Final report MO-2016-201: Restricted-limits passenger vessel the *PeeJay V*,
Fire and sinking , 18 January 2016

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

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

Final Report

Marine inquiry MO-2016-201

Restricted-limits passenger vessel the *PeeJay V* Fire and sinking

18 January 2016

Approved for publication: December 2017

Transport Accident Investigation Commission

About the Transport Accident Investigation Commission

The Transport Accident Investigation Commission (the Commission) is a standing commission of inquiry and an independent Crown entity responsible for inquiring into maritime, aviation and rail accidents and incidents for New Zealand, and co-ordinating and co-operating with other accident investigation organisations overseas. The principal purpose of its inquiries is to determine the circumstances and causes of occurrences with a view to avoiding similar occurrences in the future. Its purpose is not to ascribe blame to any person or agency or to pursue (or to assist an agency to pursue) criminal, civil or regulatory action against a person or agency. The Commission carries out its purpose by informing members of the transport sector and the public, both domestically and internationally, of the lessons that can be learnt from transport accidents and incidents.

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Important notes

Nature of the final report

This final report has not been prepared for the purpose of supporting any criminal, civil or regulatory action against any person or agency. The Transport Accident Investigation Commission Act 1990 makes this final report inadmissible as evidence in any proceedings with the exception of a Coroner's inquest.

Ownership of report

Citations and referencing

Information derived from interviews during the Commission's inquiry into the occurrence is not cited in this final report. Documents that would normally be accessible to industry participants only and not discoverable under the Official Information Act 1982 have been referenced as footnotes only. Other documents referred to during the Commission's inquiry that are publicly available are cited.

Photographs, diagrams, pictures

Unless otherwise specified, photographs, diagrams and pictures included in this final report are provided by, and owned by, the Commission.

Verbal probability expressions

The expressions listed in the following table are used in this report to describe the degree of probability (or likelihood) that an event happened or a condition existed in support of a hypothesis.

Terminology (adopted from the Intergovernmental Panel on Climate Change)	Likelihood of the occurrence/outcome	Equivalent terms
Virtually certain	> 99% probability of occurrence	Almost certain
Very likely	> 90% probability	Highly likely, very probable
Likely	> 66% probability	Probable
About as likely as not	33% to 66% probability	More or less likely
Unlikely	< 33% probability	Improbable
Very unlikely	< 10% probability	Highly unlikely
Exceptionally unlikely	< 1% probability	

The *PeeJay V*

Source: mapsof.net

Location of accident(s)

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Abbreviations

CO_2	carbon dioxide
kg	kilogram
MNZ	Maritime New Zealand
MOSS	Maritime Operator Safety System
MTOP	Maritime Transport Operator Plan
nm	nautical mile
SIB	soft inflatable boat
SRL	Skipper Restricted Limits
QDC	Qualified Deck Crew
VHF	very high frequency

Glossary

Carley float	a rigid raft which in the event of having to abandon a vessel provides buoyancy for survivors
companionway	a set of steps leading from a vessel's deck down to a cabin or lower deck.
flybridge	the deck above the main deck where the wheelhouse is located
lazarette	a large compartment below deck at the rear of the vessel used for stowage
restricted limits	enclosed water limits and inshore limits
rigid hulled inflatable boat	a vessel with a rigid hull that has an inflatable collar, which is typically used as tenders or fast rescue craft for larger vessels
single buoy mooring	an anchored float which a vessel can moor itself to
starboard	the right-hand side of the vessel when facing forward
moor	to fix a floating vessel in place by attaching it to a structure or the earth using a flexible attachment such as rope or chain

Data summary

Vehicle particulars

Name:	*PeeJay V*
Type:	passenger
Class:	not applicable
Limits:	Restricted Limits – inshore
Surveying company:	Survey Nelson until 2011, then SGS Tauranga
Length:	21.8 metres
Breadth:	5.6 metres
Displacement:	33 tonnes
Built:	2003 by Careys Boatyard in Picton
Propulsion:	two x 560 kilowatt diesel engines driving two propellers
Service speed:	20 knots
Owner/operator:	White Island Tours Limited
Port of registry:	Whakatāne
Minimum crew:	four

Date and time	18 January 2016 at about 1540[1]
Location	Whakatāne
Persons involved	seven crew and 53 passengers
Injuries	one person suffered smoke inhalation
Damage	total loss of vessel

[1] Times in this report are in New Zealand Daylight Time (Universal Co-ordinated Time + 13 hours) and are expressed in the 24-hour mode.

1. Executive summary

1.1. On 18 January 2016, the restricted-limits passenger vessel *PeeJay V* was on an all-day excursion from Whakatāne out to White Island with 53 passengers and seven crew on board. The *PeeJay V* was near the end of the journey and approaching the Whakatāne Harbour entrance when fire broke out in the engine room.

1.2. The crew released the fixed CO_2 fire extinguisher into the engine room, which suppressed the fire for a short time. However, the fire quickly escalated, forcing the skipper to order everyone to abandon the vessel. Several vessels in the vicinity responded to the skipper's distress call. All persons were eventually transferred to the assisting vessels. However, due to the speed with which the fire gained intensity several passengers were forced to enter the water without a life-jacket.

1.3. The crew were not able to access all of the life-jackets on board because of the fire. For the same reason they were not able to launch the flotation raft that was stored on top of the vessel's flybridge.

1.4. The *PeeJay V* burnt to the waterline and sank. One crew member suffered from smoke inhalation, but otherwise nobody else was seriously injured.

1.5. Due to the lack of physical evidence to work with, the Commission was unable to conclusively establish the cause of the fire. The Commission found that the absence of a fire detection and automatic alarm system on the *PeeJay V* meant the crew had limited warning time and opportunity to respond to the fire and prepare the life-saving apparatus.

1.6. The Commission also found that the CO_2 fire suppression system, which was supposed to work by displacing the air in the engine room with CO_2, was not effective in suppressing the fire. This was because air was able to enter the engine room through several openings, including a cable duct that had no means of being closed.

1.7. The Commission also found that the placement of the life-saving apparel and equipment on board was appropriate. The fact that it could not all be accessed highlights the difficulty operators of smaller vessels have in choosing where to locate such equipment.

1.8. Three main safety issues identified during the inquiry were:

- Maritime Rules did not require the *PeeJay V* to have fire detection or automatic fire alarms installed even though it could carry up to 90 passengers and operate up to 12 nautical miles from the coast
- the CO_2 fixed fire-fighting system installed in the engine room could not be fully effective in extinguishing the fire because the space it was protecting could not be fully closed down
- the builder and operators of the vessel did not fully appreciate the principles of how the CO_2 fixed fire-fighting system operated.

1.9. The Commission made one new recommendation and invited the Director of Maritime New Zealand to implement an existing previous recommendation to address these safety issues.

1.10. The key lessons arising from this inquiry are:

- early detection of a fire on board a vessel is critical to a successful fire-fighting response and for the early preparation of life-saving apparel and equipment
- crew must be fully familiar with and trained in the use of fire-fighting systems on board, otherwise the systems might not be of any use in fighting a fire
- even if a fixed CO_2 fire-fighting apparatus is fully functional, it will only be effective in fighting a fire if the design of the space it is protecting can be fully closed off.

