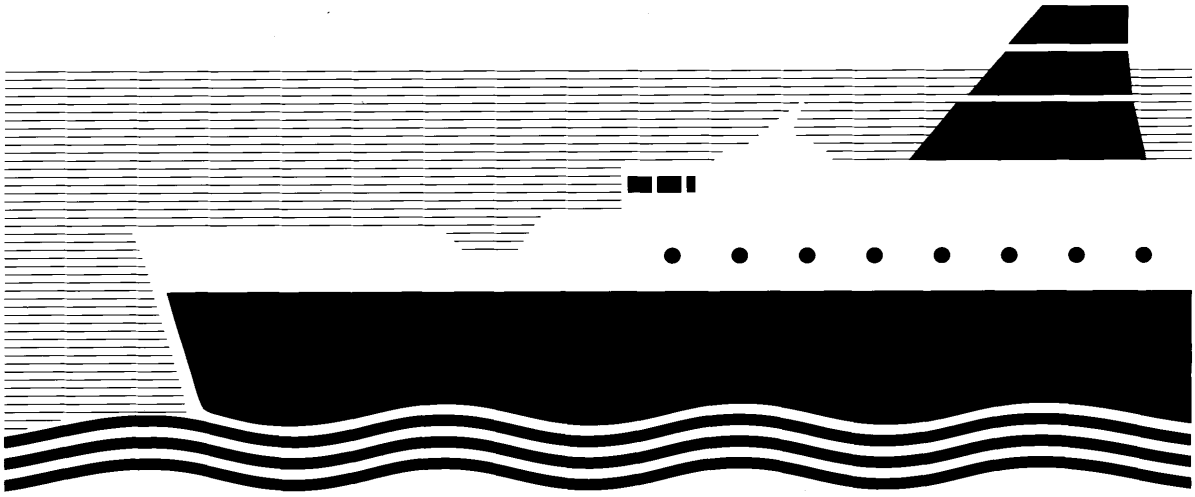
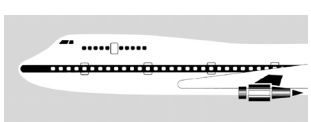
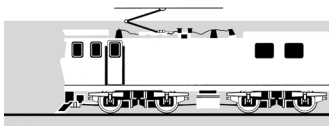


MARINE OCCURRENCE REPORT

03-207 **fishing vessel *Solander Kariqa*, fire, 300 nautical miles west of Suva, Fiji** **5 May 2003**


TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Report 03-207

fishing vessel *Solander Kariqa*

fire

300 nautical miles west of Suva, Fiji

5 May 2003

Abstract

At about 0400 on Monday 5 May 2003, while steaming towards fishing grounds to the west of Fiji, the fishing vessel *Solander Kariqa* suffered a fire in the domestic refrigeration space resulting from maintenance involving oxy-acetylene cutting. The crew fought and contained the fire, which was not totally extinguished until about 2000 that evening. There were no injuries to the crew, but had they been unable to extinguish the fire with the limited fire fighting equipment available the vessel may have been lost with resulting injuries or fatalities.

Safety issues identified were:

- insufficient fire fighting equipment
- poor management of the fire fighting effort
- no procedures for "hot work" on the vessel
- insufficient properly certified crew.

Recommendations were made to and the Director of Maritime Safety and the Chief Executive Officer of Solander Fisheries to address these issues.

The *Solander Kariqa*

Contents

Figures

Abbreviations

1DTE	First Class Diesel Trawler Engineer
2DTE	Second Class Diesel Trawler Engineer
AFFF	aqueous film forming foam
CABA	compressed air breathing apparatus
CO_2	carbon dioxide
DPA	designated person ashore

Glossary

bulkhead	nautical term for wall
deckhead	nautical term for ceiling
designated person ashore	person ashore assigned to liaise between ship and shore side management
hot spot	after a fire, an area that remains sufficiently hot to make it liable to reignite
hot work	maintenance work that is liable to generate sparks or heat, usually from gas cutting or welding
non-SOLAS	ships that are not required to comply with the SOLAS convention
single side band radio	medium and high frequency radio transceiver
SOLAS	the International Convention for the Safety of Life at Sea
surface longline	method of fishing, used to target pelagic species of fish such as tuna. A long backbone of line with a buoy at one end is paid out from the vessel. Numerous hooked and baited drop lines or snoods come off of the backbone at regular intervals. The line is left to fish passively for a time before it is retrieved and the hooked fish landed
Taupo Maritime Radio	New Zealand maritime radio station

Data Summary

Vessel Particulars:

Name:	*Solander Kariqa*
Type:	fishing
Length overall:	32.71 m
Gross tonnage:	181
Main Engine:	Akasaka MH 22R 6 cylinder diesel engine producing 372 kW at 430RPM
Propulsion:	fixed 4-bladed propeller
Built:	Japan in 1981
Port of Registry:	Nelson
Limits:	unlimited
Owner/operator:	Solander Blue Fin Partnership
Date and time:	5 May 2003 at about 0400[1]
Location:	300 nautical miles west of Suva, Fiji
Persons on board:	9
Injuries	nil
Damage:	extensive smoke damage and localised fire damage
Investigator-in-charge:	Captain Doug Monks

[1] All times in this report are local time at the ship (UTC + 12 hours) and are expressed in the 24-hour mode.

