

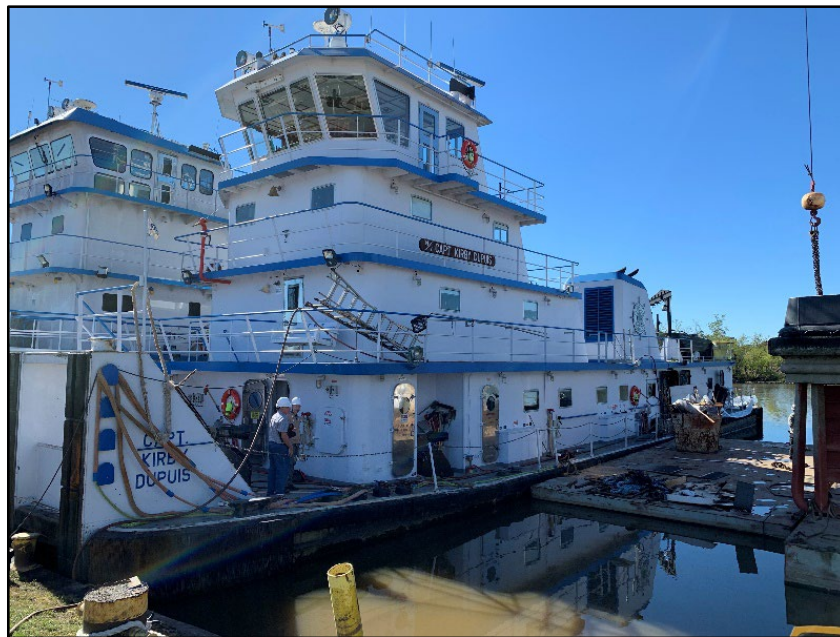


Issued September 29, 2022

MIR-22/24

# Engine Room Fire on board Towing Vessel *Capt. Kirby Dupuis*

On November 9, 2021, about 0708 local time, a fire broke out on the port main diesel engine on board the towing vessel *Capt. Kirby Dupuis*. The vessel was pushing thirteen loaded dry cargo barges while transiting upbound on the Ohio River at mile marker 501 near Belleview, Kentucky, with a crew of six.<sup>1</sup> Crewmembers fought the fire using portable extinguishers and attempted to use the vessel's fixed fire-extinguishing system. The fire was extinguished by local firefighters in the early afternoon, and the vessel was towed to port. No pollution or injuries were reported. Damage to the vessel was estimated at \$1,800,000.



**Figure 1.** *Capt. Kirby Dupuis* docked after the casualty.

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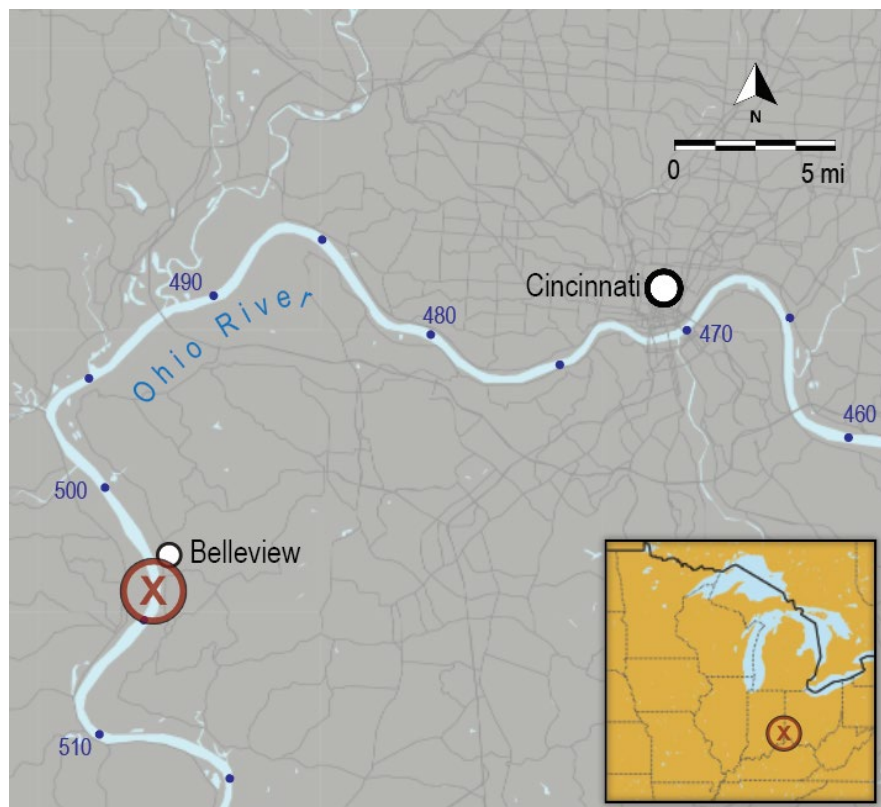
<sup>1</sup> (a) In this report, all times are central standard time, and all miles are statute miles. (b) Visit [ntsb.gov](https://www.ntsb.gov) to find additional information in the [public docket](#) for this NTSB accident investigation (case no. DCA22FM002). Use the [CAROL Query](#) to search investigations.

