Report of an Investigation

into a switchboard explosion on

m.v. *Pride of Le Havre*

on 27 July 1998

off the Port of Le Havre, France.

MAIB 1/1/127

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.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

RoRo	-	Roll on/Roll off [designed for the carriage of vehicles]
BST	-	British Summer Time
ECR	-	Engine Control Room
SCBA	-	Self Contained Breathing Apparatus
CO_2	-	Carbon Dioxide Gas
SAMU	-	French Paramedic Response Unit
TGB3	-	Ferry Terminal in Le Havre
Hz	-	Hertz or unit of frequency
Ph	-	Phase
VER	-	Voyage Event Recorder
H&S	-	Health and Safety
HSE	-	Health and Safety Executive
COM	-	Common Terminal
RMS	-	Root Mean Square [the square root of the mean value of the squares of the instantaneous voltages taken over one complete cycle]
AEG	-	German Manufacturing Company
IMO	-	International Maritime Organisation
WHO	-	World Health Organisation
ac	-	Alternating Current
dc	-	Direct current

SYNOPSIS

This accident was notified to the Marine Accident Investigation Branch (MAIB) by the Maritime Rescue Sub-Centre SOLENT at 0141 on Tuesday 28 July 1998. The investigation started later the same day and was undertaken by Mr A Rushton.

Pride of Le Havre is a 33,336 gross tonnage passenger/roro cargo vessel operating a regular ferry service between Portsmouth and Le Havre. She is registered in Portsmouth, UK and is managed by P&O European Ferries (Portsmouth) Limited The vessel is fitted with bow and stern doors and is capable of carrying 590 cars and 1600 passengers. Propulsion is by four diesel engines driving through two controllable pitch propellers. Two transverse thrust units are fitted forward.

The vessel completed loading at Le Havre at 2202, left the berth at 2211 and proceeded on passage for Portsmouth. At 2218 when passing the outer breakwater, the vessel suffered a "black out" with apparent loss of all main and auxiliary power. The main engines were not affected and the vessel retained manoeuvrability. Port Control was advised and tug assistance requested. The master was told of injuries to three engine room personnel and that a first aid party was required. Electrical power was restored at 2225 with the chief engineer reporting a fire in the engine control room. The crew alert was sounded and fire parties were sent to the engine room. The fire was reported out at 2238. Due to the serious nature of the injuries, medical help was sought from qualified passengers.

The vessel steamed south of the main approach channel while arrangements were made to return to port and for a medical team to board from the pilot boat. With two tugs attending, the vessel re-entered the harbour and berthed at 0024. The three casualties were then landed ashore by ambulance. Following a full assessment of the situation and the testing of all primary systems, the vessel sailed for Portsmouth at 0150. At 0712 the vessel arrived at Portsmouth where all passengers and vehicles were disembarked. The vessel was then taken out of service and moved to a lay-by berth to await examination and repair.

The explosion is considered to have been caused by a direct connection being made between two phases of the 660volt incoming supply. Contributory causes include the use of non-company issue test equipment and entangled test leads.

Recommendations are aimed at improving electrical safety by using fused test probes together with tighter company control over the use of non-company issue test equipment.

MV PRIDE OF LE HAVRE - Vessel Position and Timings

PARTICULARS OF VESSEL.

Name	:	*"Pride of Le Havre"*
Official No	:	725334
Port of Registry	:	Portsmouth, UK
IMO Number	:	8712518
Gross Tonnage	:	33,336
Deadweight	:	4,100 tonne
Overall Length	:	165.00 metres
Breadth	:	33.40 metres
Maximum Draught	:	6.526 metres
Year of Build	:	1989
Type	:	Passenger/RoRo Cargo
Main Engines	:	SULZER Diesel 8ZAL40S 4 off total 19,600kW
Propulsion	:	Two Controllable Pitch Propellers
Generators	:	4 x 1795kW 660V 60Hz 1 x 500kW 440V 60Hz Emergency
Owners	:	Island Shipping Ltd, Bahamas.
Managers	:	P&O European Ferries (Portsmouth) Ltd
Classification Society	:	Germanischer Lloyd
Date and Time	:	27 July 1998, 2218 BST.
Place of Incident	:	Port of Le Havre, France.
Injuries	:	One badly burnt who subsequently died. Two with less severe burns.
Damage	:	Vehicle deck fan controls, drencher pump and No 2 non-essential switchgear damaged to varying degrees.

SECTION 1 FACTUAL INFORMATION (all times BST)

1.1. BACKGROUND TO VOYAGE.

Pride of Le Havre is owned by Island Shipping Limited, a Bahamian company, with disponent owners and bareboat charterers P & O European Ferries (Portsmouth) Limited, UK operating as managers since 1993. The management company, together with its sister companies, P & O North Sea Ferries, P & O Irish Sea and P & O Scottish Ferries, currently manage 21 vessels on UK- Europe ferry routes.

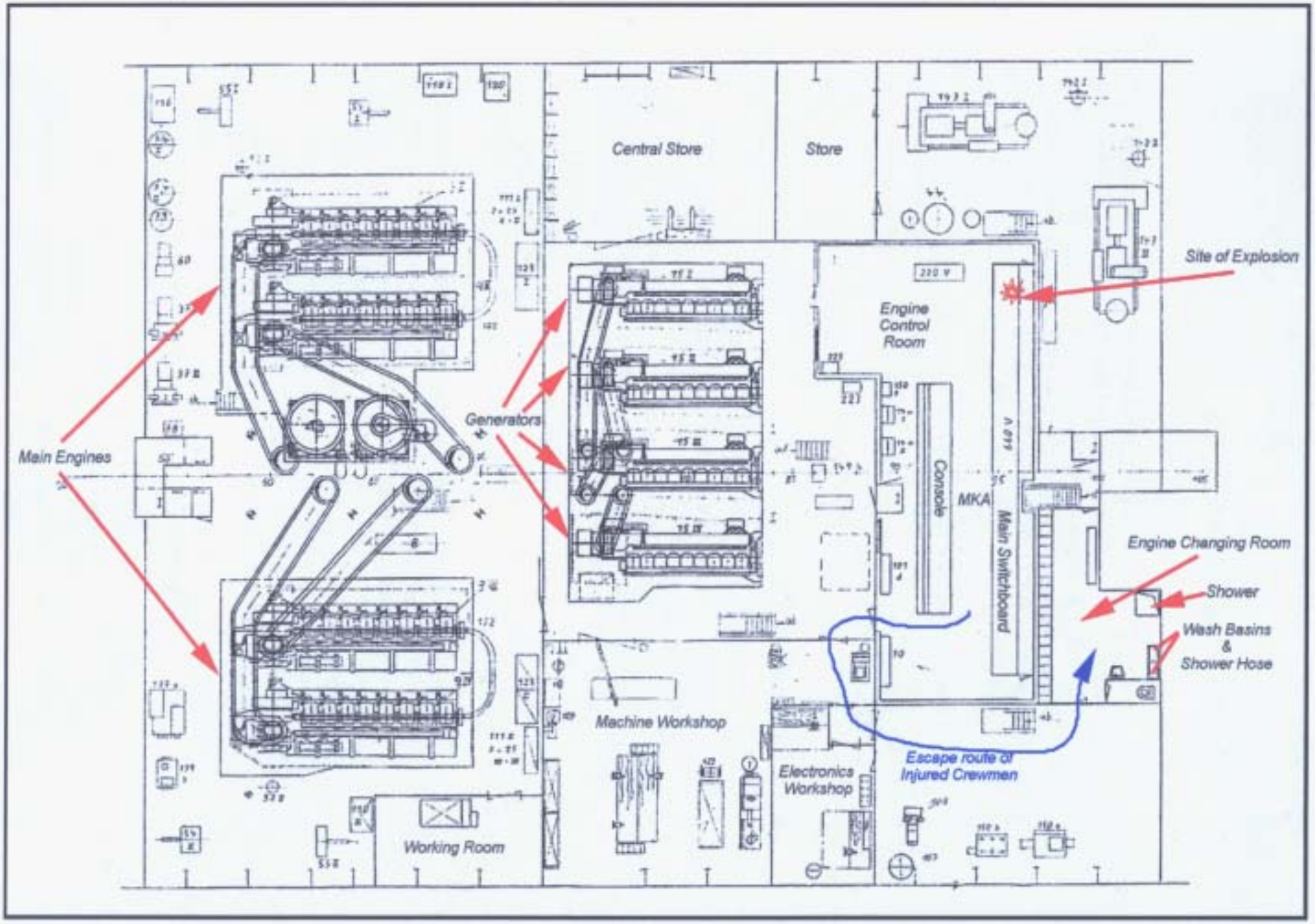
The vessel departed Portsmouth for Le Havre at 1445 on 27 July 1998 with 138 assorted vehicles and 564 passengers. The voyage was uneventful with the weather recorded as south-west force 4, good visibility and moderate conditions.

1.2. NARRATIVE.

1.2.1. As *Pride of Le Havre* was scheduled to arrive at Le Havre at 2015, standby was rung at 1936 at which time the chief engineer joined the duty third engineer in the engine control room (ECR). Just prior to the vessel passing the Le Havre breakwater, the watch changed, with the relieving third engineer taking over the watch at 2000. Standby continued until 2018 when the bridge rang "finished with engines". Various items of machinery were shut down as the state of readiness in the engine room was reduced to the in-port level. This state was reached at about 2035 at which time the chief engineer left the ECR.

The duty third engineer, after starting the diesel oil purifier, remained in the ECR as he was aware that a fire drill was due once the car deck was clear and all passengers and freight vehicles had left the vessel. At about 2050, the fire alarm was rung and all crew mustered at their emergency stations for a fire drill. This was a simulated fire occurring in the laundry room, port aft on No 5 deck. At the same time as the fire alarm sounded, the day-work second engineer entered the ECR, followed shortly afterwards by one of the electro-technical officers. This was their emergency station. The fire drill was completed at about 2120 at which time both the second engineer and the electro-technical officer left the ECR and returned to the accommodation.

1.2.2. The watch continued as usual for port duties with loading starting as soon as the fire drill had ended. The bridge gave notice of 15 minutes to stand-by at about 2150, at which time the duty third engineer called the



Plan of Engine Room - MV PRIDE OF LE HAVRE

day-work second engineer officer for departure standby. He arrived in the ECR at about 2155 followed shortly afterwards by one of the electro-technical officers. The engine room machinery had, by this time, been brought up to a higher state of readiness, with three generators running and on the board. The engine room staff were told at 2204 that all four main engines would be required for departure as well as one bow thruster.

The main engines and the electric motor for the bow thruster were started and a final check made of the engine room before the main engines were clutched in. When the bridge confirmed that all was clear aft, the engines were clutched in and control of the bow thruster transferred to the bridge. At 2208, the second engineer told the bridge that the engine room was ready for sea, stand-by was rung and main engine control transferred to the bridge.

1.2.3. At about 2210, the duty cargo second officer came into the ECR on a routine call to deliver the hazardous cargo sheet, details of which were entered into the log book. At that time, the electro-technical officer, the second engineer and the duty third engineer were standing by the control console on the starboard side of the ECR. The vessel had left the berth at 2211 having loaded 161 assorted vehicles and 628 passengers and was now heading towards the breakwater and the passage to Portsmouth. The second officer, having delivered the hazardous cargo sheet, mentioned to the electro-technical officer that he had had a problem with the aft car deck fan - it would not start. On being asked if it was important, he said that it was normal for a fan to be run when they carried horses, as they now were.

The electro-technical officer went to the port side of the main switchboard and operated the breaker switch for the aft car deck fans. On doing this, the red light came on indicating that there was no electrical supply. The electro-technical officer then went round the back of the switchboard to presumably check on the condition of the fuses. Returning to the front of the switchboard, he tried the switch, again without success. He returned to the rear of the switchboard for a short time before coming back round the front to walk over to the starboard side of the control console where a test multi-meter was kept.

This test meter was not one supplied by the company nor the electro-technical officer's personal property. Apparently it had been supplied to the ship during building and had remained aboard when the vessel was bareboat chartered by P&O. It was usually kept in the ECR by the watchkeepers for checking the continuity of control fuses. It was not included in the vessel's test meter control and calibration system.

1.2.4. The second engineer asked the electro-technical officer if he wanted him to get one of the ship's meters from the nearby electricians' workshop but was told no, as it was unlikely that one would be there. Having picked up the multimeter, the electro-technical officer went round the back of the switchboard as before. At this time, the duty third engineer was on the port side of the control console, while the second engineer and the second officer were at the starboard end. When the electro-technical officer asked for help, the second engineer went behind the switchboard. The second officer followed him round, but did not go through the gate to the area behind the switchboard.

The second engineer joined the electro-technical officer and was asked to hold the meter while he, the electro-technical officer, applied the meter leads to part of the electrical equipment. With the second engineer holding the meter and concentrating on the scale, the electro-technical officer moved to apply the leads. This was at about 2218, just as the vessel was passing the outer breakwater. There was a loud bang immediately followed by an intense bright arc light which appeared, to the second engineer, to last for about two to three seconds.

1.2.5. The second officer, who was at the end of the switchboard but outside the gate, was momentarily blinded and stumbled out into the vicinity of the console desk. As his vision cleared, he patted out odd burning bits of his uniform and high visibility jacket that had caught fire in the flash-over. The second engineer could not see a thing for a few seconds even though his eyes were open. He stumbled out from behind the switchboard, became aware that he could now see again and that smoke was billowing out at the top of the switchboard. Seeing his hands were burnt and his boiler suit on fire, he shouted and ran towards the starboard door of the ECR, passing between the switchboard and the control console.

The electro technical officer came out from behind the switchboard covered in flames, and fell down in front of the second officer. Both of them pulled off a lot of burning material before the electro-technical officer made his way towards the starboard side of the ECR. There he met the second engineer and, even though both men's hands were burnt with the skin peeling off, they managed to get out of the door and ran round to the engineers' changing room.

1.2.6. The duty third engineer, who had remained standing by the control console, was, by this time, trying to cope with the various alarms caused by the partial blackout. He tried to contact the bridge by the sound powered telephone but did not get a response. He locked on the engineers alarm and stamped out various small fires caused by bits of burning boiler suit material. The emergency generator had started automatically by this time, providing emergency lighting and power.

Smoke had built up to such an extent in the ECR that the third engineer had to temporarily vacate the space.

The chief and accommodation second engineer, both of whom had been in the accommodation, had become aware of a possible problem after seeing a power surge and noticing that the fans had stopped. As they started to respond, the engineers' alarm sounded. Both men went down to the car deck on level three, through the generator room, and into the engine room. Both men saw smoke in the ECR and met the duty third engineer. The second engineer went to check on the three injured men in the engineers' changing room while the chief engineer, after checking on the current state of the machinery, went to the port side of the ECR to check the condition of switchboard. He found the fuse switch for the vent fans open and flames on all three fuse assemblies. With smoke making the conditions difficult, he returned to the engine room. After checking on the condition of the three injured men, he went back into the ECR from where he telephoned the bridge to tell them that first aid teams and fire parties were required in the engine room. He also asked for the fire alarm to be turned off.

1.2.7. *Pride of Le Havre* was just passing the breakwater when, at 2218, the blackout occurred. The master immediately contacted Port Control advising them of the situation and that he required tug assistance. By 2220, the master had confirmed that he still had manoeuvrability but that steering was without the benefit of helm indication. By 2222 the vessel was slowly moving towards an anchorage, the chief engineer had reported that there was a problem with the main switchboard, they required first aid parties, and that there were injured men at the scene.

At about 2225, full steering control was regained. On being told by the chief engineer of the fire in the ECR, together with a request for fire parties, the crew alert was sounded at 2227 followed by a verbal announcement to the crew to close up. At this point, the master told Port Control that he had regained control and that he was going south of the channel. Port Control responded by telling him that two tugs were on their way.

