Issued March 16, 2022 MIR-22/07

Contact of Tanker *Riverside* with Moda Ingleside Energy Center No. 4 Loading Dock

On March 15, 2021, about 1302 local time, the oil tanker *Riverside* with a crew of 21 and 2 pilots was transiting outbound from the port of Corpus Christi, near Ingleside, Texas, in a loaded condition when the vessel lost propulsion and struck the no. 4 loading dock at the Moda Ingleside Energy Center.[1] No pollution or injuries were reported. Damage to the vessel was estimated at $550,000. The estimated property damage to the facility was $7 million.

Figure 1. *Riverside* before the casualty. (Source: Glory Riverside Navigation LTD)

[1] (a) In this report, all times are central daylight time, and all miles are statute miles. (b) Visit ntsb.gov to find additional information in the public docket for this NTSB investigation (case no. DCA21FM017). Use the CAROL Query to search investigations.

Casualty type	Contact
Location	Corpus Christi Channel, Ingleside, Texas 27°49′6.9" N , 97°12′31.6" W
Date	March 15, 2021
Time	1302 central daylight time (coordinated universal time –5 hrs)
Persons on board	23
Injuries	None
Property damage	$7,550,000 est.
Environmental damage	None
Weather	Visibility 4 mi, cloudy with drizzle, winds east 6 mph, air temperature 65°F, water temperature 68°F
Waterway information	Channel, depth 47 ft, width 500 ft

