ship get older or had been detained before because of many defections. During inspections, great attention should be paid to known areas vulnerable to corrosion or cracking. The shipowner could participate in these efforts by installing a hull monitoring system at high risk areas.

4.4 LOSSES OF LIVES

The history of shipping is unfortunately associated with the losses of ships and crew members. This fact is unavoidable like for any other industry where accidents occurs commonly at an acceptable rate. The risk is part of the progress of the industry as a hole. However, when the number of accidents or victims increases too much compared to the average, actions have to be taken to know the causes and find solutions.

During the last years the number of bulk carriers disasters increased to an unacceptable limit. Lives lost, after these accidents, also follow the same ascendancy.

Consequently this problem has became a major concern of the hole international maritime community. Statistics have been collected and investigations carried out to find out the causes and to try to find remedies. The problem with bulk carriers is that in many cases there were no survivals after a serious casualty. This is not the case of other types of vessels where it is rare that all the crew members died during a very serious accident. Lives saved are important witnesses who will help to understand the causes of the accident and to complete the investigation. From an other point of view, they could also contribute to overcome the problem of repugnance of seafarers to enrol onboard bulk carriers which will be considered more safer.
From data available, the trend of lives lost after bulk serious casualties is presented in the table No 7 below.

Table 7. Lives lost after bulk serious casualties between 1991 and 1996.

YEAR	1991	1992	1993	1994	1995	1996
LIVES LOST	132	14	76	63	89	117

Source IMO documents FSI

As shown in the table above, the number of victims decreased from 132 in 1991 to 14 only in 1992. In 1993, the victims were 76 almost as in 1994 when 63 persons died in bulk carrier casualties. After that the trend was increasing from 89 to 117 respectively for the years 1995 and 1996. This increase can be explained by the lack of to weather reports and increased average age of bulk carriers. Very bad weather conditions such as typhoon, tempest, hurricane or violent storm can generate the capsize of the ship so quickly that the crew did not have the time to use life rafts or rescue boats. The capsize could be generated by cargo shifting or flooding of cargo holds/machinery spaces. In the case of bad weather conditions, it is imperative that the ship's machinery will be able to work adequately. A vessel encountering violent storm with machinery problem is susceptible to have problems. As specified before, bulk carriers became more vulnerable to structural failures after the age of fifteen years old. In many cases it is impossible to carry out maintenance tasks, even with a very motivated crew, because of the turnover of the ship. The crew itself is very important because it denoted many related problems citing only communication, competence and fatigue. With a crew unable to communicate conveniently or if incompetent, it is difficult to overcome emergency situations such as fire onboard, explosion, flooding or collision. The lack of organisation and experience of the ship's crew generates a situation of confusion during and after the accident. For this reason, the ship's operator should ensure an equilibrium between experienced crew members and less competent ones.

4.5 SHIP MAINTENANCE

The most important concern of any industry is the availability of equipment at any time. In that order, keeping a ship seaworthy, safe and efficient means maintenance throughout her working life. The maintenance should be well planned and involve all crew members. As stated by J. Isbester (1993), " Everyone aboard ship has his or her part to play in keeping a ship well maintained, but good maintenance also requires owners and managers who are prepared to pay costs reasonably incurred and to provide the support which ship's staff require". For this reason, planned maintenance systems involve nowadays both ship' crew and personnel of the shipping company. Technical and purchasing departments particularly should assist and co-operate with crews to create and implement maintenance plans. The recent development in maritime communications and the use of software made possible the ship/shore or shore/ship transfer of information. With the development of computerised networks, the company head-quarter and all operated vessels become parts of the hole system.

Ship's maintenance has to be done to:

- Prepare the ship for the inspection and survey visits. These include statutory and classification surveys and government inspections of the country of registry. The class of the ship has to be maintained in order to decrease the insurance policy fees
- Ensure the vessel's safety and keep her operational during her life
- Avoid detentions in port by Port State Control. With the creation of regional Memorandums of Understanding (MOU) and communication systems to exchange information, it is very easy for a ship to be subject of inspections in all reached ports

- Make the ship more efficient economically by avoiding accidents and breakdowns

Recently, shipping companies and crews can ensure well maintained ships by using the reliability centred maintenance technique. The airline industry has benefited from this technique in the past and nowadays maintenance systems are based on this technique. When it is correctly applied, it yields to the following benefits:

- greater safety and environment protection through the application of clearer strategies for preventing failure modes which can affect safety or infringe upon environmental regulations
- improved operating performance due to the extension or elimination of overhauls intervals and shorter maintenance work-lists giving less extensive and costly shutdowns
- improved quality by better understanding of equipment capacity and capability and clearer definition of maintenance tasks or objectives
- greater maintenance cost effectiveness due to less unnecessary routine maintenance and the prevention or elimination of expensive failures
- reduced life cycle costs by optimising the maintenance workloads and providing a clearer view of spares and staffing requirements
- longer useful life expensive items due to an increased use of on-condition maintenance techniques
- a comprehensive maintenance data base which provides a better understanding of the equipment in its operating context and easy inventory system, eliminates most documents used to be exchanged between the shore and the ship and leads to more accurate drawing and manuals
- greater motivation of individuals, particularly those involved in the review and execution processes
- better teamwork brought about by the highly-structured group approach to maintenance problem analysis and decision making

In addition to the routine maintenance onboard ships, bulk carrier maintenance involves additional tasks to be carried regularly namely:

- greasing and oiling of all moving parts of equipment and replacement of defective or missing nipples

- painting of vulnerable areas to severe local corrosion. This involves renewing or reinforcing damaged areas by using adequate paint and techniques. The chief mate has to ensure the last conditions and to monitor the painting operation according to the manufacturer's instructions. Particular attention has to be made to the surface preparation before painting in order to guarantee work's quality and to inspect the thickness of the plate to be paint
- repairing of hatch coamings and covers if damaged and changing of the hatch sealing as specified by the manufacturer. Their water-tightness has to be checked especially before sailing and the securing devices, cleats and operating gear have to be inspected before and after any operation and corroded or defective ones changed
- additional inspection of vulnerable areas to cracking and structural failures due to high stresses during high seas, overloading or discharging operations. These areas have to be inspected thoroughly and monitored to repair them as soon as possible. Areas presenting such risk are double bottom, transverse bulkheads, hatch coamings, hatch corners, main frame and associated brackets of cargo holds. Particular attention should be made to the transverse watertight bulkhead between the two foremost cargo holds and the double bottom of the foremost cargo hold which are seen to be vulnerable to structural failures

As stated by J. Isbester (1993), " To remain safe and efficient a ship must be well maintained. That requires sensible spending on tools and supplies. It also requires good sense and commitment from the master and his crew,... The basic rules of maintenance are:

- Be thorough
- Be methodical
- Plan maintenance well in advance
- Consult with other department and keep them informed
- Study the manufacturer's manuals
- Use the correct tools and materials".

CHAPTER 5

BULK CARRIERS SAFETY FRAMEWORK

Following the development of any industry, rules and regulations have to be set to organise it. Unfortunately the need to create safety framework is directly related to the number of accidents affecting the sector. Due to the development of solid bulk trade, specialised ships designed exclusively for the carriage of cargoes in bulk were built. At the same time the number of accidents involving these ships increased. This fact accelerate the process of setting rules to regulate this sector. Until recently, the Safety Of Life At Sea (SOLAS) Convention did not cover many aspects related to the safe operations of such kind of vessels. Therefore the international community has to set regulations specific to the safe carriage of grain in bulk firstly and secondly to other solid bulk cargoes in general. Other rules and regulations dealing with ship's design and construction and many other aspects followed to resolve various other problems related to bulk carriers safety. These regulations were contained in codes and give guidance on the safe construction and operation of bulk carriers and the safe cargo handling.

5.1 SOLAS CONVENTION

Since the adoption of the first version of SOLAS in 1914, there had been four other SOLAS conventions. At the beginning, the convention was concerned with the safety of human life at sea. Then, requirements to improve the safety of navigation, life saving, fire protection and safe operation of ships were included in the convention. Additional requirements for the safe carriage of grain by sea and recently the safety of bulk carriers were introduced. These requirements are usually in the form of a code or an additional chapter to the convention.

The history of the SOLAS Convention shows that the first amendments were those adopted in SOLAS 1948 which required for the carriage of grain cargoes temporary fittings or its carriage in bags. Then came the 1960 SOLAS Convention where an entire chapter (Chapter VI) was devoted to measures designed to prevent grain "sinkage". Experience showed that these measures were not as safe as expected. During a short period of four years, six ships loaded according to the regulations of the 1960 SOLAS Convention were lost at sea. Consequently, IMO in its assembly held in 1969 adopted a new grain regulation commonly known as the 1969 Equivalent Grain Regulations. It was incorporated in Chapter VI of SOLAS 1974 Convention. The safety of bulk carriers meanwhile, had the same interest and the BC Code was adopted in 1965. Then, it had been updated regularly and kept under continuous review by the Sub-Committee on Dangerous Good, Solid Cargoes and Containers. It contains guidance to Governments, operators and shipmasters on the safe carriage of bulk by sea and hazards related to bulk cargoes. Following many amendments of the BC Code, the Chapter VI of SOLAS was also amended and completely rewritten in 1991. It was extended to cover in addition to grains other bulk cargoes and re-titled Carriage of Cargoes. Its provisions, which entered into force on 1 January 1994, were backed by a number of codes which could be amended more easily than the convention itself. The most important codes referred to above are the BC Code and the International Grain Code.

