Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

MARINE TRANSPORTATION SAFETY INVESTIGATION REPORT M22A0258

ENGINE ROOM FIRE

Roll-on/roll-off ferry *Holiday Island*
Wood Islands, Prince Edward Island
22 July 2022

Canada

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22 July 2022

Executive summary

The ferry *Holiday Island* operated on a 75-minute route that crosses the Northumberland Strait between Caribou, Nova Scotia, and Wood Islands, Prince Edward Island (PEI). On 22 July 2022, the vessel departed for Wood Islands on the 2nd voyage of the day. As the vessel approached Wood Islands, the fire alarm sounded in response to an engine room fire. The engines were shut down immediately and the fuel supply valves were closed shortly afterward. The master purposely beached the vessel on a sandbar to the west of the channel, outside the entrance to the Wood Islands terminal, and both anchors were dropped. The crew attempted to fight the fire locally but were unable to do so successfully. In part because of the smoke and heat, the air intake vents on the housetop deck were not closed. A remote release of the carbon dioxide (CO_2) fixed fire suppression system was unsuccessful. When the crew noticed this, the system was activated with a manual release and was partially successful. The vessel's fire team began boundary cooling.

Preparations for evacuating passengers and non-essential crew members began while the fire teams were responding to the fire. Crew members assisted passengers down both marine evacuation system slides and into the life rafts. The crews of nearby vessels evacuated passengers and non-essential crew from the life rafts and took them to the reception point at the Wood Islands dock. Approximately 1.5 hours after the fire alarm first sounded, all passengers and crew members who were not part of the fire response had left the vessel.

As shore-based firefighters boarded the vessel to assist, boundary cooling was expanded to the housetop deck and to the funnel deck and the firefighters began to monitor temperatures. At this time, a significant amount of smoke was coming out of the air intake and exhaust vents for the engine room.

Close to high tide, at 1850, the stern of the *Holiday Island* floated free. The *Holiday Island* had been listing approximately 2° to 3° to port since the early afternoon. By 2017, the list had increased to approximately 5° and by 2044, it was listing approximately 10° to port.

At 2148, out of concern for their safety, persons still on board (approximately 40) were evacuated. The fire continued to burn, and smoke from the engine room vents and stack continued to be visible until mid-afternoon on 23 July. On the morning of 24 July, the *Holiday Island* was towed to the Wood Islands terminal and the on-board vehicles were unloaded later that day. The vessel was later declared a constructive total loss.

In the course of the occurrence, different numbers of passengers and crew were recorded. The master initially reported a passenger count of 182 and a crew count of 23 (a total of 205). In total, 236 passengers were counted at the reception point.

The investigation found that a series of temporary repairs to a leaking fuel rail had been made over a period of approximately 1 month before the occurrence using non-standard materials and methods, while the vessel remained in service. When the final temporary repair to the leaking fuel rail failed, fuel sprayed onto the hot engine components and ignited.

The investigation also found the following:

- At the beginning of the firefighting response, water from a fire hose likely spread the burning engine fuel around the engine room and contributed to the spread of the fire.
- An unlubricated component of the fuel valve assembly prevented the fuel valve from closing fully, allowing the contents of the day tank to drain through the damaged fuel rail and fuel the fire in the engine room.
- The crew believed they had activated the CO_2 fire suppression system, because the resistance felt when the CO_2 release mechanism cable was pulled provided a false indication of success.
- The guidance posted was not explicit. Consequently, the CO_2 release was delayed, allowing the fire to grow. When the CO_2 was released, the engine room space was not completely sealed. Air continued to enter the space through open vents, likely displacing the released CO_2 and also adding oxygen to the fire. Consequently, the fire continued to burn.
- The flexible connection between the cooling system and the forward main engine was not protected against heat and fire. When the flexible connection was damaged by the fire, seawater from the vessel's cooling system entered and began flooding the closed engine room.

The investigation identified safety deficiencies related to policies and procedures for emergency responses and communication on the part of the crew, the vessel operator, and first responders. Specifically, the investigation also identified safety deficiencies related to accounting for passengers in case of an emergency. Lastly, the investigation identified safety deficiencies related to oversight by the authorized representative (AR) or their delegate, leading the Board to issue a recommendation.

Knowledge of the scope of the role and responsibilities of authorized representatives

Under the *Canada Shipping Act, 2001*, an AR, typically the vessel's owner, is the person who is responsible for acting with respect to all matters relating to the vessel that are not otherwise assigned to another person. The AR must keep up with changes in safety knowledge, standards, and regulations. Where matters are assigned by regulation to another role, such as the master, the AR remains responsible for oversight of those matters. In addition to ensuring regulatory compliance, the AR or the AR's delegate plays a proactive role in ensuring safety. Given the scope of the AR's responsibilities, the relationship between the master and AR is critical and collaboration is essential for the continued safe operation of a vessel. For example, this collaboration requires ongoing assessment by both the master and the AR to ensure that procedures are understood, followed, and accurately represent all operations and that they also comply with regulations.

As this investigation and many others demonstrate, the role of the AR is not always clearly understood. Transport Canada expects the AR to understand the scope of the role – that is, to take proactive measures to learn which regulations apply to their vessel and how to follow them. As such, the Board recommends that

> the Department of Transport provide comprehensive guidance for authorized representatives, outlining the full scope of their responsibilities. This guidance should support authorized representatives in understanding and complying with applicable regulations, thereby reducing the risk of vessels and crews operating without the minimum safety defences afforded by regulatory compliance.
>
> **TSB Recommendation M25-01**

1.0 FACTUAL INFORMATION

1.1 Particulars of the vessel

Table 1. Particulars of the vessel

Name	*Holiday Island*
International Maritime Organization number	7041431
Official number	344866
Port of registry	Charlottetown, PEI
Flag	Canada
Type	Roll-on/roll-off passenger ferry
Gross tonnage	3037
Registered length	98.60 m
Breadth	20.48 m
Depth	5.79 m
Built	1971, Port Weller Dry Docks Ltd., St. Catharines, Ontario, Canada
Propulsion	2 diesel engines, each with a Voith Schneider propulsion system, for a total of 5408 kW
Maximum complement	399 (381 passengers)
Owner and authorized representative	Minister of Transport, Canada
Operator	Northumberland Ferries Limited
Recognized organization and issuing authority for International Safety Management certification	Lloyd’s Register

1.2 Description of the vessel

The *Holiday Island* was a double-ended roll-on/roll-off ferry of steel construction (Figure 1) built in 1971. The vessel had 6 decks: the main deck (also called the truck deck), the mezzanine deck, the upper deck (also called the car deck), the boat deck, the housetop deck, and the funnel deck (Appendix A).

Figure 1. The *Holiday Island* ferry, before marine evacuation systems were installed (Source: M. Cathrae)

The 2 enclosed bridges,[1] crew accommodations, and offices were located on the boat deck. Each bridge was equipped with

- navigational equipment, including radars, an echo sounder, and an electronic chart system;
- a simplified voyage data recorder;
- propulsion controls at the centre helm position and at both bridge wings;
- control panels for the ballast system and for the fire detection and alarm system;
- remote controls for the fire doors on the main and upper decks and remote controls for the watertight doors below the main deck; and
- remote carbon dioxide (CO_2) release stations.

Communication equipment included 2 very high frequency (VHF) radios, 1 VHF–DSC (digital selective calling) radio, 2 sound-powered phones, and a public address (PA) system. Three portable VHF radios were also available on board.

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1 The convention on the *Holiday Island* was to refer to the bridge facing Caribou, Nova Scotia, as the forward bridge and the bridge facing Wood Islands, Prince Edward Island, as the aft bridge, irrespective of the direction of travel. Similarly, port and starboard are always the same sides. This report follows the same convention.

The pre-embarkation areas for the 2 muster stations were on the boat deck outside each bridge. The life rafts, marine evacuation systems (MESs),[2] and emergency generator were also located on the boat deck. The emergency generator fuel tank, the fan room, and the furnace rooms were located on the housetop deck. The fuel tank for the accommodations furnace was located on the funnel deck immediately above the fan and furnace rooms.

The main engine room, the engine control room (ECR), the auxiliary engine room, a workshop, and a crew dayroom, as well as fuel tanks, water tanks, and other compartments were located below the main deck. The 4 double-bottomed fuel tanks and the 2 sea chests for the engine cooling systems were located below the main engine room.

1.3 History of the occurrence

On 22 July 2022[3] at 0839, the *Holiday Island* departed Wood Islands, Prince Edward Island (PEI), on the 1st voyage of the day, with 22 crew members[4] on board. The vessel operated on a 75-minute route that crosses the Northumberland Strait between Caribou, Nova Scotia, and Wood Islands, running 3 to 8 times per day, depending on the season.

At 0945, the *Holiday Island* arrived at Caribou and the passengers disembarked. Once disembarkation was complete, the passengers waiting to make the trip to Wood Islands began to board. Two motor homes, 1 5th wheel trailer, 2 tent trailers, 5 tractor-trailers, 1 cube truck, and 78 passenger vehicles were loaded. At 1004, the *Holiday Island* departed for Wood Islands. At 1005, the Caribou toll booth operator reported a passenger count of 182 to the bridge team on the vessel.

At 1106, as the vessel approached Wood Islands (Figure 2), the fire alarm sounded on the bridge and the fire detection panel indicated that there was a fire in the main engine room. At this time, the bridge team consisted of the master, the second officer, and the quartermaster. At 1107, the fire alarm sounded throughout the vessel.

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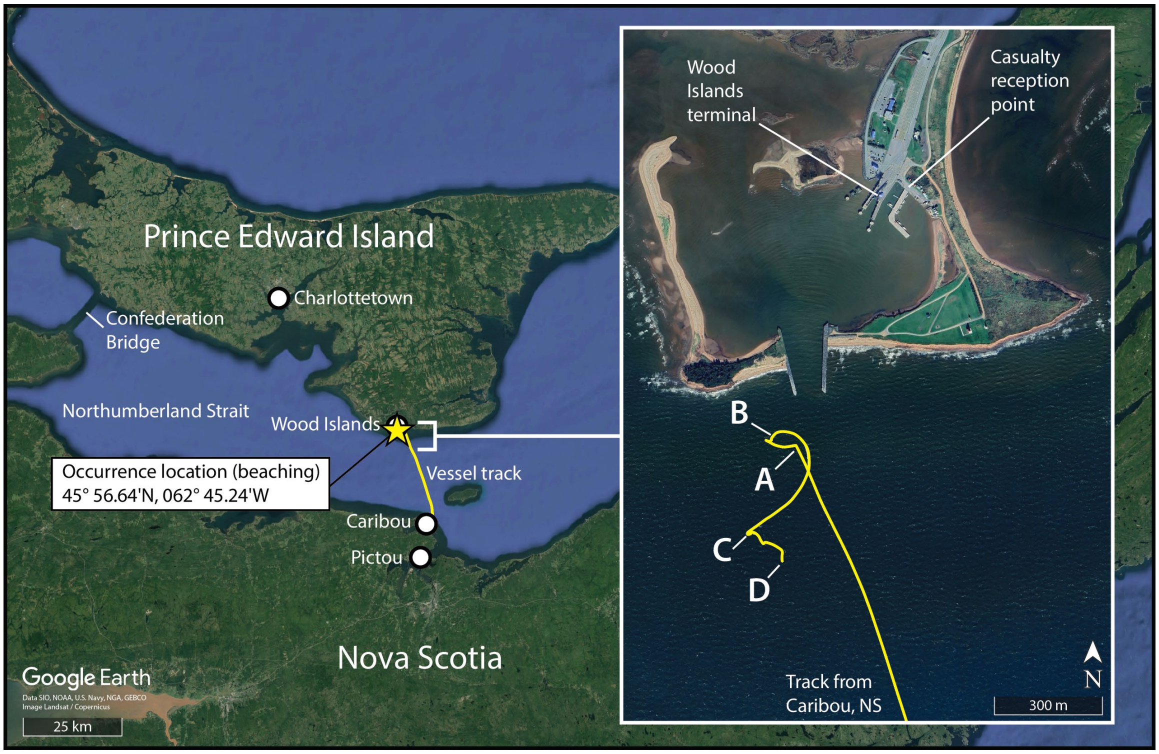
2 A marine evacuation system is "life saving equipment that consists of one or more inflatable life rafts, a slide or chute as a means of embarkation into the inflatable life rafts and, in the case of a system with more than one life raft, an inflatable rescue platform." (Source: Transport Canada, C.R.C., c. 1436, *Life Saving Equipment Regulations* (as amended 19 June 2024), subsection 2(1))

3 All times are in Atlantic Daylight Time (Coordinated Universal Time minus 3 hours).

4 A 23rd crew member (electrician) had finished his rotation on the previous day.

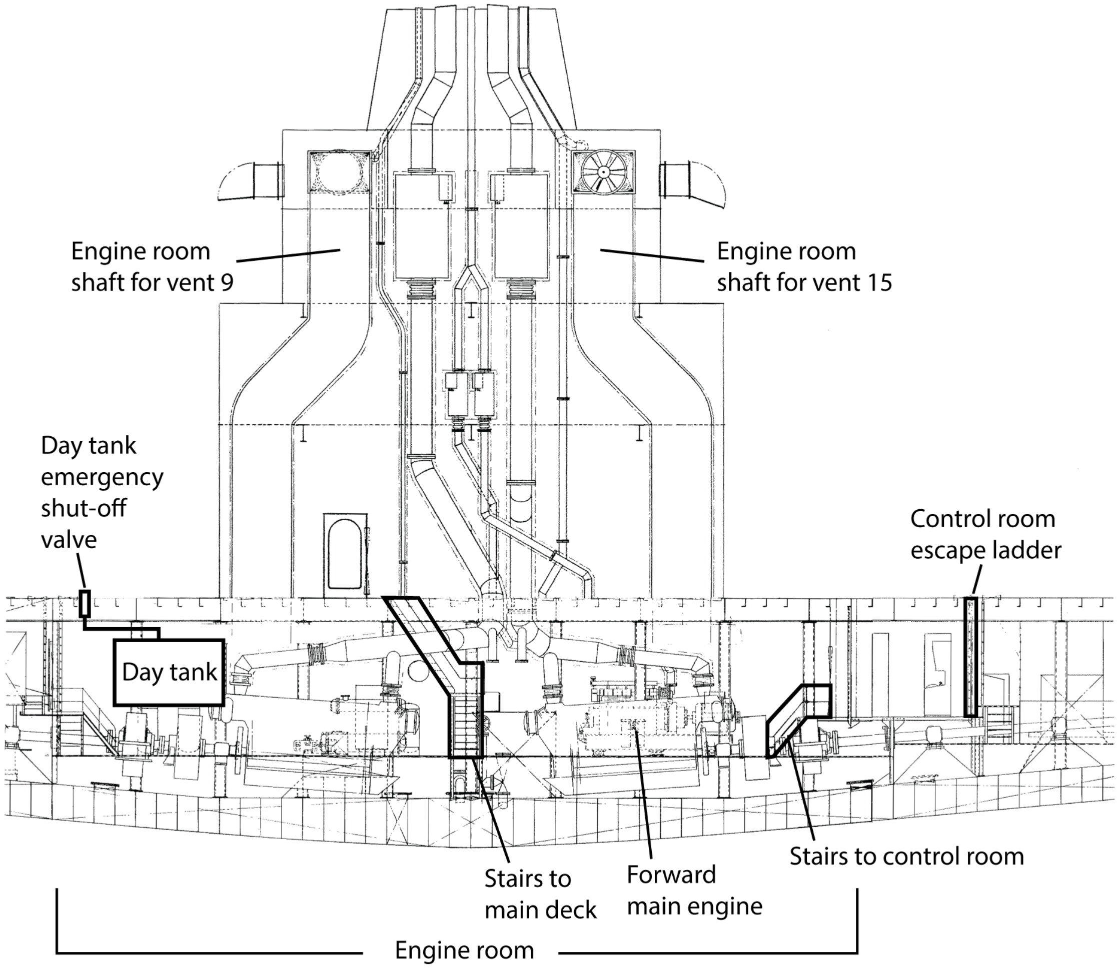
Figure 2. Map of the occurrence showing the vessel track and the beaching location, with an inset image showing the different locations of the vessel after the fire started: where the master beached the vessel (A); where the vessel floated free some hours later at high tide (B); where the vessel was towed, in deeper water (C); and where the vessel was abandoned (D) (Source of images: Google Earth, with TSB annotations)



The master used an intercom system to speak with the second engineer, who was in the ECR and who confirmed that there was a fire, informed the master that the engines had to be shut down, and then began to shut them down. The master then used the PA system to instruct all crew to prepare for an engine room fire. Deckhand 4 began to close vents and dampers. At the same time, the assistant engineer and the fourth engineer attempted to enter the main engine room from the main deck stairwell (Figure 3) but determined that the main engine room was too hot to enter. The assistant engineer went to don his firefighting suit.

Shortly afterward, the chief engineer went down to the main engine room. He also attempted to enter the engine room using the same door on the main deck but saw flames at the bottom of the stairs and closed the door. He then entered the ECR using the emergency escape hatch.

Figure 3. Profile view of the centre of the *Holiday Island* from the starboard side, showing the main engine room, engine control room, and engine room ventilation (Source: Port Weller Dry Docks Ltd., with TSB modifications)



At approximately 1108, the chief officer met the bosun on the truck deck and they began to prepare the fire hoses for firefighting and boundary cooling. While they were preparing the hoses, the master contacted the chief officer on a portable radio and requested that he prepare to drop both anchors. The quartermaster, deckhand 3, deckhand 4, the chief officer, and the bosun went to the forward mezzanine deck to prepare to drop anchor.

At 1109, the master phoned the terminal manager at Wood Islands to report the engine room fire. The terminal manager then called emergency services (911) to report the fire and request assistance.[5] From 1109 onward, the assistant engineer, deckhand 1, and the fourth engineer used a fire hose to spray water on the forward main engine from their position at the main deck entrance to the engine room.

5 The Wood Islands terminal manager and assistant manager updated the emergency services operator at 1116 and at 1125. At 1130, the terminal manager also contacted PEI Emergency Measures Organization and the Canadian Red Cross.

At 1110, the master used the PA system to instruct all passengers and crew to muster at the muster stations. This announcement was interrupted on the bridge by another fire alarm. The passenger services crew members began to direct passengers outside so they could distribute lifejackets. Some adult passengers were issued child-sized lifejackets and some children were issued adult-sized lifejackets; no infant-sized lifejackets were available.

At 1112, the master beached the vessel on a sandbar to the west of the channel, outside the entrance to the Wood Islands terminal.

At approximately 1115, both anchors were dropped and the 2 deckhands left the anchor team. Deckhand 3 was instructed to don a firefighting suit and join the bridge fire team. On his way to join the bridge fire team, he stopped to help distribute lifejackets to passengers who requested assistance. Deckhand 4 helped the engine room fire team don their gear and returned to closing vents and dampers.

At 1116, the chief engineer and second engineer left the ECR through the escape hatch and closed it behind them.

At approximately 1117, from the main deck, the second engineer used the remote controls to close the fuel shut-off valves to the main engine. When the chief engineer joined the fire team on the main deck, the fourth engineer went to close vents and dampers with deckhand 4.

At 1118, the master instructed the quartermaster to close all engine room vents on the main deck[6] in preparation for using the CO_2 fixed fire suppression system. The master immediately radioed the chief officer and the engine room fire team to inform them that the engine room vents were closed.

At 1121, a radio operator at the Sydney Marine Communications and Traffic Services (MCTS) transmitted a Mayday relay distress message for the *Holiday Island*. At the same time, the JRCC (Joint Rescue Coordination Center) Halifax tasked the Canadian Coast Guard Auxiliary (CCGA) vessel *Mellissa Jayne*, a local fishing vessel, to assist with the evacuation.

At 1124, the second officer left the bridge to join the chief officer. Because the amount of smoke billowing out of the funnel area had intensified, they decided to deploy the port MES in preparation for an evacuation.

At 1126, the fire team at the engine room door radioed the master to say that they were unable to fight the fire, that the entrances to the engine room were closed, and that everyone was out of the engine room. The fire team began boundary cooling under the supervision of the second engineer. At this point, they observed that paint had started to melt on the main deck above the engine room.

At 1127, from the bridge, the master activated the remote release for the CO_2 cylinders. Around the same time, the fourth engineer returned to inform the fire team on the main

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6 The engine room vents were located on the funnel deck and the housetop deck.

deck that he had been unable to close the exhaust vents on the funnel deck because of the smoke and heat. The assistant engineer, who was still in his firefighting suit, donned his breathing apparatus, crawled under the smoke to the vents, and closed them.

Deckhand 4 went to close air intake vents 9 and 15[7] on the housetop deck, which had to be closed from inside the fan room. The damper handle for vent 9 was in the closed position. At vent 15, the fan room was too hot and smoky to enter, so deckhand 4 closed the door by kicking it closed from the outside.

At 1142, the chief engineer observed that the amount of smoke coming out of the funnel area was increasing and temperatures were high. He went to the CO_2 control room to check whether the CO_2 had been released. When he confirmed that the pilot cylinders had not been discharged, he activated the main engine room CO_2 cylinders manually using the pilot cylinders and went to the bridge to report to the master.

1.3.1 Passenger evacuation

Preparations for evacuating passengers and non-essential crew members began while the fire teams were responding to the fire.

At 1117, using the PA system, the master directed "all passengers and crew not involved in firefighting, [to] please muster to the muster stations." The chief officer, the bosun, deckhand 2, and deckhand 3 joined the passenger evacuation teams.

Ashore, an operator from the 911 dispatch centre in Charlottetown, PEI, notified the JRCC that a ferry was on fire at Wood Islands and that it was being evacuated. At 1118, the JRCC asked an MCTS operator in Sydney, Nova Scotia, to transmit a Mayday relay. The JRCC also began to task air resources from the Canadian Armed Forces.

At 1119, the chief officer radioed to the bridge team that he was at the port MES, assisting with the passengers (Figure 4). Crew members who were familiar with the operation of the MESs gave instructions to the lined-up passengers who were within earshot.[8] At the same time, the JRCC tasked the Pictou, Nova Scotia, and Charlottetown inshore rescue boats[9] to assist with the evacuation.

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7 Vents 9 and 15 were the main engine air intake vents. They remained open throughout the occurrence.

8 The megaphone was not working because the batteries were run down.

9 Inshore rescue boats are fast rescue craft staffed by students and Naval Reserve personnel to support search and rescue operations in the busy summer season.

Figure 4. The *Holiday Island* at the entrance to the Wood Islands terminal, with the marine evacuation slides and life rafts deployed (Source: North River Fire Department, PEI)

Between 1120 and approximately 1200, the terminal manager and the assistant manager prepared the Wood Islands terminal to receive the *Holiday Island* passengers and the shore-based first responders. The terminal manager assumed the role of on-site response commander of the shore response control centre, as described in the Northumberland Ferries Limited (NFL) procedures.[10]

By 1130, the port MES slide was deployed by the chief officer. One crew member went down first to assist passengers in the life raft. By 1135, the bosun, second officer, and chief officer were assisting passengers down the slide and into the life raft.

At 1131, the alarm system began to sound on the bridge and throughout the vessel again and the bridge team was unable to silence it except by keeping the PA system active.

At 1133, as described in the NFL procedures for an evacuation, the master transmitted a Mayday call over VHF radio to report on the status of the *Holiday Island* and to announce that the crew were preparing to evacuate passengers from the vessel.

At 1136, the *Mellissa Jayne* arrived on scene and its crew began to evacuate passengers from the life raft. Many other nearby vessels arrived to help. Passengers boarded the vessels and were taken to the reception point at the Wood Islands dock. Shortly afterward, the second officer went to help with the starboard MES evacuation.

10 Northumberland Ferries Limited, Confederation / Holiday Island emergency response manual (March 2022), Section 2.3: Shore Response Control Centres.

At 1138, the master provided Sydney MCTS with a passenger count of 182 and a crew count of 23; at 1140, this count (205 persons) was reported to the JRCC by MCTS.

At approximately 1147, the second officer deployed the slide at the starboard MES. Deckhand 3 entered the starboard life raft to assist passengers.[11] From the life raft, the passengers boarded the responding vessels and were taken to the reception point at the Wood Islands dock. In total, 236 passengers were counted at the reception point.

At 1151, the master received reports that the bridge communications were being broadcast over the PA system because of the action taken to silence the fire alarm. Shortly afterward, a cloth was taped around the PA system handset so that conversations on the bridge were muffled.

By 1223, all passengers had left the vessel and the crew had searched the decks to confirm that no passengers remained on the vessel. By approximately 1228, crew members who were not part of the fire response had left the vessel.

1.3.2 Post-evacuation fire response

At 1231, the master was informed that shore-based firefighters from local fire departments had begun to arrive, bringing additional gear, such as air cylinders. A rope ladder was secured to the port main deck for the firefighters to use to board the vessel. At 1237, the master reviewed the vessel's fire control plan with the firefighters. The vessel's fire team began to take direction from the firefighters.

At 1242, the master advised the JRCC that he had accepted the firefighters' assistance. At some points, more than 30 firefighters from various fire departments were on the vessel. The deputy chief from the Belfast, PEI, fire department remained on the Wood Islands dock and tracked the firefighters as they came and went from the vessel.

With the additional firefighters, boundary cooling was expanded to the housetop deck and to the funnel deck, where the fuel tank for the accommodations furnace was located. At this time, the assistant engineer and a firefighter observed a significant amount of smoke coming out of the air intake fan for the engine room (vent 15). They attempted to enter the space, but it was too smoky to see and too hot. The firefighters monitored temperatures using thermal cameras on board and with a drone (Figure 5). At the point when firefighters began boundary cooling on the funnel deck, the funnel temperature was approximately 113 °C and the temperature of the furnace fuel tank was approximately 90 °C.

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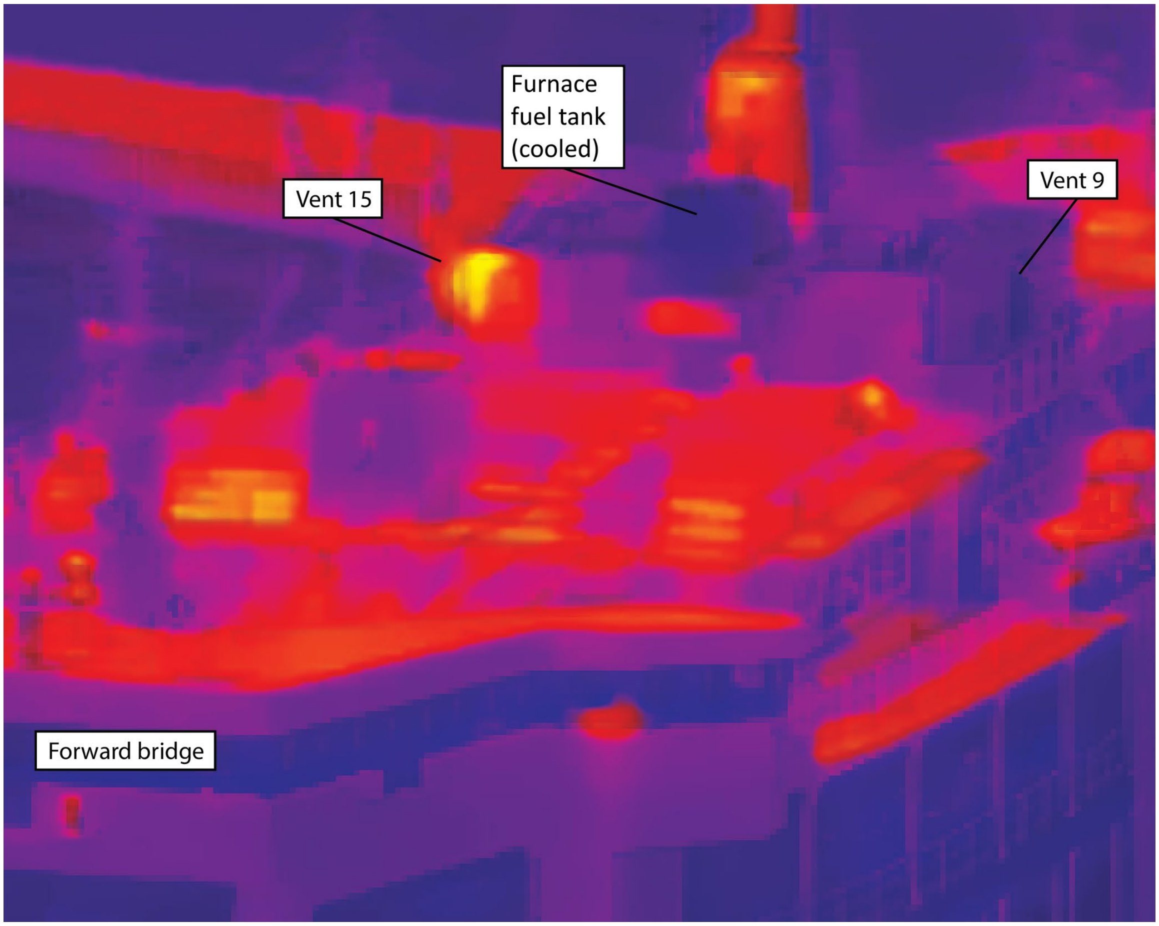
11 As the passengers came down the slide, crew members at the top and bottom of the slide used signals to control the evacuation.

