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16732
January 26, 2009

Dr. John S. Spencer
Director, Office of Marine Safety
National Transportation Safety Board (NTSB)
490 L'Enfant Plaza East, S.W.
Washington, DC 20594

Dear Dr. Spencer:

In accordance with 49 CFR 831.14 and 49 CFR 845.27, I hereby submit the following proposed Findings of Fact, Conclusions and Recommendations as the second part of the Coast Guard Party Submission in the matter of the investigation of the M/V COSCO BUSAN allision with the San Francisco-Oakland Bay Bridge on November 7, 2007. This document complements the Coast Guard's previous submission of January 23, 2009 and completes our submission in this matter.

Thank you for the opportunity to comment on these important issues.

Sincerely,

G. R. WHEATLEY
Coast Guard Party Spokesperson

Enclosure: (1) Coast Guard Proposed Findings of Fact, Conclusions & Recommendations; In the Matter of the M/V COSCO BUSAN allision with the San Francisco-Oakland Bay Bridge on November 7, 2007.

FINDINGS OF FACT:

** At 0748 on Wednesday, November 7, 2007, the container ship COSCO BUSAN cast off from Hanjin Terminal, Oakland Inner Harbor Berth 56, bound for sea.

** A San Francisco Bar Pilot was directing the movement of the vessel. The Master, Third Officer, and an able seaman were on the bridge with the pilot.

** The Third Officer was operating the engine order telegraph and the able seaman was at the helm. The Third Mate was also responsible for plotting periodic fixes as required. The Chief Officer and the boatswain were supposed to be on the bow, serving as lookouts and be prepared to drop the anchor. At the time of the accident, the Chief Mate was not on the bow, but the boatswain was.

** The Master, as the senior person on the bridge, retained full authority for the safety of his vessel.

** Visibility at departure of the COSCO BUSAN was less than one-quarter mile in fog, with reports from other vessels of heavy fog and restricted visibility in and around the Bay area. The visibility decreased when the vessel cleared the estuary and entered San Francisco Bay.

** The tug REVOLUTION assisted the undocking, and at the direction of the Pilot put a line aboard the COSCO BUSAN through a center stern chock, where it remained until after the casualty and the COSCO BUSAN was anchored in Anchorage 7.

** As the COSCO BUSAN exited the estuary and proceeded outbound, the Pilot ordered increases in engine RPM's until the vessel reached a speed of more than 11 knots.

** At 0827, a watchstander at Vessel Traffic Service (VTS) San Francisco contacted the Pilot, Captain Cota because he noted the vessel's Automatic Identification System (AIS) course was about 235 degrees True, which is approximately parallel to the Bridge, and was setting up to pass well southwest of the intended track. Based upon the position of the vessel, the operator thought that the pilot may have changed his mind and was intending to head to Anchorage 9 as opposed to transiting out as originally announced by the Pilot. The watchstander asked the pilot to confirm his intention to use the Delta-Echo span of the San Francisco-Oakland Bay Bridge (Bay Bridge), and the pilot replied that he was "…coming around. I'm steering 280 right now." At that time, the vessel's heading was actually 262 as recorded by the Voyage Data Recorder (VDR).

** At 0830, the COSCO BUSAN, which was traveling at a speed of more than 11 knots according to the vessel's Automatic Identification System (AIS), allided with the fender system of the Delta Tower of the Bay Bridge, damaging the wood/plastic fender system and causing a breach in the port side shell, above the waterline, between frames 128 and 150.

** The breach was three meters in height and extended inboard to the longitudinal bulkhead, which was buckled and punctured in way of cargo hold #2. The breach affected water ballast tank #2, fuel oil tank #3, and fuel oil tank #4. Fuel oil tank #4 discharged an estimated 53,653 gallons of Intermediate Fuel Oil (IFO 380). The discharge ended when the fuel oil level dropped below the lower edge of the breach, which was later estimated to have taken approximately 10 seconds.

** The Pilot reported the allision to the VTS immediately and anchored the vessel in Anchorage 7 at 0855. Due to relatively limited under keel clearance in this location, the COSCO BUSAN departed Anchorage 7 at 1020 and moved to Anchorage 9, where it anchored at 1105.

** As of January 5, 2008 approximately 22,836 gallons of oil had been recovered, including 17,788 gallons in liquid form and 5,048 gallons from solid waste. As of that date 1,085 live oiled birds had been rescued of which 421 were released after rehabilitation. 1,858 dead birds were recovered. In addition to birds, five mammals were recovered deceased and one more died after recovery.