The increasing number of bulk carriers casualties with the loss of the ship and all crew members during the last years shows that safety issues related to this kind of vessel has to be improved. In this order, a conference resolution proposed by the Secretary General of IMO was adopted in 1991, urging the Maritime Safety Committee (MSC) to consider further the safety of bulk carriers. This interim resolution emphasises on the structural integrity and seaworthiness of bulk carriers and safe loading and carrying of cargo with the minimum stresses. In close cooperation with IACS, the draft bulk carrier regulations was prepared and has been proposed in the 20th session of IMO Assembly held in November 1997. The regulations mentioned above were adopted in the form of a new chapter XII to SOLAS Convention titled "Additional Safety Measures for Bulk Carriers". The word additional was put intentionally in order to ensure that all safety measures contained in other chapters of SOLAS are not overlooked. The chapter XII contains inter alia:

- New survivability and structural requirements for dry bulk carriers to prevent them from sinking if water enters any cargo hold for any reason
- Condition of equilibrium after flooding which shall satisfy the requirements of the International Convention on Load Lines (LL), 1966 as amended
- Structural strength of bulk carriers after flooding of cargo hold in all loading and ballast conditions
- Surveys of cargo hold structure that bulk carriers are subject to
- Loading instrument content and requirements

Furthermore, many unsettled issues were referred to in the Maritime Safety Committee (MSC) 69 (May 1998) in order to be covered by chapter XII of SOLAS Convention. These items are:

- Bulk carriers under 150m in length
- Bulk carriers of double side skin construction
- 4-holds ships and self-unloaders for reconsideration
- Miscellaneous minor items
- Other heavy cargoes like steel products

During the same conference held in November 1997, two very important resolutions concerning bulk carrier safety were also adopted:

- Resolution A.862 (20) adopted on 27 November 1997: Code of safe practice for the safe loading and unloading of bulk carriers. It contains recommendations to provide guidance to ship-owners, masters, shippers, operators of bulk carriers, charterers and terminal operators for the safe handling, loading and unloading of solid bulk cargoes. It contains detailed information on procedures between ship/ shore prior to the ship's arrival and ship/terminal prior to cargo handling. Ship and terminal's duties during cargo loading/deballasting or unloading of cargo/ballasting operations are also explained and defined. Five appendices are also annexed to this code containing recommended contents of port and terminal information books, loading or unloading plan, ship/shore checklist, guidelines for completing the ship/shore safety checklist and the form for cargo information.

- Resolution A.866 (20) adopted on 27 November 1997: Guidance to ship's crews and terminal personnel for bulk carrier inspections. It is intended to provide guidance to ship's crew and terminal personnel with respect to the principal areas on bulk carriers that are likely to be susceptible to corrosion or damage. It is presented in the form of a simple guide aimed at ships' crew and terminal operators. It considers the owner responsible of the ship's maintenance and the report on deficient conditions found or repairs carried out. It contains all figures necessary to explain the structural features and typical damages in the upper deck areas, cargo holds, topside tanks, bilge hopper, double bottom tanks and the bottom ends of sounding pipes. Guidance on what to look for during inspections are given. Inspection targets could be deformation, cracking, corrosion or general wear tear.

In addition, many other amendments to SOLAS Convention were adopted in order to improve in general the safety at sea. They are related to:

- Life saving appliances and take into account changes in technology that have occurred recently. Many of the technical requirements have been transferred to a new International Life-Saving Appliance (LSA) Code.
- Construction-subdivision and stability, machinery and electrical installation and include a new Part A-1 dealing with the structure of ships. These amendments deal with inter alia design and construction of ships, their structural requirements and the corrosion prevention of sea water ballast tanks.
- Safety of navigation expected to enter into force 1 July 1999 particularly the SOLAS regulation on vessel traffic service used in busy straits adopted in June 1997. The 1988 amendments to SOLAS and related to the Global Maritime Distress and Safety Systems (GMDSS) will enter into force by 1 February 1999 also. The main systems involved in the GMDSS include:
  - COSPAS-SARSAT, an international satellite-based search and rescue system which uses polar-orbiting emergency position indicating radio beacons (EPIRBs) to transmit to rescue co-ordination centres a vessel's identification and accurate location from anywhere in the world.
  - the International Mobile Satellite Organisation (INMARSAT), which provides distress message facilities on the L band and transmits the SafetyNET service,

a satellite based world-wide maritime safety information broadcast of high seas weather warnings

- Digital selective calling (DSC) on VHF, MF and HF radio channels, which speeds distress and general radiotelephone calls to and from shore and other ships
- NAVTEX, which is an international automated system for distributing maritime navigational warnings, weather information and warnings, and search and rescue information to ships automatically

