MARINE INVESTIGATION REPORT
M98W0045

SWAMPING WITH LOSS OF LIVES

WHALE-WATCHING PASSENGER BOAT
"OCEAN THUNDER"
OFF TOFINO, BRITISH COLUMBIA
22 MARCH 1998

Transportation Safety Board
of Canada

Bureau de la scurit des transports

du Canada

Marine Investigation Report

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Whale-Watching Passenger Boat "OCEAN THUNDER" off Tofino, British Columbia 22 March 1998

Report Number M98W0045

Synopsis

The vessel, with three passengers and an operator on board, departed Tofino, British Columbia, on a three-hour trip to watch marine life. All wore "coverall PFD (personal flotation device) suits"; while the passengers' suits were properly worn, the operator's suit was partially zipped. After watching whales, the operator decided to show the passengers marine life in the vicinity of Plover Reefs. While in that area, the boat was swamped and broached by a large swell, which threw all the occupants into the turbulent water. The rapidity of the occurrence precluded transmission of a Mayday message. When the boat did not arrive at its destination, the owner initiated Search and Rescue action. Two passengers were rescued after about two hours. The operator and one passenger lost their lives.

The Board determined that the "OCEAN THUNDER" was swamped and rolled suddenly to a large angle, throwing all occupants into the cold water. A factor contributing to the occurrence was that the operator did not fully appreciate the conditions the boat would meet at the time of the accident in the turbulent waters in the vicinity of reefs. Contributing to the loss of lives were: anxiety associated with sudden immersion in cold water, the lack of effective communication equipment, and the absence of emergency (medium range) communication equipment, which resulted in a delay in initiating a Search and Rescue response.

Ce rapport est également disponible en français.

1.0 Factual Information

1.1 Particulars of the Vessel

	"OCEAN THUNDER"
Licence Number	13K107700
Home Port	Tofino, B.C.[1]
Flag	Canada
Type	rigid hull inflatable
Gross Tonnage[2]	under five
Length	6.4 m
Breadth	2.5 m
Built	1994, New Westminster, B.C.
Propulsion	twin Mercury outboards, 135 horsepower each
Crew	1
Passengers	3
Owner	Ocean Pacific Whale Charters Ltd. doing business as Jamie's Whaling Station Tofino, B.C.

1.1.1 Description of the Vessel

The boat is an extended version of a "Titan" class 5.5 m, designed by a naval architect in Vancouver, B.C. The deep "V" aluminium hull with longitudinal stiffeners, watertight compartments and modular fuel tank is designed to withstand rough conditions associated with whale watching on the west coast of Vancouver Island, which is exposed to the Pacific Ocean swell. The deck is self-draining, with cable routing and a battery compartment under deck. Two inflatable sponsons (chambers), one on either side, provide buoyancy and stability to the boat. Attached to the chambers on the inboard side of the boat are grab lines, which provide additional grip for the passengers. These grab lines do not extend to the waterline on the outside of the inflatable chambers.

[1] See Glossary at Appendix C for all abbreviations and acronyms.

[2] Units of measurement in this report conform to International Maritime Organization standards or, where there is no such standard, are expressed in the International System of units.

On deck, four benches with tubular framing seat backs provide seating for 12 passengers. The seat backs also provide hand holds for persons seated behind. There is no additional restraining device. Astern of the last bench is a small wheel-house booth, which houses navigation equipment, steering and propulsion controls. The operator stands in the booth, steering and navigating.

Mounted at the transom were two new Mercury outboard engines, with only about 60 hours of recorded running time on them. Two throttles mounted in the wheel-house provided remote control for the engines. Each engine was fitted with an emergency cut-off switch.

1.1.2 Stability of the Boat

The boat had never undergone a formal stability test, nor was one required. However, extensive sea trials were conducted in the presence of the owner's naval architect in Vancouver, to verify the boat's performance and seaworthiness.

Rigid hull inflatable (RHI) boats are widely used as rescue boats because of their good range of stability and their seaworthiness in bad weather conditions. The "OCEAN THUNDER" had a high degree of residual stability such that it would return to the upright even from large angles of heel. This is depicted in a video showing the boat undergoing sea trials while skimming over wave crests at high speed and undergoing a forced roll.

1.2 History of the Voyage

On Sunday, March 22, three passengers were booked for the 1200 Pacific standard time (PST)[3] departure to go on a whale-watching trip from a prominent whaling station in Tofino. The trip was scheduled to last about three hours. The boat arrived from the 0900 trip and began disembarking passengers. The investigation revealed that the boarding passengers were made aware that, on the previous trip, the boat had been partially swamped while transiting a channel and that some passengers had been frightened by the experience. The boat operator assured the waiting passengers that it was safe to make the trip and instructed them on how to don the coverall personal flotation device (PFD) suits (locally referred to as floater suits). No other safety information was provided.

All three passengers donned coverall PFD suits. The passengers tightened the ties around the ankles and wrists and wore rain gear over the suit. The passengers observed that the operator had only donned his suit loosely and did not zip it up fully, leaving part of his chest and head exposed. The boat then departed from the wharf at 1215.

The operator steered the boat through the myriad channels forming Clayoquot Sound to the open Pacific Ocean where he slowed down upon encountering heavy, confused swells in the vicinity of reefs known as the La Croix Group, Foam Reefs and Plover Reefs. The passengers then spent about half an hour looking at whales before the operator decided to show them some marine life in the vicinity of Plover Reefs.

[3] All times are PST (Coordinated Universal Time minus eight hours) unless otherwise stated.

The area consists of numerous reefs with white water around them. The waters were turbulent and the sea and swell were confused. As the boat made its way through the turbulent waters near the reefs and the operator negotiated a channel between rocks, a wave from the stern swamped the boat. Immediately thereafter, the boat was broached (broadsided) and another large swell wave struck the boat from the port side. This raised the port side to a near vertical angle and then the wave broke over the boat. The suddenness of the roll to a large angle and the breaking wave caused the passengers and the operator to be thrown over the starboard side and into the sea. No Mayday message was transmitted.

There is conflicting information as to whether the boat capsized. One account was that the boat had rolled suddenly to a large angle throwing all occupants overboard.

The operator and two passengers, one male and one female, found themselves together in the turbulent waters. They could not see the boat, which had drifted away from them. The male passenger, who was a non-swimmer, panicked and was soon lost. His body was recovered later.

The operator cast off his boots and floated with the surviving passenger, providing encouragement, and advised her not to go close to the rocks. After more than an hour, the operator was observed to be getting cold and lapsing into bouts of unconsciousness. The surviving passenger (from this group of three) then saw the boat, which was upright and had drifted within sight. She swam towards the boat and hung onto it. By now, she was weak and her attempts to board the boat were unsuccessful. When she saw a rescue plane overhead, she found the strength to board the boat and was rescued by a vessel that had been directed to the area by the search plane. The operator's body was recovered from the water nearby.

Meanwhile, the third passenger, who was also thrown off the boat, found herself carried some distance away from the group of three and alone in a lagoon of calmer water. She could not see the others or the boat. She floated, without exerting herself, with her face up; after an hour, she drifted off into unconsciousness. She was rescued sometime later.

1.3 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	1	1	-	2
Missing	-	-	-	-
Serious	-	1	-	1
Minor/None	-	1	-	1
Total	1	3	-	4

The two female survivors and the operator were swimmers, while the male passenger was a non-swimmer. The male passenger and the operator lost their lives due to drowning.