**** Pertinent vessel data for the COSCO BUSAN includes:

Name:	COSCO BUSAN
Flag:	Hong Kong
Service:	Container Ship
Gross Tons/ITC:	65131
Deadweight Tons:	68086.5
Length Overall:	274.67 meters/901 feet 2 inches
Breadth:	40.00 meters/131 feet 3 inches
Homeport:	Hong Kong
Year Built:	2001
IMO Number:	9231743
Owner/Operator:	Regal Stone Ltd.
Vessel Manager:	Fleet Management, Inc.
Classification Society:	Germanischer Lloyd
Propulsion:	Diesel Direct
Horsepower:	77600 horsepower
Draft:	40 feet 3 inches
Fuel Type/Capacity:	Heavy Fuel Oil/7,830 cubic meters

** All regulatory certificates for the COSCO BUSAN were valid and properly endorsed on November 7, 2007.

** The COSCO BUSAN was boarded by the U.S. Coast Guard six times between February 2, 2002 and July 17, 2007. The types of boardings included port state control exams, ballast water exams, International Ship and Port Facility Security Code (ISPS) exams, and security boardings.

** All boardings were conducted by either Marine Safety Office/Sector Los Angeles-Long Beach or Marine Safety Office/Sector San Francisco. No deficiencies were noted in these boardings, except on February 27, 2007, Sector San Francisco boarded the COSCO BUSAN after the vessel reported that one of two start air compressors was inoperative.

** The vessel received an interim Document of Compliance for its Safety Management System (SMS) issued by Germanischer Lloyd (GL) on October 25, 2007, only 24 hours after the new crew joined the vessel. During the interim period the vessel was engaged in cargo operations, which likely interfered with vessel familiarization.

** Each officer completed the SMS Checklist for Crew Familiarization on October 24, 2007 attesting to more than a dozen requirements, including the following:

1) Familiarization with all shipboard documents pertaining to Quality and Safety Management System of the Company.
2) Familiarization with all shipboard Duties & Training pertaining to security as per Ship Security Plan (SSP).
3) Participation in emergency contingency drills and attended Safety Committee Meeting.
4) Familiarized with Shipboard Emergency Organization (sic) in general and all emergency equipment e.g. emergency steering, emergency generator, emergency fire pump, etc.

** The Master and Chief Engineer signed these forms on November 4, 2007 attesting to completion by each officer.

** The Training Master stated that Fleet Management had successfully used this procedure in the past without difficulty, and believed the indoctrination of new crewmembers was adequate given they held all required certificates.

** The vessel was manned in compliance with the Safe Manning Certificate, and the licenses and certificates of all crewmembers were valid and appropriate for the position held.

** All crewmembers met the minimum requirements of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW). The following crewmembers are mentioned by title in this report:

Name	Position	Role
Mao Cai Sun	Master	On Bridge/In Command
Kong Xiang Hu	Chief Officer	Bow Lookout – absent @ allision
Shun Biao Zhao	Second Officer	Prepared Passage Plan
Hong Zhi Wang	Third Officer	On Bridge Watch
Liang Xian Cheng	Boatswain	Bow Lookout

** The entire crew joined the ship in Pusan (Busan), Korea in conjunction with the change in ownership to Regal Stone. It is not known whether the crew had served together on similar vessels in the past.

** The official language of the crew was Chinese. The Master had a reasonable command of English and conversed with the Pilot in English. The Third Officer and helmsman understood the Pilot's commands, relayed in simple English, and repeated them in English. All commands were properly executed in a timely manner.

** After the casualty, Coast Guard Investigating Officers (IOs) found the Master had the best grasp of English but still needed an interpreter for detailed questions. The remaining crewmembers interviewed understood nautical English, but needed an interpreter for nearly all of the questioning, and frequently responded with gestures and head nods.

** The COSCO BUSAN carries fuel oil in a combination of double bottom tanks, wing tanks, and specific purpose tanks (sumps, settling tanks, etc.).

** The locations of oil tanks are governed by SOLAS Chapter II-2, Regulation 15, which states:

> In a ship in which oil fuel is used, the arrangements for the storage, distribution and utilization of the oil fuel shall be such to ensure the safety of the ship and persons on board…"

** This regulation does not prohibit the carriage of fuel oil in vulnerable locations other than the forepeak tank. At the time of its construction and as of the date of the casualty, the COSCO BUSAN complied with SOLAS Chapter II-2, Regulation 15 (Arrangement for fuel, lubricating, and other flammable oils).

** On August 1, 2007 a new International Convention for the Prevention of Pollution From Ships (MARPOL) regulation took effect on fuel oil tank protection. This regulation requires that ships with an aggregate fuel oil capacity of 600 cubic meters or more have the fuel oil tanks located inside the double hull, helping prevent oil spills caused by groundings, allisions, and collisions.

** The new MARPOL Regulation 12A is applicable to ships delivered on or after August 1, 2010. The phrase "on or after August 1, 2010" is interpreted to apply to all vessels for which a contract is placed on or after August 1, 2007, or in the absence of a contract, for ships whose keel is laid on or after February 1, 2008.

** Although the system on the COSCO BUSAN was capable of performing as an Electronic Chart Display and Information System (ECDIS), because the way it was configured and the type of electronic charts that were being used aboard the COSCO BUSAN, it was an Electronic Chart System (ECS) rather than a certified

ECDIS. As an ECS, the system was permitted to be used as a navigation aid only; paper charts were required for primary navigation.