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<b>Accident type</b>	Fire/Explosion
<b>Location</b>	Ohio River, mile 501, near Belleview, Kentucky 39°00.44' N, 84°51.06' W
<b>Date</b>	November 9, 2021
<b>Time</b>	About 0708 eastern standard time (coordinated universal time -6 hrs)
<b>Persons on board</b>	6
<b>Injuries</b>	None
<b>Property damage</b>	\$1,800,000 est.
<b>Environmental damage</b>	None
<b>Weather</b>	Visibility 10 mi, fair skies, winds southwest 7 mph, air temperature 44°F, morning twilight 0648, sunrise 0716
<b>Waterway information</b>	River, average depth 24 ft, width about 1,700 ft (at casualty site)

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**Figure 2.** Area where the *Capt. Kirby Dupuis* engine room fire occurred, as indicated by a red X. (Background source: Google Maps)

## 1. Factual Information

### 1.1 Background

The towing vessel *Capt. Kirby Dupuis* was constructed in 2011 of welded steel in Bayou La Batre, Alabama, for Florida Marine Transporters, Inc. (FMT). The vessel was powered by two Caterpillar model 3512C marine diesel engines, each connected to a gear set and fixed propeller. At the time of the casualty, the company was operating nearly 100 towing vessels on United States inland rivers.

### 1.2 Casualty Events

On November 4, 2021, at 0600, the *Capt. Kirby Dupuis* departed Paducah, Kentucky (near mile 950), bound upriver for Steubenville, Ohio (near mile 68), pushing thirteen dry cargo barges filled with sand, rock, and steel. The vessel had a crew of six: the captain, pilot, a "deckineer" (a deckhand who was not licensed as an engineer but shared deck and engine responsibilities), and three deckhands. The deckineer was completing a company training program to be qualified as an engineer.

On the morning of November 9, the towboat was transiting with both engines about 1,275-1,290 rpm (typical underway engine loading) for a speed of about 5-6 knots. About 0708, the captain, on watch in the wheelhouse, noticed a flash on the engine room video display. Immediately following the flash, the vessel's fire detection system alarmed. The captain sounded the general alarm and instructed the deckhand on watch to notify all crewmembers about the fire and to begin firefighting efforts.

About the same time, the deckineer, in the engineer's office on the main deck overlooking the engine room, saw a fire near the port main engine in the lower engine room. He retrieved a fire extinguisher and attempted to enter the upper engine room from the main deck passageway, but the smoke and heat prevented him from accessing the space. He then joined the other crewmembers to try to fight the fire from the starboard-side exterior main deck. The deckineer tried to start the fire pump from a remote pushbutton on the exterior bulkhead, but it was inoperable (he looked through a window into the engine room and believed the electrical switchboard for the fire pump was "melting"). Unable to enter the engine room and without an operable fire pump, the deckineer contacted the captain via handheld radio and requested permission to activate the fixed fire-extinguishing (suppression) system for the engine room.

