National Transportation Safety Board

Marine Accident Brief

Allision of Bulk Carrier *Star of Abu Dhabi* with Louisiana Sugar Refinery Unloading Dock

Accident no.	DCA16FM034
Vessel name	*Star of Abu Dhabi*
Accident type	Allision
Location	Lower Mississippi River at mile marker 146.1 near Gramercy, Louisiana
Date	March 25, 2016
Time	0256 central daylight time (coordinated universal time – 5)
Injuries	None
Damage	Damage to vessel and dock, over $4.8 million est.
Environmental damage	None reported
Weather	Cloudy skies with visibility 7 miles, winds north 7-10 knots, air temperature 64°F
Waterway information	The Mississippi River has a project depth of 45 feet from Southwest Pass, near the entrance to the Gulf of Mexico, to mile marker 233.4, about 135 miles above New Orleans at Baton Rouge, Louisiana. On the accident date, the river was at high water (15 feet at the Carrolton Gauge) with a current reported at 2.3 knots.

In the early morning on March 25, 2016, the bulk carrier *Star of Abu Dhabi* was anchored using two anchors in the Lower Grandview Anchorage, mile marker 146.2, on the Lower Mississippi River near Gramercy, Louisiana. About 0230, the vessel's port anchor chain parted and the starboard anchor began to drag. As the *Star of Abu Dhabi* moved with the current, it allided with the Louisiana Sugar Refinery (LSR) raw sugar unloading dock, located at mile marker 146.1, and continued to drift downstream. The vessel's propulsion engine was started, allowing the crew to bring the vessel under control about 0.1 mile from the Veterans Memorial Bridge (also known as the Gramercy Bridge). The vessel sustained $232,210 in damages to its hull above the waterline. The dock sustained $4.6 million in damages. There were no injuries or pollution.

***Star of Abu Dhabi* after the accident, with missing port anchor. (Photo by US Coast Guard)**

Accident Events

In late March 2016, the *Star of Abu Dhabi*, loaded with a cargo of phosphate rock, transited up the Mississippi River toward the deep draft Lower Grandview Anchorage following a voyage from Las Palmas, Canary Islands.[1] The vessel planned to wait in the anchorage for an open berth at the PCS Nitrogen Fertilizer Terminal, located upriver at mile marker 187. A succession of pilots navigated the vessel to the anchorage, with the last pilot boarding the vessel at 1848 on the night before the accident. Once the pilot was on board, the master and pilot conducted a master-pilot exchange before the pilot assumed navigational control of the vessel for the final leg of the transit. The master made entries on the master-pilot exchange form including a notation that the engines were to be on "10 min notice," but there was no information about the anchoring plan.

The water level of the Mississippi River had been on the rise since early December 2015, and on March 21, 2016, the river crested at 15.23 feet on the Carrollton (New Orleans) river gauge—less than 2 feet below flood stage. Anticipating the impact of the high water and corresponding strong currents, the US Coast Guard issued Marine Safety Information Bulletins (MSIBs) providing guidance and reminding mariners of regulations during high water periods. On March 19, the third of these bulletins was released, stating "Carrollton Gauge at 15 Feet [and] on the rise."[2] The bulletins listed seven regulations in effect, including the following:

> In accordance with [Title] 33 [*Code of Federal Regulations* (*CFR*)] 160.111(c), the [Captain of the Port] has determined that during periods of high water, unless moored to a shore side facility or mooring buoys, **all deep draft vessels must have three means to hold position**. An example would be two fully operational anchors and the propulsion system in standby.[3] Should a vessel lose an anchor or become inoperable with no redundant capabilities available, such as aft anchors or two main engines, a third means of holding position could be via tug assist. (bold text in the original)

By 2106 on March 24, the *Star of Abu Dhabi* had arrived at the anchorage, the anchoring/anchor watch checklist was complete, and the pilot directed that both anchors be dropped with four shots of chain in the water. The crew dropped the port anchor first, with four shots in the water, but then dropped the starboard anchor with four shots on deck. The vessel, with a draft of 41.6 feet, was anchored about 0.4 mile upriver from the Veterans Memorial Bridge in a

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[1] A *pilot* is retained by the ship to provide local knowledge of the waterway, familiarity with tides and currents in the area, understanding of local procedures, and a thorough knowledge of the topography of the waterway. Pilots usually operate by issuing maneuvering instructions (such as heading, rudder angle, and speed orders) to the crew under the supervision of the master or the officer in charge of the navigation watch, or both.

