

National Transportation Safety Board Marine Accident Brief

Engine Explosion and Fire aboard Towing Vessel The Admiral

Accident no.	DCA16FM044	
Vessel name	The Admiral	
Accident type	Engine explosion and fire	
Location	La Quinta Channel, mile marker 544, Gulf Intracoastal Waterway, Ingleside, Texas	
Date	July 14, 2016	
Time	1635 central daylight time (coordinated universal time – 5 hours)	
Injuries	One fatality and one critical injury, both due to severe burns	
Property damage	\$300,000 est.	
Environmental damage	None	
Weather	Clear visibility, winds south-southeast at 15 mph, air temperature 84°F, calm seas	
Waterway information	The La Quinta Channel branches north from Corpus Christi Channel on the Gulf Intracoastal Waterway and follows the northeast side of Corpus Christi Bay for 4.5 miles above the entrance. The federal project depth is 45 feet in the channel. ¹	

On July 14, 2016, the uninspected towing vessel *The Admiral* was moored alongside barges in the La Quinta Channel, Gulf Intracoastal Waterway, near Ingleside, Texas. About 1635, the vessel's starboard main engine oversped and then exploded, causing a fire in the engine room. Two crewmembers who were in the engine room at the time of the explosion were severely burned; one subsequently died. Damage to the vessel was estimated at \$300,000. No pollution was reported.



The Admiral at the accident site after the fire.

¹ National Oceanic and Atmospheric Administration (NOAA), *United States Coast Pilot 5*, Washington, DC: US Department of Commerce, 2017.

Accident Events

The Admiral, a twin-screw uninspected towing vessel, was built in 1958 by Industrial Marine Service of Memphis, Tennessee. Originally named the *Defender*, the vessel was sold in 1968 to West Memphis Towing Corporation of Dallas, Texas, and then sold again in 1979 to Luhr Bros. Inc of Columbia, Illinois, which renamed it *The Admiral*.² In the summer of 2016, the vessel was chartered as a subcontractor to Great Lakes Dredge & Dock Corporation, which had been contracted by Cheniere Energy Inc to assist with a fleet of hopper and deck barges off the coast of Ingleside. The hopper barges were filled with various sizes of rocks, and the deck barges were fitted with cranes and excavators to offload the rocks as back fill material for the construction of a pier at a new liquid natural gas facility. Responsibilities for *The Admiral* while at the job site included ensuring the fleet of barges stayed together, repositioning or transporting barges as necessary, and operating as a floating office for project managers. The vessel departed its Illinois homeport on June 18, 2016, and arrived at the Texas job site on June 29. Prior to the charter, *The Admiral* had spent about 3 years in layup.



Aerial view of The Admiral standing by barges after the accident. (Photo by Coast Guard)

At the time of the accident, the crew of *The Admiral* consisted of a captain, a pilot, two deckhands, a first engineer, and a second engineer.³ Another crewmember designated as the chief engineer was on vacation at the time of the accident. When *The Admiral* was in operation, the three

² The Waterways Journal, *Inland River Record*, St. Louis, Missouri: The Waterways Journal, 2016.

 $^{^{3}}$ *Pilot* is a term used aboard towing vessels on inland waterways for a person, other than the captain, who navigates the vessel.

engineers rotated duties, with two working aboard the vessel at any given time and one off-duty on vacation. The normal schedule of rotation for the engineers was 29 days on and 14 days off.

All crewmembers stood 6-hour watches. The captain, a deckhand, and the first engineer stood the "front watches" from 0600 to 1200 and 1800 to 2400. The pilot, the second deckhand, and the second engineer stood the "aft watches" from 0000 to 0600 and 1200 to 1800.



Satellite image of accident area indicated by red circle. (Background by Google Maps)

The company provided an operations manual for the engines that stated that during extended delays, "engines should be restarted every 24 hours and brought to operating temperature to check equipment." Therefore, while *The Admiral* was standing by the rock barges, the engineers typically ran the engines at idle speed (325 rpm) for about 2 hours each day to come up to temperature.⁴ The engineers would then shut them down for the rest of the day. According to the second engineer, each engine was typically stopped by pushing an emergency stop button on top of the governor, which was mounted on the front of the engine, or by using the fuel rack lever to limit the fuel supply to the engine. On the morning of the accident, the first engineer started the main engines about 0500 and shut them down a few hours later. He then restarted the engines about 1100 that morning after the superintendent of the construction project asked to have them ready for possible maneuvering operations.