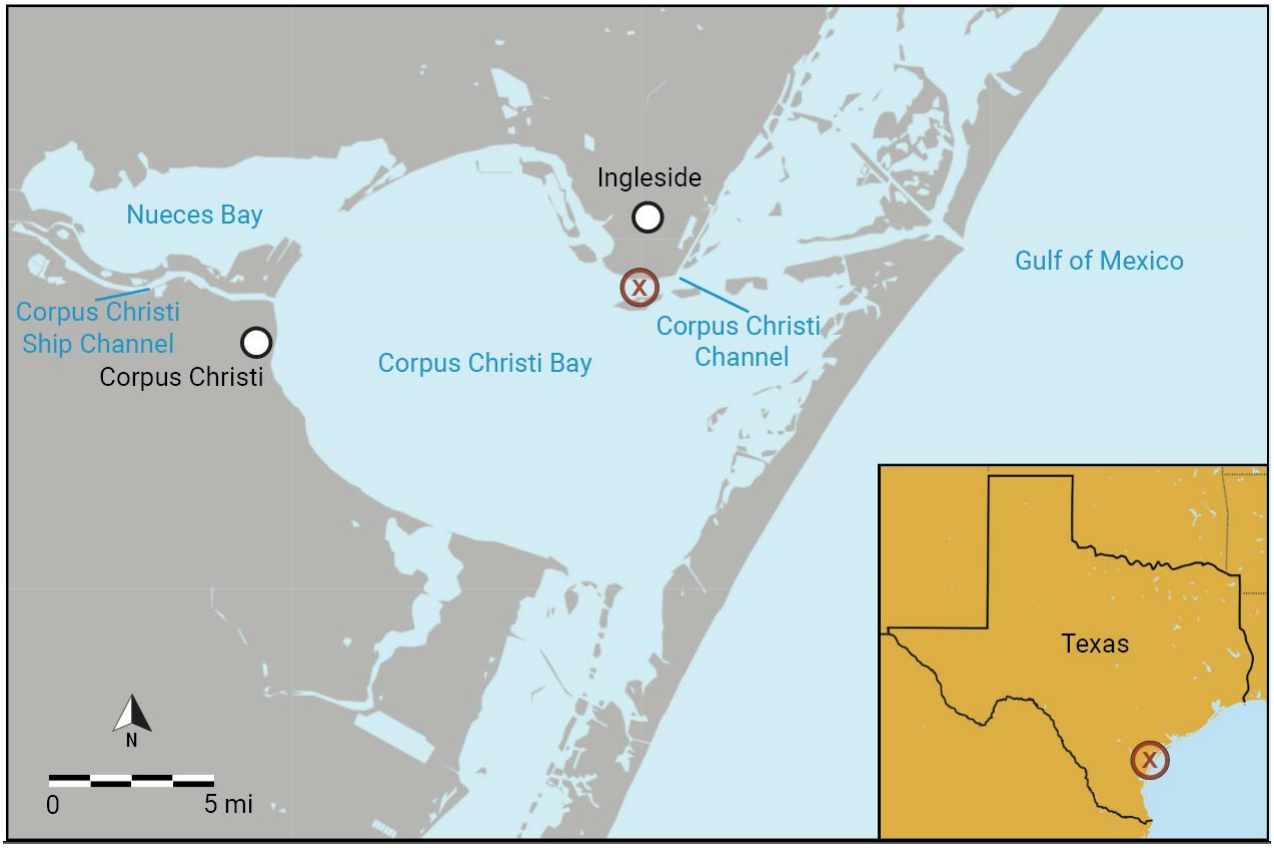

Figure 2. Area where the tanker *Riverside* struck the Moda Ingleside Energy Center no. 4 loading dock, as indicated by the red *X*. (Background source: Google Maps)

1. Factual Information

1.1 Background

The *Riverside* was an 820-foot-long, steel-hulled liquid bulk cargo vessel (oil tanker) built in 2009 by STX Offshore & Shipbuilding Jinhae Shipyard in Changwon, South Korea. It was owned by Glory Riverside Navigation LTD and operated by Thome Ship Management PTE LTD. The vessel was double hulled, meaning its cargo tanks were within an inner watertight hull separated by ballast or void tanks or other spaces from its outer hull, and had a liquid cargo capacity of 793,842 barrels of oil. The vessel was powered by one STX MAN B&W (model 6S60MC-C) slow-speed, two-stroke diesel engine, producing 18,184 hp and directly driving a single fixed-pitch propeller. The vessel's maximum speed was 15 knots. To change the propeller direction, the engine had to completely stop and then restart in the opposite direction. The main engine could be started from three locations: the bridge, the engine control room, and locally at the main engine.

1.2 Event Sequence

On March 15, 2021, at 1018, two pilots from Aransas-Corpus Christi Pilots boarded the *Riverside* to assist with maneuvering the vessel out of the port. At 1054, the *Riverside* departed the EPIC Marine Terminal on the Inner Harbor of the Corpus Christi Ship Channel, Corpus Christi, Texas, under pilot 1's direction, with the assistance of two tugs. The vessel carried 717,554 barrels of crude oil and was bound for Lisbon, Portugal. The vessel proceeded down the Inner Harbor section of the Corpus Christi Ship Channel at 3.5 knots with tug escorts. Once the *Riverside* passed through the Harbor Bridge at 1200, the tug escorts departed, and pilot 2 took control of the tanker and increased speed to 10.5 knots at a half-ahead bell. Pilot 2 continued outbound, and, about 1238, he became aware from radio transmissions that the tank vessel *Nordic Aquarius* was preparing to depart the no. 4 loading dock at the Moda Ingleside Energy Center (no. 4 Moda dock), located about 11 miles ahead of the *Riverside*. At 1245, pilot 2 was informed by the pilot aboard the *Nordic Aquarius* that it was departing the no. 4 Moda dock. The pilots on the *Riverside* agreed that the *Riverside* would slow down to allow the *Nordic Aquarius* to safely depart the dock, enter the channel, and proceed out of the port.