- Special measures to enhance maritime safety contained in Chapter XI which specify that bulk carriers and oil tankers shall be subject to an enhanced programme of inspection. For such ships of five years of age and over, enhanced surveys must be carried out during the periodical, intermediate and annual surveys prescribed by the SOLAS Convention. The guidelines pay special attention to corrosion, coatings and the thickness of plates and become more extensive as the ship ages. They contain details to explain the extra checks that should be carried during enhanced surveys. Annexes to the guidelines go into still more detail and are intended to assist implementation. They specify the structural members that should be examined, for example, in areas of extensive corrosion; outline procedures for certification of companies engaged in thickness measurement of hull structures; recommend procedures for thickness measurements and close-up surveys; and give guidance on preparing the documentation required.
- Port State control which is composed of an Administration and a team of surveyors and inspectors. Due to costs involved in creating such organisation, a regional cooperation between many countries is a better economic solution and more effective system. The first Port State control was formed between 18 Western European Countries in 1982 and known as the Paris Memorundum Of Understanding (Paris MOU). It aims to ensure that foreign ships, that visit their ports, meet international requirements and consequently target substandard ones particularly those under flags of convenience (FOC). Following the success of the Paris MOU, four other regional agreements were signed. The second one, signed in 1992, between 11 countries from Central and South America is Acuerdo de Vina del Mar. The third one, signed in 1993, was the Tokyo MOU and is composed of

Canada and 17 Asia-Pacific countries. In 1996, the Caribbean MOU was signed between 20 countries of the region. The last one was the Mediterranean MOU signed in 1997 and composed of 10 countries. These MOUs aim to eradicate substandard ships through harmonised system of surveys and inspections, elimination of unfair competition between ports in the region, sharing of information and creation of inter-regional cooperation to reach a global cooperation through the interface between regional secretariats.

5.2 BC CODE AND INTERNATIONAL GRAIN CODE

The most common solid cargoes shipped in bulk are devised into two categories namely the grain family and other solid bulk cargoes. Due to cargoes' properties which were developed in Chapter 2, dedicated codes were created to improve the safety of ships carrying solid bulk cargoes. The first one was the IMO Grain Rules and the second was the Code for Safe Practice for Solid Bulk Cargoes (BC Code).

5.2.1 IMO Grain Rules: Originally grain used to be carried in bags but the increasing demand for this product in many other regions and the development of handling techniques made its transport in bulk more easier and quicker. It could be handled easily and time taken to deliver it from producer to customer was greatly reduced as well as the costs involved. In the other hand, the carriage of grain in bulk generates the problem of cargo "sinkage" which causes the ship to list and furthermore to capsize. During the process of resolving this problem, IMO with the help of ships' masters found that prior regulations were unattainable. As a result, IMO in its 1969's assembly adopted new grain regulations in the form of Resolution A.184 which became generally known as the 1969 Equivalent Grain Regulations. These new regulations were more safer, practical and economical than the anterior ones included in SOLAS 1960. As the basis of new international requirements, the new regulations were incorporated into chapter VI of the SOLAS 1974 Convention and became mandatory since 1 January 1994. The International Grain Code was devised into two parts:

- Part A: contains special requirements and gives guidance on the stowage of grain and the use of grain fittings
- Part B: deals with the calculation of heeling moments and general assumptions

5.2.2 Code of Safe Practice for Solid Bulk Cargoes (BC Code): As it has been for grain, problems arose for other solid bulks carried by sea. In order to resolve them, IMO began its work since the 1960 conference. In 1965 the BC Code was adopted and aims to bring to the attention of those concerned an internationally-accepted method of dealing with the hazards to safety which may be encountered when carrying cargo in bulk. This code was continually updated and amended on several occasions so that in 1991, its requirements were referred to in the new chapter VI of SOLAS 1974 which entered into force also on 1 January 1994. The BC Code deals with three basic types of cargo:

- those which may liquefy
- materials which possess chemical hazards
- materials which fall into neither of these categories but may nevertheless pose other dangers

It highlights the dangers associated with the shipment of certain types of bulk cargoes, gives guidance on various procedures which should be adopted, lists typical products which are shipped in bulk, gives advice on their properties and how they should be handled and describes various test procedures which should be employed to determine the characteristic cargo properties. The trimming conditions and securing arrangements for stowing dry cargoes, prone to shift during the voyage, are also detailed . The code has seven appendices which contain:

- Appendix A: list of cargoes which may liquefy
- Appendix B: extensive list of materials possessing chemical hazards
- Appendix C: list of bulk cargoes which are neither liable to liquefy nor possess chemical hazards
- Appendix D: detailed information concerning test procedures, associated apparatus and standards which are referred to in the Code
- Appendix E: emergency schedules for those materials listed in appendix B

- Appendix F: recommendations for entering cargo spaces, tanks, pump rooms, fuel tanks and similar enclosed compartments
- Appendix G: procedures for gas monitoring of coal cargoes