To prepare for the release, the deckineer and crewmembers closed the engine room doors, windows, and ventilation dampers on the stacks. The deckineer activated the remote emergency fuel shut offs for the engines (located on the exterior bulkhead). After securing the engine room, the deckineer returned to the main passageway by his

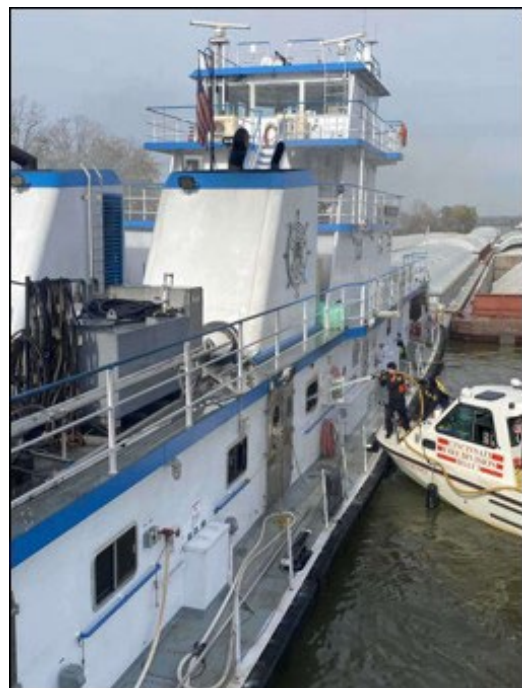
stateroom and “hit the first fire suppression system” by pulling one of the two remote pull levers.

He observed the portside fire diminishing but then saw flames growing on the starboard side of the engine room near a stack of boxes filled with oil filters. He told investigators that he believed the fire had traveled across the engine room from the port main engine to these boxes because the port ventilation supply fan, which discharged directly above the port main engine, remained on during the initial stages of the fire. (The ventilation supply fan shut down at an unknown time during the casualty; the deckineer attributed the shutdown to fire damage to the fan’s switchboard.)

The deckineer and a deckhand discharged about eight portable fire extinguishers through a slightly opened engine room door on the main deck. However, the fire continued to grow, and black smoke hindered their ability to fight the fire. When they saw that the fire had started back up on the port side of the engine room, the deckineer informed the captain that he needed to “hit the second fire suppression system” and the deckineer pulled the second remote lever. The fixed fire-extinguishing system was fitted with sirens to audibly alert personnel that the product was about to discharge. However, the deckineer, located outside the space, stated that he did not hear any sirens nor product discharging into the engine room from the system nozzles in the engine room upon activation. He told investigators he believed the fixed fire-extinguishing system extinguished the fire and stated, “the fire was pretty much out before the fire department got there.”

Meanwhile, the captain and pilot had contacted the US Coast Guard, the operating company, and nearby vessels. The *Capt. Kirby Dupuis* had lost propulsion and electrical power, but the tow remained intact and drifted into the right descending bank.

Several nearby towing vessels arrived to assist with firefighting efforts, exterior boundary cooling, controlling the *Capt. Kirby Dupuis*’ tow, and evacuating crewmembers. A fireboat arrived on scene at 0858, and the fire was extinguished about 1300 with the assistance of multiple fire



**Figure 3.** Firefighters deploying water into the engine room of the *Capt. Kirby Dupuis* through an open window. (Source: LT Meghan G. Keith, Dearborn County Water Rescue)



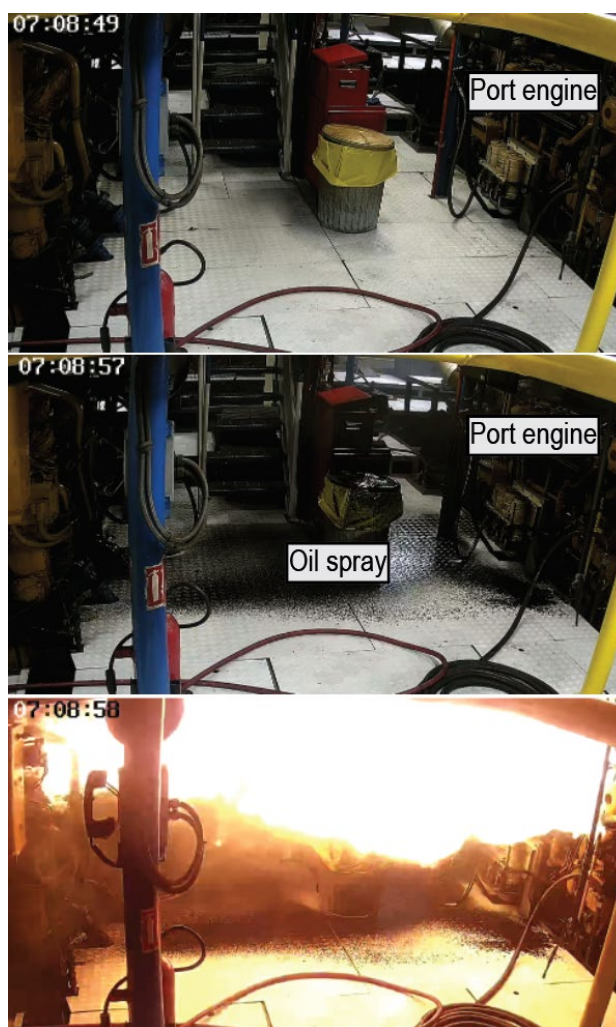
departments.<sup>2</sup> The fire caused extensive heat and smoke damage to the vessel's engine room. The upper and lower engine room bulkheads and overheads were completely burned by the fire as well as the machinery, fixtures, and equipment in the upper engine room. A marine surveyor estimated the damages to be 1.8 million dollars.

