Issued September 13, 2022 MIR-22/23

Contact of Bulk Carrier *Jalma Topic* with Office Barge

On July 12, 2021, about 0323 local time, the bulk carrier *Jalma Topic* was transiting upriver on the Lower Mississippi River near New Orleans, Louisiana (mile 93.5), when it lost steering and struck a barge with an office accommodation structure on the bank.[1] None of the 3 persons on the office barge or 20 persons (19 crew and a pilot) on the *Jalma Topic* were injured. The office barge and moorings sustained damages estimated at $6 million. The bow of the *Jalma Topic* sustained an estimated $215,000 in damages. No pollution or injuries were reported.

Figure 1. *Jalma Topic* at anchor after the contact.

[1] (a) In this report, all times are central daylight time; all miles are nautical miles (1.15 statute miles) with the exception of river miles, which are statute miles; and all vessel speeds are speed over ground. (b) Visit ntsb.gov to find additional information in the public docket for this NTSB casualty investigation (case no. DCA21FM032). Use the CAROL Query to search investigations.

Casualty type	Contact
Location	Lower Mississippi River, mile 93.5, New Orleans, Louisiana 29°57.34′ N, 90°02.42′ W
Date	July 12, 2021
Time	0323 central daylight time (coordinated universal time –5 hrs)
Persons on board	20 (*Jalma Topic*), 3 (barge)
Injuries	None
Property damage	$6,215,000 est.
Environmental damage	None
Weather	Visibility 10 mi, partly cloudy, winds southeast 5 kts, air temperature 79°F
Waterway information	River, gage 9 ft, project depth 45 ft, width 1,800 ft, current 2–2.5 kts

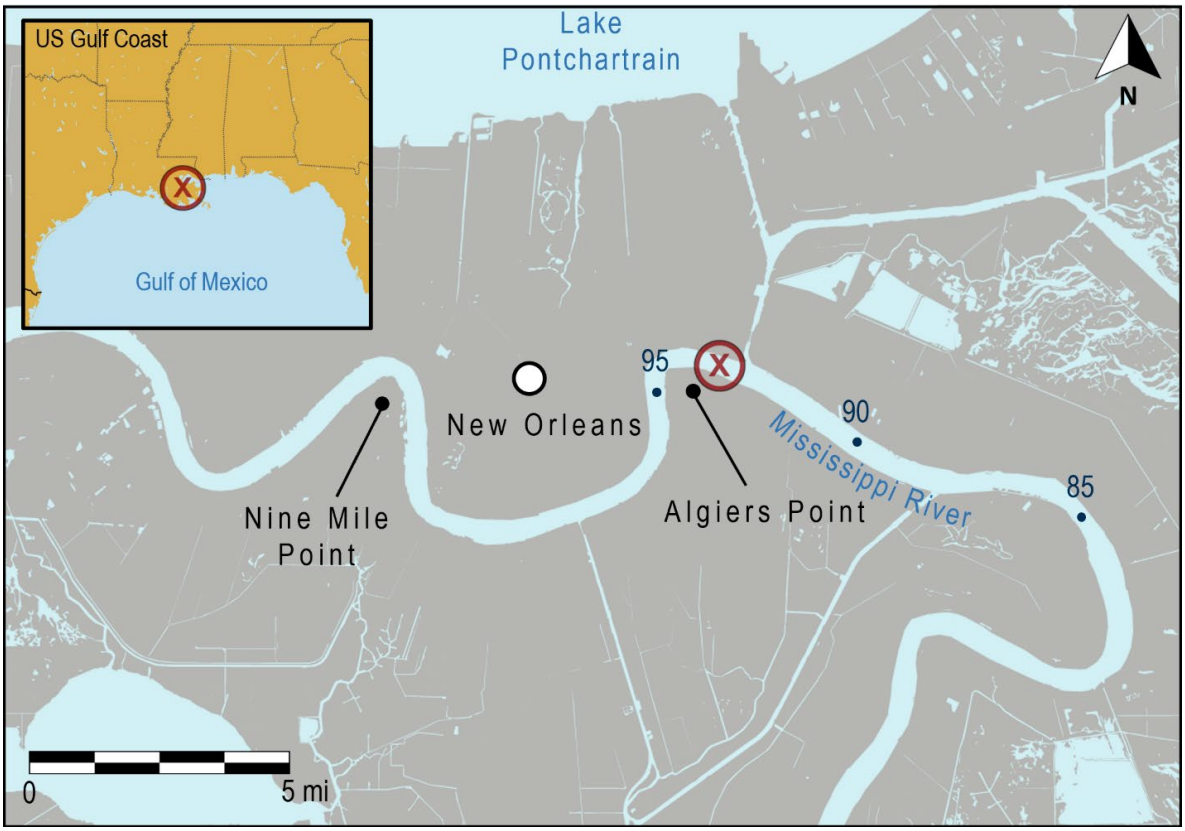

Figure 2. Area of casualty where the *Jalma Topic* struck the office barge, as indicated by a red *X*. (Background source: Google Maps)

1. Factual Information

1.1 Background

The Liberian-flagged *Jalma Topic* was a 623-foot-long steel-hulled bulk carrier built in 2006, owned by Lotina Navigation Company, and operated by Marfin Management. It was outfitted with a single rudder and a right-handed fixed-pitch propeller driven by an 11,505-hp, slow-speed, directly driven diesel main engine.

On the day of the casualty, the nearest reporting river gage on the Lower Mississippi River (Carrollton, about 9 miles up river at mile 102.8) to the site of the contact was at 9 feet and rising slowly. The current was estimated at 2–2.5 knots. The winds were from the southeast at 5 knots.

