Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

TRANSPORTATION SAFETY

REFLEXIONS

Issue 19 – January 2002

MARINE

Broke in Two

Not all Pumps are Equal

Over a Rock and in a Hard Place

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Acknowledgements

The articles in this issue of *REFLEXIONS* have been compiled from official text of TSB reports by Bill Vasiliou, under contract, and TSB staff.

Cover photograph: Marc Piché

Également disponible en français

ISSN # 1499-2434

www.tsb.gc.ca
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REFLEXIONS is a safety digest providing feedback to the transportation community on safety lessons learned, based on the circumstances of occurrences and the results of TSB investigations.

View of the *Flare* bow section from astern.

Broke in Two

On 16 January 1998, the bulk carrier *Flare* broke in two approximately 45 miles southwest of the islands of Saint-Pierre-et-Miquelon in severe weather conditions. It was en route from Rotterdam, Netherlands, to Montréal, Quebec. The stern section sank within 30 minutes; the bow section sank four and a half days later off Nova Scotia. An extensive search-and-rescue (SAR) operation was undertaken in very difficult conditions. Twenty-one of the crew perished; four survived. There was widespread, non-recoverable fuel oil pollution from the sunken stern section. — Report No. M98N0001

The Vessel

The *Flare* was built in 1972 as a single-deck, dry bulk cargo vessel of all-welded steel construction. The 16 398-gross-ton, 180.8-metre vessel was propelled by a marine diesel engine driving a single, fixed-pitch propeller. The propelling machinery, steering gear, wheelhouse, life-saving equipment, and all crew accommodation were at the after end of the vessel.

The vessel's Certificate of Cyprus Registry, Certificate of Class, and International Load Line Certificate were in order.

However, at the time of the occurrence, the vessel was operating with an Interim Certificate of Class because a Condition of Class had been imposed that required structural repairs in the upper wing ballast tanks to be completed before the end of February 1998. An annual survey by Lloyd's Register of Shipping surveyors, completed in November 1997, recorded several wasted and corroded-through structural members, primarily transverse webs and wash bulkheads in upper wing water ballast tanks.

The Crew

The crew of the *Flare* comprised four nationalities. The master and 3 crew members were Greek, 16 were Philippino, 2 were Romanian, and 3 were Yugoslav.

The master and 11 of the crew joined the ship in Rotterdam shortly before sailing. The senior officers and the remainder of the crew had joined the vessel at various times during 1997. The certificates of competency of the master and the officers were valid and appropriate to the service in which the vessel was engaged. The qualifications of the crew were also valid and conformed with regulatory requirements.

This was the master's first voyage on the *Flare* and his first command of a bulk carrier. Before joining the *Flare* in Rotterdam on 22 December 1997, he had been briefed extensively on details concerning the vessel.

Before departing the Philippines, the new crew members joining the *Flare* received some in-house training. In particular, they were briefed on issues such as safety aboard, conduct, and *International Safety Management Code* (ISM Code) requirements. Because of the bad weather after sailing, no boat drill was held for crew members joining the vessel in Rotterdam. However, the master had held a half-hour briefing on the use of the vessel's safety equipment.

History of the Voyage

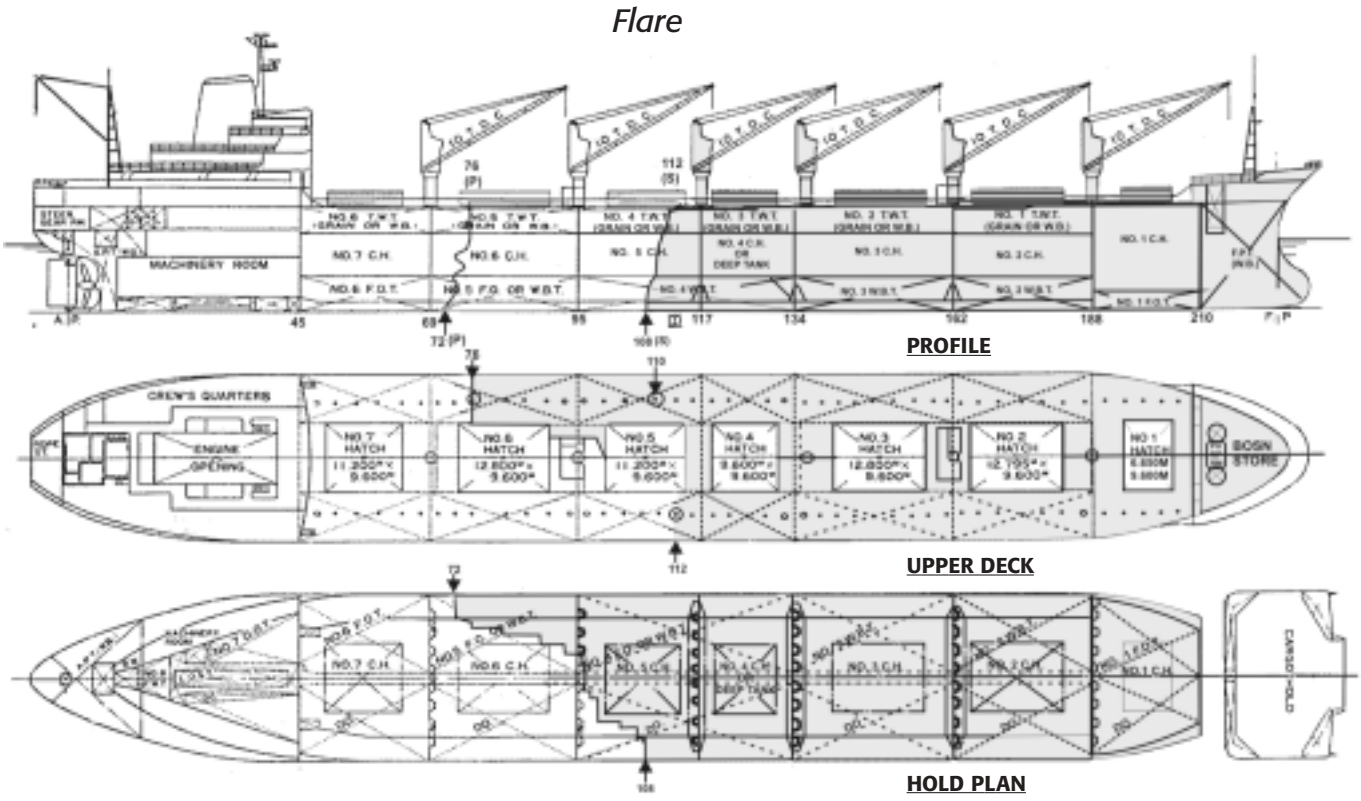
The vessel, in a lightly ballasted condition, departed Rotterdam on 30 December 1997, bound for Montréal. The harbour pilot in Rotterdam noted that the ship had a light forward draught and was trimmed by the stern. The light ballast loading condition and the shallow forward draught made the vessel highly vulnerable to pounding and slamming in rough weather.

After the *Flare* cleared the English Channel, the weather deteriorated. Throughout most of the passage, westerly gale-to-storm-force winds were encountered, with seas reaching a height of 16 m or more. Although speed was adjusted in response to the prevailing conditions, the vessel continued to pitch, pound, and slam heavily. Survivors reported that they had difficulty sleeping and eating because of the hull flexing. One survivor reported seeing the main deck flexing such that deck cranes appeared to be touching each other.

As the vessel approached the Canadian coast, the master reported to the Eastern Canada Traffic System (ECAREG) that the forward and after draughts were 11 feet (3.35 m) and 21 feet (6.4 m), respectively. He also reported that seawater ballast had been exchanged. The precise longitudinal and transverse distribution of the water ballast immediately before the hull failure is not known. However, the forward and after draughts reported to ECAREG on 13 January 1998 clearly indicate that no substantial amount of additional water ballast had been taken on board, that the afterpeak and the deep tank (No. 4 hold) remained empty, and that the forepeak tank was less than full. At about 0400 Coordinated Universal Time (UTC) on January 16, a very loud bang was heard (due to the slamming of the forefoot), followed by severe whipping and longitudinal flexing of the hull. Approximately four and a half hours later, another loud bang was heard, followed by severe hull whipping and vibration. The occurrence and severity of these pounding shocks is most likely due to the vessel suddenly encountering particularly high or irregular waves. Another vessel, in the same general area, reported having experienced similar irregular phenomena. The survivors from the *Flare* reported that crew members were startled by the severity of the latter vibrations, which were followed by the ringing of the general alarm. Upon their arrival on deck, they saw that the vessel had broken in two. The whole crew was on the after part of the vessel.

Upon their arrival on deck, they saw that the vessel had broken in two.

The stern section listed approximately 30 to 35 degrees to starboard, precluding the use of the starboard-side motor lifeboat. Attempts to launch the port-side lifeboat were unsuccessful due to difficulties encountered in freeing extra lashings made to secure the boat in the heavy weather.



Structural separation location.

Crew members manoeuvred a liferaft down one deck, launched it over the stern, and secured its painter to the poop deck rail. However, the crew did not immediately abandon ship to the liferaft because the vessel's propeller was still turning. Shortly thereafter, the painter reportedly chafed through and the liferaft drifted away. A liferaft on the foredeck apparently remained aboard.

The stern section sank in about half an hour. As it was sinking, some of the crew on the port side of the poop deck saw the bow of a vessel apparently approaching on a near reciprocal course. Their immediate impression was that a rescue vessel was at hand; however, they were dismayed to find that it was the bow section of the *Flare*. The propeller on the stern section was still turning and had likely caused it to follow an erratic course, returning it to the vicinity of the separated bow section.

The crew, except reportedly the chief, the third engineer, and one other person, were wearing hastily donned clothing and life jackets and abandoned the stern section as it sank. Six of the crew managed to swim to and climb on the port-side capsized lifeboat. Of these six, four survived to be rescued by a SAR helicopter.

SAR Response

A hurried MAYDAY message had been transmitted from the ship on very high frequency (VHF) radiotelephone channel 16 shortly before the stern section sank. At 0832 on January 16, Marine Communications and Traffic Services (MCTS) at Stephenville received a MAYDAY from an unidentified vessel through a remote antenna on Ramea Island, off the south coast of Newfoundland. The message was indistinct and incomplete. Requests for further information by the MCTS went unanswered.

At 0834, MCTS Stephenville advised St. John's Marine Rescue Sub-centre (MRSC) of the situation, and at 0837, the MRSC advised the Rescue Coordination Centre in Halifax, Nova Scotia. It was determined that the occurrence was in Canadian waters; however, because the position from which the MAYDAY originated was uncertain, SAR resources were, at first, tasked to a large area. The extensive airborne SAR response involved a chartered commercial fixed-wing aircraft equipped for aerial surveillance, five Department of National

Defence (DND) SAR fixed-wing aircraft, and four DND SAR helicopters. The seaborne SAR response involved two commercial vessels, five Canadian Coast Guard vessels, one Canadian Navy ship, and one French patrol vessel.

At 1423, a SAR helicopter sighted an overturned lifeboat with four persons clinging to it. SAR technicians (SAR TECHs) carried out a difficult but successful rescue. All four survivors, who had endured approximately six hours on the upturned lifeboat in appalling conditions, were safely on board the helicopter at 1434. They were wearing life jackets and were mostly clad in light clothing. Three of the survivors were severely hypothermic and could barely move their limbs during the rescue. The survivors reported that there had been six of the crew on the overturned lifeboat but two became too weak to hold on and were swept off by heavy seas about three hours before the rescue. The survivors confirmed that no one had time to use any of the six immersion suits that were on board the *Flare*.

By 2100, in addition to the 4 survivors, 14 bodies had been recovered and 7 persons remained unaccounted for. When the search was concluded, 15 bodies had been recovered.

Recovery of the survivors and of the bodies of the ship's crew was complicated by the oil slick (caused by fuel oil escaping from the sunken stern section) and the water temperature of 2 °C. SAR TECHs are now provided with dry suits to ward off the chill from the cold water. They are also provided with full face masks to protect against fumes from the oil.

