



Transportation
Safety Board
of Canada

Bureau de la sécurité
des transports
du Canada

MARINE INVESTIGATION REPORT

M17A0004



Groundig

Bunkering tanker *Arca 1*
Little Pond, Nova Scotia
08 January 2017

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Marine investigation report M17A0004

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Le présent rapport est également disponible en français.

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 M17A0004

Grounding

Bunkering tanker *Arca 1*
Little Pond, Nova Scotia
08 January 2017

Summary

On 08 January 2017, at 0820 Atlantic Standard Time, the bunkering tanker *Arca 1* went aground while under reduced propulsion due to a failure of the port propulsion clutch. There were 6 people on board. The vessel sustained major damage to the hull and propulsion machinery. There were no injuries and there was no pollution. The vessel was refloated and towed to Sydney, Nova Scotia.

Le présent rapport est également disponible en français.

Factual information

Particulars of the vessel

Table 1. Particulars of the vessel

Name of vessel	<i>Arca 1</i>
IMO* number	5411761
Port of registry	Panama
Flag	Panama
Type	Bunkering tanker
Gross tonnage	793
Length	51.25 m
Draft	Forward: 5.09 m Aft: 5.09 m
Built	1963, Port Weller Dry Dock Ltd. St. Catharines, ON
Propulsion	Two V12 diesel engines each driving a fixed-pitch propeller, producing a total of 559.5 kW
Crew	6
Registered owner	Petroil Marine, Mexico
Manager	MLS & Associates, Panama

* International Maritime Organization

Description of the vessel

The *Arca 1* is a bunkering tanker with a capacity of 1527 m³, designed for the transportation of oil to vessels at a maximum speed of 8 knots (Figure 1). The vessel was built in St. Catharines, Ontario, in 1963 and had operated in the ports of both Montreal and Sorel, Quebec. The vessel was restricted to minor waters voyages, Class II.¹ In 2004, a second hull was installed over the internal oil storage tanks, providing a double hull (Appendix A). The construction of the second hull provided a 750

Figure 1. *Arca 1*



¹ A minor waters voyage, Class II, is defined as a voyage made in certain lakes or rivers that are specified in the inspection certificate, with the greatest width not exceeding two miles. (Source: *Home-Trade, Inland and Minor Waters Voyages Regulations, C.R.C., c. 1430, section 6.*)

mm space between the inner and outer hulls that incorporated 3 water ballast tanks. Two 12V92 diesel engines that power 2 Z-drives are mounted on the stern and provide thrust. The diesel engines power the Z-drives via a power take-off clutch arrangement. Each Z-drive (Figure 2) can rotate 360° and is fitted with a fixed-pitch propeller. The vessel is steered by modifying the orientation of the thrust units.

Vessel certification

The vessel held a registry certificate as well as a Minimum Safe Manning Certificate and a Single Voyage for Delivery Authorization issued by Panama for delivery from Sorel, Quebec, Canada, to Mazatlán, Sinaloa, Mexico. The authorization specified that the vessel could carry out the voyage without statutory certificates. The vessel also held a radio station license.

Personnel certification and experience

The master held a credential document issued in the United States under the provisions of the *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) 1978*.² The document entitled the master to serve in the capacity of chief engineer on vessels of not more than 3000 gross tons (GT).

This credential document also entitled the master, under the *U.S. Code*, Title 46 – Shipping, to serve only in the capacity of master on vessels of not more than 500 GT on U.S. domestic voyages.³

Figure 2. Port Z-drive



² *The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers* (the STCW Convention) and its associated *Seafarer's Training, Certification and Watchkeeping Code* (the STCW Code) establish mandatory minimum standards for officers and watch personnel on merchant vessels.

³ A U.S. domestic voyage is defined as "movement of a vessel between places in, or subject to the jurisdiction of, the United States, except movement between (A) a place in a territory or possession of the United States or the Trust Territory of the Pacific Islands; and (B) a place outside that territory, possession, or Trust Territory." (Source: *U.S. Code*, Title 46, section 5101.)

The master had sailed in various capacities on U.S. Coast Guard vessels for 6 years in the early 1970s. In the mid-1980s, he had sailed for 2 years as master on registered yachts in southern waters. Since 2008, he had sailed in various engineering positions on commercial vessels and had also seasonally operated vessels for a small-craft towing company.

The second mate held a credential document issued in the U.S. under the provisions of the STCW Convention that entitled him to serve in the capacity of master on vessels of not more than 3000 GT. He had 40 years of experience in different capacities on various types of vessels, sailing mostly in the southern and western waters of the U.S.

The chief mate held a Watchkeeping Mate certificate of competency issued in Canada under the provisions of the STCW Convention. The document entitled him to serve in the capacity of chief mate on vessels of not more than 3000 GT. The chief mate also held a Master 3000 Gross Tonnage, Domestic certificate issued in Canada. He had 32 years of experience in different capacities on various types of vessels, sailing mostly in Canadian waters.

The motorman held an Engine Room Rating certificate issued in Canada. He had 6 years of experience sailing as an engine room rating on supply vessels, cargo ships, and seismic vessels.

Two able seamen holding the required certifications were also on board.

All crew member certificates were endorsed by the Panama Maritime Authority for a period of 3 months.

Pre-voyage preparations

The *Arca 1* was laid up at the shipyard dock in Sorel for 2 years after being decommissioned in 2014. The vessel was sold to a Mexican company in 2016. In October 2016, 3 crew members joined the vessel. The owner attempted to register the vessel as a Canadian yacht for the purpose of ferrying it to Mexico, but the registration request was denied and the 3 crew members were sent back home.

On 06 December 2016, the vessel obtained registration under the Panamanian flag. The 3 crew members were brought back on board and started to prepare the *Arca 1* for its voyage to Mexico. On 08 December, having completed a condition survey of the vessel, a surveyor for the classification society Inter maritime Certification Services⁴ issued a statement of seaworthiness for the vessel's voyage, as was required by Panama.