Figure 5. Thermal scan of the centre of the *Holiday Island* showing a cool area around vent 9, as well the furnace fuel tank being cooled by the boundary cooling spray. A hotter area can be seen at vent 15. Note that some areas, such as the deck surface, appear hot because of the heat from the sun. (Source: North River Fire Department [PEI] with TSB annotations; thermal image superimposed on image of vessel)



At 1255, an NFL employee called the master to advise that a tug[12] had been arranged from Port Hawkesbury, Nova Scotia, so that the *Holiday Island* could be towed to the dock and fire trucks could be used.

At 1318, the terminal manager, in his role as on-site commander, informed the JRCC that 13 crew members and 6 firefighters remained on board.

At 1339, a Transport Canada (TC) marine safety inspector arrived on board and joined the firefighters in directing the fire response. Monitoring and boundary cooling continued.

At approximately 1340, the CCG vessel *Cape Spry* arrived on scene.

At 1614, 13 crew members and 23 firefighters were reported on board. Firefighters were rotating on and off the vessel, and monitoring and boundary cooling continued. The fire was still burning and the vessel was listing slightly to port.

12 The tug *Svitzer Bedford* arrived early on the morning of 23 July 2022.

At 1734, the TC marine safety inspector suggested the crew consider releasing the auxiliary engine room CO_2 cylinders. The crew and the firefighters traced the lines to determine how to release the auxiliary engine room cylinders into the main engine room and activated the pilot cylinders. After the pilot cylinders were activated, freezing was observed on the lines to the main engine room. Monitoring and boundary cooling continued.

Near 1830, NFL staff delivered some food and water to those on board and indicated that they planned to find a relief crew for the crew on board so that the fire response could continue until the vessel could be towed to the dock.

Close to high tide at 1850, the stern of the *Holiday Island* floated free. Between 1922 and 1945, the *Holiday Island* was towed approximately 270 m to a position further from the channel by the CCG lifeboat *Cape Spry* so that the passenger ferry *Confederation* could pass on its scheduled service. The *Holiday Island* remained in approximately 9 m of water; at the time, the vessel had a mean draft of 4.9 m.

At 1948, the vessel was listing approximately 2° to 3° to port, as it had been since the early afternoon.

At 2017, the TC marine safety inspector was replaced by another TC marine safety inspector. At this point, the *Holiday Island* was listing at approximately 5° to port.

At approximately 2030, a partial crew change on the *Holiday Island* was made.

By 2044, the vessel was listing approximately 10° to port. Crew began to sound the tanks and other spaces to determine if there was water ingress, and the firefighters and crew started planning how to pump water off the vessel. Using the thermal camera, firefighters observed that the temperature of a sounding pipe cap for 1 of the double-bottomed fuel tanks was 67 °C.

At 2107, the JRCC contacted the TC marine safety inspector who reported that the temperature of the fuel tanks was close to the flashpoint of the fuel (63 °C), and there was a risk of explosion. At 2116, when the JRCC could not reach the crew on the vessel, the JRCC advised the NFL vice-president of marine operations of the perceived risk. At 2120, the JRCC advised the first responders to prevent additional vessels and firefighters from approaching the *Holiday Island*.

At approximately 2125, the approximately 40 persons still on board were instructed to evacuate the vessel. At 2148, the evacuation was complete and confirmed. Smoke from the engine room vents and stack continued to be visible until mid-afternoon on 23 July.

On the morning of 24 July, the *Holiday Island* was towed to the Wood Islands terminal and the on-board vehicles were unloaded later that day.

The vessel was later declared a constructive total loss.

1.4 Environmental conditions

On 22 July 2022, the skies were partly cloudy. Winds were from the south-southeast at 5 to 10 knots and shifted to coming from the southwest later in the day. The wave heights were below 0.5 m throughout the day. The water temperature was approximately 20 °C.[13] In Charlottetown, air temperatures reached 29 °C, and the humidex value was 38 °C at its highest point. On the day of the occurrence, the crew had logged that some areas of the vessel were too dangerous to work in because of the heat and humidity.

The first low tide of the day was at 1203 (0.8 m) and the next high tide was at 1850 (1.7 m).[14]

1.5 Personnel certification and experience

The master held a Master Mariner certificate of competency. He had completed *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers* (STCW) Advanced Firefighting (AFF) training, most recently in January 2022. The master started his seagoing career as a fish harvester in the 1980s. In 1992, he began working as watchkeeper or chief officer on other types of commercial vessels. He began working for NFL in 2013 and had been master since 2016.

The chief officer held a Chief Mate, Near Coastal certificate of competency. He had completed STCW AFF training in April 2022. The chief officer had been working for NFL since 2012 and had been chief officer or second officer since 2014.

The second officer held a Master Mariner certificate of competency. He had completed STCW AFF training in June 2021. The second officer had been working with NFL as second officer or chief officer since 2019.

The chief engineer held a Second-Class Engineer, Motor Ship certificate of competency. He had completed STCW AFF training in 2017. The chief engineer had been working for NFL and Bay Ferries (an NFL subsidiary) since 2005 and had approximately 7 years of experience as chief engineer.

The second engineer held a Third-Class Engineer, Motor Ship certificate of competency. He had completed Marine Emergency Duties (MED) training modules C and D in 1991. The second engineer had been working as a watchkeeping engineer since 1971. He started to work on the *Holiday Island* in 1972 when it was owned by CN Marine. He had been working for NFL since 2001.

The fourth engineer held a Fourth-Class Engineer, Motor Ship certificate of competency. He had completed STCW AFF training, most recently in 2021. The fourth engineer had been working for NFL since 2013 and had been a watchkeeping engineer since 2015.

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13 Sea Temperature Info, "Water temperature in Northumberland Strait (PEI) in July," at https://seatemperature.info/july/northumberland-strait-water-temperature.html (last accessed on 15 July 2024).

14 Fisheries and Oceans Canada, "Wood Islands – 01680," at https://tides.gc.ca/en/stations/01680/2022-07-22 (last accessed on 15 July 2024).

The assistant engineer held a Watchkeeping Engineer, Motor-driven Fishing Vessel certificate of competency issued in August 1985 and an Engine Room Rating certificate issued in April 2018. He had completed MED Basic Safety training in January 1985. The assistant engineer had been working for NFL since 2016.

The passenger services supervisor had first taken passenger safety management training in 2011. Her most recent certificate expired on 11 June 2022. She had completed MED Basic Safety training in 2008. The passenger services supervisor had been working for NFL since 2008.

1.6 Vessel certification

The *Holiday Island* held an inspection certificate for Near Coastal, Class 2 voyages, limited to ferry service voyages in the Northumberland Strait between the ports of Caribou and Wood Islands. The certificate was valid until 10 May 2023. The *Holiday Island* had been issued 3 safe manning documents by TC. The safe manning level depended on the number of passengers on board (Table 2).

Table 2. Safe manning levels for different numbers of passengers

Number of passengers	Number of crew
0	11
1–184	16
185–381	18

The *Holiday Island* was classed with Lloyd's Register and inspected by Lloyd's Register acting as the recognized organization (RO)[15] under the Delegated Statutory Inspection Program (DSIP). The vessel operated under a safety management system (SMS). The SMS was certified and audited by Lloyd's Register under the *International Safety Management (ISM) Code.*[16]

1.7 Authorized representative

The *Canada Shipping Act, 2001* (CSA 2001), which came into force in 2007, is the legislation that governs marine transportation in Canada. One of the objectives of CSA 2001 is the promotion of safety in marine transportation. The role of a vessel's authorized representative (AR) is described in section 14 of the CSA 2001 and in regulations made under the act. The CSA 2001 was a significant revision of the *Canada Shipping Act* (R.S.C. 1985), the previous legislation governing marine transportation. As part of this legislative update, the role of the AR expanded significantly, with added responsibilities such as

15 ROs are classification societies. Classification societies also certify international SMSs.

16 When the *Holiday Island* and NFL were first enrolled in the DSIP, an SMS was a pre-requisite for passenger vessels to participate. At the time of the occurrence, an SMS was not required by regulation. SMSs are now mandatory for all such vessels (Transport Canada, SOR/2024-133, *Marine Safety Management System Regulations*).

developing procedures for safe operation and ensuring that vessels comply with regulations. Before 2007, the AR was primarily an administrative contact.

An AR is the person[17] who is responsible for acting with respect to all matters relating to the vessel that are not otherwise assigned to another person. Even where matters are assigned to another person, the AR remains responsible for oversight of those matters. For Canadian vessels, the role of the AR is tied to ownership.[18] The AR must be the owner of the vessel (or 1 among joint owners) or the bare-boat charterer. Since June 2023, the owner of a vessel may delegate a qualified person to act as the AR for that vessel. A qualified person must be a Canadian citizen or permanent resident, or a corporation incorporated under Canadian or provincial laws.[19]

1.7.1 Scope of responsibilities

The scope of AR responsibility covers many areas (see Appendix C for a detailed list). For example, ARs are required to provide vessel masters with written procedures. The procedures must cover familiarization with shipboard equipment, operational instructions, and assigned duties. ARs are also required to ensure that the vessel and its machinery and equipment meet regulatory requirements[20] and are seaworthy.[21] The AR also shares responsibility with the master for ensuring that the vessel and the people on board are protected from hazards.[22] In TC communications such as technical publications (TPs) and ship safety bulletins (SSBs), which relate to individual regulations or topics of interest to the marine community, TC explains the responsibilities of the AR, master, or other person responsible.

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17 Under Canadian law, a corporation is a separate legal person for the purposes of liability; thus, authorized representatives can be corporations.

18 For foreign vessels operating in Canada, the authorized representative is the vessel's master.

19 Government of Canada, *Canada Shipping Act*, *2001* (S.C. 2001, c. 26, as amended 23 June 2023), section 14.

20 Ibid., subsection 106(1).

21 Ibid., section 85.

22 Ibid., section 109.

ARs and similar roles (safety designate, authorized person, qualified person[23]) are constructs that are used in other domains, both in Canada and internationally.[24] There are differences in the details of these roles and between the marine industry and other domains. To assist ARs or their equivalents in understanding the scope of their responsibilities, some government departments and safety associations have developed training programs, manuals, information bulletins, and online resources.[25,26] For example, in Newfoundland and Labrador, WorkplaceNL (the province's workplace injury insurance provider) requires that a workplace with fewer than 6 employees have a workplace health-and-safety designate.[27] The safety designate's responsibilities are similar to that of a vessel's AR in that they are responsible for the health, safety, and welfare of the people employed in their workplace. The Newfoundland and Labrador Fish Harvesting Safety Association[28] has developed a WorkplaceNL-approved, free, 6-hour online course that safety designates must participate in.

TC Marine Safety and Security (TCMSS) has voluntary programs that provide training and information for some vessel owners, although these programs do not name ARs explicitly:

- Small Vessel Compliance Program[29] (for vessels under 15 gross tonnage [GT], including tugs and fishing vessels) training to help owners understand the scope of their responsibilities;

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23 The roles of qualified persons are generally defined in terms of their qualifications, that is, their knowledge and experience. For example, in the *Canada Occupational Safety and Health* regulations, a qualified person "means, in respect of a specified duty, a person who, because of his knowledge, training and experience, is qualified to perform that duty safely and properly." See Employment and Social Development Canada, SOR/86-304, *Canada Occupational Health and Safety Regulations* (as amended 15 December 2023), section 1.2: Interpretation.

24 For examples, see A. Jury and M. Pinsi, BSI/UK/1933/ST/0221/EN/AS, *Person responsible for regulatory compliance (PRRC) – MDR/IVDR Article 15: An overview of the requirements and practical considerations* (BSI National Standards Body), at https://www.bsigroup.com/globalassets/meddev/localfiles/fr-fr/whitepapers/wp---person-responsible.pdf (last accessed on 8 May 2025) and Netherlands Enterprise Agency, RVO, *Product Safety and the Role of the Authorized Representative*, at https://business.gov.nl/regulation/product-safety-and-role-of-authorised-representative/ (last accessed on 8 May 2025).

25 Canada Revenue Agency, "Responsibilities of authorized representatives," at https://www.canada.ca/en/revenue-agency/services/e-services/represent-a-client/responsibilities-authorized-representatives.html (last accessed on 8 May 2025).

26 Transport Canada Civil Aviation, "Authorized Person Program and Bulletins," at https://tc.canada.ca/en/aviation/training-pilots-aviation-personnel/authorized-person-program-bulletins (last accessed on 8 May 2025).

27 Government of Newfoundland and Labrador, *Occupational Health and Safety Act* (as amended in 2022), section 42.1: Workplace designate.

28 Newfoundland and Labrador Fish Harvesting Safety Association, "The Fishing Vessel Safety Designate Program," at https://www.nlfhsa.com/fvsd (last accessed on 8 May 2025).

29 Transport Canada, "Small Vessel Compliance Program," at https://tc.canada.ca/en/programs/small-vessel-compliance-program (last accessed on 8 May 2025).

- Best Practices in Rental Boat Safety,[30] an online course for owners of rental boat operations; and
- TPs, SSBs, and other communications related to specific regulations and safety issues.

The investigation did not find any publicly available guidance or training from TC that describes the scope of AR responsibilities for other sizes and types of vessels.

Recent TSB investigations[31] have demonstrated that the scope of the responsibility that TC assigns to ARs is not well understood in the Canadian marine industry. Even for larger vessels, the role may be perceived as an administrative contact.[32] The TC website mentions AR responsibilities in a few places, primarily by quoting legislation and regulations.[33]

1.7.2 Owner and authorized representative of the *Holiday Island*

The Government of Canada's Minister of Transport was identified as the registered owner and AR of the *Holiday Island*. At the time of the occurrence, TC owned 3 other ferries that operated on interprovincial ferry routes. The Minister of Transport is also identified as the AR for those vessels. The management of TC-owned ferries falls under the TC Programs Group.

Reporting to the Assistant Deputy Minister of Programs, TC Programs Group staff are responsible for programs related to all modes of transportation as well as environmental management, innovation, and waterways.[34] Staff involved in the ferry program include the Regional Director, Programs, Atlantic Region; the operations manager and staff; and the capital projects manager and staff. For the day-to-day operations of the *Holiday Island*, the Regional Director, Programs, Atlantic Region acted on behalf of the registered owner.

Larger projects that require a budget beyond regular operating expenses are considered capital projects. TC Programs Group was responsible for identifying and funding capital projects and for working with NFL to implement these projects. For example, the 2022 installation of the MESs was a capital project.

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30 Transport Canada, "Best Practices in Rental Boat Safety," at https://rentalboatsafety.ca (last accessed on 8 May 2025).

31 TSB marine transportation safety investigations M22P0259, M20P0230, M20P0229, M18P0014, M16C0036, and M10F0003.

32 For example, see S. Chapelski, "Canadian Maritime Law: Increased Penalties and Responsibilities for Authorized Representatives of Vessels," Norton Rose Fulbright (25 October 2023), at https://www.nortonrosefulbright.com/en/knowledge/publications/0dcf3bc6/canadian-maritime-law-increased-penalties-and-responsibilities (last accessed on 8 May 2025).

33 For example, refer to TC's "Form 14—Appointment of Authorized Representative (form 84-0035)," which is required only if "the vessel is owned by more than 1 owner or by a foreign corporation," under "Appointing a representative" at https://tc.canada.ca/en/marine-transportation/vessel-licensing-registration/apply-manage-vessel-registration/information-you-may-need-apply#toc-5 (last accessed on 8 May 2025). The authorized representative is also often mentioned in TC's ship safety bulletins.

34 Transport Canada, "Programs Group," at https://tc.canada.ca/en/corporate-services/transparency/briefing-documents-transport-canada/20191120/20191120/programs-group (last accessed on 8 May 2025).

The TC Programs Group staff who oversaw the TC ferry program were familiar with the government processes for capital projects, such as the acquisition of the MESs, and for routine funding, such as contribution agreements. Only 2 of the staff involved in the ferry program had marine experience and both reported to the capital projects manager. They focused on capital projects such as evaluating potential replacement vessels, though they would occasionally support the operations manager, if requested. Because ferry program staff considered that the day-to-day operation of the vessel, including maintenance procedures and other AR responsibilities, had been sub-delegated to NFL, they provided limited oversight or guidance on vessel operations.

TC Programs Group operates separately from TC Safety and Security. TC Safety and Security is responsible for the development of regulations and national standards and the implementation of monitoring, testing, inspections, and subsidy programs in the aviation, marine, rail, and road sectors.

Reporting to the Assistant Deputy Minister of Safety and Security, the TCMSS staff oversee the certification and oversight of all commercial vessels under the CSA 2001.

1.8 Northumberland Ferries Limited operations

TC Programs Group had a charter party agreement with NFL to operate the *Holiday Island* on its behalf; operations were financially supported through a contribution agreement with NFL that was signed by TC's Regional Director, Programs, Atlantic Region and NFL's President and Chief Executive Officer.[35] The agreements between NFL and TC stated that NFL "shall act as if it were the 'authorized representative' (as defined in the *Canada Shipping Act, 2001*) of such vessel."[36] In administrative documents, various people at both TC Programs Group and NFL signed as the AR at different times. Under the DSIP, an AR can authorize the vessel operator to act as the signing authority. When the *Holiday Island* was enrolled into the DSIP as a fully delegated vessel, TCMSS reminded TC Programs Group that TC Programs Group remained responsible for the duties of the AR, as defined in the CSA 2001.

The agreements between TC and the operator are regularly reviewed and renewed for periods of 1 to 5 years. These agreements included requirements for NFL to

- provide the operations manager at TC Programs Group with quarterly reports about crossings;
- report any incident, accident, occurrence, or deficiency that required communications with organizations such as the RO or MCTS;

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35 At the time of the occurrence, the vice-president of marine operations for NFL also acted as the designated person ashore and the customer safety officer, and acted in other roles for Bay Ferries and the vessels associated with their routes.

36 Canada–Northumberland Ferries Limited, Ferry Services Contribution Program, Agreement for Wood Islands, Prince Edward Island to Caribou, Nova Scotia Ferry Service, Section 3.6.3: Safety of vessels.

- notify TC Programs Group when ferry crossings had to be cancelled for any reason; and
- notify TC Programs Group when emergency repairs were needed.

Emergency repairs were not defined in the agreements but were described internally as any incident that could affect the operation of the ship or a situation that could get worse if ignored. The investigation found 2 notifications from NFL to TC Programs Group in 2022 about a need for emergency repairs. One notification resulted in a repair that caused a delay in crossings. The other notification resulted in a repair that caused cancellations and was related to a system that was part of a capital project.

TC Programs Group, on behalf of the owner, was required to commission an annual vessel inspection; NFL was required to respond to this inspection report. The last annual vessel inspection report for the *Holiday Island* was produced in 2017. Informal discussions about maintenance continued during site visits and other conversations related to the quarterly reports from NFL (see section 1.14, Maintenance and repairs).

1.8.1 Typical trip

During the tourist season, PEI is a popular destination for travellers, and the demand for travel to the island is high. The Northumberland Strait separates the mainland from PEI; this body of water is significant for tourism and is also an important location for shellfish fisheries, especially lobster. To cross the Northumberland Strait, travellers can use the Confederation Bridge or take the ferry. To accommodate the volume of travellers, NFL[37] operated 2 ferries, the *Confederation* and the *Holiday Island,* for a total of 8 trips in each direction daily.[38] Ferries carry vehicles as well as walk-on passengers; some trucking companies use the ferry crossing to shorten the travel distance required for commercial deliveries.[39] The number of vehicles that could be loaded on each vessel varied according to the tide.

Throughout the year, the ferry crossing is often fully booked. Delayed or cancelled crossings could result in a long wait at the terminal or could require passengers to use the

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[37] Bay Ferries, a subsidiary of NFL, operates the ferry route between Saint John, New Brunswick, and Digby, Nova Scotia, and the route between Bar Harbor, Maine, and Yarmouth, Nova Scotia. NFL and Bay Ferries are separate organizations, but many of the administrative tasks are managed centrally and some of the shore staff have a role in both organizations.

[38] When it is not the tourist season, NFL operates 1 ferry and makes 3 to 4 trips in each direction daily.

[39] S. Bruce, "Plans in the works for extra P.E.I.–Nova Scotia sailings," CBC News (published 17 June 2016, updated 17 June 2016), at https://www.cbc.ca/news/canada/prince-edward-island/pei-nova-scotia-ferry-mv-holiday-island-1.3640913 (last accessed on 12 May 2025).

Confederation Bridge instead. Delayed or cancelled crossings often result in high-profile news coverage.[40]

On a typical day, the *Holiday Island* departed on its 1st crossing from Wood Islands at 0830 and completed the 8th crossing back to Wood Islands around 2115. The Caribou–Wood Islands crossing took approximately 75 minutes.

At each end of the trip, unloading and loading the *Holiday Island* took between 20 and 30 minutes. Passengers were asked to leave their vehicles during the crossing, and most passengers spent the trip on the boat deck or in the observation area on the housetop deck. At the beginning of each crossing, a safety briefing was broadcast over the PA system.

Passengers could book online, by phone, or when they arrived at the terminal; most passengers booked online.[41] Passengers travelling with a vehicle purchased 1 ticket for the vehicle and all passengers. Walk-on passengers purchased 1 ticket per person. Whether passengers booked online or at the terminal, they registered with the toll booth operator when they arrived.

1.8.2 Software for booking and reporting travel

Passengers purchased tickets through an online booking form on the NFL website that was created using commercially available software. The website used only some components of the software.[42] The form asked the user to select the crossing date and time, identify the number of passengers in each of 4 age groups (over 60, 13 to 59, 6 to 12, or 0 to 5 years old), choose whether the same passengers would be on the return trip (if a return trip was being booked), and add vehicle information. The name and accessibility requirements for each passenger could be entered as well as detailed contact information for the booking contact person. No controls verified that the information entered by passengers, such as the names and numbers of passengers, was accurate. As well, some passengers were unable to enter a different number of passengers on the outbound versus the return segments of round trips.

One report generated by the software was the resource manifest report. This report summarized the bookings and listed the contact details, the number of passengers, and the type of vehicle. The resource manifest report also contained a column for the numbers of passengers and vehicles that boarded; NFL did not use the module that recorded passengers as they boarded the vessel and so this column was empty. The investigation determined that the information from these manifests was not used by the crew.

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40 G. Harding, "P.E.I. premier wants 2nd ferry for Caribou–Wood Islands run," CBC News (published 09 August 2016, updated 09 August 2016), at https://www.cbc.ca/news/canada/prince-edward-island/pei-caribou-wood-islands-ferry-1.3713333 (last accessed on 12 May 2025).

41 For example, in 2021, approximately 84% of passengers booked (and paid) online, 11% booked by phone, and 5% paid on arrival. Source: Narrative Research, 2021 *Northumberland Ferries Limited Passenger Study* (February 2022).

42 The ferry system software includes booking, check-in (terminal), account management, finance, sales, and reporting components, all based on a common database.

On the day of the occurrence and in January 2023, TSB investigators requested passenger data for the occurrence voyage. For each request, investigators received a copy of the resource manifest report from the online booking system with different counts in each (230 passengers versus 166 passengers).

1.9 Passenger management

In case of an emergency, crew and passengers need to be appropriately equipped and informed. As the management of passengers on a vessel during an incident brings additional complexity, the regulations stipulate higher standards for construction, equipment, and training on passenger vessels compared with similar commercial vessels. Regulations and guidance also set time limits for completing some emergency procedures. For example, passengers on a roll-on/roll-off vessel must be mustered and counted within 30 minutes of the general alarm sounding, and evacuation cannot take longer than 30 minutes.[43]

To prepare for emergencies, crew members need training as well as access to documented emergency procedures. These procedures must be reviewed and practised regularly to ensure the crew can respond effectively. Passengers need instructions on where to muster in the event of an emergency, where to access life-saving equipment, and how to use that life-saving equipment. Being prepared for how passengers may react in an emergency scenario and having experience in how to manage them is an important element of crew training on passenger vessels.

The vessel's AR is responsible for ensuring that both the crew and the passengers receive safety training.[44] Typically, the master carries out drills for the crew, following the procedures supplied by the AR. The master is also responsible for maintaining records of training and familiarization.[45]

1.9.1 Passenger count

The *Fire and Boat Drills Regulations* require that, before a passenger vessel sails, the master is to be provided with the number of persons on board and with details of persons who have declared a need for special care or assistance during an emergency.[46] An accurate count of all persons on board (passengers and crew members) is important to ensure that

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[43] Transport Canada, C.R.C., C. 1436, *Life Saving Equipment Regulations* (as amended 20 December 2023), section 111. See also guidance provided in Transport Canada *Ship Safety Bulletin* 04/2022: Requirements for passenger evacuation and safety (08 February 2022), at https://tc.canada.ca/sites/default/files/2022-02/SSB-04-2022E.pdf (last accessed on 12 May 2025).

[44] Government of Canada, *Canada Shipping Act, 2001* (S.C. 2001, c. 26) (as amended 22 June 2023), paragraph 106(1)(c).

[45] Transport Canada, SOR/2007-115, *Marine Personnel Regulations* (as amended 23 June 2021), section 205.

[46] Transport Canada, SOR/2010-83, *Fire and Boat Drills Regulations* (as amended 20 December 2023), section 10.

everyone on board is accounted for in an emergency. An accurate count is also important for ensuring enough crew and equipment are available.

The passengers were counted by the toll booth operators before they boarded the *Holiday Island*. Once boarding was complete, a toll booth operator reported the total number of passengers to the bridge. On the occurrence voyage, the toll booth operator reported 182 passengers. As well, the bridge recorded that 2 of the 182 passengers would require assistance in an emergency. The number of children and infants was not recorded.

1.9.2 Passenger management training

The *Holiday Island* safe manning document for 185-381 passengers[47] specified that Specialized Passenger Safety Management (Ro-Ro [roll-on/roll-off] Vessels) training was required for most of the crew,[48] specifically, the master, chief mate, chief engineer, second engineer, and any crew members who interacted with passengers or who had duties involving cargo. Most of the crew members interacted with passengers, managed passengers at muster stations, or were involved in loading or discharging passengers.

In this occurrence

- the master, chief engineer, second engineer, and 2 other crew members had current Specialized Passenger Safety Management (Ro-Ro Vessels) training;
- the chief mate and 9 other crew members had general passenger safety management training (which was expired for 5 of these 10 crew); and
- the remaining 7 crew members interacted with passengers but had no passenger safety management training.

1.10 Engine systems

The *Holiday Island* was equipped with two 12-cylinder Anglo Belgian Corporation marine diesel engines (Figure 6) fuelled by marine gas oil (MGO).[49] Each engine was cooled by a seawater cooling system.

