

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Marine Safety
Washington, D.C., 20594

April 6, 2008

DECK OPERATIONS GROUP FACTUAL REPORT

DCA08MM004

A. ACCIDENT

Vessel: *M/V Cosco Busan*
Date: November 7, 2007
Time: 0830 Pacific Standard Time
Location: Pier D, San Francisco-Oakland Bay Bridge, 37° 48.1' N, 122° 22.5'W
Owner/Operator: Regal Stone Ltd., Fleet Management
Complement: 1 Pilot, 24 Crew.

B. DECK OPERATIONS GROUP

Rob Jones, NTSB
Washington, DC

C. SUMMARY

On Wednesday, November 7, 2007, about 0830 Pacific standard time, the Hong Kong-registered, 901-foot container ship *Cosco Busan* allided with the fendering system at the base of the Delta tower of the San Francisco-Oakland Bay Bridge (Bay Bridge). The ship was outbound from berth 56 in the Port of Oakland carrying 2,529 containers. It was destined for Busan, Korea.

The vessel was scheduled to depart the berth at 0630. A San Francisco Bar pilot arrived at the vessel about 0620 and met with vessel's master. Fog had restricted visibility in the harbor, and the pilot and master postponed sailing until visibility improved. While waiting for the visibility to improve, the pilot, the master, and the watch mate adjusted (tuned) the ship's two radars with regard to picture display and target acquisition on the ARPA (automatic radar plotting aid) until the pilot was satisfied that the radars were performing acceptably. According to the voyage data recorder (VDR) transcript, the ship's sailing was also delayed by the need to complete some ships paperwork. About 0730, the pilot estimated that visibility had improved to approximately 1/4 mile and, according to the pilot's statement, he consulted with the master before getting underway.

About 0745, the vessel departed berth 56 with the aid of the tractor tug *Revolution* on the port quarter pulling with one line and using the ship's 2,700-hp bow thruster. The bridge navigation crew consisted of the master, the third mate, a helmsman, and the pilot. The chief mate and a lookout were on the bow, and the second mate was on the stern. After the vessel eased off the dock, the pilot had the tug shift around to the center chock on the stern as a precaution because of the reduced visibility and, as the pilot later stated, "for insurance in case I needed help in the middle of the channel." With the tug trailing behind on a slack line, the *Cosco Busan* started making headway out of the estuary.¹ The dredge *Njord* was working toward the end and on the west side of the estuary, and the *Cosco Busan* passed to the right of it without incident.

The pilot stated that as the *Cosco Busan* continued to make its way out of the Inner Harbor Entrance Channel, he could see the No. 4 and No. 6 buoys pass by and noted that their lights were visible. He kept the vessel to the high side of the channel as he departed the estuary in anticipation of the flood current he would encounter. He stated that the visibility again diminished, and that he could not see the No. 1 buoy marking the northern boundary of the entrance to Bar Channel as the vessel passed by. At this time, the vessel was making approximately 10 knots.

The pilot stated that, as was his usual practice, he used the VRM (variable range marker) set at 0.33 nautical mile as a reference off the Island of Yerba Buena as he made his approach to the Bay Bridge. The pilot stated the 0.33 nautical mile distance keeps the vessel at approximately the mid-point of the bridge span between the Delta and Echo towers. As the *Cosco Busan* passed close to the No. 1 buoy off the southwest tip of the island, the pilot issued rudder orders that caused the vessel to start to come left. The ship continued to swing left, and the speed remained at about 10 knots. Shortly thereafter, the ship's heading was approximately 241°, which was almost parallel to the bridge.

A Vessel Traffic Service (VTS) controller monitoring vessel traffic noticed that the ship was out of position to make an approach to the bridge's Delta-Echo span. The controller contacted the pilot and informed him that the automated information system (AIS) had the *Cosco Busan* on a heading of 235° and asked the pilot if his intentions were still to use the Delta-Echo span. The pilot responded that he still intended to use the Delta-Echo span and that the vessel was swinging around to the northwest with the heading showing 280°.

According to the ship's master, he estimated the visibility to be very low—about 30 meters—as the *Cosco Busan* started coming right to make its way under the bridge. As the vessel continued its approach to the bridge, the pilot ordered hard starboard rudder. Shortly thereafter, the chief mate on the bow called the master via UHF radio, pointing out that the Delta tower was very close. The vessel struck the corner of the fendering system at the base of the Delta tower at approximately 0830. Immediately upon realizing the vessel had allided with the base of the tower, the pilot ordered hard to port on the rudder in an attempt to lift the stern of ship away from further impact.