1.2.8. The chief engineer in the meantime, had sent the accommodation second engineer and the off duty third engineer to get self contained breathing apparatus (SCBA) sets and CO_2 extinguishers while he telephoned the bridge to ask for fire parties to muster in the engine room. The duty third engineer was sent to check the boilers while the chief engineer went to the engineers' changing room to see how the injured men were coping and if the first aid parties had arrived.

On returning to the engine room, the chief engineer sent the accommodation second engineer and a mechanic, wearing SCBA sets

and carrying CO_2 extinguishers, into the ECR to put out the flames seen earlier behind the switchboard. The space was full of thick smoke and although burning embers were found in front of the switchboard, no burning or flames were found at the rear. Both men then returned to the engine room. As background noise in the engine room made communication difficult, the chief engineer went on to the vehicle deck to use his VHF radio. At 2234, he spoke to the master telling him of the serious nature of the injuries and suggesting that medical help would be required. The master enquired about the machinery situation and was told that once the men came out of the ECR he would be able to give a more accurate assessment.

The accommodation second engineer and mechanic told the chief engineer that there was no fire although the atmosphere in the ECR remained very thick and smoky. This information was passed to the master at 2238. The first aid parties had by this time reached the injured and were attempting treatment. The chief officer who had also attended the injured, realised that the injuries were serious. At 2242, he asked the master to arrange for immediate evacuation. The chief engineer discussed the electrical generating arrangement with the accommodation second engineer and agreed that No 2 generator would be shut down leaving No's 3 and 4 generators running. With the situation in the ECR under control, efforts were made to clear any small remaining defects on the alarm panels while the machinery was prepared for returning alongside. The electrical switchboard was re-checked for hot spots - one only being found on No 2 preferential trip - with a fire watch being maintained at the rear. At 2246, the chief engineer reported to the master that the main engines were satisfactory but that he might have problems with the mooring winches.

1.2.9. At 2251, the purser reported that a doctor and a nurse from the passengers were attending the injured as well as a paramedic-trained crew member. The master, who had been arranging the re-entry of the vessel to Le Havre, was informed at 2256 that the pilot boat was waiting for the arrival of SAMU (French Paramedic Response Unit). At 2303, the master was told that the pilot would be with the ship within ten minutes. At 2310, the master advised the passengers of the situation using the public address system. At 2326, the pilot and SAMU boarded and the vessel returned to port using full power. At 0024 on the 28 July 1998, *Pride of Le Havre* docked alongside TGB 3.

Once the vessel had berthed, an ambulance was driven on board and the three injured crewmen landed to local French hospitals for assessment prior to being sent on to specialised burn units.

1.3. CREW INJURIES.

1.3.1. Three members of the crew were injured in the accident, Paul Mead, electro technical officer, William Bolton, acting second engineer, and Bruce Thomas, second officer.

The most seriously injured member was Paul Mead who suffered sixty degree burns to his face and body. Although initially conscious following the accident, he subsequently fell unconscious and despite extensive hospital treatment in France, died from his injuries on Sunday 2 August 1998.

Second engineer William Bolton, suffered third degree burns to his hands and second degree burns to his face. After initial hospitalisation in France, he was transferred by air ambulance to a burns unit in the United Kingdom for further in and out-patient treatment.

Second officer Bruce Thomas suffered superficial facial burns and burns to his hands. He also, after initial hospitalisation in France, was transferred by air ambulance to a burns unit in the United Kingdom for a skin graft on his left hand. Further out patient treatment continues.

1.3.2. Although no other member of the crew suffered directly from the incident, some of the engine room staff suffered from varying degrees of shock.

1.4. DESCRIPTION OF VESSEL

1.4.1. The vessel is a steel hulled, twin screw passenger/roro cargo ferry propelled by four marine diesels driving through flexible couplings and double reduction gear boxes to two controllable pitch propellers. A single bow and twin stern doors with ramps provide double ended access. Two transverse thrusters with controllable pitch propellers are also fitted.

The engine control room (ECR) is on "2" deck, forward of, and over looking, the generator room. The main console is in the centre of the ECR, faces aft, and is fitted with controls and instrumentation for the operation and control of both main and auxiliary machinery. The main switchboard is about 1 metre aft of the forward bulkhead and runs port to starboard. The watchkeeper's normal position for monitoring the performance of the operating machinery is between the front of the switchboard and the console.

Main Switchboard (Port Side) Panels 1, 2 & 3

1.4.2. The main switchboard is a dead front, enclosed type, 14.8m long and made up of 21 separate panels. The operating systems are 660v, 3Ph , 60Hz and 440v, 3Ph, 60Hz. Four main alternators supply power to the switchboard, No's 1 and 2 on the port side, No's 3 and 4 on the starboard side. The panels are numbered from port to starboard with the fire occurring on the port side in panel No 2. Access to the 600mm wide access passage at the rear of the switchboard is from either end through a locked wire mesh gate. The switchboard is open backed giving ready access to switchgear, fuses etc. which operate at 660volts ac 60Hz.

The switchboard is well lit from the front with all panels and controls in apparent good order. The original German name plates, together with their English equivalent, are attached to the panel front, next to the appropriate switch. No 2 panel contains the breakers for the main supply to vehicle deck fans, drencher pump, and No 2 non-essential services. No 3 panel contains the actual group controls for the fans, various auxiliary engine room machinery, deck and car deck hydraulics and a galley transformer. No 1 panel contains the controls for reefer sockets and the air conditioning plant. Details of panels No 2 and 3 are shown in annex 1.

1.4.3. Access to the ECR is from aft, from the generator flat, through either of two doors, one port and one starboard. The entrance to the generator flat from the accommodation is from the starboard side, through the machinery workshop and annex into the engineers' changing room and then into the lift and stairwell on the centre line. An alternative route is through the car deck on "3" deck, direct into the generator flat on the centre line.

Hot and cold washing facilities in the engineers' changing room comprise a shower cubical, two deep stainless steel sinks and a single flexible shower connection.

1.5. SWITCHBOARD DAMAGE & REPAIRS.

1.5.1. Following the fire and the vessel's return to the UK, a full inspection of the damage switchboard was carried out by P&O and a specialised electrical switchboard engineering company. The results of that inspection were as follows:

The initial inspection indicated that core damage was concentrated in section No 2 with secondary damage to section No's 1 & 3. The switchboard was blacked out and then split between section No's 6 & 7 to enable repairs to continue in safe conditions.

Port side entrance to rear of Main Switchboard.
Note open Fuse Switch for Car Deck Ventilation Fans

SECTION No 2

Vehicle deck Fans

AFT - Fuse switch burnt beyond repair, new ships spare fitted. Supply cables from busbars cut back and re-terminated.

MIDSHIPS - Cables between fuse switch and supply contactor burnt, new cables run in and terminated.

FORWARD - Fuse switch and cables checked in good order.

All three fan supply contactors found heat damaged and contaminated by falling debris from above, contractors replaced with new ships spares. Fuse base carriers and control wiring cleaned and checked, wiring replaced as necessary. Six fuse carriers re-newed with ships spares, insulating plate renewed. Three control transformers re-newed with ships spares.

DRENCHER PUMP - 630 ampere fuse bases destroyed by heat, direct replacements not available either from ships spares or local suppliers. After consultation with "Class", it was agreed to carry out temporary repairs using available 400 ampere fuse switch pending supply of correct equipment. Original cables cut back and re-terminated. (Subsequent testing following completion of repairs proved satisfactory)

NO 2 NON ESSENTIALS - Fuse carriers contaminated and showed signs of damage. These were removed for inspection. 800 ampere fuses checked and found blown, ships spare fuse bases and carriers fitted and fuses re-newed.

SECTION NO'S 1 & 3

The following fuse switches considered to be in doubtful condition and were replaced with ships spares.

No 1 transformer	*400 ampere*
Reefer Sockets	*400 ampere*
Air Conditioning Cooling pump	*160 ampere*

In addition to repairs and replacements, the general fabric and components in section No's 1 to 4 were cleaned and checked for good order. upon completion of all work the switchboard was megger tested at 1000 volts and the following results recorded:

R 12M	*S 12M*	*T 15M*

Open Fuse Switch for Car Deck Ventilation with Fuse in situe

The switchboard was then blacked out and re-coupled and all systems checked for correct operation, repairs and testing completed at 0800 hrs 29.07.98.

1.6. CAR DECK VENTILATION.

1.6.1. There are four car decks on this vessel, numbered 3 to 6, No 3 being the lowest, and No 6, the highest. There are ten ventilation fans for these decks, all controlled from two control positions. The forward control position is on the port side at the entrance to the loading office on deck three, with the aft control position also on the port side of deck three inside the aft loading office. The fans, which are a mixture of exhaust and exhaust/supply, are operated from a local control board which has the fans grouped into three sections, forward, midships and aft. Control is interchangeable between the forward and aft control positions with an over-ride cut-off switch on the bridge.

Each fan has a five position switch, start/slow/stop/fast/start, spring loaded at the start positions. The reversible fans have, alongside the start/stop switch, a three-way exhaust/supply/off switch. All the switches are fitted with indicator lamps. Attached to the control panels are advisory notices stating that ten seconds must elapse between the starting of each fan. A further notice advises that in the event that circuits are lost, main supply fuses must be checked at the main switchboard.

1.6.2. Before the incident occurred in the ECR, the second officer, on entering the aft control position had found two forward fans and two aft exhaust fans running. As a horse box had been loaded shortly before, he attempted to follow the usual company practice of providing a fresh air supply to the car deck by running one of the exhaust/supply fans on the supply cycle. The two aft exhaust fans were shut down and attempts made to start the third exhaust/supply fan on the supply cycle. He was unable to make the supply fan operate and reported this problem when he entered the ECR with the hazardous cargo report.

1.6.3. No recent repairs had been carried out to the car deck fans. There have been a number of instances where it appears that attempts had been made to reverse the rotation of the fans without allowing sufficient time for the fan to slow down. This resulted in the failure of one or more of the 160amp fuses linking the start circuit with the 660volt 3Ph supply.

The electro-technical officers' diary, see annex 3, records three recent incidents, one of 6 July, one on 29 June and one on 8 June. Of these, two were fuse failures and one was a failed indicator light.

1.7. VESSEL RESPONSE.

1.7.1. The response of all the officers and crew to this emergency was prompt and correct. Le Havre port control were told immediately of the loss of power and kept informed of the circumstances as they changed. Two tugs were also ordered as a precaution. On confirmation that the main engines were operable and that the vessel was manoeuvrable, the vessel moved slowly out of harbour towards a safe anchorage. First aid and fire parties were mustered and emergency procedures followed. Within one minute of the bridge being told that there was a fire in the ECR, the crew alert was sounded followed by a verbal announcement to the crew to close up.

Thereafter the situation was monitored continuously by both the master and the master relief. P & O's head office was told of the incident with the result that the emergency response team was made available to assist as required. Once the extent of the injuries were known, the master abandoned any idea of anchoring and asked for a pilot and permission to return to port. He also requested that SAMU (the French paramedical response unit) attend with the pilot. Contact was made with the local Le Havre office telling them that the vessel would be back at the berth in 30 minutes and for them to make suitable arrangements. Medical assistance was requested from the passengers with the result that a doctor and a nurse attended, as well as a retired paramedic from the crew.

1.7.2. Regarding the engineering response, the chief and accommodation second engineer, were already responding to the situation before the alarm sounded. Both men, for different reasons, had become aware there had been a power surge, suggesting that all was not well technically, and were making their way towards the ECR. The duty third engineer, despite the explosion and burning men about him, concentrated on regaining control of the main and auxiliary machinery as well as trying to find out what control had been lost. The chief engineer similarly concentrated on the overall safety of the vessel after arranging first aid and fire parties. Once the initial crisis had been dealt with, the machinery was re-aligned with the object of minimising the potential for further problems. The situation was therefore successfully contained until the vessel was safely alongside where a full investigation into the extent of the damage was carried out.

1.7.3. The reaction to this emergency showed the value of frequent emergency drills and exercises carried out by the crew. Communications between the various senior officers, as identified in the VER, were positive and

clear. Situation updates were exchanged between all interested parties with the master/bridge being kept fully informed at all times.

1.8. PORT OF LE HAVRE RESPONSE.

1.8.1. The port authorities responded immediately they were made aware of the situation. All inward shipping movements were suspended with two tugs being sent to assist as asked for by the master. A pilot was organised together with SAMU (French Paramedical Response Unit) team, and arrangements made for both to be transported out to the vessel on the pilot boat.

Two tugs, *Abeilles 7 & 16*, who had been requested at 2218, reached the vessel at 2235. The pilot, who had been waiting at the pilot station for the arrival of SAMU, finally left at 2258 and reached the vessel at 2326. At 0024 the vessel was alongside TGB 3 where ambulances were waiting to take the three injured crewmen to hospital.

1.8.2. The use of evacuation by helicopter had been discussed by both the master and port control but, as the helicopter crews were not on "Standby", it was decided that the vessel could return to her berth in a shorter time than it would take to get the helicopter airborne.

Full co-operation was extended by the French authorities with port control reacting immediately to the master's requests.

1.9. P&O EMERGENCY PROCEDURES & TRAINING.

1.9.1. In the event of an on board emergency, the master is required to follow a standard procedure as outlined in the ship casualty procedures booklet. This booklet is essentially a flow chart listing all interested parties that should be contacted. On being told of an incident, the fleet director, or his deputy, will talk to the managing director and decide if the situation warrants the setting up of an emergency response team. This team would comprise all relevant personnel and would assemble in the operations managers office at the company head office.

In this particular emergency, a decision was made to activate the emergency response team and the following personnel assembled in the operations managers office:

Managing Director
Fleet Director
Senior Technical Manager

Safety, Environmental & Training Manager
Operations Manager
Personnel Manager

In addition to these senior staff, other supporting staff were brought in as required. During the period of the emergency, communication between the vessel and response team was maintained with information being freely exchanged.

1.9.2. The company's joining procedures for all staff include a detailed induction programme covering safety training and emergency procedures as well as a briefing on fleet regulations and standing orders. In addition to this more general training, there are initial job training check lists for electrical engineering and technical officers. These require them to be fully aware of fire and safety equipment, their location and operation, together with emergency procedures and remote stops. They are also required to be aware of health and safety needs, including areas particularly relevant to electrical officers. Full details of these various training requirements are given in annex 3.

Standard drill and training exercises were carried out on a weekly basis with all officers and crew participating. Annex 3 illustrates the various exercises undertaken by electro-technical officer Paul Mead during the period April 1997 and February 1998.

1.9.3. As part of the standard procedures, crew members are required to sign an acknowledgement that they have read and understood the fleet regulations and standing orders. Copies of these signed acknowledgement forms are in annex 3.

Regarding specific references to electrical safety, the check list for H&S identifies the following:

Electrical Safety	*Condition of appliances. High Voltage Awareness* *Isolation of Machinery* *Location of Safety equipment clothing* *(gloves ,boots etc.)*

Under section 5.14. GUARDING OF MACHINERY AND ELECTRICAL EQUIPMENT of fleet regulations 1994, sub-section 5.14.1 "Statutory and Company requirements" (e) states:

Where it is essential to undertake work on live electrical equipment, only fully competent personnel are to carry out this work. Every precaution must be taken to avoid electrical hazards and to prevent an accident occurring.

1.9.4. The deceased, Paul Mead, had joined the vessel in July 1997 and was considered by the chief engineer as a very competent electro-technical officer. A copy of his assessment form confirming this is in annex 4.

