National Transportation Safety Board

Marine Accident Brief

Bollard Failure Causing Breakaway of Cruise Ship *Carnival Triumph* from its Moorings, and Subsequent Collision with Dredge *Wheeler* and Towing Vessel *Noon Wednesday*

Accident no.	DCA-13-LM-015
Vessel names	*Carnival Triumph*, *Wheeler*, and *Noon Wednesday*
Accident type	Bollard failure; breakaway from moorings; subsequent collision
Location	BAE Systems shipyard, Mobile River, Mobile, Alabama 30°40.659′ N, 88°1.975′ W
Date	April 3, 2013
Time	1328 central daylight time (coordinated universal time –5 hours)
Injuries	1 fatal, 1 injured (both BAE Systems employees)
Damage to vessels	*Carnival Triumph*, $2.7 million; *Wheeler*, $200,000; *Noon Wednesday*, $3,000
Environmental damage	None
Weather	Heavy rain with limited visibility. Air temperature 59°F. The National Weather Service had issued a Special Weather Statement at 1251 CDT, warning of possible wind gusts of up to 50 mph in the vicinity of the accident.
Waterway characteristics	The Mobile River, located in southern Alabama, is about 45 miles in length from its mouth at Mobile Bay, up to the confluence of the Alabama and Tombigbee rivers.

On April 3, 2013, about 1328 local time, the cruise ship *Carnival Triumph* was moored and undergoing repairs at the BAE Systems shipyard in Mobile, Alabama, when the Port of Mobile experienced a period of high wind gusts. The vessel broke free from its moorings and drifted across the Mobile River, where it collided with the moored dredge *Wheeler*. A responding towing vessel, *Noon Wednesday*, became pinned between the cruise ship and the dredge. One shipyard employee died in the accident; another was injured. The total damage amount was estimated to be more than $2.9 million.

The *Carnival Triumph* under way at Half Moon Cay, Bahamas.

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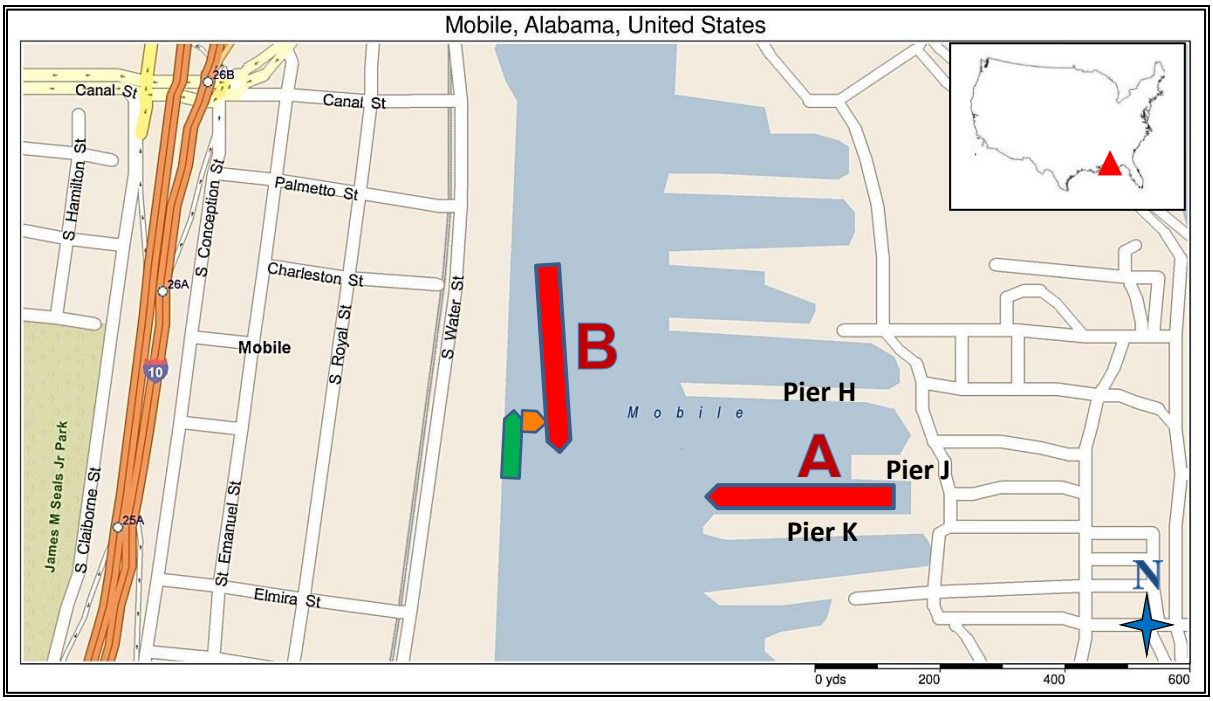
About 2 months before the accident, on February 10, 2013, the *Carnival Triumph* had experienced a fire in the aft engine room, which resulted in a loss of power and propulsion. The ship was towed to the Alabama Cruise Terminal in the Port of Mobile on the Mobile River. It arrived there on the evening of February 14, and the passengers disembarked. The following morning, towing vessels shifted the *Carnival Triumph* to the BAE Systems shipyard so that repairs could begin.