2. Conduct of the inquiry

2.1. On 18 January 2016 at about 1600 the Commission received notification from Maritime New Zealand (MNZ) of a fire on board the charter vessel *Pee Jay V. The* vessel had 53 passengers and seven crew on board, and was anchored about one kilometre off the coast near Whakatāne. The *PeeJay V* was abandoned, all persons on board were accounted for, and the vessel sank that evening.

2.2. The same day the Commission opened an inquiry under section 13(1)b of the Transport Accident Investigation Commission Act 1990 and appointed an investigator in charge.

2.3. On 19 January, two investigators travelled to Whakatāne to conduct enquiries, including conducting interviews and collecting evidence. They returned to Wellington on 21 January.

2.4. On 22 January, a preservation and protection order was issued under the Transport Accident Investigation Commission Act 1990 with respect to the wreck and flotsam from the *Pee Jay V*.

2.5. On 30 January, the Commission circulated an online survey to the passengers who were on board the *PeeJay V* at the time of the fire. The survey received 42 responses.

2.6. On 11 February, a dive survey of the wreck was conducted by the harbourmaster, and on 8 April divers contracted by the Commission surveyed the wreck.

2.7. The Commission also gathered information from MNZ, the surveyor company, and people involved in building and maintaining the vessel.

2.8. On 23 August 2017, the Commission approved the draft report for circulation to six interested parties.

2.9. On 13 December 2017, the Commission approved the final report for publication.

3. Factual information

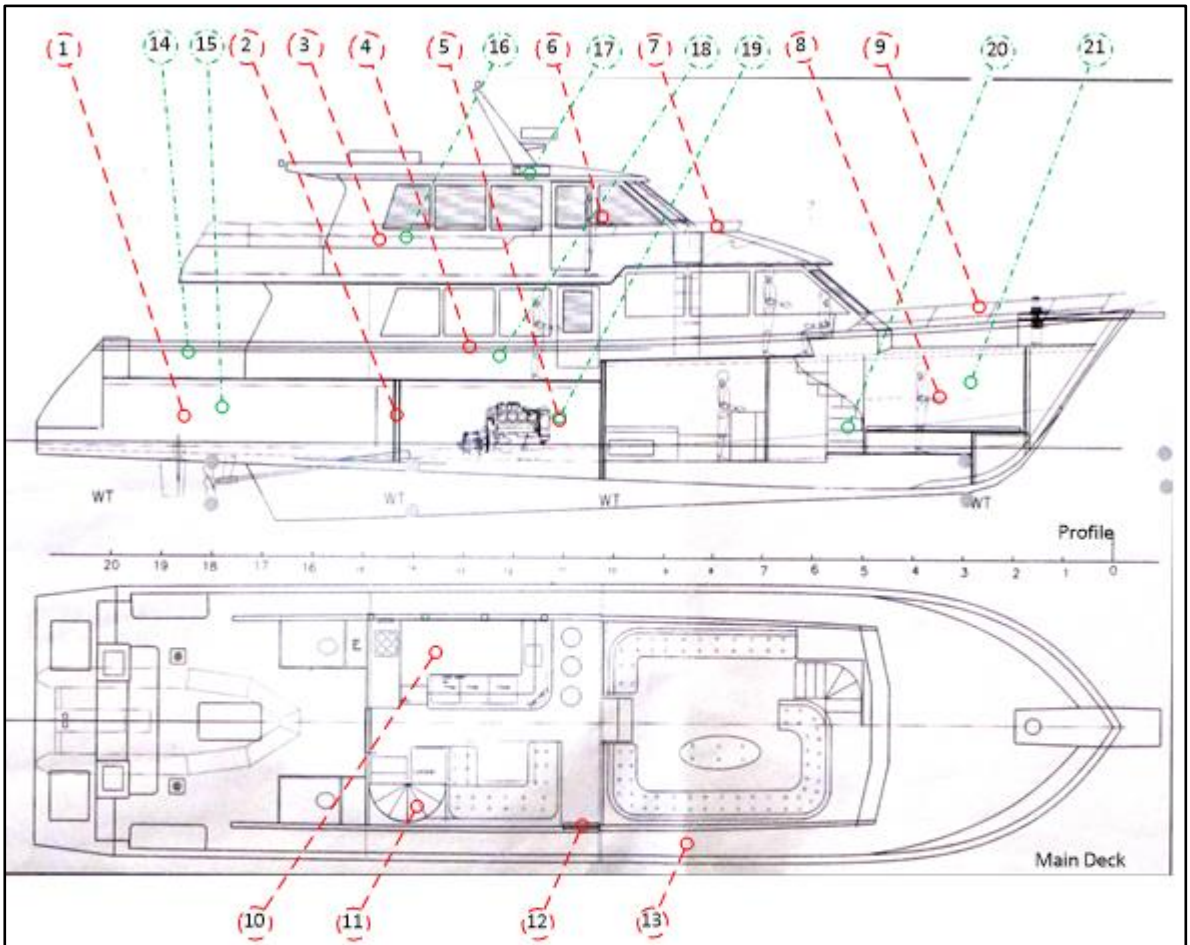
3.1. Narrative

3.1.1. White Island Tours (the operator) operated the *PeeJay V* out of Port Whakatāne to provide scheduled one-day tours to White Island and other locations of interest.

3.1.2. At 0800 on 18 January 2016, the *PeeJay V* was berthed alongside the wharf in Whakatāne. The skipper arrived shortly after 0800 and began preparing the vessel for its scheduled sailing at 1000.

3.1.3. As part of the pre-sailing preparations he reviewed the recent entries that had been made in the maintenance logbook, opened the engine room hatch and visually inspected the bilge and bilge pump, fuel level, the batteries, steering system, generator and the inverter. He started the engines and checked systems before shutting them down again. During his pre-sailing checks the skipper did not notice anything irregular. He returned to the bridge (shown in Figure 1) and continued preparations for sailing.

3.1.4. Meanwhile the rest of the crew had arrived and were carrying out their preparations for sailing, which included checking the soft inflatable boat (SIB), cleaning duties and preparing the passenger facilities.



Number	Item	Number	Item	Number	Item
1	Lazarette	8	Forward cabin	15	Life jacket storage
2	Forced draft fan	9	Foredeck	16	Life jacket storage
3	Passenger area of flybridge	10	Galley	17	Carley float
4	Main deck	11	Stairs to flybridge	18	3 x handheld extinguisher
5	Engine room	12	Door to side deck	19	2 x handheld extinguisher
6	Wheelhouse	13	Side deck	20	Handheld extinguisher
7	Walkway	14	Handheld fire extinguisher	21	Life jacket storage

Figure 1
General arrangement of the *PeeJay V*

3.1.5. By about 0920 all seven crew were aboard and all pre-sailing preparations were completed.

3.1.6. At about 1000 the passengers started boarding. When all 53 passengers were aboard the crew delivered the introductory briefing. The briefing included an overview of the day's itinerary, the location of life-jackets and other information pertinent to the safety and enjoyment of the passengers. At about 1010 the skipper started the engines and the *PeeJay V* departed Whakatāne. The *PeeJay V* crossed the Whakatāne River bar at about 1015 and began the 26 nautical mile (nm) passage to White Island (shown in Figure 2).

