Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

MARINE INVESTIGATION REPORT
M09C0051

GROUNDING

BULK CARRIER *FEDERAL AGNO*
LAC SAINT-LOUIS, QUEBEC
05 OCTOBER 2009

Canada

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

Marine Investigation Report

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Summary

On 05 October 2009, the geared bulk carrier *Federal Agno* had completed loading at Côte-Sainte-Catherine, Quebec. The vessel was docked facing upbound and, in order to proceed downbound, was to turn around in the anchorage at the west end of Lac Saint-Louis, Quebec. While executing the subsequent starboard turn, the vessel grounded near buoy A52 at approximately 1945. The vessel was refloated 3 days later. There were no injuries or pollution.

Ce rapport est également disponible en français.

Other Factual Information

Particulars of the Vessel

Name of Vessel	*Federal Agno*
Official/IMO Number	HK-1646/8316522
Port of Registry	Hong Kong
Flag	Hong Kong, China
Type	Bulk carrier
Gross Tonnage	17 821
Length [1]	182.800 m
Draught	Forward: 8.08 m Aft: 8.08 m
Built	1985, Nippon Kokan KK, Japan
Propulsion	Sulzer 6RTA58, 6988 kW (9501 HP) at 105 rpm (direct reversing) driving one fixed propeller
Cargo	18 735 tonnes of fragmentized scrap steel
Crew	27
Registered Owner	Baffin Investments Ltd
Manager	Anglo-Eastern Ship Management Ltd

Description of the Vessel

The *Federal Agno* is a geared bulk carrier with 5 cargo holds served by 4 centreline cranes located between the hatches. The engine room and accommodation are located aft. The bridge is equipped with navigational gear including both 3 cm and 10 cm radars, and an electronic chart system (ECS), all on the port side. The vessel is also fitted with a simplified voyage data recorder (S/VDR). The steering position is located on the centreline. Internal communications equipment and the engine order telegraph are located in a console on the starboard side of the bridge. A chart table, which incorporates a Global Maritime Distress Safety System (GMDSS) station, is situated behind both the radars and the console.

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

History of the Voyage

Photo 1. *Federal Agno* aground near buoy A52 (photo credit www.BoatNerd.com)

The *Federal Agno* arrived in Côte-Sainte-Catherine, Quebec, on 03 October 2009 to load fragmentized scrap steel for Spain. The vessel docked portside to, with an upbound heading. The vessel completed loading in the afternoon of October 5, at which point it was to depart for Montréal, Quebec, for bunkers. After the pilot boarded, he and the master performed the master-pilot exchange, during which the master inquired where the vessel would turn in order to proceed downbound. The pilot indicated his intention to turn the vessel at the anchorage area at the western end of Lac Saint-Louis with a starboard turn. The master then had the second officer amend the passage plan on the ECS up to the entrance to the anchorage as the details for the turn were not discussed.

At the time of departure, the bridge team consisted of the master, pilot, third officer as officer of the watch (OOW), and a helmsman. The vessel departed the dock at 1746 [2] and proceeded upbound in the South Shore Canal to Lac Saint-Louis. During the transit, the speed was adjusted various times for traffic and navigation purposes. At about 1900, after turning onto the Dorval range, [3] the vessel was proceeding at a maximum manoeuvring speed of 75 rpm. [4] In order to counteract the current on the lake, the pilot requested an rpm level in excess of this such that, with 10 minutes of "notice of reduction," the maximum manoeuvring rpm could be regained. [5] The OOW then notified the engine room.

Over the next 10 minutes, the second engineer increased the main engine's rpm to 82. The vessel crossed Lac Saint-Louis at a speed of just over 10 knots over the ground. At 1921, the pilot reported his position to Seaway Traffic Control, shortly after the vessel passed calling-in point No. 3. [6] He then altered course to steer on the Melocheville range. [7] In order to determine when to commence the starboard turn, the pilot set the radar's electronic bearing line (EBL) to indicate when the vessel was transiting Pointe Fortier. At 1935, the vessel passed between buoys A51 and A52, and the pilot ordered 20° port rudder to change the heading to 210° Gyro (G). The pilot then ordered midships to reduce the swing to port. Shortly thereafter, with the EBL approaching Pointe Fortier, and using visual cues, the pilot ordered the rudder hard to

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[2] All times are Eastern Daylight Time (Coordinated Universal Time minus 4 hours).

