



Focus on IMO



International Maritime Organization, 4 Albert Embankment, London SE1 7SR, United Kingdom
Tel: +44 (0)20 7735 7611 Fax: +44 (0)20 7587 3210
E-mail: rkohn@imo.org or nbrown@imo.org Web site: www.imo.org

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IMO and ro-ro safety

The roll-on/roll-off ship¹ is one of the most successful types operating today. Its flexibility, ability to integrate with other transport systems and speed of operation have made it extremely popular on many shipping routes.

The roll-on/roll-off ship is defined in the November 1995 amendments to Chapter II-1 of the International Convention for the Safety of Life at Sea (SOLAS), 1974 as being "a passenger ship with ro-ro cargo spaces or special category spaces..."

One of the ro-ro ship's most important roles is as a passenger/car ferry, particularly on short-sea routes. But despite its commercial success, the ro-ro concept has always had its critics. There have been disturbing accidents involving different types of ro-ro ship, the worst being the sudden and catastrophic capsizing of the passenger/car ferry *Herald of Free Enterprise* in March 1987 and the even more tragic loss of the *Estonia* in September 1994.

This paper looks at the background of ro-ros, the problems involved and the way in which IMO has endeavoured to tackle them.

The development of ro-ros

The modern roll-on/roll-off ship can trace its origins back more than one hundred years to the early days of the steam train. Ships were specially designed to take trains across rivers which were too wide for bridges: the ships were equipped with rails, and the trains simply rolled straight on to the ship, which sailed across the river to another rail berth where the train would roll off again. An example is the Firth of Forth ferry in Scotland which began operations in 1851.

It was not until the Second World War, however, that the idea of applying the ro-ro principle of road transport became practicable - and was used in constructing the tank landing craft used at D-Day and in other battles. The principle was applied to merchant ships in the late 1940s and early 1950s. It proved to be extremely popular, especially on short-sea ferry routes, encouraged by technical developments on land as well as sea, notably the increase in road transport.

For the shipper, the ro-ro ship offered a number of advantages over traditional ships, notably speed. As the name of the system implies, cars and lorries can drive straight on to a ro-ro ship at one port and off at the port on the other side of the sea within a few minutes of the ship docking.

¹For the purposes of this paper, the term *ro-ro* is used for all ro-ro type ships, including passenger car ferries except where a particular type of ro-ro vessel is intended.

Ro-ro ships also integrate well with other transport development, such as containers, and the use of Customs-sealed units (first introduced in the late 1950s) has enabled frontiers to be crossed with the minimum of delay, thereby further increasing speed and efficiency for the shipper.

Ro-ros have also proved extremely popular with holiday makers and private car owners and have significantly contributed to the growth of tourism. Until the early 1950s someone wishing to take his car from one country to another by sea had to get it loaded into the ship's hold by crane, a time-consuming and expensive process. The development of the ro-ro car ferry changed all that and many ports boomed as a result.

In the United Kingdom, Dover's first pair of drive-on berths was opened in 1953. Until then the port had handled only 10,000 crane-loaded cars each year and forecasts that the berths would enable the port to handle ten times that many must have seemed decidedly optimistic. But the 100,000 figure was exceeded in the first year and by 1985 Dover was handling over 2.5 million vehicles and units through nine ro-ro berths. By 1994 the total had risen to more than 4.5 million.

By 1994 around 4,600 ro-ro ships were in operation around the world: They are particularly popular in Europe, and trading patterns reflect this. Whereas pure container ships are to be found in large numbers operating between Europe and North America, Europe and Japan and Japan and North America, ro-ros operate primarily between Europe and North America and Europe and the Middle East, although there is an important trade between North America and the Caribbean.

Today the world ro-ro fleet can be subdivided into a number of different types. They include ships designed to carry freight vehicles only; to carry a combination of containers and freight vehicles and to transport cars without passengers. There are various other types and freight-only ro-ro ships form about two thirds of the world ro-ro fleet at present.

However, the best known ro-ro ships are ferries designed to transport commercial vehicles and private cars, together with large numbers of passengers, usually on short voyages.

The problem areas

Although ro-ros have proved commercially very successful, some concern has been expressed about ro-ro ships from the safety point of view virtually ever since the first ro-ro ships were introduced. The whole design concept is different from that of traditional ships because of the introduction of a number of elements which make ro-ro ships unique.

1. The lack of internal bulkheads

On conventional ships, the hull is divided into a number of separate holds by means of transverse bulkheads, many of which may be watertight. In the event of the hull being holed, the bulkheads will limit or delay the inrush of water, resulting in the ship sinking slowly enough for the evacuation of those on board or even preventing the ship from sinking at all.

With ro-ro ships the installation of unpierced transverse bulkheads is a major obstacle, at least on the upper "through" decks: the whole idea of the ro-ro ship depends upon being able to drive cargo on to the ship at one end and off again at the other. The installation of fixed transverse bulkheads would prevent this. Although ro-ros are all fitted with the watertight collision subdivision, and engine-room bulkheads below the freeboard deck prescribed by SOLAS, the huge vehicle decks make it possible for water to enter very rapidly and fire can also spread very quickly for the same reason.

2. Cargo access doors

The cargo access doors at the stern and bow of the ship represent a potential weak spot, as do the side doors with which some ro-ro ships are equipped. Over the years such doors can become damaged or twisted, especially when the door also serves as a ramp.

3. Stability

The movement of cargo on the vehicle deck can affect the intact stability of the ship, causing it to list. The sudden inrush of water following damage to the hull or failure of watertight doors can be

even more serious (and rapid). The fact that ro-ro ships generally have a very large superstructure compared with other types means that they can be more affected by wind and bad weather.

4. Low freeboards

Cargo access doors fitted on cargo-only ro-ros are often very close to the waterline. This means that a defective trim or a sudden list, caused, for example, by the movement of cargo, can bring the access threshold below the waterline, resulting in a sudden inrush of water (if the door is open) which will in turn result in the list increasing and a possible capsizing of the ship.

5. Cargo stowage and securing

A list can cause cargo to break loose if it is not correctly stowed and secured. The problem is made worse because the crew of the ship cannot normally see how the cargo is stowed inside or on the trailer in which it is transported. A heavy load which breaks loose can cause other units to follow suit. The result can be an increased list, the spillage of dangerous substances and, in extreme cases, damage to the hull and ship's structure.

6. Life-saving appliances

The high sides of many modern ro-ros, including passenger ships, pose problems regarding life-saving appliances: the higher a lifeboat, for example, is stowed the more difficult it can be to launch, especially if the ship is listing badly.

7. The crew

The factors referred to above indicate that ro-ros are highly sophisticated ships which require very careful handling. This makes them exceptionally vulnerable to human error.

How safe are ro-ros?

Because of the publicity surrounding accidents involving passenger ro-ro ships such as the *Herald of Free Enterprise*, *Scandinavian Star* and *Estonia* it is sometimes assumed that this type of ship is much more dangerous than others. This is not borne out by statistics. The World Casualty Statistics for 1994 published by Lloyd's Register of Shipping show that passenger/ro-ro cargo loss rate per thousand ships was 2.3 - the same as the average figure for all ships.

However, when one considers loss of life at sea the picture changes. Between 1989 and 1994, the Lloyd's Register figures show that 4,583 lives were lost in accidents at sea. Of these 1,544 were lost in accidents involving passenger/ro-ro cargo ships - exactly one third, even though ro-ro ships make up only a small fraction of world merchant marine tonnage. This would seem to indicate that although passenger ro-ro ships are involved in an average number of accidents the consequences of those accidents are usually far worse.

An important study concerning the safety of ro-ro ships (including cargo ships) was submitted to IMO in 1983 by Norway. The study was compiled by the classification society det Norske Veritas and covered the years 1965-1982. Of 341 casualties during the period, 217 were defined as serious and 36 resulted in the total loss of the ship.

The study showed that the most common causes of serious casualties were collisions (24%); machinery damage (17%); grounding (17%); shift of cargo and operational (16%); fire and explosion (14%). The figures changed significantly when total losses were studied. Here the most common cause was shift of cargo and operational faults (43%); collision (25%) and fire and explosion (18%).

The DNV study showed that total losses as a result of a collision were much higher for ro-ros than for other ships (with only a 9% occurrence). Both collisions and uncontrolled shifts of cargo more frequently led to serious consequences with ro-ros.

The paper noted that more than 70% of all ro-ro total losses due to collision resulted in loss of lives while 60% of ships reported to have capsized or sunk following a collision did so in less than ten minutes. Nearly all of the total losses involved ships of less than 110 metres in length.

A further important point made by the DNV study was that the ro-ro ships most frequently exposed to serious casualties and total losses were the pure ro-ro and freight-only types. Pure ro-ros had a high percentage share of all casualties and especially of total losses. Passenger ferries, on the other hand, had a fairly high percentage share of all categories but the serious casualty/total loss frequency was relatively low.

The study also showed that the total loss rate for ro-ros was significantly *lower* than the average for the world fleet (under 0.25% over the 13-year period compared with about 0.55% for the world fleet).

A quick look at some of the best-known accidents involving ro-ro ships also indicates some of the major problem areas. Several of them involved water getting on to the vehicle deck through the cargo doors, either as a result of a mistake or an accident.

The first ro-ro ship to be lost at sea was the *Princess Victoria*, a rail ferry which sank on a voyage to Belfast in 1953 when heavy seas stove in the stern door: 133 lives were lost. At least 264 people died in 1966 when the Greek ferry *Heraklion* sank in heavy seas on a voyage to Piraeus. Although not a ro-ro, the ship did have a large car deck without subdivisional bulkheads. This deck flooded when the loading hatch was smashed by a vehicle which had broken loose. The cargo ro-ro *Hero* was lost in 1977, partly as a result of water entering through a leaking stern door. In September 1994 the passenger ro-ro *Estonia* was lost with more than 900 lives when the bow door was torn off by heavy seas. The car deck flooded and the ship capsized within a few minutes (see page 20).

These accidents happened in heavy seas, but other ro-ros have been lost through water entering doors in port or sheltered waters. They include the *Straitsman*, which sank when the stern door was opened as the ship approached land, with the crew unaware that the door sill was below the waterline: and the *Seaspeed Dora*, which capsized in 1977 when a movement of cargo caused the ship to list sufficiently for water to enter through an open bunkering door. In the case of the *Herald of Free Enterprise*, water entered through the bow door which had been left open (see page 13).

