



**REPORT OF THE
INVESTIGATION INTO
LIVESTOCK MORTALITIES
ABOARD THE M/V
TEMBURONG
ON WEDNESDAY,
27 JANUARY 1999**

Australian Maritime Safety Authority
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1. Executive Summary

- 1.1 The Singapore flagged livestock ship *Temburong* loaded around 1100 head of cattle in Darwin and sailed for Amamapare in Irian Jaya on the Tuesday, 26 January 1999, a voyage of approximately 2.5 days.
- 1.2 On the Wednesday, 27 January at about 1000 Hrs it is reported that the deck generator supplying power to the livestock ventilation system failed. The ship's staff traced the cause of the failure to the contamination of the generator's diesel oil fuel supply with intermediate fuel oil (IFO) - a heavier grade of fuel.
- 1.3 Following the failure of the deck generator, the ship's engineers transferred the power for the livestock ventilation system to the engine room generators. At approximately 1520 hrs these generators also failed resulting in a complete loss of electrical power including the shut down of the ventilation system to the livestock spaces.
- 1.4 This second failure was traced to the contamination of the engine room generators' diesel oil fuel supply by water.
- 1.5 Following the failure of both the primary and secondary power supplies there was no power to operate the ventilation systems to the livestock spaces and a total of 829 cattle perished before power could be restored.
- 1.6 Due to the extent of the livestock losses AMSA withdrew its approval for the ship's Livestock Capacity Plan and in so doing, acceptance of the ship to load livestock at Australian ports, pending a full investigation into the incident.
- 1.7 Two AMSA surveyors carried out an investigation into the incident whilst the ship was in Singapore, in conjunction with Singapore Government, the ship's flag state Administration.
- 1.8 The incident stemmed from a failure of both the primary and the secondary sources of power to the livestock space ventilation system due to fuel contamination.
- 1.9 The severity of the incident was compounded by a lack of familiarisation by ship's staff with the fuel systems and machinery arrangements on board coupled with the absence of contemporary ship management practices.
- 1.10 The Australian Maritime Safety Authority (AMSA) would like to acknowledge the cooperation received from the Singapore authorities, the classification society Germanischer Lloyd, and the owner/operators of the ship whilst carrying out this investigation

2. Jurisdiction for Investigation

- 2.1 The incident was investigated under Australian Marine Orders Part 43 “Cargo & Cargo Handling – Livestock”, provisions 11 and 45. These Marine Orders are made in accordance with the Navigation Act 1912.

3. Methodology Used

- 3.1 Two AMSA senior marine surveyors travelled to Singapore where, in conjunction with officers of the Maritime and Port Authority of Singapore, they boarded the *Temburong* on Thursday, 11 February 1999 to carry out the investigation.
- 3.2 The ship’s officers and crew were questioned as to the events on the voyage, notes of these conversations were taken along with copies of the ship’s log book and other technical documentation.
- 3.3 Whilst on board the AMSA surveyors physically inspected the ship and its equipment with particular attention being given to the machinery, fixtures and arrangements associated with the supply of both the primary and secondary sources of power to the livestock space ventilation systems.
- 3.4 On return to Australia the AMSA surveyors prepared the report of their investigation of the incident using the information obtained in Singapore and from other sources, including the ship’s Australian operator Rooney Shipping and Trading Pty Ltd.
- 3.5 A draft copy of the report was forwarded to both Rooney Shipping and Trading Pty Ltd in Darwin and Labroy Shipping in Singapore for their information and comment. Rooney Shipping and Trading Pty Ltd responded on behalf of both organisations and these comments have been taken into account in framing the final report.

4. Ship’s Particulars

- 4.1 *Temburong* was originally built as a general cargo ship in 1981 and converted to carry livestock in 1996. During the conversion the ship’s hold was fitted with 3 horizontal decks with each deck being provided with purpose built pens for the carriage of livestock (see Annex 1).