[3] The Dorval range lights make a course of 224° true (T).

[4] Maximum sea speed was 105 rpm.

[5] A vessel's maximum manoeuvring speed and maximum sea speed are often different. In this occurrence, engineers determined the pilot's request to be 82 rpm.

[6] This is 2.15 nautical miles before buoy A52.

[7] The Melocheville range lights make a course of 241.5° (T).

starboard. After checking the vessel's position in the chartroom, the master questioned the timing of the turn, but was reassured by the pilot. The vessel, by then swinging to starboard, was still south of the Melocheville range.

Shortly afterward, the pilot noticed the rate of turn decreasing and, at 1938, ordered the main engine stopped. The second engineer acknowledged the engine order and reduced the fuel rack of the main engine to stop. However, unsure about the 10 minutes' notice of reduction, he called the bridge for clarification. While on the phone, the pilot ordered "full astern." Although the second engineer acknowledged the order, he was unable to immediately comply; engine rpm had not reached a low enough level where he could apply braking air and so expedite the slowing and reversing of the engine. This was due to the fact that, given the vessel's speed through the water, the wash against the propeller was turning the main engine. Once the rpm dropped below 55, the engineer was able to apply braking air at which point the master called the engine room to request full astern. At this time, the rpm dropped below 10, and the engineer was able to reverse the engine and apply full astern thrust.

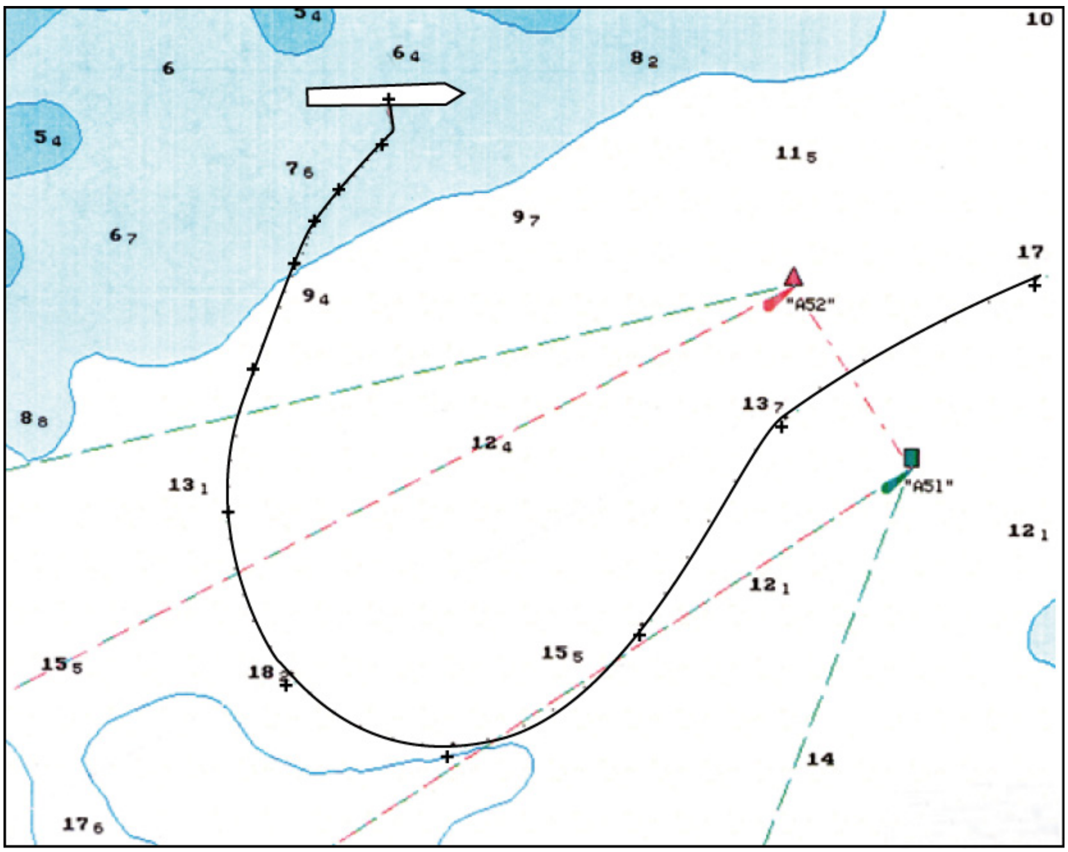

Figure 1. Track of the *Federal Agno* as shown on the vessel electronic chart system playback

The engine was run at full astern for approximately 3 minutes, but the turn rate could not be increased and the vessel exited the anchorage, running aground at approximately 1945, 4 cables northeast of buoy A52 [8] before pivoting to a final heading of 088° G.

