Report 98-211

Passenger sailing vessel *Phantom of the Straits*

electrical fire in engine enclosure

Wellington Harbour

5 September 1998

Abstract

At about 1710 on Saturday, 5 September 1998, the passenger sailing vessel *Phantom of the Straits* was engaged on a short sailing trip on Wellington Harbour when fire broke out near the engine enclosure. The fire was eventually extinguished, but not before the vessel had suffered extensive fire and smoke damage below decks. The skipper suffered from minor smoke inhalation; otherwise none of the four passengers or deck-hand were injured in the fire.

Factors contributing to the fire included substandard features in the electrical and machinery installations on board the yacht.

Other safety issues identified included:

- the non-transference of information between survey and safe ship management companies, and the adverse effect it could have on the New Zealand safe ship management system, and
- the incomplete safety briefing given by the skipper to the passengers before departing on the trip.

Safety recommendations were made to the Director of Maritime Safety, the Managing Director of Survey Nelson Limited, and the owner of the *Phantom of the Straits* to address the safety issues.

Phantom of the Straits

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Glossary of abbreviations and terms

AC	alternating current
aft	rear of the vessel
bulkhead	nautical term for wall
current shunt	a conductor joining to points of an electrical circuit, through which more or less current may be diverted
deckhead	nautical term for ceiling
DC	direct current
GRP	glass reinforced plastic
knot	nautical mile per hour
kW	kilowatt
LPG	liquid petroleum gas
m	metres
mm	millimetres
MSA	Maritime Safety Authority
M&I	Marine and Industrial
port tack	where the main sail is carried on the starboard side
PVC	polyvinyl chloride
sloop	one masted fore-and-aft rigged sailing vessel with a mainsail and jib
V	volt
VHF	very high frequency

Transport Accident Investigation Commission

Marine Accident Report 98 211

Vessel particulars:

Name:	*Phantom of the Straits*
Registered:	Wellington
Type:	Sloop rigged sailing vessel
Class:	II or V (Passenger ship engaged on inshore or coastal voyages)
Operating Limits:	Class II: Wellington Cook Strait & Marlborough Sounds Class V: Wellington River Limits & Picton River Limits
Passenger limit:	Class II: 18 Class V: 40
Length (overall):	23.77 m
Length (registered):	21.07 m
Breadth:	5.71 m
Tonnage (gross):	63 t
Construction:	Kevlar and glass reinforced plastic (GRP)
Built:	Auckland, 1985
Machinery Plant:	One 104 kW Gardner 6LXB diesel engine driving a single furling propeller, and also one Northern Lights diesel-driven alternator

Owner/operator:	The Maritime Adventure Company of New Zealand Limited
Persons on board:	Crew: 2 Passengers: 4
Injuries:	Crew: 1 (minor) Passengers: Nil
Nature of damage:	Substantial fire and smoke damage to interior and electric wiring
Location :	Oriental Bay, Wellington Harbour
Date and time:	Saturday 5 September 1998, at about. 1710[1]
Investigator-in-Charge:	Captain Tim Burfoot

[1] All times in this report refer to NZST (UTC plus 12 hours) and are expressed in the 24 hour mode

1. Factual Information

1.1 History of the voyage

1.1.1 At about 1600 on Saturday, 5 September 1998, the charter yacht *Phantom of the Straits* departed from its berth at Queens Wharf for a 90-minute sail within Wellington Harbour. The skipper, one deck-hand and four passengers were on board. On leaving the berth, the skipper used a portable very high frequency (VHF) radio to contact Beacon Hill signal station and report their intended route and the number of people on board.

1.1.2 The skipper manoeuvred *Phantom of the Straits* off the berth and out of Lambton Harbour under power. During this time he welcomed the passengers on board and briefed them on the hazards involved with sailing. He told them that they would be asked to move around the vessel in order to distance them from the moving equipment and rigging. The skipper did not brief the passengers on the location and use of the fire and lifesaving equipment.

1.1.3 Once clear of Lambton Harbour, the skipper and the deck-hand used a remotely controlled electro-hydraulic winch system to raise the mainsail and unfurl the foresail. When the sails were set, the skipper stopped the propulsion diesel engine (main engine) and set a course under sail for Somes Island near the middle of Wellington Harbour.

1.1.4 The sail handling system, the domestic water and sanitary systems, and the navigation computer were the only electrical services in operation. With so few electrical services required, the skipper did not need to run the auxiliary diesel alternator (generator), the electrical load being drawn from the 24 V house battery instead.

1.1.5 The wind was 15 to 20 knots from the north-west quadrant causing a slight sea; the weather was partly cloudy, with good visibility.

