Report of an Investigation

into an engine room fire on

the UK registered merchant vessel

Toisa Gryphon

150 miles west-south-west of the Isles of Scilly

on 2 February 1999

MAIB 1/2/130

Extract from

The Merchant Shipping

(Accident Reporting and Investigation)

Regulations 1999

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

AB	-	Able Seaman
"Blackout"	-	Complete loss of electrical power and lighting
Class	-	Classification Society
CPP	-	Controllable pitch propeller
ETA	-	Estimated Time of Arrival
FRC	-	Fast Rescue Craft
"Hung off"		To "hang off" is the action of breaking the anchor cable joining shackle close to the anchor and re-securing the anchor in the hawse pipe with a wire. The free end of the anchor cable is then fed out through the fairlead and secured to the towing wire. The cable is more resistant to wear than the towing cable.
MAIB	-	Marine Accident Investigation Branch
MRCC	-	Maritime Rescue Co-Ordination Centre
O/D Box	-	Oil Distribution Box
RNAS	-	Royal Navy Air Station
SCBA	-	Self Contained Breathing Apparatus
SARTS	-	Search and Rescue Transponders
UMS	-	Unmanned Machinery Space

SYNOPSIS

This accident was notified to the Marine Accident Investigation Branch (MAIB) by the Maritime Rescue Co-ordination Centre (MRCC) Falmouth at 0205 on Wednesday 3 February 1999. The investigation started later the same day.

Toisa Gryphon is a 4,000bhp (2984kW) offshore tug/supply vessel, registered in London, owned by Toisa Limited, and managed by Sealion Shipping Limited. Propulsion is by four diesel engines driving through two controllable pitch propellers (CPP) working in nozzles. One transverse thrust unit is fitted forward and can be driven via a clutch from the diesel generator set on the centreline.

The vessel was on charter to SIMEC, a French telecommunications company, and was in the process of carrying out a series of seabed survey operations. At 2200, on the evening of Tuesday 2 February 1999, the vessel was operating under unmanned machinery space (UMS) conditions and moving slowly towards the next survey position. The master had reduced to minimum pitch on the propellers and had called the contractor's staff. Electrical power was being supplied by shaft generators. At 2215, the automatic fire alarm sounded showing a fire in the engine room. With the crew at fire stations, the master called all remaining personnel to the bridge. As heat and smoke prevented entry, the engine room doors were closed, all vents and fire flaps shut, and fuel trips operated. The resultant blackout occurred while the chief and second engineers were shutting the watertight door to the cement room. Shortly afterwards, halon was discharged into the space. A distress signal was sent at 2227 and acknowledged by Falmouth Coastguard. The vessel's position at that time was 49^{0} 24'N, 010^{0} 30'W. Two helicopters and a Nimrod aircraft were scrambled, with the nearby Irish naval vessel *Ashling* also responding.

While waiting for the helicopters, liferafts were prepared and regular heat checks were carried out on the deck, funnel and engine room bulkheads. The first helicopter arrived at 0040, the second at 0205. *Ashling* arrived at 0112. By 0238, all 11 of the contractor's staff had been lifted off. At 0400, *Ashling* advised that her thermal imaging camera showed that the fire had diminished. At 0500, the chief engineer and two crew briefly entered the engine room to shut the main sea valves and to confirm that the fire was out. *Ashling* continued to assist, offering breakfast to the crew and allowing use of her radio equipment. The emergency fire pump was started at 1120 with the chief engineer and his staff re-entering the engine room shortly afterwards. After venting and checking the main switchboard, a generator was started and limited lighting and power restored. A tow line from *Ashling* was connected at 1410 and transferred to *Anglian Earl* at about 2230. The vessel arrived in Falmouth at about 0830 on 5 February.

The investigation showed that a seal on the high pressure piping from the starboard gearbox CPP control system had failed, spraying lub oil over the aft part of the engine room. This had been ignited by hot surfaces on adjacent main engine exhausts. A continuous fire watch was maintained in the engine room during the tow back to Falmouth. There were no injuries to either the contractors or the ship's staff.

Recommendations are made on both operational practices and fire fighting.

SECTION 1 FACTUAL INFORMATION (all times UTC)

1.1 PARTICULARS OF VESSEL AND ACCIDENT

Name	:	*Toisa Gryphon*
Official No	:	383093
Port of Registry	:	London, UK
IMO Number	:	8201442
Gross Tonnage	:	1,252
Deadweight	:	1,185 tonne
Overall Length	:	60.85m
Breadth	:	13.00m
Maximum Draught	:	5.06m
Year of Build	:	1984
Type	:	Offshore tug/supply
Main Engines	:	MAN Diesel 8L20/27
		4 off total 2,984kW
Propulsion	:	Two CP propellers in nozzles
Generators	:	2 x 244kW 440V 60Hz
		2 x 250kW (shaft generators)
Owners	:	Toisa Limited
Managers	:	Sealion Shipping Limited
Classification Society	:	Lloyd's Registry
Date and Time	:	2 February 1999, 2215 UTC
Place of Incident	:	150 miles WSW of Isles of Scilly
Injuries	:	None
Damage	:	Starboard CPP system, main and auxiliary engines, electric cabling heat/smoke damaged. Some local fire damage to electric cabling. Alarm, monitoring and control systems smoke/heat damaged.

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

1.2 BACKGROUND

Toisa Gryphon is owned by Toisa Limited, and managed by Sealion Shipping Limited of Farnham, UK. The vessel was built in China and has accommodation for 11 crew and 12 passengers/charterers. At the time of the fire, the vessel was on charter to SIMEC, a French telecommunications company, carrying out seabed surveys at dedicated sites. The contractors had 11 French nationals on board, all were employees of SIMEC, to supervise and carry out the survey process.

Although the vessel was operating in the UMS mode, the chief and second engineers were working a six hour watch routine to cope with the varying deck machinery demands of the charterers. The chief engineer was on the 1800 - 2400 watch, with the second engineer on the 0000 - 0600 watch.

1.3 NARRATIVE

1.3.1 On 2 February 1999, *Toisa Gryphon* had been undertaking survey work under the direction of the charterers. The wind had been south-south-east force 5 initially, with a slight sea and moderate swell, but during the day the wind had changed towards a south-westerly direction. The sea conditions remained the same. The survey equipment had been deployed twice during the day, and had last been brought back on board at 1930.

While survey equipment maintenance was being carried out by the contractors, the vessel made her way slowly towards the next survey position. The master was on the bridge with the engine room operating in UMS mode. The chief engineer was in his cabin, having checked the engine room at 2200, while the second engineer, together with the second officer and other crew members, were either watching a video or playing cards in the messroom. Other crew members were in their cabins.

1.3.2 At 2200, the master told the contractors that the vessel was close to the next survey position and reduced the propeller pitch to minimum. No deck machinery had been started. At 2215, the automatic fire alarm sounded with the indicator panel on the bridge showing an engine room fire. When the alarm sounded in the accommodation, the crew reacted immediately. The chief engineer, second officer and bosun went straight up the stairs to the bridge, followed by the second engineer. Seeing that the alarm panel showed a fire in the engine room, the chief engineer turned to go below, shouting to the second engineer who was behind him, that the fire was in the engine room. At about the same time, somebody shouted from the bridge that dense smoke could be seen coming from the funnels. Both men, together with the bosun, who had joined them from the accommodation, made their way to the port engine room entrance to assess how serious the fire situation was.

The master, seeing clouds of smoke coming out of the funnels, realised that the fire was serious and used the bridge intercom to call contractor staff on the main deck, telling them that there was a fire in the engine room and that they were to muster on the bridge with their survival suits and lifejackets. Smoke was by this time already filtering up from the accommodation on to the bridge.

On reaching the engine room entrance, the chief engineer was met by a wave of intense heat and dense acrid smoke billowing out of the open engine room doors. Realising that access was impossible, the chief engineer shut the inner door while the second engineer sent the bosun to shut the starboard funnel fire flaps while he shut the port funnel flaps. After shutting the fire flaps, he released all but one of the door catches on the halon compartment door.

1.3.3 The second officer, who had followed the chief engineer down into the accommodation, shouted to the three crewmen following him, the cook, motorman and the duty Able Seaman (AB), that there was a fire in the engine room and that they should go to the main deck fire locker. Once there, the AB was told to get the self-contained breathing apparatus (SCBA) out and ready for use while the second officer took the fireman's outfit out. By this time the emergency lights were on and smoke was beginning to fill the accommodation and drift up to the bridge. After leaving the fireman's outfit in the accommodation door well, next to the watertight door closing actuators, the second officer went to assist in shutting the port side funnel fire flaps. The outer door for the port engine room entrance lay flat against the bulkhead and it took the combined efforts of the second engineer and second officer using a fire axe as a crowbar to get it moving. Once free, it moved easily into the closed position.

After the outer port engine room door and fire flaps had been closed, the second officer and motorman went to the halon compartment, opening and hooking back the door. They then returned to the bridge, picking up their survival suits and lifejackets from their cabins as they went. Meanwhile the chief and second engineers went to the starboard engine room entrance. The chief engineer operated the quick closing fuel trips and closed the outer engine room door, while the second engineer operated the handwheel to remotely close the watertight door between the cement room and the steering gear space. At about this time, a "blackout" occurred as the shaft generator breakers tripped off the board. The chief and second engineers then re-entered the accommodation from the port side closing the steel door behind them. The AB had, in the meantime, moved the SCBA from the accommodation door back to a position just outside the safety locker. The chief engineer went straight to the bridge while the second engineer collected his survival suit and lifejacket from his cabin before joining him.

1.3.4 Once the chief engineer had returned to the bridge, the master asked the charterer to confirm that all his men were present while he checked the crew. On receiving confirmation that everybody on board was present and that all flaps and trips had been shut or operated, the chief engineer pulled the two halon release handles. This operation was timed at 2225. To satisfy himself that the halon had been released, the chief engineer went down to the halon compartment to check the condition of the bottles. He found the bottle gauges registering zero with the lower half of the bottles frosted over. On returning to the bridge, he confirmed to the master that the gas had been discharged.

At 2227, the master sent a "Mayday" on the 2182kHz frequency while the chief officer sent a distress message using the VHF on Channel 16. Falmouth Coastguard acknowledged the "Mayday" and asked for details. They were told that there was a fire in the engine room and that the vessel's position was 49° 24'N, 010° 30'W. The coastguard advised that two helicopters and one Nimrod aircraft had been scrambled and that the Irish fishery protection vessel *Ashling*, which was in the area, was making her way towards them with an estimated time of arrival (ETA) of 0100 the next day.

1.3.5 The master's conversation with Falmouth Coastguard on 2182kHz was difficult at times, as there were a number of other conversations taking place in Spanish. A Spanish speaking member of the crew did ask for the frequency to be cleared as there was an on-going emergency situation, but without effect. While the engineering staff were monitoring the temperature of the after deck and funnel, the deck crew were preparing the liferafts and search and rescue transponders (SARTS) in case the vessel had to be abandoned. At 2245, Falmouth Coastguard said that the ETA of the first rescue helicopter was 0040 the next morning, 3 February.

During the next few hours, the crew were organised to check bulkheads and the main deck aft, at half-hourly intervals, for local hot spots and evidence of any spread of fire. At midnight, the vessel's position was 49° 27.5'N, 010° 24.3'W. At 0040, on 3 February, the first helicopter, Rescue 193, arrived on scene and discussed procedures for winching the contractor's staff off the vessel from the forecastle and if any deck lighting was available. Following this discussion, the officers and crew helped the contractors to get ready for evacuation while waiting for the arrival on deck of the helicopter winchman. He touched down at 0055. The evacuation by helicopter started at 0057 and was completed at 0105 - seven French contractor's staff being safely lifted off. This helicopter then left the scene for Royal Navy Air Station (RNAS) Culdrose, Cornwall at 0107.