1.2 Casualty Events

On July 9, 2021, at 1540, after discharging cargo, the *Jalma Topic* departed the port of Vera Cruz, Mexico, in ballast, with a crew of 19, destined for a grain terminal at mile 117 on the Lower Mississippi River. Two days later, on July 11, beginning at 1020, while the *Jalma Topic* was under way about 100 miles from the Southwest Pass pilot boarding station, the crew conducted a steering gear test and found no deficiencies with the vessel's steering or propulsion control systems.[2]

Later that evening, the *Jalma Topic* arrived at the Southwest Pass pilot boarding station, where an Associated Branch pilot embarked at 1750. Shortly after, the *Jalma Topic* proceeded northbound through Southwest Pass towards Pilottown, Louisiana (Lower Mississippi River mile 2), where, about 2000, a pilot from the Crescent River Port pilots boarded the ship and relieved the Associated Branch pilot (who then disembarked) to continue the northbound transit towards New Orleans.

On July 12, at 0305, a New Orleans–Baton Rouge Steamship Pilots Association (NOBRA) pilot boarded the *Jalma Topic* at mile 90.5 to relieve the Crescent River Port pilot. Before disembarking the vessel, the Crescent River pilot told the NOBRA pilot that he had experienced no issues with the vessel during the transit. The NOBRA pilot and the master of the *Jalma Topic* carried out a master/pilot exchange during which they discussed the vessel's particulars, handling characteristics, and docking plan. The NOBRA pilot asked the master how many steering pumps were online. The master told

[2] According to Title 33 *Code of Federal Regulations* 164.25, vessels must test primary and secondary steering gear systems—including remote stations, internal communications, backup power systems, and alarms—and propulsion control systems no less than 12 hours before entering or getting under way in the navigable waters of the United States.

him that there was only one (steering pump no. 1) and the system was not designed to run two simultaneously, but the second pump was in standby mode available for emergency use. (The pilot told investigators that, in his experience, most ships run two steering pumps at a time on the Mississippi River.) The master informed the pilot that the engine room had personnel on watch and a crewmember (the bosun) was on the bow standing by to let go the anchors, if needed. In addition to the master, the second officer (officer of the watch), and a helmsman (steering the ship at the steering stand) were on the bridge.

The vessel proceeded upriver at full ahead order (90 rpm) at a speed of about 9.1 knots. The pilot, standing near the bridge centerline and the portside radar display, discussed matters related to the vessel characteristics with the second officer, who was standing at the starboard electronic chart and information display system console. About 0317, the master stepped off the bridge and went to his cabin one deck below to use the restroom.

At 0320:08 (at mile 92.9), the pilot ordered port 10° rudder, and the helmsman complied. About 17 seconds later, the pilot ordered the rudder to midship, and the helmsman replied to the order and moved the wheel to 0°, but the rudder remained at port 10° on the rudder angle indicator. Eight seconds later, the pilot ordered "steady."[3] The helmsman repeated the order and moved the wheel to steady the vessel, but the rudder did not move. The helmsman told the second officer (in their native language) that the rudder was not responding.

The pilot stated that he saw the bow of the *Jalma Topic* continue moving to port. At 0320:42, with the vessel at a speed of 9.2 knots with a rate of turn of 15° per minute to port, the pilot shouted, "steady!" immediately followed by "starboard 20," which he repeated twice. The pilot said he looked up at the rudder angle indicator and saw the rudder was still showing port 10° and it was at that point he knew there was a problem with the steering. At 0320:46, the helmsman responded to the pilot, "not work," and immediately after, the pilot shouted, "hard a starboard!" The pilot, who said he went into "emergency mode," then rapidly ordered hard to starboard, stop engine, and then full astern, in quick succession. An audible alarm (intermittent long-interval buzzer) activated in the background about the same time.

At 0321:09, a second audible alarm sounded (intermittent short-interval buzzer); the second officer later told investigators it was from the steering stand. The second officer told investigators that the only alarm he heard was from the steering stand annunciator unit when he was at the steering stand. He said he "switched off" the alarm

[3] When an order of "steady" is given, the helmsman uses the rudder to steer or keep the ship on the course that the ship was on when order was given. The helmsman would note the ship's heading and use the rudder to bring or keep the ship on that heading.

before operating the NFU system. He did not recall what the alarm was and said that he had no time to check before moving on to respond to the pilot's rapid engine orders and anchor-release and whistle-sounding requests.

The second officer went to the steering stand and rotated the helm wheel hard to starboard. He noticed that the rudder was not moving on the rudder angle indicator, so he switched the steering mode from follow-up (FU) mode—with commands inputted at the helm wheel—to non-follow-up (NFU) mode—with commands inputted using an NFU steering lever (tiller). The second officer actuated the NFU steering lever to starboard, which did not have any effect on moving the rudder.

At 0321:17, the second officer sounded the ship's whistle at the pilot's request, and it was at this time that the master returned to the bridge. The second officer informed the master the rudder was stuck at port 10°. He then responded to the pilot's orders of stop engine and full astern by moving to the center bridge console and pushing the propulsion control buttons for stop, dead slow astern, slow astern, all within seconds of each other about 0322. He later noted that even if they pushed the full astern button, time would be needed for the propulsion to go from full ahead to full astern.[4] The master stated that he recognized the ship was not slowing fast enough, so he called the chief engineer in the engine control room and requested that he emergency stop the engine (as opposed to pushing the emergency stop on the bridge himself), and the chief engineer promptly stopped it. The master later explained that his request would instantaneously stop the propeller shaft from turning, which would reduce the speed faster than the time needed to reverse the direction of the engine and propeller shaft to operate in full astern.