1.1.6 The trip was uneventful until about 1710, as *Phantom of the Straits* was passing Oriental Bay on the way back to its berth, when the skipper and the deck-hand both heard an alarm emanating from below decks. At that time all the hatches were closed. The skipper opened the aft hatch near the helm station and, recognising the sound of the smoke alarm located on the deckhead of the navigation station, went below to investigate.

1.1.7 The passengers recalled smelling smoke once the aft hatch was open, "something like a burning electrical smell" but they could not see smoke at that time.

1.1.8 Below decks, the skipper could smell smoke but initially could not see any. It was relatively dark below with all the other hatches closed. He opened all the electrical circuit breakers on a panel above the navigation station and opened three main battery isolating switches located at floor level in the navigation station. These switches isolated the three main battery banks: house, main engine starting, and generator starting.

1.1.9 While he was stooped down opening the three switches, the skipper noticed "fumes, or light coloured smoke" emanating from within the engine enclosure. He then went back on deck and informed the passengers and the deck-hand that they had a problem. The skipper made a call to Beacon Hill using the portable VHF radio, but he did not identify his vessel when making the call. Receiving no immediate response from Beacon Hill, the skipper went back down below to assess the situation, having instructed the deck-hand to helm the vessel downwind towards Oriental Bay.

1.1.10 At 1714, the Beacon Hill radio operator heard a call to Beacon Hill, but the call was masked by static. He identified himself as Beacon Hill and asked the unknown caller to "go ahead". He did not receive a reply.

1.1.11 On returning below, the skipper noted that the smoke coming from the machinery enclosure was denser, although still light in colour. So that he could see better, the skipper opened the main centre hatch and a smaller "trench hatch" on the starboard side, which were above and slightly forward of the apparent source of the smoke. On opening the hatches, the skipper was able to confirm that the source of the smoke was a fire inside the machinery enclosure, and that the amount of smoke was increasing.

1.1.12 The skipper made his way aft and picked up a foam fire extinguisher with the intention of opening the starboard side drop-panel and releasing the contents of the extinguisher into the enclosure, but as he approached the engine enclosure he realised that the smoke was becoming too dense. Up to that point the skipper had assumed that the fire was electrical due to the smell and nature of smoke; however, mindful that the diesel fuel system was located on the starboard side of the auxiliary diesel engine, and recalling his fire fighting training with regard to the fuel/air/heat triangle, he opted to make a hasty retreat to the deck via the aft hatch, but he left the three hatches open.

1.1.13 On arriving back on deck, the skipper closed the isolation valve for the LPG gas bottle on deck and called Beacon Hill using the portable VHF radio. Beacon Hill logged the call as being at 1715. The following radio exchange ensued:

Skipper:	Fire, fire; Beacon Hill; urgent, urgent
Beacon Hill:	What is your position and who is calling?
Skipper:	Fire, fire, this is urgent; I repeat, urgent, urgent
Beacon Hill:	Your position?
Skipper:	Oriental Bay; *Phantom of the Straits.*

1.1.14 The Beacon Hill radio operator initially dialled 111, but due to a delay getting through, radioed the Police Launch *Lady Elizabeth 3* to assist. Meanwhile observers ashore had noticed the plight of *Phantom of the Straits* and had notified the fire service using the 111 system. The Wharf Police liaised with the Fire Service and held the *Lady Elizabeth 3* at its berth until fire fighters arrived, eventually leaving the berth at 1724, and meeting *Phantom of the Straits* two minutes later at 1726.

1.1.15 On board *Phantom of the Straits*, over the 11 minutes between alerting Beacon Hill and the arrival of the *Lady Elizabeth 3*, the following events took place in chronological order:

- The skipper instructed the deck-hand to put the vessel on a port tack and head out of Oriental Bay.
- The passengers were instructed where to stand, clear of the thick smoke.
- The skipper went below via the aft hatch, picked up the foam fire extinguisher and released it for about 20 seconds in the direction of the machinery enclosure until he was driven back on deck by the thickening smoke (by then black in colour).
- The skipper and deck-hand used the remote control to begin furling the foresail (the system was wired directly to the house batteries); after about eight turns, the system went dead.
- The deck-hand noticed flames coming from the centre hatch.

- Other rescue boats arrived and passed fire extinguishers and a bucket on board (The rescue craft included the Wellington Port Company tug *Kupe*, the Coastguard rescue vessel *Spirit of Wellington* and other unidentified private craft).
- The skipper released the fire extinguishers into the open hatches while the deck-hand poured some 20 buckets of seawater on to the seat of the fire (they were assisted by someone from one of the rescue boats).
- The flames were extinguished, but dense black smoke continued to pour from the open hatches.