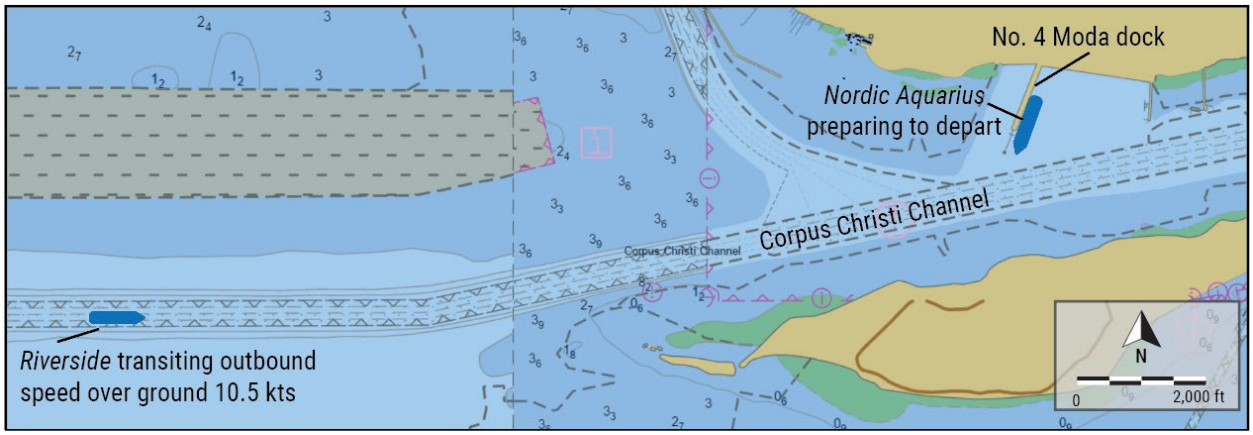

Figure 3. Approximation of *Riverside* transiting the Corpus Christi Channel outbound about 18 minutes before the casualty, with *Nordic Aquarius* preparing to depart the dock. (Background source: National Oceanic and Atmospheric Administration [NOAA])

At 1247, pilot 2 started to slow the *Riverside* at buoys 49/50, about 3.6 miles from the no. 4 Moda dock, by ringing half ahead, then slow ahead at 1248, and dead slow ahead at 1251. At 1255, after the *Riverside* passed buoys 43/44 at the port bend in the channel, pilot 2 ordered stop engines to further slow the vessel, which was moving ahead at 8 knots. At 1256, pilot 2 instructed the helmsman to inform him if he was having any problem steering the vessel as it was slowing down. After slowing to about 6 knots, the *Riverside* began to sheer to port. At 1258, pilot 2 ordered the rudder hard to starboard to counteract the heading change to port, but the rudder movement had no effect on the vessel's direction. He then ordered dead slow ahead to increase the flow of water across the rudder, which required restarting the engine in the ahead direction. The engine failed to start from the bridge. The captain contacted the engine room, and the chief engineer tried to start the engine from the engine control room; the engine again failed to start. Meanwhile, at 1258, the *Nordic Aquarius* had entered the channel and was proceeding outbound.