## 1.3 Postcasualty Information

### 1.3.1 Fire Source

The day after the fire, investigators reviewed the vessel's video system. At 0708:50, lube oil began to spray inboard from the port main engine into the center of the engine room toward the starboard main engine. About 10 seconds later, a flame at the top of the forward part of the engine by the exhaust manifold erupted inboard toward the starboard engine. The video lasted about 1 minute, until the camera stopped recording.

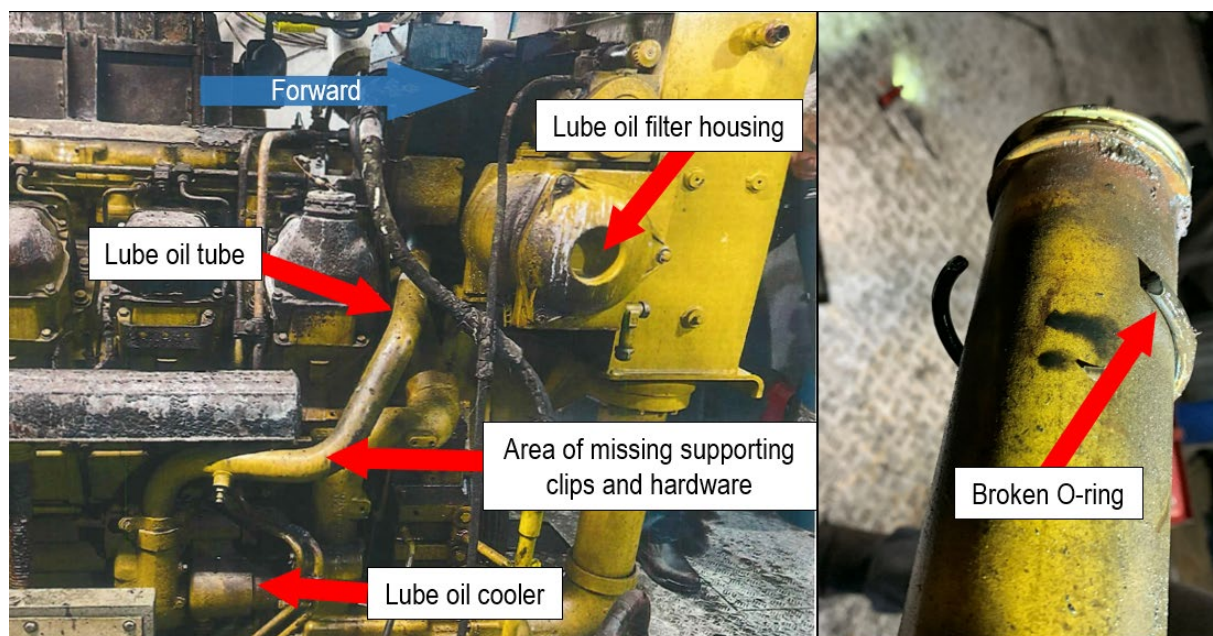
A senior technical service manager from Louisiana Cat (Caterpillar) reviewed the video and inspected the damaged port main engine. He found a broken piece of an O-ring seal on top of the front cover of the engine, directly below the upper joint area of a lube oil tube that connected the lube oil filter housing to the lube oil cooler. (The typical operating pressure of the system was about 55 pounds per square inch.)