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8 The vessel position while aground was 45°20.71' N, 073°53.38' W.

Damage to the Vessel

The seabed consisted mainly of mud, clay, and some rock. The vessel grounded from approximately hold 2 to the aft section of hold 5 without a list. The draft after grounding was 8.10 m aft and 7.40 m forward. Neither the rudder nor propeller touched the seabed. On October 8, the vessel was refloated with the assistance of 3 tugs. An underwater inspection was subsequently carried out and found the following damage:

- Heavy scratching/grooving along flat bottom, with plating waved between frames 175 and 210
- Several hull indentations on the C strake, to a depth of 70 mm
- The bilge keel was bent downward between frames 115 and 121

No ingress of water was found in any of the tanks while the vessel was aground or after it was refloated. Further, no internal examination of the tanks could be completed due to the vessel's loaded condition. As repairs were not deemed necessary, the vessel subsequently departed for Spain.

Personnel Certification and Experience

Federal Agno

The master held Master Mariner certificates of competency [9] and began his career in 1964 as a cadet. In 1968, he obtained his Officer of the Watch certification, and he began sailing as master in 1979. This was his first trip on this particular vessel, but he had sailed primarily on bulk carriers throughout his career. In 2009, he completed a course in Bridge Team Management Level 2.

The third mate, as OOW, had completed 42 months as a cadet and, in February 2009, he obtained his certificate of competency [10] as Officer in Charge of a Navigational Watch. The *Federal Agno* was his first assignment as a deck officer.

Pilot

The pilot began his career in 1974 as a cadet. In 1977, he began serving as an OOW, and was appointed master in 1992. He became a pilot in 1997, shortly after which he completed a bridge resource management (BRM) course. He had both anchored and taken vessels from anchor at the Lac Saint-Louis anchorage. This was his second time performing this type of turnaround in Lac Saint-Louis, the previous time being early in his career.

Vessel Certification

The *Federal Agno* carried all appropriate certificates for a vessel of its class and voyage. The vessel also complied with the requirements of the International Management Code for the Safe Operation of Ships and for Pollution Prevention (ISM Code) and had a safety management system on board.

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[9] These were issued by India and the United Kingdom.

[10] Issued by India.

Manoeuvring Data

Under normal (full) load condition, the *Federal Agno* has an advance of 740 m and a transfer of 395 m when executing a starboard turn at full speed.

Main Engine Interlock

In order to prevent excessive stresses and forces on the main engine, the engine control system is equipped with an interlock that prevents the introduction of starting air beyond the main engine's preset rpm limits. To brake the engine, starting air can only be introduced into the cylinders when the engine is turning less than 50 rpm. To reverse the engine, rpm must be below 10.

Seaway Requirements

The *Seaway Handbook* issued by the St. Lawrence Seaway contains the *Joint Practices and Procedures Respecting the Transit of Ships on the St. Lawrence Seaway*. Section 35(b) states that "Every ship transitting between calling-in point 2 and Tibbets Point and between calling-in points 15 and 16 shall . . . operate the propulsion machinery so that it can respond immediately through its full operating range."

Vessels Turning on Lac Saint-Louis

Traffic information provided by the St. Lawrence Seaway Management Corporation indicated that, in the 6 months before this occurrence, there were 3 other instances of vessels turning on Lac Saint-Louis, all at speeds less than 6 knots. One of the 3 vessels was equipped with a bow thruster.

Voyage Planning and Monitoring

A key concept in voyage planning and monitoring is that all members of the bridge team must have the same understanding of how the voyage will progress. This "shared mental model" must be a mutually agreed upon plan, and includes details such as where and when turns will be made, and speed of the vessel. [11]

In 1995, the TSB completed *A Safety Study of the Operational Relationship between Ship Masters/Watchkeeping Officers and Marine Pilots*. [12] In this report, the Board noted that a pilot's decision making "can become the weak link in a system prone to single-point failure; i.e., in the absence of effective monitoring, there is little safety backup for the pilot in the navigation of the vessel." Furthermore, according to this report:

> . . . monitoring vessel movements is critical to safe navigation in compulsory pilotage waters. It depends on effective communication among the bridge team. In order for the OOW to effectively monitor the vessel movements, he should know the pilot's passage plan. For the pilot to maintain his situational awareness, he must be provided with feedback from the OOW on the vessel's position relative to the plan.