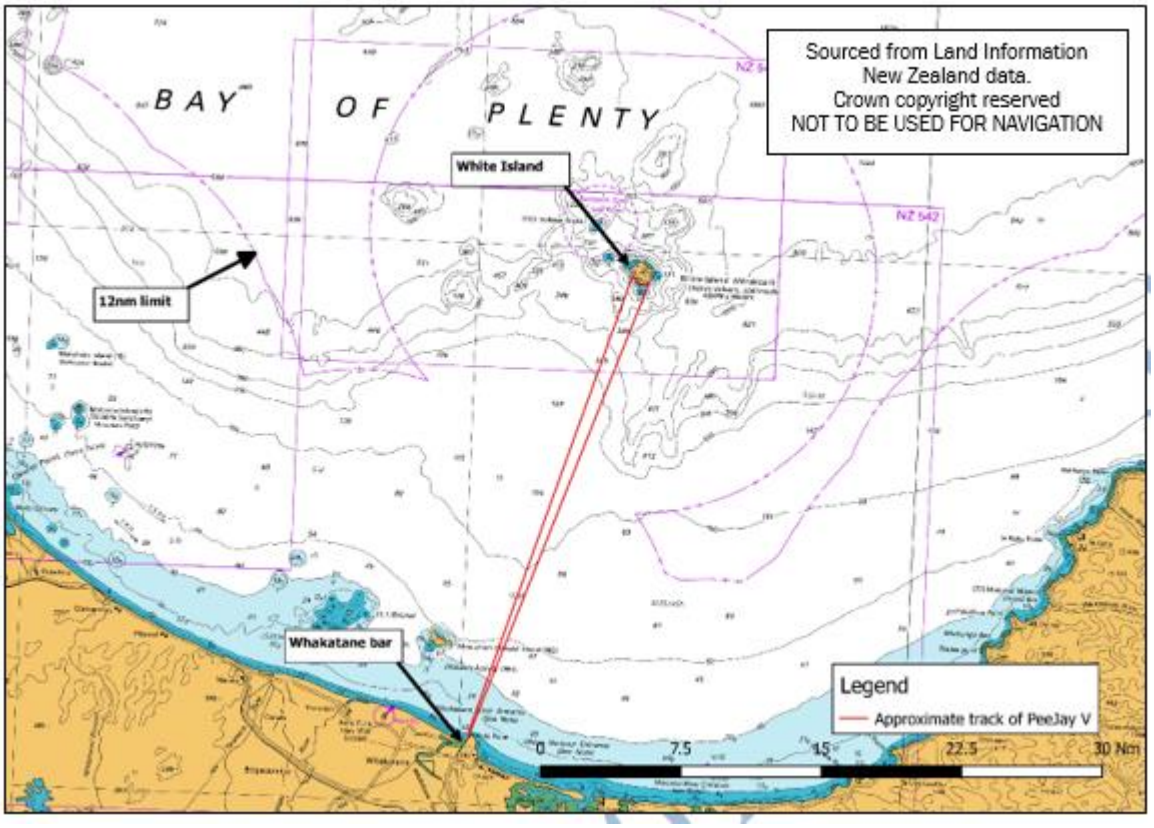


Figure 2
Chart showing approximate track of the *PeeJay V* on its passage to and from White Island[2]

3.1.7. At about 1145 the *PeeJay V* moored to a single buoy mooring in Works Bay at White Island and transferred passengers ashore using the vessel's SIB. They returned to the *PeeJay V* at about 1330.

3.1.8. Once all the passengers were back aboard the skipper slipped the mooring and moved the vessel to anchor at Black Rock on the southwest side of the island where it was more sheltered from the weather for the passengers to have lunch. After lunch they raised the anchor and began the return passage to Whakatāne.

3.1.9. At about 1530 the *PeeJay V* was about half a nautical mile away from crossing the Whakatāne bar when the tour manager and a deckhand standing near the galley (shown in Figure 1) smelt fumes. The deckhand immediately went up the stairs to the flybridge from where he could alert the skipper in the wheelhouse. The skipper checked the wheelhouse dashboard gauges and control panels but did not see or hear anything irregular.

3.1.10. Another deckhand standing alongside the skipper in the wheelhouse went down the stairs to investigate, but by the time he had reached the bottom of the stairs he could see smoke coming out from the galley cabinets. He could not see any flames, but smoke was quickly filling the cabin. The other crew member who had followed him down the stairs returned to tell the skipper it was 'bad'.

3.1.11. At about the same time the tour manager began evacuating the passengers from the main deck cabin out onto the starboard side deck where they proceeded forward to muster on the foredeck. Less than about 30 seconds passed between the crew first smelling fumes and thick grey smoke beginning to fill the cabin.

[2] The 12 nm limit is the territorial waters of New Zealand. White Island is a part of New Zealand and therefore has a 12 nm limit around it. The 12 nm limits of White Island and the North Island overlap, so the 12nm limit line on the chart appears as a bulge around White Island.

3.1.12. At about 1540 the skipper called the Coastguard on channel 80 on the very high frequency (VHF) radio to request assistance. At about 1544 the skipper spoke on the telephone with the operator's sea operations manager ashore to request assistance. He knew the sea operations manager was aboard another vessel, the *PeeJay IV*, and would be able to respond quickly. The skipper had also called the reception at White Island Tours to report the vessel was on fire and to request they send boats to help.

3.1.13. The skipper had brought the vessel head-to-wind and requested one of the deckhands to drop the anchor.

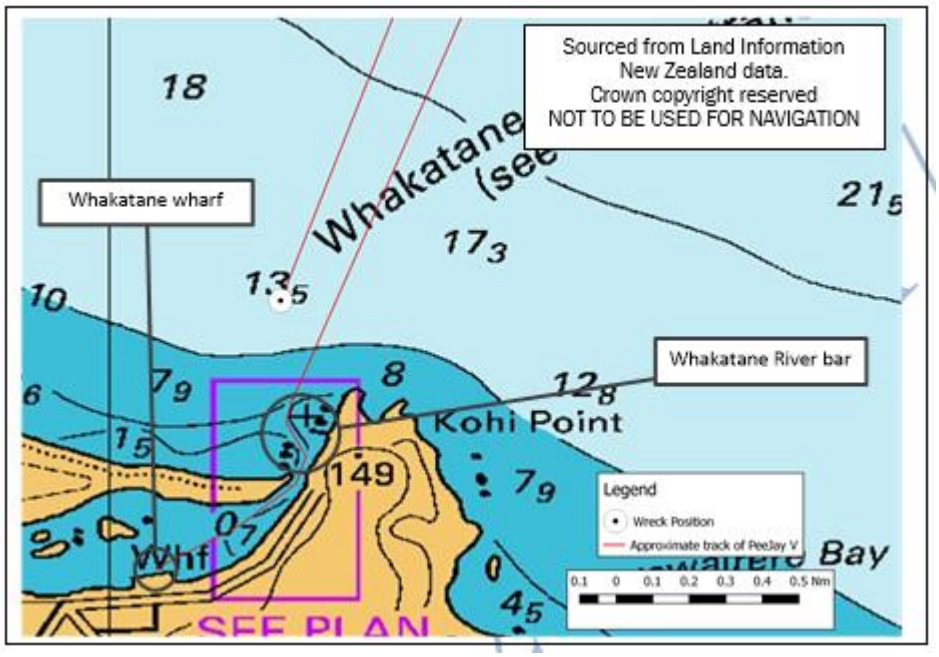


Figure 3
The approach to Whakatāne River bar showing position that *PeeJay V* foundered

3.1.14. Once the passengers had been evacuated from the cabin the tour manager attempted to contain the fire by closing the fire flaps to the engine room. The cabin had filled with thick smoke, and he put his head through the side window to breathe while he closed the fire flaps. He closed five of the six fire flaps. Once he had closed the five flaps another crew member activated the fixed fire smothering system to flood the engine room with CO_2. The CO_2 appeared to subdue the fire for about six minutes before smoke started flowing from the cabin again. During this time the tour manager returned to the cabin and closed the last fire flap.