On 09 December 2016, the Panama Maritime Authority issued a Minimum Safe Manning Certificate (Appendix B) as well as a Single Voyage for Delivery Authorization

⁴ Inter maritime Certification Services is a recognized organization authorized to offer statutory or class certification on behalf of flag states under the mandatory rules, regulations and requirements by national and International Maritime Organization legislation.

(Appendix C). The authorization imposed, among other things, the following requirements to mitigate risks to the vessel and its crew:

Weather forecast are to be obtained 24/48 hours prior departure and on a daily basis throughout the entire voyage planned and agreed rout [sic].

The vessel is not to depart if seas waves exceeding [sic] 4 meters are expected within 24 hours. Including to all intermediate stops made during the intended voyage. [...]

The vessel is not permitted to sail is [sic] seas of Beaufort 7^[5] and/or above. In the event thatt [sic] the vessel is at sea in said Beaufort scale, master should proceed to a port of shelter.

On 13 December 2016, Transport Canada (TC) conducted a Port State Control⁶ inspection that identified 13 deficiencies related to radio equipment, life-saving equipment, the number of crew, the certification of crew members, and voyage planning. Given the deficiencies identified in the inspection, the Port State Control inspection was suspended under section 3.6 of the Paris Memorandum of Understanding protocol and the vessel was restricted from sailing.

Following the inspection and to comply with the conditions of the Minimum Safe Manning Certificate, the capacity of the master was changed in the vessel's Articles of Agreement⁷ from master to engineer, and the capacity of the second mate was changed from second mate to master. However, during the occurrence voyage, these 2 crew members carried out the same duties that were originally specified in the vessel's Articles of Agreement.

On 16 December, the crew was increased to 6 members to meet the requirements of the Minimum Safe Manning Certificate.

On 21 December, the vessel's authorized representative contacted TC Port State Control officers to ask TC to complete the inspection, clear previous findings, and remove the restricted-to-sail order. It was determined that a chief mate with the required certification was necessary to comply with the officer certification requirements of the Minimum Safe Manning Certificate. The TC inspector also asked the master to present a voyage plan that

⁵ Beaufort scale 7 is equivalent to wind speed of 28 to 33 knots with wave height of 4 to 5.5 m. For the full Beaufort scale, see Environment and Climate Change Canada, "Beaufort Wind Scale Table," at <https://www.canada.ca/en/environment-climate-change/services/general-marine-weather-information/understanding-forecasts/beaufort-wind-scale-table.html> (last accessed on 22 February 2018).

⁶ In the port state control ship inspection program, foreign vessels entering a sovereign state's waters are boarded and inspected to ensure compliance with various major international conventions.

⁷ A vessel's Articles of Agreement is a legal document between a ship owner and/or master of a vessel and crew members. The Articles of Agreement capture such information as, the date of employment, date of discharge, capacity of employment, etc.

complied with the limitations of the voyage imposed by Panama's Single Voyage for Delivery Authorization (Appendix C).⁸

TC was provided with a handwritten voyage plan signed by the master. The plan consisted of 2 pages that identified the 7 intermediate ports of the voyage and summarized the chart numbers for the planned route with no further details.

On 30 December, a new chief mate with the required certification arrived on board to replace the uncertificated chief mate.

History of the voyage

On 31 December 2016, the vessel departed Sorel with the master, the second mate, the new chief mate, a motorman, and 2 able seamen on board.

On 03 January 2017, the *Arca 1* diverted to Îles-de-la-Madeleine, Quebec, due to a failure of a fuel injector on the starboard main engine. The repairs to the starboard main engine were completed on 06 January.

On 07 January, at approximately 1038,⁹ the *Arca 1* departed Îles-de-la-Madeleine. The winds were from the west at 14 knots. The forecast indicated that a gale warning was in effect with wind increasing to 40 to 45 knots, with seas building from 3 to 5 m on the morning of 08 January and to 5 to 7 m that afternoon. The vessel was underway at a speed of approximately 8 knots, on a course of 098° en route to Sydney, Nova Scotia (Appendix D).

At approximately 1710, the tachometer reading for the port main engine dropped to 0 revolutions per minute (rpm). The motorman left the bridge to check the tachometer reading on the engine. Upon arriving at the engine, the motorman noticed a burning smell. The port propulsion clutch was slipping, which had resulted in overheating of the clutch, its housing, and the engine flywheel. The master was informed of the issue and placed the propeller at 90° to the stern to provide better steerage and shut down the port engine.

At approximately 1725, the master changed course to about 111° to go around Cape North. At that time, the wind was from the northwest at 15 knots. The vessel travelled for approximately 3 hours at a reduced average speed of 6 knots. At 2005, the course was set at 173° to arrive at the entrance of Sydney Harbour.

After the last course change, the vessel travelled at approximately 6.4 knots until 0100 on 08 January, when the wind veered to the southeast and began to increase. The vessel travelled 9.1 nautical miles (nm) over the next 2 hours.

⁸ A vessel on a single international voyage may be exempt from certain requirements in accordance with the *International Convention for the Safety of Life at Sea* (SOLAS), Chapter I, Regulation 4, "Exemptions."

⁹ All times are Atlantic Standard Time (Coordinated Universal Time minus 4 hours).

The heavy weather persisted. At approximately 0315, the *Arca 1* could not make headway, and the southeasterly winds of approximately 30 to 50 knots pushed the vessel to the west, toward the shoreline.

At 0558, a pilot who was supposed to board the vessel at the entrance of Sydney Harbour informed Sydney Marine Communications and Traffic Services (MCTS) that the *Arca 1* could not be boarded due to the strong winds and high seas.

At 0624, the Halifax Joint Rescue Coordination Centre (JRCC) contacted the vessel by cellphone and asked if they wanted to declare distress. The master confirmed, and Halifax JRCC forwarded the information to Sydney MCTS, which then broadcast the distress call and tasked several Canadian Coast Guard vessels to assist. At that time, the wind was from the east-southeast at 35 knots, and the seas were at 2 m.