Ro-ro ships which have sunk rapidly as a result of a collision have included the *Jolly Azzurro* (1978), *Collo* (1980), *Tollan* (1980), *Sloman Ranger* (1980), *Ems* (1981), *European Gateway* (1983) and *Mont Louis* (1984).

Among ships which have been lost following a shift of cargo are the *Espresso Sardegna* (1973), *Zenobia* (1980) and *Mekhanik Tarasov* (1982, in very bad weather).

IMO's activities in the area of ro-ro safety

Since coming into being in 1959, IMO has adopted numerous international conventions and other instruments which are designed to improve maritime safety in general. Some of these are particularly relevant to ro-ros.

The International Regulations for Preventing Collisions at Sea, 1972, for example, contain a series of measures to improve the safety of shipping in confined waters, such as straits and narrow channels. These include the introduction of traffic separation schemes and other routeing measures. Ro-ros, such as passenger ferries, frequently operate in such waters which are not only confined but are frequently congested as well.

These measures have been very successful in reducing collisions, especially head-on collisions. Studies made of collisions in the English Channel, for example, show that the collision rate has been cut dramatically since the 1960s and there can be little doubt that these measures have saved many ro-ro ships operating on the short-sea crossing between the United Kingdom and the Continent from accidents.

Other important conventions which are relevant to safety include the International Convention for the Safety of Life at Sea, 1960 and 1974, the International Convention on Load Lines, 1966, and the International Convention for Safe Containers, 1972.

However, since the early 1970s, when ro-ros were appearing in increasing numbers, IMO has developed various measures with the special features of ro-ro ships in mind. These are dealt with below under different subject headings.

Subdivision and damage stability

The feature which distinguishes the ro-ro ship from other types is the open vehicle deck (or decks) which run the full length of the ship with a door at either end. It is crucial to the whole ro-ro concept - and one of its most controversial features, since it has led to considerable concern about the safety of ro-ro ships is their stability in both the intact and damaged condition.

Under the International Convention on Load Lines, 1966, ships are divided into two basic types: type A ships include tankers, which are assigned lower freeboards than type B ships. Type A ships are better protected from the sea because they have more internal subdivision and fewer surface areas for openings. Dry cargo ships, including ro-ro ships, are type B with larger freeboards and are subject to less stringent requirements for subdivision and damage stability.

As far as SOLAS is concerned, subdivision and damage stability requirements for passenger ships are contained in part B of chapter II of the 1960 version and chapter II-1 of the 1974 version. In both, the standard of subdivision varies according to the length of ships and the number of passengers on board. Passenger ships are defined as ships which carry more than 12 passengers.

This is important as far as ro-ros are concerned because it means that passenger ferries, including car ferries, are classed as passenger ships. The most important result of this is to make it mandatory for passenger car ferries to be constructed in such a way that the deck on which the vehicles are parked is above the waterline. The area beneath this deck must be subdivided by vertical watertight bulkheads.

The 1960 SOLAS Convention used what is known as the deterministic method. This lays down precise calculations for determining such parameters as the permissible length of compartments, special requirements concerning subdivision, stability in a damaged condition, and other factors.

However, many authorities felt that the deterministic method was far from ideal. In 1973, therefore, the IMO Assembly adopted resolution A.265(VIII), entitled Regulations on Subdivision and Stability of Passenger Ships. This was intended as an equivalent to part B of chapter II of SOLAS 60 and when the 1974 Convention was adopted a reference was made to the requirements of this resolution which may be used instead of those contained in part B.

Resolution A.265 uses a completely different approach known as the probabilistic method. This tries to establish the probability of the ship surviving in the event of certain damage occurring.

The degree of subdivision required for each ship is determined by a formula known as required Subdivision Index R. This is so calculated that the degree of safety required increases with the number of passengers carried and the length of the ship. Further regulations contain formulae for calculating the probable effect on stability if certain damage occurs. These formulae can be used to calculate the attained Subdivision Index A. The ship's degree of subdivision is considered sufficient if the stability of the ship in a damaged condition meets the requirements of the regulations and the attained Subdivision Index A is not less than Subdivision Index R.

Guidance Notes issued by IMO to help application of these requirements state that the attained Subdivision Index A 'is based on the concept of the probability of survival of the ship in case of collision'.

The notes state:

'In order to develop this concept it is assumed that the ship is damaged. Since the location and size of the damage is random, it is not possible to state which part of the ship becomes flooded. However, the probability of flooding of a space can be determined if the probability of occurrence of certain damages is known; the probability of flooding a space is equal to the probability of occurrence of all such damages which just open the considered space. Thereby a space is a part of the volume of the ship which is bounded by undamaged watertight structural divisions.

'Next it is assumed that a certain space is flooded. In addition to some invariable characteristics of the ship, whether the ship can survive flooding depends, in such a case, on the initial draught and GM^2 , the permeability of the space and the weather conditions, which are all random at the time when the ship is damaged. Provided that the limiting combinations of the aforementioned variables and the probability of their occurrence are known, the probability that the ship with the considered space flooded will not capsize or sink can be determined.

'The probability of survival is the sum of the products for each compartment or group of compartments of the probability that a space is flooded multiplied by the probability that the ship will not capsize or sink with the considered space flooded.'

Whether they are built according to part B in chapter II of SOLAS 74 or resolution A.265, the fact that they are classified as passenger ships means that car ferries are constructed in such a way that the vehicle deck is above the water line. The area below the vehicle deck is subdivided. This means that if the ship is holed in a collision the water which enters will be retained either permanently or for some time by the vertical bulkheads. Even if the damage is so great that the ship eventually sinks, it will generally do so slowly enough for those on board to be evacuated safely.

By the early 1970s more and more ro-ros were being built for the carriage of goods vehicles and containers rather than private cars and ordinary passengers. Many of those engaged in this growing trade felt that existing IMO requirements were unnecessarily stringent. In 1973 some delegations maintained at a meeting of IMO's Maritime Safety Committee (MSC), that the drivers of goods vehicles were not passengers but were on board the ship in order to pilot cargo. They should therefore be regarded as engaged on board on the ship's business.

Had this opinion been accepted it would have meant that ro-ro ships designed for the carriage of goods vehicles and carrying 12 or more drivers would no longer have been classed as passenger ships. They could have been so constructed that they could incorporate another vehicle deck below the bulkhead deck (and below the waterline) without any transverse subdivision bulkheads besides machinery space and pier bulkheads being required. Watertight subdivision would then have been formed mainly by the longitudinal bulkheads.

The MSC decided by a majority that drivers should not be regarded as part of the crew. But it did recognize that the existing requirements for subdivision by unpierced bulkheads imposed severe constraints on ro-ro designs which might not be necessary. The reasoning behind this was that drivers are generally able-bodied and used to being on board ship: they are likely to be able to

²*GM is the metacentric height i.e. the distance between the ship's centre of gravity (g) and metacentre (m). The metacentre is the point where a vertical line passing through the centre of buoyancy meets a vertical line passing through the centre of buoyancy when the ship is heeling. If the GM is too small the ship will heel slowly but tend to be unstable. If it is too great stability will be high but the ship will tend to roll quickly. This is not only uncomfortable for those on board but can impose strains on fittings and cargo lashings.*

cope with an emergency better than the average ferry passengers, who might include women, children, elderly and infirm people.

It was decided that the matter should be further considered and in 1975 the IMO Assembly adopted resolution A.323(IX) which permitted in passenger ships the fitting of bulkheads below the bulkhead deck with watertight doors designed to permit the movement of vehicles, on condition that other more stringent safety requirements were met. The Assembly recommended that amendments to the 1974 SOLAS Convention embodying these provisions be adopted upon its entry into force. This was done in the 1981 amendments to SOLAS which entered into force on 1 September 1984.

In 1976 the whole question of ro-ro safety was raised at the MSC by France in a comprehensive paper prepared by an Administrative Technical Committee set up specifically to investigate ro-ro safety. Its report contained a number of proposals for amending existing international regulations for cargo ro-ro ships together with suggestions as to *how* they might be improved. Several of these proposals concerned subdivision and stability requirements, one proposal being that a special type C category be created in the Load Line Convention to cover ro-ros which would give higher freeboard values than those of type B.

Some other delegations felt that while ro-ros were undoubtedly a specific type of ship this did not mean that they required special regulations. So were many other ship types, it was argued. It was, however, agreed that the matter should be studied carefully and the MSC referred the French report to a number of sub-committees.

The Sub-Committee on Subdivision, Stability and Load Lines considered the subject in October 1977 but decided that the subdivision, stability and load lines requirements of ro-ro ships did not require special consideration. Instead the matter should be pursued in the context of requirements for cargo ships in general.

Concern was expressed about dangerous situations that could arise, due to the free liquid surface effect, if loose water from leakage, fire-extinguishing water, etc. were present in enclosed spaces - such as the vehicle deck of a ro-ro ship which extends for a substantial proportion of the ship's length and which is not provided with internal subdivision. To solve this problem a circular was elaborated which provided requirements for the internal drainage of such spaces. These were adopted by the Assembly in 1983 as resolution A.515(13) and were included in the 1989 amendments to SOLAS.

In January 1984 the Sub-Committee (now renamed the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety), in line with its decision to develop subdivision and stability requirements for dry cargo ships including ro-ro ships, agreed to a proposal concerning a draft probabilistic method for testing subdivision and stability requirements for such ships. Members were invited to perform sample calculations on various types and sizes of ships using this method. In June 1986, the Sub-Committee drafted regulations which Member States were again requested to apply on a trial basis to appropriate ship-types and to submit results to IMO. The replies were still coming in when the *Herald of Free Enterprise* capsized in March 1987.

Fire safety

The large open spaces associated with ro-ro ships also have implications as far as fire safety is concerned and this matter was considered by IMO as early as the 1960s.

In 1967 the Assembly adopted, with resolution A.122(V), a new regulation 108 as an amendment to the 1960 SOLAS Convention concerned with the protection of special category spaces above or below the bulkhead deck in passenger ships. The underlying philosophy was that normal main vertical zoning may not be practicable for such horizontally extended spaces. To enable the modification to the vertical zones concept, the Assembly also adopted, with resolution A.123(V), a Recommendation on fixed fire-extinguishing systems for special category spaces.