3.1.15. At about 1550 a member of the public who could see the vessel was on fire telephoned the police to report the incident. Police relayed the message through to the Marine Operations Centre. Plenty Maritime Radio broadcast a Mayday relay, '…of a possible boat fire, half a mile off Kohi Point Whakatāne, no other information to hand…'.

3.1.16. The crew launched the SIB from its stowage location in the stern of the vessel, and from it were able to conduct a head count. From video taken at the time by a passenger it was evident there were 33 passengers mustered on the foredeck. There were also 20 on the flybridge level mustered on the side deck and forward of the bridge.

3.1.17. Life-jackets on board the *PeeJay V* were stored in three locations: the forward cabin, the flybridge and the lazarette. The crew were able to access the life-jackets stored on the flybridge and distribute them to the passengers in the vicinity. However, the life-jackets stored in the forward cabin and lazarette were not accessible due to the fire. The passengers mustered on the foredeck were not provided with life-jackets.

3.1.18. The skipper of the *PeeJay V* used the VHF radio to broadcast a Mayday signal at about 1557.

3.1.19. By about 1558 two other vessels had put to sea and were standing off the *PeeJay V* ready to assist. Once the assisting vessels were in position the skipper of the *PeeJay V* ordered 'abandon ship'. The crew instructed the passengers to jump into the water so they could be picked up by the *PeeJay V*'s crew in the SIB and transferred to one of the two assisting vessels.

3.1.20. Due to the location of the fire, the crew were not able to access enough life-jackets for everyone on board. Once each passenger with a life-jacket had jumped overboard and was safe on board the rescue vessel their life-jacket was passed back on board the *PeeJay V* and used by the passengers still on board. As the fire grew the pressure to abandon ship increased, and in total about 18 passengers jumped from the *PeeJay V* without wearing a life-jacket.

3.1.21. The *PeeJay V* was fitted with a 10 person Carley float, which is a solid raft fitted with rope hand-holds. The Carley float can be thrown into the water in an emergency and acts as a flotation support for passengers and crew to hold onto in the water. The Carley float was located on the roof of the flybridge. Due to the fire the crew were unable to access the rooftop to launch the Carley float.

3.1.22. By about 1620 all of the passengers and crew, including the skipper, had been transferred to the assisting vessels.

3.1.23. The passengers and crew disembarked alongside in Whakatāne. There were no significant injuries reported, although one of the crew had suffered minor smoke inhalation.

3.1.24. Plenty Maritime Radio cancelled the distress signal at about 1708 and the *PeeJay V* sank later that evening.

3.2. Vessel details

3.2.1. In 2001, the owner contracted Carey's Boatyard (the builder) to build and deliver a vessel in full survey for 90 passengers to operate within inshore limits, which is defined as the territorial sea of New Zealand, nominally within 12 nm of the coast.

3.2.2. The builder contracted a naval architect to provide design drawings for the hull shape and general arrangement of the vessel. The design was approved by Survey Nelson (the surveyor) as meeting the requirements of Maritime Rules Part 40A – Design, Construction, and Equipment –Passenger Ships which are not SOLAS (Safety Of Life At Sea) Ships. This Maritime Rule came into force on 1 February 2001, and prescribes the requirements for the design, construction and equipment of New Zealand passenger ships such as the *PeeJay V*.

3.2.3. The builder constructed the vessel to the approved drawings. The detail design and construction of the vessel, including the engineering systems, were carried out by the builder 'in-house'. There were no design drawings of the engineering systems available to the Commission to verify fire detection and/or automatic fire alarms. The surveyor inspected the vessel and its systems at various stages during construction to confirm it complied with the requirements of the Maritime Rules, in particular Part 40A. The *PeeJay V* was constructed with a composite of timber and fibreglass reinforced plastic.

3.2.4. The surveyor issued a Fit-For-Purpose certificate in 2003 and the vessel was put into service the same year. SGS Tauranga became the surveyor for the *PeeJay V* in February 2011.

3.2.5. On 1 July 2014, when the Marine Operator Safety System (MOSS) came into force, the *PeeJay V* had a valid Fit-for-Purpose certificate and a current New Zealand Safe Ship Management certificate. Hence it was deemed to have a valid certificate of survey.

3.3. Fire protection, detection and fire-fighting systems of the *PeeJay V*

3.3.1. Under Maritime Rule 40A, the *PeeJay V* was required to have a fixed fire-fighting system for use in the event of a fire in the engine room. The *PeeJay V* had a CO_2 flooding system installed.

3.3.2. The *PeeJay V* also had various portable fire extinguishers located around the vessel:

- three 4.5 kilogram (kg) dry powder type extinguishers distributed through the cabin and saloon
- one 2 kg dry powder type extinguisher in the galley
- two 4 litre foam type extinguishers in the engine room
- one 49 kg CO_2 type extinguisher for the engine room with the trigger and gas bottle located in the cockpit.

3.3.3. The crew did not have the opportunity to deploy the portable fire extinguishers effectively due to the location and the speed with which the fire took hold.

3.3.4. The *PeeJay V* was fitted with a manual push button alarm to alert passengers and crew in the event of an emergency. The operators believed the *PeeJay V* was fitted with a fire detection system and automatic fire alarm and this point is discussed in section 4.3 of this report.

3.3.5. The survey company (during construction) found the *PeeJay V* complied with the Maritime Rules with respect to structural fire protection and fire divisions. However, the Commission found some issues with the integrity of the arrangement, which are discussed in section 4.6 of this report.

3.4. Life-saving appliances of the *PeeJay V*

3.4.1. The *PeeJay V*'s safety equipment list identified 107 foam life-jackets distributed between the forward cabin and the flybridge. There were also a number of foam life-jackets stored in the lazarette.

3.4.2. A Carley[3] float for 10 persons was carried on the roof above the flybridge.

3.4.3. The *PeeJay V* also had a SIB rescue boat which was certified to carry 16 people.

3.5. Crew

3.5.1. The minimum number of crew required to safely crew the *PeeJay V* was dependent on where it was operating and how many passengers it had on board. The *PeeJay V* minimum safe manning required by MNZ for the area of operations on the day of the fire was:

- skipper with minimum qualification of Skippers Restricted Limits (SRL)
- one deck crew with minimum qualification of Qualified Deck Crew (QDC)
- two crew with no minimum qualification.

3.5.2. The *PeeJay V* crew also acted as guides for the tours on White Island. The tours required more guides than the minimum number of crew required by MNZ, hence the the *PeeJay V* sailed with more than the minimum required crew. On the day of the accident there were seven crew on board.