At 0704, the crew dropped the vessel's only anchor in an attempt to hold the vessel's position.

At 0720, the *Arca 1* was holding position with the anchor and the power of the remaining operable engine. The winds were east-northeast at 30 knots with seas of 3 m.

Shortly afterward, the anchor started to drag. The crew then raised the anchor to reset it. However, before they had a chance to do so, the vessel hit bottom, damaging the starboard Z-drive, and lost all means of propulsion. The anchor was dropped again but could not hold, and the vessel drifted closer to the shoreline until it grounded at 0811.

At 0833, the master contacted Sydney MCTS and informed them that the vessel had grounded. No search-and-rescue (SAR) vessels had arrived on scene by this time.

At approximately 1300, the crew was air lifted from the *Arca 1* by a SAR helicopter sent by the Halifax JRCC. The crew was then taken to the Sydney/J. A. Douglas McCurdy Airport.

On 15 January, the vessel was refloated and towed to Sydney.

Damage to the vessel

During the occurrence, the friction plate on the port propulsion clutch arrangement slipped, which caused overheating and led to the failure of the clutch.

The starboard Z-drive separated from the mounting arrangement when the vessel contacted the bottom, causing the destruction of the starboard transmission. The outer hull was indented, and several transverse members sustained damage.

Environmental information

Environment and Climate Change Canada issued a marine weather statement on 07 January 2017 at 0336, indicating that gale-force northeasterly winds were expected to develop that evening with the approach of an intense low, centred to the south of Nova Scotia.

The weather forecast issued by Environment and Climate Change Canada for the Cabot Strait at 0500 on 07 January called for

[w]ind increasing to east 20 [knots] overnight and to east 40 to 45 [knots] Sunday [08 January] morning.^[10] Wind veering to southerly 35 to 45 [knots] near noon Sunday then becoming northwest 45 [knots] Sunday afternoon.

The wave height forecast called for seas of 1 to 2 m building to 3 to 5 m in the morning of 08 January, and to 5 to 7 m that afternoon.

At the time of the grounding, the winds were from the east-northeast at 30 knots, and the seas were at 3 m.

Life-saving equipment

The following life-saving and firefighting equipment was on board at the time of the occurrence, which met Canadian regulatory requirements:

- Life jackets
- Flares
- Immersion suits
- Life rafts
- Line-throwing appliance
- Emergency position-indicating radio beacon
- Fire detection system
- Portable fire extinguishers
- Emergency fire pump

Vessel manning

To ensure safe and efficient operation at all times, a vessel is required to carry certificated officers as well as certificated and non-certificated ratings of a sufficient number and grades/capacities.¹¹ In determining the minimum safe manning for a specific vessel, the flag state applies the International Maritime Organization's *Principles of Minimum Safe Manning*.¹² The minimum safe manning, as determined by the flag state, is detailed in the minimum safe manning document issued to the vessel.

The Panama Maritime Authority issued a Minimum Safe Manning Certificate to the *Arca 1* for a "single voyage from Sorel, Quebec, Canada, to Mazatlan, Sinaloa, Mexico, by coastal

¹⁰ Environment and Climate Change Canada defines "morning" as the period of time from 0600 to 1159.

¹¹ International Maritime Organization, *International Convention for the Safety of Life at Sea (SOLAS)*, Chapter V, Regulation 14.

¹² International Maritime Organization, Resolution A.1047(27), *Principles of Minimum Safe Manning* (adopted 30 November 2011).

navigation.” The certificate required the vessel to carry personnel with certification meeting the STCW requirements as detailed in Table 2.

Table 2. Crew certification requirements

Capacity	STCW certification required
Master	II/2
Chief mate	II/2
Able seamen (2)	II/4 or II/5
Engineer officer	III/1
Motorman	III/4

The vessel’s Articles of Agreement indicated that the crew for the voyage consisted of a master, a chief mate, 2 able seamen, an engineer, and a motorman. The various positions undertaken by the crew are indicated in Table 3.

Table 3. Positions, certifications, and roles of each crew member

Crew member	Intended position	Position indicated on vessel’s documents (on-paper role)	Actual STCW certification	Role during voyage (actual role)
1	master	master engineer*	III/1	master
2	2nd mate	2nd mate master*	II/2	2nd mate
3	chief mate	chief mate	II/2	chief mate
4	deckhand	deckhand	II/4	deckhand
5	deckhand	deckhand	II/4	deckhand
6	motorman (oiler)	motorman	III/4	motorman/oiler

* As modified in vessel documents

Voyage planning

Subsection 14(1) of the *Charts and Nautical Publications Regulations* requires the master to take into account the requirements for voyage planning as detailed in the International Maritime Organization’s *Guidelines for Voyage Planning*, which state, among other things, that the following should be included in a detailed voyage or passage plan:

- .1 safe speed, having regard to the proximity of navigational hazards along the intended route or track, the manoeuvring characteristics of the vessel and its draught in relation to the available water depth;
- .2 necessary speed alterations en route, e.g., where there may be limitations because of night passage, tidal restrictions, or allowance for the increase of draught due to squat and heel effect when turning;
- .3 minimum clearance required under the keel in critical areas with restricted water depth;
- .4 positions where a change in machinery status is required;

- .5 course alteration points, taking into account the vessel's turning circle at the planned speed and any expected effect of tidal streams and currents;
- .6 the method and frequency of position fixing, including primary and secondary options, and the indication of areas where accuracy of position fixing is critical and where maximum reliability must be obtained;
- .7 use of ships' routing and reporting systems and vessel traffic services;
- .8 considerations relating to the protection of the marine environment; and
- .9 contingency plans for alternative action to place the vessel in deep water or proceed to a port of refuge or safe anchorage in the event of any emergency necessitating abandonment of the plan, taking into account existing shore-based emergency response arrangements and equipment and the nature of the cargo and of the emergency itself.¹³

The guidelines go on to note that the details of the voyage plan should be clearly marked and recorded,¹⁴ the details of the voyage plan should be approved by the master,¹⁵ the voyage plan should be available at all times on the bridge,¹⁶ and the progress of the vessel should be closely and continuously monitored against the plan.¹⁷ Any changes to the plan "should be made consistent with the Guidelines and clearly marked and recorded."¹⁸ Any significant deviations from the voyage plan, such as a route diversion, should lead to the development of a new voyage plan.