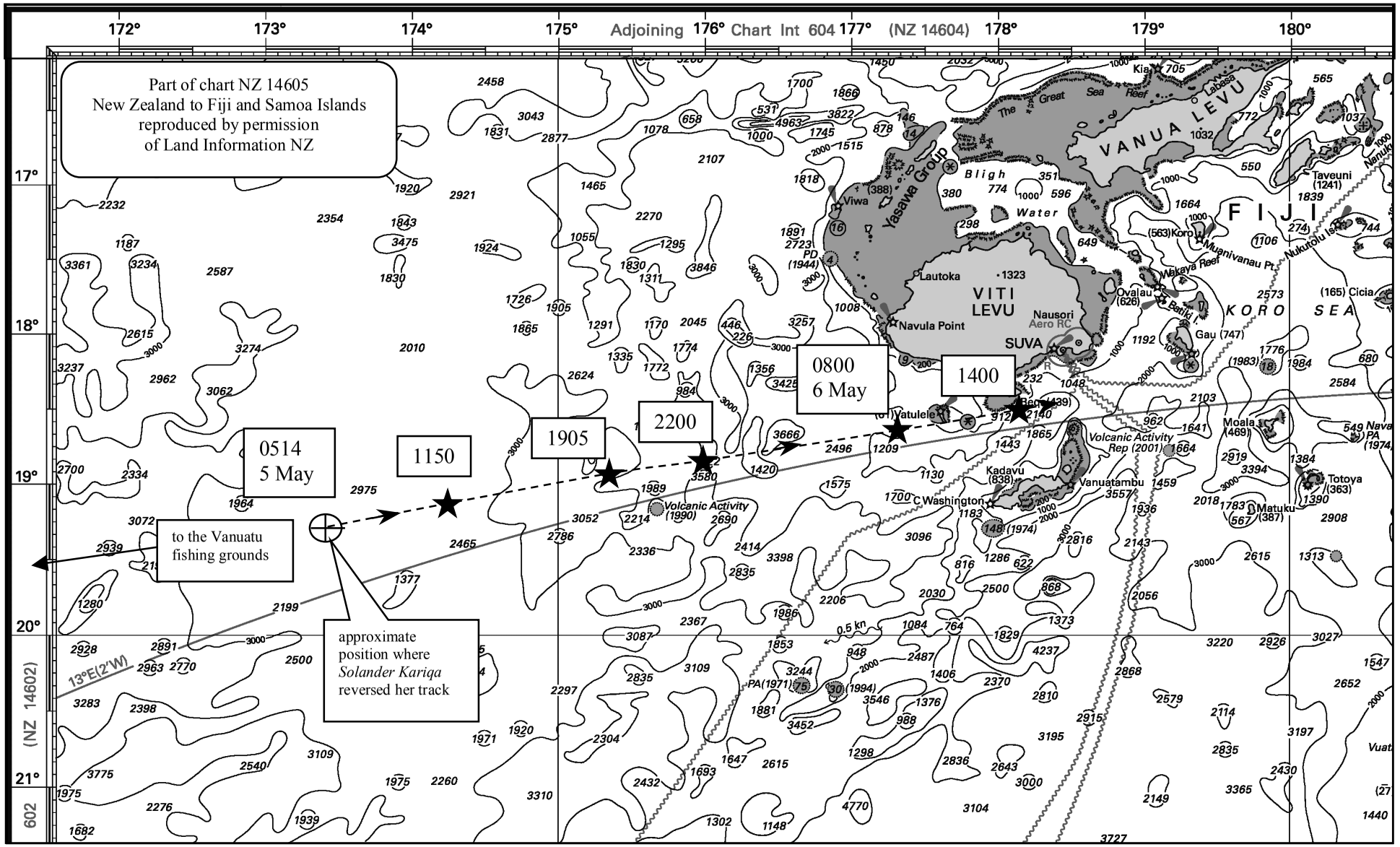


Figure 1
Excerpt of Chart 14605 showing track of *Solander Kariqa*

1 Factual Information

1.1 Narrative

1.1.1 On Saturday 3 May 2003 at about 1900, the surface longline fishing vessel *Solander Kariqa* left Suva, Fiji, bound for tuna fishing grounds 300 nm to the west. On board were the master and 8 crew.

1.1.2 The ship's crew adopted their normal routine on the voyage. The master and mate stood navigational watches and the chief engineer and the second engineer shared the engine room watches. The chief engineer also stood navigational watches when required.

1.1.3 On Sunday 4 May, during his usual engine room watch between 0800 and 2000, the chief engineer started to remove refrigeration pipework and wall panelling from the vegetable room of the defunct domestic refrigerated spaces (see Figures 2 and 3). At 2000 that evening, when the second engineer took over the engine room watch from the chief engineer, he was told to continue removing the refrigeration pipework from the meat room, the after of the 2 refrigerated spaces, as his duties and time permitted.

1.1.4 At about 0200, the second engineer started work in the refrigeration space, including using oxy-acetylene cutting equipment to remove the coil securing bolts. Shortly after 0300, he stopped work in the refrigeration space to carry out his engine room rounds.

1.1.5 At about 0345, while doing his rounds, the second engineer noticed smoke in the upper part of the engine room. He thought that the smoke was coming from the main engine but on checking could not find any sign of a source. He then thought of the refrigeration space and went to check there. Initially, he could not see any fire but on closer inspection saw a red glow through nail holes in the insulation behind the panelling on the port bulkhead. He started to attack the fire with a foam extinguisher he had at hand.

1.1.6 At about the same time, the master, who was on watch on the bridge noticed smoke coming from one of the ventilators on the port after deck, and he went down to the accommodation to check. As he entered the galley/messroom, he noticed smoke coming from the refrigeration space and heard the second engineer in the doorway to the meat room fighting the fire. The master asked the second engineer how he was managing, and was told that the fire was getting out of control.

1.1.7 The master immediately called the chief engineer, who was asleep in his cabin to the starboard side of the messroom, and explained the situation. The chief engineer went straight to the refrigeration space to check the situation and then went to the engine room where he collected the nearest fire extinguisher; a carbon dioxide (CO_2) unit positioned close to the switchboard. Meanwhile, the master woke the remainder of the crew, who mustered on the afterdeck, before returning to the refrigeration space to assist the second engineer.

1.1.8 The chief engineer returned to the refrigeration space with the CO_2 fire extinguisher to find the second engineer and the master tearing down bulkhead and deckhead panelling to get access to the fire behind. The chief engineer started to attack the fire with the CO_2 fire extinguisher. His efforts failed to extinguish the fire and the 3 men were forced to vacate the area owing to the smoke and CO_2 making it difficult to breathe. After instructing the crew how to boundary cool, the master returned to the bridge.

1.1.9 By this time, the crew had run out a fire hose on the deck above the galley/messroom and started boundary cooling by allowing water to flow onto the deck above the refrigeration space and cascade down the port side of the hull.