In November 1975 the Assembly adopted resolution A.327(IX), concerning fire safety requirements for cargo ships which recommends the implementation of improved fire safety requirements in addition to those incorporated in SOLAS 60 and SOLAS 74 (which at that time had not entered into force). It called upon IMO to continue working on the subject with a view to amending SOLAS 74 when it entered into force.

Regulation 18 of that resolution deals with cargo spaces intended for the carriage of motor vehicles with fuel in their tanks (which basically means ro-ro ships). It includes additional fire detection and alarm requirements, improved fire extinguishing arrangements, ventilation and precautions against the ignition of flammable vapours.

In view of this resolution the Sub-Committee on Fire Protection felt that there was no need for additional fire safety requirements for ro-ro cargo ships when the French paper was considered in July 1977. It was agreed, however, that resolution A.327(IX) might need to be amended and a special working group was established to consider the matter.

As a result, amendments to the requirements of chapter II-2 were incorporated in the 1981 SOLAS amendments, which entered into force on 1 September 1984. Several regulations concerning fire safety in cargo ships were affected by these changes, including regulation 53 (fire protection arrangements in cargo spaces), while a new regulation 54 was added dealing with special requirements for ships carrying dangerous goods. Specific reference is made to ro-ro ships.

Regulations 53 and 54 of chapter II-2 of SOLAS 74 were further improved in the 1983 SOLAS amendments and the 1989 SOLAS amendments which were adopted by the Assembly as recommendations in resolution A.515(13).

Cargo safety

Apart from stability, the problem which once created most concern in ro-ro shipping is cargo stowage and security. The det Norske Veritas study quoted earlier showed that 43% of ro-ro losses could be attributed to shift of cargo and operational faults.

A survey of ro-ro damage in the Channel and Mediterranean, carried out by the French marine insurance market and quoted in *Lloyd's List* in January 1984, stated that at least half could be attributed to inadequate or defective securing of vehicles or their cargo.

And another survey carried out by the United Kingdom Department of Trade and Industry in 1979 of 26 ro-ro ships, including some passenger car ferries, showed that 12 had suffered accidents resulting from the shifting of cargo following the failure of security arrangements. Of these, nine were said to be minor in nature, but three were serious and resulted in extensive damage to vehicles and cargo. The survey, incidentally, was carried out because the Department had become concerned by the frequency of such incidents in the previous two years.

Among the difficulties which cargo stowage presents to the ro-ro operators are the following:

- 1. Stowage of cargo on deck:** since the cargo is driven on and off the ship and, once on board, stowed tightly together, it is often difficult to position the lashings and other arrangements for securing the cargo in the best possible locations.
- 2. The variety of vehicles and cargo carried:** ro-ro ships have to be able to carry many different types of wheeled cargo from small cars to 45-ton trailers and, in special cases, loads of several hundred tons. It is almost impossible to devise a lashing system which is ideal for all of these cases.
- 3. The design of trailers and containers:** trailers which are carried on ro-ro ships are not normally designed primarily for this use. The fact that they occasionally have to be carried by sea is often of secondary importance to the land operator who is not always aware of the forces which act upon the ship and its cargo.

Since trailers and lorries are designed primarily for road usage they very often lack adequate securing points, which makes it difficult to secure trailers to the ship. An additional complication is the trailer's suspension system, which may cause the lashings to become disengaged if proper precautions are not taken.

4. Securing the cargo within the unit: containers and other units carried on ro-ro trailers are frequently sealed when they leave the place where they are loaded and they are not opened again until they arrive at their final destination. This is done for reasons of security and also to satisfy customs regulations. But it means that the crew of the ship and the port staff responsible for loading it are unable to examine the cargo to make sure that it is properly secured. They are dependent on the skill and diligence of people who very often have no knowledge of the forces which may be encountered on board a ship in rough seas.

5. The lack of transverse bulkheads on board ro-ro ships means that a relatively minor incident - such as a trailer toppling over as a result of a defective lashing - can rapidly escalate into something more serious. Nearby units can be dislodged with the result that a series of units eventually fall like dominoes. Such shifts of cargo can cause severe stability problems for the ship.

6. It is difficult to arrange the best loading conditions since cargo units arrive at the port of embarkation in a random order and it is equally difficult for the crew to obtain detailed information about the vehicles, the cargo, weights, etc. in advance.

7. Stability and rolling periods: road trailers tend to have a very high point of gravity when they are loaded: the cargo may be stable on the trailer, but the trailer and cargo together are not necessarily very stable on the deck of the ship (or even on the road, as the number of overturned articulated lorries and trailers testifies).

Ro-ro ships themselves have a low centre of gravity. This results in a rolling period (i.e. the time taken for the ship to roll from the furthest point on one side to the furthest point on the other) of as little as seven seconds. This is very short, and the movement of the ship and its cargo is therefore very rapid. This can put a severe strain on lashings.

Since the 1970s, IMO has developed a series of measures to improve the safety of cargoes carried on ro-ro ships. In 1975, for example, IMO and the International Labour Organisation (ILO) began work on guidelines for training in the packing of cargo in freight containers. These were published in 1978 and were intended as a short guide to the essentials of safe packing for use by those responsible for the packing and securing of cargo in freight containers or vehicles.

The advice given in the guidelines refers to the packing of goods in containers but much of the advice applies equally to vehicles which are to make a ro-ro international voyage.

It is vital that containers and vehicles be properly packed, for sea voyages are made in a variety of weather conditions likely to exert a combination of forces upon the ship and its cargo. The guidelines state that these will give rise to pitching, rolling, heaving, surging, yawing or swaying forces or a combination of two or more. Such movements can exert forces on the cargo greater than those usually found ashore and may exert them over a prolonged period.

The importance of applying the provisions of the guidelines to vehicles was highlighted by a report to the Sub-Committee from Sweden of a survey in which loaded vehicles leaving Swedish ro-ro terminals had been spot-checked as to the securing of their cargoes.

Out of 535 loaded vehicles, fewer than 300 had been found to conform with the Swedish regulations concerning cargo securing on road vehicles. Thus 45% of the cargo on road vehicles had been found to be partly or completely unsecured.

In 1985 IMO and ILO issued revised Guidelines for Packing of Cargo in Freight Containers or Vehicles. The observer of the International Confederation of Free Trade Unions stated that the

revised guidelines would make a valuable contribution to raising safety standards in the port and transport industries. A survey of the experience of its union members with containers had indicated that whilst the introduction of containers has served to eliminate accidents associated with traditional methods of cargo handling, those accidents which occur in container handling are more serious in extent and degree. The packing of containers is frequently a contributory factor and when it is done badly the dockers and seafarers suffer.

The guidelines state: 'Packing and securing of cargo inside a container or vehicle should be carried out with this in mind. It should never be assumed that the weather will be kindly and the sea smooth or that securing methods used only for land transport will always be adequate.

'Whilst the use of freight containers substantially reduces the physical hazard to which goods are exposed, improper or careless loading of goods into a container may be the cause of personal injury when the container is handled or transported; in addition, serious and costly damage may occur to the goods inside or to equipment. The person who packs and secures goods into the container for export may be the last person to look inside the container until it is opened by the consignee at its final destination. Consequently, a great many persons will rely on his skill: road vehicle drivers and other highway users when the container is carried by road, railway personnel and others when the container is carried on a rail-car, dock workers when the container is lifted on or off a ship, and crew members of the ship which may be taking the container through its most difficult conditions; as well as shippers and consignees, etc. All may be at risk from a poorly packed container, in particular, one which is carrying dangerous goods.'

By 1981 the Assembly adopted guidelines on the safe stowage and securing of cargo units and other entities in ships other than container ships (resolution A.489 (XII)).

The guidelines are intended for use in connection with wheeled cargoes, containers, flats, pallets, portable tanks, packaged units, vehicles, etc. and parts of loading equipment which belong to the ship but are not fixed to the ship.

One of the most important recommendations made is that ships should carry a Cargo Securing Manual 'appropriate to the characteristics of the ship and its intended service, in particular the ship's main dimensions, its hydrostatic properties, the weather and sea conditions which may be expected in the ship's trading area and also the cargo composition'.

To assist Governments in the development of these Manuals, the Sub-Committee prepared a number of provisions to be included. These were issued as MSC/Circular 385 in January 1985.

The provisions are intended to provide a uniform approach to the preparation of Cargo Securing Manuals, their layout and content. The subjects covered include details of fixed cargo securing arrangements and their location; location and stowage of portable cargo securing gear and its correct application; inventory of items provided; and an indication of the magnitude of forces expected to act on cargo units in various positions on board the ship.

In February 1982, work began on developing a resolution on elements to be taken into account when considering the safe stowage and securing of cargo units and vehicles in ships. This was adopted in November 1983 as resolution A.533(13) which recognizes that cargo 'is stowed on and secured to cargo units and vehicles in most cases at the shipper's premises ... and that the cargo on cargo units and vehicles may not always be adequately stowed or secured for safe sea transport'.

The resolution covers elements to be considered by the shipowner and shipbuilder, the master of the ship and finally the shipper, forwarding agents, road hauliers, stevedores and port authorities.

IMO also developed guidelines for securing arrangements for the transport of road vehicles on ro-ro ships. A resolution on this subject (A.581(14)) was adopted by the Assembly in November 1985.

The guidelines are intended to apply to commercial vehicles, including semi-trailers and road trains, with a total mass (including cargoes) of up to 40 tons, and articulated road trains of not more than 45 tons. They do not apply to buses.

The resolution says that given adequately designed ships and properly equipped road vehicles, lashing of sufficient strength will be capable of withstanding the forces imposed on them during the voyage. The side guards often required for vehicles can obstruct proper securing and the guidelines take this difficulty into account. They cover securing points both on the deck of the ship and on the vehicle, as well as lashings and stowage.

The Sub-Committee on Containers and Cargoes continued its work in this field, concentrating on two main areas. One was the development of a harmonized calculation method for determining accelerations acting on cargo units, including vehicles, on board ship.

The second and more important was the development of a Code of Safe Practice for the Safe Stowage and Securing of Cargo, Cargo Units and Vehicles. The aim of this code is to advise masters on the specific hazards and difficulties associated with the transport of certain cargoes; the stowage and securing of such cargoes; and associated ship handling measures.

The Sub-Committee also began work on a new revised chapter VI of SOLAS 74 with the intention, among other things, of making elements of the code mandatory. But before this work could be completed an event occurred which was to have a major impact upon IMO and the whole ro-ro trade.