[2] United States Coast Guard Sector New Orleans, *Marine Safety Information Bulletin* 16, no. 49 (March 2016).

[3] Per the *Seafarer's Training, Certification, and Watchkeeping Code (STCW Code)*, Part A, Chapter VIII, Section 68, when the engine-room is put in a *stand-by* condition, "the officer in charge of the engineering watch shall ensure that all machinery and equipment which may be used during maneuvering is in a state of immediate readiness and that an adequate reserve of power is available for steering gear and other requirements." International Maritime Organization (IMO), *STCW Code*, 3rd consolidated ed. (London, UK: International Maritime Organization, 2001).

charted depth of 63 feet. The Carrollton gauge was still about 15 feet, making the water depth about 78 feet.

At 2154, the master was heard on the voyage data recorder (VDR) bridge audio ordering "finished with engines" on the engine order telegraph.[4] Finished with engines (FWE) is a standard order informing the engine room that the vessel has completed maneuvering and that the engine and associated equipment may be shut down. The order implies that there is no expectation that the engine will be required on short notice.

The pilot made no audible comment regarding FWE but told the master to maintain a good anchor watch and to contact vessel traffic service (VTS) if there were any problems such as dragging anchors. The pilot told investigators that he directed the master to "use the rudder to keep the bow pointed toward the east bank if need be and to keep the vessel on short notice." The pilot then departed the vessel at 2206.

The March 25 0000-0400 watch consisted of the second officer on the bridge as anchor watch, an able seaman making security rounds, and an oiler in the engine room. Included in the master's night orders for the officer of the watch were directions to "frequently monitor ship's position by sight and radar; any sign of dragging, call me." The night orders did not require the main engine to be in standby while at anchor. The oiler on watch, as an unlicensed engineer, was not authorized to start the main engine.

At 0002, the second officer fixed the vessel's position by the radar, with the ship holding steady at 0.4 mile from the Veterans Memorial Bridge. The officer noted that the current was 2.3 knots.

Sometime between 0228 and 0230 (based on automatic information system [AIS] data of the vessel's motion), the port anchor chain parted at the 35th link from the kenter shackle (detachable link) on the 4th shot.[5] The vessel's heading swung to port, and the bulk carrier began dragging the starboard anchor at 1.7 knots. At 0236 the second officer called the master to report that the anchor was dragging. The master arrived on the bridge two minutes later and directed the second officer to call the engine room to give a 10-minute notice to bring the main engine on line. The vessel initially moved out toward the center of the channel before drifting back towards the left descending bank of the river.[6] As the ship drifted, its speed over ground increased, eventually reaching 3.9 knots, while its heading shifted back to starboard.

At 0239, VTS hailed the *Star of Abu Dhabi* and the master replied that he thought that the vessel was dragging its anchor. VTS informed the master he was authorized to maneuver the vessel with main engines to maintain the position of the vessel. VTS further instructed the captain not to