1.3.6 At 0112, the Irish fishery protection vessel *Ashling* arrived and stood by, about six cables off. At 0115, the master was advised by Rescue 193, that the ETA of the next helicopter, Rescue 169, was 0205. At about 0130, the chief engineer, together with the second engineer and bosun, attempted to enter the bow thrust space via the forward escape hatch to start the diesel driven emergency fire pump. Dense smoke, which had entered the space before the watertight door had been shut, prevented entry and the attempt was abandoned. At 0200, the master spoke to Falmouth Coastguard about what arrangements had been made for a towing vessel and what time it might be expected. He was told that the coastguard tug *Far Minara* was on its way with an ETA of 1530 that afternoon.

At 0205, the second rescue helicopter arrived, Rescue 169, with the winchman landing aboard at 0220. The remaining four contractor's staff were lifted off by 0237 with the helicopter leaving for RNAS Culdrose at 0238. At 0240, with the situation under control, *Ashling* standing by, and all contractor's staff air lifted off, MRCC Falmouth lifted the distress situation. While some of the officers and crew remained on watch monitoring the deck and funnel temperatures, *Ashling* continued to monitor the hull with her thermal imaging camera. Those crew members not on watch were stood down and advised to get some rest.

1.3.7 At about 0400, *Ashling* reported that the "red glow" had diminished, suggesting that the fire was out. It was decided however, that any attempt to gain entry should be postponed until daylight. At 0430, the chief engineer, who had been resting in his cabin, returned to the bridge as he was concerned that the fire may have damaged some of the flexible cooling water pipes to the main engines and generators. With the main sea valves still open, this would result in gradual flooding of the engine room. As the only way to check this was to enter the engine room, it was agreed that this should be attempted as soon as possible. At 0500, the chief engineer, second engineer, and bosun, having checked that their radio link with the bridge worked, made their way down to the port engine room entrance. After confirming that the space between the inner and outer engine room doors, and the upper level of the engine room was clear of smoke, the chief engineer entered the engine room.

Although finding the atmosphere acrid, he decided that it was safe enough for the second engineer and the bosun to join him. With the aid of torches, a cursory check was made of the engine room for smouldering debris or evidence of flooding, but nothing was found. The three men then shut the main sea valves, checked that all fuel valves were closed, and left the engine room; closing both the inner and outer engine room doors. At no time were either the SCBA or the smoke helmets used. All three men were back on the bridge by 0515. With the vessel safe from flooding, the chief engineer went to rest, leaving the second engineer on the bridge.

1.3.8 At about 0800, *Ashling* offered the crew breakfast, using their fast rescue craft (FRC) as transport between the two vessels. This offer was accepted with the first five going over shortly afterwards and returning at 0915. Not all the crew took advantage of this offer but at 0930, the master, chief engineer and bosun went over to use their radio to talk to the owners about the fire and what towing arrangements had been made. The bosun meanwhile was discussing with *Ashling* what arrangements needed to be made for towing *Toisa Gryphon*.

During this conversation with the owners of the vessel, the master learnt that the coastguard tug had been replaced by a chartered tug, *Anglian Earl*. Before returning to his vessel, the master established that their position was 49° 29'.6N, 010° 08'.2W.

On re-joining *Toisa Gryphon*, the chief engineer decided to attempt to enter the bow thruster room to start the emergency fire pump. By this time, the smoke had cleared and they managed to start the emergency fire pump and pressurise the fire main. At the same time it was arranged that the fire flaps, vents and the engine room doors would be opened to allow any residual smoke and fumes to be cleared and the engine room ventilated.

1.3.9 At about mid-morning, the chief engineer, second engineer, and bosun re-entered the engine room to try and get a more accurate idea of what state the machinery was in and what might have caused the fire. They found a considerable amount of clean oil on the floor plates between No 3 and No 4 main engines. The chief engineer knew that this could not be from the main engines themselves as, being trunk piston engines, any oil spill from them would be dirty and black. One potential source was from the hydraulic oil pipes for the deck machinery fitted at deckhead level, right above the fire. To confirm the security of that system, it was decided to top up the system header tank using the hand pump. Normally it required only one or two strokes to top up the header tank and cause an overflow in the sight glass. If more was needed, then oil had been lost from the system. On testing, only the usual two strokes were necessary, confirming that this system was not the source of the oil. As the only other source of clean oil was the main engine gearboxes, these were checked and the starboard gearbox contained no oil at all. Having found this, the chief engineer, second engineer and bosun returned to the bridge to discuss what the next move should be.

After some discussion, it was decided that attempts should be made to start one of the main generators to provide lighting and power to the accommodation. As it was not known what cables might have been damaged in the fire, it was decided that extra men should go down into the engine room to stand-by with fire extinguishers to put out any sparks or outbreaks of fire that might occur. The master and chief engineer therefore arranged for the crew to be split into two teams; one for the towing operation, the other to enter the engine room. By this time, the emergency battery supply which had been in operation in for some eight hours (two hours longer than required under the regulations), had failed. With the master remaining on the bridge, the chief officer, bosun and one AB went forward to prepare the anchor cable for towing, while the chief engineer, second engineer, second officer, motorman, and the other AB entered the engine room.

1.3.10 On re-entering the engine room, the chief engineer tripped all the breakers off the main switchboard while the second engineer prepared the small harbour generator/emergency air compressor diesel for starting. Once everybody was positioned around the engine room, either with fire extinguishers or a fire hose, the chief engineer started the three cylinder emergency diesel. With the diesel running safely, the air compressor was clutched in and the main air bottles filled. Once the air bottles reached a pressure of 25 bar, the diesel was stopped and preparations made to start No 2 main generator. After starting the generator and checking that it was running normally, the chief engineer put the main breaker back on the switchboard and started to increase the electrical load. Just after this process had started, the generator stopped.

An investigation showed that the fuel trips, which had been tripped at the start of the fire, had not been reset. Lack of fuel was the reason the generator had stopped. All breakers were again cleared off the switchboard while the second engineer reset the fuel valve trips. The generator fuel system was bled and the generator restarted. Some time was spent venting air from the fuel system but eventually they managed to get the generator to run successfully. The breakers were then re-engaged on the switchboard, one at a time, checking that each circuit was safe before moving on to the next breaker. With the extent of the fire damage not known, the chief engineer kept the electrical load down and only put on the accommodation lights, refrigeration, domestic water pump, chlorifier and galley power. The main breaker for one of the two main air compressors was engaged and the air compressor given a quick test run to see that it was safe to operate.

1.3.11 While work was progressing in the engine room, the chief officer, bosun and an AB had "hung off" the starboard anchor in preparation for receiving a tow line from *Ashling*. The tow line was passed, secured and the tow underway by 1410. Although some electrical power and lighting was then available, the chief engineer was conscious that the engine room was still suffering from the effects of the fire and that a fire watch would need to be maintained until they reached port. A two-man engine room watch system was organised with the watchkeepers reporting to the bridge every hour. Temporary lights were rigged up in the engine room, fed from the galley distribution board, as it was too risky to use the normal engine lighting circuits. This watch system was maintained until *Toisa Gryphon* arrived in Falmouth.

The tow continued until about 2104, when *Ashling* started to reduce speed as *Anglian Earl* was due to meet them at about 2200. The tow was slipped at 2155 with *Anglian Earl* all fast and towing at 2230. The position of *Toisa Gryphon* at the start of the tow was 49° 46'N, 009° 16.5W. The Irish vessel *Ashling* was released and she resumed her normal duties. At 0138, *Anglian Earl* reported that the course was 095°, speed 6 knots, length of tow 435m and an ETA in Falmouth of 0600 on 5 February. She eventually arrived in Falmouth Bay at 0450 and came alongside at 0930 on 5 February 1999.

1.4 DESCRIPTION OF VESSEL

1.4.1 *Toisa Gryphon* was built in China as an offshore tug/supply vessel to Lloyd's requirements and is designed and registered to operate under UMS certification. A full vessel specification and general arrangement plan is in Annexe 1. She is fitted with a fire detection system covering five zones - accommodation (2), cement room, engine room and steering gear. A halon fire fighting system is fitted covering the engine room and cement room. A diesel driven emergency fire pump is fitted forward in the bow thrust compartment. Emergency lighting is by battery.

Toisa Gryphon is a 4000bhp(2984kW) platform supply vessel with full depth side tanks, double bottom tanks, five decks, accommodation forward, and a large flat working deck aft. She is fitted with four marine diesels driving through a fixed ratio gearbox onto twin four bladed variable pitch propellers working in nozzles. She is also fitted with two semi-balanced rudders and a 500bhp(373kW) thruster forward. Electrical power is from two diesel generators and two main shaft alternators.

The accommodation block forward is arranged over five decks; the navigating bridge deck, forecastle deck, main deck, platform deck, and hold bottom. The navigation bridge deck contains the wheelhouse, battery storage and four inflatable liferafts. On the forecastle deck forward is the anchor windlass and mooring equipment, with the six officer cabins immediately aft. Stowed between the twin funnels is a fast rescue craft. On the main deck is both crew and passenger (contractors) accommodation with galley, messroom, and service spaces. Also on this deck, but aft of the accommodation and separated from it by double steel doors, is the air-conditioning and refrigeration machinery, engine room entrances, halon storage room, and various anchor handling and tugger winches. Aft of the winches is the main working deck.

1.4.2 Below the main deck is the platform deck which is subdivided by three watertight bulkheads and is in reality, two half decks, one forward and one aft. The forward half deck contains two passenger cabins with access from the main deck accommodation. The aft half deck contains the engine room store, workshop, with access to the steering gear flat through a watertight door in the aft watertight bulkhead. Access to this aft deck is from the engine room. The two centre sections of the platform deck, separated by a watertight bulkhead, form the upper parts of the main engine room and the cement room.

On the hold bottom, forward is the bow thrust compartment, with access through a watertight door from the cement room. The cement room, which lies beneath the accommodation block, contains four dry bulk cylindrical storage tanks, and is separated from the main engine room by a watertight bulkhead. Access between the two spaces is by a watertight door fitted on the centre line at hold bottom level between the two diesel generators. The engine room contains the main and auxiliary machinery, a central machinery monitoring, control and alarm console, with the main switchboard fitted at platform deck level.

1.5 DESCRIPTION OF GEARBOX

1.5.1 Each twin input, single output, fixed reduction gearbox is fitted with two gearbox driven oil pumps, both pumps being fitted on the aft side of the gearbox. One pump supplies low pressure lubricating oil to a common lug oil manifold, while the other supplies high pressure oil to the distribution box (O/D box) of the controllable pitch propeller system (CPP). Each pump is part of a separate closed system which draws from, and returns to, the common gearbox sump. The gearbox sump contains 300 litres of lubricating oil when at working level. The low pressure lubricating lub oil manifold is mounted at high level on the aft side of the gearbox. From here, various 10, 18, or 42mm diameter steel pipe lines lead off to bearings and sprayers in the gearbox. The high pressure pump, feeding oil to the CPP system, is of heavier gauge 65 or 80mm steel piping, fitted with square flanges and neoprene rubber seal rings. From the pump, the piping passes round to the forward side of the gearbox and into the O/D box mounted on the end of the propeller shaft.

1.5.2 This O/D box has the controls for the CPP system mounted on top, with the high pressure piping from the pump connected between the controls and the O/D box itself. Access to the various pipe connections on the O/D box is very restricted with a number of large diameter pipe flanges in close proximity. The working pressure of the CPP system is 21 bar, but can rise to 32 bar when pitch alterations are made.