1.10. MEDICAL FACILITIES

The Merchant Shipping (Ships' Doctors) Regulations 1995 do not apply to this vessel as, although she is engaged on an international voyage and has more than 100 persons on board, the voyage is less than one and a half days' sailing time from a port with adequate medical equipment.

The medical facilities on this vessel comply with the Merchant Shipping and Fishing Vessel (Medical Stores) regulations 1995, SI 1995 No 1802 as well as with EC Directive 92/29. These regulations set out the minimum safety and health requirements for improved medical treatment on board vessels, as well as listing the medicines to be carried on ships. In addition to the above, ferries whose operating arrangements do not normally allow sufficient forewarning of the nature of any dangerous substances which might be transported on them, must carry at least the antidotes listed in the regulations. The IMO/WHO Medical First Aid Guide for Ships and the attendant IMO provisions relating to dangerous cargoes also normally apply to this vessel.

Regarding first aid trained personnel; all certificated officers are first aid trained as are a number of other crew members. On the particular voyage in question, there were about 40 trained first aid members amongst the crew. In addition, one of the crew had originally worked ashore as a paramedic.

1.11. HSE INSPECTION AND REPORT.

1.11.1. The test meter used in the accident was a multi-meter, made by Radio Shack, and sold as a Micronta type 22-193. This meter was not P&O issue and had apparently been left on board by the previous vessel owners. It had been retained in the ECR for general use by the watchkeepers. It was not generally used by the electro-technical officers. The full specification for the multi-meter is given in annex 2. The type of meter issued to P&O staff are of Fluke manufacture and are subjected to testing and calibration annually by RS Components Ltd. The official P&O meters are not supplied with fused test leads.

"Micronta" Multi-Meter condition after explosion.
Note test lead in closed loop with meter set to measure Volts.

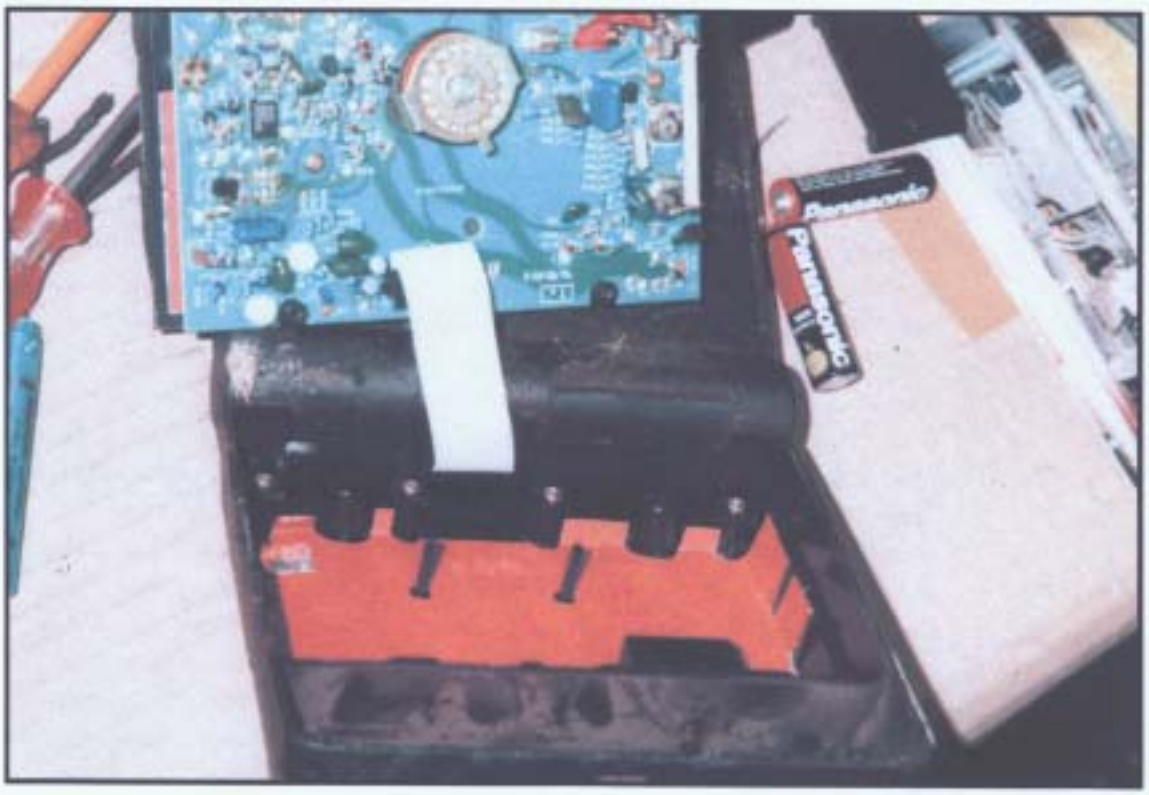
An electrical voltage tester (max 400v) was found in the ECR on the starboard side of the control desk. The cable lead was in a damaged condition and unfit for use. It is not known how it came to be where it was, but it is thought to have been in the pocket of Paul Mead when he was in the control room.

1.11.2. Following the accident, the meter, together with electrical components removed or replaced in the main switchboard during repairs, were examined by an HSE electrical specialist. Extracts from his report are as follows:

The meter had suffered external heat damage and was partially covered in a soot like deposit. The meter selector switches were set to read ac volts and the on/off switch was in the on position. The digital readout was not showing a display when initially seen, but when a new set of batteries were installed the display read 0000. The rear case was removed and the internal circuitry was found to be clean and it did not exhibit any signs of damage which could have been caused by an internal electrical fault. The printed circuit board was broken beneath the test terminal marked "+", apparently due to excessive pressure on the terminal. This damage appeared to have disconnected this terminal from the rest of the circuit board. Plugged into the "COM" and "+" terminals was a test lead. This lead had black coloured insulation and was fitted with male 4mm plugs on both ends. The insulation of this lead had suffered damage of a type usually caused by heat. The lead was unfused. Connected in this way this lead shorted out the two terminals which are used in voltage measurements. There was a third test terminal on the instrument which is used in conjunction with the "COM" terminal for current measurement. The metalwork within this terminal was slightly discoloured indicating that no plug had been inserted into this terminal when the fault occurred which caused damage to the rest of the exterior of the meter. The test lead was unplugged from the test terminals and the male plugs and the metalwork of the sockets was found to be bright, indicating that both the plugs and sockets had been protected at the time of the fault which caused the damage to the rest of the meter.

In a recess in the multi-meter case were two test probes. These were covered by a layer of soot like material, but it was possible to see that the plastic moulding of one of the probes had red coloured plastic insulation. The metalwork of these probes was undamaged. Also with the meter was an instruction leaflet. This had a section in various foreign languages, but not in English. Examination of the leaflet showed that whilst the meter was rated for use up to 2000 volts dc, it was only rated for 500volts RMS ac.

I was shown what appeared to be the remains of a second test lead. There were pieces of cable and the remains of two 4mm male plugs. The male pins of the plugs had been eroded away. The conductor insulation was black in colour. There were two pieces of similar cable stuck to the base of



Internals of "Micronta" Multi-Meter.
Note lack of damage showing that meter was not in circuit at time of explosion.

the multi-meter, one of which became detached during the course of the examination. I formed the opinion that these pieces were the remains of a test lead similar to that plugged into the meter.

1.11.3. Following the examination of the multi-meter, the HSE principal inspector was shown a number of items removed from the vessel switchboard during the repair. It had also been arranged that after looking at these items, he would visit the vessel to inspect the actual switchboard in the company of the repairer. His comments following this inspection are as follows:

Also seen were the remains of various items of switchgear all of which appeared to have been involved in a high intensity electrical fault. Amongst these items were the following:-

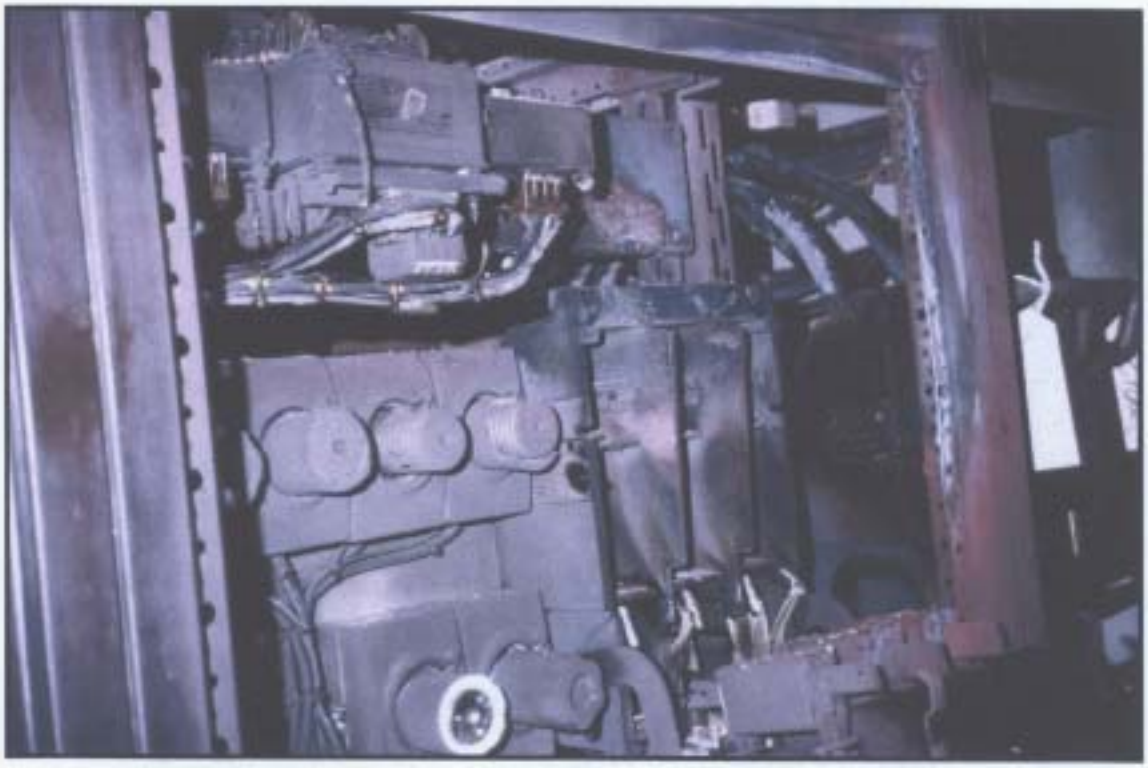
a) An AEG 250amp fuse switch. The arc chutes had been removed from the switch and had suffered sooting only, indicating that they had not been in place on the switch at the time of the fault. The outgoing terminals of the switch were also relatively undamaged. The incoming bus-bar side terminals of this switch had been destroyed in the fault. Tests showed that the three 160amp fuses, though physically damaged, had not ruptured.

b) The remains of a badly damaged fuse switch. I was informed that this had supplied the drencher pump and had been installed immediately above the 250amp fuse switch previously described.

c) Three 800amp cartridge fuses. Tests showed that these had ruptured. The fuses were discoloured by a soot like substance.

d) Other items were seen which had been damaged by heat or were discoloured.

On board the Pride of Le Havre, I was shown the main switchboard in the engine control room. Access to the rear of the switchboard was controlled by gates which were locked when first seen. A permit to work had been issued to authorise access and one gate was unlocked. Mr Jackson, who had carried out repairs following the accident, described the work that he had carried out. Various new pieces of equipment were evident in the section containing the switchgear for the ventilating fans and the drencher pump. Both the essential and non-essential service bars could be seen within the switchboard. The connections between the ventilation fan fuse and the non-essential service bars were seen to be cables to the top of the fuse switch. The contactor for the fans was mounted directly below the fuse switch and was clearly visible, as were the bare copper connections between the two. The outgoing cables to the fans were below the contactor. There was a small area of heat damage to the metal framework of the switchboard in the area of the ventilating fan fuse switch, with a small amount of erosion of the metal.



Car Deck Ventilation Fan Fuse Switch.
Note arcing damage to top of Fuse Switch (incoming power).

It was confirmed to me that the power supply on board the ferry was not referenced to the metal work of the ship. This is normal practice for ships power systems.

It was also confirmed that after repairs were complete, the ventilation fan which had been reported as faulty, operated correctly without any other repairs being necessary.

These findings confirmed the assessment reached after the initial investigation carried out on board the vessel by both MAIB and P&O Inspectors. The original opinion was that the fault had occurred due to a direct phase to frame connection being made. Following further discussion opinion changed and it was considered that the fault was the result of a phase to phase connection.

SECTION 2 ANALYSIS

2.1. CIRCUMSTANCES OF THE SWITCHBOARD EXPLOSION.

2.1.1. The explosion is considered to have been caused by a direct connection being made between two phases of the 660volt incoming supply.

This is thought to have occurred when the electro-technical officer chose to test the availability of the incoming voltage by applying a voltmeter across two phases. Unfortunately, the two leads in use, both black, appear to have become entangled with each other with the result that rather than having one end of each lead, with the meter in the middle, the officer held both ends of the same lead.

The arc chutes fitted to the fuse switch were found to have been removed. This not only gave easier access to the power connections but also allowed any arc to develop unimpeded.

The probable sequence of events was that when the two leads were applied, the direct phase-to-phase connection gave a short circuit. The resultant arc flashed over and upwards to the drencher pump connections and ultimately to the non-essential circuit breaker. The 800amp fuses supplying the non-essential bus-bars ruptured with the resultant voltage depression on the main bus-bars causing the arc across the three phases of the drencher pump switchgear to be extinguished.

2.1.2. Following the inspection of the damaged components and the visit to the vessel, other possible causes and/or reasons for the accident were discussed with the HSE electrical specialist. The questions raised and his responses are as follows:

a. *Was there a fault with the ventilation fan which led to the fault finding which was in progress at the time of the accident ?*

It seems unlikely that there was a fault unless evidence of it was destroyed in the accident, as the fan apparently operated correctly once the damaged equipment had been replaced.. The most likely reason for a fan powered by a three phase motor to fail to start, other than because of a fault on the control circuit or motor (which is not relevant in this case) would be for one of more phases of the supply to open circuit or for the motor contactor to fail. Tests showed that the fan circuit fuses had not ruptured, however, it is possible that one of the cable connections within the switchboard on this circuit had failed open circuit and was replaced when the repairs were carried out. It is also possible that there was a fault with the motor contactor, but this was damaged in the accident and subsequently replaced. It is not therefore possible to rule out a fault on the fan circuit prior to the accident.

b) *Could a fuse supplying the non-essential bus-bars have ruptured before the accident ?*

These three 800amp fuses were found ruptured after the accident, but that could be explained by the accident. If one or more of them had ruptured prior to the accident it would explain why the fan subsequently failed to start, however the fault current necessary to cause them to rupture is substantial and any fault should have been noticed. Additionally other equipment supplied from the non-essential services bus-bars would have failed prior to the accident and it is likely that this would have been noticed. It is the writers opinion that these fuses ruptured during the accident and not prior to it.

c) *Could the electro-technical officer have been attempting to check the phase to frame voltage at the time of the accident ?*

It is possible that he was attempting to check the phase to frame voltages. It is not known if the officer had read the instruction book and was therefore aware of the limitation that the meter was not rated for voltage tests above 500volts RMS. An experienced electro technical officer is unlikely to have done so as the various switches on the meter are self explanatory. If he had been attempting such tests, the results that he obtained would have been unpredictable, as the readings obtained would be dependent on the leakage to frame of the ships electrical system at that time. The meter had an internal fuse which should have ruptured if the meter had been subjected to a substantial overvoltage.

d) *If the electro technical officer had been attempting to measure phase to frame voltages at the time of the accident and accidentally shorted phase to frame would this have resulted in an initial fault of sufficient magnitude to develop into the fault involving all three phases which subsequently occurred ?*

This would depend on the leakage to frame of the rest of the ships system at the time of the accident. There would have had to have been a sufficiently low impedance between the system and the frame at that instant to allow a substantial current flow across the short circuit and thus cause the lead to fuse and ionisation of the air to occur. It is the writers opinion that this was not the case and that the electro technical officer was attempting to measure phase to phase voltages.

e) *Why did the electro technical officer use this multi-meter rather than one of the Fluke meters supplied by the company ?*

This may have been because the Micronta meter was available in the engine control room (apparently used to check fuses) and it would therefore have saved him time that it would have taken to collect the other meter.

f) *Why did the electro technical officer start his fault finding on the main switchboard ?*

It is quite normal to check circuits such as this from the supply end first and in addition, the electro technical officer was at that end when informed of the fault and therefore understandably started from there.