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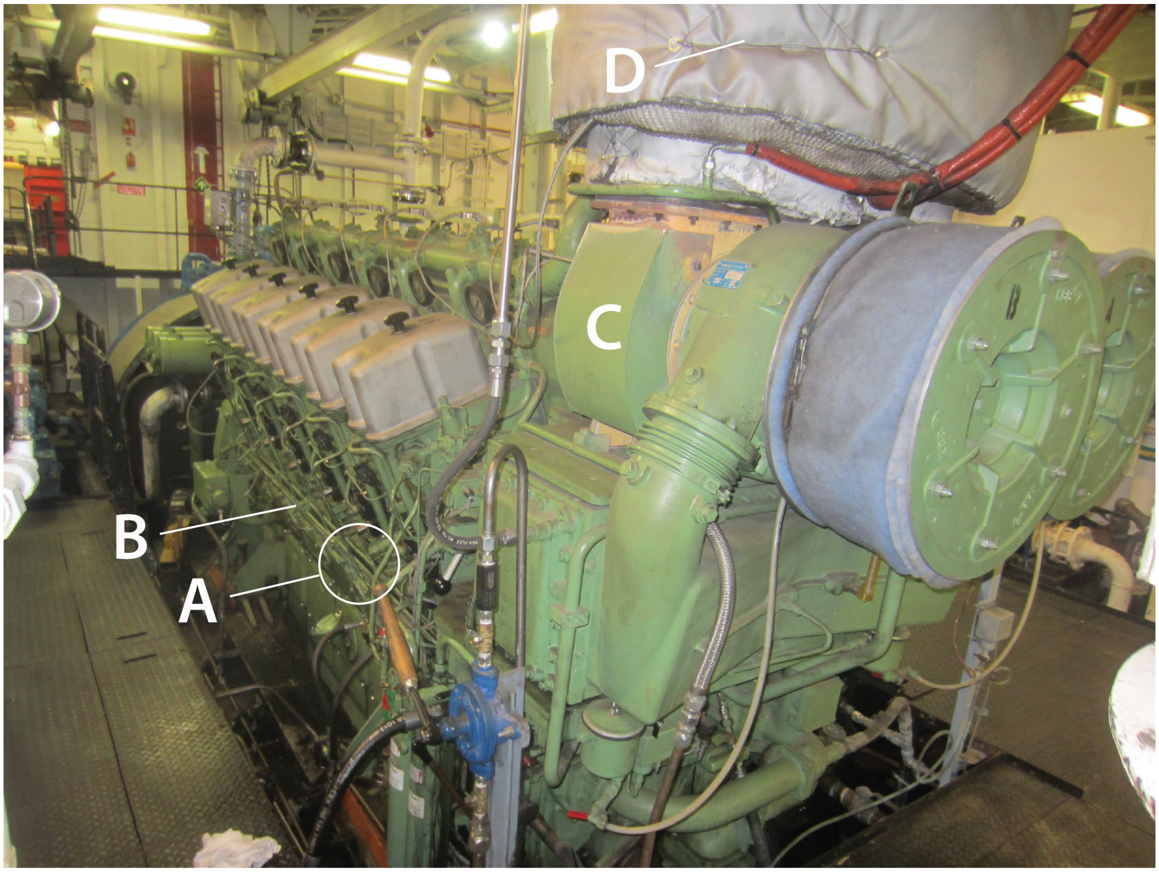
[47] The safe manning document for 1-184 passengers specified that appropriate crew members are to hold relevant specialized passenger safety management and passenger safety management in accordance with sections 205 and 229 of the *Marine Personnel Regulations*.

[48] Transport Canada, SOR/2007-115, *Marine Personnel Regulations* (as amended 23 June 2021), section 229.

[49] Irving, Safety Data Sheet #27944: Marine Gas Oil (18 November 2022).

Figure 6. The aft engine before the occurrence, showing the location of the repairs (A) to the fuel rail (B), the turbo charger assembly (C), and the exhaust (D). The arrangement is identical to that of the forward engine, where the fire started (Source: Northumberland Ferries Limited, with TSB annotations)



The engines were replaced in 2014. The vessel was in class and enrolled in the DSIP; the replacement followed both Lloyd's Register class rules and TC regulations.

Many hot surfaces and potential ignition sources exist in engine rooms and similar spaces (Table 3). To assist in preventing a fire, TC required a means to prevent escaping oil from coming into contact with hot surfaces.[50] International Maritime Organization (IMO) guidelines further recommend that all vessels should protect surfaces that can reach temperatures above 220 °C and that may be exposed in the case of a fuel system failure.[51]

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50 Transport Canada, SOR/90-264, *Marine Machinery Regulations* (as amended 23 June 2021), Schedule XII, Part 1 (Section 4), Item 21. Newer vessels may also be subject to the *International Convention for the Safety of Life at Sea (SOLAS), 1974*.

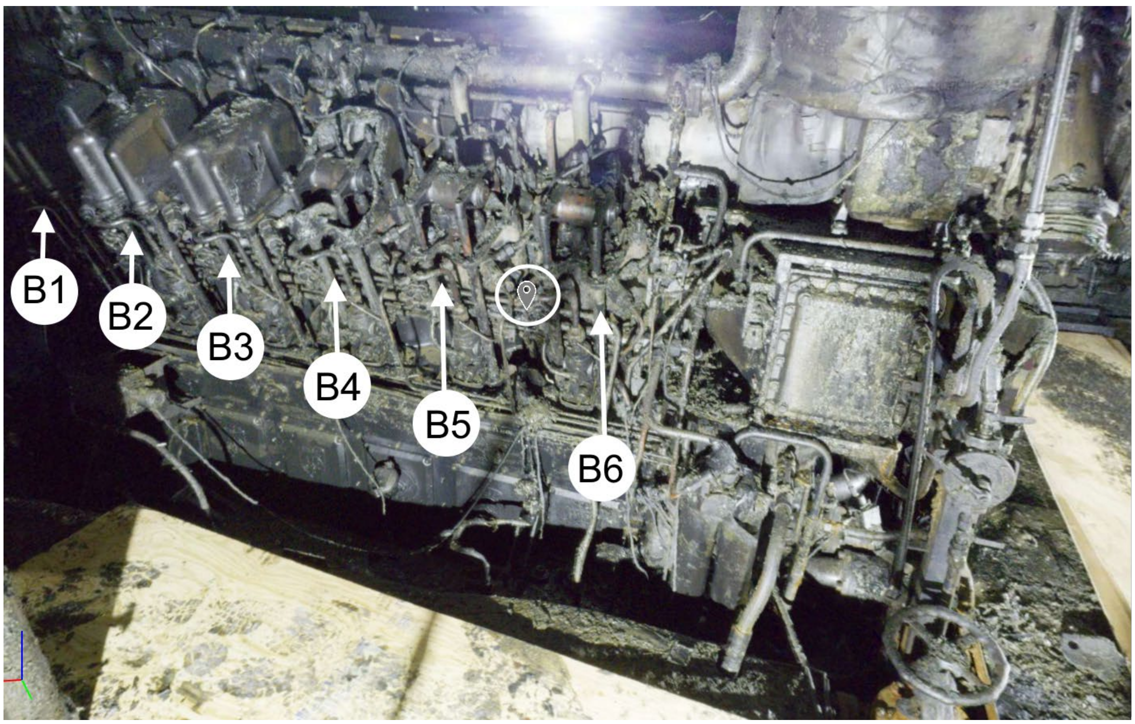
51 International Maritime Organization, MSC.1/Circ.1321, "Guidelines for Measures to Prevent Fires in Engine-Rooms and Cargo Pump-Rooms" (11 June 2009), at https://webaccounts.imo.org/Common/WebLogin.aspx?App=IMODOCS (last accessed on 10 June 2025). It is necessary to create a free account to view the circulars.

Table 3. Engine temperatures (°C) for the forward engine of the *Holiday Island* (Source: Anglo Belgian Corporation, Diesel engine test report [2014])

Location	Temperature
Exhaust before turbine	590 °C at 75% load
Exhaust at each cylinder	445 to 465 °C at 75% load

Post-occurrence, the greatest fire damage was observed on the main engine between cylinders B5 and B6 (Figure 7).

Figure 7. The cylinder head covers on cylinders B1 and B2 are intact. The covers on cylinders B3 and B4 are partially damaged and the covers on cylinders B5 and B6 are completely destroyed. The location of temporary repair to the fuel line is circled. (Source: TSB)



1.10.1 Fuel system

Fuel was stored in double-bottomed tanks and transferred to the day tank[52] inside the engine room. The fuel for each engine was gravity-fed from the day tank. The day tank held approximately 5 metric tonnes and was refilled multiple times daily. Post-occurrence, the TSB laboratory calculated that the flow rate of the MGO through a severed forward main engine rail could drain the volume of the day tank within 6 hours. The TSB laboratory concluded that unburned fuel from failures in fuel supply components likely collected in the bilge and supplied additional fuel to the fire.

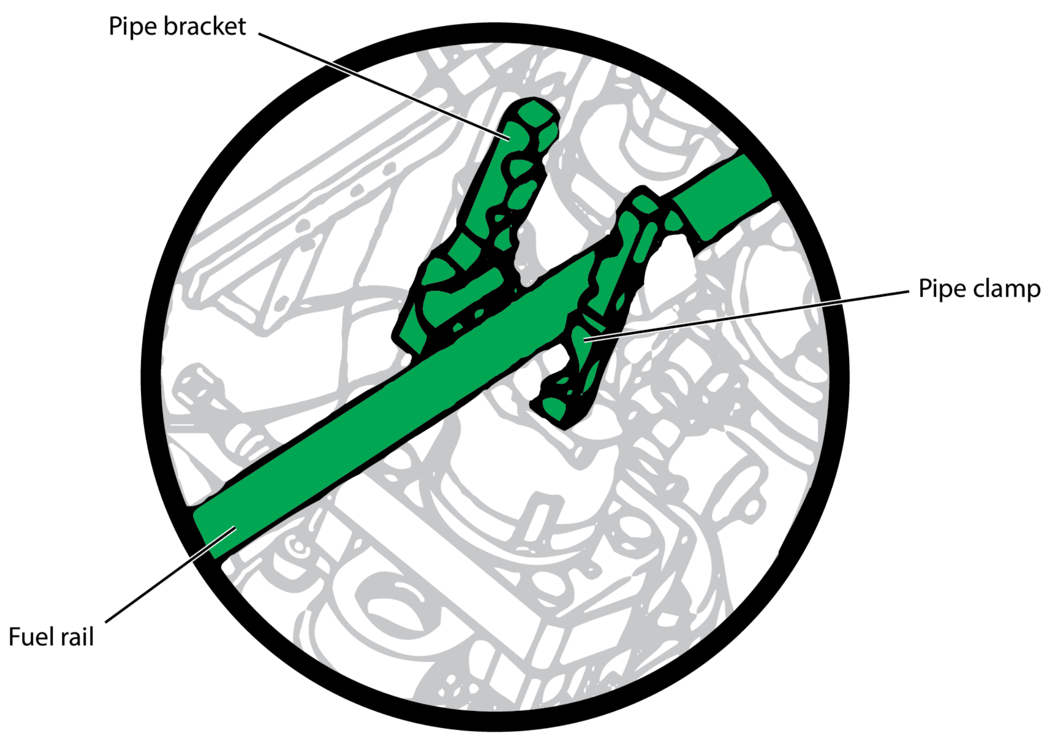
A fuel rail delivered fuel to the fuel injection pump and fuel injector for each engine cylinder. The fuel rail was a 25 mm diameter steel pipe,[53] supported between the cylinders

52 The day tank supplied both the main engines and the 2 ship service generators.

53 The fuel rail was manufactured from DIN 2391 ST 35 steel.

by pipe clamps secured to pipe brackets (Figure 8). The nominal working pressure of the fuel rail was approximately 2.0 to 2.5 bars. The fuel system was last inspected by the RO on 30 May 2021. This inspection included tightness of fittings, fire precaution arrangements (for example, jacketed pipes and their leak detection equipment), flexible hoses, and sounding arrangements. It also included emergency fuel shut-offs and vents.

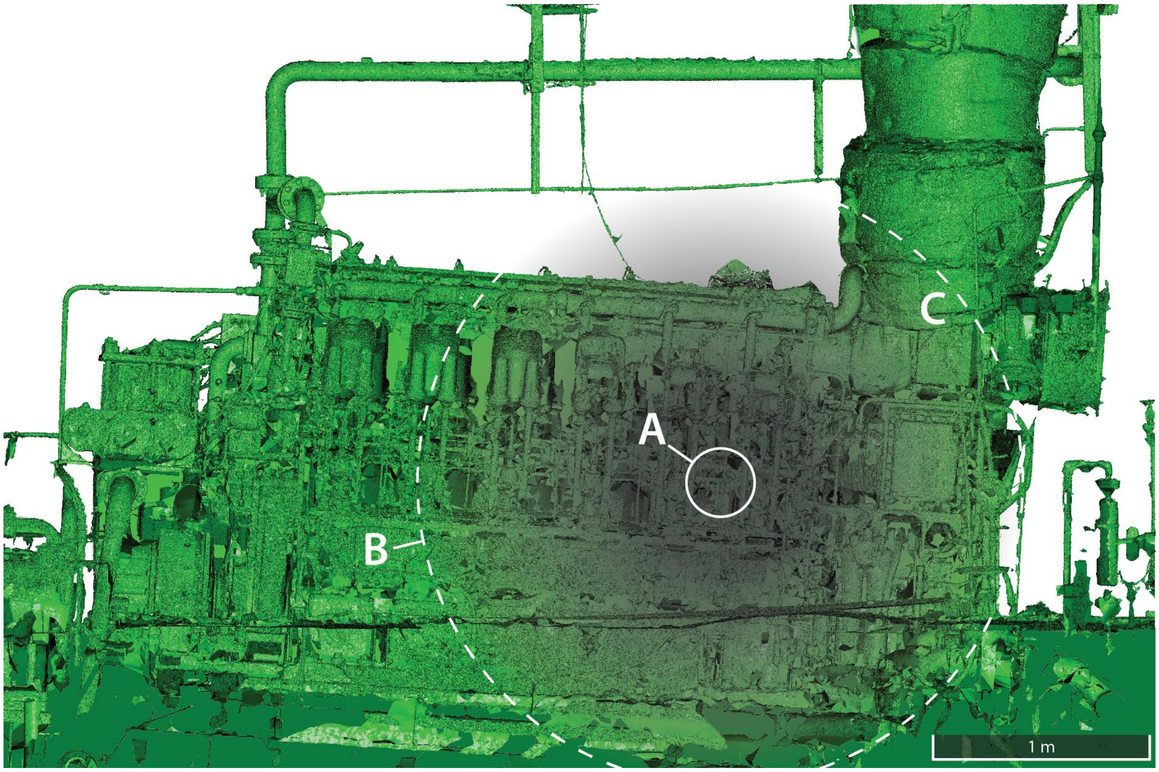
Figure 8. The fuel rail was supported by pipe clamps secured to pipe brackets. (Source: TSB, based on the Anglo-Belgian Corporation engine manual)



In June 2022, the crew observed a fuel oil leak between cylinders B5 and B6. The source was identified as a damaged location on the fuel rail on the port side of the forward main engine, and a series of temporary repairs was made (see section 1.10.1.2, below). The damaged location[54] was within 80 cm of the turbo charger assembly (Figure 9). The TSB laboratory simulated the final temporary repair with the hose clamped onto the fuel rail and exposed it to temperatures and pressures similar to those in the occurrence. This simulation revealed that fuel could be sprayed from under the ends of the repaired, clamped hose, and that this fuel spray could reach distances greater than 137 cm (see Appendix B for details).

54 Post-occurrence examination found that the fuel rail was compliant with DIN 2391 ST 35 steel and that no thinning of the fuel rail wall had occurred near the fracture.

Figure 9. Three-dimensional laser scan of the forward main engine showing the location of the damaged fuel rail (A), the estimated area of fuel spray (B), and the turbo charger assembly (C), the hottest surface on the engine (Source: TSB)



Laboratory examination of other parts of the fuel system identified 4 fractures and 1 crack[55] that were present before or during the occurrence fire. The examination also identified 1 crack for which it was not possible to determine the timing.

1.10.1.1 Fuel shut-off valves

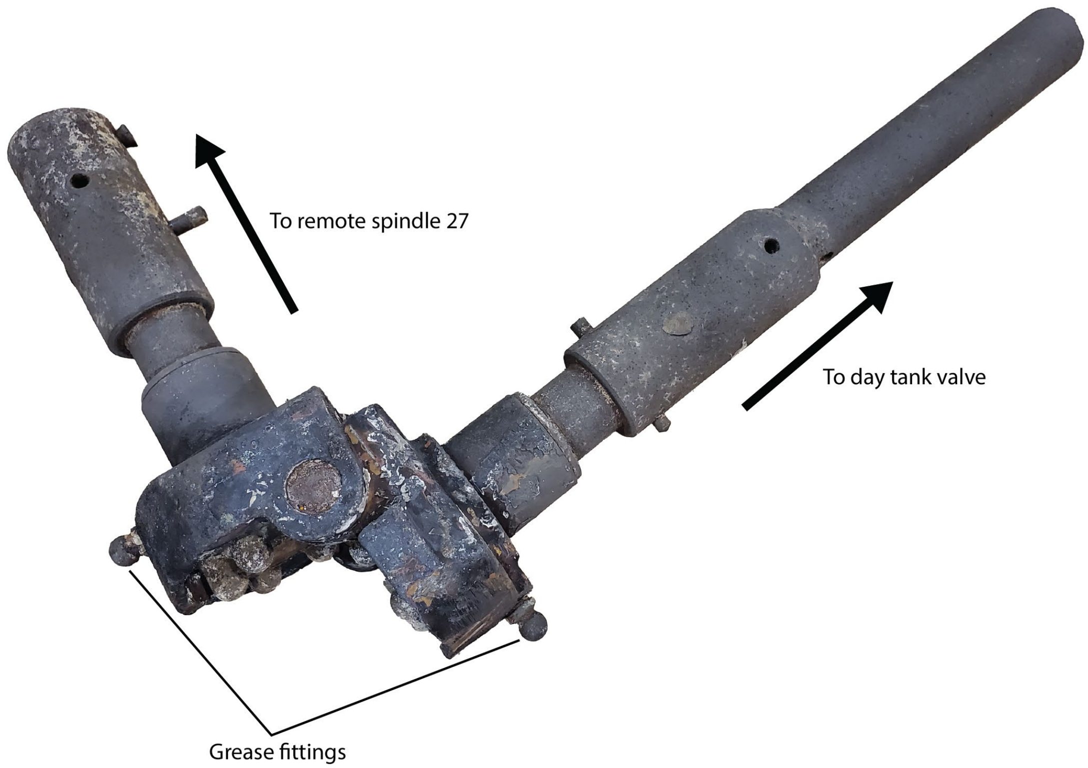
Fuel tanks are required to have shut-off valves that can be closed in an emergency. The day tank on the *Holiday Island* was equipped with 3 remotely operated fuel shut-off valves: 1 for both main engines, 1 for the generator, and 1 for the engine room heating furnaces. The controls for the remote valves were located forward of the CO_2 room on the main deck (Figure 10). When the system was examined after the fire, the control indicators for the main engine and generator fuel shut-off valves were in the open position and the fuel valves were approximately half open. The heating furnace valve was closed and its control indicator was in the shut position.

55 A fracture is a fully failed part while a crack has yet to progress to a fracture.

Figure 10. Spindles for the fuel shut-off valves in the compartment on the main deck. The spindle that closes the fuel valve for both main engines is circled in white. (Source: TSB)

Each extended spindle arrangement had several linkages between the control and the day tank valve. All of these linkages required regular greasing. For the main engine spindle arrangement, the first 90° knuckle below the main deck (Figure 11) had 2 grease fittings; the grease fitting on the side closest to the main deck was not visible from where maintenance was performed and was difficult to access. During post-occurrence examination onboard the vessel, it was observed that the knuckle was seized and would not turn. A knuckle on the main engine spindle assembly was disassembled and examined by the TSB laboratory. The grease recess in the side of the knuckle closest to the main deck was dry and the valve side, closer to the fire, had retained grease.

Figure 11. The opened knuckle in the main engine spindle assembly showing the 2 grease fittings (Source: TSB)



1.10.1.2 Maintenance and repairs of the fuel rail

In June 2022, a series of temporary repairs to the fuel rail on the forward main engine began (Table 4). After 2 temporary repairs failed, a replacement fuel rail was ordered.

Table 4. Temporary repairs to the fuel rail in the month preceding the occurrence

Date (2022)	Action
20 June	A fuel oil leak that was identified on the forward main engine was leaking at a rate of 1 drop every few minutes. A 1st repair was made using fuel-rated gasket material and hose clamps.
28 June	A 2nd repair was made using similar materials.
03 July	A replacement fuel rail was ordered. An engine manufacturer's representative offered a patch kit.
07 July	An engine representative delivered a patch kit.
19 July	Two more repairs were made (3rd and 4th) using fuel-rated gasket material and hose clamps.
20 July	A 5th repair was made using similar materials and fuel rail clamps were removed. A contractor applied the repair patch provided by the engine representative; the repair failed immediately. The damage had grown to approximately 75–80% of the fuel rail's circumference. A 6th repair was made using fuel-rated gasket material and hose clamps.
21 July	After the 1st trip of the day, the fuel rail was cut fully to slide a section of heater hose over the damaged area. The heater hose was secured with hose clamps.

Date (2022)	Action
	NFL followed up with the engine representative about a delivery date for the replacement fuel rail.
22 July	Fuel rail brackets were remounted (when the TSB investigated immediately after the occurrence, the fuel rail clamp between cylinders 5 and 6 was missing). NFL received an update stating that the replacement fuel rail was on back order and additional information would be available on 25 July.

When the damage was first identified, a crew member suggested permanently repairing the fuel rail by removing and welding the damaged section of fuel rail, instead of patching it. External consultants also recommended the same repair. A weld would have required taking the vessel out of service for 1 or 2 days.

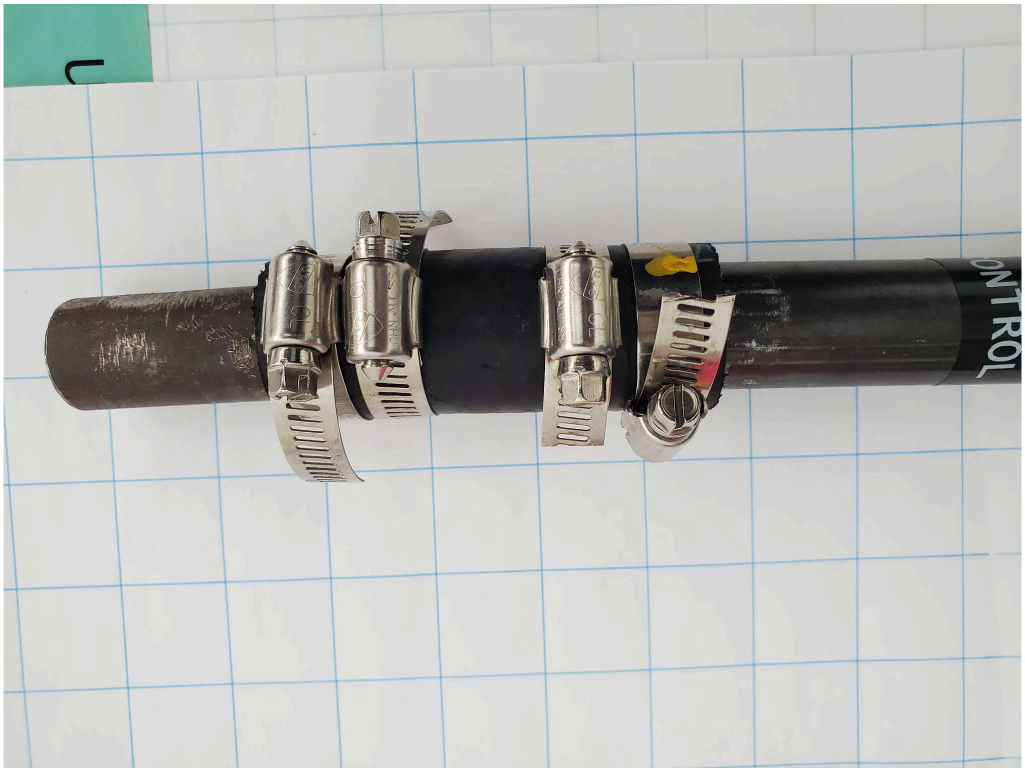
On 20 July 2022, the external consultants were directed to apply the patch kit supplied by the engine representative. Fuel rails are installed very close to the engine block, and hard to repair in place. The fuel rail location and the size of the crack meant that not all instructions for applying the patch kit could be followed and this patch failed within minutes.

On 21 July 2022, after the 1st voyage of the day, a temporary repair was made using a section of heater hose, which was made of a material the manufacturer describes as unsuitable for fuel or oil transfer,[56] secured with 4 worm drive hose clamps (Figure 12). The next 3 voyages that day were delayed by 1 hour or less and the remaining voyages were on time.

Post-occurrence, the TSB laboratory carried out a series of tests and determined that, with a combination of line pressure, exposure to fuel, engine room heat, engine vibration, and a marginally torqued clamp, a sudden leak could have developed.

[56] Dayco, Products Guide (2021), "Coolant Hose," p. 53.

Figure 12. A reconstruction of the final temporary repair (Source: TSB)



1.10.2 Engine cooling system

Each of the *Holiday Island*'s main engines and auxiliary generators was cooled by an open jacket water cooling system. The jacket water was cooled by seawater through a heat exchanger.

Seawater was brought in through suction piping from below the waterline, passed through the heat exchanger, and discharged above the waterline. The seawater intake could only be closed using hand-operated valves located on the port and starboard sides of the hull in the middle of the engine room.

The seawater cooling system consisted of rigid steel piping with a flexible connection at each intake and discharge point on the engine-driven seawater pumps. These flexible connections isolated the rigid piping and hull from normal engine vibration.

According to both the *Marine Machinery Regulations* and the technical specifications of the engine replacement contract, when the new engines on the *Holiday Island* were installed in 2014, the installation was required to meet class rules. Under these rules, the flexible connections installed between the seawater cooling system and the engines, where failure could result in flooding, were to be of a fire-resistant type.[57] The type approval certificate for the flexible connections fitted on the *Holiday Island* had a similar requirement.[58]

In this occurrence, the flexible connection was not rated as fire resistant and was not protected by a fire-resistant sleeve. Investigators found no record that any deficiency related to the fire resistance of the flexible connection had been noted on the engine replacement plans, at the post-installation inspection, or in subsequent inspections.

Finding: Other

The need for fire protection of the flexible connections between the seawater cooling system and the engine was not identified at the engine replacement planning stage or during post-installation and subsequent inspections.

When the vessel was towed to the dock on 24 July 2022, the engine room was found to be flooded to a level of 3.58 m from the tank top, above the tops of the main engines. The TSB's post-occurrence examination of the vessel found that the flexible connection between the seawater cooling system and the forward engine was extensively damaged by the fire and was the main source of water ingress. As well, the main seawater intake valves were open.[59]

Depending on the type of vessel and voyage, TC regulations may require remote controls for the intake valves of the seawater cooling system. However, a passenger vessel such as the *Holiday Island*, operating on Near Coastal, Class 2 voyages, was not required to have remote valve controls[60] and the *Holiday Island* was not equipped with them.

1.11 Structural fire protection

Statutory requirements for the maintenance of a vessel define a minimum level of safety. Given the high degree of risk posed by fire, vessel construction regulations include requirements for structural fire protection as well as for fire suppression systems and other equipment for fighting a fire, such as portable foam applicators and firefighting suits.

Provisions in new regulations may define exemptions ('grandfathering') in terms of the age of the vessel, the date it was registered in Canada, the age of the engine, and so on, but regulations typically require existing vessels to apply new elements that are considered feasible. Any installation of new equipment or machinery or substantial structural modifications must meet the regulations in force at the time.

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57 Lloyd's Register Group Limited, *Rules and Regulations for the Classification of Ships* (July 2022), section 7.3.4.

58 DNV GL, Type Approval Certificate, issued to Elaflex HIBY GmbH & Co. KG (20 February 2020), at https://elaflex.de/dokumente/download/Certificate/Zert_ERV_DNV_GL_ERV.pdf (last accessed on 16 July 2024).

59 The main seawater intake valves could not be closed until a few days after the vessel was towed to the dock. The flooding stopped once the valves were closed. The port generator had a flexible cooling hose that was also damaged by the fire.

60 Transport Canada, SOR/90-264, *Marine Machinery Regulations* (as amended 20 December 2023), schedule VIII, sections 23 and 24.

Therefore, vessels of similar sizes operating in Canadian waters are required to meet quite different construction and equipment requirements, depending on their age.[61] Because of the date it was built, the *Holiday Island* was required to comply with the *Fire Detection and Extinguishing Equipment Regulations* (now repealed) and the *Hull Construction Regulations* (as amended 02 February 2017).

The *Holiday Island* engine room was a category A machinery space.[62] In such spaces, all doors, hatches, vents, and other openings must be airtight when closed and bulkheads and decks must be "A" class divisions.[63]

1.11.1 Vents and air circulation

Engine rooms and other machinery spaces are workspaces that require good ventilation during operations, which is provided by a ventilation system that consists of intake fans and exhaust fans. In case of a fire, such a space must be sealed by closing all vents and other openings to limit the availability of oxygen. The *Holiday Island*'s main engine room had 5 doors, 1 hatch, and 8 vents (2 air intake vents and 6 exhaust vents). Four of the 8 vents were on the housetop deck and 4 were on the funnel deck. The locations of these vents and all other vents were depicted on the fire control plan. Each vent was labelled with a number on the fire control plan and on placards that indicated the open and closed positions for the damper handle (Figure 13). The crew also used an informal document showing the location of the vents on each deck. Not all vents on this document were labelled. For example, only 1 of the 2 main engine intake vents was labelled as such.

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61 For more detail, see the Regulatory Impact Analysis Statement for the *Vessel Construction and Equipment Regulations* published in the Government of Canada's *Canada Gazette*, Part 1, Vol. 156, Number 44.

