Office of Transport Safety Investigations

FERRY SAFETY INVESTIGATION REPORT

PASSENGER FATALITY – *MV LADY ROSE*

SYDNEY HARBOUR, NSW

2 FEBRUARY 2019

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THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

The Office of Transport Safety Investigations (OTSI) is an independent NSW agency whose purpose is to improve transport safety through the investigation of incidents and accidents in the rail, bus and ferry industries. OTSI investigations are independent of regulatory, operator or other external entities.

Established on 1 January 2004 by the *Transport Administration Act 1988*, and confirmed by amending legislation as an independent statutory office on 1 July 2005, OTSI is responsible for determining the contributing factors of accidents and to make recommendations for the implementation of remedial safety action to prevent recurrence. Importantly, however, OTSI does not confine itself to the consideration of just those matters that contributed to a particular incident; it also seeks to identify any transport safety matters, which, if left unaddressed, might contribute to other accidents.

OTSI's investigations are conducted under powers conferred by the *Transport Administration Act 1988, Passenger Transport Act 1990 and Passenger Transport Act 2014.* Additionally, all OTSI publications that are considered investigation reports are also conferred by this Act. OTSI investigators normally seek to obtain information cooperatively when conducting an accident investigation. However, where it is necessary to do so, OTSI investigators may exercise statutory powers to interview persons, enter premises, examine, and retain physical and documentary evidence.

It is not within OTSI's jurisdiction, nor an object of its investigations, to apportion blame or determine liability. At all times, OTSI's investigation reports strive to reflect our balanced approach to the investigation, that properly explains what happened, and why, in a fair and unbiased manner.

Once OTSI has completed an investigation, its report is provided to the NSW Minister for Transport and Roads for tabling in Parliament. The Minister is required to table the report in both Houses of the NSW Parliament within seven days of receiving it. Following tabling, the report is published on OTSI's website at www.otsi.nsw.gov.au.

CONTENTS

TABLE OF FIGURES

EXECUTIVE SUMMARY

On the afternoon of Saturday 2 February 2019, an All Occasions Cruises vessel *MV Lady Rose* was chartered by a group of 27 passengers for a private function. During the charter, one of the passengers was noticed as missing and, following a short search, was found in an unresponsive state in a toilet cubicle on board the vessel. Emergency services were called and attended, however the passenger was unable to be revived.

Crews from the Hazmat Division of Fire and Rescue NSW were requested by NSW Police Rescue to carry out atmospheric testing in the subject toilet cubicle. The Hazmat Division confirmed that dangerous levels of a toxic gas known as hydrogen sulphide were found in the toilet cubicle.

The cruise had commenced with sewage remaining in the sullage tanks from a previous charter. During the cruise several members of the crew received complaints from the passengers regarding the presence of foul odours coming from the rear of the vessel. Some passengers were becoming increasingly ill. The master, who was made aware of the complaints approximately two hours after the first complaint, made the decision to interrupt the cruise to pump out the tanks at Bailey's Marine, White Bay.

The investigation found that it was likely the passenger was overcome by exposure to hydrogen sulphide that permeated into the toilet cubicle through a faulty waterless basin trap. This was also the opinion of a consulting Forensic Pharmacologist. The investigation also found that the sewage system design, construction, maintenance, and deficiency of applicable standards contributed to the build-up of hydrogen sulphide in the toilet cubicle.

OTSI has made a number of recommendations including;

- That maritime regulators, in consultation with industry and in collaboration with other relevant agencies, develop standards for the design, construction and maintenance of sewage systems for DCVs.
- That a suitably qualified technical assessor with plumbing qualifications is included in the inspections of these vessels.

Full details of the Findings and Recommendations of this ferry safety investigation report are contained in Parts 3 and 4 respectively.

PART 1 FACTUAL INFORMATION

The occurrence

1.1 At approximately 12:15[1] on Saturday 2 February 2019, a Charter Vessel operated by All Occasion Cruises (AOC), the Motor Vessel (*MV*) *Lady Rose (Lady Rose)* departed its home berth to take on passengers at the Casino Wharf in Pyrmont Bay. *Lady Rose* was exclusively booked by a group of 27 passengers for a four-hour cruise within the confines of Sydney Harbour.

1.2 *Lady Rose* departed the Casino Wharf at 12:30 with a crew of six. After approximately thirty minutes into the cruise, verbal complaints were made by several passengers to members of the crew about a foul odour throughout the main deck and at the stern of the vessel. For the next half hour, these odours increased and further complaints were made to the crew.

1.3 Following the serving of lunch, around 13:15, the odour was now described as '*like rotten eggs*', was becoming progressively worse. At this point several of the passengers were ill and had succumbed to vomiting. At approximately 14:50, one of the crew reported to the master the issue with the odour on the lower decks. Up to this point the master was unaware of the evolving situation as he was located on the vessel's upper deck away from the passengers.

1.4 The cruise had commenced with the port[2] and starboard sullage tanks partially full. From the levels indicated on the gauges in the wheel house, it became apparent to the master that the effluent level in the port sullage tank was rising and could possibly become full whilst the cruise was still in progress. The master then instructed the general purpose hand (GPH) to lock the port side toilets to reduce the effluent flow to the port sullage tank.

1.5 At 15:20, several members of the crew continued to receive complaints from the passengers regarding the presence of foul odours coming from the rear of the vessel. More of the passengers were becoming increasingly ill. To alleviate the odours, the master made the decision to interrupt the cruise in

1 Times in this report are in 24-hour clock form in Australian Eastern Daylight Time (AEDT).
2 Port and Starboard are nautical terms for left and right, respectively. Port is the left-hand side of or direction from a vessel, facing forward. Starboard is the right-hand side, facing forward.

order to empty the contents of the sullage tanks at the sewage pumping stations located adjacent to Bailey's Marine at White Bay.

1.6 At some point in time between 15:20 and 15:30, a passenger entered the inner starboard toilet cubicle located on the lower deck. Shortly after 15:30, passengers raised concerns with a member of the crew that this passenger was missing. A search of the vessel then commenced.

1.7 At 15:45, *Lady Rose* arrived at Bailey's Marine and the GPH secured the vessel to the wharf. Once the vessel was secure, the master and GPH connected the shore line from the sewer pump to the port sullage tank pump out connection. The master then started the shore pump to begin emptying the port sullage tank.

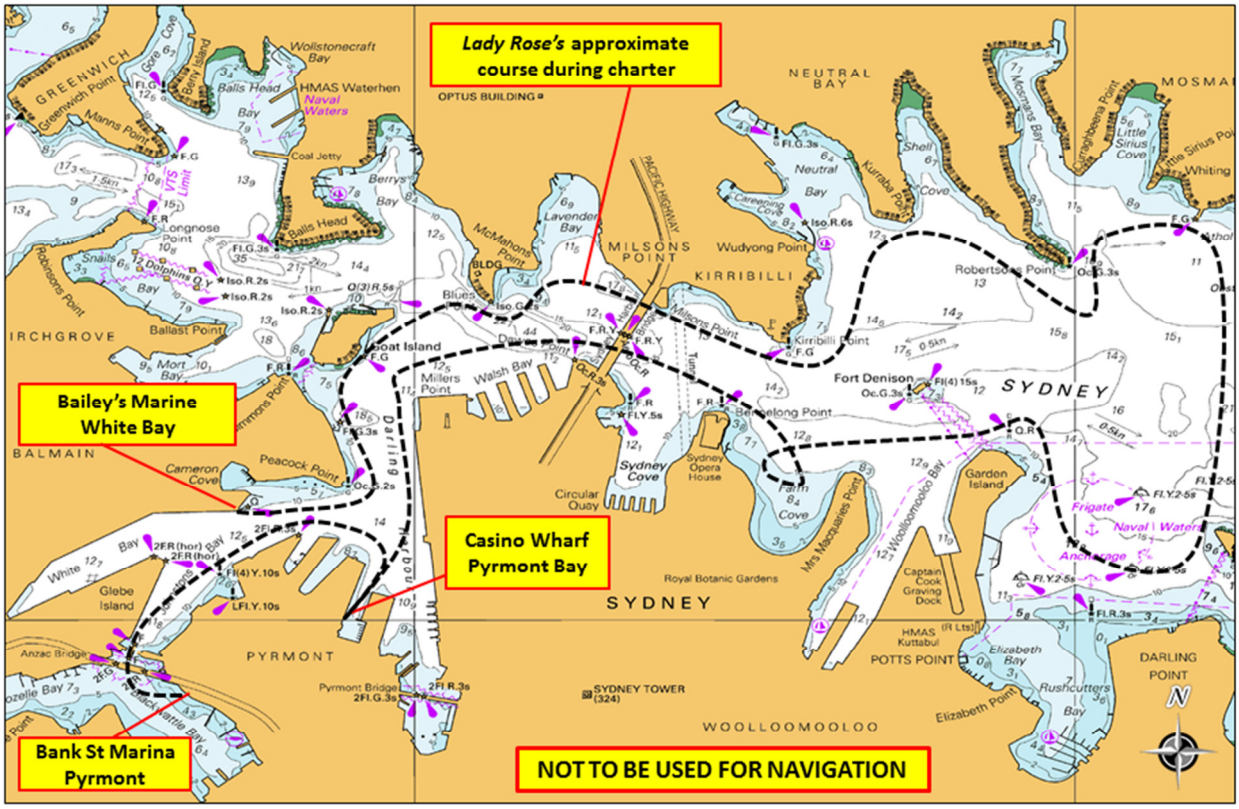
1.8 Shortly after this, the GPH began to check the toilet cubicles on the lower deck for the missing passenger. The GPH then discovered a passenger in an unresponsive state in the inner starboard lower deck toilet cubicle.

1.9 At 16:04, a call was placed to triple zero requesting assistance from emergency services. Several of the passengers, including a registered nurse, applied first aid until NSW Ambulance paramedics arrived at 16:14. Unfortunately, the passenger was unable to be revived.

1.10 NSW Police, Police Rescue, Ambulance and the Fire and Rescue's Hazmat Team responded to the site. The Hazmat Team conducted atmospheric testing and detected a known toxic gas in close proximity to, and inside the toilet cubicle.

Location

1.11 The *Lady Rose* departed its home base at the Bank Street Marina, Pyrmont prior to boarding passengers at the Casino Wharf, Pyrmont Bay. The cruise then continued within the confines of Sydney Harbour. The vessel eventually berthed at Bailey's Marine, White Bay where the passenger was discovered and emergency services attended (refer *Figure 1*).



Source: AUS200 – *Australian Hydrographic Office* – Notated by OTSI

Figure 1: Incident location and approximate course of *Lady Rose*

Environmental information

1.12 Environmental conditions at the time of the incident as recorded by the Bureau of Meteorology, Observatory Hill:

- A low tide was recorded prior to the incident at 14:28 at 0.46m. This resulted in a flood tide in progress at the time of the incident.
- The prevailing wind was from the east at approximately 10 knots with an ambient temperature of 25.0℃.

1.13 It was determined that the environmental conditions did not contribute to the incident.

Vessel information

1.14 *MV Lady Rose* is a 23.95 m aluminium catamaran-type charter vessel with an 11.04 m beam[3]. In 2001, the vessel was constructed in Queensland to the Uniform Shipping Laws (USL)[4] code. Two Caterpillar 3208TA 261 kW engines power the vessel; both are eight-cylinder diesel engines. The vessels main propulsion is through two drive transmissions attached to conventional drive shafts and propellers.

1.15 The vessel was in survey[5] with the Australian Maritime Safety Authority (AMSA)[6] issued with identification number 22273. *Lady Rose* was certified to carry 230 passengers in Class 1D and 500 in class 1E[7].

1.16 The vessel provided facilities for dining and entertainment on three decks. The two lower decks comprise both weathertight cabins and external open-air areas. The sundeck, which is the top deck, is fully open to the elements.

1.17 The lower deck has six toilet cubicles with an additional three cubicles on the upper deck. Each cubicle is fitted with a flushing toilet, a hand basin and a floor waste drain. The cubicle where the passenger was discovered was located inboard on the lower starboard deck (refer to *Figures 2 and 3*).