Departure Loading, Draughts, and Trim

The total weight of ballast on board after cargo discharge in Rotterdam was significantly less than the 8113 long tons shown in the light ballast departure condition included in the vessel's Loading Manual. The manual indicated that all water ballast tanks except the deep tank be filled to ensure forward and after draughts of 3.65 m and 7.0 m, respectively. The actual recorded forward draught was 0.58 m less than that shown for the light ballast departure condition. While the after draught was also less, the top of the propeller was submerged by 0.5 m.

Riding Repairs During Crossing

Before sailing from Rotterdam, a portable welding machine and 1.69 tonnes of steel plates and flat bars were taken on board. It was intended that riding repairs to various damaged items and replacement of some corroded parts of the vessel's structure would be carried out during the voyage.

Some of the work required access to the upper wing tanks and would necessitate their being temporarily emptied of the water ballast. The precise distribution of water ballast at the time of the hull separation is not known. Fractures in the boundaries of the upper wing ballast tanks had been discovered and repaired during the voyage, but the internal structural repairs required by the Condition of Class had not been completed at the time of the occurrence.

The internal structural repairs required by the Condition of Class had not been completed at the time of the occurrence.

The imposition of a Condition of Class calling for the completion of remedial action at the next routinely scheduled survey (or within a shorter specified time) is a long-established and universally adopted practice of classification societies. Class surveyors determine how long repairs may be deferred, based, in part, on the perceived importance of the deficiency and the availability of suitable repair facilities at the current location.

Depending on the nature of the deficiency, class surveyors may require that remedial action be carried out immediately or, in the absence of suitable local repair facilities, at the nearest or the next suitably equipped port of call. Class surveyors may also impose operational limitations on the vessel until the remedial repairs are satisfactorily completed. None of these actions was deemed necessary in this instance.

Weather and Sea Conditions

The plain language text forecast for Cabot Strait, issued at 1000, January 16, stated in part:

> Gale and freezing spray warning continued. Winds Westerly 25 to gales 35 knots diminishing to Westerly winds 20 early afternoon.

The *Gulf of St. Lawrence Marine Weather Guide*, issued by Environment Canada, Atlantic Region, gives in part the following information for the Cabot Strait / Magdalen area:

> Cabot Strait is exposed to very long open water fetches. These long fetches can permit very large seas to form in the area. … Waves will continue to roll for a long time after the wind dies down. These combined effects can make this one of the roughest areas in Atlantic Canadian waters.

Records show that on January 16 the current in the area would have been against the wind. This wind/current condition, in conjunction with the shallowing water at the edge of the Saint-Pierre Bank, can disturb the established normal wave pattern, leading to the creation of large, irregular waves.

EPIRB

The battery-operated distress radio beacon transmits a coded digital signal on 406 MHz when automatically or manually activated. The signal is relayed by satellite to one of many receiving stations on land and decoded to identify the owner, the name of the vessel, and the location of the EPIRB (emergency position-indicating radio beacon). This information is used to determine where to direct a SAR response.

A previous master of the *Flare* stated that, to prevent the theft of the EPIRB while the vessel was in port, he usually removed it from its float-free mounting and stowed it in the accommodation or in the secured wheelhouse.

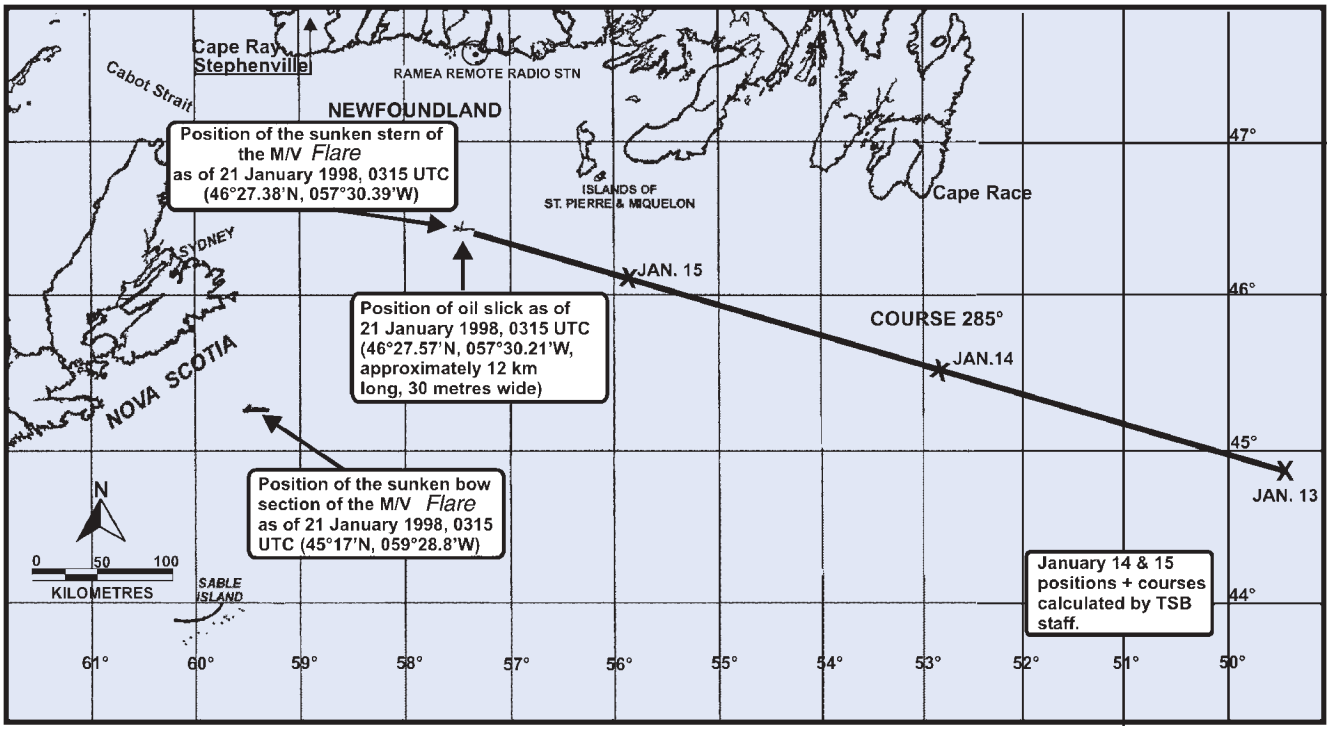
No EPIRB signal was received from the *Flare*, nor was the EPIRB recovered. It is not known whether the EPIRB was in its dedicated mounting on the starboard wing of the bridge. It is also unknown whether the unit floated free.

SART

The purpose of a SART (search-and-rescue transponder) is to indicate the position of persons or vessels in distress. It is easily portable and should be taken into the liferaft or lifeboat when abandoning ship. The *Flare* was equipped with two SARTs stowed on the bridge deck; however, SAR equipment received no SART response.

Investigation Findings

The TSB found that the *Flare* was making a winter crossing of the North Atlantic with its No. 4 hold/deep tank not filled with water ballast as indicated in the deep ballast loading condition of the vessel's Loading Manual. The *Flare* encountered large and steep irregular waves, which slammed the vessel's forefoot and caused severe hull whipping and vibration. Consequently,



The MAYDAY was short, incomplete, and difficult to understand, and the EPIRB did not provide any information.

loss of longitudinal structural integrity was initiated by rapid brittle fractures in the main-deck plating in way of grain-loading ports and existing fatigue fissure damage near midships. Bottom structural failure, resulting from suddenly imposed compressive loading and excessive localized stress concentrations in way of existing fissure damage, caused the hull to break in two.
In addition, the Board found that the loss of life was probably exacerbated by the lack of information from the vessel regarding its location; the MAYDAY was short, incomplete, and difficult to understand, and the EPIRB did not provide any information.

Action Taken

Preliminary analysis using aerial photographs and the underwater survey of the *Flare* bow section indicated that fissure damage and failure in the main-deck plating adjacent to grain-loading ports may have existed before the hull failure. The TSB identified 14 vessels of similar age and built to the same plans that were believed to be still in service and that could be subject to similar defects. In September 1998, the TSB apprised the involved Flag States so that appropriate remedial action could be taken.

The TSB also apprised Transport Canada (TC) so its Port State Control inspectors could take action during their inspection of similar vessels or of the 14 vessels mentioned above. Two of the 14 vessels arrived in Canada and were inspected. Both were detained; one for structural defects similar to those of the *Flare*, and the other for defective life-saving equipment, navigation equipment, and tank remote shut-offs.

The TSB also communicated safety information to the international media. *The Motor Ship* magazine provided coverage on the occurrence and safety issues to the global maritime community in its November 1998 issue.

Action Recommended

- **EPIRBs**

The fact that no signal was received from the *Flare*'s EPIRB contributed to the severity of consequences. The Board was concerned that ship management personnel, ships' officers, and crews may not be aware of the severe consequences of the improper stowage and installation of EPIRBs, thereby exposing themselves to undue risk in emergencies. As such, the Board recommended that:

The Department of Transport, working through the appropriate agencies, advocate increased international measures aimed at ensuring that Emergency Position Indicating Radio Beacons are properly installed and deployable on vessels so that their distress signals are transmitted without delay in distress situations.
M00-01

In response, TC submitted an information document for consideration to the Sub-Committee on Radio Communications and Search and Rescue (COMSAR) December 2000 meeting of the International Maritime Organization (IMO). The paper advised members to focus on EPIRB installations during Flag State and Port State inspections.

- **Operations in Cold Waters**

Current *International Convention for Safety of Life at Sea* (SOLAS) regulations do not require that an immersion suit be provided for each person on all cargo vessels. However, the regulations are such that an Administration may, at its discretion, require the provision of an immersion suit for each person on board. Canadian-flag ships, which regularly operate in higher latitudes, are required by regulations to provide at least one immersion suit for each crew member. International organizations, however, have not taken such action.

For a person wearing an immersion suit, survival time can run to several hours.

The North Atlantic Ocean is one of the most hostile environments in the world. Average midwinter sea surface temperatures off the eastern seaboard range from 0°C to 2°C. Midsummer temperatures range from 8°C to 16°C. In such harsh marine conditions, the survival time for a person immersed in water is often measured in minutes, while for a person wearing an immersion suit, survival time can run to several hours. The Board believes that crew survival largely depends on adequate thermal protection and recommended that:

The Department of Transport advocate international measures requiring that an adequate immersion suit be provided for each person on board vessels operating in waters where hypothermia can greatly reduce an individual's survival time.
M00-02

In rapidly developing distress situations, such as those involving bulk carriers, it is critical that life-saving equipment, such as immersion suits, be readily accessible and rapidly retrievable without confusion. The Board further recommended that:

The Department of Transport advocate international measures to help ensure that critical life-saving equipment, such as immersion suits and thermal protective aids, are stowed so that they are readily retrievable, without confusion, and that all crew members are familiar with their use and their stowage location.
M00-03

TC agreed with both recommendations. TC submitted a proposal to adopt requirements similar to those in place in Canada (that is, an immersion suit for each person on board vessels operating in waters where hypothermia can greatly reduce an individual's survival time) to the 74th session of the IMO's Maritime Safety Committee, which met in May 2001. The proposal stressed the importance of the use and location of safety equipment. The Committee agreed to the Canadian proposal and included, in the Ship Design and Equipment Sub-Committee's work program, a high-priority item on carriage and stowage of immersion suits, with a target completion date of 2003. In this context, the Committee agreed that consideration should be given to the carriage and stowage of immersion suits on passenger and cargo vessels.

- **Dynamic Loads Due to Waves and Ship Motions**

The investigation found that the shallow forward draught made the vessel highly vulnerable to repeated pounding and slamming throughout the stormy voyage. "Slamming", the impact of the bow on the water during a large downward pitch, causes "vibratory stresses" or "slamming stresses". The investigation concluded that the resulting severe whipping and flexing of the hull of the *Flare* caused the sudden brittle fracture of the main-deck and upper-side shell plating.

