Report of the Inspector's Inquiry

into Three Fatalities and Injuries

to Six Crew Members on board

fv **ATLANTIC PRINCESS**

on 25 July 1996

off the Coast of Mauritania, West Africa

Marine Accident Investigation Branch
Carlton House
Carlton Place
SOUTHAMPTON
Hants SO15 2DZ

London: The Stationery Office

ISBN 0 11 552007 4

Marine Accident Investigation Branch
Department of the Environment, Transport
and the Regions
Carlton House
Carlton Place
Southampton SO15 2DZ

24 July 1997

The Right Honourable John Prescott MP
Deputy Prime Minister and Secretary of State
for the Environment, Transport and the Regions

Sir

I have the honour to submit the report of Mr J Stuart Withington, a Principal Inspector of Marine Accidents, on the circumstances which led to the loss of three lives and injuries to six people on board the UK registered trawler ATLANTIC PRINCESS while fishing off the Mauritanian coast on 25 July 1996.

I have the honour to be
Sir
Your obedient servant

J S Lang
Rear Admiral
Chief Inspector of Marine Accidents

Extract from
The Merchant Shipping
(Accident Reporting and Investigation)
Regulations 1994

The fundamental purpose of investigating an accident under these Regulations is to determine its circumstances and the causes with the aim of improving the safety of life at sea and the avoidance of accidents in the future. It is not the purpose to apportion liability, nor, except so far as is necessary to achieve the fundamental purpose, to apportion blame.

CONTENTS

GLOSSARY OF ABBREVIATIONS AND TERMINOLOGY USE IN THIS REPORT

CPR	Cardio-pulmonary Resuscitation
Cod end	The collecting bag of the trawl net
°C	Degrees Celsius
DB tanks	Double Bottom tanks
ER	Engine Room
MSA	Marine Safety Agency
m^3	Cubic Metres
Pathogen	An agent, such as a Bacterium, that can cause disease
Pelagic	Denotes fish caught some distance above the seabed
Pound Board	Portable wooden planks that form the sides of the fish pounds on deck
SCBA	Self contained Breathing Apparatus
RSW	Refrigerated Sea Water
UTC	Universal Co-ordinated Time

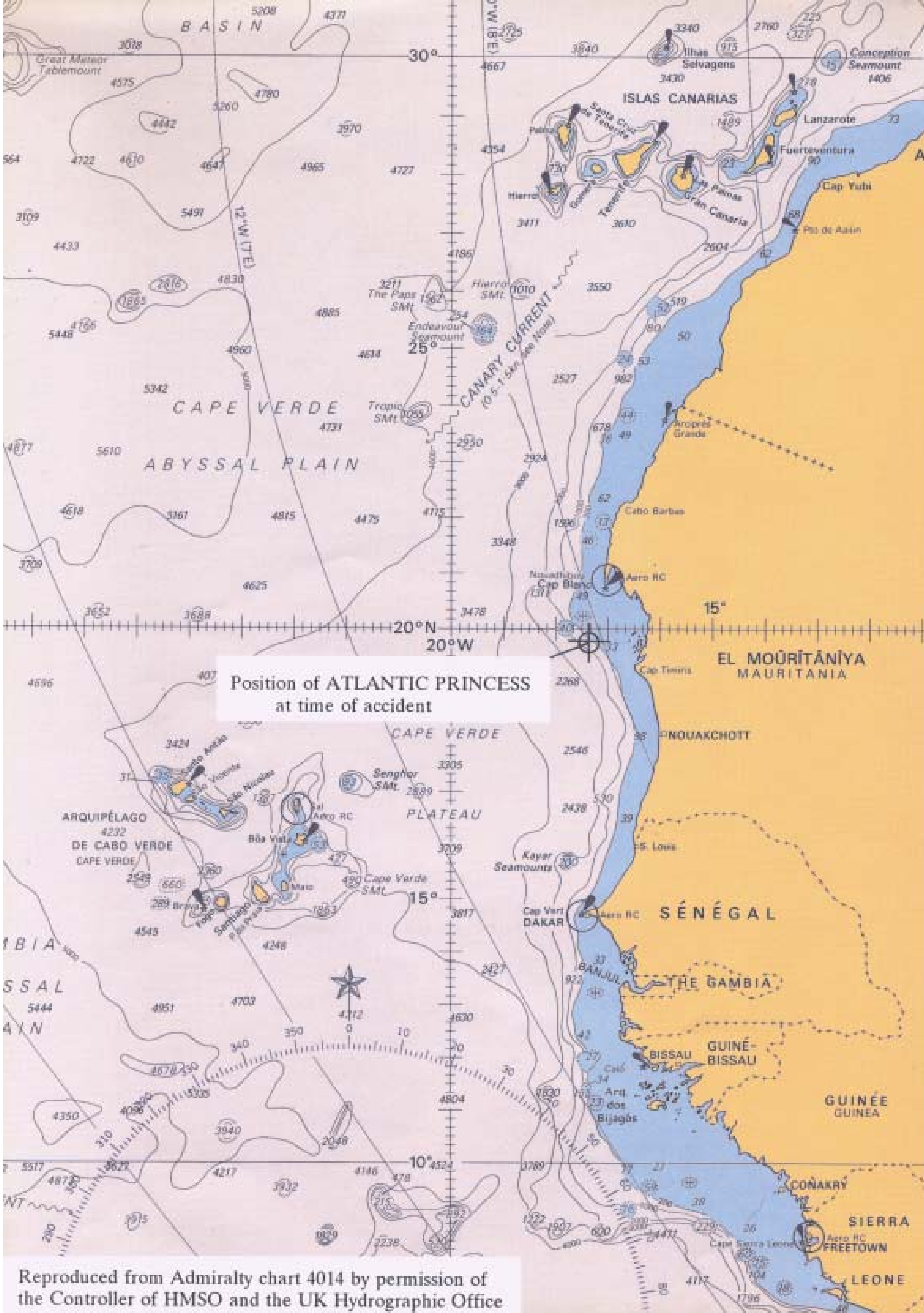
Figure 1

Photograph courtesy of Valiant Trawlers Ltd

fv ATLANTIC PRINCESS

PARTICULARS OF ATLANTIC PRINCESS

Port of Registry:	Hull
Fishing Number:	H90
Previous name:	ASTRID
Type:	Stern freezing trawler for pelagic trawling
Built:	1985
Building yard:	Welgelegen Scheepswerf and Machinefabriek BV Harlingen, Holland
Flag:	United Kingdom
Class:	Bureau Veritas
Owners:	Valiant Trawlers Limited Croudace House Godstone Road Caterham Surrey CR3 6XZ
Gross tonnage:	3229
Length:	97.75 metres
Breadth:	14.50 metres
Depth:	9.00 metres
Propulsion:	2 x 2467 kW at 600 rpm, Deutz SBV 6M540 diesel engines geared to a single screw shaft and controllable pitched propeller.
Crew:	34
Position of Accident:	19° 50'N 17° 20'W. 40 miles off Mauritanian Coast
Date and time:	25 July 1996 at 1830 UTC
Injuries:	3 fatalities, 6 injured



Reproduced from Admiralty chart 4014 by permission of
the Controller of HMSO and the UK Hydrographic Office

SYNOPSIS

The accident was notified to the Marine Accident Investigation Branch (MAIB) at Southampton on 26 July 1996 and an investigation commenced on the same day. The investigation was carried out by Mr J Stuart Withington, Principal Inspector.

The pelagic freezer trawler ATLANTIC PRINCESS was fishing off the coast of Mauritania and approaching the end of her first voyage to these waters. The accident occurred while she was making one of her last hauls before proceeding to Las Palmas to land her catch. It happened when one of the crew, the Third Engineer Officer, opened the side door of a Refrigerated Sea Water (RSW) tank to flush it out prior to it being loading with freshly caught fish.

