MARINE OCCURRENCE REPORT
M96W0187

NEAR-COLLISION

BETWEEN THE CRUISE SHIP “STATENDAM”
AND THE TUG/BARGE UNIT
“BELLEISLE SOUND”/“RADIUM 622”
DISCOVERY PASSAGE, BRITISH COLUMBIA
11 AUGUST 1996

Transportation Safety Board
of Canada

Bureau de la scurit des transports

du Canada

Marine Occurrence Report

Near-collision

Between the Cruise Ship "STATENDAM" and the Tug/barge Unit "BELLEISLE SOUND"/"RADIUM 622"

Discovery Passage, British Columbia
11 August 1996

Report Number M96W0187

Synopsis

On the evening of 11 August 1996, the cruise ship "STATENDAM", on passage from Sitka, Alaska, to Vancouver, British Columbia, made a wide turn around Chatham Point and passed close ahead of the northbound tug/barge unit "BELLEISLE SOUND"/"RADIUM 622" which was laden mostly with dangerous cargo. The cruise ship incurred minor damage to fittings in public areas when the vessel heeled over to port during a subsequent emergency manoeuvre. A number of passengers and crew sustained minor injuries. The tug/barge unit was undamaged.

The Board determined that the near-collision between the "STATENDAM" and the "BELLEISLE SOUND"/"RADIUM 622" occurred because the slow rate of turn of the "STATENDAM" placed the vessel on the east side of Discovery Passage in the path of the oncoming tug/barge unit. Contributing to the incident were: the reduced visibility in fog and darkness; the pilot's lack of familiarity with the navigational systems of the "STATENDAM"; and the non-application of bridge resource management principles, especially with regard to the logical division of the workload according to the area of expertise of each member of the bridge team.

Ce rapport est également disponible en français.

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1.0 Factual Information

1.1 Particulars of the Vessels

	"STATENDAM"	"BELLEISLE SOUND"	"RADIUM 622"
Official Number	70658	348884	188607
Port of Registry	Rotterdam, Netherlands	Vancouver, B.C.	Vancouver, B.C.
Flag	Netherlands	Canada	Canada
Type	Cruise ship	Coastal tug	Oil/general cargo barge
Gross Tons	55,451	140.96	320
Length	219.4 m	20.9 m	45.7 m
Breadth	30.8 m	7.65 m	10.6 m
Draught	F: 7.5 m A: 7.6 m	F: 1.22 m A: 2.13 m	
Built	1992, Monfalcone, Italy	1974, Richmond, B.C.	1956, Vancouver, B.C. Rebuilt 1995, Victoria, B.C.
Propulsion	Sulzer diesel-electric, 24,000 kW, twin controllable-pitch propellers	Caterpillar diesel, 1,406 BHP, twin fixed-pitch propellers	Non-self-propelled
Owners	Holland America Line Westours Inc., Seattle, Washington, USA	Inlet Navigation, Campbell River, B.C.	Inlet Navigation, Campbell River, B.C.

1.1.1 Description of the Vessels

"STATENDAM"

The "STATENDAM" is a large passenger cruise ship which makes Alaskan cruises in the summer season and Caribbean cruises in the winter.

[1] See Glossary for all abbreviations and acronyms.

[2] 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 vessel is powered by five diesel-electric generators driving two propulsion motors, and twin controllable-pitch, four-blade, inturning propellers. She is equipped with two bow thrusters of 1,720 kW each, one 1,720 kW stern thruster, and twin double-flapped high performance rudders (See Section 1.9) with four steering gear pump units.

The vessel is equipped with a Krupp Atlas NCC 25 Nacos integrated navigating system for manoeuvring.

The vessel has an enclosed wheel-house. Microphones are mounted outside the wheel-house to monitor outside sound. Propulsion and steering controls are located on the centre, port and starboard consoles. There is a computerized display unit and recorder for monitoring engine performance data. The distance from bridge to bow is 48.6 m, and 170.8 m from bridge to stern. Rate of turn, rudder angle, heel angle, and Doppler log indicators are located midships and at each side of the wheel-house.

The vessel has a full sea speed of approximately 21.7 knots (kn) and a manoeuvring full ahead speed of 16.7 kn.

The vessel's sea trial data indicate that when the rudders are placed hard-a-starboard while travelling at 20.24 kn, the advance distance is 426 m, the transfer 94 m, the tactical diameter 292 m, and the final diameter 258 m. Crash stop distances and times estimations indicate that a crash stop would take 171 seconds and 899 m when carried out at 20.57 kn, and 141.4 seconds and 716.8 m at 16 kn.

Generally, the vessel deploys her stabilizers when transiting the inside passages of British Columbia. The stabilizers tend to slow listing and eliminate the after roll when altering course. On 11 August, the starboard stabilizer would not deploy, and at 1210, the port stabilizer was retracted.

The use of stabilizers in confined/restricted navigational areas was the subject of an investigation by the Netherlands Maritime Board of Inquiry in 1986. The Inquiry concluded that the use of stabilizers in such waters must, in principle, be avoided.

"BELLEISLE SOUND"

The "BELLEISLE SOUND" is a steel tug originally designed for river and coastal use in Arctic waters. She has a flat-nosed pusher bow which allows the tug to be used for either pushing or towing. She is currently used in the pushing mode. The vessel is powered by two diesel engines driving twin fixed-pitch propellers with fixed nozzles and four rudders. The wheel-house is well laid out and affords a 360-degree view. The propulsion controls are within easy reach of the wheel located on the console amidships. The vessel's two radar sets are also immediately adjacent to the wheel.
The tug/barge unit is capable of operating at a top speed of 8.5 kn at 1,700 rpm, but generally operates at a service speed of 7.5 kn (1,400 to 1,500 rpm) when towing.

"RADIUM 622"

The "RADIUM 622" is a steel, non-propelled barge designed to carry fuel and general cargo. It is flat-topped

and ramped. It carries roll-on/roll-off vehicles and general cargo on deck. Under deck, it is subdivided into four sets of port, centre and starboard tanks for a total of 12 compartments that are used for the carriage of fuel oils. There is a pump room forward. The stern of the barge is designed to hook up with the bow of the tug.

The barge was carrying general cargo for delivery to logging and fishing camps. In addition, the barge carried the following dangerous cargo on deck: 71,620 litres (L) of propane, 9,225 L of Jet B fuel, 1,250 kg of dynamite, 3,725 kg of ammonium nitrate explosive, and 10 cases of non-electric detonators. (See Appendix A for details of stowage and cargo distribution and Section 1.25 for Class, Division and Compatibility Groups of the dangerous goods in accordance with the International Maritime Dangerous Goods (IMDG) Code and the Dangerous Goods Shipping Regulations (DGSR)).

Under deck, the barge was carrying 15,000 L of stove oil, 247,000 L of diesel oil, and 183,000 L of gasoline.

1.2 History of the Voyages

"STATENDAM"

The "STATENDAM" sailed from Sitka at 1400, 10 August 1996, bound for Vancouver with 1,327 passengers and 557 crew on board. She was the last of four southbound cruise ships proceeding to transit Seymour Narrows at slack water, at 2310, 11 August.

At 0300, 11 August, two British Columbia Coast pilots boarded the vessel off Triple Island, B.C. On departing the pilot station, the vessel proceeded southbound in Hecate Strait. Pilots alternate their shifts while on board. The first pilot assumed the conduct of the vessel at 1115 off McInnes Island at the entrance to Milbanke Sound. He piloted the vessel through the inner passages and was relieved by the second pilot at 1600 when the vessel was off Dugout Rocks in Queen Charlotte Strait.

The senior third officer relieved the wheel-house watch at 2030, taking over the duties of the officer of the watch (OOW). The first pilot resumed the conduct of the vessel again at 2037, in the vicinity of Broken Islands, Johnstone Strait.
The "STATENDAM"was displaying the navigation lights as required by the International Regulations for Preventing Collisions at Sea (COLREGS). The vessel's four radar sets were fully operational and the very high frequency (VHF) radiotelephones were monitoring channel 71, the Vancouver Marine Communications and Traffic Services (MCTS) Centre's frequency; and channel 16, the distress and calling frequency. In addition, the pilot used his own handheld VHF on a ship-to-ship channel to converse with the pilots of other vessels that were transiting the area.

At 2209 shortly after passing Bear Point, Johnstone Strait, the master was summoned to the wheel-house. About three miles ahead, the southbound cruise ship "SKY PRINCESS" had been seen to enter a fog bank at Ripple Point. The OOW turned on the automatic fog signal and placed the engines on stand-by.

[3] All times are PDT (Coordinated Universal Time (UTC) minus seven hours) unless otherwise stated.

The "STATENDAM" passed Ripple Point at 2213, at which time the pilot reported to MCTS and gave an estimated time of arrival (ETA) of 2245 for Cinque Islands. The MCTS informed him that the tug "BELLEISLE SOUND" was northbound, pushing a barge and approaching Cinque Islands. This message was received through the VHF loudspeaker in the wheel-house.

The master, pilot, OOW, and two quartermasters (QM) were in the wheel-house. The master utilised the radar to the port side of the steering console; the OOW, the one to starboard of the steering console; and the pilot, the radar to the right of the set used by the OOW. One QM was at the steering position, steering the vessel by hand. Four steering motors were in operation. The other QM was at the port side of the wheel-house keeping a look-out.

The pilot ordered a reduction in speed to manoeuvring full ahead at 2216, when the vessel was in the vicinity of Walkem Islands.

For guidance, the "STATENDAM" had courses to steer drawn on her charts. In the vicinity of Turn Island, the "STATENDAM" altered course to starboard to pass a northbound vessel thought to have been a fishing vessel. No attempt was made to call the unidentified vessel on VHF. The alteration placed the "STATENDAM" south of the intended course line and she was brought to a more easterly heading.

At 2230, Beaver Rock was bearing 138° T, four cables distant by radar. The light on the rock was barely visible through the fog, but its foghorn could be heard on the wheel-house loudspeaker. From the 2230 position, the vessel had a distance of approximately eight cables to travel to arrive at her charted southbound track in Discovery Passage. The shoreline of Sonora Island was 1.6 miles ahead.

At this time, the pilot ordered the helmsman to execute a turn to starboard at the rate of 10 degrees per minute. This order was given to round Chatham Point and come to a southerly course in Discovery Passage. The pilot soon discovered that this rate of turn was too slow to bring the vessel onto her intended track, and the rate was increased to 20 degrees per minute, and subsequently to 25 degrees per minute.

The slow turn placed the "STATENDAM" well to the east of her intended track, on the east side of Discovery Passage, some two to three cables off Sonora Island.

Also at 2230, the master noted a target on his radar just over two miles away on the starboard side. An automatic radar plotting aid (ARPA) plot indicated that the vessel was on a northerly course, travelling at a speed of 7 kn. The pilot, who was paying close attention to his vessel's rate of turn, did not become aware of the target until the "STATENDAM" was well into her swing and about 2½ to 3 cables off Sonora Island. He did not note the other vessel's bearing and distance when he first detected her by radar. At this time, reportedly neither the pilot nor other members of the bridge team were aware of the identity of the approaching target.

The OOW plotted the 2230 radar position on both charts CHS 3543 and 3539, then, at the master's orders, instructed the engine-room by telephone to take one generator off-line since the vessel did not require the power of this generator to maintain schedule. He carried out the order and made the appropriate entry in the bridge logbook.