The *Jalma Topic* continued turning to port with its rate of turn increasing to 25° per minute, moving towards the right descending bank. Ahead of it, about mile 93.5, was a permanently moored office barge, connected to a work barge by a catwalk, belonging to the Cooper/T Smith Corporation (the location was commonly referred to as Smith's fleet). On board the fleet office barge were two dispatchers (one for tugs and the other for a linehandler company), working their 1800–0600 shift on the second level of the office structure, and a cleaner. At Smith's fleet, an uncrewed deck barge, the *Mandy*, and three harbor tugs were also moored: the *Mardi Gras*, manned with a crew of five, was standing by for work, while the *Ervin S. Cooper* and *Angus R. Cooper* were not in service and were manned by one duty engineer working between both vessels.

[4] According to the vessel's maneuvering characteristics, posted on the bridge, it would take 6.2 minutes and 0.6 miles for the vessel to stop from full ahead (90 rpm) while using "engines emergency astern."

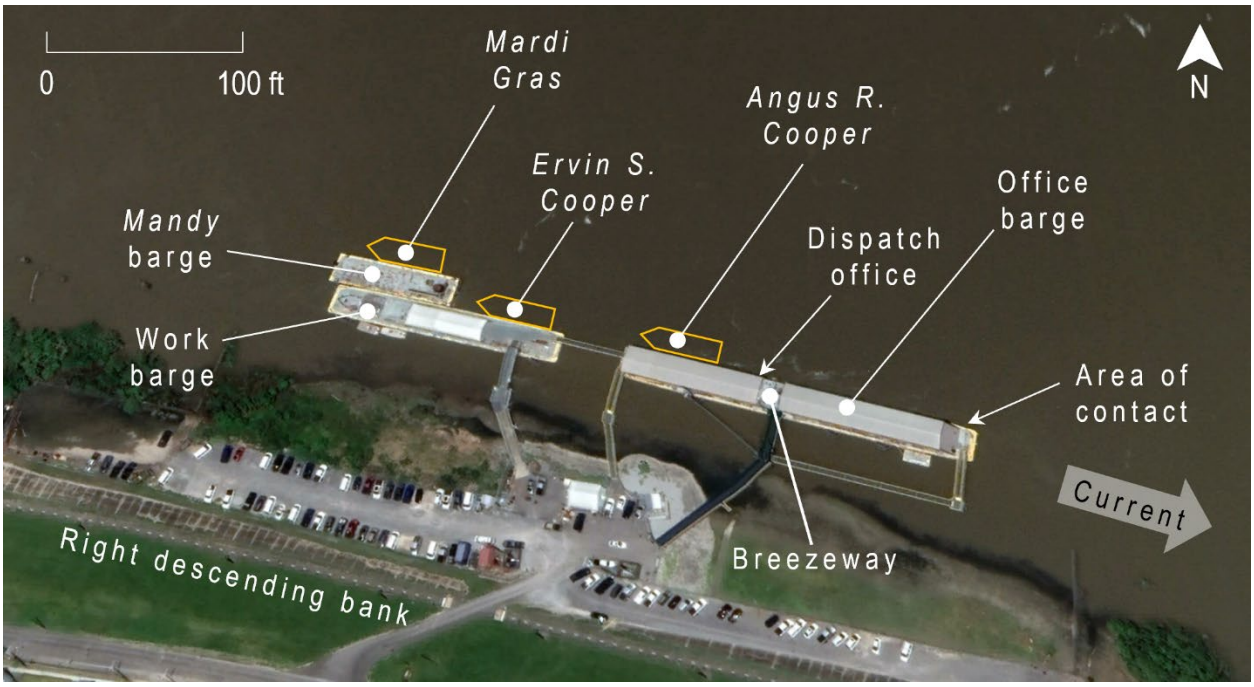

Figure 3. Google Earth image of the Smith's fleet barges and tug positions at the time of the contact.

The NOBRA pilot, who had previously worked for the tug company based out of Smith's fleet, stated that he knew there were people working on the barges and that they were not monitoring the bridge-to-bridge radio frequencies in the area, so at 0320:58, he radioed New Orleans Vessel Traffic Center (VTC) and announced, "Call up Smith's fleet right away and tell them I'm headed…right in for them; tell 'em get outta there." While he was making the call, he also ordered the bridge team to "drop starboard anchor." The pilot then ordered the port anchor let go and for the whistle to again be sounded. The second officer radioed the bosun on the bow to drop both anchors; he again pushed the whistle button to sound it. The pilot shouted to VTC over the radio, "Tell 'em to get out of there traffic; right away, get out, get out!" At 0322, New Orleans VTC broadcast a Sécurité (important safety-related information for vessels in the broadcast area) message on the traffic frequency, stating the *Jalma Topic* had lost steering and requesting Smith's fleet be evacuated.

The two dispatchers aboard the office barge received calls (via phone and handheld radio) from other nearby vessels and New Orleans VTC warning them that there was a ship headed toward the barge so they should evacuate. As they were attempting to evacuate, the dispatcher for the linehandler company heard the blast of the ship's whistle. The tug company dispatcher got up from his desk but made it only a "few steps" before the bulbous bow of the *Jalma Topic* struck the downriver (river side) corner of the office barge at 0322:40, at a speed of 6.2 knots. The second officer said that the bosun was able to let go the port anchor "seconds" before the ship struck the

barge (although both anchors were ordered let go, only the port anchor was able to be let go before the *Jalma Topic* struck the office barge).