The Herald of Free Enterprise disaster

In March 1987 the roll-on/roll-off passenger ferry *Herald of Free Enterprise* capsized and sank shortly after leaving Zeebrugge in Belgium. The accident occurred because the bow door was left open when the ship left port allowing water to enter and flood the car deck. The accident resulted in the deaths of 193 passengers and crew members.

It was not the first time that a ro-ro ship had capsized but the circumstances of the disaster - not least the dramatic photographs that appeared in the press and on television - made a strong impression on public opinion.

Shortly after the accident the United Kingdom came to IMO with a request that a series of emergency measures be considered for adoption. Most of these consisted of proposed amendments to the International Convention for the Safety of Life at Sea (SOLAS), 1974, the most important treaty dealing with the safety of the world's ships. It has so far been ratified by 128 countries and applies to 98% of world merchant tonnage.

The proposals, many of which were based on the findings of the inquiry into the disaster, were presented to IMO in separate packages, the first of which was adopted by the MSC in April 1988.

The 1988 (April) amendments to SOLAS

The amendments affect regulations 23 and 42 of Chapter II-1 of the SOLAS Convention. The first deals with the integrity of the hull and superstructure, damage prevention and control and involves the addition of a new regulation 23-2 which requires that indicators be provided on the navigating bridge for all doors which, if left open, could lead to major flooding of a special category space or a ro-ro cargo space.

The same regulation also requires that means be arranged, such as television surveillance or a water leakage detection system, to provide an indication to the navigating bridge of any leakage through doors which could lead to major flooding.

Special category and ro-ro spaces must also be patrolled or monitored by effective means, such as television surveillance, so that undue movement of vehicles in adverse weather, fire, the presence of water or unauthorized access by passengers can be observed whilst the ship is underway.

A new regulation 42-1 deals with supplementary emergency lighting for ro-ro passenger ships. All public spaces and alleyways must be provided with supplementary lighting that can operate for at least three hours when all other sources of electric power have failed and under any condition of heel.

A portable rechargeable battery-operated lamp must be provided in every crew space alleyway, recreational space and every working space which is normally occupied unless supplementary emergency lighting is provided.

The amendments entered into force on 22 October 1989 under a procedure known as "tacit acceptance." This normally results in amendments entering into force within two and a half years of the date of adoption by the MSC, but Article VIII does allow the Committee to select a different period of time and this was the first time that the procedure had been used to reduce the period before entry into force to less than two years. The amendments entered into force only 18 months after adoption - an indication of the great importance which IMO attaches to ro-ro safety.

The 1988 (October) Amendments

In October 1988 the MSC met again in a special session requested and paid for by the United Kingdom to consider a second package of amendments arising from the *Herald of Free Enterprise* tragedy. The amendments adopted entered into force on 29 April 1990. They became known as the "SOLAS 90" standard.

One of the most important amendments concerns regulation 8 of Chapter II-1 and is designed to improve the stability of passenger ships in the damaged condition. Work on the amendment had actually begun some years before following an accident involving another ro-ro ship. This was the *European Gateway*, which capsized following a collision with another ship in 1982. Like the *Herald of Free Enterprise* five years later, the *European Gateway* ended up lying on her side in relatively shallow water and only five lives were lost. The adoption of the amendments was brought forward because of its relevance to ro-ro safety.

The amendment applies to ships built after 29 April 1990. The amendment considerably expands the existing regulation and takes into account such factors as the crowding of passengers on to one side of the ship, the launching of survival craft on one side of the ship and wind pressure. The amendment stipulates that the maximum angle of heel after flooding but before equalization shall not exceed 15 degrees.

A research programme set up by the United Kingdom Department of Transport analysed the new standard and the Steering Committee carrying out the study reported that SOLAS 90 "should provide an adequate standard of protection against capsize up to sea state 3, i.e. in moderate seas having a significant wave height³ up to 1.5m. This is an important finding and one which appears to validate SOLAS 90 as a standard that should enable ro-ro ferries and any other conventional design of passenger ship to survive the effects of prescribed damage in such seas."

³Wave height is the vertical distance between the crest and trough of the wave. The UK Steering Committee report says that as wave heights in a given sea state are subject to considerable variation it is the recognized practice to refer to their apparent height as being "the significant wave height." This is defined as the average of the third highest observed wave height over a given period.

A further amendment to regulation 8 was proposed by the United Kingdom. It is concerned with intact rather than damage stability. It requires masters to be supplied with data necessary to maintain sufficient intact stability and the amendment expands the section by requiring that the information must show the influence of various trims, taking into account operational limits.

Ships must also have scales of draught marked clearly at the bow and stern. Where these are not easily readable the ship must also be fitted with a reliable draught indicating system. After loading and before departure the master must determine the ship's trim and stability.

The next amendment adds a new regulation 20-1 which requires that cargo loading doors shall be locked before the ship proceeds on any voyage and remain closed until the ship is at its next berth.

Another amendment affects regulation 22 and states that at periods not exceeding five years a lightweight survey must be carried out to passenger ships to verify any changes in lightweight displacement and the longitudinal centre of gravity. The lightweight of a ship consists of the hull, machinery crew and fittings without fuel and stores. Additions to the structure can add significantly to lightweight and affect the ship's stability.

The April 1989 Amendments

Further amendments to SOLAS were adopted by the MSC in April 1989. They also entered into force on 1 February 1992.

Several regulations of Chapter II-1 were amended, the most important being regulation 15 which deals with openings in watertight bulkheads in passenger ships. From 1 February 1992 new ships have had to be equipped with power-operated sliding doors, except in specific cases and must be capable of being closed from a console on the bridge in not more than 60 seconds. The amendments make it clear that all watertight doors must be kept closed except in exceptional circumstances.

The May 1990 Amendments

Important changes were made to the way in which the subdivision and damage stability of cargo ships (including freight-only ro-ro ships) is calculated. They apply to ships of 100 metres or more in length built after 1 February 1992.

The amendments are contained in a new part B-1 of Chapter II-1 and are based upon the so-called "probabilistic" concept of survival, which was originally developed through study of data relating to collisions collected by IMO. This showed a pattern in accidents which could be used in improving the design of ships: most damage, for example, is sustained in the forward part of ships and it seemed logical, therefore, to improve the standard of subdivision there rather than towards the stem. Because it is based on statistical evidence as to what actually happens when ships collide, the probabilistic concept provides a far more realistic scenario than the earlier "deterministic" method, whose principles regarding the subdivision of passenger ships are theoretical rather than practical in concept.

The May 1991 amendments

The amendments, which entered into force on 1 January 1994, are mostly concerned with cargo safety, and involve a complete re-writing of chapter VI. As previously noted (see page 13) the amendments were being prepared before the *Herald of Free Enterprise* disaster. The new chapter refers to the Code of Safe Practice for Cargo Stowage and Securing, the aim of which is to provide an international standard for the safe stowage and securing of cargoes.

It gives advice on ways of securing and stowing cargoes and gives specific guidance on cargoes which are known to create difficulties or hazards. It also gives advice on actions to be taken in heavy seas and to remedy cargo shift.

The Code is divided into seven chapters and a number of annexes dealing with such "problem" cargoes as wheel-based cargoes and unit loads, both of which are carried on ro-ro ships.

Other amendments concern chapter II-2: construction - fire protection, fire detection and fire extinction. Two of them apply to all ships. They affect regulations 20 and 21, which deal respectively with fire control plans and ready availability of fire-extinguishing appliances.

The remaining amendments concern new passenger ships built on or after 1 January 1994 and are particularly concerned with fire safety on ships on which large open spaces such as atriums are commonly provided.

Atriums are defined as public spaces which span three or more decks and contain combustibles such as furniture and enclosed spaces, such as shops, offices and restaurants. Regulation 28 has been revised to make it mandatory for such spaces to be provided with two means of escape, one of which gives direct access to an enclosed vertical means of escape.

Regulation 32 requires that such spaces be fitted with a smoke extraction system, which can be activated manually as well as by a smoke detection system, which is required under the amended regulation 40. Regulation 36 has been amended to make it mandatory for such spaces to be fitted with automatic sprinkler systems.

The April 1992 Amendments

Although the entry into force of the October 1988 amendments to SOLAS meant that all ro-ro passenger ferries built since April 1990 had been built to improved damage stability standards, some Governments were still concerned at the safety levels of existing ships.

The United Kingdom proposed that the SOLAS 90 standard be made mandatory on existing ships under a phase-in programme that would have lasted from 1994 to 2004, with the ships that were furthest from the standard being converted first. The British Government pointed out that the study initiated following the *Herald* disaster had shown that for existing ships "capsize may still be a possibility if damage of the prescribed extent is received in the most vulnerable regions of the ship whilst operating in a moderate sea."

Although there was general agreement that an improvement to the standard for existing ships was needed, the majority of IMO Member States felt that the SOLAS 90 standard was too high. Traditionally major changes to ship design had only be made applicable to new ships because of the costs involved in applying them to existing tonnage. The industry pointed out that United Kingdom estimates showed that it would cost on average £650,000 a ship to bring the British passenger ro-ro fleet up to the SOLAS 90 standard and several Governments also raised the question of cost (they would reach a "prohibitive magnitude" according to one paper submitted to IMO).

When the proposed amendments were discussed in April 1992, therefore, the majority of Governments (with the exception of the United Kingdom and Ireland) opted for a slightly modified version of the SOLAS 90 standard and agreed that it would be phased in over 11 years beginning on 1 October 1994.

The phase-in period allowed depends upon the value of a ratio known as A/Amax, determined in accordance with a calculation procedure developed by the MSC to assess the survivability characteristics of existing ro-ro passenger ships. A/Amax is a simplified probabilistic approach attempting to assess the survivability standard of one ferry against another. It assumes a number of simplifications and is a rough guide used because it allowed all countries to carry out relatively quick calculations on a representative number of ferries. It is not a survivability standard as such but enables a hierarchy of vessels to be established.

The date by which each vessel must comply with the April 1992 standard depends on the A/Amax value attained. Those with an A/Amax value of less than 70% for example, had to comply with the amendments by 1 October 1994, the date on which the amendments entered into force.

The complete phase-in period and degree of compliance is shown below:

Compliance	
A/Amax value	Date
Less than 70%	1 October 1994
70%-less than 75%	1 October 1996
75%- less than 85%	1 October 1998
85%- less than 90%	1 October 2000
90%- less than 95%	1 October 2005

The application of the modified SOLAS 90 standard to existing ships means modifying a large part of the world's ro-ro fleet. In some cases the changes could be extensive and the high cost involved has already led to some of them being scrapped and replaced with new tonnage.