The gearbox is fitted with bearing temperature gauges (reading and alarm), sump oil temperature, pressure gauges and alarms for both low and high pressure systems. The output from these local monitoring and alarm systems is connected into the general machinery remote monitoring system.

1.6 ENGINE ROOM DAMAGE

1.6.1 Direct fire damage was fairly localised but the effect from heat and soot was much more widespread. The origin of the fire centred on the starboard gearbox and the inner of the two starboard main engines; in particular, the engine turbo-charger. The aft area of the engine room, particularly at deckhead level, was heavily affected by heat with considerable damage to electrical cabling and plastic fittings. Deckhead paint blistering in two areas suggested local secondary fires had occurred.

The area was also heavily sooted which prevented an accurate assessment of the extent of the peripheral damage until cleaning had been carried out. With the engine room instrumentation and controls, including the main switchboards and distribution boards, being largely open to the main engine room space, this equipment required cleaning, checking and testing before the vessel re-entered service. Similarly, all four main engines and their auxiliaries were affected to some degree by the soot and required examination and testing.

1.6.2 Due to the loss of oil from the starboard gearbox, the CPP controls for that shaft and gearbox, required examination and repair/replacement. With many of the cargo handling system pipelines secured to the deckhead, these needed pressure testing to ensure that the systems remained intact and secure. No structural damage was evident, although it is probable that some fitting support structures may have suffered a degree of distortion due to localised heat effects. The basic inspection and repair specification prepared for the ship yard is in Annexe 2.

1.7 CREW RESPONSE TO THE INCIDENT

1.7.1 The response was immediate and professional. The master kept both crew and contractors' staff fully informed of the situation and carefully monitored the situation throughout. Before the arrival of the helicopter, the crew ensured that all contractors' staff were correctly dressed in survival suits and lifejackets and were aware of the procedure for evacuation by air. The subsequent airlift of the contractors off the vessel followed the procedure agreed between the helicopter and the master and was achieved without incident.

Communication between the various senior officers was positive and clear. Situation updates were exchanged between all interested parties with the master/bridge being kept fully informed at all times.

Good co-operation was evident between crew members in the shutting of the engine room vents, fire flaps, operation of the remote trips, and closing of the watertight doors. A sound practical action was the closing of the aft access doors to the accommodation at main deck level to prevent the entry of smoke.

1.7.2 The second officer organised a fire party immediately and arranged for the SCBA and fireman's outfit to be readily available for use. Apart from using the fire axe to release a stiff entrance door, none of the equipment was subsequently used.

Two attempts were made to enter the bow thrust compartment to start the emergency fire pump, the second being successful when the smoke had cleared. The first attempt was aborted as smoke in the cement room prevented the crew from opening an overboard discharge valve in the fire pump diesel exhaust line. SCBA or helmets could not be used for entry due to the configuration of hatch layout and the positioning of ladders, walkways etc.

When entering the engine room at 0500, neither the fireman's outfit nor the SCBA was used.

1.8 THE FIRE INVESTIGATION

1.8.1 On arrival at Falmouth, an investigation was carried out by the owners of *Toisa Gryphon* and the MAIB inspector to try to establish how and where, the lub oil from the starboard gearbox had escaped.

The gearbox itself was not fire damaged, but was covered in sooty oil deposits. Initial investigations showed no obvious signs of split or broken lub oil pipes but the soot pattern showed that oil had sprayed across the forward side of the gearbox and over the turbo charger of No 3 main engine. As the engine was operating, this was considered as the probable source of ignition.

1.8.2 With no visible evidence of where the lub oil had escaped from the gearbox, it was decided that the quickest solution was to pressurise both the low and high pressure CPP system. Before this could done, however, it was necessary to carry out general cleaning in the engine room and remove as much of the oil soaked soot as possible.

Once this had been done, and before any pumps could be operated, it was necessary to inspect and test the electric distribution system as well as the condition of the switchboard.

As this work might have taken several days, it was agreed that the owners would push ahead with the cleaning and checking of the various systems keeping the MAIB inspector fully informed of progress.

When the standby lub oil pump circuits had been confirmed as intact and suitable for use, the starboard gearbox was refilled with oil. One of the lub oil pumps was then started and pressure began to build-up in the system. The low pressure lub oil system proved to be intact with no sign of leakage. The high pressure CPP system, however, immediately developed a serious leak at a pipe flange on the discharge side of the pump close to the O/D box.

On the high pressure system, the connecting pipe flange to the O/D box was oblong in shape with a semicircular ring groove machined in the mating face. A similar mating face with a ring groove was machined on the O/D box. A nitrile rubber ring, fitted in the groove, was compressed to provide the seal. Four fitted Allen bolts, one in each corner of the oblong flange, provided the compressive force.

1.8.3 Once the source of the lub oil leak had been located, the standby pump was stopped and the pressure allowed to drain down. The pipe flange was dismantled and the cause of the leak found to be a broken seal ring. When the flange bolts were removed, it was discovered that the individual tension on each of the four bolts varied. This suggested that at some time in the past, either they had not been tensioned evenly in the first place, that they had "worked" loose, or that the loss of part of the seal ring resulted in uneven tension in the bolts. Chisel marks on the bolt faces suggested that with access being very restricted, difficulty had been experienced in the past in tightening the bolts to an even and correct tension. Available records suggested that the flange had last been touched some three to five years before.

Following the discovery of the broken seal ring, it was arranged that the CPP system manufacturers would carry out a full assessment of the damage and make any refurbishment or repairs that were considered necessary. The broken nitrile rubber ring was taken by the insurers for analysis, the results of which have not been sighted.

SECTION 2 ANALYSIS

2.1 CIRCUMSTANCES OF THE FIRE

2.1.1 The engine room at the time of the incident was operating under UMS conditions, although the chief and second engineers were maintaining six hour watches so as to monitor the deck machinery requirements of the contractors. Both the inner and outer engine room doors had been left open as had the watertight door between the engine room and the cement room.

All four main engines were operating and clutched in to the two gearboxes. Both propellers were operating on minimum pitch with all electrical power being supplied through the shaft generators.

2.1.2 Shortly before 2215, a flange seal ring on the CPP high pressure oil line on the forward side of the starboard gearbox failed. High pressure lub oil sprayed towards the port side of the engine room covering the deckhead and aft part of No 3 generator, including the turbo-charger and exhaust trunking. On contact with a hot surface, the oil rapidly rises in temperature and evaporates into a mist or vapour. A further increase in the temperature would likely lead this vapour to smoulder and eventually ignite. With the engine room atmosphere contaminated with a fine lub oil spray, it is probable that sudden ignition of the oil vapour cloud would follow.

This ignition process would most likely have had a slow flame speed as the oil spray is likely to have been of the form of large droplets in an over-rich mixture of air and fuel. The resultant slow pressure rise was experienced by the chief engineer as a sudden wave of intense heat and dense acrid smoke when he approached the engine room entrance.

2.2 REACTIONS OF THE CREW TO THE FIRE

2.2.1 The immediate stoppage of the main engine and the loss of all electrical power, resulted in an unforeseen, but automatic, cessation of the forced ventilation of the engine room. This action, which was followed up very quickly by the crew closing all vents and fire flaps, curtailed the extent of the fire and prevented it developing.

The decision to use halon was both sensible and correct, as any attempt to enter the engine room space to fight the fire in those early stages would have been highly dangerous and ineffective.

2.2.2 The initial actions of the second officer in organising the fire team followed good practice and was a controlled response. The subsequent actions of the chief engineer and other crew members to attempt to enter smoke and/or gas filled spaces without SCBA was foolhardy and positively dangerous. The master, who was still in command, should have ensured that any action taken was carried out in a safe and controlled manner.

The first action, at about 0130, to try and enter the cement room was aborted due to the presence of smoke. This smoke was present as the watertight door between the cement room and the engine room, had been left open. The reason for the attempted entry to the space was to open an overboard valve on the exhaust line from the emergency fire pump. With this valve closed, the fire pump could not be started, leaving the vessel unable to charge the fire main and incapable of fighting any further outbreak of fire.

The second action of the chief engineer in entering the engine room in the aftermath of a fire, when halon had been used, and without the use of an available SCBA, was particularly foolhardy. In these circumstances, oxygen levels are low and there are likely to be areas within the engine room with high levels of carbon monoxide and other gases. To enter without any protection, even though it was available, could have led to his death and possibly others, in an attempt to carry out a rescue. It was fortunate that the outcome was successful.

2.2.3 In addition to the points made above, it is also a cardinal point of fire fighting that a fire team consists of a minimum of two and that when entering a smoke filled space, a safety line is rigged. It appears that neither of these was considered necessary in this particular accident.

2.3 OTHER ISSUES

2.3.1 The Merchant Shipping (Fire Protection) (Amendment) Regulations 1999, require vessels to carry firemen's outfits which include breathing apparatus complying with schedule 5 in Merchant Shipping Notice MSN 1665; such breathing apparatus may be either the self contained type, or the smoke helmet/smoke mask type.

The smoke helmet and bellows identified here as an acceptable alternative to the SCBA has been part of the fire equipment carried on board ships for a considerable number of years. Although at the time of its introduction, it offered a considerable and significant advance in the then shipboard fire fighting and rescue actions, the development of SCBA has relegated this system to a support function. Despite the widespread adoption of SCBA in both marine and shoreside fire fighting, the smoke helmet and bellows are still accepted under Merchant Shipping Regulations as an alternative to the modern SCBA.

The advantages claimed for this system are:

- No time limit
- Cool in use
- Small amount of training required

- Care and maintenance easy
- Testing simple
- Mask is at positive pressure, providing pumping rate is maintained at bellows.

The disadvantages of the system are:

- All intakes must be carefully watched (smoke/fumes)
- Two or more people required to use equipment
- Tubing heavy, difficulty in laying hose lines
- Air supply line may be damaged or trapped
- Distance travelled limited.

These smoke helmets, and the accompanying 36m air hose, are neither popular nor practical in the fighting of fires and require a constant source of fit and healthy people to manually operate the air pump. With the reduced numbers of crew now carried on most vessels, providing a schedule for regular changing of the air pump operators would be a major difficulty. The helmets themselves have restricted vision and the trailing air pipes are a constant source of worry to the wearer, particularly in the more modern vessels with compact engine rooms. The trailing air hose, combined with the need for the team to carry with them a fire hose, makes progress both slow and physically demanding and generally adds to the stress of the situation.

The current fire courses, which all seafarers attend at various times, base their strategy on pre-planning and determination with the strategy requiring two essential elements for quick control of a fire:

- A good knowledge of the ship's layout
- The obtaining, collating and updating of risk information.

With the vast majority of ship fires occurring within closed spaces and involving differing levels of smoke generation, this strategy makes breathing apparatus an essential part of any fire fighting operation. The extent to which a fire may be fought or contained, relies heavily on the speed of response and how quickly the fire team can gain entry to the area where the source of the fire is thought to be. For this initial assessment to be made at an early stage, the fire team needs to be free to enter the area from wherever the most advantageous point is. A fire team using a combination of a smoke helmet and a SCBA would be limited in this respect due to:

- The entry point may not be close to the open air with the result that the team member wearing the traditional smoke helmet would have a limited work area. Although the second team member is likely to be wearing a SCBA, he also, would be restricted due to the necessity for maintaining contact with his colleague.

- Under certain fire/smoke conditions, it may also be advantageous for the fire team to exit the area at a different point from where they entered. This would not be possible using the smoke helmet.

The fire fighting education and training undertaken on these mandatory courses, involves practical fire fighting, during which the wearing of SCBA is an essential part of the training. It is illogical therefore, for mandatory fire training to be based on fire teams wearing SCBA and then expect a similar response with one member of the team wearing a smoke helmet.