5.3 THE INTERNATIONAL CONVENTION ON STANDARDS OF TRAINING, CERTIFICATION AND WATCHKEEPING FOR SEAFARERS, 1978, AS AMENDED IN 1995 (STCW 95)

When talking about safety of ships at sea, the human factor has to be considered. Giving more and more interest to this factor, IMO adopted STCW 78. This convention was the most important treaty dealing with officer and crew standards. However, too many gaps were found in this convention concerning particularly qualification and competency of seafarers. Therefore, the maritime community was urged to amend the convention taking into account technical development that have occurred in shipping since 1978. This was done in 1995 when IMO adopted important amendments to STCW 78. These amendments are considered to be very important and are expected to raise considerably seafarers' standards. The new convention commonly known as STCW 95 entered into force on 1 February 1997 and aim to:

- Transfer all detailed technical requirements to an associated STCW Code, part A of which was made mandatory and also entered into force on 1 February 1997
- Clarify the skills and competence required
- Require Administrations to maintain direct control over and endorse the qualifications of those masters, officers and radio personnel they authorise to serve on their ships
- Make Parties to the Convention accountable to each other, through IMO, for the proper implementation of the Convention and the quality of their training and certification activities.

In order to ensure safe operation of certain type of ships, the new convention contain mandatory minimum standards of competence for personnel onboard them. These standards are contained in Chapter V of STCW 95 which specify minimum requirements for the training and qualification of masters, officers and ratings on tankers and ro-ro passenger ships. Consequently, Administrations shall ensure that crew members have the appropriate certificate or that their existing certificates are endorsed in accordance to new requirements of Chapter V. The endorsement, which reflects the special expertise necessary for a particular type of ships, generates reluctance to its introduction because it reduce the mobility of ship's crews.

Personnel onboard bulk carriers were not included in Chapter V of STCW 95 because possibly the human factor was not considered as contributing in bulk carriers losses. However, when drafting new construction standards for bulk carriers, IMO acts simultaneously on possible operational solution for improving the safety of bulk carriers. Accordingly, two human element-related resolutions were adopted during the conference held November 1997. These resolutions were mentioned and discussed above with the SOLAS Convention. The innovation in these resolutions is that not only the crew is considered responsible for the safety of bulk carriers but also ship and terminal operators, shipowners, shippers and charterers. As reported in Lloyds List (1998), "draft requirements were developed by the training experts of IMO at the 29th session. The Sub-Committee on Standards of Training and Watchkeeping (STW) agreed the new standards should be effective from January 1, 2003, subject to the condition of tacit amendment procedure being fulfilled by July 1, 2002". These standards have to be submitted to the Maritime Safety Committee for approval and adoption as amendments to the mandatory Code A of STCW 95. They cover special requirements for training of bulk carrier personnel at the operational and management levels. At the operational level, the amendments emphasise competence in establishing and maintaining effective communication during loading and unloading operations, and the need to inspect and report defects and damage to cargo spaces, hatch covers and ballast tanks. At the management level, the amendments emphasise the importance of knowing the operational and design limitation of bulk carriers and the detrimental effects on bulk carriers of corrosion, fatigue and inadequate cargo handling.

In addition to the STCW 95 and being aware of the impact of human element on ship's safety, IMO adopted the Resolution A.850 (20). It is intended to achieve the following goals:

- To have in place a structured approach for the proper consideration of human element issues for use in the development of regulations and guidelines by all committees and sub-committees;
- To conduct a comprehensive review of selected existing IMO instruments from the human element perspective;
- To promote and communicate through human element principles a maritime safety culture and heightened maritime environmental awareness;
- To provide a framework to encourage the development of non-regulatory solutions for their assessment based upon human element principles;
- To have in place a system to discover and disseminate to maritime interests studies, research and other relevant information on the human element, including from marine and non-marine incident investigations; and
- To provide material to educate seafarers to increase their knowledge and awareness of the impact of human element issues on safe ship operations to help them do the right thing.

5.4 INTERNATIONAL SAFETY MANAGEMENT (ISM) CODE

Conscious that shipowners and managers are in the best position to ensure high standards, IMO introduced in 1994 a new chapter IX to SOLAS 74. This new chapter was called International Safety Management (ISM) Code and entered into force on 1 July 1998. It applies to passenger ships, oil and chemical tankers, bulk carriers, gas carriers and cargo high-speed craft of 500 gross tonnage and above. The ISM Code establishes safety management objectives which are:

- to provide for safe practices in ship operation and a safe working environment;
- to establish safeguards against all identified risks;
- to continuously improve safety-management skills of personnel, including preparing for emergencies.

