

Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

MARINE INVESTIGATION REPORT
M03W0265



COLLISION

BETWEEN

PLEASURE CRAFT MISTRAL

AND

BARGE *PACKMORE 4000* UNDER TOW BY TUG *TIGER SHAMAN*

FRASER RIVER NEAR MISSION, BRITISH COLUMBIA

20 DECEMBER 2003

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Marine Investigation Report

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Summary

On the evening of 20 December 2003, the pleasure craft *Mistral*, with the owner/operator and 12 adult guests on board, was part of an annual event with two other vessels to celebrate the holiday season on the Fraser River near Mission. Shortly after separating from the other vessels, the *Mistral* collided with the deck barge *Packmore 4000* under tow by the tug *Tiger Shaman*. The *Mistral* was destroyed upon impact and its occupants were thrown into the water. The crew of the tug recovered 12 survivors. One person drowned.

Ce rapport est également disponible en français.

Other Factual Information

Particulars of the Vessels

| Name | <i>Mistral</i> | <i>Tiger Shaman</i> | <i>Packmore 4000</i> |
|---------------------|-----------------------------------|---|-----------------------------------|
| Official Number | 170772 | 345930 | 348554 |
| Port of Registry | Vancouver, B.C. | Vancouver, B.C. | New Westminster, B.C. |
| Flag | Canada | Canada | Canada |
| Type | Pleasure craft | Tug | Deck barge |
| Gross Tonnage | 15.44 | 31.31 | 1621.45 |
| Length ¹ | 10.3 m | 12.3 m | 64.6 m |
| Draught Fwd | 0.7 m | 1.2 m | 0.9 m |
| Draught Aft | 0.8 m | 1.5 m | 1.0 m |
| Built | 1938 Vancouver, B.C. | 1973 Vancouver, B.C. | 1976 Delta, B.C. |
| Propulsion | Gasoline, single screw, 112 kW | Diesel, twin screw, 753 kW | none |
| Cargo | none | none | none |
| Crew | 1 | 2 | 0 |
| Guests | 12 | 0 | 0 |
| Owners | Private owner, Mission, B.C. | Smit Harbour Towage, Vancouver, B.C. | Rivtow Marine, Vancouver, B.C. |

Description of the Vessels

Mistral

The *Mistral* was a wooden pleasure craft of just over 15 gross tonnage. It was powered by a single 112 kW gasoline engine located between the forward 'V' berth cabin and the main saloon aft. Situated above the main engine compartment, the raised wheelhouse was enclosed by an arc of seven vertically mounted windows which provided a view forward of the beam from the control position located on the port side of the wheelhouse (see Photo 1).

The navigation instruments included an echo sounder, Global Positioning System (GPS), Very High Frequency (VHF) radio, and a magnetic compass. The vessel was not fitted with radar.



Photo 1. Pleasure craft *Mistral*

¹ Units of measurement in this report conform to International Maritime Organization (IMO) standards or, where there is no such standard, are expressed in the International System (SI) of units.

The wheelhouse could be accessed internally from both the main saloon and the forward 'V' berth cabin. Access to the open decks was by way of a sliding door at each side of the wheelhouse and through a companionway at the aft end of the saloon. The vessel had live-aboard facilities and served as the owner's residence at the marina in Mission, B.C.

Tiger Shaman

The *Tiger Shaman* is steel-built tug based at Mission, B.C. It does not have berthed accommodation and is used as a shift vessel, under the conduct of a certificated master with the assistance of a deckhand during towing operations on the Fraser River. The wheelhouse is fitted with windows on all four sides, and the main control console is centred at the forward windows. Navigation instruments include a magnetic compass, echo sounder, two VHF radios, and radar. A secondary control station is located on the wheelhouse top. The towing winch is situated on the main deck aft of the wheelhouse between two vertical, engine-exhaust trunks (see Photo 2).



Photo 2. Tug *Tiger Shaman* with mast lowered 45 degrees

Packmore 4000

The *Packmore 4000* is a steel-hulled deck barge primarily used for transporting gravel. Along the sides of the open deck are two reinforced steel bulwarks approximately 3 m high to contain the cargo. Brackets for portable navigation lights are located at the extreme ends of each bulwark at a height of approximately 1.5 m above deck. A portable hopper/cargo handling boom was located on the main deck aft (see Photo 3).

The barge is unmanned and non-propelled.