** An Electronic Chart Display and Information System (ECDIS) is a computer-based navigation information system that complies with International Maritime Organization (IMO) regulations. It can be used in lieu of paper navigation charts in some areas provided there is adequate back up of the system, such as up-to-date paper charts or an additional ECDIS.

** An ECDIS system visually displays information derived from an Electronic Navigation Chart (ENC) database that is developed, issued and kept up-to-date by a responsible Hydrographic Office (NOAA in the U.S.) or by their approved authorized distributors. The ECDIS then translates and displays this information graphically in a chart format and, at a minimum, integrates position information from the Global Positioning System (GPS). It may also integrate other navigational sensors, such as radar, fathometer, and the Automatic Identification System (AIS) as desired.

** Only when official ENCs are updated and run in a compliant ECDIS system can it be called an ECDIS. An IMO type-approved ECDIS is required to conform to the International Hydrographic Organizations (IHO) Standard 57 for color and symbols.

** ECDIS chart displays can provide increasingly detailed and complex chart overlays and other supplemental information as the consumer desires, but it must display the minimum information provided in the ENC database. The ECDIS must have the ability to display vector charts derived from an ENC database but must also be able to display rastor charts in those areas where an ENC has not been developed.

** ECDIS equipment is described in IMO Resolution A.817 (19) as follows:

> Electronic Chart Display and Information System (ECDIS) means a navigation information system which, with adequate back up arrangements, can be accepted as complying with the up-to-date chart required by regulation V/19 & V/27 of the 1974 SOLAS Convention, by displaying selected information from a System Electronic Navigational Chart (SENC) with positional information from navigation sensors to assist the mariner in route planning and route monitoring, and by displaying additional navigation-related information if required.

** The ECDIS (ECS) aboard the COSCO BUSAN was type-approved and the symbols displayed on the date of the casualty were consistent with IHO Standard 57.

** A Voyage Data Recorder (VDR) is a data recording system for vessels required to comply with IMO Resolution A.861 (20) to collect data from various sensors on board the vessel. It then digitizes, compresses, and stores this information in an externally mounted protective storage unit. The protective storage unit is a tamper-proof unit

designed to withstand the extreme shock, impact, pressure, and heat, which could be associated with a marine incident. The last 12 hours of stored data in the protected unit can be recovered and replayed for incident investigation.

** VDRs are a relatively new technology for the marine transportation industry. The VDR on the COSCO BUSAN was a simplified VDR and captured data from the X-band, 3 centimeter Automatic Radar Plotting Aid (ARPA), one of two ARPA units fitted onboard the COSCO BUSAN. It also captured audio recordings from six microphones, four on the bridge and one on each bridge wing. The VDR did not capture screen shots of the ECDIS or the second S-band, 10 centimeter ARPA. Two DVDs of the VDR data from the COSCO BUSAN were recovered by the Coast Guard.

** The Coast Guard has ample authority to seize and use VDRs and the information that they contain.

** The Coast Guard does not currently have a state-of-the-art capability to analyze VDR data and relies on the National Transportation Safety Board (NTSB) to perform the analysis.

** In recent years many U.S. Pilot Associations have begun using a personal laptop computer, loaded with electronic chart software of their preference, to pilot ships. These systems have varying degrees of sophistication, but in their basic form the laptop is connected to the ship's AIS using an IMO approved Pilot Plug consisting of either a cable or Bluetooth (wireless) technology. This has come to be colloquially referred to as "The Pilot Plug."

** The use of a portable device such as a laptop is not mandated by Federal regulation, the State of California, or the San Francisco Bar Pilots Association.

** The COSCO BUSAN was fitted with a Pilot Plug, although the Pilot did not use it. It is estimated that one-third of San Francisco Bar Pilots voluntarily carry and use this type of portable equipment, but the Pilot of the COSCO BUSAN was not one of them.

** Captain Cota did not own a laptop computer for navigation at the time of the accident. Hence, he could not connect to AIS on board the COSCO BUSAN via the Pilot Plug.

** The following information was taken in part from the Coast Pilot and an e-mail from the Chief of the Eleventh Coast Guard District Bridge Branch.

San Francisco-Oakland Bay Bridge (hereinafter "Bay Bridge") is said to be the eighth longest bridge in the world, and crosses the Bay from Rincon Point in San Francisco to Yerba Buena Island (YBI), then to Oakland. Construction was completed in 1936, and a new bridge is currently under construction parallel to the existing bridge. The wood and plastic fender system, so constructed to prevent sparks in the event of an allision, was replaced under contract in 2006 and was in good condition on November 7, 2007.

RACONS mark the centerlines of the main navigable channels under the primary bridge spans. The recommended passage for southbound (inbound) traffic is the southwest half of the channel beneath the Alpha-Bravo span, and the recommended passage for northbound (outbound) traffic is the northeast half of the channel beneath the Delta-Echo span. The Delta-Echo span has a horizontal clearance of 2,210 feet and a vertical clearance of 204 feet at mid-span. Post casualty operational tests of the RACONS found them all to be on station and working properly. This was confirmed by radar images captured by the VDR onboard the COSCO BUSAN.