62 "Machinery spaces of category 'A' are spaces and trunks to such spaces [that] contain internal combustion machinery used for main propulsion, internal combustion machinery for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW, or any oil fired boiler or oil fuel unit." Source: Transport Canada, TP 11469, *Guide to Structural Fire Protection* (1993), Part 1: Definitions, at https://tc.canada.ca/en/marine-transportation/marine-safety/guide-structural-fire-protection-1993-tp-11469-e (last accessed on 16 July 2024).

63 "'A' class divisions are bulkheads and decks constructed of steel or other equivalent material, capable of preventing the passage of smoke and flame to the end of the one-hour standard fire test." (Source: Ibid.).

Figure 13. Vent 15, with the damper handle in the open position and an access panel removed. The labels represent the location and appearance of the identification placards that were destroyed by the fire. (Source: TSB)

The air intake vents for the main engine room, vents 9 and 15 on the housetop deck, closed with louvre dampers. The dampers were accessed from inside the fan room, which was inside the same fire space as the engine room. The location of the dampers met the requirements in the regulations that were in force at the time of the occurrence.[64] On newer vessels, damper handles must be capable of being closed from outside the space being ventilated, must operate both manually and automatically, and must pass the requirements for sealing defined in the fire test procedures.[65] Vent 15 was installed in a conventional manner: when the vent was in the closed position, the handle was perpendicular to the direction of airflow. Vent 9 was non-standard, and the damper handle operated in the opposite direction. The fact that the operation of vent 9 was non-standard had been noted by the crew in May 2022, following maintenance of the vents, but the vent had not yet been adjusted. The engine room exhaust vents on the funnel deck also closed with louvre dampers.

The vents met requirements at the time the vessel was constructed. Louvre dampers are not capable of completely sealing a vent; solid fire dampers seal more effectively. Planned maintenance on the intake louvre dampers included replacement with similar dampers, not solid dampers.

Finding: Other

The louvre dampers on the air intake vents were being replaced with the same type of damper, which is less effective at sealing vents than solid fire dampers.

Post-occurrence, vents 9 and 15 were both found to be open. As the fire burned under vent 15, hot air flowed out from vent 15, which made it act as an exhaust, and fresh air came from vent 9, acting as an air intake (Figure 14; see also Figure 5).

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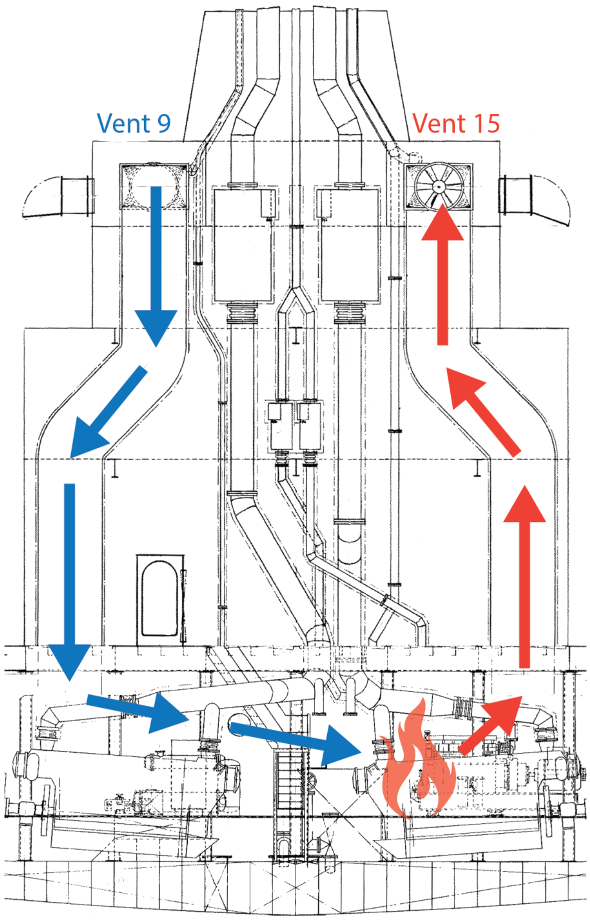
64 Transport Canada, C.R.C., c. 1422, *Fire Detection and Extinguishing Equipment Regulations* (as amended 03 February 2017), subsection 8(2). These regulations were repealed in 2017.

65 Transport Canada, SOR/2017-14, *Vessel Fire Safety Regulations* (as amended 23 November 2022), subsection 112(1).

Figure 14. A diagram showing the hot air from the fire leaving the engine room through vent 15 (in red) and the fresh air drawing in through vent 9 (in blue) (Source: *Port Weller Dry Docks Ltd.*, with TSB annotations)



1.12 Fire safety systems

Vessel construction regulations contain requirements for fire suppression systems and other equipment for fighting a fire, such as portable foam applicators and firefighting suits. Unlike structural systems, most requirements related to firefighting equipment apply to all registered vessels, regardless of age.

Success in fighting a fire depends on the equipment available, the experience of those fighting the fire, and the area of the fire. The larger a fire is, the more likely it is that a manual firefighting response will be unsuccessful and a fixed fire suppression system will have to be used.[66]

[66] United States National Fire Protection Association, *NFPA 921: Guide for Fire and Explosion Investigations* (2024).

1.12.1 Fire alarms

The purpose of a fire alarm system is to detect the presence of fire or smoke and alert the occupants of the vessel, allowing them to evacuate to safety and facilitating a quick response to the fire emergency. Fire detection and alarm systems may have an event log to capture when the heat and smoke sensors and CO_2 pilot cylinders are activated. The *International Code for Fire Safety Systems*[67] specifies that a means to manually acknowledge all alarm and fault signals must be provided at the control panel. The code also specifies that it must be possible to manually silence the audible alarms on the control panel and indicating units.

In this occurrence, the bridge crew activated the PA system as a workaround to silence the fire alarm. When they were notified that bridge conversations were being broadcast, they covered the microphone with a cloth. The investigation was unable to determine why the fire alarm could not be silenced.

1.12.2 Firefighting equipment

Firefighting equipment is carried on vessels to fight fires and protect crew. Firefighting equipment includes fixed fire suppression systems and portable equipment to fight small fires. The required firefighting equipment on board the *Holiday Island* included firefighting suits and equipment for the bridge fire team and the engine room fire team.

Water was supplied to the 38 fire hydrants through a network of pipes by multiple fire pumps, bilge pumps, and emergency pumps located below the main deck. As well, portable foam applicator firefighting equipment was stored on the forward main deck and the aft upper deck. The emergency generator and the pumps worked throughout the occurrence, and boundary cooling continued until the vessel was completely evacuated.

The safety data sheet for the marine gas oil (MGO) used on the *Holiday Island* lists alcohol-resistant foam, water fog, dry chemical powder, and CO_2 as suitable firefighting agents.[68] The safety data sheet warns against using jets of water, because this spreads the fire.[69] The same considerations apply to fuel that might be released from vehicles carried on the ferry.

1.12.3 Carbon dioxide fixed fire suppression systems

CO_2 is a colourless, odourless inert gas. It is non-flammable and non-conductive. CO_2 is often used for fire suppression in category A machinery spaces such as engine rooms and in other confined spaces, such as cargo holds.

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67 International Maritime Organization, *International Code for Fire Safety Systems* (IMO Publishing, 2016), Chapter 9: Fixed Fire Detection and Fire Alarm Systems, Section 2.5.1, Visual and Audible Fire Signals.

68 In the *Guide for Land-Based Fire Departments that Respond to Marine Vessel Fires (*NFPA 1405, section 12.10.8.5), the U.S. National Fire Protection Agency also states that the preferred agent for fighting a fire in the main engine room is foam.

69 Irving, *Safety Data Sheet #27944* (18 November 2022), Marine Gas Oil (3095).

When applied to a fire, CO_2 provides a heavy blanket of gas that displaces the oxygen to a point where combustion cannot occur. Proper sealing of the space where the CO_2 will be released is essential to effectively extinguish the fire. CO_2 is less efficient at cooling than water or other fire suppressants.

After the decision to use a CO_2 fixed fire suppression system is made, a number of preparatory steps must be carried out to ensure the crew is safe and the CO_2 release is effective:

- confirm all personnel are present and out of the space,
- seal the space (ensure vents, fire dampers, and access points are closed),
- close any oil and fuel valves,
- confirm that all machinery inside the space is stopped, and then
- activate the release of CO_2.

When the system is activated, a warning alarm sounds in the protected space. At the same time, a signal is sent to the fire alarm system that indicates that CO_2 has been released and gives the location of the protected space. After a brief delay, the CO_2 release begins and within a few minutes, cylinders are emptied. After use, the components must be recharged, replaced, or reset by qualified technicians.

After CO_2 has been released, the space must be cooled and ventilated before it is safe to re-enter. Ventilation of the space should not be started until it has been established both that the fire has been extinguished completely and that conditions are no longer sufficient for the fire to restart. Critically, the space must remain sealed until the temperature has cooled below the self-ignition point of any remaining fuel. If a space is re-entered too early, the fire may reignite and backdrafts may occur.[70] Boundary cooling can be used to reduce the temperature of the space more quickly.

The *Holiday Island* had CO_2 fixed fire suppression systems for the main engine room and for the auxiliary engine room. The systems were supplied by thirty-three 53 kg cylinders that were stored in the CO_2 room, which was located along the centreline of the main deck. The system was configured so that if CO_2 were released for the main engine room first, the contents of all 33 cylinders would be released; if CO_2 were released for the auxiliary engine room first, the contents of 11 cylinders would be released.

The remote CO_2 releases on the bridges were connected by a common cable that raised a pulley and then activated the control head of the pilot cylinders in the CO_2 control room. The CO_2 could also be released manually directly from the control head of the pilot cylinders in the CO_2 control room. Successful activation of the pilot cylinders, whether via local or

70 Government of the United Kingdom, Marine Accident Investigation Branch, *Safety Digest: Lessons from Marine Accident Reports* No. 2/2017 (October 2017), at https://assets.publishing.service.gov.uk/media/5e81e5d2e90e0706fba5421d/2017-SD2-MAIBSafetyDigest.pdf (last accessed on 15 May 2025).

remote release, is recorded as a signal event. A record of this event is available through the control panel for the fire detection and alarm system on the bridge.

In this occurrence, the CO_2 release handle on the bridge did not provide feedback to the operator as to whether the operation of the handle had resulted in the release of CO_2. The instructions for the crew, which were typical of CO_2 fixed fire suppression system instructions, were “pull handle hard.” The investigation found that the release handle had been pulled to a distance of 7 cm when resistance was felt. At this distance, the slack in the cable between the bridges was taken up. Following the occurrence, the TSB examination of the release handle found it would need to be pulled to 24 cm to trigger the release of CO_2.

The TSB examination also found that 1 of the pilot cylinders in the CO_2 control room was installed in a way that made it impossible to fully deploy the system using the manual trigger.[71]

1.13 Engine room fires

Any fire on a vessel is serious because onboard fire fighting resources are limited; it takes time for outside help to arrive, and the options for personnel to escape (such as abandoning the vessel) carry their own risks. Therefore, in general, the crew of a vessel must be prepared to fight the fire themselves.

To continue burning, fire requires fuel (flammable material), an oxidizing agent (air), heat, and a chemical chain reaction (Figure 15). Engine rooms contain a large amount of flammable material such as engine fuel, hydraulic fluids, oils, hoses, cleaning equipment, power tools, furniture, and cardboard.

In this occurrence, the contents of the day tank fuelled the fire initially. As the temperature rose, the engine room contents were also consumed.

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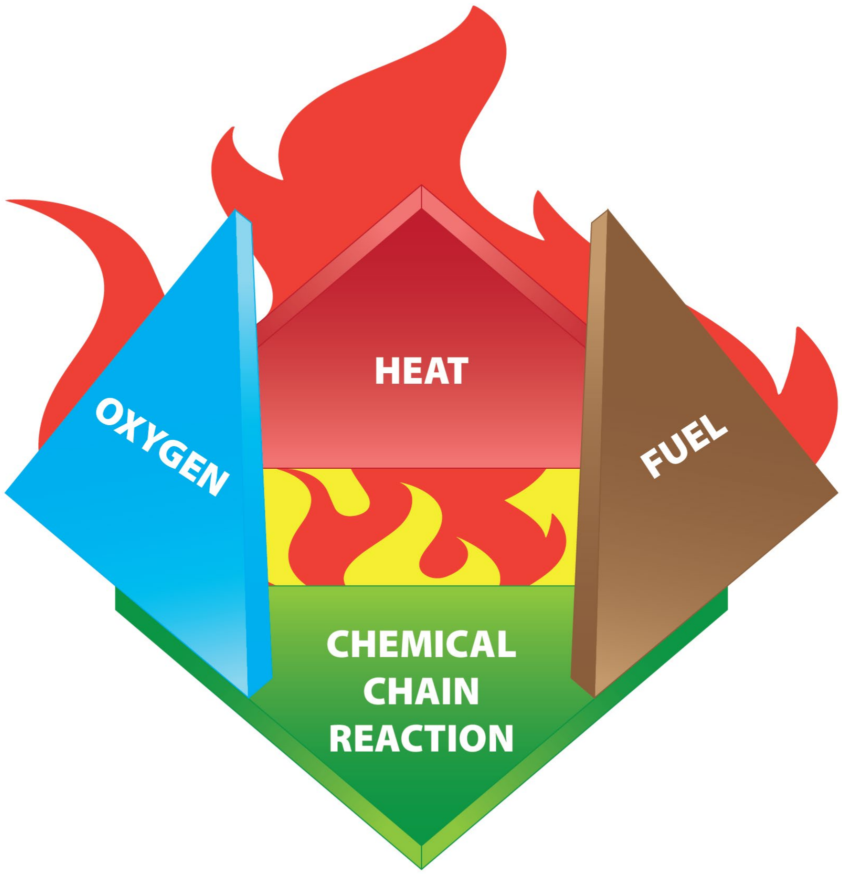
71 On 05 May 2023, the TSB sent Marine Safety Information Letter 03/23 to the Director General of Transport Canada Marine Safety and Security.

Figure 15. Diagram showing the 4 elements of a fire tetrahedron: fuel, heat, air, and a chemical chain reaction (Source: TSB)



In 2022, fires and explosions accounted for 17% of all shipping accidents reported to the TSB.[72] In the 10 years before this occurrence, 95 fires were reported on commercial vessels over 150 GT, 48 (25%) of which were on passenger vessels. A total of 16 of the 48 fires (33%) originated in the engine room.[73] Worldwide, a majority of fires originate in the engine room[74,75] and almost 70% of those involve leaking engine fuel.[76]A common source of engine fuel in these fires is fuel system leakage, often attributed to vibration and errors in

72 Transportation Safety Board of Canada, "Marine transportation occurrences in 2022," at https://www.bst-tsb.gc.ca/eng/stats/marine/2022/ssem-ssmo-2022.html (last accessed on 15 May 2025).

73 In 2024, passenger vessels accounted for 12% (273 out of 2222) of the registered commercial vessels over 150 GT.

74 Gard AS, "Engine room fires are still a major concern" (13 February 2025), at https://www.gard.no/insights/engine-room-fires-are-still-a-major-concern/(last accessed on 11 June 2025).

75 The Nordic Association of Marine Insurers, "Cefor Fire trend analysis" (December 2021), at https://cefor.no/globalassets/documents/statistics/nomis/2021/cefor-fire-trend-analysis-per-december-2021.pdf (last accessed on 15 May 2025).

76 Gard AS, "Engine room fires are still a major concern" (13 February 2025), at https://www.gard.no/insights/engine-room-fires-are-still-a-major-concern/(last accessed on 11 June 2025).

the reassembly of fuel system components and insulation.[77] As well, a sharp increase in the number of engine room fires was observed globally in 2020 and 2021,[78] with approximately half of these fires caused by the contact of flammable liquid with hot surfaces.

1.13.1 Fuel and heat

Whether the fuel source is solid, liquid, or gaseous, only vapours burn; solids and liquids must be heated to temperatures where they emit vapours before ignition is possible. The temperature at which a material emits enough vapour to ignite in air with an ignition source is its flashpoint; the temperature at which a material ignites without an ignition source is the auto-ignition temperature. If the temperature of a surface is higher than the auto-ignition temperature of a material that comes into contact with the surface, vapour from the material may ignite (hot surface ignition).[79]

The flashpoint of the MGO used on the *Holiday Island* was 63 °C[80] and the auto-ignition temperature was 257 °C.[81] The United States National Institute for Occupational Safety and Health found that fuel with the same specifications as the fuel used on the *Holiday Island* under conditions typical of the *Holiday Island* engine room could ignite on hot surfaces at temperatures as low as 380 °C and would always ignite on surfaces at temperatures above 580 °C.[82] When a fire is fuelled by hydrocarbons (for example, MGO) and oxygen is available, a fire can reach temperatures of up to 1100 °C within 30 minutes.[83]

1.13.2 Effects of ventilation in a compartment fire

At the early stage of a fire in a large compartment such as an engine room, when the intensity of a fire[84] is determined by the amount of fuel available, hot gases created by fire

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77 A. Charchalis and S. Czyż, "Analysis of Fire Hazard and Safety Requirements of a [*sic*] Sea Vessel Engine Rooms," *Journal of KONES Powertrain and Transport*, Vol. 18, No. 2 (2011), at https://kones.eu/ep/2011/vol18/no2/6.pdf (last accessed on 18 July 2024).

78 The Nordic Association of Marine Insurers, "Cefor Fire trend analysis" (December 2021), at https://cefor.no/globalassets/documents/statistics/nomis/2021/cefor-fire-trend-analysis-per-december-2021.pdf (last accessed on 15 May 2025).

79 The geometry of the surface and the air flow close to the surface are also factors. See V. Babrauskas, "Ignition of Gases, Vapors, and Liquids by Hot Surfaces," *Fire Technology,* Vol. 58 (June 2021), pp. 281–310, at https://doi.org/10.1007/s10694-021-01144-8 (last accessed on 20 May 2025).

80 Irving, *Certificate of Analysis*, Certificate No. 3234279 (11 July 2022).

81 Irving, *Safety Data Sheet #27944* (18 November 2022), Marine Gas Oil (3095).

82 W. Tang, D. Bahrami, L. Yuan, et al., "Hot Surface Ignition of Liquid Fuels Under Ventilation," *Mining, Metallurgy & Exploration*, Vol. 39, Issue 3 (04 May 2022), pp. 961–968, at https://doi.org/10.1007/s42461-022-00609-w (last accessed on 20 May 2025).

83 T. Hakkarainen, J. Hietaniemi, S. Hostikka, et al., VTT Research Notes 2497, *Survivability for ships in case of fire: Final report of SURSHIP-FIRE project* (2009), p. 85, at https://cris.vtt.fi/en/publications/survivability-for-ships-in-case-of-fire-final-report-of-surship-f (last accessed on 20 May 2025).

84 The heat release rate of a fire is a measure of its intensity. U.S. National Fire Protection Association, *NFPA 921: Guide for Fire and Explosion Investigations* (2024).

rise by convection and circulate. Heat that radiates from this hot layer can cause the fire to spread.

The intensity of a fire is also determined by the amount of oxygen available. Openings into and out of the compartment can act as both air supplies and exhausts. If the compartment is sealed, a fire may be extinguished when the available oxygen in the compartment is consumed. If more oxygen is supplied through ventilation or other air sources, other flammable materials may ignite and the entire compartment may become involved, increasing the risk that the fire will spread by radiation to other compartments.

During the post-occurrence examination of the *Holiday Island*, 2 main-engine air intakes and 2 small unnumbered exhaust vents on the housetop deck were found in an open position. Although there was evidence of high heat in some adjacent spaces, the investigation found that the fire did not spread outside the main engine room space.

1.14 Maintenance and repairs

Vessels require routine maintenance, and operators must plan for unexpected maintenance or emergency repairs.

Routine maintenance includes scheduled maintenance according to regulatory requirements, manufacturer recommendations, and vessel procedures. Scheduled maintenance may be done while the vessel is operating, while the vessel is at dock but out of service (anything from replacing engine hoses to rebuilding pieces of equipment), or in dry dock (such as to measure hull thickness).

Corrective repairs are unplanned repairs due to ship defects and usually do not affect the vessel's ability to safely operate. These repairs are done when operations allow, and may require parts that are not readily available. That is, vessels may continue to operate while waiting for parts or for a scheduled repair time, or may operate with temporary repairs. See Appendix E for some examples.

Emergency repairs[85] are unplanned repairs that are required, usually immediately, for the safety of the vessel or its ability to operate. In many cases, emergency repairs take a vessel out of service for at least a short period. In its *Guidelines for the Survey of Repairs*, the IMO states that "[w]here emergency repairs are necessary, the repairs should be documented in the ship's log and submitted thereafter to the Administration or to the classification society acting on its behalf […]."[86]

In general, repairs of the hull, machinery, or equipment may affect statutory certificates and class certificates. These repairs should therefore be authorized by TCMSS or the RO.

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85 International Maritime Organization, MSC/Circular 1070, *Ship Design, Construction, Repair and Maintenance* (12 June 2003).

86 International Maritime Organization, MSC/Circular 1070, Annex – Guidelines for the Survey of Repairs, *Ship Design, Construction, Repair and Maintenance* (12 June 2003).

As required by the charter agreement, NFL provided TC Programs Group with quarterly reports of upcoming and completed maintenance. In its quarterly reports to TC Programs Group, NFL divided proposed work into categories: statutory work, class-related or safety-critical work, justified urgent work, and discretionary work. Some notes mention safety but most notes are related to costs.

NFL was required by the charter party agreement to notify TC Programs Group of any emergency repairs. The charter party agreement defines emergency repairs as

> repairs which have to be carried out in the course of the Operating Season as a result of a marine casualty or other unforeseen event causing damage to the Vessel(s) or loss of operational capability of the Vessel(s) and that are necessary to ensure the seaworthiness of the Vessel(s) or the Vessel(s)'s operational status;[87]

NFL was also required by the DSIP agreement and class rules[88] to notify the RO when emergency repairs were needed. When an RO is notified of an emergency repair, a visit from an RO surveyor may be scheduled and the vessel may remain out of service until the repair and visit are completed. The investigation determined that the RO does not necessarily consider repairs to the main engine fuel system to be emergency repairs requiring such notification.

The *Confederation/Holiday Island Emergency Response* manual[89] and other NFL SMS documents do not define any circumstances that would require notification of TC Programs Group or the RO, nor did the manual have a procedure that would support decisions around voyage cancellation.

1.15 Safety

Within the last decade, organizational resilience research has proposed that the practice of safety inside a complex organization should not be defined solely by examining why things go wrong, for example why an accident has taken place. It should also include an understanding of why things go right, for example how people inside the organization create safety dynamically through minor adjustments[90] to written procedures in response to new and unusual conditions. In other words, the definition of safety is changing from a primarily reactive approach based on examination of incidents and accidents to a

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87 Transport Canada, Charter Party Agreement between Her Majesty the Queen in Right of Canada and Northumberland Ferries Ltd. (September 2014).

88 Lloyd's Register Group Limited, *Rules and Regulations for the Classification of Ships* (July 2022), section 3.4.3.

89 The *Confederation* differs from the *Holiday Island* in a number of ways, which makes instructions specific to both vessels difficult to produce. Specifically, the *Confederation* is a single-bridge ferry, newer (built in 1993), and with a larger capacity. The passenger capacity is 599 and the vehicle capacity is 210.

90 E. Hollnagel, R. L. Wears, and J. Braithwaite, *From Safety-I to Safety-II: A White Paper* (University of Southern Denmark, University of Florida, and Macquarie University, 2015), at https://www.england.nhs.uk/signuptosafety/wp-content/uploads/sites/16/2015/10/safety-1-safety-2-whte-papr.pdf (last accessed on 20 May 2025).

complementary proactive approach that examines and recognizes actions or processes that contribute to an organization's safety.

Vessels like the *Holiday Island* represent an example of a complex system, the operation of which requires crew to be flexible and adaptive[91] in their actions while remaining within the bounds of written procedures. Demonstrating such flexibility in daily operations is also the way a crew achieves success and contributes to safety. This can be accomplished by proactively anticipating how events can emerge inside the system.

1.15.1 Safety culture

An organization's safety culture is generally defined by the values, attitudes, beliefs, and behaviours of the people working within it. Organizations that have a healthy safety culture prioritize safety at all levels, that is, safety considerations outrank other pressures. An effective shipboard safety culture is a collaborative on-board effort supported by the willing and active participation of the crew (e.g., reflected in day-to-day activities, communication, and awareness of safety).[92,93] In this occurrence, safety decisions aboard the vessel were affected by interactions between the crew and the organization's shore staff and by the influence of external stakeholders and their priorities.

1.15.2 Safety management systems

An SMS is an internationally recognized framework for formal documented safety management processes. An SMS enables companies to systematically identify hazards, manage risks, and make company[94] and vessel operations safer. One part of an SMS is to document these formal processes. According to the IMO,

> [t]he cornerstone of good safety management is commitment from the top. In matters of safety and pollution prevention it is the commitment, competence, attitudes and motivation of individuals at all levels that determines the end result.[95]

The NFL SMS was audited by Lloyd's Register against the requirements of the ISM Code. The most recent audit was completed on 05 October 2017, with satisfactory results.

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91 Ibid.

92 J. Fenstad, Ø. Dahl, and T. Kongsvik, "Shipboard safety: exploring organizational and regulatory factors," *Maritime Policy & Management*, Vol. 43, Issue 5 (2016), pp. 552–568 at https://doi.org/10.1080/03088839.2016.1154993 (last accessed on 20 May 2025).

93 J. Reason, *Managing the Risks of Organizational Accidents* (Ashgate Publishing, 1997), p. 252.

94 Chapter IX of the International Maritime Organization's *International Convention for the Safety of Life at Sea (SOLAS), 1974* defines company as "the owner of the ship or any other organization or person such as the manager, or the bareboat charterer, who has assumed the responsibility for operation of the ship from the owner of the ship and who on assuming such responsibility has agreed to take over all the duties and responsibilities imposed by the International Safety Management Code."

95 International Maritime Organization, *The International Safety Management (ISM) Code* (IMO Publishing, 2018).

The NFL SMS included a safety management manual and an emergency response manual. On the *Holiday Island*, printed copies of these 2 manuals were located in the ship's office and the crew's mess, in accordance with the SMS.

1.15.3 Emergency procedures

Emergency procedures are intended to facilitate an efficient and effective response to an unexpected event. They contribute to safety when they are operationally specific and when they consider the various conditions in which emergencies unfold. They must also take into account the resources (such as the number of crew members or the type of equipment) needed to respond. Procedures should clearly state when certain steps need to be taken in a particular order. Emergency procedures should consolidate key information that crew need to act in a timely manner and provide guidance to assist crew in identifying when safe limits are approached. The emergency procedures might then outline a decision process to assist crew in determining next steps, such as abandonment.

The *Confederation* and the *Holiday Island* used the same safety management and emergency response manuals. The emergency response manual contained generic emergency checklists that were used by both vessels. The checklists covered various emergency scenarios, including blackout, grounding, collision, flooding, fire, and abandon ship. The checklist for fire set out the primary and secondary responses to be taken by crew in bullet-point form. The primary responses to be taken were listed as follows:

- Immediately extinguish or contain the fire, inform the Bridge, notify the Master.
- Sound general emergency alarm and the ship's horn, and announce position of the fire.
- Verify that fire doors, watertight doors, ventilation, fire dampers and ports are closed.
- Start emergency pumps.
- Ensure Bridge Teams are at stations.
- Fire parties muster and proceed to the fire area.
- Inform passengers of the nature of the emergency; muster passengers to the appropriate safe haven(s); respond to any passengers requiring special assistance.
- Take precautions against flooding.
- If possible, maneuver ship to prevent spread of fire.
- Transmit security or pan message, as appropriate.
- Report the incident to the nearest Coast Guard VTS [vessel traffic services], if within an area covered by VTS, otherwise report to the Coast Guard Radio Station. The information to be reported is contained in the Transportation Safety Board of Canada – Report of Marine Occurrence/Hazardous Occurrence Report (contained in the NFL Forms Manual).

- Notify appropriate Terminal Supervisor providing details of the incident and requesting appropriate response agencies.[96]

The secondary responses to be taken were listed as follows:

- Log all events throughout the incident, if situation permits.
- Ensure that VHF channel 16 and 2182 KHz are guarded.
- Provide periodic status reports to the Terminal Supervisor.
- As soon as situation permits, complete all reports required in Section 9 of the Safety Management Manual.[97]

The checklist for fire was last modified in March 2018.