3.5.3. The skipper gained a certificate of competency as skipper of a Coastal Fishing Boat and a Second-Class Diesel Trawler engineer's certificate in 1982. He joined White Island Tours as a skipper in 2013.

[3] A Carley float is a type of emergency liferaft.

4. Analysis

4.1. General

4.1.1. The *PeeJay V* was a passenger vessel used to take tourists from Whakatāne to White Island and back. During a return voyage a catastrophic fire took hold and the vessel burned to the waterline and sank. All passengers and crew abandoned the vessel and were recovered without significant injury.

4.1.2. The vessel was designed and built specifically for the type of operation it was engaged in on the day of the accident. MNZ had issued the operator with a Maritime Transport Operators Certificate, but had not yet conducted the initial audit scheduled for the following year.

4.1.3. The Commission identified three safety issues relating to the implementation of the vessel's safety management system and the fire detection and extinguishing system on board:

- *the PeeJay V could carry up to 90 passengers and operate up to 12 nm from the coast, and very likely did not have fire detection or automatic fire alarms installed*
- *the CO_2 fixed fire-fighting system installed in the engine room could not be fully effective in extinguishing the fire because the space it was protecting could not be fully closed down*
- *the builder and operators of the vessel did not fully appreciate the principles of how the CO_2 fixed fire-fighting system operated.*

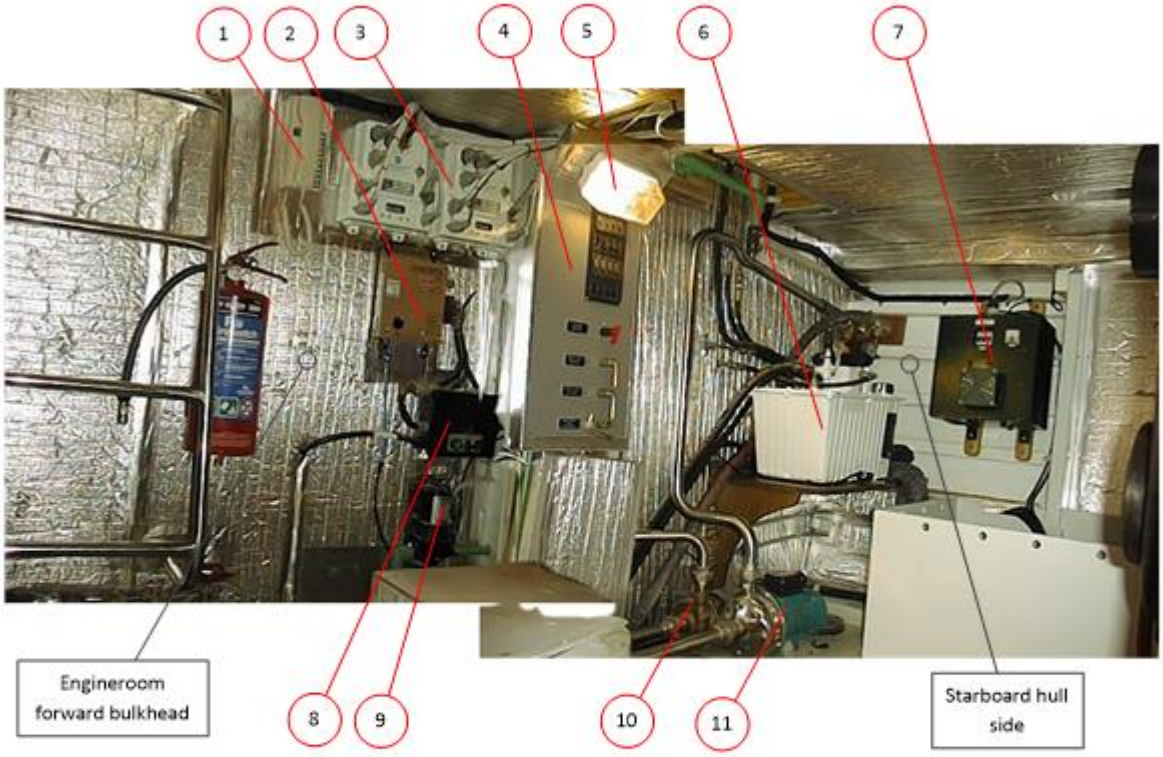
4.2. Source of ignition and location of the fire

4.2.1. The fire consumed the entire vessel down to the waterline, at which point it sank. Consequently, there was very little physical evidence remaining and the Commission was unable to conclusively establish the cause of the fire.

4.2.2. The first sign of smoke came from within the galley cabinets above the engine room, and later thick smoke was seen flowing from the engine room vents. It is very likely therefore that the fire started in the engine room.

4.2.3. The underwater survey of the wreck showed the charring in the timber hull was deepest in the forward starboard area of the engine room. Depth of charring is one indicator of how long a fire has burnt for. However, it can also be an indicator of the intensity of the fire in that area. Factors affecting the intensity of a fire include the supply of air to the space and the combustibility of materials in the area.

4.2.4. Most of the electrical installations and systems were located in the starboard forward area of the engine room, but so too was the hydraulic tank for the steering system. Electrical systems are a common cause of fires on small vessels. However, once ignited, hydraulic oil is known to burn with intensity, which could be one explanation for the deeper charring in the area. The deeper charring in that area was therefore not necessarily proof that the fire originated in that area.



Number	Item	Number	Item
1	Telephone	7	Inverter
2	Engine control	8	Engine control manual shutdown
3	Engine control computers	9	Fresh water pump
4	Battery switches	10	Air conditioning pump
5	Engine room light	11	Bilge pump
6	Hydraulic steering pump and system		

Figure 4
Composite image of the forward starboard area of the *PeeJay V* engine room (from survey records)

4.2.5. There are a number of other common causes of fire. Ruptured high pressure fuel lines can spray fuel onto hot surfaces. However, the fuel lines on the *PeeJay V*'s engine were effectively enclosed within the engine and the lines from the main fuel tank entered at its aft end.

4.2.6. Engine exhaust failure directing hot exhaust gas onto a flammable material is another potential cause. However, the exhaust system was located at the aft end of the engine room.

4.2.7. The main batteries were situated approximately mid-point on the starboard side of the engine room. It was not possible to establish what level of electrical protection was built into the system to prevent a short circuit from causing a fire.

4.2.8. Spontaneous or assisted combustion of oily rags and detritus is another known cause of fires. However, the engine room was known to have been kept in a clean and tidy state.

Finding

1. The Commission determined that the fire likely started in the engine room. However, the Commission has not been able to determine the cause of the fire.

4.3. Fire detection

Safety issue: a vessel certified to carry up to 90 passengers and operating up to 12 nm from the coast very likely did not have fire detection equipment or automatic fire alarms installed.

4.3.1. Maritime Rules Part 19 Maritime Transport Operator – Certification and Responsibilities. The purpose of Part 19 is to require maritime transport operators to develop, and operate in accordance with, safety systems that are specific and appropriate to their maritime transport operation. The Maritime Transport Operator Safety System is known as MOSS and is regulated by MNZ.

4.3.2. To enter MOSS, the operator must develop a Maritime Transport Operator Plan (MTOP) and submit it for a desktop review and site visit by MNZ. When MNZ are satisfied the MTOP complies with Part 19, they issue a Maritime Transport Operators Certificate (MTOC) to the operator. The maritime rules require that the MTOP ensures:

- 19.42 1 (a); identify and manage the safety risks involved in the maritime transport operation'.
- 19.42 2 (c); Address 'all reasonably foreseeable hazards associated with the… operation'.