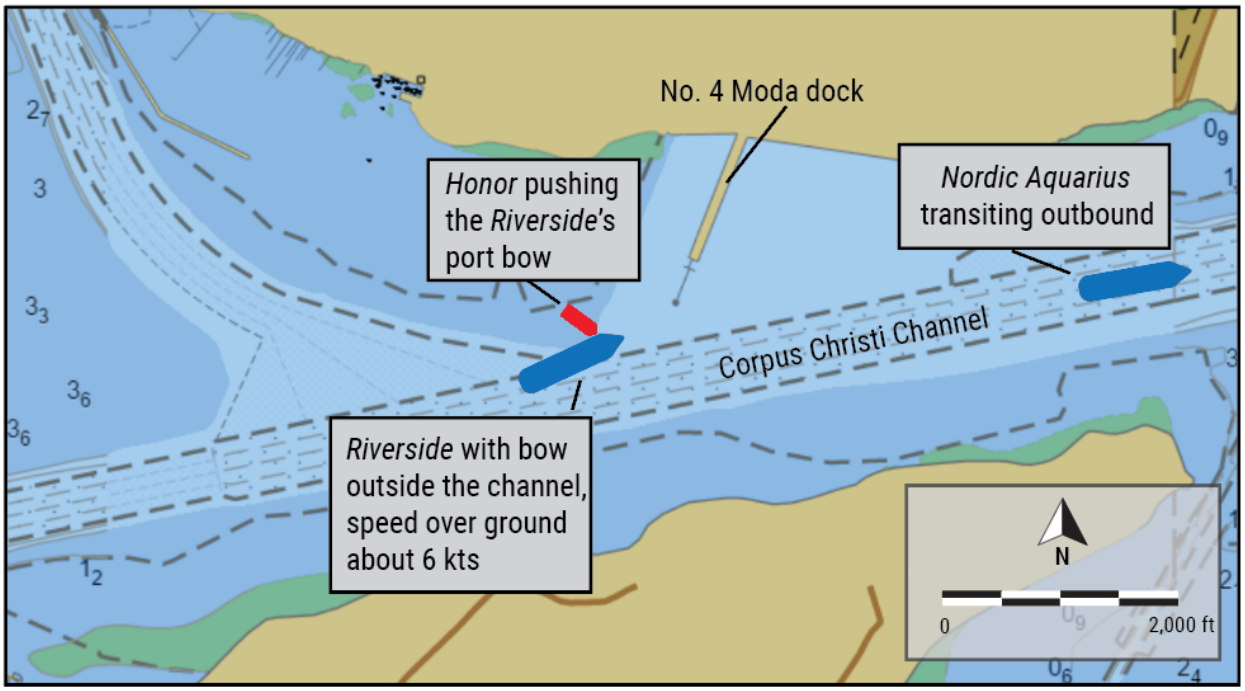

Figure 4. Approximation of *Riverside* at 1300, just before the contact with the no. 4 Moda dock dolphin and catwalk, with the tug *Honor* pushing its port bow; the *Nordic Aquarius* has departed the no. 4 Moda dock and is transiting outbound. (Background source: NOAA)

Pilot 2 noticed that the captain was focused on adjusting the engine controls and inquired if there was a problem. The captain informed him that they had "lost the engine." In response to that notification and realizing that the *Riverside* was heading toward the no. 4 Moda dock, pilot 2 contacted a nearby tug, *Honor,* which was standing by on the west side of the no. 4 Moda dock, and requested that the tug push on the *Riverside*'s port bow in an effort to clear the pier. The tug pushed against the *Riverside*'s port bow and was able to affect the vessel's direction back toward the channel, but the tug had to move out of the way to avoid becoming trapped between the pier and the vessel. Pilot 2 ordered dead slow astern, and the chief engineer tried to start the engine astern locally, but it failed to start. Pilot 2 and the captain considered dropping the starboard anchor, but they decided against that action out of concern the anchor might puncture the vessel's hull due to the vessel's speed (about 5 knots) and shallow water near the no. 4 Moda dock. At 1302, the *Riverside*'s port bow struck the mooring dolphin and catwalk at the end of the no. 4 Moda dock at 5 knots. The *Riverside* continued past the pier, and the tug *Honor* maneuvered to the vessel's stern, attached a line on the stern, and, with the assistance of the tugs *Strength*, *America*, and *Courageous*, stopped the vessel about 1,600 feet past the no. 4 Moda dock. After the vessel stopped, the tugs assisted in docking the *Riverside* at the Flint Hills dock no. 4, a facility next to the Moda Ingleside Energy Center.