Shortly after opening the tank's side door the Third Engineer collapsed. Unaware of the reasons, several of his colleagues went to his assistance. By the time they realised that the fumes emerging from the tank were toxic, several other members of the crew had also been overcome. The situation was eventually brought under control but not before three seamen had been killed and six injured.

The investigation found that the deceased and injured had succumbed to the effects of breathing toxic fumes which had built up in the sealed RSW tank. Laboratory tests have revealed that in high ambient temperatures, toxic gases including hydrogen cyanide, are generated by the growth of bacteria in spoiling fish and sea water. This combination of factors had arisen in the RSW tank on board ATLANTIC PRINCESS which had been left unventilated and unrefrigerated for several days before the accident.

The investigation has resulted in recommendations being made to improve both the design of freezer trawlers and on board operating procedures.

1 FACTUAL INFORMATION

1.1 Background to the Fishing Operation

Valiant Trawlers Limited is a wholly owned subsidiary of North Atlantic (Holdings) Ltd, which in turn is owned by Cornelis Vrolijk Holding BV, a Netherlands Company. North Atlantic (Holdings) has been operating vessels in the United Kingdom since 1984 and currently operates two freezer trawlers one of which is ATLANTIC PRINCESS (Figure 1).

ATLANTIC PRINCESS's voyage to Mauritanian waters in June 1996 was the first to warm distant waters for either of the two vessels. Previously the vessel had operated in the North Atlantic. North Atlantic (Holdings) liaise closely with the Netherlands parent company on the operation of their vessels operating in the area under the jurisdiction of the Mauritanian Government.

The landing and transhipping of catches takes place in either Las Palmas or Tenerife in the Canary Islands. These operations are overseen by a local agent, and technical staff from the Netherlands who are employed by the parent company. Sardinella is the principal type of fish caught. ATLANTIC PRINCESS had intended to land fish in Las Palmas.

ATLANTIC PRINCESS sailed from Ijmuiden, in the Netherlands, on 20 June 1996 with the British Skipper, British Mate and the Dutch contingent of her multi-national crew. Later on the same day she called at Dover to embark the remaining eighteen members of the British crew. Having done so, ATLANTIC PRINCESS sailed for the fishing grounds off the West African coast where she arrived on 27 June 1996.

1.2 Narrative of Events (Times are UTC plus 2)

Fishing commenced as soon as ATLANTIC PRINCESS arrived on the fishing ground.

During the next four weeks hauls were light. Several days were spent searching for fish but the average catch per day was three 30 tonne hauls.

The first large haul was made on 29 June 1996 when, as normal for bigger catches, the Refrigerated Sea Water (RSW) tanks on the ramp deck were used to store fish including No 3 starboard RSW tank. Because fishing was light for most of July, this particular tank was used infrequently. No record exists of its actual use.

The incident occurred during the 1600 to 2000 fishing watch on 25 July 1996 and at the end of an uneventful voyage. The weather was fine and the wind was variable force 2. There was a slight swell.

The haul, one of the last of the voyage was large (about 50 tonne), and because the length of some fish exceeded 0.5 metres, the normal method of handling fish by pumping them out of the cod end was replaced by the alternative system of "bagging". This involved dropping the fish onto the aft upper deck, passing them through deck openings onto the ramp deck and then transferring them to the fish processing chain. (See Section 1.5 for a detailed description of the fish catching and processing operation).

At the time of the accident, the fish processing deck and holds were manned by the Bosun and ten deckhands: three on the ramp deck, six in the fish processing room and two in the holds. The Fishing Mate was on the bridge; the Fishing Skipper was off-duty in his cabin.

Prior to the accident, one of the deckhands, Mr Kurelus, was working on the aft port side of the ramp deck (see Figure 2) using a water hose to direct fish dropped down from the upper deck, towards another deckhand, Mr van der Plas, who was at the starboard forward corner of the ramp deck. His task was to guide the fish forward through the sluice gate for onward transfer to the fish processing system.

Small fish were being fed to the climber and block belts (see Figure 3), while larger fish were manhandled from the ramp deck to the top of the climber belt. On this occasion the third deckhand on the ramp deck, Mr Fairbairn, was passing them to the Bosun, Mr Hannath, who placed the fish onto the block belt.

On the fish processing deck another deckhand, Mr Collier, was preparing the freezer blocks while his colleagues Messrs Howlett and Young were placing fish into those blocks which were ready. Further along the processing chain, Messrs Heavey and Hogg were boxing and strapping the frozen fish while Messrs Crompton and Windass were stacking the boxed fish in the upper hold.

Because the haul was large, it became necessary to store some fish in one of the six RSW tanks situated either side of the ramp deck. With the three port side RSW tanks already in use, No 3 starboard was selected. Because it had not been cleaned after last being used, it had to be flushed out and cleaned before being filled with fresh fish.

Cleaning out of starboard No 3 RSW tank commenced at 1810 when the engineer officer on the 1200 to 1800 watch started to pump it out. Since only the RSW pump could be used for this purpose, it was necessary to stop RSW circulating on the other tanks and for the refrigeration compressor to be stopped.

The Third Engineer on the 1800 to 2400 watch, Mr Bruin, took over the pumping operation which was expected to take about 20 to 25 minutes. He left the engine room and proceeded to the upper deck before going down to the ramp deck. He climbed over the low side of the pound boards and into the caged area (Figure 4) where he opened the door to No 3 starboard RSW tank (Figure 5) to release what was described later as grey/black water.