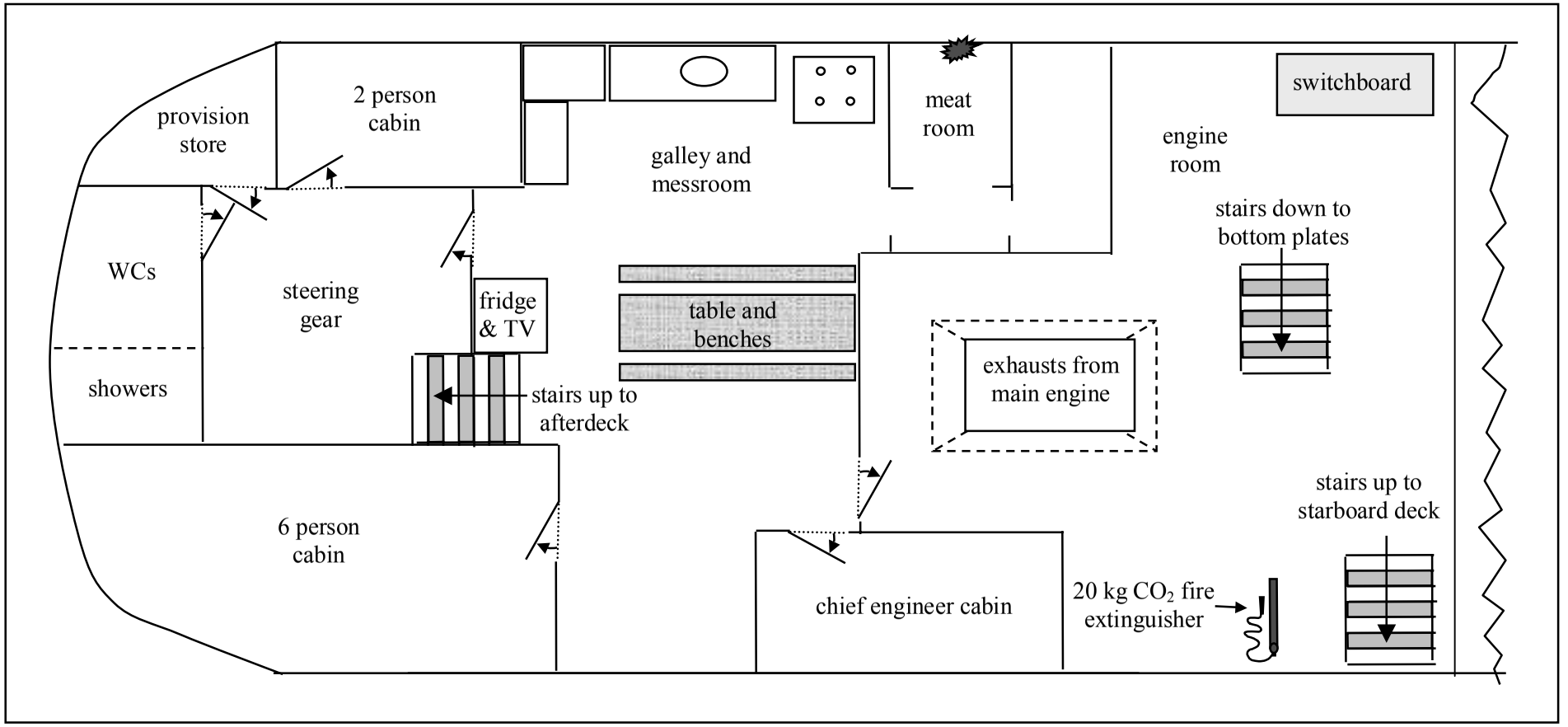


Figure 2
Plan of accommodation area on *Solander Kariqa*

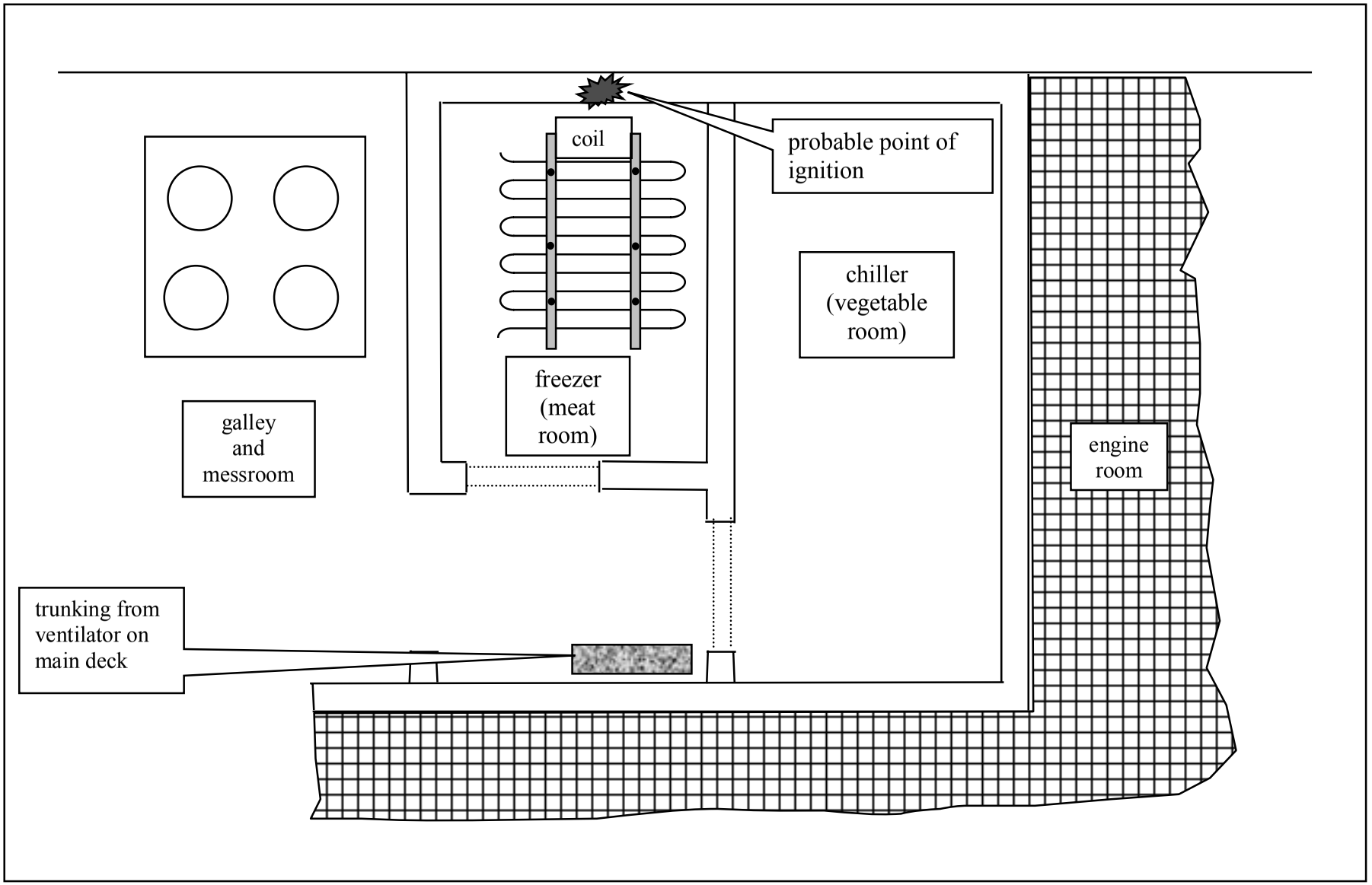


Figure 3
Plan of refrigeration spaces

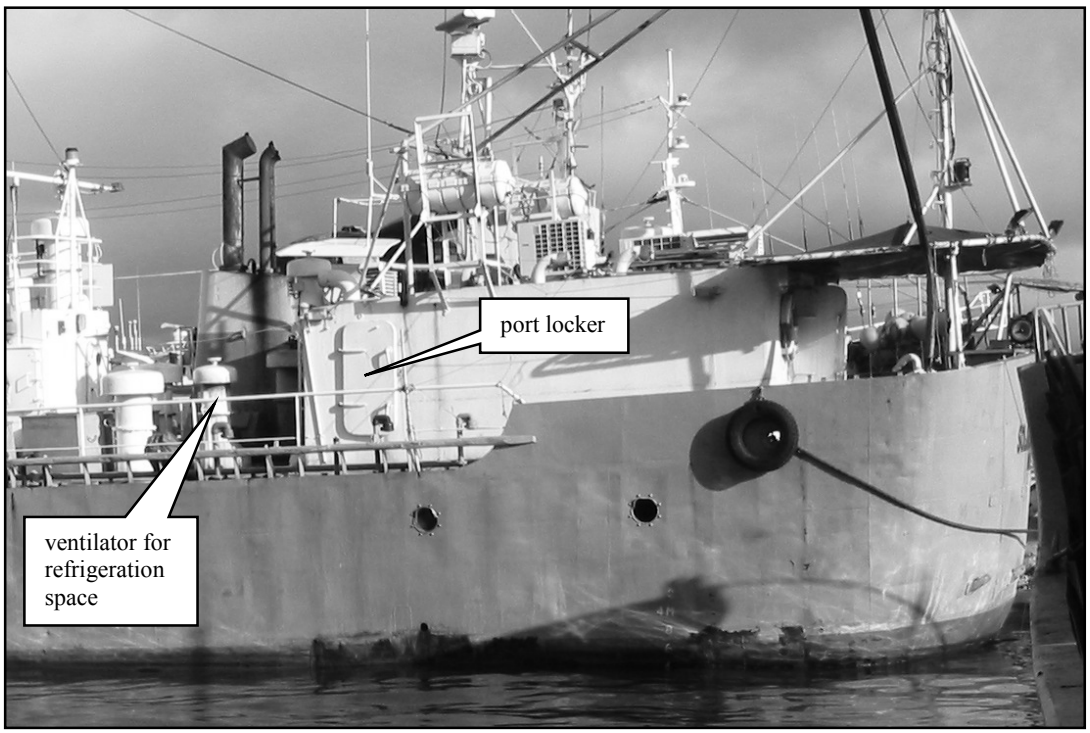


Figure 4
Port afterdeck of *Solander Kariqa*

1.1.10 Shortly after 0500, the chief engineer briefed the master on the situation regarding the fire. At 0514, the master called Taupo Maritime Radio on the single side band radio, advising the operator of the fire and that the ship and the crew were not in any immediate danger.

1.1.11 The master turned the vessel around to put the easterly wind ahead so that the smoke would be blown astern. They came onto a course of 081°(T), the reciprocal to the heading at the time of the fire and the course needed to return to Suva.

1.1.12 At about 0745, the master tried to call the designated person ashore (DPA) of Solander Fisheries, Nelson by mobile satellite telephone. At the time of the call, the DPA was on board an aeroplane flying between Nelson and Wellington, and had his cellular telephone switched off. The master, not being aware of why he could not contact the DPA, decided to contact his own wife on Inmarsat C, who in turn contacted the Nelson office of Solander Fisheries, who then contacted both the DPA, who had by that time arrived in Wellington, and the Superintendent Engineer, who was temporarily managing the Suva office.

1.1.13 At 0817, the Superintendent Engineer established contact with the vessel on single sideband radio. He received confirmation that all crew were safe and that the vessel was in position 19° 15' S 173° 42' E and heading towards Suva. He directed another company vessel, which was about 280 miles away, to steam towards the *Solander Kariqa*. Later in the day a Fijian naval vessel was also dispatched from Suva to assist. The *Solander Kariqa* kept hourly radio schedules with Taupo Maritime Radio throughout the day, advising of the situation on board.

1.1.14 The crew continued boundary cooling throughout the day and entered the accommodation on a number of occasions to assess the situation, fight the fire and get food from the provisions store in the steering flat.

1.1.15 In the evening at about 1930, all the breathing apparatus bottles were empty so the mate organised the crewmembers into 2 fire parties; one consisting of himself and 2 seamen and the other the bosun and one seaman. The men wrapped damp towels over their mouths and noses as a barrier against the smoke and fumes. The bosun's party entered the accommodation from the engine room and the mate's through the after entrance. The mate had the fire hose from the

deck and the bosun had the freshwater hose from the engine room. They managed to hold their breath long enough to train their hoses and douse the areas of deckhead still on fire. The parties then withdrew to the deck to regain their breath. At about 2000, the mate went back in and confirmed that the fire was out.