2.2. OTHER ISSUES

2.2.1. Electrical Testing Instruments.

The policy of the managing company, P&O European Ferries (Portsmouth) Ltd, is to issue standard Fluke meters to electro-technical and electrical officers for their use and to ensure that they are tested annually for safety and for calibration. The meters are fitted with an internal fuse and are supplied with non-fused insulated test leads and probes, one black and one red.

During the investigation, the HSE electrical specialist demonstrated silicon rubber test leads used in shore-based industry which include a 10amp fuse in each test probe as well as a retractable insulating skirt

which protects the metal tip of the probe when not in use. This is a recommended industrial standard which would have prevented the sort of accident that occurred on this occasion. The particular test leads shown were made by ROBIN although other makes are also available. The meter shown also incorporated shutter operated lead connections which prevent incorrect usage of the leads.

Whenever possible, voltage indicators rather than multi-meters, should be used for checking voltages. With the leads on voltage indicators being permanently attached, accidents caused by leads being wrongly connected or becoming disconnected are avoided. In addition, voltage indicators which do not have a range selector switch, cannot be selected to the wrong range as multi-meters can, thus avoiding another source of accidents.

2.2.2. **Non-company Supplied Test Equipment.**

The unfortunate circumstances of this incident illustrate the need for companies to re-emphasise to all staff that only company supplied and tested equipment should be used. Many of the staff are qualified and experienced professionals who may well have purchased test equipment for their own use as well as for use on board. Despite the quality of the equipment and the possible care in which it is kept, all non-company test equipment should be left ashore. Under the Merchant Shipping (Health and Safety: General Duties) Regulations 1984, every employee has to take reasonable care of the health and safety of himself and other persons aboard ship who may be affected by his acts or omissions. Only company supplied equipment should therefore be used.

As for the company, it is required to supply all test equipment likely to be needed during the course of normal operations. It must ensure that all such equipment is tested and suitable for that particular job.

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 EXPLOSION.

The explosion is considered to have been caused by a direct connection being made between two phases of the 660volt incoming supply.

3.2. CONTRIBUTORY CAUSE.

The two leads connected to the test meter used by the electro-technical officer were both black, and understood to be entangled with each other. This made it difficult to separate out the ends of individual leads and increased the risk of a mistake being made.

3.3. FINDINGS.

3.3.1. The test meter used in the accident was not of P&O issue and had been left on board by the previous owners.
[Ref: 1.10.1.]

3.3.2. The test meter had been retained in the ECR for use by the engine watchkeepers.
[Ref: 1.10.1.]

3.3.3. The test meter instruction book did not contain a section written in English.
[Ref: 1.10.2.]

3.3.4. Examination of the test meter instruction book showed that although it was rated for use up to 2000volts dc, it was only rated for 500volts RMS ac.
[Ref: 1.10.2.]

3.3.5. A subsequent examination of the internal circuitry of the test meter showed that the meter did not exhibit any signs of damage which could have been caused by an internal electrical fault.
[Ref: 1.10.2.]

3.3.6. A black coloured, heat damaged, test lead was found to have been fitted between the "COM" and "+" terminals. Connected in this way, the test lead shorted out the terminals used in voltage measurement.
[Ref: 1.10.2.]

3.3.7. When unplugged from the terminal sockets, all surfaces were found to be bright indicating that they had been in place at the time of the accident.
[Ref: 1.10.2.]

3.3.8. The AEG 250amp fuse switch, which feeds the car deck ventilation fans, was found in the open position after the explosion.
[Ref: 1.2.6.]

3.3.9. The arc chutes on the AEG 250amp fuse switch had been removed and were found to be covered in soot showing that they had not been in place at the time of the explosion.
[Ref: 1.10.3. & 2.1.1.]

3.3.10. The incoming bus-bar terminals of the AEG 250amp fuse switch had been destroyed in the explosion.
[Ref: 1.10.3.]

3.3.11. The outgoing terminals of the AEG 250amp fuse switch were relatively undamaged although the 160amp fuses fitted in the carrier were physically damaged but not ruptured.
[Ref: 1.10.3.]

3.3.12. It is thought that when attempting to test the availability of the incoming voltage by applying the test meter across two phases, the test leads became entangled resulting in the electro technical officer applying each end of the same test lead to two phases.
[Ref: 2.1.1.]

3.3.13. P&O supply test instruments for use on their vessels and these are tested and calibrated annually by RS Components Ltd.
[Ref: 1.10.1.]

3.3.14. The deceased, Paul Mead, was considered by the chief engineer to be a very competent electro-technical officer.
[Ref: 1.9.4.]

3.4. OTHER FINDINGS.

3.4.1. It is not thought that there was a fault with the ventilation fan at the time of the accident.
[Ref: 2.1.2 a.]

3.4.2. It is considered unlikely that the electro-technical officer was attempting to measure phase to frame voltage at the time of the accident.
[Ref: 2.1.2 c&d.]

3.4.3. The electro-technical officer may have used the multi-meter rather than the company supplied Fluke because it was readily available.
[Ref: 1.2.3.,1.2.4.,2.1.2 e.]

3.4.4. The medical facilities available on the vessel complied with current regulations.
[Ref: 2.2.]

SECTION 4 RECOMMENDATIONS

P&O European Ferries (Portsmouth) Ltd are recommended to:

1. Re-emphasis to all staff in writing that only company approved and tested electrical test instruments are to be used on board.

2. Supply fused test leads for multi-meters and instruct staff that these fused leads are to be used for measurements, except where the use of these leads is not possible for technical reasons.

3. Advise staff that whenever possible, voltage indicators should be used for checking voltages rather than multi-meters.

The Marine and Coastguard Agency are recommended to:

4. Issue a Marine Guidance Note based on HSE publication GS 38, *"Electrical Test Equipment for use by Electricians"*, with particular reference to the use of test probes fitted with HBC fuses and/or current limitation devices in each test probe.

GLOSSARY OF TERMS

"Black out"	-	Complete loss of electrical power and lighting
Drencher Pump	-	Large pump delivering sea water to fixed fire fighting system
Hazardous Cargo Sheet	-	Record of known hazardous cargo being carried on board by passenger vehicles
Breaker Switch	-	Control switch for opening/closing electrical circuit breaker
Multi-meter	-	Electrical instrument measuring current, voltage and resistance over a wide range in either ac or dc
Fuse Switch	-	Isolating switch incorporating fuses.
Preferential Trip	-	Automatic switch fitted in an electrical circuit to protect the main switchboard from overload
Dead front	-	No electrically alive parts on the front of the switchboard
Bus-bars	-	Non-insulated metal bars at the back of main switchboard to which feeders from the main alternators main breakers are attached
Contactors	-	Device for breaking and remaking an electrical circuit
Class	-	Classification Society
Non-essential circuit	-	Breaker controlling electrical circuits the disconnection of which do not affect the breaker safety of the vessel or its operation.
Emergency Response Team	-	Shore based management team led by Managing Director to assist and advise in the event of an emergency
Arc Shutes	-	Insulating material fitted between each phase connection on a breaker or fuse carrier to prevent arcing between phases

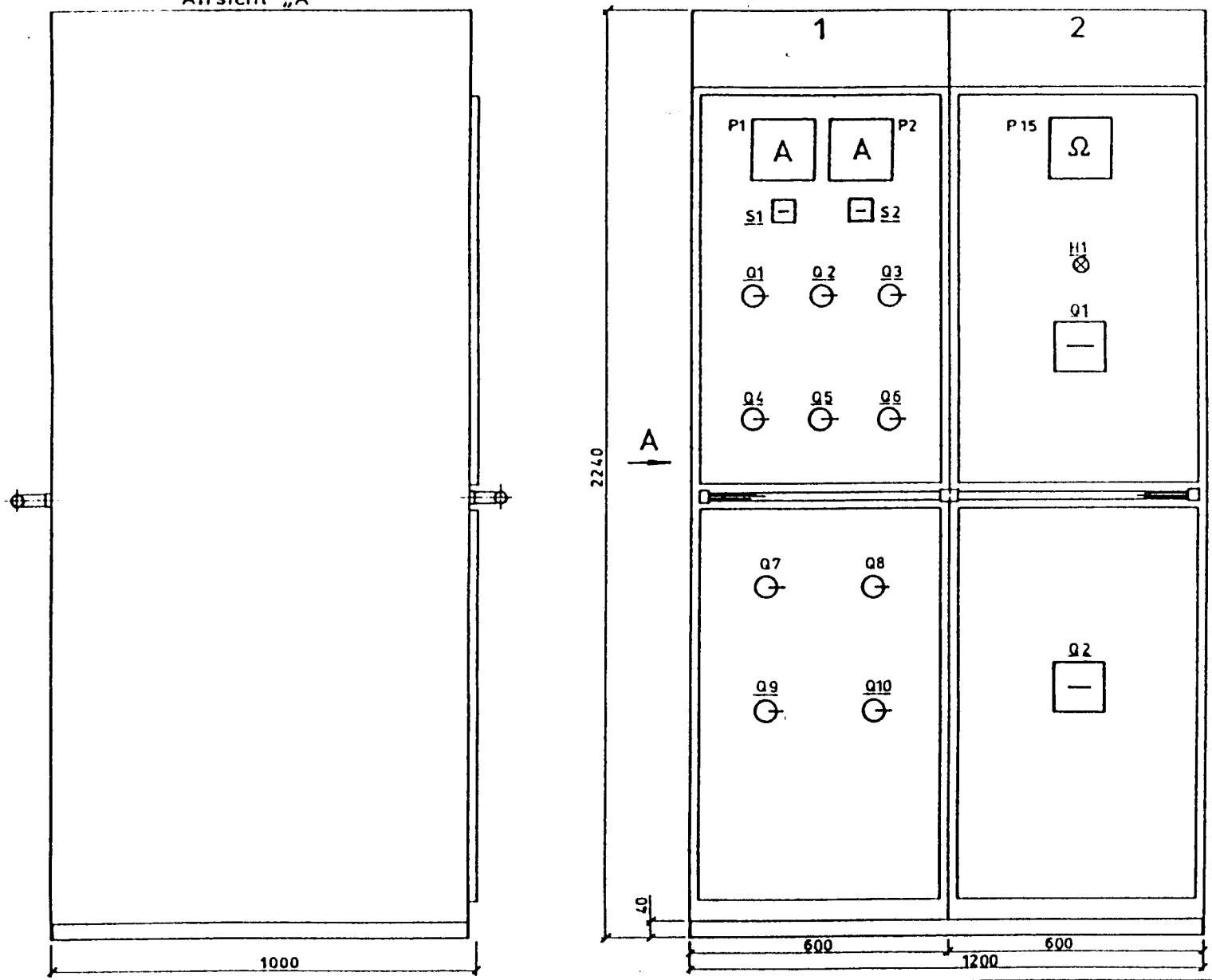
ANNEX 1

Switchboard Panels one to six, plus
circuit diagrams for Car Deck Ventilation,
Drencher Pump, and Non-Essential Services.

Pride of Le Havre
27 July 1998

Ansicht „A"

660V 3~ 60Hz



Vorschriften: / RULES:

Germanischer Lloyd 45°C Bt.

660V 3~ 60Hz und
440V 3~ 60Hz

Alle Generatorfelder durch Trennbleche geschottet.
ALL GENERATOR PANELS SEPARATION WITH PARTITION SHEET.

Schalttafellänge:
LENGTH OF SWITCHBOARD:

660V	Feld	1 + 2	1200
	PANEL Feld	3 - 6	3000
	Feld	7 - 9	2400
	Feld	10 + 11	1600
	Feld	12 - 15	3000
440V	Feld	16 - 19	2400
	Feld	20 + 21	1200
	TOTAL LENGTH		14800

Farbe: RAL 7032 Struktur
COLOUR:

Belüftungsschlitze:

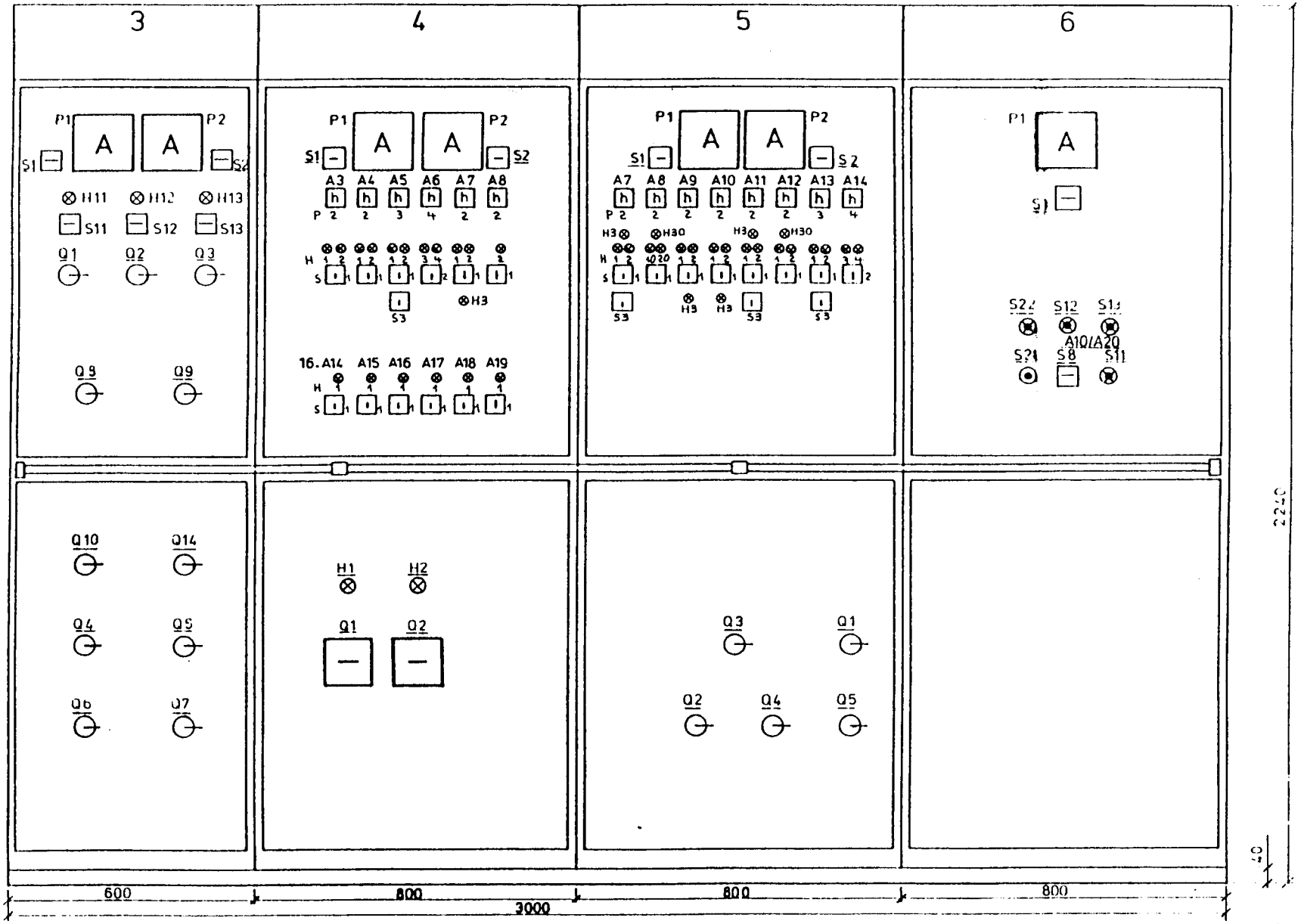
Alle Türen Vorderseite unten sowie die Stecktüren i. Feld 22-24 oben.