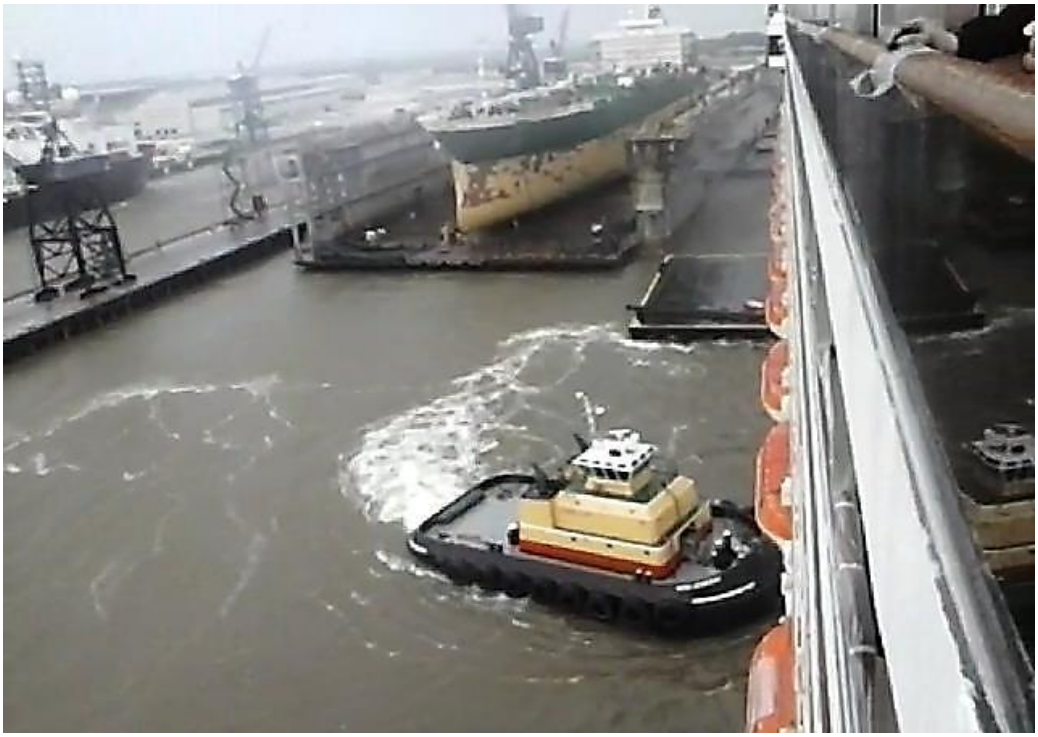
During the repair work, the *Carnival Triumph* was moored port side to at the shipyard's Pier K, using high strength co-polymer (HSCP), 8-strand, 68-mm-diameter mooring lines, which were individually rated at a breaking strength of 93 tons. Forward on the ship, 10 mooring lines were used (6 head, 2 breast, and 2 spring lines), affixed to 4 bollards. Aft on the ship, another 10 mooring lines were used (in this case, 4 head, 4 breast, and 2 spring lines), also affixed to 4 bollards. Sometime later, three work barges were arranged end to end, tied off to the aft starboard side of the *Carnival Triumph* and to an adjacent finger pier (Pier J) to facilitate materials transfer between the vessel and shore.