1.1.16 The crew then ventilated the space, continually checking for hot spots. They also bailed the excess water from the messroom and steering gear areas.

1.1.17 On the following morning, Tuesday 6 May at 0800, the *Solander Kariqa* rendezvoused with the Fijian Navy patrol vessel *Kiakikau*. The Nuclear, Biological, Chemical Defence Instructor for the Fijian Navy, who was also the tutor for the basic and advanced fire fighting courses in Suva, boarded the fishing vessel. He checked the situation and found that the fire was completely extinguished. Additional fire fighting equipment was transferred to the *Solander Kariqa* from the navy vessel in case the fire re-ignited.

1.1.18 At 1715, the *Solander Kariqa* berthed in Suva. All the crew were sent ashore for medical checks to ascertain the extent of smoke inhalation. They were all discharged without treatment.

1.2 The vessel and operator

1.2.1 The *Solander Kariqa* was built in Shimizu, Japan in 1981. It was built to a standard longline fishing vessel design and was constructed of steel. It was originally designed and used as a combination fishing and training vessel by the Solomon Islands Government. In 1987 it was sold to New Zealand fishing interests and had been used for surface long lining in the tuna fishery since that time. It had a length of 32.71 m, was 181 gross registered tons and had a single diesel main engine that developed 372 kW power at 430 RPM.

1.2.2 Solander Blue Fin Partnership owned the vessel and operated it through Solander Fisheries in Nelson. While the *Solander Kariqa* was operating out of Suva, Solander Pacific, a wholly owned subsidiary of the Solander Group of companies, undertook the vessel's day-to-day operation. The vessel was under safe ship management with Survey Nelson Safe Ship Management; its certificate being issued on 11 January 2002 and valid to 28 December 2005, subject to periodic inspections. The vessel was a registered fishing vessel and licensed for the unlimited operating area.

1.2.3 The ship had 2 superstructures; one amidships that housed the navigating bridge and master's cabin. Immediately abaft of this was the engine room, and aft of that again was the remainder of the accommodation housing the crew cabins and galley/messroom. Abaft of that was the steering gear, another cabin, a provision store and ablution facilities.

1.2.4 Generally, the accommodation bulkheads were lined with 6 mm faced oil-tempered hardboard panels and the deckheads were lined with 10 mm plywood panels. The panels were fixed to wooden battens that were attached to the steel structure. The refrigeration space bulkheads were lined with a combination of hardboard and plywood panels. Throughout the galley/messroom and refrigeration space area there was insulation between the panelling and the steel structure of the vessel. The insulation was bi-layered; the outer layer (closest to the steel) was fibreglass batts, the inner layer was polystyrene board.

1.2.5 Japanese Standard A 9511 – Foamed Polystyrene Heat Insulating Material, 1979 detailed the specification of the insulating polystyrene used in the construction of the *Solander Kariqa*. The insulating board was formed by mixing polystyrene resin, a foaming agent and an agent to retard combustion. The toxicity of the fumes emanating from combusting insulation was not included in the standard.

1.2.6 The refrigeration space forward of the galley was originally used to store chilled and frozen food for the crew. However, as the length of voyages and number of crew reduced, the need for large domestic refrigeration spaces disappeared. In addition, the steel bulkhead between the vegetable room and the engine room was corroded and needed repair. To do this required the

lining be removed before cutting and welding could take place. Consequently, the vessel's crew and the operator decided to dismantle the refrigeration space and convert it into a general storeroom. During April 2003, while the *Solander Kariqa* was in Suva, the refrigeration compressor and condenser were removed along with some of the refrigeration coils and associated pipework. The removal of this equipment and the wooden battens used to support the coils, left holes in the panelling in both the meat and vegetable rooms. There was insufficient time in port to complete the job, so the removal of the remainder of the equipment and panelling was left for the ship's crew to progress this during the voyage, when time permitted.

1.3 Legislation and procedures

1.3.1 The *Solander Kariqa* originally left New Zealand in January 2002, to fish out of Fiji. It returned to New Zealand in April 2002, where it stayed to fish and undergo survey work until July when it returned to Fiji. Since then, it had been based in Suva, fishing the waters of Fiji and Vanuatu.

1.3.2 Maritime Rules Part 46.20 required that the owner of a non-passenger ship of less than 500 tons gross tonnage, and less than 45 metres in length proceeding on an international voyage to which this rule applies must ensure that:

> (a) the ship complies with the requirements of rules 46.17 and 46.18 [Inspections and Maintenance]; and
>
> (b) before the ship departs on any international voyage it carries on board a maritime document, which is a certificate as to the ship's fitness for an international voyage in a form approved by the Director and issued by the Director in accordance with section 41 of the Act.

The document to fulfil the requirement of (b) above was called a Non-SOLAS Ship Undertaking an International Voyage Certificate. The *Solander Kariqa* had been issued with such a certificate on 11 January 2002, which was valid until 11 January 2003. The certificate itemised the following conditions:

- That the vessel remains within the Safe Ship Management System of Survey Nelson
- The certificate is valid for a (sic) 12 calendar months from the date of issue
- If the vessel returns to New Zealand during the validity of this certificate it is to be re inspected by Survey Nelson
- The vessel carries the correct manning for such a voyage (s) or has a dispensation granted by the Maritime Safety Authority to enable it to complete the voyage. All crew required under Rule Part 31C must have certificates recognised by the Maritime Safety Authority
- Vessel complies with all local regulations in the port of destination.

The Non-SOLAS Ship Undertaking an International Voyage Certificate had not been renewed in January 2003.

1.3.3 Survey Nelson sub-contracted the Fijian based marine surveying company Billet, Wright and Associates to carry out inspections on its behalf in Fiji. On 24 January 2003, Billet and Wright's surveyor started the annual inspection on the *Solander Kariqa*. The majority of the survey was concluded by the end of January, but a number of items, such as pyrotechnics and hydrostatic releases, which took time to procure from overseas, were outstanding at the time of the fire, and so the survey could not be completed. The survey was concluded and signed off on 16 May 2003.

1.3.4 The *Solander Kariqa*'s Safe Ship Management Manual did not include procedures for carrying out maintenance, including hot work. There were no guidelines on how and when this work should be carried out or what precautions should be taken or who should be advised.

1.3.5 Hot work is a potentially dangerous undertaking that should not be underestimated. There is a wealth of information available throughout the world on the precautions that need to be exercised before, during and after welding and cutting work is carried out. As an example, the International Maritime Organization MSC/Circular 1084 indicated a list of principles that should be followed when hot work is conducted on board a ship. The principles recommended that, where possible, hot work should be carried out in a designated area, but where that is not possible the following should be adhered to:

- The master or designated safety officer should be responsible for deciding whether hot work is justified and whether it can be conducted safely
- A permit to work system should be employed
- Hot work procedures should take account of national laws or regulations or other national safety and health rules
- A responsible officer, not involved in the hot work, should be designated to ensure that safe procedures are followed
- A written plan for the operation should be agreed by all who will have responsibilities in connection with the hot work
- The work area should be carefully prepared and isolated before hot work commences
- Fire safety precautions should be reviewed, including fire equipment preparations, setting a fire watch in adjacent compartments and areas, and fire extinguishing measures
- Isolation of the work area and fire precautions should be continued until the risk of fire no longer exists.

1.4 Personnel and minimum crewing

1.4.1 The crew on board the *Solander Kariqa* at the time of the fire were the master and chief engineer from New Zealand and the remaining 7 crew from Fiji. One of the crew was the shore-based operations manager of Solander Pacific, who was on a familiarisation trip.

1.4.2 The master held a New Zealand Skipper of a Deep Sea Fishing Boat Certificate issued on 19 November 1986 and a First Class Diesel Trawler Engineer (1DTE) Certificate issued on 6 March 1996. He first went to sea in 1964, gained his Coastal Master Certificate in 1971 and, except for 5 years when he had taught nautical and fishing studies at Nelson Polytechnic, had sailed as master since. After the spell of teaching, he joined Skeggs Seafood Limited, the original New Zealand owner of *Solander Kariqa*, as a master and carried out some experimental surface longline fishing. In 1991, Skeggs Seafood Limited was disbanded and the *Solander Kariqa* was sold to the master, who continued to fish for tuna with it until he sold it to Solander Blue Fin Partnership in January 2002. As part of the sale, the master was contracted to fish for Solander on an "as required" basis. During the accident trip the master was relieving the usual master.