The *Arca 1*'s voyage plan consisted of a list of 7 intermediate ports as well as a list of charts covering the passage from Sorel, Quebec, to Shelburne, Nova Scotia. The original voyage plan remained unchanged after the diversion to Îles-de-la-Madeleine. There were no other detailed documented voyage plans for any leg of the voyage.

The master estimated that the passage from Îles-de-la-Madeleine to Sydney (sea buoy to sea buoy), would take approximately 12 hours at a speed of 8 knots. Based on a speed of 8 knots, this time represents a distance of 96 nm. The actual distance from berth to berth is 120 nm. This difference in distance represents an additional 3 hours in transit time, for a total of 15 hours.

Maintenance

Maintenance carried out before the vessel left Sorel was limited to correcting issues with the vessel's emergency fire pump, bilge-pumping arrangement, and bilge-alarm equipment,

¹³ International Maritime Organization, Resolution A.893(21), *Guidelines for Voyage Planning* (adopted 25 November 1999), section 3.2.

¹⁴ *Ibid.*, section 3.3.

¹⁵ *Ibid.*, section 3.4.

¹⁶ *Ibid.*, section 5.1.

¹⁷ *Ibid.*, section 5.2.

¹⁸ *Ibid.*

which were necessary to obtain the certificate of seaworthiness and satisfy the requirement of the Port State Control inspection.

The original equipment manufacturer's operating manual for the main propulsion clutch states the following:

New power take-offs must have clutch adjustment checked before being placed into service and after the first 10 hours of operation. This includes any power takeoffs with new friction plates. New plates have a wear-in period and the clutch may require several adjustments before the new plates are worn-in.

After wear-in, clutch adjustment should be checked regularly. Heavy duty applications (rock crushers, etc.) which have frequent engagement, numerous engagements in an operating day or relatively long periods of slip (large inertias), require more frequent readjustment than light duty applications.

Adjust the clutch **BEFORE** it overheats, does not pull (slips), or the operating lever jumps from the engaged position. These symptoms are indications that clutch adjustment is required.¹⁹

Prior to departure from Sorel, the crew did not review the operating manuals for this machinery. The clutch was visually inspected, and its operation was verified at each arrival and before every departure. However, no preventative maintenance, such as lubricating, checking, or adjusting the clutch tension on the main propulsion system as per the original equipment manufacturer's recommendation, was carried out before or after the vessel's departure. Furthermore, some of the tools required to check the clutch tension were not on board.

Previous occurrences

Occurrences in Canada involving issues relating to unqualified crew members

M03M0040 - In the late evening of 03 May 2003, in clear conditions with moderate winds from the north-northwest, the *Shinei Maru No. 85* was outbound from Halifax Harbour when it ran aground near Portuguese Cove. Two fuel tanks were breached, causing the loss of a considerable amount of marine diesel oil. The master of the vessel held a marine engineer certificate and was unqualified to serve as master.

Occurrences in Canada involving issues relating to maintenance that was not carried out in accordance with the original equipment manufacturer's recommendations

M14P0023 - On 11 February 2014, at approximately 0305 Pacific Standard Time, the tug *Jose Narvaez*, while towing the empty barge *TCT 8000* down the South Arm Fraser River, British Columbia, sustained a loss of propulsion due to a main engine seizure. The investigation determined that the lubricating oil in the engine was contaminated; a complete flush and cleaning of the lubricating oil system had never been done.

¹⁹ Twin Disc Incorporated, *Power Take-off Service Manual #10022762*, p. 91.

M13W0057 – On 23 April 2013, at approximately 0818 Pacific Daylight Time, the fishing vessel *American Dynasty* experienced a complete loss of electrical power (blackout) while approaching the graving dock in Esquimalt, British Columbia. The vessel was under the conduct of a docking pilot and was being assisted by 2 tugs at the time. Following the blackout, the *American Dynasty* gained speed to an estimated 5 knots, veered to starboard, and struck the HMCS *Winnipeg*, which was berthed nearby at the Canadian Forces Base Esquimalt. There was extensive damage to both vessels and minor injuries were sustained by 6 shipyard workers on the HMCS *Winnipeg*. The investigation found that on-board maintenance of some of the safety-critical equipment on board, namely the back-up batteries and the whistle, did not follow an established schedule to ensure regular testing and servicing.

Analysis

The investigation found that the port propulsion clutch on the *Arca 1* failed. Due to the resulting reduced propulsion and the adverse environmental conditions, the vessel was unable to make headway, drifted to the shoreline, and went aground.

The analysis will focus on manning and crew roles, voyage planning, and the maintenance of vessel equipment.

Factors leading to the grounding

Although the master estimated that the voyage to Sydney, Nova Scotia, would take 12 hours, in reality 15 hours would have been required. This additional 3 hours of transit shortened the time available for the vessel to arrive at Sydney before the weather deteriorated.

When port propulsion was lost as a result of the failure of the port propulsion clutch, the available propulsion power was reduced by 50%, reducing the vessel's speed to approximately 6 knots. Following the reduction of speed, the increased time required to complete the passage prevented the vessel from arriving at Sydney before the weather deteriorated. In the severe weather, the vessel gradually lost headway and ultimately drifted to the west.