Source: news.com.au – annotated by OTSI

Figure 2: *Lady Rose* prior to decal changes

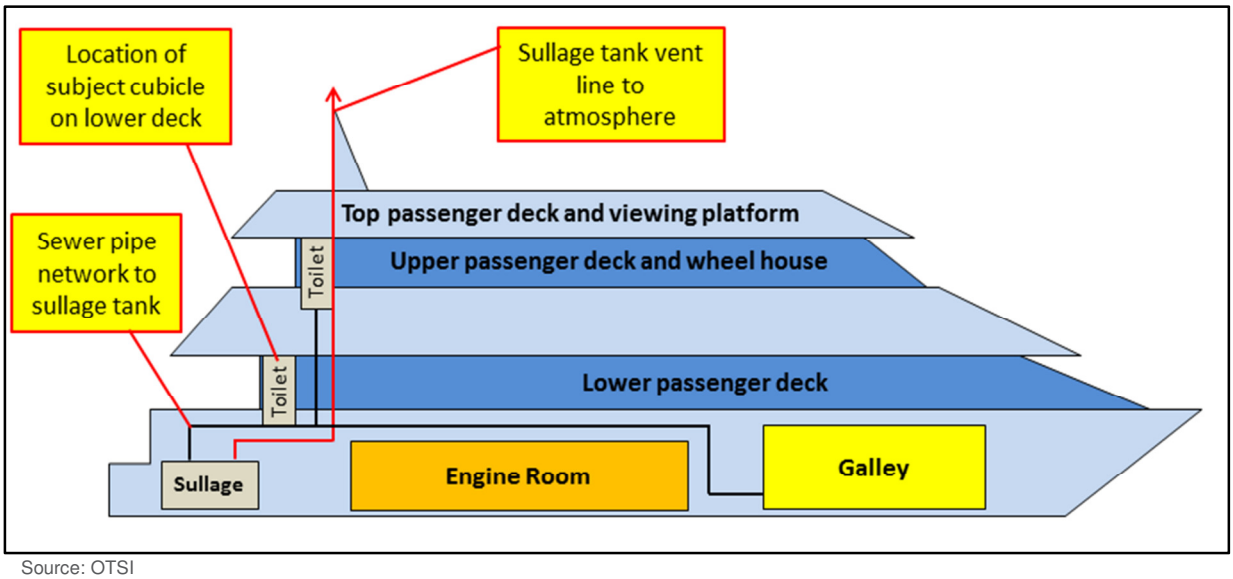
3 The beam of a vessel is its width at the widest point.
4 USL Code refers to *Uniform Shipping Laws*. The Uniform Shipping Laws provides standards for the design, construction and operations of domestic commercial vessels in Australia. The USL code was first published in 1979 in response to the need for a common national safety standard for commercial vessels.
5 A survey checks that a domestic commercial vessel is compliant with Australian laws and standards.
6 AMSA is a statutory authority and Corporate Commonwealth Entity and was established under the *Australian Maritime Safety Authority Act*. It is a legislative requirement that a domestic commercial vessel in Australia have a current survey applicable for its intended operations.
7 For an explanation of survey classes see: *https://www.amsa.gov.au/vessels-operators/domestic-commercial-vessels/vessel-classes-and-service-categories.*

Source: OTSI

Figure 3: *Lady Rose* – stern view

1.18 The toilets, basins and floor wastes emptied into two sullage tanks via a network of vapour traps and sewer pipes. The sullage tanks are located below decks in the aft lazzarette[8] and vent to atmosphere via a pipe that runs through the three decks to the masthead (refer to *Figure 4*).

1.19 Waste from the starboard and port galley areas pass through a grease separator prior to entering two 100 litre grey water tanks that then feed via two submersible pumps into the corresponding sullage tanks.



Source: OTSI

Figure 4: Side elevation showing basic layout of *Lady Rose*

8 In modern shipbuilding of most sizes, the lazzarette is the location of the steering gear equipment for the vessel. It is typically found below the weather deck in the stern of the vessel and is accessed through a hatch if accessed from the main deck or a doorway if accessed from below decks.

All Occasion Cruises

1.20 All Occasion Cruises (AOC) is a privately owned charter vessel company. AOC has been providing leisure cruises on Sydney Harbour for over 20 years. Their current fleet comprises of six vessels with passenger capacities ranging from approximately 30 to 950.

Crew information

1.21 The crew of six consisted of the master, a GPH, a cruise director, a bartender, a kitchen hand, and entertainment staff. The crew held the appropriate Certificates of Competency[9] issued by AMSA and applicable to the operation of *Lady Rose*.

1.22 The master held both a *Master less than 35m* and *Engineer Class 3* (*near coastal*) certificates of competency. He had been working on a casual basis for AOC for approximately 10 years and had operated several other vessels in the AOC fleet.

Regulatory standards

1.23 The initial survey process (initial construction) for *Lady Rose* commenced on 4 May 2001. The design approval was done in NSW and construction was inspected by the Waterways Authority in NSW up to 1 November 2001. The owner of the vessel then transferred to a Queensland Survey and a Certificate of Survey (CoS) was issued by Queensland Transport on 21 November 2001. On 23 November 2001, the owner applied for a Certificate of Recognition from the Waterways Authority[10] in NSW *(later know as NSW Maritime and Maritime Authority of NSW*), based on the Queensland Certificate of Survey.

1.24 The Certificate of Recognition authorised interstate vessels to operate commercially in NSW. This was done in compliance with the conditions and maximum passenger numbers shown on the valid interstate Certificate of Survey.

9 A Certificate of Competency issued by AMSA shows a seafarer's capability to Master a vessel and its passengers. It is a legislative requirement that masters and engineers hold a valid Certificate of Competency before they can work on a domestic commercial vessel in Australia.

10 Waterways Authority evolved into Roads and Maritime Services in 2013, and since 2019 its functions were incorporated into Transport for NSW.

1.25 At the time of construction of *Lady Rose*, the governing standard for sewage systems was the *Marine Pollution Act 1987* (NSW) which focussed primarily on environmental protection factors.

1.26 Following construction of the vessel, the Waterways Authority in NSW provided ongoing survey inspections up until they became NSW Roads and Maritime Services (RMS) in 2013. RMS was part of the NSW transport cluster and was responsible for managing the operations and programs of NSW roads and waterways. Since July 2018, AMSA assumed responsibility for service delivery of the national system. RMS remained a compliance partner of AMSA under a service level agreement carrying out compliance inspections as AMSA appointed marine safety inspectors. RMS provided AMSA with inspection reports in accordance with that agreement.

1.27 AMSA was the national marine regulator and a commonwealth statutory authority responsible for ensuring DCVs met minimum safety standards for design and operation. AMSA regulated this process through a survey inspection regime. The survey encompassed vessel design, stability, floatation, navigation and safety equipment.

1.28 Although RMS still retained the delegation for providing certificates until 30 June 2018, RMS ceased providing survey services at the end of 2017.

1.29 RMS continued to remain the waterway manager of NSW waters and as such, monitored compliance of Domestic Commercial Vessels (DCVs) on NSW waters with applicable state laws including sewage and pollution legislation.

1.30 On 21 November 2019, NSW Parliament passed legislation that enabled the full integration of Transport for New South Wales (TfNSW) and RMS into one organisation. Effective as at 1 December 2019, RMS was dissolved and its functions became the functions of TfNSW.

Related occurrences

1.32 There have been numerous case reports of human deaths after single exposures to high concentrations of hydrogen sulphide gas. Most fatal cases associated with hydrogen sulphide exposure have occurred in relatively confined spaces; the victims lost consciousness quickly after inhalation of hydrogen sulphide, sometimes after only one or two breaths. In some cases, the victims were exposed for a period of time ranging from a few minutes to an hour and were unable to be revived[11].

1.33 Death occurring after single exposures to high concentrations of hydrogen sulphide appears to be the result of respiratory failure or arrest, with most cases initially presenting with respiratory insufficiency, non-cardiogenic pulmonary oedema, coma and cyanosis[12].

1.34 International research indicates hydrogen sulphide is the second most common cause of fatal gas inhalation exposures in the workplace, after carbon monoxide. Hydrogen sulphide accounts for 7.7% of such cases[12].

1.35 An example of the effects of hydrogen sulphide in a marine environment was on a cruise ship berthed at Los Angles, California USA. In September 2005, three crew members of a passenger cruise ship were affecting repairs to a leaky pipe containing solids and liquids as resulting from food waste production. During the process of repairing the pipe, the pipe burst and released hydrogen sulphide gas into the atmosphere that the workers were breathing. The three workers in the immediate area were killed instantly. Nearby workers cried out for help, which prompted the ship's staff to administer a ship wide call for help. The ships medical staff responded without any protective gear. As a result, 19 crewmembers were taken to an emergency department at various hospitals on shore.[13]

11 *Fatal hydrogen sulphide intoxication: Report of three cases occurring in a sewer;* Arch Pathol 81:375-380, Adelson L, Sunshine I.
12 *Hydrogen Sulphide: Human Health Aspects;* Concise International Chemical Assessment Document
13 *Deaths And Illness From Hydrogen Sulphide Among Ship Workers*: Acute Communicable Disease Control 2005 Special Reports

PART 2 ANALYSIS

Introduction

2.1 On Saturday 2 February 2019, charter vessel *Lady Rose* with six crew and 27 passengers on board was chartered for a cruise on Sydney Harbour. After approximately three hours of the cruise, a passenger entered a toilet cubicle and was likely overcome by a toxic gas. The passenger was later found by a member of the crew. The passenger was found unresponsive and was not able to be revived.

2.2 The analysis section of this report explores various factors that contributed to the incident. These included:

- The actions of the crew
- Management of safety risk by the operator and regulators
- Regulatory oversight of the sewage system
- The maintenance of the vessel
- The design and maintenance of the sewage system
- The cause of the presence of hydrogen sulphide into the toilet cubicle
- Effects of hydrogen sulphide
- Regulatory standards and oversight.

Crew actions

2.3 The master said that on the morning of the incident, he carried out all of the usual pre-departure checks for *Lady Rose* and noticed that both sullage tanks had not been emptied by the previous master. He noted in the vessels log book that the sullage tank gauges showed the port side tank was at ¾ full and the starboard tank was ½ full. The log book showed that the last recorded sullage pump out was on 21 January 2019, twelve days before.

2.4 During interview, the master said that the food preparation for the cruise occurred on another AOC vessel and that this process was behind schedule. This caused a delay in his departure from the AOC wharf, hindering the possibility of decanting the sullage tanks without further delaying the

commencement of the cruise. This was also noted by the master in the vessel's logbook.

2.5 The master decided that due to the minimal number of guests expected for the cruise, the remaining capacity of the tanks would be sufficient for the duration of the four-hour charter. The master stated that it had been his experience that the port sullage tank would normally fill before the starboard. This was due to the majority of the toilets, the bar area glass washer and port galley dishwasher all connected to the port tank. He thought that he could manage the tank levels by closing off the port side toilets if required. The master had done this on previous occasions with *Lady Rose*.

2.6 As the cruise continued, several of the passengers complained to members of the crew that foul odours appeared to be emanating from the area around the stern of the vessel. The complaints were made over a period of approximately two hours before the issue was reported by the crew to the master. Up until this point the master was unaware of the situation as he had been stationed in the wheel house which is located forward and on the upper deck.

2.7 Due to the levels indicated on the sullage tank gauges the master realised that the tanks were filling quicker than he had previously anticipated. He decided that the remaining capacity of the tanks would be insufficient for the rest of the cruise. To alleviate the situation, he instructed the GPH to close the port side toilets, as the port sullage tank gauge was indicating near full.

2.8 Approximately 30 minutes later, the crew again reported to the master that the foul odours were worsening and passengers were becoming ill.

2.9 The master then contacted the owner of AOC for authorisation to decant the tanks in an attempt to alleviate the situation. The master said that whilst he had decanted tanks during previous charters, he normally avoided this process due to the additional odour and the inconvenience to the passengers.

2.10 The owner of AOC authorised the decanting of the tanks. The master then proceeded to Bailey's Marine at White Bay to draw down the sullage tanks. It had been approximately 55 minutes from when the master was made aware

of the passenger complaints, to when the vessel arrived at Bailey's Marine to decant the sullage tanks.

2.11 The GPH said that when he boarded *Lady Rose* on the day of the incident, he followed his normal allocated duties. Part of these duties was to check and clean the toilets which he carried out prior to the start of the cruise. He stated that three of the nine toilets on board were locked and that one of the port toilet cubicle basins was not functioning. The GPH said there were no unusual odours at the commencement of the cruise. However, during the latter part of the cruise he noticed '*an unbearable stench*' at the stern of the vessel.

Management of safety risk

2.12 A requirement was introduced in 2004 in the *Passenger Transport Act 1990 (NSW)*, that operators of DCV's were required to develop and implement a Safety Management System (SMS). Currently this requirement is governed by the National Law under Marine Order 504 (MO504).

2.13 The SMS supplied to OTSI by AOC for *Lady Rose* was found to be significantly non-compliant when reviewed against the requirements set out by Marine Order 504 and the International Safety Management Code (ISM). After the incident a desk top assessment of *Lady Rose's* SMS was conducted by AMSA who found 13 non-compliant items.

2.14 Significant non-compliant items included:

- *'No risk registers available within the SMS assessing the operation of the vessel.*
- *No procedure identified within the SMS for review of the onboard risk assessment when the vessel undertakes an operation that that differs from that normally undertaken.*
- *Not all shipboard procedures are identified and fully risk assessed.*
- *Follow-up procedures after a major incident or a non-conformance is not detailed within the SMS.*
- *SMS does not include documentation requirements for log book, record of incidents, communications, key activities, position and weather etc.*

- *No records of the review of the SMS within the first 3 months of each year are available on board'*.

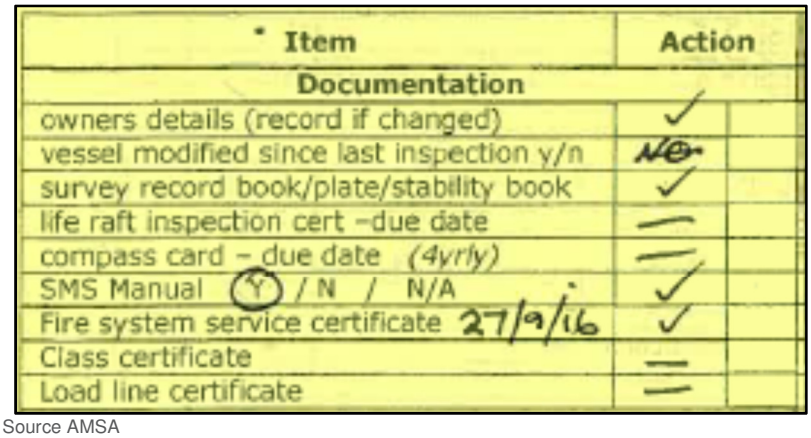
2.15 AMSA's website provides guidance for developing a SMS. It states; '*Each vessel's SMS must be tailored to reflect the size and complexity of your specific operation, as well as the risks unique to your vessel and its operation'*.

