National Transportation Safety Board

Marine Accident Brief

Anchor Contact of Articulated Tug and Barge *Clyde S VanEnkevort/ Erie Trader* with Underwater Cables and Pipelines

Accident type	Contact	**No.** DCA18FM019
Vessel names	*Clyde S VanEnkevort/Erie Trader*	
Location	Straits of Mackinac, Michigan, about 2 miles west of Mackinac Bridge[1] 45°49.20' N, 084°46.30' W	
Date	April 1, 2018	
Time	1732 eastern daylight time (coordinated universal time – 4 hours)	
Injuries	None	
Property damage	> $100 million est. (to the underwater power cables)	
Environmental damage	Release of about 800 gallons of dielectric mineral oil into the waterway	
Weather	Few clouds, no precipitation, visibility greater than 10 nautical miles, winds southwest at more than 30 knots, seas 6–8 feet, air temperature 25°F, water temperature about 35°F.	
Waterway information	The Straits of Mackinac is a waterway between the lower and upper peninsula of Michigan that connects Lake Michigan and Lake Huron. The current at the time of the accident was easterly at about 1 mile per hour.	

At 1732 local time on April 1, 2018, the articulated tug and barge (ATB) *Clyde S VanEnkevort/ Erie Trader* was westbound with a crew of 14 in the Straits of Mackinac, Michigan, when the barge's starboard anchor, which had unknowingly released and was dragging on the bottom, struck and damaged three underwater electrical transmission cables and two oil pipelines. About 800 gallons of dielectric mineral oil leaked into the water from the cables; the oil pipelines sustained only superficial damage. Repair and replacement of the cables was estimated at more than $100 million. No injuries were reported.



ATB *Clyde S VanEnkevort/Erie Trader*. (Photo by P. Markham)

[1] All distances and speeds in this report are referenced in statute miles and miles per hour.

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Background

The *Clyde S VanEnkevort*, a 10,800-horsepower tugboat with two controllable-pitch propellers (CPPs) and two rudders, was built in 2012 by Donjon Shipbuilding & Repair LLC in Erie, Pennsylvania. The vessel was owned and operated by VanEnkevort Tug & Barge, headquartered in Escanaba, Michigan. The tugboat was connected to the self-unloading barge *Erie Trader*, which was 740 feet long with a 78-foot beam. The deepest draft of the barge with its cargo of ore was 27 feet on an even keel. When the barge was coupled with the tugboat, the combined length of the ATB was 845 feet. The *Clyde S VanEnkevort* was an uninspected towing vessel, while the hull of the unmanned *Erie Trader* was inspected and classified by the American Bureau of Shipping (ABS).

The *Clyde S VanEnkevort/Erie Trader* was laid up in the Port of Superior, Wisconsin, during the 2017–18 winter season. During the layup, engineering crew and contractors conducted maintenance and repairs on the tugboat, including overhaul of the vessel's two main engines. The crew also replaced the *Erie Trader*'s cracked top brake band liner on the starboard anchor windlass brake, which had been out of service since October 2017.

The *Erie Trader* was fitted with two stockless B-type anchors that each weighed 12,000 pounds. Each anchor was connected to a 2-5/8-inch stud link chain. Each anchor chain was 6 shots long (1 shot = 90 feet) and each shot weighed about 5,820 pounds. The rated maximum brake-holding capacity of the anchor windlass was 341,100 pounds. Typical for large vessels, the anchor system was designed with two additional mechanisms to protect against unintended release: the pawl (chain stopper) and the devil's claw.[2]

The *Clyde S VanEnkevort* had two navigational watches, which consisted of a deck officer and an able seaman (AB) working a 6-hours-on and 6-hours-off rotation. The first mate and an AB worked the 0600–1200 and 1800–2400 watches, and the second mate and another AB worked the 1200–1800 and 0000–0600 watches. The captain of the vessel would be in the wheelhouse for arrivals and departures and during periods of increased navigational risk, such as transits in confined waters, arriving in and leaving port, or in bad weather.