The anchor was deployed but could not hold and dragged. The crew raised the anchor with the intent of redeploying it later. A few minutes later, the vessel hit bottom, rendering the starboard Z-drive inoperative. The anchor was set again, but the vessel kept drifting west towards the shore until it ultimately ran aground.

Vessel manning and crew roles

To ensure safe and efficient operation at all times, a vessel is required to carry certificated officers as well as certificated and non-certificated ratings of a sufficient number and grades/capacities as laid out in the vessel's flag state's Minimum Safe Manning Certificate (Appendix C).

The *Seafarer's Training, Certification and Watchkeeping Code* (the STCW Code), an annex to the *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers* (the STCW Convention) sets out mandatory minimum standards for masters and engineers. A master should be qualified to carry out the tasks, duties, and responsibilities required to plan and conduct safe navigation; manoeuvre and handle the vessel in all conditions; moor and unmoor the vessel safely; and maintain a safe navigational watch. A vessel engineer should be qualified to carry out the tasks, duties, and responsibilities required to operate and monitor the vessel's main propulsion and auxiliary machinery and evaluate the performance of such machinery; manage and perform fuel and ballast operations; maintain the safety of the vessel's engine equipment, systems, and services; and maintain a safe engineering watch.

In this occurrence, the flag state required the master of the *Arca 1* to be certificated according to STCW Regulation II/2, the engineering officer to be certificated according to STCW Regulation III/1, and the motorman to be certificated according to STCW Regulation III/4. Before 16 December 2016, the vessel's Articles of Agreement documented the master as master and the second mate as second mate. On 16 December, the master amended the vessel's Articles of Agreement by changing his capacity to chief engineer and the second mate's capacity to master in order to comply with the vessel's Minimum Safe Manning Certificate requirements. However, during the voyage, these crew members continued to perform the roles originally documented in the vessel's Articles of Agreement.

The investigation determined that, as a result of some crew members' performing roles for which they were not qualified, certain critical tasks were not carried out, and others were performed ineffectively.

The master, who was not qualified to serve in that role on the *Arca 1*, carried on assuming the role of master during the voyage and made critical decisions, such as the decision to sail on the day of the occurrence. Because he did not serve the role of chief engineer, for which he was qualified, the primary oversight of the mechanical systems during the voyage was left to the motorman, who was not a qualified chief engineer. Thus, there was no formal oversight of the vessel's mechanical systems by a qualified engineer.

During the voyage, the master was not qualified to serve in that role on the vessel, and the motorman was not qualified to act as chief engineer.

As was demonstrated in both a previous marine accident and this occurrence, if crew members are not qualified for the positions to which they are assigned, they may not carry out these duties effectively, increasing the risk of accident or injury.

Voyage planning

The characteristics of an effective voyage plan, set out in the International Maritime Organization's resolution *Guidelines for Voyage Planning*, include the taking into account of all relevant information, including any vessel limitations or restrictions, and planning for contingencies, such as proceeding to a port of refuge or safe anchorage in the event of any emergency necessitating abandonment of the voyage.

A voyage plan from Sorel, Quebec, to Shelburne, Nova Scotia, was prepared during the port state control inspection process, but it listed only the intermediate ports as well as a list of charts covering the voyage and did not include details such as the limitations of the authorization or any accounting for contingencies.

Once the *Arca 1* was diverted to Îles-de-la-Madeleine, the voyage plan was not revised. In the passage to Sydney no ports of refuge or safe anchorages had been identified, and none were sought after the vessel lost port propulsion. The vessel carried on with the voyage toward Sydney.

The voyage planning was carried out in a manner that was inconsistent with best practices: contingencies and limitations were not taken into account.

Decision to sail

Because the vessel was not designed for long seagoing passages, the Panama Single Voyage for Delivery Authorization prohibited departure if the current weather conditions were of Beaufort 7 or if waves of 4 m were expected within a period of 24 hours.

Although the master was aware that sea conditions in excess of the limitations imposed by the Single Voyage Delivery Authorization were forecast for the morning of 08 January 2017, he chose to sail on 07 January.

The decision to sail was not consistent with the limitations imposed on the vessel in its Single Voyage for Delivery Authorization, given that seas in excess of 4 m were forecast to develop within 24 hours.

Vessel equipment maintenance

Vessel machinery requires a certain level of maintenance to be conducted to reduce the risk of machinery failure. Maintenance procedures are usually established according to the original equipment manufacturer's recommendations. For the port main propulsion clutch, the original equipment manufacturer's operating manual stated that clutch tension should be checked and adjusted if necessary when a new clutch plate is installed and during the wearing-in process. The manual stated that, after wear-in, the clutch adjustment should be checked regularly. Clutch slippage indicates that clutch adjustment is required.

The crew was not aware of previous maintenance carried out on the vessel, and the vessel had been out of service for 2 years. The clutch had been visually inspected, and its operation was verified before departure; however, the tension on the main propulsion clutch was not checked and adjusted before or during the voyage as per the original equipment manufacturer's recommendation. Clutch slippage occurred and caused the loss of port propulsion.

If vessel maintenance is not carried out as per the original equipment manufacturer's recommendations, the equipment may fail, increasing the risk of accident or injury.

Findings

Findings as to causes and contributing factors

1. The tension on the main propulsion clutch was not checked and adjusted before or during the voyage as per the original equipment manufacturer's recommendation. As a result, clutch slippage occurred and caused the loss of port propulsion.
2. When the port propulsion clutch failed and port propulsion was lost, the available propulsion power was reduced by 50%.
3. Following the reduction of speed, the increased time required to complete the passage prevented the vessel from arriving at Sydney, Nova Scotia, before the weather deteriorated.
4. In the severe weather, the vessel gradually lost headway and ultimately drifted to the west.
5. The anchor was deployed twice, but could not hold and was dragged. The vessel drifted west toward the shore until it ultimately ran aground.
6. The master was not qualified to act as master of the vessel and the motorman was not qualified to act as chief engineer.
7. The voyage planning was carried out in a manner that was inconsistent with best practices, as contingencies and limitations were not taken into account.
8. The decision to sail was not consistent with the limitations imposed on the vessel in its Single Voyage for Delivery Authorization, given that seas in excess of 4 m were forecast to develop within 24 hours.