**Figure 4.** Screenshots from the *Capt. Kirby Dupuis* engine room video camera (looking aft) at 0708:49-0708:58.

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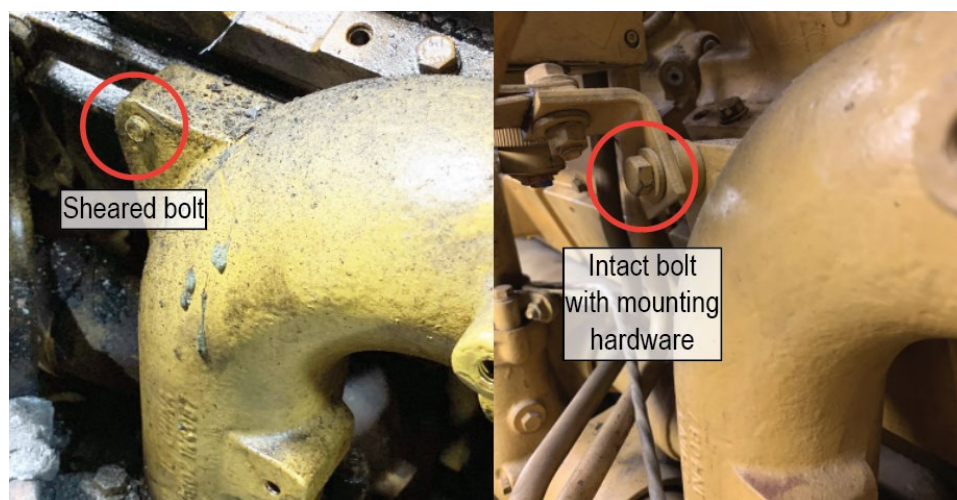
<sup>2</sup> Multiple agencies responded, including Rising Sun Fire Department; Ohio County, Indiana, Emergency Medical Services; Lawrenceburg, Indiana, Fire Department; Dearborn County Water Rescue; Covington, Kentucky, Fire Department; and Cincinnati Fire Department.



**Figure 5.** Port main engine lube oil components (*left*). Port main engine lube oil tube with broken O-ring after removal on upper section of tube (*right*). (Source: Louisiana Cat, annotated by NTSB)

When the service manager removed the tube from the engine, he found the remainder of the broken O-ring and observed that the retaining ring, which should have been installed to secure the tube in its joint, was missing where the tube connected to the lube oil filter housing. It is unknown when the tube had last been removed from the engine. Upon further inspection, the technician discovered "wear to the seal O-ring groove lip" on the upper section of the removed tube.

Additionally, supporting clips and mounting hardware for the lube oil tube were missing on the port main engine in the mid-section area, and the bolt that had held the supporting clips appeared to be sheared. The service manager's report concluded that the cause of the fire was "a severe oil leak" that sprayed onto the exhaust manifold of the port main engine near the no. 1 cylinder and ignited. "Ventilating air from the air duct above the [port main] engine supplied the fire with oxygen and blew the fire across the engine room damaging the stbd. [starboard] main engine."



**Figure 6.** Sheared bolt for lube oil tube mounting on *Capt. Kirby Dupuis* port main engine (left). Proper arrangement of supporting clips and mounting hardware on board similar FMT towing vessel *David McNemar* (right).

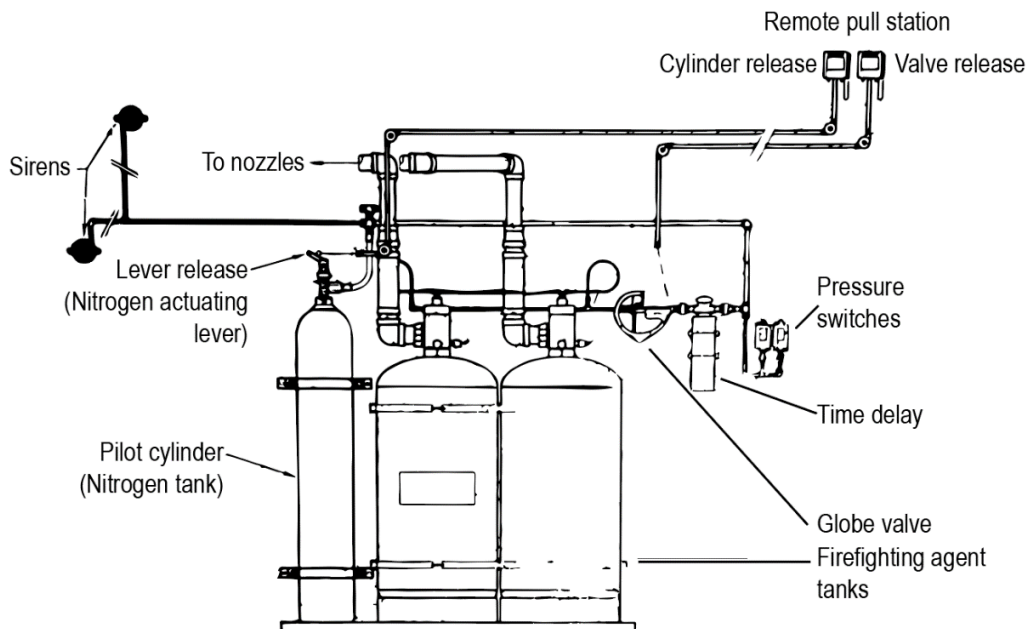
### 1.3.2 Fixed Fire-extinguishing System