RAMP DECK AREA AND RSW TANKS
Not to Scale

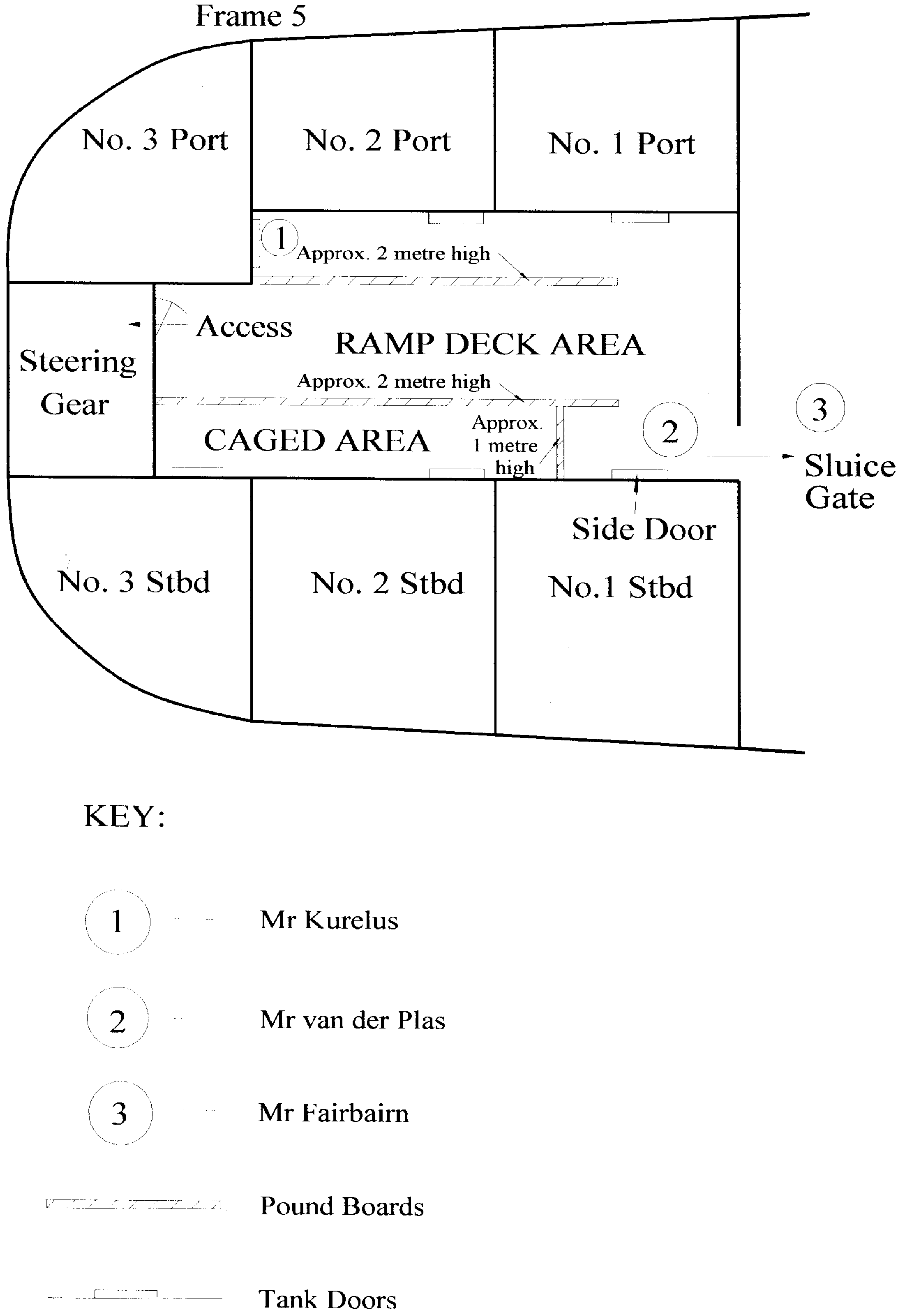
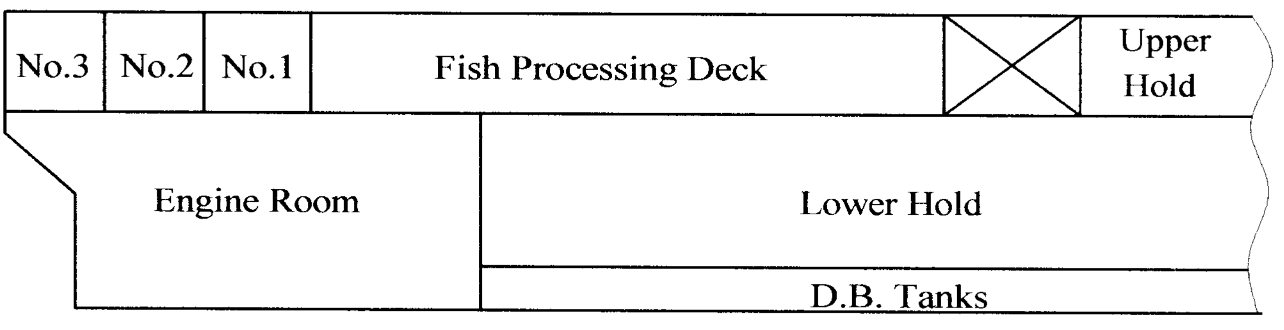


Figure 3

FISH HANDLING SYSTEM
Not to Scale



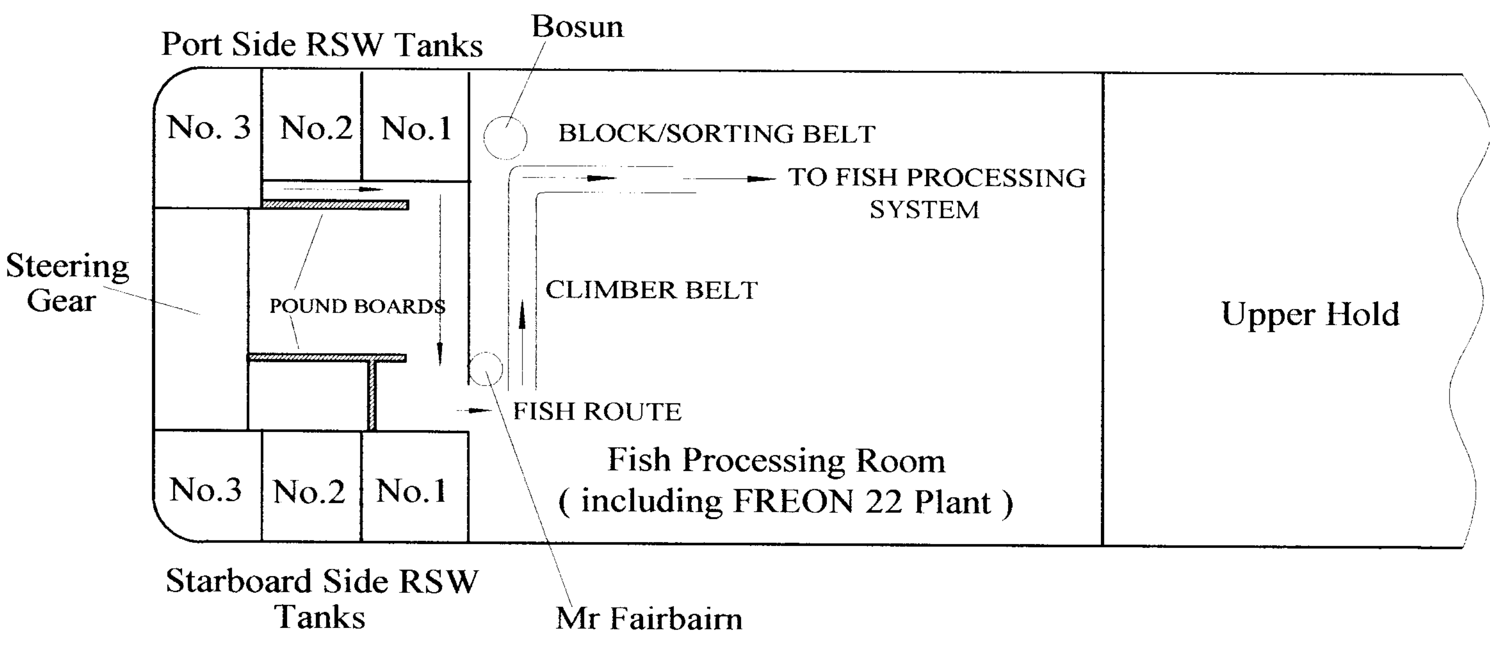


Figure 4

Starboard side of ramp deck in area of accident

Figure 5

RSW tank side door: partly obscured door is
that of No 3 starboard RSW tank

This water began to swill across the deck from between the pound boards towards the port side of the deck. As it did so, Mr Fairbairn suddenly saw the Third Engineer, Mr Bruin, collapse. Without hesitating he went to provide assistance and called out as he did so.

Because of the speed with which the following events happened the precise sequence or timing has never been accurately determined.

On hearing Mr Fairbairn's shouts, one of the other two seamen on the ramp deck, Mr van der Plas, followed him into the caged area to provide assistance. Meanwhile the third member of the ramp deck crew, Mr Kurelus, and the Bosun, Mr Hannath, went to the forward end of the cage to see what was happening.

By then water in the caged area had reached a depth of some 80 cm and Mr van der Plas and Mr Fairbairn were holding the Third Engineer's head above the water as they attempted to pull him towards the forward end of the cage.

Without stepping into the cage, both the Bosun and Mr Kurelus tried to assist. Attempts were also made to reduce the water level in the cage by removing some of the pound boards but, by now, all involved were showing signs of distress. The Bosun began to feel unsteady and called for help. Mr Fairbairn lost consciousness and Mr van der Plas was seen to be red eyed and disorientated before he, too, collapsed. His nearest colleague, Mr Kurelus, attempted to remove him from the caged area but lost consciousness before doing so.

The removal of the pound boards had meanwhile reduced the water level in the caged area to about 20 cm.

Although nobody knew exactly what was happening it was evident to those present that there was something seriously wrong with the atmosphere. Reacting to the situation, another deckhand, Mr Crompton, went to the bridge to fetch the self contained breathing apparatus (SCBA), while his colleague Mr Windass reported events to the vessel's Skipper.