At times of increased navigational risk, the AB on watch would be instructed to go to the bow of the barge and clear the anchors to be ready for immediate use. To clear an anchor, the devil's claw was removed from the chain, the pawl lifted, and the wildcat disengaged, leaving the anchors held only by their brakes.[3] Once the anchors were cleared, the AB on watch would be stationed as lookout in the barge's forward crow's nest directly above the anchor windlass room and, should the order be given, release the anchors by opening each individual brake handwheel. Once back in open waters or upon order from the captain or officer of the watch, the AB would secure each anchor by closing the pawl and placing the devil's claw on the chain and disengaging the wildcat with the brake closed. The two watchkeeping ABs who constituted the anchor detail were the only persons tasked with clearing and securing the anchors unless maintenance and inspection was to be conducted.

Accident Events

The ATB's first voyage of the season took place March 21–30, 2018, with a roundtrip between Duluth, Minnesota, and Detroit, Michigan. The accident voyage began on March 30, when the ATB got under way from Duluth bound for Indiana Harbor, Indiana, with a cargo of iron ore. The voyage

[2] The *pawl* is designed to be set while riding at anchor or to be used when the anchor is in the stowed position.
[3] *Wildcat* is a drum on a windlass that is able to engage the links of the anchor chain.

ENBDNR0003059

would take the ATB eastbound through Lake Superior to the Sault Sainte Marie locks, colloquially called "the Soo Locks," on the border between the United States and Canada. After passing through the locks, the ATB would enter Lake Huron before turning west through the Straits of Mackinac and then south through Lake Michigan to its destination port of Indiana Harbor.



The ATB's travel area. The accident location is marked by a red triangle. (Map data by Google Maps)

On March 31 at 1737, the ATB passed Gros Cap Reef, a light in Ontario, Canada, where vessels are required to report to St. Marys River Vessel Traffic Service (VTS). According to the captain, because of the confined waters beyond Gros Cap Reef, the officer of the watch instructed the AB to clear and make ready the anchors for immediate use for the transit through the Soo Locks and St. Marys River, a standard procedure on board.

According to the 1200–1800 AB on watch at that time, when ordered to clear the anchors at Gros Cap Reef, he cleared only the port anchor. He told investigators that he did not clear the starboard anchor because, during their first transit through the St. Marys River on March 25, he had seen it sticking out of the anchor pocket about a foot or two. Therefore, he believed that it was still out of service awaiting repair, as it had been at the end of the 2017 season (see "Maintenance and Testing of

ENBDNR0003060

Anchor Windlass" later in this report). He said he had an understanding with the other AB to not clear the starboard anchor.

About 2000, the ATB arrived at the Soo Locks. It completed locking through at 2052 and the vessel was moored for the night along the southeast pier because the St. Marys River, which they were next to transit southbound, was closed due to ice conditions. The next morning, April 1 (Easter Sunday), the ATB got under way about 0845 and proceeded southbound through the confined waters of the river behind a Coast Guard ice breaker. The 0600–1200 AB on bow watch at the time of departure told investigators he did not touch the anchors while at the pier. The captain was in the wheelhouse for the transit through the St. Marys River and remained in the wheelhouse with the second mate who took the watch at 1200. At 1358, the ATB passed De Tour Reef Light and entered the open waters of Lake Huron. With only a little ice in the area, the second mate increased the ATB's speed to full ahead. The second mate stated that he radioed the 1200–1800 AB on bow watch to secure the anchors, which was routine practice when the vessel entered open waters, and said he received an answer back from the AB that all was secure. The 1200–1800 AB told investigators that he secured only the port anchor, because the port anchor was the only anchor that he cleared the previous evening at Gros Cap Reef. Thinking the other watch AB would not have cleared the starboard anchor, he did not physically check it, assuming it was already secured.