The *Capt. Kirby Dupuis* was outfitted with a manually activated fixed fire-extinguishing system to protect the engine room. The system used 3M Novec 1230 fire-protection fluid, which was designed to flood the protected area (in this case, the engine room) and extinguish a fire by rapidly removing heat after discharging through fixed nozzles as a gas. The fluid was stored as liquid in cylinders pressurized by nitrogen. Novec 1230 was designed to evaporate without damaging any equipment.

The suppression system cylinders were located forward of the engine room and could also be actuated locally from this location. Instructions were posted in both locations for manual and remote actuation. Two remote pull levers were located in the passageway on the main deck in the accommodation space. One lever was labelled "cylinder release" and was connected via a cable to a lever actuator of a nitrogen-filled pilot cylinder. The other pull lever was labelled as "valve release" and connected via a cable to a globe valve in the nitrogen discharge pipe and would allow nitrogen to activate the tank valves on the two pressurized cylinders filled with suppression fluid. Both the nitrogen actuator lever and the globe valve needed to be opened for proper operation of the system. Instructions at the remote pull station stated, "break glass and pull handle hard until red paint mark on cable shows."

The system was equipped with a nitrogen-powered siren to alert personnel, pressure switches to shut down ventilation fans and the main engines, and a 60-second

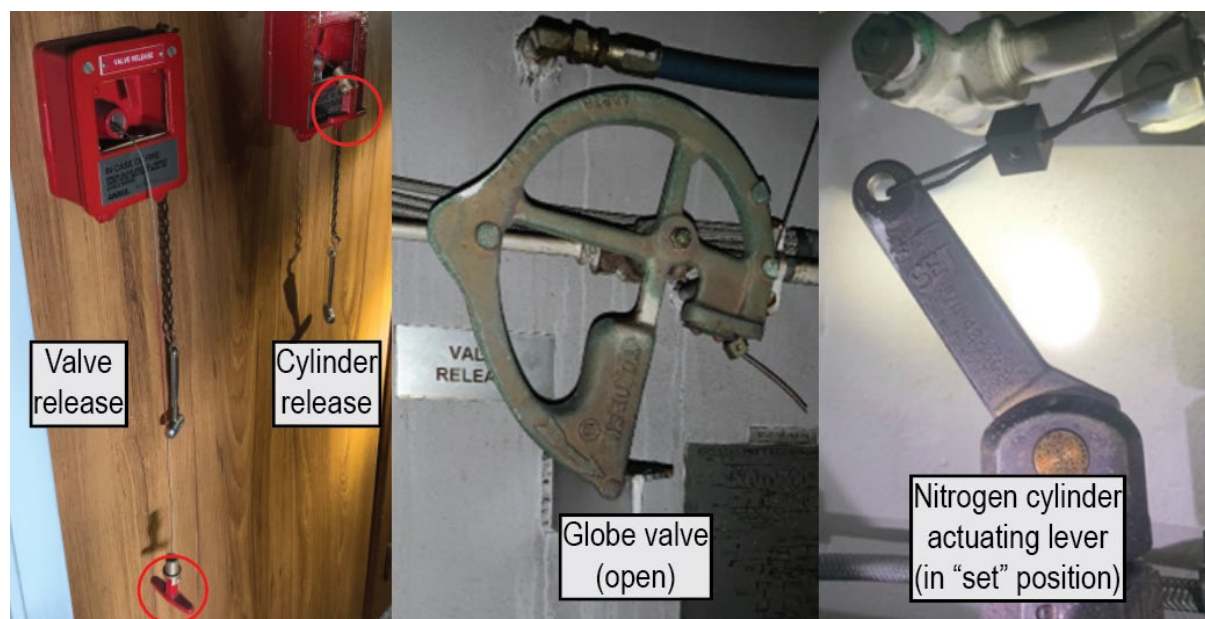
time delay to allow for evacuation of the engine room before the suppression fluid was released.