Meanwhile fish had stopped coming along the block belt and Mr Howlett, who had been packing the fish into the freezer blocks, went aft to see what was happening. He found an incapacitated Mr Kurelus leaning up against the pound boards outside the caged area and Messrs van der Plas and Fairbairn sitting in the water within it. The Third Engineer was seen lying face down in the water.

Without any thought for his own safety, Mr Howlett grabbed the collar of the Third Engineer with one hand and held onto Mr Kurelus with the other. As he did so Mr Fairbairn slid below the surface of the water and, almost immediately afterwards, Mr Howlett himself passed out.

Responding to the earlier shouts, Messrs Collier and Young went aft to the ramp deck where they saw Mr Fairbairn lying face down in the black water, Mr Kurelus lying on his side in water outside the caged area and Mr Howlett lying on his back underwater.

Mr Collier tried to help Messrs Kurelus and Howlett whose faces were underwater, while Mr Young attempted to assist Mr Fairbairn before starting to feel dizzy himself. Mr Collier retreated to the fish room and started to shake as though having a fit. They were now joined by other crew members, including the Mate and Mr Windass.

A rescue attempt using the SCBA, brought down from the bridge, was abandoned because the person attempting the rescue became entangled in its straps and hoses. Other evidence has suggested that the SCBA bottle was empty, but this was not confirmed by the investigation.

Aware of the presence of toxic gas, Mr Windass covered his mouth with the thermal hood of his jacket and, with the help of the Mate, dragged Messrs Kurelus and Young away from the ramp deck area. Meanwhile Mr Howlett suddenly appeared having emerged from the water in the caged area: he too was dragged away. At this point Mr Windass was overcome and had to be helped to safety.

By now the Fishing Mate, Mr Varkevisser, who was on the bridge, had realised something was seriously wrong and reported his concerns to the Fishing Master who took over the bridge watch and stopped the haul winch. The vessel's position was noted to be 19°50'N, 17°20'W approximately 40 miles off the coast of Mauritania and 500 miles from the Canary Islands. Using VHF the Fishing Master called the fv FRANZISCA, another vessel fishing in the same area, to request a helicopter.

The Fishing Mate went to the aft main deck and saw Mr Kurelus being helped up into the open air. In his capacity as the vessel's designated First Aider, Mr Varkevisser promptly went to the assistance of the casualty.

The next person to be brought into the open was Mr Howlett who was unable to sit down and was described by others as being rigid. He had fixed staring eyes and could not speak. The third person brought up on deck was Mr Windass. Although conscious, he made uncontrollable movements as though having an epileptic fit.

Meanwhile there were further shouts from the deck below. The Fishing Mate, seeing two more deckhands in considerable distress and Mr van der Plas and Mr Fairbairn lying face down in the water, chose to ignore warnings not to enter the ramp deck area and proceeded below. Remaining outside the caged area, he lifted the heads of Messrs van der Plas and Fairbairn out of the water and pulled them back towards the low side of the cage. At this point he too lost consciousness and had to be dragged forward into the fish processing room. He eventually recovered sufficiently to walk to his cabin with support from his shipmates.

All the casualties were brought to the upper deck. Crew members attempted cardio-pulmonary resuscitation (CPR) on those who were unconscious but, despite their efforts, three men died and six were injured.

The accident was reported to the Mauritanian Authorities and their help sought. Communications ashore were channelled through the Mauritanian observer on board fv FRANZISCA. The Mauritanians were unable to supply a helicopter direct, so they in turn requested one from Las Palmas but, in view of the long distances involved, a helicopter rescue was not possible.

The catch of fish was dropped back into the sea and ATLANTIC PRINCESS headed for the Mauritanian port of Nouadhibou where, after anchoring off the breakwater at 2345 on 25 July, a doctor boarded the vessel. The three deceased and five injured men were taken ashore but the sixth injured person was well enough to remain on board.

ATLANTIC PRINCESS sailed for Las Palmas at 0230 on 26 July 1996.

1.3 The Ship

ATLANTIC PRINCESS is the largest fishing vessel on the United Kingdom register. The ship appeared well found and had a valid United Kingdom Fishing Vessel Certificate.

The fish processing deck is aft of the fish holds and below the upper deck. It is divided into two spaces: the aft most ramp deck and the fish processing room.

The general arrangement of the fish handling area on board ATLANTIC PRINCESS is shown in Figures 2 and 3.

Direct access from the fish processing deck into the fish hold is through manually operated watertight doors.

On either side of the ramp deck are three RSW tanks, each of 40 tonne capacity and used to store fish before they are processed.

The area of the ramp deck between the port and starboard RSW tanks is sub-divided fore and aft by pound boards up to two metres high (see Figure 2). On the day of the incident, the starboard sub-divided area was further sectioned off by one metre high transverse pound boards near the entrance leading into the fish processing room. In the text of the report this area is described simply as the caged area.

There are three fish holds interconnected by watertight doors which, together with the watertight door separating the fish processing room from the aft hold, are normally open during the fish processing operation. The holds have a total capacity of $4100m^3$, and a storage temperature for deep frozen products of -25°C.

1.4 The Crew

The vessel carried a crew of 34 comprising 20 British, 13 Dutch and 1 Polish national.

In common with a number of British registered fishing vessels, the Skipper and Fishing Master were two distinct ranks filled by two different people. The former is in command of the vessel and the latter was responsible for the commercial aspect of the fish catching operation: he also undertook a navigational watch. The Skipper and Mate were British; the Fishing Master and Fishing Mate were Dutch. All four were properly certificated.

The fishing watches were of four hours duration; the engine room watches worked on a six hour system.

1.5 The Fish Catching and Processing Operation

Once fish are caught and hauled in, the cod end is recovered to the stern of the trawler.

There are two methods of transferring fish from the trawl net to the vessel. One way is by attaching a hydraulically operated pump to the cod end and pumping the fish from the trawl net through a 14" (35.5 cm) diameter flexible hose and pipeline into one of two water/fish separator tanks situated on the port and starboard sides of the upper deck aft end. Sea water from the separation tanks is directed overboard, while the fish are led either to the RSW tanks or onto the ramp deck through the deck openings.

The second method is by bagging the fish from the cod end of the trawl net directly into the RSW tanks or onto the ramp deck through openings in the upper deck.

In both methods, and with large hauls, the RSW tanks are usually filled first, and any remaining fish are then dropped onto the ramp deck.

The fish on the ramp deck are cleared first. The pressure of weight of fish forces the bulk forward to a hydraulically operated sluice gate.

The fish pass through this gate onto the inclined conveyor belt (climber belt), then onto the conveyor belt (block belt) leading into the fish processing room where they are graded and processed.

Fish in the RSW tanks are pumped out directly onto the climber belt to be graded and processed. There they are graded for type and size and then transported by conveyor belt to intermediate RSW tanks (buffer tanks of $6m^3$ capacity) which contain chilled sea water circulating at 0° to 1°C.

From the buffer tanks the fish are pumped onto conveyor belts (filling belts) which lead to the chosen fish freezer. These are arranged into 35 sections and each section has 40 freezing blocks.

Freezing capacity of each section is about 180 tonne a day and freezing time is about 4 hours. Once frozen, each block is packed in cartons, strapped and stored in the hold on pallets at -22°C to -25°C in readiness for landing. Freezing is achieved using a direct freon 22 refrigeration system.

Fish in the RSW tanks which are too big to go through the grading machine, are emptied through the side doors of the tanks onto the ramp deck. They are then manhandled into the fish processing room before freezing.

1.6 Refrigerated Sea Water (RSW) Tanks

The six RSW tanks on the ramp deck, three on either side, are used to store fish before they are passed forward to the fish processing area. They are used when the amount of fish caught exceeds the fish processing output.

In northern waters where temperatures are low, the RSW tanks will normally contain a maximum of 30 tonne of mackerel or herring.

During this warm water voyage it was found that the tanks could hold only a maximum of 20 to 24 tonne of sardinella without damage.

Sea water, chilled to between 0° and 1°C using freon 22 gas as the cooling medium, is circulated through the tanks using a single pump and a system of piping common to all six tanks. However, depending on operational requirements, each tank can be isolated from the system.