Photo 3. End view of barge *Packmore 4000*

History of the Voyages

Tiger Shaman and Packmore 4000

At 1250 on 20 December 2003, the crew started their shift on tug *Tiger Shaman* at Mission B.C., and sailed 5.5 miles east (upriver) to the Mainland Sand and Gravel quarry. Two loaded gravel barges were then towed to Stones on the Fraser River, approximately 20 miles west of Mission. After delivery of the barges at Stones, the crew of the tug prepared to tow the empty deck barge, *Packmore 4000*, for a return passage to the gravel quarry. Portable navigation lights (sidelights and a stern light) were secured on the barge in designated locations approximately 6.1 m above the waterline. The tug displayed two masthead lights in a vertical line, in addition to sidelights, towing lights, and a stern light. The tug's sidelights were significantly closer to the water than those on the barge.

At 2010, the *Tiger Shaman* and *Packmore 4000* departed Stones, and both barge sidelights were seen from the tug to be operating normally. The estimated length of the tow wire was 90 m. The tug monitored VHF channel 80 (company frequency), and VHF channel 06 (ship-to-ship) in addition to dual-watch VHF channel 16. The first three hours of passage were uneventful with the tug and tow averaging 7 knots. The Albion ferry was the only traffic encountered, about 12 miles west of Mission.

Spanning the Fraser River at Mission are two bridges: a CPR railway bridge and, 500 m to the west, the Highway No. 11 road bridge. The highway bridge is a fixed span with a stipulated clearance of 19 m. The railway bridge has a lower profile and is supported by 13 concrete piers with a swing span situated near the south shore to allow passage of high air draft vessels. Marine traffic with low air draft, such as the *Tiger Shaman* and *Packmore 4000*, transit through the channel beneath the fixed span of the rail bridge between support piers 5 and 6 from the north bank.

When the *Tiger Shaman* was approximately 1800 m west of the highway bridge, the tug's main mast was lowered by tilting it backwards about 45 degrees, the mast lights remaining lit. This was done to reduce the tug's air draft.

At approximately 2300, the tow was abeam of a temporary pile to the south of the channel, 7 cables (1300 m) west of the highway bridge. The master had conduct of the tug and was assisted in the wheelhouse by the deckhand. A lookout was being maintained, both visually and by radar. The vessels were approaching a bend in the river when lights were seen off the port bow at a range of 5 cables (926 m). The approaching vessel, later identified as the *Mistral*, displayed such a profusion of multi-coloured lights that it was not possible for the *Tiger Shaman* to determine the aspect of the vessel. Subsequently, the *Mistral* began crossing to the tug's starboard bow.

The tug's searchlight, mounted on the starboard wheelhouse top, was energized, rotated clockwise past the *Mistral*, and steadied on the barge to make the *Packmore 4000* more visible to the approaching vessel. The deckhand then left the wheelhouse for the tug's winch station, where a second searchlight was shone at the barge. The navigable width of the river in this area is quite narrow (200 m), but in order to increase the closest point of approach (CPA) between the vessels, the *Tiger Shaman* made an alteration to port toward log booms secured along the north bank of the river.