It was reported that, as the vessel swung around Chatham Point, the pilot called the "SKY PRINCESS" on his handheld VHF. He learned that the "SKY PRINCESS" had an ETA of 2330 for Seymour Narrows. This meant that the "STATENDAM" would have to follow the "SKY PRINCESS" through the Narrows at some time after 2330, some 20 minutes after slack water and later than originally planned. Therefore, it was not necessary for the cruise ship to maintain her present speed, and the master told the OOW to telephone the engine-room to order a further reduction to three generators and to advise that speed would be reduced shortly.

After carrying out the master's orders, the OOW went to his radar. He noted that the "STATENDAM" was well over to the east side of the channel. At about the same time, the master brought this fact to the pilot's attention.

The helm was brought to midships and port rudder applied momentarily to steady the vessel. The target was on the starboard bow, four cables distant, with a closest point of approach (CPA) of less than one cable.

With the target estimated to be at 1½ cables' distance, approximately 20 to 30 degrees on the starboard bow and closing quickly, two red sidelights and two masthead navigation lights were seen through a break in the fog.

At 2236, the "STATENDAM" crossed an estimated 60 to 90 m ahead of the "BELLEISLE SOUND"/"RADIUM 622". The pilot ordered hard-a-starboard helm when the tug/barge unit was abeam to starboard of the navigation bridge of the "STATENDAM". This allowed the stern of the cruise ship to swing clear of the bow of the "RADIUM 622", and also allowed the cruise ship to swing clear of Sonora Island. The position of the occurrence was approximately 50°19.3'N, 125°24.7'W.

The "STATENDAM" continued her swing to starboard until she was on a heading of approximately 250°T, after which the vessel gained her proper position about mid-channel in Discovery Passage, and the helm was placed hard-a-port and the vessel brought around to her correct track. The "STATENDAM" proceeded toward Seymour Narrows, passing Separation Head at 2312.

The hard-a-starboard manoeuvre caused the "STATENDAM" to heel over to port, and resulted in some minor injuries to six passengers and two of the crew. Some minor damage resulted in the hotel/galley department.

At 0710, 12 August 1996, the "STATENDAM" secured at Canada Place in Vancouver Harbour.

"BELLEISLE SOUND"/"RADIUM 622"

At 2115, 11 August, the tug/barge unit "BELLEISLE SOUND"/ "RADIUM 622", with a crew of five on board, departed her berth at Huntingford Point, Menzies Bay, B.C., bound for Phillips Arm off Cardero Channel. On departure, the vessel reported to Vancouver MCTS as required and informed that she had dangerous cargo on board.

The vessel transited Seymour Narrows and passed Separation Head at 2135, and Cinque Island at 2225. At Separation Head, Vancouver MCTS informed the vessel of four southbound cruise ships.

The "BELLEISLE SOUND" was proceeding at about 1,450 rpm for a speed of approximately 7 kn. The master was in the wheel-house alone, in charge of the vessel's conduct. One radar was fully operational, and the vessel was being steered by hand. The VHF sets were monitoring channels 6, 16, and 71. The tug/barge unit was displaying the navigation lights as required by the International Regulations for Preventing Collisions at Sea (COLREGS). The tug displayed two white lights in a vertical line on her mast, a stern light, and red and green sidelights. The barge displayed sidelights forward.

At 2225, the tug/barge unit passed 1½ cables abeam of Cinque Islands light. The master had been keeping the tow closer to Sonora Island than usual because of the number of southbound cruise ships. He normally passed about 3½ cables off Cinque Islands. At Cinque Islands, he

could see Beaver Rock light and the house lights of the "STATENDAM" through the haze as she rounded Chatham Point. He noted that the "STATENDAM" made a wide turn. The "BELLEISLE SOUND" was brought to a heading later estimated to have been north-northwesterly.

When abeam of the prominent point of land on Sonora Island, about nine cables north of Cinque Islands, the "BELLEISLE SOUND" ran into thick fog. The tug would normally execute an alteration of course to starboard at this time to pass about three cables off Howe Island, thence round the island into Nodales Channel. However, the "STATENDAM" was observed on radar to be well over to the east of the passage and fine on the port bow. A course alteration was made placing the vessel on a northerly heading to pass 1½ cables off Howe Island. The tug did not sound fog signals.

The master of the "BELLEISLE SOUND" reportedly called the "STATENDAM" twice in the intervening minutes but did not receive a reply. He continued to make small course alterations to starboard until he was on a course tangential to the north shore of Sonora Island.

The "STATENDAM" continued toward the "BELLEISLE SOUND" on a constant bearing fine on the port bow. The master of the tug reduced engine rpm to approximately 1,000 and altered course further to starboard until the tow was on an approximate heading of 030°T and heading toward the shoreline of Sonora Island. The chief engineer completed engine-room rounds and entered the wheel-house at this time. Moments later, the navigation lights of the "STATENDAM" were seen fine on the port bow as the cruise ship, estimated to be 100 m distant, was about to cross ahead.

At 2245, the master placed the engine controls on full astern and the helm hard-a-port. The tug/barge unit then slid and swung somewhat to port as the "STATENDAM" passed an estimated 10 m ahead and close down the starboard side. The tug/barge unit was stopped in the water as the cruise ship passed clear. The position of the occurrence was reported as approximately 50°19.0'N, 125°24.5'W.

The "STATENDAM" was then noted to heel over heavily to port as she turned to starboard, heading out to mid-channel. The "BELLEISLE SOUND" proceeded on her voyage, entered Nodales Channel at 2305, and arrived at Phillips Arm at 0130, 12 August 1996.

1.3 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	-	-	-	-
Missing	-	-	-	-
Serious	-	-	-	-
Minor	2	6	-	8
None	555	1321	-	1876
Total	557	1327	-	1884

Four passengers suffered sprains, one broke two toes when she lost her balance and fell, and one sustained multiple cuts and abrasions when she fell from a stool in the casino. Two of the crew also suffered sprains.

1.4 Damage

There was no structural damage to the "STATENDAM". An unsecured grand piano in the passenger atrium area moved 2 or 3 m and came to rest against a bulkhead. Some water from the vessel's two outdoor swimming pools poured down the after companionway and a small quantity entered the doorways below. No serious damage resulted.

The tug/barge unit was undamaged.

1.5 Certification

1.5.1 Vessels

All three vessels involved met the crewing, certification and equipment requirements of the existing regulations.

1.5.2 Personnel

The officers and crew of both vessels who were directly involved in the occurrence held certificates/qualifications appropriate to their positions and for the service in which their vessel was employed.

The pilot on duty on the "STATENDAM" at the time of the occurrence held a Canadian Tug Master 350 Ton Certificate of Competency. He has held a Class I Pilot's Licence since July 1991.

1.6 Personnel History

"STATENDAM"

The master had sailed with Holland America Line (HAL) since he started his seagoing career as a cadet in 1973, and had sailed solely on passenger vessels since 1974. His first command was in 1990, and he was appointed as a regular captain in 1992. He had sailed previously on the "STATENDAM" and had rejoined the vessel on 05 August 1996. He had sailed on the Alaskan run for most summers since 1973.

The third officer on watch in the wheel-house at the time of the occurrence started his seagoing career as a cadet in 1990, and had sailed with HAL since 1993. He had sailed on the "STATENDAM" as third officer in 1995, and rejoined the vessel in May 1996.

The QM at the wheel at the time of the occurrence had been at sea with HAL since 1982. He had been on board the "STATENDAM" for 10 months as quartermaster on this particular tour of duty and had also sailed on the vessel's sister ship.

The pilot sailed in the tow boat industry on the west coast of North America from 1956 to 1990. Starting in 1967, he sailed as master on tugs and joined the British Columbia Coast Pilots in 1990. He had piloted numerous cruise ships; however, this was his first trip on board the "STATENDAM".

"BELLEISLE SOUND"

The master had approximately 14 years' seagoing experience on the west coast of Canada. He had sailed with the company for five years and had been master since acquiring his master's certification in May 1996. He was on his first trip as master of the "BELLEISLE SOUND" and had sailed previously on the vessel as mate. He was thoroughly familiar with the waters of Discovery Passage.

1.7 Environmental Information

1.7.1 Weather as Recorded by the Vessels

At the time of the occurrence, visibility was estimated to be from near zero to three cables. In these sheltered waters the seas were calm and the wind variable at 1 to 2 kn.

1.7.2 Tides and Currents in Discovery Passage

Tidal differences for Seymour Narrows are referenced on Owen Bay and given in the Canadian Tide and Current Tables, Volume 6, as are Current Tables for Seymour Narrows.

On 11 August 1996, low water at Seymour Narrows was predicted to be at 2035, with a height of 2.62 m above chart datum, and high water was predicted to be at 0205, on 12 August, with a height of 3.62 m above chart datum. Slack water was predicted to be at 2310, and the time of maximum current velocity on the flood

tide flowing in a southerly direction was predicted to be at 0145, 12 August, with a rate of 6.6 kn.

The current in the vicinity of the occurrence reaches a maximum of 2 kn and is estimated to have been negligible at the time of the occurrence.

1.7.3 Geographical Information

Between Cape Scott and Campbell River, B.C., the passage separating Vancouver Island from the mainland is narrow and strewn with islands. This, and the fact that the tide from the south takes two hours more to reach the narrowest parts of the channel than the tide from the north, explains the extremely rapid tidal streams associated with Seymour Narrows. This difference results in a two-hour lag in the time of the tides at Campbell River as compared to Seymour Narrows.

The northern part of Discovery Passage is approximately 1.2 miles across from the Vancouver Island shoreline to the west and Sonora Island to the east. The 50 m depth contour line is within one cable of the Sonora Island shoreline.

1.8 Navigation Equipment

Both vessels were equipped with modern navigational aids in good working order at the time of the occurrence.

"STATENDAM"

The vessel's aids to navigation, communication, and collision avoidance included:

- Four radar sets; two X-band (3 cm) and two S-band (10 cm). All four sets were operational at the time of the occurrence and all have ARPA capabilities;

- Four VHF radiotelephones, two at the centre of the wheel-house and one at each wing;

- An electronic chart display integrated system (ECDIS), fitted on a trial and evaluation basis. The system was integrated with a Global Positioning System (GPS), but was not integrated with the Doppler log. Although the system was installed on a trial basis, the GPS positions recorded and plotted are considered to be an accurate representation of the vessel's track as she rounded Chatham Point;

- Two Anschutz Kiel gyrocompasses with digital repeaters on each bridge wing, and two course and rudder recorders - one for each rudder; and

- A Doppler speed log; a depth-sounder, and a Global Maritime Distress and Safety System (GMDSS) station.

On a trial basis, the vessel had a VHS voice-logging recorder installed in the wheel-house to record wheel-house conversations. Following the occurrence, it was discovered that the tape in the machine had been stuck for some weeks.

The course recorder graphs were found to be slow at the end of the voyage; the starboard rudder graph was approximately seven minutes slow and the port rudder graph approximately three minutes slow.