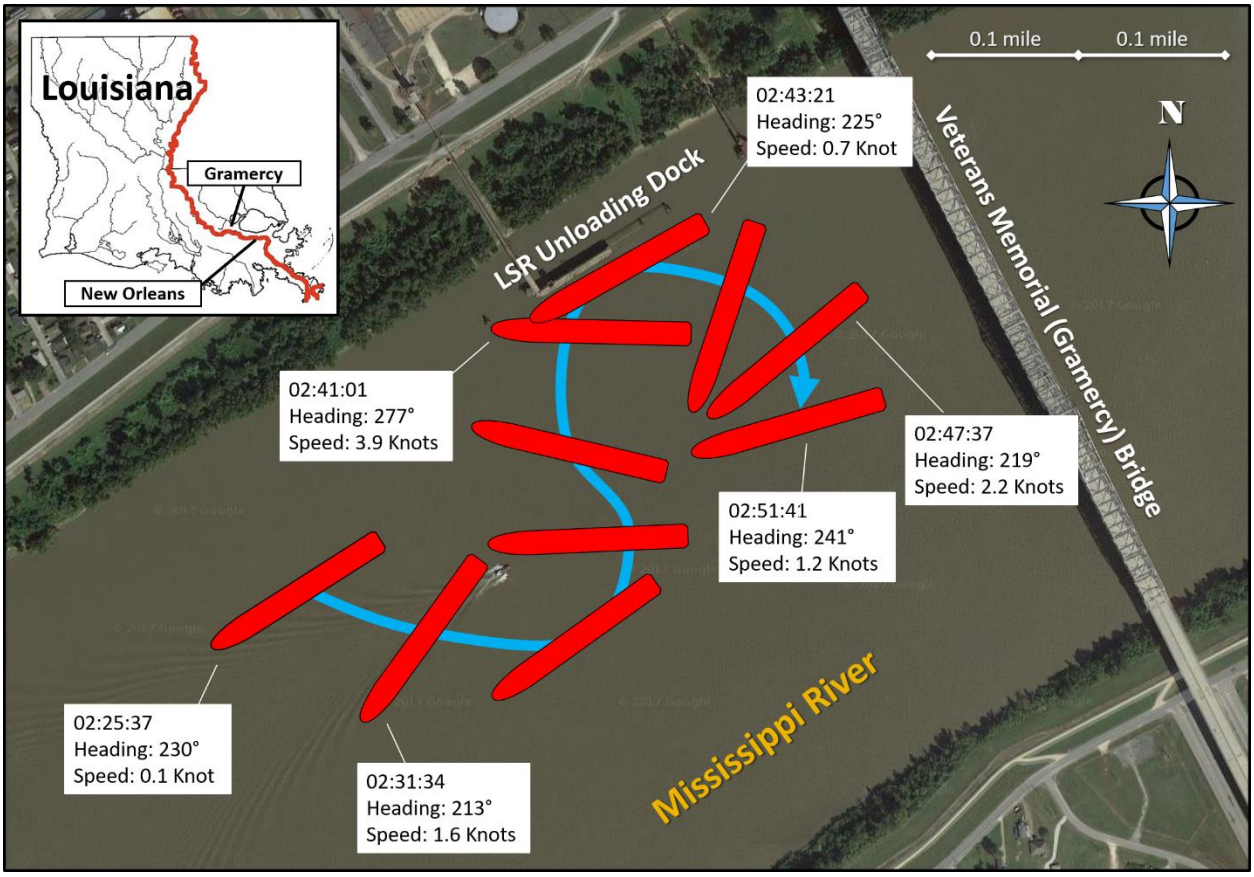
[4] A *voyage data recorder* (VDR) maintains a continuous, sequential record of data relating to a ship's equipment and its command and control; it also captures audio from certain areas on the bridge and bridge wings.

[5] A *shot* is a length of anchor chain equal to 15 fathoms (90 feet). Typically, each shot of chain in the anchor rode is connected to the next shot by a detachable link, such as a kenter shackle.

[6] The banks of the Mississippi River are named left and right when traveling downstream. Thus, when the river is oriented north to south, the east bank of the Mississippi River is its left bank and the west bank is its right bank. To avoid confusion, commercial river traffic often calls the left bank the left descending bank and the right bank the right descending bank. (Source: Coast Guard)

weigh anchors but to leave the anchors down. At 0240, VTS informed the vessel that a pilot had been ordered. About the same time, a slight vibration was heard and felt as the bulk carrier's starboard side allided with the LSR raw sugar unloading dock. A minute later, the master announced the vessel's starboard quarter was on the LSR dock and sounded the emergency signal.

By 0243, the chief engineer was in the engine room. Four minutes later, the propulsion engine responded to a dead slow ahead command, and the vessel was brought under control about 0.1 mile from the Veterans Memorial Bridge.



Track of *Star of Abu Dhabi*, compiled from AIS data, as it dragged anchor, allided with the LSR raw sugar unloading dock, and was brought under control 0.1 mile from the Veterans Memorial Bridge. (Background by Google Maps)

The pilot arrived at the vessel at 0312 and shortly thereafter the tug *John Turecamo* was made up to the starboard side. At 0340, the tug *Beverly B* joined the first tug on the bulk carrier's starboard side and both assisted the *Star of Abu Dhabi* in maintaining position in the anchorage. About 4 hours later, the vessel re-anchored using its starboard anchor, with both tugs remaining alongside to keep the vessel in position.