The United Kingdom announced after the meeting that it would be considering national action to ensure the safety of ferries operating between its ports and the Continent of Europe and in 1993 an agreement was concluded which meant that existing ferries operating on most of these routes would have to meet the full SOLAS 1990 standard.

Important amendments were also made to chapter II-2 which were influenced by an accident that occurred in 1988 when the passenger ferry *Scandinavian Star* caught fire during a voyage from Norway to Denmark. As a result 165 people lost their lives and although the fact that the ship was a ro-ro did not contribute to the disaster it again resulted in increased public concern about this type of ship. IMO was called upon to take action and developed a number of amendments to chapter II-2 of SOLAS which were also adopted in April 1992 and also apply to existing ships.

Since 1 October, 1994, for example, all passenger ships carrying more than 36 passengers have had to be provided with plans and booklets on fire protection, fire patrol members have had to be provided with two-way portable radiotelephones and further requirements have been introduced concerning water fog applicators, portable foam applicators and hose nozzles.

From 1 October 1997 all accommodation and services spaces, stairway enclosures and corridors must be equipped with a smoke detection and alarm system as well as a sprinkler system. Other requirements concern public address and emergency alarm systems and emergency lighting.

From 1 October 2000 all stairways in accommodation and services areas must be made of steel and certain machinery spaces must be fitted with a fixed fire-extinguishing system. Requirements have been introduced regarding ventilation ducts and fire doors.

It is, perhaps, worth stressing that the April 1992 amendments are particularly important because they apply to existing ships. In the past, major changes to SOLAS have been restricted to new ships by the so-called "grandfather clauses". On this occasion the MSC decided that the new stability and fire safety standards were so important that they should be applied to existing ships as well.

The December 1992 Amendments

The amendments are concerned primarily with fire safety standards for new passenger ships (including of course ro-ro passenger ships) built on or after 1 October 1994, the date on which the amendments will enter into force under the Convention's "tacit acceptance" provisions.

Major changes have been made to the requirements of chapter II-2 dealing with the fire protection of new passenger ships. Several regulations are affected, dealing with such matters as fire pump sizing, the release mechanism of carbon dioxide fire-extinguishing systems, the prohibition of new halon systems, and fixed fire-detection and fire-alarm systems.

A new regulation 20-4 has been added making it mandatory for ships carrying more than 36 passengers to have plans providing information on fire safety measures. These are to be based on guidelines developed by IMO. Regulations dealing with the fire integrity of bulkheads and decks have been amended. Regulation 28 (means of escape) has been considerably altered: corridors from which there is only one route of escape will be prohibited on new ships. All means of escape must be marked by lighting or photoluminescent strip indicators placed not more than 0.3 m above the deck. The lighting must identify escape routes and escape exits.

Requirements for fire doors (regulation 30) have been improved and passenger ships carrying more than 36 passengers will have to be equipped with an automatic sprinkler, fire-detection and fire-alarm system.

The amendments will make it mandatory for new passenger ships carrying more than 36 passengers to be fitted with fire-detection alarms centralized in a control station which must be continuously manned and from which it is possible to control the fire-detection system, fire doors, watertight doors, ventilation fans, alarms, communications system and the microphone to the public address system.

The May 1994 amendments: the SOLAS conference

The SOLAS Convention is now so widely accepted that, to some extent at least, virtually every ship in the world complies with it. Thanks to the tacit acceptance amendment procedure it has proved possible to keep the Convention up to date and further changes were made in May 1994. Some of them were adopted by the Maritime Safety Committee expanded to include all Contracting Parties to the Convention but, for technical reasons, others were dealt with by a special conference.

The changes made by the conference included the addition of three new chapters to the Convention which are relevant to ro-ro operations.

The details are as follows:

Chapter IX: Management for the Safe Operation of Ships: the main purpose of the new chapter is to make the International Safety Management (ISM) Code mandatory. The ISM Code was adopted by the 1993 Assembly as resolution A.741(18). This already gives it considerable force, since it was adopted unanimously and can therefore be regarded as having the full support of IMO's 152 Member States - but it is still only a recommendation. By adding the Code to SOLAS it is intended to provide an international standard for the safe management of ships and for pollution prevention.

The Code requires a safety management system (SMS) to be established by the shipowner or manager to ensure compliance with all mandatory regulations and that codes, guidelines and standards recommended by IMO and others are taken into account.

Companies are required to prepare plans and instructions for key shipboard operations and to make preparations for dealing with any emergencies which might arise. The importance of maintenance is stressed and companies are required to ensure that regular inspections are held and corrective measures taken where necessary.

The procedures required by the Code should be documented and compiled in a Safety Management Manual, a copy of which should be kept on board. Regular checks and audits should be held by the company to ensure that the SMS is being complied with and the system itself should be reviewed periodically to evaluate its efficiency.

The chapter is expected to enter into force under tacit acceptance on 1 July 1998. It will apply to passenger ships, oil and chemical tankers, bulk carriers, gas carriers and cargo high speed craft of 500 gross tonnage and above not later than that date and to other cargo ships and mobile offshore drilling units of 500 gross tonnage and above not later than 1 July 2002.

Chapter XI Special Measures to Enhance Maritime Safety. The chapter will enter into force on 1 January 1996. It contains four regulations, three of which are relevant to ro-ro ships.

Regulation 1 states that organizations entrusted by Administrations with the responsibility for carrying out surveys and inspections shall comply with the guidelines adopted by the IMO Assembly by resolution A.739 (18) in November 1993.

Such organizations - which include classification societies - are often used to carry out surveys and inspections required by SOLAS and other Conventions. The guidelines are intended to ensure that organizations employed in this comply with standards listed in an appendix.

Regulation 3 provides that all passenger ships of 100 gross tonnage and above and all cargo ships of 300 gross tonnage and above shall be provided with an identification number conforming to the IMO ship identification number scheme, as adopted by resolution A.600(15) in 1987. This is to enable ships to be identified no matter how many times their name or flag is changed.

Regulation 4 makes it possible for port State control officers inspecting foreign ships to check operational requirements "when there are clear grounds for believing that the master or crew are not familiar with essential shipboard procedures relating to the safety of ships."

The way in which this should be done is described in resolution A.742(18), which was adopted by the IMO Assembly in November 1993. It acknowledges the need for port States to be able to monitor not only the way in which foreign ships comply with IMO standards but also to be able to assess "the ability of ships' crews in respect of operational requirements relevant to their duties, especially with regard to passenger ships and ships which may present a special hazard".

Several other amendments will enter into force on 1 January 1996. They include a new regulation 8-1 in chapter V which makes it possible to introduce mandatory ship reporting systems. By making IMO-adopted ship reporting systems mandatory, the SOLAS amendments make it obligatory for ships entering or using a system to give their position, identity and other information. This will enable their journey through the system to be tracked. If the ship begins to head off course, or if there is a danger of collision or grounding, the shore authority will be able to give a warning and take what other action is necessary to prevent an accident.

Finally, a new regulation 22 has been added to improve bridge navigation visibility.

The *Estonia* disaster of September 1994

Following the adoption of the May 1994 amendments to SOLAS, the shipping community was looking forward to a period of consolidation during which the changes of the previous few years could be absorbed. It appeared to many that the doubts concerning ro-ro ships had been solved and that no more major changes were needed. Then, on 28 September 1994 the passenger ro-ro ship *Estonia* suddenly capsized in a severe storm in the north Baltic Sea and sank with the loss of more than 900 lives.

The scale of the disaster was so great that immediately the whole question of ro-ro safety was reopened. Preliminary inquiries showed that the outer bow door of the ship had been ripped off during the storm, allowing water to accumulate on the car deck to such an extent that the ship very quickly listed and then rolled over and sank. The accident occurred in the early morning when most passengers were asleep and the ship sank so suddenly that the majority of them had virtually no chance of escaping. And unlike the *Herald of Free Enterprise* and the *European Gateway* the *Estonia* was operating in deep water and did not end up lying on her side on a sandbank but sank to the bottom several hundred metres below.

The fact that the accident once again involved a bow door and water on the car deck led to renewed criticisms of ro-ros, the way they were operated and the basic ro-ro concept.

On 4 October, the Secretary-General of IMO, Mr William A. O'Neil, proposed that a complete review of the safety of roll-on/roll-off ferries be carried out by a specially selected panel of experts. The Secretary-General announced this initiative after consultation with Dr Giuliano Pattofatto, the chairman of the MSC.

He made it clear that the review should look not only at such key issues as bow and stern door safety and the possible need for sub-divisions on the vehicle deck but everything involved in ro-ro ferry operations. He said: "During the last few years a great deal has been done to improve the safety of ferries. Nevertheless, we cannot simply refer to what has been done during the last few years and claim that there is no need for further action. The only way of reassuring people that ro-ro ferries are safe is by looking at every aspect of ro-ro ferry operations and ensuring that any problems are remedied."

In his proposals, which were submitted to the MSC for consideration at its meeting in December 1994, the Secretary-General listed a number of items which needed particular attention. They included:

- the strength and watertightness of openings to the vehicle spaces, in particular bow and stern doors
- increasing the survivability standards by the fitting of bulkheads
- the evaluation of life-saving appliances and on-board evacuation arrangements, if necessary
- the need to prepare operational guidelines for use in adverse weather conditions, given the size and type of the ro-ro ships concerned and their area of operation
- the on-board communication issues, in particular when ships are manned by multinational crews carrying multinational passengers
- revising the reporting of incidents concerning safety matters of ro-ro ships to appropriate authorities and the action the authorities should take on receiving these reports.

The MSC met from 5-9 December and agreed to establish a panel of experts to carry out an intensive study into ro-ro design and operations. It would work under the supervision of a Steering Committee chaired by Dr Pattofatto. Mr Torkild Funder of Denmark, a former chairman of the MSC, was chosen to be chairman of the panel of experts, which was to consist of designated specialists and the chairmen of a number of IMO sub-committees.

The MSC's 65th session

The panel's reports and recommendations were considered by the Steering Committee in April and then by the full MSC at its 65th session in May. The report represented the most complete study into ro-ro ferry safety ever made and it is expected that its implications will be far reaching and take several years to implement fully.