1.15.4 Stability and flooding

Regulations define limits for vessel stability, such as a maximum angle of heel after flooding.[98] Stability booklets provide guidance to the crew about how to operate the vessel within the stability limits and how to evaluate the vessel's stability under varying conditions of service in both regular operating conditions and in emergencies.

The 2 main conditions documented in stability booklets are intact stability and damage stability. An intact stability assessment measures the vessel's ability to right itself during normal operations, such as loading and unloading. Damage stability assesses the effects of flooding on the vessel's stability under various damage conditions. In the event of an emergency, the stability booklet is used to determine the risk of capsizing.

TC requires passenger ferries such as the *Holiday Island* to have a stability assessment and to keep the intact stability and damage stability booklets available for use by the master and crew.[99] These documents were kept in the master's cabin. A copy of section 10.3 of the intact stability booklet, *Carrying Capacity*, was also posted on the bridge.

In the *Holiday Island* damage stability booklet, no worst-case damage condition exceeded 4° of heel.[100] In 3 of the worst-case conditions, the ability of the vessel to right itself began to

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96 Northumberland Ferries Limited, *Confederation/Holiday Island Emergency Response Manual* (March 2022).

97 Ibid.

98 For example, for unsymmetrical flooding, the equilibrium angle of heel for 1 compartment flooding is not to exceed 7°. See Transport Canada, C.R.C. c. 1431, *Hull Construction Regulations* (as amended 30 December 2023), subsection 12(6) and schedule II, section 2. Note that these regulations were superseded by Transport Canada's *Vessel Construction and Equipment Regulations* (SOR/2023-257) as of 04 December 2023.

99 Transport Canada, C.R.C., c. 1431, *Hull Construction Regulations* (as amended 20 December 2023), subsection 12(6). Note that these regulations were superseded by the *Vessel Construction and Equipment Regulations* as of 04 December 2023.

100 Allswater Naval Architects & Engineers, "*M.V. Holiday Island* Damage Stability Booklet for Northumberland Ferries Limited," 09105-150-R-001, Rev 0 (24 March 2010). The vessel copies of both the intact stability and damage stability booklets were stored in the master's cabin.

weaken around 7° and was negative near 15°. With a flooding emergency and degrees of heel of this extent, a vessel can capsize very quickly.[101]

In this occurrence, the angle of heel exceeded the worst-case limits when the vessel floated free, going from 2° to 3° to 10° within an hour. The crew monitored the increasing angle of heel after the vessel floated free and began to sound compartments to establish the flooding boundaries, according to the flooding emergency checklist. When a hot sounding pipe was discovered, the sounding efforts ended and the focus shifted to the potential of an explosion occurring.

The crew asked shore staff to evaluate the vessel's stability when the heel angle began to worsen. Shore staff asked a third party to evaluate the stability of the vessel; the results were received a week after the fire occurred.

1.15.5 Emergency duties

The *Holiday Island*'s SMS contained a muster list that set out duties for a fire and prepare to abandon ship emergency and an abandon ship emergency. The muster list was organized according to crew member position (role) and described the duties assigned to each crew member. Some crew members had duties in both types of emergencies (Appendix D).

There were 3 portable radios on board at the time of the occurrence, held by the chief officer, the engine room fire team, and the passenger services supervisor. All 3 radios worked, but the passenger services supervisor's radio stopped working early in the occurrence, possibly because of a run-down battery. During emergency drills, the VHF channel that was used to communicate depended on which port the vessel was in. VHF channel 4 was used at Wood Islands and VHF channel 3 was used at Caribou, matching the frequency used by the terminal staff. The VHF channel used on board was changed upon arrival at each terminal. In this occurrence, the vessel had not yet reached port at Wood Islands, and there was initially some confusion among the crew about which channel to use.

1.15.6 Emergency drills

In an emergency, crew members may be required to make decisions in a high-stress environment. They may have limited time available to respond and little previous experience in emergency situations. When crew members have an opportunity to regularly practise responding to different emergency scenarios through drills, the likelihood of a successful emergency response is increased.

The *Fire and Boat Drills Regulations* mandate that passenger vessels conduct drills to ensure that crew are prepared to respond in an emergency. Masters are required to "ensure that

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101 Government of the United Kingdom, Maritime and Coastguard Agency, Marine Guidance Note MGN 344 (M), "Observations and Recommendations arising from a Series of Domestic Passenger Vessel Evacuation Exercises" (November 2007), at https://assets.publishing.service.gov.uk/media/5a80408de5274a2e8ab4f130/MGN_344.pdf (last accessed on 21 May 2025).

drills, in so far as is feasible, are carried out as if there were an actual emergency."[102] Drills that involve realistic scenarios support crew members in responding to actual emergencies by increasing their preparedness. Realistic scenarios might integrate unexpected factors or involve multiple emergencies that overlap. Unexpected factors could include darkness, noise, a missing team member, or inaccessible equipment. Involving these variables can help crew members explore contingencies that may be needed and identify where there may be gaps in the procedures that impact the response to the emergency.

A debrief is critical for crews to evaluate the effectiveness of drills, identify areas for improvement, and discuss comments or concerns regarding roles, equipment, communications, and so on. Incorporating feedback from drills can help keep emergency procedures up to date.

The *Holiday Island* crews carried out fire drills every 4 days (every crew rotation) to practise the emergency procedures documented in the SMS.[103] The fire drills rotated equally through each of 8 different locations on the vessel, including the engine room. During each drill, the crew would muster, check the firefighting equipment, test the fire and watertight doors, and check the vents and dampers. All crew would then muster at the boat stations, don lifejackets, and review the evacuation procedures. A record of the drill and equipment tested was entered after each drill as required by the *Fire and Boat Drills Regulations.*[104] Over the course of a year, each fire hose would also be tested for water pressure during the drills.

The drills were typically completed within an average of 8.5 minutes during the approximately 20 to 30 minutes when the ferry was loading and unloading. The drills did not involve passengers. Drill records show that, following 2 fire drills in 2021, crew on 1 rotation had discussions about and attended a demonstration on the use of firefighting foam.

1.15.6.1 Evaluation of drills

Drills are good opportunities to evaluate whether crew understand their duties as per the muster list, whether there are enough crew to conduct the drill effectively, and whether emergency equipment is available and functioning. A drill typically focuses on 1 emergency (fire, for example). When this drill is complete, it is followed by another, such as an abandon ship emergency drill, simulating a full abandonment. Crew members take the roles defined in the muster list. Annual inspections by TCMSS or the RO may require the observation of emergency equipment in operation. This observation of emergency equipment may be part of a drill, giving inspectors or surveyors the opportunity to also evaluate the drill's

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[102] Transport Canada, SOR/2010-83, *Fire and Boat Drills Regulations* (last amended 23 June 2021), section 17.

[103] Other drills (e.g., blackout, bomb threat) were conducted at different intervals based on the SMS requirements. Some of these were tabletop (discussion-based) exercises rather than actual drills.

[104] Transport Canada, SOR/2010-83, *Fire and Boat Drills Regulations* (last amended 23 June 2021), section 37.

effectiveness. Inspections do not otherwise require the observation of drills, although a marine safety inspector or a surveyor may request to observe drills at their discretion. For example, inspectors may request to observe drills to verify that the master has ensured that the crew is "competent and operationally ready to respond to the emergencies addressed by the drills."[105] However, TSB investigations[106] have found that the scope of drills conducted during an inspection may be limited.

1.15.7 Skill-, rule-, and knowledge-based processing of information

The degree of conscious control exercised by an individual over their activities can be assessed based on the individual's manner of processing information. Broadly speaking, the interactions of skill-, rule-, and knowledge-based processing reflect how the individual is interacting in the operational environment and performing tasks at hand.

Knowledge-based information processing is largely conscious, occurring as an individual experiences novel situations. As training progresses, rules will be learned that will produce methodical responses in familiar situations. Practising tasks that are performed less frequently or are less familiar enables an individual to develop, to some degree, the skills required to perform the actions. The goal of regular interaction with procedures and practices is to make performance more automatic, where the individual responds appropriately upon perceiving relevant cues.

When a scenario requires the performance of less familiar tasks, individuals rely on memory prompts (e.g., a checklist or operational briefing) to help initiate the appropriate sequence of actions. Training helps the individual anticipate the workload and potential consequences of the tasks ahead. Recurrent training reinforces the knowledge and rules related to operational contexts and it can also be a means to identify any gaps between course material and actual work practices that may change over time.

1.15.8 Shared mental model

A mental model describes a form of cognitive structure that allows humans to interact effectively with their environment by organizing knowledge into meaningful patterns.[107]

> The term "shared mental model" refers to the extent to which individual team members' mental models overlap; or the extent to which members share the same understanding of the task and the team. There is considerable evidence to support the idea that the greater [the] degree of shared knowledge, the better the team will perform.[108]

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105 Ibid., section 22.

106 TSB marine transportation safety investigations M22C0231, M17C0179, M15A0009, M13M0287, M13L0067, M12C0058, and M06W0052.

107 R. Reynolds and E. Blickensderfer, "Crew Resource Management and Shared Mental Models: A Proposal," *Journal of Aviation/Aerospace Education & Research*, Vol. 19, Issue 1 (2009), pp. 15–23, at https://commons.erau.edu/cgi/viewcontent.cgi?article=1380&context=jaaer (last accessed on 26 May 2025).

108 Ibid.

Success can be measured by the accuracy with which information is shared and, in turn, perceived and understood among the personnel on the vessel and the management representatives on shore that, as a whole, comprise the NFL team. Various influences may increase the gap between the mental models of ship versus shore personnel, although "[...]ship and shore personnel have at least partially shared mental models, largely due to their background and training […]."[109] A shared mental model is a positive factor when team members' knowledge and experience overlap. Good-quality communication in the decision-making process is particularly important, considering that participation by shore staff is almost always remote. As such, the shore staff's role is "narrowly embedded" in the team (i.e., they are provided with observational or derived knowledge only) which, according to human factors research, results in shore staff depending heavily on "others for acquiring a basis for their decision making and may have little control over the authenticity or accuracy of the information provided."[110]

In this occurrence, the NFL team was made up of the people closest to the problem of a leaking fuel rail and those who were responsible for successful ferry operations. After detection of the leak, the NFL team determined that applying local, temporary repairs was a feasible approach: a successful temporary repair meant continued serviceability of the *Holiday Island* and the replacement of the fuel rail itself could be scheduled with third-party contractors for a later date. The plan met a common goal for decision-makers within the NFL team, given that the fuel leak was a critical problem that coincided with the busiest period of the sailing season.

The willingness of the *Holiday Island*'s engine room staff to attempt a series of temporary repairs to the fuel rail while the vessel was alongside meant no further disruptions[111] to the sailing schedule that season. Alternatively, contracting a replacement of the damaged fuel rail would have incurred prolonged disruptions to the serviceability of the vessel, and as a result, created challenges for the NFL team to accommodate the passengers who had pre-purchased trips.

Once the final temporary repair had been applied, communication about the repair was limited to a brief emailed status report from the vessel that the leak had been stopped. The brevity of the communication between shore and vessel precluded analysis that could have created a shared comprehension or perception of the risk related to the temporary repair.

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109 M. Imset and K.I. Øvergård, "Shared Mental Models of Challenging Maritime Situations: Comparisons of Ship and Shore Personnel in the Straits of Malacca and Singapore," *TransNav, the International Journal on Marine Navigation and Safety of Sea Transportation*, Vol. 11, Issue 2 (2017), pp. 57–62, at https://doi.org/10.12716/1001.11.02.05 (last accessed on 26 May 2025).

110 M. J. Van der Hoven (2001) cited in S. Dekker, *Second Victim: Error, Guilt, Trauma, and Resilience* (Routledge, 2013), p. 32.

111 The *Holiday Island* had missed several days sailing earlier in the 2022 season due to other repairs.

1.16 Marine emergencies

Depending on the marine environment in which a vessel is operating, it may be subject to any number of hazards. These hazards may result in marine emergencies such as fire, collision, person overboard, grounding, swamping, or capsizing. The vessel owner or master is responsible for being prepared for and responding to emergencies. While crew members on commercial vessels are trained and equipped to handle many emergencies with the resources available on board, sometimes an emergency shifts to become an emergency where outside help is needed.

1.16.1 Reporting of marine incidents

Because the *Holiday Island* was operating in the Eastern Canada VTS Zone (ECAREG), the master of the vessel was required by regulation to report an on-board fire as soon as practicable.[112]

At sea, when there is a potential or immediate need for help, it is best practice to notify search and rescue (SAR) authorities as soon as possible. Doing so gives responders early and direct notice that their assistance may be required. The TSB has reported on a number of recent occurrences in which a delay in reporting an incident affected the response.[113] The IMO,[114] the International Telecommunications Union,[115] the International Chamber of Shipping,[116] the CCG,[117] and TC[118] all recommend that such a report be made to a radio ship reporting station by radio without delay when a situation has the potential to constitute a danger to life.

In coastal areas, it is best practice to make a broadcast on VHF channel 16 (an international distress, safety, and calling frequency), as this also alerts vessels in proximity to the developing situation. Outside of VTS zones, vessels must maintain a continuous listening watch on VHF channel 16. In a distress situation, they are obliged to respond.[119]

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112 Transport Canada, SOR/89-99, *Eastern Canada Vessel Traffic Services Zone Regulations*, subsection 6(a).

113 TSB marine transportation safety investigations M22A0312, M20A0048, M20P0229, M17C0179, M15C0045, and M15A0009.

114 International Maritime Organization, MSC/Circ. 892, *Alerting of Search and Rescue Authorities* (16 December 1998) and COM/Circ. 108, *GMDSS [Global Maritime Distress and Safety System] Operating Guidance for Masters of Ships in Distress Situations* (superseded on 01 January 2024 by MSC.1/Circ. 1656).

115 International Telecommunication Union (ITU), World Radiocommunication Conference, *Radio Regulations* (ITU Publications, 2016), section 32.

116 International Chamber of Shipping, *Bridge Procedures Guide,* Sixth Edition (International Chamber of Shipping Publications, 2022), section 4.19.2.

117 Fisheries and Oceans Canada, Canadian Coast Guard, *Radio Aids to Marine Navigation 2024 (Atlantic, St. Lawrence, Great Lakes, Lake Winnipeg, Arctic and Pacific)*, at https://www.ccg-gcc.gc.ca/publications/mcts-sctm/ramn-arnm/index-eng.html (last accessed on 26 May 2025).

118 Transport Canada, TP 9878, *Safety and Distress Radiotelephone and Procedures*.

119 Government of Canada, *Canada Shipping Act, 2001* (S.C. 2001, c. 26), Part 5, subsection 131(1).

The NFL *Emergency Response Manual* and NFL *Safety Management Manual* set out general reporting requirements for emergencies. As well, most of the emergency checklists, including the checklist for fire, contained 3 steps for reporting emergencies:

- Transmit security or pan message, as appropriate.
- Report the incident to the nearest Coast Guard VTS, if within an area covered by VTS, otherwise report to the Coast Guard Radio Station. The information to be reported is contained in the Transportation Safety Board of Canada – Report of Marine Occurrence/Hazardous Occurrence Report (contained in the NFL Forms Manual).
- Notify appropriate Terminal Supervisor providing details of the incident and requesting appropriate response agencies.[120]

The Abandon Ship checklist specified that a distress call, rather than a security or pan message, should be communicated:

- Transmit distress call:
  - Mayday message on 2182 KHZ and/or 156.8 MHZ (channel 16 VHF) by radio telephone giving ship's name, position and conditions and danger.
  - Depress the Distress Alarm button.
  - Notify the appropriate Terminal Supervisor providing details of the incident and requesting appropriate response agencies.[121]

In this occurrence, the master notified the NFL terminal staff when the fire was detected and issued a distress call (Mayday) when the abandon ship procedure began. In Canada, the report should be made to the nearest MCTS centre.[122]

1.16.2 Response

Responses to marine emergencies in Canadian waters that involve risk to human lives are coordinated by a JRCC or a Marine Rescue Sub-Centre (MRSC), which have the authority to assign SAR resources.[123] Once a JRCC or MRSC is notified of an emergency, its staff will begin to coordinate SAR operations. The JRCC or MRSC then maintains its authority to coordinate SAR operations until all people on board are reported safe or until there is no chance that a missing person could survive. For this reason, JRCC coordinators must keep track of how many people are on a vessel in distress and provide advice and support if evacuating these people becomes necessary. If a risk to the environment or to the vessel remains, then a new phase of the response begins, typically after the SAR phase ends.

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[120] Northumberland Ferries Limited, *Confederation/Holiday Island Emergency Response Manual* (March 2022).

[121] Ibid.

[122] Fisheries and Oceans Canada, Canadian Coast Guard, *Radio Aids to Marine Navigation 2024 (Atlantic, St. Lawrence, Great Lakes, Lake Winnipeg, Arctic and Pacific)*, at https://www.ccg-gcc.gc.ca/publications/mcts-sctm/ramn-arnm/index-eng.html (last accessed on 26 May 2025).

[123] Government of Canada, *Canada Shipping Act, 2001* (S.C. 2001, c. 26, as amended 23 June 2023), section 130.

1.16.2.1 Shore-based first responders

When a marine emergency occurs close to shore, shore-based first responders may become involved. Shore-based first responders may include paramedics, firefighters, and police. The degree of involvement by the first responders depends on the situation and, ideally, takes into account their training and experience. For example, in a recent occurrence involving an engine room fire on the bulk carrier *Tecumseh*,[124] the shore-based fire department provided logistical support and boundary cooling from shore, but it did not board the vessel as the firefighters were not trained in marine firefighting.

Shore-based first responders are accustomed to coordinating their responses through a formal incident command system (ICS). An ICS is a standardized management system for emergencies, disasters, and non-emergency events.[125] The system is designed to allow its users to adopt an integrated organizational structure capable of dealing with the complexity and demands of the incident without being hindered by jurisdictional boundaries. In an ICS, 1 incident commander at a time coordinates the response.

In this occurrence, the emergency response involved many agencies and individuals, including the CCG, the Canadian Armed Forces, NFL management, the PEI Emergency Measures Organization, Island Emergency Medical Services, the RCMP (Royal Canadian Mounted Police), TCMSS staff, approximately 200 firefighters from PEI fire departments, and the crews of various vessels of opportunity. Those who boarded the vessel while the response to the fire was ongoing included a rotation of firefighters, NFL staff, replacement NFL crew, and 2 TCMSS staff.

On the shore, a paramedic tracked firefighters as they left the dock and returned. On the vessel, the investigation found no records of firefighters, crew, or other people being tracked as they left or boarded the vessel.

After the occurrence, the PEI Emergency Measures Organization prepared a review. In its report, the organization identified some areas of strength with respect to communication and inter-agency cooperation, but it also recommended a more formal plan for information sharing and communication.[126]

1.16.2.2 Risk of environmental effects

Marine emergencies and incidents must be reported even where they do not pose, or no longer pose, a danger to human life, such as incidents posing a risk to the vessel or a risk of

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[124] TSB Marine Transportation Safety Investigation Report M19C0403.

[125] ICS Canada, "Incident Command System," at https://icscanada.ca/# (last accessed on 26 May 2025).

[126] B. MacIsaac, D. Murray, *Northumberland Ferries Ltd. M/V* Holiday Island *Fire/Evacuation: After Action Review*, Prince Edward Island Emergency Measures Organization (2022).

marine pollution. Plans exist to support emergency responses for some sectors, vessels, and emergencies. For example:

- Port authorities in the 17 larger Canadian ports may have pre-arranged relationships with shore-based firefighters and may have arranged contingency plans for fires on board vessels.[127] In these ports, the shore-based firefighters are professional firefighting departments, with more capacity for specialized training.
- Some classes of vessel that also operate in U.S. waters are required to have contracts in place with salvage and marine firefighting providers so that emergencies can be handled in a timely manner. These resource providers, who have some knowledge of the vessel, may be called upon for emergencies in Canadian waters.[128] Canada does not currently require pre-arranged plans for fire response or marine salvage.
- TC's National Marine Oil Spill Preparedness and Response Regime has been in place since 1995 and sets out a national preparedness plan for responding to oil spills.[129] Work is in progress for responding to spills of other hazardous materials.[130]

Internationally, certain passenger vessels are required to have SAR cooperation plans that were developed with the vessel crew, the vessel owner, and SAR services.[131] This plan must be available to responders in the event of an emergency and include provisions for periodic exercises. In Canada, this requirement is partially incorporated into the *Navigation Safety Regulations, 2020*.

TC is proposing some changes to the CSA 2001 to strengthen preparedness requirements. One of the proposed changes would be to require "vessels to have arrangements for firefighting and salvage services, and a response specialist to work with the Government of Canada and other partners to manage the incident."[132] In June 2023, the CSA 2001 was amended to give the Governor in Council the authority to make regulations, on the recommendation of the Minister, "respecting arrangements for emergency services, including

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127 Earlier versions of regulations required joint ship and shore fire drills. (Source: Transport Canada, SOR/2005-280, *Board and Fire Drill and Means of Exit Regulations,* section 139 [repealed and replaced by SOR/2010-83]). These requirements were removed in 2010 because they had proven to be "impracticable or impossible to enforce." (Source: Government of Canada, *Canada Gazette*, Part I, Vol. 143, No. 41 [10 October 2009], Fire and Boat Drills Regulations, Regulatory Impact Analysis Statement, p. 3081).

128 U.S. *Code of Federal Regulations*, Title 33, Chapter I, Subchapter O, Part 155, Subpart I: Salvage and Marine Firefighting.

129 Transport Canada, "National Oil Spill Preparedness and Response Regime," Overview, at https://tc.canada.ca/en/marine-transportation/marine-safety/national-oil-spill-preparedness-response-regime-0 (last accessed on 27 May 2025)

130 Transport Canada, "Marine Pollution Preparedness, Response and Recovery Discussion Paper," at https://tc.canada.ca/sites/default/files/2023-01/MPPRR%20Paper_EN1.pdf (last accessed on 27 May 2025).

131 International Maritime Organization, *International Convention for the Safety of Life at Sea, 1974* (2022), Chapter V, Regulation 7, paragraph 3.

132 Transport Canada, "Marine Pollution Preparedness, Response and Recovery Discussion Paper," at https://tc.canada.ca/sites/default/files/2023-01/MPPRR%20Paper_EN1.pdf (last accessed on 27 May 2025), p. 5.

requiring vessels or classes of vessels to enter into such arrangements."[133] In May 2024, TC indicated that work to develop regulations under this provision of the CSA 2001 is underway.

1.17 Life-saving equipment

The *Holiday Island* had the required life-saving equipment on board.[134]

On each side of the vessel, the *Holiday Island* had

- one 100-person life raft that was connected to the MESs,
- one 100-person life raft that can be linked to an MES,
- one 50-person life raft that can be linked to an MES, and
- 1 davit-launched rescue boat.

The *Holiday Island* carried 420 adult lifejackets and 40 child lifejackets for passengers, as well as an additional 17 lifejackets for the crew. Adult and child lifejackets were stored together, and some locker doors were mislabelled. The vessel did not carry infant lifejackets, nor was it required to at the time of the occurrence.[135] At least 2 passengers with infants did not have access to lifejackets for the infants. As well, when the lifejackets were being distributed, some children initially received adult-sized lifejackets and some adults received child-sized lifejackets.

The MESs had been installed in the spring of 2022 as a replacement for the davit-launched life rafts.[136] To deploy the MES on each side, a crew member used 2 manual pumps, first to remove the protective door and then to deploy the slide and life raft. This process took just over a minute. Each MES slide could transfer 2 people at a time from the evacuation station directly to a 100-person life raft. Additional life rafts could be deployed and linked to the first life raft. In this occurrence, 1 crew member helped passengers in the life raft at the bottom of each slide. The passengers then helped one another as they continued onto the responding vessels for the trip to the dock. Because of the immediate transfer, the linked life rafts were not needed. Some crew members, firefighters, and other persons on the vessel also used the MES for rotating off the vessel.

[133] Government of Canada, *Canada Shipping Act, 2001* (as amended 22 June 2023), subsection 120(1), paragraph s.1.

[134] Transport Canada, C.R.C., c. 1436, *Life Saving Equipment Regulations* (as amended 22 December 2022), section 14. Requirements depend on the vessel and on the type of voyage. The *Holiday Island* was a non–Safety Convention ship with over 12 passengers on a Class III home-trade voyage.

[135] According to the *Life Saving Equipment Regulations* (Transport Canada, C.R.C., c. 1436, as amended 22 December 2022, paragraph 16(1)f)), enough lifejackets for each member of the complement are required. The greater of 10% of the complement or 1 for each child on board must be suitable for children. The *Holiday Island* carried manufacturer statements of compliance for the adult and child lifejackets carried on board. The *Vessel Construction and Equipment Regulations* requires passenger vessels to carry sufficient infant lifejackets for all infants on board as of 20 December 2024.

[136] An MES may be substituted for a life raft if the MES is of at least equal capacity and meets the regulatory requirements. See Transport Canada, C.R.C., c. 1436, *Life Saving Equipment Regulations* (as amended 22 December 2022), section 5.2.

Twelve of the 22 crew on board at the time of the occurrence had taken MES training in the spring of 2022. Of the 10 who had not taken this training, 7 had emergency duties related to assisting passengers and launching the MESs.

Finding: Other

The MESs installed on the vessel contributed to the safe and rapid evacuation of passengers.

1.18 Transport Canada oversight

TC is responsible for developing regulations and ensuring that vessels comply with them. For vessels 24 m in length and above, TC delegates most statutory inspections to ROs through the DSIP.

1.18.1 Delegated Statutory Inspection Program

The DSIP was implemented in 2001 and became mandatory for Canadian vessels 24 m in length and above in 2014.[137] Through the DSIP, ROs complete the inspections required under section 16 of the CSA 2001 and deliver certain Canadian maritime documents. The *Holiday Island* was enrolled in the DSIP as a fully delegated vessel and was in class with Lloyd's Register. The last annual safety inspection certificate was issued to the *Holiday Island* by the RO on 11 May 2022.[138]

At the time of the occurrence, TC had a target of completing compliance inspections on 25% of the delegated vessels each year. TC uses a risk-based approach to target delegated vessels. Compliance inspections provide an opportunity to verify the level of compliance on delegated vessels. Compliance inspections also provide an opportunity to oversee the performance of ROs by monitoring the type and severity of deficiencies found during compliance inspections.

TC maintains responsibility for the registration of vessels, the determination of safe manning, and ensuring compliance with the *Maritime Occupational Health and Safety Regulations* and the *International Ship and Port Facility Security Code*. The authority to grant exemptions from regulatory requirements is likewise solely reserved for TC's Marine Technical Review Board. Lastly, TC has sole responsibility for enforcement.

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137 Of the 5444 passenger vessels and ferries listed in the Transport Canada registries on 08 August 2024, 275 are 24 m or longer. Of these 275 vessels, 163 were built in 1990 or before, 36 were built between 1991 and 2000, 30 were built between 2001 and 2010, and 45 were built between 2011 and the date of the query. Previous TSB marine transportation safety investigations (M20P0229 and M20A0160) have found that registry numbers do not reflect exact numbers of active vessels (for example, the *Holiday Island* was still registered as an active passenger vessel on the date of this query), and that they rather give some indication of the age of the Canadian fleet of passenger vessels in the DSIP. See Transport Canada, Vessel Registration Query System, at https://wwwapps.tc.gc.ca/Saf-Sec-Sur/4/vrqs-srib/eng/vessel-registrations (last accessed 28 May 2025).

138 A safety inspection certificate certifies that a vessel has been duly inspected in accordance with subsection 16(2) of the *Canada Shipping Act, 2001*, and that the vessel meets the requirements of regulations made under Part 4 of the Act.

In June 2016, 2 TC marine safety inspectors carried out a compliance inspection on the *Holiday Island*. After this inspection found structural defects, 1 of these marine safety inspectors was transferred to TC Programs Group to work on the ferry program. As a technical advisor to TC Programs Group, he produced 1 oversight report on behalf of the AR, as well as coordinated ongoing maintenance requirements, oversaw technical operations on board the vessel, and worked on capital projects. The assignment continued until his departure in mid-2018, after which time the role changed to focus on capital projects.

1.19 Organizational and management factors

Gaps in organizational risk management, oversight, and hazard reporting are examples of organizational and management factors that can affect safety. At the organizational and management levels of an operation, these factors can contribute to unsafe conditions, impact human performance, and inhibit the proactive identification and mitigation of risk.

1.19.1 Practical drift

In contemporary safety science, practical drift is a term used to describe how work inside a complex organization may demonstrate a slow, steady uncoupling of practice from written procedure.[139] This subtle departure from written procedure is invariably connected to the various priorities and operational constraints faced by organizations in transportation industries.