¹ Referring to the Oakland Bar Channel where the Inner Harbor Entrance Channel and the Outer Harbor Entrance Channel merge.

Shortly afterward, the pilot radioed the VTS controllers and informed them that his ship had allided with the tower and that he was proceeding to Anchorage 7, located just west of Treasure Island, where he planned to anchor the vessel. He notified his pilot office of the incident and stated that when he saw a sheen of oil in the water at the anchorage, he immediately notified the VTS.

Another San Francisco Bar pilot relieved the pilot of the *Cosco Busan* while the ship was at Anchorage 7, and the accident pilot was tested for alcohol using a saliva strip before he departed the ship. The accident pilot was then taken to the pilot office for mandatory drug and alcohol testing. About 1002 and due to the relief pilot's concern over the vessel's draft and the water depth at Anchorage 7, the *Cosco Busan* heaved anchor and shifted to Anchorage 9, located just south of the Bay Bridge, where the vessel again anchored.

D. BRIDGE TEAM PERSONNEL

San Francisco Bar Pilot

At the time of the allision, the *Cosco Busan* pilot had been a pilot for 26 years. After graduating from high school, he joined a maritime union and first went to sea in 1966. He made various trips on the west Coast and then enrolled in California Maritime Academy in 1967. After graduating in 1972, he worked overseas until 1977, when he returned and started working on harbor and oceangoing tugs with the goal of becoming a pilot. He became a member of the San Francisco Bar Pilots Association on February 1, 1981, and remains with this organization. The pilot told investigators that he has undertaken various training during his career, including radar and simulator training that involved training with small-scale model ships in France and Poland.

In interviews with investigators, the pilot stated that while the *Cosco Busan* remained in the berth, he was manipulating the radars with regard to their imaging and their ability to acquire and track targets and that the radars were working.² By various methods, the pilot continued to attempt to estimate the visibility and assess conditions for sailing. He plotted the approaching tug *Solano* when he saw it visually and stated:

He [*Solano*] was over a quarter of a mile. I don't remember the exact distance but it was more than a quarter of a mile. So the visibility around the vessel around the vessel was, I would say, at least a quarter mile, but I don't think it was a half a mile. You know, that's a guess. So at that point, I asked the Captain, are you...satisfied with the conditions to get underway? ...do you want to wait or do you want to go....? And he said,

² Pilot interview pg. 9 line 4.

well, looks like--well, I'd better not say that, but he agreed to say--I'm not sure--his English isn't very good, but he agreed that it looked safe to sail.³

With the aid of the *Cosco Busan's* bow thruster and the tug *Revolution* positioned on the port quarter, the vessel maneuvered off the dock and out into the estuary. The pilot then ordered the tug to reposition on the stern, "and I put him in the center--aft as insurance in case I needed some help getting through the channel."⁴ The containership proceeded outbound through the estuary with the tractor tug *Revolution* following closely behind secured with a slack line. The pilot continued to describe how he navigated outbound from the berth through the harbor:

And we kept going, you know, still in the channel and--in the middle of the channel, I believe. And it was flooding, so I was going to--I kept going up the channel, and I stayed high towards the green buoy number one because everything would be setting into the port, but I didn't see the green buoy and I didn't see number two buoy. But number two buoy, we were turning at that time, so I wasn't really looking for it. I knew where I was relative to the number one buoy. And what I have used to go through the Bay Bridge in the fog before electronic charts and everything is .33 tenths of a mile off of the light on the southern end of Yerba Buena Island. So I had the variable range ring set on that. And what I usually -- what you do is put the ring on there, and it just keeps the ring on the island as you go through the bridge, and that brings you to the center of the bridge.⁵

The pilot continued to describe the maneuvering of the *Cosco Busan* as it made its way toward the San Francisco Oakland Bay Bridge.