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11 M. R. Adams, *Shipboard Bridge Resource Management*, Nor'easter Press, 2006.

12 TSB Report SM9501.

Other TSB reports have seen the Board comment on the importance of sharing details of a planned manoeuvre before its execution. [13] More recently, following the 2009 grounding of a bulk carrier, [14] the TSB issued Marine Safety Advisory 02/10, which stated: "without the intentions and pilotage techniques of the pilot being made known to the bridge team (e.g., use of radar range, visual aids, etc.), it was difficult for them to follow and effectively challenge the pilot when the vessel was standing into danger."

This issue is not only recognized in Canada. A 2009 report by the United Kingdom's Marine Accident Investigation Branch noted the following about an occurrence involving the exchange of information between the pilot and the bridge team:

> The master had not gained sufficient information about the pilot's intentions for him to check progress against the plan, or to ensure the safety of his vessel by monitoring the pilot's actions. However, the pilot had not given the bridge team the information they needed to be able to monitor his execution of the plan. Both parties were content that their interaction would be minimal, and as a result the principles of [bridge resource management] could not be applied during the pilotage. [15]

Simplified Voyage Data Recorder Installation

The S-VDR on board the *Federal Agno* was installed in December 2008 and consisted of 2 main components: the float-free capsule, which stores the data, and the main electronic unit (MEU). After the vessel grounded, the crew pushed the "save" button on the S-VDR. However, when the company representative later attempted to retrieve the data, it was found that no relevant data had been stored. [16]

The system is designed with self-monitoring features. When system components fail or do not output the right signal, the system initiates a "cold restart." This "cold restart" is prevented if switch SW4-5 [17] is activated. The switch's use is outlined in the installation guide for this particular S-VDR, which states that SW4-5 must be in the ON position during the software setup, and then turned OFF upon completion. [18] A post-occurrence service call revealed that switch SW4-5[19] was still in the ON position at the time of the grounding.

Depending on which subsystem fails or sends a signal for a "cold restart," the system will sound an alarm and display an on-screen message identifying that the system has an alarm state. The float-free capsule not receiving data is reason for a "cold restart" and subsequent

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13 TSB investigation reports M95C0120, M97L0030, M97W0197

14 TSB Occurrence No. M09L0175 (*Balsa 71*)

15 United Kingdom Marine Accident Investigations Branch, *Report on the Investigation into the Contact Made by the Tanker Vallermosa, with the Tankers Navion Fennia and BW Orinoco at the Fawley Marine Terminal*, MAIB Report No. 23/2009, November 2009.

16 The data stored were up to 30 June 2009 and from 06 October 2009.

17 This switch is named "watchdog—no reset."

18 *Installation Guide*, November 2007, p. 66.

19 The switch is usually only accessed during installation or service by an authorized technician.

alarm if the situation is not rectified. The investigation could not confirm the message displayed, the sounding of the alarm, nor any subsequent action taken by the crew. No records of a requested service call was registered by the manufacturer.

Issues related to the reliability of stored data and S-VDR installation are not limited to this occurrence. In a 2005 collision between a container vessel and tanker, [20] the Board found that the quality of the VDR bridge audio recording on the container vessel was so poor that many conversations were unintelligible during playback and, although radar images of the accident were recorded every 15 seconds, due to either an improper installation of video transmission cables or an interface failure on the radar side, no radar images were visible.

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[20] TSB Investigation Report M05L0205 (*Cast Prosperity* and *Hyde Park*).

Analysis

Events Leading to the Grounding

The pilot's plan was to turn to port upon passing buoys A51 and A52, so as to move further south in the anchorage and thereby leave maximum room for the starboard turn. Following this, his plan was to complete the turn over starboard so that any astern movement that might be required would help the vessel turn. [21] However, the details of these manoeuvres—such as the exact point for beginning the starboard turn—were not indicated in advance but were to be formulated closer to the execution point.

Given that the pilot had transited this area many times previously, he would have viewed the turn as relatively straightforward and not requiring a high degree of precision. As a result, he would have been comfortable with "opportunistic planning;" [22] details were to be determined while the plan was being executed. This left no advance opportunity for either the pilot or the bridge team to identify possible planning errors, nor for the bridge team to identify any errors during the manoeuvre.