Organizations develop rules, policies, and procedures that are aimed at setting safe limits. As people in organizations respond to external pressures, they adjust their manner of working to achieve or maintain productivity, resulting in a departure from written procedures. If these changes do not result in a negative consequence, they may be recognized as acceptable. When such actions are repeated over time, these decisions result in adaptations to the procedures themselves and deviations from prescribed limits, leading to unsafe practices.[140]

A complex system comprises many elements (e.g. equipment, processes, and procedures) whose interactions are not always visible to all people in that organization. The risk in gradually adjusting procedures, without evaluating the impact of these changes to the other parts of the system, is that they can drift toward the boundaries of safe operation.

1.20 Cognition and human performance

There are many factors that can influence the cognitive processes of humans as we respond to developing situations. For example, our responses can be affected by various types of biases, heuristics, or other perceptions that are based on our individual experiences,

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139 S.A. Snook, *Friendly fire: The accidental shootdown of US Black Hawks over northern Iraq*. (Princeton University Press, 2000).

140 J. Rasmussen, "Risk Management in a Dynamic Society: A Modeling Problem," in *Safety Science*, Vol. 27, Issue 2/3 (1997), pp. 183–213.

training, and beliefs. These factors can shape the ways that individuals respond to a given situation.

1.20.1 Perception of risk

Generally, risk perception is based on the ability to evaluate risks associated with a particular hazard. This involves assessing the probability of that hazard occurring and the severity of any consequence from it. The ability to see and detect risk depends particularly on a person's own understanding and tolerance of risk. Many factors influence individual risk perception and tolerance, including pressure to accept risk, team dynamics and communication, personal experience, the approval of others, and confidence in one's ability to mitigate risk (for example, the ability to monitor the effectiveness of a repair, alerting equipment, training, and drills).

Regional economic conditions, crew availability issues, and regulatory systems may influence the operational priorities, choices, and decisions that crew and masters face as they strive to operate safely and adhere to the daily sailing schedule.

Common risks that are familiar to ferry crews include navigation challenges, adverse weather, and ensuring minimum crew levels. Safety risks associated with maintenance activities that occur less often may not be straightforward to recognize, especially when the resources of time and crewing are limited alongside a busy sailing schedule.

1.20.2 Diffused responsibility

Diffused responsibility can suppress interaction or intervention by encouraging the perception that someone else is better qualified to act, has more authority to act, or has better proximity to act. Diffused responsibility is more likely to occur in instances when many people are involved or when there is more than 1 leader or person of authority involved. Diffused responsibility is seen as an indirect outcome of a weak or non-interacting team in which members of the group act in loose isolation without a defined common goal.

1.21 Related occurrences

In the 10 years before the occurrence, 400 fires on commercial vessels were reported to the TSB. Of these fires, 60 (15%) were on board passenger vessels or ferries. None of these 60 occurrences resulted in a total loss and 21 were either in or related to the engine room.

The TSB has investigated marine occurrences similar to this occurrence that have had issues related to fixed fire suppression systems, passenger management, and the role of the AR. International accident investigation bodies have also investigated similar marine occurrences (Appendix E).

Data on all marine transportation occurrences since 1995 are available on the TSB website at https://www.tsb.gc.ca/eng/stats/marine/data-6.html. This information is updated monthly.

1.22 TSB recommendations

1.22.1 Carbon dioxide fixed fire suppression systems

On 12 May 2003, the roll-on/roll-off passenger ferry *Queen of Surrey* suffered a diesel oil fire in the engine room.[141] Some of the CO_2 escaped when the CO_2 fixed fire suppression system was activated, although enough reached the engine room to extinguish the fire. Following this occurrence, the Board recommended that

> the Department of Transport, in conjunction with other stakeholders, review Canadian and international marine regulations respecting fixed fire-extinguishing systems to ensure that their design, maintenance, inspection, and testing regimes effectively demonstrate continued structural and functional integrity.
>
> **TSB Recommendation M05-05**

The *Vessel Fire Safety Regulations* describe standards that are additional or complementary to IMO's *International Convention for the Safety of Life at Sea (SOLAS), 1974* regulations and codes. The IMO's *International Code for Fire Safety Systems* relates to system design and installation requirements for extinguishing systems. The *Vessel Fire Safety Regulations* came into force in February 2017 and applied at least in part to all vessels after February 2018. Between 2003 and 2018, there were no instances of a major engine room fire on Canadian vessels in which the fixed fire-extinguishing system was an issue. In 2018, the Board considered the response to Recommendation M05-05 to be **Fully Satisfactory**. The TSB's assessment of this response, as well as previous responses and assessments, are available on the TSB website.[142]

The TSB notes that, even when the response to a recommendation is rated as Fully Satisfactory, there may continue to be residual risk. Since 2018, there have been a number of instances in which the unsuccessful operation of a CO_2 fixed fire suppression system was a factor. In January 2024, the Board issued a safety concern about the level of knowledge of the operation of CO_2 fixed fire suppression systems as part of its report on the loss of the fishing vessel *Atlantic Destiny*.[143]

1.22.2 Crew preparedness and realistic drills

On 20 August 2022, the passenger ferry *Sam McBride*, with 6 crew members and approximately 910 passengers on board, struck the dock while berthing at the Jack Layton Ferry Terminal in Toronto, Ontario.[144] Twenty passengers were reported injured. No

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[141] TSB Marine Investigation Report M03W0073.

[142] TSB Recommendation M05-05: Design, inspection, and testing of the CO_2 system (issued February 2006), accessible at https://www.tsb.gc.ca/eng/recommandations-recommendations/marine/2005/rec-m0505.html (last accessed 29 May 2025)

[143] "Knowledge of the operation of carbon dioxide fixed fire suppression systems," in TSB Marine Transportation Safety Investigation M21A0041.

[144] TSB Marine Transportation Safety Investigation Report M22C0231.

pollution was reported. The vessel and dock sustained minor damage. Emergency services responded to the occurrence and 6 of the injured passengers were taken to hospital. Following this occurrence, the Board recommended that

> the Department of Transport implement a requirement for crew members of all passenger vessels, including those on sheltered waters voyages, to complete appropriate training in passenger safety management.
>
> **TSB Recommendation M24-01**

In this occurrence, although a portion of the *Holiday Island* crew had the required passenger management training, drills as conducted did not include passengers. Therefore, operators could not evaluate the preparedness of their crews to effectively manage passengers during an emergency.

1.22.3 Passenger vessel evacuation procedures

The *Life Saving Equipment Regulations* require all passenger vessels to have an evacuation procedure that dictates how all passengers and crew members will be evacuated from the vessel within 30 minutes of the abandon ship signal being given. Although this regulatory requirement is in place, TC has no formal procedure to assess if this requirement is being met. Operators who develop evacuation procedures have no approval process to confirm their procedure meets the requirement or to obtain approval from the regulator. Following the occurrence involving the *Sam McBride*, the Board recommended that

> the Department of Transport implement a formal validation and approval process for passenger vessel evacuation procedures.
>
> **TSB Recommendation M24-02**

The passenger evacuation from the *Holiday Island* took 56 minutes. As well, the investigation found that drills were not conducted with passengers.

1.22.4 Passenger counting

Following the same occurrence involving the *Sam McBride*, the Board recommended that

> the Department of Transport implement a process to validate that passenger vessels are keeping an accurate count of all passengers, including a separate count of the number of children and infants, on all voyages.
>
> **TSB Recommendation M24-03**

During this occurrence, passengers were not accurately counted when they boarded the *Holiday Island*, and different counts were reported to the authorities. Furthermore, since there was no count of passengers when they mustered or evacuated the vessel, there was no way to determine if a passenger was unaccounted for. Lastly, the investigation found that drills were not conducted with passengers to practise effective accounting.

1.23 TSB Watchlist

The TSB Watchlist identifies the key safety issues that need to be addressed to make Canada's transportation system even safer.

Regulatory surveillance is a Watchlist 2022 issue. TC's surveillance program is not always effective. The CSA 2001 places responsibility for safety on ARs; however, many ARs and operators have limited awareness of key sections of the CSA 2001 or of the broader regulatory framework, as this occurrence demonstrates.

ACTION REQUIRED

The issue of **regulatory surveillance in marine transportation** will remain on the Watchlist until TC provides more oversight of the commercial vessel inspection process by demonstrating that its surveillance and monitoring are effective in ensuring that authorized representatives and recognized organizations are ensuring vessel compliance with regulatory requirements; and until TC demonstrates an increase in proactive surveillance.

Safety management is a Watchlist 2022 issue. SMS is an internationally recognized framework that allows companies to identify hazards, manage risks, and make operations safer—ideally before an accident occurs.[145] Although the issue of safety management has been on the Watchlist since 2010 and industry awareness about SMS has slowly increased since that time, TSB investigation reports continue to note deficiencies and concerns. Even when operators have safety management processes in place, as in this occurrence, hazards are not being identified and effective risk-mitigation measures are not being implemented.

ACTION REQUIRED

The issue of **safety management in marine transportation** will remain on the Watchlist until

- TC implements regulations requiring all commercial operators to have formal safety management processes; and
- operators that do have an SMS demonstrate to TC that it is working—that hazards are being identified and effective risk-mitigation measures are being implemented.

1.24 TSB laboratory reports

The TSB completed the following laboratory reports in support of this investigation:

- LP066/2022 – NVM [non-volatile memory] Recovery – PC [personal computer]
- LP107/2022 – Laser Scanning and Publishing
- LP113/2022 – Fire Monitoring System Analysis
- LP129/2022 – Fuel System Components Examination
- LP013/2023 – Engine System Analysis
- LP053/2024 – VDR [voyage data recorder] Data Recovery and Analysis

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145 As of 2024, the *Marine Safety Management System Regulations* require most commercial vessels to have a documented safety management system. These regulations do not apply to fishing vessels and most non-propelled vessels (Transport Canada, SOR/2024-133).

2.0 ANALYSIS

The analysis will look at the causes of the engine room fire and how it spread on the *Holiday Island*. As well, the analysis will look at the role of the authorized representative (AR) in vessel maintenance, safety procedures, and emergency management, and at how well this role is understood in the industry. Finally, the analysis will look at the preparedness of Canadian resources to respond to marine emergencies.

2.1 Engine room fire

2.1.1 Fuel rail leak and repairs

On 20 June 2022, a fuel oil leak was identified on the fuel rail for the forward main engine of the *Holiday Island*. Over the course of the following month, several temporary repairs were made to the rail. On 22 July 2022, while the vessel was on its 2nd voyage of the day, the last temporary repair failed, spraying fuel onto hot engine surfaces.

Fuel line leaks are not unusual on vessels. Because of the serious potential consequences, industry guidelines emphasize that special attention should be paid to fire risks during maintenance work, and that repairs should use replacement parts that comply with system specifications. However, in practice, vessels sometimes continue to operate with patches and temporary repairs.[146]

Although engine room fires are recognized as a serious consequence of fuel line leaks, engine room fires are rare. Throughout their careers, engineers may accumulate experience with fuel line leaks and similar failures that have no serious consequences, lowering their perception of the associated risks over time. On the *Holiday Island*, the application of a series of temporary repairs to fix the fuel rail leak was deemed acceptable under the circumstances and the risks were perceived to be low.

The crew and shore staff were aware that a service interruption would be needed to repair by welding or to replace the damaged fuel rail. Without a formal risk assessment process to assess the impact of repairs to defects, the risks associated with continuing operations without making a permanent repair went unrecognized and the focus remained on the need to keep the ferry service on schedule.

Over the course of a month, the leak in the fuel rail progressed from a pinhole to a crack that was over 75% of the circumference of the fuel rail, and the failure rate of the temporary repairs increased. As required by the safety management system (SMS), Northumberland Ferries Limited (NFL) crew and shore staff discussed the temporary repairs and also

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[146] For example, see TSB marine transportation safety investigation reports M19C0403 and M18P0014. For an international example, see a recent United Kingdom Marine Accident Investigation Board report (Report on the investigation of 2 catastrophic engine failures, 1 resulting in a fire on board the ro-ro passenger ferry *Wight Sky*, at https://assets.publishing.service.gov.uk/media/6267cc85e90e071690c1b679/2022-4-WightSky-Report.pdf [last accessed 02 June 2025]).

communicated with the engine manufacturer and external consultants. However, communication was related to technical steps more than the risk. On the day before the occurrence, the fuel rail had been cut all the way through to apply a section of flexible hose; this hose was made of material unsuitable for fuel or oil transfer.

Finding as to causes and contributing factors

For approximately a month after the initial leak in the fuel rail was observed, a series of temporary repairs using non-standard materials and methods was made while the vessel remained in service.

Crew and shore staff were accustomed to applying patches and making temporary repairs as part of their routine day-to-day work. This work meant that NFL was able to keep the ferry service running during the peak tourist season; consequently, crew received acknowledgements and thanks from the shore staff on the repairs. Although crew members relayed their concern to shore staff about the final (temporary) repair, the level of communication between the crew and shore staff regarding the level of risk associated with the temporary repair was minimal. Because no ferry runs were cancelled and the crew did not consider the fuel line repair to be a reportable repair, neither the AR nor the recognized organization responsible for certifying the vessel were notified about the repairs to the fuel line.

Finding as to risk

If the hazards posed by temporary repairs to a vessel are not objectively assessed in order to counter operational pressures, the practice of temporary repairs may be normalized. Consequently, risks may go unidentified or unmitigated, jeopardizing people on board and the vessel.

When the final repair to the fuel rail failed, the fuel sprayed over an area that was one of the hottest parts of the engine. The fuel spray made contact with hot exhaust surfaces that were at temperatures well in excess of the auto-ignition temperature of marine gas oil (MGO) (Figure 9). Although the parts of an engine that exceed 220 °C when the engine is operating should be protected by fireproof insulation, large fuel sprays can spread as vapour or liquid and reach hot engine components through small gaps, even where insulation is installed.

Finding as to causes and contributing factors

When the final temporary repair to the leaking fuel rail failed, fuel sprayed onto the hot engine components and ignited.

Crew members initially attempted to control the fire using a direct water spray from a fire hose, which had been the 1st step in most fire drills on the *Holiday Island*. However, diesel fires may continue to burn and even spread when sprayed directly with water because diesel oil will float. For this reason, the recommendation for fighting a diesel fire is to use foam, water fog, dry chemical powder, or carbon dioxide (CO_2) rather than jets of water.

Finding as to causes and contributing factors

Water from a fire hose likely spread the burning engine fuel around the engine room and contributed to the spread of the fire.

One way to limit fire growth is to control the availability of flammable materials such as engine fuel. On the *Holiday Island*, the main engines were supplied from the day tank. The crew believed that the fuel supply had been fully shut off by the remote fuel shut-off control for the main engine fuel supply. However, post-occurrence examination showed that a knuckle of the valve assembly was unlubricated and had seized, leaving the fuel supply valve partially open. Consequently, the full contents of the day tank , part of which may have accumulated in the bilge, supplied fuel to the fire.

Finding as to causes and contributing factors

An unlubricated component of the fuel valve assembly prevented the fuel valve from closing fully, allowing the contents of the day tank to drain through the damaged fuel rail and fuel the fire in the engine room.

2.1.2 Use of the carbon dioxide fixed fire suppression system

CO_2 fixed fire suppression systems are used to smother fire by displacing the oxygen available for the fire to persist. After CO_2 is released into a space, the space must remain sealed so that it can cool below the temperature at which a fire could reignite if air were reintroduced; cooling may take many hours or even days. Consequently, it is also important to release the CO_2 as soon as possible to limit damage within the space and reduce the risk of the fire spreading beyond the space. If the fire has not yet reached its maximum intensity, this may also increase the effectiveness of the fixed fire suppression system and reduce the cooling time needed.

On the *Holiday Island,* the primary means to release CO_2 was from 1 of the 2 remote CO_2 release mechanisms. A remote release mechanism was located on each bridge and installed with a common cable. Pulling 1 of the CO_2 release mechanisms pulled this common cable, which should then have pulled a second cable to activate the CO_2 cylinders. When the master first attempted to release the CO_2, he pulled the release mechanism to a point where he felt resistance and believed this indicated that the CO_2 was released. However, this action only removed the slack in the common cable between the bridges; the remote release mechanism did not provide any other indication of success.

The master and the fire team became aware that the release of CO_2 had not been effective only when they observed that the fire was continuing to grow. At this point, they used the local release mechanism to successfully release the CO_2. However, the 15-minute delay meant that the CO_2 was not released until 36 minutes after the fire was detected. This additional time allowed the fire to build in size and likely allowed it to reach the maximum temperature for a diesel fire.

The instructions to "pull handle hard," commonly given on placards for such systems, did not give a comparison point for how hard to pull, the approximate length of the cable once pulled, or any similar detail to use for a measure of success. Given there is no practical way to activate CO_2 systems safely in drills and training, guidance in the form of instructions and feedback is critical for success. For example, instructions should include a reminder to check the control panel of the fire detection and alarm system for an indication of successful release.

The TSB has investigated a number of occurrences[147] in which insufficient knowledge of the use of CO_2 fixed fire suppression systems led to delays or failures during a fire response. Other accident investigation boards have made similar observations.[148] Following the fire and flooding on board the *Atlantic Destiny*, the Board also issued a safety concern.[149]

Finding as to causes and contributing factors

The resistance felt when the CO_2 release mechanism cable was pulled provided a false indication that the CO_2 had been released and there was no unambiguous, direct feedback from the remote-release mechanism to indicate success. As well, the posted guidance was not explicit. Consequently, the CO_2 release was delayed, allowing the fire to grow.

After everyone is safely out of a space where there is a fire and before CO_2 is released, the space must be sealed; sealing the space means that additional air cannot enter before the fire area has cooled below the temperature at which the fire could reignite. To effectively and quickly use a CO_2 fixed fire suppression system, the fire response team must know which vents, hatches, fans, and doors need to be closed to seal the space.

In this occurrence, the crew members responsible for closing vents and managing the fire scene began closing all vents shortly after the fire alarm went off and the announcement was made. However, they did not have a reference that would highlight the location of all the engine room vents that needed to be closed to isolate the space. Consequently, when they were directed to deploy the anchors and then prepare to abandon ship, the main engine room vents had not been closed, and therefore were open when the CO_2 was released. By the time crew members returned, vent 15 for the engine room air intake could not be closed because the damper handle could not be reached due to smoke and heat. Additionally, the handle for vent 9, the 2nd air intake vent, was not configured correctly and looked closed when it was actually open. The air intake vent closest to the fire served as an exhaust for the fire and the 2nd air intake vent continued to supply air, increasing the flow of air to the fire (Figure 14) and likely displacing the CO_2 that had been released.

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147 TSB Marine transportation safety investigation reports M21A0041, M19C0403, and M15C0045.

148 Australian Transport Safety Bureau (MO-2019-004), "Suspected engine room fire and passenger evacuation involving domestic commercial vessel *Fitzroy Flyer*, 13km ENE of Cairns, Queensland on 29 March 2019," at https://www.atsb.gov.au/publications/investigation_reports/2019/mair/mo-2019-004 (last accessed on 03 June 2025); Danish Maritime Accident Investigation Board, "Summary report on engine room fire on board *World Calima*" (19 February 2018), at https://safety4sea.com/wp-content/uploads/2018/02/DMAIB-WORLD-CALIMA-Summary-report-on-engine-room-fire-2018_02.pdf (last accessed on 03 June 2025).

149 TSB Marine Transportation Safety Investigation Report M21A0041.

Finding as to causes and contributing factors

The engine room space was not completely sealed and air continued to enter the space through open vents, likely displacing the released CO_2 and also adding oxygen to the fire. Consequently, the fire continued to burn.

2.1.3 Engine room flooding

The fire in the engine room damaged a flexible connection in the main engine cooling system, resulting in seawater leaking into the engine room. Because the engine room had been closed for the CO_2 release and was inaccessible because of the fire, the leak went unnoticed.

Flexible connections for the main engine cooling system are located close to the main engine and directly below the turbo assembly. For this reason, they were required by both Transport Canada (TC) regulations and classification society rules to be protected against heat and fire. Such protection gives a crew more time to respond to a fire or to evacuate a vessel before flooding can affect the vessel's stability and add to the risk to the crew, vessel, and the environment. However, the flexible connections between the cooling systems and the main engines on the *Holiday Island* were not made of heat-resistant material, nor were they protected by a fire protection sleeve.

Finding as to causes and contributing factors

The flexible connection between the cooling system and the forward main engine was not protected against heat and fire. When the flexible connection was damaged by the fire, seawater from the vessel's cooling system entered and began flooding the closed engine room.

As water entered the vessel, it accumulated in the engine room and other places. The weight of the accumulating water was not evenly distributed and caused the vessel to begin listing to port. Shortly after the engine was shut down, the master beached the vessel on a sandbar, where it remained for close to 8 hours. Although the accumulating water was negatively affecting the vessel's stability, resting on the sandbar made the *Holiday Island* more stable for transferring passengers and also kept the vessel off the ferry track (i.e., the route travelled by the *Confederation*).

Finding: Other

Beaching the *Holiday Island* on a sandbar stabilized the vessel during the passenger evacuation.

When the tide rose and the vessel floated free, the port list increased within an hour from approximately 3° to close to 10°. In response to such a negative change in the vessel's stability, the crew investigated the extent of water ingress by sounding the tanks. Because the engine room was sealed for the fire response, the greatest accumulation of water was not noted; however, when the space was re-entered, the water was found to be above the level of the engine block, a height of approximately 3.58 m above the tank top. At their highest, water levels in the engine room covered the engine block and the turbo assembly and likely helped extinguish the fire.

The *Holiday Island's* damage stability booklet described worst-case scenarios with heel angles of less than 4°. However, this critical stability information was not readily available to the bridge team because it was found only in the stability booklet and was not integrated into the emergency procedures. As a result, the team was not aware that, after the vessel floated free, the heel angle of 10° was more than double the worst-case scenarios. Consequently, the crew on the vessel perceived a need to investigate if there was water ingress instead of evaluating the potential risk of capsizing.

Finding as to risk

Once a vessel lists beyond its documented worst-case stability scenarios, the risk of sudden capsizing becomes high, posing a risk to the lives of the people on board.

2.2 Responsibilities of the authorized representative

The current role of a vessel's AR was created in the *Canada Shipping Act, 2001* (CSA 2001) as 1 of a number of changes to define the responsibilities of vessel owners more clearly. The role of the AR was extended from the definition in its previous version, where the AR was simply a single point of contact. The CSA 2001 gives the AR responsibility for all matters related to the vessel that are not otherwise assigned in it and its regulations. This includes broad responsibility for safety on the vessel, including development of procedures for safe operation and for dealing with emergencies. Even where the master or another person is named, the AR is responsible for ensuring that person fulfills their responsibility.

Given the scope of the AR's responsibilities, the relationship between the master and AR is critical and collaboration is essential for the continued safe operation of a vessel. This collaboration requires ongoing assessment by both the master and the AR to ensure that procedures are understood and followed, that they accurately represent all operations and that they also comply with regulations.

2.2.1 Safety management systems

A common approach for ensuring that a vessel has procedures for safe operation is through the implementation of an SMS. Documented policies and procedures for operations and for emergencies are integrated in the SMS.

The SMS and its operational and emergency procedures are examined at many points and by many levels of oversight:

- The AR is responsible for ensuring that such procedures are available to the master.
- The master is responsible for conducting drills on the emergency procedures and ensuring crew are trained and operations on board are conducted safely.
- The classification society that issues the SMS certificate audits the SMS regularly.
- During inspections for certification, TC inspectors or recognized organization surveyors may witness and time drills.

In this occurrence, the *Holiday Island* had an SMS with current certification issued by Lloyd's Register.

Assessment of procedures should be frequent to ensure continuous improvement of the system. For example, after a drill, it is critical to carry out a debrief, identify any gaps in the procedures or drills, and update the procedures as necessary.

The NFL SMS included a form for crew member feedback. While most of the emergency procedures had not changed in the 4 years before the occurrence, the installation of the MES created a significant change to the abandon ship procedure. Also, the crew shared handwritten information related to vents that was not in the documented procedures. The SMS manuals, including the emergency response manual, were not kept on the bridge or in the engine control room where the emergency procedures were likely to be carried out. Recurring maintenance issues, such as those related to the fuel system, were not identified as a reportable incident. Although the SMS did include a process for reviewing procedures, the investigation found no record of this process being used.

Finding as to risk

If ARs do not ensure that procedures related to vessel operation and safety are periodically evaluated and updated with feedback from those who use them, there is a risk that these procedures will not support an effective emergency response.

2.2.1.1 Emergency procedures

During an emergency, time and cognitive resources are limited and should be focused on the emergency itself. It is critical to ensure that all information required in an emergency is part of the emergency procedures. Furthermore, this information should be at a level of vessel-specific detail that allows it to be used immediately. Other TSB investigations have shown that the absence of such information has been a factor in emergency responses.[150]

This occurrence was complex as it involved several factors: an engine room fire and subsequent flooding, passengers (including children and disabled persons), extremely warm weather, crew with varying levels of qualifications and experience in their roles and with the life-saving equipment, a large number of first responders, and response teams located throughout the vessel. This complexity increased the need for clear procedures. However, the *Holiday Island*'s emergency procedures were missing the following:

- Specific instructions for the remote release of the CO_2
- Direction in the fire response procedure to close the correct vents to isolate specific locations
- Pre-identified priorities for boundary cooling
- A procedure to account for passengers by counting them during an emergency

[150] For examples, see TSB marine transportation safety investigation reports M22A0332, M21A0041, and M13M0287.

Additionally, critical stability information was not readily available to the master and crew.

Finding as to risk

If emergency procedures do not contain explicit, vessel-specific information that can be used immediately, there is a risk that crew members will not have critical information needed to effectively set priorities and make decisions during an emergency.

Regulations require procedures for the complete evacuation of passengers and crew. These procedures existed in the NFL SMS and were practiced in abandon ship drills. However, while there may be situations where some crew members remain on board to continue the emergency response, there are no requirements to have a procedure to guide actions taken after a partial evacuation.

In this occurrence, there was no ongoing evaluation of risk on board the vessel to determine when people still on board should evacuate, nor was there any guidance to support such an evaluation. For example, when the temperature of the fuel tank was found to be near the flashpoint for MGO and the perceived risk of explosion was high, indirect discussions about the evacuation took place between the master, NFL management ashore, first responders, TC, and Joint Rescue Coordination Centre (JRCC). Consequently, there was a delay of at least 20 minutes before a decision was made to completely evacuate the vessel. Recent occurrences[151] show that a partial evacuation is not unusual in marine emergencies.

Findings as to risk

If a vessel's SMS does not include a decision process for the period of the emergency response that follows a partial abandonment, decisions may be delayed or tasks may be missed, increasing the risk to people on board and to the safety of the vessel.

2.2.1.2 Emergency drills

On the *Holiday Island*, crews routinely drilled every 4 days, matching crew rotations and providing any new crew the opportunity to practice. Drills were always performed in port within the 20- to 30-minute period that was needed for embarking and disembarking vehicles and passengers. Consequently, drills were short and simple to avoid a delay in departure time. Drills were rotated equally through 8 locations on board, even though engine room fires are more likely than fires in other locations and of more serious consequence to the vessel.

The *Holiday Island* carried foam extinguishing agents and portable foam applicators that were available to the crew at the time of the fire. However, foam was rarely used or discussed in drills and was not included in NFL's emergency checklist for a fire response.

On the Holiday *Island,* neither fire drills nor abandon ship drills included anyone playing the role of passengers. Therefore, crew members had not had experience with passengers during simulated emergencies on board, including passengers who were unable or unwilling to respond to instructions.

[151] TSB marine transportation safety investigation reports M21P0197, M21A0041, M18P0014, and M18C0225.

As with all types of emergency response, fire and abandon ship drills are most effective if there is a mix of activity to develop automatic responses, such as donning fire gear or confirming tasks are complete; varied scenarios that represent likely situations, such as the probable locations of fires; and realistic scenarios to practice adjusting to problems in an emergency, such as missing equipment or passengers who are unable or unwilling to respond to instructions.

In this occurrence, crew members did what they had practiced in the drills. They successfully used the fire hoses to maintain boundary cooling for more than 8 hours. Crew members who did not always perform drills with safety equipment were unfamiliar with it and did not initially don it to perform their tasks. As well, crew members experienced some delays in responding to problems, such as interruptions for dropping anchor, and changes in leadership at the scene of the fire.

Because the occurrence did not happen in port where they usually drilled and where it was clear what radio channel to use, there was some confusion over communication using the portable radios. As well, those portable radios that were functional in the emergency were split between teams carrying out firefighting and abandon ship procedures at the same time. In some cases, team leaders needed to send messengers to maintain communication. This delayed communication as the messengers had to travel between decks in hot and humid conditions, and this took crew away from their tasks in the emergency.