Although the breathing apparatus carried on this vessel, one SCBA and a smoke helmet, complies with the regulations, the provision of just one SCBA limits the amount of fire fighting action that can safely be undertaken. As stated earlier, fire fighting teams should consist of a minimum of two people. It is difficult however to maintain an effective team when one member of the team is restricted in movement by the limitations of the smoke helmet and pipework. Safe and effective fire fighting requires two firemen suitably equipped for unrestricted passage and action. A 36 meter air hose, plus surplus crew members to man it, does not meet this criteria.

The continued acceptance of the smoke helmet as an alternative to a SCBA is not one that can be recommended and owners should equip their fire teams with a minimum of two SCBA, together with their appropriate equipment. Similarly, regular exercises by various members of the crew moving about the vessel wearing SCBA and operating as a team should be practised.

2.3.2 While understanding the reason for the exhaust line valve for the emergency fire pump, the need for access to both the cement room and the bow thruster room, adds to the complexity of the system. The need for local operation of the exhaust line valve makes remote starting of the emergency fire pump redundant. Either an extended spindle system should be fitted or, better still the exhaust line re-positioned to allow direct access to it from the forecastle deck or forward accommodation. The practice of leaving the watertight door between the engine room and the cement room in the open position must also be reviewed. It was this practice which allowed smoke to build up in the cement room preventing operation of the overboard exhaust valve.

In this incident, the emergency fire pump could not be started, preventing pressurisation of the fire main and considerably reducing the vessel's ability to fight any subsequent outbreak of fire.

2.3.3 At the time the incident occurred, both doors to the engine room were secured in the open position. Under the Merchant Shipping (Fire Protection) Regulations, every door which forms part of the casing of a machinery space must be self-closing for fire protection. The practice of securing these doors in the open position, particularly when the machinery space is unoccupied, places the vessel at risk. The stairway leading from the engine room to the open deck area will create a chimney effect when the two doors on the stairwell are open. This will encourage the fire to travel upwards with increasing ferocity and force. In the event of a serious explosion, the open doorway provides a ready access for the subsequent inrush of oxygen, leading to a possible second and more devastating explosion.

2.3.4 The tight arrangement of pipe connections on the O/D box suggests that the original design envisaged assemble/dismantling on a total overhaul basis, i.e. the pipes being fitted or dismantled in order. This design concept would involve replacing nitrile seal rings on a strict time based maintenance schedule. However, the chisel marks suggest that either the seal had been replaced outside the normal unit overhaul schedule, or that a leak had developed and attempts had been made to tighten the bolts without disturbing the complete unit. There is also the possibility that the bolts were not tightened correctly at the time of the last scheduled overhaul and had become loose during service.

Bearing in mind access difficulty, the chisel marks, and the seal failure, the fitting of locking devices on the flange bolts should be considered at the next overhaul. It would not prevent a seal failure, but it would remove the possibility of bolt slackening during service.

2.3.5 During the emergency, conversations between the master and Falmouth Coastguard on 2182kHz were frequently interrupted by Spanish speakers. The origin of the transmissions are unknown, and despite requests made in Spanish for the frequency to be cleared, the transmissions continued.

Although in this case these transmissions did not affect the outcome, the continued use of this emergency frequency for non-urgent messages or conversations, is a practice that must be stopped. Apart from contravening international regulations, it indicates complete disregard for the safety of other seafarers.

SECTION 3 CONCLUSIONS

These conclusions identify the cause and factors contributing to the accident and should not be taken as apportioning either blame or liability.

3.1 CAUSE OF THE FIRE

The cause of the fire was the presence of lubricating oil from the starboard main engine gearbox on the turbo-charger and exhaust trunking of No 3 main engine.

3.2 CONTRIBUTORY CAUSE

The failure of a nitride rubber seal ring in a pipe flange on the high pressure side of the CPP pump allowed lubricating oil at high pressure to be sprayed over the aft centre and port sides of the engine room. This oil spray also covered the aft part of No 3 main engine and in particular the turbo-charger and exhaust trunking of that engine.

3.3 FINDINGS

3.3.1 At the time of the outbreak of fire, the vessel was operating under UMS with all four main engines operating, both propellers set at minimum pitch and all electrical power being supplied from shaft generators.
(Ref: 2.1.1)

3.3.2 Both the inner and outer doors of the engine room were secured in the open position, contrary to good practice and Merchant Shipping (Fire Protection) Regulations.
(Ref: 1.3.2, 2.3.2 & 2.3.3)

3.3.3 On contact with a hot surface, such as the turbo-charger casing or exhaust manifold, the oil temperature rose rapidly and evaporated into a mist or vapour. A further increase in temperature led the vapour to smoulder and eventually ignite. The ignition process would most likely have had a slow flame speed as the oil spray would comprise large droplets in an over-rich air and fuel mixture. The resultant slow pressure rise was experienced by the chief engineer as a sudden wave of intense heat and dense acrid smoke when he approached the engine room entrance.
(Ref: 2.1.2)

3.3.4 Immediate stoppage of the main engines resulted in a blackout, loss of all electrical power, and cessation of forced ventilation to the engine room. Prompt closing of all vents and fire flaps by the crew curtailed the extent of the fire and prevented it developing.
(Ref: 2.2.1)

3.3.5 The decision to use halon was both sensible and correct.
(Ref: 2.2.1)

3.3.6 The subsequent actions of the chief engineer and other crew members to attempt to enter smoke filled and/or gas filled spaces without SCBA was foolhardy and positively dangerous. The master, who was still in command, should have ensured that any action taken was carried out in a safe and controlled manner.
(Ref: 2.2.2)

3.3.7 When entry is to be made to a smoke filled space, a fire team should consist of a minimum of two persons, and a safety line should be rigged.
(Ref: 2.2.3)

3.3.8 The current position of the overboard valve on the diesel driven emergency fire pump exhaust line requires either the fitting of an extended spindle system or, better still, the repositioning of the exhaust line to allow direct access to it from the forecastle deck or forward accommodation.
(Ref: 2.3.2)

3.3.9 The practice of leaving the watertight door between the engine room and the cement room in the open position, led to smoke logging of the cement room, preventing access to the emergency fire pump.
(Ref: 2.3.2)

3.3.10 Although the fire equipment carried on this vessel; one SCBA and a smoke hood, complies with the regulations, the provision of just one SCBA limits the amount of fire fighting action that can safely be undertaken.
(Ref: 2.3.1)

3.3.11 Chisel marks on the bolts suggest that access difficulty prevented easy tightening of bolts or the replacement of seals unless the complete unit was dismantled.
(Ref: 2.3.4)

3.3.12 The use of the 2182kHz emergency channel for conversations and/or non-urgent messages frequently interrupted the conversation between the master and Falmouth Coastguard.
(Ref: 2.3.5)

SECTION 4 RECOMMENDATIONS

Sealion Shipping Ltd is recommended to:

1. Re-examine the emergency diesel driven fire pump exhaust system with a view to providing either extended spindle operation of the overboard valve, or re-routing the exhaust line to allow direct access to the valve from the forecastle deck or forward accommodation.

2. Advise all their crew members on current fire fighting practices and instruct senior officers in the dangers of entering smoke or gas filled spaces without the use of SCBA and the correct procedures that should be followed before, and during, entry.

3. To install an additional SCBA and associated equipment on board its managed and owned vessels in the interests of crew and vessel fire fighting safety.

4. Consider the fitting of locking devices on the pipe flange bolts securing the hydraulic oil pipes to the O/D box.

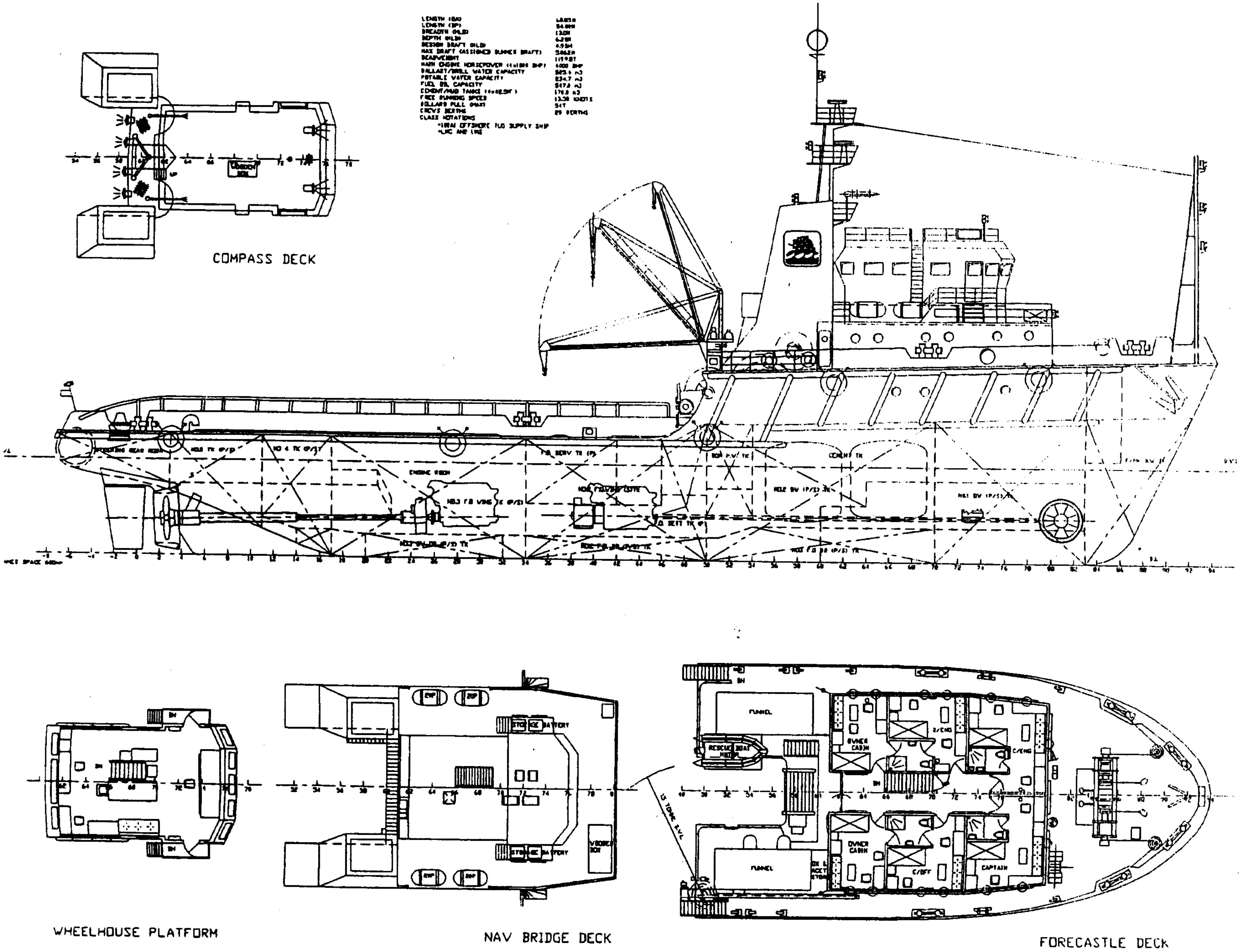
5. Review the practice of leaving the watertight door between the engine room and the cement room in the open position.