Findings as to risk

1. If crew members are not qualified for the positions to which they are assigned, they may not carry out these duties effectively, increasing the risk of accident or injury.
2. If vessel maintenance is not carried out as per the original equipment manufacturer's recommendations, the equipment may fail, increasing the risk of accident or injury.

Safety action

Safety action taken

Following the occurrence, the company informed the TSB that it had taken the following measures to address safety concerns and avoid occurrences in the future:

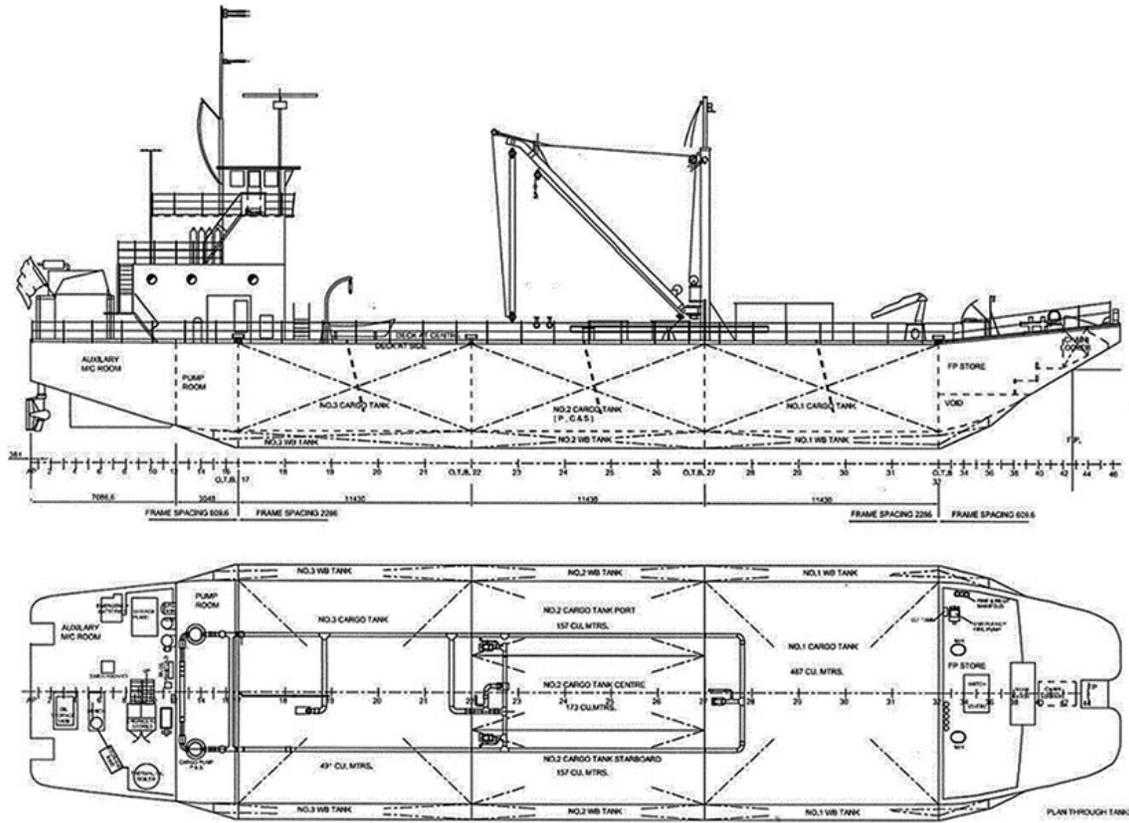
- The owner brought the vessel to its final destination in Mazatlán, Mexico, on board a heavy-lift transport.
- An agreement has been signed with Lloyd's Register to certify the vessel and the company's management processes under international safety management rules.
- The company has contracted Lloyd's Register to certify the vessel, limited to operations in ports and short-distance coastal navigation.
- The company has contracted Mexican (flag) maritime authorities to certify the vessel, limited to operations in ports and short-distance coastal navigation.

This report concludes the Transportation Safety Board of Canada's investigation into this occurrence. The Board authorized the release of this report on 28 February 2018. It was officially released on 19 March 2018.

Visit the Transportation Safety Board of Canada's website (www.tsb.gc.ca) for information about the TSB and its products and services. You will also find the Watchlist, which identifies the key safety issues that need to be addressed to make Canada's transportation system even safer. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

Appendices

Appendix A – General arrangement of the Arca 1



Source: Verreault Navigation

Appendix B – Minimum Safe Manning Certificate issued by the Panama Maritime Authority



CERTIFICADO RELATIVO A LA DOTACION MINIMA

No. **M39040**

**DE SEGURIDAD
MINIMUM SAFE MANNING CERTIFICATE**

Expedido en virtud de las disposiciones de la regla V/14 del
Issued under the provisions of regulation V/14 of the

CONVENIO INTERNACIONAL PARA LA SEGURIDAD DE LA VIDA HUMANA EN EL MAR, 1974, enmendado
INTERNATIONAL CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974, as amended

REPUBLICA DE PANAMA
Republic of Panama

Autoridad Marítima de Panamá
PANAMA MARITIME AUTHORITY

Nombre del Buque: **ARCA 1**
Name of ship

Numero IMO: **5411761**
IMO No.