1.1.16 At 1726, fire fighters from the *Lady Elizabeth 3* boarded *Phantom of the Straits* and continued to fight the fire. At 1733 they declared the fire out, the passengers were disembarked and the *Phantom of the Straits* was taken in tow back to its berth.

1.1.17 The skipper suffered from minor smoke inhalation; apart from him no other persons were injured as a result of the fire.

1.2 Personnel information

1.2.1 The skipper of the *Phantom of the Straits* had been sailing yachts for some 40 years, beginning in small sailing dinghies and eventually progressing up to deep-sea ocean-racing yachts. He had sailed extensively on his own yachts for about 15 years. Since purchasing *Phantom of the Straits* in the United States, he sailed it back to New Zealand and operated the yacht as a passenger charter yacht using qualified skippers until 1997, when he obtained his Coastal Launchmaster Certificate. Since then he had skippered the vessel himself.

1.2.2 The deck-hand was a volunteer crew member as were most of the crew used for inner harbour cruises. He had sailed on the *Phantom of the Straits* on numerous occasions.

1.3 Vessel operating history

1.3.1 *Phantom of the Straits* (ex *Lion New Zealand*) was a New Zealand purpose-built, "maxi" racing sloop, built in 1985 for the Whitbread round-the-world yacht race. At the time of build it was classed as a pleasure vessel.

1.3.2 Following its time as a racing yacht it was sold to a foreign buyer who, after making some modifications, used the vessel as a private yacht until 1995, when it was bought by its current owner who sailed the vessel to New Zealand. In late 1995, he started the process of entering the vessel into survey as a Restricted-Limit Passenger Ship.

1.3.3 The yacht was inspected by surveyors from Marine and Industrial Safety Inspection Services Limited (M&I) and, following several required modifications, was issued an Interim Certificate of Survey by the Maritime Safety Authority (MSA) on 5 March 1996, when the vessel began trading as a passenger charter sailing vessel owned and operated by the company, The Maritime Adventure Company of New Zealand Limited.

1.3.4 In January 1998 the owner approached Survey Nelson Limited, an MSA approved safe ship management company, to have *Phantom of the Straits* entered into their safe ship management system. The yacht was inspected by a Survey Nelson surveyor on 8 January 1998 for entry into Survey Nelson's system. Following this, MSA issued an exemption certificate pending full entry into safe ship management. Survey Nelson issued a full safe ship management certificate for *Phantom of the Straits* on 3 June 1998.