4.3.3. There are effectively two steps to achieving those requirements. The first step is to identify the risks to the operation and develop controls for those risks. For example, the operator had identified that fire in the engine room was a risk, and hence the safety management system included a specific emergency procedure for that risk (see Appendix 1 Emergency procedures for fire).

4.3.4. The second step is to continuously monitor and review the operation for emerging risks or safety hazards.

4.3.5. The *PeeJay V* was built subject to Rule 40A which required that surfaces and materials of the engine room had 'low flame spread', 'fire-resisting' or 'non-combustible' properties. The use of such materials gave more time to detect and fight a fire. It is not known how long this fire had been burning in the engine compartment before smoke was first observed in the galley. The first indication of the fire was when the crew members standing adjacent to the galley smelt fumes. Because the source of the fire could not be determined, it is not known whether the fire had been building for some time or whether the onset was rapid.

4.3.6. There was a heat detector with a flashing light fitted in the engine room, but it was not connected to an alarm and hence was of limited benefit. Nobody could recall whether any other form of fire detection and automatic alarm system was installed on the vessel. There was nothing recorded in the vessel's documentation or maintenance plan and records, nor in the survey records. The survey checklist was notated 'not applicable' against the item fire detectors and automatic fire alarms. The crew were not aware of any detection and automatic alarm panel in the wheelhouse. It is therefore very unlikely that any form of useful fire detection and alarm system was installed on the vessel.

4.3.7. Maritime Rules do not require fire detection or automatic fire alarms to be fitted on board a restricted-limits[4] vessel less than 24 metres (m), such as the *PeeJay V*. If the vessel had been over 24 m in length maritime rules would require fire detection and automatic fire alarms to have been installed, regardless of how many people it was permitted to carry. Yet being under 24 m meant that no such a system was required.

4.3.8. Maritime rules are minimum standards that must be met, but operators can install a greater level of safety commensurate with the risk involved. Risk is a function of consequence and the likelihood of an accident happening. The consequence of a fire in the engine room of a passenger vessel is significant and the likelihood potentially greater than for some other areas of the vessel.

[4] Restricted limits means enclosed water limits and inshore water limits.

4.3.9. Safety management systems require operators to identify all of the hazards involved with their operation, and either eliminate or mitigate the hazard to reduce the risk to as low as reasonably practicable.

4.3.10. The operator's hazard register focused mainly on personal injury, such as slips, trips and falls, and gave limited consideration to fire and other catastrophic events. The only mention of fire in the hazard register was the spontaneous combustion of dirty rags in the engine room.

4.3.11. In 2003, the Commission published a report concerning a fire in the engine room of a 20 m long passenger vessel. That investigation, and subsequent discussion with the Maritime Safety Agency,[5] resulted in a recommendation (033/03) to the Director of the Maritime Safety Agency that:

> When conducting any review of maritime rule part 40A (Design and Equipment – Passenger Ships SOLAS) undertake a cost benefit analysis to consider any existing restricted limit passenger ships with totally enclosed engine spaces to be fitted with a fire detection system and a remotely operated fire extinguishing system in the engine space.
>
> Where a cost benefit is demonstrated as positive, consider drafting an amendment to maritime rule part 40A for the Minister's consideration.
>
> Any amendment of the rule to be phased so that existing passenger vessels above 15m, or carrying more than 36 passengers to be fitted with this equipment first.

4.3.12. Although automatic fire alarms were not specifically mentioned in the above recommendation, it logically follows that any fire detection system should incorporate an automatic alarm system. Since the recommendation was made Maritime Rules Part Rule 40A remains unchanged with respect to mandatory fire detection and automatic fire alarms on restricted-limits vessels. The recommendation is applicable to this accident as well. Currently, the recommendation remains with an open status. Consequently, the Commission has not repeated the recommendation, but draws the Director's attention to the safety issue and invites his further consideration of the issue in the interests of maritime transport safety.

4.3.13. The matter is on MNZ's policy issue register, and is due to be considered as part of the comprehensive review of the Maritime Rules Part Rule 40 for 2017/18.

4.4. Fighting the fire

Safety issue: the CO_2 fixed fire-fighting system installed in the engine room could not be fully effective in extinguishing the fire because the space it was protecting could not be fully closed down.

4.4.1. Fire is a chain reaction of rapid oxidation of a material and it requires three ingredients to continue: heat, fuel and oxygen. If one of the ingredients is removed the fire will be extinguished. A CO_2 flooding system is designed to displace the oxygen within a compartment and thus extinguish any fire within that space. It is a fire-fighting system commonly used in a vessel's engine room.

4.4.2. A CO_2 flooding system consists of liquid CO_2 stored in gas cylinders, a manual triggering mechanism, and a valve and pipe arrangement distributing CO_2 from the cylinder into the engine room. The CO_2 cylinders and the manual triggering mechanism are located outside the compartment they were designed to protect.

4.4.3. The integrity of a CO_2 flooding system in subduing a fire is dependent on depriving the fire of oxygen. For the CO_2 flooding system to work effectively, it follows that the compartment must be impervious to the escape of CO_2, or to the re-entry of air. This outcome is embodied in the Maritime Rules Part 42B.20 (4) [with respect to CO_2 flooding systems], 'Means must be provided to close all openings that may admit or allow gas to escape from a protected space'. A CO_2 flooding system will only work effectively if the compartment has been sealed by closing

[5] The Maritime Safety Agency was renamed Maritime New Zealand in 1993.

all doors, ducts and vents and then manually triggering the system and injecting CO_2 into the compartment.

4.4.4. The engine room of the *PeeJay V* was designed with a ventilation system to supply air for the engines. The ventilation system included a forced draft fan to force air into the engine room. There was also a set of passive ducts which vented the engine room to the atmosphere.

4.4.5. The passive ducts were fitted with flaps which could be closed in the event of a fire. The forced draft fan could be turned off remotely and also had a flap which could be closed.

4.4.6. When the CO_2 system was triggered it did suppress the fire, but only for a few minutes. The reason for this was there were at least four ways for fresh air to enter the engine room after the CO_2 had been injected into the compartment:

- one of the engine room ventilation flaps was closed some time after the CO_2 system had been triggered
- the master turned off the power to the forced draft fan when the fire was first discovered, but the crew were not able to close the fire flap over the duct as the closing mechanism was located within the lazarette
- during interviews the operators acknowledged a duct, or ducts, that ran from the engine room and vented to the atmosphere but did not have any method of closure
- smoke from the engine room was seen flowing out from the galley cabinets located above the engine room, but if it could flow out from the engine room then air could flow in.

4.4.7. Two of the four means for fresh air to enter the engine room were related to construction and two to crew training

4.5. Construction

4.5.1. The boat builder had built two vessels for the owner prior to the *PeeJay V*. The contract for *PeeJay V* was for the builder to manage the project, design and build the vessel. The owner would take delivery of a completed vessel with a Fit-For-Purpose certificate.

4.5.2. The builder sub-contracted a naval architect to provide drawings for the hull, decks and superstructure of the vessel. The design of engineering systems, including engine room ventilation and the CO_2 flooding system, was carried out by the boat builder.