** Vessel Traffic Service (VTS) San Francisco is operated by the Waterways Management Division of Coast Guard Sector San Francisco, and is located on Yerba Buena Island (YBI).

** The VTS operates 24/7/365 with multiple watchstanders providing safety information to vessels transiting San Francisco Bay and it tributaries.

** On November 7, 2007, all VTS watchstanders were fully qualified.

** The VTS does not routinely direct and control the movement of vessels. In normal conditions, the VTS notifies participants of vessel traffic, marine events, minimum-wake zones, concentrations of radar targets (such as recreational or fishing vessels), unidentified targets deemed to be a hazard, aid-to-navigation (ATON) discrepancies, uncharted hazards to navigation, areas of restricted visibility, and information about safety or security zones currently in effect. When visibility decreases to one nautical mile or less, the VTS reports all vessel radar targets that may affect another vessel's transit.

** The VTS can, when necessary, direct and control the movement of vessels through existing Captain of the Port (COTP) authority, which has been delegated to the VTS. This includes authority to require a vessel remain at the pier for safety reasons, which could include restricted visibility.

** VTS San Francisco did not have a written procedure, such as a Quick Response Card (QRC), for watchstanders to follow when exercising this authority at the time of the accident.

** Since the accident, the VTS worked with the San Francisco Bar Pilots and the San Francisco Bay Harbor Safety Committee to develop protocols for periods of reduced visibility including (1) limiting vessels greater than 1600 GT from getting underway when visibility is less than ½ mile; (2) adding an additional radar operator to the VTS watch floor when visibility is less than ½ mile; and (3) developed enhanced in-house training and re-certification processes for experienced VTS operators.

** The nearest National Weather Service Station is located at San Francisco International Airport. At 0830 on November 7, 2007, weather at this station was overcast with a ceiling of one foot, with visibility ¾ mile in mist or thin fog. Winds were variable

at three knots and the air temperature was 52 degrees Fahrenheit.

** Prior to, and at the time of the casualty, participants in the VTS reported visibility in the Bay as low as 350 feet.

** At 0800 on November 7, 2007, the tide was rising, with peak high tide predicted for 0924 at +5.83 feet above MLLW. The tidal current at Yerba Buena Island (YBI), west of mid-channel, was 1.2 knots with a direction of 168 degrees True .

** There currently is a dual pilotage system in use in the United States. Under this dual pilotage system, foreign ships and U.S. vessels sailing on register, entering or leaving ports of the United States, take a state pilot; and U.S. vessels engaged in coastwise trade employ federal pilots.

** In the U.S., most Pilot Associations, including the San Francisco Bar Pilots, require members to hold both a state and federal license. When piloting a foreign vessel or U.S. vessel sailing on register, the pilot is acting under the authority of his or her state license.

** When piloting a U.S. flag coastwise vessel, the pilot is acting under the authority of his or her federal license. The COSCO BUSAN was a foreign flagged vessel engaged in international trade, and thus was subject to the pilotage laws of the State of California.

In California, most Pilot Associations are regulated by the California State Board of Pilot Commissioners, which is the oldest Commission in the State of California. It was created by the first legislature to be the governing body of the already established San Francisco Bar Pilots. The Board of Pilot Commissioners for the Port of San Francisco (hereinafter "Board") was formed on February 25, 1850. The name has since become the Board of Pilot Commissioners for the Bays of San Francisco, San Pablo, and Suisun.

** The regulations governing pilots are contained in the California Harbors and Navigation Code. Section 1178 of the Code requires that persons applying for an original license have "proper federal endorsements."

** The state pilot of the COSCO BUSAN was Captain John Cota. Captain Cota's career at sea began in 1966 as a messman. He entered the California Maritime Academy (CMA) in 1967, left for a period to continue working at sea, and reenrolled in 1969. He graduated from the Academy and tested for and was issued a Third Officer's license by the Coast Guard in 1972

** After graduating from CMA, Cota sailed on deep draft vessels and tugs in various capacities world wide, before returning to San Francisco in 1977 to begin working as a Pilot Trainee in order to obtain the required number of vessel pilot trips needed to qualify for both state and federal pilot licenses. He finished his pilot training in 1980, but had to wait until February 1981 for a vacancy with the San Francisco Bar Pilots. On the day of the incident, Cota held a Master of Steam or Motor Vessels not more than 1600 Gross

Tons with a First Class Pilot Endorsement.

** Captain Cota attended and underwent electronic simulator training every three years and manned model training every five years. He has not had specific training on the use of ECDIS. He produced certificates documenting the following training:

Bridge Resource Management	California Maritime Academy	November 11, 2001
Ship-Handling Tug Course	Grenoble, France	August 23, 2003
Fatigue, Sleep and Medications	MITAGS	June 6, 2005
Ship Simulator Course	MITAGS	June 8, 2005
Emergency Ship-Handling/Bridge Resource Management for Pilots	MITAGS	June 11, 2005

** Prior to arrival in Oakland, the Second Officer was supposed to prepare a Passage Plan including preparing a chart for the inbound and outbound voyages. This should have included placement of tracklines on the chart for both transits. Instead of preparing the required chart, the Second Officer simply used a previous chart with the tracklines already laid out, but did not verify any of the tracklines or waypoints before using the chart. The outbound trackline laid out on the chart did not pass through the centerline of the Delta-Echo span of the Bay Bridge, which is marked by RACON "Y," but was offset to the southwest of the Delta-Echo channel centerline and exactly bisected the midpoint between RACONs "B" and "Y". The space between RACONs "B" and "Y" is 0.3 Nautical Miles (NM).