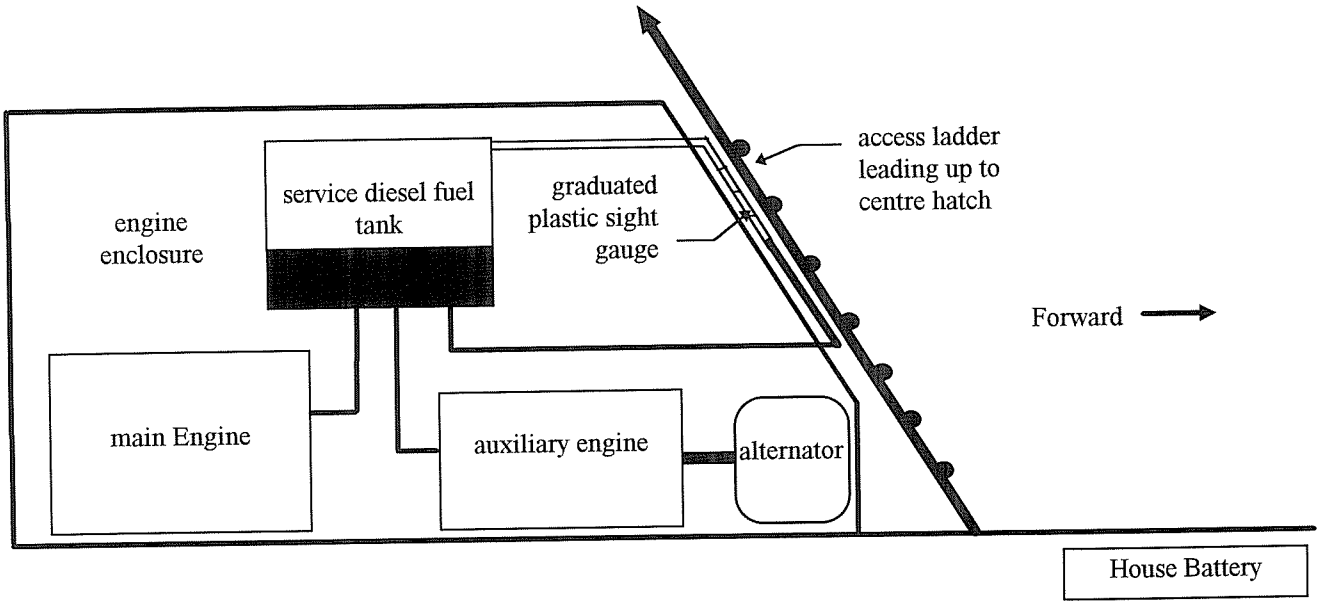

Figure 2
Engine enclosure arrangement, profile looking from starboard side
(Diagram not to scale)

1.4.6 The batteries were electrically connected by a common negative rail and bonded to the metal frames of the engine enclosure. The positive terminals were separated and individually isolated with the three isolating switches located at floor level in the navigation station, some distance from the batteries. The battery cables to these isolating switches were unprotected against potential fault currents.

1.4.7 The DC distribution to sub-circuits was from the circuit breaker panel located on the deckhead of the navigation station.

1.4.8 The main engine battery was charged by the main engine alternator via a regulator and two large cables connecting the two (see Figure 1).

1.4.9 The generator fed an AC powered battery charger mounted above the service fuel tank, which charged the generator starting battery. The owner said that any battery could be charged or switched to support any load by operating a set of cross-over switches located under the floor near the house battery.

Wiring

1.4.10 A cable loom of individually Polyvinyl Chloride (PVC) sheathed control wires had been run up inside the engine enclosure near its front starboard corner, and then run aft at half enclosure height. The loom split between the two engines, one branch running up and over to the port side of the generator; the other continued aft and eventually up to the main engine starter control panel.

1.4.11 A similar cable route, but with larger PVC insulated cables, had been run on the port side of the engine enclosure. The two heavy horizontal cables (about 35 mm^2) connecting the main engine alternator to the main engine starting battery had been loomed together and run along the length of the port side engine enclosure. These high current cables were loosely supported along their route, but were unsupported for about 1000 mm past the main engine. At one point they were resting on the main engine air intake duct. A current shunt had been installed in the positive conductor of this cable pair to provide an instrument reading representative of the main engine charging current. The shunt had been installed within the cable loom with no apparent additional support, and with a poorly crimped lug.

Cable support systems

1.4.12 Cable loom support systems consisted of metal cable clamps screwed to the metal framework of the engine enclosure, and plastic spiral wrap cable loom sleeves. Cable clamps were widely spaced through the engine enclosure. The owner said this was to enable the cable looms to be moved to gain access to the engines.

1.4.13 Strain relief had not been provided for cable looms at two locations where they made an acute transition from vertical to horizontal. The cable insulation was unprotected from the sharp edge of the cable clamps in these areas.

Cable penetrations

1.4.14 The main battery cabling was examined when the floor plates were removed. Some attempts had been made to protect under-floor cables where they passed through metal bulkheads; however, the cables were found pressing hard against the rough metal edge of these penetrations and were totally reliant upon their PVC sheath for electrical insulation.

Remote sail-winch control

1.4.15 The hand held winch control box used to furl the sails was in use at the time of the fire. This had a flexible cable that entered the cabin through the centre hatch and then into the top of the engine enclosure, beside the plastic tube of the sight gauge for the service fuel tank. The cable then ran under the floor to the DC powered hydraulic pump motor and solenoid valves, which were mounted under the galley table. A direct connection from the batteries provided power to this pump and remote control system, so that the sails could be set while the batteries were isolated. No fuse protection for this pump could be found. The flexible cable had been severed near the aluminium access ladder by the flames from the engine enclosure.

1.5 Damage to the vessel

1.5.1 The fire damage had been mainly contained within the engine enclosure, except near the starboard forward end of the enclosure where flames had been seen by the skipper and deckhand while fighting the fire. The heat generated by the fire in this area had been sufficient to melt the rungs of the aluminium access ladder. Moderate heat damage was evident in the immediate area surrounding the enclosure. Smoke damage throughout the cabin was severe.

1.6.9 It was reported to the Commission that sometimes, when existing vessels are presented for survey, or vessels are imported from overseas, their electrical installations do not meet the required New Zealand survey standard. Because of the high cost to the owner of rewiring or modifying their vessel, the electrical installation is occasionally overlooked on the basis of "no past problems".