The graphs indicate that after the vessel commenced her swing around Chatham Point, approximately 16 degrees port helm was applied to steady the vessel before the helm was placed hard-a-starboard. This coincides partially with crew information that the vessel was steadied on a southerly heading before it was necessary to place the helm hard-a-starboard to avoid the "BELLEISLE SOUND". However, it is evident from the graph and from the ECDIS, that the vessel was on a southerly heading only momentarily before swinging hard-a-starboard.

The pilot reported that the vessel was not steadied on a southerly heading, but that starboard helm applied rounding Chatham Point remained applied until the "STATENDAM" crossed ahead of the tug and tow.

The time scale used on the course recorder graphs is barely adequate to discern small alterations of course.

"BELLEISLE SOUND"

The vessel's aids to navigation, communication and collision avoidance included:

- Two radar sets, one of which was fully operational. Neither set had ARPA capabilities; and

- A magnetic compass/autopilot; a GPS; a depth-sounder and three VHF radiotelephones.

1.9 "STATENDAM"—High Performance Rudder

The "STATENDAM" is fitted with two Becker-type high performance rudders, with a maximum rudder angle of 45 degrees.

This type of rudder has a movable trailing edge flap which is activated by a link system located at the top of the rudder. The flap angle is a function of the main rudder angle and enhances the performance of the rudder both in maintaining a good course and when manoeuvring the vessel. A flap rudder in combination with bow and stern thrusters also improves the manoeuvrability of a vessel with little headway or moving astern.

Under most circumstances, helm movements of two or three degrees are sufficient to alter course at high speeds. At full speed, these rudders achieve a smaller final turning radius and tactical diameter than a conventional rudder, but the quick response and larger rate of turn achieved are more difficult to check (steady). Care must be exercised that too much rudder is not applied. The stability characteristics of most passenger vessels are such that large angles of heel may be produced by the application of too much rudder when the vessel is proceeding at speeds over 16 kn. If the rudder is suddenly moved to counteract an excessive heel, dangerous heel angles can occur.

To avoid large angles of heel when turning, the maximum rate of turn normally applied is 10 degrees per minute at 20 kn. For the safety and comfort of passengers, when large alterations of course are planned, the vessel's speed is reduced to 16 kn.

Helm orders for course alterations, particularly large alterations, are given as a rate of turn in degrees per minute. The vessel's master, officers and the QM at the helm were well experienced in steering by this method. The pilot who made the large alteration of course around Chatham Point was not well versed in the method.

Conventional methods of altering course (directing the helmsman to apply degrees of helm or to steer a given course) are still the norm for pilots, most of whom are less familiar with the "rate-of-turn" method.

Before he was dispatched to the vessel, the pilot had been informed by the pilotage authority that the "STATENDAM" was equipped with high performance rudders.

1.10 VHF Communications

Discovery Passage is in sector four of the Vancouver Traffic Zone, and communications are handled from the MCTS Centre at Comox, B.C. The assigned working frequency for the area is 156.575 MHz, channel 71, and all conversations are recorded. There is no MCTS radar coverage for the area.

1.10.1 Vessels Carrying Dangerous Goods—Marine Communications and Traffic Services (MCTS) Procedures

Vessel Traffic Services (VTS) and the Coast Guard Radio Stations (CGRS) had recently amalgamated. A Manual of Operations was being developed for the new organization, the Marine Communications and Traffic Services (MCTS). At the time of the occurrence, both the National and Vancouver VTS Manuals of Operations (MANOPS) stated that:

> When (a Marine Traffic Regulator (MTR)) is advised of any pollutant and/or dangerous goods movements in VTS zones, MTRs shall if possible:
>
> 1. obtain the nature of the pollutant and/or dangerous goods (IMO code, cargo code, or pollutant code);
>
> 2. obtain the weight and measure of the pollutant and/or dangerous goods;
>
> 3. obtain the type of storage used such as:
>
>   - bulk;
>   - container;
>   - etc.
>
> 4. advise all opposing, crossing and overtaking traffic that the vessel carries pollutant and/or dangerous goods and what the vessel's intentions are.

In addition, the Vancouver VTS MANOPS states, with regard to pollutant and/or dangerous goods movements:

> 1. The MTR will receive a report from the vessel specifying whether any pollutant or dangerous goods cargo is carried on board the ship or any vessel or object being towed or pushed by the ship; and
>
> 2. Special attention shall be given by MTRs to ships and tugs carrying pollutants and/or dangerous goods.

1.10.2 Communications with MCTS

Both the "STATENDAM" and the "BELLEISLE SOUND" participated fully in the MCTS reporting system.

The "BELLEISLE SOUND" called MCTS on departing Menzies Bay and advised the MTR on duty of her intentions and that she was carrying dangerous goods. She subsequently confirmed her intentions at the two calling-in points on her route.
On VHF channel 71, MCTS notified the following southbound cruise ships of the presence and whereabouts of the "BELLEISLE SOUND": the "CROWN DESTINY" at 2138; the "WINDWARD" at 2145, and the "SKY

PRINCESS" at 2154.

While the MTR on duty at the time of the occurrence informed these vessels of the presence and intentions of the "BELLEISLE SOUND"/"RADIUM 622" as required by the MANOPS, he did not inform them of the fact that the tug/barge unit was carrying dangerous goods.

Times from MCTS audio transcripts indicate that by the time the "BELLEISLE SOUND" passed Cinque Islands, she had safely passed the other three southbound cruise ships.

When the "STATENDAM" reported at Ripple Point at 2213, MCTS notified the vessel that the "BELLEISLE SOUND" was pushing a barge and approaching Cinque Islands, northbound.

Neither the "STATENDAM" nor the "BELLEISLE SOUND" informed MCTS of the close-quarters situation after the occurrence. When the "BELLEISLE SOUND" attempted to call the "STATENDAM" at 2242, the MCTS operator assisted, but the operator was not aware at the time of the dangerous occurrence.

1.10.3 "STATENDAM"—Responsibility for Communications

VHF communications by the "STATENDAM" were handled exclusively by the pilot.

In the British Columbia pilotage area, the general practice is that the pilot exclusively handles VHF communications, particularly with MCTS. The pilot of the "STATENDAM" reported that he was the logical person to handle communications since he had the con and was better versed to answer questions regarding the vessel's passage, position, intentions, etc. This view was supported by the shore-based pilotage personnel interviewed. The master indicated that the OOW would not answer the VHF while the pilot had the con unless the pilot asked him to do so.

1.10.4 Communications Between Vessels

The "BELLEISLE SOUND" reportedly called the "STATENDAM" twice on channel 71 before the occurrence. The MCTS channel 71 audio recordings do not indicate that VHF communication took place between the two vessels at that time.

MCTS audio recordings indicate that the "BELLEISLE SOUND" called the "STATENDAM" at 2242 and at 2243. Both of these calls went unanswered. The tug successfully established communication with MCTS in the interval between her two calls to the cruise ship. At 2250, the tug made another call, which was acknowledged by the "STATENDAM". The cruise ship was requested to go to channel 70 but did not reply on that channel, and no further inter-ship communication took place.

1.11 Time of the Occurrence

The "STATENDAM" reported the time of the occurrence as 2236, and the "BELLEISLE SOUND" as approximately 2245. The information available, including MCTS recorded times of each vessel passing calling-in points, average speeds and distances to go, and bridge recordings of GPS positions on the

"STATENDAM", indicate that 2236 is the time closest to the time of the near-collision.

1.12 Passenger Vessel Activity, Scheduling and Seymour Narrows

During the 1996 season, a total of 283 voyages were made by the 24 cruise ships engaged on the Vancouver-to-Alaska service. The number of passengers carried was 701,547. This activity contributed some $200 million to the economy of British Columbia.

The logistics of cruise ship operations are influenced by some or all of the following factors: the time of arrival at Vancouver southbound to enable passengers to make airline connections; the costs associated with longshoremen, storing and refuelling; the number of cruise ships arriving in port about the same time; and the requirement to meet scheduled sailing times. Scheduling is a primary consideration for the owners, masters, pilots and crews of passenger vessels.

Voyage planning, routing and speed on passage, either northbound or southbound, are dictated by the time of slack water at Separation Head, Seymour Narrows, where maximum rates of current can attain 16 kn. It is necessary to transit the Narrows at or near slack water. Depending on the amount of power a vessel has, there is a window of approximately 30 minutes to 1 hour to make the transit. Outside of this window, the transit becomes too dangerous due to strong currents and eddies encountered at later stages of the tide.

The maximum ebb setting in a northerly direction on 11 August, was at 2005, at a rate of 9.6 kn. The maximum flood was predicted to be at 0145 the following morning, setting south at 6.6 kn, giving the vessel a larger than usual window.

On boarding a southbound vessel at the Triple Island pilot station, pilots consult with the master on the speed to set on the first leg of the passage to Pine Island at the entrance to Queen Charlotte Strait. The planned time of arrival at Pine Island is calculated to allow the vessel to proceed at a reduced speed on the next leg to arrive at the time of slack water at Seymour Narrows and for unforseen conditions, such as fog.

In order to keep to the vessel's arrival and departure schedule for Vancouver Harbour, the master of the "STATENDAM" and the pilot agreed that it was necessary for the vessel to be at Separation Head at the entrance to Seymour Narrows for slack water at 2310, and speeds were calculated and set accordingly.

The Canadian Coast Guard produces an advisory notice each year to commercial and fishing vessels transiting the inside passages. The notice instructs on VHF procedures to assist in a safe passage during the fishing season when the traffic in places such as Discovery Passage becomes congested, making it more difficult and dangerous for cruise ships to transit the area.

1.13 Voyage Planning—"BELLEISLE SOUND"

The "BELLEISLE SOUND" was on short runs between logging camps and fishing camps, and since it was only about four hours' journey to Phillips Arm where the vessel would anchor until daylight, it was intended

that the master would take the vessel straight to her destination without setting up watches. Watches would be set for longer runs.

1.14 Speeds

"STATENDAM"

The speed of the "STATENDAM" was reduced to manoeuvring full ahead (approximately 16 kn) at 2216, off Ripple Point. However, the vessel averaged approximately 18.33 kn between Ripple Point and her position as plotted at 2230. According to GPS positions taken between 2230 and 2236, the "STATENDAM" averaged a speed of 18 kn while rounding Chatham Point.

The computer printout from the ECDIS indicates a speed of 17.3 kn immediately before the near-collision. However, the ECDIS was not integrated with the Doppler log and the speed as shown would therefore be derived from the last GPS positions immediately before the near-collision.

"BELLEISLE SOUND"

The "BELLEISLE SOUND" was travelling at 1,450 rpm, approximately 7 kn. The vessel did not proceed at her full sea revolutions (1,700 rpm = 8.5 kn) at any time on this voyage. She averaged approximately 8.64 kn between Separation Head and Cinque Islands while under the influence of a northerly current of approximately 2 kn, but after passing Cinque Islands, the current would have been negligible. The vessel further reduced speed shortly after entering the fog mainly because the master was aware that the "STATENDAM" was approaching.

1.15 Pilotage

1.15.1 Pilotage in British Columbia Waters

Pilotage, compulsory in all coastal waters of British Columbia, is under the jurisdiction of the Pacific Pilotage Authority (PPA), a Crown Corporation established under the provisions of the *Pilotage Act*. The waters of British Columbia are divided into five pilotage areas administered by the PPA.
The British Columbia Coast Pilots Limited (BCCP), to which the pilots aboard the "STATENDAM" belong, is structured as a company which contracts pilotage services to the PPA for the whole of British Columbia, with the exception of Area 1, the Fraser River.