**Figure 7.** Schematic of *Capt. Kirby Dupuis* fixed fire-extinguishing system.

When investigators inspected the fire-extinguishing system, they observed that the "valve release" remote pull lever was pulled out as per the instructions, and its corresponding globe valve was open. However, the "cylinder release" remote pull lever was not fully extended, and its corresponding nitrogen cylinder's actuating lever remained in the "set" position.





**Figure 8.** Remote pull stations for *Capt. Kirby Dupuis's* fixed fire-extinguishing system as found after the fire. Red pull levers are circled (*left*). Globe valve in open position after the fire (*center*). Nitrogen cylinder's actuating lever in the "set" position as found after the fire (*right*). (Source: Coast Guard).

The gauges on the nitrogen and suppression fluid cylinders indicated they were fully charged. Fire suppression technicians inspected the system and verified that the nitrogen cylinder was fully charged, and two suppression fluid cylinders were at full capacity weight. The system was then evaluated and tested from the remote stations by the technicians and was determined to operate as per design.

### 1.3.3 Engine Maintenance

At the time of the fire, the engine had about 73,135 running hours. In May 2018, the port main engine underwent a top end overhaul that included replacement or refurbishment of cylinder heads, fuel injectors, pumps, and turbochargers. The invoice for the top end overhaul did not include any parts associated with the lube oil tube. The vessel's deckineer stated that he performed routine maintenance on the engines, such as oil and filter changes, and that any major repairs would be carried out by service technicians. According to the deckineer, there were no outstanding maintenance tasks associated with the port main engine, and he was not aware of any operating issues. In his year as a deckineer aboard the *Capt. Kirby Dupuis*, there had not been any need for a service technician to conduct any maintenance or repair on the port main engine.

It is unknown how long the port main engine had been operating without the retaining ring, supporting clips, and hardware on the lube oil tube. After the casualty, FMT requested that crewmembers and Caterpillar service technicians inspect the

Caterpillar 3512 main engines throughout their fleet for proper installation of supporting clips and mounting hardware on the lube oil tubes. About 10% of the inspected engines required attention and were corrected.

### 1.3.4 Crew Training

From January 2021 to the date of the fire, more than forty documented drills and safety meetings were held aboard the *Capt. Kirby Dupuis* consisting of simulated fires in various locations of the vessel (including the upper engine room), oil spills, collisions, abandoning the vessel, and person overboard retrieval. The operating company had a safety management system that included vessel safety orientation for new crewmembers, a training matrix, and procedures for responding to fires on board.

None of the drills or procedures included familiarization or training on the fixed fire-extinguishing system. As of the date of this report, FMT is developing a training video on fixed fire-extinguishing systems that will become required training for their crews.

## 2. Analysis

The initial cause of the *Capt. Kirby Dupuis* port main engine (a Caterpillar model 3512C) fire was an oil leak from the pressurized lube oil system at the tube connection to the lube oil filter housing, which released oil that came in contact with a hot surface, likely the exhaust manifold on the engine. The retaining ring that was supposed to be installed behind the O-ring lip of the lube oil tube was missing, so the O-ring was not properly sealed nor supported in the joint for an unknown amount of time, leading to its failure. The wear found on the seal O-ring groove lip of the lube oil tube indicates that there was movement of the tube in the joint due to natural vibration of the operating engine. It is likely that at some installation, after maintenance that required removal of the tube, the retaining ring was not re-installed on the tube.

Additionally, the supporting clips and hardware were also missing from the mid-section of the lube oil tube, preventing it from being secured in accordance with the manufacturer's design. It is unknown how long the supporting clips and hardware had been missing from the engine. The last major work on this engine was in May 2018 when a top end overhaul was conducted, and it is possible that the oil tube was removed during that work. However, none of the parts associated with the tube were ordered at that time. A sheared bolt found postcasualty indicates that the supporting clips and hardware had originally been installed on the engine but had failed at some point. Without the supporting clips and hardware, the tube was unsupported in the mid-section area and more susceptible to vibration and associated movement.