Circulation of RSW can be reversed as it can be pumped into the bottom of a tank though a strainer (see Figure 6), and be drawn out from the top through a similar strainer or vice versa.

As well as circulating RSW, the pump can be used for ballasting the tanks and for cleaning purposes.

Unless the RSW tank is flushed immediately after use, any fish, or fish debris left in the tank will begin to spoil and produce toxic gases.

To empty the tank, the water residue is pumped overboard using the RSW circulating pump. Once the pump loses suction, anything remaining in the tank is drained out onto the ramp deck through the tank side door opening. Finally, the tank is swilled down and its contents flushed out again onto the ramp deck using a water hose directed through either the upper deck opening or through the side door opening. Any residue left in the bilges is pumped overboard using the bilge pump. The bilge strainers, in which the remains of any fish might have become trapped, are cleaned out from time to time.

The RSW system, as installed on ATLANTIC PRINCESS, is equipped to enable the system cooler, strainers and pipework to be back-flushed overboard. The system piping is so designed that it can be cleaned and sanitized independently of the RSW tanks.

The method of cleaning is clearly illustrated in the manufacturer's Instruction

Figure 6

RSW circulating strainer in RSW tank

Manual which was supplied to the owners. The manual does not include information on how often the RSW system should be cleaned or maintained. The manufacturers advise that the system should be cleaned through with detergents every voyage, or at least once a month, not only to prevent accidents but to maintain the quality of the fish.

Prior to the accident there was no evidence to indicate that No 3 starboard RSW tank or the system piping and components were flushed after last being used for chilling fish. The temperature of fish and water left over in the tank would have risen to the surrounding temperature of between about 26°C and 50°C, the estimated sea water and ramp deck air temperatures respectively.

1.7 Ventilation System

The fish processing room has a forced ventilation system.

The ramp deck does not have its own ventilation system, but shares the same air space as the fish processing room. Ventilation of the ramp deck space is, therefore, dependent on the influence of air movement caused by the forced ventilation within the adjoining space of the fish processing room and the engine room space (with the engine room door open). The air circulation in the space can be supplemented by natural draughts through the open door leading to the steering gear room, aft of the ramp deck, and through the stairwell leading to the accommodation and service spaces on the deck above.

Ventilation of the refrigerated hold spaces is by air circulation between the fish processing room when the watertight doors are open, or by natural means when the hatch covers are open.

1.8 Injuries

The three deceased were the Third Engineer, Mr Bruin, and the deckhands Mr van der Plas and Mr Fairbairn. Those injured were the Fishing Mate, Mr Varkevisser, the Bosun, Mr Hannath, and the deckhands Messrs Kurelus, Howlett, Young and Windass.

A postmortem examination was conducted on the one British crew member who died, Mr Fairbairn. The examination concluded that the cause of death was due to inhalation of toxic fumes.

Postmortems were not carried out on the other two who died because their bodies were taken to the Netherlands and dealt with under different procedures to those in the United Kingdom. However, there are no indications to suggest that they, and the six who were injured, were affected by any other cause.

It is assessed that those who lost their lives or were injured were overcome by toxic fumes which accumulated on the ramp deck when the RSW tank door was opened.

1.9 Toxic Gases

Enclosed and confined spaces in fishing vessels include fish holds, fuel tanks, ballast tanks and refrigerated sea water tanks. The atmosphere of these spaces may put at risk the health or life of any person entering them due to lack of oxygen or the presence of toxic gases.

Information readily available to fishermen on the possibility of a dangerous atmosphere existing on board fishing vessels is set out in a guide to safe working practices for fishermen, "Fishermen and Safety", published by the Marine Safety Agency (MSA). The guide warns that:

> *"It may be unsafe to enter an enclosed compartment or confined space either because the air in it has too little oxygen or because it has poisonous fumes in it."*

Poisonous fumes may for example be caused by rotting fish in an RSW tank.

The working space of the ramp deck was in constant use on ATLANTIC PRINCESS and was not considered to be enclosed or confined.

The risk of toxic gases produced by rotting fish infiltrating working areas of fishing vessels is not generally appreciated. No warning has been published to alert fishermen of the risk.

Furthermore, the type of toxic gases created in this way is not generally known throughout the fishing industry.

The presence of toxic gases on the ramp deck of ATLANTIC PRINCESS had never been considered by either the crew or operator. Consequently there was no operating procedure in force to deal with the possibility of toxic fumes in working spaces, and no training had been carried out in the methods required to rescue someone overcome by them.

1.10 Emergency Procedures

The MSA guide to safe working practices for fishermen, "Fishermen and Safety", in the section entitled "Enclosed Spaces", states:

> *"If you have to enter a compartment which may contain dangerous gases or too little oxygen, you should wear an approved type of breathing apparatus. Therefore ensure that you are trained to check, maintain and use that apparatus. This should be done at an early date so that you are ready for emergencies.*
>
> *In addition to the breathing apparatus, you should wear a safety harness to which a safety line is attached. That line should be held by someone standing outside the enclosed space so that, if necessary, he can pull you out without going into the space himself. The person outside the space should know how to resuscitate you if you stop breathing."*

All the British fishermen on board ATLANTIC PRINCESS were trained and qualified in basic first aid, sea survival and fire-fighting.

Self contained breathing apparatus is carried on board for use by personnel when fighting fires. Two sets were carried on board ATLANTIC PRINCESS.

Under the provision of the Fishing Vessels (Safety Provisions) Rules 1975 it is required that musters and training in the use of lifesaving and fire-fighting equipment are undertaken at regular intervals.

There is no mandatory requirement on United Kingdom fishing vessels for either training or regular exercises in emergency procedures for entry into enclosed spaces.

The last training exercise before the accident on board ATLANTIC PRINCESS took place on 24 June 1996.

1.11 The European Union Directives on Health and Safety

New Directives applicable to both fishing and merchant vessels provide for the need for assurance that:

1. the operator has done his utmost to avoid risks;
2. that these risks have been evaluated and that action has been taken to minimise avoidable risk;
3. that a coherent policy has been prepared with regard to health and safety; and
4. that relevant information and instructions have been provided.

These Directives did not apply to United Kingdom fishing vessels at the time of the accident on board ATLANTIC PRINCESS.

The Marine Safety Agency states that The EC Occupational Health and Safety Directives had not been incorporated into UK law because:

- "directives were designed for land-based industry principally and application to the maritime sector is not straightforward because of, for example, different organisation of responsibilities as between master/owner/operator etc;
- UK maritime industry can "flag out" if they don't like UK regulations; landbased industry cannot opt out in the same way;

- the whole philosophy of merchant shipping legislation is different from the approach in the directives - it is by tradition prescriptive, not risk based;

- we have been conscious of the need to avoid unnecessary burdens on industry in terms of cost;

- a number of other member states have also found difficulty in applying the directives to the maritime sector - or at least have taken a long time to implement."

2 ANALYSIS

2.1 General

The casualties occurred when the contents of the RSW tank were emptied onto the ramp deck.

The Third Engineer collapsed shortly after he opened No 3 Starboard RSW tank door allowing water to flow onto the ramp deck and to accumulate in the caged area between the pound boards and the tank.

Of the four men who first went to his rescue, two died. CPR was attempted for more than one and a half hours on the three men who died. In addition six men were injured during rescue attempts.

The incident was totally unexpected, and occurred in a working space during the normal course of work. Those who first went to the Third Engineer's rescue did so without any regard for their own safety. The reasons for his collapse were not clear at the time and they assumed he had tripped, was ill or had been knocked over by the force of water discharging from the tank.

Mr Fairbairn was the first to assist the Third Engineer, calling out for help to his colleagues as he did so. The Bosun and Messrs Kurelus and van der Plas, being nearest, responded immediately. However all were rapidly overcome, possibly within a minute of Mr Fairbairn's call for help.