2.16 OTSI's review of *Lady Rose's* SMS found that not all procedures reflected the current operational environment. For example, the SMS included sewer decanting procedures which instructed crew to connect to shore pumps when the vessel returned to its berth. However, at their current base in Bank Street, Pyrmont, the crew were unable to pump out as there were no pumping facilities available. This was due to AOC moving from their previous base at Blackwattle Bay to Bank Street, Pyrmont in June 2018. At Blackwattle Bay there was an RMS installed sewer pumping facility, which allowed all AOC's vessels to use the facility to pump out sewage tanks at any time, including before and after each cruise.

2.17 The lack of pumps meant that the crew needed to empty the sullage tanks at the completion of a charter and prior to returning the vessel to Bank Street. Crew statements indicated that at times this was difficult due to other vessels utilising the available pumping facilities and time constraints.

2.18 Following introduction of the national law, AMSA became responsible for the standards of survey for DCV's. In NSW, RMS, as AMSA's delegate, continued to provide survey services directly to industry up until 31 December 2017. RMS accepted reports from accredited surveyors prior to this date. From 1 Jan 2018, periodic survey was carried out by the accredited private surveyors.

2.19 It was noted that a survey was completed for *Lady Rose* by an RMS surveyor on 19 October 2016. The surveyor utilised the RMS survey form known as the General Survey Checklist (SOP-CP-039). The section for the SMS was ticked in the "action" column and the "Y" was circled in the same section under documentation. Additionally; there were no deficiencies for the SMS identified in the comment section of the checklist (refer to *Figure 5*).

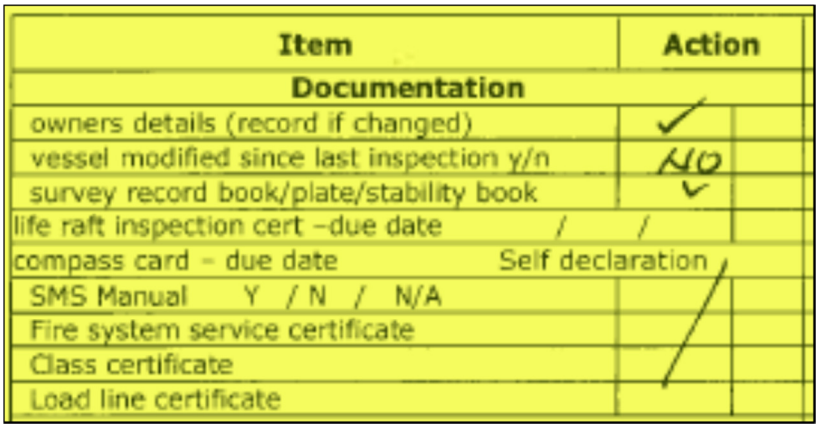


Item	Action	
Documentation		
owners details (record if changed)	✓	
vessel modified since last inspection y/n	NO	
survey record book/plate/stability book	✓	
life raft inspection cert –due date	—	
compass card – due date *(4yrly)*	—	
SMS Manual (Y) / N / N/A	✓	
Fire system service certificate 27/9/16	✓	
Class certificate	—	
Load line certificate	—	

Source AMSA

Figure 5: RMS Survey form dated 19 October 2016

2.20 The most recent survey conducted on *Lady Rose* prior to the introduction of the national law was completed by an accredited marine surveyor also utilising the RMS survey form, General Survey Checklist (SOP-CP-039). The survey was completed on 25 May 2017. An excerpt contained in *Figure 6* below indicates that the section pertaining to the SMS was not completed. There were no deficiencies for the SMS identified in the comment section of the checklist.



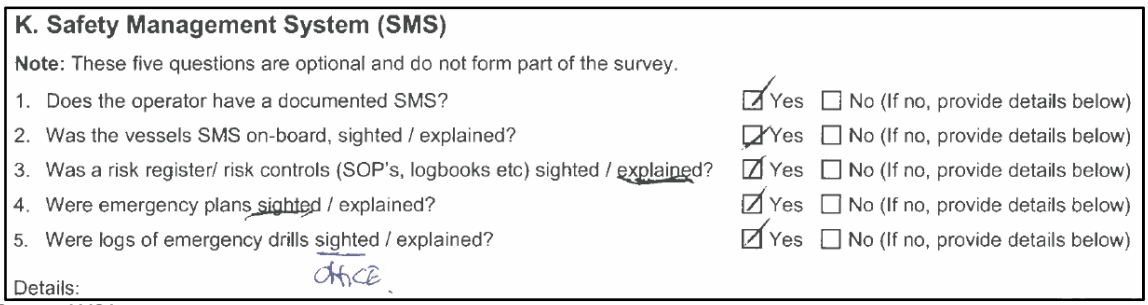
Item	Action	
Documentation		
owners details (record if changed)	✓	
vessel modified since last inspection y/n	NO	
survey record book/plate/stability book	✓	
life raft inspection cert –due date / /		
compass card – due date Self declaration		
SMS Manual Y / N / N/A		
Fire system service certificate		
Class certificate		
Load line certificate		

Source AMSA

Figure 6: RMS Survey form dated 25 May 2017

2.21 Prior to the incident, the most recent survey conducted on *Lady Rose* was conducted by an accredited surveyor utilising the AMSA form known as the Survey Report and Recommendations form. The form states; '*This form is an approved form for the purpose of S36 (Section 36) of the Marine Safety (Domestic Commercial Vessel) National Law Regulation 2013 and can be used to make a recommendation to the National Regulator in relation to a periodic/renewal survey in accordance with the requirements of the Marine Surveyors Accreditation Guidance Manual*'. Section K of the form relates to

whether an SMS was sighted on board for *Lady Rose*. The form states; '*these five questions are optional and do not form part of the survey*'. However, on this occasion, the questions were marked off which indicated the surveyor had made enquiries in relation to the SMS (refer to *Figure 7*).



K. Safety Management System (SMS)

Note: These five questions are optional and do not form part of the survey.

1. Does the operator have a documented SMS?	☑ Yes	☐ No (If no, provide details below)
2. Was the vessels SMS on-board, sighted / explained?	☑ Yes	☐ No (If no, provide details below)
3. Was a risk register/ risk controls (SOP's, logbooks etc) sighted / explained?	☑ Yes	☐ No (If no, provide details below)
4. Were emergency plans sighted / explained?	☑ Yes	☐ No (If no, provide details below)
5. Were logs of emergency drills sighted / explained?	☑ Yes	☐ No (If no, provide details below)

Details: OHCE

Source: AMSA

Figure 7: AMSA survey form dated 15 August 2018

2.22 AMSA have stated that; '*SMS Audit is not a category of accreditation (or function) of the accredited surveyors, as such section K of the form (used by the accredited surveyors) is designed to capture basic intelligence on the existence and basic elements of an SMS'.* AMSA also state*; 'AMSA routinely assesses operators' SMS. The assessment process is conducted to confirm that the vessel owner's SMS meets the requirements of MO504. It is not an audit but an assessment of the vessel owner's compliance with MO504. A SMS assessment may be conducted:*

- *As part of a high risk Certificate of Operation (CoO) new application (includes all Class 1 vessels);*
- *During a vessel inspection;*
- *Following a request by an AMSA Delegate;*
- *As part of an incident investigation'.*

2.23 A review of the SMS requirements and the associated audit processes show that the processes in place had been insufficient to ensure that the SMS is a robust document which identifies, assesses and controls risks. In particular risks associated with the inherent dangers of onboard sewage systems, such as that fitted to *Lady Rose.* This was confirmed by the assessment of the SMS by AMSA following the incident. It was also noted that since the introduction of the national law and prior to the incident, there had been no assessments of the SMS for *Lady Rose*.

Regulatory oversight of sewage systems

2.24 The build standard for *Lady Rose* at the time of construction was the USL code. The USL code contained limited requirements for the design, construction and maintenance of DCV sewage systems. The exception being ensuring that sullage tank vents and air pipes are the correct height, in good condition and do not present a downflooding risk to the vessel. This left the monitoring and inspection of sewage systems under the control of the RMS and the applicable NSW state legislations.

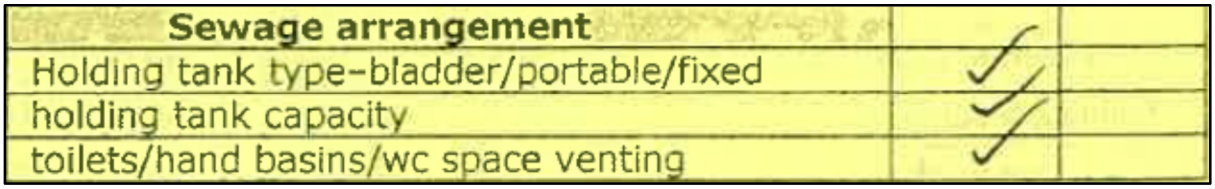
2.25 At the time of the issue of *Lady Rose's* certificate of recognition by NSW, sewage systems for DCV's in NSW were regulated by the Management of Waters and Waterside Lands Regulation NSW, which is a regulation under the *Maritime Services Act 1935 (NSW)*. This regulation was limited to basic requirements for the construction and ongoing inspection of the sewage system fitted to *Lady Rose*. The regulation stated that; '*the vessel must be fitted with a toilet that is connected to a holding tank. The toilet, holding tank and fittings must be in good and serviceable condition and that the tank must be constructed of an approved material'*. The regulation also stated that; '*the waste must only be discharged into a waste collection facility'*.

2.26 It was noted that the regulations didn't refer to any relevant standards as guidance to manage the detail of construction, testing and commissioning of onboard sewage systems.

2.27 The current NSW regulation for the sewage systems fitted to DCV's is the Marine Pollution Regulation 2014 (NSW). However, *Lady Rose* is defined in the *Marine Pollution Act 2012 (NSW)* as a 'large ship'. The Marine Pollution Regulation 2014 (NSW), Clause 11 of Part 3 states that; '*Part 3*, *control of toilet and galley wastes from vessels does not apply to large ships'*. Therefore this exempts *Lady Rose* from these requirements. TfNSW have stated '*Whilst the NSW state authority requests that the requirements of Part 3 of the Regulation are met, there is no basis for enforcement of this part of the Regulation for large ships*'.

2.28 Since *Lady Rose* has been in service, RMS and its predecessors had carried out inspections of sewage systems fitted to DCV's as a part the annual survey

process. Included in this process is the use of the RMS *General Survey Checklist (SOP-CP-039)*. The content for the inspection of the sewage arrangement in this checklist is limited to three points that do not encompass inspection of critical items of the sewage system. The inspection report only indicates that the system was inspected and does not indicate any defects where identified (refer to *Figure 8*).



Source: AMSA

Figure 8: RMS general survey checklist extract dated 19/10/2016

2.29 Review of the RMS and AMSA survey documents applicable to *Lady Rose* and DCV's in general, indicated that there were no references or acknowledgements of any applicable Australian or international plumbing standard to which a surveyor can test the adequacy and serviceability of the sewage system fitted to a DCV.

2.30 Following introduction of the national law, AMSA became responsible for the standards of survey for DCV's from 1 July 2018. AMSA have stated; '*Current National System laws (including standards) do not cover sewage systems for DCVs. Any recommendations to modify existing laws should be made to the Commonwealth Government. Compliance with the NSW Marine Pollution laws is a matter for the NSW Government. It should not be conflated with the survey process or the requirements of the National Law*'.

2.31 *Lady Rose's* last AMSA survey requirement was a year two, in-water periodic survey in September 2018. The AMSA survey report form is titled '*Survey Activity Report and Temporary Operations'*. This was commenced in August 2018 and was not completed or recommended by the accredited surveyor due to outstanding deficiencies. None of the deficiencies identified related to sewage tanks or venting. It was also noted that when the vessel was inspected by AMSA following the incident, several of the deficiencies noted had not been rectified.

2.32 It is apparent from the evidence presented that the legislations existing at the time of construction and those currently applicable (both state and commonwealth) do not adequately cover the area of DCV sewage systems. Designers, builders, maintainers and operators of DCV's need robust standards that provide guidance in the construction and maintenance of sewage systems.

Vessel maintenance

2.33 AOC's maintenance program was managed by their senior master who held a Master 4 Commercial Vessel Licence and a Marine Engine Driver 1 (MED1) qualification. The MED1 qualification allows the master to act as an engineer on a vessel with an engine rating up to 1500kW. This also allows the master to perform a range of maintenance tasks including, but not limited to, changing engine oil, engine filters, replacing drive belts, seawater pumps and other engine related repairs.

2.34 The master's role was to oversee the maintenance of the AOC fleet, including *Lady Rose*. The master carried out a range of repairs that were within his qualifications. According to AOC, major works, including plumbing repairs, were carried out by qualified tradespersons.

2.35 The master was notified of repairs required to the AOC fleet in a number of ways: verbal reports by other masters, cruise reports submitted by other masters or notes from the logbooks of each vessel.

2.36 The master and external technicians also carried out regular inspections of the vessels and performed maintenance as necessary in respect of main engines, generators, fuel pumps, water pumps, gear boxes and exhaust systems. The master kept a private diary of such maintenance that was carried out. Information supplied by AOC indicated that all repairs to toilets were carried out by licensed plumbers.