As I made the turn and headed towards the bridge, the radar picture of the bridge got distorted. It got wider. The bridge, the bridge got wider. The RACON never appeared. And I couldn't see the bridge piers or the buoys south of the span. I couldn't pick it up on the radar. So at that point, I figured that the electronic chart would be more accurate because the radar was -- both radars were not -- I wasn't, I wasn't comfortable with the display. So when I went to the electronic chart, once again I asked the Captain, I said, is this center of the bridge the point that he had indicated earlier, and he said that's the center. Okay. So I'm making my approach to the -- like I say, I'm not sure what rudder commands I was giving. I'm sure they will all come out on the machine, but somewhere along this as we're traversing this section, traffic [VTS] called and said we have your heading as 235, what is your intention? And I'm standing at the radar, and the radar and the electronic chart are right next to each other, and I had the radio in my hand. I said my heading flasher is on 280. I said I'm showing -- I forget what I said, showing me clearing the bridge or hitting the center, but I was nowhere near 235. I mean it's not even a course you use to get

³ Pilot interview pg. 9 lines 15-25, pg. 10 line 1.

⁴ Pilot interview pg. 10 line 6-7.

⁵ Pilot interview pg. 10 line 19-25, pg. 11 line 1-8.

to the bridge. I never go left of 250. When I leave the Bar Channel generally, I steer towards the tower or somewhere between 250 and 260, depending on the current. So I mean that really stunned me. I was really confused by that. I couldn't understand how they could have me at 235 and I had me at 280. And I forget it, it was at that point or shortly after that I gave -- oh, on the electronic chart, the heading flasher showed that I had already cleared what the Captain had indicated was the center of the bridge. The heading flasher was to the right of it and we were still coming right. But when they said they had me going 235, I don't know how many minutes went between then and I ordered full ahead and hard starboard to increase it. Although I -- from the electronic chart, it looked to me like I was already past the center and I was going to be going -- I was a little concerned about going too far to the starboard.⁶

And then, shortly after that, the bridge appeared, you know, appeared just slightly off the port bow, and then the ship didn't go bang or shift or I didn't feel any movement on the ship, but I went out on the port bridge wing as we were going down the side of the pier, and I could see, you know, the fendering getting knocked off. So I put the ship hard port to lift the stern away from the pier. I didn't want the stern to keep swinging and do more damage, so I put it hard port, and then I called traffic [VTS] on the radio and said 'I just hit the Delta Echo span, and I'm going to anchor at [anchorage] seven.' So from there, I used various courses and speeds to get into the anchor at seven, and then I anchored the ship. And then after I anchored the ship, I looked over to the side, and then I saw oil. To be perfectly honest with you, I didn't realize I had put a hole in the ship until we were anchored, I anchored, and then you could see the oil running down the side of the ship. So I called traffic again, and I think I called them on a telephone this time. But they have a tape of the telephone conversation too. So I called them, and I said there's oil in the water, I'm letting you know that, you know, there's oil, there's a sheen in the water, and I, I believe the traffic guy said, yeah, we just got a report from a ferry boat about oil in the water, and the pilot boat was coming alongside about that time, and I believe Captain McIssac called somebody in the Coast Guard and, and reported that they could see the oil coming out of the ship."⁷

The pilot stated in his interview that the RACON⁸ never appeared and that he could not see the bridge piers or the buoys south of the span. He stated that the radar picture of the bridge got distorted and he was not comfortable with the display and this was the reason he went to the electronic chart.

⁶ Pilot interview pgs. 12-13, lines 1-25 and

⁷ Pilot interview pgs. 13-14, lines 11-25 and 1-10.

⁸ Racon- Acronym for RADar -BeaCON. Emits an image on the radar display usually in morse code radiating away from the location of the beacon.

The pilot in his interview described the visibility as about eight or nine hundred feet, that he could still see the bow of the ship and the foremast.⁹

When the pilot was asked by Safety Board investigators if he believed that the ship master's English was adequate for participating in a master/pilot exchange and if the master understood their conversation, he answered, "I believe so."¹⁰

In describing the current on the morning of the allision, the pilot stated that it was not at the height of the flood (tide) but that it was running around a knot or a little more than a knot. He further stated that if the tide was ebbing, "everything would be wrong. The flood at least is holding you off the bridge, and I definitely considered that in my decision to sail. If [the tide] was ebbing, I would not have sailed."¹¹

The pilot stated that he waited for all the traffic to clear before he departed because he did not want to have to worry about encountering traffic, meeting other vessels, having to make course changes, or having to "do something radical" in the Bar Channel.

The pilot stated that the ship handled reasonably well, although was perhaps a little sluggish because of its deep draft. The pilot card produced by the ship indicated a forward draft of 39 feet 9 inches, and an aft draft of 40 feet 4 inches.