4.5.3. The survey company (during construction) approved the design drawings of the hull, deck and superstructure vessel and he also inspected the vessel at various stages of construction to confirm its compliance with the Maritime Rules.

4.5.4. Regarding the engine room CO_2 flooding arrangement, the surveyor inspected and tested the components of the CO_2 flooding system. The components of the CO_2 system operated correctly and complied with the Maritime Rules. However, the vessel was constructed with at least two ducts into the engine room that were not possible to close or seal in the event of a fire. The surveyor was unaware of this route for CO_2 to escape and fresh air to enter the engine room. The owner had subsequently sealed one of the duct vents to stop sea-water ingress.

4.5.5. It could not be established whether the openings that allowed smoke to escape from the engine room into the galley had always been present or were the result of subsequent maintenance work. The routing of cables and pipework between adjacent compartments is a common cause of the fire integrity of compartments being compromised. It is important that this is considered by people and organisations involved in the design, installation and use of any fixed fire-fighting systems.

4.5.6. The construction arrangement demonstrated limited appreciation of a critical feature of CO_2 flooding systems.

4.6. Training

Safety issue: the operator and crew of the PeeJay V did not fully appreciate the principles underlying how a fixed fire-fighting CO_2 flooding systems works.

4.6.1. At interview it was apparent that the crew and operators of the *PeeJay V* did not fully appreciate the importance of completely sealing the engine room before activating the CO_2 system to extinguish the fire. Although they were aware that at least one duct could not be closed they did not consider this to be a serious threat.

4.6.2. Their training and understanding of the system was limited to the instructions printed on a notice in the cupboard alongside the triggering mechanism (see Figure 4). The emergency procedure instructions stated:

- Check no-one is in the engine space
- PASSENGERS out
- Close AIR FLAPS
- Shut FUEL OFF
- Release the CO_2.

4.6.3. The emergency procedure for a fire in the engine room, which the crew followed, was described in the *Boat Work Manual.* It was basically the same procedure as that given in the cupboard of the triggering mechanism.

Figure 5
CO_2 locker showing the CO_2 bottle and its instructions for use

4.6.4. The *PeeJay V*'s operator and crew training included fire drills on board the vessel, and they attended the local fire station to receive training and gain experience using fire extinguishers. However, the training on the CO_2 flooding system was limited. Consequently, the principles underlying how the CO_2 system worked were not well understood. Had they had a better appreciation for the principles of the CO_2 system it is more likely they would have understood the critical need for the compartment to be fully closed down.

4.6.5. However, it is likely that even if all the fire flaps had been closed before the CO_2 was triggered, the fire would not have been extinguished because air was able to enter the engine room through the duct.

Findings

2. The absence of a fire detection and alarm system on the *PeeJay V* meant the crew had less time and opportunity to respond to the fire and prepare the life-saving apparatus.

3. The construction of the engine room did not allow the compartment to be fully sealed, which rendered the CO_2 fixed fire-fighting system ineffective.

4. The crew were not sufficiently familiar with the principles of the CO_2 fixed fire-fighting system for the engine room, which meant they lacked the knowledge to ensure the integrity of the system before and during the fire.

4.7. Abandon ship

4.7.1. On this occasion, the *PeeJay V* was in the sheltered waters of Whakatāne River entrance and close to assistance when the passengers and crew had to abandon ship, some without wearing a life-jacket. Had the accident occurred further off-shore those passengers without life-jackets would have been exposed to a significantly increased risk.

4.7.2. In the event, the evacuation of passengers to their muster areas on the flybridge and foredeck was conducted by the crew decisively and efficiently. Likewise, the crew maintained good control of the situation during the transfer of passengers across to the assisting vessels.

4.7.3. However, due to the fire blocking access to where the life-jackets were stowed they were unable to access most of them on board and distribute them to the passengers.

4.7.4. Maritime Rule 40A requires, life-jackets must be stowed in locations approved by a surveyor and must be readily accessible to persons on board in an emergency. Life-jackets on board the *PeeJay V* were distributed between the forward cabin, the flybridge deck and the lazarette, with most stored in the forward cabin.

4.7.5. Access to the forward cabin was via an internal companionway down from the main cabin, or by climbing down through a hatch in the foredeck. The internal companionway and forward cabin was quickly filled by smoke and the crew did not have an opportunity to access the life-jackets. The crew faced similar conditions in the area of the lazarette and for the same reasons were unable to access the life-jackets stowed there.

4.7.6. The life-jacket stowage on board the *PeeJay V* was approved by the surveyor, and reasonably so. Although not required under the Maritime Rules, life-jackets were distributed around the vessel in three separate locations in an attempt to mitigate the risk from one location becoming inaccessible.

4.7.7. There will always be an element of risk, wherever life-jackets are stowed, that they may become inaccessible in the event of an emergency. In this accident a fire made the main and forward cabin inaccessible. The implication is that the life-jackets could have been stored elsewhere, but given the need to keep them protected from the elements and readily accessible the options available on a vessel the size of the *PeeJay V* were limited.

4.7.8. Maritime Rule 40A requires that, liferafts or buoyancy apparatus must be stowed so that they can be readily placed in the water on either side of the ship. The Carley float was stowed on the roof of the flybridge from where it could be launched on either side of the ship. However, the crew were unable to access the roof of the flybridge due to the fire and smoke and

therefore a vital piece of life-saving equipment, particularly for those passengers without life-jackets, was not available.

4.7.9. This accident demonstrates the difficulty small boat operators face when deciding where to stow fire-fighting and life-saving apparatus to be readily available in any foreseeable event. There was no fault in the way the operator distributed the life-saving apparatus on board the *PeeJay V*. The fire simply took hold too fast for the crew to make full use of all of the life-jackets and the Carley float.

4.7.10. The accident is also a good demonstration of how important it is to have systems for the early detection and suppression of emerging problems, leaving the crew with more options for responding to the situation in accordance with a pre-defined response plan.

Finding

5. Although the placement and storage of the lifesaving equipment on board the *PeeJay V* was well thought out, the speed with which the fire obstructed access meant a high percentage of the life-jackets and the Carley float could not be accessed.

5. Findings

5.1. The Commission determined that the fire likely started in the engine room. However, the Commission has not been able to determine the cause of the fire.

5.2. The absence of a fire detection and alarm system on the *PeeJay V* meant the crew had less time and opportunity to respond to the fire and prepare the life-saving apparatus.

5.3. The construction of the engine room did not allow the compartment to be fully sealed, which rendered the CO_2 fixed fire-fighting system ineffective.

5.4. The crew were not sufficiently familiar with the principles of the CO_2 fixed fire-fighting system for the engine room, which meant they lacked the knowledge to ensure the integrity of the system before and during the fire.

5.5. Although the placement and storage of the life-saving equipment on board the *PeeJay V* was well thought out, the speed with which the fire obstructed access meant a high percentage of the life-jackets and the Carley float could not be accessed.

6. Safety issues

6.1. The Maritime Rules did not require the *PeeJay V* to have fire detection or automatic fire alarms installed even though it could carry up to 90 passengers and operate up to 12 nm from the coast.

6.2. The CO_2 fixed fire-fighting system installed in the engine room could not be fully effective in extinguishing the fire because the space it was protecting could not be fully closed down.