BCCP pilots are required to maintain expertise and competence in all four pilotage areas, not just one specific area or port. The total area involved is vast and contains many ports. In most other pilotage jurisdictions in Canada and in other parts of the world, pilots are expected to be knowledgeable of a smaller designated area or number of ports.

In 1996, 12,713 pilotage assignments were completed within the PPA jurisdiction and 19 accidents/incidents were reported.

1.15.2 Pilots' Qualifications

In many countries, pilots are ex-shipmasters with Master Foreign Going or equivalent certification, but there are few holders of the superior certificates required for use on larger ships who have the necessary "experience at sea" qualification on the B.C. coast.

The pilot on duty at the time of the occurrence holds a Tug Master 350 Ton Certificate of Competency issued in Vancouver on 06 April 1965, and was qualified to pilot ships of any length.

The General Pilotage Regulations set out the requirements for licences and pilotage certificates. Pilots' minimum entry qualifications vary throughout the pilotage areas of Canada and are adapted as required locally. The requirements in the Pacific region are predicated by the fact that the towing industry is a major component of maritime commerce in the area and the recruiting base for most pilots.

For acceptance as an Apprentice Pilot, the PPA requires that the candidate possess a certificate of competency at a level not lower than Master, Home-Trade, unlimited tonnage. In the event that no application is received from applicants so qualified, this requirement may be lowered to Master, Home-Trade, Steamship of under 350 tons gross tonnage. There is also a requirement for a period of three years of "sea service" in the B.C. Coast area.

After passing the entrance examinations, the pilot completes a six-month apprenticeship before receiving a pilot's licence. All pilots have taken SEN I, SEN II, and ARPA radar courses and are also sent to training courses in ship handling at a facility in France, and to ship-handling simulator training in Rhode Island, USA. The Pacific Pilotage Authority provides funds to the BCCP to conduct skills enhancement training. A period of a further five years as a pilot is required before qualifying to pilot vessels of any length.

Pilots are kept aware of changing technology and advances in the field of navigation by their own newsletter. They do not, however, have a system of training in place to ensure that they are regularly trained to meet the demands of the new technology in ship-handling equipment, nor do they have frequent updates to their training.

1.16 General Perspective—Pilotage Issues

To gain a better perspective of ship's crew/pilot relationship within the cruise ship industry in British Columbia, representatives of the PPA, the BCCP and HAL were interviewed.

At the beginning of each season, the PPA meets with cruise ships' masters, and twice yearly with the North West Cruise Ship Association, to address issues. This approach reportedly has been successful and has contributed to a better relationship, but residual issues continue to cause concern to pilots, masters and shipowners.

It was reported that on some ships the cabins assigned to off-duty pilots are poorly located and do not enable the pilots to get adequate sleep on long runs. Pilots' scheduling is also a concern and may, with the lack of adequate sleep caused by their location, lead to pilot fatigue. These issues have adversely affected the crew/pilot relationship on some ships where such problems are ongoing. It was reported, however, that accommodation matters had been previously satisfactorily addressed on the "STATENDAM" and the other HAL vessels.

Shipping company representatives implied that pilots do not always maintain currency with the latest manoeuvring technology and are not trained in bridge resource management (BRM). Cited was the fact that the integrated navigation system on the "STATENDAM" is not used because pilots are not trained in its use.

Reportedly, the pilots' background and qualifications are, in some instances, the cause of strained relationships between ship masters, navigating officers and pilots. This was reported to be more prevalent on the West Coast than in other parts of Canada. Corporate attitudes, pilotage fees, pilots' limited liability, and the experience of senior HAL officers, who have spent many years on Alaska cruise ships and know the waters well, also have an effect on the attitudes of ships' officers.

For efficiency, and in an attempt to solve pilot fatigue issues due to the 30-hour length of a pilotage assignment, a new system of direct transfers was tested during the 1996 season.

The system involved pilots disembarking from northbound ships at Triple Island. Instead of disembarking and going to rest in a hotel in Prince Rupert before boarding a southbound vessel 24 hours later, the pilot transferred directly to a southbound vessel if the approximate time of the transfer was between 2330 and 0230, because the time normally lost in the inner passages

was when passengers slept. The pilots then rested on board and took over the pilotage at McInnes Island. In the event of bad weather necessitating routing by the inner passages, this system could not be used.

Cruise lines were not entirely happy with this proposed arrangement as the opportunity to travel the northern part of the inner passages was then lost and the transit of these scenic passages is a major factor in attracting passengers to cruise the area.

In the 1997 cruise ship season, from mid-May to the latter part of September, a new pilot station was established at Port Hardy (Pine Island) on a trial basis and this was very successful. Vessels which did not wish to transit the inner passages disembarked their pilots at the station and proceeded through Hecate Strait without a pilot on board. Due to the bad weather often experienced in the Pine Island area, there was some concern as to the ability of pilots to disembark there. For the trial period commencing on 12 May, only pilots from northbound vessels did so.

1.17 Navigation with a Pilot on Board

Traditionally, mariners have confidence in the knowledge and skills of marine pilots who, in many countries, become pilots after having served as master mariners and having commanded large ocean-going ships. The usual relationship is that ship masters and officers trust in the pilot's accumulated and local knowledge, and they are reluctant to distract, or interfere with, the pilot.

The position of a pilot on board a vessel was summarized by the Royal Commission on Pilotage, Ottawa, 1968, as follows:

> "To conduct a ship" must not be confused with being "in command of a ship." The first expression refers to an action, to a personal service being performed; the second to a power. The question whether a pilot has control of navigation is a question of fact and not of law. The fact that a pilot has been given the control of a ship for navigational purposes does not mean that the pilot has superseded the Master. The Master is, and remains, in command; he is the authority aboard. He may, and does, delegate part of his authority to subordinates and to outside assistants whom he employs to navigate his ship, i.e., pilots. A delegation of power is not an abandonment of authority but merely one way of exercising authority.

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978, as amended in 1995, and the International Maritime Organization (IMO) Code of Nautical Procedures and Practices, adopted by Canada and distributed as publication TP 1018, state in part:

> Navigation with pilot on board
>
> 49 Despite the duties and obligations of pilots, their presence on board does not relieve the master or officer in charge of the navigational watch from their duties and obligations for the safety of the ship. The master and the pilot shall exchange information regarding navigation procedures, local conditions and the ship's

> characteristics. The master and/or the officer in charge of the navigational watch shall co-operate closely with the pilot and maintain an accurate check of the ship's position and movement.
>
> 50 If in any doubt as to the pilot's actions or intentions, the officer in charge of the navigational watch shall seek clarification from the pilot and, if doubt still exists, shall notify the master immediately and take whatever action is necessary before the master arrives.

The *Bridge Procedures Guide* published by the International Chamber of Shipping also indicates that the presence of a pilot does not relieve the master or the OOW of their duties and obligations. The Guide stresses that the responsibility for the ship's navigation is not transferred to the pilot and the OOW retains all of his duties. The expertise of the pilot should, however, be fully supported by the ship's bridge personnel.

Under Netherlands law, the pilot has an advisory status to the master.

1.18 The Pilotage Act

Subsection 25.(2) of the *Pilotage Act* dealing with a pilot's responsibility to the master states:

> A licensed pilot who has the conduct of a ship is responsible to the master for the safe navigation of the ship.

Section 26 of the *Act* pertaining to a master relieving a pilot or pilotage certificate holder provides:

> (1) Notwithstanding any provision of this Act, where the master of a ship believes on reasonable grounds that the actions of a licensed pilot or holder of a pilotage certificate on board a ship are, in any way, endangering the safety of the ship, the master may, in the interest of the safety of the ship, take the conduct of the ship from the licensed pilot or holder of a pilotage certificate or relieve the licensed pilot from duty on board ship.

> Master to report
>
> (2) Where the master of a ship takes the conduct of a ship from a licensed pilot or holder of a pilotage certificate pursuant to section (1), the master shall file, within three days of taking the conduct of the ship, a written report setting out the master's reasons therefor with the Authority that issued the license or pilotage certificate.

The PPA issues a letter to the masters of cruise ships at the start of the season along with special requirements under the heading "Guidelines for Masters of Cruise Ships." The first paragraph states:

> Pilotage is compulsory when transiting British Columbia Coastal waters. The Pilot MUST have the conduct of the ship in accordance with Section 25(1) of the Pilotage Act. You may only relieve the pilot if you have reason to believe the actions of the pilot are, in any way, endangering the safety of your ship. If this occurs, you must report, in writing, with your reasons, to the Authority within three days under Section 26(2).

1.19 Holland America Line—Operating Regulations

The HAL Masters' and Deck Officers' Operating Regulations make the following reference to navigation with a pilot on board:

> The Master - Responsibilities and Duties
>
> Pilotage
>
> The master must remain alert and attentive to the pilot's handling of the vessel and must counsel the pilot at any time the pilot is in error or otherwise neglecting the safe navigation of the vessel.
>
> Should the pilot fail to act on the master's council when the master judges the safety of the vessel to be jeopardized, the master must relieve the pilot and take control of the vessel. Full details of this action must be entered in the deck log.

The company's *Safety Management Manual* dated 01 June 1996, as set out for the International Safety Management (ISM) Code, makes it clear that the master is granted by law, the company and the traditions of the sea, the authority necessary to carry out his responsibilities.

Bridge Watchkeepers

The standing orders for watchstanders also indicate that the OOW should coordinate bridge-to-bridge, ship-to-shore and station-to-station communications.

Additionally, the master of the "STATENDAM" had his own set of standing orders for the guidance of watchkeeping officers. One entire section dealt with wheel-house duties with a pilot on board, including being aware of all VHF communications.

1.20 Exchange of Information—"STATENDAM"

The "STATENDAM" displayed a wheel-house poster, as developed by IMO, on the after wheel-house bulkhead. Pilot cards giving the vessel's characteristics were readily available in the wheel-house.

When the two pilots boarded the vessel at 0300, on 11 August, an exchange of basic information took place with the master. The information exchanged included the fact that the pilot had not been on the "STATENDAM" before; the time at which it was planned to transit Seymour Narrows; the ETA at Vancouver First Narrows; and that the engine-room did not require notice to reduce speed.

The vessel proceeded in a southerly direction in Hecate Strait. The ship's officers were in charge. The pilots were resting below as they were not due to take over the conduct of the vessel until she reached the approaches to Milbanke Sound at 1030 that morning.

The OOW in charge of the morning bridge watch reported that the pilot entered the wheel-house before he was scheduled to take over the con, had some coffee and was fully briefed on the vessel's manoeuvring characteristics. The pilot already had a copy of the pilot card. The OOW reported that he went over the details of the ship's navigation and propulsion equipment, the amount of rudder angle needed for turns, and how to use the rate-of-turn method to alter course. The OOW reported that the pilot used this method to alter course for the remainder of the watch.

The OOW also reported that he discussed with the pilot the limitation on rates of turn at speeds of 20 kn and the reasons for these limitations (See Section 1.9). Also discussed was the fact that the rate of turn could be increased if the vessel's speed was reduced, and that when negotiating sharp bends in channels, an ideal speed was about 16 kn.