The forward draught and the total quantity of water ballast on board were lower than those shown for the light ballast departure condition in the Loading Manual. Also, the No. 4 hold/deep tank was not filled with ballast as indicated for the deep ballast loading condition. The total weight of water ballast on board was significantly less than that stipulated in the Loading Manual.

A common factor throughout the recorded and reported loading conditions is that the forward draught throughout the voyage was consistently shallower than any of the ballasted departure conditions given in the vessel's Loading Manual. The forward draught was also less than that contained in *Lloyd's Rules and Regulations for the Construction and Classification of Steel Ships.* The minimum forward draught so indicated has been found satisfactory—and proven by extensive operational experience—for the prevention or reduction of hull pounding.

The *International Convention on Load Lines, 1966*, requires that the master of every ship be supplied with sufficient information for the loading and ballasting of the ship so as to avoid any unacceptable stresses in the ship's structure. The Convention requires that the ship be provided with a booklet that includes, inter alia, ballasting and deballasting rates and capabilities and general loading and unloading instructions on the most adverse operating conditions during loading, unloading, ballasting operations, and the voyage.

The *Flare*'s forward draught reported to ECAREG three days before the occurrence was substantially less than the minimum required to avoid excessive forefoot exposure in rough seas. However, the investigation was unable to determine why the instructions in the Loading Manual were not followed.

Mariners may not fully appreciate the adverse consequences of dynamic loadings on the hull.

The Board is concerned that mariners may not fully appreciate the adverse consequences of dynamic loadings on the hull caused by slamming and bow flare impacts due to inadequate forward draughts. The Board therefore recommended that:

The Department of Transport promote increased awareness and understanding in the international maritime community of potential structural failure associated with high-frequency stresses on the hull due to slamming and pounding as a result of inadequate draughts of vessels operating in ballast conditions.
M00-04

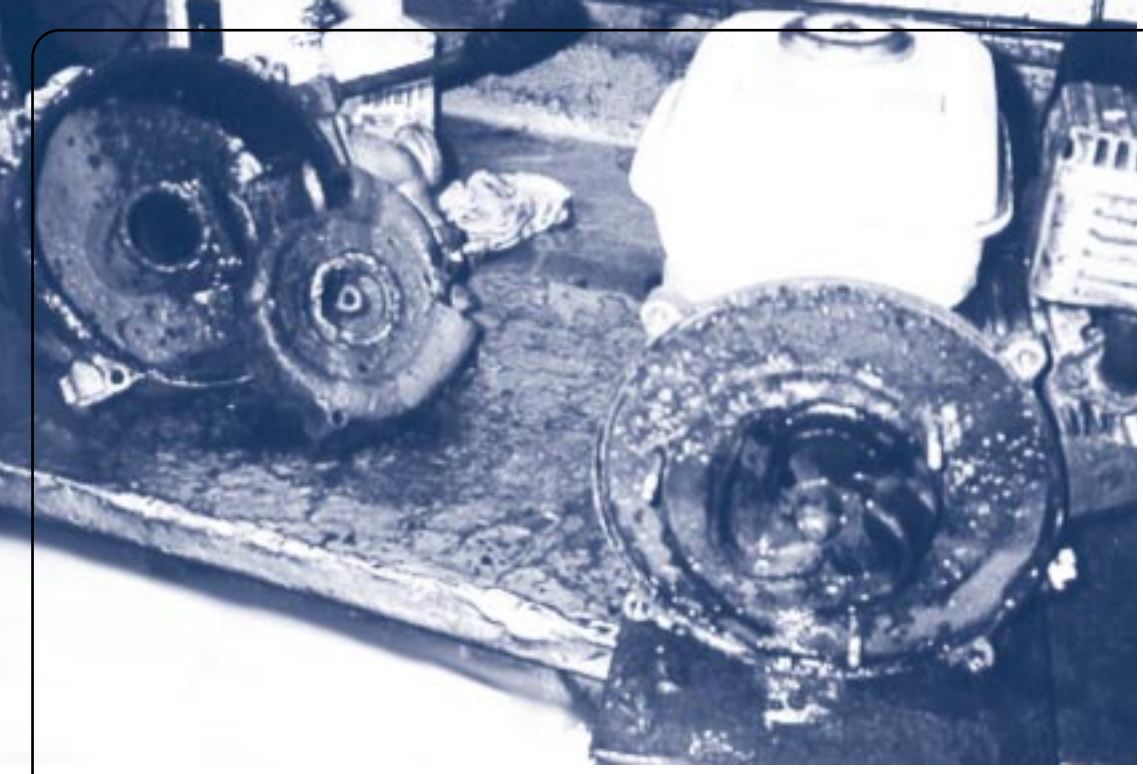
and that:

The Department of Transport, in coordination with international agencies (including the International Maritime Organization and the International Association of Classification Societies), bring the need for stricter adherence to approved loading manuals to the attention of shipowners, ship operators and ship masters in order to avoid undue structural stresses in bulk carriers.
M00-05

In its response to recommendation M00-04, TC advised that Port State Control inspectors are instructed to review the loading and ballasting of the vessel's last few voyages. They are then in a position to ascertain whether the vessel is operated in a proper manner or if it is necessary to discuss this matter with the senior officers. To ensure follow-up, a deficiency may be recorded so future Port State Control inspections will determine if proper action was taken to avoid unsafe operation. TC brought this matter to the IMO, Port State Control Members, and other administrations through the Formal Safety Assessment Working Group on Bulk Carriers to ensure that the maritime community is aware and understands the dangers related to improper ballast conditions. The Formal Safety Assessment Working Group on Bulk Carriers submitted a progress report to the 73rd session of the IMO's Maritime Safety Committee, which met in December 2000.

An International Steering Committee was formed, and a hazard identification was completed and submitted to the 74th session of the Maritime Safety Committee. A risk assessment is under way by the Formal Safety Assessment Working Group.

TC also agreed with recommendation M00-05 and indicated that TC Marine Safety inspectors ensure, during Port Warden and Port State Control inspections, that proposed loading plans and sequences are in accordance with the approved loading manuals. If an improper loading condition is proposed by the vessel, the Port Wardens will not allow the ship to be loaded in this fashion. The Port Wardens will require either a plan to be submitted in accordance with the approved loading manual or approval by the Flag State and classification society concerned before issuing a certificate of readiness to load.



Portable Honda dewatering pump showing dismantled aluminum casing and steel impeller parts severely corroded.

Not all Pumps are Equal

A failure to follow good seamanship practices, combined with inadequate pumping equipment, jeopardized the safety of a commercial fishing vessel. — Report No. M97M0005

The 51-gross-ton fishing vessel *Scotia Gold* departed Digby, Nova Scotia, on 22 January 1997 at 0930 Atlantic standard time, with a crew of three, bound for Fairhaven, Deer Island, New Brunswick. The vessel had taken on four tonnes of ice before departure.

At about 1500, while crossing the Bay of Fundy, the skipper noticed an excess of water in the engine room. The vessel's engine-driven bilge pump was running but could not pump the water out, and the vessel's portable gasoline-powered Honda de-watering pump would not start. The skipper called the Canadian Coast Guard (CCG) for assistance while the crew attempted to repair the portable pump. The pull-start cord was jammed, and the recoil mechanism had to be removed to free it. The gasoline motor eventually started and ran, but the pump itself did not work.

The CCG dispatched a helicopter from Yarmouth, N.S., and a rescue vessel from Grand Manan Island, N.B. The CCG helicopter arrived on the scene at 1640 and lowered a portable gasoline-powered Honda de-watering pump assembly to the *Scotia Gold*. When attempts were made to start this pump motor, the pull-start cord jammed in its housing. The recoil starting mechanism was removed, repaired, and replaced. The gasoline motor then started, but the unit failed to pump water. Despite the crew's efforts, the pump did not remove any water from the vessel.

The Canadian Coast Guard Cutter *Cumella* arrived at 1747 and escorted the *Scotia Gold* to Dipper Harbour, N.B. The *Cumella*'s Search and Rescue (SAR)-approved de-watering pump, made by another manufacturer, was then used on board the *Scotia Gold*; this unit started without difficulty, and the flood water was pumped from the vessel.

While the vessel was moored in Dipper Harbour, the following observations were made:

- The portable cover plates over the drain well in the fish hold were not set in place. Crushed ice, loaded in the fish hold before departure, had fallen into the drain well and blocked the bilge suction line.
- A seawater pump used for washing down was located in the engine room. The discharge piping from this pump extended to the weather deck at the after wheelhouse bulkhead where a hose was usually connected to the pipe. This hose was missing.
- Securing dogs to the deck hatches were functional, but the hatches were improperly secured, allowing water shipped on deck and water from the wash-down pump to drain into the fish hold and through to the engine room.
- The CCG helicopter-supplied pump unit had been packed into a container that was designed for a different pump assembly made by another manufacturer.

CCG-Supplied De-watering Pumps

The pump unit lowered to the *Scotia Gold* was similar to the ship's own portable Honda unit. When this second pump was dismantled, the interior was found to be in the initial stages of corrosion. The impeller parts were manufactured from steel, and the pump body of aluminum alloy. A warning in the Honda pump owner's manual cautioned: "to avoid pump corrosion, never pump sea water."

The CCG pump had been packaged for SAR using a drum container originally designed for a portable pump made by another manufacturer. The Honda pump originally would not fit into the aluminum drum container and had been adapted locally to fit. Fitting the adapted pump unit into the container forced the flanged suction pipe hard up against the inside of the container wall. A fracture in the pump's suction flange propagated from this contact point and caused the pump to fail.

The service history of the helicopter-supplied Honda pump was not recorded in the maintenance records received from the CCG; nor were there records of formal approval by a marine authority to use Honda de-watering pumps on board ships.

Besides the Honda pumps, the CCG uses a de-watering pump manufactured by Briggs & Stratton/Ohler (B&S/O). This unit is an earlier generation of portable de-watering pumps being phased out by the CCG in favour of the Honda unit. The B&S/O or latest /Scot series of pump assemblies have been approved by the United States Coast Guard (USCG) and Canada's Department of National Defence (DND). Their primary purpose is for SAR use as air-droppable assemblies or for ship-to-ship delivery to discharge fresh or salt water from vessels that are in danger of sinking.

Maintenance records were inadequate, incomplete, and in some cases nonexistent.

Maintenance of SAR De-watering Pumps

The CCG is responsible for the maintenance of its SAR de-watering pump assemblies. At the time of the occurrence, the CCG depots in the Maritimes region were required to service this emergency equipment, maintain records, and arrange to have the reconditioned pump assemblies reallocated to the various CCG stations, vessels, and helicopters as necessary. The CCG Rescue, Safety and Environmental Response (RSER) reported that all pumps were tested at the beginning of every work period after each crew change (that is, every one to three weeks maximum). RSER also reported that every region was satisfied with the Honda portable pumps and had attested to their reliability and durability.

During the investigation into this occurrence, two repair depots in the Maritimes were visited, and their pump placement and maintenance records were examined. The maintenance facilities were well equipped; however, maintenance records were inadequate, incomplete, and in some cases nonexistent. Some field-allocated pumps were long overdue

for return to their respective depots, and there was no follow-up program to ensure an effective rotation cycle. At the time of the occurrence, there was no standard, either within the individual CCG depots or among the various depots, for record-keeping procedures and inventory control.

According to information received from the two repair depots, SAR pumps were tested, sealed in drums, and either put on the shelf or allocated to SAR field units as required. If units were deployed in an emergency, it was the field supervisor's responsibility to return the pump assembly to the depot for servicing immediately after use. If they were not deployed, the field supervisor was to return the pump assemblies to the depot every 12 months. In practice, some of the pump units remained sealed in their respective drums for much longer periods. One of the CCG depots visited did not keep Honda pumps in its inventory as it was felt that the units, being prone to corrosion by sea water, were not suitable for marine use.

CCG Replacement of B&S/O Pumps

The RSER reported that the B&S/O portable pumps have been gradually replaced with Honda pumps because of their greater reliability, simpler operational and maintenance procedures, and the availability of spare parts.