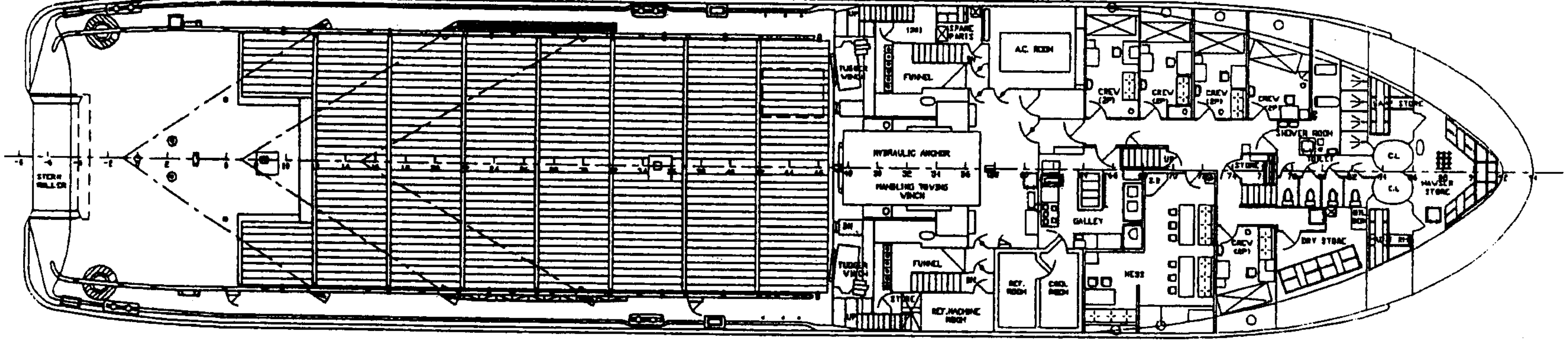
The Marine and Coastguard Agency is recommended to:

6. Review the Merchant Shipping (Fire Protection) (Amendment) Regulations 1999, which continues to accept a smoke helmet/smoke mask as an alternative to a SCBA.

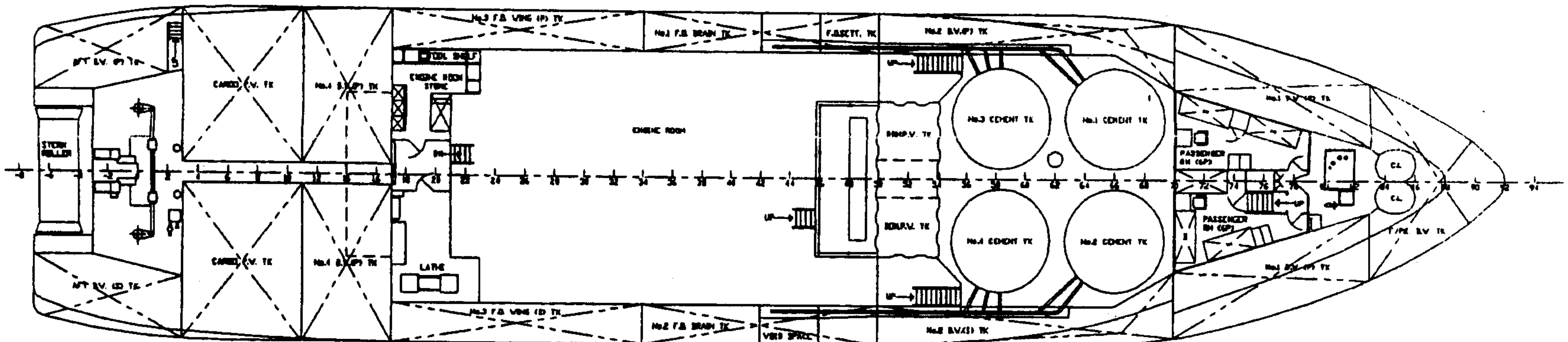
ANNEXE 1

1. Vessel Specification and Plan.

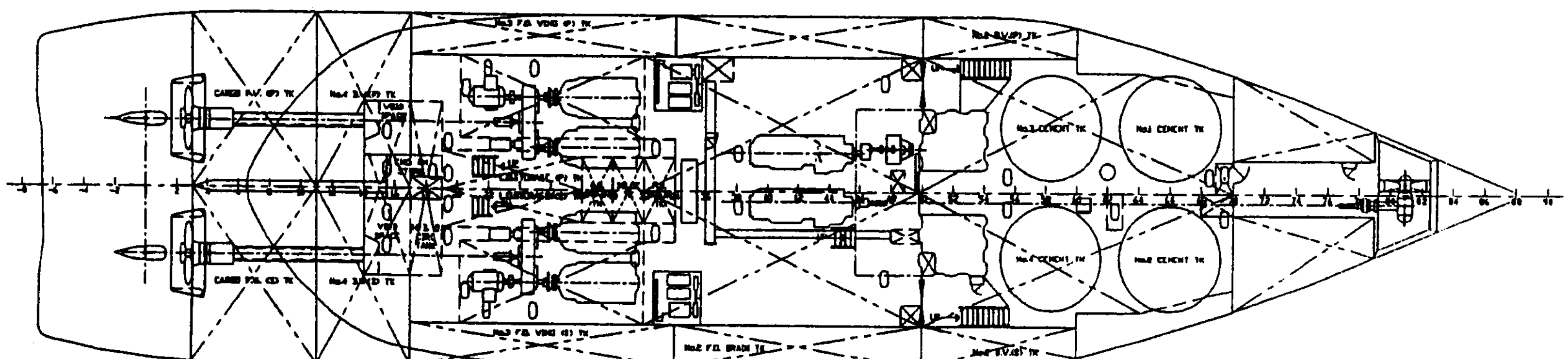

COMPASS DECK
WHEELHOUSE PLATFORM
NAV BRIDGE DECK
FORECASTLE DECK



MAIN DECK



PLATFORM



HOLD BOTTOM

VESSEL SPECIFICATION - TOISA GRYPHON

4,000 BHP PLATFORM SUPPLY VESSEL

GENERAL

VESSEL NAME	: Toisa Gryphon
PREVIOUS NAME	: SSS Freemantle / TNT Lynx
OWNER/MANAGER	: Toisa Limited / Sealion Shipping Limited
TYPE/DESIGN	: North Sea Platform Supply Vessel
BUILDER	: Hu Dong Yard, China
YARD NUMBER	: 1149
DELIVERY DATE	: June 1984
FLAG	: British
PORT OF REGISTRY	: London
OFFICIAL NUMBER	: 383093
CALL SIGN	: G D V H
CLASSIFICATION	: LRS +100A1+ LMC, UMS, Offshore Tug/Supply Ship

DIMENSIONS

L.O.A.	: 60.85 metres
L.B.P.	: 54.00 metres
BEAM (MOULDED)	: 13.00 metres
DEPTH (MOULDED)	: 6.20 metres
DRAFT (SUMMER)	: 5.06 metres
MAX DEADWEIGHT	: 1,184.5 tonnes
SUMMER DISPLACE.	: 2,499.5 tonnes
AIR DRAFT	: 23.80 metres
GRT / NRT	: 1252 / 375

CARGO CAPACITIES

CLEAR DECK	: 31.0 metres x 10.0 metres
DECK AREA	: 310 m^2
DECK CARGO	: 500 tonnes
DECK LOAD	: 5-7 tonnes per m^2
POTABLE WATER	: 362.65 m^3
DRILL WATER	: 534.07 m^3
FUEL OIL	: 404.9 m^3
OIL BASED MUD	: 1,745 Bbls
BRINE	: 1,745 Bbls
BASE OIL	: 1,745 Bbls
DRY BULK	: 6,000 Cu Ft.
NO. OF BULK TANKS	: 4 pressure tanks, each 1,500 Cu Ft.

DISCHARGE RATES

POTABLE WATER	: 100 m^3 per hour against a 65 metre head
DRILL WATER	: 100 m^3 per hour against a 65 metre head
FUEL OIL	: 100 m^3 per hour against a 65 metre head
OIL BASED MUD	: 500 Bbls per hour against a 60 metre head
BRINE	: 500 Bbls per hour against a 60 metre head
BASE OIL	: 500 Bbls per hour against a 60 metre head
DRY BULK	: 50 m^3 per hour / 60 PSI system

SPECIFICATION - TOISA GRYPHON (continued)

MACHINERY

MAIN ENGINES	: 4 x MAN-B+W type 8L20/27 each rated 1,000 BHP at 1,000 RPM
TOTAL BHP	: 4,000 BHP
AUXILLIARIES	: 2 x MAN-B+W type 5L20/27
SHAFT ALTERNATORS	: 2 x AVK, each rated 250 Kw
ELECTRICAL POWER	: 220/440 V, 60 Hz
RUDDERS	: 2 x semi balanced rudders
PROPELLERS	: 2 x four bladed, variable pitch in nozzles
BOW THRUSTER	: 1 x 500 BHP Jastram tunnel thruster (6.25 tonnes thrust)
TUGGER WINCHES	: 2 x 10 tonnes
CAPSTANS	: 2 x 10 tonnes
JOYSTICK	: Poscon system
FIFI	: 2 x 300m^3/hr monitors mounted on gantry between funnels

PERFORMANCE

SPEED/FUEL	: About 0.5 tonnes MGO per day in port About 3.5 tonnes MGO per day at 5 knots About 5.5 tonnes MGO per day at 10 knots (economical) About 11.25 tonnes MGO per day at 13.25 knots (maximum)

NAV/COMMS

: 1 x Navstar 2000
: 1 x Furuno FSN-70
: 1 x Decca Bridgmaster (ARPA type)
: 1 x Furuno FR1011
: 1 x Autopilot Tokyo PR2000
: 1 x Tokyo Gyro Compass
: 1 x Tokyo Magnetic Compass
: 1 x Echo Sounder Furuno FE502
: 1 x Log Furuno MF22
: 1 x Joystick syatem
: 1 x Skanti TRP6000
: 1 x Sailor RT144C VHF
: 1 x JRC NCE2211 VHF
: 1 x Satcom C (Telex)
: 1 x Cellular Telephone
: 1 x DF Furuno ED120

ACCOMMODATION

CREW	: 9 x 1 berth, 1 x 2 berth
PASSENGERS	: 1 x 2 berth, 1 x 4 berth, 1 x 6 berth (with dedicated WC's and Showers)

This specification is subject to change without prior notification.
The particulars above are believed to be correct, but are not guaranteed.

2. Owners Inspection & Repair Specification.

1. DRAWINGS AND OPERATION MANUALS

1. Owner will supply copies of drawings and extracts from operation manuals for the original installation, to assist in estimating the cost to carry out the repairs. (see enclosed cabling schedule).
2. It will be the Contractors responsibility to document any proposed changes to the reinstated installation covering types of equipment, types and sizes of cables etc.
3. Any changes to original installation must be to Lloyds and Owners approval.
4. As fitted drawings of the completed work will be required.

2. EXECUTION OF THE WORK

1. All reinstatement work to be carried out to the standard required by LRS rules and to the satisfaction of the local Surveyor.
2. Were appropriate SOLAS and the IEE regulations for marine installations will apply.
3. Cables above 35 mm^2 are to be spliced by an approved priopriety system. Any deviation from this is to be stated at time of tender.
4. A **"Method Statement"** describing the Contractors proposed method of achieving cable reinstatement is to be submitted with the tender. The statement should cover, but not be limited to: -
   a) Identification of cables prior to removal or cutting.
   b) Tagging of cables to be cut with rugged identity tags.
   c) Methods of jointing cable.
   d) Testing procedure covering conductor resistance and insulation resistance.
   e) Commissioning procedure.
   f) Testing procedure covering conductor resistance and insulation resistance.
   g) Commissioning procedure.
5. Method statements covering all systems, pneumatic and electrical, will be required to be submitted to Owners and the local Surveyors for discussion and approval before work is commenced.
6. Damaged cables and pneumatic control piping, as they are identified, are to be scheduled, by destination area, (i.e. Bridge, Emergency stops station, etc.), by circuit (i.e. Distribution boards, bridge controls, alarms etc.), size and length. During this stage of the work daily schedules are to be completed and submitted to the Owners representative.