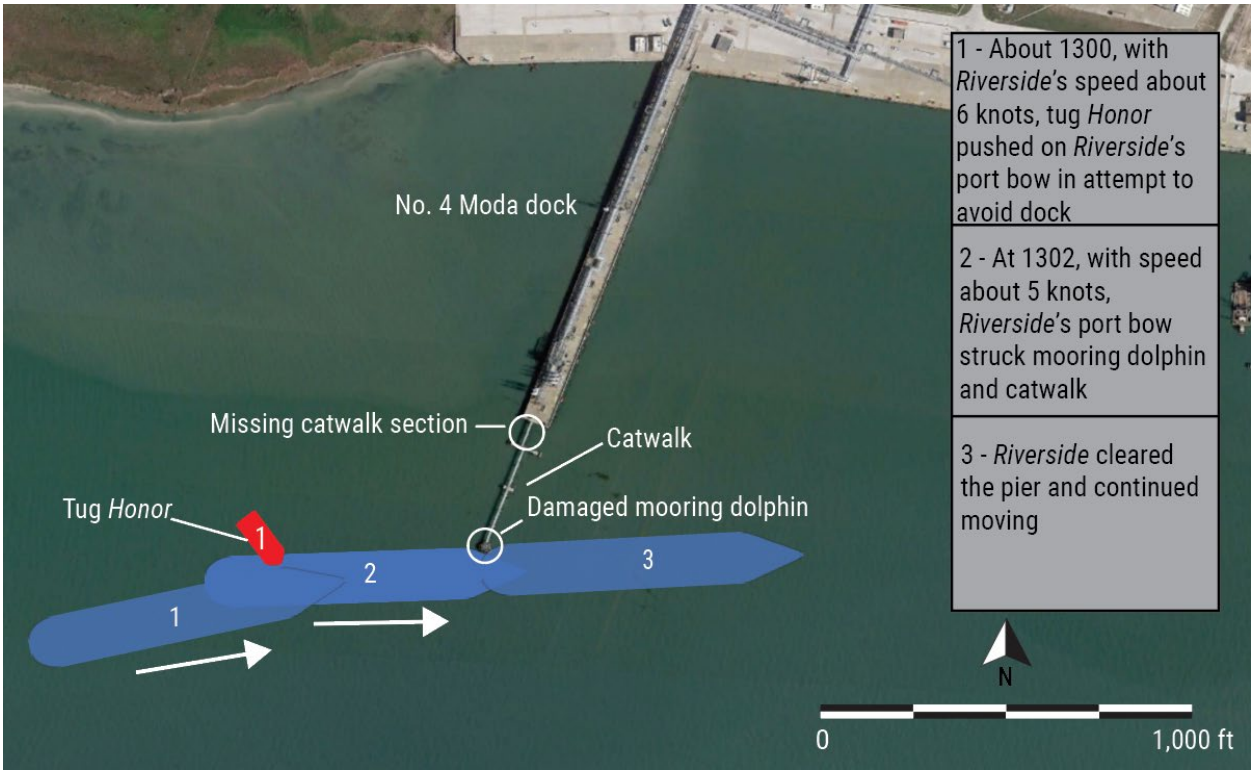

Figure 5. Final events surrounding the *Riverside*'s contact with the no. 4 Moda dock. (Background source: Google Earth)

1.3 Additional Information

1.3.1 Damage

A damage survey determined that the no. 4 Moda dock and mooring dolphin sustained significant damage; a portion of the no. 4 Moda dock's catwalk between the mooring dolphins was missing. According to the classification society report on the damage to the *Riverside*, dated March 16, 2021, the vessel sustained several bent internal frames and hull indents to the fore void space, forepeak tank, and the no. 1 port water ballast double bottom side tank. Additionally, the port anchor shank was bent 20°, and there was scraping damage to the hull.