The *Star of Abu Dhabi* sustained about $232,210 in damage, including a 14-foot-by-7-foot hole and heavy internal structural distortion on the starboard side between frames 190 and 195 above the water line. The port anchor and 4.5 shots (about 405 feet) of anchor chain were lost, but they were later salvaged and reattached. Damage to the LSR raw sugar unloading dock was estimated at $4.6 million.

Damaged LSR raw sugar unloading dock. (Photo by Coast Guard)

Analysis

Anchoring Procedures

The pilot directed that each anchor be dropped with four shots of chain in the water. He stated that four shots of chain were normally used at this anchorage when the water depth was about 78 feet. The crew correctly dropped the port anchor with four shots in the water (about 385 feet), but then dropped the starboard anchor with four shots on deck (about 345 feet).

The scope of the port anchor chain was about 4.3:1, while the scope of the starboard anchor chain was only about 3.5:1.[7] The second anchor was intended to minimize the back and forth motion of the bow, and the scope of the anchor chain should have been adjusted to equalize tension on both anchors. A jerking motion or shock load can break a chain, whereas a constant load is less likely to cause a break. Given the longer scope of chain and the current on the port bow, the port anchor chain was likely taking the majority of the strain. As suggested by the pilot, the rudder can be used to keep the vessel's bow out of the current, but this does not fully mitigate the force of the water flow on the vessel.

Ground Tackle and Anchor Chain

The *Star of Abu Dhabi* was equipped with two 8.2-ton stockless high-holding-power anchors, each with a proof test load of 107.9 tons. The anchors were last certified by the classification society Nippon Kaiji Kyokai (ClassNK) on May 18, 2012, and found to be satisfactory.[8] The Setozaki Iron Works Co., Ltd., hydraulic anchor windlass, with a rated pull of 31.3 tons, was last certified by the classification society Det Norske Veritas on June 24, 2009, and found to be satisfactory. Maintenance records showed that on March 22, 2016, the anchor windlass

[7] *Scope* is the ratio of the length of anchor chain (rode) deployed from the ship to the depth of the water under the bow of the vessel as measured from deck height.

[8] All tons in long tons (2,240 lbs.).

and mooring winch were inspected by the chief officer and were found to be in satisfactory condition.

The anchor chain was a grade III flash-butt welded stud link chain with 3.2-inch nominal diameter, a breaking test load of 484 tons, and a proof test load of 339 tons. There was a total of 12 shots (1,080 feet) of chain for the port anchor and 13 shots (1,170 feet) of chain for the starboard anchor, with 85 links per shot of anchor chain. The chains were last certified by ClassNK on May 2, 2012, and found to be satisfactory. Every other shot of chain was connected by a grade III drop forged 3.2-inch nominal diameter kenter shackle with a breaking test load of 483.7 tons and a proof test load of 339.2 tons. They were certified by ClassNK on June 28, 2012, and found to be satisfactory. The last periodic anchor chain survey was conducted on October 9, 2014, by the Huarun Dadong Dockyard Co., Ltd., in Shanghai, China. No issues were documented during the survey.

Photo left shows the roller-bar-type anchor chain stopper, handle painted yellow, in the engaged position. (Photo by *Star of Abu Dhabi* crew) Photo right shows the broken anchor chain link with the fractured mating surfaces labeled "A" and "B." (Photo by Bartlett Engineering)

Following the accident, a third-party metallurgist was commissioned to conduct a non-destructive exam of the failed chain link. Records of the October 2014 anchor chain survey, when the linkages were last gauged, were examined. The mean diameters of all linkages were within acceptable wastage limits for the original 3.2-inch nominal diameter.[9] Wastage was measured again after the accident and was likewise within acceptable limits. Ratchet marks, which indicate multiple microscopic crack initiation sites, were observed along the edge of the extrados.[10] When it failed, the link was in contact with a roller-bar-type anchor chain stopper.[11] During the exam,

[9] Per the American Bureau of Shipping *ABS Rules for Survey after Construction, 2008*, section 5.1.4, "At Special Periodical Survey No. 2 and subsequent Special Periodical Surveys, chain cables are to be gauged and renewed in cases where their mean diameter is 12% or more below the original required nominal size."

[10] The *extrados* is the exterior curve of an arc; *intrados* is the interior curve of an arc.