When rescued, the survivor who had made her way back to the boat was suffering from mild hypothermia. She was treated at a local hospital and later released.

When the rescuers found the other female passenger, who was unconscious, she was suffering from severe hypothermia—there was no pulse and her body temperature was low. Artificial respiration was begun and she was revived. She was rushed to the hospital in Tofino where she was admitted and treated; she was released a few days later.

1.4 Damage

1.4.1 Damage to the Boat

Upon recovery, an examination of the boat revealed, amongst others, the following:

- The throttles of both engines were found set at the half-ahead position.
- The port engine had a smashed lower cowling and a cracked upper cowling, its air filter was found soaked with water, and water was found on top of the air intake throttle plates. The number four cylinder was full of water and, in the other cylinders, there was indication of water on the spark plugs.
- The starboard engine was tilted up past its limit. There was damage to the cowling and the starter solenoid battery connection had deposits of green verdigris corrosion. Water was found throughout the cowling. All cylinders showed signs of water ingestion and cranking the engine expelled water from the spark plug holes.
- The tachometers, port hour meter, very high frequency (VHF) radio, Global Positioning System (GPS) and radar were found to be damaged by sea water; however, all other instruments and wiring on the main instrument panel were functional. The ignition safety cut-off lanyard was missing.

- The battery connections were green and corroded.
- The operator's cabin window pane was broken, and scratches and scuffs were found on the port side of the hull. On top of the operator's cabin, the radar dome, the antenna and lights were intact.

1.4.2 Damage to the Environment

There was no pollution as a result of the accident.

1.5 Certification

1.5.1 Vessel Certification

1.5.1.1 Transport Canada Regulatory Requirements and New Initiatives

Currently, a vessel under five gross tons and carrying 12 or fewer passengers is not required by the regulations made pursuant to the *Canada Shipping Act* to be inspected by Transport Canada Marine Safety (TCMS).

At the time of the occurrence, Transport Canada (TC), in conjunction with industry stakeholders, was reviewing the *Construction Standards for Small Vessels* (TP 1332E). For the purposes of inspection of small vessels, be they fishing vessels or passenger vessels, it is the intention of TC to raise the tonnage limit of uninspected passenger vessels to 15 gross tons.[4] The proposed standards are divided into two segments for application: one for commercial vessels and the other for pleasure craft. The standards are nearing the final stages; however, there is resistance from the stakeholders to incorporate minimum stability criteria for small vessel commercial operations. Following the development of the construction standards, additional initiatives addressing crew certification, safety equipment carriage requirements, and voyage limitations will be developed.

Currently, no construction standard exists for RHIs used for carrying passengers and engaged in operations similar to whale watching, which tend to be operated by a single person and make trips in exposed areas of open waters. However, a TC standard entitled *Standards for Rescue Boats* (TP 7322E) does exist for RHIs used as "rescue boats."[5] These rescue boats, also referred to as "fast rescue craft," are designed for use in rough weather conditions similar to those found on the west coast of Vancouver Island. The standards require, in part, that:

[4] Ministerial response to TSB Recommendation M96-04 (TSB report No. M93L0004)

[5] The hull design of the "OCEAN THUNDER" is similar to that of a rescue boat.

- the boat meet stability criteria;
- becketed lifelines be fitted inside and outside the boat, giving person(s) in the water a hand-hold so they may stay with the boat; and
- the boat be equipped with a boarding ladder to help persons boarding from the water.

1.5.1.2 Industry Initiatives

At the time of the occurrence, the British Columbia Whale Watching Society of Victoria Harbour, an industry association, had been reviewing the operational practices for whale-watching boats with a view to establishing standards. The proposed (local) industry standards, entitled *Standards for Victoria Area Whale Watching Companies Operating Vessels of Less Than 5 Gross Tons and Carrying 12 or Fewer Passengers,* deal with vessel construction, safety equipment, communication equipment, navigation equipment and operator proficiency. These standards call for equipment in excess of that currently required under TC regulations, and include the following:

- that open boats should carry a full-length Minister of Transport (MOT/CCG)- approved flotation suit for each adult and a correctly sized, approved lifejacket for each child. Suits and lifejackets must be worn by passengers and crew;[6]
- that three additional flares be on board to fit the pocket of operator's floater suit;
- that open vessels operated by a single operator be fitted with an engine kill switch and lanyard/emergency engine shut-off;
- that the vessel be fitted with a waterproof VHF Channel 16 emergency transmitter with long-life battery secured to a float and tethered to the boat, or an emergency position indicating radio beacon (EPIRB) of a type suitable to the boat's activity and operating range (manually activated);
- that an emergency calling decal with Mayday instructions be on board for the benefit of persons other than the operator; and
- that the vessel be fitted with a GPS for navigation.

1.5.2 Personnel Certification

Currently, there is no regulatory requirement under the *Canada Shipping Act* for boats the size and type of the "OCEAN THUNDER"—under five gross tons and carrying 12 or fewer passengers—to have their operators certificated. However, joint new initiatives currently under consideration by the industry and TC will address the marine qualification and certification requirements.

In this instance, the operator of the "OCEAN THUNDER" had a valid Certificate of Competency as Master of Small Passenger Craft and a certificate to operate temporarily as an Engineer on two of the larger vessels operated by the same company. He had also successfully completed courses in Simulated Electronic Navigation I (which gives training in electronic navigation aids and radar), A1 Marine Emergency Duties (MED), Standard

[6] TC's participation in formation of the standards should result in proper terminology being used in the final standard.

First Aid, Radiotelephone Operator's Restricted Certificate (Maritime), Open Water Dive certification and Flat Water Canoeing.

Of the three passengers, the two who survived had spent some time with recreational water craft, but none had any formal training.

1.6 Personnel History

The operator of the vessel had been employed by the company for just over a year. His experience included two year's service as a deckhand on larger vessels at a different location in British Columbia and varied experience in the outdoor recreation industry. He underwent the employer-sponsored training program, which comprised a training course conducted by a local company and hands-on training and familiarization of the area by working with other operators. Following an evaluation of his performance, he was employed as an operator of the "OCEAN THUNDER". The operator had made many trips in the vicinity of Plover Reefs.

His daily schedule varied depending on the number of trips that were required to be made. Generally, in the peak tourist season, the day started with the morning trip at 0900 and ended before sunset after the third trip.

1.7 Weather and Current Information

1.7.1 Weather Forecast

The three-day weather forecast for the west coast of Vancouver Island issued by Environment Canada at 0624, Saturday, March 21, included a gale warning. The forecast predicted a fairly intense system crossing the coast on Saturday, bringing rain and wind. This would give way to cool unstable air and showers on Sunday, March 22, followed by another frontal system which would bring more rain and wind on Monday, March 23.

The 1030 forecast on Sunday, March 22, called for light winds rising to easterly, 15 to 20 knots (kn) overnight and 20 to 30 kn on Monday morning. The skies were predicted to be mainly cloudy, with a few showers and 3 m to 4 m seas. The outlook was for strong to gale force winds.