Puerto de Matrícula: **PANAMA**
Port of registry

Letras de Radio: **H07761**
Call Sign

Nacional: **0.00**
National Gross Tonnage

Potencia (KW): **279.75**
Propulsion (KW)

Arqueo Bruto (Convenio **793.00**
Internacional 1969):
International Tonnage Convention, 1969

Tipo de Buque: **TANKER BARGE**
Type of Ship

Espacio de Máquinas sin dotación Permanente: **NO**
Periodically unattended machinery space

Compañía que explota el buque: **V.SHIPS CANADA INC.**
Operating Company

Zona de Navegación (Trading area)

ONLY FOR SINGLE VOYAGE FROM BOREL, QUEBEC (CANADA) TO MAZATLAN, SINALOA (MEXICO) BY COASTAL NAVIGATION

Se considerará que el buque cuyo nombre figura en el presente certificado tiene la dotación de seguridad adecuada si, al hacerse a la mar, lleva a bordo como mínimo el número de personas con las categorías o cargos indicados en el cuadro siguiente:

The ship named in this document is considered to be safety manned if, when it proceeds to sea, it carries not less than the number and grades/capacities of personnel specified in the table(s) below.

Categoría/Cargo Grade/Capacity	Título (Regla del Convenio de Formación STCW) Certificate (STCW regulation)	Número de Personas Number of Persons
Master	IV/2	ONE (1)
Chief Mate	IV/2	ONE (1)
A.B. Seamen	IV/4 or IV/5	TWO(2)
Eng. Officer	III/1	ONE (1)
Oiler(s)/Motorman	III/4	ONE (1)

REQUISITOS O CONDICIONES ESPECIALES:

Special Requirements or Conditions

- Ships carrying 100 or more persons and ordinary engaged on international voyages of more than three (3) days duration shall carry a qualified medical doctor according to MLC 2006 A4.1.4(b).
- Ships carrying ten (10) or more persons shall require a fully qualified cook according to MLC 2006 A 3.2.5
- The certificate of competency or sufficiency (COC/COP) provided shall also authorize the holder thereof to perform any lower ranking position, as long as it is of the same nature as the one for which the respective COC or COP was issued.
- At least one (1) member of the crew must have a Radiotelephone Permit or License.

5. Radar Maintenance Record Book
6. Garbage Record book (MARPOL Annex V)
7. Oil Record Book (MARPOL Annex I)
8. Cargo Record Book (MARPOL Annex II)
9. GMDSS Maintenance Record Book
10. Engine Room Logbook ←
11. Engine Room Bell Book
12. Radio Logbook ←
13. Bridge Logbook ←
14. Bridge Bell Book
15. Crew Roll List (endorsed by a Panamanian Official or Official Edition) ←
16. Official Logbook (endorsed by a Panamanian Official or the Official Logbook Edition)
17. Panamanian Annual Safety Inspection Record

*List of Call Signs and Numerical Identities Used by the Maritime Mobile and Maritime Mobile-Satellite Services for vessels trading in Sea Area A3. List of Ship Stations for vessels trading in Sea Area A2

March 1999 (revised)

Inquiries concerning the subject of this Circular or any requests should be directed to:

Directorate General of Merchant Marine, New York Office

Department of Maritime Safety (SEGUMAR)

6 West 48th Street, 10 floor

New York, NY 10036,

U.S.A.

phone: ++1 (212) 869-6440

fax: ++1 (212) 575-2285 / 2288

Appendix C – Single Voyage for Delivery Authorization issued by the Panama Maritime Authority

TO: WHOM IT MAY CONCERN
DATE: DECEMBER 09, 2016
FROM: GENERAL DIRECTORATE OF MERCHANT MARINE, SEGUMAR NEW YORK
SUBJ.: M.V. ARCA I IMO: 5411761 CALL SIGN: HO7781

SINGLE VOYAGE FOR DELIVERY - AUTHORIZATION

OUR REF: JAP 12/16/514

THIS ADMINISTRATION AUTHORIZES THE SUBJECT VESSEL TO CARRY OUT A SINGLE VOYAGE FOR DELIVERY AND IN BALLAST CONDITION (WITHOUT PASSENGERS OR ANY CARGO) FROM SOREL, QUEBEC CANADA TO MAZATLAN, SINALOA, MEXICO (ETD: 10 DECEMBER 2016 – ETA: 28 FEBRUARY 2017). THIS AUTHORIZATION IS ONLY VALID UNTIL 28 FEBRUARY 2017, OR WHEN THE VOYAGE IS COMPLETED, WHICHEVER OCCURS EARLIER.

THIS AUTHORIZATION IS GRANTED CONSIDERING THAT THE RO (INTERMARITIME CERTIFICATION SERVICES) HAS ISSUED A SEAWORTHINESS STATEMENT (NO. A/16/1163) INDICATING THAT IN ACCORDANCE WITH THE INSPECTION, SHOWED THAT THE HULL, MACHINERY AND SAFETY EQUIPMENT WERE FOUND IN GOOD AND EFFICIENT CONDITIONS FOR INTENDED THIS SINGLE VOYAGE.

FURTHERMORE, NOTE THAT THE VESSEL WILL BE MANNED WITH THE FOLLOWING CREW MEMBERS FOR THE INTENDED SINGLE VOYAGE:

CUBIERTA - DECK		MAQUINAS - ENGINE	
OFICIALES - OFFICERS ONE (1) MASTER ONE (1) CHIEF MATE XXXXXXXXXXXXXXXXXX	MARINEROS – RATINGS TWO (2) A.B. SEAMEN XXXXXXXXXXXXXXXXXX	INGENIEROS-ENGINEERS ONE (1) ENG. OFFICER XXXXXXXXXXXXXXXXXX	AYUDANTES – RATINGS ONE (1) OILER XXXXXXXXXXXXXXXXXX

THIS AUTHORIZATION WILL BE SUBJECT TO THE MINIMUM FOLLOWING REQUIREMENTS:

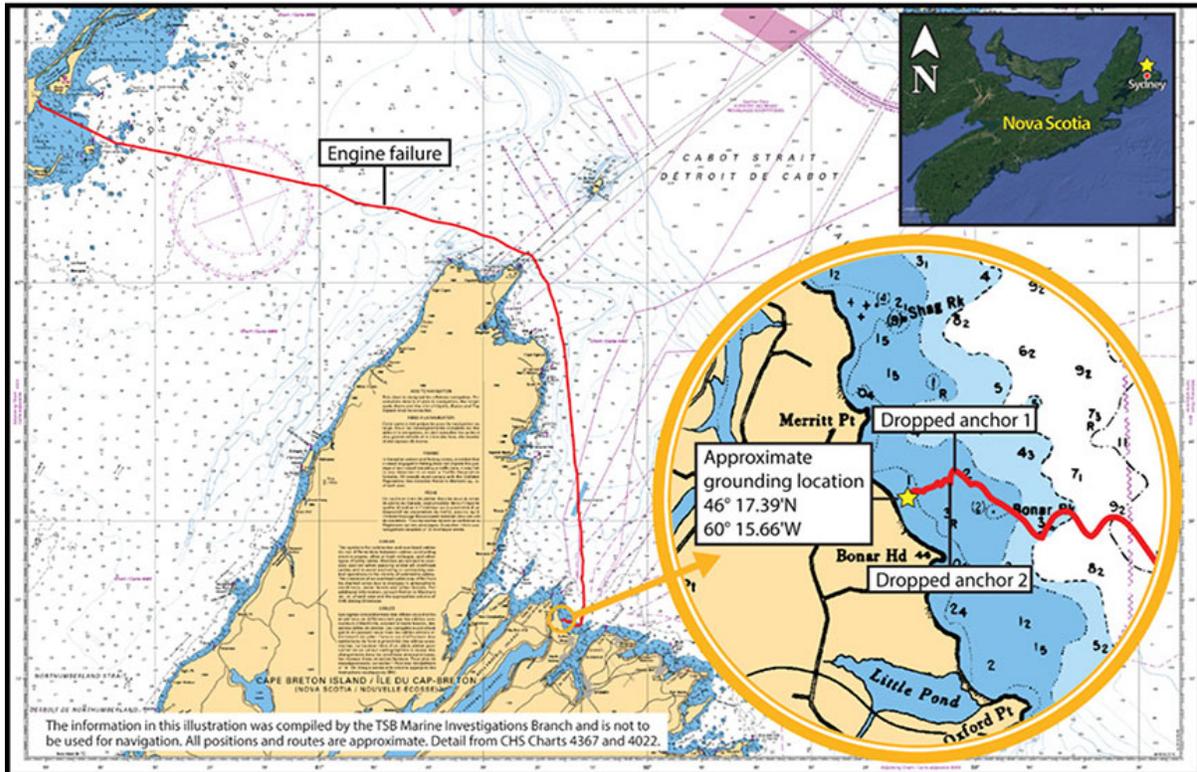
- WEATHER FORECAST ARE TO BE OBTAINED 24/48 HOURS PRIOR DEPARTURE AND ON DAILY BASIS THROUGHOUT THE ENTIRE VOYAGE PLANNED AND AGREED ROUT.
- THE VESSEL IS NOT TO DEPART IF SEAS WAVES ARE EXCEEDING 4 METERS ARE EXPECTED WITHIN 24 HOURS. INCLUDING TO ALL INTERMEDIATE STOPS MADE DURING THE INTENDED VOYAGE. POTENCIAL INTERMEDIATE STOPS : HALIFAX, NUEVA ESCOCIA, NEW YORK, NORFOLK, VIRGINIA, NASSAU, BAHAMAS, PANAMA, GOLFITO, COSTA RICA SALINA, CRUZ, MEXICO MANZAILLO, MEXICO, MAZATLAN, MEXICO. (IF ARE REQUERIED)
- THE VESSEL IS NOT PERMITTED TO SAIL IS SEAS OF BEAUFORT 7 AND/OR ABOVE. IN THE EVENT THATT THE VESSEL IS AT SEA IN SAID BEAUFORT SCALE, MASTER SHOULD PROCEED TO A PORT OF SHELTER.
- VESSEL WILL CARRY OUT THE VOYAGE WITHOUT STATUTORY CERTIFICATES DURING THE INTENDED VOYAGE.
- CONTACT TO COAST GUARD STATIONS AND REPORTING POSITIONS AS REQUIRED THROUGHOUT THE VOYAGE SHALL BE KEPT AND OBSERVED AT ALL TIME.
- VESSEL IS TO STAY AS CLOSE AS POSSIBLE TO THE SHORE LINE
- ANY DESVIATION FROM PLANNED AND AGREED ROUTE SHALL BE REPORTED TO ICS CLASS.
- WATCHKEEPING DECK OFFICERS ARE REQUIRED TO HAVE THE APPROPRIATE GMDSS RADIO OPERATOR CERTIFICATE GENERAL OR RESTRICTED, DEPENDING UPON THE SHIP'S INTENDED SEA AREA OF OPERATION.
- THE MASTER OF THE VESSEL IS RESPONSIBLE TO GUARANTEE THAT THE ORGANIZATION OF THE WATCHKEEPING PERIOD IS APPROPRIATE AND EFFICIENT DURING ALL THE INTEND VOYAGE AND AS PER THE VOYAGE PLAN.

- IS UNDERSTOOD THAT DURING THE NAVIGATION, AND ESPECIALLY DURING THE NIGHT TIME, THE DECK OFFICER AND DECK RATING SHALL NOT BE ASSIGNED OR UNDERTAKE ANY DUTY THAT COULD INTERFERE WITH THE SAFE NAVIGATION OF THE SHIP.

THIS ADMINISTRATION REQUESTS TO ALL PORT AUTHORITIES COOPERATION AND UNDERSTANDING OF THIS STATEMENT WHILE THE SUBJECT VESSEL IS ARRIVING, STAYING AND DEPARTING FROM PORT.

PLEASE PROCEED ACCORDINGLY AND NOTIFY ALL CONCERNED PARTIES.

Appendix D – Area of the occurrence



Source: Canadian Hydrographic Service and Google Earth, with TSB annotations