Bemerk.: Kabelverbindungen zwischen Sammelschienen ---- Element/Baustein in
a) H07-VK in Schutzschlauch
b) NSGAFöU 3kV verlegen.

Abgangskabelschuhe: Type wie für Hata S1046/1047 geliefert.

Änderung	Datum	Name	Datum	8.1.81	Seebeckwerft S.1067 / 68	AEG	HAUPTSCHALTTAFEL	Ansicht / VIEW	
			Gepr.	Hatat				Feld / PANEL 1 + 2	271 121 906 GZ-3
			Norm		Ursprung	Ersatz	Ersatz		Blatt 1 16

660V 3~ 60Hz



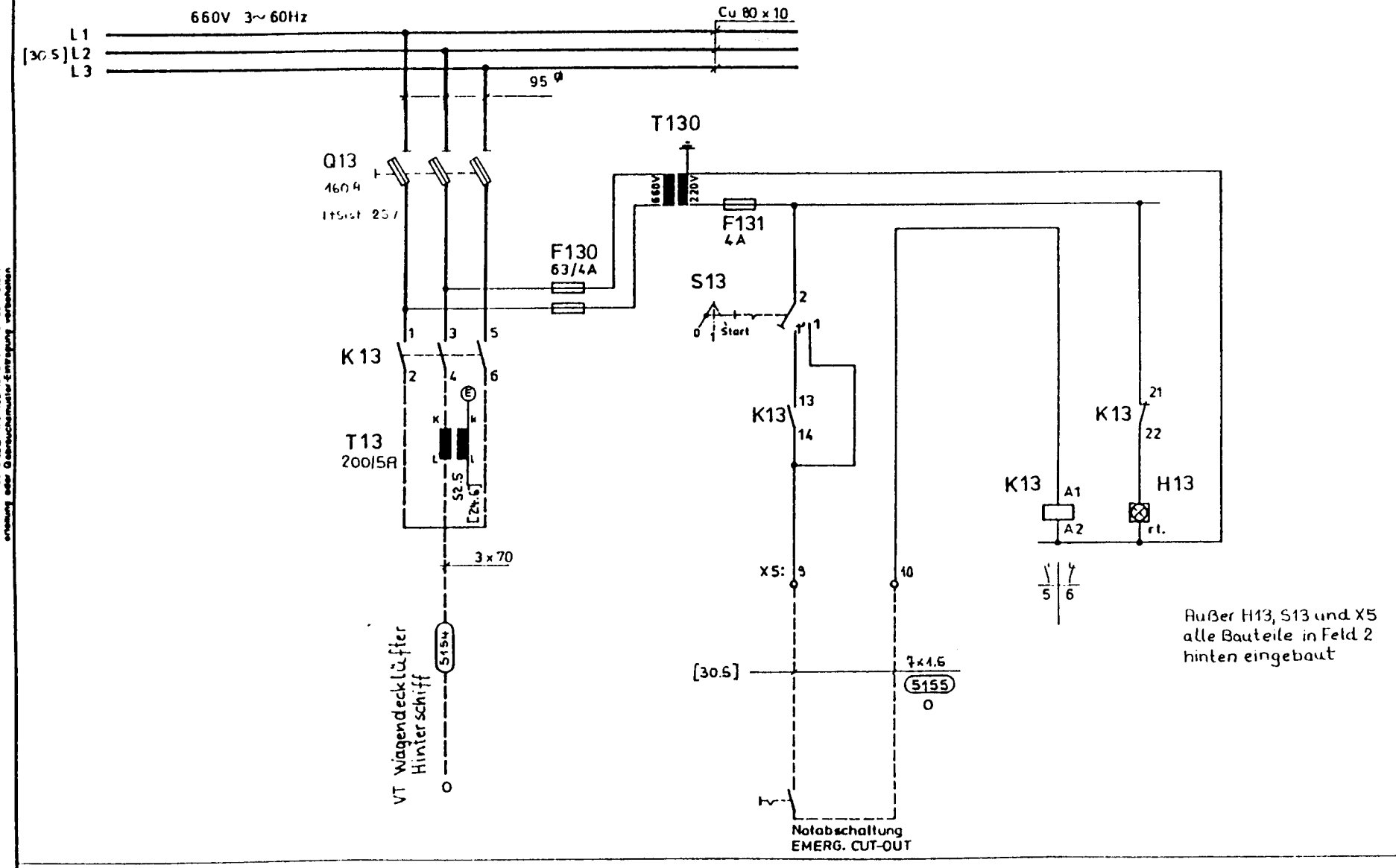
Änderung	Datum	Name	Datum / Bearb. / Gepr. / Norm	8.3.87 Hofmann	Urspr.	Ers. f.	Ers. d.	AEG	HAUPTSCHALTTAFEL

Ansicht / VIEW

Feld / PANEL 3-6

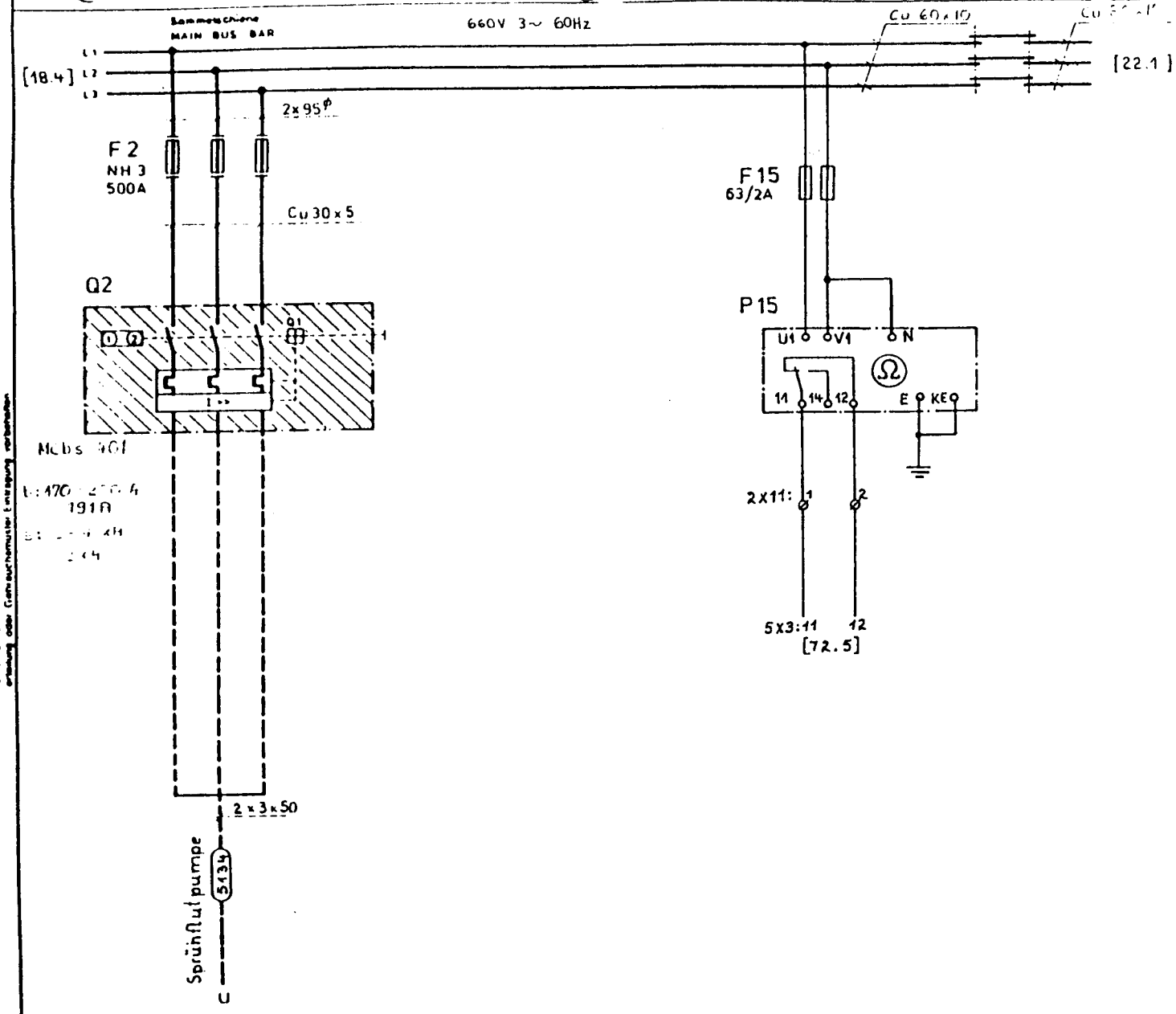
271 121 906 GZ-3

Blatt 2



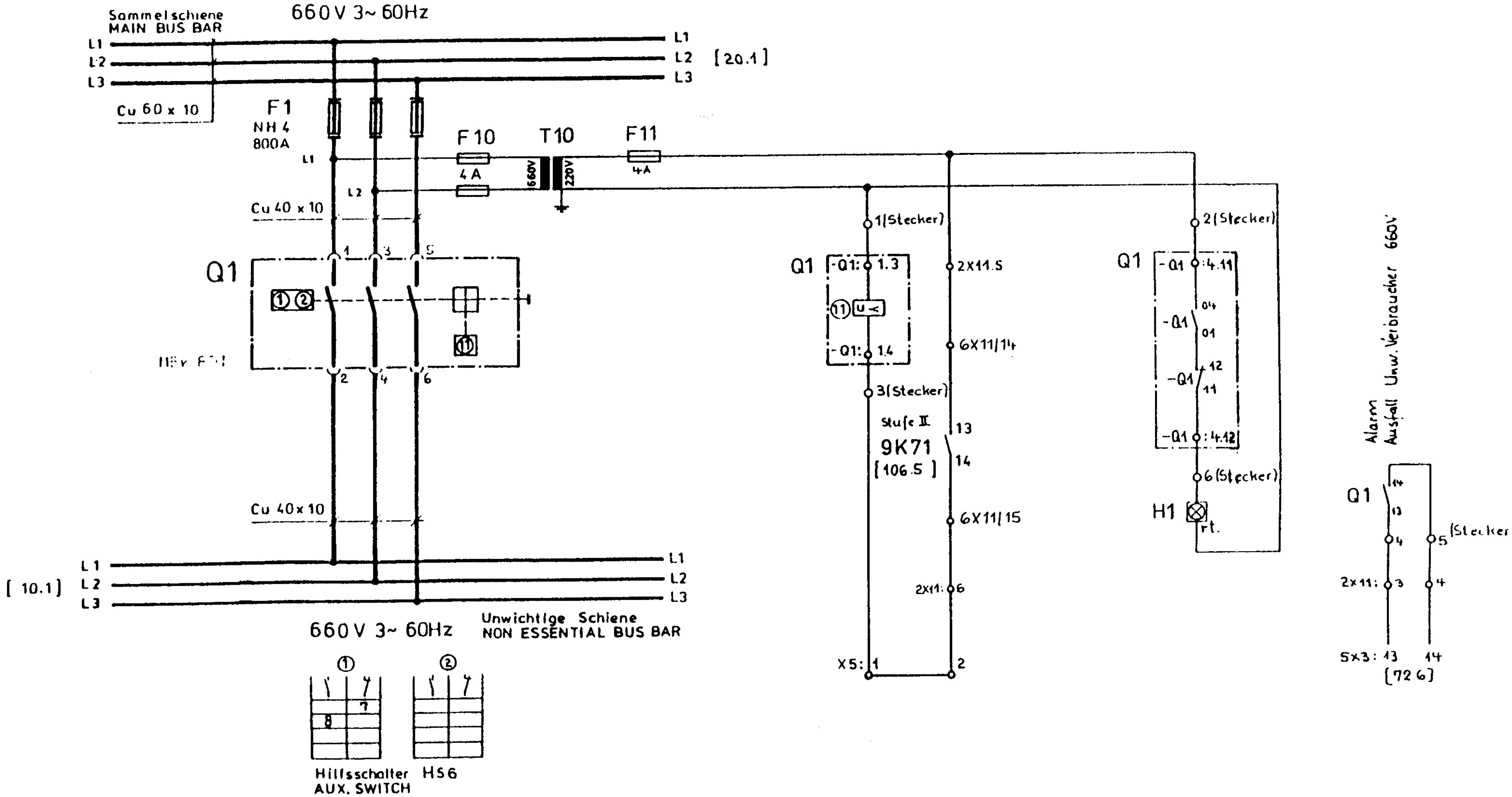
Außer H13, S13 und X5 alle Bauteile in Feld 2 hinten eingebaut

			Datum	8.1.89		AEG	HAUPTSCHALTTAFEL	VT Wagendecklüfter Hinterschiff	=	32
			Bearb	Hafner					+	
			Gepr					Feld PANEL 3	271 121 906; STR-3	Blatt 13/1 81
Änderung	Datum	Name	Norm		Urspr	Ers.f	Ers.d			



175 kW
191 A

Änderung	Datum	Name	8.3.89 Ha/mtv	AEG	HAUPTSCHALTTAFEL	Sprühflutpumpe	= 20 / +
		Konstr.				Feld PANEL 2	271.121 906 . STR-3
		Gepr.					Blatt 7
		Norm					
		Ers.f.					



Datum 8.3.89 Bearb. Hafner Gepr. Norm	AEG	HAUPTSCHALTTAFEL	Unwichtige Verbraucher 660 V	= 18 +
Änderung / Datum / Name / Urspr. / Ers. f. / Ers. d.			Feld PANEL 2	271 121 906 STR-3	Blatt 6 Bl.