4.2 Ship’s Details:

Name:	<i>Temburong</i>
Flag State:	Singapore
IMO Number:	8103614
Official Number:	387015

Gross Tonnage:	2637
Length:	90.42 metres
Service Speed:	12 Knots
Ship Owner:	Labroy Shipping
Ship Operator:	Rooney Shipping and Trading Pty Ltd
Class Society:	Germanischer Lloyd (GL)
Call Sign:	S6DP
Ship Type:	Livestock Carrier
Year of Build:	1981 (as general cargo ship)
Date of Conversion:	1996 (to livestock carrier)
Cargo Owner:	Carabao Exports Pty Ltd

5. Ship's and Crew Certification

- 5.1 The ship is registered in Singapore. All the ship's statutory certificates were issued by the classification society Germanischer Lloyd (GL) on behalf of the Government of Singapore.
- 5.2 The ship's Cargo Ship Safety Equipment, Cargo Ship Safety Construction and International Load Line certificates were in order.
- 5.3 The ship's Cargo Ship Safety Radio Certificate (issued 27 November 1998 in Darwin) had no Record of Equipment attached to it. The ship's owner/operator supplied a copy of this attachment.
- 5.4 The ship's International Oil Pollution Prevention Certificate was withdrawn in Darwin on Monday, 25 January 1999 and an interim certificate issued following repairs to the oil pollution prevention equipment. A full term certificate was issued on Monday, 1 February 1999 by GL.
- 5.5 Under Marine Orders Part 43, Issues 1 and 2, prior to a ship being allowed to load livestock at an Australian port, AMSA is required to inspect the ship for compliance against its previously submitted Livestock Capacity Plan (LCP). On satisfactory completion of this inspection AMSA issued a Certificate of Approval for the LCP which allowed the ship to commence trading from Australia.
- 5.6 AMSA issued LCP Certificate of Approval Number 4669 for *Temburong* on 29 October 1996.
- 5.7 The ship's officers' certificates of competency were issued by the Philippine Maritime Authority.

Details are as follows:

Master – Master Mariner (STCW II/2) issued 07/08/1991
Chief Mate – Chief Mate (STCW II/2) issued 02/02/1993

Second Mate – Second Mate (STCW II/4) issued 24/01/1989
(All holding GMDSS qualifications)

Chief Engineer – Chief Marine Engineer (STCW 1978, III/2) issued 30/10/1990

Second Engineer – Second Marine Engineer (STCW 1978, III/2) issued
05/08/1992

Third Engineer – Third Marine Engineer (STCW 1978, III/4) issued 12/02/1998

5.8 This officer manning is in accordance with the ship's Safety Manning Certificate.

5.9 Two extra persons are required for the engine room and may be any of the following: assistant engineer, engine cadet, motorman, oiler, wiper, fireman, electrical engineer, electrician, fitter or GP. The ship normally carried an electrician and an oiler, but the electrician had been hospitalised and was not on board *Temburong* when it departed Darwin. He later rejoined the ship at sea whilst the dead cattle were being jettisoned.

5.10 Five extra persons are required in the Deck department and 6 are ordinarily carried.

5.11 The engine room is manned whilst *Temburong* is at sea as follows:

The Chief Engineer (who joined the ship in February 1997, left in February 1998 and rejoined the ship in May 1998) normally kept the 8 to 12 watch.

The Second Engineer (who had been on the ship for 9 months) kept the 4 to 8 watch.

The Third Engineer (who had also been on the ship for 9 months) kept the 12 to 4 watch

6. Marine Orders Part 43 Requirements

6.1 Marine Orders Part 43 "Cargo and Cargo Handling – Livestock" contains the statutory requirements for:

- the loading of livestock on board ship
- the certification and the inspection of livestock ships to ensure compliance with the criteria that must be met before a livestock ship can load live animals at an Australian port; and
- stability, ventilation, lighting, drainage, fire fighting appliances, access for both animals and personnel, arrangements for fodder and water, strength of pens and their fittings, stocking densities, carcass disposal and mortality reporting.

7. Generator and Ventilation Systems

7.1 The ventilation requirements of Marine Orders Part 43 Section 10 which was in force at the time of approval, states that there must be a primary and secondary source of power for the livestock ventilation system as follows:

“10.7 The primary source of power required by 10.6 must be sufficient to supply continuous power for all that part of a voyage during which livestock is on board without interfering with the normal operation of the ship.

“10.8 The secondary source of power required by 10.6 must:

- (a) be located in a space, each boundary of which is not contiguous with a boundary of any space containing the primary source of power;*
- (b) be capable of being readily started;*
- (c) be capable, for a continuous period of three days, of delivering power sufficient to comply with 10.1.1, 10.2.1 or 15.12.1(b).*
- (d) in the event of fire in a space containing the primary source of power, remain capable of complying with (b) and (c).”*

7.2 All the livestock are carried below deck with a mechanical ventilation system supplying air to the livestock. This system comprises 12 fans driven by electric motors. Each fan is located on deck mounted in vertical trunking. The trunking extends down to the lower decks with horizontal distribution ducts supplying air to the pens at the extremities of the ship's hold. This arrangement complies with the requirements of Marine Orders Part 43 and in fact the number of air changes achieved exceeds the minimum number prescribed in the Marine Order.