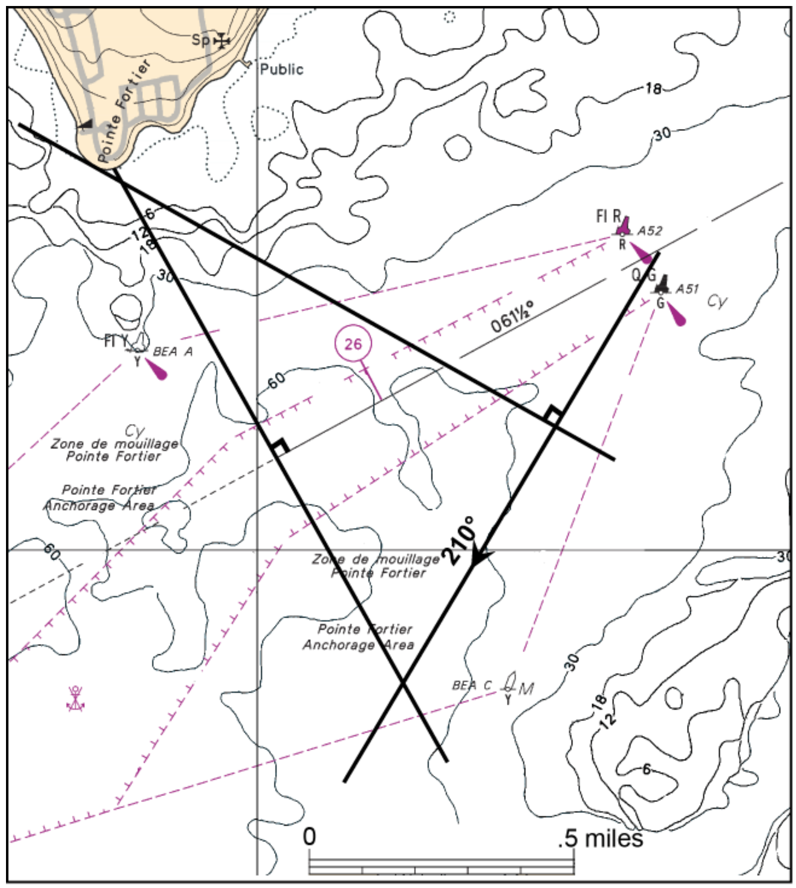

Figure 2. Two beam bearings off Pointe Fortier: one perpendicular to the course along the Melocheville range, and the other to heading 210°

When transiting the anchorage toward Lower Beauharnois Lock, the pilot's practice was to track the vessel's progress using a beam bearing off Pointe Fortier. He identified this location by setting the radar's EBL at 90° to the vessel's course—usually 235° T down the centre of the channel. In this occurrence, however, the usual beam bearing was set relative to the intended port alteration to a course of 210°. This alteration from the normal course through the anchorage area meant that Pointe Fortier would bear abeam much earlier than usual (see Figure 2).

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21 A vessel with a right-turning propeller turns to starboard at slow speeds when engines are going astern.

22 A. Newell and H. A. Simon, *Human Problem Solving*, Englewood Cliffs, NJ: Prentice Hall, 1972.

The pilot was using the radar to help determine when to initiate the turn; however, his focus was on when the EBL would approach Pointe Fortier rather than the exact position of the vessel. Reliance on the EBL as set meant that the vessel's turn was initiated at an assumed position rather than a verified one. As a result, the vessel's turn was initiated too early, and the vessel subsequently did not have enough room to complete the manoeuvre as intended.

Bridge Resource Management

One key element of BRM is monitoring of both the vessel's progression and the performance of bridge team members in order to trap and mitigate errors. To do this, best navigating practices dictate that all members of a bridge team should have the same understanding of how the voyage will progress. The advantage of such a system is that it offers an opportunity for multiple checks from different points of view, thereby reducing the possibility of single-point failure.

In this occurrence, although the master and pilot were in agreement about the general plan for the turn, the pilot did not make his detailed plan explicit in advance. As a consequence, a voyage plan was only made up to the anchorage in Lac Saint-Louis, but not for this turn itself. In addition, the bridge team had neither advance opportunity to verify the plan, nor the shared understanding to effectively monitor its execution. However, as the vessel was turning to starboard, the master became concerned that the manoeuvre had been started too soon. After he reviewed the situation in the chart room and returned, he queried the pilot but was subsequently reassured.