1.4.3 The chief engineer held a Second Class Diesel Trawler Engineer (2DTE) Certificate issued on 15 October 1997 and a New Zealand Coastal Master Certificate issued 2 July 1997. He first went to sea in 1991 following a fishing cadet course at Nelson Polytechnic. He had been working on the *Solander Kariqa* since 1994. At the end of 2002, he had completed the course for his Marine Engineer Class 4 (1DTE) Certificate but had still to complete the first aid short course before he was eligible to hold the certificate. One of the short courses required for the Marine Engineer Class 4 Certificate was advanced fire fighting, which he had completed.

1.4.4 The mate was a Fijian national and held no maritime qualifications. He first went to sea in 1995 and had been on the *Solander Kariqa* since December 2002. Between July and December 2002 he had studied for his Class 5 Master Certificate and had passed all the written exams except for stability, which he was due to re-sit. He had also completed the relevant short courses, including first aid, survival and both basic and advanced fire fighting.

1.4.5 The second Engineer was a Fijian national and held no maritime qualifications. He had started an engineering cadetship in 1999 and had spent one year on local coastal passenger and freight vessels, and about 15 months with Solander Pacific on longline fishing vessels. He had completed basic and advanced fire fighting courses in February and March 2003. He joined the *Solander Kariqa* at the end of March 2003 and this was his second trip on the vessel.

1.4.6 The remainder of the crew had no formal maritime training or certification except that some of them had taken first aid, survival and fire fighting short courses.

1.4.7 Maritime Rules Part 31C, Crewing and Watchkeeping - Fishing Vessels, prescribes the minimum manning for a vessel of 20 m or more but less than 45 m in the unlimited operating area to be:

- a Master of a Deep Sea Fishing Vessel
- a Mate of a Deep Sea Fishing Vessel
- 2 Advanced Deckhand with Fishing endorsement
- one Marine Engineer Class 4 (1DTE) which may be the master or other seafarer
- a total minimum complement of 6 persons.

The *Solander Kariqa,* which was such a vessel*,* did not have sufficient qualified personnel on board to comply with these requirements nor did it have a Maritime Safety Authority dispensation from carrying the prescribed personnel.

1.5 Fire fighting equipment

1.5.1 As a fishing vessel of 24 metres or more in length but less than 45 metres that operated in the unlimited area, the *Solander Kariqa* was required to be equipped with fire fighting equipment as specified in Maritime Rules Part 40D - Design, Construction, and Equipment - Fishing ships, Appendix 2.2. Mostly, *Solander Kariqa* did comply with the requirement of Appendix 2.2; in that it had sufficient portable and semi-portable fire extinguishers, fire pumps and hoses. However, it had only one of the 2 required fire suits, and one self-contained compressed air breathing apparatus (CABA) with 3 air bottles.

1.5.2 In addition to the fire fighting items required by the rules, the *Solander Kariqa* had been retrospectively fitted with a fire detection system and a CO_2 smothering system for the machinery space.

1.5.3 Maritime Rules Part 40D came into force on 1 February 2000 and superseded the standards and requirements prescribed in the New Zealand Gazette October 1989 which were made pursuant to the Shipping and Seamen Act 1952. In general the requirements in the 2 pieces of legislation were similar but in some areas the Maritime Rules required additional or improved equipment. One example was the carriage of fire crew outfits for fishing vessels of less than 55m (45 metres under Part 40D) that operated in the unlimited area, such as the *Solander Kariqa*. Under the Gazette such a vessel had to carry one outfit, but under Part 40D was required to carry 2 outfits. The *Solander Kariqa* was never equipped with a second fire crew outfit.

1.5.4 Maritime Rules Part 42B - Safety Equipment - Fire Appliance Performance Standards prescribed the characteristics of fire appliances. When it was drafted an oversight resulted in breathing apparatus not being included as part of a fire crew outfit and so legally there was no requirement for breathing apparatus to be carried. However, in practice, safe ship management

company surveyors routinely required that a breathing apparatus be fitted where a fire crew outfit was required by the rules.

1.5.5 The *Solander Kariqa* was required to carry 2 fire crew outfits and therefore could be expected to have 2 CABAs, but the vessel was only ever fitted with one fire crew outfit and one CABA. In December 2001, the then owner of the *Solander Kariqa* and Survey Nelson applied to the Maritime Safety Authority for an exemption from the requirement to carry a second breathing apparatus (although it was not actually required by the rules) on the grounds that the engine room was protected by a fixed smothering system.

1.5.6 The Maritime Safety Authority considered the proposal and in an internal memorandum suggested that in lieu of 2 CABAs, a smoke helmet be fitted in the place of one of those sets. A smoke helmet comprised of a facemask, similar to that on a CABA, which was connected by an uncrushable umbilical pipe to a bellows, which supplied air from outside the space to the wearer. Some of the reasons given to justify the need for 2 sets of breathing apparatus to be carried were:

- the ship was unlimited
- 2 sets would give the ship redundancy
- should only one man be able to access a space, 2 sets would allow twice the time to extinguish the fire
- BA sets may be used to fight a fire in other spaces and not just the engine room.

A smoke helmet was suggested as a replacement for one of the CABA sets because it required less maintenance and was able to give a continuous supply of air.

1.5.7 On 16 January 2002, the Maritime Safety Authority responded to the petitioners advising, in part:

> ...we see it appropriate for the vessel to have a complete 'Smoke helmet' be made available on board to support and back-up the use of the existing breathing apparatus.

1.5.8 This response was inaccurately incorporated into the *Solander Kariqa's* Safe Ship Management Manual under the heading of Special Conditions and read, in part:

> *Solander Kariqa* has been issued with a letter of dispensation for the requirement to carry 2 BA sets and fire-fighting outfits by NZ Maritime Safety Authority dated 16 January 2002.

Consequently, the *Solander Kariqa* continued to operate with one fire crew outfit and one self-contained compressed air breathing apparatus with 3 air bottles.

1.5.9 The pro-forma checklist that was issued by Survey Nelson for its surveyors to use during annual inspections of the vessel had the following item:

57 [X] Fireman's Suit	1 x Complete suit with BA bottles and spare bottles Plus 1 x Smoke Helmet Breathing Apparatus: 1 x Sabre Series 6 Positive Pressure BA 3 x 1200 litre 200 bar cylinders 1 x fireman's outfit – No fire leggings Date Serviced.....

The item was checked as present and correct but failed to note the absence of "1 x Smoke Helmet"

1.6 The fire and fire fighting effort

1.6.1 The second engineer had been instructed to remove the refrigeration coils from the meat room during his time on watch. He prepared for the task by removing the debris that the chief engineer had put in the meat room during the day. He then started to remove the nuts that were holding the lower of the 2 coils in place. The nuts had been welded in place to stop them vibrating loose, so the second engineer could not remove them using spanners. He opted to cut them off using the oxy-acetylene cutting torch rather than a cold chisel because the noise would have woken the sleeping crew. As a precaution against fire, he took a bottle of water and an aqueous film forming foam (AFFF) extinguisher into the meat room before he started the hot work.

1.6.2 After he had cut off the 6 bolts securing the lower coil, he cut the pipe joining the 2 coils and pulled down the lower one. He then continued to cut off the bolts securing the upper coil. After removing 4 of the bolts he stopped so that he could carry out his engine room rounds. Before leaving the area he said that he checked for signs of fire and found none.

1.6.3 About 30 minutes later, the second engineer saw smoke on the upper plates of the engine room and, after checking for fire in the engine room, went to the refrigeration space where he found fire in the panelling of the port bulkhead of the meat room. He initially tried to extinguish the fire using the AFFF fire extinguisher, squirting the foam through the various holes in the panelling. However, as soon as he had smothered one area, flame was visible through another hole further along the panel. When the master arrived at the refrigerator space, the fire extinguisher being used by the second engineer ran out and it became apparent to the second engineer that he had lost control of the situation. He informed the master that the fire was getting out of hand, so the master woke the crew, starting with the chief engineer.