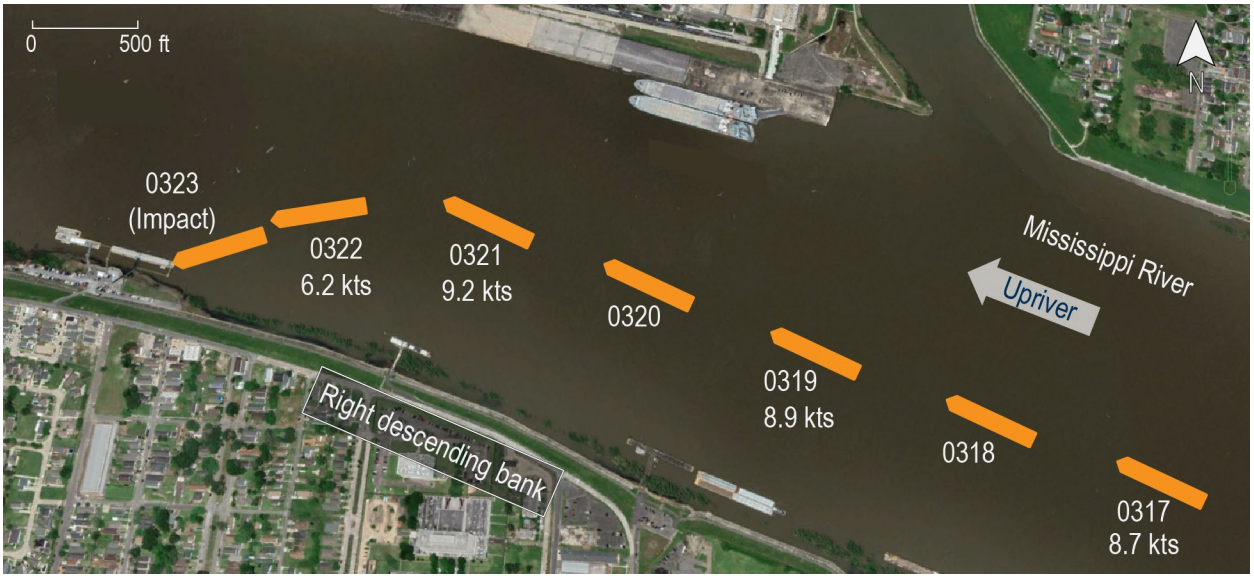

Figure 4. Plotted positions of the *Jalma Topic* taken from the vessel's VDR from 0317 to the time when it struck the corner of the Smith's fleet office barge. (Background source: Google Maps)

The linehandler dispatcher was knocked down by the force of the impact. He got up and exited through the door into the outdoor second level breezeway between the two structures on the office barge, where both he and the tug dispatcher remained and braced themselves for the resulting motion of the barge. The cleaner also exited to the outdoor first level breezeway and climbed the stairs to be with both dispatchers.

With the main engine stopped, the *Jalma Topic* drifted downriver about 360 feet with its port anchor down. The *Jalma Topic*'s bulbous bow was breached, and the forepeak water ballast tank, which was partially filled with ballast water at the time of the casualty, spilled out into the river through the penetration.

Figure 5. *Jalma Topic* down river of the office barge at 0328 with its port anchor out. Inset shows a close-up of the damage to the vessel's bulbous bow. (Background source: J. Claverie)

The captain of the *Mardi Gras*, which was moored at the upriver work barge, got the *Mardi Gras* under way at 0325. The captain placed two *Mardi Gras* crewmembers (the mate and a deckhand) on the moored *Angus R. Cooper* to check on the personnel on the office barge and tug. Once the personnel were accounted for, he had the mate and deckhand from the *Mardi Gras*, along with the engineer tending to the two out of service tugs, start up and get the *Angus R. Cooper* under way. The captain stated that he saw that the office barge had come away from its permanent moorings, so he instructed the mate on the *Angus R. Cooper* to hold the office barge in position until daylight when a proper assessment could be made.

Once the *Angus R. Cooper* was holding the office barge in position, the *Mardi Gras* moved to the *Jalma Topic* and stood by with the vessel without a line on it in case there was an urgent need to get back to the office barge. VTC stopped traffic from mile 93 to 95 so that passing vessels would not disrupt the displaced barges. VTC reopened that area of the river at 0853 after confirmation that the office barge was held securely in place.

The chief engineer said that on board the *Jalma Topic*, the crew carried out a damage assessment, and once complete, they concentrated on assessing what had happened with the steering gear and control system (see section 1.3.3 Troubleshooting and Investigation).

The *Jalma Topic* remained anchored at the casualty site until 1930, when it was repositioned with tug assistance to a general anchorage about 1.7 miles down river, where it was anchored about an hour later.

1.3 Additional Information

1.3.1 Damage

The contact pushed the office and work barge and the *Mandy* up river from their moored positions. The office barge sustained damages to its superstructure and its hull. Electrical, plumbing, and communication connections to the shore were severed, and the heating ventilation and air conditioning systems were damaged. The mooring system and all gangways and surrounding catwalks to the barges were either damaged or destroyed. There was damage to interior sheetrock and door frames; externally, there were penetrations and indentations to the inshore side and roof of the office structure.

Figure 6. Postcasualty damage to office barge moorings, catwalks, and gangways (*top*) and office barge with detached mooring apparatus and structural penetrations (outlined in orange) (*right*).

1.3.2 Steering Gear and Autopilot

1.3.2.1 Pumps

The *Jalma Topic* was fitted with an electrohydraulic steering gear system (Rapson-slide type), which consisted of two hydraulic steering pumps that moved the rudder by way of a hydraulic ram to a maximum angle of 37° to port and starboard. The steering gear manual (written by Kawasaki Precision Machinery) on the *Jalma Topic* stated that "the two pump units are designed not to operate simultaneously by interlocking device in starters (supplied by the shipbuilder)." This was further noted in between the two steering pump panels on the bridge stating, "No. 1 and 2 steering gear motors are interlocked, therefore cannot be run in parallel."