4. TESTING OF THE COMPLETED WORK

1. On completion of the repairs, it will be necessary to carry out a full Schedule of testing and commissioning, to prove that all systems both mechanical and electrical have been successfully brought back into service.
2. At an early stage of the refurbishment, a program is to be prepared by the contractor setting out the proposed testing procedures and documentation

5. PROGRAMME PLANING

1. The Contractor is to submit time scale / schedule to carry out the repairs.
2. A program of all the works to be carried out is to be submitted, showing how the Contractor is to achieve the refurbishment in the quoted time scale.
3. The program to cover but not be limited to:-
   a) Damaged cable identification.
   b) Procurement
   c) Installation
   d) Testing and commissioning.
   e) Control and alarm systems.
4. The successful Contractor will be required to submit a fully detailed program of works within one week of an order being placed.

6. SCOPE OF WORK - Refurbishment

1. **Main 440v AEG Switchboard.**
   Allow for cleaning and refurbishment of the 440V 60HZ Switchboard controlling generators and feeder circuits.
2. **Motor Starter Cabinets.**
   Allow for cleaning and refurbishment of all motor starters located in the engine room, steering gear flat, workshop area, and refrigeration machinery room.
3. **220V Main switchboard Section.**
   Allow for cleaning and refurbishment of the 230 Volt 60Hz switchboard.
4. **Transformers.**
   Allow for refurbishment of 440/220V 3ph 60 Hz transformers.

5. **Governors.**
   The condition of Main engine and Auxiliary governors is to be assessed, refurbishment by the manufacture or an approved Agent to be carried out if necessary.

6. **Engine Control Room Console.**
   Allow for refurbishment of the engine room control console and associated systems, which incorporates pneumatic and electrical control and monitoring systems for the following: -

   1. Main Engines
   2. Steering gear
   3. Auxiliary engines
   4. Pumps
   5. Clutches
   6. Controllable pitch propellers

7. **Control and Alarm System.**
   Allow for refurbishment of the Honeywell control and alarm system. A price is also to be quoted for a new control and alarm system to be installed consisting of the following: -

   1. 19 inch racks, Input Boards, Out Boards in engine room consul.
   2. Marine Operations Workstation, in engine room consul.
   3. Duty Engineer Selection Unit, in engine room consul.
   4. 4- off duty call stations in cabins and mess room.
   5. Local Operators panel to include group alarms, located on the bridge.
   6. Un-interuptable powers supply (UPS).
   7. Alarm and Control system Software.
   8. Alarm Sensors An allowance is to be made to refurbish / renew sensors. An alarm schedule giving location of sensors, type, operating range and set points is to be prepared and agreed with Owners and Lloyd's at an early stage.of the contract.

8. **Engine Room Power Sockets.**
   Allow for the refurbishment of the power outlet sockets 220 and 440 Volts.

9. **Engine Room Lighting.**
   Allow for the renewal of 90% of engine room and workshop light fittings.

10. **Engine Room Distribution Boards.**
Allow for Refurbishment of engine room 440 and 220 volts distribution circuit breaker or fuse boards.

11. **Diesel Driven and Shaft Driven Alternators 440V, 3ph, 60Hz (4-off).**
The end covers to be removed to allow examination and cleaning of the Alternators. Automatic Voltage Regulators (AVR) to be carefully examined for signs of damage, and refurbished by manufacture to be arranged if necessary.

12. **Engine Room Auxiliary motors**

    1. All Engine Room motors to be megger tested and insulation readings recorder.
    2. Allow for the refurbishment/ cleaning of all end ventilated drop proof (EVDP) motors in the engine room. If satisfactory insulation readings can not be achieved, then it will be necessary to rewind the motors.
    3. Totally closed fan cooled (TEFC) motors to have their fan cowls removed and the motor casing thoroughly cleaned. And reassembled.

13. **Communications Equipment.**
Allow for the refurbishment of or replacement of engine room communication equipment to included the following: -

    1. Emergency telegraphs.
    2. Automatic telephones.
    3. Sound powered telephones.
    4. Flashing beacons and or bells.

14. **Fire Detection and General Alarm Systems (Yamatai Honeywell).**
Allow for the refurbishment or replacement of the fire detection system in the engine room as follows.

    1. One repeater panel at engine room control consul.
    2. Smoke and heat detector heads.
    3. Manual call points.
    4. Alarm sounders.

15. **Engine Room Halon Flooding System Allow** for refurbishment and recharging of the engine room Halon flooding system.

7. RECABLING IN ENGINE ROOM

All cables to and from main switchboard to engine room equipment to be inspected, megger tested and all readings recorded. Damaged cables to be renewed according to original cabling schedule to the approval of Lloyds and Owners. To include but not be limited to the following: -

1.All engine room Motors

2.Air Conditioning Refrigeration and ventilation equipment.

3.Workshop machinery.

4.UMS Monitoring and alarm system.

5.Main Engine control system.

6.Controllable Pitch propeller plant and controls.

10. CONTRALABLE PITCH PROPELLER SYSTEM

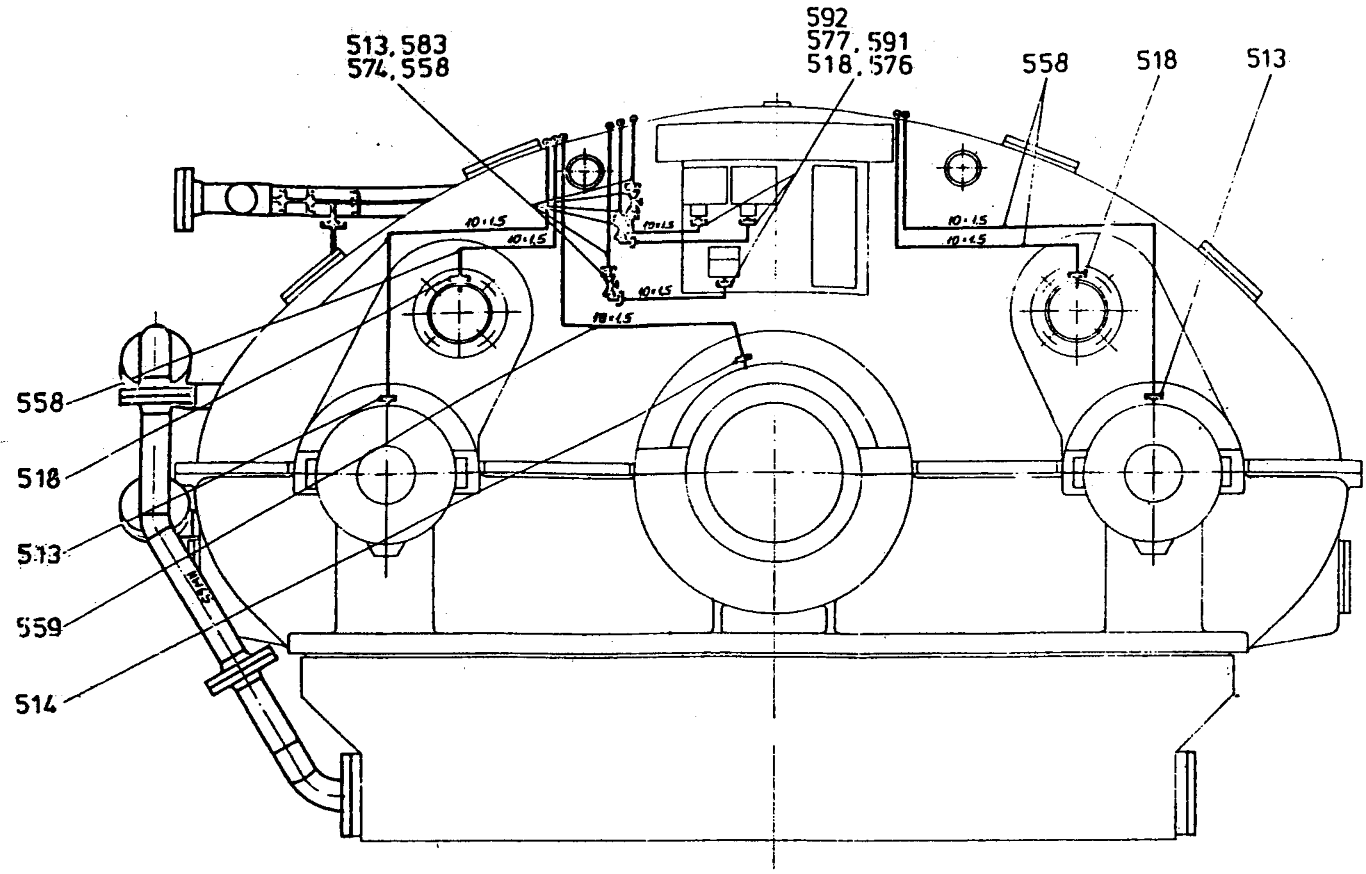
1. The CPP system to the Starboard propeller is damaged. It will be necessary to call in the manufactures (B&W Alpha) to carry out refurbishment and repairs to this system.

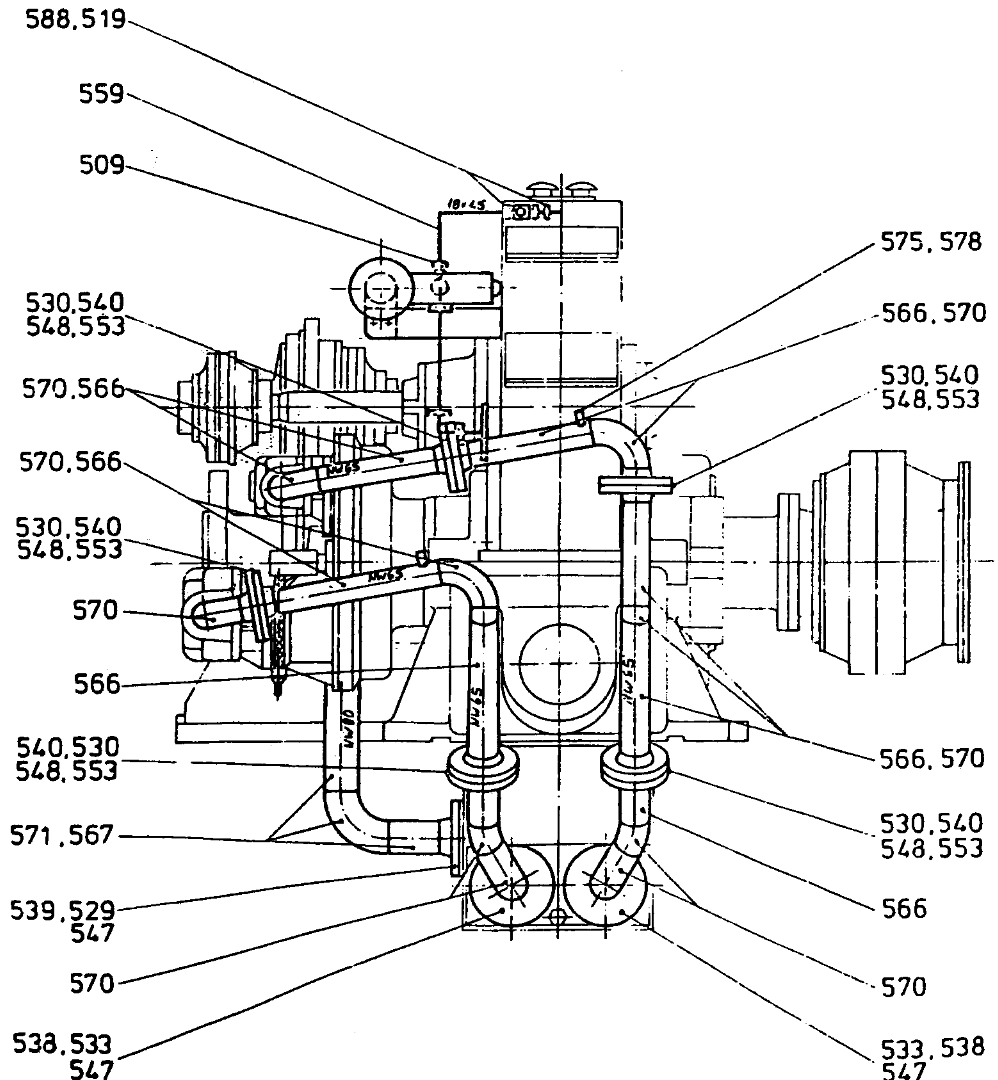
11. COMMISSIOING OF REFURBISED EQUIPMENT

1. As stated in section 4 a full schedule of testing and commissioning is to be carried out, this to included but not be limited to the following: -
    1. All mechanical commissioning, including running of the main engine and propulsion plant, and diesel driven and shaft driven alternators.
    2. The Protection and control systems of main and auxiliary systems. Clutch control system.
    3. CPP control System.
    4. If required by Lloyds, alternator load testing is to be carried out, to include the hire and connection of load tanks.
    5. Testing and commissioning of all electrical and instrumentation associated with then ships UMS notation is to be allowed for, to the satisfaction of the local Lloyd's Surveyor.