** The charted course of 313 degrees True is just 0.05 NM (approximately 300 feet) northeast of the Delta Tower, extremely close for a prudent passage. While inbound, San Francisco Bar Pilot Einar Nyborg reviewed the vessel's chart and noted the planned outbound trackline was too close to the Delta Tower. He pointed this out to the crew, but the chart was not revised prior to departure as recommended by Nyborg.

** A formal Passage Plan was not prepared in accordance with the SMS procedure for sailing in unrestricted visibility on the day of the accident. This SMS procedure recommends plotting the vessel's position every 10 minutes in pilotage waters and every hour at sea. Accordingly, a properly prepared Passage Plan would have required that the vessel's position be plotted every 10 minutes. The Second Officer did not enter any waypoints, intended tracklines, wheel over points, or any other navigational information or alarms into the ECDIS/ENC for the outbound transit, possibly because the SMS did not require this as part of a properly prepared Passage Plan.

** The SMS also included a procedure for sailing in restricted visibility. However, since no Passage Plan was ever prepared, there was no need to revise the plan to account for the restricted visibility. Even if a properly prepared Passage Plan had been completed and revised in accordance with the SMS procedure for sailing in restricted visibility, that procedure did not include a requirement for more frequent position fixes; prudent

seamanship suggests this to be in error.

** Captain Cota boarded the COSCO BUSAN while alongside Berth 56 in Oakland, California at about 0620 on November 7, 2007 and proceeded to the bridge, where he met the Master, received the pilot card, and provided the Master with a pamphlet produced by the San Francisco Bar Pilots to facilitate the pilot-master exchange.

** Captain Cota examined the radars and requested the crew adjust the radars. Captain Cota, the Master, and the Third Officer spent 45 to 60 minutes adjusting the radars until Captain Cota was satisfied with the radar picture and the ability to acquire and track targets. Captain Cota and the crew had a difficult time getting both ARPAs to acquire and track targets, but Captain Cota was ultimately satisfied. Since the ARPAs were tested after the casualty and found to be working properly it is likely that the difficulties encountered with acquiring and tracking targets prior to departure were not due to human error, but may instead have been related to crane interference.

** Beyond the discussions surrounding Captain Cota's dissatisfaction with the radar images and tracking of targets, there was no true pilot-master exchange. There was a brief discussion of pilot ladder arrangements, but no discussion among the bridge management team of the vessel's intended passage.

** Captain Cota did not review the paper chart prepared by the Second Officer and specifically did not examine the tracklines laid out on the chart. There was no discussion of the frequency or methods for taking fixes or reporting the fixes to the Master or Pilot. Captain Cota also did not tell the Master of his intended plans for the passage.

** At 0620 someone in the crew, most likely the Third Officer, logged a test of the main engine ahead and astern in the bridge log. The Third Officer completed part of a pre-underway checklist as required by the SMS, which was signed at an unknown time by the Master. However, the checklist did not meet the requirements of 33 Code of Federal Regulations (CFR) 164.25 because it did not include tests of the emergency batteries or standby/emergency generators. The crew also failed to make a log entry documenting the tests as required by 33 CFR 164.11(q).

** At 0636 Captain Cota checked in with VTS San Francisco via VHF radio and was advised of inbound vessel traffic and low visibility conditions.

** At 0713 Captain Cota reported a delay in departure due to paperwork, to VTS and was advised of an inbound tug. In actuality, the vessel's departure was delayed in order to allow the Training Master to get off before sailing.

** At 0743 Captain Cota reported to the VTS that he intended to depart as soon as the second inbound tug passed.

** Prior to departure there was no discussion between Captain Cota and the Master about whether the vessel should remain at the pier until visibility improved. There was,

however, conversation among the crew about the fog, who expressed concern to each other but not to the Master or Pilot.

** There was no known undue pressure or an overwhelming need to depart. The Master did not express any concerns about delays to the Pilot, and in fact the vessel was delayed briefly while paperwork was completed and while waiting for the two inbound tugs to pass. There was no pressing need for the berth to be vacated for another vessel.

** At the time of departure, the bridge management team was comprised of the Master, the Third Officer (who executed engine orders at the engine order telegraph and carried out other duties), an able seaman (helmsman), and the Pilot (who had the "Conn").

** At 0748 the last line was singled up, and at 0806 Captain Cota reported to VTS that the COSCO BUSAN was underway.

** Captain Cota stated afterward that he could see across the estuary at the time of departure, which would indicate visibility was at least one-quarter mile.