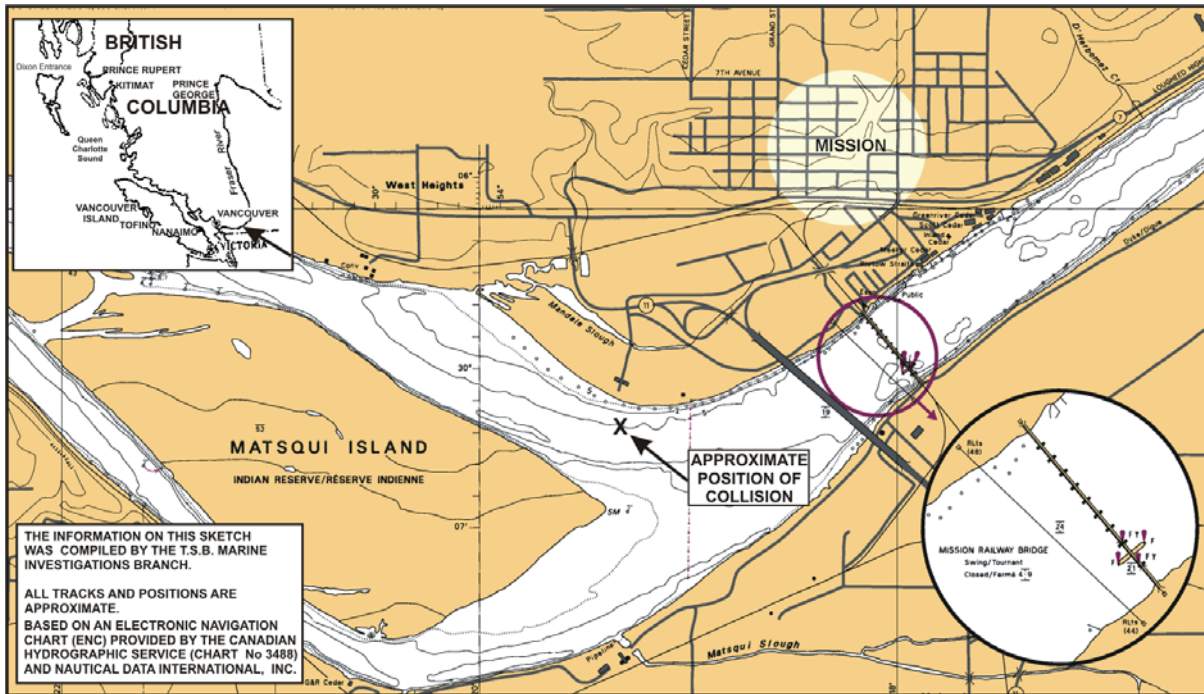


Figure 1. Fraser River, north of Matsqui Island, where collision occurred

From the *Tiger Shaman*, the *Mistral* did not appear to be taking avoiding action, and the distance between the two vessels continued to decrease. Concerned that the vessel might attempt to pass between the tug and its tow, the tug's engines were reversed, slackening the tow wire and reducing the chance of it fouling the *Mistral*. The *Mistral* then altered to port and struck the starboard bow of the barge.

Mistral

The *Mistral* had been rigged with exterior Christmas lights for the holiday season. The multi-coloured lights outlined the deck edge of the vessel, and they were also suspended from the masthead to the stern.

On the evening of December 20, 11 invited friends met the owner on board the *Mistral*. The plan was to accompany two other similarly decorated pleasure craft from the same marina for an evening on the river. It was an annual event for the three vessels to be underway, with those on board socializing and singing Christmas carols.

At approximately 2000, the *Mistral* departed the marina to meet the two other vessels, before leading the small flotilla approximately two miles upriver. The three vessels were then rafted together to drift downriver with the current for the next two hours and one-half. During this time, people moved from vessel to vessel as a portable stereo played music in the wheelhouse and alcohol was consumed. By the time they finally cast off from each other, a total of 13 persons were aboard the *Mistral*, one additional person having come from another vessel.

At about 2250 and nearing their starting point, the two other vessels returned to the marina, but the *Mistral* continued downriver without a specific passage plan. The throttle was increased to give an estimated vessel speed of 7 knots through the water. The *Mistral* passed between bridge support piers closer to the north shore (most likely between piers 5 and 6). It then passed beneath the highway bridge. West of the bridge the river flows to the north of Matsqui Island and the *Mistral* altered course about 60° to starboard to follow the navigable channel. Of the 13 people aboard, 3 were in the saloon and 10 were in the wheelhouse. Most were engaged in conversation although one or two, besides the operator, were taking an interest in the vessel's passage.

The operator first became aware of the tug when its searchlight was shone toward his vessel. He was initially unsure as to whether he was seeing the other vessel's true light or a reflection of it from another direction due to the reflections created by the multiple surfaces of *Mistral's* wheelhouse windows. He then realized, by the masthead lights displayed, that the tug had an object in tow. The tug's bearing relative to the *Mistral's* heading was estimated to be 60° on the pleasure craft's starboard bow at an approximate range of 160 m. The tug's tow was not observed. In passing the tug, the *Mistral* altered course to port, and no one on board was aware of the barge until the *Mistral* was struck on its starboard side.

The Collision

The collision occurred around 2300, 20 December 2003, in a position approximately 1200 m west of the Highway bridge at Mission, B.C. The starboard side of the pleasure craft *Mistral* came in contact with the starboard bow of the deck barge *Packmore 4000* under tow by the tug *Tiger Shaman*. The *Mistral's* occupants were thrown into the water as the pleasure craft broke into pieces and was overrun by the *Packmore 4000*.