7.3 The ship has two diesel generators situated in the engine room on the bottom platform level and two generators situated in a deckhouse on the main deck. The two deck generators were fitted during the conversion to a livestock carrier.

7.4 There is no alarm system fitted to the deck generators to let the watchkeeping engineer know that there is a fault on the generator. There is however a livestock ventilation fan alarm panel on the navigating bridge giving both visual and audible indication of failure.

7.5 Details of the ship's generators follow:

Main Generators:

Type: Yanmar, 6 MAL
Number: 2
Location: Engine room.
Power: 160KW.

Secondary/Emergency Generators as required by Marine Orders Part 43:

Type: Cummins, NT-55-04
Number: 2
Location: Enclosed deckhouse on main deck.
Power: 180KW.

7.6 The generator numbering is as follows:

No 1 Generator – Starboard engine room Yanmar
No 2 Generator – Port engine room Yanmar
No 3 Generator – Port deck Cummins
No 4 Generator – Starboard deck Cummins

7.7 The two engine room generators (1 & 2) can be run in parallel (operated in tandem) with each other. The two deck generators (3 & 4) cannot be run in parallel with each other or in parallel with either of the two engine room generators. This limits the flexibility of the system to operate with different combinations (deck and engine room) generators into a single distribution system.

7.8 Owing to this arrangement and in order to comply with Marine Orders Part 43 the ship's engineers would have to keep either No 3 or 4 generator as a secondary source of power to the other generators in case of failure.

7.9 There are two switchboards fitted, one is located in the engine room and distributes power to the engine room and other shipboard services. The other switchboard is in the same enclosed deckhouse as the port deck generator on the main deck and according to the drawings on board only distributes power to the livestock ventilation system, deck sockets for refrigerated containers and a small number of the vessel's domestic services. It does not distribute power to the engine room.

7.10 There is a circuit breaker that ties the two switchboards together so that the engine room generators can supply power to the deck switchboard and then onto the livestock ventilation system and the container deck power sockets.

- 7.11 The Cummins generator maintenance is done mostly by shore contractors – only relatively minor maintenance such as filters and oil changes are done by ship's staff.
- 7.12 The ship's owner/operator prefers to engage shore contractors to carry out servicing work on the Cummins generators and as such there are no special tools on board for major maintenance. Routine maintenance of the Yanmar generators is usually done by ships staff; however it was reported during the interview process that due to limited port time that both the Yanmar generators required major overhauls.

8. Fuel Tank Arrangements

- 8.1 The two types of fuel used in the main and auxiliary machinery on board are:

Intermediate fuel oil (IFO)
Diesel oil (DO)
- 8.2 The fuel is used as follows:

Main engine – IFO,DO.
Yanmar Generators – DO
Cummins Generators – DO
- 8.3 The engine room diesel generators Nos 1 and 2 were originally designed to run on blended fuel oil but this practice has been discontinued.
- 8.4 The ship is equipped with 6 tanks, 4 of which are normally used to supply diesel fuel to the diesel generators. These are known as No.3 double bottom tanks port and starboard, No.4 port and starboard tanks (which are situated on the auxiliary engine flat) and Cummins 3 and 4 which are situated on deck just forward of the deckhouse at frame 84-85 (see Annexes 3 and 4).
- 8.5 No.4 starboard was originally designated as a blended oil tank, as there is a blender mixer on board, although it is no longer used for this purpose.
- 8.6 Tank sludging (to allow draining of water and other liquid waste) arrangements were fitted to both No.4 port and starboard tanks and to the Cummins 3 and 4 tanks but in general did not appear to AMSA to meet Class rule requirements. Apart from a series of filters there is no diesel oil treatment equipment fitted unlike comparable ships where it is accepted practice to have purifiers or at least a coalescer for removing fine foreign particles and/or water.
- 8.7 The blended fuel oil used previously had to be heated to ensure complete combustion, so cooling of the fuel injector nozzles was required and this system was still fitted to the engine room Yanmar generators. The cooling medium used

was DO and originally the nozzle cooling oil was taken from the No.4 port tank and returned to the same tank.