** Captain Cota navigated the COSCO BUSAN out of the estuary using radar and visual observations of Lighted Buoys "7" and "8" and Lighted Buoys "5" and "6."

** At 0822, while underway in the estuary, Captain Cota told the Master that he could not figure out the meaning of red triangle symbols on the ECDIS video display. The Master replied that the symbols were on the bridge. It is not known which symbols Captain Cota was asking about since there are several triangle symbols on the ECDIS display along the path of the outbound transit, but the two red triangle symbols on the ECDIS display that are "on the bridge" are the symbols for the buoys marking the Delta Tower Island.

** Captain Cota was not carrying a personal laptop with familiar chart software to assist him during the transit. A navigational laptop with familiar software might have helped him decipher the meaning of symbols on the ECDIS display.

** As the COSCO BUSAN continued outbound Captain Cota was unable to visually see Lighted Buoys "1" or "2," indicating that visibility was worse in the Bay than the estuary. After clearing Lighted Buoys "1" and "2" Captain Cota attempted to maintain a distance of .33 nautical miles off Yerba Buena Island (YBI) using radar, a practice he had used extensively in the past and which he stated would result in passing under the center of the Delta-Echo span. Based on AIS data, when the COSCO BUSAN was abeam of Lighted Buoy "1" and .33 nautical miles from Yerba Buena Island, it was on a heading of 261 degrees True.

** To continue as planned, Captain Cota should have executed a turn to starboard to a course of about 313 degrees True to maintain the desired .33 nautical miles from Yerba Buena Island and pass safely through the Delta-Echo span near the centerline of the

channel. Captain Cota stated this was his standard practice for voyages such as this and other pilots utilized the same procedure.

** Captain Cota also could have directed an appropriate heading to make good a course to RACON "Y," which was visible on the ARPA he was using.

** At 0823 Captain Cota initiated a swing to port by ordering the helm 10 degrees to port.

** At 0825 Captain Cota ordered the rudder midships, but this order did not check the vessel's port swing. AIS data shows that the vessel swung unchecked to port and ultimately reached a heading of 237 degrees True, nearly parallel to the bridge, at 0827.

** At 0826, the Helmsman called out that the rudder was 10 port. This was answered to the affirmative by Captain Cota.

** Captain Cota stated that after the vessel entered the Bay the radar picture deteriorated and was not showing the RACONS or bridge piers after he turned the vessel to maintain .33 nautical miles off Yerba Buena Island. This statement conflicts with the radar images captured by the VDR, which reveal that the radar picture, while not ideal, actually improved after the COSCO BUSAN entered the Bay. The bridge and RACONS were clearly visible, except for a brief period when the bridge return disappeared while the COSCO BUSAN was under the bridge, an occurrence that should have been expected by Captain Cota. Yerba Buena Island presented a clear radar image.

** The radar's Variable Range Marker (VRM) was set to .33 nautical miles and remained there throughout as directed by Captain Cota before departure. The radar scale was originally set at 1.5 nautical miles and remained at that range throughout with the exception of one brief instance when the range was changed to the 3.0 nautical mile scale. As of 0826:30, the Electronic Bearing Line (EBL) was set to 310 degrees True and remained there until after the allision.

** At 0820 the Third Officer plotted the first of two positions he plotted using the ship's Global Positioning System (GPS) receiver. This "fix" placed the COSCO BUSAN a little under 200 yards to the left of the intended trackline, that had been presumably laid out on the chart by the Second Officer. According to AIS data, at this time the vessel's heading was 278 degrees True and speed was 7.6 knots and increasing.

** At 08:20:07 AIS placed the vessel in the Inner Harbor Entrance Channel, just past Lighted Buoys "5" and "6." The vessel's actual position, based on AIS, was .92 nautical miles east of the Third Officer's GPS plot. Since AIS data is based on information from the ship's GPS, the Third Officer either incorrectly plotted this position, recorded the time of the fix incorrectly, or both.

** The AIS trackline shows the COSCO BUSAN was never closer than 200 yards of the 0820 position marked on the chart by the Third Officer. The Third Officer did not

report this discrepancy to the Master or Pilot. When interviewed, he stated that the trackline was just for reference and that 200 yards off the trackline was within "reasonable limits for the situation".

** The COSCO BUSAN was steady on a course between 279 and 276 degrees True for less than four minutes as the vessel entered the Bay and passed Lighted Buoy "1."

** Between 08:25:07 and 08:26:03 the vessel swung to port to 261 degrees True. At this point the vessel was about .33 nautical miles off Yerba Buena Island, the position intended by Captain Cota.

** After Captain Cota ordered the rudder to port 10 at 08:23:21, and then midships at 08:25:30, the vessel continued to swing to port, ultimately reaching a heading of 237 degrees True at 08:27:07, which opened up and increased the distance off Yerba Buena Island. This swing to port was unchecked until 08:26:23, when Captain Cota ordered the rudder starboard 10, and then starboard 20 at 08:26:33. At 08:26:54 Captain Cota ordered the engine full ahead.