The engine room video showed that, within 10 seconds of the leak starting, the oil sprayed inboard into the center of the engine room and upward onto the exhaust manifold on top of the running engine. Immediately after contacting the hot surface of the exhaust manifold, the oil ignited and started the fire. Forced air from the running ventilation supply fan discharging above the engine fueled the fire with oxygen and propelled it across the engine room, damaging the starboard engine and the equipment in the upper engine room.

Although the crew attempted to activate the vessel's fixed fire-extinguishing system—and believed they had successfully discharged the fire suppression fluid—investigators determined that the system was not activated during the fire. After the fire, the nitrogen pilot cylinder lever was found in the "set" position and its cylinder was still fully charged. Both suppression fluid cylinders were also found full to capacity after the fire. Despite the deckineer stating that he pulled both remote pull levers, only the "valve release" lever was found to be fully extended; its attached cable properly opened the globe valve. However, the "cylinder release" remote pull valve handle was found only slightly extended from its stowed position in the cradle; therefore, the nitrogen gas from the pilot cylinder had not been discharged. Lacking pilot pressure, the sequence for release could not activate: the siren did not sound, and the remote shutdowns of the engines and ventilation fans were not activated.

Although the crew drilled regularly in the months preceding the fire, including simulated fires in that included the upper engine room, they did not include scenarios or exercises that simulated activation and operation of the fixed fire-extinguishing system. The deckineer referred to the system as having a "first" and "second" bank, and his actions during system activation were consistent in attempting to use a primary dispersion of suppression fluid, followed by a secondary release of additional fluid—contrary to the system's design for a single pressurized release. During interviews, the deckineer did not display a confident understanding of the overall operation of the system. Had the crew been more familiar with the system, and activated it properly, the system would have shut down the engines and ventilation fans before a complete release of both cylinders of suppression fluid into the engine room and may have quickly extinguished the fire.

## 3. Conclusions

### 3.1 Probable Cause

The National Transportation Safety Board determines that the probable cause of the engine room fire aboard the towing vessel *Capt. Kirby Dupuis* was a lube oil tube on the port main engine that vibrated out of a joint due to a missing retaining ring and

mounting bracket, spraying pressurized oil that made contact with a hot exhaust surface and ignited. Contributing to the severity of the fire damage was the crew's unfamiliarity with activation procedures for the fixed fire-extinguishing system, which resulted in an unsuccessful attempt to release the fire suppression fluid and extinguish the fire.

## **3.2 Lessons Learned**

### **Crew Training in Use of Fixed Fire-extinguishing Systems**

The small confines of the engine room space and the location of fire equipment within that same space demonstrate a risk to crews fighting engine room fires. On towing vessels, the risk to crews fighting engine room fires has led to the development of designs that incorporate both a means for securing ventilation to the engine room and a fire-extinguishing system to extinguish the fire without requiring crews to enter the space. Crewmembers should train for engine room fires and review extinguishing system instructions. Training drills should ensure that crewmembers are familiar with fixed fire-extinguishing systems and procedures, including confirming crew evacuation, isolating the protected space, and activating the system.



<b>Vessel</b>	<i>Capt. Kirby Dupuis</i>
<b>Type</b>	Towing/Barge (Towing vessel)
<b>Flag</b>	United States
<b>Port of registry</b>	New Orleans, Louisiana
<b>Year built</b>	2011
<b>Official number (US)</b>	1229999
<b>IMO number</b>	N/A
<b>Classification society</b>	N/A
<b>Length (overall)</b>	120 ft (36.6 m)
<b>Beam</b>	35 ft (10.7 m)
<b>Draft</b>	11.6 ft (3.5 m)
<b>Tonnage</b>	436 GRT
<b>Engine power; manufacturer</b>	2 x 2,000 hp (1,491 kW); Caterpillar 3512C diesel engines

NTSB investigators worked closely with our counterparts from **Coast Guard Marine Safety Detachment Cincinnati** throughout this investigation.

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For more detailed background information on this report, visit the NTSB investigations website and search for NTSB accident ID DCA22FM002. Recent publications are available in their entirety on the NTSB website. Other information about available publications also may be obtained from the website or by contacting—

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