1.6.4 In his drowsy, freshly awoken state, the chief engineer went to the refrigeration space to assess the situation, he then went to get the nearest extinguisher that he was aware of, which was a CO_2 extinguisher sited near the switchboard on the top flat of the engine room. Once back in the refrigeration space, he activated the extinguisher but the trigger of the extinguisher jammed in the "on" position so that its discharge could not be stopped. The CO_2 soon displaced the air in the confined space of the meat room, and that, combined with the fumes and smoke from the fire, made breathing difficult, so the second engineer and master withdrew to the after deck, to join the remainder of the crew. When the chief engineer could no longer hold his breath, he left the extinguisher to fully discharge and also retreated to the after deck.

1.6.5 Once on deck, the chief engineer collected the fire crew outfit and CABA, from the laundry area, and started to don them. Meanwhile the rest of the crew were battening down the galley/messroom area by closing the ventilator flaps. When he had the CABA on, the chief engineer entered the engine room through the door on the starboard side of the after deck. On the upper flat of the engine room there was a semi-portable 20 kg CO_2 extinguisher (see Figure 2), which the chief engineer dragged into the messroom and uncoiled the extension hose to again attack the fire in the meat room. By this time the galley/messroom area had filled with thick black toxic smoke reducing visibility to a minimum. The heat had increased sufficiently to prevent access right into the refrigeration space. The chief engineer could not see any flames and so he stayed in the entrance to the refrigeration space and aimed the flow of CO_2 in the general direction of the meat room. Once the extinguisher was fully discharged, the chief engineer returned to the deck through the engine room, making sure all the cabin doors were closed as he went but omitted to close the door between the messroom and the steering gear.

1.6.6 The chief engineer took off the CABA, which still had 60 bar of air left in it. The mate fitted a new air bottle, donned the apparatus and entered the space the same way as the chief engineer had, through the engine room. He found that the fire had spread to the deckhead in the galley area and the heat had increased to such an extent that he was unable to approach the entrance of the refrigerator space. The smoke was extremely thick and black; this was just over an hour after the fire had been discovered. He set off another CO_2 fire extinguisher in the galley area but

this had little effect on the fire. After this, the mate had the crew send a fire hose in through the aft entrance door to the accommodation for him to fight the fire. He was still unable to approach the refrigerator space closer than 3 or 4 metres and so could not aim the water directly at the seat of the fire. After about 5 more minutes, the low air pressure alarm sounded on the CABA so he had to exit the space. The crew hauled the hose back up the stairs and closed the after access door. The mate returned the way he had entered the area, through the engine room and up the stairs to the starboard afterdeck door.

1.6.7 Throughout the day, the crew continued boundary cooling the extremities of the space. At intervals of about 30 minutes they opened the aft door and directed water into the accommodation. There was a plastic fresh water garden hose in the engine room, which the crew used for boundary cooling on the bulkhead between engine room and the refrigerator space.

1.6.8 At about 0800, it was noted that the deck in a locker on the port side (see Figure 4) of the aftercastle was getting hot, so water was sprayed into this space to assist boundary cooling. The flaps on the ventilators on the afterdeck were closed but smoke continued to exude from the ventilator that serviced the refrigeration space and the galley. The second engineer unbolted and removed the top of the ventilator and the crew sealed the trunking with a plywood plug and plastic bags.

1.6.9 At about 0930, the mate reattached the partly used bottle, which had about 60 bar pressure remaining, to the CABA and donned the apparatus before again entering the accommodation. He checked the situation and noted that the fire was spreading across the deckhead towards the after part of the galley/messroom. There were still thick fumes and heat from the fire; he also checked that the amount of water in the messroom area had not become excessive. During the short time the 60 bar of air allowed him, he collected some food from the provision store in the port after part of the steering gear. He also omitted to close the door between the messroom and steering gear on his way out of the space.

1.6.10 After midday, the last of the breathing apparatus air bottles was attached to the CABA and the mate donned it and entered the accommodation. On this occasion, he could not see any flames or embers but heat and smoke were still present. He stayed in the accommodation for about 5 minutes and when he came out there was about 120 bar of air remaining in the bottle.

1.6.11 In the early afternoon the crew took the plastic cover and plug from the ventilator into the refrigeration space and directed fresh water into the space before replacing the plug. This they did at 10 to 15 minute intervals. There was also a ventilator into the accommodation on the starboard side; into which the crew directed water at regular intervals.

1.6.12 During the afternoon, some of the crew slept on the foredeck, while the remainder continued boundary cooling. One of the crew was instructed by the master to check out the situation in the accommodation and he entered using the CABA. In doing this he used about 60 bar of air leaving about 60 bar in the bottle.

1.6.13 At about 1900, the mate re-entered the accommodation using the CABA. He found that there were flames coming from the deckhead at the after port corner of the galley/messroom, and more flames in the vicinity of the stove. He had the small engine room fresh water hose with him and he sprayed both areas of flames, which were temporarily doused. But, after he had sprayed over the stove, he noticed that the pilot lights for the elements were lit, indicating that there was still power at the stove. The low air pressure warning for the CABA sounded and he had to evacuate the area. The chief engineer isolated the stove at the main switchboard and in addition, the mate briefly re-entered the accommodation without the CABA and turned off the main switch for the stove.

1.6.14 In desperation, the mate, the bosun and 3 seamen entered the space without breathing apparatus, and extinguished the fire by dousing it with water.

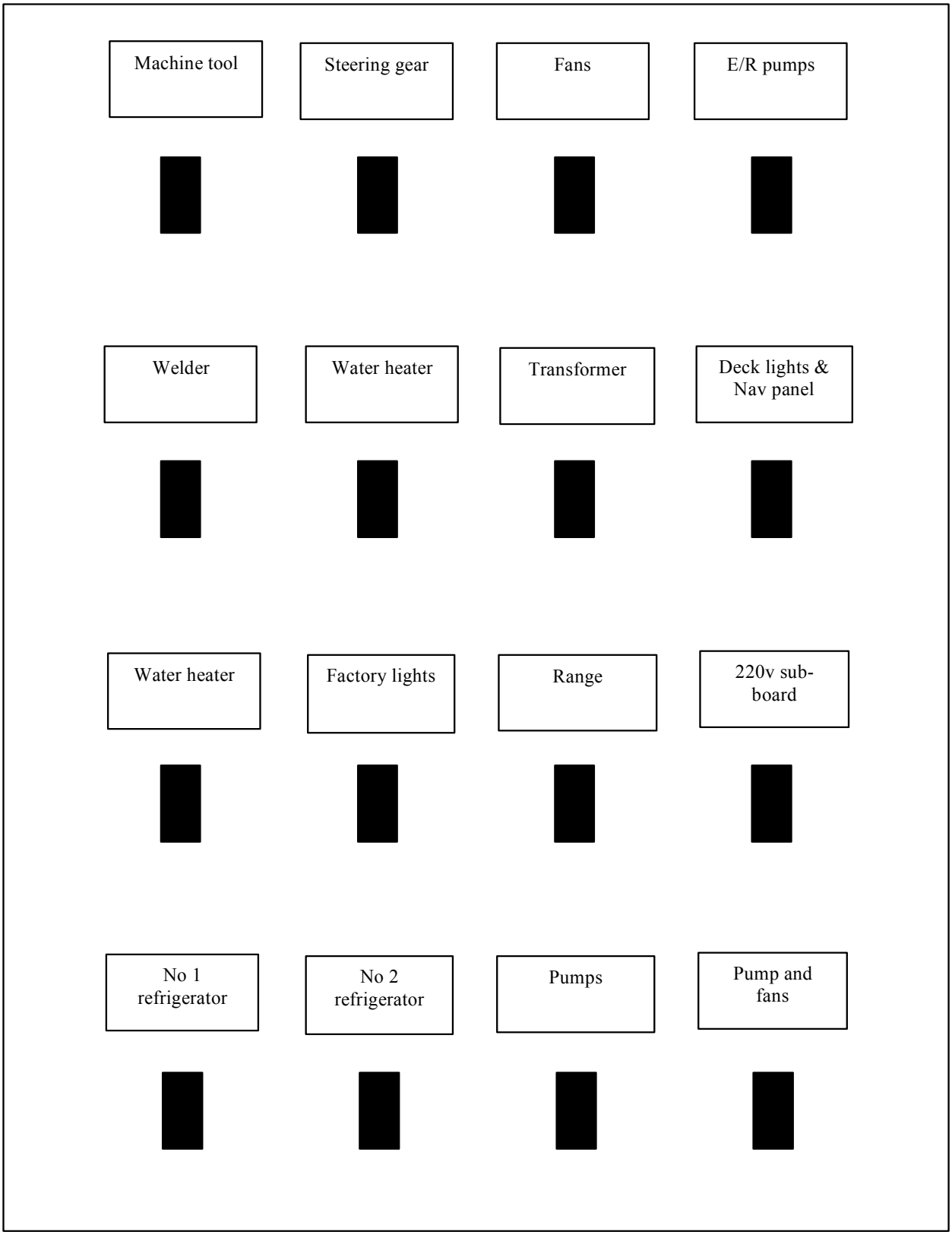


Figure 5
Layout of circuit breakers on the upper centre section of the switchboard showing the main circuits that they protected