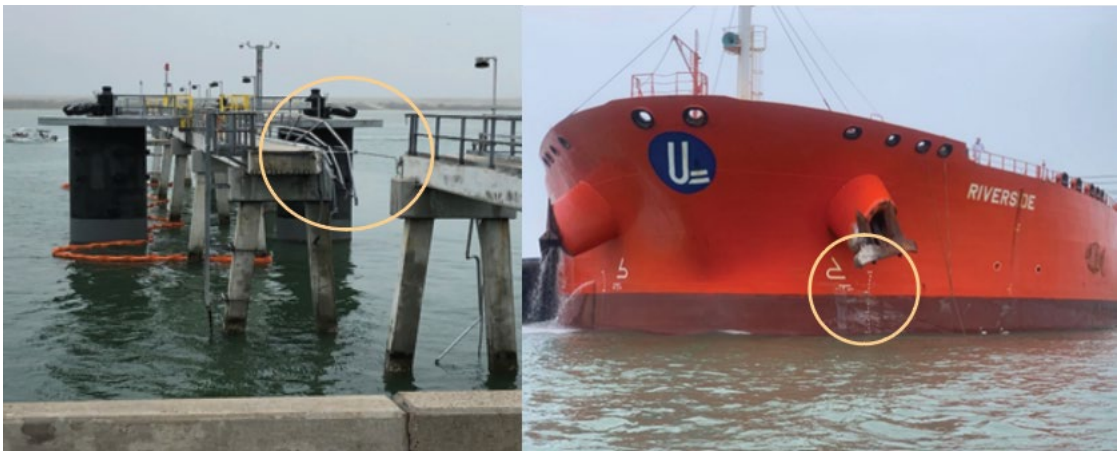

Figure 6. Damage to the no. 4 Moda dock catwalk (*left*) and the *Riverside* (*right*), circled. (Source: US Coast Guard)

1.3.2 Previous Engine Issues

The chief engineer joined the *Riverside* on February 15 in Tramandai, Brazil, to relieve the previous chief engineer, who had to depart unexpectedly due to medical issues. Both the departing chief engineer and new chief engineer signed and submitted the chief engineer's handover form on February 16, 2021, per the vessel's safety management procedure, with no significant concerns noted about the condition of the main engine or the other systems. The vessel departed Brazil for Corpus Christi on February 16, and the crew encountered no problems with starting and stopping the engine. During the voyage, no issues were noted with the vessel's main engine.

The *Riverside* switched the main engine fuel supply to low-sulfur marine gas oil on March 11. On March 12, after arriving off the Corpus Christi (Port Aransas) coast at 0548, the engine was secured, and the *Riverside* drifted while the crew waited for the pilots to arrive to take the vessel into port. After drifting for about 5 hours, at 1030, the deck watch officer on the bridge attempted to start the main engine in preparation for entering port, but it failed to start. The chief engineer switched engine control to the engine room and successfully started the engine in ahead mode, but it failed to start in astern mode. The chief engineer started the engine again at the local control, but the engine rpm was too low for proper operation, so the engine was secured to troubleshoot the cause. During the crew's evaluation of the engine to determine why it was not starting properly, they discovered that the chiller for the low-sulfur marine gas oil had not been put in operation, but after the chiller was put in operation, the engine still did not start.

After troubleshooting the engine start system, which included leak testing air control valves on the pneumatic start system and replacing two of them, the engine would start in the ahead mode but still would not start in the astern mode. The chief

engineer contacted the operating company for advice. The company's technician recommended to the chief engineer that the fuel rack position be increased in order to introduce more fuel to start the engine. However, the chief engineer decided it would be more effective to engage the limit cancel mode on fuel injection (a procedure not included in the engine's instruction manual), which allowed 10% more fuel at engine start. At 1555, when the chief engineer made the adjustment to the limit cancel mode, the engine started ahead and was successfully switched between ahead and astern modes. The chief engineer told investigators that no additional evaluation was conducted. The vessel picked up the pilots at 1630 and proceeded to the EPIC Marine Terminal in Corpus Christi Inner Harbor. During the transit, the engine was stopped and started twice, once in astern mode and once in ahead mode—with the limit cancel mode engaged—as the vessel maneuvered in the channel and docked with no incident.

Since the company did not consider this a marine casualty or a long-term issue, neither the pilots nor the US Coast Guard were notified that the *Riverside* had operational problems with the main engine. Because they believed the problem was resolved, the crew did not request the assistance of a diesel technician from the engine manufacturer.

1.3.3 Main Engine Air Start System Evaluation

Following the contact with the no. 4 Moda dock, the Coast Guard detained the *Riverside* to prevent the vessel from departing US waters until the cause of the engine failure was identified and corrected. Two MAN-certified diesel engine technicians (technician 1 and technician 2) attended the *Riverside* to determine why the vessel's 6-cylinder main engine failed to start.