Tanks

1.6.10 In the letter from M&I to the owner of *Phantom of the Straits*, the following reference was made to the service fuel tank:

"A means of establishing the contents of the tank shall be provided. If a gauge glass is fitted, self-closing valves shall be fitted between the gauge glass and the tank"

1.6.11 In the letter from M&I to MSA, the corresponding comment was: "Fuel gauge is fitted".

1.6.12 According to the owner of *Phantom of the Straits* the plastic sight gauge, as described in paragraph 1.4.3, without a self closing valve, had been in place when he purchased the yacht overseas, and had not been altered by him before the fire.

2. Analysis

2.1 The fire

2.1.1 Numerous conditions existed in the 24 V wiring system on board *Phantom of the Straits* for uncontrolled electrical faults to develop. Once an electrical short circuit occurred in a cable loom, others could rapidly follow because the fault current was limited only by the battery capacity. Standard wiring regulations require that all cables are automatically protected from exceeding their maximum current capacity by fuses or circuit breakers fitted at the origin of supply. Some of the wiring within the engine enclosure was not protected by automatically operating devices to limit potential fault currents, and some of it was not installed in compliance with the applicable regulations for PVC insulated cables with regard to maximum temperature rating and cable support and protection.

2.1.2 The strong smell of burning electrics, and the little or light coloured smoke described by the skipper and passengers when the fire was first detected, suggest that the initial cause was a failure in what was fundamentally a substandard electrical wiring installation.

2.1.3 The exact sequence of events of this failure could not be determined; however, the number of potential faults made their individual sequence insignificant.

2.1.4 There are a number of flammable substances within an engine enclosure around which an electrical fire could take hold, including residue oils, cleaning agents, paint, or the PVC cable insulation itself. It was not established what the initial fuel for the fire was, but once the fire took hold, it appears to have melted the reinforced plastic fuel sight gauge where it was routed from the bottom of the diesel service tank across to the starboard forward corner of the engine enclosure. As the sight gauge was common with the tank, when the plastic hose was pierced by fire the entire contents of the tank would have emptied on to the source of the fire. With the opening of the three access and ventilation hatches, and the addition of diesel fuel on to the source of the fire, the fire then rapidly took hold and began to spread.

2.1.5 The appearance of flames near the centre access hatch, together with the presence of thick black smoke, was consistent with an oil-fed fire. The melting of the aluminium access ladder was an indication of the heat generated by the fire. It was fortunate that the service fuel tank contained only a limited quantity of fuel. Had it been full, the fire may not have been so easily extinguished by the crew and rescuers.

2.2 Emergency procedures

2.2.1 Although the crew were successful in all but extinguishing the fire using seawater and fire extinguishers before the Fire Service arrived, their management of the emergency was not ideal.

2.2.2 The skipper's use of non-standard radio technique for conveying the urgency message resulted in some delay in Beacon Hill being briefed on the situation. It was fortunate that observers ashore had noticed their plight and summoned the emergency services.

2.2.3 Having discovered the fire, the skipper was not prudent to have opened as many hatches as he did. With the wind astern, he provided for an ideal air flow from the aft hatch, past the seat of the fire and up through the centre hatch. All three hatches remained open while the skipper and crew fought the fire.

2.2.4 The passengers had not been briefed on what to do in the event of an emergency. None of them knew where the life-jackets were stowed, or the location of the fire extinguishers.

2.2.5 With a crew of only two, their resources were limited. Had the yacht been in a more remote location, and had they not been successful in putting out the fire, the outcome of the trip might have been worse.

2.3 Substandard electrical installation

2.3.1 The one cable in the starboard cable loom that had been heated by excessive electrical fault current was not protected by a fuse. The heat generated by this cable, which was sufficient to melt through the house battery casing, illustrates the importance of cable protection. The unprotected cable was an example of non-compliance with the regulations.

2.3.2 On the port side of the engine enclosure, where the heavy cables between the main engine alternator and battery passed over the engine air intake, it appeared that heat from the adjacent main engine exhaust manifold had heated the cable insulation to plastic flow temperature, allowing gravity and vibration to gradually expose the conductors. The maximum safe operating surface temperature limit of the PVC cable insulation is approximately 75 degrees Celsius, which would have been exceeded at this point. These cables were not adequately supported or protected from external heat radiation as required by the applicable code.

2.3.3 The current shunt installed in the positive of the two cables had a poorly crimped lug. This relatively high resistance joint might have become hot while the shunt was conducting current, or heat from the generator might have softened the insulation at some stage. As the cables were unsupported, the sharp corners of the hot cable shunt might have melted into the insulation of the adjacent negative cable, which would have eventually caused a short circuit directly across the engine battery. Such a fault would explain the observed rapid electrical fault separation of both cables in this area. The shunt should have been mounted on an insulated frame and the cables should have been protected from heat and adequately supported. The shunt was a possible source of ignition for the fire.