The first engineer was relieved by the second engineer soon after the engines were restarted. About halfway through his watch, the second engineer noticed an unusual sound, which he described as a "ticking sound," coming from the inboard aft part of the starboard main engine while it was at idle speed. About 1600, he went to the wheelhouse and informed the pilot on watch about the sound. The second engineer left the wheelhouse about 1605. He was not sure of the significance of the ticking sound and decided to wait until the off-duty first engineer, who had

⁴ Idle speed information from Electro-Motive Division, 645E2 Main Engine Service Data, General Engine Information, 1972, pg. 0-7.

more experience with this type of engine, woke up. After the first engineer woke up, the two engineers met in the galley, discussed the situation, and then proceeded to the engine room.

According to the second engineer, the two engineers had planned on shutting down both engines. But before attempting the shutdown, the engineers walked around the starboard engine. The first engineer nodded when he was by the inboard aft side of the engine, acknowledging the ticking sound. A deckhand told investigators that he walked across the upper engine room about this time and saw the engineers standing in front of the starboard engine.



Governor emergency stop push-button and fuel rack handle of The Admiral's starboard engine.

The first engineer then attempted to stop the engine by pushing the emergency stop button on top of the governor. However, after starting to slow down, the engine rapidly accelerated. According to the pilot in the wheelhouse, white smoke began billowing from the starboard stack about 1630. He also recalled that he saw the engine speed increase to 2,452 rpm on the digital tachometer in the wheelhouse. The first engineer subsequently grabbed onto the fuel rack lever in an attempt to stop the fuel supply to the engine, but this made no difference in the engine speed.⁵ The second engineer ran up the ladderwell to close the emergency fuel supply valve, which was located forward on the main deck outside of the engine room. While the second engineer was on the ladderwell, an explosion erupted from the engine. The force of the explosion blew several of the airbox covers off the engine and set the engine room ablaze. The pilot immediately sounded the general alarm from the wheelhouse console. After the explosion, the second engineer climbed out of the forward port window of the upper engine room and directed other crewmembers to assist the first engineer, who was still in the engine room.

The pilot believed that he used a button on the alarm panel in the wheelhouse to stop the port engine, but investigators confirmed that there was no stop button in that location. The pilot then ran below and saw the second engineer, who was burned and appeared to be in shock. The

⁵ During an interview, the second engineer explained that pulling the fuel lever toward the operator increased the fuel supply to the engine, and pushing the lever away from the operator decreased the fuel supply to the engine.

second engineer stumbled and yelled for other crewmembers to get the first engineer. The pilot entered the smoke- and flamed-filled engine room through the port engine room door, crawled on the deck, grabbed the first engineer who was about halfway up the ladderwell from the lower level, and pulled him out of engine room. The pilot then called emergency response services and the Coast Guard. A deckhand shut off the fuel supply at the emergency fuel shutoff station, stopping the fuel supply to the main engines and generators.

The vessel was equipped with a heat detection system in the engine room but did not have a fixed fire suppression system. The crew fought the fire through the engine room doors and windows using portable pumps and firefighting equipment from the nearby towing vessel *Billy Gene*. Because electrical power was secured, the fire pump aboard *The Admiral* was inoperative. The fire was extinguished about an hour and a half later. The injured crewmembers were transported ashore by boat and taken to the local hospital for treatment. The first engineer later died from his injuries.



Damaged starboard engine aboard *The Admiral* after the fire.

All crewmembers were tested for alcohol and other drugs following the accident. The test results were negative except for the second engineer, who tested positive for a prescribed medication that was administered during medical treatment.