- 8.8 At some time in the past, modifications were carried out to the ship's fuel systems. These consisted of:
- 1) Allowing the engine fuel oil spill to be returned to No.4 port tank as well as No. 4 starboard tank.
 - 2) Allowing the fuel injector nozzle cooling oil to be returned to No.4 starboard tank as well as No.4 port tank.
 - 3) Fitting a drain valve to No.4 port tank, the pipe work for which was led into the drain pipe work of No.4 starboard tank, this pipe work led to the No.2 IFO double bottom tank.
 - 4) On No.4 port and starboard tanks fitting of a cross connections between the tank filling lines and the tank outlet lines.
 - 5) No.4 starboard overflow was broken and diverted to No.4 port tank overflow.
 - 6) Removing part of the pipe work fitted at 3) above and using the drain valves as sludge valves.
 - 7) Additional valves fitted to generator engine spill lines and fuel injector nozzle cooling return lines to allow isolation of each engine for maintenance purposes.
 - 8) Adding a direct bunker line to No. 4 port and starboard fuel tanks.
- 8.9 As both outlet valves from No 4 port and starboard tanks are left open to equalise the tank levels, diesel fuel for the engine room generators is taken from both tanks at once. Fuel passes through a strainer to a generator engine fuel supply pump which pumps the diesel oil through a duplex filter, a now unused fuel heater and then to the individual generators where an engine driven supply pump discharges to the fuel injection pumps via a duplex filter.
- 8.10 On deck the Cummins 3 and 4 diesel fuel tanks are filled from a transfer pump in the engine room discharging through pipe work running along the main deck. It is the policy on the vessel to take diesel only from No.3 port double bottom tank for the Cummins fuel tanks.
- 8.11 There were no drawings on board showing the piping to the Cummins fuel tanks. Each new engineer learns how to transfer fuel to these tanks by being shown by another engineer.

- 8.12 To minimise the possibility of contaminating the deck Cummins generator 3 and 4 tanks the chief engineer noted that before diesel fuel is transferred to these tanks it is normal practice to first pump fuel from 3 port double bottom fuel tank to 3 starboard double bottom fuel tank to flush the pipe lines through.
- 8.13 Only the No.4 Cummins tank is fitted with a filling connection. No. 3 Cummins tank is filled either by filling No. 4 Cummins tank and then overflowing it to No. 3 Cummins tank, or by opening cross connection valves that are near the bottom of the tanks and filling them both simultaneously.
- 8.14 No. 3 Cummins tank overflows to No.4 Cummins tank which overflows to No.3 double bottom tank. Unless the tank cross connection valves are open to make the tanks common, each generator can only use diesel fuel from its respective tank.

Ship Bunkering Arrangements

- 8.15 The ship has a common bunkering line for all fuel used on board but No.4 port and starboard tanks also have their own individual dedicated filling connections on the main deck.
- 8.16 There are no arrangements provided on the ship to enable fuel samples to be taken when bunkering and there is no formal or informal testing carried out of any fuel coming on board.
- 8.17 When bunkering diesel fuel in Darwin, the information supplied is generally limited to fuel type (ie diesel) and specific gravity. The vessel lacked an acceptable procedural framework within which the bunkering process could be properly managed and any non-conformity addressed.

9. Incident Details

Loading of Cargo

- 9.1 The vessel loaded 1111 cattle at the Hudson Creek wharf, Darwin on Tuesday, 26 January 1999 without any reported incident.

Inspection Arrangements

- 9.2 An AMSA surveyor did not carry out a pre-loading inspection prior to the loading in Darwin as AMSA had previously inspected the ship on 27 November 1998 at Karumba. The ship was operating under the 60 day inspection program (as allowed for under Marine Orders Part 43) and as such was not due for a pre-loading inspection again until its next voyage from Australia.
- 9.3 The history of livestock pre-loading inspections did not note any major deficiencies with the on-board livestock carriage arrangements. A review of port

State control inspections revealed a number of deficiencies however the ship had never been detained by AMSA.

Departure

- 9.4 The vessel departed Darwin at approximately 1300 hrs on Tuesday, 26 January 1999. On leaving port the ship had the two engine room Yanmar generators running together with the port Cummins No 3 deck generator. The other deck generator (starboard Cummins No 4) had a reported electrical fault in the stator and was therefore inoperable. Crew comments indicated that this had been the case since December 30 1998.
- 9.5 The Chief Engineer stated that the Yanmar engine room generators had a problem with their governors (causing the frequency to fall as the load increased) so he had to run both engine room generators to adequately carry the engine room and remaining ship load (excluding the livestock ventilation system).