It requires also a safety-management system (SMS) to be established by the company operating the ship. This system should be designated to ensure compliance with all mandatory regulations and also ensures that codes, guidelines and standards recommended by IMO and other regulatory bodies are taken into account. The SMS should include a number of functional requirements:

- a safety and environmental-protection policy;
- instructions and procedures to ensure safe operation of ships and protection of the environment in compliance with relevant international and flag State legislation;
- define levels of authority and lines of communication between, and amongst, shore and shipboard personnel;
- procedures for reporting accidents and non-conformities with the provisions of this Code;
- procedures to prepare for and respond to emergency situation; and
- procedures for internal audits and management reviews.

The company is required to establish and implement a policy for achieving theses objectives, to prepare plans and instructions for key shipboard operations and to ensure that regular inspections are held and corrective measures taken where necessary. The documents used to describe and implement the SMS may be referred to as the Safety Management Manual. A copy of this manual shall be kept onboard the ship for periodic checks to verify that the SMS is functioning properly. The responsibility, for ensuring that the Code is complied with, was left to Governments which have to issue documents of compliance to companies. A copy of the document of compliance has to be kept onboard and presented if requested during inspections.

Since the adoption of the ISM Code, many resolutions concerning the implementation of this Code were also adopted. One of the most important was the Resolution A.848 (20) which urges some Governments to give effect to the ISM Code through promulgation of domestic legislation. It notes that a significant number of shipping companies operating bulk carriers have not yet obtained ISM certification. It also notes that SOLAS does not provide for any extension of the implementation date for the introduction of the ISM Code. It was followed by the Resolution A.852(20) which gives guidelines for a structure of an integrated system of contingency planning for shipboard emergencies. The guidelines provide a framework for preparing contingency plan required by the ISM Code as part of the ship's safety management system (SMS).

5.5 OTHER IMO INSTRUMENTS

Most of bulk cargoes did not present a threat to the marine environment. However, bulk carriers are subject to most regulations related to the prevention of pollution from ships. Consequently, they are required to contribute to the effort that IMO deploy to reduce any form of pollution from ships. They have to consider the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78): with regards to oil pollution, bulk carriers are subject to the provision of the present Convention. These provisions require bulk carriers to be fitted with oil discharge monitoring and control systems and oily-water separating and oil filtering equipment to prevent accidental or intentional discharge of oily effluents into the sea. A sludge tank is also required to receive residues that cannot be dealt with otherwise namely those resulting from purification of fuel and lubricating oils and oil leakage into machinery spaces. All these systems and equipment have to be identified in the international oil pollution prevention (IOPP) certificate and checked regularly by authorised inspectors. In addition bulk carriers has to maintain an oil record book part 1 regarding the machinery space operations. They include ballasting or cleaning of oil fuel tanks, discharge of dirty ballast or cleaning water from oil fuel tanks, disposal of oily residues and disposal or discharge overboard of machinery space bilge water. In the case of combined carriers, which are designed to carry either oil or solid cargoes in bulk, they are subject to the provision of the hole Annex I to MARPOL 73/78. The convention contains also additional measures to reduce other form of pollution from ships namely sewage and garbage. While regulations for the prevention of pollution by sewage are not yet in force, those pertaining to the prevention of pollution by garbage entered into force on 31 December 1988. Furthermore some cargoes, when spilled into the sea, may present hazards to marine environment or to the human life. This was the case of the Panamanian wheat carrier "Fenes" which grounded south of Corsica during a heavy storm. People working to recover the cargo experienced nausea, sickness and irritation from toxic hydrogen sulphide fumes. In addition, there was the effect of suffocating of Posidonia oceanica, a protected species of marine plant which is important to the local ecosystem. This experience shows that even cargoes considered non pollutant can ferment and produce very noxious fumes or, in very particular situations react with other substances, and thereby generate hazards to human or marine life.

The International Maritime Dangerous Goods (IMDG) Code lists all marine pollutants not covered by MARPOL 73/78. It gives also details about hazards that may present these products to the marine environment. However it has to be brought into line with the tenth revised edition of the United Nations Recommendations on the Transport of Dangerous Goods in order to make its use more friendly. The IMDG Code could also be used as a guideline to prevent any threat to the marine life.

5.6 INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS) RULES

As a part of the maritime community, the classification societies are also concerned about the increase of bulk carriers casualties. In cooperation with IMO, IACS participates to the effort to determine and implement realistic measures for casualty reduction and long term safety gains for the bulk carrier fleet. This work emphasises on the vulnerability of older ships to structural problems resulting in water ingress into the cargo holds. Since 1991, intensive investigations have been carried out to understand why bulk carriers were becoming more vulnerable, to provide solutions to improve their structural performance and to make industry fully aware of the findings. Consequently in 1992, IACS produced new Unified Requirements (URS) for the corrosion protection of ballast tanks and cargo holds and in 1994, guidelines for surveys, assessment and repair of hull structure of bulk carriers. They were intended primarily to IACS surveyors but could assist other interested parties involved in the survey and inspection process as well. The guidelines for surveys, assessment and repair of hull structure of bulk carriers contains details of surveys to detect possible structural defects and damages and to establish the extend of any deterioration. Illustrative and detailed figures are also provided concerning structural failures and repairs. The guidelines specify what to look for during survey and describe possible damages and fatigue fractures of:

- Shell plating, frames and end brackets;

- Transverse bulkheads and associated structure;
- Deck structure including cross deck strips, main cargo hatchway corners, hatch covers and coamings and topside tanks;
- Double bottom structure including hopper;
- Transition regions in cargo spaces, fore and aft; and
- Fore and aft peak structure.