3. Plan of gearbox.

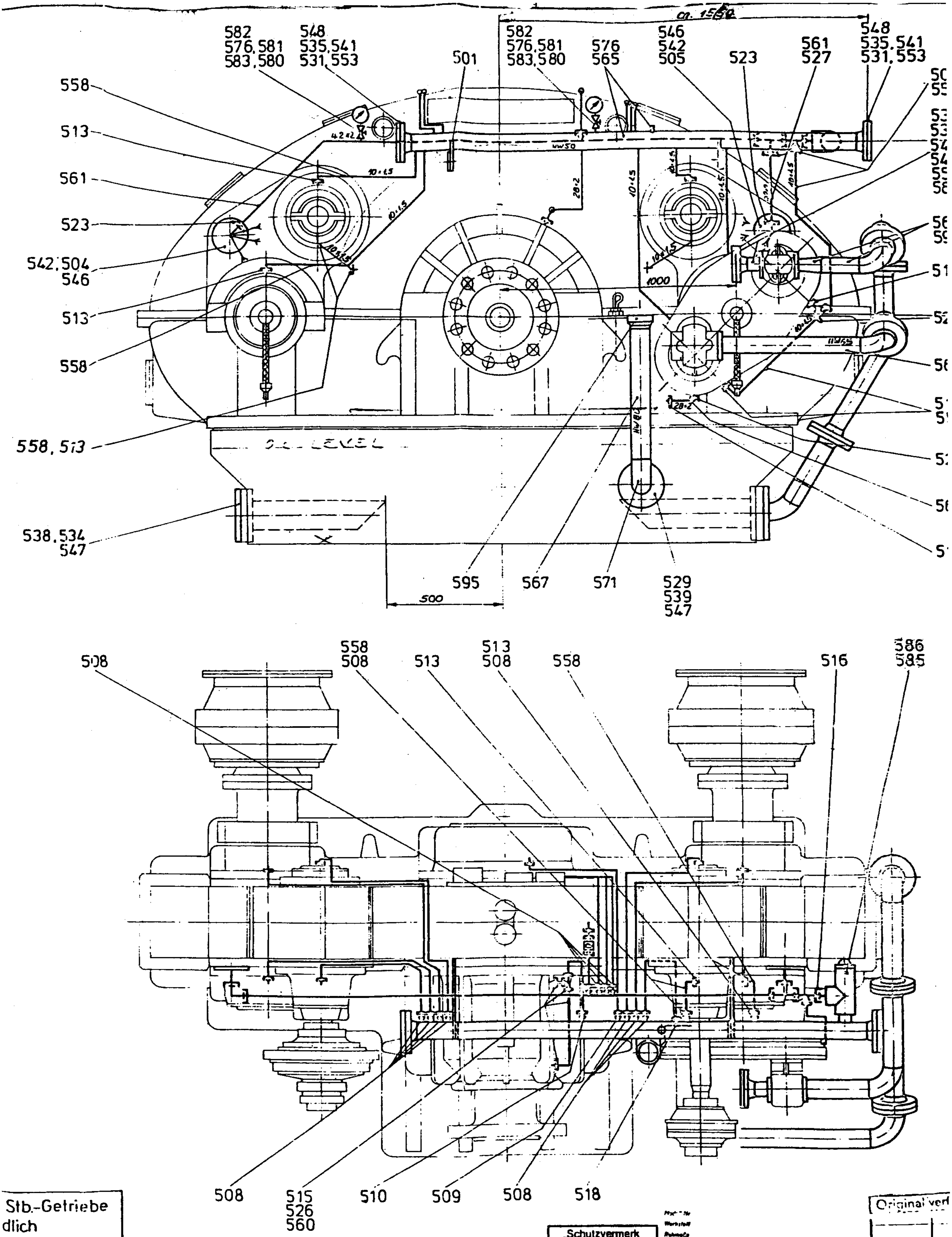
6





Darstellung zeigt das
Bb.-Getriebe spiegelt

drawing shows the
Bb.-gear specular



Stb.-Getriebe
dlich
b.-gear

„Schutzvermerk nach DIN 34 beachten"

Original verf

SVR 1000 B

Type

Rohrplan

GMBH-Witten

1 / 4596 / 1030 / 1

421 240 476 ... 479
12 / 240 471 ... 475

4. Photographs of Vessel & Fire Damage.

Fig 1 View of *Toisa Gryphon* arriving in Falmouth after the fire.

Fig 2 View of accommodation block from aft. Note entrance to the Halon Compartment, port side adjacent to ladder access to forecastle deck.

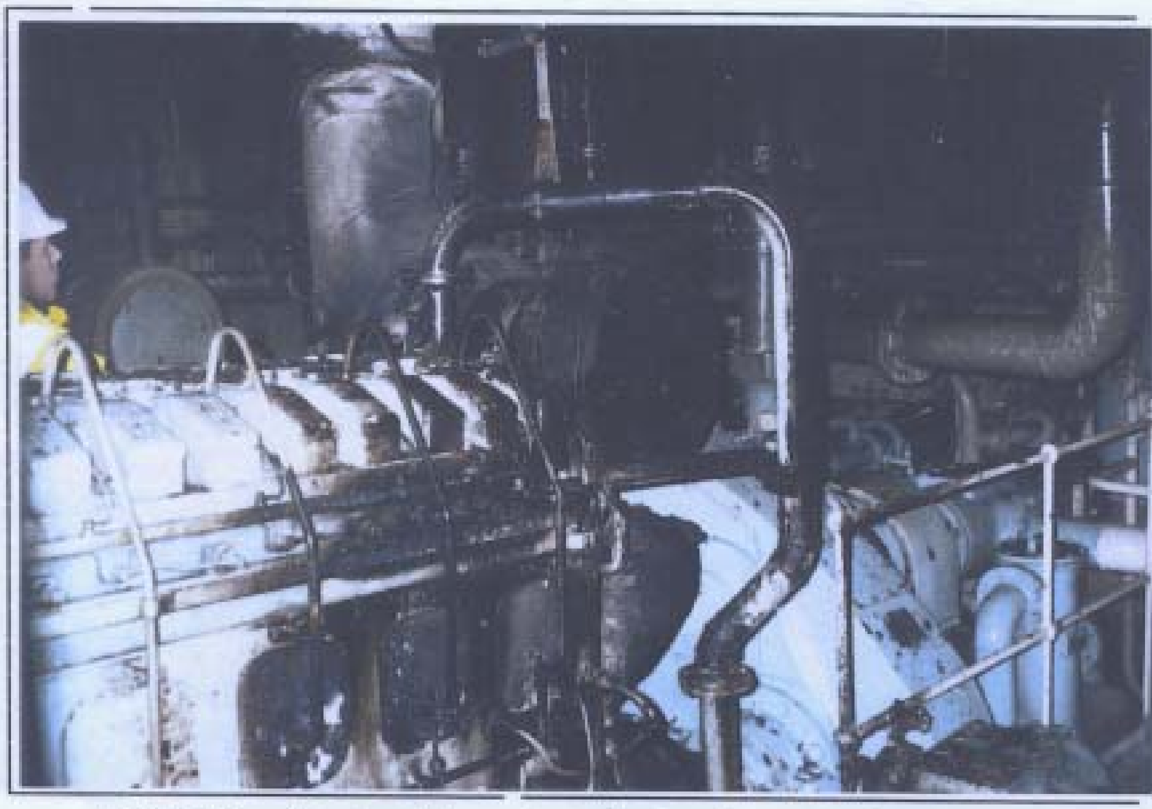


Fig 3 View of starboard inner main engine showing extent of heat and smoke marking on engine crankcase and turbo-charger.

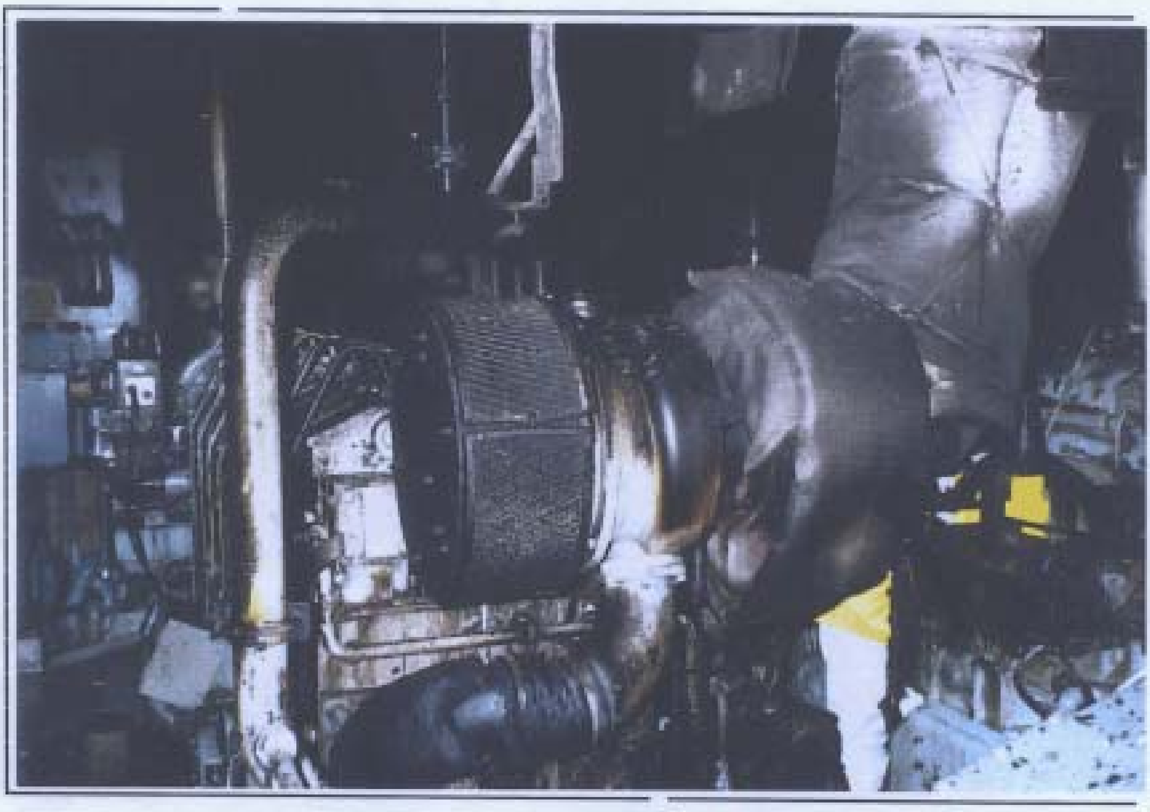


Fig 4 View starboard inner main engine turbo-charger showing localised nature of oil burning at lower levels.