Steering pump starter control and alarm panels (one for each pump) were located on the aft bulkhead of the bridge—the only location on the bridge where an operator could start and stop the two steering pumps. Alarms on the steering pump panels would activate by indication of a light and a buzzer to show "no volt," "overload," "phase fail," "hydraulic tank low level," and "DC (direct current) no volt." If an operating (online) steering pump were to fail, an audible buzzer and visual alarm would be triggered at the panel on the bridge and in the engine control room. The standby steering pump would have to be started by means of a push button at the respective panel on the bridge, in the engine control room, or locally in the steering gear room.

The master of the *Jalma Topic* said that use of each steering pump was alternated every 7 days when the vessel was at sea. Pump no. 1 was in use at the time of the casualty. According to the steering gear electrical power system diagram for the *Jalma Topic*, steering gear pump no. 1 was connected to the emergency switchboard so that in the event of a power failure, that pump would be powered by the emergency generator. The master said that steering gear pump no. 1 was always used for arrival (and departure) in port, river navigation, and maneuvering, given that pump no. 1 was the only pump on the emergency switchboard.

1.3.2.2 Control System

The steering system was controlled by a PT500D (type N series) autopilot system manufactured by YDK Technologies (Yokogawa). On the bridge, and contained within the steering stand, was a helm control wheel, an autopilot, an annunciator unit, and a switch unit. In the steering gear room, there were two independent servo control and power boxes (system nos. 1 and 2; one for each steering pump), along with transmitters and motors to send a feedback signal for the rudder angle. When one of the steering pumps was energized for use, signals from the steering gear starter for the pump would be transmitted to the corresponding servo control board (no.1 for pump no. 1 or no. 2

for pump no. 2), which would then serve as the control board amplifier for the steering signals to the solenoid valves (each steering gear pump had its own port and starboard solenoid valves) to control the direction of hydraulic oil, which subsequently acted on the hydraulic ram, in turn moving the rudder to the desired rudder angle. The steering control system could be operated from the steering stand on the bridge in one of three steering modes—helm wheel (FU mode), NFU steering lever (NFU mode), or autopilot. Using any of these modes would send a signal via one of the two independent servo control and power boxes in the steering gear room to actuate the port or starboard solenoid valves. From the bridge, an operator could select either the no. 1 (FU-1) or no. 2 (FU-2) system by means of a selector switch at the steering stand. Regardless of whether FU-1 or FU-2 was selected, steering control signals would be transmitted from either respective terminal control board (located in the steering stand) to either no. 1 or no. 2 servo control boards, depending on the steering pump running at the time. For emergencies, the solenoid valves could be actuated locally (in the steering gear room) at each pump unit, which would bypass each respective servo control board.

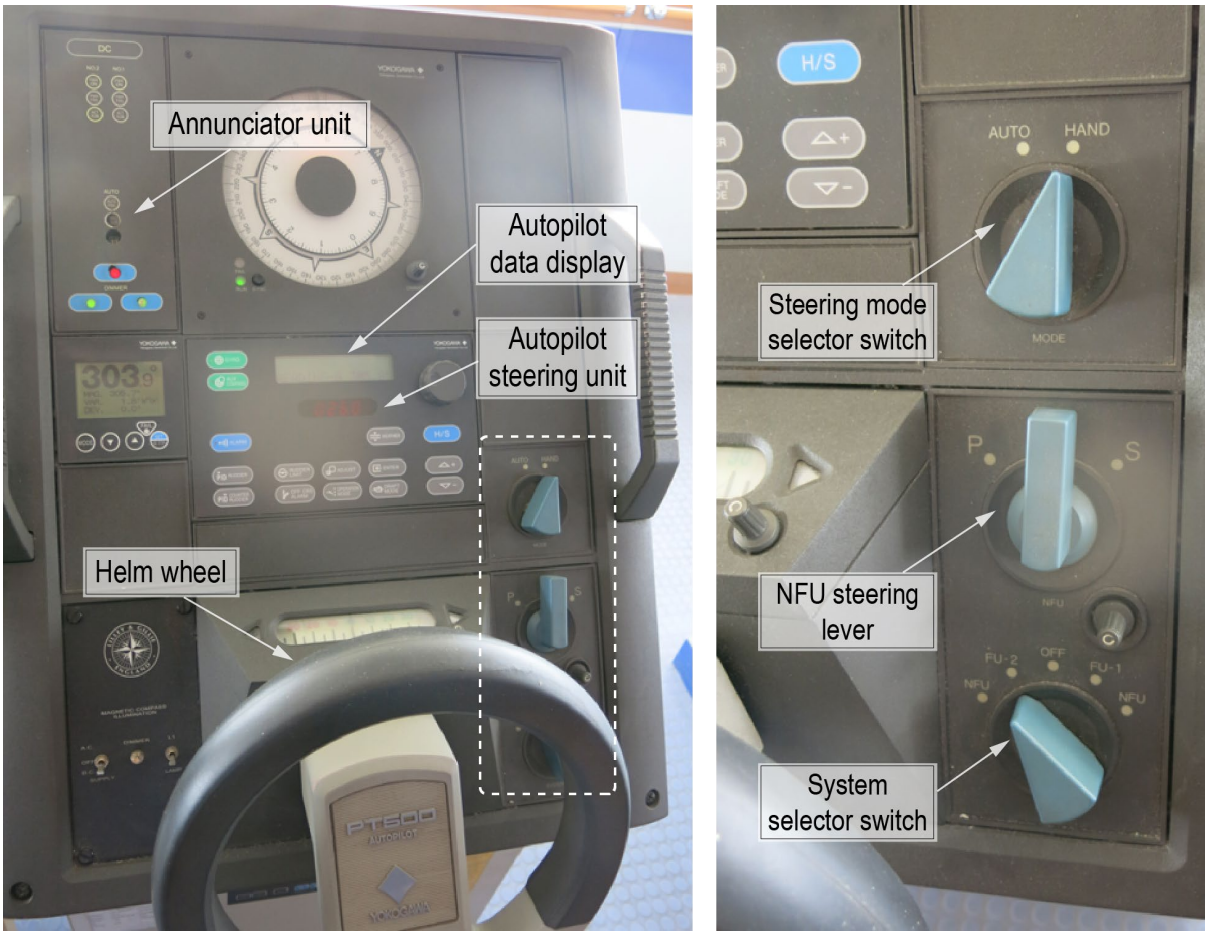

Figure 7. YDK (Yokogawa) main steering stand at the center of the bridge of the *Jalma Topic* (*left*). System selector switch and non-follow up steering lever and selector switch (*right*).