Given that a detailed shared mental model of the turn—including the means of navigation and wheel-over points—had not been created, and given that the pilot was aware that he alone knew all the details, the bridge team was unable to work effectively together to trap the error.

Engine Revolutions at Start of Turn

When a vessel is in a situation where manoeuvring might be required, [23] it is important that the engines are set such that timely movement can be made both ahead and astern, should they be required.

In this occurrence, the vessel was proceeding in excess of maximum manoeuvring speed [24] when the pilot ordered full astern partway through the turn. However, astern thrust was not immediately available as the main engine rpm had to first be slowed to 50. Only then could braking air be introduced. This investigation was unable to determine if the time it took to slow down the main engine before going full astern would have been sufficient to let the vessel successfully complete its manoeuvre. However, the vessel's manoeuvring ability was compromised because the planning for the manoeuvre failed to consider the ability of the engine to reverse at the chosen rpm.

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23 These include, for example, entering port, coming alongside a dock, anchoring or turning in a channel or other confined waters.

24 But not maximum sea speed.

Voyage Data Recorder Performance

The purpose of a VDR/S-VDR is to create and maintain a secure, retrievable record of information indicating the position, movement, physical status, and command and control of a vessel for the period covering the most recent 12 hours of operation. Objective data are invaluable to investigators and operators in seeking to understand the sequence of events and identify operational problems and human factors.

Accident investigation agencies using VDR data benefit from efficient, timely, and accurate collection, assimilation, and analysis of information. This leads to a shortened investigation process and more timely communication of safety deficiencies and investigation reports to stakeholders and the public.

In this occurrence, the crew of the *Federal Agno* attempted to save the data immediately following the grounding. However, this proved unsuccessful as the system had recorded no data since 30 June 2009. Although the system would normally have rebooted under such a scenario, this was prevented by the incorrect position of dip switch SW4-5.

Given the dates of data stored, it is likely that the system failed on 30 June 2009. Although an alarm should have sounded at that time and an on-screen message should have appeared, the investigation was unable to determine how the crew responded to that alarm, nor what maintenance actions, if any, were taken. [25]

The lack of a properly installed, functioning, and maintained data recorder may deprive accident investigators of a fundamental source of information and the industry of a proven and valuable tool to continually enhance and improve performance and safety.

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[25] It is worth noting, however, that the manual does not specify the exact action required by the crew to rectify this error message; of the two possible error sources, it recommends only "service" for one, and nothing for the other.

Findings as to Causes and Contributing Factors

1. The pilot's main focus was on when the electronic bearing line (EBL) would approach Pointe Fortier rather than the exact position of the vessel and, as a result, the vessel's turn was initiated too early, and the vessel subsequently did not have enough room to complete the manoeuvre as intended.
2. The vessel's manoeuvring ability was compromised because the planning for the manoeuvre failed to consider the ability of the engine to reverse at the chosen rpm.
3. The pilot set his EBL according to his normal use when transitting through the anchorage, rather than this specific manoeuvre.
4. The absence of a detailed plan and a shared mental model for how the turn was to take place prevented the pilot and bridge team from effectively trapping the error of turning early.

Finding as to Risk

1. The lack of a properly installed, functioning, and maintained data recorder may deprive accident investigators of a fundamental source of information and the industry of a proven and valuable tool to continually enhance and improve performance and safety.

Safety Action

Action Taken

Anglo-Eastern Ship Management Ltd.

Following this occurrence, the management company took the following action:

- A fleet circular was distributed to its vessels highlighting the occurrence and its causes.
- The installation of the simplified voyage data recorder (S-VDR) was verified on all its vessels.
- This occurrence is being used in its company-run Bridge Team Management courses to emphasize the importance of monitoring the pilot's actions and the necessity for a detailed passage plan especially when operating in restricted waters.

Great Lake Pilotage Authority

Following this occurrence, the Great Lakes Pilotage Authority has made it mandatory for all local pilots to review/practice this manoeuvre during Authority pilot training programs undertaken every 5 years.

Transas Marine International AB

Technical bulletin 2010-05-17 was issued by Transas Marine International AB and sent to all vessels equipped with Transas VDR/SVDR 3200 with a notification that crew should check the switch SW4-5 setting.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 22 July 2010.

Visit the Transportation Safety Board's Web site (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.

Appendix A – Area of the Occurrence