A postaccident survey completed by a marine surveyor found extreme heat and smoke damage on the starboard main engine, starboard reduction gear, both generator sets, and all electrical wiring. Heat and smoke damage was also found on the exhaust lagging on both engines, the corrugated air intake hoses, and all the gauges, switches, and relays of the starboard engine.

Requirements for the inspection of towing vessels changed substantially with the release of Title 46 *Code of Federal Regulations (CFR)* Subchapter M on July 20, 2016—just after the accident. Prior to the release of these regulations, the Coast Guard examined towing vessels to ensure that they met the minimum standards found in the uninspected vessel regulations of Title 46 *CFR* Subchapter C. The Coast Guard issued decals to those towing vessels that met these standards. The decals allowed Coast Guard personnel to quickly determine if a vessel was in regulatory compliance. The last Coast Guard examination records that were provided for *The Admiral* were from May 27, 2010. Four minor deficiencies were reported and were all corrected within 30 days. The decal that was issued following the examination expired in 2013.

Analysis

Personnel

The chief engineer who was on vacation at the time of the accident was interviewed about 2 months later. He had worked in the industry for 32 years, the entire time with Luhr Bros., and had 9 years' experience as an engineer aboard *The Admiral*. He described his job duties as "to see that the motor's serviced, the engines are serviced and ready to work, and periodic checks every watch." A typical watch was described as a visual walk-through, checking the engines, generators, and fluids about every 2 hours. The rest of the time on watch was spent cleaning or painting.

The second engineer was interviewed about 4 months after the accident, after spending several weeks in the hospital and burn center. He had worked for Luhr Bros. since 1999 and had worked aboard *The Admiral* for about 4 years. During those 4 years, *The Admiral* was operational for the first 6 months of his employment and then laid up in drydock for about 3.5 years until it was contracted for the Ingleside job. The second engineer described his duties as monitoring the engines and oil levels, taking on fuel, and cooking. He stated that he had not received any formal training on maintenance or operation of the engines; other crewmembers had shown him how to start and stop them, as well as how to check the oil levels. The second engineer was not aware of any mechanical breakdowns aboard *The Admiral* during the time he had worked on the vessel.

Neither of the engineers interviewed had any formal training; they stated that their training was typically "on the job." They did not have any Coast Guard-issued credentials, nor were they required to have them. Crewmembers stated that they attended drills and tested the general alarm, fire pump, and fuel shutoff valves weekly. The shutoff valves were rotated during these drills but not completely closed.

Audits and Examinations

As a member of the towing-industry advocacy-group the American Waterways Operators (AWO), the owner of *The Admiral* was required to participate in the Responsible Carrier Program (RCP), a safety management framework developed by the AWO. Among other provisions, the RCP directed the company to implement vessel operating procedures, implement vessel maintenance procedures (including persons responsible for maintenance, maintenance schedules, and maintenance record retention procedures), and conduct annual internal audits of vessels and managing offices to ensure compliance with the program. The port engineer stated that the company conducted vessel audits as part of the program, but he did not know the last time *The Admiral* was audited. Investigators were provided no documentation of audits conducted on *The Admiral*. The only documentation received was a statement of auditors' training from February

and March 2016. The second engineer stated that he believed that the vessel was on the list to be audited.

Engines and Maintenance

The vessel's engines were 12-cylinder, 1,200-horsepower, 2-cycle diesel engines manufactured by the Electro-Motive Division of General Motors Corporation. Investigators reviewed the engine maintenance manual for the model 567C engine, and there were no specific hourly intervals for engine maintenance on any systems. To modernize the engines and reduce the inventory of spare parts, the engines were converted from 567C to 645E engines in 2003. According to the service record, the overhaul consisted of installing new power packs, blowers, counterweights, main bearings, oil pumps, and a water pump. This was the last time the engines were overhauled. After the 2003 conversion, the hour meters were zeroed. On the day of the accident, the starboard engine had 39,608 hours on the hour meter, yet there was no record of overhaul since 2003.

The chief engineer stated that the captain would be notified when general maintenance items, such as filter changes and oil changes, were performed on *The Admiral*'s engines. The most recent maintenance on the starboard engine, performed by the crew on July 11, 2016, was replacement of the starter. The port engineer would be notified via phone when major maintenance tasks were required that were beyond the crew's comfort level. The port engineer would then send maintenance personnel from Luhr Bros. to the vessel to perform the maintenance.