At the time of the occurrence, the weather at the La Perouse weather buoy, south-west of Tofino, recorded wind speeds of 10 kn, significant wave height of about 3 m to 4 m, and air and surface temperatures of 11.5°C. Reportedly, information from other vessels in the area indicated that the morning weather had moderated in the afternoon.
On the evening of March 23, while the investigation into this occurrence was in progress, a frontal system passed over Tofino cutting off power supply to most of the city. The severity of the system confirmed the accuracy of the gale warning in the weather report.

1.7.2 Current Information

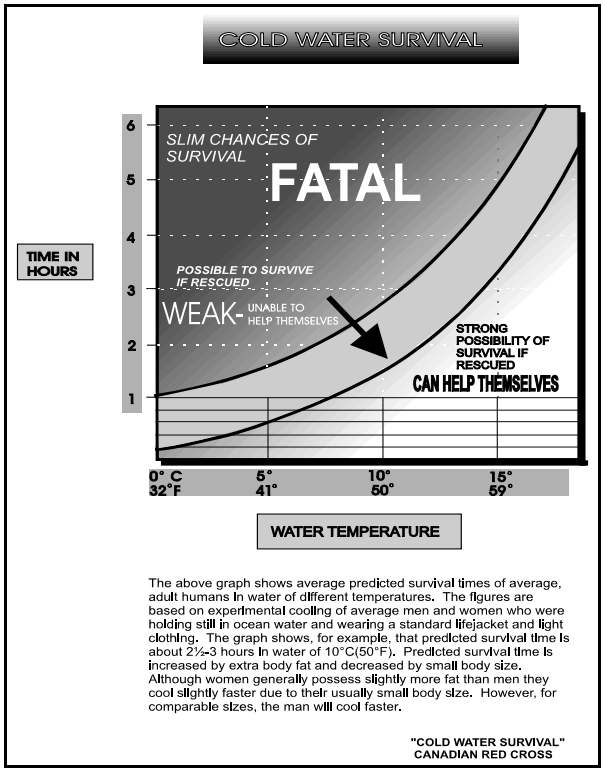
The *Sailing Directions—British Columbia Coast (South Portion)* Volume 1 warns that the tidal streams are accentuated by the in-draught into the large sounds, especially during strong winds from south-east and south-west. Low water at Tofino, on March 22, was at 1355.

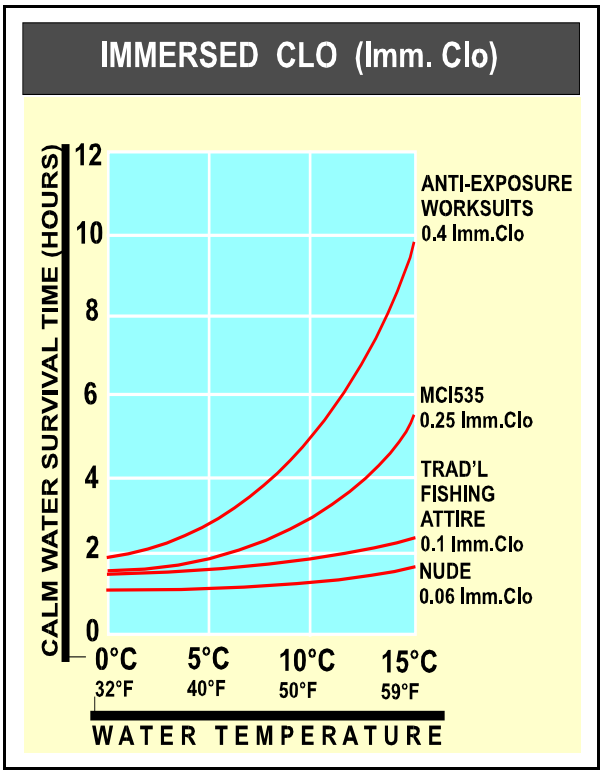
1.7.3 Cold Water Survival

The sea water temperature was 11.5°C. Studies of cooling rates for an average adult holding still in ocean water of 11.5°C (wearing a standard lifejacket and light clothing) show a predicted survival time of about 1.8 hours. Extra body fat can increase survival time.

The operator was 1.79 m tall and weighed approximately 97 kg. He was wearing a coverall PFD suit, which was not fully zipped, over seasonal clothing. The passenger who lost his life was 1.86 m tall and weighed about 147 kg. He was a non-swimmer and was wearing a coverall PFD suit which was fully zipped over seasonal clothing.

The donning of the suits protected those on board from the harsh environmental conditions. According to the manufacturer of the suit, the thermal protection afforded by the suit had the potential to increase their survival time between two to four times.





1.8 Search and Rescue Issues

1.8.1 Sail Plan Monitoring

The vessel's sail plan was left with the company dispatcher but there was no established regular calling-in procedure to keep track of the boat's progress. Rather, the boat was in contact with the dispatcher and other boats as required. Communication was by way of a VHF radiotelephone (R/T). The dispatcher had observed, and the operator was aware, that the radio reception from the "OCEAN THUNDER" on the day of the occurrence was such that they were frequently out of touch when the boat was in the open waters. There was no known problem associated with VHF coverage or general radio reception in the area. The general practice of the operator was to notify the dispatcher when the boat was on her return trip.

1.8.2 Search and Rescue Operations

When the boat did not call in or return at the scheduled time, the dispatcher contacted other vessels in the area at about 1450 and the owner some 15 minutes later. When it was established that no other vessels had sighted the "OCEAN THUNDER" at that time, the owner called Tofino Air and an aircraft was tasked to search for the "OCEAN THUNDER". The owner also requested other vessels in the area to assist in the search, and contacted the Tofino Lifeboat to apprise the Lifeboat of the overdue vessel. At 1541, the Tofino Lifeboat apprised the Rescue Coordination Centre in Victoria of the situation, setting in motion an official Search and Rescue (SAR) response. The search was conducted by two aircraft and nine surface craft. The Tofino Air fixed-wing aircraft was on scene at 1557 and saw the boat drifting in the vicinity of Plover Reefs with a person sitting in it. Other boats belonging to commercial operators and to the Canadian Coast Guard (CCG), which had joined the search, rescued the passengers and retrieved bodies of the other persons who had been on board the "OCEAN THUNDER".

1.9 Life-saving Equipment

The "OCEAN THUNDER" carried life-saving equipment for a vessel of its size and type.[7] In lieu of the lifejackets, a one-piece coverall PFD suit was carried for each person on board, and each passenger and the

[7] Following the occurrence, Board of Steamship Inspection Decision No. 6587, dated 16 July 1998, permitted "coverall PFD suits" approved as PFDs to be carried in lieu of standard lifejackets on vessels engaged on whale-watching operations—provided that the full-length PFD suits are worn throughout the voyage.

operator wore one. Some of the suits were constructed to CAN/CGSB-65.11-M88 (Personal Flotation Devices) standards, and carried a marking of "Anti-Exposure Suits."[8] While the passengers had fully zipped their suits, the operator had not. The six flares required by the *Small Vessel Regulations,* and a medical kit, were stowed in the bow locker. None of the survivors knew where this emergency equipment was located, nor were they instructed in its use. The flares became inaccessible when the occupants of the boat were thrown into the water.