Rescue Operation

Immediately after the collision, the master of the *Tiger Shaman* activated the towing winch abort system and released the tow wire from the winch drum. He then contacted the towing company on VHF channel 80 to report the collision and had the dispatcher make all necessary emergency calls on behalf of the tug. The tug's deck floodlights were turned on, and the master moved to the upper control station for better vantage. The *Tiger Shaman* manoeuvred along the starboard side of the *Packmore 4000*, while the deckhand remained on the deck of the tug in readiness for recovery. The tug encountered wreckage astern of the barge where some survivors were seen clinging to flotsam. The crew of the tug located and brought the survivors on board and into the wheelhouse.

When no further survivors were sighted, 12 persons had been recovered but one other was missing. After continuing the search for a short while, the master headed the *Tiger Shaman* back to Mission, the barge having been left temporarily 'anchored' by the weight of the tow wire on the river bed. At approximately 2350, the 12 survivors were handed over to Emergency Health Services (EHS) personnel at Mission, where the managers of the *Tiger Shaman* had arranged for a relief crew to meet the tug upon its arrival.

Search and Rescue

At 2301, the Joint Rescue Coordination Centre (JRCC) in Esquimalt, B.C., logged the emergency call from the towing company's dispatcher and the Canadian Coast Guard (CCG) hovercraft *Siyay* was tasked within four minutes. At the same time, volunteer search and rescue (SAR) units from Maple Ridge, Mission and Abbotsford were mobilized together with an RCMP dive team.

At 2317, the CCG hovercraft *Siyay* was underway from its base on Sea Island at the mouth of the Fraser River. En route upriver, the crew set up dive gear in preparation for a full penetration dive. During the passage, the *Siyay* maintained communications with the SAR resources moving on scene, and the hovercraft was advised to commence a surface search from the west end of Crescent Island, six miles downriver from the accident site.

Meanwhile, with the survivors were safely ashore, the *Tiger Shaman* and its company-arranged relief crew returned to the scene of the collision to assist in the search for the missing person.

At 0001, December 21, the Mission SAR unit arrived on scene, followed closely by the other units.

At 0054, the *Siyay* initiated a surface search for the missing person.

With other SAR resources on scene, the *Tiger Shaman* stopped its search and secured the *Packmore 4000* to an adjacent log boom before returning to Mission. The navigation lights on the tug and barge were seen from the *Siyay* to be operating.

By 0359, the *Siyay* located a floating section of the *Mistral's* wooden decking tethered to the riverbed west of the highway bridge at Mission. It was decided in consultation with the RCMP that a SCUBA reconnaissance dive would be made by a CCG diver from the *Siyay*.

At 0412 the diver entered the water with clear visibility and examined the underside of the floating debris before descending 4.6 m to the riverbed. The sunken hull of the *Mistral* was found tethered to the floating section of deck by a synthetic line. The damaged hull was sitting upright on the river bottom and held there by the weight of the engine. The diver had an unobstructed view of the vessel's interior and found severe damage to *Mistral's* starboard side. After a thorough search of the area at and around the sunken vessel, the missing person was not found.

Injuries to Persons

Of the 12 survivors recovered by the *Tiger Shaman*, 11 received minor injuries and one person displayed symptoms of shock. In the care of the EHS personnel at Mission, they were taken to hospital and released after treatment. One person was kept overnight for observation.

The missing person was found in the river several months afterward. An autopsy concluded death by drowning.

None of the tug's crew was injured.

Damage to Vessels and Environment

The pleasure craft *Mistral* was completely destroyed. A large section of the vessel's aft starboard side was missing from an area about 1.2 m forward of the transom, extending 4.6 m long and 0.6 m down from the gunwale.

The tug *Tiger Shaman* was undamaged.

The barge *Packmore 4000* had fresh paint scuffs on the starboard side of the bow.

The amount of gasoline released from the damaged *Mistral* was minimal and was dispersed by the river flow.

Vessel and Personnel Certification, and Personnel Experience

The *Tiger Shaman*, as a tug of 31 Gross Tons, is inspected by Transport Canada. It was certificated, equipped, and crewed to existing regulations.

The master held a certificate of competency appropriate for the trade. He had 35 years of towing experience and worked the last four years aboard the *Tiger Shaman* on this section of the Fraser River. The deckhand had equivalent service experience. He did not hold a certificate of competency and was not required to do so.