The approximate location of the *Carnival Triumph* before the collision is marked "A" (the ship icon is red), and its approximate location at the time of the collision (west side of the Mobile River) is marked "B." The dredge *Wheeler* is shown as a green icon and the towing vessel *Noon Wednesday* as an orange icon. Vessel icons and positions are not to scale. (Background by Microsoft Trips and Streets)

On April 3, 2013, about 1328, a passing storm front generated unexpected winds out of the southeast that increased in speed from 25 to 55 mph over a 10- to 15-minute period. Personnel on the bridge of the *Carnival Triumph* observed a peak wind speed of 65 mph. About that time, the wind force caused the stern of the ship to swing away from Pier K in a northwesterly direction, and this movement strained the aft mooring lines. The three aft mooring bollards parted from their mounts on Pier K, one stern winch paid out off its line under strain, and another line parted, setting the stern of the ship adrift.

The three work barges attached between the aft starboard side of the *Carnival Triumph* and Pier J also shifted with the movement of the ship's stern. Either the tension placed on the mooring lines attaching the work barges to Pier J, or possibly contact between this pier and the stern of the *Carnival Triumph*, caused the end section of the pier to shift and collapse into the water. Two shipyard employees were on the section of the pier that collapsed into the water. One of them was rescued, but the other employee died in the event. Local authorities recovered his body from the waterway days later. (See US Department of Labor, Occupational Safety & Health Administration [OSHA] case #899880 for more detail.)



In this image taken from the *Carnival Triumph* (starboard side, looking aft), the towing vessel *Noon Wednesday* is seen taking position on the hull. The dry-dock facility and the still-attached work barges are also visible in this image. (Photo provided by Carnival Corporation)

As the stern of the *Carnival Triumph* continued to swing in a northwesterly direction, the end of one of the attached work barges punctured the steel plate on the outboard side of a floating dry-dock structure attached to the south side of Pier H. The bow of the *Carnival Triumph* was setting off the dock at this time when a fourth bollard affixed to a forward mooring line parted from its mount on Pier K. Two of the other forward mooring lines paid out off the winch and two others parted. All shore-to-ship connections pulled free, including the electrical service connection, and the *Carnival Triumph* was adrift.

The master of the *Carnival Triumph* made an urgent very high frequency (VHF) broadcast for tug assistance, and the uninspected towing vessel *Noon Wednesday*, which was standing by at the shipyard on another job, promptly responded to the call. About 1330, the *Noon Wednesday* took position on the starboard side of the *Carnival Triumph*, just forward of amidships, and began to push against the hull. The master of the *Carnival Triumph* sounded several short blasts on the ship's horn as the starboard stern contacted the side of the floating dry-

dock structure. The *Carnival Triumph* drifted from the shipyard basin, dead ship across the river in a westerly direction, with one work barge still attached. The *Noon Wednesday* was unable to stop the westerly drift of the ship, and about 1335, the master of the *Carnival Triumph* ordered the port anchor dropped. The port anchor dragged momentarily, then took hold of the river bottom to slow the movement of the bow, and the stern of the ship swung to starboard. The master then ordered the starboard anchor dropped.

The dredge *Wheeler*. (Photo provided by the US Army Corps of Engineers)

On the dredge *Wheeler*, which was moored port side to across the river at the Signal Ship Repair facility, the master and crew had become aware of the situation by monitoring the VHF radio and hearing sound signals from the *Carnival Triumph*. As the *Carnival Triumph* approached the *Wheeler*, the master of the dredge ordered all crew and shipyard personnel to abandon ship.

About 1350, the *Carnival Triumph*'s starboard bow collided with the starboard side of the *Wheeler.* The starboard stern of the *Carnival Triumph*, and the attached work barge, came to rest on a fender system and the west bank of the Mobile River. The towing vessel *Noon Wednesday* became pinned between the hulls of the *Carnival Triumph* and the *Wheeler.*

This image, taken by Coast Guard investigators from the bulkhead of the Signal Ship Repair facility shortly after the collision, shows the positions of (from left to right) the *Carnival Triumph*, *Noon Wednesday*, and *Wheeler*.

The breakaway and collision resulted in the following damage:

- *Carnival Triumph*: Damage at various points along the entire length of the starboard hull, just above the waterline, extending up to deck #5 aft, known as the Promenade deck, and deck #4 forward, known as the Atlantic deck. Damage included puncture and inset of the hull plating, and distortion of vertical and horizontal framing. The estimated damage amount was $2.7 million.

- *Wheeler*: Damage to the forward portion of the starboard hull, including parts of the superstructure, which included inset of the plating and distortion of the framing. Some damage also occurred to dredging gear located on the main deck, starboard side forward. The estimated damage amount was $200,000.