1.6.15 During the entire period the ship's engines continued to propel the vessel and full electrical services were maintained. The chief engineer was concerned that if the main 220v AC accommodation circuit were turned off the vessel would lose its steering gear. However, the

steering gear did have a clearly marked breaker on the main switchboard separate to the general circuits (see Figure 5).

1.6.16 A tutor who ran Maritime Safety Authority approved fire fighting courses was asked whether water could be used where there was the possibility of live electricity. He indicated that it was usual for fire fighters to start fighting a fire immediately and not to wait until the power was isolated. He said that the safety systems of fuses and breakers were designed to operate should a short circuit occur and so protect the fire fighter.

1.6.17 A fire requires 3 components for it to exist, heat, and fuel and oxygen. Generally, fire extinguishing required the removal of one of these components.

1.6.18 The materials in the refrigeration space and messroom area were predominately dry materials and so the fire was categorised as a class 'A' fire. Most fire extinguishing mediums are suitable for this class of fire, but the recommended medium and method of fighting such a fire was to drench it in water, thus removing heat. CO_2 was the least recommended medium as it provided little or no cooling, so allowing the combustible material to continue smouldering and possibly reignite when the CO_2 dissipated, and oxygen was allowed to reach the hot spots.

1.6.19 Maritime Rules Part 42B.21 specified that when CO_2 is used in a fixed fire smothering installation for cargo or machinery spaces, sufficient gas must be provided to fill a space to a percentile of the volume of that space. The relative percentage volume of gas ranged between 30 and 45 percent depending on the type of space to be protected. The volume of CO_2 was required to be calculated at 0.56 cubic metres per kilogram. CO_2 is about one and a half times as heavy as air and so will tend to be more concentrated in the lower part of a space. In this case, the portable CO_2 extinguishers were used over a period of at least one hour and so never reached a concentration capable of displacing sufficient oxygen to smother the fire. The doors had been removed from the refrigeration spaces and so it was not possible to contain the CO_2 in the immediate vicinity of the fire to improve the saturation.

1.6.20 The approximate volume of the refrigeration space, the galley/messroom area and the steering gear was about 75 cubic metres. Using 0.56 cubic metres per kilogram of CO_2 to provide a saturation of 40% CO_2 would have required about 50 kg of CO_2. The fixed smothering system for the engine room had more than this amount of CO_2 but it was unavailable for use outside of the engine room. The portable and semi portable extinguishers on board totalled 29 kg, all of which was used.

1.7 Damage

1.7.1 The accommodation was extensively damaged by smoke and fire. The refrigeration space was gutted with almost all combustible materials being spent. In the galley/messroom area, a large section of structural timber, and bulkhead and deckhead panelling were burnt, with fire damage to electrical cables and plastic water pipes that ran through the area. The whole of the accommodation, including those cabins whose doors were closed throughout, was smoke damaged. Most of the appliances in the messroom were destroyed.

Figure 6
Refrigeration space showing fallen coils and hanging wires

Figure 7
Forward bulkhead of the messroom showing microwave, melted clock and circuit breaker cabinet

Figure 8
Refrigerator by doorway into steering gear, with melted television on top

2 Analysis

2.1 The fire was almost certainly started when hot metal spatter, from the refrigeration coil nuts cut off by the second engineer with the oxy-acetylene torch, penetrated holes in the bulkhead panelling in the meat room igniting the polystyrene insulation board behind. The fire spread along and up the insulation, eventually generating sufficient heat to ignite the plywood and coated hardboard panelling, and the structural timbers.

2.2 On discovering the fire the second engineer did not raise the alarm immediately as he should have been trained to do, but decided to fight the fire on his own. Had he raised the alarm immediately, a quicker and more co-ordinated response might have been possible. It wasn't until the master noticed the smoke coming from the ventilator and investigated the source that the remainder of the crew were alerted to the fire.

2.3 The fire occurring at night resulted in the second responders being drowsy, which probably caused them to choose the least effective fire fighting medium, CO_2.

2.4 The use of CO_2 as a first response measure resulted in personnel being unable to remain in the area without breathing apparatus, so restricting the early fire fighting effort. The fumes from the combustion would have eventually prevented access to the area but there was a window of opportunity, between when the fire was discovered and the fumes becoming too thick, where the most effective action would have been to attack the fire with water through a fire hose. This opportunity was missed due to the early use of CO_2. A second opportunity, when the chief engineer entered the space using breathing apparatus was also missed when CO_2 was again used instead of water.

2.5 Although better suited to oil based fires, AFFF was a suitable first response fire fighting medium for class 'A' fires, as it had cooling and smothering properties. CO_2 was not an ideal fire fighting agent for class 'A' fires as it provided little or no cooling and so the dry materials such as wood were able to continue smouldering and reignite once the concentration of CO_2 diminished. CO_2 was heavier than air, so it would be more concentrated at lower levels of a

compartment leaving sufficient air to support combustion at the upper levels. In addition, because there were no doors on the refrigeration space, the CO_2 would have flowed out of the refrigeration space and into the galley/messroom, the steering gear and any cabins whose doors were open at that time, and so diminishing its concentration. Had there been doors on the refrigeration space, the volume of CO_2 available in portable and semi portable extinguishers might have been sufficient to smother the fire in the early stages.

2.6 The volume of CO_2 required to sufficiently saturate the whole area of the refrigeration space, the messroom and the steering gear was about 50 kg, far exceeding that available in the portable and semi-portable extinguishers.

2.7 The CO_2 carried for the fixed smothering system in the engine room, which would have been sufficient to saturate the accommodation areas, was not available to address a fire other than in the engine room.

2.8 Had the fire fighters closed the door between the messroom and the steering gear compartment, there would have been less free air for the fire to draw upon and would have possibly increased the effectiveness of the CO_2.

2.9 The containment of the fire was to an extent compromised by the number of times the crew entered the accommodation and the number of times the door was opened to direct water into the space. Each entry allowed fresh air in, and so diluted the concentration of combustion inhibiting gases.

2.10 The *Solander Kariqa* was equipped with one CABA only with no back up system. The usual fire fighting philosophy was for 2 persons to fight a fire simultaneously (the buddy system), increasing the effectiveness of the operation and providing both physical and moral support between the fire fighters. Having only one fire crew outfit, resulted in only one properly outfitted person being able to enter the accommodation at any time and that person being isolated if anything untoward occurred. Consequently, the fire fighting effort was not as effective as it should have been.

2.11 Once all the CABA air bottles had been exhausted, the mate realised that desperate measures needed to be taken. Consequently, the crew did not heed the dangers that could be expected from breathing noxious fumes in the accommodation. They entered the space with only damp towels for protection. It is possible that the combustion of plastics among the other combusted materials might have produced poisonous fumes that could seriously affect a person's health. In the event, the sortie had a successful conclusion and did not result in any ongoing health problems for the fire fighters.