The Honda equipment has been adopted without the formal approval procedures normally required.

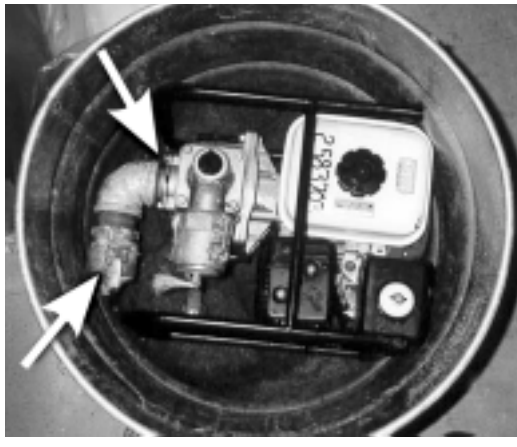
The Honda equipment has been adopted without the formal pre-acquisition/technical approval procedures normally required in the selection of such essential marine emergency equipment. The CCG decision to replace the B&S/O pump with the much less expensive Honda unit appears to have been initiated primarily as a cost-cutting measure.

Follow-up Action

Following the occurrence, the CCG initiated an internal investigation to determine why this particular pump model was used almost exclusively by the SAR units and why the pump delivered to the *Scotia Gold* malfunctioned. As a result, the CCG decided not to purchase any further Honda pumps for SAR duties. Further, the CCG has begun to standardize SAR pumps with equipment that is better suited to the marine environment.

The CCG issued a memorandum to its regions to remind every CCG ship, CCG base, and SAR station to follow the maintenance schedule recommended by the manufacturer in the operator's manual, to rinse pumps and equipment with fresh water after use in sea water, and to test pumps and equipment monthly on vessels and at CCG bases. The memorandum recommended that the Yarmouth-based CCG helicopter carry a drum container, adequately packed and capable of withstanding an air drop. It also recommended that CCG ships, CCG bases, and SAR stations be made aware of the danger of a pump malfunction that could result from strong impact and take appropriate measures regarding drum container packing.

SAR-approved assembly, as carried on CCGC *Cumella*. Unit is held centrally by circular base, with ample clearance around components.



CCG helicopter-delivered Honda unit, tightly fitted into the drum. 'A' indicates contact point of pump with drum. Location of suction flange fracture is shown at 'B'.

Transport Canada issued a Ship Safety Bulletin alerting vessel owners to the dangers of using inappropriate equipment and to the necessity of maintaining all equipment in good working condition.

Steering Gear Failure

On 10 May 1997, the 9407-gross-ton Greek-registered bulk carrier *Jeannie* was upbound in the St. Lawrence River for Montréal, Quebec. The vessel, under the conduct of a pilot, was abeam Lotbinière when the bridge watch realized that the rudder angle indicator was hard to port. They tried in vain to bring the vessel back on course by changing the steering gear mode from the steering position on the bridge. At approximately 2255 eastern daylight time, before the anchor could be let go or the main engine put astern, the *Jeannie* grounded on the south edge of the channel in the approaches to buoy Q83.
— Report No. M97L0035

After the grounding, the tanks were sounded, and water was found in the forepeak. The vessel's pumps were unable to reduce the level of water in the tank below the waterline forward. It was later revealed that the forepeak was holed and that the hull plates and internal structure in the forward section had sustained significant deformation. The repairs to the structure eventually required nearly 43 tons of steel. On May 11, at approximately 1010, the vessel refloated by itself on the rising tide.

The Board determined that the *Jeannie* ran aground because a steering gear hydraulic hose failed, and the crew of the vessel could not react in time to regain steering control before the two power units became inoperative.

Steering Gear

The steering gear on the *Jeannie* was of the articulated-cylinder type. It consisted of two units, each having two double-action cylinders. Each unit was fitted with a constant-speed pump. These pumps were mounted on a single hydraulic fluid reservoir. A multiple-valve collector isolated either of the units for maintenance or emergency manual operation. Inspection of the steering gear compartment revealed that a hydraulic system

The system would have drained completely even with the intervention of engine room staff.

hose was hardened and cracked and that it had separated from its coupling, causing the hydraulic fluid reservoir to empty.

Although there was direct access to the steering gear compartment from the engine room, the design of the system was such that the system would have drained completely even with the intervention of engine room staff. The two units were supplied by a single reservoir, and there was no storage tank permanently connected to the hydraulic system. Had each of the units been fitted with an independent reservoir, the steering gear would have remained in operation without any action by personnel. On some recently built vessels, the steering gear will remain in operation even when one of the units fails.

On the *Jeannie*, whenever the amount of hydraulic fluid in the reservoir dropped to a predetermined level, an alarm sounded in the engine control room. A crew member would have to go into the steering gear compartment, identify the problem, shut off four valves using a special wrench, and then open two other valves to isolate the unit in trouble. In this occurrence, the low-level alarm apparently sounded in the engine control room but went unheard. When the first person did arrive in the steering gear compartment, the hydraulic fluid reservoir was already empty, and nothing could be done to rectify the situation.

At least 15 steering gear failures had been directly attributed to failure of hydraulic system components.

Room for Concern

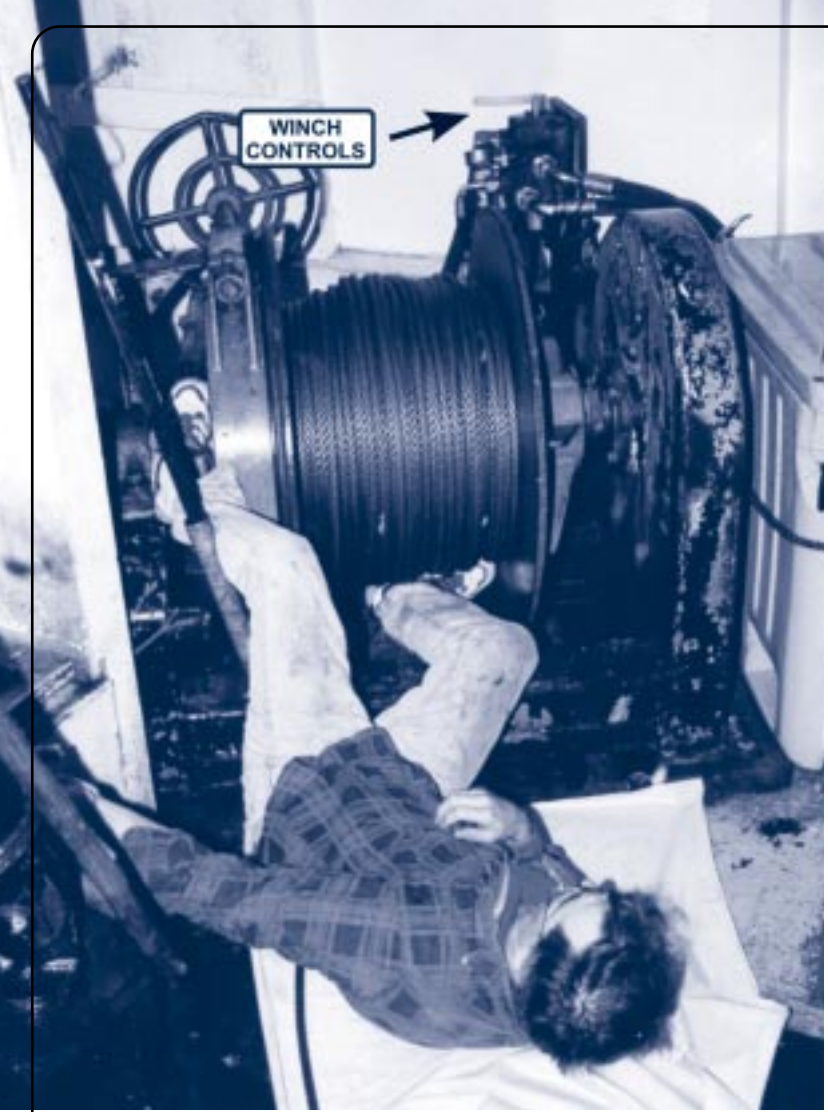
As a result of this occurrence, the TSB forwarded a Marine Safety Advisory to Transport Canada concerning the risk associated with a steering failure occurring within confined and high-traffic areas of Canadian waterways. TSB data indicate that between January 1975 and May 1997, steering failures resulted in over 120 groundings, bottom contacts, and strikings in Canadian waters. The TSB determined that at least 15 steering gear failures on ships navigating in confined waters in Canada had been directly attributed to failure of hydraulic system components, such as that experienced by the *Jeannie*. Among the affected vessels were three loaded petroleum tankers under 20 000 gross tons and one passenger ferry.

In its reply to the TSB Advisory, Transport Canada indicated that the current requirements for hydraulic systems were considered to be adequate and that the incident rate of failures did not warrant a review of the requirements. Subsequent to Transport Canada's reply, another five vessels grounded, between June 1997 and July 1998, in confined waters of the St. Lawrence River and Great Lakes area as a result of steering gear failures. The causes of the steering failures in these five incidents are varied. However, all the failures resulted in groundings due to the failure either being undetected by the crew or detected when there was insufficient time to take corrective action.

The vessels involved in the five above-mentioned incidents apparently met the current requirements for hydraulic steering systems; yet failures in these systems precipitated the groundings and had the potential for severe consequences. The Board believes that additional measures —such as changes in operating and watchkeeping procedures on ships entering or operating in confined waters—could facilitate the timely detection of, and response to, steering system failures. Such a timely response would allow affected vessels to be controlled, either by rectifying the malfunction or by activating a standby system before an accident or incident occurred. The Board is therefore concerned that the industry and the regulators are not pursuing additional means to reduce the number of marine occurrences that result from steering system failures in congested and confined waters.

REFLEXION

Between August 1998 and July 1999, there were at least another 14 marine occurrences involving steering gears, three of which involved failure of the hydraulic system.



Re-enactment of events leading to right foot becoming crushed between incoming wire rope and rotating winch barrel.

No Guard on Winch

On 08 October 1996, while on the fishing grounds off Yarmouth, Nova Scotia, the 41-gross-ton fishing vessel *S.S. Brothers* was hauling in the scallop rake in good weather conditions. Two deckhands were at work; one was positioned at the winch controls, and the other was guiding the incoming wire onto the winch barrel. No guard was fitted to the winch. — Report No. M96M0144

Once the hauling process had started, the deckhand at the winch controls left the controls unattended to begin the task of washing down the deck in preparation for the return to Yarmouth. When the other deckhand, who was engaged in guiding the incoming wire, saw the 25-fathom warning mark on the wire, he decided to climb over the after end of the winch to handle the controls, rather than go around the winch to access the controls or call out to his shipmate. He put his left foot on the aft barrel shaft bearing housing in the vicinity of the grease nipple. When his weight came on the housing, his left foot slipped, and he fell to the deck. His right foot was drawn

onto the winch drum and crushed by the wire.

The vessel had departed Yarmouth on 05 October 1996 at approximately 0040 Atlantic daylight time, with a crew of four. Throughout the trip, the crew worked a nine-hours-on, three-hours-off schedule. During the three hours crew members were off duty, they were expected to have their meals, attend to personal needs, and sleep. The accident occurred after three days of working this schedule.

Legislative Issues

The *Canada Shipping Act* and its regulations set safety standards relating to the structural and operational safety of all vessels, except for equipment and work spaces used in the "business of fishing". During its 15 years of operation, the *S.S. Brothers* had been issued a Transport Canada (TC) Ship Inspection Certificate. There is no written record that the federal authority ever inspected the vessel's scallop rake hauling winch or its operation, and it was not a requirement for certification.

Provincial authorities are responsible for the regulatory supervision of the "business of fishing", including the work deck space and equipment. However, there is no written record that the provincial authorities ever inspected the scallop rake hauling winch. Except for British Columbia and Ontario, provinces do not regularly inspect either work deck space or machinery used for the "business of fishing" but tend to react to accidents. Some provincial governments were implementing programs to train operators and crews in the safe use of fishing equipment; however, such programs were not yet in place when the report on the *S.S. Brothers* was issued.