6.3. The builder and operators of the vessel did not fully appreciate the principles of how the CO_2 fixed fire-fighting system operated.

7. Safety actions

General

7.1. The Commission classifies safety actions by two types:

(a) safety actions taken by the regulator or an operator to address safety issues identified by the Commission during an inquiry that would otherwise result in the Commission issuing a recommendation,

(b) safety actions taken by the regulator or an operator to address other safety issues that would not normally result in the Commission issuing a recommendation.

Safety actions addressing safety issues identified during an inquiry

7.2. The owner of the *PeeJay V* operated another vessel with a similar arrangement for the forced draft fan into the engine room. The owner installed a closing mechanism so the fire flap on that forced draft fan could be closed remotely without having to enter the vessel.

Safety actions addressing other safety issues

7.3. None.

8. Recommendations

General

8.1. The Commission may issue, or give notice of, recommendations to any person or organisation that it considers the most appropriate to address the identified safety issues, depending on whether these safety issues are applicable to a single operator only or to the wider transport sector. In this case, recommendations have been issued to [insert organisations], with notice of these recommendations given to [insert organisations].

8.2. In the interests of transport safety, it is important that these recommendations are implemented without delay to help prevent similar accidents or incidents occurring in the future.

Previous recommendations

8.3. Maritime Rules did not require the *PeeJay V* to have fire detection or automatic fire alarms installed even though it could carry up to 90 passengers and operate up to 12 nm from the coast.

The Commission determined that the fire likely started in the engine room of the *PeeJay V.* The very likely absence of an alarm system on the *PeeJay V* meant the crew had less time and opportunity to respond to the fire and prepare the life-saving apparatus.

In 2003, the Commission published a report concerning a fire in the engine room of a 20 m long passenger vessel. That investigation, and subsequent discussion with the Maritime Safety Agency,[6] resulted in a recommendation (033/03) to the Director of the Maritime Safety Agency that:

> When conducting any review of maritime rule part 40A (Design and Equipment – Passenger Ships SOLAS) undertake a cost benefit analysis to consider any existing restricted limit passenger ships with totally enclosed engine spaces to be fitted with a fire detection system and a remotely operated fire extinguishing system in the engine space.
>
> Where a cost benefit is demonstrated as positive, consider drafting an amendment to maritime rule part 40A for the Minister's consideration.
>
> Any amendment of the rule to be phased so that existing passenger vessels above 15m, or carrying more than 36 passengers to be fitted with this equipment first.

Currently, the recommendation remains with an open status. Since the recommendation was made, Maritime Rules Part Rule 40A remains unchanged with respect to mandatory fire detection and automatic fire alarms on restricted-limits vessels. The matter is on MNZ's policy issue register, and is due to be considered as part of the comprehensive review of the Maritime Rules Part Rule 40 for 2017/18.

The safety issue that this recommendation was to address is equally applicable to this accident, and it is virtually certain that it will arise again in the future unless it is addressed.

Therefore the Commission invites the Director of Maritime New Zealand to implement this recommendation as part of the 2017/18 review of Rule Part 40.

On 17 January 2018, Maritime New Zealand replied:

> At the time recommendation 033/03 was originally issued, MNZ was required to demonstrate that a regulatory change would meet a prescribed cost-benefit ratio before it could proceed. At that time, MNZ determined the change did not meet that threshold. While there is no longer a requirement to meet a prescribed cost-benefit ratio, in light of the PeeJay V incident, MNZ will:

[6] The Maritime Safety Agency was renamed Maritime New Zealand in 1993.

1. Undertake an appropriate cost-benefit analysis of the proposal as part of its wider review of the 40 series of Maritime Rules
2. If the cost-benefit analysis supports regulatory intervention, MNZ will recommend appropriate rule amendment(s) to the Minister to consider.
3. MNZ will ensure that any proposed amendments are prioritised according to the safety risks which those amendments intend to address.

The scoping for the review of the 40 series is due for completion within the next 6-12 months. The actual amendments will be sequenced over multiple years, beginning in the 2018/19 financial year. I foresee that MNZ will conclude its response to recommendation 033/03 during this period.

I will keep the Commission informed of progress on this matter.

New recommendation

8.4. The CO_2 fixed fire-fighting system installed in the engine room of the *PeeJay V* was not fully effective in extinguishing the fire because the space it was protecting was not, and could not, be fully closed down.

When the CO_2 system was triggered it did suppress the fire, but only for a few minutes. The reason for this was there was four ways for fresh air to enter the engine room after the CO_2 had been injected into the compartment.

The construction of the engine room did not allow the compartment to be fully sealed, which rendered the CO_2 fixed fire-fighting system ineffective.

The crew were not sufficiently familiar with the principles of the CO_2 fixed fire-fighting system for the engine room, which meant they lacked the knowledge to ensure the integrity of the system before and during the fire.

The Commission recommends to the Director of MNZ that he promotes the need for people and organisations involved in the design, installation and use of any fixed fire-fighting systems to fully document and understand the principles and operation of those systems. (035/17)

8.5. On 17 January 2018, Maritime New Zealand replied:

> I accept this recommendation. Maritime New Zealand (MNZ) will communicate directly with surveyors and other relevant persons to promote this need over the coming 12 months.

9. Key lessons

9.1. Early detection of a fire on board a vessel is critical to a successful fire-fighting response and for the early preparation of life-saving apparel and equipment.

9.2. Crew must be fully familiar with and trained in the use of fire-fighting systems on board, otherwise the systems might not be of any use in fighting a fire.

9.3. Even if a fixed Co_2 fire-fighting apparatus is fully functional, it will only be effective in fighting a fire if the design of the space it is protecting can be fully closed off.

Appendix 1: Emergency procedures for fire aboard the *PeeJay V*

EMERGENCY PROCEDURES FIRE

PEEJAY V

Fire ENGINE ROOM

Sound alarm

Close engine room flaps (port & starboard and also in pantry)

Consult with skipper (shut off E/room fan)

Move all passengers onto outside lower decks, check cabins

Flood engine room by opening valve on cylinder in port cupboard

Fire OTHER AREAS

Sound alarm

Consult with skipper

Muster passengers onto outside lower decks, check cabins

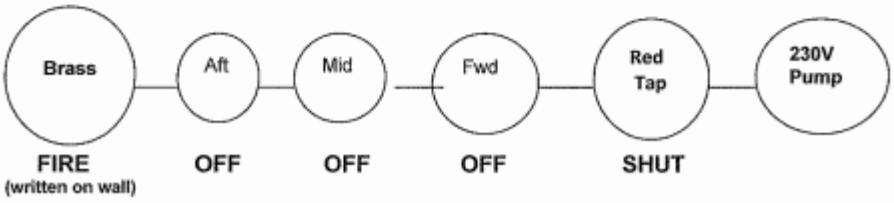
Depending on location of fire:

Options - 1. Fire extinguishers - galley, forward bunk cabin, main saloon, engine room, stairway leading to helm and aft lazerette

2. Fire buckets - centre hatch in cockpit

3. Fire hose - electric, hatch in back transom. Switch on saloon panel **"Fire pump"**

4. Fire hose - motor driven, hose stored in front starboard rope locker and connected on port side under step. Switch on panel at helm **"Engine Clutch Pump"**



White Island Tours Ltd, PeeJay V Boat Work Manual

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