10. Discussion on Generator Failures

Failure of deck (Cummins) generator

- 10.1 The No 4 starboard Cummins generator was out of commission because of an electrical fault. It was due for repair when the ship next returned to Darwin.
- 10.2 On Wednesday, 27 January 1999 at about 0800 hrs the Chief Engineer transferred diesel fuel from 3 port double bottom fuel tank to the deck generator tanks.
- 10.3 At around 1000 hrs the Chief Engineer stated that he heard the livestock ventilation fans stop. Upon investigation he found that No. 3 Cummins deck generator had also stopped. The Chief Engineer immediately switched the power for the livestock ventilation system to the engine room generators and restarted the livestock space ventilation fans.

Failure of engine room (Yanmar) generators

- 10.4 With both deck generators inoperable, one due to contaminated fuel and the other with an existing electrical fault, power for the livestock ventilation system and all other services was now being supplied by the two engine room generators.
- 10.5 At approximately 1520 hrs, both engine room generators stopped resulting in the ship suffering a complete loss of electrical power.
- 10.6 The Third Engineer, who was on watch in the engine room at the time, attempted to restart both generators in turn but neither would start. In order to protect the

main engine from damage through lack of cooling water, he manually shut it down.

10.7 The Chief Engineer who was working on the deck Cummins diesel fuel tanks proceeded to the engine room to investigate the cause. He quickly traced the problem to water in the fuel. He checked 4 port and starboard diesel fuel tanks and found water in them. He took tank soundings and, using a water indicating chemical paste on the sounding tape, noted the following readings:

- 4 Port diesel fuel tank – total sounding 186 cm with 89 cm of water. From the tank sounding tables this equates approximately to 12 m³ total in the tank, 4.7 m³ water and 7.3 m³ of fuel.
- 4 Starboard diesel fuel tank – total sounding 184 cm with 60 cm of water. From the tank sounding tables this equates approximately to 12 m³ total in tank, 2.9 m³ water and 9.1 m³ of fuel.

10.8 About one hour after the black out the master no longer had external communications available, other than the ability to send an emergency distress message, as the batteries of the notebook computer he was using for routine communications purposes in conjunction with the GMDSS equipment had completely discharged.

11. Ship's Response

11.1 Following the failure of no. 3 port Cummins deck generator the Chief Engineer changed the fuel filters which are of a throw away cartridge type. On removal he apparently found them blocked with a dirty coloured fuel. After replacing the two fuel filters (primary and secondary) he started the generator again and it ran for some two minutes before stopping again. The fuel filters were then changed for a second time.

11.2 On visual inspection of the contents of the deck diesel fuel tank through the level gauge sight glass the fuel was found to be dirty in colour. The Chief Engineer then drained both deck generator fuel tanks to No 2 double bottom fuel tank and after removing the inspection door found black sludge in the bottom of the tanks.

11.3 He cleaned the deck diesel fuel tanks and started to refill no. 4 Cummins tank with the access door removed to observe the diesel fuel coming from the engine room transfer pump. When he saw that the fuel coming from the engine room was dirty he stopped the transfer pump and again drained and cleaned the tank. He said the normal colour of the diesel fuel should be light yellow colour.

11.4 He then went down to the engine room and took off the fuel tank access cover for No 3 port double bottom tank and found that diesel fuel in the tank was contaminated with what appeared to be either IFO or heavy fuel oil.