1.10 Emergency Signalling Equipment

Emergency signalling equipment (ESE) can be categorized as "self-activated" and "survivor-activated," as outlined in the following table.[9]

MEANS OF EMERGENCY SIGNALLING		
TYPE	**DAY**	**NIGHT**
SHORT RANGE		
self-activated	- international orange colours	- canopy lights
survivor-activated	- smoke signals - rocket flares - mirrors - whistles	- flashlight/lanterns - rocket flares - flares - whistles
LONG RANGE		
self-activated	- EPIRB	- EPIRB
survivor-activated	- portable radio	- portable radio

[8] With the exception of a standard lifejacket, the terminology for various suits constructed under different standards has changed.

[9] *Performance Recommendations for Marine Lifesaving Systems,* The Society of Naval Architects and Marine Engineers, Technical and Research Report R-27, 1983.

Short range ESE is primarily targeted at other craft that are within visible range, to initiate rapid rescue response. In long range ESE, radio equipment is used. The longer radio range permits transmissions to be targeted at a wide range of shipboard and shore-based radio stations for a rapid SAR response.

The "OCEAN THUNDER" carried neither an emergency (portable) VHF radio nor an EPIRB, nor is there a regulatory requirement for the carriage of such equipment. The rapidity with which the occupants of the boat were thrown into the water precluded the transmission of a Mayday message.

There are various EPIRBs available on the market; their differences in position accuracy can affect SAR response time and, hence, the eventual success of a SAR mission. Care should be exercised in determining which equipment is best suited for operations.

The CCG has undertaken an initiative to upgrade the VHF radio distress system by providing VHF Digital Selective Calling (DSC) services. This new digital radio transmits (either by hand-held or fixed radio) an automatic, digital, all stations distress alert signal on VHF Channel 70. This distress alert includes vessel identification, position (as obtained from GPS) and nature of distress. Commercial vessels larger than 8 m will be required to carry this VHF DSC radio, but smaller vessels may do so voluntarily.

1.11 Safety and Record Keeping

Safety meetings were held by the company on a periodic basis, with the last meeting having taken place some two weeks before the occurrence. The investigation revealed that the coverall PFD suits were maintained and that they were periodically inspected by the owner's representative. There is no regulatory requirement to keep a maintenance record for PFD suits; however, the owner kept a record.

2.0 Analysis

2.1 Impact of Weather in the Vicinity of the Occurrence

The weather was reportedly clear with a light breeze at the onset of the whale-watching trip. However, the confused swell from the previous frontal system, and a new swell from the oncoming frontal system, likely produced breaking waves across the channel in Plover Reefs, creating turbulent waters. A visit to the site of the occurrence showed that, even in relatively calm sea conditions, there was a lot of breaking surf and white water.

2.2 Capsizing vs. Swamping

The boat, when found, was upright and was boarded by one of the survivors. The lack of damage to the mast head and cabin-top structure, and the absence of shorting of the electrical system in the cabin is consistent with the boat having remained essentially upright after attaining the large angle of roll that threw all of the occupants into the water.

2.3 Decision to Operate the Boat

The decision of whether or not to make a trip rests with both the owner and the operator. However, in this occurrence, the owner took a hands-off approach to decision making.

In the past, the owner of the boat had considered cancelling a trip when there were fewer than four passengers on board and weather conditions were adverse. In this instance, while the boat was operated in a lightly loaded condition in turbulent waters, there was no intervention from the owner. The operator, the on-site decision maker, has the discretion to cancel a trip due to operating conditions.

While the owner or operator would not knowingly compromise safety, the dynamics of deciding whether or not to make a trip can be influenced by the nature of the business. In a commercial enterprise, cancelled bookings reduce revenues. An employee's decision to make a trip would be influenced by the impact such a decision would have on business.

2.4 Small Boat Operation and Safety

In the marine environment, because various components that affect the safety of a vessel are interlinked, there is often a trade-off between them. Every vessel, irrespective of its size, has operating limitations and, in any given circumstance, a smaller vessel such as an RHI is more prone to risk elements than a larger vessel. It is, therefore, essential that an operator appreciates the limitations in the operation of the vessel. In this instance, although the operator was not

required to hold any formal qualification, he was certificated to operate a small passenger vessel. Part of his ability to operate the vessel was gained from his practical experience. The operator had completed many trips in the area.

On a previous trip, the boat had experienced turbulent waters in the vicinity of the reefs and had been partially swamped, which had scared some of the passengers. As the area is known for its marine life, the operator elected to return to it on the afternoon trip.

In a competitive marine environment with seasonal operations, customer service and satisfaction are essential for the success of small businesses such as whale-watching operations. Passengers expect to see whales and marine life. The operator, therefore, may have felt obliged to meet these expectations—while operating the vessel safely—to ensure customer satisfaction and further clientele base. Observations by passengers who sailed on the "OCEAN THUNDER" depicted the operator as having confidence in his abilities to handle the boat and in the boat's ability to withstand severe operational conditions.

The weather had moderated before the start of the afternoon trip, and the operator decided to revisit the area of Plover Reefs. Although the weather had somewhat abated, swell in the vicinity of the reefs would continue. Despite this, the operator elected to revisit Plover Reefs. This would suggest that, although the operator was trained and had experience, he did not fully appreciate the conditions the vessel would meet in the vicinity of the reefs at the time of the accident, and the impact that operation of the boat in such waters could have on passenger safety.

The operator's decision to revisit Plover Reefs may be attributable, in part, to the abating of the weather, the desire to obtain customer satisfaction, and confidence that the vessel could be operated safely in such waters.

2.5 Factors Affecting Survival

Instances have been recorded where people who have no medical problem, who are in good health and good spirits, and who are good swimmers, drown. Any person who enters water rapidly or from a height may become disoriented. Individuals faced with a rapidly developing adverse situation will react in different ways. An individual's ability to survive when immersed in cold water is influenced by a number of factors, including:

- the psychological effect of entry into the water,
- the prevailing weather conditions, and
- the individual's ability to prevent drowning.[10]

2.5.1 Loss of Lives

In this instance, the deaths were attributable to drowning.

Passenger

Because the passengers' suits were fully zipped, they would have provided thermal protection, delayed the onset of hypothermia, and increased the chance of survival. The male passenger was a non-swimmer and the water was turbulent. This, together with the anxiety associated with entering the cold water, would have lowered his ability to resist drowning.

Crew

It could not be established whether the operator's suit was fully zipped at the time he entered water. However, it is known that the operator discarded his boots after entering cold water. Improper donning of the suits, exposure of the head, limbs, chest and groin area would make a person in the water more susceptible to hypothermia. One of the survivors observed that the operator became progressively weaker and slipped into unconsciousness. This would have made him more vulnerable to swallowing sea water in the turbulent seas.

2.6 Lifejacket, Personal Flotation Devices (PFDs) and Survival

The coverall PFD suits worn by the passengers and the operator of the "OCEAN THUNDER" were approved by the Department of Transport/CCG.[11] Coverall PFD suits are designed to reduce thermal shock upon entry into cold water, delay the onset of hypothermia, provide acceptable flotation and minimize the risk of drowning. These coverall PFD suits use a wet suit principle; the survival time for a person wearing such a suit is shorter than for a person wearing a dry (immersion) suit.

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[10] Transport Canada study, entitled *Thermal Protection Performance of Personal Flotation Devices: Assessment of Representative Types* by J. S. Mayward of the University of Victoria.

[11] Department of Fisheries and Oceans, the agency responsible for PFDs, has advised the industry that certificates of approval for PFDs will no longer be issued. Instead, these devices are tested by the Underwriters' Laboratories of Canada as part of a quality assurance program.