Finding as to risk

If shipboard emergency drills do not represent realistic scenarios, there is a risk that crews will be unable to respond effectively to an emergency.

On the *Holiday Island*, like on many other vessels in the marine transportation industry, emergency procedures were drilled singly: when a fire drill ended, the crew would muster for an abandon ship drill. All crew members had roles in both the fire response procedure and the abandon ship procedure. However, because the procedures were drilled sequentially, there was no opportunity to identify any potential problems related to this overlap. For example, the leader of the fire response at the scene also had a key role in the abandon ship procedure; when he left the scene of the fire, the fire response team had to adjust. The muster list was not examined for overlap of duties during audits or inspections, and such an examination is not expected or required for domestic vessels.

The *Life Saving Equipment Regulations* specify requirements for emergencies, such as the maximum time allowed to complete an evacuation (abandon ship order), and the *Fire and Boats Drills Regulations* state that drills should be carried out as if there were an actual emergency. However, there is no requirement for anyone to verify that a vessel's evacuation plans can be implemented, and there is no requirement to practise such a drill with a realistic number of passengers, although TC has published a ship safety bulletin[152] in which the practice is encouraged. Accordingly, in a complex scenario—such as a fire combined with beaching—the number of crew members available may not be adequate to respond to all aspects of the emergency.

Although regulations set out a minimum level of safety, vessel ARs must consider all of the risks faced by the vessel. Simultaneous emergencies, especially an emergency combined with an evacuation, can be expected, especially in the marine environment, where vessel abandonment is complex and presents many risks. If drills are planned around meeting the minimum regulatory requirements, the primary goal of being prepared for actual, complex emergencies may not be reached.

Finding as to risk

If a vessel's muster list assigns crew members to duties in multiple emergency procedures, then leadership and communication issues, delays, or other problems are likely to occur when the emergencies happen at the same time, increasing the risk to people on board, the vessel, and the environment.

2.2.1.3 Passenger management

Managing passengers in an emergency is a skill that can be acquired by training and practise; the crew members who must be trained in passenger management are identified on the safe manning document. However, in this occurrence, more than half of those who were assigned roles in mustering passengers did not hold current passenger management training. As well, drills were conducted without anyone playing the role of passenger and so the crew had not had the opportunity to practise managing and tracking a large group of people.

In an emergency on a passenger vessel, it is critical to plan and assign resources, on and off the vessel, that will keep track of how many passengers are on board and which passengers may need special assistance. An accurate count of passengers is also needed when they are boarding to ensure that the capacity of the vessel is respected and that enough emergency equipment is available, including lifejackets and life rafts.

In 2008, the TSB issued a recommendation requiring vessels such as ferries to have passenger counts, including counts for different age categories and for any individuals who need special assistance in emergencies.[153] The recommendation was closed as fully satisfactory in 2010 when the *Fire and Boat Drills Regulations* came into force. However, since that time a number of TSB investigations have found that passenger counts have not been accurate and that the lack of this information has placed passengers, crew, and first

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[152] Transport Canada, *Ship Safety Bulletin* 04/2022: Requirements for passenger evacuation and safety (08 February 2022), at https://tc.canada.ca/sites/default/files/2022-02/SSB-04-2022E.pdf (last accessed on 05 June 2025).

[153] TSB Marine Transportation Safety Recommendation M08-01.

responders at additional risk.[154] In 2024, following the occurrence on the ferry *Sam McBride*, the TSB issued 3 recommendations, related to the safety management, evacuation, and count of passengers.[155]

During the *Holiday Island* occurrence, the shore staff, crew, and first responders did not have an accurate count of the number of passengers on board the vessel: counts varied from 182, at boarding, to the 236 passengers who were counted as they arrived at Wood Islands.

Finding as to risk

If there is no accurate count kept of passengers boarding a vessel, some passengers may not be accounted for in an emergency, increasing risks to passengers, crew, and first responders.

In addition to not having processes in place to ensure that an accurate count of passengers was maintained, neither TC Programs Group nor NFL required ferry crews to keep a separate count of children and infants. Although this specific count is not required by regulation, regulations do require that a vessel have child-sized lifejackets equivalent to 10% of the total complement, or the number of children on board, whichever is greater. However, ensuring this requirement is met would be practically impossible without a separate count of children.

Finding as to risk

If a crew does not ensure that the number of lifejackets of the correct sizes is sufficient for the number of children and infants boarding the vessel, there is a risk that children and infants will not have lifejackets in an emergency.

2.2.2 The authorized representative

The scope of the AR responsibilities is broad. Although these responsibilities are defined in the CSA 2001 and its associated regulations, the form of the definition varies depending on when and how the regulation was updated. There are many regulations that assign responsibility to the AR (see Appendix C), and the AR also has the residual responsibility for any requirements where the primary party responsible is not named.

TC is responsible for setting a minimum level of safety in regulations and for oversight of compliance with the regulations. The current definition of the role of the AR provides a clear path for enforcement, but the need for the AR or the AR's delegate to play a proactive role in ensuring safety is critical. For this arrangement to succeed, all of the parties involved must understand the scope of that role. Articles in industry publications and other information for vessel owners suggest that not all vessel owners understand the scope of their responsibilities; this suggests that TC's approach of providing explanation through voluntary programs, including communications specific to individual regulations and safety

[154] TSB marine transportation safety investigation reports M22A0312, M17C0179, and M13L0067.

[155] TSB Marine Transportation Safety Investigation Report M22C0231.

issues, is not entirely successful. Recent TSB investigations have also demonstrated that the scope of AR responsibilities is not well understood in the broader Canadian marine industry, such as in the sectors in which smaller fishing[156] and commercial[157] vessels operate.

The AR must also keep up with changes in safety knowledge and standards. Keeping informed on the relevant sections of CSA 2001, regulations, and guidelines is not an easy task, especially for ARs responsible for older vessels such as the *Holiday Island*. As safety standards change, regulations change with them. Older vessels are often exempt from regulatory changes due to the costs and feasibility of making changes to meet the newer standards. However, judgment is required on the part of the AR because improved vessel safety may be achieved by exceeding the minimum standard required by regulation.

Finding as to risk

If ARs do not have a clear understanding of the scope of their responsibilities with respect to safety, vessels may operate without the minimum defences provided by meeting regulatory requirements, increasing the risk of incidents and accidents.

As the responsible party, the AR must be aware of the regulations that apply to their vessel and keep up with safety knowledge and standards to maintain safe operations.

For the *Holiday Island*, the Minister of Transport was the named AR according to the vessel registration. In practice, within TC, it was generally understood that the Minister of Transport was the named AR and that TC Programs Group was acting for the Minister. The contracts between TC Programs Group and NFL stated that NFL was to act as if it were the AR. However, many staff members at TC Programs Group and NFL were unsure of what was required of an AR and who was responsible for carrying out the AR's responsibilities.

The contracts defined requirements for reports from NFL to TC Programs Group, such as reports about emergency repairs,[158] quarterly vessel maintenance, and any ferry cancellations. The quarterly maintenance reports were organized around costs, category of work, and timing. Some notes mention safety but most are related to costs. Furthermore, despite contractual and regulatory requirements to report on emergency repairs or safety issues, no procedures in the SMS instructed the master, or others, to report to anyone outside NFL except during emergencies.

TC Programs Group was required to provide an annual inspection report to NFL. However, although some informal contact by TC Programs Group was maintained with the crew, the last formal report was issued in 2017. Through the contracts with NFL, TC Programs Group

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[156] TSB Marine Transportation Safety Investigation Report M20P0229.

[157] TSB Marine transportation safety investigation reports M22P0259 and M21P0030.

[158] Under the delegated statutory inspection program (DSIP), NFL was also required to report emergency repairs to the recognized organization. However, problems such as the damaged fuel rail in this occurrence were not considered emergency repairs, and any decision about what constitutes an emergency repair is based on the judgment of the crew.

staff believed they had fully delegated the AR's responsibilities for operations, including developing maintenance and emergency procedures; however, as the AR of the vessel, they remained responsible under CSA 2001. Although capital projects remained the responsibility of TC, NFL staff understood that they were to carry out the AR's responsibilities for day-to-day operations. As a result, TC Programs Group was not invited to participate in the development and review of procedures, did not carry out internal audits of the vessel directly, and did not have a mechanism to carry out oversight of the vessel operator. Consequently, the immediate, operational pressures on NFL staff contributed to practical drift with respect to risk assessments, drills, and emergency procedures.

Finding as to risk

Without effective oversight by an AR, practical drift can emerge in the execution of a vessel's operational and emergency procedures, and the safety objective of the CSA 2001 may not be achieved.

2.3 Canada's preparedness for marine emergencies

The occurrence involving the *Holiday Island* demonstrated some of the risks involved in responding to marine emergencies in Canadian waters. It also raised questions about the availability and capability of Canadian resources to respond to vessel fires. On commercial vessels, crew are equipped and trained to handle many emergencies with the resources on board the vessel. However, any emergency can quickly shift to become an emergency that requires external support. For engine room fires, such as in this occurrence and in a number of incidents recently investigated by the TSB, the on-board response capacity is limited to boundary cooling after the CO_2 fixed fire suppression system has been used. Whenever outside resources are involved, a response plan is needed on the part of the responding authorities as well as the vessel in distress.

In this occurrence, the emergency response involved many agencies and individuals, including the CCG, the Canadian Armed Forces, NFL management, the PEI Emergency Measures Organization, Island Emergency Medical Services, the RCMP (Royal Canadian Mounted Police), TC Marine Safety and Security staff, approximately 200 firefighters from PEI fire departments, and crews from various vessels of opportunity. Those who boarded the vessel while the response to the fire was ongoing included a rotation of firefighters, NFL staff, replacement NFL crew, and 2 TC Marine Safety and Security staff. This level of response was feasible because the vessel was beached on a sandbar close to Wood Islands terminal during daylight and in favourable weather. However, this level of support is often unavailable in an occurrence due to the location of the vessel, the environmental conditions, or the specialized nature of marine firefighting.

In the later stages of the fire response, the vessel was at a perceived risk for an explosion. Furthermore, the water ingress negatively impacted stability, putting the lives of the responders at risk. Capsizing would have put the environment of the Northumberland Strait at risk.

Pre-arranged plans exist to support emergency responses for some sectors, vessels, and emergencies. However, Canada does not require pre-arranged plans for fire response or marine salvage, unlike the U.S. For passenger vessels, only vessels that make international voyages are required to provide information, such as SAR cooperation plans, as preparation for emergencies.

In June 2023, the CSA 2001 was amended to give the Governor in Council the authority to make regulations, on the recommendation of the Minister, "respecting arrangements for emergency services, including requiring vessels or classes of vessels to enter into such arrangements."[159] However these regulations may take many years to put into place.

Finding as to risk

If Canada's level of preparedness and coordination for marine emergencies, beyond the search and rescue regime, is not increased, there is a risk that these emergencies will not be managed in a timely and effective manner, endangering vessels, people on board, the environment, and the public.

2.3.1.1 Communications with the vessel in distress

It is best practice to have methods of communication clearly defined in emergency procedures so that responders can focus on the emergency itself. This is true for both communication between teams on board the vessel and for communication with outside resources.

In practice, communication between the leadership of the shore-based first responders, the shore management of the vessel, the master and crew, and the JRCC may not be well coordinated, especially at the initial stage of the response when resources are first being dispatched.

In this occurrence, the shore-based response included NFL management, PEI paramedics, police, and approximately 200 firefighters from PEI fire departments. As these resources were dispatched by 911 operators, they did not all establish communications with the JRCC when they deployed. During the occurrence, some information was relayed between shore-based first responders and the JRCC by the marine-based responders. There was no communication plan to coordinate between all responders during the occurrence, and there was infrequent communication directly between the vessel and the JRCC. Following the occurrence, the shore-based responders also identified a need for a formal information plan and for improved information sharing.

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159 Government of Canada, *Canada Shipping Act, 2001* (as amended 22 June 2023), subsection 120, paragraph s.1.

Finding as to risk

When first responders do not have a communication plan for marine emergencies, information may be missed and decisions may be delayed, increasing the risks to those on board, to the vessel, and to the environment.

When a marine emergency is detected, it is a best practice for the crew to notify a radio ship reporting station (in Canada, a Marine Communications and Traffic Services station) of a potential or immediate need for help using radio distress frequencies. This action signals that outside help may be needed. The reporting station can then give a JRCC or maritime rescue sub-centre (MRSC) early notice of a potential emergency so that the search and rescue coordinators can then notify appropriate resources and prepare for an effective response. As well, using radio for the initial call means nearby vessels that can potentially help are also alerted that help may be required.

NFL emergency procedures emphasized that the master should contact shore staff directly, which he did, using a cell phone. The terminal manager in turn contacted 911, which then contacted JRCC Halifax. The Marine Communications and Traffic Services Sydney issued a Mayday relay broadcast message 12 minutes later. Once the emergency reached the point where the vessel was being abandoned, NFL procedures then instructed the master to issue a Mayday call, which he did.

Finding as to risk

If emergency response procedures do not instruct crew to make an early and direct report to a radio ship reporting station, there is a risk that assistance will be delayed.

3.0 FINDINGS

3.1 Findings as to causes and contributing factors

These are the factors that were found to have caused or contributed to the occurrence.

1. For approximately a month after the initial leak in the fuel rail was observed, a series of temporary repairs using non-standard materials and methods was made while the vessel remained in service.

2. When the final temporary repair to the leaking fuel rail failed, fuel sprayed onto the hot engine components and ignited.

3. Water from a fire hose likely spread the burning engine fuel around the engine room and contributed to the spread of the fire.

4. An unlubricated component of the fuel valve assembly prevented the fuel valve from closing fully, allowing the contents of the day tank to drain through the damaged fuel rail and fuel the fire in the engine room.

5. The resistance felt when the carbon dioxide (CO_2) release mechanism cable was pulled provided a false indication that the CO_2 had been released and there was no unambiguous, direct feedback from the remote-release mechanism to indicate success. As well, the posted guidance was not explicit. Consequently, the CO_2 release was delayed, allowing the fire to grow.

6. The engine room space was not completely sealed and air continued to enter the space through open vents, likely displacing the released CO_2 and also adding oxygen to the fire. Consequently, the fire continued to burn.

7. The flexible connection between the cooling system and the forward main engine was not protected against heat and fire. When the flexible connection was damaged by the fire, seawater from the vessel’s cooling system entered and began flooding the closed engine room.

3.2 Findings as to risk

These are the factors in the occurrence that were found to pose a risk to the transportation system. These factors may or may not have been causal or contributing to the occurrence but could pose a risk in the future.

1. If the hazards posed by temporary repairs to a vessel are not objectively assessed in order to counter operational pressures, the practice of temporary repairs may be normalized. Consequently, risks may go unidentified or unmitigated, jeopardizing people on board and the vessel.

2. Once a vessel lists beyond its documented worst-case stability scenarios, the risk of sudden capsizing becomes high, posing a risk to the lives of the people on board.

3. If authorized representatives (ARs) do not ensure that procedures related to vessel operation and safety are periodically evaluated and updated with feedback from those who use them, there is a risk that these procedures will not support an effective emergency response.

4. If emergency procedures do not contain explicit, vessel-specific information that can be used immediately, there is a risk that crew members will not have critical information needed to effectively set priorities and make decisions during an emergency.

5. If a vessel's safety management system does not include a decision process for the period of the emergency response that follows a partial abandonment, decisions may be delayed or tasks may be missed, increasing the risk to people on board and to the safety of the vessel.

6. If shipboard emergency drills do not represent realistic scenarios, there is a risk that crews will be unable to respond effectively to an emergency.

7. If a vessel's muster list assigns crew members to duties in multiple emergency procedures, then leadership and communication issues, delays, or other problems are likely to occur when the emergencies happen at the same time, increasing the risk to people on board, the vessel, and the environment.

8. If there is no accurate count kept of passengers boarding a vessel, some passengers may not be accounted for in an emergency, increasing risks to passengers, crew, and first responders.

9. If a crew does not ensure that the number of lifejackets of the correct sizes is sufficient for the number of children and infants boarding the vessel, there is a risk that children and infants will not have lifejackets in an emergency.

10. If ARs do not have a clear understanding of the scope of their responsibilities with respect to safety, vessels may operate without the minimum defences provided by meeting regulatory requirements, increasing the risk of incidents and accidents.

11. Without effective oversight by an AR, practical drift can emerge in the execution of a vessel's operational and emergency procedures, and the safety objective of the *Canada Shipping Act*, *2001,* may not be achieved.

12. If Canada's level of preparedness and coordination for marine emergencies, beyond the search and rescue regime, is not increased, there is a risk that these emergencies will not be managed in a timely and effective manner, endangering vessels, people on board, the environment, and the public.

13. When first responders do not have a communication plan for marine emergencies, information may be missed and decisions may be delayed, increasing the risks to those on board, to the vessel, and to the environment.

14. If emergency response procedures do not instruct crew to make an early and direct report to a radio ship reporting station, there is a risk that assistance will be delayed.

3.3 Other findings

These findings resolve an issue of controversy, identify a mitigating circumstance, or acknowledge a noteworthy element of the occurrence.

1. The need for fire protection on the flexible connections between the seawater cooling system and the engine was not identified at the engine replacement planning stages or during post-installation and subsequent inspections.

2. The louvre dampers on the air intake vents were being replaced with the same type of damper, which is less effective at sealing vents than solid fire dampers.

3. The marine evacuation systems installed on the vessel contributed to the safe and rapid evacuation of passengers.

4. Beaching the *Holiday Island* on a sandbar stabilized the vessel during the passenger evacuation.

4.0 SAFETY ACTION

4.1 Safety action taken

4.1.1 Transportation Safety Board of Canada

On 05 May 2023, the TSB sent a Marine Safety Information Letter (MSI 03 23) to the Director General of Transport Canada (TC) Marine Safety and Security. In the letter, the TSB described installation of equipment that affected access to the manual release lever of at least 1 carbon dioxide pilot cartridge. On 26 May 2023, the Director of Product Management & Strategy at Kidde Fire Systems, who had been copied on the letter, stated that Kidde Fire Systems was reviewing the incident as part of its product safety process.

During the analysis of the fire on the *Holiday Island*, gaps in data to assess the underlying factors were identified. This followed safety concerns in other recent investigations,[160] where similar gaps in data were found. To more fully investigate the potential significant safety risks in the transportation system, the Board launched a safety issue investigation about vessel fires and response in Canada in April 2025.

4.1.2 Transport Canada

4.1.2.1 Transport Canada – Marine Safety and Security

On 29 February 2024, TC included information from the TSB Marine Safety Information Letter in a ship safety bulletin (SSB 06/2024).

4.1.2.2 Transport Canada – Programs Group

Maintenance report meetings with the operator (Northumberland Ferries Limited) are now monthly instead of quarterly.

4.1.3 Northumberland Ferries Limited

Since the occurrence, Northumberland Ferries Limited (NFL) has undertaken an ongoing safety program and has completed the following actions:

- The passenger services supervisor position has been added to the target audience for Specialized Passenger Safety Management (Ro-Ro Vessels) training.
- NFL has implemented a new policy which must be followed by ships' crew in the event of a leak on a fuel or pressurized oil system, including escalation to shore management and the classification society.
- NFL has implemented policy which directs additional care and attention in the conduct of planned maintenance and testing of emergency fuel shut-off valves to ensure that the valves fully close.

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[160] TSB marine transportation safety investigations M21P0297, M21A0041, and M19C0403.

- NFL has developed new policy that outlines the steps that must be taken by ships' crew in the event of a defect that impacts, or has the potential to impact, vessel or personnel safety. This includes defects for which a temporary repair has been made.
- Project work is ongoing to bolster existing procedures and checklists. Resources include the fleet captain, safety department, and an external plain language expert, as well as other operators' best practices.
- NFL has reviewed and updated emergency plans. NFL has acquired access to communication equipment that uses provincial communication systems (PICS2 [Provincial Integrated Communications System] Prince Edward Island/TMR [Trunk Mobile Radio] Nova Scotia, New Brunswick) and related training. The use of this technology is included in drills and training to increase familiarity and effectiveness during actual responses.
- NFL has ensured that the on-scene commander and the incident command system (ICS) team practise emergency response scenarios. NFL has ensured that all emergency management staff have ICS training.
- NFL has ensured that all bridge and appropriate terminal staff receive training and familiarization on the manifest report.
- A series of firefighting scenarios have been developed for *MV Confederation*. This document includes 22 different scenarios and details on risks specific to each space.
- Rewritten policy and procedures documents direct that the captain is to know what the count of total persons on board is, as well as the total number of passengers requiring assistance prior to each departure. This information must also be stored ashore.
- NFL continues to work with local first responders, including the concept of unified command (incident command system) to ensure a seamless transfer of information leading to objective, collaborative decisions in the heat of the emergency.
- Safe beaching and anchoring locations have been added to the voyage plan.
- Counters are in place at all marine evacuation system stations. Evacuation team leaders and crew are instructed on their use, and the counters are used during drills.
- The Shipboard Operations Manual has been updated and shipboard and terminal policies and procedures are more closely connected, based on lessons learned from this occurrence.
- The muster lists for the new vessel are designed so that crew members can be reassigned as required.
- The procedure for internal audits has been improved.
- Improvements have been made to how crew qualifications are managed.

4.2 Recommendation

4.2.1 Knowledge of the role and the scope of responsibilities of authorized representatives

An authorized representative (AR) is the person[161] who is responsible for acting with respect to all matters relating to the vessel that are not otherwise assigned to another person. The AR must keep up with changes in safety knowledge, standards, and regulations. Where matters are assigned by regulation to another role, such as the master, the AR remains responsible for oversight of those matters. By default, the AR is an owner of the vessel. However, a vessel owner can delegate this role to a qualified person. The owner remains responsible for the acts and omissions of their AR.

The role of a vessel's AR is described in sections 14 and 106 of the *Canada Shipping Act, 2001* (CSA 2001). Specific duties are defined in the more than 30 regulations made under the act that refer to the AR. Understanding and keeping up with such a broad scope of responsibility can be a challenging and difficult task; ARs or their delegates may be experts in their own operations but are not typically experts in interpreting numerous, complex regulations that may exist in multiple versions and that may have differing application criteria.

The current definition of the role of the AR provides a clear path for oversight and enforcement. TC states that "the oversight regime is based on the legal responsibility of the AR to comply with regulations as stated under the CSA, 2001." However, in addition to ensuring regulatory compliance, the AR or the AR's delegate plays a proactive role in ensuring safety. Consequently, it is critical that they understand the scope of their role. Recent TSB investigations,[162] articles in industry publications, and other information for vessel owners suggest that not all vessel owners and ARs understand the scope of the responsibility that TC assigns to ARs. Even for larger vessels, the role of AR may still be perceived as an administrative contact.[163]

TC is responsible for administering the CSA 2001 and more than 40 associated regulations, most of which have the potential to apply to the role of AR. The regulations cover many topics and have been written over a period of decades. Accordingly, definitions can differ between regulations or the style of writing may change, making it very complex for ARs to access and comprehend their specific requirements.

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161 Under Canadian law, a corporation is a separate legal person for the purposes of liability; thus, authorized representatives can be corporations.

162 TSB marine transportation safety investigations M22P0259, M20P0230, M20P0229, M18P0014, M16C0036, and M10F0003.

163 For example, see S. Chapelski, "Canadian Maritime Law: Increased Penalties and Responsibilities for Authorized Representatives of Vessels," Norton Rose Fulbright (25 October 2023), at https://www.nortonrosefulbright.com/en/knowledge/publications/0dcf3bc6/canadian-maritime-law-increased-penalties-and-responsibilities (last accessed on 13 June 2025).

TC communicates with the marine community via ship safety bulletins and maintains a distribution list where members can subscribe to receive updates, for example to technical publications (TPs). These publications and bulletins explain the responsibilities of the AR or related roles with respect to individual regulations or topics of interest. However, some ARs may not be aware of the availability of these safety documents.

Recognizing the complexity of the regulatory regime, TC also has voluntary programs for some vessel owners. These programs provide training and information, although they may not name ARs explicitly. For example, the Small Vessel Compliance Program (for vessels under 15 gross tonnage [GT], including tugs and fishing vessels) is described as "an easy-to-use tool that brings together all requirements for small non-pleasure vessels"[164] to help vessel owners understand the scope of their responsibilities. For larger vessels, ARs are likely to be supported by an organization with access to more resources.

TC expects the AR to understand the role – that is, to take proactive measures to learn which regulations apply to their vessel and how to follow them. However, as this investigation and many others demonstrate, the role of AR is not clearly understood across many parts of the industry. If ARs do not have a clear understanding of the scope of their responsibilities with respect to safety, vessels may operate without the minimum defences provided by meeting regulatory requirements, increasing the risk of incidents and accidents. For this reason, the Board recommends that

> the Department of Transport provide comprehensive guidance for authorized representatives, outlining the full scope of their responsibilities. This guidance should support authorized representatives in understanding and complying with applicable regulations, thereby reducing the risk of vessels and crews operating without the minimum safety defences afforded by regulatory compliance.
>
> **TSB Recommendation M25-01**

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 04 June 2025. It was officially released on 23 July 2025.

Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

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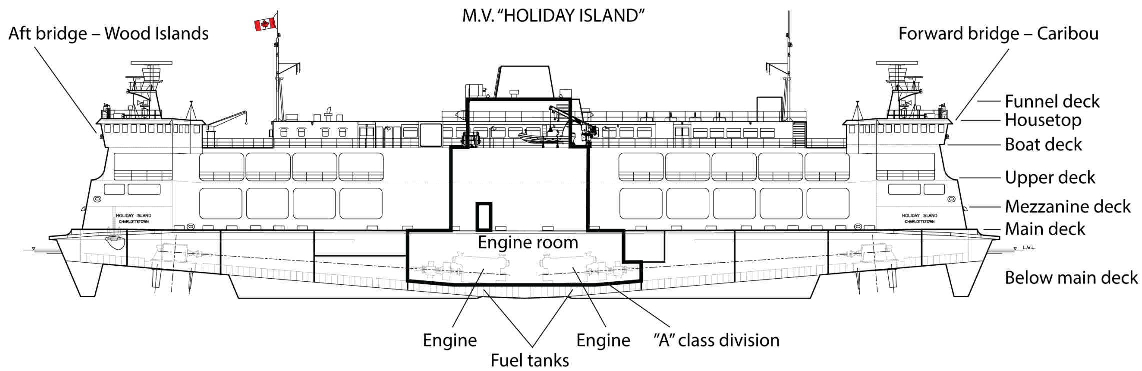
[164] Transport Canada, "Small Vessel Compliance Program," at https://tc.canada.ca/en/programs/small-vessel-compliance-program (last accessed on 13 June 2025).

APPENDICES

Appendix A – General layout of the *Holiday Island*

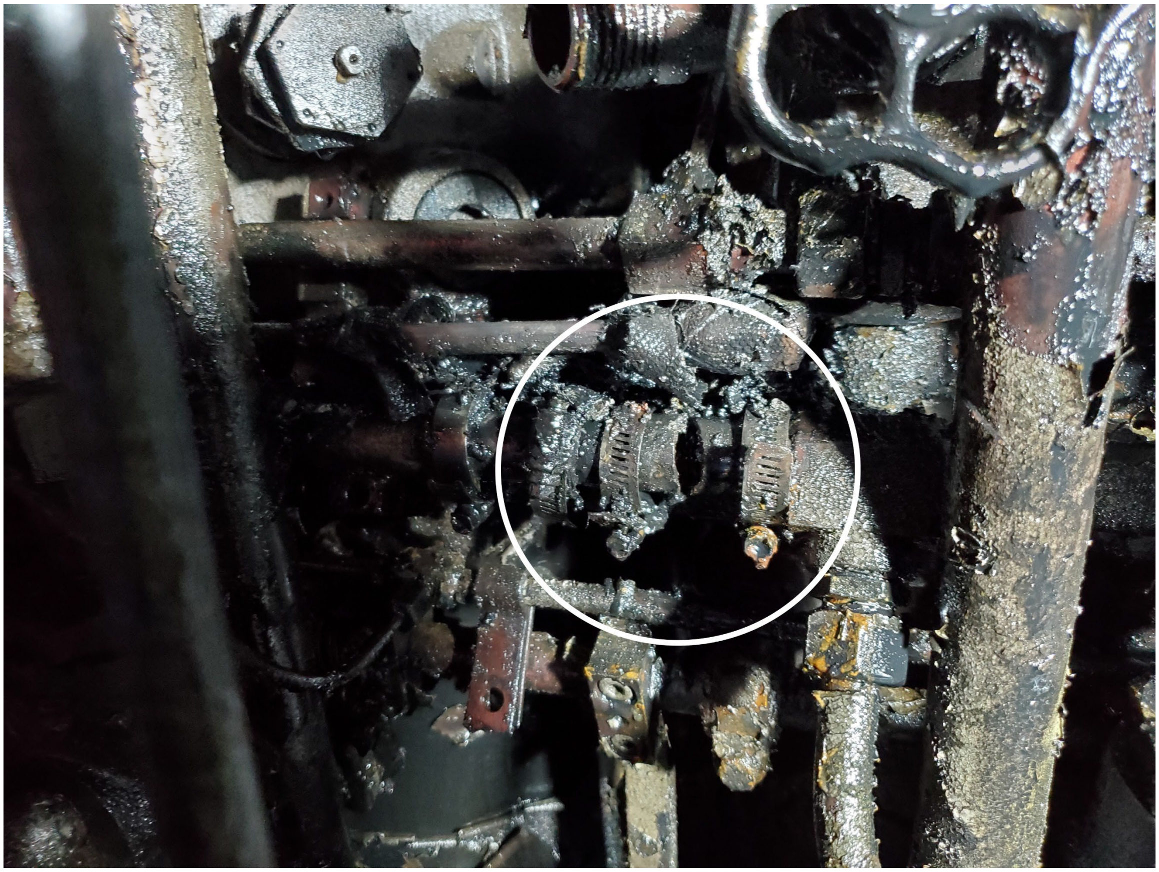
Figure A1. General layout of the *Holiday Island* (Source: Lengkeek Vessel Engineering Inc., with TSB annotations)



Appendix B – TSB laboratory analysis of the fuel rail repair

Post-occurrence, the fuel rail repair was observed to be damaged (Figure B1).