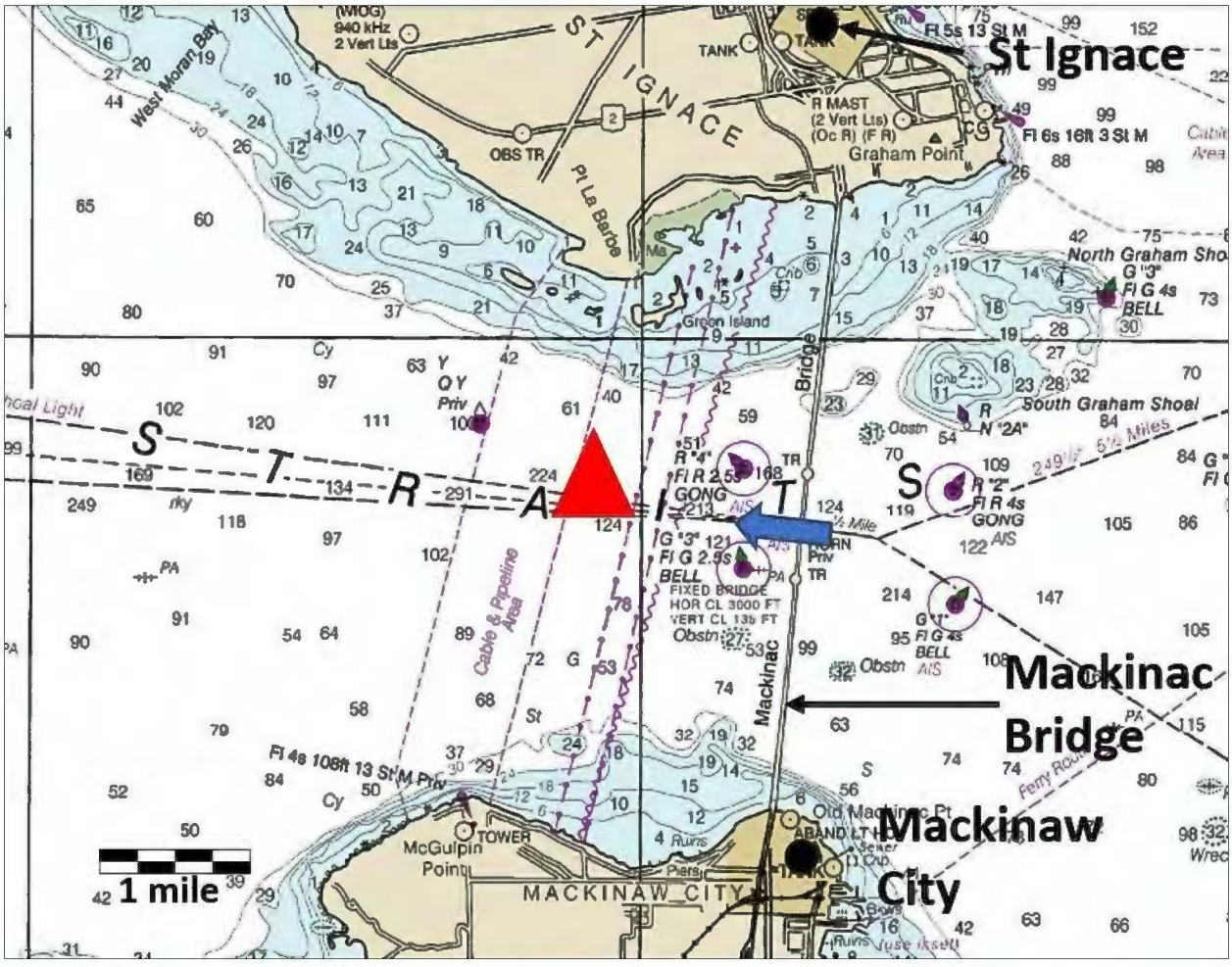
Postaccident photo of the starboard anchor's devil's claw and pawl in the secured and stowed (home) position.

Because it was Easter Sunday, most of the vessel crew had the day off except personnel on watch, so no crewmembers worked on the barge deck that afternoon. After passing De Tour Reef Light, the captain went below. He returned to the wheelhouse about 1649 for the passage between Round and Mackinac Islands and the approach to the Straits of Mackinac. The captain noted that the winds were a steady 30 knots and higher. He estimated the waves to be about 6–8 feet and said there was some ice in the area.