All casualties fell into an unconscious or semi-conscious state in or near to the accumulating water in the caged area. Some were described as making uncontrollable movements, as though suffering epileptic fits, while others appeared to be totally rigid with fixed staring eyes. Survivors said they felt no pain, seemed to lose control of their breathing and had no sense of smell.

All the evidence indicated that the three deaths and six casualties had been caused by the effect of toxic gases. Determining the origins of these gases became a focal point of the investigation.

2.2 Possible Causes

Possible origins of the toxic gases were considered in the investigation.

The most likely causes were either:

(a) leakage of refrigerant gas from the RSW system, or

(b) the generation of gases from bacteria formed on spoiling fish.

2.2.1 Refrigerant Gas

There is no evidence of any leakage of refrigerant gas or its accumulation on the ramp deck. Although it is possible that refrigerant gas could leak past the RSW coolers into the sea water circulating system and into the RSW tanks, such leaks are normally detected. There were no reports of any gas leakages either before or since the accident.

If there had been a leak it would almost certainly have been confined to the engine room, fish room or the hold space where that part of the refrigeration installation containing refrigerant gas is situated. In this situation the men working in those spaces would have been affected before those working on the ramp deck.

The presence of refrigerant gas as the cause of the accident has therefore been ruled out.

2.2.2 Generation of Gases from Bacteria found on Spoiling Fish

The generation of toxic gases from bacteria formed in fish spoil is a known hazard and in the past dangerous gases have been produced on fishing vessels from this source, causing injury and death. In one case, for example, three persons were overcome by toxic gases when water was inadvertently discharged into the enclosed space of an RSW tank in which they were working. The tank had been opened for maintenance for a number of days, but the water discharged into the tank had remained stagnant in the system's piping during the vessel's lay-up period.

In ATLANTIC PRINCESS, the toxic gases were probably located in the "head space" of the RSW tank above the mixture of decomposing fish and sea water, as well as being dissolved in the mixture.

On opening the tank door to discharge the mixture some head space gas would have moved into the ramp deck space. The rapid movement of the bulk of spoiled mixture flowing onto the deck may have resulted in some of the dissolved toxic gases coming out of solution and adding to the concentration of gases in the atmosphere. Such degassing by vigorous and sudden movement of aqueous solutions can occur especially if water has become supersaturated with gas, and if the mixture has remained stagnant for some time.

Scientific sources indicate a number of principal factors relating to the rapid formation of dangerous atmospheres from spoiling fish on trawlers. These factors occur when:

a. there is a relatively high temperature and lack of ventilation;

b. the temperature of the catch remains high. Fish without ice, or other means of cooling, spoil rapidly using up oxygen and replacing it with carbon dioxide and poisonous gases such as hydrogen sulphide and ammonia;

c. damaged fish is allowed to remain on board. Fish spoil produces dangerous gases more easily, while bacterial action in water polluted by spoiling fish can affect the surrounding air and produce a dangerous atmosphere.

These factors will be considered in relation to the operational conditions on board ATLANTIC PRINCESS.

2.3 Toxic Gases

The investigation concentrated on establishing the conditions conducive to the presence of toxic gases.

2.3.1 Temperature and ventilation

The temperature on the ramp deck may have been as high as 50°C at the time of the accident. Ventilation of the ramp deck was limited to the influence of air movement caused by the forced ventilation within the adjoining fish processing room and engine room, together with a natural through draught. Neither air changes nor air flow patterns on the ramp deck were quantified for the purpose of this investigation, but ventilation of the space was known to be inefficient in maintaining a comfortable working environment, particularly in the hot climate off the West African coast.

Had an efficient ventilation system existed in the space, concentrations of toxic gases emitted from the RSW tank might have been diluted to safe levels in time to prevent casualties. However, because of the type and mixture of toxic gases involved and the rates at which they may have discharged into the atmosphere, this possibility cannot be established with any degree of certainty.

2.3.2 Spoiled fish

Prior to 1995 on ATLANTIC PRINCESS, chilled fish was moved from the RSW tanks to the fish processing room by emptying the fish and water through the tank doors onto the ramp deck and then transferring the fish onto the climber belt to enter the processing system.

Water discharged from the tank was pumped overboard from the bilge well on the ramp deck. Despite the inner surfaces of the sides of the tanks being smooth with a hopper-shaped base to enable good drainage, a small amount of fish sometimes stuck to the tank sides after draining.

A system for pumping out the RSW tanks directly onto the conveyor belt was installed in May 1995. The tanks cannot, however, be completely emptied using this method, because there is a gap between the end of the pump suction pipe and the bottom of the tank (Figure 7). The remaining fish and water left over has to be flushed out through the tank door openings onto the ramp deck as before.

Any fish remaining in the tank has to be flushed out using a water hose directed through either the tank deck covers or the door openings on the ramp deck, before any recirculation of the RSW and storage of freshly caught fish can start.

Whichever method is used, the tank must be cleaned thoroughly by flushing out immediately after use. Otherwise, any fish left in the tank will begin to spoil and produce toxic gases.

2.3.3 Cleanliness of the RSW system

There is no legal requirement to keep records of when tanks were last used for chilling fish. The owners have said that at the beginning and end of each voyage the six RSW tanks are cleaned out by the crew. Although detergents are placed on board to assist in the cleaning operation the owners had not specified that the crew should regularly flush out the pipework, suction strainers and RSW pump. On this particular voyage the tanks were cleaned on the way to the fishing grounds.

There is no means of establishing how much fish residue was in the tank at the time of the accident. It is also uncertain how much water was in the tank and to what degree it was contaminated in order to produce the mixture of toxic gases which caused the loss of life and injuries.

There is no record on board ATLANTIC PRINCESS to indicate when No 3 starboard RSW tank was last used for chilling fish before the accident. Crew members believe that it was probably five to ten days prior to the accident.

It does not appear that the tank residue was flushed out and cleaned immediately after its previous use, and it is assessed that this polluted water/fish spoil lay stagnant in the tank for five to ten days.

2.3.4 Damaged fish spoil and contaminated water

The evidence supports the hypothesis that before it was flushed out, No 3 starboard RSW tank contained some damaged fish.

Although fish can be damaged in a number of ways, the most probable cause in this instance was the pumping action of the system pump and the crushing of fish in overfilled RSW tanks from earlier catches. Because the action of the cod end and RSW pumps damages fish over a certain size, the fish on 25 July 1996 were being bagged and transferred directly through the aft upper deck onto the ramp deck below.

Figure 7

End of fish suction pipe (elephant's foot) in RSW tank

When RSW tanks are emptied and cleaned, fish debris will be discharged from the tank. Some will remain in stagnant water held in the pipework, be circulated in other parts of the system under chilled conditions, or accumulate in the pump system strainers.

Any fish debris and stagnant water left will become contaminated, especially in high temperatures.

Indication of contaminated water in the RSW system can be characterised by foul smelling, black, slimy and scummy water, discharging from the tank onto the ramp deck. The water discharged by the Third Engineer on ATLANTIC PRINCESS was described as such, although some men said that they could not smell anything. It is known that hydrogen sulphide at toxic concentrations appears odourless as it anaesthetizes the olfactory nerve. At very low concentrations it has the distinct smell of "rotten eggs".

The black colour of the water was probably due to corrosion of the internal walls of the steel pipes, but the foulness of the water was due to the polluting effect of spoiling and damaged fish.

Lack of cleanliness of the RSW system as a whole was a factor in the production of toxic gases on the ramp deck.

The volume of water that lay stagnant in No 3 starboard RSW tank over the five to ten day period is uncertain. It is possible that the tank was filled to capacity (42 tonne) to counterbalance the weight of fish/water stored in the port RSW tanks.

The tank contents would have included sea water pumped in as ballast, a mixture of contaminated water from the pipelines of the RSW system, and water and fish residue from the last time the tank was used. The conditions were right for the breeding of bacteria in decaying fish and the production of toxic gases.