- 11.5 After the failure of the engine room Yanmar generators, the engineers started to drain the water from both 4 port and starboard diesel fuel tanks by opening a drain valve on each tank. These two valves and their associated pipeline arrangement were originally designed for draining the contents of 4 port and starboard to No 2 centre fuel oil tank, rather than for the specific purpose of removing water and or fuel residues.
- 11.6 During some time between the Chief Engineer having last been on the ship and this occasion, part of this pipe work had been removed to observe what might be coming out to the tank and allow any water to be drained off. This modification was obviously done as when the ship was built it appears there were no specific arrangements for draining the water from 4 port and starboard tanks - as would normally be the case for similar tanks on board comparable ships.
- 11.7 The Chief Engineer said that when he opened up the drain valves fully there was a small amount of fuel as well as water draining out, so he closed in the valves to restrict the flow to the extent that only the water was draining out. He tasted the water draining out of the tank and claimed it tasted salty and had the colour of tea.
- 11.8 With these valves shut in as described above it took about 20 minutes to drain all the water from the starboard tank and some 4 hours for the water to drain from the port tank.
- 11.9 The Chief Engineer also said that he had opened both these valves on 4 port & starboard tanks that morning but had only found a small amount of water at the time.
- 11.10 The engine room generators have fuel injector nozzle cooling as they are designed to operate on blended oil if required. This fuel injector nozzle cooling is achieved by having a small engine driven pump circulating diesel fuel from and to 4 port tank.
- 11.11 According to the ship's drawings and confirmed by sighting the pipe work this system had been altered in the past so that the fuel injector nozzle cooling system could also operate from 4 starboard tank as well. The Chief Engineer stated that he believed that the fuel injector nozzle cooling could not be run from and returned to No. 4 starboard fuel tank.
- 11.12 The Chief Engineer was not prepared to operate the engine room generators without fuel injector nozzle cooling and so waited until all the water had drained out of 4 port fuel tank before attempting to restart a generator.
- 11.13 While draining the water out of 4 port and starboard tanks the engineers set about draining water from the generator fuel lines, fuel pumps and injectors.
- 11.14 As a result of the initially attempted generator starts immediately after the black out and the time taken to drain the water from 4 port and starboard diesel fuel

- tanks there was insufficient air at the required pressure remaining in the air receivers to start a generator.
- 11.15 The ship's first or "dead ship" start arrangement is a hand operated air compressor that pumps up a small generator air receiver and according to ship's staff takes about 1 – 1.5 hours to pump up to the required pressure of 20 Kg/cm² when empty.
 - 11.16 There is no emergency generator on board and batteries are used to supply the statutory minimum amount of emergency power.
 - 11.17 At about 1930 hrs the engineers attempted to start No 2 Yanmar generator but the engine failed to start and this exercise consumed all the compressed air in the generator air receiver. With the aid of the deck crew the generator start air receiver was pumped up again. While the crew was pumping up the air receiver the engineers once more bled through the fuel pumps and injectors to remove any remaining water from the engine's fuel system.
 - 11.18 At 2030 hrs there was sufficient air pressure to attempt another start of No 2 generator. It started, but only ran for approximately 3 minutes. At 2200 hrs there was again sufficient air pressure to attempt yet another start of No 2 generator however it again only ran for a few minutes.
 - 11.19 As there appeared to be major difficulties in starting the engine room generator the Chief Engineer decided to see if it was possible to get the No 3 Cummins deck generator running as they used batteries rather than compressed air for starting purposes.
 - 11.20 On checking the fuel in No 3 starboard double bottom tank he found that although it was also contaminated with heavy oil or IFO it was not as bad as 3 port double bottom tank. He transferred some fuel from 3 starboard tank to the deck generator tanks (although how this was done remains unclear) and then managed to start the Cummins generator, although it only ran for approximately 20 minutes before stopping.
 - 11.21 This was sufficient time however to enable the main air compressors to pump up the main starting air receivers using the electrical power available from the Cummins deck generator.
 - 11.22 At around 0025 hrs on Thursday, 28 January the main air receivers had sufficient air pressure to enable the engineers to start No 2 Yanmar generator and then restore power to essential shipboard systems including the livestock space ventilation fans.
 - 11.23 At 0100 hrs No 1 engine room generator was started and full power restored to the ship.

- 11.24 Except for a brief period when the engineers managed to start and run No 3 Cummins deck generator to pump up the main air receivers, the ship was without power from approximately 1524Hrs hours on Wednesday, 27 January to 0025Hrs on Thursday, 28 January, a period of approximately 9 hours.
- 11.25 During the period the ship was without power the crew opened up a series of deck vents to allow as much natural ventilation to the livestock as possible, but as a result of inadequate ventilation a total of 829 animals died.
- 11.26 It is also worth noting that the ship was drifting throughout this period in an area in relatively close proximity to a reported reef. Whilst this reported hazard provided no immediate threat to the vessel it was just another issue that added to the risks facing the vessel particularly given the failure of the GMDSS equipment.