The pilot confirmed in his interview that the electronic chart had no course lines. He further stated that he sees approximately 10 different electronic chart display and information systems (ECDISs) during a week and that he has never seen one that uses a red triangle as navigation information.¹²

During Safety Board questioning of the pilot while on scene, the pilot stated that RACONs on the Bay Bridge have been fairly inconsistent.¹³ The pilot further stated that, when he goes through a bridge in the Bay, "I have a distance of a piece of land I use, and I use a RACON—if it show up—as a confirmation."¹⁴

In answering questions relating to fog and restricted visibility, the pilot remarked that fog is not an uncommon event in the Bay. He said that "fog is an annual event, [both] winter and summer. We live with fog. Fog is a regular event."¹⁵

Cosco Busan Master

The master of the *Cosco Busan* was born in China in 1960. He studied at the Maritime University in Dalian, China beginning in 1978 and has been sailing since 1982. In 1988, his first license, which was as a 3rd mate, was issued by the Liaoning Maritime Safety Administration of the Peoples Republic of China. He held a Chinese master's

⁹ Pilot interview pg. 23, lines 2-3.

¹⁰ Pilot interview pg. 30 lines 16-19.

¹¹ Pilot interview pg. 33, lines 6-13.

¹² Pilot interview pg. 78, lines 5-14.

¹³ Pilot interview pg. 107, line 19.

¹⁴ Pilot interview pg. 108-109, lines 24-25 and 1.

¹⁵ Pilot interview pg. 109, lines 12-24.

license and first sailed as a captain in 1998. The accident trip was the master's first time sailing with Fleet Management. He had previously sailed on at least three ships that were larger (in tonnage) than the *Cosco Busan*.¹⁶

Cosco Busan 3rd Officer

The 3rd officer who was on the bridge at the time of the allision had been sailing since 2003. He was trained at Wu Han University of Technology. He received his first license from Tianjin Maritime Safety Administration in December 2005. The 3rd officer first sailed with Fleet Management in September 2006. This was his first trip with this master. He had never sailed on a vessel as big as the *Cosco Busan*, and this was his first time in San Francisco Bay.

Cosco Busan 2nd Officer

The *Cosco Busan*'s 2nd officer had been sailing since 2003. He was trained at Wu Han University of Technology. In about 2004, he received a 3rd Officer certificate from Tian Jin Maritime Safety Administration, the Peoples Republic of China. This was his first voyage on the *Cosco Busan*, and he has not worked on a ship similar to the *Cosco Busan*. He joined the ship as the other crewmembers did on October 24, 2007. The 2nd Officer has never been to Oakland before this voyage.

Cosco Busan Chief Officer

The chief officer, who was on the bow of the *Cosco Busan* at the time of the allision, had been sailing since July 1997. He was trained at Shanghai Maritime University and was issued his first license in 1999 by the Shanghai Maritime Safety Administration. He first sailed for Fleet Management when he boarded the *Cosco Busan* on October 24, 2007. He has sailed on one other vessel similar in size to the *Cosco Busan*. He was in San Francisco Bay in about 1999, but his vessel stayed at anchorage and never docked.

Cosco Busan Bos'un

The *Cosco Busan*'s Bos'n had been sailing since 1992. He received his maritime training at the Guang Zhou Maritime School. He received his marine credentials from the Guang Zhou Maritime Safety Administration. This was his first job with Fleet Management, and he too started on the October 24, 2007. He did not have previous experience on vessels similar to the *Cosco Busan*. The bos'n's first trip into San Francisco was in approximately 2000.

Cosco Busan Helmsman

The AB (able-bodied seaman) who was on the helm at the time the *Cosco Busan* allided with the bridge tower had been sailing for approximately 10 years. He received his maritime training at the Nan Ton Navigation Academy, Gan Su Province. He had never been on a ship similar to the *Cosco Busan*, before and he had never been to San Francisco. He received his seagoing certification or documentation from the Tian Jin Maritime Administration. As did the other crewmembers, he joined the *Cosco Busan* on October 24, 2007.

¹⁶ Personnel information for all *Cosco Busan* crewmembers supplied by legal representation via email.

E. TUG REVOLUTION

The tug *Revolution* had horsepower rated 5,080 and was 78 feet in length. It had a design speed of 12 knots. The tug had a certified bollard pull of 65 tons ahead and 60 tons astern. The towing hawser, or line that the *Revolution* had secured to the stern of the *Cosco Busan*, was 2 3/4 inches in diameter and was tested at a maximum load of 737,000 lbs.