2.37 In addition, cruise reports were provided every Monday morning to the AOC operations manager. These may have identified repair requirements following cruises where AOC personnel or external repairers then carried out necessary repairs.

2.38 Maintenance and repairs were also carried out following deficiencies identified in annual in-water surveys.

2.39 AMSA specify in Marine Order 504 (*Certificates of operation and operation requirements*) that a system of regular programmed inspection and maintenance is carried out that is appropriate for the vessel, its machinery and equipment. AMSA suggest that the details of these inspections and repairs can be kept in the vessels log book. AMSA also provide examples of a planned maintenance programs for use by DCV operators.

2.40 OTSI found that AOC's maintenance program was not formally documented as per Marine Order 504. Additionally, there were no regular checks or cleaning procedures relating to the galley grease traps or sullage tanks mentioned in the SMS for *Lady Rose*.

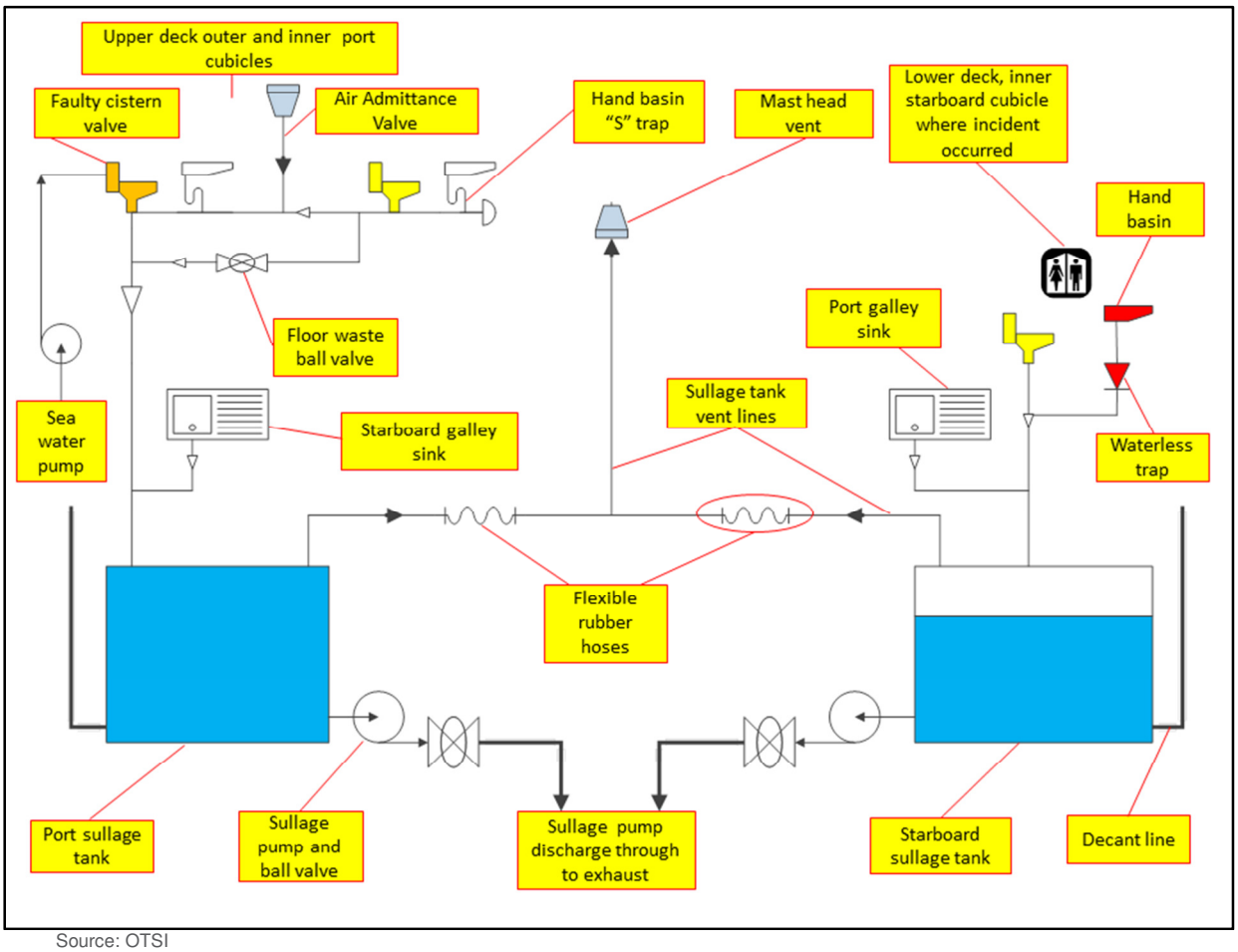
2.41 A desk top audit of *Lady Rose's* SMS was carried out by AMSA, ten days after the incident that included a review of AOC's maintenance program. This audit identified a number of deficiencies in accordance with Marine Order 504, which found that:

- *'A system is not identified and put in place for regular inspection and maintenance of vessels essential machinery and its equipment (MO504 SCH1/10*)
- *No record is available for maintenance, service or inspection of the essential shipboard machinery (e.g. sewage systems & galley waste systems) (MO504 SCH 1/10)'.*

2.42 However, since the incident and following the refurbishment of the vessel, AOC implemented a formal planned maintenance program that reflects the requirements under Marine Order 504.

Sewage system

2.43 *Lady Rose* is fitted with nine toilet cubicles in total; six are located on the lower deck with an additional three on the upper deck. Each are fitted with a flushing toilet, hand basin and floor waste drain. The schematic in *Figure 9* provides a simplified layout of the system showing only the toilet cubicles that are relevant to the investigation.



Source: OTSI

Figure 9: Simplified *Lady Rose* basic sewage system schematic

2.44 The system incorporates two sea-water pumps that feed to the cisterns of each of the nine toilets. A separate pump supplies fresh water to the nine hand basins and washing facilities in both galleys. The fresh water is stored on board in two 1,650 litre tanks.

2.45 The toilets, hand basins, galley sinks and cubicle floor wastes drain into two separate sewer manifolds that empty into the port and starboard sullage tanks. The tanks have an approximate capacity of 2,200 litres each. Each tank is fitted with a discharge pipe that connects to a camlock fitting above decks

that allows the tanks to be emptied via a shore based vacuum pump extraction system.

2.46 Inspection of the sullage tanks following the incident indicated that the tanks were fitted with an internal bracing structure and the floor of the tanks were completely flat. This, in combination with the level of the discharge outlet, likely resulted in approximately 70mm to 100mm of sewage remaining in the bottom of the sullage tanks after they were pumped out. This inspection also found a layer of a fat like substance remaining on the surface of the liquid that was still present in the starboard tank when the pumping cycle had completed.

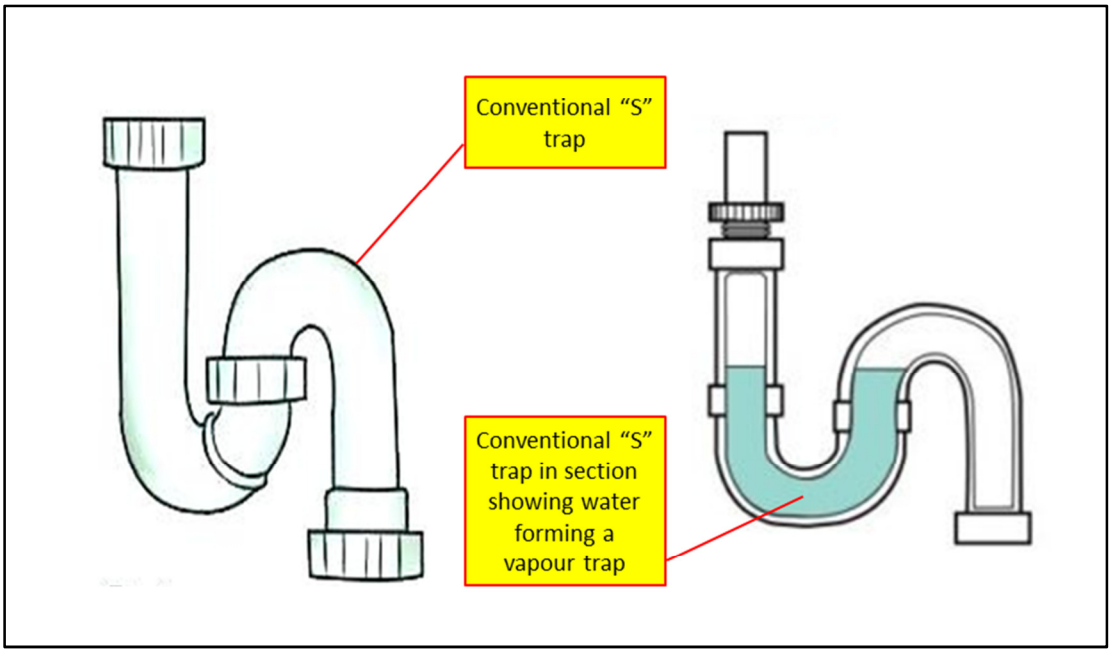
2.47 The port and starboard sullage tanks are vented to atmosphere via a network of pipes. A vent pipe runs horizontally between the two tanks which join in the centre to a vertical pipe at a three way junction. Each of the horizontal pipes had a section of flexible rubber hose fitted (refer to *Figures 9 and 12*).

2.48 The vertical vent pipe extends from a centre junction through all three decks to a pipe attached to the masthead. Normally a gooseneck pipe is attached to the pipe at the masthead to prevent foreign objects and water entering the venting system. When the vessel was inspected the gooseneck pipe was not installed and was found lying on the deck. One of the guy-wires that normally secure the masthead vent pipe was found to be broken.

2.49 When the sullage tank vent lines were tested following the incident it was found that a pipe was leaking above the bar area of the lower deck. Witness statements from the incident noted that the smell of rotten eggs and sewage was also prevalent in this area.

2.50 A list of completed works carried out on *Lady Rose* supplied by AOC following the incident indicated that the vent pipe in this area was found to be faulty and had been replaced.

2.51 The hand basins in eight of the nine cubicles were fitted with conventional tubular S traps (refer to *Figure 10)*. The waste trap fitted to the hand basin in the incident toilet cubicle was known as a waterless trap (refer to *Figure 11*). It was the only toilet fitted with such a trap. It was not known why this trap was different.



Source: www.agenpulsa.info / Annotated by OTSI

Figure 10: Conventional S traps schematic

Source: OTSI / myportal.wavin.co.uk / Annotated by OTSI

Figure 11: Waterless trap in as fitted orientation

2.52 Waterless traps, unlike conventional traps, do not rely on trapped water to create a seal to isolate sewer gases. Instead they use a self-sealing silicon membrane which performs the same function as a water seal trap without the risk of evaporation and siphonage. The investigation determined that the waterless trap installed in the incident toilet had a tear in the silicon membrane of the trap that likely allowed sewer gases to enter the cubicle.

2.53 Prior to commencing the cruise on the day of the incident, the master noted in the vessels log book that during his pre-departure checks, the sullage tank gauges indicated the port side tank was ¾ full (1,650 litres) and the starboard tank was ½ full (1,100 litres). He also noted that the log book showed the last recorded sullage pump out was on 21 January 2019.

2.54 The decision was made by the master to commence the cruise with the sullage tanks at the levels he saw when conducting pre-departure checks. The master said that he believed that the remaining capacity of the tanks would be sufficient due to the duration of the cruise and the minimal number of passengers on board. According to certification supplied for *Lady Rose,* the vessel has facilities sufficient for up to 500 passengers and crew. However, during the course of the cruise the tank levels rose quicker than the master anticipated which, along with complaints from the passengers relating to odours at the stern of the vessel, led to the decision to draw down the port side tank.

2.55 Information supplied by AOC indicated that *Lady Rose* had only operated on one occasion between 21 January and the day of the incident, however there were no log book entries to reflect this or any confirmation that the tanks had been emptied in this period.

2.56 According to AOC, the only cruise for *Lady Rose* between 21 January 2019 and 2 February 2019 occurred on 26 January 2019. The master on this occasion said that, to the best of his recollection, at the completion of the cruise the port sullage tank gauge was reading one bar above ¼ (660 litres) and the starboard two bars above ¼ (770 litres). This equates to a difference of 1,320 litres between the volumes noted on 26 January 2019 and 2 February 2019.

2.57 The master for the 26 January 2019 cruise also explained that he was unable to pump out at the three RMS facilities that are suitable for *Lady Rose* (*Bailey's Marine, King Street Wharf and Blackwattle Bay*) due to congestion. He felt that the contents of the tanks could be quickly pumped out before the next cruise. According to the master for the 26th, he did not make a log book entry as the log book could not be found on board the vessel that day.

2.58 According to RMS records, *Lady Rose* pumped out two amounts of sewage on the afternoon and night of the incident that totalled 4,278 litres. RMS records and CCTV evidence indicated that 1,753 litres were pumped from the port tank which commenced shortly after *Lady Rose* arrived at Bailey's Marine. According to statements made by the master, a request was made by emergency services later on the night of the incident to draw down the starboard sullage tank in order to reduce the vapours suspected to be coming from the tank. RMS records indicated that at total of 2,525 litres was pumped out from *Lady Rose* between 22:27 and 22:59.

2.59 Approximately an hour following the completion of pumping out the starboard tank, the master boarded *Lady Rose* to relocate the vessel under supervision of the NSW Police Marine Area Command (MAC) to their wharf located at Balmain. During interview, the master said that when he entered the wheel house, the port sullage tank high-level alarm was sounding and the indicator panel was showing full. The indicator panel also showed the starboard tank as half full.