Discussion on the failure of Cummins deck generators

- 11.27 When the ship sailed from Darwin on Tuesday, 26 January 1999, the No 4 Cummins generator was not operational due to an electrical fault. In addition, due to a problem with the two engine room generators, both were running to supply the normal ship services with the remaining deck generator was being used to supply power to the livestock ventilation system.
- 11.28 The ship bunkered diesel oil in Darwin on Tuesday, 26 January 1999. A road tanker discharged this fuel to the ship using the shore bunkering pipelines. The Chief Engineer noted during the bunkering process that the pressure in the bunkering line was less than normal. Upon investigation he found a valve from a storage tank open approximately 3 turns. After closing this valve the pressure returned to normal.
- 11.29 When bunkering was complete the Chief Engineer noted that from fuel tank soundings the vessel only had on board 11 of the 21 tonnes of diesel fuel ordered. The shore tank was sounded and it was found to have 10 tonnes more than it did before bunkering.
- 11.30 The precise nature of the contents of this tank are not known but according to the Chief Engineer this tank is used for heavy fuel oil supply to other ships operated by Rooney Shipping and Trading Pty Ltd when heavy fuel oil is not available in Darwin. This tank is sometimes filled by ships visiting the Hudson Creek wharf and discharging fuel to the storage tank (see Annex 5 which shows a sketch provided of the bunkering tank and associated piping at Hudson Creek Wharf).
- 11.31 Although there are other valves in the bunkering line to the ship, from the time these were opened to the time bunkering commenced, there was more than sufficient time to allow a quantity of heavy fuel oil from this storage tank to drain into the line and eventually find its way on to the ship.

- 11.32 From the information supplied by the Chief Engineer and confirmed verbally by the superintendent acting for Rooney Shipping and Trading Pty Ltd, it appears that contamination had come from this source.

Discussion on failure of the engine room Yanmar generators

- 11.33 All the ship's engineers claimed that they had sludged/dewatered the fuel tanks during their watches prior to the incident.
- 11.34 The Chief Engineer said there was no fuel transferred into 4 port and starboard tanks either on Wednesday, 27 January or for several days beforehand, indicating that it is unlikely that the water contamination had come from transferring fuel into the tank.
- 11.35 The daily fuel tank soundings are taken and recorded on a piece of paper - but are then thrown away at the end of each day (ie there is no long term record kept of the daily tank soundings). This is generally indicative of the lack of records that the ship's staff kept regarding the ship's operation.
- 11.36 As a result of this lack of record keeping it is not known if the tank level rose significantly between Tuesday, 26 January and Wednesday, 27 January as would be expected if there was a quick ingress of water into the tank, as opposed to a slow build up over a period of time.
- 11.37 The ship's Master reported that there was no rain from sailing on Tuesday, 26 January to the time of the incident, thereby eliminating the possibility of rain water entering the tanks via an air vent or separate tank filling lines.
- 11.38 There is a crew's bathroom located almost directly above No 4 port fuel tank on the deck above. During the investigation the engineers removed a tank access door for inspection for possible water ingress. As a test, the crew's bathroom scuppers were plugged and the shower recesses filled with water. An inspection of the inside of the tank for possible leaks into the tank was conducted but none were found.
- 11.39 To check the accuracy of the soundings of water content taken through the sounding pipe, a sounding was also taken when the access door was removed and compared against one taken through the sounding pipe. The sounding through the access door was 2 cm and by the sounding pipe 23 cm. This is a substantial difference between the two indicating that the reading the ships engineers were getting initially through the sounding pipe was probably misleading.
- 11.40 During the investigation the Singapore authority surveyor decided to carry out a more thorough inspection of the condition of No 4 fuel tank with the tank empty and his report notes:

“The integrity of the tank is intact, no tell tale sign of water ingress or water mark or corrosion on the sides of the tank. Sounding pipe is clear and open-ended with a striking pad on tank bottom. Tank drain pipe is at 70mm from bottom. Tank outlet pipe to the Yanmar diesel generators ends at 260mm from tank bottom. Tank fill/suction pipe bellmouth is 10mm above the tank bottom. However the tank fill/suction quick-closing valve is defective and cannot be opened. This valve had been left in closed position for an unknown period which implies that bunkering of or suction from the tank could not be possible through the transfer system. This also confirmed that the engine had been taking suction well above the drain pipe. No.4P and 4S D.O tanks are normally filled via their respective overhead filling pipes.”