Figure B1. The location of the fuel rail repair on the forward main engine between cylinders B5 and B6 (Source: TSB)



A series of tests were conducted at the TSB laboratory to determine

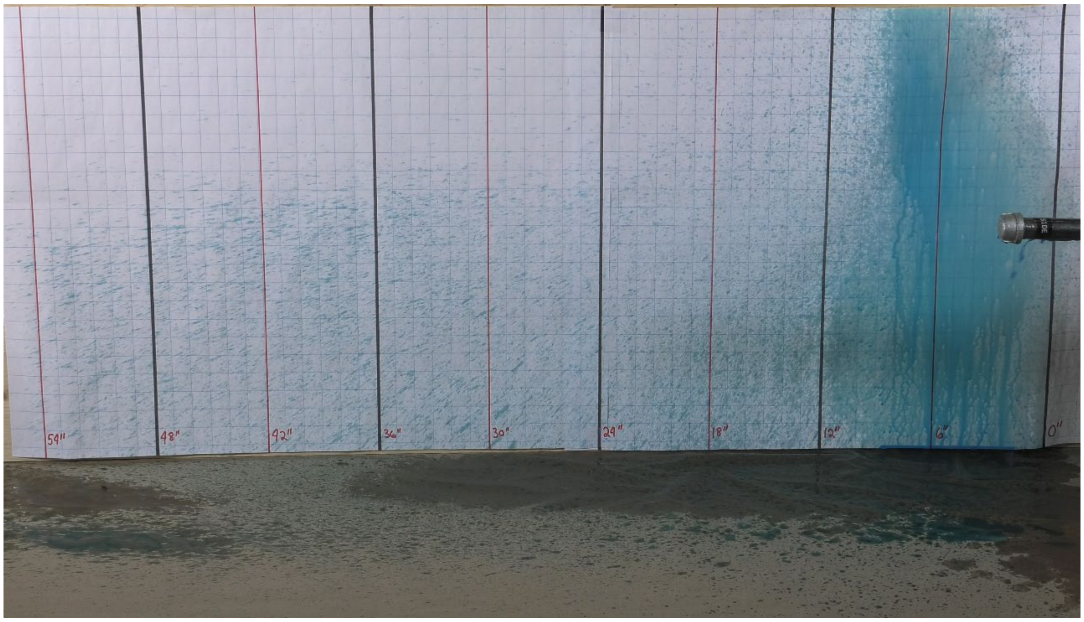
- the effects of marine gas oil (MGO) on the hose used in the repair;
- the effects of normal fuel line operating pressures on a simulated pipe repair;
- the effects of worm drive tightening torque on hose clamp performance; and
- the spray pattern of a fuel leak under simulated conditions.

The results can be summarized as follows:

- Although there was some swelling near the ends of the test sample, prolonged exposure to MGO alone is not believed to have caused the repair to fail.
- The installation of worm drive hose clamps can cause considerable variation on the efficacy of the seal.
- Due to the design of worm drive clamps, it is possible for them to appear adequately torqued but not be torqued enough to provide a good seal. As well, adding an additional clamp, if not properly torqued, does not improve the sealing.

- Immediately next to the clamped hose, a fuel spray was observed to be in a ring-like pattern vertically around the repair location and horizontally sprayed at least 54” from the simulated repair (Figure B2).

Figure B2. Fuel spray test results in 2 dimensions. Note that the spray would be in 3 dimensions, and that spray near an engine may reflect or drip onto nearby surfaces. (Source: TSB)



The TSB laboratory concluded that with the combination of line pressure, exposure to fuel, engine room heat, engine vibration, and a marginally torqued clamp, a sudden leak could have developed.

Appendix C – Scope of responsibilities of the authorized representative

For Canadian vessels, subsection s14(1) of the *Canada Shipping Act*, *2001* (CSA 2001) states that the authorized representative (AR) "is responsible under this Act for acting with respect to all matters that are not otherwise assigned by this Act to any other person."[165] Even where another person is named, the AR is responsible for oversight of that person. Some regulations also begin with a statement such as the following: "the authorized representative of a vessel must ensure that requirements of these regulations are met in respect of the vessel."[166] Of the 49 regulations made pursuant to the CSA 2001, at least 31 have the potential to apply to AR role.

At the time of the occurrence, certain regulations were applicable under the *Canada Shipping Act* (R.S.C. 1985) and not the CSA 2001; as of 20 December 2023, those regulations were replaced by the *Vessel Construction and Equipment Regulations* (SOR/2023-257). These regulations apply to new vessels and may not apply to older vessels such as the *Holiday Island*. Depending on the regulations that apply to an older vessel, the AR may need to consult regulations that have since been repealed.

Some regulations mention the AR explicitly as being responsible for certain requirements. Others name the master or owner as responsible for or as sharing responsibility for similar items in the regulations.

Section 4 of the *Administrative Monetary Penalties and Notices (CSA 2001) Regulations*[167] gives details about how to serve a document on a vessel to individual or corporate ARs.

Section 4 of the *Arctic Shipping Safety and Pollution Prevention Regulations*[168] distinguishes between "requirements," which the AR must ensure are met, and "operational requirements," which the master must ensure are met.

In the *Ballast Water Regulations*, the role of the AR is extended to the "owner and operator"[169] of a pleasure craft that is not a Canadian vessel. Section 4 of the regulations specifies that the "authorized representative and the master of a vessel must ensure that the requirements"[170] of certain sections are met and defines the period of responsibility for each role with respect to the ballast water record book.

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[165] Government of Canada, *Canada Shipping Act*, *2001* (S.C. 2001, c. 26, as amended 22 June 2023), subsection 14(1).

[166] For example, see the *Navigation Safety Regulations* or the *Vessel Safety Certificates Regulations*.

[167] Transport Canada, SOR/2008-97, *Administrative Monetary Penalties and Notices (CSA 2001) Regulations* (as amended 10 April 2024).

[168] Transport Canada, SOR/2017-286, *Arctic Shipping Safety and Pollution Prevention Regulations* (as amended 07 June 2023).

[169] Transport Canada, SOR/2021-120, *Ballast Water Regulations* (as amended 16 April 2024), subsection 1(2).

[170] Ibid., section 4.

The *Cargo, Fumigation and Tackle Regulations* add that a company, "in respect of a Canadian vessel, means its authorized representative."[171] These regulations also assign some responsibilities to the "authorized representative and the master" of a vessel (for example, subsections 102[2] and 115[2]), the AR or the master (for example, subsection 146[3]), or divide the responsibilities between the 2 roles (for example, section 218).

Section 4, Compliance, of the *Collision Regulations* lists the AR and master together. Rule 2: Responsibility, lists "any vessel, or the owner, master or crew thereof."[172]

The *Fishing Vessel Safety Regulations* state that "unless otherwise indicated in this Part [Part 0.1: Interpretation], the authorized representative and the master of a fishing vessel shall ensure that the requirements of this Part are met."[173] The specific requirements are directed to the AR.

The *Load Line Regulations* (SOR/207-99) and the *Vessel Registration and Tonnage Regulations* (SOR/207-126) contain numerous mentions of AR responsibilities, which vary according to factors such as the age and voyage type of the vessel and whether the vessel is "maintained in accordance with the requirements of a classification society."[174]

The *Long-Range Identification and Tracking of Vessels Regulations* (SOR/2010-227) name the vessel's master in subsection 11(2). Compliance with sections 4 to 10 is the responsibility of the AR.

In the *Marine Personnel Regulations* (SOR/2007-115), most references to the AR are used as an alternative to the employer.

The *Navigation Safety Regulations, 2020* (SOR/2020-216) contain references to the AR unless "otherwise provided."[175] These regulations and the *Vessel Safety Certificates Regulations* (SOR/2021-135) also contain references to the AR and/or the master being responsible for meeting requirements or ensuring that requirements are met.

The *Small Vessel Regulations* (SOR/2010-91) state that "owner, in respect of a vessel other than a pleasure craft, means the authorized representative as defined in section 2 of the Act."[176] Specific requirements are assigned to the owner and/or the operator.

The *Vessel Detention Orders Review Regulations* (SOR/2007-127) refer to the AR.

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171 Transport Canada, SOR/20017-128, *Cargo, Fumigation and Tackle Regulations* (as amended 31 October 2021), paragraph 100(1)(a).

172 Transport Canada, C.R.C. c. 1416, *Collision Regulations* (as amended 06 June 2023), Schedule 1, Rule 2: Responsibility, paragraph (a).

173 Transport Canada, C.R.C. c. 1486, *Fishing Vessel Safety Regulations* (as amended 20 December 2023), section 3.02.

174 Transport Canada, SOR/2007-99, *Load Line Regulations* (as amended 20 December 2023), subsection 5(1)(b).

175 Transport Canada, SOR/2020-216, *Navigation Safety Regulations* (as amended 20 December 2023), section 4.

176 Transport Canada, SOR/2010-91, *Small Vessel Regulations* (as amended 20 December 2023), subsection 1(1).

The *Vessel Pollution and Dangerous Chemicals Regulations* (SOR/2012-69) refer to the AR of a vessel in many individual requirements.

The *Vessel Fire Safety Regulations* refer to the AR and the master in different sections. For example, section 103 states

> If a vessel that is not a Safety Convention vessel and that was constructed before the day on which this section comes into force held, at any time before that day, a certificate issued under the *Vessel Certificates Regulations* or under section 318 or 319 of the *Canada Shipping Act*, R.S.C., 1985, c. S-9, its authorized representative may ensure that the requirements with respect to structural fire protection and fire safety systems and equipment that would have been required under the Act to be met, on the day before that day, are met instead of the requirements referred to in section 102 of these Regulations with respect to structural fire protection and fire safety systems and equipment.[177]

Other regulations made under the CSA 2001 are listed below. Those flagged with an asterisk were made under the original *Canada Shipping Act* (R.S.C. 1985). While these regulations were transferred to the CSA 2001, interpretation may require reviewing definitions or context from the preceding *Canada Shipping Act*.

- *Cross-border Movement of Hazardous Waste and Hazardous Recyclable Material Regulations* (SOR/2021-25)
- *Fire and Boat Drills Regulations* (SOR/2010-83)
- *Home-Trade, Inland and Minor Waters Voyages Regulations* (C.R.C., c. 1430)
- *Hull Construction Regulations* (C.R.C., c. 1431)
- *Large Fishing Vessel Inspection Regulations* (C.R.C., c. 1435)
- *Life Saving Equipment Regulations* (C.R.C., c. 1436)
- *Marine Machinery Regulations* (SOR/90-264)*
- *Minor Waters Order* (C.R.C., c. 1448) (defines minor waters only; does not contain any requirements)
- *Private Buoy Regulations* (SOR/99-335)*
- *Response Organizations Regulations* (SOR/95-405)*
- *Safe Working Practices Regulations* (C.R.C., c. 1467)*
- *Safety Management Regulations* (SOR/98-348)*
- *Ship Radio Inspection Fees Regulations* (C.R.C., c. 1472)*
- *Shipping Casualties Reporting Regulations* (SOR/85-514)*
- *Special-purpose Vessels Regulations* (SOR/2008-121)
- *Tackle Regulations* (C.R.C., c. 1494)

For reference in the original *Canada Shipping Ac*t (R.S.C. 1985), there are 24 mentions of the AR in the sections related to registration and marking of a vessel.

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177 Transport Canada, SOR/2017-14, *Vessel Fire Safety Regulations* (as amended 23 November 2022), section 103.

> 9 (1) Every Canadian ship, other than a pleasure craft, must have a person who is responsible for acting with respect to all matters relating to the ship and who is to be known as the authorized representative.[178]

There are 109 mentions of the AR in the CSA 2001.

> 14 (1) Every Canadian vessel must have a person — the authorized representative — who is responsible under this Act for acting with respect to all matters relating to the vessel that are not otherwise assigned by this Act to any other person.[179]

[178] Government of Canada, *Canada Shipping Act* (R.S.C., 1985, c. S-9), subsection 9(1).

[179] Government of Canada, *Canada Shipping Act, 2001* (S.C. 2001, c. 26) (as amended 22 June 2023), subsection 14(1).

Appendix D – Emergency duties for fire and preparation for abandoning ship

Table D1. Summary of the Northumberland Ferries Limited muster list showing emergency duties for fire and preparation for abandoning ship (Source: Northumberland Ferries Limited; adaptation by the TSB)

Position	Fire and prepare to abandon ship	Abandon ship
Master	**In command.**	**In command.** Disembarks in port raft.
Chief officer	In charge at scene of fire. Carries portable radio. **TEAM LEADER**	In charge of launching port marine evacuation system (MES). **TEAM LEADER**
Second officer	On bridge, assists master. Principal communicator. Carries portable radio for abandon ship.	In charge of launching starboard MES. **TEAM LEADER**
Chief engineer	In charge of engine room. **TEAM LEADER**	In charge of engine room. Goes in starboard raft. **TEAM LEADER**
Second engineer	At scene of fire. **In charge** of fire team 2 (deck).	Prepares to launch starboard rescue boat and assists launching starboard life rafts.
Fourth engineer	In engine room; assists chief engineer.	Prepares to launch port rescue boat and assists launching port life rafts.
Assistant engineer	Takes breathing apparatus (BA) to scene of fire. Part of fire team 1 (engine room).	Prepares to launch port MES. First down in port life raft. Assists at bottom of slide.
Quartermaster	Assists master on bridge.	Coxswain of starboard rescue boat.
Bosun	At scene of fire. Organizes fire teams until chief officer arrives. **In charge** of fire team 1 (engine room).	Coxswain of port rescue boat.
Deckhand 1	Takes BA to scene of fire. Part of fire team 1 (engine room).	Part of starboard rescue boat crew.
Deckhand 2	Takes BA to scene of fire. Part of fire team 2 (deck).	Part of port rescue boat crew.
Deckhand 3	Takes BA to scene of fire. Part of fire team 2 (deck).	Prepares to launch starboard MES. First down in starboard raft. Assists at bottom of slide.
Deckhand 4	Closes all vents and dampers in area of fire. When completed, reports this to the bridge. In preparation for abandon ship, sweeps vehicle decks for passengers.	Prepares to launch port MES. Second down in port raft. Assists at bottom of slide.
Deckhand/steward	Sweeps vehicle decks for passengers. Assists mustering passengers.	Prepares to launch starboard MES. Second down in starboard raft. Assists at bottom of slide.

Position	Fire and prepare to abandon ship	Abandon ship
Passenger services supervisor	In charge of mustering passengers. Carries portable radio. **TEAM LEADER**	Prepares to launch starboard MES. Assigns assistance for passengers requiring assistance. Goes in starboard raft.
Cook and/or galley steward, passenger services crew members 1, 2, 3, 4	Assists mustering passengers at pre-embarkation areas A and B and muster stations A and B.	Prepares to launch port and starboard MES.
Supernumeraries	Assist passenger services supervisor.	Prepare to launch port MES. Disembark as directed.

Appendix E – Related occurrences

Transportation Safety Board of Canada occurrences

M22A0312 (*Confederation*) – On 04 September 2022, the passenger vessel *Confederation*, with 217 passengers on board, sustained a rudder failure and grounded while leaving Caribou, Nova Scotia. The number of passengers was not recorded prior to sailing and the master did not receive the official count of passengers until more than 1 hour after the occurrence began.

M21P0297 (*ZIM Kingston*) – On 21 October 2021, the container vessel *ZIM Kingston*, with 21 crew members on board, experienced parametric rolling and lost 109 containers overboard while drifting south of Ucluelet, British Columbia (BC). A partial evacuation took place during the response to the subsequent fire. The TSB made findings related to comprehensive procedures, and emergency response.

M21A0041 (*Atlantic Destiny*) – On 02 March 2021, the fishing vessel *Atlantic Destiny*, with 31 persons on board, sustained a catastrophic engine failure while the vessel was about 120 nautical miles south of Yarmouth, Nova Scotia. In this occurrence, 4 crew members and 2 search and rescue technicians remained on board for close to 5 hours after a partial crew evacuation. The TSB made findings related to safety culture (i.e., postponing maintenance tasks), emergency procedures, safety management systems (SMSs), and uncontrollable flooding due to fire damage.

M20P0230 (*Risco Warrior*) – On 07 August 2020, while the tug *Risco Warrior* was holding the barge *Western Carrier* against the dock at Mellersh Point in Bute Inlet, BC, an explosion occurred in the tug's battery compartment, located in the lazarette. The TSB made findings related to safety culture (i.e., normalized unsafe practices), authorized representative (AR) oversight, SMS, and hazard identification.

M20P0229 (*Arctic Fox II*) – On 11 August 2020, the fishing vessel *Arctic Fox II*, with 3 crew members on board, reported taking on water. The crew abandoned the vessel approximately 77 nautical miles west-southwest of Bamfield, Vancouver Island, BC. The TSB made findings related to safety culture (i.e., perception of risk), and AR oversight.

M19C0403 (*Tecumseh*) – On 15 December 2019, the bulk carrier *Tecumseh* had a fire in the engine room from a fuel hose failure while transiting the Detroit River off Windsor, Ontario. There were 16 crew members on board at the time. The vessel dropped both anchors and the fixed fire suppression system was used to extinguish the fire. The fire later reignited when oxygen was reintroduced into the space. The vessel had ongoing issues with leaks and failures in the fuel oil system. The TSB made findings related to vessel maintenance, emergency equipment operation, emergency procedures, drills, and SMSs.

M19P0029 (*Spirit of Sooke*) – On 07 February 2019, the Royal Canadian Marine Search and Rescue vessel *Spirit of Sooke* was returning to its station after a training exercise when it ran aground on Christie Point in Sooke Harbour, BC. The TSB made findings related to reporting incidents, emergency procedures, safety culture (i.e., normalized unsafe practices), and SMS.

M18C0225 – (*Akademik Ioffe*) – On 24 August 2018, the passenger vessel *Akademik Ioffe* ran aground north-northwest of Kugaaruk, Nunavut. In this investigation, the TSB made findings related to reporting incidents, decision support systems, crew readiness, and post-occurrence contingencies.

M18P0014 (*MOL Prestige*) – On 31 January 2018, a fire broke out in the engine room of the container vessel *MOL Prestige* while the vessel was at sea 146 nautical miles south-southwest of Haida Gwaii, BC. There were 22 crew and 1 supernumerary on board at the time. The fire was eventually extinguished. The TSB made findings related to safety culture (i.e., equipment adaptations), AR responsibility, emergency procedures, drills, and SMS.

M17C0179 (*Island Queen III*) – On 08 August 2017, the passenger vessel *Island Queen III*, with 279 passengers on board, made bottom contact and flooded the steering compartment, off Kingston, Ontario. The TSB made findings related to familiarization with and quantities of life-saving equipment and the counting of passengers, SMS, drills, and emergency procedures. The investigation included 3 safety concerns: there was no requirement for infant lifejackets, passenger evacuation procedures were not assessed, and there was a gap in passenger safety management training for crew on sheltered waters voyages.

M15C0045 (*Frederike C-2*) – On 28 April 2015, the fishing vessel *Frederike C-2*, with 4 people on board, had a fire in the engine room off Rimouski, Quebec, that caused the vessel to sink. The TSB made findings related to familiarity with firefighting equipment, emergency preparedness, distress reporting, repair reporting, and a fire alarm failure.

M14A0051 (*John I*) – On 14 March 2014, the bulk carrier *John I*, with 23 crew on board, became disabled off the southwest coast of Newfoundland and Labrador due to flooding in the engine room. The vessel drifted before grounding the following day. The TSB made findings related to communications between the ship and the Canadian Coast Guard and the coordination of the emergency response.

M14C0156 (*La Relève II*) – On 11 August 2014, the passenger vessel *La Relève II*, with 33 passengers on board, had a fire in the engine compartment off Havre Saint Pierre, Quebec. The TSB made findings related to emergency procedures, SMS, and Transport Canada (TC) oversight, including the applicability of the safe manning document to vessel operations.

M13M0287 (*Princess of Acadia*) – On 07 November 2013, the roll-on/roll-off passenger ferry *Princess of Acadia*, which was carrying a total of 87 passengers and crew, sustained a main generator blackout and grounded while approaching the ferry terminal at Digby, Nova Scotia. The TSB made findings related to communications, emergency procedures, drills, SMS, TC oversight, and vessel maintenance.

M13L0067 (*Louis Jolliet*) – On 16 May 2013, the passenger vessel *Louis Jolliet* ran aground off Île d'Orléans, Quebec, with 57 passengers and 21 crew members aboard. The TSB made findings related to emergency management training for crew, comprehensive documented procedures, and realistic drills for passenger safety management. The report also documented a discrepancy between the number of passengers on board and the number recorded in the vessel's logbook.

M12N0017 (*Beaumont Hamel*) – On 30 May 2012, the passenger ferry *Beaumont Hamel* experienced an electrical failure, resulting in loss of propulsion and steering while approaching Portugal Cove, Newfoundland and Labrador, and struck the wharf. The TSB made findings related to vessel maintenance and SMS.

M10F0003 (*Concordia*) – On 17 February 2010, the sail training yacht *Concordia* was knocked down and capsized after encountering a squall off the coast of Brazil. All 64 crew, faculty, and students abandoned the vessel and transferred to life rafts. The TSB made findings related to AR oversight and emergency procedures.

M06W0052 (*Queen of the North*) – On 22 March 2006, the passenger vessel *Queen of the North,* with 59 passengers on board, struck the northeast side of Gil Island, BC, and sank, resulting in 2 fatalities. The TSB made findings related to the counting of passengers, assessment of emergency procedures, and SMS.

The Board issued 3 recommendations in this report, including a requirement to develop effective passenger accounting (M08-01), realistic exercises so that operators of passenger vessels can evaluate the preparedness of their crews (M08-02), and an extension of the requirement to carry voyage data recorders (M08-03). M08-01 and M08-02 were closed as fully satisfactory in 2010 and M08-03 was closed as fully satisfactory in 2012.

M03N0050 (*Joseph and Clara Smallwood*) – On 12 May 2003, a fire was discovered on the vehicle deck of the roll-on/roll-off passenger ferry *Joseph and Clara Smallwood* 8 nautical miles from Port aux Basques, Newfoundland and Labrador. Upon arrival in port, local volunteer firefighters, under the supervision of the crew, helped fight the fire. The TSB made findings related to following procedures, crew training, familiarity with fire-extinguishing equipment, and communications during an emergency.

M03W0073 (*Queen of Surrey*) – On 12 May 2003, while en route in clear and calm conditions from Horseshoe Bay, BC, to Langdale, BC, with 318 passengers and 137 vehicles on board, the *Queen of Surrey* suffered a diesel oil fire on its number 2 main engine due to a fuel pipe fracture spraying onto an exhaust manifold. The engine room was evacuated and sealed, and carbon dioxide (CO_2) gas was released. A steel pressure gauge pipe had been replaced with a copper one. The unsuitable material remained unnoticed during a leak repair 2 days before the fire. The TSB made findings related to the removal of a heat shield, SMS, and oversight by TC and the classification society.

International occurrences

Australian Transportation Safety Bureau (*Fitzroy Flyer)* – On 29 March 2019, the catamaran ferry *Fitzroy Flyer* was on a scheduled trip when a fire alarm sounded and the crew suspected fire, near Fitzroy Island, Australia. After initial attempts to extinguish the fire using portable extinguishers, the master activated the fixed fire suppression system. The investigators made findings about the on-board response, including the fire response, the passenger evacuation, and the emergency communication.[180]

Danish Maritime Accident Investigation Board *(World Calima)* – On 15 November 2017, the *World Calima* sustained an engine room fire while delivering technicians to windfarm installations near Helgoland, Germany. The master attempted to release CO_2 from the bridge but was unable to see or hear whether the CO_2 mechanism had been activated. The mate activated the CO_2 mechanism manually from the CO_2 room. The fire was extinguished and the vessel was towed back to port. The Danish Maritime Accident Investigation Board's report contained findings about the absence of any confirmation that the CO_2 mechanism had been successfully activated and the need to improve guidance and information. Following the occurrence, the company installed a sound and visual system to show the crew when the fixed CO_2 mechanism was activated on the bridge.[181]

United Kingdom Marine Accident Investigation Branch (*Wight Sky*) – On 26 August and 14 December 2018, the passenger ferry *Wight Sky* suffered 2 catastrophic engine failures, 1 resulting in a fire near the Isle of Wight, United Kingdom. The United Kingdom Marine Accident Investigation Branch's investigation also looked at 3 other engine failures. The investigators made findings related to engine maintenance, the management of engine maintenance, oversight, and communication about repairs and non-conformities.[182]

United Kingdom Marine Accident Investigation Branch (*Acro Avon*) – On 18 August 2015, a fire started on the dredger *Acro Avon* 12 miles off the coast of Great Yarmouth, UK. In this occurrence, the initial repair attempt to a failed fuel pipe may have been rationalized through experience and positive attitude to prompt remedial action. Isolating the fuel system to perform the repair would have interrupted the loading programme.[183]

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180 Australian Transport Safety Bureau, "Suspected engine room fire and passenger evacuation involving domestic commercial vessel Fitzroy Flyer, 13km ENE of Cairns, Queensland on 29 March 2019," at https://www.atsb.gov.au/publications/investigation_reports/2019/mair/mo-2019-004 (last accessed 18 June 2025)

181 Danish Maritime Accident Investigation Board, "World Calima summary report on engine room fire" (15 November 2017), at https://safety4sea.com/wp-content/uploads/2018/02/DMAIB-WORLD-CALIMA-Summary-report-on-engine-room-fire-2018_02.pdf (last accessed 18 June 2025).

182 United Kingdom Marine Accident Investigation Branch, Accident Investigation Report No. 4/2022, "Report on the investigation of 2 catastrophic engine failures, 1 resulting in a fire, on board the ro-ro [roll-on/roll-off] passenger ferry *Wight Sky* at the entrance to Lymington River and before berthing at Lymington Pier on 26 August and 14 December 2018" (April 2022), at https://assets.publishing.service.gov.uk/media/6267cc85e90e071690c1b679/2022-4-WightSky-Report.pdf (last accessed 18 June 2025).

183 United Kingdom Marine Accident Investigation Branch, Accident Investigation Report No. 17/2016, "Report on the investigation of a fire in the engine room on the suction dredger *Arco Avon,*" (September 2016), at https://assets.publishing.service.gov.uk/media/57cd64fbe5274a34fb000010/MAIBInvReport17_2016.pdf (last accessed 18 June 2025).

United States National Transportation Safety Board (*President Eisenhower*) – On 28 April 2021, the containership *President Eisenhower* experienced an engine room fire southwest of Santa Barbara, California, USA. The crew fought the fire using fire hoses and a fixed water mist system, before using the engine room's fixed carbon dioxide fire-extinguishing system. A pinhole leak in a main engine fuel line had been patched for about 2 months before new tubing could be procured. The effectiveness of the crew's response to the fire was credited to their realistic scenario-based training.[184]

[184] United States National Transportation Safety Board, MIR-22/15, "Engine Room Fire aboard Containership *President Eisenhower*," (10 May 2022) at https://www.ntsb.gov/investigations/AccidentReports/Reports/MIR2215.pdf (last accessed 18 June 2025).