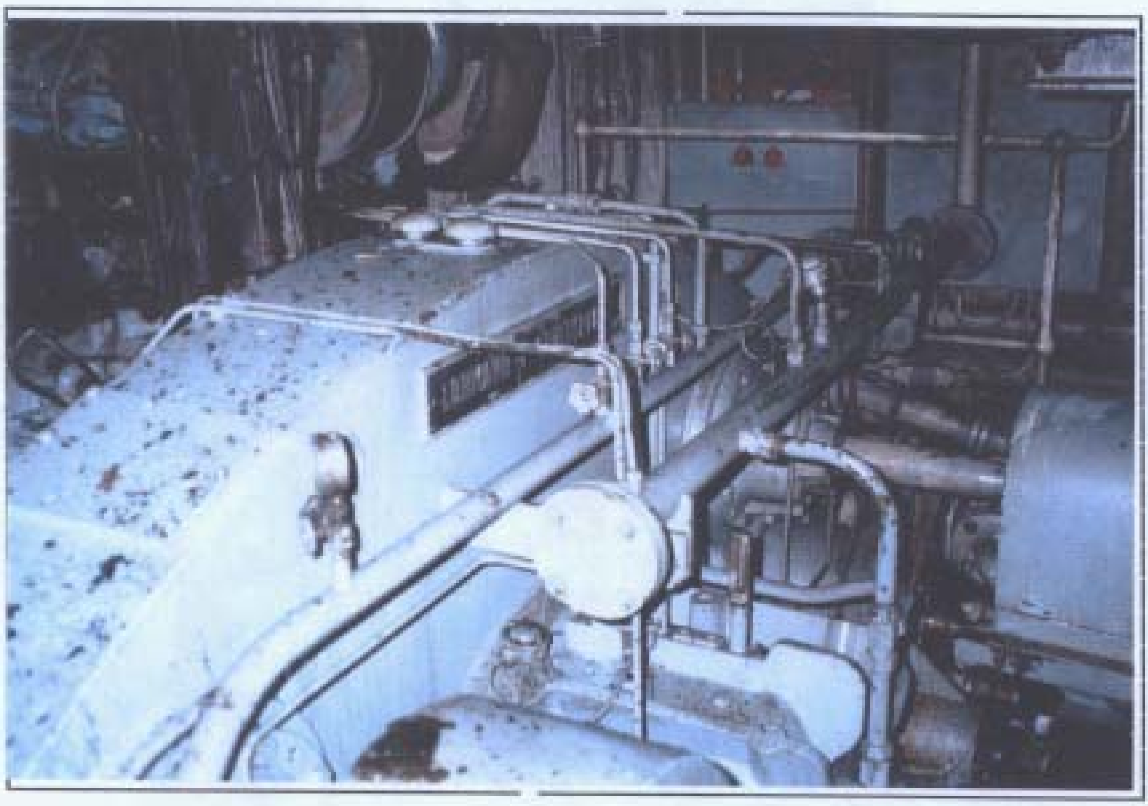


Fig 5 View of starboard gear box from aft. Note lack of discolouration or smoke damage.

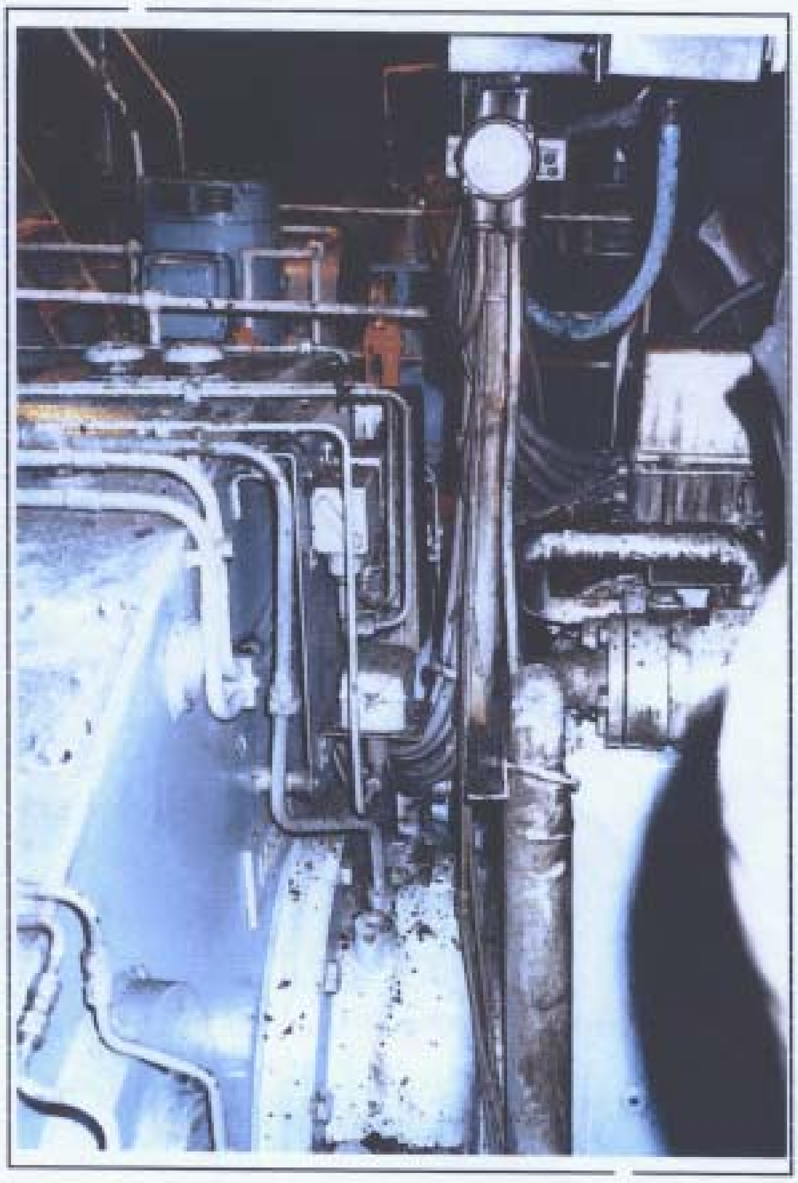


Fig 6 View of starboard gear box, forward side, looking from starboard to port.

Fig 7 View of alarm and signal actuator panel above starboard gear box showing increasing damage towards the deckhead.

Fig 8 View of deck machinery hydraulic pipework at deckhead, starboard side, aft. Note heat blistering of paintwork.

Fig 9 View of starboard side deckhead and bulkhead interface showing soot and oil runs as well as failure of lagging clips.

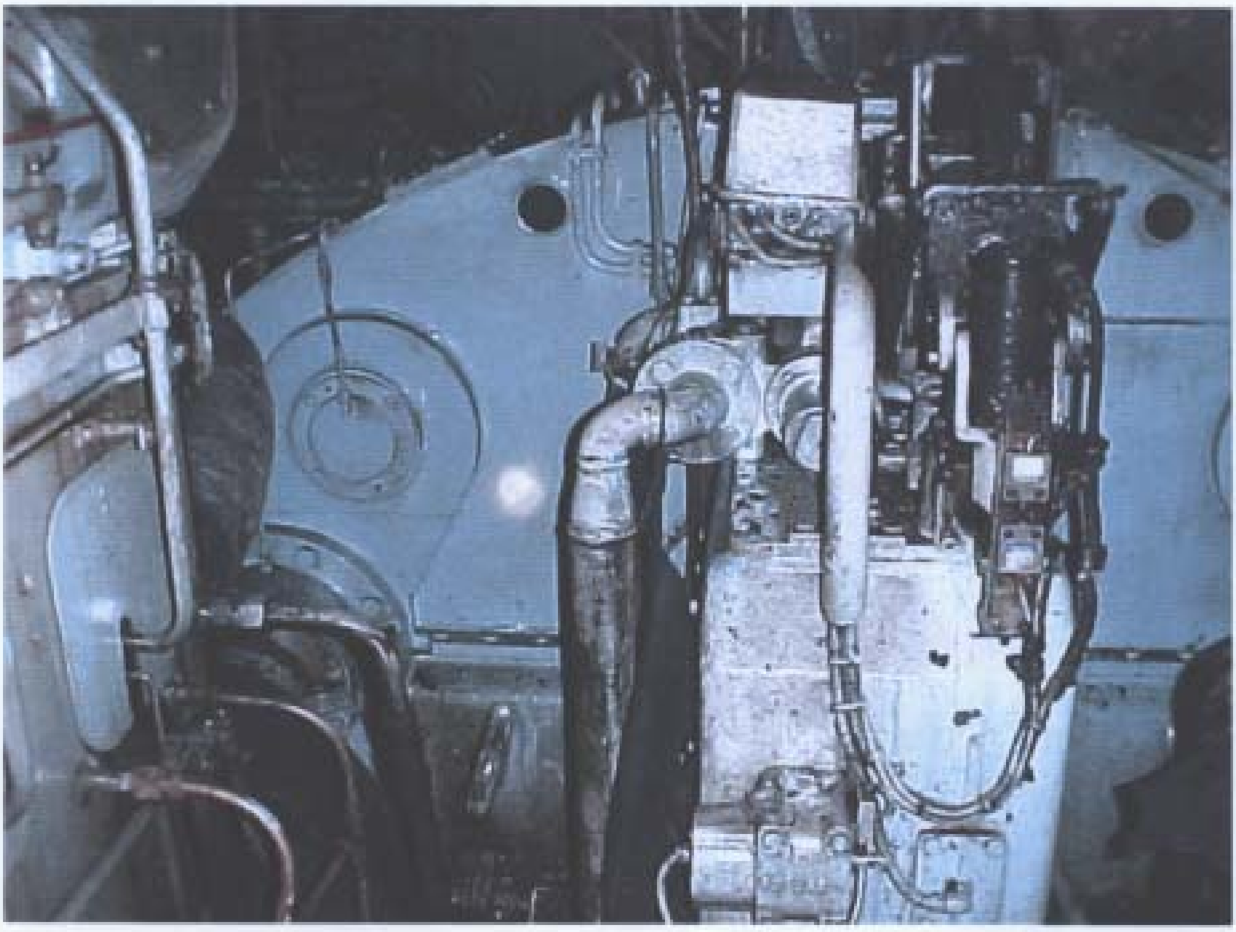
Fig 10 View of aft cross alleyway outside of accommodation block. This gives access to both port and starboard engine room entrances. Note outer accommodation door in normal open position.

Fig 11 View looking to port from outer entrance door of engine room, through inner door to lobby showing open stores locker. Entrance to engine room is to the left where cables are passing down stairway.

Fig 12 View looking aft through port alleyway showing outer engine door flat against funnel casing. This is not as shown on GA.

5. Owners Photographs of Flange and Broken Seal Ring.

Close up view of O/D box after fire



Forward side of starboard gear box with CP propeller O/D box in foreground

Close up of leaking HP flange connection (bolts removed)

Broken seal ring

Undamaged seal ring groove on pipe flange

Pipe flange showing missing section of seal ring

General view of pipe flange connections

Close up of flange face of O/D box

Other pipe flange showing seal ring complete and in place