Tug Revolution Master

The tug master was 37 years old and graduated from high school in 1988. He received a B.A. degree in communication in 1993 from San Diego State University. His first experience on the water was working on sport fishing vessels out of San Diego. He obtained a 100-ton near-coastal master's license in 1997. From about 1997 through 2005, he worked primarily as a deckhand on tractor tugs working for or assisting Navy vessels out of San Diego. The last 4 years of this period, he sailed as captain. He left the company after a change of contract. He began working in his present assignment about 3 months before the incident. He currently holds a U.S. Coast Guard 200-ton Master of Towing Vessel near-coastal towing license.

On the day of incident, the tug *Revolution* had completed its previous assignments and was waiting aft of the *Cosco Busan* at its dock at berth 56. The master of the tug *Revolution* awaited orders from the pilot (designated as Unit Romeo), which came at 0615. The ship was scheduled to sail at 0630. The pilot related to the tug master that some paperwork remained to be finished. The tug made up a single line through a chock¹⁷ on the port quarter. The pilot radioed the tug master and asked him to let the pilot know when a tug and barge that were heading into the estuary had passed the tug's position near the stern. At 0755, the tug master radioed that the tug and barge were clear, and the pilot gave the tug the order to stretch out his tow line and start pulling the vessel off the dock. The tug master stated that after the ship was off the dock and into the center of the channel, he loosed his line at the port quarter and shifted it to the center chock aft. He positioned the tug astern of the vessel and let out about 100 feet of towline. By the tug master's recollection, the *Cosco Busan* was underway down the center of the channel about 0800.

The tug master informed the pilot that the tug *Revolution* had another job at 0830. The pilot acknowledged this and remarked that he was just going to keep the tug with his vessel through the Oakland Bar Channel. The pilot's instructions to the tug were to stay with the *Cosco Busan* and keep a slack line.¹⁸ At buoys 1 and 2, just south of the tip of the southern end of Yerba Buena Island, the tug's GPS showed that the vessels were making 12 knots. During this time, the tug master was engaged in driving his vessel behind the *Cosco Busan* and ensuring the line between them did remain slack. Shortly after the position at buoys 1 and 2, the container ship started a left turn,

¹⁷ Opening in the steel bulwark for passing a line through to a set of bits.

¹⁸ Slack line meant for the tug to keep up with the container vessel and not allow the line which was secured to the stern of the *Cosco Busan* to become taught.

which the tugmaster described as a “hard port turn.”¹⁹ He maintained the tug’ position outside the containership’s prop wash to starboard.

The tug master recalled that after the turn to port, the *Cosco Busan* continued in a general southwest direction. The vessel remained on this course and then started a slow turn to starboard. The tug master’s reaction to the starboard turn was to once again cross the wake of the containership and position the tug on the port side of the vessel. During these maneuvers, there were no communications between the tug and the pilot on the bridge of the *Cosco Busan*.²⁰ The tug master reiterated that he saw no visual references with regard to land or structures. All he could see was the containership as he continued to concentrate on maneuvering his towing vessel behind it. At some point, the ship increased speed, which the tug master referenced by the “kick up” of prop wash behind the container ship. The tug master further described that the container ship heeled to port by about 30° as the *Cosco Busan* turned hard to starboard.²¹ At this point, with the increase in speed and the heel to port, the tug was experiencing difficulty in maintaining position off the containership’s port quarter. The tug master released more line to better control his vessel in its position behind the *Cosco Busan*. He speculated that three things could have happened had he not released more line: The line could have snapped; the bits on deck could have pulled out or buckled the deck; or the tug could have been pulled under.²²

After this maneuver, the tug master experienced or witnessed another hard turn, now to port, by the *Cosco Busan*. The tug had released or reeled out approximately 400 feet of line and was down to about a turn left on the winch. As the tug heaved up its line and continued to maneuver in and around the stern and prop wash of the container ship, the tug master could see the damage to the fendering system on the delta tower support and realized the larger ship must have allided with the Delta tower. He noticed that the time was 8:29.²³

The tug master maintained his position aft of the vessel and commenced recovering his towline to a measurement of about 150 feet. Over the radio, the tug master heard that the vessel would be heading to Anchorage 7, and he resumed his role of just following behind and maintaining his line. The tug master stated that he did not call the bridge because he knew the crewmembers would be occupied dealing with the incident.²⁴ Upon hearing that the *Cosco Busan* was moving to Anchorage 7, the tug followed along. About 0900, the tug master received word from the pilot that he was released. The tug master recalled the pilot saying, containership “I guess I forgot about you in all the excitement.”²⁵

¹⁹ Tug masters interview transcript pg. 22 line 17

²⁰ Tug masters interview transcript pg. 26 line 10.