2.60 The sullage tank levels that the master observed when reboarding the vessel approximately reflected those observed when *Lady Rose* arrived at Bailey's Marine. Given this observation, it is likely the total of the two amounts of sewage that were pumped from the vessel since arriving at Bailey's Marine approximately equated to the amount of liquid that re-entered the two sullage tanks.

2.61 Due to the circumstances surrounding the fatality, the incident was now the subject of an investigation by the MAC. A professional plumber was contracted by the MAC as a subject matter expert to inspect the sewage system on board Lady Rose. During this inspection the contracted MAC plumber identified the cistern flushing valve of the upper outer port side toilet was faulty allowing a continuous flow of water to bypass the valve and enter the port sewage system.

2.62 It is likely that the volume of liquid that re-entered the sullage tanks had originated from the sea-water pumps that supply water to the faulty toilet cistern. On the afternoon and night of the incident, the pumps had a

continuous supply of power from the two generators that were left running to supply power to the vessel. It was also noted that during this period the passengers and crew had disembarked and no one was on board other than emergency services. Therefore, the faulty cistern was most likely the only supply of water into the sewage system.

2.63 Given the duration of the cruise, the pre-existing sullage tank levels and the likely flow of water from the faulty cistern valve, it would be reasonable to conclude that the port sullage tank had completely filled prior to *Lady Rose* reaching the pump out station.

2.64 According to a statement made by the master to the MAC during a video interview on the night of the incident, the port sullage tank was already '*chockers full*' when the vessel arrived at the Bailey's Marine pump out station.

2.65 A list of rectification works supplied by AOC that were carried out on *Lady Rose* following the incident stated the '*sullage tank gauges on the bridge showed incorrect readings*' and were replaced. An improvement notice issued to AOC by AMSA on 11 February 2019 (A01752) also listed the sullage tank gauges as *showing incorrect readings*.

2.66 During an inspection of the sewage system, the contracted MAC plumber found that a flexible hose fitted to the horizontal sullage tank vent pipe had sagged approximately equivalent to the outer diameter of the hose. The hose was supported by a piece of cord tied to a bundle of electrical cables above it (refer to *Figure 12*).

2.67 The contracted MAC plumber disconnected this length of rubber hose from the vent pipe near the connection to the top of the starboard sullage tank. He noted that a large quantity of effluent was present inside the hose. He was of the opinion that the liquid trapped in the sag in the hose would form a vapour blockage that '*would stop the flow of air'* from the starboard tank, through the vent pipe and to the mast head vent to atmosphere.

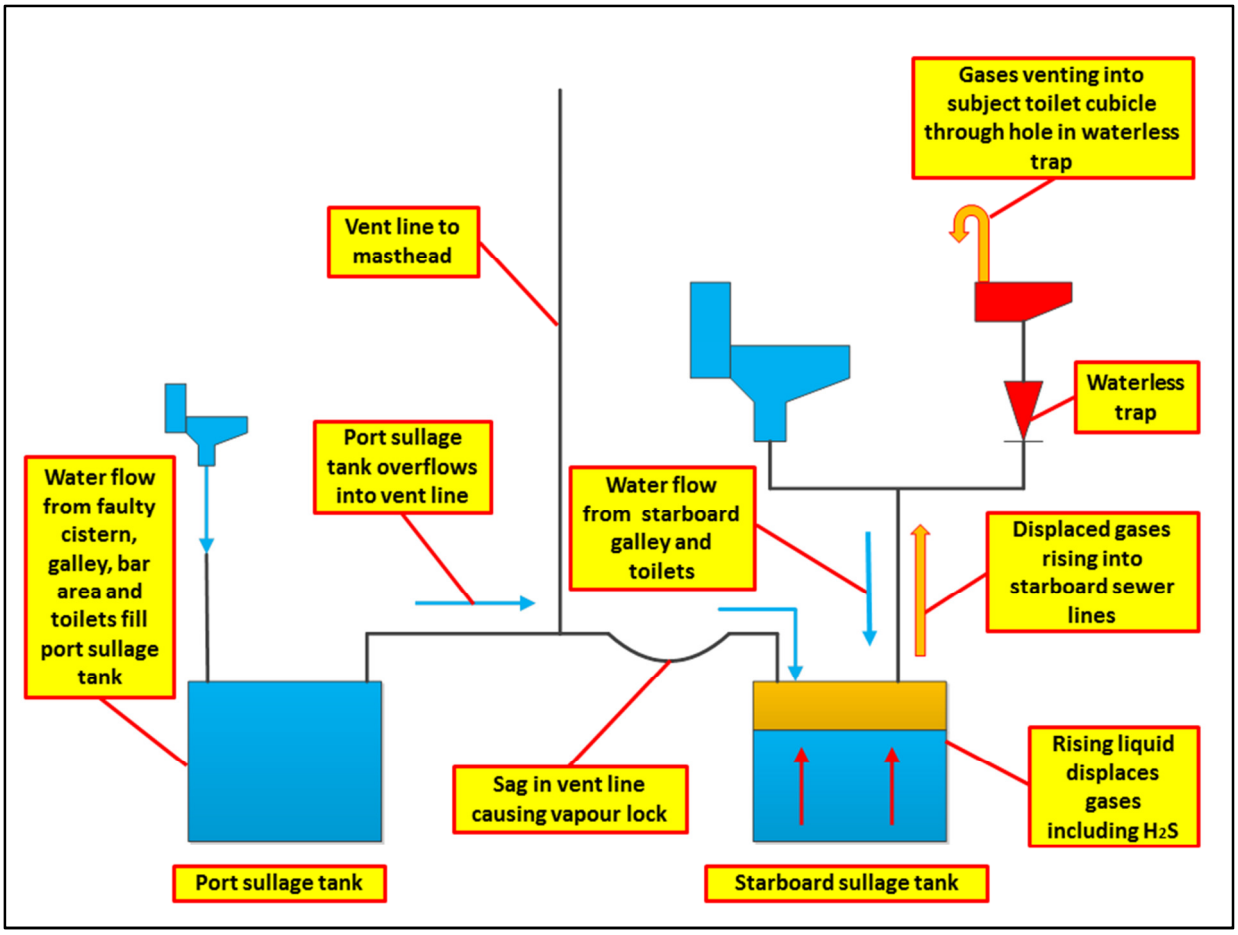
2.68 A plumber was engaged by AOC and their insurers as an independent expert to advise on matters relating to the sewage and plumbing system on board *Lady Rose*. The AOC plumbers observations in relation to the flexible hose

fitted to the vent line were; '*Adequate clamping and support of flexible piping systems is required to prevent sagging of flexible piping elements and to ensure adequate fall is provided on the flexible piping, which may otherwise impede the proper operation of the sanitary plumbing system if adequate support is not provided*'.

2.69 It is likely that the liquid observed within the rubber hose originated from the port sullage tank due to the tank overflowing from the faulty cistern valve. With the inflow of liquid from the port tank via the vent line and the starboard toilets and galley, it is likely that the available air space in the starboard tank was reduced. As the normal pathway for the sewer gases was impeded by the blocked tank vent line, it is likely that sewer gases from the tank were forced into the main starboard sewer network (refer *to Figures 13 and 14*).

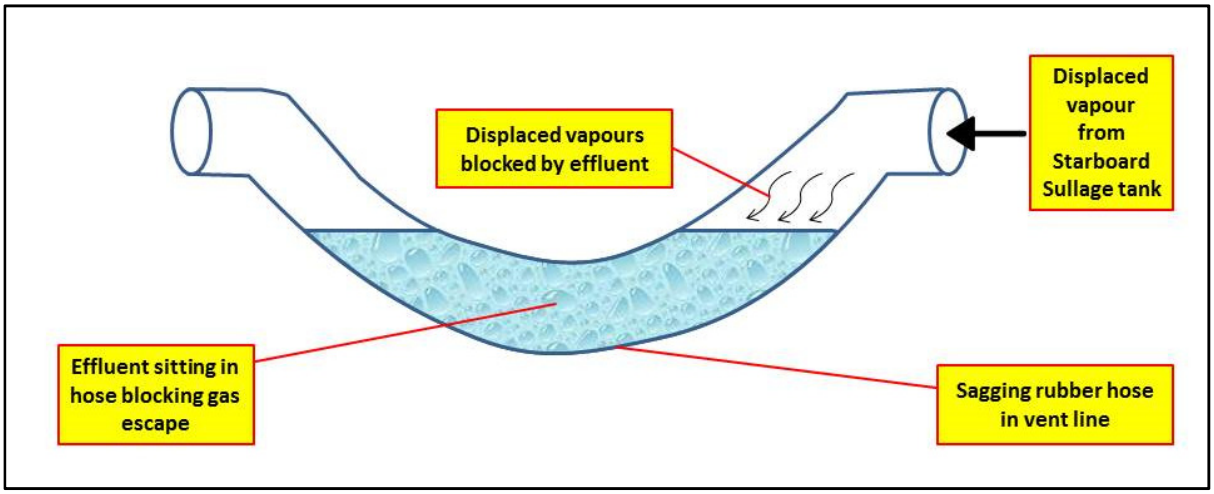
Source: MAC

Figure 12: Chord securing rubber hose fitted to vent line



Source: OTSI

Figure 13: Simplified sewage system diagram



Source: OTSI

Figure 14: Vapour lock caused by sagging vent line

2.70 Ordinarily the path of the displaced gases would be prevented from entering into the toilet cubicles due to the S traps fitted to the basins and toilets in each of the cubicles. In the subject cubicle this flow would have normally been controlled by the waterless trap fitted to the basin.

2.71 Following the incident, the waterless trap fitted to the hand basin in the incident cubicle was removed for inspection by the contracted MAC plumber. It was found that the upper edge of the silicon membrane was damaged with a tear approximately 6mm in length. This tear would likely allow sewer gases to bypass the membrane and enter the cubicle (refer *to Figures 16, 17 and 18*).

2.72 The contracted MAC plumber, under the supervision of the MAC and recorded by NSW Police Force Forensic Imaging Section, conducted a re-enactment to, as close as possible, replicate the circumstances on the afternoon of the incident. The re-enactment showed that it was highly likely that vapours from the sullage tank would enter the toilet cubicle via the hole in the waterless trap.

2.73 AOC stated that to the best of their recollection, the waterless trap in the subject cubicle was replaced in October or November of 2018. The date indicator on the waterless trap showed a manufacturing date identification of July 2010 as confirmed by the OEM (refer to *Figure 15*).

2.74 Service information from the manufacturer of the waterless trap specific to life expectancy states: '*Installed correctly can be expected to have a life expectancy at least equivalent to current water sealed traps. In addition, HepvO is guaranteed against defects in materials or manufacturing for a period of three years'.*

2.75 The contracted MAC plumber was of the opinion that the waterless trap was not fit for the application. He said; '*I would not use of this type of trap in a public facility or commercial survey vessel due to common instances of foreign articles placed down the drain'*. This was evident during the removal and inspection of the trap as he also states; '*when I removed the trap from the starboard inboard cubicle, I noticed it was a waterless trap. I immediately*

noticed it was partially blocked with debris and a hairpin. I also noted a ¼ inch tear in the silicon membrane'.

Source: OTSI

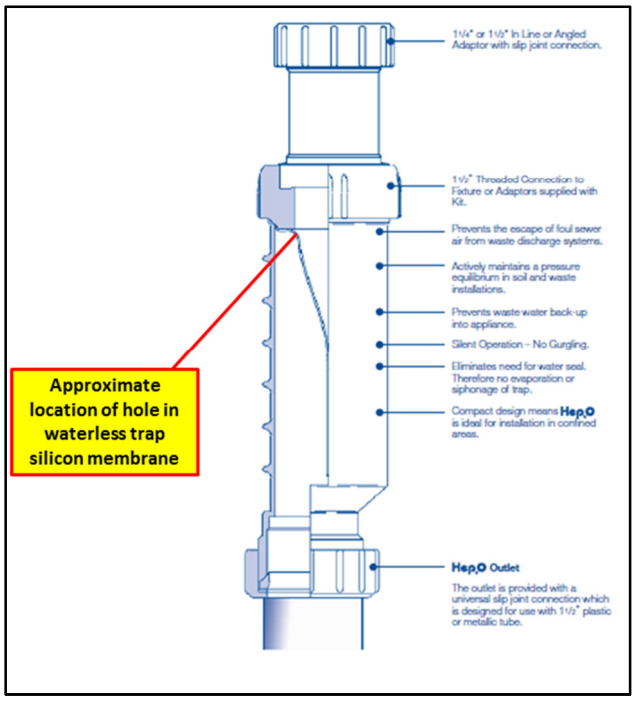
Figure 15: Manufacture date stamp on waterless valve