** At 08:27:24 VTS San Francisco contacted Captain Cota by radio and initiated the following exchange:

Time	Party	Verbatim Transcript
08:27:24	VTS	Unit Romeo (Cota), Traffic.
08:27:45	Romeo	Traffic, Romeo.
08:27:48	VTS	Unit Romeo, Traffic. AIS shows you on a 235 heading. What are your intentions? Over.
08:27:57	Romeo	Um. I'm coming around. I'm steering 280 right now.
08:28:04	VTS	Roger, understand you still intend the Delta-Echo span. Over.
08:28:15	Romeo	Yeah, we're still Delta-Echo.

** Although the VTS Operator indicated that he had the COSCO BUSAN's "heading" at approximately 235 degrees True when he contacted the Pilot at 0828, the Operator was well aware that his display only gave him the Course over Ground (COG) information via the vessel's Global Positioning System (GPS) transmitted via the Automatic Identification System (AIS). It did not actually provide him with the vessel's heading information.

** The COSCO BUSAN's AIS signal was refreshed every three seconds while the vessel was conducting its turn. The COSCO BUSAN initiated its starboard turn at approximately 0826:30.

** A vessel's heading is a static measurement typically taken from the vessel's gyro compass and measures where the vessel's bow is pointing. The vessel's COG is a measurement of the vessel's movement over a period of time typically calculated from the vessel's GPS input. If a vessel is traveling in a straight line with no side forces

working on it, the heading and the COG will be the same. Similarly, if a vessel is engaged in a turn, the movement of the heading would precede the movement of the vessel's COG.

** During this radio exchange with the VTS Captain Cota continued to give helm commands, first easing the rudder to starboard 10 at 08:27:37.

** At 08: 28:02 Captain Cota ordered starboard 20. At about this time, Captain Cota moved to the adjacent ECDIS display and asked the Master a second time whether the red triangle symbols marked the center of the bridge. Captain Cota stated that the Master replied "yeah.".

** At 08:28:15, after receiving this confirmation from the Master, Captain Cota ordered the rudder hard starboard and responded to the VTS, "Yeah, we're still Delta-Echo".

** At 08:28:42 Captain Cota ordered the rudder midship; at 08:28:51 he ordered the rudder starboard 20; and at 08:29:01 he ordered the rudder hard starboard again.

** At 08:29:09 the Boatswain called the bridge on his portable radio and reported the bridge column ahead. The Master and Captain Cota both saw the column seconds later. Captain Cota responded by ordering the rudder midships at 08:29:26; hard port at 08:29:31; and midships at 08:30:07. Captain Cota ordered the engine to dead slow ahead at 08:30:10. These latter maneuvers were intended to "lift" the stern off the tower (i.e. cause the stern to swing to starboard, away from the tower).

** Captain Cota's emergency maneuvers were executed properly and quickly by the crew, but were too late to prevent the allision with the fender system for the Delta Tower.

** The bell recorder recorded the dead slow ahead order at 08:30:24, which is most likely the time it was executed after Captain Cota's order at 08:30:10. The engine RPMs dropped from a peak of 66 RPMs to 18 RPMs at 08:34:08, when a stop order was given.

** The Third Officer plotted a second GPS position at 0830, which placed the vessel right at the Delta Tower. Taken together, the AIS data, bell recorder, and radio recordings indicate that the COSCO BUSAN allided with the Delta tower at 0830.

** At 0855 Captain Cota anchored the COSCO BUSAN in Anchorage 7. Another pilot boarded and relieved Captain Cota, who was taken ashore for drug and alcohol testing. Due to limited under keel clearance the COSCO BUSAN departed Anchorage 7 at 1020, and re-anchored in Anchorage 9 at 1105.

** After assisting with undocking, Captain Cota ordered the tug REVOLUTION to take up a position at the stern, with a line through the center stern chock of the COSCO BUSAN. The tug was made fast at 0806.

** At 0808 Captain Cota indicated that he would release the tug after the COSCO BUSAN got through the Bar Channel, which would allow the REVOLUTION to make its next job, a ship undocking from Berth 37 at 0830. Instead, the tug remained connected to the COSCO BUSAN until the vessel reached Anchorage 7.

** AIS data shows the REVOLUTION in the wake of the COSCO BUSAN, crossing from the starboard side of the wake, as the COSCO BUSAN turned to port, and then to the port side of the wake when the COSCO BUSAN went hard starboard.

** As the speed of the COSCO BUSAN increased, the REVOLUTION had difficulty keeping up, and the tug's operator was forced to slip more line.

** At about 0829 the operator of the REVOLUTION ordered the winch brake released to prevent the line from parting.

** After the casualty the tug's operator stated that while being towed astern of the COSCO BUSAN he did not understand why the pilot had the ship on a course parallel to the bridge. However, he did not attempt to contact the pilot to question the course because he was preoccupied with keeping his own vessel safe, and had monitored the radio traffic between the VTS and pilot and did not feel it was necessary

** As a result of the allision, the Bay Bridge sustained damage to the wood and plastic fender system and concrete tower support. Some fender material that fell into the water was recovered by the Army Corps of Engineers (ACOE), and some washed up on beaches in the days following the casualty.