ANNEX 2

Specification of MICRONTA multi-meter type 22-193

Pride of Le Havre
27 July 1998

MICRONTA®

Multimètre digital automatique pliable avec affichage à cristaux liquides

Toeklapbare digitale LCD-multimeter met automatische meetgebiedinstelling

Zuklappbares Digital-Multimeter mit Flussigkristallanzeige und automatischer Bereichsumschaltung

Cat. No. **22-193**

DONNEES TECHNIQUES

Affichage :	LCD, à 3 chiffres 1/2	
Précision :		
VOLTS CC		
200 mV-2-20-200	± 0,8% en lecture et ± 0,2% en pleine échelle, ± 1 au dernier chiffre	
2000 V (mesure max. = 1000 V)		
VOLTS CA		
2-20-200-2000V (mesure max. = 500 V RMS)	± 1% en lecture et ± 0,5% en pleine échelle, ± 1 au dernier chiffre	à 50/60 Hz
45 Hz à 1kHz	± 1,5% en lecture et ±0,5% en pleine échelle, ± 1 au dernier chiffre	sur l'échelle 20V
Jusqu'à 10 kHz	± 6% en lecture, et ±0,5% en pleine échelle, ± 1 au dernier chiffre	sur l'échelle 20V
INTENSITE CC 200 mA,10W	±1,5% en lecture, et ±0,2% en pleine échelle, ± 1 au dernier chiffre	
INTENSITE CA 200 mA.10A	± 1,5% en lecture, et ±0,5% en pleine échelle ± 1 au dernier chiffre	
RESISTANCES 200Ω-2-20-200-2000K OHM	±1,5% en lecture, et ± 0,2% en pleine échelle, ± 1 du dernier chiffre	
Fonction de continuité	±18 max à 200Ω le vibreur retentit pour une résistance nominale de 300Ω (limite 150—500 ohms)	
Fonction de contrôle des diodes	pour contrôler si les diodes sont ouvertes, fermées ou normales	
Impédance d'entrée :	10MΩ (VCC/VCA). plus de 100 MΩ sur l'échelle 200 mV CC	
Sélection des des échelles :	automatique avec la fonction RANGE-HOLD	
Alimentation	6 mW typiques, 15 mW à fonction de continuité	

Indication de l'état des piles	«BATT» à la gauche de l'affichage pour une tension inférieure à 1,2 à 1,3 V
Polarité	automatique
Indication de surcapacité	1000 avec le «1» clignotant
Arrêt	90,120,150,180°
Températures de fonctionnement	0 à 50°C
Températures de	−20 à + 60°C
Poids	500 g
Dimensions	278 x 145 x 37 mm (complètement ouvert) 153 x 145 x 52 mm (complètement fermé)
Accessoires :	Fusible : 0,315A 250 V Fils de test à fiches «banane» (n° de Cat. 278-704)

Tandy CORPORATION

AUSTRALIA	BELGIUM	U.K.
91, KURRAJONG AVENUE MOUNT DRUITT, N.S.W. 2770	PARC INDUSTRIEL DE NANINNE 5140 NANINNE	BILSTON ROAD WEDNESBURY WEST MIDLANDS WS 10 7 JN

Custom manufactured in Korea for Tandy Corporation

9A4

Printed in Korea

ANNEX 3

Details of Personnel Induction, Initial Job Training, Fleet Regulations, Safety Drill Records, and electro technical officers Maintenance Diary.

Pride of Le Havre
27 July 1998

P & O EUROPEAN FERRIES (PORTSMOUTH) LTD

CREW INDUCTION - PARTS 1 AND 2 PRIDE OF PORTSMOUTH

PART 1 - INITIAL INDUCTION PRIOR TO SAILING

Name: T O	PAUL MEAD	**Work Area:**	
ID No:		**Department:**	TECHNICAL
Position:	ELECTRO-TECH OFF.	**Date of Joining:**	7-7-97

	ITEM TO BE EXPLAINED	CHECK
1	Emergency Alarm Signals	✓
2	Muster Station and Action in the Event of an Emergency	✓
3	Lifejacket Stowage and Donning Instructions	✓
4	Cabin Location and Escape Route	✓
5	Work Area and Escape Route	✓
6	Nearest Fire Alarm and Fire Fighting Appliance to Cabin and Work Area	✓
7	Crew Mess Location and Escape Route	✓
8	Full explanation of Drug & Alcohol Policy	✓
9	Name of H.O.D. and Immediate Supervisor	✓

This is to certify that the training outlined in Part 1 above has been carried out prior to sailing.

SIGNED.....INDUCTEE .....INDUCTING OFFICER

PART 2 - FULL SAFETY INDUCTION TOUR WITHIN 24HRS OF JOINING VESSEL

	ITEM TO BE COVERED	CHECK
1	Overall Picture of the Muster List, Moding and Emergency Stations Duties	✓
2	Grand Tour of Ship with Special Reference to Life Saving and Fire Fighting Equipment and Procedures	✓
3	Comprehensive Bridge Tour	✓
4	Safety & Environmental Briefing including "Duty of Care" Responsibilities	✓
5	Safe Operation of Watertight, Fire and Pneumatic Doors.	✓
6	Hospital, Dispensary and Medical Procedures	✓
7	Accident Reporting	✓
8	Extracts from Fleet Regulations	✓

This is to certify that the training outlined in Part 2 above has been carried out within 24 Hrs of this crew member joining the vessel.

SIGNED.....INDUCTEE .....INDUCTING OFFICER

A McFADYEN.

P & O EUROPEAN FERRIES (PORTSMOUTH)LTD

PRIDE OF.. PRIDE OF LE HAVRE

CREW INDUCTION

ELEC / TO

Name	P. MEAD
ID Number	021585
Join Date	8/8/97

Department	ENGINE
Work Area	ALL AREAS

	PRIOR TO SAILING	CHECK
1	Emergency Alarm Signal	✓
2	Action in an Emergency (Temporary Muster Stn.)	✓
3	Lifejacket Stowage and Donning Instruction	✓
4	Cabin Location and Escape Route	✓
5	Work Area and Escape Route	✓
6	Nearest Fire Alarm to Cabin & Work Area	✓
7	Crew Mess Location and Escape Route	✓
8	Full Explanation of Drug & Alcohol Policy	✓
9	Name of HOD and Supervisor	✓

I certify the training detailed above has been undertaken prior to sailing.

SIGNED..... INDUCTEE..... INDUCTING OFFICER/SUPV

FULL SAFETY INDUCTION WITHIN 24HRS OF JOINING VESSEL

		CHECK
1	Comprehensive Explanation of Muster List, Moding & Emergency Duties	
2	Complete Tour of the Ship with Special Reference to LSA & FFE and Procedures with reference to Training Manual	
3	Comprehensive Bridge Tour with Special Reference to Fire Alarm Reception	
4	Safety and Environmental Briefing including "Duty of Care" Responsibilities and Code of Safe Working Practices for Seamen	
5	Safe Operation of Watertight, Fire & Pneumatic Doors	
6	Hospital, Dispensary and Medical Procedures	✓
7	Accident Reporting	
8	Extracts from Fleet Regulations	

I certify the training detailed above has been undertaken within 24 hrs of joining

SIGNED..... INDUCTEE..... INDUCTING OFFICER

Ex Ldo.

Initial Job Training

For: P. MEAD.

ELECTRICAL ENGINEERING OFFICERS
AND TECHNICAL OFFICERS

Key Duties/Areas	Knowledge Required	Completed (Signature of Trainer)
1 SAFETY BASIC KNOWLEDGE	Standing Orders Fleet Regulations	
2 HEALTH AND SAFETY	Code of Safe Working Practice	
3 MAINTENANCE, REPAIRS, STORES		
4		
5		
6		

See also document 0401u EEOCL/4/92

* = Certificate of Competency Required

Master HOD ______ 11/7/97.

[illegible] Dept Member ______

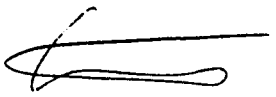
Date Completed 10/7/97

P&O EUROPEAN FERRIES (PORTSMOUTH) LTD

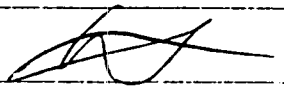
Initial Job Training

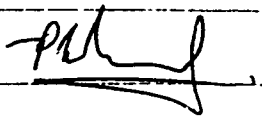
For: P. MEAD

ELECTRICAL ENGINEERING OFFICERS

Key Duties/Areas	Knowledge Required	Completed (Signature of Trainer)
1 SAFETY BASIC KNOWLEDGE	Standing Orders Fleet Regulations	
2 HEALTH AND SAFETY	Code of Safe Working Practice	
3 MAINTENANCE, REPAIRS, STORES		
4		
5		
6		
7	See also document 0401u.EEOCL/4/92	

* = Certificate of Competence required

Master/HOD 

New Crew Member 

Date Completed 20-7-97

Chief Engineers Standing Orders

All Engine Room Personnel must read the standing orders and once understood sign the sheet below.

Print Name	Signature	Rank	Date
J. BURGESS	J Burgess	CARPENTER	21/1/98
G. BARRAT	G Barrat	E.R.P.O.	22/1/98
P. McHD	P McHD	ETO	31/1/98.
J CALLAN	J Callan	CADET	12/2/98
N. HIGGINS	N.J. Higgins	CADET	13/2/98.
D. GLENNON	D Glennon	3/E/O	9/5/98
M MMcMullen	M McMullen	2/E	3/6/98
F.J. GARDINAR	F J Gardinar	3/E	3/6/98
F/ G.T. BON.)		2/E	4/6/98
W.H. RICHMOND	W.H. Richmond	3/E	4/6/98
M. AZAM QURESHI	M Azam	3/E	20/6/98.
D PHENIX	D Phenix	ETO	30/7/98
R. HALL	R. Hall	3/E	30/7/98

P&O EUROPEAN FERRIES (PORTSMOUTH) LIMITED

Initial Job Training

Check List for Electrical Engineering Officers

SAFETY/BASIC KNOWLEDGE

Watertight Doors Escapes & Entrances	Location of All Entrances & Escapes. Where escapes exit to.
Fire Pumps & Valves	Location of all Fire Pumps & Valves plus location of remote control stations.
Hose & Extinguishers	Location. Number per space. Types and uses. Operation.
BA Sets	Location. Purpose. Limit of Duration.
Fire Damper & Doors	Location. Operation. Normally open or shut. Test Routines. Flap Type-Distinguish-FKA/RKA.
Fire Lockers	How Many? Locations. Nearest. Contents.
Remote Stops	Locations. Groupings. Consequences. Test Routines.
Emergency: D. Alt and M/G Set.	Auto/Manual Starting. First Start System. Putting on Switchboard.
Familiarisation	Sequence of Events & 'First Line Maintained' Services.
Lifts	Emergency Escape Procedures.
Machinery Space Ventilation	Unit Number. Power Source & Control.
Fire Pumps Starting	Locally and remotely. Remote Valves. Location of Start Stations.
Halon Systems	Main Station. Stbd. Station. FER Station. Alarm Test Operation.
Alarms	Fire. Engineers. Halon Telephone. Norimos. General.
Remote Bilge Panel	Location. Operation. Fire Pump also from here.
Drencher System	Drencher Pump. Starting. Test Routine. Drench Room and Section Valves Crossovers.
F.O. Tanks & Quick Closing Valves	Location of QC Valves and Panel. Test Routine. Location of Tanks. Transfer Routines.
Steering Gear & Tests	Pre departure test. Standby Routine. Weekly Tests. Hand Steering.

P&O EUROPEAN FERRIES (PORTSMOUTH) LIMITED

Initial Job Training

Check List for Electrical Engineering Officers

SAFETY/BASIC KNOWLEDGE Cont'd

Crankcase	Procedure for Shut Down C/E Orders P.36/37.
Oil Mist Detector	Testing. Function Test.
Switchboard	Locations. Main & Emergency. Non Essential Discrimination. Blackout Procedures. Power Distribution noting relation to Fire Zones & Ability to isolate Prime Services (Galley. Vehicle Deck Ventilation Passenger Accommodation etc).
Fleet Regulations	Availability. Sign when read.
Masters & Chief Engineers Standing Orders	Sight & Sign.
Lifeboat Engines & Gear	Identify battery charge system & power source.
Ship Knowledge	

P&O EUROPEAN FERRIES (PORTSMOUTH) LIMITED

Initial Job Training

Check List for Electrical Engineering Officers

HEALTH & SAFETY

Cleaning Chemicals & Chemicals	Storage Areas. Understand Compatibility. Safe Usage. Precautions.
Manual Handling	Correct lifting techniques.
Entry into Enclosed Spaces	Permit to Work.
Electrical Safety	Condition of appliances. High Voltage Awareness. Isolation of Machinery. Location of Safety equipment/clothing (gloves, boots etc.).
Ship Board Training Manual	
Code of Safe Working Practices	Machinery & Vehicle Deck Policy.
Fleet Regulations	Job Description. Responsible To. Responsible For Management Organisation. Periphery Activities. Uniform & Messing Standard.
Masters Standing Orders	
Chief Engineers Standing Orders	

P&O EUROPEAN FERRIES (PORTSMOUTH) LIMITED

Initial Job Training

Check List for Electrical Engineering Officers

MAINTENANCE, REPAIRS, STORES

Location of Supply Boards.
Location of Work Shops & Stores.
System of Ordering Stores.
Location of Elect. Drawings.
Location of Reefer Socket Supplies.
Routine for Plugging in Fridge Lorries (reference to F.S.O...
Plan Maintenance Routines.
Location of Life Boat Davit Supply and Overside Lighting.
Location of Ventilation Supplies.
Self Contained E.M Light Routines.
Location and Operation of Lift Machinery.
Work Chit System.
Galley Power Supplies.
415v 50Hz System for Public Entertainment Facilities.
Cooling Systems. Ring Main & Free Standing.
Winch Machinery.
Vehicle Deck Ventilation Control & Supplies.
Incinerator Plant.
Main Engine Load Control System.
P.A. System.
Fire Alarm System.
W.T. Doors

FLEET REGULATIONS - RECORD OF ACKNOWLEDGEMENT

PRIDE OF LE HAVRE

All Officers must sign this form (in the Master's copy only) to signify that they have read and understood those sections of the Fleet Regulations which are relevant to their duties, and are aware of the contents of the remainder of the Fleet Regulations.

RANK	NAME / SIGNATURE	DATE	NAME / SIGNATURE	DATE	NAME / SIGNATURE	DATE
C/O.	A. S. [illegible]	20/6.	K. SIMPKIN	20/6/98	[illegible]	20/6/98
	[illegible]		[illegible]		[illegible] ETO	
	D PHENIX	20/6/98	G. [illegible]OND	22/6/98		
	David Phenix ETO		[illegible]			
	W BOLTON	20/6/98	F. J. GARDINER	20/6/98		
	[illegible] 3EO		[illegible]			
	RJ RAMSDEN	3/E.				
	RJ Ramsden	20/6/98				
	N. AZAM QURESHI	3/E				
	[illegible]	20/6/98				

CHAPTER 5 SHIPBOARD OPERATIONS: GENERAL: ENGINE ROOM

5.1 FAMILIARISATION OF ENGINEER, ELECTRICAL, ELECTROTECHNICAL OFFICERS AND TECHNICAL OFFICERS (GMDSS) NEW TO THE VESSEL

As part of their induction training all Engineer, Electrical, Electrotechnical Officers and Technical Officers (GMDSS) on joining the ship, must complete Form 1/1B . See FR 1.10.4/5

Additionally, Form 3, FR Ch I App.1, is to be completed to gain familiarity with the equipment provided on board. Among other things the list below covers the location, arrangement and operation, particularly of the following:

1 Fire fighting apparatus, including alarm systems and fire dampers;

2 Lifesaving appliances;

3 Operation of watertight doors;

4 Means of escape;

5 Fuel, oil and water tank quick closing valves;

6 Emergency generator, fire pump and air compressor;

7 Main engines, including transfer of control;

8 CCP system: inc. testing and emergency system;

9 Steering systems, including emergency steering;

10 Actions in an emergency:

(a) Black out,

(b) Crankcase explosion,

(c) Fire,

(d) Loss of control air;

11 Oily water separator system;

12 Ballast, heeling tank and emergency bilge pumping (inc. emergency bilge injection) systems;

13 Fuel system, action when supply fails;

14 Damage control systems, cross flooding arrangements, storm valves;

15 Electrical switchboard procedures, shaft and diesel alternators;

16 Emergency stops - fuel/lub oil pumps, ventilation, main and auxiliary engines, overboard discharges;

17 P.A. systems and cell phones. (ETO & TO(GMDSS)).

The SCEO is to ensure that the Engineering Officers are aware of any recent developments, modifications and changes in procedures on board their ship.

This list is not to be considered exhaustive and it may be amended by the ship's senior management.

5.9 WATERTIGHT INTEGRITY

The operational procedures contained in the documents referred to in FR Chapter 3 are to be followed at all times, FR 3.13.

All manholes/portable plates (which close any opening to a space which is required to be watertight) must be fitted in place before the ship proceeds on any voyage. The manholes must be kept in place until the ship is in a secure berth or anchorage.