The main engine used a 435-psi (30-bar) pneumatic system for starting in both the ahead and astern directions. It also used a 100-psi (7-bar) control air system to maintain its operation. During a main engine starting air system evaluation, technician 1 determined that the piston slide valve on the no. 6 starting air actuator within the starting air distributor was sticking, which prevented the 7-bar pneumatic signal (pilot air) from opening the no. 6 cylinder air valve. When the actuator and housing were removed, the technician found hardened grease and dirt within the actuator, which he concluded prevented the actuator from moving properly.

The distributor directed 30-bar starting air via a pilot line (pilot air) to each of the cylinder's starting air valves to open and close them. When open, the start air valves admitted a large volume of 30-bar starting air into the cylinder. The distributor timed the delivery of pilot air to cylinders' start air valves to correspond to the engine's firing order—beginning rotation in the ahead or astern direction until combustion began. The technician told investigators that the buildup on the actuator may have been a result of

moisture accumulation within the start air tanks and piping system due to insufficient draining of the system on a routine schedule. After the actuator was cleaned, the technicians tested the engine and started it in both in the ahead and the astern modes from the bridge, the engine control room, and locally at the main engine with no further issues.

The chief engineer told investigators that when the vessel departed the EPIC dock and the engine failed to start before the casualty, the engine was still in the limit cancel mode. Technicians 1 and 2 both told investigators that the engagement of the limit cancel mode, which added 10% more fuel to the piston, had no impact on the engine's ability to start. Technician 1 explained to investigators that the unpredictability of the engine to start both in the ahead and astern modes may have been a result of the engine position when it stopped and whether the no. 6 actuator was needed to restart the engine. If the engine was stopped in a position where the no. 6 actuator was skipped, the engine would start (as other cylinder actuators allowed pilot air to open main start valves); however, if the actuator was required to start the engine, the engine had a higher failure-to-start potential.

The chief engineer's written standing orders required daily draining of the control air and air start systems during engine room rounds. The purpose of the routine draining from the compressed air systems at all the draining points, including air reservoir, piping system, and compressor outlet, was to remove water and oil residues from the pneumatic system.

Figure 7. The main engine's starting air distributor containing the no. 6 starting air actuator valve. (Source: Thome Ship Management)

1.3.4 Main Engine System Evaluation

During the evaluation of all systems related to the main engine, technician 2 identified minor issues with the fuel system pumps, which showed signs of wear and would eventually need to be replaced. Additionally, the technicians found leaking air control valves that required maintenance while the technicians were on board to return them to their proper operational status. Although these deficiencies needed to be addressed, the technicians did not indicate that they contributed to the main engine's failure to reliably start.

Figure 8. The top of the *Riverside* main engine. (Source: Coast Guard)

The Coast Guard also required an external port state control audit of the vessel's safety management system by the classification society. The classification society issued two non-conformities for the vessel's safety management system for the main engine: 1) the company should establish procedures to ensure that the vessel is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the company, and 2) in meeting these requirements, the company should ensure that inspections are held at appropriate intervals.

1.3.5 Related Casualty

The NTSB investigated a previous casualty caused by a main engine start failure. In 2014, the bulk carrier *Anna Smile* experienced problems with the starting system of a similar MAN B&W main engine while maneuvering during docking operations and

contacted the Louis Dreyfus Grain Elevator in Houston, Texas.[2] Following the casualty, excessive moisture was found in the control air system, which prevented the pneumatic changeover valves from functioning properly. The casualty caused an estimated $2.5 million in damage to the grain elevator and its foundation.

2. Analysis

The engine's failure to reliably start was discovered before the *Riverside* entered the port of Corpus Christi, while the vessel was waiting for pilots offshore. The vessel's chief engineer and the operating company technician evaluated the engine to determine the problem, and, after about 5 hours, the engine started when the chief engineer engaged the limit cancel mode for fuel, allowing 10% more fuel into each piston. While the engine started successfully, both ahead and astern, the cause of the engine start failure was not properly identified or corrected, leaving the engine unreliable to respond to the maneuvering demands generally encountered while transiting within a commercial port. According to technicians from the engine's manufacturer, the engagement of the limit cancel mode had no effect on the starting of the engine.