[11] The anchor chain stopper is a thick bar of steel that can be raised up out of the way of the chain or lowered to engage a vertical link to prevent the chain from paying out.

flattened indentations on the extrados of the fractured chain link were observed, which indicated that the link had been bearing against the anchor chain stopper.[12]

Smooth texture along most of the fracture surface, along with the presence of a "final fracture" area and ratchet marks on the opposite end of the fracture surface from the final fracture, demonstrated that a microscopic crack propagated across the link due to cyclical loading. The dynamic loading on the ship's anchor chain caused motion between the extrados of the chain link and the anchor chain stopper bar. The motion led to fretting, a known initiator of microscopic fatigue cracks, which explains the observed ratchet marks. Multiple microscopic fatigue cracks, once initiated in a high tensile stress area such as the extrados of the chain link, would propagate rapidly enough to lead to the observed failure of the link.[13]

In summary, the metallurgist determined that the fracture was caused by fatigue initiated by the chain link rubbing on the anchor chain stopper, and not an overload failure caused by a material deficiency or abnormal loading condition.

Watchstanding

Coast Guard investigators noted that anchor watch alarms were available on the vessel's GPS and radar, but neither were activated. Regulations for vessels at anchor, as published in Title 33 *CFR* 164 and *US Coast Pilot 5*, included the following:[14]

> The master or person in charge of each vessel that is anchored shall ensure that – (a) a proper anchor watch is maintained; (b) procedures are followed to detect a dragging anchor; and (c) whenever weather, tide, or current conditions are likely to cause the vessel's anchor to drag, action is taken to ensure the safety of the vessel, structures, and other vessels, such as being ready to veer chain, let go a second anchor, or get underway using the vessel's own propulsion or tug assistance.

Engine Status

The *Star of Abu Dhabi* used two means of holding position: its two anchors. The propulsion system was not in standby, although the master believed the engine was on 10-minute's notice. The engine order telegraph indicated that the vessel was FWE following anchoring, and the chief engineer did not receive any instruction to have the engine ready in under two hours. The chief engineer indicated that if the engine was in standby, a licensed engineering officer would have been in the engine room on watch and the engine would have been available for immediate use by the bridge, in compliance with the Coast Guard MSIBs in effect.

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[12] Bartlett Engineering, *Evaluation of Anchor Chain Link from the N/V Star of Abu Dhabi,* Barlett Engineering Project No. 1540, March 10, 2017.

[13] Bartlett Engineering.

[14] (a) Title 33 *CFR* 164.19; (b) National Oceanic and Atmospheric Administration (NOAA), *United States Coast Pilot 5*, 44th ed., (Washington, DC: US Department of Commerce, 2017), page 127.

The master stated that he was not aware of the MSIB requirement for three means of holding position. This information should have been passed to him by the pilot and the ship's agent prior to arrival at the anchorage. But, regardless of whether the MSIBs or the information contained within the bulletins were provided to him, the master should have recognized the risk posed by the strong current and taken measures to ensure the vessel was ready to respond to an anchor dragging situation.

A similar accident occurred two months earlier on January 17, 2016, as the Mississippi River was on the rise. The vessel *Manizales* dragged its two anchors and the main propulsion engine could not be used effectively in time to prevent a collision with a vessel downriver.[15]

Probable Cause

The National Transportation Safety Board determines that the probable cause of the allision of the *Star of Abu Dhabi* with the Louisiana Sugar Refinery unloading dock was the failure of the master to ensure the ship’s propulsion engine was ready to maneuver while the vessel was anchored in a river with high water conditions.

[15] National Transportation Safety Board, *Collision between Cargo Vessel Manizales and Bulk Carrier Zen-Noh Grain Pegasus*, NTSB/MAB-17/03 (Washington, DC: National Transportation Safety Board, 2017).

Vessel Particulars

Vessel	*Star of Abu Dhabi*
Owner	Abu Dhabi Shipping International S.A. Japan
Operator	Fairmont Shipping (Canada) Ltd.
Port of registry	Panama City
Flag	Panama
Type	Bulk carrier
Year built	2006
Official number (US)	n/a
IMO number	9375927
Construction	Steel
Length	737.9 ft (224.9 m)
Draft	41.6 ft (12.7 m)
Beam/width	105.6 ft (32.2 m)
ITC tonnage	42,751 ITC tons
Engine power; manufacturer	14,831 hp (11,060 kW); Hitachi Zosen MAN B&W
Persons on board	21

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

For more details about this accident, visit www.ntsb.gov and search for NTSB accident ID DCA16FM034.

Approved: April 13, 2017