2.12 In the circumstances, the fire fighting effort needed to be based predominately on boundary cooling and confining the fire, which the crew effectively managed. The sorties into the refrigeration space to fight the fire, assess the situation and collect provisions for the crew were largely uncoordinated. The chief engineer and the mate appeared to be working independently and the master stayed mainly on the bridge operating the communications equipment.

2.13 The crew said that they had concerns over there being live electricity in the refrigeration space and cited this as the reason why they did not use water. The chief engineer was loath to cut power to the 220v AC circuits for fear of losing power to the steering gear. The switchboard breakers were clearly marked with the systems they protected, so it would have been possible to isolate the power to the circuits in the refrigeration, and galley/messroom areas while leaving the steering gear live. It any event, power cables for other systems were housed in the deckhead space of the accommodation areas. These were protected by circuit breakers should water or the fire have short-circuited them.

2.14 The ship's procedure manuals did not cover the safe practices that should be exercised during the maintenance of the vessel. In particular there were no procedures for hot work. On this

occasion, the hot work had not been planned prior to it being carried out; a "permit to work" system did not operate on board.

2.15 Carrying out the hot work at night resulted in there being no one available to assist the second engineer, or to maintain a fire watch while he was away from the area carrying out his engine room duties. The second engineer did take some precautions in that he had cleared the immediate area of debris and had a fire extinguisher and bottle of water on hand.

2.16 The *Solander Kariqa* did not have sufficient properly qualified persons on board to comply with the minimum safe crewing requirements of Maritime Rules Part 31C. The master had the required certification for both the master's and chief engineer's position. The chief engineer's 2DTE was insufficient for the chief engineer's position and his Coastal Master Certificate was inadequate for the mate's position. None of the Fijian crew held, with the exception of short courses, any maritime qualifications. Consequently, the requirement that a Mate of a Deep Sea Fishing Vessel and 2 Advanced Deckhand with Fishing endorsements be carried were not complied with, nor were they covered by a dispensation granted by the Maritime Safety Authority.

2.17 A completely qualified crew might have attacked the fire in a more cohesive way, using the most effective fire fighting medium and so might have reduced the length of time that the fire burned and therefore the damage that the vessel sustained.

2.18 The annual survey for the continuation of the vessel's Safe Ship Management Certificate had been commenced in January 2003. A number of deficiencies had been noted, principally in the form of expired consumables including pyrotechnics, which were being sourced at the time of the fire. The survey was completed on 16 May 2003, when the last of the pyrotechnics were delivered to the vessel. The outstanding items on the ship's annual survey did not have any bearing on the cause or the way the fire was fought.

2.19 The application for dispensation from carrying 2 complete breathing apparatus sets was misguided. First there was no actual requirement in Maritime Rule Part 40D for the ship to carry any breathing apparatus. It was required to carry 2 fire crew outfits, but only had one. The spirit of the Maritime Rule and the way in which the Safe Ship Management Company surveyors applied the rule, implied that a CABA be included with each fire crew outfit. Second, the application hinged on the premise that only an engine room fire would require the use of CABA. When the Maritime Safety Authority considered the application, the reasoning behind rejecting the dispensation but allowing a smoke helmet to be carried in lieu of the second CABA was sound and in fact was ominously foresighted. The letter of dispensation from the Maritime Safety Authority of New Zealand to the Safe Ship Management Company and the previous owner was not sufficiently explicit and was open to misinterpretation as occurred on this occasion.

2.20 The incorrectly noted special condition in the Safe Ship Management Manual referring to a dispensation from carrying 2 CABA sets resulted in the surveyor in Suva being unaware that the vessel was not complying with the Maritime Safety Authority of New Zealand's requirement to carry a smoke helmet in lieu of the second CABA. However, the pro-forma checklist completed during the annual survey did make note of the requirement to carry a smoke helmet but the surveyor overlooked this at the time of the survey.

2.21 The inability of the master to contact the DPA did not detract from the fire fighting effort nor did it significantly delay the dispatch of other vessels to assist the *Solander Kariqa*. The communications with Taupo Maritime Radio maintained a continuous link with the vessel and enabled the situation to be monitored.

2.22 The *Solander Kariqa*'s Non-SOLAS Ship Undertaking an International Voyage Certificate expired on 11 January 2003. Maritime Rule Part 46.20(b) required that a ship hold such a certificate before it departed on an international voyage, but the rule did not specifically require that the certificate be kept current once the vessel was outside New Zealand jurisdiction. This

consequently raises the question of whether the conditions on the Non-SOLAS Ship Undertaking an International Voyage Certificate needed to be continually complied with. In the event, the majority of the conditions were met with the exception of the requirement to carry the correct manning as required by Part 31C.

3 Findings

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

3.1 The domestic refrigeration space of the *Solander Kariqa* caught fire when hot metal spatter, from oxy-acetylene cutting, came into contact and ignited the polystyrene insulation board behind the panelling of the meat room.

3.2 Had the second engineer raised the alarm on discovering the fire, the fire fighting effort would have been started quicker and may have been better coordinated and would probably have resulted in the fire being extinguished sooner.

3.3 The fire fighting effort was compromised because the *Solander Kariqa* was only equipped with one breathing apparatus. To finally extinguish the fire, the crew entered the accommodation without breathing apparatus which could have resulted in the inhalation of and possible poisoning from the combustion particulates in the smoke laden atmosphere.

3.4 The fire fighting medium chosen by the crew, CO_2, was the least efficacious for the type of fire they were confronting.

3.5 The fire continued to smoulder for about 16 hours after it was discovered.

3.6 The boundary cooling effectively assisted containing the fire.

3.7 The vessel maintained main propulsion and electrical power throughout the period.

3.8 Maritime Rules Part 40D, Appendix 2.2 did not specify the carriage of CABA neither did Maritime Rules Part 42B include breathing apparatus as part of a fire crew outfit.

3.9 There were insufficient properly qualified personnel on board the vessel to meet the requirements of Maritime Rule Part 31C.

3.10 The requirement for the issue of a Non-SOLAS Ship Undertaking an International Voyage Certificate was open to interpretation; whether the certificate needed to be current continuously while the vessel was operating outside New Zealand waters was debatable.

4 Safety Recommendations

4.1 On 4 February 2004 the Commission recommended to the Director of Maritime Safety that he:

4.1.1 Draft an amendment to Maritime Rules Part 42B.66 for the Minister's consideration, to provide that a self-contained breathing apparatus as prescribed in Part 42B.59 is included as part of a fire crew outfit. Where 2 or more fire outfits are required, one of the self-contained breathing apparatus may be substituted by a smoke helmet as prescribed in Part 42B.58 (054/03).

4.1.2 Communicate with the operator of Solander Fisheries and operators of other New Zealand registered unlimited area ships advising them of this accident and the need to ensure that these operators crew their vessels with suitably qualified crew in accordance with the requirements of the Maritime Rules (055/03).

4.1.3 Correspond with all Safe Ship Management Companies and operators of New Zealand registered unlimited area ships advising them of this accident and the need to ensure all applicable vessels operating overseas maintain a current Non-SOLAS certificate (056/03).

4.1.4 As and when Maritime Rules Part 21 or Part 46 is reviewed, any amendments should include the provision that New Zealand registered ships operating outside New Zealand territorial waters maintain continuous certification (066/03).

4.2 On 16 February 2004, the Director of Maritime Safety replied:

> Recommendation 054/03
> The proposed recommendation is acceptable to the MSA and will be included in a future rules programme bid to the Ministry of Transport as soon as practicable.
>
> Recommendations 055/03 and 056/03
> The Maritime Safety Authority accept these recommendations.
>
> Recommendation 066/03
> This recommendation is acceptable to the Maritime Safety Authority, and we will include it in the forthcoming amendment of Maritime Rule 21 planned for the year 2004/2005.

4.3 On 4 February 2004 the Commission recommended to the Chief Executive Officer of Solander Fisheries that he:

4.3.1 In conjunction with the Maritime Safety Authority, determine and put in place measures to ensure that the company vessels comply fully with the provisions of Maritime Rules Part 31C (057/03).

4.3.2 In conjunction with the Safe Ship Management Company. prepare procedures covering maintenance on board company vessels with particular regard to hot work involving the use of welding or cutting equipment (058/03).

Approved for publication 29 January 2004

Hon W P Jeffries
Chief Commissioner

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