2.3.4 The possibility existed that, over time, heat from the generator was partly responsible for creating the conditions for an electrical fault at the shunt. The engines were water cooled and vented naturally from deck, with the aspiration air supply being drawn from the cabin. Under these conditions the temperature in the engine enclosure might have risen to a level that would place PVC cable insulation at risk of failure.

2.3.5 None of the three batteries had electrical fault protection installed at source, and several examples of inadequate cable protection were evident in the routing of the cables between the batteries and their respective isolating switches.

2.3.6 To comply with the regulations, the section of fuel gauge pipe from the bottom of the tank to the point outside the engine enclosure should have been constructed from steel or other approved material, and a self-closing valve should have been installed at that point.

2.4 Regulations and survey

2.4.1 Although the New Zealand and Australian regulations governing extra-low-voltage installations were similar, the Australian regulations were more precise and, to a certain degree, more flexible than those of New Zealand.

2.4.2 The New Zealand regulations have always allowed PVC insulated cables to be used in New Zealand ships, though not in machinery or refrigerated spaces unless the cables were enclosed in a suitable conduit. The Australian regulations were more flexible in their approach, in that any kind of approved insulation could be used as long as due regard was given to the temperature of the space through which they passed. The Australian regulations also provided a table giving maximum rated conducted temperatures for each type of approved insulating material.

2.4.3 The MSA acceptance of the standards given in Section 9, Part 4, Paragraph 27 of the Australian Uniform Shipping Laws Code for extra-low-voltage installations was a positive move, and their Circular Letter 76 needed only to simply state this acceptance, and included a copy of the Australian standards to which the letter referred. The second sentence of the letter, "Therefore it is permitted to use automotive cables complying with the Australian Standard", served no purpose other than to create potential for confusion.

2.4.4 Anyone reading the circular could have been misled into thinking that automotive cabling was accepted for use in any area of a ship, when in fact it ***might*** have been accepted ***subject to other provisions*** stated in the Australian code. If the Australian code was to be used, then it should have been used in its entirety. There were other sections in the Australian code relating to the spacing of cable supports and positioning of batteries, to which the 24 V installation on *Phantom of the Straits* did not comply.

2.4.5 Notwithstanding the above, a prudent surveyor or surveying company would have obtained a copy of the relevant Australian Code and studied it before inspecting and approving an installation as being compliant.

2.4.6 The inappropriate installation of PVC insulated wiring in the engine enclosure on board *Phantom of the Straits* was only one of many deficiencies in a substandard electrical installation. The Commission looked deeply into the electrical and mechanical systems on board the *Phantom of the Straits* in its quest for the cause of the fire. A surveyor could not realistically be expected to detect all of the deficiencies found in the installation; however, there were many examples of poor design and poor workmanship which should have been obvious.

2.4.7 None of these deficiencies were detected, or if they were, then none had been required to be rectified, in spite of the initial and subsequent annual surveys by M&I surveyors, and the initial inspection by a surveyor from Survey Nelson for entry of the yacht into their safe ship management system.

2.4.8 If the electrical installations on existing or imported vessels are being certified by surveyors on the basis of "no past problems", then it is likely that the *Phantom of the Straits* was not the only passenger ship operating in New Zealand with a substandard electrical installation at the time of the fire.

2.4.9 It is of concern that there may be many other vessels operating in New Zealand with substandard electrical installations, particularly as many are licensed to carry passengers. Even if such a situation was generally accepted by the maritime industry as a whole, there were many basic improvements that could have been made to the electrical installation on *Phantom of the Straits* at limited expense that would have significantly reduced the likelihood of fire, and enhanced the safety of those on board.

2.4.10 When a safe ship management company accepts a vessel into their system from another safe ship management company, it is imperative that knowledge of the vessel and its operator's past survey and operating history is passed on to the new safe ship management company. It appears that in some cases, commercial pressure between safe ship management companies is resulting in important vessel and operator information *not* being passed on. The concept of the safe ship management system relies on an effective database of such knowledge to enable the continuous history of a vessel and its operator to be maintained and monitored.

2.4.11 It is of concern that commercial competition within the safe ship management system is precluding this from happening.

3. Findings

Findings and safety recommendations are listed in order of development and not in order of priority.

3.1 The *Phantom of the Straits* was certified as fit for purpose and had a current maritime document at the time of the fire.

3.2 The fire was probably initiated by an electrical fault in the extra-low-voltage DC installation, which could not be accurately traced because of subsequent fire damage to the electrical wiring.