Technicians identified that the cause of the main engine start failures was the inability of the no. 6 actuator to initiate piston rotation due to hardened grease and dirt, preventing proper movement. Following the casualty, technicians discovered other problems within several main engine systems, including the fuel pumps, the control air drying system and start air system, and numerous pneumatic air control valves.

The technicians told investigators that the engine start system failed because the vessel's engineers did not clear moisture from the start air system by draining the air tanks on a routine basis. The chief engineer's written standing orders required daily draining during machinery space rounds. However, based on the technicians' assessments, it appears this routine maintenance was not regularly performed. Over time (and before the vessel arrived in Corpus Christi), this allowed hardened grease to build up in the actuator.

The chief engineer stopped evaluating the engine start failure 3 days before the casualty, on March 12, after engaging the limit cancel mode on the fuel, concluding at the time that the issue was addressed. However, engaging the limit cancel mode was not recommended by the MAN diesel operating manual as a method to start the engine, and, as stated by the diesel technicians, did not have any impact on the starting of the

[2] *Allision of Bulk Carrier* Anna Smile *with Louis Dreyfus Grain Elevator*, Marine Accident Brief NTSB/MAB-15/08. Washington, DC: NTSB.

engine. The fact that the chief engineer left the limit cancel mode engaged—an abnormal operating condition—should have indicated that there was still an unresolved issue with starting the main engine. Had the chief engineer or the company technical representative decided to further inspect the engine or request an inspection by a diesel engine technician before the *Riverside* entered port, or alongside the berth before departing, the buildup on the starting air valve would have likely been identified and corrected.

3. Conclusions

3.1 Probable Cause

The National Transportation Safety Board determines that the probable cause of the contact of the tanker *Riverside* with the Moda Ingleside Energy Center no. 4 loading dock was the ineffective evaluation and incorrect solution for a main engine start issue by the company and shipboard engineers, overlooking the fouling of the main engine's no. 6 air start actuator valve within the starting air distributor. Contributing to the casualty was the presence of moisture in and lack of routine drainage of the air start system, which allowed the buildup of hardened grease within the air start actuator valve.

3.2 Lesson Learned: Evaluation of Engine Start Issues

On vessels with slow-speed diesel propulsion engines, starting and stopping main engines is a critical function for effective maneuverability. The NTSB has investigated multiple casualties involving slow-speed engine pneumatic starting and control systems and, in particular, air actuating valves within the systems. Vessel operators should ensure their crews are equipped with the resources and training to execute timely and thorough maintenance and repair on engines. If the root cause of an engine operating issue cannot be determined, it is critical for a chief engineer and vessel owner/operator to have a diesel technician further evaluate and determine the cause of the malfunction. Vessel reliability is dependent on the complete resolution of equipment malfunctions and abnormalities when they occur.

Vessel	*Riverside*
Type	Cargo, liquid bulk (oil tanker)
Flag	Malta
Port of registry	Valletta, Malta
Year built	2009
Official number (US)	N/A
IMO number	9412464
Classification society	DNV (formerly Det Norske Veritas Germanischer Lloyd)
Length (overall)	819.9 ft (249.9 m)
Beam	144.5 ft (44.0 m)
Draft (accident)	43.0 ft (13.1 m)
Tonnage	62,856 GT ITC
Engine power; manufacturer	1 x 18,184 hp (13,560 kW); 6S60MC-C MAN B&W diesel engine

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

The National Transportation Safety Board (NTSB) is an independent federal agency dedicated to promoting aviation, railroad, highway, marine, and pipeline safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974, to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

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For more detailed background information on this report, visit the NTSB investigations website and search for NTSB accident ID DCA21FM017. 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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