The pilot did not recall being briefed on the manoeuvring capabilities of the vessel by the OOW but reported that he was given a copy of the pilot card which lists some of these particulars. He also reported that only basic information was exchanged between the ship's master, the OOW and himself.

Up to the time the vessel rounded Chatham Point, the pilot reported that he did not employ the rate-of-turn method to alter course but gave the helmsman the new course to steer when an alteration was required.

1.21 Bridge Resource Management

BRM principles advocate that members of the bridge team should:

- divide tasks to share the workload;
- share information to ensure, as far as is possible, that all relevant factors are taken into account in decision making;
- create an environment to allow the members of the team to challenge an action perceived to be unsafe; and
- enable the primary decision-maker or team to make decisions on the basis of *all* the information available.

Following a collision between the Netherlands Antilles passenger ship "NOORDAM" and the Maltese bulk carrier "MOUNT YMITOS" in the Gulf of Mexico on 06 November 1993, the United States National Transportation Safety Board (NTSB) made recommendations.

Subsequent to these recommendations, HAL implemented BRM training for its officers. Some 90 per cent of the 150 officers had completed the course. The remaining 10 per cent were scheduled for training before the end of 1996. The course, which consists of 2½ days of theory and 2½ days of simulator training, was designed for HAL by outside agencies specializing in BRM. HAL is also reportedly developing an engine-room resource training course.

The master of the "STATENDAM" had completed the BRM training, and the OOW was scheduled for the fall training course.

In view of safety deficiencies in the effectiveness of current bridge team management practices in compulsory pilotage areas, the Transportation Safety Board of Canada conducted *A Safety Study of the Operational Relationship Between Ship Masters/Watchkeeping Officers and Marine Pilots* and made several recommendations in 1995. Inter alia, the Board recommended that:

> The Department of Transport require that the initial training syllabus for all ship officers be modified to include demonstration of skills in Bridge Resource Management (M95-09); and
>
> The Department of Transport require that all pilots demonstrate skills in Bridge Resource Management before the issuance and/or renewal of a pilotage licence (M95-11).

In response, Transport Canada (TC) indicated that it will promote the development and the provision of BRM training courses and, in conjunction with Canadian pilotage authorities, will promote the inclusion of a BRM training course for applicants and holders of pilot licences and pilotage certificates.

At present, there are several centres in Canada at which BRM training is given for ship's masters and officers. At least one major Canadian shipping company sends its officers to one of these Canadian centres; several other companies arrange such training at a course in the USA. Prior to 1997, there was no minimum, uniform and

approved national standard to which trainees were trained and at which level a universally recognized training certificate was issued. In 1997 however, TC convened a working group to establish and make public such standards. Representatives of shipowners, marine schools, pilotage authorities and officer unions were present and provided their input to TC.

At the time of this occurrence, pilots from the Pacific pilotage area had not been given structured BRM training. The PPA reports that it awaits the establishment of a TC training standard/syllabus but has commenced BRM training for its pilots, on its own initiative, in the meantime.

1.22 HAL—Safety Management Issues

To comply with one of the NTSB recommendations made following the "NOORDAM" collision, HAL sets up yearly conferences for ships' captains and yearly conferences for senior officers. The object of these conferences is to identify and discuss operational problems encountered during the year.

HAL has produced a *Safety Management Manual* signed by the Chief Executive Officer; updated "Technical Directives" and "Operational Directives," and rewritten "Deck and Engine-room Regulations" to conform with the 1995 amendments made to the Annex and Code of the STCW.

At the time of the occurrence, HAL had requested several classification societies to bid to audit the company for full compliance with the ISM Code for the safe operation of ships and for oil pollution prevention. The ISM Code, by virtue of the entry into force of Chapter IX of the International Convention for the Safety of Life at Sea (SOLAS), became mandatory for passenger ships on 01 July 1998. The company is also in the process of implementing audit programs, investigations, and its own computerized accident reporting system to comply with the Code.

1.23 Occurrence Reporting Requirements

The *Pilotage Act*, the *Canadian Transportation Accident Investigation and Safety Board Act* and the *Canada Shipping Act* (CSA) all require the reporting of a dangerous occurrence, accident or incident.
The CSA requires that a dangerous occurrence be reported to the nearest shore station as soon as possible with a written report within 24 hours or as soon as practicable after the occurrence.

The master of the "STATENDAM" reported the occurrence to the owners of the vessel. The pilot reported it to the BCCP. No representative of either the "STATENDAM" or the "BELLEISLE SOUND" reported the occurrence as required and described above.

1.24 Carriage of Dangerous Goods

Dangerous Goods Shipping Regulations (DGSR)

These comprehensive regulations address the packing, stowage, carrying, marking, and inspection of dangerous goods on ships but do not apply to dangerous goods that are carried in bulk.

Goods, articles or materials classified as dangerous in the IMDG Code are considered to be dangerous goods by the DGSR.

Only when quantities of more than 25 tonnes of Class 1 explosives are to be carried on a ship does the DGSR require that at least 24 hours' notice be given to the nearest office of TC Marine Safety before loading.

When less than 25 tonnes is to be transported, as was the case with the "BELLEISLE SOUND"/"RADIUM 622", the shipper is still required to comply with the IMDG Code/DGSR with regards to the stowage and segregation of the dangerous goods.

Where dangerous goods are carried on an uncrewed barge under tow, the requirement of these regulations respecting documentation and personal protection equipment apply to the towing vessel and not to the barge. It would appear that the "BELLEISLE SOUND" complied with these requirements. Additionally, the "RADIUM 622" had a Shipboard Oil Pollution Emergency Plan approved by TC Marine Safety on 07 June 1996.

The DGSR and IMDG Code call for segregation between the various classes of dangerous goods, both for goods carried under deck and those carried on deck. The IMDG Code also calls for separation between the flammable cargoes on deck. A separation of some 6 m is required between the grades of explosives, and 24 m between the flammable liquids and gases on deck and also between flammable liquids under deck. Under-deck stowage also requires an intervening compartment for separation in addition to the distance of 24 m. In Canada, the requirements for separation are subject to special rulings by the Board of Steamship Inspection.

Both the IMDG Code and the DGSR require the master of a ship or, in the case of an uncrewed barge, the person in charge of that barge, to ensure that dangerous goods are safeguarded and handled carefully while they are being loaded on, carried by, and discharged from the vessel or barge.

Reportedly, the larger companies which operate larger barges are generally in compliance with the IMDG Code and the DGSR.

The dimensions of the "RADIUM 622" (length 45.7 m, breadth 10.6 m) are such that the dangerous goods carried could not be segregated and separated as required by the IMDG Code or the DGSR made pursuant to the CSA.

Similarly, by virtue of the dimensions of the small tug/barge units operated by the majority of companies which supply dangerous and other goods to remote logging and fishing camps in British Columbia, the full requirements of the IMDG Code for large crewed ships and of the DGSR are not met—in particular those requirements which relate to the segregation and separation of dangerous goods.

Statistically, it can be shown that, in the past 35 years in British Columbia, no major accident/incident involving the carriage of dangerous goods by sea has occurred. Current industry practices may, however, create the conditions for similar dangerous occurrences.

Report of Occurrence

The DGSR require that, if a ship is at any time in serious and imminent danger by reason of an occurrence while dangerous goods are being loaded, unloaded or transported, the master of the ship or his agent shall immediately report the occurrence to the nearest office of TC Marine Safety or steamship inspector by the quickest means available.

The "BELLEISLE SOUND" did not report the occurrence as required.

1.25 Properties of the Dangerous Goods Carried on the "RADIUM 622"

The "RADIUM 622" carried as cargo on deck:

Liquid Propane (71,620 L): a flammable gas, Class 2, Division 1. If released from its containers, this quantity is equivalent to a volume of about 19 million litres of propane gas and a cloud of some 921 million litres (approximating a cube of gas with sides of 100 metres) of air/propane mix at its lower explosive limit.

Jet B Fuel (9,225 L): a flammable liquid, Class 3.

Dynamite (1,250 kg, brand name AP Cogel): an explosive, Blasting Type A, Class 1.1D UN 0081, with a mass explosion hazard. A detonator is required to activate the explosive.

Ammonium Nitrate (3,725 kg, brand name Austinite 15): an explosive, Blasting Type B, Class 1.5D UN 0331, with a mass explosion hazard. It requires both a primer (fuel oil/diesel, etc.) and a detonator to activate.

Detonators: 10 cases of detonator assemblies, non-electric, Class 1.1B UN 0360.

The following fuels were carried under deck:

Stove oil (15,000 L): a fuel similar to diesel oil.

Diesel oil (247,000 L), UN 1202: flash point not less than -18°C but less than 23°C.

Gasoline (183,000 L), UN 1203: flash point -45°C, lower explosive limit 1.4 per cent.

2.0 Analysis

2.1 Exchange of Information—"STATENDAM"

To be effective, the master or OOW/pilot dialogue should be initiated with the formal presentation of the pilot card and examination of the bridge poster, and continued through informal discussion about the capabilities of the ship, status of relevant equipment, the intended pilotage, and any pertinent regulations or special conditions. Performed in this manner, the exchange of information removes doubt as to the intended course of action of any party to the exchange.

Conflicting information collected in this instance does not make it clear whether or not a full exchange of information took place. However, it is evident that the exchange did not take place at one session or in the formalized manner necessary for a complete understanding of the intentions of the vessel's master/OOW and the pilot.

2.2 BRM—"STATENDAM"

The working relationship between ship masters/watchkeeping officers and pilots is a crucial factor in the safe navigation of cruise ships in the inside passages and coastal waters of British Columbia.

Because of the different maritime background (experience and training) of BCCP pilots and the masters and officers of these cruise ships, it is essential that the skills of each person be combined in the working relationship of a bridge team. Within the team, it is also essential that the different tasks required for the safe navigation of the vessel be allocated to the person best equipped/experienced to carry them out and that each person not carry too much workload.

Although the principles of BRM are well known and have gained wide acceptance in the shipping industry, the non-application of these principles was a major factor in the development of the close-quarters situation.

Of the bridge team, only the master had been trained in BRM, but he neither interfered with, nor challenged, the pilot's decisions until after the vessel had been committed to a course which led her into danger. Further, because arrangements were not made to share the workload/tasks involved in navigation and in communications, members of the bridge team, including the pilot, were not effectively engaged on those tasks in which they were most experienced and which were fundamental to safe navigation.

Because the master was preoccupied with the vessel's scheduling (in this instance her ETA at Seymour Narrows), he was concentrating on the vessel's speed and, at the time the vessel was rounding Chatham Point, ordered the OOW to tell the engine-room to reduce the number of

generators to three. The effect of this was that, during the initial part of the swing, attention was momentarily diverted from both the rate of turn and the identification of the radar target of the "BELLEISLE SOUND" about whose intentions they had previously been informed by MCTS.

Similarly, the pilot was preoccupied with the vessel's rate of turn, using a method with which he was not familiar. The master, OOW and the helmsman were familiar with the method but the master and OOW were, at least initially, acting upon the need to reduce speed to arrive at Seymour Narrows at a suitable time. The effect was that the pilot, unassisted, chose a rate of turn which could not bring the vessel onto her intended track for the next leg of the voyage.