The recommendations of the Panel of Experts focused on requirements applicable to the existing ro-ro passenger fleet. However, due to the nature of the recommendations, in some cases the proposed requirements have been extended to passenger ships other than ro-ro ferries.

All appointed experts were made available by Member Governments or interested segments of the industry on condition that their participation in the Panel would incur no financial obligations to the Organization.

The Panel was instructed by the Steering Committee to also take into account in its work accidents with a low probability, the consequences of which would, however, be deemed unacceptable. This instruction, seen against the background of the short time available, made it impossible for the Panel to draw the cost-benefit analysis which should, otherwise, accompany any proposals for amendments to mandatory instruments.

The Panel was aware that some of its proposals would have severe implications to existing ro-ro passenger ships and might even lead to some ships being forced out of service. But it considered it necessary to present a complete package of proposals so that the industry could be ensured that, for a number of years, additional requirements, if deemed necessary, would only address issues entailing minor financial implications.

It is therefore not surprising that, even against the background of the accidents which led to the establishment of the Panel, it was never suggested that the ro-ro concept should be discontinued, nor would this, from a practical point of view, be possible. The Panel saw its main task as being to propose such changes to the construction, equipment and operation of ro-ro ships as would improve their safety and restore public faith in the transportation of passengers and goods by this form of transport.

Although it was recognized that implementing the complete package of proposals would involve several years of work, the MSC recognized that some matters had to be dealt with as a matter of urgency. It was therefore agreed that a special conference would be held at IMO headquarters in November 1995 to consider a number of proposed amendments to SOLAS. These included amendments concerning the crucial question of stability.

Intact and damage stability of ro-ro passenger ships

One of the most important proposals in the report of the Panel of Experts concerns the effect of a build-up of water on the enclosed ro-ro deck, which it describes as the "most dangerous problem for a ro-ro ship."

As we have seen, since April 1990 all new passenger ro-ro ships have had to be built according to SOLAS 90 while a slightly modified version was made applicable to existing ro-ro passenger ships. Tests carried out in the United Kingdom have shown that SOLAS 90 would give an "adequate standard" of protection following an accident, such as a collision, which occurs in wave heights of up to 1.5 metres.

The Panel concluded that these requirements should be improved to include the effect of water being accumulated on the ro-ro deck in order to enable the ship to survive in more severe sea states. It felt that this could certainly not be excluded when realistic scenarios are considered and the Committee endorsed that view.

It agreed the Panel's proposals would have profound implications for the existing ro-ro fleet, necessitating substantial design and construction improvements which would, in turn, be costly and could make some existing ro-ros commercially non-viable. Understandably, there were considerable difference of opinion among delegates about the proposals and in particular about the recommendation that SOLAS 90 should be modified to take into account water on the vehicle deck.

Nevertheless, draft texts were prepared and circulated to Parties to the SOLAS Convention. This had to be done at least six months before the November Conference for legal reasons. Having decided this, the Committee turned its attention to other issues raised by the Panel of Experts' report.

One-compartment standard ships

The Committee agreed that the one-compartment standard should not be accepted for new ro-ro passenger ships carrying more than a relatively low number of passengers. This standard means that ships should be able to survive if one watertight compartment is flooded.

The Committee agreed that existing one-compartment ships should be modified to comply with a two-compartment standard or have their certified number of passengers reduced over a period of years to an approved limited number.

Second line of defence

It was agreed that there should always be an inner door behind the bow door or visor to act as a second line of defence. Further measures to prevent water entering the ro-ro deck - for example, through doors leading to other parts of the ship - were agreed. These include the banning of the practice of operating ro-ro passenger ships with watertight doors open. This would only be allowed if such doors are power-operated and controlled from the bridge.

Drainage

It was agreed that the drainage of water from the ro-ro deck should be improved. An amendment to SOLAS requiring that discharge valves, which can be closed from a position above the bulkhead deck, shall be kept open at sea was submitted to the Conference.

Operational matters

There was agreement that ferry operations are generally performed in a safe and orderly manner, but experience has shown that some improvements could be made.

The MSC also recognized that early implementation of the International Safety Management (ISM) Code will have an important impact on the safety of ro-ro passenger ships. Although it will not be applied to passenger ships until 1 July 1998, the MSC agreed that this does not prevent Governments from making the Code mandatory for ships flying their flags at an earlier date and a recommendation that this be done was actually adopted by IMO in 1993.

Working language

The MSC stressed the importance of all crew members being able to understand each other. It agreed to an amendment to SOLAS requiring that a working language be established for each individual ro-ro passenger ship and further agreed that this requirement could be extended to all passenger ships.

Operational limitations

In some cases limitations are imposed on how and where a ship may be operated, but these can be lost or mislaid during the ship's life, for example, if it changes hands or flag. The MSC approved a new SOLAS regulation making it a requirement for this information to be included in a manual to be kept by the master which would remain with the ship for its entire life and be updated as necessary and that this requirement be made applicable to all types of ships.

Lashing and securing of cargoes

On 1 July 1996 a SOLAS amendment will enter into force making it mandatory for ships to carry a Cargo Securing Manual. The rapid turn-round times of ro-ro ships makes the lashing and securing of cargoes difficult and the MSC agreed to an amendment to SOLAS to ensure that securing in compliance with the Code be completed before ro-ro ships are allowed to sail. It points out the importance of ensuring that cargoes are properly stowed and secured within containers and wheeled vehicles carried on ro-ro ships. It also undertook to arrange appropriate solutions to this problem with bodies dealing with road transport.

Access to ro-ro decks

The MSC agreed that access by passengers to the ro-ro deck when the ship is under way should be banned.

Alarms on, and surveillance of, hull doors

The Committee decided that a better safety level could be achieved if alarms required on the navigating bridge were supplemented by an audible alarm indicating any change of state of the doors under surveillance. Audible alarms should be fitted to doors for which surveillance is required. Leakage surveillance by closed circuit television should be provided in the engine room as well as on the bridge.

Constructional matters

An amendment to SOLAS designed to eliminate the risk of flooding of vehicle spaces through ventilation trunks and air pipes was approved.

Training and related matters

As draft amendments to the STCW Convention and a related STCW Code were to be adopted at a conference in June/July this year, the MSC felt that there was a need for additional training of crew members with special duties in emergencies, such as crews of fast rescue boats.

It further agreed that there should be additional training for personnel on ro-ro passenger ships in such topics as shore-based fire fighting, crowd management, loading and unloading, stability, crisis management and human behaviour.

Communications

The MSC agreed to develop performance standards for public address systems and that requirements should be introduced into SOLAS to ensure that they operate efficiently. To ensure efficient external communications, arrangements should be made so that at least one member of the crew is dedicated to perform radiocommunication duties in the event of an emergency.

The MSC agreed to ensure that distress messages are efficiently sent and received and that the work currently being carried out by IMO concerning the mandatory carriage of identification transponders be given high priority.

The MSC further agreed that float-free voyage data recorders - similar to the "black boxes" carried by aircraft - should be fitted to ro-ro passenger ships.

Survey requirements

The MSC agreed that unscheduled inspections, especially concentrated on operational matters, should be held at least once a year on ro-ro passenger ships. As this will require an amendment to SOLAS that will take time to bring into force, an Assembly resolution calling for Governments to take action to ensure that damage to shell doors is reported so that remedial action can be taken on similar ships was approved for adoption as an interim solution.

Search and rescue

The MSC noted that maritime search and rescue (SAR) aircraft are not always equipped with equipment covering maritime radio frequencies. The matter is still under discussion with the International Civil Aviation Organization (ICAO) but so far with no positive results. The MSC agreed that the situation which may result in ships and SAR aircraft being unable to communicate in connection with SAR operations must be seen as unacceptable. It proposed that this be remedied by adopting an amendment to the SOLAS Convention which would require ships to be equipped so that they can communicate with SAR aircraft.

An amendment to SOLAS was approved requiring ferry operators to establish the number and identities of passengers. Other amendments were prepared that will require ro-ro passenger ships to carry an approved SAR plan that can be put into effect in the event of an emergency.

Although it did not regard the creation of helicopter landing areas as practical for most ferries, the MSC agreed that requirements on the establishment of a helicopter pick-up or hoisting area on board existing ships should be adopted by the Conference.

Changes were proposed to the SAR Convention, including the addition of operational guidance for distress and SAR communications.

Fire safety

The MSC recalled that although a number of changes to the existing fire safety regulations have been introduced into SOLAS, the threat of a local fire starting in a high-risk area is not adequately addressed. It therefore agreed to an amendment that would require the installation of a local fire-extinguishing system in such areas.

Life-saving appliances

The MSC recognized that, in the case of a rapid capsize - the greatest danger facing ro-ro ships - there is no possibility of an organized abandonment of the ship under a trained crew. Normal life-saving appliances (LSAs) and practices therefore appear insufficient and it therefore recommended that LSAs for ro-ro ships must be designed so that they can be used by anyone with little or no training. It agreed to a series of proposals based on this principle.

SOLAS regulations require survival craft to be embarked and launched within 30 minutes of the order being given to abandon ship. This is only a type approval and design criterion which should not be taken as an indication that ships will stay afloat for at least 30 minutes, irrespective of the damage they have sustained. Such an indication would be impossible because it is impossible to specify how much damage will result from an accident.

The proposed requirements concern liferafts, the provision of fast rescue boats on ferries, rescue platforms and improvements, such as the fitting of lights to lifejackets. The Committee agreed the addition of other long-term measures to its work programme for further consideration.

Evacuation arrangements

The MSC agreed to a number of changes to the arrangements for evacuating ships in the event of an emergency. These are designed to ensure that evacuation routes are arranged to allow the rapid and orderly movement of passengers to assembly stations, embarkation stations and survival craft.

It agreed to further develop an active system for guidance of passengers in cases of emergency and take other measures to improve evacuation procedures. This includes reviewing the standard signs and symbols displayed on ships in line with the standards of the International Organization for Standardization (ISO). A study to ascertain the time taken to evacuate ro-ro passenger ships was also agreed. The matter will be further discussed at the intersession at working group.

Information to passengers

Recognizing that the level of information required by passengers may vary from country to country and that it would be impossible to make detailed requirements, the MSC approved guidelines for passenger safety instructions on ro-ro passenger ships which should also be made applicable to all passenger ships.