The *Mistral*, as a pleasure craft, was not required to be inspected or certified by Transport Canada. The owner/operator of the vessel did not hold a *Pleasure Craft Operator Card*, nor was he required to do so. He purchased the vessel in 1994 and had berthed it at Mission since 1995. It is reported that he sailed the vessel frequently with occasional trips after dark.

Weather and Current Information

At the time of the occurrence, it was a clear moonlit night with light winds and calm water. Water levels on the Fraser River are affected by tides and, on December 20, the ebb tide supplemented the flow of the river at Mission between 1430 and 2300 to give a river flow velocity of approximately 0.75 knot.

Communications

Vessel Traffic Services (VTS) are provided for the lower portion of the Fraser River, west of New Westminster, B.C. However, the *Mistral* and *Tiger Shaman* were operating east of this zone, which is not covered by VTS.

Neither vessel attempted to use the VHF radio, nor were sound signals used to communicate their intentions to the other prior to the collision, as required by regulations.

Navigation Lights

Mistral

The pleasure craft was reported to be equipped with and displaying the required navigation lights. It also displayed multi-coloured Christmas lights which outlined the vessel's deck edge and ran from the stern to the masthead. The *Collision Regulations* (COLREGS), Rule 20, states in part:

The Rules concerning lights shall be complied with from sunset to sunrise, and during such times no other lights shall be exhibited, except such lights as cannot be mistaken for the lights specified in these Rules or do not impair their visibility or distinctive character, or interfere with the keeping of a proper lookout.

Tiger Shaman and Packmore 4000

The tug and tow were required to, and did, display appropriate towing lights for a tow not exceeding 200 m. The barge *Packmore 4000* is not equipped to generate or store electrical energy.

As required by regulations, the *Tiger Shaman* carries and maintains portable barge navigation lights to be mounted on the barge when required. These Light Emitting Diode (LED) lights were fitted port, starboard, and at the stern of the *Packmore 4000* in designated brackets prior to commencement of the night passage. As the barge was without cargo, these sidelights were significantly higher above the water than those on the *Tiger Shaman*. Following the collision, the green starboard LED light was sent to the TSB Engineering Branch Laboratory for performance testing.

Portable Navigation Lights

There are approximately 2072 barges registered in Canada. Of these, approximately 1512 are registered on the West Coast. Because the majority of barges are without their own power source, battery-operated navigation lamps are supplied by the towing vessel. The lamps must be lightweight for portability and meet the requirements of the COLREGS, including the visibility range requirements.

LED Barge Navigation Lamps

The investigation by the TSB into the 1999 collision between the pleasure craft *Sunboy* and the tug *Jose Narvaez* towing the barge *Texada B.C.* (M99W0133) determined that the portable lamp in use on the barge did not meet the minimum range requirements. With this knowledge, the towing industry and Transport Canada sought an alternative. Barge navigation lamps manufactured in the USA that meet relevant USCG regulations were subsequently further tested and found by Transport Canada to meet the requirements of the *Collision Regulations and Standards for Navigation Lights, Shapes, Sound Signal Appliances, and Radar Reflectors*, TP 1861, for use on unmanned barges in Canadian waters. These approved lamps make use of LED technology (see Photo 4).



Photo 4. LED barge navigation lamp

Requirements for Lamp Visibility

The vertical sector of the electric navigation lights specified in the International COLREGS requires that the minimum intensity be maintained at all angles from 5 degrees above to 5 degrees below the horizontal, and at least 60 percent of the required minimum intensity be maintained from 7.5 degrees above to 7.5 degrees below the horizontal. The specified minimum intensity is 12 candelas at a visible range of 3 miles.

Canadian modifications to the COLREGS provide that:

Where from any sufficient cause it is impracticable for an unmanned barge ... in Canadian waters of a roadstead, harbour, lake, or inland waterway to exhibit lights that comply with the vertical sector requirements ... the lights on the unmanned barge ... need not comply with the vertical sector requirements but shall maintain the required minimum intensity on the horizontal.

The United States of America modifies the COLREGS for Inland Waters as follows:

In the case of unmanned barges the required intensity of electric lights as fitted shall be maintained on the horizontal.