The following must be inspected at intervals of not more than 7 days:

(a) all valves which must be closed to make watertight any compartment beneath the margin line. (e.g. bilge-main valves); and
(b) all valves which must be operated for the efficient operation of damage-control cross-connections.

Suitable notices/signs are to be placed on or near these valves to indicate their purpose, the procedures for operation and any precautions required, as necessary.

References
SI 1987/1298 MS(Closing of openings in Hulls and in Watertight Bulkheads) Regs.
M 1361 The dangers of flooding

5.10 MAINTENANCE

Schedules and routines to ensure that all machinery is maintained to manufacturer's or Company specifications are to be included in the Engine Room Standing Orders, FR 5.2.

All work on the vessel's machinery should be carried out to a high standard of craftsmanship with safe working practices being observed. Tools required to overhaul machinery should be kept in good condition and ready for use. If in any doubt regarding maintenance procedures, or if personnel are unfamiliar with equipment, the advice of a Senior Engineer Officer should be sought.

The guidance and advice contained in the Code of Safe Working Practices for Merchant Seamen is to be observed. Of particular importance and relevance are chapters 12, 13, 20, 22 and 23.

It is to be noted that, under the MS (Health and Safety : General Duties) Regulations 1984, all personnel have a duty to take all reasonable precautions in the performance of their duties to prevent accidents, dangerous occurrences and hazardous incidents.

In line with the environmental policy, and with particular attention to exhaust emissions, maintenance procedures for main and auxiliary engines should be regularly reviewed and performance monitored to ensure that, where practicable, they are operated at their optimum level.

References
Technical Manual and CSWP.
M 588 Engine room gantry cranes.
M 1195 Protective clothing and equipment regulations.
M 1355 Guarding of machinery and safety of electrical equipment.
M 1358 Protective clothing and equipment regulations.
M 1415 Code of practice for noise levels in ships.
M 1428 Asbestos - health hazards and precautions.

5.14 GUARDING OF MACHINERY AND ELECTRICAL EQUIPMENT

5.14.1 Statutory and Company requirements

It is the owner's and Master's responsibility to ensure that every dangerous part of a ship's machinery is securely guarded, or be as safe as if it were securely guarded. Electrical equipment and installations must be so constructed, installed, operated and maintained that the ship and all persons are protected against electrical hazards.

(a) Guards and fencing should be of substantial construction, properly maintained and kept in position at all times; save when any such part is necessarily exposed for examination, maintenance, cleaning or adjustment.

(b) Where work on any dangerous part of machinery or equipment is necessary, adequate precautions should be taken to guard against the hazards arising thereby.

(c) No person is to adjust, maintain, repair or clean machinery or equipment unless competent in the work to be done and conversant with the precautions to be taken.

(d) Except as allowed in (e) below, no work is to be undertaken on any electrical equipment unless that equipment has been properly and effectively isolated and due precautions have been taken to prevent other personnel inadvertently re-connecting that equipment to the electrical supply.

(e) Where it is essential to undertake work on live electrical equipment, only fully competent personnel are to carry out that work. Every precaution must be taken to avoid electrical hazards and to prevent an accident occurring.

5.14.2 Machinery - dangerous parts

Only those parts which are dangerous in motion need to be guarded, e.g.: gearing, belt drives, reciprocating components, revolving shafts and couplings.

Windlass, winch and capstan barrels are not normally considered to be dangerous parts. Care must be exercised when using such equipment.

Steam and exhaust fittings which by their temperature and location present a possible hazard are to be adequately lagged or otherwise shielded.

5.14.3 Principles of machine safety

(a) Hazards should be identified and assessments of risk made, taking into account the probability of occurrence and the severity of foreseeable injuries. Safety measures must be more certain as risk increases.

(b) Risk should be eliminated or reduced by:

(i) the design of machinery of equipment,
(ii) the use of safeguards, and
(iii) the use of safeworking practices.

The ship's Officers should assess the relevant machinery and equipment of the ship and, in conjunction with the relevant shore management, ensure that the statutory requirements are met.

References

See FR 5.11 Repairs and FR 7C.26 Portable electrical equipment.

CSWP Chapter 12
The Electricity at Work Regulations.
Regulations for the Electrical and Electronic Equipment on Ships (IEE).

SI 1988/1636	MS (Guarding of Machinery and Safety of Electrical Equipment) Regs.
M 1132	Electrical equipment and installations.
M 1355	The guarding of machinery and safety of electrical equipment.
BS 5304	The safeguarding of machines.

RANK	3RD ENG	ETO	
NAME	BOLTON WILLIAM	MEAD PAUL	
ID NUMBER	20952	21585	
BSS	YES	YES	
FF-IND		YES	
DLR			
DLR-IND			
CPSC	YES		
F-AID			
FF 1	YES		
FF 2			
FORKLIFT			
LIFEGUARD			
D G			
MLIST	03/04/97	09/08/97	START DATES (MUSTER LIST EXPLAINED
IND	03/04/97	09/08/97	STARRT DATES (FULL INDUCTION)
FIRE , V20			
LB	24/08/97		
DLR			
SURV, V13			
ACC.PREV.V41			
GEN.F.FIGHTG			
BOMB			
IST AID			
MAN LIFT			
03/04/3/97			
09/03/97			
17/03/97			
24/03/97			
31/03/97			
06/04/97			
13/04/97			
19/04/97	WATCH		
24/04/97			
26/04/97	F1		Full Fire Drill
27/04/97	MSA		MSA witnessed drill
05/05/97			
11/05/97	S1,S2, V12		Liferaft familiarity,Survival,Liferaftvideo
19/05/97			
26/05/97			
01/06/97	L1 L4 L7		Staged evacuation, Lifeboat drill, DLR drill
09/06/97			
17/06/97			
23/06/97			
29/06/97	L4		Lifeboat drill
07/07/97			
13/07/97			
20/07/97	M7,M8,M9		Crew evacuation, Epirbs & Sarts, TPA's & immersion suits
29/07/97	TOUCH DRILL		
04/08/97			
12/08/97	M1	M1	Entry into enclosed spaces
18/08/97		F1,F6,M7	Full fire drill, smoke area search routine, Crew evacuation
24/08/97	L1,L4,L7		staged evacuation, Lifeboat drill & DLR drill
01/09/97	S2	S2	Survival techniques
07/09/97			
15/09/97	F1,F3,M4	F1,F3,M4	Full fire drill, Breathing apparatus, Hazardous cargo
22/09/97		L8	DLR inflation exercise

RANK	3RD ENG	ETO	
NAME	BOLTON WILLIAM	MEAD PAUL	
27/09/97	EXEMPT		
05/10/97	L4	L4	Lifeboat drill
13/10/97			
17/10/97		L1, M6	Full staged evacuation, Damage contro exercise
27/10/97		F1	Full fire drill
03/11/97	F3, F6		Breathing apparatus, Smoke area search routine
09/11/97	F1,M4,F7	F1,M4,F7	Full fire drill, Hazardous cargo incident, Foam equipment
14/11/97			
16/11/97			
24/11/97	S1, M5	S1, M5	Liferaft familiarity, Emergency equipment lockers
30/11/97		P8	First Aid training
08/12/97	F1		Full fire drill
15/12/97	M6	M6	Damage control exercise
22/12/97			
30/12/97	F1,F3,F6,F1O	F1,F3,F6,F1O	Fire drill, smoke search, B.A., ventilation control
05/01/98		P1,L2	Passenger muster & Lifeboat drill
12/01/98			
19/01/98	F,WATCH	F,L1,L3,L4	Fire drill, staged evacuation, Lifeboat drill
26/01/98			
02/02/98	L8,S1	L8,S1	DLR inflation exercise and survival techniques
08/02/98		F1,F9,L2	Fire drill, Fixed installation, Lifeboat drill
16/02/98			
22/02/98	F,F3,M1	F,F3,M1	Fire drill, B.A, Entry into enclosed space

1998

1	10	20	20	
RANK	2ND OFFICER	3RD ENG	ETO	
NAME	THOMAS BRUCE	BOLTON WILLIAM	MEAD PAUL	
ID NUMBER	22517	20952	21585	
BSS	YES	YES	YES	
FF-IND			YES	
DLR-IND				
DLR				
CPSC	YES	OCT 97		
F-AID	YES			
MED CARE	YES			
FF 1	YES	YES		
FF 2	YES			
FF 3		OCT 97		
FORKLIFT				
LIFEGUARD				
LIFT/SLING		FEB 98		
GMDSS	OCT 95			
D G				
MLIST	29/04/98	03/04/97	09/08/97	START DATES (MUSTER LIST EXPLAINED)
IND	29/04/98	03/04/97	09/08/97	START DATES (FULL INDUCTION)
FIRE , V20				
LB				
DLR				
SURV, V13				
ACC.PREV.V41				
GEN.F.FIGHTG				
BOMB				
IST AID				
MAN LIFT				
14/03/98			EXEMPT	
22/03/98		F1		Full Fire Drill
23/03/98		MSA, F1.L1		Full Fire Drill MSA witnessed and Full staged evacuatio
29,30/03/98		EXEMPT	EXEMPT	
06/04/98				
12/04/98				
0/04/98			F6,F1	Full Fire Drill , Smoke area search routine
27/04/98			F1 M4 MCA	Full Fire Drill, Hazardous cargo incident
02/05/98	F14,S2,M8	F14,S2,M8	F14,S2,M8	W/T door procedure, survival techniques, Epirbs & Sart
12/05/98	P1,F14			Passenger Muster Drill, W/T door procedure
18/05/98		M10,L2	M10,L2	Oil spill emergency, Lifeboat drill
22/05/98			F1	Full Fire Drill
26/05/98			L8	Davit Launched Raft inflation
01/06/98	F1	F1		Full Fire Drill
05/06/98				
13/06/98				
21/06/98		M3	M3, L1	Hazardous Cargo incident, Full staged evacuation
23/06/98	EXEMPT	F1,M4,L1	F1,M4,L1	Fire DrillHazardous Cargo incident, staged evacuation
27/06/98			F01, F09	Fire Drill, fixed installations
05/07/98	F 01	F 01		Full fire drill
12/07/98		M 01	M 01	Entry into enclosed space
19/07/98				
28/07/98				
03/08/98				
10/08/98				
16/08/98				

OS	CLEAR
DS PMS	ALL HEADS IN ENGINE-ROOM SPACES (A-H) DONE. KLAXONS & FLASHING BEACONS ALSO CHECKED — 1 LAMP REPLACED, OTHERWISE ALL SATISFACTORY.
DRILL	WASH-UP ON LAST NIGHTS EXERCISE. I SUGGESTED THAT VHF WALKIE TALKIES & LOUDHAILERS ARE KEPT IN 10 DK TELEPHONE EXCH LOCKER. IF P.A. IS KNOCKED OUT WE'LL HAVE PROBLEMS WITH COMMS.
EBCOM	CHECK OVER BRIDGE UNIT & MAKE A START ON CHECKING THROUGH SPARES ETC
KG GEN	RUN FOR 1/2 HOUR ON LOAD — BRIDGE GEAR TESTED & RESET ON COMPLETION.
L	REPAIRED DATA MGRS VCR.
K FANS	AFT FANS TRIPPED — REPLACED ONE FUSE — NOW OK. MATE ADMITTED THAT THERE WAS NO DELAY IN PUTTING THEM ON

[illegible] OF [illegible]

EXTRACT FROM ETO'S DIARY

29 Monday
Week 27 · 180-185

FDS	CLEAR
PAX DOOR LOCKS	2 DOOR LOCK CONTROLLERS REPAIRED & 1 LOCK MOTOR TESTED & SATISFACTORY.
SAT TV	CHECKED THROUGHOUT THE DAY & ALL SATISFACTO
UHF RADIOS	RADIO EX SECURITY TO BRIDGE - NEW PLUG ON CHARGER. RADIO EX STBY MAN TO INFO BACK OTHER CHARGER. EX SECURITY, NEW PLUG & NOW IN BRIDGE LOCKER AS SPARE (UNDER UHF BASE STN). 1 RADIO EX BRIDGE (MX1000) REPORTED POOR RX. STRIPPED DOWN IN CABIN - INVESTIGATIN SAW DEBORAH MCGRATH & OBTAINED TO BATTE CLIPS FOR GP300S - NOT SUPPLIED WITH SPARE BATTERIES. CLIPS GIVEN TO STBY MAN/SECURITY.
VEH DK FANS	C/O (STARKY) REBOOTS MIDSHIPS PORT FRD FAN U/S CHECK IN MIDSHIPS STN (LOCAL CONTROL) SHOWS FAN RUNNING - CK FAN EXHAUST ON VEH DK & OK. IAM OUT ON CONTROL PANEL - GREE MATES!!
M/E GOVERNOR	PAUL REPLACES BROKEN SOCKET ON NO2 M/E. ORDERED 3 SPARE PLUGS & SOCKETS FM ESSEX GOVERNORS - RQ 5004666 REFERS.

PRIDE OF LE HAVRE

1990 EXTRACT FROM ELECTRICIANS DIARY JUNE

Monday 8
Week 24 159-206

DECK FANS — AFT. SECTION OF CAR DECK FANS NOT WORKING CHECKED OUT AND FOUND 160AMP. FUSE BLOWN BEHIND MAIN SWITCHBOARD ⊛ LEFT HAND FUSE FRONT ELEVATION ⊛ CHECKED OUT AND STARTED FANS O'K.

GALLEY 220VOLT EARTH — EARTH ON 220VOLT BOARD - TRACED ONE EARTH FAULT TO COLD SLAB IN MAIN RESTAURANT 3-DECK ⊛ THE CAUSE WAS MULTI-CABLE CONNECTORS LAYING IN WATER (PORT SIDE COLD COUNTER SLAB) DRIED OUT AND CLEARED.
⊛ THERE IS ANOTHER EARTH DOWN IN SELF SERVICE RESTAURANT YET TO BE TRACED AND CLEARED.

BAIN-MARIE — FWD. ONE OF 2 - CHECKED OUT AND FOUND CABLE LUG BURNT OFF- RE-MADE AND WORKING O'K.

SELF-SERVICE — AFT. ONE OF 2 THE FWD. ONE IS OUT OF ACTION ANYWAY ⊛ 3-16AMP FUSES BLOWN ⊛ CAUSE → CONTROL THERMOSTAT (FLASHED OVER AND BURNT OUT (CHANGED FOR SPARE) ⊛

PRIDE OF LE HAVRE

July Wed 1 Thu 2 Fri 3 Sat 4 Sun 5 | Mon 6 Tue 7 Wed 8 Thu 9 Fri 10 Sat 11 Sun 12 | Mon 13 Tue 14 Wed 15 Thu 16 Fri 17 Sat 18 Sun 19 | Mon 20 Tue 21 Wed 22 Thu 23 Fri 24 Sat 25 Sun 26 | Mon 27 Tue 28 Wed 29 Thu 30 Fri 31

ANNEX 4

Paul MEADS Assessment form 16.07.97.