2.3.4.1 Laboratory based simulation project.

Because no air, water or fish samples were taken at the time of the accident, steps were taken to recreate the circumstances of the incident.

Bristol University was commissioned to identify the range of conditions under which toxins of the type that may have led to death and injury of the crew could have been produced. The work was divided into three phases:

(i) a literature review to identify pathogenic and spoilage bacteria associated with fish, their growth characteristics and toxic products produced;

(ii) a study into the combination of conditions likely to lead to the development of hydrogen sulphide, hydrogen cyanide and carbon dioxide. (Experiment 1);

(iii) a study into the rate of development of hydrogen sulphide, hydrogen cyanide and carbon dioxide under the conditions identified. (Experiment 2).

The results of the project were reported in the MAIB document entitled "Production of Toxic Gases from Decaying Fish" - 19 December 1996, which is summarised below.

Literature Review

A number of clear conclusions emerged from the review. It showed that a range of pathogenic organisms are present on fish and many of them have optimum growth temperatures that are in the range of interest. These pathogens are known to produce food poisoning through ingestion of contaminated food. However, there is no evidence that they are associated with the production of toxic gases.

Spoilage organisms on the other hand are commonly associated with the production of a wide variety of volatile compounds, notably sulphides such as hydrogen sulphide. The numerous volatiles produced by the most common species responsible for spoilage, Pseudomonades, have been widely studied. The toxicity of these compounds has never, however, been investigated in any depth.

Carbon dioxide is a breakdown product of many reactions and will be produced by a wide range of spoilage bacteria. Since this bacterial activity is likely to consume the available oxygen at the same time as producing carbon dioxide, its effect may be more severe than the limits suggest.

A number of bacterial species have been identified as producing hydrogen cyanide, and one in particular, Pseudomonas Fluorescens, is a common fish spoilage organism. Laboratory studies show that peak rates of cyanide production are achieved in the temperature range 32° to 38°C. They also show that cyanide is not normally produced during the growth stage of the bacteria: cyanide appears typically after approximately six hours. However, in the commercial situation, the temperature of the fish when caught would be similar to that of the sea, ie in this particular case 26°C. Under these conditions many of the bacteria could be into their growth stage so cyanide could be produced sooner.

Unfortunately no previous work has been identified that links the spoilage of fish to the production of hydrogen cyanide. Furthermore there appears to have been no systematic study or research of this or other toxic gas production during the decay of fish and other foods. The studies of cyanide production by bacteria all appear to have been carried out on pure cultures on growth medium under near optimum growth conditions.

Experiment 1

Results of the initial experimental studies showed that substantial amounts of hydrogen cyanide were produced by mackerel, herring and sardinella when 50% fish to salt water mixtures were held above 20°C. Small amounts of the gas were also produced by 1% mixtures. The type of fish appeared to have little effect on the amount of hydrogen cyanide produced.

Experiment 2

Six replicate samples of a 50% sardinella/sea water mixture in sealed containers were stored for up to 10 days at each of four temperatures: 5°, 20°, 35° and 45°C. Within one day at a storage temperature of 45°C levels of hydrogen cyanide, hydrogen sulphide and carbon dioxide above permissible exposure limits were measured. In the case of hydrogen cyanide and carbon dioxide, concentrations were higher than those considered to be immediately damaging to life and health. An extrapolation of the result indicated that within 30 hours, levels of hydrogen cyanide and hydrogen sulphide would exceed those which are considered to cause death within minutes.

Results at 35°C were very similar in that, within 28 hours, hydrogen cyanide, hydrogen sulphide and carbon dioxide concentrations were above those considered to be immediately damaging to life and health. Again, an extrapolation of the results indicate that within 36 hours, levels of hydrogen cyanide and hydrogen sulphide would exceed those which are considered to cause death within minutes.

At 20°C substantial quantities of hydrogen cyanide, hydrogen sulphide and carbon dioxide were also measured. However, the rate of production was slower. It took 64 hours before levels of all three gases had exceeded permissible exposure limits. After 68 hours, hydrogen cyanide and carbon dioxide concentrations were higher than those considered to be immediately damaging to life and health.

Only traces of the three gases were measured at a storage temperature of 5°C and this was only towards the end of the ten day storage period.

Conclusions from Experiments

The conditions used in Experiment 2, the main trial, would approximately represent the conditions found in an unventilated tank with 2% of the volume containing 50% fish/sea water mixture. However, the results of Experiment 1 indicate that substantial amounts of gas could still be produced with much lower fish concentrations. Further experiments are needed to quantify this.

2.4 Refrigerated Sea Water Installation

The RSW installation on board ATLANTIC PRINCESS is typical of installations on other freezer trawlers: the RSW tanks are ballasted using RSW system pipelines and pumps which may be contaminated by bacteria laden water.

To ensure that clean sea water is used to ballast the tanks, the systems should be designed so that the sea water is pumped through a separate ballasting system independent of the RSW circulating system.

In the case of ATLANTIC PRINCESS, ballasting of RSW tanks is unnecessary if the port and starboard RSW tanks are used to store equal amounts of fish during normal fishing operations.

Because of the arrangement of the inlet to the fish suction pipe in the RSW tank, (Figure 7), it is not possible to clean out the tank completely without resorting to the emptying of residuals through the tank side doors onto the ramp deck. The fish suction pipe should be designed to ensure that the tank can be cleaned out without having to open it to the ramp deck.

2.5 Self Contained Breathing Apparatus

Once the presence of dangerous fumes or toxic gases was recognised, a rescue attempt using the SCBA was made. Initially it was reported that the person attempting to use the equipment became entangled in its straps and hoses and so abandoned it. Later, when questioned during the Coroner's Inquest in Hull, he said that the air bottle was empty, possibly because it was leaking. As his latter evidence was revealed almost a year after the accident, it was impossible to check its validity. In any case had the SCBA been used correctly, or been ready for use, at the outset of the initial rescue attempt of the Third Engineer, it is possible that lives may have been saved and the number of casualties reduced.

2.6 Risk Assessment and Code of Safe Working Practice

Had the European Directive on Health and Safety applied to ATLANTIC PRINCESS and been implemented, the risks associated with contaminated water in RSW tanks could have been evaluated and actions taken to minimise them.

Notwithstanding what might have been found by carrying out a thorough risk assessment, the investigation has revealed that the hazard of deadly toxic fumes concentration from the RSW tanks is far greater than had been previously thought.

It is understood that the United Kingdom's Marine Safety Agency (MSA) intends to produce a new Code of Safe Working Practice that will make it clear that enclosed areas are not just tanks and holds. The Code will highlight the potential dangers of releasing stale air or toxic gases from piping and tanks into relatively open spaces, such as the ramp deck on ATLANTIC PRINCESS.

It is also intended to provide advice on risk assessment for fishing vessels, perhaps by producing a model, which can be adapted to the specific circumstances of a vessel. This will highlight how the release of toxic gases into a working space which has limited ventilation, will make that space a dangerous environment and that necessary equipment, eg SCBA, should be readily available.

The new Code of Safe Working Practices together with advice on risk assessment should improve the safe operation of fishing vessels. However, consideration should be given to producing a more specialised Code of Practice to cover RSW systems and installations. The design and installation of RSW systems, as well as their operation, should be considered when assessing the risk of toxic gas generation and oxygen depletion.