Source: OTSI

Figure 16: Location of waterless trap behind basin pedestal

Source: OTSI

Figure 17: Tear in waterless trap sealing membrane

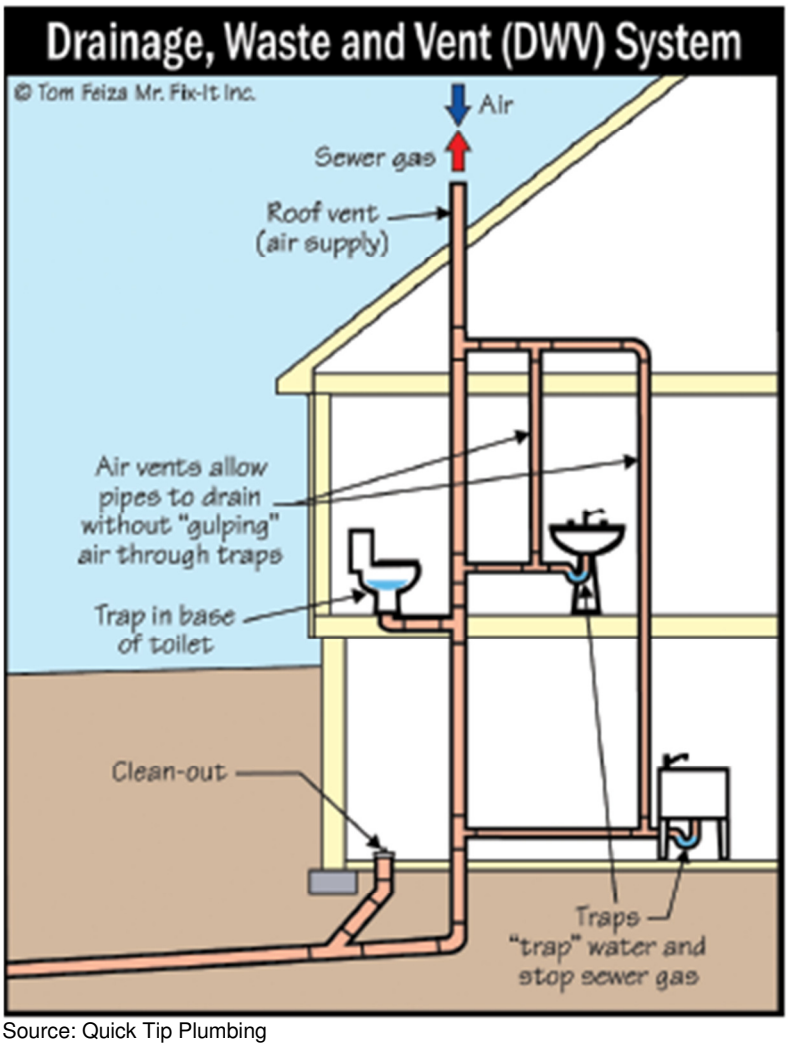


Source: Wavin Limited - HepvO US Technical Design Guide - Oct18 – Annotated by OTSI

Figure 18: OEM diagram of waterless trap

2.76 In land-based plumbing systems, a drain waste vent is part of a system that allows air to enter a plumbing system to maintain proper system air pressure to enable the removal of sewage and greywater from a dwelling. As water flows in the system, proper venting is required to avoid a vacuum from being created and depleting water in basin and toilet traps. Air must be allowed into the waste pipe either through a roof vent, or an Air Admittance Valve (AAV).

2.77 The schematic in *Figure 19* shows a simple land-based layout for the venting of sewer gases and the inlet of fresh air to avoid displacement of water in S type water traps. When compared to the schematic in *Figures 9 and 13*, the system on board *Lady Rose* lacked the ability to vent gases from within the sewer line system. The configuration of the starboard side system did not allow air into these lines to avoid possible depletion of water from within S type traps when toilets are flushed.

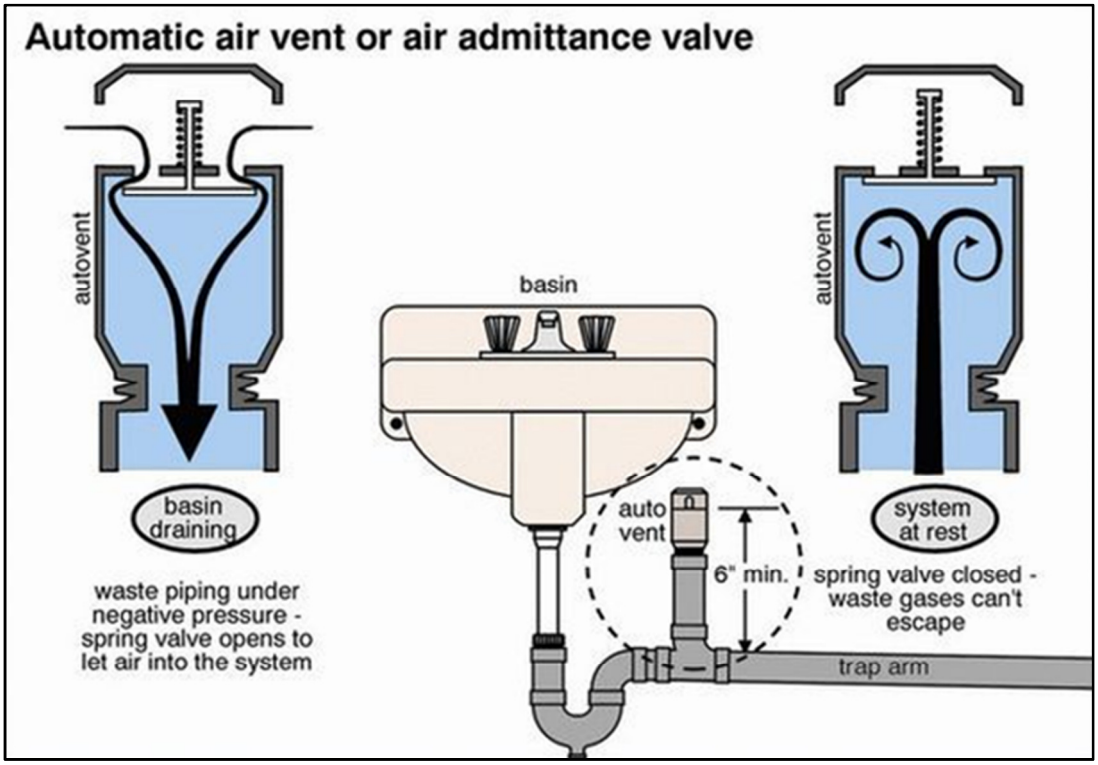


Source: Quick Tip Plumbing

Figure 19: Simple domestic sewer venting arrangement

2.78 The exception to this is the AAV fitted to the sewer line joining the two toilets on the upper portside deck (refer to *Figure 9*). It is likely the AAV was installed sometime after *Lady Rose* was constructed to alleviate what was most likely an odour problem with these toilets due to line vacuum caused by the flushing of the toilets.

2.79 The AAV fitted to the upper portside sewer line provided venting to the six portside toilets. This one-way valve addresses vacuum in the drainage system created when a toilet was flushed. This prevented vacuum from drawing water from the conventional S traps which could allow sewer gases to bypass the trap (refer to *Figure 20*).



Source: Pinterest

Figure 20: AAV Schematic

2.80 Inspection of the starboard toilet system noted that the sewer pipe network and toilets did not have an AAV fitted. It is likely that the lack of an AAV, or adequate venting to atmosphere, led to the water partially draining from the S traps fitted to the starboard cubicle basins thus allowing sewer gases to enter the toilet cubicles. According to a statement made by the contracted MAC plumber, '*This air admittance valve was the only form of venting on the pipe work on the entire vessel*'.

2.81 According to a statement made by the contracted MAC plumber, the type of AAV fitted to the vessel has the capacity to '*vent up to 1000 fixture units [toilets] making it suitable for venting a stack system up to 10 stories high*' and was beyond the requirements for this application. He also stated that the installation method and application of the AAV did not comply with applicable land-based plumbing Australian standards (*AS/NZS 3500.2003*) and may have been fitted after the vessel's initial build.

2.82 The location of the AAV also likely created an additional hazard as it vented to an enclosed space. A potential failure of the valve may allow sewer gases to enter the toilet cubicle creating a hazardous environment.

2.83 A review of the passenger and crew accounts of the cruise indicated that the presence of rotten-egg smell (hydrogen sulphide), whilst strongest in the subject cubicle, appeared to also be present in the remaining starboard toilet cubicles. The fitment of the AAV to the port side sewer system most likely explains why the passenger statements indicated a lower intensity of foul odours in the portside toilets.

2.84 From these witness accounts and the fact that hydrogen sulphide is a heavier than air gas, it is likely that the vapours from the sullage tanks had also bypassed the depleted vapour traps of the other starboard toilet cubicles; most likely, via the basin S traps.

2.85 All of the toilet cubicle doors were fitted with two louvered fresh air vents approximately 75mm in diameter on the upper and lower edges of the doors. The vents rely on external airflow and temperature differentiation to create fresh air supply into the cubicles. None of the cubicles were fitted with mechanical ventilation.

2.86 Hydrogen sulphide levels recorded on the night of the incident, and during the MAC re-enactment, rose significantly whenever the doors of the cubicles were closed indicating that it was likely that the existing ventilation was insufficient to provide adequate air transfer into the cubicles.

2.87 The sewage system on *Lady Rose* consisted of components that are normally used in land-based plumbing applications. However the vessel's design layout

differs greatly when compared to typical land-based applications. Land-based applications are required to comply with Australian plumbing standards, for example AS/NZS 3500.2003. Currently and at the time of construction of the vessel, there are limited marine standards applicable to the design, construction and maintenance of DCV's plumbing systems.

2.88 The contracted MAC plumber made an assessment of *Lady Rose's* plumbing system and its maintenance in accordance with land-based Australian plumbing standards (AS/NZS 3500.2003) due to the lack of an equivalent marine standard. This included the use of components, their applications and maintenance in this installation.

2.89 The contracted MAC plumber stated that overall the sewage system installation and standard of repairs were poor and not in accordance with what would be relevant domestic standards. The report stated:

- '*The toilet pan in the subject cubicle was not properly secured, having a section of floor tile fitted between the toilet pan and the floor. This installation would potentially allow sewer gases to enter the cubicle*
- *The vent line that ran between the starboard and port sullage tanks that joined to the vertical vent pipe were installed with no fall to allow liquid to drain back into the tanks*
- *Additionally, repairs had been carried out on these lines with a flexible pipe that was not fit for purpose. The line also sagged due to lack of supporting brackets, which allowed liquid to accumulate in the pipe effectively blocking vapours flowing into the vertical vent pipe*
- *In my opinion there was a total lack of maintenance regarding clearing this waterless trap. I make this opinion because there was a fair build-up of hair and soap scum which in my experience would occur over years*
- *On the portside upper deck I noticed that the maintenance was at a lower level. I noted a poor choice of materials used in the portside outboard cubicle and noticed that these materials had also been*

incorrectly installed. This to me demonstrated that the work had been carried out by unqualified personnel'.

2.90 A statement made by the AOC vessel master who was responsible for the maintenance of the AOC fleet indicated that when they were based at Blackwattle Bay, checks and cleaning of the galley tanks occurred every two weeks to once a month in the busy season. He defined the busy season as between September and April. In less busy times the frequency of checks is reduced. He also said that about four or five years ago, a plumber had inspected and cleaned the starboard sullage tank; however, since this inspection the tank had not been checked or cleaned.

2.91 When the starboard sullage tank was inspected following the incident, a heavy layer of grease and or fat was floating on the surface of the liquid. It appears that the layer has been there for some time due to its thickness. The layer most likely appears to have originated from the starboard galley area via the galley grey water tank.

2.92 A Prohibition Notice (A02451) was served by AMSA on 11 February 2019 against AOC. The notice contained two items relating to the condition of the interior of the '*black and grey water'* tanks fitted to *Lady Rose*. The notice stated; '*the black and grey water tanks port and starboard to be emptied and cleaned of accumulated grease layer*', and '*the galley bilge system to be cleaned and grease trap to be reinstated as per the applicable standards and certified by a licenced plumber with report provided to the satisfaction of AMSA'*.

2.93 Additionally, there are no regular checks or cleaning procedures relating to the galley grease traps or sullage tanks mentioned in the SMS for *Lady Rose*. This was also highlighted in a Direction Notice given to AOC by AMSA on 12 February 2019. The notice stated; '*not all shipboard procedures are identified and fully risk assessed within the SMS (e.g.: handling of black water & risks associated with the faulty sanitary equipment & transferring galley's sump tanks) (MO504 SVH 1/7)'* and '*no record is available for maintenance, service or inspection of the essential shipboard machinery (e.g.: sewage systems & galley waste systems) (MO504 SCH1/10)'.*

Hydrogen sulphide

2.94 Hydrogen sulphide is a chemical compound with the chemical symbol of H_2S. It is a colourless, poisonous, flammable, corrosive chalcogen hydride gas with a characteristic foul odour of rotten eggs[14].

2.95 Hydrogen sulphide is slightly heavier than air and may accumulate in enclosed, poorly ventilated, and low-lying areas[15] . It is produced naturally and also as a result of human activity. Natural sources include non-specific and anaerobic bacterial reduction of sulphates and sulphur containing organic compounds. Hydrogen sulphide is also found naturally in crude petroleum, natural gas, volcanic gases, hot springs and groundwater. It is released from stagnant or polluted waters and manure or coal pits[16].

2.96 Hydrogen sulphide is also often produced from the microbial breakdown of organic matter in the absence of oxygen, such as in swamps and sewers; this process is commonly known as anaerobic digestion[17], which is achieved by sulfate-reducing microorganisms.

2.97 Inhalation is the major route of hydrogen sulphide exposure. When inhaled, the lungs rapidly absorb the gas and which also affects the nose and throat. Low concentrations (50 ppm) can rapidly produce irritation of the nose, throat, and lower respiratory tract. Pulmonary manifestations include cough, shortness of breath, and bronchial or lung haemorrhage[18].