Underwriters Laboratories Inc. provides the recognized standard for *Marine Navigation Lights, Commercial* in UL 1104. Products that meet this standard are in compliance with the international COLREGS as adopted and modified by the USA. This standard is endorsed and adopted by Transport Canada. Section 22.3 of UL 1104 states:

Exception: A battery powered light intended for use on unmanned barges not equipped for generation of electricity need only comply with the intensity requirements in the horizontal plane.

Alcohol

About three hours after the survivors arrived at Mission, a blood sample was provided by the *Mistral's* owner/operator indicating a blood alcohol level that exceeded the legal limit.

Analysis

Events Leading to Collision

The multi-coloured lights displayed by *Mistral* impaired the ability of the *Tiger Shaman*'s crew to recognize the distinctive character of the *Mistral*'s navigation lights and made it impossible to determine the aspect of the brightly lit pleasure craft.

The *Mistral* was not equipped with radar; the owner maintained a visual lookout as he operated the vessel. However, 10 people were in the wheelhouse, where conversation and music provided distractions as the two vessels approached each other. The use of the tug's spotlight alerted the operator of the *Mistral* to the former's presence. However, the *Mistral*'s operator experienced difficulty in ascertaining its relative bearing due to the reflections created by the wheelhouse windows. This, in combination with the back scatter from its Christmas lights, would have hindered the *Mistral*'s ability to maintain a proper look-out.² The distractions, impaired visibility, and the effects of alcohol may account for:

- the operator's delay in detecting the *Tiger Shaman* until it was at an estimated range of 160 m; and
- the *Mistral*'s alteration of course to port into the path of the tow.

Prior to the operator of the *Mistral* observing the *Tiger Shaman*, the tug made an alteration to port and reversed its engines to avoid a collision. As the barge was at the end of the tug's 90 m tow wire, it would have continued on its original heading and remained closer to the centre of the navigable channel. The tug's alteration, therefore, would have had minimal impact on the original track of the *Packmore 4000*. As it was a dark night with few shore lights in the vicinity, the lights of the tug – which were higher above the water than those of the barge – would have been more readily visible. The *Mistral*'s master, unaware of the tug's collision-avoidance actions and without the benefit of radar, may have been expecting to see the tow lights to his starboard, whereas they were on his port side. It is, therefore, likely that the operator of the *Mistral* did not see the barge's green light.

Although the operator of *Mistral* recognized that the tug was displaying towing lights, i.e., two masthead lights one above the other, he did not see the barge under tow. However, the COLREGS are clear with regard to the determination of risk of collision and require that if there is any doubt, such risk shall be deemed to exist.³ These rules also require that, in order to avoid a collision or allow more time to assess the situation, a vessel shall slacken her speed or take all way off by stopping or reversing her means of propulsion.⁴ The *Mistral* did not take any of these measures.

Performance of the Packmore 4000's LED Barge Lamp

The starboard LED light was removed from the barge and sent to the TSB Engineering Branch Laboratory to be performance-tested together with another LED light of the same model used aboard the *Packmore 4000* and supplied by Transport Canada.

² Rule 5 of the *Collision Regulations*.

³ *Collision Regulations*. Rule 7 (a)

⁴ *Collision Regulations*. Rule 8 (e)

The TSB laboratory made calculations to determine minimum required luminous intensities at intermediate ranges that would equate to the requisite 12 candelas at 3 miles. Using the formula, the maximum observed output was 16.45 candelas – 37 per cent beyond the 3-mile range requirement.

However, the vertical sector of the emitted light from the lamp exceeding 12 candelas was approximately 1.8 degrees, and the vertical sector exceeding 7.2 candelas was 4.9 degrees.

On the night of the occurrence, the LED sidelights on the *Packmore 4000* were fitted into the appropriate brackets welded to the leading face of the bulwarks, port and starboard. The bulwarks are erected perpendicular to the deck of the barge, and the brackets are aligned so that the zero axis of the light shines parallel to the water plane when the barge is trimmed to an even keel. The empty barge was trimmed 10 cm by the stern, which would change the horizontal plane by less than 0.1°. This change would not significantly affect the performance of the lamp.

The *Packmore 4000*'s starboard sidelight was observed by the *Tiger Shaman*'s crew members to be operating before the collision and again, by the master of the *Siyay*, after the collision. TSB laboratory tests found that the light was available to be seen from the relative positions of the observer.