Contributing Factors

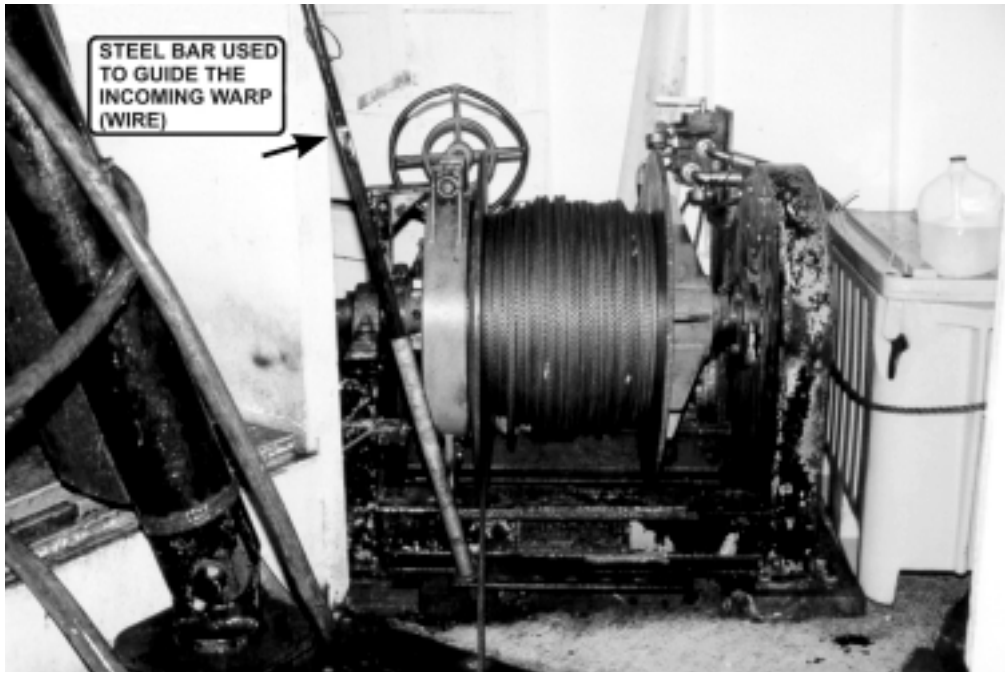
The Board determined that several factors contributed to the accident: the deck winch was uninspected and not fitted with a machinery guard; the deckhand was operating the winch alone; and the deck and the surfaces of the winch were slippery. It is also likely that fatigue caused by his work/rest schedule adversely affected the deckhand's ability to make a reasoned decision on the safe operation of the winch.

Remedial Action

After being informed of the TSB investigation, the Nova Scotia Department of Labour (NSDL) initiated its own industrial safety investigation. The NSDL ordered the owners of the *S.S. Brothers* to ensure "scallop drag cable winches were properly guarded to ensure that no one could get caught in the cable and/or winch." Subsequently, the owners installed a guard at the front of the winch. They also installed a cage over the cable at the winch. Similar guards have also been fitted on other vessels managed by the company.

In 1998, TC met with representatives of provincial ministries of labour to develop contacts and discuss the application of federal and provincial legislation to commercial fishing operations.

In May 2001, TC and the Workers' Compensation Board of British Columbia entered into a memorandum of understanding that clarified their respective roles and responsibilities concerning occupational safety and health in the fishing industry.



General view of winch on after-deck of *S.S. Brothers*.

The FRC *G.R. 1* aground.

Over a Rock and in a Hard Place

At approximately 0130 on 29 March 1997, in response to a search-and-rescue call, the Canadian Coast Guard (CCG) patrol vessel *Gordon Reid* launched the *G.R. 1*, a fast rescue craft (FRC), in Norman Morrison Bay, near Campbell Island, British Columbia. The chief mate and two deckhands were on board but were not wearing safety helmets. The night was dark and overcast, with rain and a strong southeasterly wind gusting up to 35 knots. The sea state was described as a heavy chop, and visibility was reduced in the rain. — Report No. M97W0048

Because of a previously noted anomaly with the radar, the mate decided to test the radar's heading marker before departing. He instructed the wheelsman to take the FRC approximately one cable (0.1 nautical mile) away, turn around, and steady the boat's head onto the *Gordon Reid*, which would still be in visual range. At the same time, the mate compared the radar picture with the visual sighting. No heading marker error was found.

Satisfied with the result, the mate told the wheelsman to turn the boat away from the *Gordon Reid*. The wheelsman turned the boat to starboard and increased the speed.

The mate was familiar with the area and had a chart on board. He knew that, to depart from the bay, he would first have to proceed in a northerly direction, then pass between Kintail Point on Campbell Island and Hose

As the echo at the land widened and remained dead ahead, the mate ordered a further course alteration of 20º to starboard.

Point on Horsfall Island, leaving the latter on the port side. The radar, set to operate on low ranges, between 0.25 and 0.5 mile, was the only aid used to navigate the boat.

A few seconds later, the mate noticed the echo of a land mass appear dead ahead near the edge of the screen. Assuming that it was a point of land on Horsfall Island, he ordered the wheelsman to steer more to starboard. As the echo of the land widened and remained dead ahead and the distance decreased, the mate ordered a further course alteration of 20° to starboard. The wheelsman observed that the compass heading was approximately 050° and was about to inform the mate when the boat, travelling at approximately 30 knots, struck a hard object. The boat flew through the air, ejecting all three occupants from their seats, and landed on a rock.

The occupants were thrown over the rock and landed in the water on the other side. They all managed to swim or crawl toward the grounded FRC and then, helping each other, climbed into it. The two deckhands were injured, one seriously. The boat was declared a constructive total loss.

The FRC had never left the bay.

Navigational Error

The FRC had never left the bay. After the heading marker test was completed, the boat made a turn to starboard and advanced eastward into the bay. The mate indicated that when he gave the order to the wheelsman to steer away from the *Gordon Reid*, he used the radar picture and his mental depiction of the area but did not refer to the compass, which was not readily visible from his seat. He interpreted the land that appeared ahead on the radar screen as Horsfall Island, which was to be passed on the port side. Consequently, he ordered the boat turned to starboard.

Radar Operation

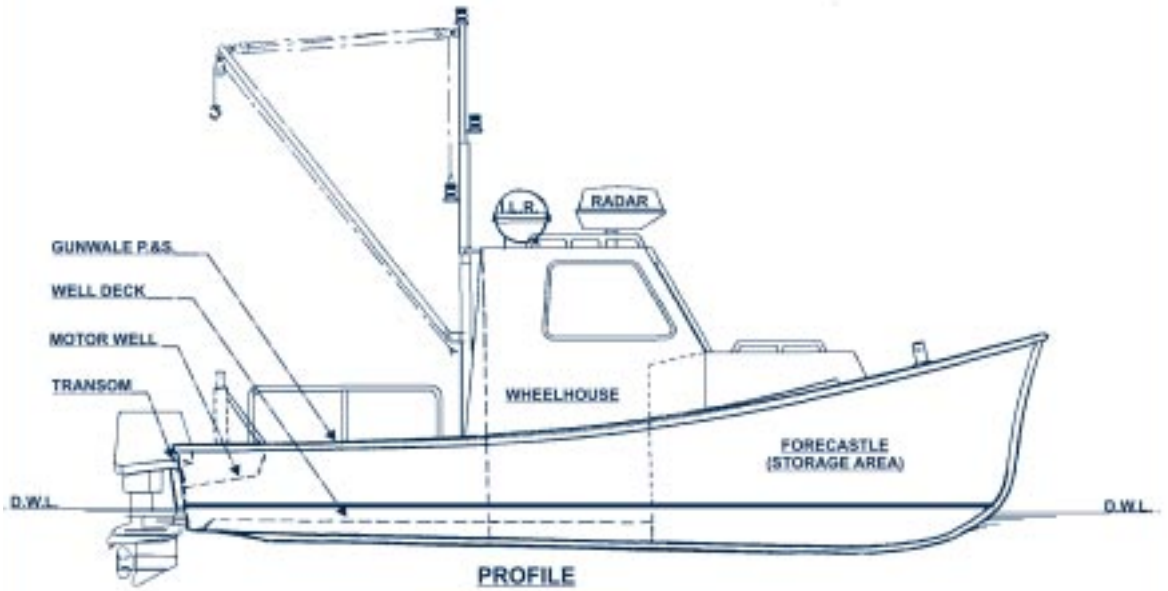
The radar on the *G.R. 1* could operate only in the "head-up" mode, meaning that the motionless heading marker could not yield any information about the boat's course with reference to North. The radar had a 24-mile range with various range scales. The lower-range radar scales did not allow the mate to compare the screen image with the chart's depiction of the area.

The echo of the nearest land on the edge of the radar screen indicated to the mate that he was heading directly toward it. Had he switched the radar to a longer range, he would have seen that the land ahead was actually Campbell Island, to be passed on the starboard side.

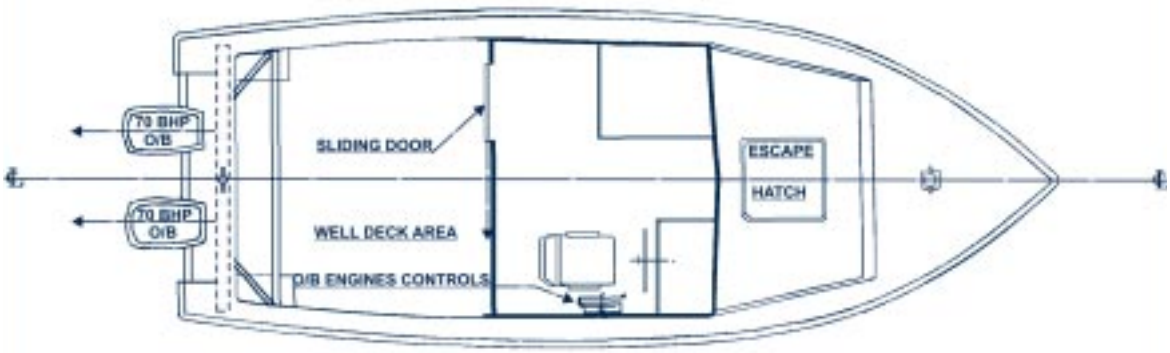
Remedial Action

The CCG, Pacific Region, reviewed this occurrence and introduced several preventive measures through the development of a Fleet Safety Management System. Crews of CCG patrol ships using similar FRCs were instructed to use the mandatory safety equipment and to apply the principles of bridge resource management. These principles include predeployment briefings, communication between the FRC crew, and cross-checking of intentions.

Regional fleet circulars were introduced to amplify FRC standard operating procedures and restrictions regarding weather conditions and crew experience. Ships' masters were instructed to include specific or local operating instructions in their standing orders.



PROFILE



PLAN VIEW

Shipped Water

The *Marsouin* is a small fisheries research vessel, less than five gross tons, employed in marine biology research projects conducted by scientists at the Institut Maurice-Lamontagne. The vessel is of glass-reinforced plastic construction, and a watertight well deck extends from the after end of the wheelhouse to the stern, beneath which permanent foamed-in-place buoyancy is fitted. — Report No. M97L0050

On 09 June 1997, the *Marsouin* was tied up starboard side to a pontoon inside the marina at Rivière-du-Loup, Quebec, while a mechanic repaired the port-side outboard motor. Some wave crests occasionally shipped over the transom and were pumped overboard by the intermittent use of an electrically powered bilge pump at the after end of the well deck. The pontoon was aligned with the marina entrance, and the stern of the vessel was exposed to the prevailing winds and waves.