Standard lifejackets, unlike PFDs, must meet rigid buoyancy standards and have the ability to turn an unconscious person to a face-up position in the water, but they provide poor thermal protection in cold water.[12] Their design makes them cumbersome and, consequently, they are worn only in an emergency. In contrast, PFDs, such as coverall PFD suits, provide good thermal protection in cold water and have reasonable flotation capabilities. Information provided by manufacturers shows that the minimum survival time for a person wearing a coverall PFD suit is more than twice the survival time afforded by a standard lifejacket, and can be as much as eight times greater, depending on the water temperature.[13]

2.6.1 PFDs with Inflatable Pillows/Collars and Inflatable Lifejackets

Vessels under five gross tons and carrying 12 or fewer passengers, are required to carry one standard lifejacket or a small vessel lifejacket for each person on board.

Approved PFDs such as coverall PFD suits with inflatable pillows or collars, which are designed to keep the wearer's head above water to reduce the risk of drowning, are available on the market, but they do not have the ability to turn a person—unconscious in the water—to a face-up position. TC draft standards for inflatable lifejackets that would meet International Convention for Safety of Life at Sea, 1974 (SOLAS) standards are in the final stages of review. Meanwhile, CCG-approved inflatable PFDs that have the ability to turn a person—unconscious in the water—to a face-up position are available on the market, but these do not provide thermal protection. There is an expectation that inflatable lifejackets or inflatable PFDs with similar capabilities to that of a lifejacket could then be worn over the coverall PFD suits. This is not without some disadvantage and care should be exercised in determining the type of personal life-saving equipment best suited for the intended purpose. While the suits provide support/buoyancy for the whole body, standard lifejackets provide support/buoyancy to the upper section of the body. Thus, the righting ability of any PFD or lifejacket, be it of a standard approved type or an inflatable type, will be diminished when that item is worn over a coverall PFD suit.

2.6.2 Regulatory Overview

[12] Transport Canada study entitled *Thermal Protection Performance of Personal Flotation Devices: Assessment of Representative Types* by J. S. Mayward of the University of Victoria.

[13] Where comparisons are made with exposure suits, they are for the design and type used by the occupants of the boat.

Under the current regulatory regime, a coverall PFD suit is only an aid to keep a person afloat; it is not a substitute for, nor is it intended to function as, an approved lifejacket. Neither the regulations in force at the time of the occurrence nor the new *Small Vessel Regulations* that came into force on 31 May 1998 (some two months following the occurrence) require thermal protection for passengers—a key component in survival in the cold waters of Canada. To maximize survival time for a person in the water, all personal life-saving equipment for use in Canadian waters ought to incorporate both requirements: thermal protection and inherent buoyancy. This need has been highlighted, for over a decade, in a number of marine investigation reports. The Board, concerned about the high risk to survival faced by personnel in the cold waters of Canada, recommended to TC that small boats be required to carry anti-exposure work suits or immersion suits.[14]

While the recommendation was made with respect to small fishing vessels, the need for the provision of thermal protection applies equally to all small vessels, be they small fishing vessels, small passenger vessels or pleasure craft. Despite this, the new regulations, such as *Small Vessel Regulations,* that affect small vessel safety, do not address the recommendation.

It is the position of TCMS that, to impose a regulatory requirement to carry a specific device, especially in the absence of a "required to wear rule," would be expensive and counter-productive. In TCMS's opinion, the industry has always maintained that, in addition to the regulatory minimum carriage requirements for passenger vessels, additional equipment may be carried based on the operator's assessment of "risk." At the same time, Board of Steamship Inspection Decision No. 6587 allows vessels engaged in whale watching to use full-length PFD suits in lieu of the carriage requirement of approved standard lifejackets, provided that the suits are worn by passengers and crew for the duration of the trip.

2.7 Care, Maintenance and Inspection of PFDs

PFDs, when submitted for approval, have excess buoyancy built into them according to a formula and a factor of buoyancy retention of the particular foam material(s) used. In theory, after five years of occasional recreational use, the device will be at its minimum design buoyancy. The useful life of a suit will depend upon the frequency of its use and the wear and tear it receives. Hence, barring inspection, it is difficult to determine its life expectancy.

Coverall PFD suits that are in frequent use and exposed to the elements (particularly sunlight) tend to degrade over time. Currently, TC does not have any requirement for retesting or replacement of old, frequently used PFDs. TC and manufacturers, however, recommend that the suits be tested annually, be it by the owners of the suit or by a manufacturer's accredited representative. TC recommends that owners test the device in a pool to determine if it still provides adequate flotation—the only practical method to determine the buoyancy loss after each season. Care and maintenance information is available from the manufacturers.

[14] TSB Recommendation M92-07 (report No. M90N5017)

The onus is on the owners/operators of the boats to ensure that these suits are well maintained and suitable for use. There is no requirement that they be inspected nor that maintenance records be kept by owners/operators. In this instance, the owner *had* kept maintenance records of the coverall PFD suits.

2.8 Practice of Wearing Rain Gear Over Coverall PFD Suits

The practice of some whale-watching boat operators is to have waterproof oilskins or rain gear worn over the coverall PFD suits. This is reportedly based on their belief that the older types of suits are not very water resistant; however, the new suits are treated with a waterproof coating that will prevent water from seeping through the material. As the passengers are exposed to spray and water when sitting in the open boat, this practice has evolved to provide passengers with greater comfort.

The difficulty arises when persons are in the water with the coverall PFD/rain gear combination. The coverall PFD suits have velcro closures at the cuffs and ankles which, when properly used, will reduce the ingress of water. These suits work on a wet suit principle whereby water, which enters the suit from the extremities, upon reaching body temperature reduces the further loss of body heat. The suits, however, make it difficult to negotiate ladders or board vessels. The practice of donning rain gear over a coverall PFD suit has the potential to trap water between the suit and the rain gear causing the latter to billow out or bunch up, thereby further reducing the mobility of the wearer. The rain gear, particularly a full-length rain coat similar to the one worn by one of the passengers, is more susceptible to the forces of current and underwater turbulence.

2.9 Reboarding the Vessel

The nature of a whale-watching trip is such that the boats are crewed by one person and operate in open waters. As such, some of the requirements in operating these craft are similar to those pertaining to rescue boats.

A person in the water can delay the onset of hypothermia and have an increased chance of survival by reboarding a boat. The design of most small RHI passenger vessels makes reboarding from the water difficult. The problem is compounded by the absence of a boarding ladder and/or other arrangement that is readily accessible from the water—items that are essential for persons who find themselves in the water. While rescue boats/fast rescue craft require a boarding ladder, there is no such requirement for small passenger vessels. The absence of a boarding ladder decreases the chances of survival for a person in the water.

The "OCEAN THUNDER" had grab lines, but they did not extend to the waterline on the outside. The primary function of such grab lines would be to provide a hand-hold for persons in the water to stay alongside the boat. However, even if the lines extended close to the waterline, it would be difficult for most passengers to climb over the sponsons to board the boat.

2.10 Accessibility and Suitability of Emergency Signalling Equipment

Once the vessel broached and the occupants were thrown into the water, the onboard emergency signalling equipment (which was limited to flares) could only have been accessed by climbing back into the swamped vessel. The vessel, which had drifted away, only appeared close to the survivors a few minutes before the rescue units came within sight, and the use of rain gear over the coverall PFD suits made reboarding the boat difficult.