From the TSB Engineering Laboratory tests, it was concluded that:

- The portable navigation lamp in use at the time of the occurrence was certified for use on unmanned barges.
- Properly configured, these lamps meet the horizontal luminous intensity requirements as set forth in the *Marine Navigation Lights* standard UL 1104 .
- These portable, battery-powered lamps do not meet the vertical luminous criterion for other commercial vessels stipulated in the UL 1104 standard, nor are they required to meet the vertical specification when used on unmanned barges in Canadian and United States waters.
- A potential exists to misalign the head and base assemblies of these lamps. This may result in a lamp's failure to meet the horizontal luminous intensity requirement. The manufacturer does not provide alignment documentation.
- It was not possible to determine the lamp's configuration (i.e., lens cap, LED array holder, and base assembly alignment) at the time of the occurrence.
- A properly configured lamp would have been visible to the approaching pleasure craft. Note: This assumes no line-of-sight obstructions.

TSB Engineering Report LP 008/04 entitled *Marine Collision Light Analysis - MISTRAL & PACKMORE 4000* is available upon request.

Three factors determine the distance at which a lamp can be sighted: the vertical sector component of the lamp, its height above sea level, and the height of the observer's eye on an approaching vessel. Even if an approaching vessel is within a lamp's (theoretical) horizontal visible range, however, the narrow vertical sector component can preclude navigators on that vessel from actually seeing the light. Thus, the exemption of unmanned barges from the vertical sector component requirements applicable to other commercial vessels can impede visual detection of light, and make any misalignment (for whatever reason), safety-critical.

Findings as to Causes and Contributing Factors

1. The multi-coloured Christmas lights exhibited by the *Mistral* impaired both the visibility and the distinctive character of that vessel's navigation lights such that the vessel's aspect could not be determined.
2. The multi-coloured lights – and the presence of nine additional non-watchkeeping personnel in the wheelhouse – interfered with the operator's ability to keep a proper lookout.
3. The operator of the *Mistral* had consumed alcoholic beverages, and his blood-alcohol level was in excess of the legal limit.
4. The collision-avoidance actions taken by the *Tiger Shaman* were not recognized by the operator of the *Mistral*. This action changed the aspect of the tug relative to the barge and may account for the *Mistral* not seeing the barge at its anticipated location.
5. Although the approaching vessel was identified by the *Mistral* as a towing vessel and the location of the tow was not determined, the pleasure craft neither stopped nor slowed to allow more time to assess the situation.

Findings as to Risk

1. The misalignment of a Light Emitting Diode (LED) barge navigation lamp could significantly reduce its visible range, due to the narrow vertical sector of emitted light, and as the manufacturer does not provide alignment documentation.
2. The exemption of unmanned barges lamps from the vertical sector component requirements applicable to other commercial vessels makes any misalignment safety-critical and may deprive navigators on the approaching vessel from sighting the light in sufficient time to take collision-avoidance action.

Other Finding

1. It was not possible to determine the lamp's configuration at the time of the occurrence.

Safety Action

Action Taken

Following the occurrence, the TSB met with the Council of Marine Carriers (CMC) and expressed concerns about the Light Emitting Diode (LED) navigation lamps.

Safety Concern

Performance Requirements for LED Navigation Lamps on Unmanned Barges

The *Collision Regulations* have established that the minimum range of visibility for navigation sidelights must be three miles, thereby allowing vessels sufficient time to evaluate the risk of collision and take collision-avoidance action.

Although the use of LED lamps for barges in recent years has increased the visibility range of the lights, their narrow vertical-sector component can limit the actual horizontal range at which light may be sighted. The LED lamps tested showed that, at the minimum three-mile range requirement, the vertical luminous sector was approximately ± 1.8 degrees, in contrast to the ± 5 degree vertical luminous sector requirement for other commercial vessels. Consequently, any characteristic that obstructs line-of-sight detection or substantive misalignment of an LED barge navigation lamp would reduce its visible range due to the narrow vertical sector of emitted light, even if it exceeds the minimum intensity requirements.

There are over 2000 barges registered in Canada, of which a large number are without their own power source and therefore rely on the battery-powered LED lamps. The Board, therefore, is concerned that the unmanned barges will continue to carry navigation sidelights that may not be visible at the minimum range for all conditions of operation, thereby increasing the chance of accidents and subjecting other vessels to undue risk. The Board will continue to monitor the situation.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 19 July 2006.