3 CONCLUSIONS

3.1 Findings

(i) ATLANTIC PRINCESS appeared to be a well found fishing vessel which was properly manned and equipped for fishing. The Skipper, Mate, Fishing Master and Fishing Mate were all experienced and properly certificated. **(1.3 & 1.4)**

(ii) This was the first voyage ATLANTIC PRINCESS had made to the warm waters off the West African coast. **(1.1)**

(iii) The accident occurred on the last day before leaving the fishing ground to unload the catch at Las Palmas. **(1.2)**

(iv) Hauls in the earlier part of the voyage had, in general, been light. Only partial use had been made of the RSW tanks to store fish. **(1.2)**

(v) No 3 starboard RSW tank had been used during the voyage but not for between five and ten days before the accident. **(1.2 & 1.6)**

(vi) There is no record of No 3 starboard RSW tank having being cleaned out after it was last used before the accident. **(1.2 & 2.3.3)**

(vii) The accident was initiated when the Third Engineer opened the door of No 3 starboard RSW tank and allowed black, slimy liquid to flow onto the ramp deck. The liquid was contaminated by fish spoil. **(1.2 & 2.3.4)**

(viii) The quantity and type of toxic gases produced in the RSW tank is uncertain. However, experiments in the production of toxic gases from decaying fish indicate that significant concentrations of hydrogen sulphide, hydrogen cyanide and carbon dioxide were probably present. **(2.3.4.1)**

(ix) At temperatures of 20°C and above, the experiment produced concentrations of hydrogen sulphide, hydrogen cyanide and carbon dioxide above levels considered immediately damaging to life and health. **(2.3.4.1)**

(x) The temperature of the tank residue is estimated to have been between 26°C and 50°C. **(1.6)**

(xi) The Third Engineer collapsed within moments of opening the door to No 3 Starboard RSW tank. **(1.2)**

(xii) Several members of the crew went to the rescue of the Third Engineer without either regard for their own safety or any appreciation of what had occurred on the ramp deck. **(1.2)**

(xiii) Two deckhands, Messrs van der Plas and Fairbairn collapsed and subsequently died due to inhalation of toxic gases as they attempted to provide assistance. **(1.2)**

(xiv) Six fishermen were incapacitated by the toxic gases when they attempted to provide assistance. **(1.2)**

(xv) Once the presence of toxic gases was realised, the use of an SCBA was considered. Although it was collected from the bridge, the SCBA could not be used because its compressed air bottle was empty. The possibility of a more successful attempt was therefore denied. **(1.2 & 2.5)**

(xvi) The accident occurred in the working space of the ramp deck where the seamen were performing their normal duties. **(1.2 & 1.9)**

(xvii) Advice to fishermen and fishing vessel operators on the danger of toxic gases in working spaces of fishing vessels is lacking. **(1.10)**

(xviii) There is no mandatory requirement on UK fishing vessels for training and regular exercise in emergency procedures for entry into spaces which could contain a dangerous atmosphere. **(1.10)**

(xix) The possibility of the presence of toxic fumes on the ramp deck had not been considered by either the operators or crew. No orders or operating procedures were in force to deal with the possibility of toxic fumes in working spaces. No training or practices had been carried out to rescue a person overcome by toxic gases. **(1.10)**

(xx) Ventilation on the ramp deck and other working spaces on ATLANTIC PRINCESS was inadequate for the ambient temperature off the West African coast. **(2.3.1)**

(xxi) The RSW tanks were cleaned out on a regular basis but not immediately after they had been used for storing fish. **(2.3.3)**

(xxii) The RSW pipelines, strainers, cooler and pump were not flushed out in accordance with manufacturers' guidelines. **(1.6)**

(xxiii) No air, water or fish debris samples were taken immediately after the accident. **(2.3.4.1)**

(xxiv) Postmortems were not carried out on two of the three deceased because their bodies were taken to the Netherlands and dealt with under different procedures to those in the United Kingdom. **1.8.**

(xxv) The hazard of toxic gas concentrations from RSW systems is far greater than was previously thought. **(1.9 & 2.3.4.1)**

(xxvi) There is a lack of information, both published and otherwise, on the production of toxic gases, especially hydrogen cyanide, due to decaying fish and food under conditions met in commercial operations. **(2.3.4.1)**

(xxvii) Throughout the international fishing industry there appears to be insufficient knowledge or understanding of the circumstances which could give rise to toxic gas production on fishing vessels. **(2.3.4.1)**

3.2 Causes

(i) The accident was caused by the release of toxic gas emanating from contaminated water and fish debris from No 3 Starboard RSW tank. **(2.2.2)**

(ii) The fatal injuries were caused by inhaling toxic gases. These toxic gases probably included sufficient quantities of hydrogen cyanide, hydrogen sulphide and carbon dioxide to kill. **(2.3.4.1)**

(iii) The non fatal injuries were caused by inhaling the same toxic gases in smaller quantities. **(2.3.4.1)**

(iv) The build up of toxic gases was caused by allowing fish debris to lie in No 3 Starboard RSW tank for at least five days after the tank was last used. **(2.3.4.1)**

(v) Inadequate design and poor standards of operation of the RSW system were factors in the accident. **(1.6, 2.3.3, 2.3.4, 2.3.4.1 and 2.4)**

4 RECOMMENDATIONS

It is recommended that Valiant Trawlers and all operators of fishing vessels equipped with Refrigerated Sea Water systems:

1. Ensure that all refrigerated processing and storage systems are thoroughly cleaned immediately after use so that no residual fish and sea water is left to decay.

2. Fully ventilate all fish storage tanks and areas with outside air where a mixture of fish and sea water, or sea water contaminated with fish waste, is likely to remain for more than a few hours.

3. Ensure that all working areas including ramp decks are fully ventilated using a positive pressure system to remove dangerous concentrations of toxic gases from fish storage and processing areas and bilges.

4. Provide rescue equipment such as self contained breathing apparatus for use in spaces likely to be subjected to the presence of toxic gases, and ensure that the crew are properly trained in its use. It is also recommended that periodic emergency exercises are conducted.

5. Ensure that crew members are trained to a defined level of competence in the use of RSW systems.

6. Introduce monitoring, by management ashore, of the implementation and effectiveness of precautions for the safe use of RSW systems.

7. Make suitable arrangements to ensure that when crew changes take place, safety precautions are continuously implemented.

8. Ensure that precautions continue to be carried out and that adequate information is available for checking what is done in practice. A record should be kept showing specified information including when RSW tanks are cleaned.

9. Supply and maintain gas level and oxygen depletion monitoring equipment on board and ensure that crew are trained and practised in its use.

10. Assess the risk of toxic gases and oxygen depletion as a result of operation of RSW systems during:

    a. routine operation of the plant;

    b. other use of the plant such as for ballasting purposes;

    c. maintenance;

    d. breakdown;

    e. abnormal operation; and

    f. commissioning.

Owners and seamen should be satisfied that RSW systems can be operated safely under any circumstances.

11. Ensure that any SCBAs placed on board any fishing vessels are always kept fully charged with clean compressed air and available for use.

It is recommended that the Marine Safety Agency:

1. Introduces a Code of Practice which addresses the risk of toxic gas production arising from the operation of RSW systems during:

   a. routine operation of the plant;

   b. other use of the plant such as for ballasting purposes;

   c. maintenance;

   d. breakdown;

   e. abnormal operation; and

   f. commissioning.

   The Code should advise of the need:

   i. to define levels of crew competence in the use of RSW systems;

   ii. to define and clearly set out crew members' levels of responsibilities;

   iii. for careful monitoring by management ashore of the implementation and effectiveness of precautions taken for the safe use of RSW systems;

   iv. to make effective arrangements to ensure that precautions are continuously implemented when crews are changed;

   v. for management to be assured that precautions continue to be carried out, that adequate information is available for checking what is practised, and that a record is kept showing specified information.

2. Considers alone, or in conjunction with other interested governmental and inter-governmental organisations:

    a. undertaking a systematic study of the production of toxic gases from decaying fish and;

    b. undertaking a systematic study of hygienic design and operation of fishing vessels;

    c. commend all those involved in the courageous rescue attempts including, posthumously, Messrs van der Plas and Fairbairn.

3. Remind skippers of fishing vessels which carry Self Contained Breathing Apparatus to regularly check that all compressed air bottles are fully charged with clean air and available for use.

J Stuart Withington
Principal Inspector
Marine Accident Investigation Branch
Department of the Environment, Transport
and the Regions

July 1997

Printed in the United Kingdom for The Stationery Office

J31746 C5 12/97