The ATB continued on a southwest heading toward Mackinac Bridge at a speed of about 11 mph and passed under the bridge about 1720. Once clear of the bridge, the captain exited the wheelhouse. The second mate, who remained on watch until about 1800, told investigators that nothing was abnormal with the handling characteristics of the vessel throughout his 6-hour watch.

The captain stated that he next returned to the wheelhouse about 1400 the following day, April 2. At that time, he noticed that the ATB was making only 12.4 mph even though he expected the speed to be about 1 mph higher based on how the vessel was loaded (the charted depth in this area varied from about 324 to 356 feet). He stated that he attributed the slower speed to the weather and a problem with the tugboat's starboard-side CPP not maintaining full pitch, for which a repair technician was requested to meet the vessel at Indiana Harbor.

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Section of NOAA chart 14881 showing a portion of the Straits of Mackinac. The accident site is indicated by a red triangle. The blue arrow indicates the ATB's direction of travel. The soundings are indicated in feet.

About 2320 local time that night, the ATB was approaching the entrance to Indiana Harbor. When the AB was walking up the starboard-side of the barge toward the bow to clear the anchors, he heard something rubbing on the hull and looked over the side expecting to see ice. Instead he saw the starboard anchor chain in the water trailing aft against the hull. He told investigators he then checked the starboard anchor compartment, where he found the starboard anchor cleared (meaning the devil's claw not on the chain, hoisted up by a pulley away from the chain), the pawl off , and the chain paid out. He also said the wildcat was not engaged.

He notified the second mate in the wheelhouse, who then took all pitch off on the propellers. In addition, the captain—who had returned to the wheelhouse for the arrival in port—reversed both engines to get the vessel stopped and ordered the AB to heave the anchor. At this point, the ATB was about 2.5 miles north of the entrance to Indiana Harbor. According to the captain, the crew had not picked up much anchor chain before the AB said four shots (360 feet) of chain were in the water. The crew heaved the anchor as the captain maneuvered the ATB astern. Once the anchor was out of the water, the AB informed the captain that the flukes were missing but the shank was still there. With what was left of the anchor, the crew resumed the transit at 0009 on April 3 and proceeded into Indiana Harbor where the ATB docked about 0115. That morning, the captain notified the company. The ore cargo was discharged, and the ATB then got under way to the next port of Silver Bay, Minnesota.

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None of the ATB crewmembers knew when the anchor paid out. Additionally, they neither heard any unusual noises nor detected any abnormal handling characteristics during the ATB's voyage from the Soo Locks to Indiana Harbor. The vessel did run slower than the crew expected but they thought that was because of the starboard-side CPP not being at full pitch and because the ATB was transiting into a strong headwind. Throughout the voyage, the ATB operated in ice, wind, and waves that created noise and movement expected for those conditions. Further, the tugboat and barge were separate vessels and thus subjected to different movements in the water. On the morning of April 2, the deck crewmembers were de-icing the bow of the barge with hot water from a hose. No one heard the anchor chain dragging against the hull. However, at the time of de-icing, no crewmember entered the space where the pawl and devil's claw were located. From the wheelhouse, about 750 feet back from the bow, it was not possible to see the enclosed anchor equipment or chain. In addition, according to the first mate, engine noise from the exhaust stacks located directly behind the wheelhouse reduced the ability to hear sounds that may have come from the trailing anchor chain.

The captain told investigators that he was unable to determine the amount of time the anchor dragged and the location where the chain paid out. None of the crewmembers knew of any damage the anchor caused while out. Because the barge was required to have only one anchor, there was no requirement to report the loss of the anchor flukes to the Coast Guard or classification society.