2.98 The typical rotten-egg smell of hydrogen sulphide is often an inadequate warning indicator of exposure. Hydrogen sulphide levels between 150ppm to 250ppm may cause acute paralysis of the olfactory nerve[19] after only a few inhalations. The sense of smell then quickly disappears, often together with the awareness of danger. This may lead to loss of consciousness at relatively low level doses[20].

14 *Chemistry of the Elements* (*2nd Ed.);* Butterworth-Heinemann. Greenwood, Norman N. Earnshaw, Alan
15 *Hydrogen Sulphide* (*H_2S*) CAS 7783-060-4; UN 1053 *Concise International Chemical Assessment Document*
16 *Hydrogen Sulphide* (*H_2S*) CAS 7783-060-4; UN 1053 *Concise International Chemical Assessment Document*
17 Anaerobic digestion is a collection of processes by which microorganisms break down biodegradable material in the absence of oxygen.
18 *Hydrogen Sulphide* (*H_2S*) CAS 7783-060-4; UN 1053
19 The olfactory nerve is the first cranial nerve and conveys special sensory information related to smell. It is the shortest of the cranial nerves and passes from its receptors in the nasal mucosa to the forebrain. It enters the skull through the cribriform plate of the ethmoid bone.
20 *Hydrogen Sulphide Poisoning: A Case Report of Quadruple Fatalities;* JPAFMAT 2008; 8(1). ISSN 0972-5687

2.99 The respiratory effects of exposure to very high concentrations of hydrogen sulphide can result in respiratory arrest and/or pulmonary oedema. Numerous case reports suggest that these effects can occur after a brief exposure to hydrogen sulphide. The neurological effects of a brief exposure to very high concentrations of hydrogen sulphide can result in unconsciousness[21].

2.100 Case reports involving overexposure have documented a variety of central nervous system transitory symptoms, such as dizziness, nausea, headache and others more long-acting such as abrupt physical collapse, all of which have been attributed to direct effects of hydrogen sulphide on the brain. Prolonged unconsciousness can lead to respiratory failure, hypoxia and death. Levels associated with collapse are estimated to be in the range of 500ppm to 1,000ppm. Levels associated with pulmonary oedema have been estimated to be in the range of 250ppm to 500ppm (refer to *Figure 21*). Measurements taken by Fire and Rescue NSW (FRNSW) on the night of the incident indicated levels of hydrogen sulphide reached 227ppm.

214 OCCUPATIONAL MEDICINE

Table 1. Effects of H_2S on humans[a]

Hydrogen sulphide levels (p.p.m.)	Effects
0.003–0.02	Odour threshold
50	Eye and respiratory irritation
150	Olfactory nerve paralysis
250	Exposure may cause pulmonary oedema
500	Anxiety, headache, ataxia, dizziness, stimulation of respiration, amnesia, unconsciousness
750	Quickly unconscious; death without rescue
1000	Rapid collapse; respiratory paralysis leading to death
5000	Immediate death

[a]Adapted from Fuller and Suruda [1] and other sources [3,6].

Source: Occupational Medicine Case Report 2011

Figure 21: Inhalation effects of hydrogen sulphide

2.101 Several eyewitness accounts have identified physical symptoms of the passenger that are consistent with a high-level exposure to hydrogen sulphide. This also was the opinion of a consulting Forensic Pharmacologist engaged by the MAC. Estimates of the period of time that the passenger was

21 *Hydrogen Sulphide: Human Health Aspects; Concise International Chemical Assessment Document*

unaccounted for vary from between 17 to 44 minutes. At some stage during this period, the passenger had entered the toilet cubicle.

2.102 The investigation has found that when the sullage tanks were previously decanted, fluid and organic matter remained in the bottom of the tank. A layer of fat has also formed above this fluid level. According to statements made by AOC staff the sullage tanks have not been cleaned for a period of four to five years. It is likely that the resultant layer of solids floating on the surface of the liquid remaining in the tank created an environment conducive to an increased level of production of hydrogen sulphide.

2.103 *'In wastewater, varieties of aerobic bacteria metabolize organic materials to smaller molecules such as sulphates, ammonia, methane, carbon monoxide, and exude acidic by-products. Bacterial decomposition and organic decay may be facilitated by formation of a protective slime biofilm. Where the wastewater flow is swift, the biofilm layer is relatively thin. However, where the flow is slow or stagnant, a thick biofilm layer a quarter of an inch deep or more may form. The biofilm may be considered a gelatinous organic matrix consisting principally of a polymeric coating of sugars (polysaccharides). The film is produced when bacteria attach to a surface. Biofilms entrap nutrients and provide an optimum microenvironment for bacterial growth and reproduction'*[22].

2.104 The investigation found that the sullage tanks remained partially full for a period of seven days prior to the charter on the day of the incident. This was due to the master of the previous charter leaving sewage in the tanks at the completion of a charter.

2.105 Hydrogen sulphide is also highly water soluble; approximately 10 times more than carbon dioxide, so unstirred water can often contains large quantities. When the water is disturbed, the dissolved hydrogen sulphide can quickly enter the gaseous phase and form a lethal cloud, generally referred to as a soda-can effect[23].

22 *Hydrogen Sulphide And Microbiologically Influenced Corrosion Of Concrete, Steel And Ductile Iron In Waste Water Facilities*
23 *Airborne occupational hazards in sewer systems:* Amy Forsgren / Kristina Brinck.

2.106 It is likely that on the afternoon of the cruise the influx of effluent, along with the movement of the vessel, has resulted in the disturbance of the existing effluent in the starboard sullage tank. This fluid movement has likely to have contributed to the release of hydrogen sulphide into the remaining air space of the tank.

2.107 During the cruise several passengers reported to the crew overwhelming rotten egg-like smells, especially near the stern of the vessel. A number of passengers reported that they could only use the toilet by holding their breath, while a friend held the cubical door open. Other passengers also reported having breathing difficulties, headaches and some became ill after using the toilets. These symptoms are consistent with exposure to hydrogen sulphide[24].

2.108 When emergency services attended the incident following the discovery of the passenger, they also raised concerns in relation to the smell of rotten eggs in the general vicinity of the lower rear deck area around the toilet cubicles. The rotten-egg smell is often associated with the presence of hydrogen sulphide.

2.109 Initial testing carried out by NSW Police Rescue during the incident response indicated low levels (less than five parts per million [ppm]), of hydrogen sulphide in the toilet cubicle where the passenger was found. NSW Police Rescue personnel had carried out the tests with a handheld test gas detector held at chest height with the door of the cubicle in the open position.

2.110 NSW Police Rescue requested assistance from the FRNSW to measure the levels of hydrogen sulphide on board the vessel. FRNSW carried out further testing of the toilet cubicle with the gas analyser placed on the floor with the door in the closed position. The test ran for a period of thirty minutes.

2.111 After a short period, FRNSW's readings for hydrogen sulphide reached 178.8 ppm. They also noted the presence of low levels of Volatile Organic Compounds (VOC).[25] FRNSW continuously monitored and recorded the gas levels every five minutes for the next thirty minutes. During this time

24 *Hydrogen Sulphide: Human Health Aspects*; Concise International Chemical Assessment Document

25 Volatile organic compounds (VOCs) VOCs are a group of carbon-based chemicals that easily evaporate at room temperature. Many common household materials and products, such as paints and cleaning products, give off VOCs. Common VOCs include acetone, benzene, ethylene glycol, formaldehyde, methylene chloride, perchloroethylene, toluene and xylene. Different VOCs have different health effects, and range from those that are highly toxic to those with no known health effect. Air toxics are pollutants that are usually present in ambient air in relatively low concentrations, but have characteristics such as toxicity or persistence that make them hazardous to human, plant or animal health

dangerous levels of hydrogen sulphide were recorded, the highest of which was 227.7 ppm.

2.112 It is likely that the hydrogen sulphide levels measured on the night of the incident would have been less than those suffered by the passenger. This was likely due to a number of factors; the duration and number of times that the toilet cubicle door was opened, the height above the floor that the measuring devices were held in the initial testing, the pumping of the sullage tanks and the inflow of water from the faulty cistern diluting the concentration of sewage in the tanks.

2.113 The MAC also conducted tests on the sewage system attached to the starboard sullage tank to ascertain the possible path for sewage vapours to enter the subject cubicle. The tests indicated that it was possible for this to occur.

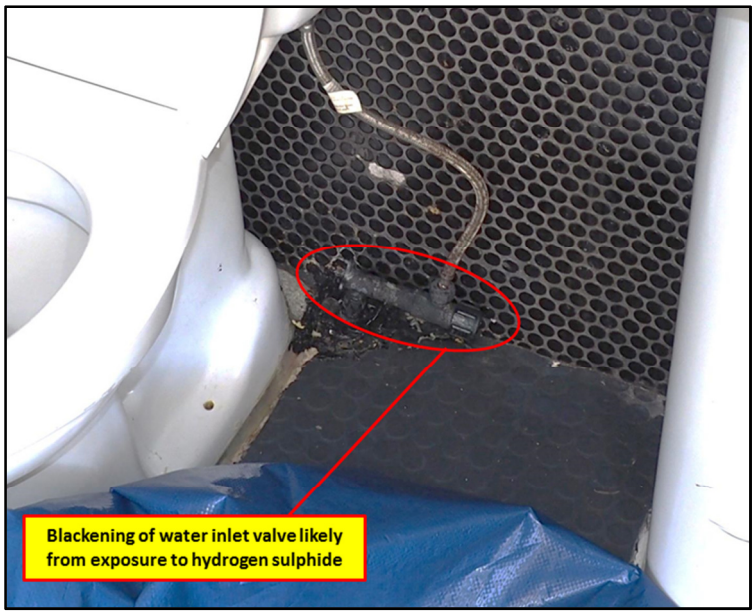
2.114 Hydrogen sulphide is also an acidic gas, provoking acid corrosion. The water inlet valve and flexible hose that supply water to the incident toilet cistern exhibited surface discoloration consistent with the corrosive effects of prolonged exposure to hydrogen sulphide. This corrosive effect was only observed in the incident toilet cubicle (refer to *Figure 22*).

2.115 The corrosion effect on the water inlet valve and hose was observed to decrease in elevation above the floor level. This is consistent with the fact that hydrogen sulphide is a heavier that air gas and naturally settles at floor level. The door aperture to the toilet cubicle also does not extend to floor level as the rear bulkhead forms a coaming that extends to approximately 50mm above floor level.

2.116 It is likely that the coaming created a barrier preventing the gas from escaping the toilet cubicle. This allowed the hydrogen sulphide entering the cubicle from the leaking toilet pan collar and defective waterless trap to pool around the water inlet valve causing the metal to corrode. Additionally, the height that the vent fitted to the door of the cubicle also likely contributed to the pooling effect of the gas.

2.117 *Figure 23,* shows a sample of the corrosion observed in the remaining toilet cubicles. The corrosion in these cubicles is likely to have originated from exposure to salt water and or urine and is green / blue in colour.

2.118 '*In some investigation diagnoses, identifying the presence of hydrogen sulphide is made indirectly through identification of blackening of metal objects. The diagnosis is based on known sources of pollution or investigation of the accident site for blackened metals, a characteristic of exposure to hydrogen sulphide'*[26].



Source: OTSI

Figure 22: Water inlet valve showing blackening of chrome finish

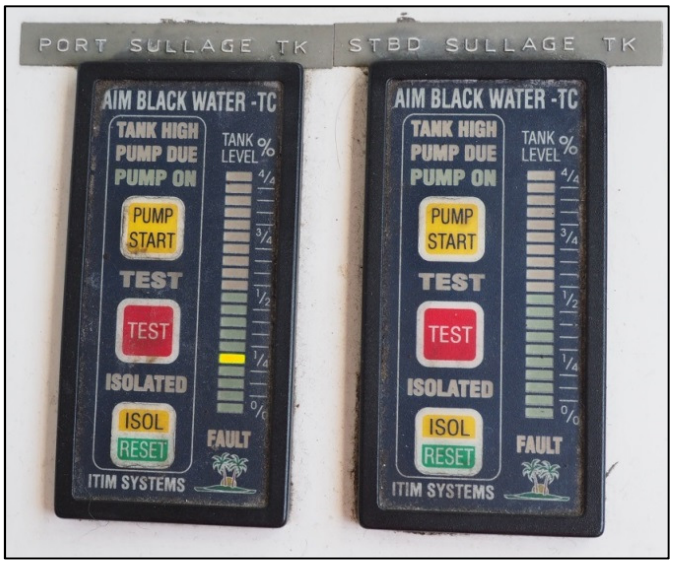
Source: MAC

Figure 23: Comparison photo of similar water inlet valve

26 *Fatal hydrogen sulphide poisoning in unconfined spaces;* Occupational Medicine 2011

Direct overboard discharge facility

2.119 The two sullage tanks on *Lady Rose* were each fitted with a system known as a direct overboard discharge facility. The system was fitted with two electric pumps that allow untreated sewage to be drawn from the sullage tanks and discharged overboard via the engine exhaust outlets at the stern of the vessel. Power is supplied to these pumps through two circuit breakers marked 'sullage pump' located in the vessel's main circuit breaker panel. The sullage pumps are operated remotely via a switch on the sullage tank indicator panels located in the wheelhouse. The switches are labelled as 'pump start' (refer to *Figure 24*).