As flares have a limited visual range, they can only be used to draw attention of other traffic in the vicinity. Thus, the effectiveness of the flares in seeking assistance would have been limited.

The boat carried a VHF R/T which was used to communicate with the company office ashore. On the day of the occurrence, the VHF aboard the "OCEAN THUNDER" was not functioning satisfactorily and problems were experienced in receiving transmissions from the boat. There is no known problem associated with VHF coverage of the area. Because the vessel was not required to carry an EPIRB or an emergency waterproof portable radio, the only means of communication on board was lost when the occupants were suddenly thrown into the water.

Valuable time was lost as SAR operations began only after the boat did not return to the base at its scheduled time. The carriage of a waterproof portable buoyant distress radio on the person of the operator and secured by a lanyard to a suitable point on his coverall PFD suit would have allowed the operator (or, if incapacitated, another person) to broadcast an immediate distress call. In circumstances such as this occurrence, it is possible that an EPIRB would not float free and it is unlikely that there would be an opportunity to activate it manually.

In cold Canadian waters, the success of a SAR mission depends upon the prompt notification of SAR authorities (of vessel position and other relevant information) and the prompt tasking of SAR resources. The lack of emergency communication equipment can result in the loss of valuable time and adversely affect the success of a SAR mission.

2.11 Survival and Marine Emergency Duties (MED) Training

Although not required to by regulations, the operator of the "OCEAN THUNDER" had undergone MED training. When the occupants of the boat found themselves in the water, the operator showed leadership in the face of adversity and impending danger. While one of the survivors drifted away, the one who was with the operator received direction and words of encouragement. The actions of the operator and the eventual survival of one of the passengers can, in part, be attributable to the MED training received by the operator. The survival of some of the passengers shows the value of MED training. The Board, concerned that a lack of such training

compromises the safety of personnel in emergency situations, has expressed concerns in a number of reports and made recommendations to the Minister of Transport respecting MED training.[15] It is TC's position that the proposed amendments to the *Crewing Regulations* will require basic MED training for all persons on vessels over five gross tons. The responsibility for MED training of uncertificated crew rests with the owners and masters of these vessels.[16]

2.12 Pre-departure Safety Briefings and Communications

The safety information provided to the passengers was limited to the instructions on how to don the coverall PFD suits. Although the vessel was manned by a single operator, an appropriate pre-departure safety briefing (as per Ship Safety Bulletin 4/95) was not given, in that information was not provided on the stowage and use of pyrotechnics, emergency distress communication procedures or action to be taken by the passengers in case of a mishap. A lone operator may become incapacitated in an emergency; hence, to ensure the well-being of passengers, an explanation of emergency procedures is essential in preparing passengers for emergency situations and in reducing the negative consequences of accidents. The Board, concerned about the safety of passengers, recommended to the Department of Transport that pre-departure safety instructions be made mandatory for such operations.[17] In response to the recommendation, TCMS issued Ship Safety Bulletin 4/95 as an interim safety measure to be followed by regulatory initiatives (as amendments to the *Small Vessel Regulations*). The bulletin advised operators to provide pre-departure safety briefings to passengers, including the essential actions that passengers need to take in an emergency and the various means at their disposal to attract attention and seek assistance.

In this instance, the poor VHF R/T performance precluded periodic reporting. However, action was initiated when the vessel failed to return to the base at the expected time.

2.13 Regulatory Regime and Safety

2.13.1 Scope of Small Passenger Vessel Operations and Industry Standards

There are some 30,000 to 40,000 small commercial vessels operating in Canada (excluding small fishing vessels), many of which are engaged in carrying passengers. A large number of those carrying passengers are engaged in sightseeing, whale watching, charters and sport fishing, using boats, other than those specifically designed for passenger transportation, such as tow boats and small fishing vessels. The industry in British Columbia is made up of a number of independent owners operating from urban centres and remote locations on Vancouver Island, the islands in the Strait of Georgia and the mainland west coast of Canada. Similar operations exist throughout Canada, including on the east coast, the St. Lawrence Seaway, and the Great Lakes.

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[15] TSB Recommendation M92-06 (TSB report No. M90N5017)

[16] TSB report No. M93W0005

[17] TSB Recommendation M96-05

Whale watching, in particular, is a rapidly growing and loosely knit industry with a number of leaders who, in view of the low tonnage/passenger requirements within the current regulatory regime, have implemented carriage requirements that are in excess of the regulatory minimum. In Victoria, some 15 area companies are signatory to the industry standards; however, the remainder, for the most part, do not belong to any such parallel association.[18]

While there are differing levels of safety among the operators across Canada, the voluntary standard developed in Victoria can provide guidance elsewhere, with appropriate modifications for the type and area of operation. However, in the diverse and far flung waters of the Canadian coastline, the influence of a voluntary association is limited and localized; therefore, the dissemination and application of similar standards would benefit from the support of a national agency or organization. In any event, until various standards are developed that address the broad range of passenger vessel activity, passengers will be subject to varying levels of safety, depending upon the safety culture of the owner/operator.

2.13.2 Self-imposed Local Industry Standards

Although not required by regulations, the industry (locally) has recognized the need for safety equipment that provides thermal protection. Hence, some owners of whale-watching boats (including those of the "OCEAN THUNDER") provide coverall PFD suits, which are donned by all passengers and crew before a trip begins. However, not all owners are members of the association/industry organization. Until such time as there is a standard applied to all owners, only some (usually those who are members of industry organizations) will assume the financial burden involved in the purchasing and maintenance required to operate safely. As a result, there are differing levels of safety among operators. There is no system in place to make the public better aware of these differences in safety standards.

2.13.3 Dissemination of Safety Information

TCMS uses Ship Safety Bulletins as a means to promote safety; the bulletins are widely distributed. However, the investigation revealed that these bulletins do not always reach the target audience. In this case, some of the small passenger vessel operators had no knowledge of

[18] *Standards for Victoria Area Whale Watching Companies Operating Vessels of Less Than 5 Gross Tons and Carrying 12 or Fewer Passengers.*

the program or the existence of Ship Safety Bulletins. Further, these bulletins are not available on the TC web site, and there is no alternative means available to access/receive this safety information.

2.13.4 Federal Regulatory Initiatives

Vessels under five gross tons and carrying 12 or fewer passengers, like the "OCEAN THUNDER", are not subject to inspection. Further, TC is currently amending the *Canada Shipping Act* to eliminate regulatory inspection on all commercial vessels under 15 gross tons and carrying 12 or fewer passengers. Vessels entering passenger service will not be required to report to TC, nor will an initial inspection be carried out. However, TC will encourage operators to request a voluntary inspection of their vessels.

2.13.5 Provincial Initiatives

In the absence of mandatory inspection, there is a need to ensure that passengers are afforded a minimum level of safety. That this is in the best interest of the tourism industry has been recognized by the province of Quebec. In February 1998, Quebec passed a decree[19] requiring all small passenger vessels under five gross tons and carrying 12 or fewer passengers to be inspected (by a professional surveyor approved by TC) and to carry at least one million dollars of liability insurance. The survey includes inspection of the vessel as well as boarding and landing sites. The surveyor will issue a letter of compliance stipulating that the vessel meets TC regulatory requirements and is appropriately equipped to operate a safe service (as described in the surveyor's report), and that the operating crew is knowledgeable to conduct the specified commercial activity in a specified area/territory.