Crisis management

The MSC considered measures for improving the basis for rapid decision-making in emergencies which could be assisted by introducing a fully computerized monitoring and decision support system to alert the officer of the watch if a critical trend is detected or the alarm level is exceeded. A recommendation was agreed on this subject in respect of new ships while an amendment to the SOLAS Convention was approved to apply to existing ro-ro passenger ships. The MSC recognized though that more experience is needed before such a system can be made mandatory.

A resolution concerning training in crisis management and human behaviour for personnel on board ro-ro passenger ships was adopted in July 1995 by the conference of Parties to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978.

Formal safety assessment

Recognizing that FSA is used in other areas - for example, the offshore industry - as a way of identifying hazards and then deciding on how best they should be managed, the MSC agreed to give priority to considering adopting Formal Safety Assessment (FSA) as a basis for IMO's future work. It further recognized that the outcome of this work should not only result in regulations to be applied at the ship design and operation stages but that FSA should also form part of the overall rule-making process of the Organization.

The MSC agreed that technical requirements alone, both constructional and operational, will not establish a safe environment in the area of passenger ships. It is, therefore, necessary that every person with a professional interest in passenger ships feels responsible for their safety.

Changes already made or in the course of being made will help but the MSC stressed that "establishing a safety centred culture cannot...be established by regulations." A resolution adopted by IMO Assembly in November refers to this (see below).

The IMO Assembly: 19th session

The Assembly, which met in November 1995, just before the MSC, adopted five resolutions concerning the safety of roll on-roll off passenger ships. The first (A.792(19)) is entitled *Safety culture in and around passenger ships*.

It says that the familiarization, basic safety training and instruction all seafarers should receive in accordance with regulation VI/1 of the amended 1978 STCW Convention will, after entry into force, be instrumental in establishing a safety-orientated attitude among crew members.

At the same time, the introduction of the International Safety Management (ISM) Code will be instrumental in establishing a safety-orientated attitude among shore-based personnel of shipping companies.

The resolution points out that these instruments do not cover shore-based activities such as those related to duties and responsibilities of port authorities, shipbuilding and shiprepairing industries and the replenishment of ships and recommends that Governments and international organizations initiate work with the aim of establishing a safety culture in and around passenger ships under their flag addressing all persons working professionally in or in relation to such ships, irrespective of whether their work is covered by relevant instruments developed by the Organization.

Resolution A.793(19) is concerned with *strength and securing and locking arrangements of shell doors on ro-ro passenger ships*. It notes that the International Association of Classification Societies (IACS) has issued the Unified Requirement S8 for Bow Doors (as amended in 1995) related to the strength and to the securing and locking arrangements of bow doors and that it will be applied not only to new ro-ro passenger ships but retrospectively to existing ro-ro passenger ships as well.

It urges Governments to ensure that all ro-ro passenger ships, whether or not they are classed with classification societies being members of IACS, comply with the Requirement and the Unified Requirements applicable to all other shell doors, when accepted by the MSC.

The next resolution is A.794(19) which deals with *surveys and inspections of ro-ro passenger ships*. It notes that several ro-ro passenger ships have been subjected to serious casualties some of which have resulted in severe loss of life and that not all safety incidents on ro-ro ships have been reported to the appropriate authorities.

The resolution says that the safety of ro-ro passenger ships would be improved by increasing surveys and inspections and urges Administrations to conduct, or arrange for the conduct of, unscheduled inspections of ro-ro passenger ships in addition to renewal and periodical surveys.

It recommends that these inspections should, in particular, address aspects of an operational nature such as familiarization of crew members with and their effectiveness in regard to safety procedures, emergency procedures, maintenance, safe manning, working practices, passenger safety, bridge procedures and cargo and vehicle related operations.

It further urges Governments to ensure that they are promptly made aware of any damage to, or permanent deflection of, shell doors and associated hull plating that may affect the integrity of ro-ro ships and requests the MSC to develop, as a matter of urgency, guidelines for unscheduled inspections of ro-ro passenger ships, taking into account the guidelines existing and presently being developed by recognized organizations.

Resolution A.795(19) contains *navigational guidance and information scheme for ro-ro ferry operations*. It recognizes the important role the human element can play in the prevention of accidents to ro-ro passenger ships and that their safe navigation will be greatly enhanced by supporting navigational guidance and information schemes.

It says that a major improvement in the safety of ferry traffic will be achieved when not only masters, officers, ratings and other personnel on board but also those working in shipping companies, shipyards and ports observe the pertinent technical requirements, both constructional and operational and when ferry operators, together with relevant authorities and organizations, provide navigational guidance and information so that masters are in a position to conduct their passage in a safe manner.

Although many measures concerning ship safety and the training and qualifications of seafarers have been adopted in recent years, resolution A.796(19) points out that they do not provide for bridge-based monitoring of sensor signals or standards for the layout and organization of a decision-support system for masters on passenger ships to be used in emergency situations. The resolution adopts recommendations on a *decision-support system for masters on passenger ships* and the MSC is requested to consider using them as the basis for amendments to SOLAS.

The November 1995 SOLAS conference

The conference had on its agenda a number of important - and controversial - proposed changes to SOLAS. The most important concerned requirements for the watertight integrity and stability of ro-ro passenger ships.

A major success was the unanimous adoption of amendments which will have the effect of applying the full SOLAS 90 damage stability standard to existing passenger ro-ro ferries. A new regulation chapter II-1, 8-1 will mean that existing ro-ro passenger ships will have to fully comply with SOLAS 90 in accordance with an agreed phase-in programme, which will depend on how closely a ship complies with the A/Amax ratio. This is determined in accordance with a calculation procedure designed to assess the survivability characteristics of existing ro-ro passenger ships. Ships which only meet an A/Amax value of 85%, will have to comply fully by 1 October 1998 and those meeting 97.5% or above by 1 October 2005.

A new regulation 8-2 was also adopted which contains special requirements for ro-ro passenger ships carrying 400 passengers or more. This is intended to require new ships to be built and existing ships built to a one-compartment standard of subdivision to be phased out, to ensure that they can survive with two compartments flooded following damage.

The most controversial issue before the conference concerned the Panel of Experts' proposal that the SOLAS 90 standard can be met with up to 50 cm of water on the vehicle deck. It also proposed that this standard should not only be applied to new ships but should be applied to existing ferries over a number of years. It was recognized that this could result in extensive modifications having to be made to some existing ships and that the costs would be so high that some of the ships might have to be scrapped.

An indication of the costs involved was given in a report by the United Kingdom into the costs of making changes to the British fleet, based on a study of 12 ferries. This showed that six already comply with the SOLAS 90 standard.

The capital cost of complying with SOLAS 90 for those which still required to be improved, varied between £0.645 million and £1.50 million per ship. The capital cost of complying with SOLAS 90 plus the further requirements proposed by the Panel of Experts (50 cm of water-on-deck) varied between £0.546 million and £2.30 million. The paper said that it was not possible to give any precise indication of the costs needed to modify any other ferry. However, using the average cost likely to be incurred to modify the ro-ro ferries investigated, the following estimates were prepared:

- The average cost for the UK ships operating on international voyages (Class II) to comply with SOLAS 90 alone, is approximately £1.024 million per ship (for those which need to comply). For the 23 ships which do not comply with SOLAS 90, this would give a total of £23.55 million for the UK fleet.
- The costs identified to comply with the Panel of Experts' recommendations, for all ships, were estimated to average £0.793 million per ship and £28.55 million for the UK fleet.
- The total cost to the UK fleet of complying with both SOLAS 90 and the Panel requirements is therefore estimated to be £52.10 million.

The ship modifications may also result in a loss of revenue due to reduced capacity and longer turnaround times. In ships which are relatively small, the space for long commercial vehicles may be particularly restricted. Including these losses and making an allowance for the annualized capital costs of modification, the total cost for a UK international ferry to move from SOLAS 90 to the higher standard of SOLAS 90 + 50 cm of water on deck is estimated to be in the order of 5% of gross annual revenue for the ship concerned.

During the course of the conference it became clear that a number of countries felt that meeting this standard would be very difficult and costly for some ships and many would have to be scrapped. Several Governments said that sea and weather conditions in their regions meant that the proposed standard was not necessary.

Proposals that a new requirement dealing with water on the vehicle deck be included in the SOLAS Convention were given up and instead the conference adopted a resolution which permits regional agreements to be concluded on specific stability requirements for ro-ro passenger ships. The draft resolution was submitted by Denmark, France, Italy, Norway, Spain, Sweden and the United Kingdom.

The resolution refers to regulation II-1/8-1 and acknowledges the desire of certain SOLAS Contracting Governments that, having regard to the prevailing sea conditions and other local conditions, specific stability requirements should apply to all ro-ro passenger ships undertaking regular scheduled voyages between designated ports of those Contracting Governments.

It then agrees that two or more Contracting Governments may conclude agreements modifying the requirements of regulation II-1/8-1 in respect of every ro-ro passenger ship carrying passengers on regular scheduled voyages between designated ports in their territory, provided that these ships comply with safety requirements which are adequate, in the opinion of these Governments, for the voyages to be undertaken.

It also agrees that, if these safety requirements include specific stability requirements, they should not exceed those specified in the Annex to the resolution. These requirements include provisions that are designed to ensure that the SOLAS 90 stability standard can be achieved even with up to 50 cm of water on the vehicle deck.

Governments proposing an agreement will have to notify the Secretary-General of IMO of their intention to negotiate an agreement and shall make appropriate arrangements for other interested Contracting Governments to be involved in the negotiations. An agreement shall not enter into force until 12 months after its conclusion has been notified to the Secretary-General. The Governments which had initially proposed the SOLAS 90 + 50 cm standard duly concluded an agreement (the Stockholm Agreement) which will enter into force on 1 April 1997. Existing ferries operating between ports in the signatory countries will have to be upgraded between then and 1 October 2002.

The conference also adopted amendments to several other chapters in the SOLAS Convention. Other changes to Chapter II-1 dealt with such issues as extending the collision bulkhead (reg. 10), keeping doors that do not comply with the provisions of the Convention closed during navigation (reg. 15), the strength of ventilation trunks penetrating the bulkhead deck (reg. 19) and the position of the end of air pipes (reg. 20).

Three new regulations were added to the chapter. These deal with watertight integrity from the ro-ro deck (bulkhead deck) to spaces below (reg. 20-2), access to ro-ro decks when the ship is underway, which is to be banned to passengers (reg. 20-3) and closure of bulkheads on the ro-ro deck (reg. 20-4). Regulation 23-2, which deals with the integrity of the hull and superstructure, damage prevention and control has been completely replaced. It deals with the indicator system for all shell doors, loading doors and other closing appliances.