When helm steering (FU) mode was in use, signals from the helm wheel on the steering stand on the bridge were transmitted to the servo control board in use (either no. 1 or no. 2). Rudder feedback from the feedback (μ) transmitter was applied to the in-use servo control board, where the two signals were compared and an amplified output signal driven to one of two solid-state relays (SSR) on the servo control board, the port or starboard relay, which in turn sent a signal to actuate either the port or starboard solenoid valve on the selected steering pump. When NFU mode was selected, signals from the steering lever would be directed through the in-use servo control board SSRs, either port or starboard, to either the port or starboard solenoid valves on the operating pump, thus bypassing the rudder feedback.

There was no specific maintenance or lifecycle part replacement for the servo control boards contained within the autopilot steering gear room equipment user's manual (written by Yokogawa), which stated, "If properly operated, it is not necessary to disassemble and repair the Control & Power Box and the μ Transmitters as they can maintain high performance over a long period."

1.3.3 Troubleshooting and Investigation

After the *Jalma Topic* struck the office barge, the NOBRA pilot discussed the rudder problem with the master, second officer, and chief engineer; he stated that no one had an explanation as to what went wrong. The master and second officer said they had never witnessed the rudder get stuck on the *Jalma Topic* or vessels of the same class that they had been aboard.

The chief engineer, who began his watch at midnight in the engine control room, said there were no machinery automation system alarms (which had alarm inputs from the steering gear pumps but not the steering control system) in the time leading up to the casualty. Further, there were no machinery automation system alarms indicating a loss of power from the ship's mains or direct current supply to the steering system. The second officer of the *Jalma Topic* stated that he began his watch about midnight and there had been no visual or audible alarms from the steering gear starter panel (on the aft bulkhead of the bridge) in the time leading up to and at the time of casualty. He noted that if there had been, his response would have been to go to the panel and change over the steering pumps.

After an initial damage assessment, the chief engineer, first engineer, and mechanic attempted to troubleshoot the issue. They replaced the solenoid valve assembly on steering pump no. 1, which had been in use at the time of the casualty, with a spare, but the rudder remained in the port 10° position. They found steering gear system hydraulic and lubricating oil levels to be at the appropriate levels with no blockages and no contamination. The chief engineer also said they tested each steering

pump and manually actuated each solenoid valve of the steering system locally using the emergency controls in the steering gear room, and both pumps worked to move the rudder.

They tested the steering control system from the bridge. When steering pump no. 2 was used, the system worked as normal in both FU-1 and FU-2 (hand steering) and NFU mode (NFU steering lever). When steering pump no. 1 was used, the rudder was not able to move out of the port 10° position in FU-1, FU-2, or NFU mode.

On July 15, a technician qualified in the service and repair of Yokogawa PT500D steering systems attended the *Jalma Topic* to conduct troubleshooting efforts on the steering control system. The technician found that when steering pump no. 1 was in operation, the "rudder drives [moves] hard port with no wheel command." He saw that the rudder would move all the way to port (about 37°) as soon as the no. 1 steering pump was energized. He found that in helm (FU) mode, when a rudder order was applied to the helm wheel, "no command [was] given to [the] rudder." The technician discovered the port SSR in servo control board no. 1 was faulty, as it was "always closed" (in a conducting state). Typically, the SSR would be open unless an input current was received, which would close the contact (when the current stopped, the contact would again open). The SSR was a 24-volt DC 2-amp Omron model number G3R-ODX02SN, which used semiconductors and contained no mechanical parts. The technician replaced both the starboard (which was determined to be functional but removed for examination) and port SSRs with spares from on board, and then tested system no. 1 (the no. 1 pump and servo control