At the time of the occurrence, companies with the British Columbia Whale Watching Society of Victoria Harbour had initiated action to set local industry standards specific to their type of operation. The initiative covers a range of issues including: the carriage of safety, communication and navigation equipment; vessel construction; and operator proficiency. Presently, the standards have been finalized and their implementation is well underway.

2.13.6 Regulatory Overview and Safety

While inspection is not mandatory for all small passenger vessels, TCMS can inspect vessels that are signatory to the voluntary standards. Most operators require a business license of some type, and the cooperation of city licencing departments is essential. In addition, insurance and underwriters may require inspection/certification. It is the position of TCMS that this type of licensing activity is an effective way to increase compliance and TCMS will continue to encourage it as an alternative to prescriptive legislation. However, to date, there is no formal arrangement among the local licensing systems, insurance/underwriters inspection requirements and TCMS, nor is there in place a system similar to the one adopted in Quebec that will help ensure a level of safety for all passengers.

[19] Number 147–98, 4/2/98

3.0 Conclusions

3.1 Findings

1. The "OCEAN THUNDER", in a lightly loaded condition, was being operated in breaking and confused seas near Plover Reefs.

2. In the past, the owner had considered cancelling trips when four or fewer passengers were booked and the weather conditions were adverse; he did not do so on this occasion.

3. An operator's decision to cancel a trip can be influenced, in part, by the economic pressures of the business.

4. The operator's decision to revisit the Plover Reefs may be attributable, in part, to the abating of the weather, the desire to obtain customer satisfaction, and confidence that the vessel could be operated safely in such waters.

5. The operator may not have fully appreciated the persistence of the swell, or the conditions the vessel would meet in the vicinity of the reefs.

6. The "OCEAN THUNDER" was swamped, rolled to a large angle and ejected its occupants, all of whom were wearing coverall personal flotation device (PFD) suits, overboard into the sea.

7. There was no established call-in procedure, and the pre-existing problem experienced with very high frequency (VHF) transmissions from the boat precluded periodic radio contact with the vessel's base station ashore.

8. The rapidity with which the occupants were thrown into the water precluded a Mayday transmission from the vessel and the only means of communication was lost.

9. The Search and Rescue (SAR) operation was initiated when the "OCEAN THUNDER" failed to return to its base at the scheduled time.

10. The passenger who was a non-swimmer was seen to panic and to quickly drown. The operator, whose coverall PFD suit was not properly closed at the time of boarding the boat, later succumbed to hypothermia and drowned.

11. The passenger who was successful in reboarding the vessel some time later was suffering from mild hypothermia when rescued. The passenger who was rescued from the water, unconscious, was suffering from severe hypothermia.

12. The regulatory regime does not include thermal protection criteria for personal life-saving equipment for passengers or crew.

13. Although not required to by regulations, all occupants of the boat were wearing coverall PFD suits of approved quality, substantially increasing their chances of survival.

14. Although not required to by regulations, there was a regime in place to record inspection results of the life-saving equipment.

15. A safety briefing was given to the passengers but it was limited to instructions in donning coverall PFD suits. Information on other safety equipment and emergency procedures was not provided.

16. The absence of a requirement for the carriage of an emergency position indicating radio beacon (EPIRB) or an emergency VHF radio transmitter on the "OCEAN THUNDER" may have precluded a timely SAR response and so adversely affected the success of the SAR mission.

17. The absence of a boarding ladder hindered access to the vessel, to the detriment of passenger and crew safety; a ladder was not required by regulations.

18. The survival of one of the passengers can be attributed, in part, to the operator's Marine Emergency Duties training. The survival of the passenger who was unconscious can be attributed to the prompt first aid rendered by the rescuers.

19. The province of Quebec and Transport Canada have reached a formal arrangement to provide a level of safety for small passenger vessels under five gross tons and carrying 12 or fewer passengers. However, there is no similar arrangement with any other province.

3.2 Causes

The "OCEAN THUNDER" was swamped and rolled suddenly to a large angle, throwing all occupants into the cold water. A factor contributing to the occurrence was that the operator did not fully appreciate the conditions the boat would meet at the time of the accident in the turbulent waters in the vicinity of reefs. Contributing to the loss of lives were: anxiety associated with sudden immersion in cold water, the lack of effective communication equipment, and the absence of emergency (medium range) communication equipment, which resulted in a delay in initiating a Search and Rescue response.

4.0 Safety Action

4.1 Action Taken

4.1.1 Whale-Watching Industry Standards

Following the occurrence, and at the request of the industry, Board of Steamship Inspection Decision No. 6587, dated 16 July 1998, permits "coverall PFD suits" approved as personal flotation device (PFDs) to be carried in lieu of standard lifejackets on vessels engaged in whale-watching operations, provided they are worn throughout the voyage.

Also, the draft *Standards for Victoria Area Whale Watching Companies Operating Vessels of Less Than 5 Gross Tons and Carrying 12 or Fewer Passengers* has undergone further revision to more accurately depict the type of safety equipment required to be carried on board vessels engaged in whale-watching operations. The final draft also contains a provision that Transport Canada (TC) has the authority to inspect vessels for compliance with these standards and, upon request, to test operators for knowledge and proficiency.

Transport Canada Marine Safety (TCMS), in consultation with the industry, is in the process of developing new national standards for all whale-watching vessels and is considering operator certification to apply to all vessels carrying passengers.

4.1.2 Safety Concern Respecting Small Passenger Vessel Operations

Subsequent to this occurrence, the Board reviewed its past safety recommendations made as a result of similar occurrences involving small commercial vessels to determine the extent to which deficiencies identified in these recommendations are being addressed.[20] While there has been some remedial action taken to improve the safety of small passenger vessel operations, the Board is concerned that several deficiencies remain unaddressed; to highlight this concern, the TSB placed the "Safety of Small Passenger Vessel Operations" on its list of Key Safety Issues in 1999. The Board will continue to closely monitor the action taken by TC to address the deficiencies identified in the Board's recommendations and, where deemed appropriate, will make further recommendations.