Regulation 45, which deals with precautions against shock, fire and other hazards of electrical origin has been modified to require installation of cabling for emergency alarms and public address systems and their approval by Administrations, having regard to recommendations developed by IMO.

Amendments have also been made to Chapter II-2, which deals with fire protection, fire detection and fire extinction. A new regulation 28-1 has been added which specifies requirements for escape routes on ro-ro passenger ships. The first part will apply to all ro-ro passenger ships, although for ships built before 1 July 1997 they will not become applicable until the date of the first periodical survey after that date.

It introduces requirements for handrails to be provided in corridors along escape routes and gives details of how these should be arranged. Decks must be numbered and plans provided to enable passengers to establish exactly where they are and where the escape routes are located. The routes must not be obstructed and the amendments stipulate that cabin doors must be capable of being opened from inside without keys.

The second part applies only to ships built on or after 1 July 1997. It contains further requirements for escape routes, including one which requires the lower part of bulkheads along escape routes to be strengthened so that they can be walked upon safely when the ship is at a large angle of heel.

The third part applies to ships built on or after 1 July 1999. It requires the escape routes provided on ro-ros to be evaluated by an evacuation analysis early in the design process to ensure that congestion is avoided and that escape routes are sufficiently flexible.

Changes have also been made to regulation 37 dealing with the protection of special category spaces. It requires discharge valves for scuppers operable from a position above the bulkhead deck to be kept open when the ship is at sea.

The changes to Chapter III, which deals with life-saving appliances and arrangements, include a number of important additions. A new paragraph has been added to regulation 6 (communications) dealing with public address systems on passenger ships. It requires these to be fitted to existing ships not later than the date of the first periodical survey after 1 July 1997. Additional requirements are included for ships built on or after 1 July 1997.

A series of new regulations have been added to the chapter. Regulation 24-1, dealing with life-saving appliances and arrangements, applies to ro-ro passenger ships, but some of them will not be required on existing ships until the first periodical survey after 1 July 2000. Requirements for liferafts are strengthened. They must be served by marine evacuation systems or launching appliances and must be automatically self-righting or be "a canopied reversible liferaft which is stable in a sea-way and is capable of operating safely whichever way up it is floating."

Ro-ro passenger ships will be required to carry at least one fast rescue boat and at least two crews must be trained in their use. They must also be fitted with means for recovering survivors from the water and transferring survivors from rescue units or survival craft to the ship. This may be part of a marine evacuation system whose slide is fitted with handlines or ladders.

Sufficient lifejackets will have to be provided near the assembly station so that passengers do not have to return to their cabins to collect them, and the jackets must also be fitted with lights.

Regulation 24-2 covers information on passengers. It says that all persons on board passenger ships (not just ro-ros) must be counted prior to departure. Details of passengers with special needs must be recorded and, not later than 1 January 1999, the names and gender of all persons on board, distinguishing between adults, children and infants.

By regulation 24-3, ro-ro passenger ships will be required to be fitted with helicopter pick-up areas (in the case of existing ships, not later than the first periodical survey after 1 July 1997) and passenger ships of 130 metres in length and over built after 1 July 1999 will have to be fitted with a helicopter landing area.

Regulation 24-4 applies to all passenger ships, although those built before 1 July 1997 will not have to comply until the first periodical survey after 1 July 1999. The regulation requires a decision support system for emergency management to be placed on the navigation bridge. It should cover all foreseeable emergencies and show the procedures to be taken.

A number of changes have been made to Chapter IV dealing with radiocommunications. New paragraphs have been added to regulation 6 which require a distress panel to be fitted at the conning position on passenger ships. This is to enable a distress alert to be initiated by pressing a single button. A distress alarm panel must be provided at the conning position to indicate any distress message received.

Regulation 7 has been amended to make it mandatory for all passenger ships to be provided with means for two-way on-scene radiocommunications for search and rescue purposes using the aeronautical frequencies 121.5 MHz and 123.1 MHz. Because at present ships and aircraft generally use different radio frequencies it is not possible for aircraft which spot a ship in distress to communicate with it and vice versa. Regulation 16 has been amended to make it mandatory on passenger ships for at least one properly-qualified person to be assigned to perform only radiocommunication duties during distress incidents.

Regulation 10 of Chapter V (safety of navigation) has been amended to clarify obligations and procedures in the event of emergencies. The master of a ship which is in a position to provide assistance to persons who are in distress at sea "is bound to proceed at all speed to their assistance." The master of the ship in distress or the SAR service concerned has the right to requisition ships to render assistance. The regulation gives details of how this is to be done.

A new regulation 10-1 has been added which states: "The master shall not be constrained by the shipowner, charterer or any other person from taking any decision which, in the professional judgement of the master is necessary for safe navigation, particularly in severe weather and in heavy seas."

Regulation 13 has been amended to require a working language to be established on passenger ships to ensure effective crew performance in safety matters. Each seafarer must be able to understand and, where appropriate, give orders in that language.

Regulation 15 has been amended to make it mandatory for passenger ships trading on fixed routes to have on board a plan for co-operation with appropriate SAR services in the event of emergencies.

A new regulation 23 has been added to the Chapter. It deals with operational limitations, such as restrictions in operating areas, weather restrictions, sea state conditions, limits on permissible loads, speed and other factors which must be complied before passenger ships are put into service.

Finally, regulation 5 of Chapter VI (carriage of cargoes) has been amended to require cargo units, including vehicles and containers, to be loaded, stowed and secured in accordance with a Cargo Securing Manual, based on guidelines to be developed by IMO. On ro-ro ships, all securing of cargo units must be complied with before the ship leaves the berth.

In addition to the amendments, the conference also adopted 14 resolutions, including one on the adoption of the amendments and the other on regional arrangements referred to above. The others deal with the following subjects:

- Fire extinguishing arrangements in machinery spaces of passenger ships: the Sub-Committee on Fire Protection is currently working on requirements for automatic local fire extinguishing systems in areas presenting high risks and the resolution urges the Committee to expedite this work.
- Escape arrangements in ships constructed before 1 July 1997: the resolution urges that when modifications are carried out to the accommodation spaces consideration is given to fitting bulkheads and partitions which form vertical divisions along escape routes so that they can be used as walking surfaces when the ship is at large angles of heel.
- Maximum evacuation time for new ro-ro passenger ships: the resolution, noting that it has been proposed that this should be 60 minutes, urges the MSC to consider this matter and develop requirements or recommendations.
- Amendments to Chapter III of the 1974 SOLAS Convention: the resolution requests the Secretary-General to convey the text of the amendments adopted by the conference to the spring 1996 session of the MSC so that they can be incorporated in the revised Chapter III which is due to be adopted then.
- Low-powered radio homing devices for liferafts on ro-ro passenger ships: these devices are intended to operate on frequencies which have yet to be allocated by the International Telecommunication Union (ITU), but the resolution notes that this process will take some time. It invites the MSC to develop operational requirements and performance standards for low-powered radio homing devices for liferafts as a matter of urgency and to consider amendments to SOLAS which will make their carriage mandatory. IMO is invited to co-operate with ITU on developing technical standards and allocating frequencies.
- Development of requirements, guidelines and performance standards: the MSC is requested to develop these for public address systems, automatically self-righting liferafts and canopied reversible liferafts, fast rescue boats, launching appliances for fast rescue boats and helicopter landing and pick-up areas. All of these will become mandatory under the SOLAS amendments.
- Distress messages: obligations and procedures: this resolution refers to the amended SOLAS regulation V/10(a) and requests the MSC to develop appropriate amendments to the Merchant Ship Search and Rescue (MERSAR) Manual.

- Automatic ship identification transponder/transceiver systems: the resolution says that safety would be greatly improved if these systems were installed to enable information to be automatically provided to shore stations and other ships on a ship's identity, type, position, course, speed, navigational status and other safety-related information. The MSC is invited to develop operational requirements and to co-operate with ITU on developing performance standards and allocating suitable radio frequencies.
- Establishment of working languages on ships: this has been done as far as passenger ships to which SOLAS Chapter I applies by means of amendments to regulation 13 of Chapter V of SOLAS (see above) and the resolution urges Governments to take steps to ensure that a working language is established for all other ships, whether on an international voyage or not.
- Operational limitations on passenger ships: the resolution urges Governments to ensure that lists of all operational limitations are maintained on board, whether the ships are on an international voyage or not, and that they be kept up to date so as to be readily available to the master.
- Voyage data recorders (VDRs): the resolution requests the MSC to develop operational requirements and performance standards for them and consider developing carriage requirements for inclusion in SOLAS. It urges Governments to encourage the use of VDRs on their ships on an experimental basis to gain experience in their use.
- Cargo securing equipment: the resolution urges the MSC to include in the Cargo Securing Manual now being developed minimum strength requirements for equipment used for securing cargo units, including vehicles and containers on ro-ro ships.

The adoption of the amendments represents only the most urgently needed amendments to the SOLAS Convention in a programme of change that is expected to take several years to complete. The Panel of Experts made many other proposals for improving ferry safety. Some of them dealing with training were adopted by the July 1995 conference to amend the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978. Others were prepared by the Maritime Safety Committee and adopted by the IMO Assembly in November (see the section on the outcome of the Assembly in this issue) while others were delegated to sub-committees for further consideration.

The future

During the last few years a great deal of work has been done by IMO to improve the safety of ro-ro ships and the proposals made by the Panel of Experts will keep the MSC and its sub-committees occupied for some time to come. But experience has shown that safety cannot be assured just by adopting regulations.

Many of the accidents to ro-ros that have occurred have been because regulations were not properly implemented or through human error. This is true of other ship types as well, of course, but ro-ro ships are perhaps more complex than most ships and any errors made can lead to catastrophic consequences, because of the large number of people on board.

A new Sub-Committee has been created to improve the way measures are implemented by flag States. The creation of regional port State control systems has been encouraged. The ISM Code will help to raise management standards while the amendments to the STCW Convention will do the same for the training and certification of seafarers. Further work is being carried out on such issues as fatigue and other causes of accidents.

Many of the measures adopted by IMO in the past have been designed to minimize the consequences of accidents. The emphasis now is on trying to prevent accidents happening at all.