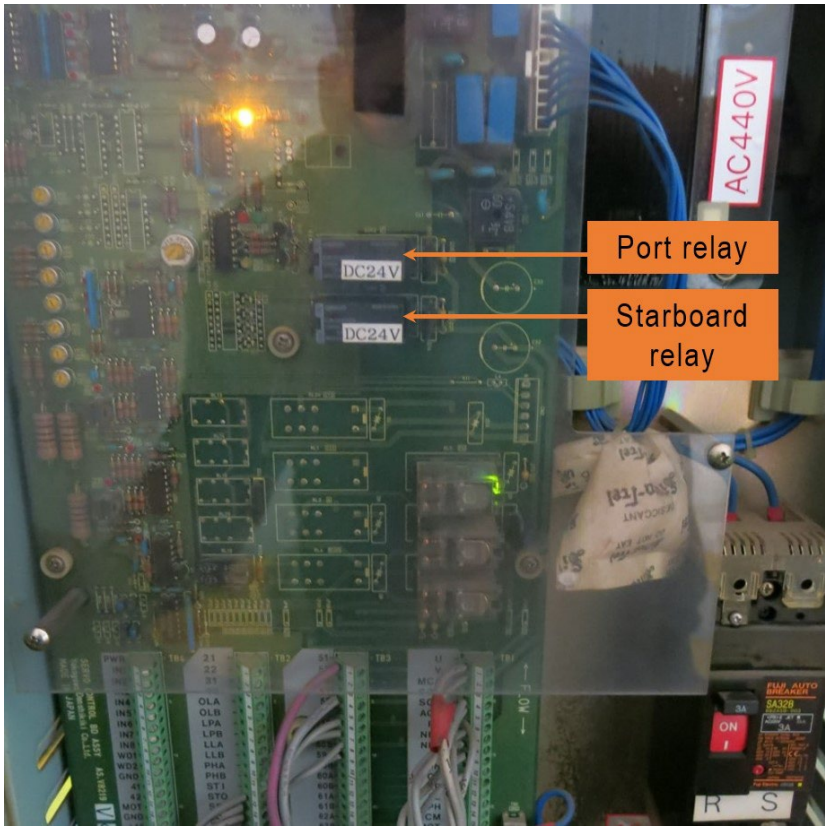

Figure 8. No. 1 servo control board located inside a cabinet near steering gear pump no. 1 in the steering gear room of the *Jalma Topic* showing the port and starboard solid-state relays.

board), and "found steering operation now normal." The attending technician also tested the feedback system and found no problem with the feedback transmitter signal.

After the casualty, investigators found that a steering system alarm was displayed on the autopilot data display on the steering stand that read, "Emergency-07 1 servo loop." According to the autopilot manual (written by Yokogawa), this emergency alarm would sound an audible intermittent short interval buzzer and indicated a servo loop failure of the no. 1 steering control system. This alarm was issued when the difference between the rudder order and feedback rudder angle was about 5° or more and the follow-up time did not finish within the following time. The technician told investigators that the alarm indicated an error in the signal loop between the helm (FU) control at the steering stand, the pump motor controller circuit board, and the rudder angle position. He noted the system had built-in safety parameters relative to the time the rudder took to respond to an applied helm order from the steering stand as well as the variation from the ordered and actual rudder angles (27 seconds). He said that if those parameters were exceeded, either for response time or rudder angle variation, the alarm would sound.

Both the port and starboard SSRs from the no. 1 servo control board were retained by legal counsel representing the vessel owner so that examination and failure analysis could be carried out on these relays by a third-party engineering analysis firm. At the time of release of this report, no failure analysis report has been submitted to the Coast Guard or NTSB.

1.3.4 Control System Failure Caution Sticker

Investigators were informed by the technician that attended the *Jalma Topic* that YDK Technologies produced a "caution sticker" to be distributed to owners of vessels equipped with the PT500 autopilot system. The sticker was intended to be installed on the bridge steering console and detailed how a bridge crew could regain steering control in the event of a "SERVO LOOP" or "FB [Feedback] FAIL" in the steering control system. On YDK Technologies' website, an "Important Notice Concerning Operation of PT500 Autopilot System in Event of Emergency Alarm," dated December 24, 2014, was available under the Important Notice section. The notice described the PT500 autopilot system as having an automatic function that forced the rudder to maintain its current position if either a SERVO LOOP or FB FAIL was issued and provided guidance if this occurred.

Marfin Management stated that they were not provided with either the caution sticker or notice until after the casualty; they then placed the notice on the steering stand of the *Jalma Topic* for reference for bridge team members. The company also noted that they made this response part of crew training and emergency drills. Marfin did not post

the caution sticker because it contained an instruction (no. 2 in figure 9) that could not be followed on board the *Jalma Topic*, since the interlocked steering pumps could not be run at the same time.

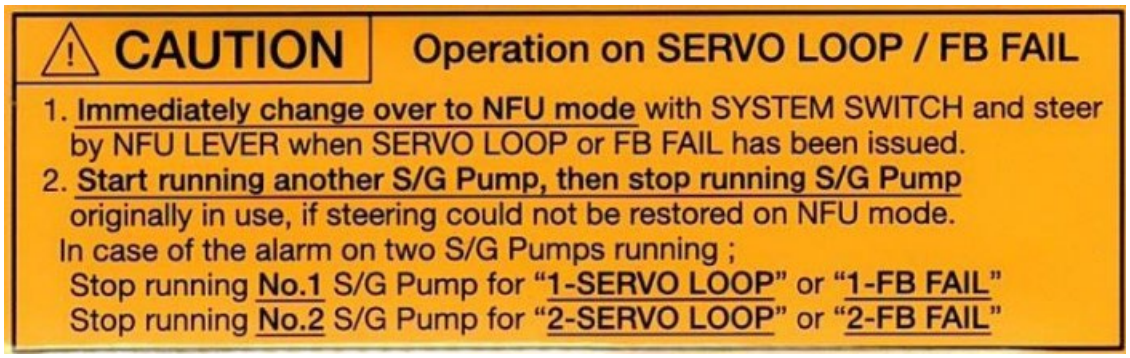

Figure 9. Caution sticker for Operation on SERVO LOOP/FB (feedback) FAIL. (Source: Wilson Elser Moskowitz Edelman & Dicker LLP)

1.3.5 Safety Management System and Equipment Manuals

The International Safety Management Code requires companies to establish procedures, plans, and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship, and protection of the environment. Marfin Management's safety management system stated that in case of a steering gear failure, the officer on duty should:

1. Disengage the autopilot;
2. Engage alternate or emergency steering system;
3. Call master;
4. Advise engineer watch officer;
5. Check positions of vessel[s] in vicinity;
6. Maneuver as appropriate and if necessary stop engines;
7. Take away *(sic)* off ship is safe to do so;
8. If necessary – make appropriate sound signals.

There were an additional 14 actions in the steering gear failure contingency, but nothing directly relevant to actions to take with the specific type of steering control system on the *Jalma Topic*.

1.3.6 Personnel

The *Jalma Topic*'s pilot, master, second officer, and helmsman were all appropriately credentialed for the operation of the vessel. Deck and engine personnel and the NOBRA pilot on duty at the time were tested postcasualty for alcohol and other drugs with negative results. The master, pilot, and second officer all said they had adequate rest before assuming their duties on board the *Jalma Topic*.