In the Straits of Mackinac, beginning about 0.9 miles west of the Mackinac Bridge and extending to 2.5 miles west of the bridge, was a charted and published area with underwater pipelines and transmission cables running in a general north and south direction. Restrictions were in place prohibiting anchoring, trawling, and dragging. Six underwater electrical transmission cables—owned by American Transmission Company and supplying electrical power to Michigan's upper peninsula—were located at a depth of about 220 feet and spaced about 200 feet apart from each other. Also in the area west of Mackinac Bridge were two oil pipelines (collectively called "Line 5"), which were owned by Enbridge Inc. and which transported crude oil from Canada to the United States. On April 1 at 1731:40 and 1732:02, the American Transmission Company's system operations center in Pewaukee, Wisconsin, received relays of two electrical circuits tripping offline. The activation times corresponded to automatic identification system (AIS) data of the ATB transiting the waters above the six electrical transmission cables.

On April 3, the Coast Guard was notified of the damaged underwater transmission cables and the contact with the pipelines. On April 6, at the Soo Locks, the Coast Guard boarded the ATB during its transit toward Silver Bay. After preliminary interviews with the crew, investigators determined that the *Erie Trader*'s starboard anchor was the likely source of the damage to the transmission cables and pipelines.

Underwater footage, taken by a remotely-operated vehicle, showed drag marks on the lakebed just before the Line 5 pipeline at a depth of about 230 feet. The Army Corps of Engineers surveyed the area between Mackinac and Round Islands for the missing anchor crown and flukes but found nothing.

Damage

The ATB anchor damaged three of American Transmission Company's six 138-kilowatt cables. Two were so severely damaged that they required complete replacement; the third could be repaired. After the impact, header tanks continued to supply oil that leaked into the waterway until the lines were shut down. An estimated 800 gallons of dielectric DF45 fluid (a coolant and insulator) spilled from the cables into the water.

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The anchor also struck the west leg of Enbridge's Line 5 dual pipeline, causing one minor dent in one pipeline and two minor dents in the other. Both lines were determined to be structurally sound.



The bow of barge *Erie Trader* after the accident. An inset highlights the remnant shank of the starboard anchor in the anchor pocket. (Photo by Coast Guard)

The marine casualty report that the vessel captain submitted on April 6, 2018 stated that "the starboard-side anchor was not secured properly and released without anyone's knowledge at an unknown place and time."

Additional Information

Maintenance and Testing of Anchor Windlass

During the winter 2017–18 layup at the shipyard, the tugboat crew replaced the top brake band liner on the *Erie Trader*'s starboard anchor windlass. The company had purchased a replacement woven brake liner and associated hardware directly from the anchor manufacturer, Coastal Marine Equipment (CME), which was delivered to the vessel on November 30, 2017. No instructions as to how to replace and adjust the brake band were included with the order, and investigators found no evidence that the crew asked the equipment manufacturer for instructions. Further, in the anchor parts and installation manual on board the *Clyde S VanEnkevort*, investigators found no instructions pertaining to brake band liner replacement or adjustment, which tugboat crewmembers completed on March 11, 2018, under supervision by the chief engineer. No service technician from CME was requested or consulted for the replacement.

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The maintenance section of the anchor manual did, however, include a cautionary statement: "Maintenance and replacement work must be carried out by expert maintenance technicians trained in the observance of the applicable laws on health and safety at work and the special ambient problems attendant on the installation."

After the upper brake liner was replaced on the starboard anchor windlass, the crew tested the anchor and its gear by paying out the anchor to the water's surface, which at the time was covered in ice. Because the barge was classified as an unmanned bulk cargo barge, the anchor equipment was not required as a condition of classification. Although not required to, an ABS surveyor—on board for the barge's annual hull survey—witnessed the anchor test. He stated that the brake held effectively and that he did not observe any problems. He stated he was not informed of any repairs made to the brake band prior to the test.