The pilot was not alone in believing that he was best equipped to handle VHF communications; shore-based pilotage personnel also shared this traditional view. The pilot also communicated by handheld VHF which, although equipped with a speaker, was reportedly used in such a way that only he knew what was said in these conversations. It was reported that the pilot was using his radio while starting the turn at Chatham Point which also may have distracted him from the more important decision of establishing the appropriate rate of turn.

Had BRM been practised, the whole bridge team could have been kept aware of all information received on the bridge by this means while concentrating on primary tasks. If other members of the bridge team, as well as the pilot, had monitored VHF communications, it is probable that the important information regarding the position and intentions of the "BELLEISLE SOUND" would have received the attention it required.

2.3 Navigation with a Pilot on Board

In general, the non-application of BRM principles may have been influenced by maritime culture, and in particular by the PPA letter given to masters of cruise ships which emphasizes that the pilot *must* be given the con of the ship. However, the IMO Code of Nautical Procedures and Practices, the STCW, and HAL Operating Regulations all indicate that the presence of a pilot does not relieve the master of his duties and responsibilities and require that the master and/or the OOW closely monitor the pilot's actions and intervene if necessary to assure the vessel's safety.

Despite the master's clear right to delegate a part of his authority while retaining overall command, the language of the PPA letter could be construed as intimidating - especially to a master unfamiliar with the working relationships which necessarily evolve from such an apparent contradiction.

2.4 Master/Pilot Relationship

The master of the "STATENDAM" reported that he had full confidence in the pilot before the development of the near-collision situation because there had been no disagreement on the bridge, but he did consider taking over the con when the close-quarters situation developed. However, he did not do so because he felt that the vessel was committed to the orders given by the pilot to avert collision.

It would appear, nonetheless, that had the master intervened from the time that it became evident that the "STATENDAM" was turning too slowly to stay on her preplanned course, it might have been possible to avoid crossing ahead of the tug and tow.

2.5 Factors Affecting the Turn at Chatham Point

From the manoeuvring data of the "STATENDAM" established during trials, it is evident that the vessel had ample room to negotiate the turn at Chatham Point and that the turn was commenced in ample time to come round to the next course which ran mid-channel for the transit of Discovery Passage.

There is conflicting information as to the method used by the pilot to alter course before Chatham Point. The OOW reported that the pilot used the rate-of-turn method for all alterations made after receiving a briefing earlier in the watch. The pilot did not recall this briefing and stated that he did not employ the rate-of-turn method until Chatham Point. There is, however, no doubt that the pilot used the rate-of-turn method at Chatham Point. The helmsman was thoroughly conversant with the characteristics of the rudder.

Given the prevailing visibility and the maximum speed of 16 kn at which large alterations of course could comfortably be made, the vessel's speed (over 17 kn) was too high.

During the turn, the master apparently became distracted from the manoeuvres at hand by the scheduling requirement to reduce the number of generators. The master also distracted the OOW from monitoring the rate of turn and from radar observations by instructing him to make telephone calls to the engine-room.

The result was that the pilot, who was the least familiar with rates of turn, chose the rate. Reportedly, he then became distracted when he called the "SKY PRINCESS" on his handheld VHF radiotelephone. When he again concentrated on the vessel's rate of turn, he realized that the vessel was not turning quickly enough.

Both the master and the OOW, who were familiar with the rate-of-turn method, were not concentrating upon it, as they were otherwise involved.

Although the master also carried out an ARPA plot of the "BELLEISLE SOUND", he did not immediately bring her approach to the pilot's attention.

2.6 Determination of Risk of Collision

"STATENDAM"

The pilot had been informed of the presence of the "BELLEISLE SOUND" by MCTS, but he did not look out for the vessel as he made the turn at Chatham Point. Reportedly, he was distracted by talking to the "SKY PRINCESS" on his handheld VHF and by the slow rate of turn in response to the helm order. Even after he became aware of the target, he did not recall that it was likely to be the "BELLEISLE SOUND". The positioning of the navigation lights when first sighted led him to believe that it was two fishing vessels.

It would appear, therefore, from the facts as reported, that no member of the bridge team gave undivided attention to either the vessel's course alteration or to the approach of the "BELLEISLE SOUND", and that there was minimal communication between them concerning these crucial matters. Although MCTS had relayed the movements of the "BELLEISLE SOUND"/"RADIUM 622" to other vessels and to the "STATENDAM", no VHF communication was attempted by the "STATENDAM" to determine the intentions of the tug/barge. The bridge team did not know the identity of the approaching vessels until they were sighted visually just before the occurrence.

"BELLEISLE SOUND"

Although alone on the bridge as the close-quarters situation developed, the master of the "BELLEISLE SOUND" was aware of the approach of the "STATENDAM" because he had maintained communications with MCTS; had sighted the vessel rounding Chatham Point; and had observed the vessel's echo by radar. It is most probable that the evasive action he took contributed, in large part, to the avoidance of the collision.

However, because the tug did not sound fog signals and the MCTS record does not show that the tug initiated VHF communication before the occurrence, the opportunity to make her presence known to the" "STATENDAM" by these means was lost.

2.7 Transport of Dangerous Goods by Barges in British Columbia Waters

Because of their remoteness, some logging and fishing camps in British Columbia depend upon supply by sea, and many of these camps are accessible only by smaller barges.

These barges, by virtue of their size and construction, may not be able to comply with the full requirements of the IMDG Code for large crewed ships and the DGSR, especially with regard to the separation of dangerous goods.
This problem has been recognized. TC Marine Safety has decided to create a West Coast Industry Working Group to work out the requirements for carrying dangerous goods on oil barges, which will form part of TP11960 "Standards and Guidelines for the Construction, Inspection and Operation of Barges that Carry Oil in Bulk". A Board of Steamship Inspection Decision will be made for West Coast compliance, which will later follow the CMAC procedure for national compliance.

TC Marine Safety officials have decided that, when the amended Standard is developed, they will commence a plan to board tug/barge units.

2.8 Isolation of Traffic Carrying Dangerous Goods

The realities of the transportation of goods, including different categories of dangerous goods, to remote camps and communities in British Columbia by sea are that dangerous goods carried on board smaller barges such as the "RADIUM 622" cannot be separated as required by the applicable regulations and codes. The IMDG Code is mainly applicable to large, crewed, seagoing vessels in international trade.

In other modes of transportation, when dangerous goods (especially different categories of dangerous goods) are transported, an isolation of the vehicle is attempted to reduce the risk and the consequences of an accident or collision. It may be argued that only one class of dangerous goods should be transported on small coastal vessels or barges. While this appears reasonable in principle, it would considerably increase the number of voyages needed, and, consequently, the risk of an accident or incident.

Although the tug/barge unit and the "STATENDAM" both reported their progress to MCTS on the night of the occurrence, the degree of traffic separation necessary for a safe passing was not achieved. It is most probable that more attention would have been paid to achieve a safe passing distance had the type of cargo carried been known by all involved. However, the tug/barge unit had safely passed three other passenger vessels before encountering the "STATENDAM".

3.0 Conclusions

3.1 Findings

"STATENDAM"

1. The exchange of information between the master/OOW and the pilots was not conducted in the formalized manner necessary to ensure that the intentions of each were fully understood.

2. Arrangements were not made for the bridge team to share the workload and tasks of navigation and communications in accordance with the principles of bridge resource management (BRM).

3. The members of the bridge team were not effectively engaged in those tasks with which they were individually most experienced.

4. The preoccupation of the master and OOW with scheduling matters diverted their attention from the navigation of the vessel, collision avoidance measures and ship handling.

5. Given the prevailing visibility and the maximum speed of 16 knots (kn) at which large alterations of course could comfortably be made, the vessel's speed (over 17 kn) rounding Chatham Point was too high.

6. The pilot chose a rate of turn of ten degrees per minute to round Chatham Point but this was insufficient to bring the vessel onto her next planned course at the speed being made good.

7. The chosen rate of turn placed the vessel on the east side of Discovery Passage and into the path of the oncoming tug/barge unit.

8. The master/OOW did not challenge the pilot's handling of the vessel when it became apparent that the vessel was not turning quickly enough to follow her preplanned course.

9. No member of the bridge team gave continuous undivided attention to the approach of the tug/barge unit to determine risk of collision. The MCTS information on VHF, concerning the north-bound progress of the tug barge unit, went unheeded.

10. The bridge team did not recognize a dangerous occurrence was imminent and consequently did not take early action to avoid the developing close-quarters situation.

11. An efficient very high frequency (VHF) watch was not maintained and there was little effective communication between the members of the bridge team.

12. After the occurrence, it was discovered that the vessel's wheel-house voice-logging recorder had malfunctioned for several weeks.

13. The time scales of the vessel's two course recorder graphs were such that they were difficult to interpret, and both were incorrectly set.

14. At the time of the occurrence, pilots from the Pacific pilotage area had not been given structured BRM training.

"BELLEISLE SOUND"

15. It is most probable that the evasive action taken by the master of the "BELLEISLE SOUND" contributed, in large part, to the avoidance of the collision.

16. The vessel did not have a dedicated look-out in reduced visibility until immediately before the dangerous occurrence took place.

17. The vessel did not sound the required fog signals.

18. The vessel was not in compliance with the applicable regulations for the carriage of dangerous goods. In British Columbia waters, dangerous goods are frequently transported by small tug/barge units which cannot meet the requirements of the International Maritime Dangerous Goods (IMDG) Code and the Dangerous Goods Shipping Regulations (DGSR).

Both Vessels

19. According to MCTS records, neither vessel used its VHF bridge-to-bridge radiotelephone to communicate with the other to reach agreement concerning the impending passing situation.

20. Neither vessel reported the dangerous occurrence to the MCTS.

MCTS

21. Although the Marine Traffic Regulator (MTR) on duty informed other vessels of the position and intentions of the "BELLEISLE SOUND"/"RADIUM 622", he did not advise them that the tug/barge unit was carrying dangerous goods.

Pilotage

22. Although equipped with a speaker, the manner in which portable VHF radiotelephones are used by British Columbia Coast pilots may make inter-ship communications so received inaudible to those not in the immediate area.

23. Transport Canada (TC) did not have a BRM training syllabus in place for the training of pilots.

24. The tone of the letter issued by the Pacific Pilotage Authority (PPA) to cruise ship masters could be construed as intimidating.

3.2 Causes

The near-collision between the "STATENDAM" and the "BELLEISLE SOUND"/"RADIUM 622" occurred because the slow rate of turn of the "STATENDAM" placed the vessel on the east side of Discovery Passage in the path of the oncoming tug/barge unit. Contributing to the incident were the reduced visibility in fog and darkness; the pilot's lack of familiarity with the navigational systems of the "STATENDAM"; and the non-application of bridge resource management principles, especially with regard to the logical division of the workload according to the area of expertise of each member of the bridge team.