2. Analysis

In the time leading up to and during the loss of steering control, steering control system no. 1 (steering pump no.1 and servo control board no. 1) was in use with FU-1 selected. Before the helmsman noticed that the rudder was stuck at port 10°, there were no indications or alarms on the bridge (or in the engine control room) to indicate a problem to the bridge team: the only alarms were an audible buzzer and flashing lamp from the annunciator unit on the steering stand after the helmsman told the pilot the rudder was not working. The second officer did not check the autopilot data display on the steering stand when he heard it sound and therefore was not aware of the nature of the alarm; after the casualty, investigators found the alarm indicated a servo loop failure.

After the casualty, a technician found the port SSR on servo control board no. 1 had failed and installing a spare SSR resulted in normal operation. Postcasualty troubleshooting efforts identified no problems with the steering system's power supply, hydraulics, solenoid valves, feedback systems, or the no. 2 system while operational. Thus, the failure of the port SSR on servo control board no. 1 was the cause of the *Jalma Topic*'s rudder remaining in a port 10° position (its last ordered position before the failure). Because a failure analysis for the port SSR has not yet been produced, no conclusions can be made regarding how or why the port SSR failed.

There were about 2 minutes from the time the helmsman announced the rudder was not working to when the *Jalma Topic* struck the office barge, leaving the bridge team with minimal time to identify the problem causing the rudder to be stuck and take appropriate countermeasures, nor was there time to engage emergency steering locally from the steering gear room. The second officer checked the rudder response in FU mode at the steering stand before switching to NFU mode, which was unsuccessful in moving the rudder. This was because even in NFU mode, with the feedback loop bypassed, the steering signals still had to pass through the same servo control board that contained the failed port SSR. Further, any action to move the mode selector switch from FU-1 to FU-2 while in hand steering would have had no effect in moving the rudder because helm steering signals would have been sent through the servo control board with the failed SSR.

After giving the starboard 20° helm order, the pilot said he saw that the rudder was not responding, and he went into "emergency mode." He gave orders to minimize or eliminate the headway of the ship towards the bank or barges and tugs as well as signals to alert persons at the site of the incoming danger. The second officer first moved to the steering stand to verify the rudder was not working before activating NFU mode and then moving to address the pilot's rapid orders (full astern, drop the anchors, and sound the whistle). The master was not on the bridge initially when the loss of steering control began, and the second officer was the only bridge team officer available to fulfill the requests of the pilot, who was also busy communicating the situation to VTC, requiring him to move to different locations on the bridge. When the master arrived back on the bridge, he had to quickly apprise himself of the situation, after which he told the chief engineer to emergency-stop the engine. The second officer was faced with multiple tasks in response to both the pilot's rudder and emergency orders.

Postcasualty, the investigation found that the steering control system manufacturer, YDK Technologies, had created a caution sticker and released an important notice to be distributed to vessels with PT500 autopilot systems in December 2014. Both the notice and sticker stated that in the event of a "SERVO LOOP/FB Fail," the crew should switch to the standby steering gear pump, thus energizing the servo control board for that steering gear pump and shutting down the pump in use. This procedure would likely have resulted in the vessel regaining steering. However, these instructions were not available to the bridge team of the *Jalma Topic* at the time of the casualty because Marfin Management stated that they were not notified of the 2014 notice and caution sticker from YDK Technologies until after the casualty. As such, the company's contingency for failure of the steering system did not contain specific, accurate actions for a bridge team to address a servo loop failure upon receiving the alarm. Additionally, the company's safety management system guidance for a steering gear failure ("Engage alternate or emergency steering system") could have been interpreted in several ways—given the nature of the steering control system failure encountered and the controls and characteristics of the steering control system—leaving it up to the operator to evaluate between multiple available alternatives (FU-1, FU-2, NFU) in a time-critical emergency.

At the time of the casualty, the *Jalma Topic* was traveling at 9.2 knots on the Mississippi River with little time (or space in the river) for the bridge team to either attempt to stop or turn the vessel. From his previous experience working in the area, the pilot knew that there were people on board the office barge, and, recognizing the danger to them, he took immediate and effective action to ensure they were notified as quickly as possible to allow time for them to escape, and to slow the vessel as much as possible as it moved toward Smith's fleet.

3. Conclusions

3.1 Probable Cause

The National Transportation Safety Board determines that the probable cause of the contact of the *Jalma Topic* with the office barge was a loss of steering due to the failure of an electrical solid-state relay on the servo control board of the operating control system to the steering gear. Contributing was the lack of specific procedures available to the bridge team to respond to a failure of the steering control system.

3.2 Lessons Learned

Vessel-specific Procedures for Steering Casualties While Maneuvering

Failures in steering control systems can result in damaging consequences. In channels or during maneuvering, where immediate hazards (grounding, traffic, objects) are in proximity and therefore response time is critical to avoiding a casualty, steering system failure contingencies require immediate crew response. Companies should review and identify potential steering system failures and make quick response procedures readily available to bridge and engine teams. Bridge and engine teams should conduct scenario-based drills to maintain proficiency in implementing these procedures.

Vessel	Jalma Topic
Type	Cargo, Dry Bulk (Bulk Carrier)
Flag	Liberia
Port of registry	Monrovia, Liberia
Year built	2006
Official number (US)	None
IMO number	9309655
Classification society	Lloyds Register
Length (overall)	623.3 ft (190.0 m)
Beam	105.8 ft (32.2 m)
Draft (casualty)	24.3 ft (7.4 m)
Tonnage	30,369 GT ITC
Engine power; manufacturer	1 x 11,505 hp (8,580 kW); Mitsui-Man B&W 6S50MC (Mark 5) diesel engine

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