Once the motor was repaired, the vessel headed toward the entrance of the marina to test the engines under way. While proceeding to the more exposed marina entrance, it encountered short, steep, one-metre-high waves, and some spray shipped over the gunwales. The pump activated automatically as the vessel was turned to resume its

The vessel was manoeuvred astern into following seas that were three times the height of the effective transom freeboard.

former berth. During the return, it was decided to berth port-side-to on the more sheltered side of the pontoon, and during the subsequent manoeuvres, the motors were put into reverse.

As the vessel gathered stern way, the transom became buried in a following sea causing both motors to stall and water to ship over the transom. Several attempts to restart the motors from the conning position in the wheelhouse were unsuccessful. As the vessel trimmed by the stern, two more waves soon swamped the well deck. At about 1115, the vessel capsized to starboard.

The *Marsouin* capsized so rapidly that it remained afloat in the inverted position, supported by air trapped in the forecastle and the wheelhouse and by the built-in buoyancy under the well deck. The mechanic and the deckhand, who were on the well deck at the time of the capsizing, were immersed but soon surfaced and held onto the inverted hull. However, the operator, impeded by loosely stowed items floating out of the forecastle, experienced some difficulty exiting the enclosed wheelhouse.

The capsizing was witnessed from the shore, and a small boat was launched quickly from a tour boat berthed nearby. Within five minutes, all three people were retrieved from the water and returned to shore without any apparent signs of injury.

The *Marsouin*, its gear, and its research equipment were subsequently recovered.

The investigation found that the owners did not provide the operator with standing orders or formal instructions regarding the loading, freeboard, trim, or weather-related operational limitations of the vessel. There was no formal monitoring system or assessment by a suitably qualified person of the loading, operational limitations, trim, and stability of this small vessel, which was operated by uncertified personnel engaged in marine biology research projects. The cumulative effect of additional navigation equipment, deck and rigging fittings, extra fuel tanks, biology research equipment, and spare gear reduced the as-designed freeboard and made the vessel more vulnerable to shipping seas over the gunwale and transom.

The well deck swamped when the vessel was manoeuvred astern into following seas that were three times the height of the effective transom freeboard. Intact transverse stability was satisfactory on departure; however, the vessel capsized when stability was lost because of the weight and free-surface effects of water shipped and retained on the well deck.

Despite the relatively rough weather conditions observed before departure, no one on board wore a personal flotation device, and because the lifebuoy and the inflatable liferaft were secured to the wheelhouse top, they could not float free after the capsizing.

Remedial Action

The Department of Fisheries and Oceans implemented a series of actions to improve safety for users of small vessels and to correct the observed deficiencies, including the following:

- implementation of a more severe monitoring system for users of small vessels, including the presence of a coxswain in certain areas of operation;
- development of an academic and hands-on training program for users of small vessels, in collaboration with the Institut maritime du Québec in Rimouski;
- establishment of a subcommittee on occupational safety and health for small vessels to receive complaints and comments; and
- implementation of an awareness and information program for users of small vessels.

Opening Day Upset

At approximately 0620 Newfoundland daylight time on 15 May 1997, an 8.5-m long, unnamed, small fishing vessel left the dock in Brig Bay, Newfoundland, for fishing grounds about two miles off the coast. — Report No. M97N0067

On board were the operator and a crew member. The vessel was carrying 72 lobster traps, which were stacked four- and five-high, overhanging the port and starboard gunwales of the vessel. May 15 was the first day of the 1997 lobster fishing season for the area of Brig Bay, and a good catch was expected. The two men planned to make every effort to place all of the traps in the water on the first day of the season. The first load of traps had been loaded on the vessel early that morning.

Weather at the time of departure was patchy fog, with wind from the northwest between 20 and 25 knots. The vessel was heavily laden, with little freeboard on leaving the dock. As the vessel left the relatively sheltered waters of Brig Bay and moved into the open sea, the vessel encountered a 2- to 3-m swell. The crew member soon noticed that the bow seemed to be deeper in the water and told the operator. The operator immediately throttled back the vessel's outboard engine to the idle position, but the bow submerged and the vessel swamped. The position of the vessel at this time was about two cables (0.2 nautical mile) west of Entrance Island, off the entrance to Brig Bay.

The vessel was heavily laden, with little freeboard on leaving the dock.

The operator held on to one of the portable five-gallon (22.7 L) fuel tanks and drifted away from the vessel. The crew member floated clear as the vessel slowly capsized. He was able to get on top of the overturned hull by using the keel as a handgrip and was rescued by a passing fisher. There was no sign of the operator at this time.

An extensive air and sea search for the operator was conducted using two helicopters, the Canadian Coast Guard auxiliary vessel *Morris Elaine,* and some 15 to 20 local vessels. The operator's body was recovered by Royal Canadian Mounted Police divers the following day. He was found entangled in fishing gear in approximately 60 feet (18.3 m) of water. An autopsy determined that death was caused by drowning. The vessel was recovered with no apparent damage.

Forward Visibility

The height of the stow of traps, together with the overhang of approximately 30 cm at each side, made it impossible for the men, who were situated aft, to view the forward end of the vessel directly. They first realized that the vessel had begun to ship water forward when they noted an apparent increase in the forward draught.

Stability

Two drain holes in the forward thwartship bulkhead allowed water shipped in the forward section to drain aft to the bilge pump. These holes were approximately 3.5 cm in diameter and drilled in the bulkhead in the vicinity of the bilges.

The lobster traps each weighed approximately 17.7 kg. The total weight of the load, including traps, lines, and buoys, was estimated at 1400 kg. With the vessel so heavily laden, there was little freeboard remaining on leaving the dock. The crew had no formal training in vessel stability.

The investigation found that the heavy load of traps reduced the freeboard, causing the small open vessel to ship water forward when outside the relatively protected waters of Brig Bay. The transverse stability of the vessel was further compromised by shipped water not being quickly removed from the vessel. The water retained in the forward section led to the swamping and capsizing of the vessel. The men were initially unaware that water was being shipped over the bow because the load of traps restricted their view forward. The operator's decision to undertake the trip in the deeply laden vessel in unfavourable weather conditions was likely influenced, in part, by economic considerations. No life jackets or personal flotation devices were on the vessel at the time of the occurrence.

The crew had no formal training in vessel stability.

REFLEXION

In planning your bottom line, are you giving SAFETY its fair share?

Marine Occurrence Statistics

		2001 (Jan.–Nov.)	2000	1999	1995–1999 Average
Accidents		**486**	**525**	**602**	**632**
	Accidents aboard ship	**59**	**76**	**69**	**60**
	Shipping accidents	**427**	**449**	**533**	**571**
	Collision	12	16	23	19
	Capsizing	7	15	6	17
	Foundering/Sinking	34	38	32	39
	Fire/Explosion	78	64	70	78
	Grounding	106	124	146	140
	Striking	84	68	82	96
	Ice damage	4	6	10	16
	Propeller/Rudder/Structural damage	18	32	40	41
	Flooding	66	50	65	68
	Other	18	36	59	57
Incidents		**234**	**243**	**179**	**166**
	Close-quarters situation	60	57	35	42
	Engine/Rudder/Propeller	95	101	74	63
	Cargo trouble	3	5	1	7
	Personal incidents	8	7	5	5
	Other	68	73	64	49
Vessels Involved in Shipping Accidents		**466**	**489**	**578**	**623**
Type	Cargo	29	24	25	26
	Bulk carrier / OBO	52	59	72	83
	Tanker	13	14	14	17
	Tug	33	33	42	44
	Barge	19	30	35	37
	Ferry	22	24	22	22
	Passenger	16	20	19	20
	Fishing	232	239	280	313
	Service vessel	26	23	35	30
	Non-commercial	16	13	14	18
	Other	8	10	20	13

		2001 (Jan.–Nov.)	2000	1999	1995–1999 Average
Flag	Canadian (Non-fishing)	175	174	219	222
	Canadian (Fishing)	219	228	273	301
	Foreign	72	87	86	100
Vessels Lost		**37**	**28**	**45**	**59**
	1600 grt and over	0	0	1	1
	150 to 1599 grt	2	1	3	3
	60 to 149 grt	6	0	5	6
	15 to 59 grt	12	11	7	17
	Less than 15 grt	12	12	21	22
	Unknown tonnage	5	4	8	11
Fatalities		**30**	**31**	**29**	**33**
	Accidents aboard ship	13	15	15	12
	Shipping accidents	17	16	14	21
Injuries		**59**	**87**	**80**	**79**
	Accidents aboard ship	8	70	61	55
	Shipping accidents	51	17	19	25

Figures are preliminary as of 12 December 2001.

All five-year averages have been rounded. Totals sometimes do not coincide to the sum of averages.

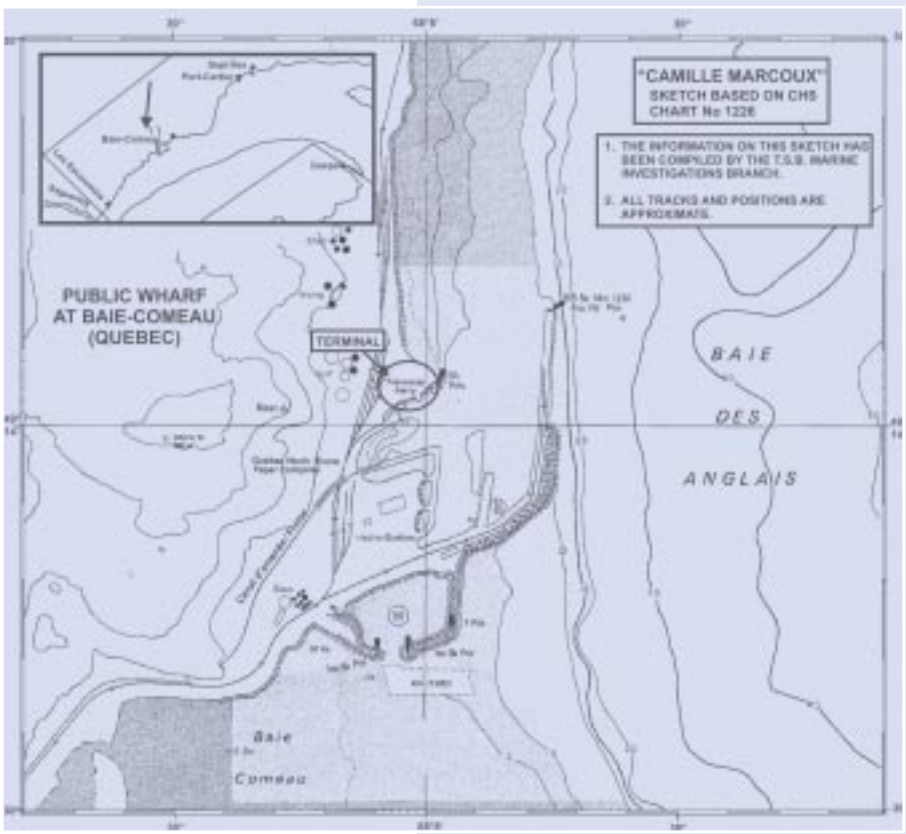
MARINE Occurrence *Summaries*

The following summaries highlight pertinent safety information from TSB reports on these investigations.

FERRY BOARDING FATALITY

On 09 July 1996, the 6122-gross-ton ferry Camille Marcoux *was docked at the ferry wharf at Baie-Comeau, Quebec. Passengers and vehicles used the same loading ramp to proceed to the parking deck. — Report No. M96L0069*

During the final stages of loading vehicles on the parking deck, a tow truck towing a cement mixer moved onto the apron leading to the parking deck. After parking the cement mixer, the tow truck, guided in the confined space by only one signaller (positioned in front), backed up toward the wharf. The crew did not require the tow truck to turn around on the parking deck before proceeding to the loading ramp. Repeated warnings by the loading ramp attendant and others near the ramp failed to attract the attention of a passenger walking on the loading ramp toward the exit. The man, who had been walking with his back to the tow truck, was struck and transported to the local hospital, where he was pronounced dead on arrival.