According to the deckhand tasked with operating the starboard brake handwheel during the test, the anchor was walked out of the pocket using the windlass with the wildcat in gear and held there. Once the anchor was above the ice that surrounded the ATB in the port that day, the brake was set and the wildcat was disengaged. The crew waited about 30 seconds to 1 minute to ensure that the anchor held on the brake, which it did. After that, they put the wildcat back in gear and heaved the anchor home, securing it with the pawl and devil's claw. The deckhand stated he had to "crank the hell out of it," meaning that the handwheel was hard to turn. He said he thought the difficulty was because the brake liner was new.

The captain joined the vessel on March 19 in Duluth, about a day before the ATB departed on its first voyage of the season. The port engineer informed him that the anchor had been repaired, tested, and demonstrated to ABS. The captain told investigators that the starboard anchor was never used (let go) for anchoring after the ATB departed Duluth.

Examination of Starboard Anchor Assembly

On April 9 in Silver Bay, investigators boarded the vessel and visually examined the starboard anchor assembly. When the brake was applied, a noticeable gap—about 0.3-inch wide—was observed at the top section of the brake band. The pawl, devil's claw, brake, wildcat, handwheel, and main shaft on the starboard windlass had no visible signs of damage.

On May 4, in the port of Toledo, Ohio, investigators and party representatives witnessed the disassembly and replacement of both the upper and lower section of the starboard anchor brake band liners. At the request of the vessel owner, an attending technician from CME supervised the process. The lower brake band liner appeared to have been in place for the life of the vessel, and frictional wear was uniform along the surface. When the upper brake band liner was removed, it had only minimal wear due to its new condition, and much of the liner surface had no visible friction or notable surface contact. However, near the top of the liner and at the aft end were notable uneven friction marks. Friction marks also appeared at the forward end of the liner near the edge and on the brake band inner surface. In addition, paint was burned from the surface in both places as well as at the forward end.

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Photo of the upper brake band liner for the starboard anchor. Highlighted in red are the friction marks on the liner. The inset shows the paint worn from heat accumulation through the liner aft section of the upper band.

According to CME's field service report, "upon inspection at winch, noticed brake band was out of adjustment." CME noted no problems with the anchor windlass assembly and, after the adjustment, the anchor was tested with satisfactory results.



Left: Postaccident photo of the starboard anchor windlass' upper brake band liner with the brake closed. The red arrows highlight the gap at the top between the drum and liner. Right: Photo of the upper brake band liner with the brake closed after the CME technician supervised the installation and adjustment. Note the lack of gap between the brake band liner and the drum.

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Analysis

The condition of the starboard pawl, devil's claw, and wildcat indicated that the anchor had been intentionally cleared and had not let go due to any failure of those components. In addition, no problems were apparent with the wildcat or windlass motor, given that the crewmembers could immediately retrieve the anchor once they found it paid out.

During the accident voyage, the anchors were first ordered cleared when the vessel passed Gros Cap Reef. Neither of the two ABs on board, who were responsible for clearing and securing the anchors, stated that they cleared the starboard anchor. Although the second mate said he ordered the anchors secured when departing De Tour Reef (the last order to secure them before the accident), the AB on watch at the time stated he did not actually secure the starboard anchor despite communicating to the wheelhouse that all anchors were secured. Due to conflicting statements and lack of definitive information, it could not be determined when the starboard anchor was last cleared.

On the afternoon of the accident, no crew worked the deck of the barge after the on-watch AB was released from his lookout- and anchor-detail duties on the bow. Because the AB did not hear or feel any noise or vibration while there, it is probable that the anchor paid out after he left. In addition, the ATB's vibration in the ice and motion in open water likely led to a slow payout of the anchor until it reached the water, at which point the additional force from traveling through the water and the increasing weight of hanging chain likely hastened the payout (as the brake was overwhelmed). The crewmembers were unaware that the barge anchor was dragging until the ATB approached Indiana Harbor. According to one of the watch ABs, they did make regular rounds on the vessel and barge but checking the anchor-handling spaces was not customary. Had VanEnkevort Tug & Barge had procedures in place to regularly monitor these spaces, the unsecured anchor may have been detected earlier.