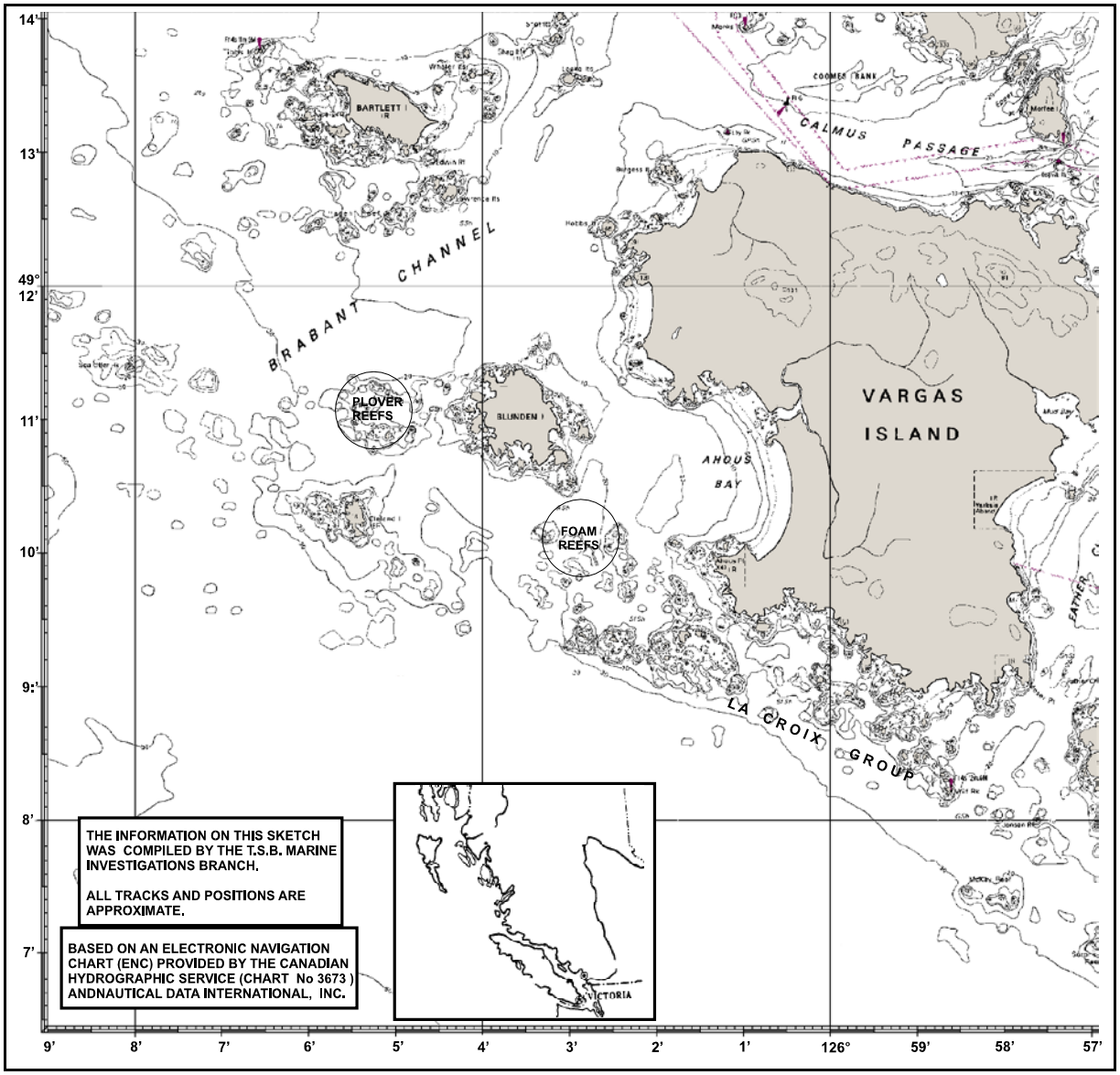
[20] A total of 11 recommendations identified safety deficiencies concerning small commercial vessels: M94-01, M94-02, M94-04, M94-05 (all issued February 1994), M94-13 (issued August 1996), and M96-01 to M96-05 (issued April 1996).

4.2 Action Required

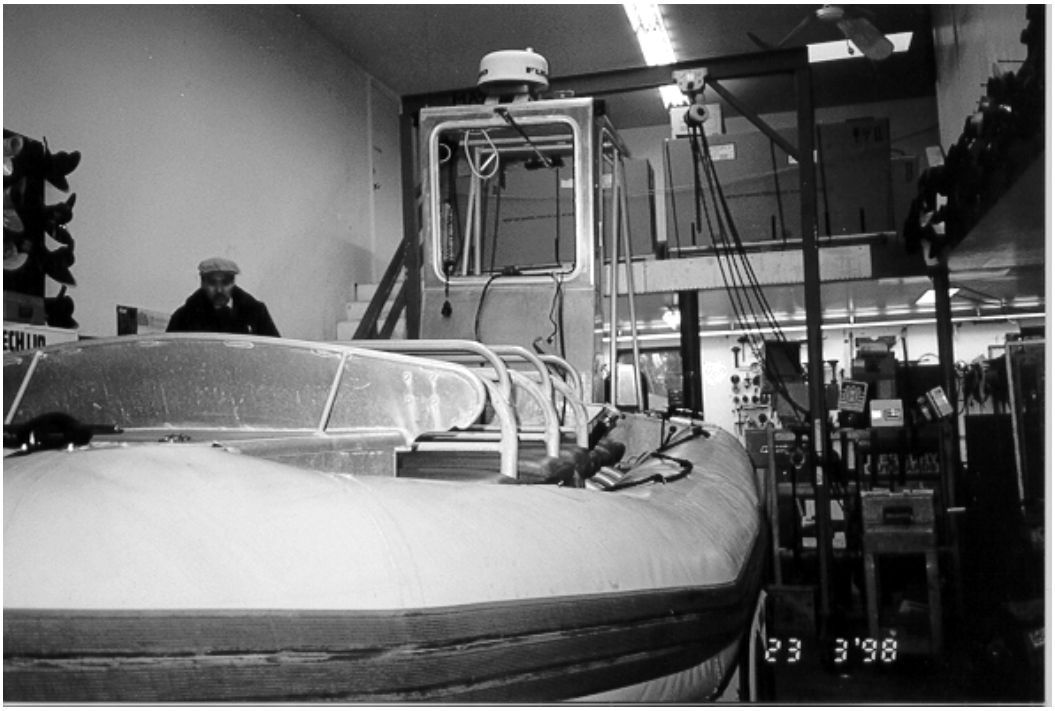
Dispensation is given to the whale-watching industry to permit carriage of "coverall PFD suits" in lieu of lifejackets. However, persons on many small vessels (including small fishing vessels) are not afforded similar protection; i.e. both thermal protection *and* flotation. With respect to small fishing vessels, while TC is attempting to address this issue, no concrete measures have been instituted. The Board is concerned that, because the current regulations do not reflect the need for thermal protection, mariners and passengers on small vessels and small fishing vessels may be exposed to undue risk of hypothermia. The Board will continue to monitor the life-saving carriage requirements with a view to ensuring that these take into consideration both flotation and thermal protection capabilities, and thereby provide mariners and passengers a reasonable chance of survival in cold Canadian waters.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 01 March 2000.

Appendix A - Sketch of the Occurrence Area



Appendix B - Photographs

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Appendix C - Glossary

B.C.	British Columbia
C	Celsius
CCG	Canadian Coast Guard
DSC	Digital Selective Calling
EPIRB	emergency position indicating radio beacon
ESE	emergency signalling equipment
F	Fahrenheit
GPS	Global Positioning System
immersed clo	Values which depict the level of thermal insulation a garment provides through the rate at which heat is lost from the body, as well as the difference in temperature between skin and water. Once these values have been determined, predictions can be made of the rate at which a person's body temperature will drop in cold water.
kg	kilogram
kn	knot
m	metre
MED	Marine Emergency Duties
MOT	Minister of Transport
PFD	personal flotation device
PST	Pacific standard time
RHI	rigid hull inflatable
R/T	radiotelephone
SAR	Search and Rescue
SOLAS	International Convention for Safety of Life at Sea, 1974
TC	Transport Canada
TCMS	Transport Canada Marine Safety
VHF	very high frequency
°	degree