The Board determined that the victim was struck because access was not closed to vehicles while passengers were walking on the loading ramp, and no signaller was positioned at the rear of the tow truck to guide it while backing up. Contributing to this

occurrence was the lack of an automatic backing-up alarm on the tow truck. Since 1988, coroners in Quebec had made recommendations to the organizations concerned to take action to prevent this type of accident, but nothing had been done as of this occurrence. Despite the many recommendations to the Société de l'assurance automobile du Québec that backing-up alarms should be made mandatory on heavy trucks, the *Quebec Highway Safety Code* contained no provisions to that effect.

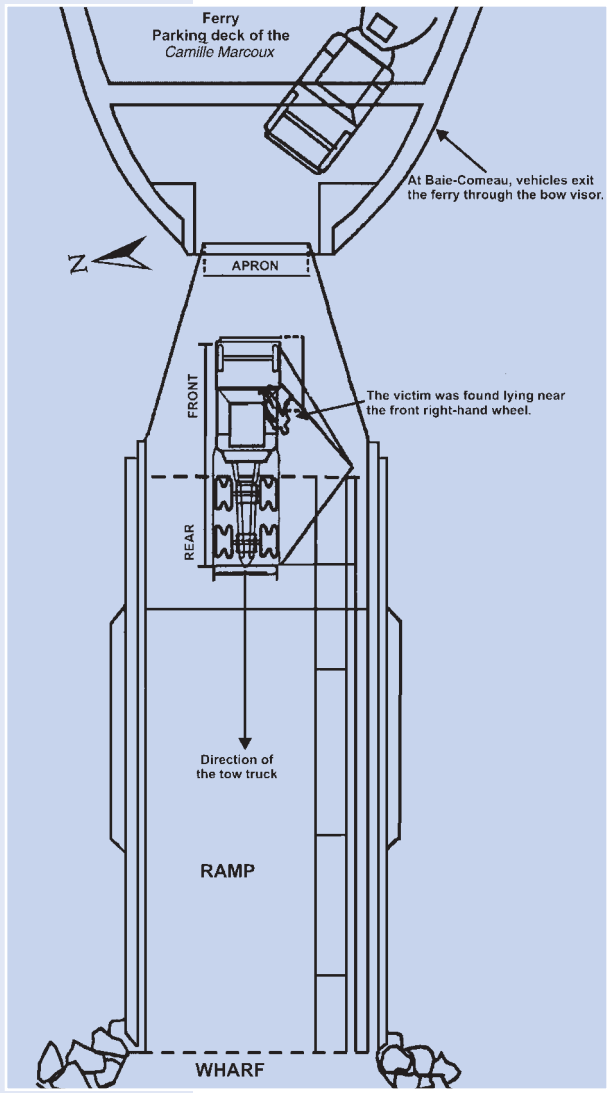
Local Action

In 1997, the Société des traversiers du Québec made improvements to the passenger embarkation facilities at the Matane and Baie-Comeau terminals. Improvements included a covered walkway and a completely separate boarding ramp for safer boarding of pedestrians. Following this occurrence, the owner of the tow truck installed a backing-up alarm on the vehicle.

COLREGS DISREGARDED

At approximately 1200 eastern daylight time on 09 September 1997, in clear weather, the 129-gross-ton fishing vessel Navegante *and the 121-gross-ton fishing vessel* Teresa Maria *were near S.E. Shoal in Lake Erie, bound for Wheatley, Ontario. — Report No. M97C0057*

Both vessels were on converging courses. The *Navegante* was steering 010° (T) at 11 knots, and the *Teresa Maria* was steering 000° (T) at 10 knots. Both vessels were on automatic steering and were crossing the main shipping channel near S.E. Shoal. No other shipping traffic was in the area at the time. Visibility was several miles, and each vessel was visible to the other. The relative bearing between the vessels remained almost constant, and as the distance between the vessels decreased, neither vessel altered course or reduced speed. At 1230, when the vessels were an estimated 15 to 25 m apart and nearly abeam of each other, the *Navegante* suddenly veered to starboard. About three to five seconds later, the bow struck the port side of the *Teresa Maria*, amidships, at an estimated angle of 45°. After the collision, the two vessels were briefly locked together and stopped in the water. One person on the *Teresa Maria* suffered a minor injury. Both vessels were lightly damaged.



Sketch reproduced from the original drawn by the Sécurité publique, Baie-Comeau.

The Operators

The operator of the *Teresa Maria* was uncertificated and was acting as master while the regular master was on vacation. He had been doing this for several weeks each year for the last 10 years. He had been working in the Lake Erie fishing trade for approximately 15 years and had a good command of the English language.

The operator of the *Navegante* was new to the vessel, having been transferred to the *Navegante* from another vessel of the same company. After initial training given over two weeks, this was his first time navigating the vessel alone without the assistance of the master, whom he had relieved for lunch. He had been engaged in the Lake Erie fishery for about 11 years. During the investigation, he maintained that he did not speak English or French and required a Portuguese translator when interviewed. However, in 1988 he was issued a Canadian Fishing Master Class IV Certificate. Two of the prerequisites for obtaining this certificate were a fundamental understanding of the *International Regulations for Preventing Collisions at Sea* (Colregs, Rules of the Road) and a Radio-telephone Operator's Restricted (Maritime) Certificate (RORC). A candidate for an RORC is required to demonstrate a working knowledge of either English or French.

The investigation determined that the vessels collided because the hydrodynamic interaction between them caused the *Navegante* to sheer to starboard and collide with the *Teresa Maria* when both were proceeding on near-parallel courses, at speed, and in close proximity to each other. The *Navegante*, being the overtaking and give-way vessel, did not give way, and the *Teresa Maria*, when it became apparent that the development of a close-quarters situation could not be avoided, did not take action to avoid collision. The vessels did not change steering mode from automatic to manual—to reduce rudder response time—until after they had collided. A lack of inter-ship communication and the operators' level of training and knowledge of the Rules of the Road also contributed to the accident. Although both operators claimed a good understanding of the Colregs, neither implemented the appropriate course of action specified in "Part B—Steering and Sailing Rules".

REFLEXION

On a clear summer's day, with visibility of several miles, two vessels collide in open waters—unbelievable!

COLREGS—AGAIN!!

On 23 June 1997, at about 2215 eastern daylight time, the 48-gross-ton fishing vessel Frédéric C *was returning to Grande-Rivière, Quebec, from the fishing grounds. A fisherman's helper had just taken over the watch. The vessel was on autopilot. — Report No. M97L0053*

A short time later, he noticed two targets to starboard on the radar screen, but they did not appear to interfere with the course of his vessel. Then, a third target appeared on the radar screen at a distance of about three nautical miles to port; however, he did not consider it necessary to place the radar's cursor on the target. He glanced from time to time at the radar screen to observe the progress of the targets but did not follow them closely. He made most of his observations visually rather than by radar and could now make out the green sidelight of the third target. He continued his observations, alternating between the target to port and the two targets to starboard. When he went to glance again at the target to port, he had difficulty locating it visually. Suddenly, he saw reflections of lights followed by the

bow of the other vessel striking the port side of the *Frédéric C*. Part of the space containing the latrines and the exhaust piping was dislodged by the impact of the collision.

The other vessel, the 61-gross-ton fishing vessel *Nicole Claude*, had departed Newport at 2030 for the fishing grounds east of Bradelle Bank. At about 2230, the fisherman's helper who was on watch noticed the red sidelight of a vessel to starboard, which he estimated to be a mile away and which appeared to be keeping a constant course and speed. After a few moments, he decided to make a first course alteration of five degrees to starboard using the autopilot control. He then made a second course alteration of ten degrees to starboard. To attract attention and to prompt the other vessel to take action, he switched on the working lights on the main deck. Despite the alterations of course to avoid collision, the *Nicole Claude* struck the *Frédéric C* at about 2250. The combined speed of both vessels at the time of the collision was estimated to have been about 19 knots.

Under the force of the impact, part of the port bow was torn away.

Under the force of the impact, part of the port bow of the *Nicole Claude* was torn away, leaving a gaping hole in the crew's quarters. Flooding occurred so quickly that the crew had barely enough time to escape from the damaged section. The vessel eventually sank, and the crew were taken to Grande-Rivière by the *Frédéric C*.

Some Things That Went Wrong

Instead of making large alterations of course, which would be readily apparent to another vessel observing visually or by radar, the *Nicole Claude* made a succession of small course alterations that were insufficient to be noticed and too late to be effective. The *Frédéric C* kept its course and speed while a dangerous situation was developing ahead. Both vessels were on automatic steering as they approached each other instead of being steered manually so as to execute promptly any required changes of heading. Despite the availability of communications equipment on both vessels, neither sought to communicate their respective intentions to avoid collision.

Training

The fisherman's helpers on watch at the time of the collision had never received any formal training in the use of charts or in safe navigation. They did not hold certificates of competency, nor were they required to by current regulations. Professional fishermen who do not have training in safe navigation are nevertheless faced with this responsibility when they are in charge of the watch on the bridge. A lack of training in the use of radar and the interpretation of targets and a lack of knowledge of the *Collision Regulations* contributed to the collision.

Professional fishermen who do not have training in safe navigation are nevertheless faced with this responsibility.

Ongoing Actions

Transport Canada (TC) has modified the *Crewing Regulations* to require a certificated master or mate on board vessels greater than 60 gross registered tons. However, the amended regulations do not apply to vessels the size of the *Frédéric C.*

Since the occurrence, the government of Quebec has passed a law and implemented regulations to ensure that every fisherman and fisherman's helper receives the appropriate training and apprenticeship at sea, leading to a professional status in fishing. The status is validated by a certificate. Furthermore, a book to contain information on the holder's continuous proficiency will also be issued and will be mandatory to practice commercial fishing in Quebec.

At present, Newfoundland fish harvesters are issued a certificate of designation under the *Professional Fish Harvesters Act* on a voluntary basis. Existing fish harvesters were classified to the appropriate level in 1997 based on their dependence on the industry for income. In addition, TC Marine Safety has recently negotiated an agreement with the industry for a commitment to further reduce the vessel tonnage required for the carriage of a certificated master on fishing vessels.

ALONE ON THE BRIDGE IN FOG

On 08 September 1997, at 0550 Pacific daylight time, the second mate of the 9518-gross-ton log carrier Haida Monarch *relieved the chief mate and took over as officer of the watch (OOW). The vessel was abeam of Dupont Island in Caamaño Sound, British Columbia.*
— Report No. M97W0186

While passing through the sound, the vessel encountered several fog patches. The OOW notified the engine room to have the engines on standby, posted a lookout, and began sounding the appropriate fog signals. At 0625, the vessel encountered another fog patch, and the visibility decreased sharply. At 0630, the vessel passed Ulric Point and entered Laredo Channel where the visibility improved. The OOW regularly checked and plotted the vessel's position using radar bearings and distances. At 0710, a fix of Shotbolt Point was plotted and recorded in the logbook as the vessel entered a fog bank; the visibility was reduced to one cable (0.1 nautical mile) or less.

A 10° course alteration to starboard was planned off Ramsbotham Island, approximately four nautical miles from the 0710 position along the plotted course line of 137°. In preparation for the course alteration, the OOW was parallel-indexing off Shotbolt Point and checking the vessel's progress on the radar.

At 0720, the OOW took a radar bearing and distance abaft the starboard beam. Assuming that this was Ramsbotham Island, he plotted and marked it "0720". Because the fix fell on the intended course alteration position, he ordered the new course of 146° to be steered. At about 0730, both the helmsman and the OOW noticed an

unidentified object that looked like a rock with a breaking wave dead ahead. The OOW immediately reversed the engines, but this failed to prevent the vessel from grounding. At 0735, the OOW stopped the engines and entered "Vessel Aground" in the logbook. The *Haida Monarch* sustained extensive bottom damage forward.

Grounding

The OOW acknowledged that he had mistaken Louis Island for Ramsbotham Island and had plotted an incorrect position of the vessel at 0720. Consequently, the course alteration ordered, based on the incorrect assumption, was made too early and resulted in the grounding.