- 11.41 From the information supplied by the Singapore surveyor the height of the suction pipe from 4 port fuel tank supplying the generators is 260 mm from the bottom of the tank. When the water level had risen to this point the generators would have had water enter their fuel systems and would eventually stop. This water volume is approximately 1.2 m³; not the 4.7 m³ as originally indicated from the engineers' soundings.
- 11.42 From the information gathered it is probable that the water in 4 port and starboard fuel tanks had built up over a period of time for the following reasons:
1. Water in the fuel when supplied to the ship
 2. Condensation from the atmosphere
 3. Inadequate tank sludging and dewatering arrangements however given the design the engineers may not have been able to do a more effective job.
 4. The colour of the water coming out of the drain pipe was a similar colour to the fuel and may have led them to think that the water was indeed fuel.
- 11.43 It is a generally accepted marine engineering practice that an engine operating on unheated diesel fuel could be run for a period of time without the fuel injector nozzle cooling being required.
- 11.44 Regardless of this previous statement the modifications made to the generator fuel system meant that the engineers could have isolated No 4 port fuel tank once No 4 starboard fuel tank was free of water thereby enabling the restoration of power to the ship by using fuel from No 4 starboard fuel tank to the engine room generators rather than also waiting for the water to drain from No 4 port fuel tank.
- 11.45 As mentioned earlier it is not known how fuel was transferred to the deck tank during the black out given these tanks were supposed to be empty and had been

wiped out. The Chief Engineer was questioned further about this but was unable to provide an explanation of how this had been done.

12. Shore Management

- 12.1 It has long been recognised that it requires the combined effort and commitment of both shore and ship management if the outcome of a safe and environmentally responsible maritime transport system is to be assured. Whilst this incident is related to the immediate failure of critical ship board systems the role of shore management must also be considered.
- 12.2 Both the ship's engineers and representatives of Rooney Shipping and Trading Pty Ltd have conceded that the vessel's diesel supply was probably contaminated during bunkering in Darwin on Tuesday, 26 January 1999. Since this incident AMSA has received copies of company procedures in relation to a number of critical on-board procedures (including bunkering) although it appears that many of these instructions were either not operating or were not being fully adhered too at the time.
- 12.3 It is crucial that representatives of the ship's owner/operators ensure that the crew has a proven familiarity with the ship, especially in emergency situations. This includes the ability of the crew to fully understand the operation of shipboard equipment and systems so as to provide an adequate response to emergencies. The extent to which this responsibility was actually being met at the time of the incident by *Temburong's* shore management remains unclear.

13. Other Issues

- 13.1 The crew spent just over 4 days disposing of the dead carcasses overboard at sea.
- 13.2 On Monday, 1 February *Aya 3*, another ship operated by Rooney Shipping and Trading Pty Ltd rendezvoused with *Temburong* to transfer personnel to assist with the disposal of the livestock.
- 13.3 The Master stated that as the intended receiver of the cattle no longer wanted the remaining cattle arrangements were made to discharge the remaining livestock at Surabaya.
- 13.4 The Chief Engineer stated that there was only 3 emergency lights available in the engine room for emergency escape purposes consequently most of the work in the engine room was done using torchlight only, making conditions extremely difficult.
- 13.5 There was no evidence found to support the reported claim that the ship's electrical power systems had been disabled by a lightning strike.

14. Conclusions

- 14.1 The failure of both the primary and secondary sources of power was due to contamination of the ship's fuel supplies:
- contamination of the fuel for the primary power source was water and the contamination in the case of the secondary power source was heavy fuel oil.
- 14.2 The situation was compounded by the failure of the ship's communications systems during the incident as a result of an unexplained battery failure.
- 14.3 The serious nature of the incident was exacerbated by inadequacies on the part of the ship's personnel in their immediate response to the incident and the absence of contemporary ship management practices.
- 14.4 The severity of the incident may have been lessened had the ship's personnel been prepared to run the engine room generators without the use of fuel injector nozzle cooling or been aware that both fuel tanks were capable of being used separately for this purpose.
- 14.5 The absence of contemporary ship management practices is evidenced through:
- the failure to adequately monitor bunkering procedures
 - inadequate procedures available to ship's staff to properly oversight bunkering procedures and lack of procedures / training to activate an adequate emergency breakdown response.
- 14.6 On departure the operation and configuration of the ship's generating equipment was in accord with the prescribed regulatory requirements. However the manner of operation has raised the issue of whether the Marine Order requires redrafting so as to ensure that the meaning of a "secondary power source" is more clearly defined.
- 14.7 Whilst the fuel contamination situation was avoidable the incident has nevertheless raised the general issue of the ability of livestock vessels to recover from a dead-ship situation. Whilst the *Temburong* satisfied class and flag rules in this regard the system was shown to be particularly vulnerable when the well being of the livestock is considered.
- 14.8 Following the restoration of power the crew performed well in a most difficult situation to remove the dead cattle from the vessel.