Source: OTSI

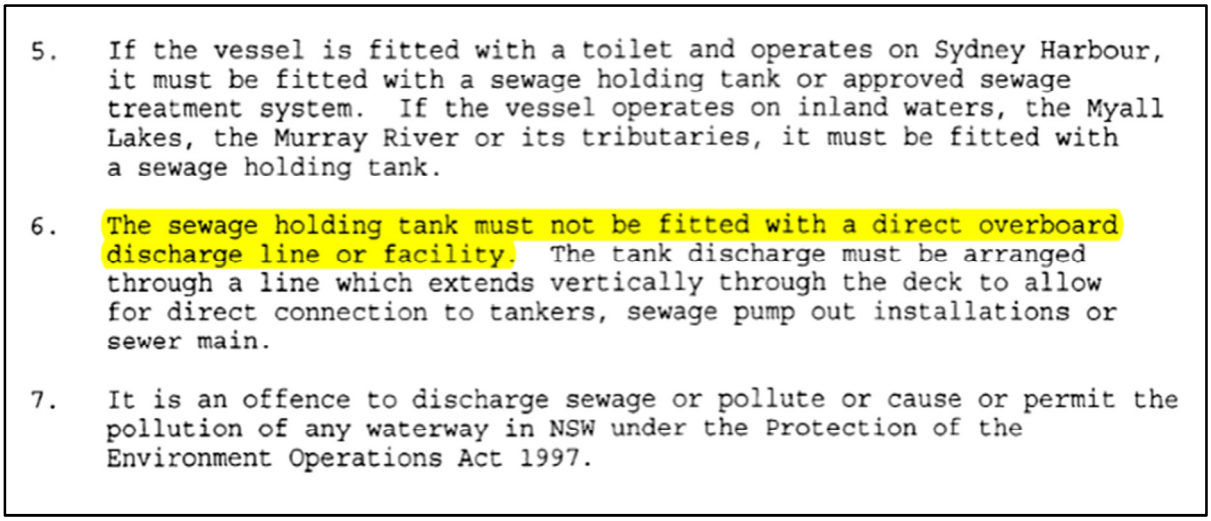
Figure 24: Sullage tank indicator panel with pump start switch

2.120 Following an unscheduled RMS inspection in November of 2018, instruction was given to the operator of *Lady Rose* to disconnect the discharge system. A follow up inspection by the RMS confirmed that the instruction had been followed. However, when the vessel was inspected following the incident, the discharge system was reconnected and fully functional.

2.121 Following the incident and during a joint technical investigation by RMS and AMSA, conjecture was raised in relation to the direct overboard sewage discharge facility that it had possibly contributed to the incident. The concern was that this system had allowed exhaust gases to enter the sewage system.

2.122 Further investigation revealed that this pathway for exhaust gases was highly unlikely due to the configuration of the pumping arrangements. Tests were also carried out to determine the presence of exhaust gases within the system, however none were found. This pathway has been eliminated as a contributing factor in the presence of hydrogen sulphide in the toilet cubicle.

2.123 The fitment of the discharge facility was in contradiction with the conditions of Appendix A, section 6 of the Recognition Certificate issued against *Lady Rose* in 2001 (refer to *Figure 25*). Up until the removal of this condition in the National Certificate of Survey and Operation issued by RMS in December 2014, the condition was noted in no less that ten prior surveys carried out on the vessel.



5. If the vessel is fitted with a toilet and operates on Sydney Harbour, it must be fitted with a sewage holding tank or approved sewage treatment system. If the vessel operates on inland waters, the Myall Lakes, the Murray River or its tributaries, it must be fitted with a sewage holding tank.

6. The sewage holding tank must not be fitted with a direct overboard discharge line or facility. The tank discharge must be arranged through a line which extends vertically through the deck to allow for direct connection to tankers, sewage pump out installations or sewer main.

7. It is an offence to discharge sewage or pollute or cause or permit the pollution of any waterway in NSW under the Protection of the Environment Operations Act 1997.

Source: RMS – annotated by OTSI

Figure 25: Recognition certificate

PART 3 FINDINGS

The investigation determined that it was likely that the passenger was overcome by hydrogen sulphide. A consulting Forensic Pharmacologist was also of the opinion that the fatality was a consequence of hydrogen sulphide toxicity. From the available evidence during the course of the investigation, the following contributory factors are identified with respect to the passenger fatality on board *MV Lady Rose* on 2 February 2019.

Contributory factors

3.1 The applicable regulations for DCV sewage and plumbing systems as fitted to *Lady Rose* were inadequate to provide a safe operational environment for crew and passengers.

3.2 The flow of gases from within the sullage tanks were enabled by the inherent design deficiencies within the sewer system design. There was also a lack of adequate venting to the main sewer lines.

3.3 The design of the sullage tank and sewage remaining in the tank prior to the incident created an environment which has likely contributed to the production of hydrogen sulphide.

3.4 The production of hydrogen sulphide within the sullage tanks of *Lady Rose* was also exacerbated by the lack of a regular scheduled cleaning program.

3.5 A continuous flow of water from the faulty cistern valve contributed to an increase in waste fluid levels in the port sullage tank. Once full, the flow filled the horizontal vent pipe and drained into the starboard tank. The flow of liquid created a vapour block which prevented the flow of gases into the main vent line.

3.6 Rising fluid levels in the starboard sullage tank forced gases containing hydrogen sulphide into the sewage pipe network.

3.7 A tear in the silicon membrane of the waterless trap fitted to the hand basin of the subject cubicle likely allowed gases to enter the cubicle.

3.8 The lack of urgency from the crew in responding to the presence of rotten-egg like odours on board the vessel likely contributed to the amount of hydrogen sulphide entering the subject toilet cubicle. Their actions indicated a lack of awareness concerning the risk hydrogen sulphide presented.

3.9 It is likely that contaminants trapped in the sagging hose fitted to the horizontal vent pipe prevented the normal path for displaced gases to flow into the masthead vent. This sag in the hose was a result of the hose material not being rigid and being ineffectively secured. The horizontal pipe was installed without adequate fall.

3.10 The toilet cubicles lacked adequate fresh air transfer and allowed the build-up of hydrogen sulphide. The inflow rate of hydrogen sulphide was likely such that it displaced the air in the toilet cubicle and fatally overcome the passenger.

Other safety factors

3.11 The SMS for *Lady Rose* at the time of the incident did not reflect the change in location for the operation. It also lacked a risk register or mechanism for identifying risks and mitigating measures for the safe operation of the vessel. Therefore the AOC SMS did not consider the presence of harmful sewage gases onboard the vessel.

3.12 It is likely that the difficulty for AOC masters to access sewer pumping facilities on Sydney Harbour may have led to the cruise commencing without the sullage tanks being emptied.

3.13 Regulatory oversight did not adequately identify deficiencies within the AOC SMS.

Remedial actions

3.14 Following the incident AOC carried out repairs and refurbishment of the vessel, including: replacement of mast head vent, refurbishment of all toilet cubicles, renewed all plumbing fixtures and pipework associated with the sewage system, replaced existing and installed additional sullage tanks, fitted new sullage tank gauges, upgraded some electrical systems, repaired and painted the hull, replaced engine room insulation and renewed main drive engines. Defibrillators are now fitted to all its vessels.

3.15 AOC have also implemented changes to their SMS procedures for *Lady Rose*. These include:

- Improved management of sullage tanks
- Improved management of sewage and grey water systems
- Implemented monitoring of hydrogen sulphide and carbon monoxide gas levels
- Made improvements to sullage tank pump out procedures
- Improved risk assessment procedures
- Developed and implemented a new planned maintenance plan
- Developed and implemented improved reporting in vessel logbooks
- Removed direct overboard discharge facility.

PART 4 RECOMMENDATIONS

It is recommended that the following actions be undertaken by the specified responsible entities in the interest of enhancing safety.

All Occasion Cruises

4.1 Assess the SMS and associated safe work instructions to reflect the current working arrangements for all vessels as per AMSA's guidelines.

4.2 Adopt a risk assessment-based approach to the development of the SMS as per AMSA's guidelines.

4.3 Ensure all sullage and grey water tanks on vessels have been emptied at the completion of all cruises.

4.4 Effect repairs to the *Lady Rose* to ensure hazardous gases are contained and do not enter areas where personnel and passengers are likely to access.

4.5 Engage a qualified plumber to inspect and repair any other outstanding or unidentified defects with the sewage system on all vessels in the fleet.

4.6 Ensure ventilation to all toilet cubicles is sufficient to provide a safe environment.

AMSA

4.7 In consultation with industry and in collaboration with other relevant agencies, develop and implement standards for the safe design, construction and maintenance of sewage systems for DCVs.

4.8 Consider the introduction of a requirement that a suitably qualified technical assessor with plumbing qualifications carries out an inspection of sewage systems in conjunction with the AMSA survey processes.

4.9 In consultation with industry and collaboration with other relevant agencies consider the inclusion in certificate of competency syllabuses, education on risks involved with hazardous gases in DCV sewage systems for onboard staff.

4.10 Further support the adoption and implementation of safety management systems for DCV operators through AMSA's regulatory activities.

Transport for NSW

4.11 Work in conjunction with AMSA and any other relevant agencies to assist in the development and implementation of robust standards for the inspections of sewage systems on DCVs.

4.12 Consider the introduction of a requirement that a suitably qualified technical assessor with plumbing qualifications carries out an inspection in conjunction with the TfNSW inspection process of sewage systems, repairs and venting systems.

4.13 Further support the adoption and implementation of safety management systems for DCV operators through TfNSW's regulatory activities.

References

- [11] *Fatal hydrogen sulphide intoxication: Report of three cases occurring in a sewer;* Arch Pathol 81:375-380, Adelson L, Sunshine I. 1966.
- [12, 21, 24] *Hydrogen Sulphide: Human Health Aspects;* Concise International Chemical Assessment Document 53 - Dr C.-H. Selene J. Chou, Agency for Toxic Substances and Disease Registry, Atlanta, Georgia, USA
- [13] *Deaths And Illness From Hydrogen Sulphide Among Ship Workers:* Acute Communicable Disease Control 2005 Special Reports - http://www.publichealth.lacounty.gov
- [14] *Chemistry of the Elements (2nd Ed.);* Butterworth-Heinemann. Greenwood, Norman N. Earnshaw, Alan
- [15, 16, 18] *Hydrogen Sulphide* (*H_2S*) CAS 7783-060-4; UN 1053 *Concise International Chemical Assessment Document*
- [20] *Hydrogen Sulphide Poisoning: A Case Report of Quadruple Fatalities;* JPAFMAT 2008; 8(1). ISSN 0972-5687
- [22] *Hydrogen Sulphide And Microbiologically Influenced Corrosion Of Concrete, Steel And Ductile Iron In Waste Water Facilities;* Kenneth B. Tator P.E. KTA-Tator
- [23] *Airborne occupational hazards in sewer systems* – Amy Forsgren / Kristina Brinck. CRC
- [26] *Fatal hydrogen sulphide poisoning in unconfined spaces;* Occupational Medicine 2011-61:212– 214 Advance Access publication on 5 April 2011
- *Occupationally related hydrogen sulphide deaths in the United States from 1984;* Fuller DJ, and Suruda AJ.
- *The problem of protection of metal from the hydrogen sulphide corrosion;* http://himipex.com
- *Hydrogen sulphide-induced changes in coin appearance* [abstract] Graeme KA, Wallace KL, Curry SC, Tanen DA, Higgins TJ. 1999.]. ClinToxicol 36(5):469 – 470
- *Anaerobic Digestion;* NNFCC Renewable Fuels and Energy Factsheet*:* National Non-Food Crops Centre.
- *Toxicological Review of Hydrogen Sulphide* – US EPA/635/R-03/005 – www.epa.gov.iris
- *H_2S-The Relationship of Bacteria to its Formation, Prevention and Elimination*; V.A. Edwards, C. P. Velasco, K.J. Edwards Jr.; March 11, 2002.
- *Toxicology of hydrogen sulphide;* Annual Revue Pharmacology Toxicology 1992; 32: 109–134.
- *Toxicological Profile for Hydrogen Sulphide and Carbonyl Sulphide; U.S.* Department Of Health And Human Services. Public Health Service Agency for Toxic Substances and Disease Registry November 2016.
- *Two maintenance workers die after inhaling hydrogen sulphide in manhole, January 31, 1989;* Fatal accident circumstances and epidemiology (FACE) report; Morgantown, WV: National Institute for Occupational Safety and Health. PB91212761.
- *Hydrogen Sulphide and Microbiologically Influenced Corrosion of Concrete, Steel and Ductile Iron in Waste Water Facilities:* Kenneth B. Tator P.E. KTA-Tator, Corrosion 2003, Paper No: 03060.
- *Hydrogen sulphide advances in understanding human toxicity*. Guidotti, T.L. (2010) International Journal of Toxicology, 29(6), 569-581.
- *Toxicology Letters - Case studies of hydrogen sulphide occupational exposure incidents in the UK:* Kate Jones, Health and Safety Laboratory, Harpur Hill, Buxton SK17 9JN, UK – August 2014

Submissions

The Chief Investigator forwarded a copy of the Draft Report to the Directly Involved Parties (DIPs) to provide them with the opportunity to contribute to the compilation of the Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and to submit recommendations for amendments to the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- All Occasion Cruises
- Transport for NSW
- NSW Police Marine Area Command
- AMSA

Submissions were received from the following DIPs.

- All Occasion Cruises
- Transport for NSW
- NSW Police Marine Area Command
- AMSA

The Chief Investigator considered all representations made by DIPs and responded to the author of each of the submissions advising which of their recommended amendments would be incorporated in the Final Report, and those that would not. Where any recommended amendment was excluded, the reasons for doing so were explained.