In 1993, IACS published new requirements for the minimum side shell frame web thickness and launched its important Enhanced Survey Programme (ESP). the programme was designed to reduce the risks of water ingress through the primary watertight barrier, the side shell and hatch covers. The ESP became more extensive, more focused and more frequent as the ship get older. Following a research programme carried out in 1995 and 1996 concerning the safety of bulk carriers, IACS announced that older ships carrying heavy cargoes would have to comply with higher strength standards under their new conditions of class. The most important in these conditions of class is to require older bulk carriers to strengthen the transverse watertight bulkhead between the two foremost holds and the double bottom in way in order to withstand flooding loads in the No.1 hold. These structural reinforcements will depend on the bulkhead design and the steel-work diminution through corrosion. There had been a strong debate on the cost of such operation but informed persons find out in IMO News (1998) that the average cost for such operation is about US$ 300,000. For a bulk carrier with 30 crew members, it represents US$ 10,000 per life saved which is very acceptable. It should be noted that these costs depend on the size of the ship and the shipyard location. An other problem was raised about this operation arguing that the amount of steel added will be diminished from the ship's dead-weight. IACS was also concerned by problems related to cargo handling and the risk of overloading. In collaboration with IMO, INTERCARGO, the International Chamber of Shipping (ICS), BIMCO and the International Association of Ports and Harbours (IAPH), IACS published the book Bulk carriers - Handle with care. This publication aims particularly to a better awareness by bulk terminal operating staff and port authorities of the risks in accidental overloading. It deals with ship-to-shore communication, load distribution, overloading by high capacity systems and potential damages from grabs, hydraulic hammers and other equipment used during cargo discharge.

5.7 OTHER EXPERTS

Other organisations are also working to improve bulk carrier safety including institutes, research centres, shipowners' organisation, naval architects and other international organisations. They contributed to bulk carriers safety through:

- Specialised publications: which could be publication could be periodicals, journals or books. Some of the well known periodicals are BIMCO Bulletin, INTERCARGO journal, IACS briefings, ITF News the journal of the International Transport Workers' Federation and Lloyd's List. In these publications many valuable expert's points of view are presented and concerning new practical ideas, measures and procedures to improve the safety of bulk carriers. The Nautical Institute published some precious books and articles dealing with this subject. Many of them are written by Captain J. Isbester.
- Organisation of dedicated seminars and conferences: where specialists all around the world are invited to present their work and to participate to debates about the safety of bulk carriers
- Participation in working groups set by IMO: this is the case of intergovernmental organisations which have concluded agreements of cooperation with IMO or non-governmental organisations in consultative status with IMO. The International Labour Organisation (ILO) provides through ILO Convention no.147 the basis for ship's inspection concerning minimum age, medical examination, accommodation, food and catering of crews. Some of the most active non-governmental organisations are BIMCO, IACS, INTERCARGO and the ITF which participate actively to the work of IMO.
- Presentation of paper work to IMO: all Member States are requested to participate to the work of IMO bodies and any presentation of paper work to help the organisation in its effort is highly welcomed.
- Research: some research are done all around the world by universities, research centres and organisations to improve the safety of bulk carriers. These research are

related to ship's structure, cargo handling equipment, engines reliability, coating techniques and prevention or monitoring of corrosion.

- International campaign: like the one launched by ITF against flags of convenience substandard ships and the bad conditions of work onboard some ships. Concerned by the human factor and conscious of its impact on the safety of bulk carrier, ITF's inspectors are aiming to improve the work and sanitary conditions onboard ships. Multiple actions are taken with the help of different unions against substandard ships which vary from sensitisation to the boycott when they are in ports.
- Investigating accidents: This is the case of particularly the Australian Department of Transport and the Transport Safety Board of Canada which have investigated many accidents and are still participating to this effort. The result of these investigations, when published, will contribute to avoid such accidents in the future.

5.7 APPROACH TO IMPROVE SAFETY RECORDS

During the last years, many actions were taken to improve the safety of bulk carriers. Almost all necessary regulations related to ship's construction and design, crew qualification, cargo handling operations and the safety of navigation are available. Some of these rules and regulations are already mandatory and the remaining will enter into force soon. Port State Control agreements were signed and cover approximately all ports of the world. However the implementation of all these rules and regulation encounter many difficulties by Member States of IMO. These difficulties are related principally to finances, lack of expertise and in some case of willingness.