The company engine operations manual stated that "time intervals for preventative maintenance are calculated at Corporate Headquarters using engine running times provided by each boat." Specific maintenance items were also addressed: fuel filters were to be changed based on pressure readings and main engine oil samples were to be taken monthly for analysis. There was no documentation of oil analysis provided after September 2013. Investigators reviewed the previous 3 years of engine logbooks, and the only major maintenance recorded were the following:

- December 2012: General ring inspection, port and starboard blowers replaced.
- April 2015: Both clutches and propellers replaced.
- December 2015: Port main engine starter motor replaced.
- July 2016: Starboard main engine starter motor replaced.

The engines were not run for long periods of time during the 3-year layup period preceding the accident, and thus engine hours had not significantly increased.

According to the manufacturer's specifications, full speed of the engine was 800 rpm, and the mechanical overspeed trip device was set to stop the engine between 900 and 915 rpm.⁶ Investigators asked the vessel engineers about the operation and maintenance of the governor and the engine-mounted mechanical overspeed trip device. The chief engineer stated that he did not know much about either device and he was not aware if they were ever tested. The second engineer indicated that he was not aware of any maintenance performed on the governor or overspeed trip device during the time he was aboard. According to the port engineer, the overspeed trip was tested

⁶ The governor maintains the speed of the engine at a setting determined by the engine operator. The overspeed trip mechanism is a safety feature installed on an engine to stop the injection of fuel into the cylinders should the engine speed become excessive.

and set during major overhauls and generally not touched until the next overhaul. However, there was no record that the overspeed trip had been set during the 2003 overhaul or any time thereafter. The governor was not removed from the vessel for inspection after the accident.

The emergency shutdown button on the governor did not stop the engine when the engineer pressed the button. Also, the engine did not stop when the engineer attempted to shift the fuel rack arm to the off position. Furthermore, the overspeed trip device did not shut down the engine once the speed of the engine exceeded the setpoint, even though the overspeed trip device was found in the tripped position. Postaccident inspection of the damaged engine by the port engineer revealed that the number seven fuel injector was stuck in the full-open position, and the fuel rack arm was in the off position. Despite attempts to shut off the fuel supply to the engine, the engine accelerated in an uncontrolled manner, indicating that an external fuel supply outside its normal diesel-injection system was present.

After the accident, the company hired a forensic engineer to determine the cause of the engine explosion. He concluded that the engine had been in a runaway condition and likely used its own lubricating oil as an uncontrolled fuel source for combustion. The white smoke that the pilot saw was an indicator of lubricating oil combustion. The forensic engineer determined that the ticking sound likely was a sticking hydraulic lash adjuster, which functioned to maintain the timing of the opening and closing of the exhaust valves on the cylinder head. The engineer's report concluded that a misfiring cylinder, with pressurized exhaust gases and combustion products entering the airbox, could have caused the lubricating oil in the airbox to reach a combination of pressure and temperature necessary for an explosion to occur.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the engine explosion and resulting fire aboard the towing vessel *The Admiral* was a misfiring cylinder that ignited lubricating oil in the sump of the engine.

Vessel Particulars

Vessel	The Admiral
Owner/operator	Luhr Bros. Inc.
Port of registry	St. Louis, Missouri
Flag	United States
Туре	Towing vessel
Year built	1958
Official number (US)	277215
IMO number	N/A
Classification society	N/A
Construction	Steel
Length	112.5 ft (34.3 m)
Draft	8.2 ft (2.5 m)
Beam/width	34 ft (10.4 m)
Gross tonnage	461 gross tons
Engine power; manufacturer	2 @ 1,200 hp (895 kW); General Motors EMD 567C/ 645E
Persons on board	6

NTSB investigators worked closely with our counterparts from Coast Guard Sector Corpus Christi throughout this investigation.

For more details about this accident, visit <u>www.ntsb.gov</u> and search for NTSB accident ID DCA16FM044.

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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*, 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).