3.3 Numerous conditions existed in the 24 V wiring system on board *Phantom of the Straits* for uncontrolled electrical faults to develop.

3.4 The 24 V electrical system on board *Phantom of the Straits* did not comply with the requirements of the relevant regulations.

3.5 Once ignited, the fire was fed by diesel fuel leaking from the service tank above, via the melted plastic hose of the sight gauge for the tank. The sight gauge for the fuel tank did not meet the standards required by the relevant regulations.

3.6 The effects of the fire were exacerbated when three access and ventilation hatches were opened to assist in locating the source of the fire.

3.7 It was fortunate that the contents of the diesel fuel tank were minimal, that the location of the vessel was close to emergency services, and that few passengers were on board; otherwise the consequences of the fire could have been substantially worse.

3.8 The substandard condition of the extra-low-voltage DC electrical installation, and that of the diesel tank sight gauge, went undetected, or unactioned, through three inspections by different surveyors.

3.9 The non-transference of vessel and operator information between survey and safe ship management companies has the potential to compromise the New Zealand safe ship management system.

3.10 It is probable that the *Phantom of the Straits* is only one of many existing passenger vessels operating in New Zealand with substandard electrical and machinery installations.

3.11 The poor standard of safety briefing the skipper gave to the passengers was not consistent with good safe ship management and might have compromised their safety.

4. Safety Recommendations

4.1 On 15 February 1999 it was recommended to the Director of Maritime Safety that he:

4.1.1 Withdraw MSA Circular Letter number 76 and replaces it with a notice to surveyors and safe ship management companies, specifying which standards for extra-low-voltage electrical equipment installations are accepted by MSA, and stipulating that surveyors should apply a single such standard in its entirety to each vessel, rather than mixing standards (007/99), and

4.1.2 Conduct a random survey of New Zealand passenger ships to determine the extent of the problem regarding substandard electrical and machinery installations, and initiates a strategy involving all MSA approved surveyors to progressively upgrade the New Zealand passenger fleet to comply (008/99), and

4.1.3 Take steps to ensure that, when a vessel operator changes safe ship management company, or a vessel changes ownership, adequate information transfer takes place between surveyors, survey companies and safe ship management companies, to enable the continuous history of a vessel and operator to be maintained, and any risk profile for each operator established and monitored (009/99).

4.2 On 31 March 1999 the Director of Maritime Safety responded as follows:

4.2.1 **007/99**
MSA circular Letter number 76 will be withdrawn and replaced with a new MSA Circular Letter, indicating the current standard. In due course, the current Standards for low voltage electrical cables will be contained in the requirements of Par 40F of the Maritime Rules for this type of ship.

It is our intention to introduce this Part early in the year 2000.

4.2.2 **008/99**

The Maritime Safety Authority does not intend to implement this recommendation. It is our belief that a more practical response would be to ensure that Safe Ship Management company inspectors and surveyors follow up on the reissue of the Circular Letter mentioned above by paying particular attention to the standard of electrical wiring during their inspections/surveys of boats.

4.2.3 **009/99**

The Maritime Safety Authority intends to adopt this Safety Recommendation. The matter has been raised with the Safe Ship Management companies at a recent meeting in Wellington. The criteria of the MSA is that the owner must first give permission for access to information on a ship file and there after providing that has been done, Safe Ship Management companies must make information available to another company if requested.

4.3 On 15 February 1999 it was recommended to the managing director of Survey Nelson Limited that he:

4.3.1 Ensures that the re-installation of the electrical and machinery installations on *Phantom of the Straits* fully meets the requirements of the relevant rules and regulations (010/99), and

4.3.2 Conducts a full audit on the Maritime Adventure Company's emergency and safety procedures before the maritime document for the *Phantom of the Straits* is re-issued (011/99).

4.4 On 9 April 1999 the director of Survey Nelson Limited responded as follows:

4.4.1 Survey Nelson intend to adopt both of these recommendations.

We will require the electrical and machinery installations on the *Phantom of the Straits* to fully meet the requirements of the current rules and regulations before a fit-for-purpose certificate is re-issued.

We are currently working with the operator to ensure that its emergency and safety procedures are adequate.

4.5 On 15 February 1999 it was recommended to the owner of *Phantom of the Straits* that he:

4.5.1 Includes in his passenger safety briefing, a talk on the location and use of the fire fighting and safety equipment on board *Phantom of the Straits* (012/99).

4.6 On 6 April 1999 the owner of *Phantom of the Straits* responded as follows:

4.6.1 We confirm adoption of the safety recommendation. A revised passenger and safety briefing is being prepared in conjunction with our Safe Ship Management System surveyors for inclusion in a new Safety Management Policy Manual for the vessel.