²¹ Tug masters interview transcript pg. 28-29, lines 18-25 and 1-10.

²² Tug masters interview transcript pg. 31 line 15.

²³ Tug masters interview transcript pg. 31 line 20.

²⁴ Tug master interview transcript pg. 34 line 15.

²⁵ Tugmaster interview transcript pg. 36 line 10.

F. THE NAVIGATION BRIDGE

The pilot and ship' master met on the bridge at 0620, according to the vessel's VDR. The pilot stated in his interview that he gave a copy of their master/pilot exchange card to the captain. The card is instructional in nature and elicits a response from the shipboard personnel with regard to the proper working order of equipment and specific and general information relating to the safe navigation of the vessel and the exchange between vessel personnel and the pilot. The pilot did not receive any notice of deficiencies from the captain and, to his knowledge, the captain could understand the document and read the same to his satisfaction.

The following information was taken from the vessel's VDR.

At 0636, the vessel is waiting to get underway due to some last minute paperwork and some vessel personnel that still have to depart. The pilot contacts VTS and checks on visibility at Alcatraz. VTS responds that visibility is 1/8 to 1/4 mile all the way to the Golden Gate.

At 0644, the pilot asks if the bow thrusters "are "okay." From 0646 to 0648, the pilot and crew can be talking about manipulating or adjusting the radar. At 0650, the pilot mentions to the captain that there is traffic in the channel and that the ship can depart as soon as the traffic is clear because the pilot "can see to the other side of the channel now."

At 0651, the pilot can be heard discussing the pilot ladder arrangements with the captain. The captain acknowledges these instructions and says "thank you."

At 0700, the pilot can be heard again talking to the crew about the ARPA and its ability to plot or hold on to a target. At 0713, the pilot and crew have continued to work with the radars to get a picture that the pilot is comfortable with. During this time, other radio traffic can be heard stating visibility in their estimation is at zero coming out of the end of the estuary. Also the pilot informs VTS that the *Cosco Busan* is still awaiting paperwork before departing and that he will inform VTS when they start to depart.

At 0721, the pilot gives the order to the captain to single up²⁶ in preparation for getting underway as soon as the tug *Solana* gets clear of their position at berth 56.

About 0744, the pilot informs VTS that as soon as the tug *Solana* gets by, the *Cosco Busan* will be getting underway and that he (the pilot) can see the other side of the estuary. Shortly thereafter, the pilot instructs the captain that he can start letting go lines.

At 0750, the crew has started to let go the remaining lines, and the pilot asks to be informed when the the *Solana* is abeam of the ship. The VDR transcript shows that the pilot asked "can you come out and tell me." No other orders or instructions can be heard over the VDR from the captain or pilot. The vessel's deck log has "A. L. Cast Off, S. B

²⁶ *Single up* means to take in all lines except one bow line, one forward spring line, one after spring line and one stern line.

Both Anchors” (all lines cast off, stand by both anchors) written in at 0748. The next entry is “0800 Shift tug to aft center.”

At about 0806, the pilot and captain can again be heard entering the bridge, and the pilot gives the order of “bow thruster full to port.” The crew responds, and the pilot informs VTS that the vessel is underway. The time is 0806.

At 0808, the *Cosco Busan* is moving away from berth 56 with the tug *Revolution* following behind with one line secured to the ship through the center chock. The pilot ordered a course of 285° heading out of the estuary and a dead slow ahead bell and has informed the tug master that “yeah I’m just gonna keep you here until I get through the bar channel.” The pilot continues to maneuver the containership out of the estuary, and at 0809 has ordered slow ahead on the engines and adjusts the ships course to 288° true. The pilot also instructs a crewmember to sound the fog signal.

At 0820, the pilot orders half ahead and the crew responded to the order. The vessel is on a course of 283° true.