4.0 Safety Action

4.1 Action Taken

4.1.1 Carriage of Dangerous Goods

Subsequent to this occurrence, several corrective actions have been taken by various agencies as follows:

a) A joint industry and government working group has been set up to review the circumstances surrounding the occurrence and to evaluate the potential risk with respect to the carriage, segregation, and stowage of dangerous goods in restricted waterways. It is understood that the findings of the working group will form the basis for appropriate risk reduction measures, such as making amendments to current regulations, implementing Board of Steamship Inspection decisions, etc. The measures will be incorporated in TP11960, *Standards and Guidelines for the Construction, Inspection and Operation of Barges that Carry Oil in Bulk.*

b) TC Marine Safety has conducted a number of meetings with West Coast towing companies and the Council of Marine Carriers with a view to solving problems regarding the carriage, stowage, and segregation of different types of dangerous goods in smaller barges such as the "RADIUM 622".

c) A multi-modal Dangerous Goods Committee has been established within the Pacific region. The objectives of the Committee are to facilitate safe transits of dangerous goods throughout British Columbia, to educate persons on the requirements, and to seek harmonization of the regulations where needed.

d) In consultation with United States operators of tugs and tows (American Waterways Association) that transit the inside passages of British Columbia, the Marine Communications and Traffic Services (MCTS) have also initiated voluntary reporting measures for all of those vessels that transport pollutants or dangerous goods. A voluntary report is also requested from operators of tugs and tows carrying pollutants or dangerous goods for voyages originating in the United States with a destination within British Columbia. Further consultations are planned with the Canadian towing industry to institute similar procedures regarding dangerous cargo.

4.1.2 Incident Reporting

Immediately after the dangerous occurrence, TC Marine Safety, Vancouver, apprised the master of the "STATENDAM", the pilot who was conning the ship at the time of the occurrence and the master of the "BELLEISLE SOUND" of their responsibilities including, inter alia, the requirement to report occurrences and the obligation to comply with the International Regulations for Preventing Collisions at Sea,(COLREGS).

4.1.3 Bridge Resource Management (BRM) Training Standards for Pilots

Subsequent to TSB Recommendation M95-07 with respect to training and the practice on the use of hand-over procedures, TC, in conjunction with pilotage authorities, has promoted procedures for the formal exchange of information between masters and pilots. TC tabled this recommendation at the May 1996 meeting of the Canadian Marine Advisory Council (CMAC) in Ottawa and at the Simulated Electronic Navigation (SEN) seminar held in Vancouver in August 1996.

In 1996, the Canadian Shipowners Association arranged with Marine Safety International of Newport, R.I., USA to have their masters undergo BRM training at their facilities. One Great Lakes shipping company, representing Canadian Shipowners Association, approached Transport Canada, Marine Safety (MS) to monitor the course for approval. In February 1996, MS agreed to monitor the course but could not officially approve it since no BRM standard existed. Subsequently, MS prepared a draft BRM policy paper and presented it to the CMAC at its November 1996 meeting. At the May, 1997 CMAC meeting, MS announced the formation of a working group with a mandate to develop a course curriculum in BRM. The course topics include passage planning and execution, error trapping and monitoring, Master/OOW relationship, exchange of information, team work and communication. In November 1997, the working group presented the course curriculum to the CMAC and received approval with a provision that the BRM course be non mandatory. This resulted in the publication of the *Training Program in Bridge Resource Management* TP 13117.

Since then, three schools have received TC Marine Safety's approval, namely: the Marine Institute, St. John's, Newfoundland; Marine Safety International, Newport, R.I., USA; and the Nova Scotia Nautical Institute, Port Hawkesbury, N.S.

In May 1997, after evaluating the BRM courses available, the PPA began training its pilots in BRM. Training in BRM is being conducted at a facility in Dania, Florida; the same facility is being utilised to train pilots in an ongoing advanced ship-handling course that will include the latest technology used on cruise ships.

It is reported most B.C. Coast pilots will have completed the training in 1998.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 13 October 1998.

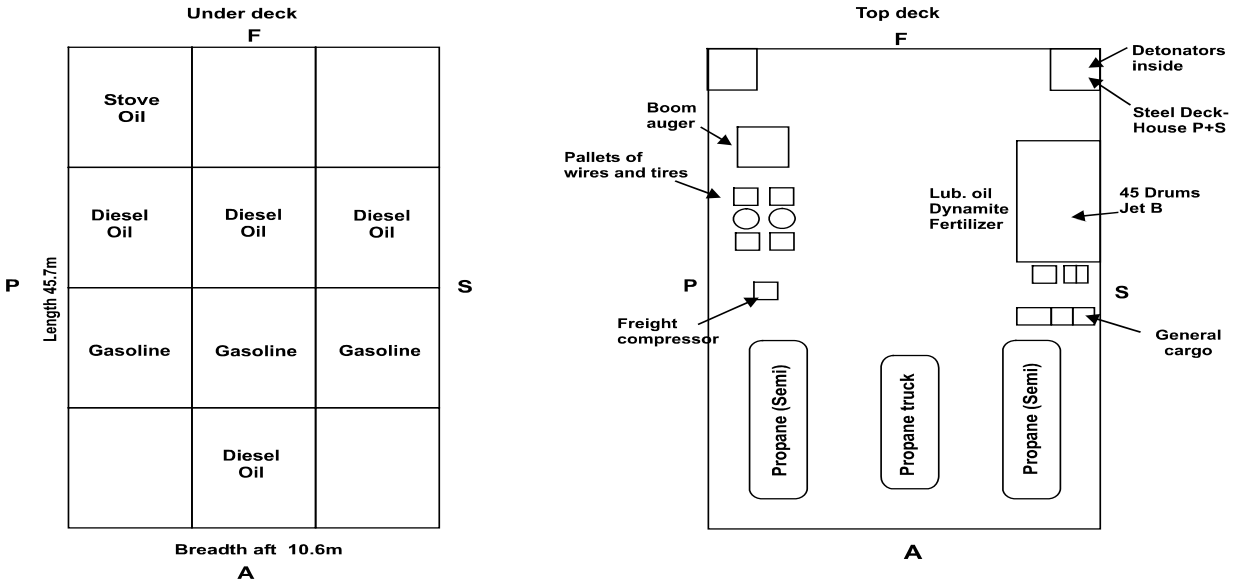
Appendix A Stowage of Dangerous Goods—"RADIUM 622"

On Deck

Propane (71,620 L)	Carried in two semi-trailers at the after end of the wood-sheathed deck, one on each side. A propane truck was on the centre line, between the two semi-trailers.
Jet B Fuel (9,225 L)	Forward of the semi-trailer on the starboard side, some general cargo was stowed, and forward of that were forty-five 205 L drums of Jet B fuel.
Explosives (4,975 kg)	Stowed immediately to port of the Jet B fuel were explosives (in 25 kg bags): 50 bags of dynamite (1,250 kg) and 149 bags of ammonium nitrate (3,725 kg), packaged 25 bags to a pallet and covered with shrink-wrapped plastic.
Detonators (10 cases)	Separated from the explosives and stowed in the top deck starboard forward deck-house were 10 cases of detonators.

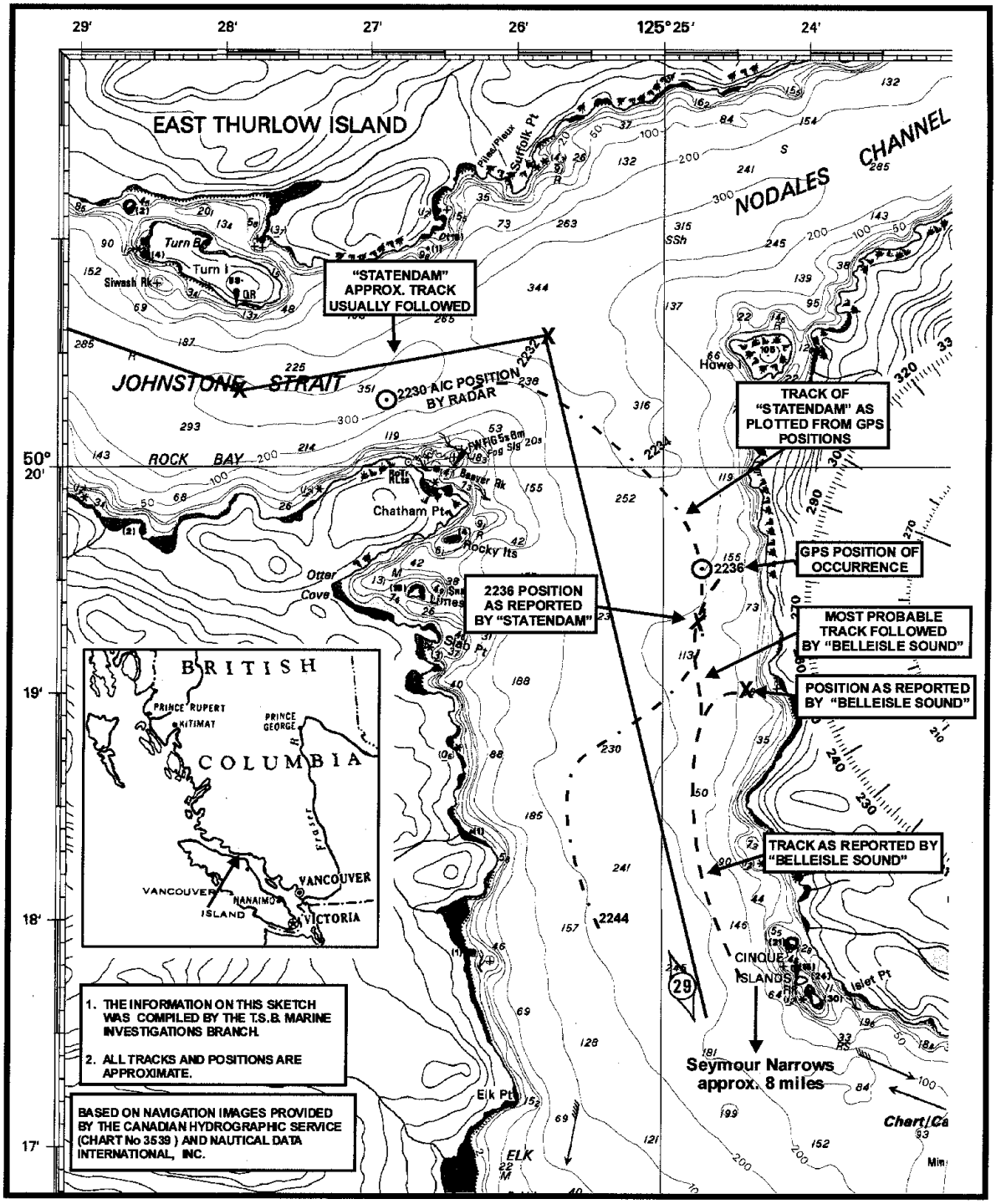
Under Deck

Stove Oil (15,000 L)	Carried in No. 1 port tank.
Diesel Oil (247,000 L)	Carried in No. 2 port, centre and starboard tanks and in No. 4 centre tank.
Gasoline (183,000 L)	Carried in No. 3 port, centre and starboard tanks.