Approved for publication, 31 March 1999

Hon. W P Jeffries
Chief Commissioner

Appendix 1

Extracts from the Ministry of Transport Maritime Transport Division's "Requirements for the Construction and Equipment for Fishing Boats"

16.2 (General) (d):

> Electrical equipment, switchboards, and cables shall be so selected and located that they are unaffected by sea air, water, steam, oil, or fumes to which they are likely to be exposed. They shall be so installed that they will be clear of boilers, steam or oil pipes, settling tanks and diesel engine exhaust pipes or manifolds.

16.3 (Electrical systems for use in fishing boats) (d):

> For extra-low voltage installations the system can, be either two-wire insulated with control as in (c) above, or can be insulated in one pole only, with the other pole earthed. A single-pole circuit breaker fitted with an overload release, or a fuse and single-pole switch are required to control such an installation.

16.6 (Cables and installation) (b):

(1) In machinery spaces and refrigerated spaces, or where they are exposed to the weather, or to the action of sea water, fixed cables shall, unless run in steel or copper conduit or steel pipe, be either:

- (i) lead alloy sheathed, with or without braid or armour; or
- (ii) mineral insulated, copper sheathed; or
- (iii) Polychloropene sheathed, with or without braid; or
- (iv) Butyl rubber insulated with or without braid.

(2) In galleys, bathrooms, laundries and toilets, or where they are exposed to harmful gas or vapour, fixed cables shall, unless run in conduit or steel pipe, be either one of the types described in (b) (1) above, or PVC insulated or PVC sheathed.

(3) Cables having a sheath or covering of PVC shall not be used in refrigerated spaces or in any situation where it is necessary for them to pass through watertight bulkhead glands or deck tubes.

Appendix 2

MSA Circular Letter No. 76, Electrical Wiring Standards in Surveyed NZ Ships of Less Than 35 Metres

MSA now accept the standards given in the Para. 27 (Electrical Equipment Extra Low Voltage) of Part 4 of Section 9 of the *Australian Uniform Shipping Laws Code, 1993*. Therefore it is permitted to use automotive cables complying with the Australian Standard 2218 in low voltage electrical supply systems not exceeding 32 volts, for ships less than 35 metres.

For Higher voltage DC and AC systems wiring is required to comply with IEE Regulations for the Electrical and Electronic Equipment of ships or the relevant provisions of a Classification Society.

Appendix 3

Relevant extracts from Paragraph 27 (Electrical Equipment Extra Low Voltage), Part 4 of Section 9 of the Australian Uniform Shipping Laws Code 1993, with which *Phantom of the Straits* did not comply

27.5. 2 Conductors may be insulated by one of the following materials, having regard to the temperature of the space through which they pass:

(a) Polyvinyl Chloride compound (PVC) complying with Australian Standards AS 1695 or AS 3147;

(b) Chlorosulphonated Polyethylene complying with Australian Standard AS 3116;

(c) Ethylene Propylene Rubber complying with Australian Standards AS1168 or AS 3116;

(d) Mineral complying with Australian Standard AS3157:

(e) Silicone Rubber complying with Australian Standard AS3178; and

(f) Cross-linked Polyethylene (XLPE) complying with Australian Standard AS3198.

Table 27.2.2B, Insulation Temperature Ratings

Insulating Material	Maximum Rated Conducted Temp. ° C
Heat resisting Polyvinyl Chloride	75
Ethylene Polylene Rubber	85
Cross Linked Polyethylene	85
Chlorosulphonated Polyethylene	85
Silicone Rubber	95
Mineral Insulated Metal Sheathed	75

27.6.1 Trays, cable clips, saddles, and fixing screws for the support of cables shall be of corrosion resistant material or be suitably corrosion inhibited before installation. the distance between supports is to be in accordance with the requirements of Table 27.6.1 having regard to the type of cable being supported.

	Spacing in mm	
External diameter of cable in mm	Non-armoured cables	Armoured cables
Less than 8	200	250
8 and over but less than 13	250	300
13 and over but less than 20	300	350
20 and over but less than 30	350	400
30 and over	400	450

27.6.3 Where conductors or cables pass through conduits or ducts or through openings formed in metal work, the openings are to be of ample size and provided with effective bushes.

27.8 Battery charging equipment

There shall be fitted suitable control equipment for generators and batteries including ammeters, isolating switches, voltage regulators, cut outs and fuses or circuit breakers.

27.12 Batteries

27.12.1 Provision shall be made to electrically isolate the batteries