Pride of Le Havre
27 July 1998

Assessment Form for Engineer/Deck Officers
Short Term Employment/Transfer to new vessel

P&O European Ferries

Full name of officer: MR. P. MEAD. ELECT OFF.
Joined ship on (date): 07/07/97. Left ship on (date): / / Ship: POPO.
Recommendation for re-employment (Yes/No):

Complete all sections based on observation and discussion

Safety:	Asmnt.
Follows safe working practices	C
Familiar with Company Safety Policy	C

Skill Assessment:	Asmnt.
Technical skills	C
Fault finding skills	C
Communication skills (verbal and written)	C
Self management and motivation i.e. effectiveness/efficiency	C

Personal Qualities:	Asmnt.
Often exceeds standards set for a task or for the role	C
Seeks to develop self in job	C
Good time keeper	C

Work with Others:	Asmnt.
Maintains the trust of senior officer(s)	C
Exchanges information to solve problems and make decisions	C
Co-operates with others (including people from other departments)	C

ecific Competencies:	Asmnt.
Recognises conditions that may lead to system/plant failure	C
Implements correct action to deal with failures and emergencies	C
Starts and stops plant, as required	C
Follows 'hand over' instructions and acts on 'hand over' information	C
'Hand over' a watch	C

Supporting comments:
HAVE FOUND MR P. MEAD TO BE A VERY COMPETENT OFFICER VERY WILLING TO LEARN OUR OPERATIONAL PROCEDURES AND ROUTINES ALSO WILLING TO EXCHANGE HIS KNOWLEDGE. HIS EMPLOYMENT WILL BE AN ASSET TO THE ELECTRICAL ARM OF THE COMPANY.

hief Engineer (signature): _____ Date: 16.07.97.

ANNEX 5

Copy of HSE Guidance Note GS 38
"Electrical Test Equipment for use by Electricians"

Pride of Le Havre
27 July 1998

Electrical test equipment for use by electricians

Guidance Notes are published under five subject headings:

Medical
Environmental Hygiene
Chemical Safety
Plant and Machinery
General

(revised February 1995)

INTRODUCTION

1 This document gives guidance to electrically competent people involved in electrical testing, diagnosis and repair. Electrically competent people may include electricians, electrical contractors, test supervisors, technicians, managers or appliance repairers. It offers advice in the selection and use of:

- test probes;
- leads;
- lamps;
- voltage indicating devices;
- measuring equipment

for circuits with rated voltages not exceeding 650V.

THE LAW

2 The Electricity at Work Regulations 1989 require those in control of part or all of an electrical system to ensure that it is safe to use and that it is maintained in a safe condition. This section does not seek to give a definitive interpretation of the law. It summarises the main issues to be borne in mind when carrying out electrical testing.

3 The most important features that are relevant for electrical test equipment for use by electrically competent people are as follows:

(a) Equipment should be, so far as reasonably practicable:
(i) constructed;
(ii) maintained; AND
(iii) used in a way to prevent danger.

(b) No live working unless:
(i) it is unreasonable to work dead; AND
(ii) it is reasonable to work live; AND
(ii) suitable precautions are taken to prevent injury.

(c) Work must be carried out in a safe manner. Factors to consider when developing safe working practices include:
(i) control of risks while working;
(ii) control of test areas;
(iii) use of suitable tools and clothing;
(iv) use of suitable insulated barriers;
(v) adequate information;
(vi) adequate accompaniment;
(vii) adequate space, access, lighting.

(d) People at work must:
(i) prevent danger and injury:
(ii) have adequate training, skill and experience;
(iii) have adequate supervision when appropriate.

RISKS

4 Unfortunately experienced electricians have used unsatisfactory electrical test equipment, which has caused serious burns or electric shock. Arcing or 'flashover' caused by poor test probes result in more injuries than electric shocks in electrical testing. Arcs once drawn, ionise surrounding air and cause further 'flashovers'. These can rapidly engulf the working area, before anybody can escape. These accidents can be **FATAL.**

5 Systems where voltages are below 50V ac or 120V dc (extra low voltage) reduce the risk of electric shock to a

low level. If system energy levels are low, then arcing is unlikely to cause burns. Where possible it is recommended that tests are carried out at reduced voltages which will usually reduce the risk of injury. Equipment should be constructed with suitably insulated and shrouded terminals to minimise the risk of short circuits, which could be dangerous. For example, batteries can cause a high energy flashover when short circuited.

6 In addition to the risk of electric shock and burn, there could be other risks to consider. For example:

(a) chemical burns, eg from battery acid;

(b) falls from ladders or platforms when testing.

ACCIDENT CAUSES

7 Unsuitable test probes, leads, lamps, voltage indicators and multimeters have caused arcs due to:

(a) inadequately insulated test probes (typically having an excessive length of bare metal at the contact end) accidentally bridging a live conductor and adjacent earthed metalwork; or

(b) excessive current drawn through test probes, leads and measuring instruments. This happens when a multimeter is set to the wrong function, eg set on a current or resistance range when measuring voltage.

8 Other causes of accidents which could lead to electric shock are:

(a) inadequate insulation of test leads and probes;

(b) exposed live terminations at instruments and indicators;

(c) a lead falling off one of the terminals of a meter and either the meter terminal or the lead terminal remaining live;

(d) incorrect use of test equipment, eg a multimeter applied to conductors at a voltage which exceeds the maximum working voltage of the instrument;

(e) use of poorly constructed makeshift test equipment, eg a test lamp consisting of a combination of a bayonet lamp holder, bulb and two single insulated conductors with bared ends;

(f) the use of long intertwined leads which were not easily distinguished, resulting in one lead being connected across the instrument and the other short circuiting the live conductors under test.

DESIGN SAFETY REQUIREMENTS

Test probes and leads

9 The test probes and leads used in conjunction with a voltmeter, multimeter, electrician's test lamp or voltage indicator should be selected to prevent danger. Good test probes and leads will have the following:

(a) The probes:
(i) have finger barriers or are shaped to guard against inadvertent hand contact with the live conductors under test;
(ii) are insulated to leave an exposed metal tip not exceeding 4 mm measured across any surface of the tip. Where practicable it is strongly recommended that this is reduced to 2 mm or less, or that spring loaded retractable screened probes are used;
(iii) should have suitable high breaking capacity (hbc), sometimes known as hrc, fuse, or fuses, with a low current rating (usually not exceeding 500 mA), or a current-limiting resistor and a fuse.

(b) The leads:
(i) are adequately insulated (choice of insulating material may be influenced by the environment in which the leads are to be used);
(ii) are coloured so that one lead can be easily distinguished from the other;
(iii) are flexible and of sufficient capacity for the duty expected of them;
(iv) are sheathed to protect against mechanical damage;
(v) are long enough for the purpose, while not too long so that they are clumsy or unwieldy;
(vi) do not have accessible exposed conductors other

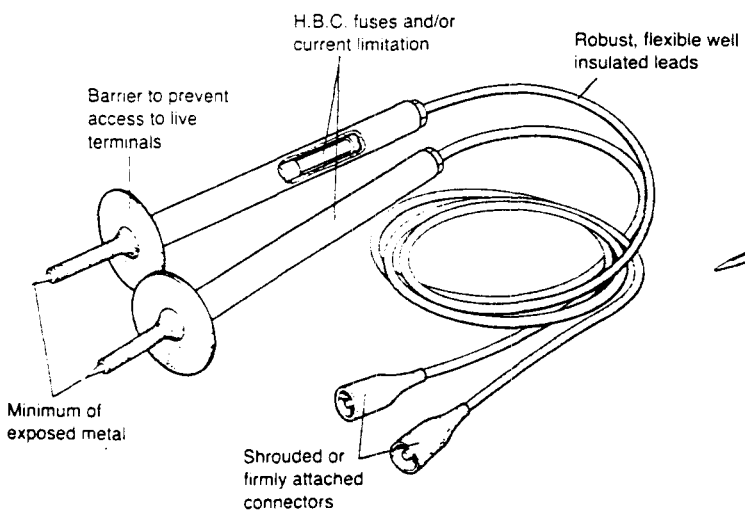


Figure 1: Test probes and leads (recommended type)

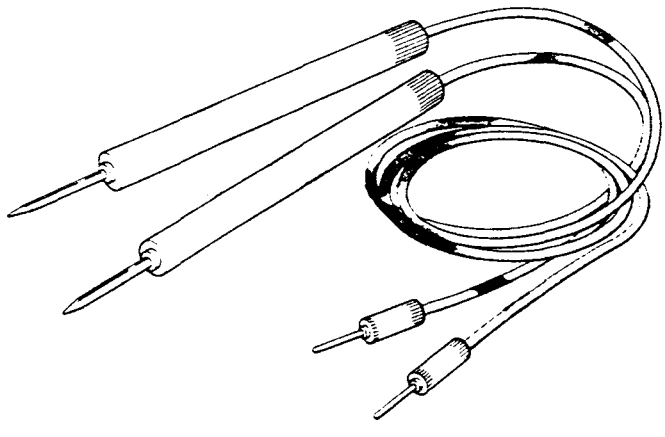


Figure 2: Test probes and leads (not recommended)

than the probe tips, or have live conductors accessible to a person's finger if a lead becomes detached from a probe, indicator or instrument when in use. The test lead or leads are held captive and sealed into the body of the voltage detector.

10 Probes can be provided with a variety of shapes of tip to allow access to the different types of contact.

Sockets and terminals

11 Risks of inadvertent hand or finger contact with any live test socket conductor when the equipment is live need to be reduced. The terminals and test sockets of test equipment may require shrouding.

Voltage detection instruments

12 Instruments used solely for detecting voltage fall into two categories. These are:

(a) detectors which rely on an illuminated bulb (test lamp) or a meter scale (test meter). Test lamps fitted with glass bulbs should not give rise to danger if the bulb is broken. It may be protected by a guard.

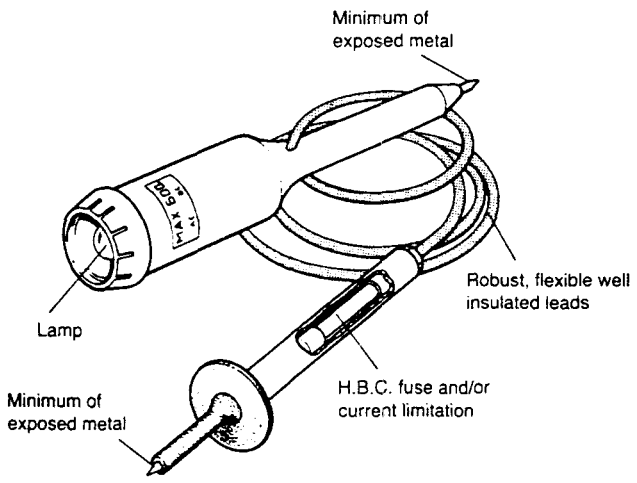


Figure 3: Typical test lamp

These detectors require protection against excess current. This may be provided by a suitable high breaking capacity (hbc or hrc) fuse or fuses, with a low current rating (usually not exceeding 500 mA), or by means of a current-limiting resistor and a fuse. These protective devices are housed in the probes themselves. The test lead or leads are held captive and sealed into the body of the voltage detector.

(b) detectors which use two or more independent indicating systems (one of which may be audible) and limit energy input to the detector by the circuitry used. An example is a 2-pole voltage detector, ie a detector unit with an integral test probe, an interconnecting lead and a second test probe.

These detectors are designed and constructed to limit the current and energy which can flow into the detector. The limitation is usually provided by a combination of circuit design, using the concept of protective impedance, and current limiting resistors built into the test probes. These detectors are provided with in-built test features to check the functioning of the detector before and after use. The interconnecting lead and second test probe are not detachable components. These types of detector **do not** require additional current limiting resistors or hbc fuses to be fitted provided that they are made to an acceptable standard and the contact electrodes are shrouded as in 9(a)(ii).

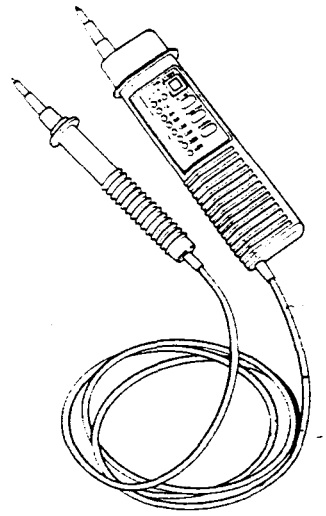


Figure 4: A typical 2-pole voltage detector

13 Test lamps and voltage indicators are recommended to be clearly marked with:

(a) the maximum voltage which may be tested by the device; and

(b) any short time rating for the device if applicable. This rating is the recommended maximum current which should pass through the device for a few seconds. These devices are generally not designed to be connected for more than a few seconds.

SYSTEMS OF WORK

14 The use of test equipment by electricians falls into three main categories:

(a) testing for voltage (voltage detection);

(b) measuring voltages; and

(c) measuring current, resistance and (occasionally) inductance and capacitance.

Item (a) forms an essential part of the procedure for proving a system dead before starting work but may also be associated with simple tests to prove the presence of voltage. Items (b) and (c) are more concerned with commissioning procedures and fault finding.

Precautions before testing

15 Before testing begins it is essential to establish that the test device including all leads, probes and connectors

is suitably rated for the voltages and currents which may be present on the system under test.

16 Before any testing is carried out ensure that:

(a) the equipment which is to be worked on is safe for the intended tests; and

(b) the working environment does not present additional dangers. These dangers include:
(i) inadequate space to work safely;
(ii) an insecure footing;
(iii) insufficient light;
(iv) potentially flammable gases or vapours;
(v) explosive or conductive dusts.

17 Where a test is being made simply to establish the presence or absence of voltage, the preferred method is to use a proprietary test lamp or 2-pole voltage detector suitable for the working voltage of the system rather than a multimeter. Accident history has shown that the use of incorrectly set multimeters or makeshift devices for voltage detection has often caused accidents.

Note: Test lamps and some voltage indicators may fail to danger, eg a faulty lamp not indicating a live circuit. These devices should be proved before and after use on a known live source of similar voltage to the circuit under test, or alternatively on a portable test source.

Precautions during testing

18 For voltage detection or measurement, test leads protected by a fuse (or fuses) are recommended when voltmeters and in particular multimeters, are used. Although some multimeters are fitted with electromechanical overload devices, these are often inadequately rated to deal with short circuit energy present on electrical power systems. It is usually necessary to use leads which incorporate high breaking capacity (hbc) fuses even if the multimeter has an overload trip. If terminal clips are provided for connection to test points, they should be adequately insulated and arranged to be suitable for use with the test leads, as a safe alternative to the use of test probes. It is important that a multifunction or multirange meter is set to the correct function and/or range before the connections are made. Where there is doubt about the value of voltage to be detected or measured, the highest range should be selected at first, provided that the maximum voltage possible is known to fall within the range of the instrument.

19 Progressive voltage detection or measurement is often used to prove circuit continuity. The dangers from exposed live conductors should be borne in mind when using this method. In many cases, continuity testing can be carried out safely with the apparatus dead, using a self-contained low voltage dc source and indicator.

20 If tong-test instruments are to be used, it is necessary to check first that there is adequate working space free from danger (ie from bare live conductors at dangerous voltages) at the place where the instrument will be held. The tong insulation should always be examined visually before the instrument is used; if defects are present the instrument should not be used.

Note: Special precautions and provisions may be necessary for current measurement in CT secondary circuits and such measurement techniques are outside the scope of the guidance in this document.

21 Where current measurements are to be made using instruments other than insulated tong-test type instruments, the connections should be made with the apparatus dead, and should be made secure before the power is switched on. Any such temporary connections need to be adequately rated both for current and voltage.

22 If regular testing needs to be done, for example on complex control panels, nearby bare live conductors should not be accessible (eg screened) where access is not required. Alternatively, purpose-made screened test points or instrumentation may be provided.

Examination of equipment

23 All items of test equipment, including those items issued on a personal basis, should receive a regular inspection and, where necessary, a test by a competent person. Records are recommended to be kept of inspection and testing of the equipment, particularly where faults are found. These records will help decide how often visual inspection or testing will need to be carried out. It is important that electricians are aware of the kinds of defect which may occur in test equipment. Examples of common faults are:

(a) cracked meter cases;

(b) damaged insulation (abrasion, cuts or perishing of flexible insulation);

(c) loose terminals.

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