IMO Member States consequently have to ensure:

- Ratification of all IMO conventions, particularly SOLAS and STCW, in order to ensure quality standards of their Administrations, maritime institutions and shipping industries. Assistance from international or regional organisations and developed countries is needed to help those failing to participate conveniently to the global effort to improve the safety of bulk carriers. This assistance could be in the form of financial support to equip Administrations and maritime institutions adequately and through specialised training offered to personnel involved in the implementation process. In that order, the implementation and enforcement of flag State control procedures and port State control procedures on a national and regional basis is a priority. Assistance and support to suppliers of seafaring labour countries is now highly needed to maintain a certain equilibrium of the offer and demand of manpower. Furthermore, these countries need also expertise to be able to ensure quality standards of their Administrations and maritime institutions.

- Implementation of all ratified IMO conventions and other instruments. Following the entry into force principally of STCW 95, the ISM Code and Port State Control agreements, all governments have to comply with these instruments in order to allow their ships to trade internationally and their seafarers to be employed by foreign countries.

The technical co-operation programmes of IMO aim to achieve these goals and periodical reviews of these programmes are done by the Technical Co-operation Committee. However, IMO is now seeking for more funds to satisfy all these needs and to support these programmes. The last work programme for 1998-1999 adopted by the Assembly in its 20th session aims to:

- Promote flag State compliance with IMO standards
- Implement new legislation only on the basis of demonstrable need
- Promote a better understanding of the linkages between the causes of accidents and the human element
- Foster the effective implementation of IMO conventions
- Promote the use of new information technology in safety and environmental protection
- Strengthen the capacity of developing countries by improved focus on technical assistance through the Integrated Technical Co-operation Programme.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

Following the decision made by IMO to improve the safety of bulk carriers, all parties involved in this process have to act individually and in co-operation with other parties to achieve this objective. The international maritime community must primarily implement adequately all existing rules and regulations relative to the safety of bulk carriers before adopting new ones. Each of the above should be responsible as listed in the following:

- IMO: it is primordial that the Organisation thinks to give effect to the existing rules and to allow a period of time to Member States to implement them. It is inadmissible to adopt new regulations while many of the existing are still not implemented or enforced. The Organisation should provide assistance to Member States falling to implement adequately the adopted conventions and Codes. The Technical Co-operation Committee should establish programmes on a regional or individual basis to help developing countries to strengthen their institutional, legal managerial, technical and training capabilities and thereby to implement IMO regulations effectively. Priority should be attributed to Conventions which already entered into force. Consequently substandard ships will be eradicated because the possibility for them to trade between countries where IMO instruments are not implemented will be eliminated. Through a good co-operation between Member States, there will be no more favourable treatments but only standard procedures and inspections.
- Member States: they have to implement IMO instruments and if they could not, they have the possibility to request assistance or delegate their responsibilities to classification societies. This does not mean that they are no more responsible vis-a-vis the international maritime community. They have to ensure that classification societies, to whom delegations are given, are doing their obligations properly and adequately.

- IACS: this association possesses the best network of inspectors all around the world. They act in many cases on behalf of some Flag States to carry surveys and to issue certificates. However, in some cases the competency of classification societies' surveyors is not identical so that many shipowners benefit from this situation. They have to provide unified requirements and uniform services all around the world and to assist, through delegation process, Flag States to implement IMO instruments.
- Underwriters: they have already introduced a new structural condition warranty to be written into the hull insurance policies of ships suspected to be substandard. Furthermore, they can request that the surveys carried out by classification societies should be more rigorous and meticulous, particularly for older ships.
- Shipowners: the entry into force of the ISM Code requires shipowners and operators to ensure safe operation of bulk carriers and the competency of crews employed. Ship's operations include cargo handling and delivery of the cargo, maintenance of the hull, equipment and machinery and their manning. All these operations have to be carried out safely and in accordance to international conventions. They also have to be written in details and responsibilities of all persons involved in this process clearly defined.

Further actions could be taken to prevent bulk carriers disaster mainly:

- Rejecting cargo that is not conform to documents
- Preparing loading/deballasting and discharging/ballasting plans
- Avoiding overloading and keeping to the loading manual limits approved by the classification society
- Calculating stresses and bending moments throughout the operation and keeping them under the specified limits
- Trimming cargo reasonably in accordance to the BC Code
- Inspecting hatch covers and deck equipment before departure and also regularly during the voyage
- Preventing stevedores' damage particularly during the discharging operation
- Reporting damages to the ship and having them surveyed and repaired
- Minimising corrosion by maintaining coatings

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