Under deck
F
Stove Oil
Diesel Oil
Diesel Oil
Diesel Oil
Diesel Oil
Diesel Oil
Gasoline
Gasoline
Gasoline
Diesel Oil
P
S
Length 45.7m
Breadth aft 10.6m
A
Top deck
F
Detonators inside
Steel Deck-House P+S
Boom auger
Pallets of wires and tires
Lub. oil Dynamite Fertilizer
45 Drums Jet B
P
S
Freight compressor
General cargo
Propane (Semi)
Propane truck
Propane (Semi)
A

Not to scale

Appendix B Sketch of the Occurrence Area



Appendix C Photographs


RADIUM 622

Appendix D Pilot Card and Turning Circle Diagram

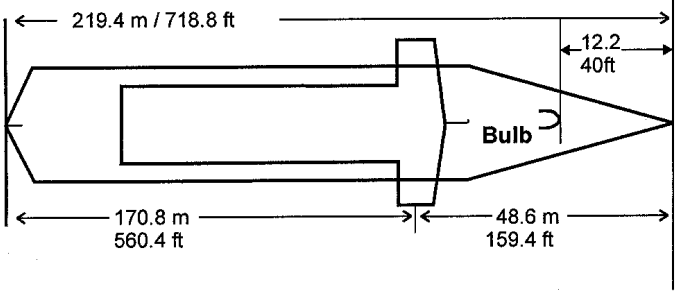
PILOT CARD

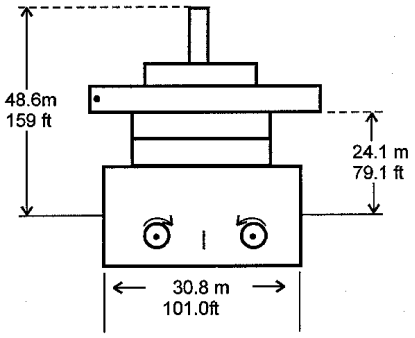
Call sign-----> PHSG **Building year----->** 1992 Tel: 1302517 / Fax: 1302516

Draught: (mean) ---> forward 7.50 m/ 24'07" aft 7.50 m/ 24'07"
: (max) ---> forward 7.70 m/ 25'03" aft 7.70 m/ 25'03"

Gross tonnage 55451 Nett tonnage 26945 Off. Number 706658

Length overall ----------> 219.4 m / 718.8 ft. BULBOUS BOW
Breadth moulded----------> 30.8 m / 101.1 ft.
Bridge wing to bow----------> 48.6 m / 159.4 ft.
Bridge wing to stern ----------> 170.8 m / 560.4 ft.
Height bridge above sea level---------> 24.1 m / 79.1 ft.
Height funnel above sea level---------> 48.6 m / 159.4 ft.
Height radio antennas above sea level-> 52.5 m / 173.0 ft.





Anchor chains --->

Port ----------> 12.4 shackles (bow anchors can be dropped from the bridge)
Starboard ----------> 12.4 shackles (1 shackle = 27.50 m = 90 feet = 15 fathoms)
Stern ----------> 6.2 Shackles

Engines--->

Maneuvering order	Rpm	Pitch	Speed	Main engines
FULL AHEAD	102	PITCH+ 4.5	16.7 KNT	Sulzer diesel generators 2 x 12 cyl. 8640 KW each 3 x 8 cyl. 5760 KW each Two Propulsion Motors 12000 KW (16108 HP) each Pitch controlled 4 bladed in turning propellors
HALF AHEAD	93	PITCH+ 3.5	12.0 KNT	
SLOW AHEAD	79	PITCH+ 2.5	8.0 KNT	
DEAD SLOW AHEAD	66	PITCH+ 1.5	4.5 KNT	
DEAD SLOW ASTERN	66	PITCH- 1.5		Thrusters
SLOW ASTERN	79	PITCH- 2.5		Two bow thrusters, 1720 KW (2308 HP) each One sternthruster, 1720 KW (2308 HP)
HALF AHEAD	93	PITCH- 3.5		
FULL ASTERN	102	PITCH- 4.5		

PILOT CARD

Rudder- - - →

Double flapped rudders with a maximum rudder angle of 45°
Rudder hard over to hard over in 14 sec (2 powerunits), 28 sec (1 powerunit)

Turning circle - - - →
Speed 20 knots, rudder 35° diameter : 446 m

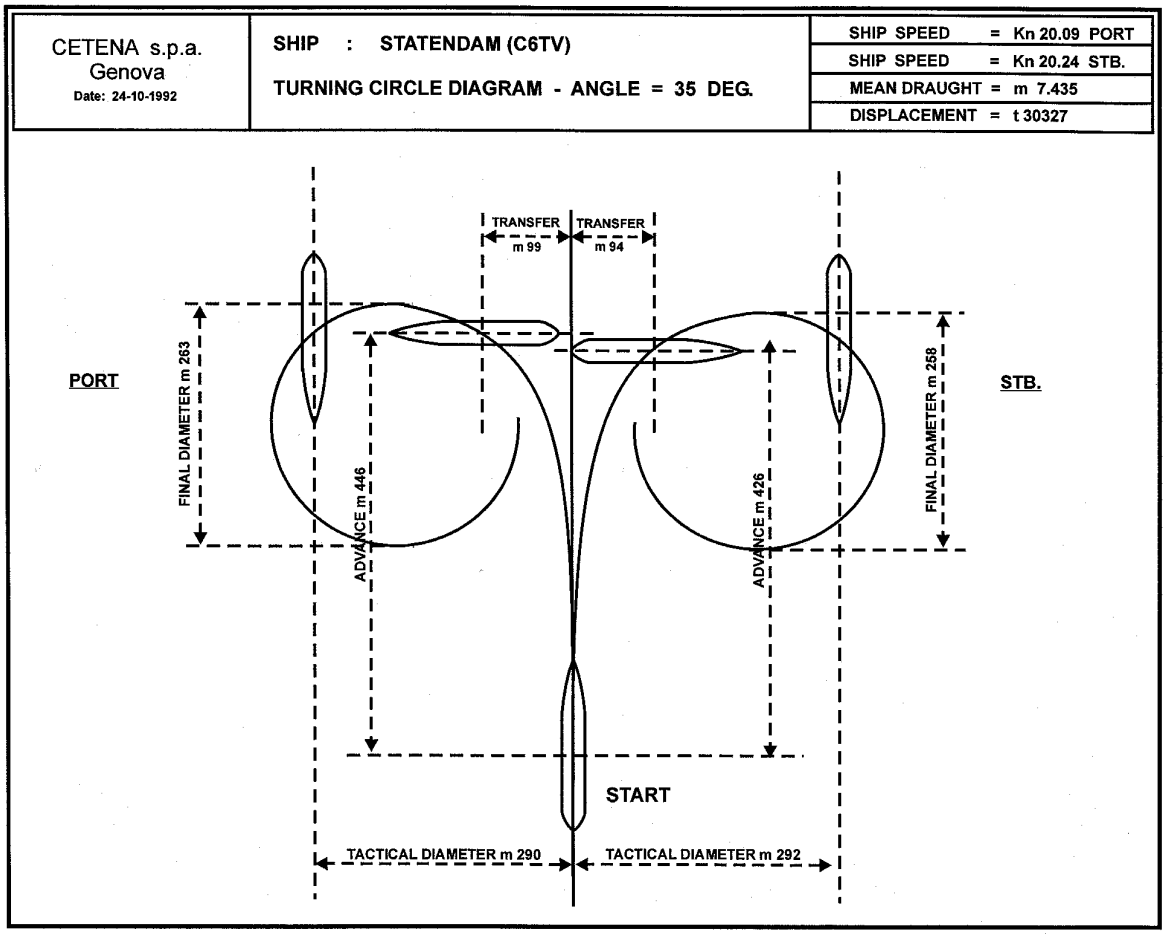
Crash stop - - - →
Speed 20.57 knots : 900 m.

Instruments - - - →

—— Krupp Atlas Radars 8600 NAV, 3 and 10 cm.
Four displays in center and one on each wing.
—— Krupp Atlas NCC 25 Nacos navigating system.
—— Two Anschutz gyro compasses with digital repeaters in center and wings.
—— Rate of turn indicators in center and wings.
—— Doppler speed log, Atlas Dolog with bottom and watertrack.
—— Kamewa joystick control center and each wing.
—— Kamewa Manoeuvre Recorder.
—— Latest gyro error
—— GPS Magnavox MX200 and Racal Decca MNS2000.
—— Loran-C, Decca, Omega and Satnav integrated in Racal Decca MNS2000.
—— Steering gear pumps units four.
—— VHF Skanti, two center and one each wing.
—— VHF Direction finder Furuno FD527
—— VHF DSC Controller Debeg 381
—— Depth sounder, Krupp-Atlas 481, units meters/feet/fathoms.
—— Radio direction finder JRC JLD-10
—— Navtex Lokata Navtex 2.
—— Weather fax JRC JAX-90.

Breakdoors ------→

	Deck	Height	Width	Above water	Aft from Bridge
Passengers:					
Main deck break	**Main**	**2.20m**	**2.20m**	**8.98m**	**139.0m**
Cruise break	**B**	**2.10m**	**2.50m**	**3.25m**	**27.8m**
Aft break	**B**	**2.50m**	**2.50m**	**3.19m**	**125.8m**
Other doors:					
Bunker break	**B**	**2.00m**	**1.00m**	**3.25m**	**116.7m**
Garbage break	**B**	**2.00m**	**1.00m**	**3.25m**	**90.1m**
Provision break	**B**	**2.50m**	**2.50m**	**3.19m**	**83.8m**
Provision break	**B**	**2.50m**	**2.50m**	**3.19m**	**78.2m**
Fresh water brk	**B**	**1.00m**	**1.00m**	**4.23m**	**29.9m**


CETENA s.p.a.
Genova
Date: 24-10-1992
SHIP : STATENDAM (C6TV)
TURNING CIRCLE DIAGRAM - ANGLE = 35 DEG.
SHIP SPEED = Kn 20.09 PORT
SHIP SPEED = Kn 20.24 STB.
MEAN DRAUGHT = m 7.435
DISPLACEMENT = t 30327
TRANSFER m 99
TRANSFER m 94
PORT
STB.
FINAL DIAMETER m 263
FINAL DIAMETER m 258
ADVANCE m 446
ADVANCE m 426
START
TACTICAL DIAMETER m 290
TACTICAL DIAMETER m 292

Appendix E Glossary

A	aft
ARPA	automatic radar plotting aid
B.C.	British Columbia
BCCP	British Columbia Coast Pilots Limited
BHP	brake horsepower
BRM	bridge resource management
CGRS	Coast Guard Radio Station
CHS	Canadian Hydrographic Service
cm	centimetre
CMAC	Canadian Marine Advisory Council
COLREGS	International Regulations for Preventing Collisions at Sea
CPA	closest point of approach
CSA	*Canada Shipping Act*
DGSR	Dangerous Goods Shipping Regulations
ECDIS	electronic chart display integrated system
ETA	estimated time of arrival
F	forward
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
HAL	Holland America Line
IMDG	International Maritime Dangerous Goods (Code)
IMO	International Maritime Organization
ISM	International Safety Management (Code)
kn	knot : one nautical mile per hour
kW	kilowatt
L	litre
m	metre
MANOPS	Manual of Operations
MCTS	Marine Communications and Traffic Services
MHz	megahertz
MTR	Marine Traffic Regulator
N	north
NTSB	National Transportation Safety Board (USA)
OOW	officer of the watch
PPA	Pacific Pilotage Authority
QM	quartermaster
rpm	revolution(s) per minute
SEN	Simulated Electronic Navigation
SI	International System (of units)
SOLAS	International Convention for the Safety of Life at Sea

STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978
T	true (degrees)
TC	Transport Canada
TSB	Transportation Safety Board of Canada
USA	United States of America
VHF	very high frequency
VTS	Vessel Traffic Services
W	west
°	degree
'	minute