Although anchor windlass brakes are not intended to hold an anchor and chain indefinitely during the dynamic conditions that vessels typically encounter on voyages, a properly adjusted brake should have had ample holding capacity for the weight of the *Erie Trader*'s anchor and chain. However, during the postaccident teardown and replacement of the *Erie Trader*'s starboard anchor windlass brake-band liners, the brake band had to be adjusted to ensure proper contact between the liner and drum with the brake activated. Based on the friction contact pattern on the upper liner, it is likely that the chief engineer and crew who replaced the top liner did not properly adjust the brake band. The brake band liner and hardware were replaced without the training, supervision, or instructions to properly carry out the task and ensure appropriate adjustments. Aside from the improperly adjusted band, investigators found no other defects in the anchor assembly.

The procedure used in testing the starboard anchor windlass brake after the shipyard replacement was inadequate for determining the brake's full functionality. According to an international association of classification societies (IACS) guidance document for anchor windlass testing and design, "the braking capacity is to be tested by intermittently paying out and holding the chain cable by means of application of the brake." The guidance document further stated that "where the available water depth is insufficient," as was the case with the vessel docked in ice at the time of the last brake test post-repair, "the proposed test method should be specially considered." However, the starboard anchor was lowered only the short distance down to the ice. Additionally, the installation and parts manual on board the vessel did not define any test procedure or any type of planned maintenance for checking the anchor windlass brake; therefore, the chief engineer and crew did not have adequate documents to properly repair or test the windlass brake.

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At the time of the accident, VanEnkevort Tug & Barge was implementing a towing safety management system (TSMS) to comply with new regulations for towing vessels. Although in progress, the system had not yet been fully implemented with compliance verification. There were no policies and procedures related to anchor operations, checklists, planned and unplanned maintenance, and reporting of equipment deficiencies and corrective actions, and safety measures to place defective equipment out of service.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the anchor contact of articulated tug and barge *Clyde S VanEnkevort/Erie Trader* with underwater electricity transmission cables and oil pipelines was the failure of the anchor detail to secure the barge's starboard anchor, and the improper adjustment of the anchor brake band after the engineering crew replaced the brake liner, the combination of which allowed the anchor and chain to pay out under way.

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Vessel Particulars

Vessels	*Clyde S VanEnkevort*	*Erie Trader*
Owner/operator	VanEnkevort Tug & Barge, Inc.	VanEnkevort Tug & Barge, Inc.
Port of registry	Escanaba, Michigan	Escanaba, Michigan
Flag	United States	United States
Type	Uninspected towing vessel	Bulk cargo self-unloading barge
Year built	2012	2012
Official number (US)	1232691	1238380
Classification society	N/A	American Bureau of Shipping
IMO number	9618484	N/A
Construction	Welded steel	Welded steel
Length	129.9 ft (39.6 m)	740.1 ft (225.6 m)
Draft	21 ft (6.4 m)	27 ft (8.2 m)
Beam/width	50 ft (10.7 m)	78 ft (23.8 m)
Gross tonnage	1,250	16,552
Engine power; manufacturer	2 x MaK 8M32C 5,364 hp (4,000 kW); twin CPPs	None
Persons on board	14	0

NTSB investigators worked closely with our counterparts from Coast Guard Sector Sault Sainte Marie throughout this investigation.

For more details about this accident, visit www.ntsb.gov and search for NTSB accident ID DCA18FM019.

Issued: May 21, 2019

The NTSB has authority to investigate and establish the probable cause of any major marine casualty or any marine casualty involving both public and nonpublic vessels under Title 49 *United States Code* 1131. This report is based on factual information either gathered by NTSB investigators or provided by the Coast Guard from its informal investigation of the accident.

The NTSB does not assign fault or blame for a marine casualty; rather, as specified by NTSB regulation, "[NTSB] investigations are fact-finding proceedings with no formal issues and no adverse parties . . . and are not conducted for the purpose of determining the rights or liabilities of any person." Title 49 *Code of Federal Regulations*, Section 831.4.

Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by conducting investigations and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report. Title 49 *United States Code*, Section 1154(b).

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