At about 0822, the *Cosco Busan* is approximately 1.1 nautical miles²⁷ from the center of the D and E span and making 9 knots²⁸ the pilot inquires “what are these...ah...red? To which the captain responds, “this is on bridge.” And the pilot replied “oh oh I couldn’t figure out what the red light...red...red triangle was.” At 0823, the pilot orders port 10 to start his turn out of the bar channel. The helmsman confirms the order and, according to the VDR, the vessel starts to move to port. About 90 seconds later, the helmsman confirms again that the rudder is port 10, and the pilot acknowledges. About 40 seconds later, the pilot orders the wheel mid-ships and the crew confirms the order. The pilot orders the vessel to a course of 250° about 10 seconds after the mid-ships order, and the helmsman confirms the 250° order and then informs the pilot 4 seconds later that the heading was currently 247°. The pilot responds “yeah, make it 245° all right.” The helmsman confirmed the 245° order and is again concurred with by the pilot.

About 25 seconds later, the pilot orders starboard 10 and the helmsman repeats the order. Fourteen seconds later, the pilot increases the rudder to starboard 20. The vessel, according to the VDR radar image, is just less than 0.33 miles from the San Francisco Oakland Bay Bridge. Seventeen seconds later, the pilot orders full ahead on the engine, and the crew responds and orders the engine full ahead.

At 0827, VTS contacts the pilot on the *Cosco Busan* to ask what his intentions are and to inform him that their AIS²⁹ had the *Cosco Busan* on a heading of 235°. After consulting with the vessel’s crew with regard to the electronic chart, the pilot confirms that the *Cosco Busan* is still intending to proceed through Delta/Echo. No further communication is heard from VTC. At 0828, the vessel is maneuvering at approximately

²⁷ 1 nautical mile = 6,080 feet (Bowditch defines 1 International Nautical Mile as 6,076 feet)

²⁸ 1 knot = 1 nautical mile per hour, (or 1.15 statute miles per hour).

²⁹ Automatic Identification System – It is a system used by ships and vessel traffic services to locate, identify and track vessels.

10 knots, and the pilot has used various degrees of right rudder ranging from starboard 20, to mid-ships and starboard 10. At 0829, the pilot orders a hard starboard rudder order, which is answered by the crew. Four seconds later, there is some unintelligible communication over the radio by the chief officer, which is repeated 5 seconds later and is now heard to be a warning that the chief officer on the bow is reporting that he can see the bridge column. At approximately 0829, both pilot and captain verbally acknowledge that they see the bridge, and the pilot, with crew responding, then gives various rudder orders as the ship closely approaches the Delta tower of the bridge. At 0830, the pilot orders mid-ships on the wheel, dead slow ahead on the engines, and calls VTC on the radio, informing controllers that the ship just “touched” the Delta tower and was now proceeding to anchorage.

G. WATERWAY

The vessel departed from berth 56 at the Oakland Marine Terminal. The estuary has a controlling depth, on average, of about 40 feet measured at MLLW (mean lower low water). For a length of about 1 nautical mile until the end of the estuary and the start of the inner harbor entrance channel, the width of the estuary is approximately 275 yards, or 0.14 nautical mile, across. This is the measured distance of land across the estuary. The navigable width of the estuary is smaller at approximately 180 yards across. The approximate course out of the estuary is 286° true and then a course to the left of 286° as per pilot instruction through the Bar Channel to line up for a course to pass under the span of the Bay Bridge between the D and E towers which is approximately 310° true. The span of navigable water between the D and E towers is approximately 2,200 feet. Buoys on either side of the D tower mark the preferred channel. These are green and red buoys, with the top mark being red. The D and E spans other distinguishing characteristic is the RACON, which is at the center of the span and produces the morse code symbol yankee or (dash, dot, dash, dash) once a vessel's radar has interrogated it.

H. WEATHER

Weather at the time of the accident was dense fog, visibility was forecast as 1/4 mile or less from Oakland out to the Golden Gate bridge. Wind was calm or light airs. Temperature was about 52° F, and relative humidity was 98 percent. Barometric pressure was 30.10 inches. At the time of the accident, the current was flooding at 168° true with an approximate velocity of 1.25 knots.³⁰ High water at station Yerba Buena Island was predicted for 0958 local time on the 7th. The high water measurement at that time was calculated to be 6.1 feet above mean tide level.³¹

³⁰ Tidal current chart supplied by San Francisco Bar pilots in docket.

³¹ Weather factual report submitted in docket.