- *Noon Wednesday*: Minor damage to the aft tank, starboard corner, which included inset of the hull plating and some framing distortion. The estimated damage amount was $3,000.

Mooring bollards at the BAE Systems shipyard

Each mooring bollard at the BAE Systems shipyard, Pier K, was affixed to the pier using four large steel anchor bolts, 30 inches in length and about 1.5 inches in diameter, with backing plates encased in concrete. The two images in the upper row show side and bottom views of one of the bollards recovered after the accident. The image on the lower left shows a section of a fractured anchor bolt that remained in one of the recovered bollards. The image on the lower right shows a concrete base pad where one of the failed bollards had been mounted.

In June 2010, BAE Systems had contracted an engineering firm to ascertain the general condition of Piers K and H. The assessment included examining all mooring hardware. The engineering firm concluded that most of the mounting hardware was poorly attached to Pier K, that many fasteners holding the bollards to the deck had evidence of corrosion, and that the remaining capacity of those fasteners was suspect. The report rated the overall condition of the mooring hardware as "serious" per the engineering Condition Index (CI) Rating table and indicated that further analysis was needed to determine if the installations were adequate to handle mooring loads. A recommendation in the report stated, "conduct an analysis of the mooring capacity of the pier with consideration for heavy weather mooring conditions." The overall condition of Pier K was deemed "poor." However, despite these results, BAE Systems did not perform any further engineering analysis on the mooring hardware on Pier K before the accident. Three bollards that had been identified as damaged were reset, and one missing bollard was replaced with another bollard in late June or July 2010. BAE Systems did not disclose to *Carnival Triumph* personnel that Pier K was deemed to be in poor condition.

After the accident, a metallurgical consulting firm hired by BAE Systems performed a preliminary evaluation of the 16 anchor bolt sections that remained in the concrete base pads of the failed bollards on Pier K. The evaluation report identified three types of rupture conditions as

being present in the bolt specimens: brittle fracture, ductile rupture, and severe corrosion prior to ductile rupture. The report indicated that although some of the bolts had lost material from corrosion before the failure, further study would be necessary to determine whether the reduction in the bolts' cross-sectional area was a result of elongation from high force, corrosion, or a combination of both factors. The bolts and bolt parts were transferred to OSHA's Salt Lake Technical Center in Utah for further examination. As of the date of this brief, no findings have been issued.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the breakaway of the *Carnival Triumph* from its moorings and the subsequent collision with the dredge *Wheeler* and the towing vessel *Noon Wednesday* was the successive failure of multiple mooring bollards, which were known by BAE Systems to be in poor condition with an undetermined mooring load capability.

Vessel Particulars

Vessels	*Carnival Triumph*	*Wheeler*	*Noon Wednesday*
Owner/operator	Carnival Corporation	US Army Corps of Engineers (US Government)	Crescent Towing and Salvage
Port of registry	Nassau, Bahamas	Not Documented	Mobile, Alabama
Flag	Bahamas	United States	United States
Type	Cruise ship	Dredge	Towing vessel
Built	January 29, 1998	October 31, 1979	May 1, 2005
IMO number	9138850	7923184	1180110
Construction	Steel	Steel	Steel
Length	893 ft (272.19 m)	386.7 ft (117.87 m)	75 ft (22.86 m)
Draft	27.25 ft (8.3 m)	21.5 ft (6.55 m)	12.5 ft (3.81 m)
Beam	116.5 ft (35.5 m)	82.0 ft (25.0 m)	40.0 ft (12.19 m)
Gross tonnage	101509	10614	95
Engine power	23172 hp/17042 kW diesel	10400 hp/7649 kW diesel	4200 hp/3089 kW diesel
Persons on board	810 Carnival and shipyard personnel (vessel was wet-docked and undergoing repairs for fire damage)	20 (vessel was wet-docked and undergoing engine replacement)	4

For more details about this accident, visit www.ntsb.gov/investigations/dms.html and search for NTSB accident ID DCA13LM015.

Adopted: January 23, 2014

The NTSB has authority to investigate and establish the probable cause of any major marine casualty or any marine casualty involving both public and nonpublic vessels under 49 *United States Code* 1131. This report is based on information provided by the US Coast Guard and OSHA during each agency's informal investigation of the accident. The NTSB also conducted its own limited on-scene investigation.