Bridge Resource Management

The Master's Standing Orders included the following requirement: "2. Periods of Restricted Visibility the Regulation Sound Signals shall be used. Have engines on S/B, post look-out & call me if necessary." This and one other order were conditional; the other orders were absolute, ex. "5. ...fire... call me immediately" or "18. If any doubt whatsoever, call me."

The OOW followed these orders faithfully, except for calling the master. The OOW believed from experience that the master would not come to the wheelhouse because the master did not consider restricted visibility as a sufficient reason for him to be called. The working relationship between the OOW and the master was ineffective and was not based on bridge resource management principles. The breakdown in communications resulted in the OOW not calling the master during a difficult period of navigation.

EXPLOSIVE VAPOURS

The seven-gross-ton fishing vessel Sha 122 *was moored, second from the dock, in a row of four vessels at the floating dock on the east side of the jetty at the Comox, British Columbia, Small Craft Harbour. —Report No. M97W0044*

On the afternoon of 23 March 1997, the operator returned to the vessel after an absence of 48 hours, during which the vessel was unattended. Intending to sail to Prince Rupert, he boarded the vessel and opened the gasoline tank valves. He then went forward to start the engines. The operator had run the vessel this way since his appointment two months earlier and noticed nothing unusual that afternoon.

Though required by the *Small Fishing Vessel Inspection Regulations*, a forced ventilation system was not installed in the vessel's engine compartment and the void space where the fuel tanks were located. Consequently, any build-up of gasoline vapours could not be vented before starting the engines. Also, the forward bulkhead of the engine compartment was neither watertight nor gastight, and a gasoline leak, in either space, could affect both spaces. The owners were

The owners relied on the fact that the vessel had been operating in this way before their purchase of it.

unaware of the regulatory requirement and relied on the fact that the vessel had been operating in this way before their purchase of it.

When the operator started the port engine, an explosion occurred, followed by a large gasoline-fuelled fire. The force of the explosion ejected the operator from the *Sha 122*, and he landed on the deck of another vessel. A piece of canvas that wrapped around him before he was ejected saved him from being burned; however, he suffered a shrapnel wound to his knee. The *Sha 122* was extensively damaged and was declared a constructive total loss.

Crew members from other vessels at the dock moved their boats away from the burning vessel and freed it from the berth. A Department of Fisheries and Oceans patrol vessel and the Comox Fire Department participated in fighting the fire.

The foremost concern was to keep the fiercely burning *Sha 122* away from the wooden wharf fitted with jet fuel lines, running from the shore to the Department of National Defence (DND) fuel wharf. The southeasterly wind tried to push the vessel downwind onto the wharf, which had no boom or restraining chain to protect it from vessels either drifting or driven down onto it from the southeast. The exposed jet fuel lines on the east side of the wharf were also in danger of being fractured or gashed by vessels at high tide. Two free-standing piles east of the wooden wharf could be used to hold a floating boom or chains.

The investigation determined that the fire was most likely caused by gasoline fuel in the void space or engine compartment that ignited when the port engine starter was engaged. The lack of forced ventilation in the void spaces and the engine compartment prevented the operator from properly purging any gasoline vapours from the spaces before starting the engines.

Remedial Action

The harbour master of the Comox Small Craft Harbour requested that a floating boom be installed to prevent any vessel from contacting the wooden wharf. This request was acted upon, and a floating boom now protects the jet fuel lines on the DND wharf.

REFLEXION

When purchasing vessels, and especially where safety is concerned, this accident brings to mind the adage "forewarned is forearmed".

Investigations

The following is *preliminary* information on all the occurrences under investigation by the TSB that were reported between 01 January 2000 and 30 September 2001. Final determination of events is subject to the TSB's full investigation of these occurrences.

DATE	LOCATION	VESSEL (S)	TYPE	GRT	EVENT	OCCURRENCE NO.
JANUARY 2000 15	N. arm of Fraser River, B.C.	*T.L. Sharpe* *Sea Cap XII*	Barge Tug	356 52	Striking	M00W0005
MARCH 13	Port Alberni, B.C.	*C-Joy*	Fishing	15	Accident on board	M00W0059
18	Off St. Anthony, Nfld.	*BCM Atlantic*	Fishing	878	Striking and sinking	M00N0009
28	Seaforth Channel, B.C.	*Lori Cathlynn*	Fishing	37	Capsizing	M00W0044
APRIL 11	Off Godbout, Que.	*Millenium Yama*	Bulk carrier	14 038	Main engine failure	M00L0034
27	Sorel, Que.	*Tecam Sea* *Federal Fuji*	Bulk carrier Bulk carrier	17 056 17 814	Striking	M00L0039
MAY 12	Ottawa River, Hull, Que.	*Miss Gatineau*	Passenger	52	Fall overboard	M00L0043
18	Lake Saint Francis, Que.	*Sunny Blossom*	Tanker	11 598	Grounding	M00C0019
JUNE 01	Bruce Mines, Ont.	*Algowood*	Bulk carrier	22 558	Structural failure	M00C0026
16	Georgian Bay, Ont.	*True North II*	Passenger	6	Sinking	M00C0033

DATE	LOCATION	VESSEL (S)	TYPE	GRT	EVENT	OCCURRENCE NO.
AUGUST 10	Amherstburg Channel, Ont.	*Algoeast*	Tanker	8 545	Bottom contact	M00C0053
14	Country Harbour, N.S.	*Mersey Venture*	Fishing	2 337	Accident on board	M00M0083
25	W. shore of Hudson Bay	*Avataq*	Fishing	29	Foundering	M00H0008
SEPTEMBER 06	Fraser River, B.C	*Star Queen*	Fishing	n/a	Accident on board	M00W0230
14	Swartz Bay, B.C	*Star Ruby* *Spirit of Vancouver Island*	Yacht Ferry	16 18 747	Collision	M00W0220
25	Lake Erie, Ont.	*Griffon* *Atlantic Huron*	Buoy tender/ resupply Cargo	2 212 23 355	Striking	M00C0069
OCTOBER 01	Off Yarmouth, N.S.	*Flying Swan VI*	Fishing	63	Capsizing	M00M0104
02	Liverpool, N.S.	*Keta V*	Tug	236	Grouding and sinking	M00M0106
08	Off Twillingate, Nfld.	no name	Fishing	n/a	Foundering	M00N0089
18	Off Cap Martin, Que.	*Fossnes*	Bulk Carrier	11 542	Grounding	M00L0114
26	Vancouver, B.C.	*Pacmonarch*	Bulk Carrier	38 878	Accident on board	M00W0265
31	Off Nain, Labrador	*Mokami*	Tanker	3 015	Grounding	M00N0098

DATE	LOCATION	VESSEL (S)	TYPE	GRT	EVENT	OCCURRENCE NO.
DECEMBER 18	Port of Saint John, N.B.	*Severn* *Irving Primrose*	Tanker Tanker	18 023 163 720	Contact	M00M0136
18	Port Coquitlam, B.C.	*Miller 201*	Barge	849	Striking	M00W0303
JANUARY 2001 09	Vancouver, B.C.	*Alligator Victory*	Container	42 809	Accident on board	M01W0006
FEBRUARY 03	Off Halifax N.S.	*Thebaud Sea*	Offshore supply	2 594	Fire	M01M0005
MARCH 22	Off Chebucto Head, N.S.	*Kitano*	Container	50 618	Fire	M01M0017
APRIL 01	Hamilton Harbour, Ont.	*Utviken* *Hamilton Energy* *Provmar Terminal*	Bulk carrier Tanker Tanker	17 460 982 4 947	Striking	M01C0008
18	Off Belle Isle , Nfld.	*Fame*	Fishing	1 025	Abandonment and sinking	M01N0020
MAY 14	Off Goderich, Ont.	*Canadian Transfer*	Bulk carrier	16 353	Bottom contact	M01C0019
JUNE 13	Wascana Lake, Sask.	*Wascana II*	Ferry	n/a	Taking water	M01W0116
15	Lake Winnipeg, Man.	*Shannon Dawn* *Rachel M*	Fishing Fishing	n/a n/a	Swamping	M01C0029

DATE	LOCATION	VESSEL (S)	TYPE	GRT	EVENT	OCCURRENCE NO.
JUNE 30	Ottawa River, Ottawa, Ont.	*Lady Duck*	Amphibious	n/a	Taking on water and sinking	M01C0033
JULY 29	Contrecoeur, Que.	*Cast Privilege*	Container	26 383	Grounding	M01L0080
AUGUST 11	Welland Canal, Ont.	*Windoc*	Bulk carrier	18 517	Striking	M01C0054
22	Sault Ste. Marie, Ont.	*Coral Trader* *PML 2501* *Adanac III*	Tanker Barge Tug	4 143 1 954 108	Striking	M01C0059
SEPTEMBER 05	Baie Sainte-Anne, N.B.	*Alain Josée*	Fishing	13	Abandonment and sinking	M01M0100

Final Reports

The following investigation reports were approved between 01 January 2000 and 30 September 2001.

DATE	VESSEL(S)	EVENT	REPORT NO.
97-04-17 **97-04-18**	*Venus*	Groundings	M97L0030
97-08-07	*Navimar V*	Overturning	M97L0076
97-11-03	*Atlantic Erie*	Fall from pilot ladder	M97M0141
98-02-03	*Cape Chidley*	Accident on board	M98M0003
98-03-22	*Ocean Thunder*	Swamping	M98W0045
98-04-02	*Enerchem Refiner*	Grounding	M98C0004
98-04-10	*Agawa Canyon, Emerald Star*	Collision	M98F0039
98-06-10	*Saute Moutons 6*	Accident on board	M98C0026
98-06-11	*Grant Carrier*	Bottom contact	M98C0015
98-08-29	*Seaflight I*	Collision	M98F0023
98-09-04	*Incat 046, Lady Megan II*	Collision	M98M0061
98-10-14	*Algolake*	Grounding	M98C0066
98-10-22	no name	Capsizing	M98M0078
98-10-26	*Southgate*	Fire	M98L0139
98-11-06	*Atlantic Prize*	Foundering	M98N0064
98-11-09	*Iolcos Grace*	Accident on board	M98W0245
98-11-27	*Brier Mist*	Swamping and sinking	M98L0149
98-12-12	*Federal Bergen*	Striking	M98C0082
98-12-24	*Jade Star*	Grounding	M98L0165
99-01-27	*Canmar Spirit*	Compressor bursting	M99L0011
99-03-01	*Westisle*	Near-capsizing	M99W0033

DATE	VESSEL(S)	EVENT	REPORT NO.
99-04-05	*Paterson*	Grounding	M99C0003
99-04-05	*Algontario*	Grounding	M99C0005
99-04-09	*Cape Acacia*	Striking bottom	M99W0058
99-05-13	*Canadian Empress*	Bottom contact	M99C0016
99-06-03	*Hope I*	Grounding	M99C0019
99-06-09	*Algobay*	Striking	M99F0042
99-06-09	*Bluenose II*	Grounding	M99M0062
99-06-16	*Alam Selamat*	Bottom contact	M99W0087
99-07-12	*Flip*	Capsizing	M99W0137
99-07-16	*Sunny Blossom*	Grounding	M99C0027
99-07-20	*Nanticoke*	Fire	M99F0023
99-08-17	*Mandarin Arrow*	Grounding	M99W0145
99-09-25	*Canmar Valour*	Fall overboard	M99L0099
99-10-14	*Joseph & Sisters*	Sinking	M99M0142
99-12-01	*Wet n' Wild II*	Capsizing and sinking	M99M0161
99-12-28	*Juneau, Seaspan Pacer, Escort Eagle*	Fall overboard	M99F0038
00-01-15	*Sea Cap XII, T.L. Sharpe*	Striking	M00W0005
00-03-18	*BCM Atlantic*	Sinking	M00N0009
00-03-28	*Lori Cathlynn*	Capsizing	M00W0044
00-05-12	*Miss Gatineau*	Fall overboard	M00L0043
00-06-16	*True North II*	Sinking	M00C0033

TRANSPORTATION SAFETY

REFLEXIONS

MARINE

Issue 19 – January 2002

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