** The Bridge was inspected by the California Department of Transportation (CALTRANS) and found structurally sound. The estimate for repairs to the fender system was between $1.5 to $2 million.

** As a result of the allision, the COSCO BUSAN sustained significant structural damage to the port side shell above the waterline between frames 128 and 150. The hull was breached to a height of three meters, and inboard to the longitudinal bulkhead, which was buckled and punctured in way of cargo hold #2. All associated internals were completely destroyed.

** Temporary repairs to the COSCO BUSAN were completed in San Francisco at an estimated cost of $1 million. Permanent repairs were completed outside the U.S., at an estimated cost of $1.5 million.

** The side shell of the COSCO BUSAN was damaged in way of the #2 water ballast tank, #3 wing fuel oil tank and #4 wing fuel oil tank. The fuel oil level in the #3 tank was below the lower edge of the damage, and thus it is unlikely that there was a substantial flow of oil, if any, from the #3 fuel oil tank. The #4 fuel oil tank discharged an estimated 53,653 gallons of Intermediate Fuel Oil (IFO 380).

** Based on calculations by the Coast Guard Marine Safety Center (MSC), the majority of the discharge occurred in a period estimated at less than 10 seconds. One witness reported that a "substantial flow of oil" was pouring out of the after part of the damaged area as late as 0852.

** The Master ordered the Chief Engineer to begin pumping oil from the affected tanks at 0857, but by that time the heavy outflow had slowed. Because the majority of the oil escaped within seconds of the casualty this delay did not likely have a major impact, if any, on the amount of oil spilled.

** By 0909 the relief Pilot reported that enough oil had been pumped out or leaked out so that oil was no longer flowing from the breach in the hull. The initial estimate of the amount of oil spilled came from the Master and was 10 barrels. This was communicated to the Coast Guard by the relief Pilot at 0919. At 0921 the Chief Officer reported to the Master that not much oil was leaking from the breach.

** The discharged oil spread quickly with the tide and contaminated many miles of salt marshes, mudflats, rocky coastline, and sandy beaches. As of January 5, 2008 approximately 22,836 gallons of oil had been recovered, including 17,788 gallons in liquid form and 5,048 gallons from solid waste. As of that date 1,085 live oiled birds had been rescued of which 421 were released after rehabilitation. 1,858 dead birds were recovered. In addition to birds, five mammals were recovered deceased and one more died after recovery.

** After the COSCO BUSAN had been anchored, a pilot boat delivered another pilot, who went to the bridge and met Captain Cota. Although untrained in its use, Captain Cota carried an approved alcohol screening device and self-administered the test with the aid of the relief pilot and using the instructions with the kit. The test was negative for the presence of alcohol.

** Captain Cota was then transported ashore to the Pilot Station at Pier 9, where he submitted to a breath test for alcohol and a urine test for dangerous drugs administered by qualified personnel under contract to the San Francisco Bar Pilots. All tests were taken within required time limits and were negative.

** A Coast Guard Investigating Officer (IO) administered breath alcohol tests to the Master, Chief Engineer, Third Officer (officer on watch), and able seaman (helmsman) between 1124 and 1130 on November 7, 2007. All tests were negative.

** A properly trained and certified collector, employed by National Safety Compliance, Inc., boarded the COSCO BUSAN on November 7, 2007 at approximately 1200 to administer drug and alcohol tests to the crewmembers directly involved in the casualty. The collector collected a urine specimen from the Master at 1506 and departed the vessel without testing any other crewmembers. This error was not detected by the marine employer.

** On November 9, 2007, after the 32-hour time period for drug testing had passed, the Coast Guard became aware of the error and directed additional testing, which was completed between 1347 and 1406 on November 9, 2007, about 53 hours after the casualty.

** Because of the delay in the collection of samples, the marine employer failed to properly and timely carryout the post-casualty drug and alcohol testing required by 46 CFR 4.06-3(b)(i). The Chief Mate (lookout), Third Mate (officer on watch), able seaman (helmsman), Chief Engineer (on watch), Second Engineer (on watch), and boatswain (lookout) were eventually tested. All drug and alcohol tests were negative.

** Captain Cota stands duty one week on and one week off, changing at noon on Wednesdays. November 7, 2007, the day of the casualty, was the last day of his one week duty. He was scheduled to take the COSCO BUSAN to sea at 0600 and bring an inbound ship in that afternoon before ending his duty week.

** Captain Cota produced his dispatch schedule for his week of duty and did his best to recall when he took meals and when he slept in the previous 24 hours. Other than work, Captain Cota's reported lifestyle is relatively inactive. When not working he relaxes at home reading or watching television.

** Captain Cota stated that he tries to get at least seven hours of sleep before a job, but because of his erratic schedule he often must take naps in mid-day, and he reported taking medication to assist with falling asleep at least two or three times a week, particularly when trying to sleep at odd times.

** Captain Cota stated that he ate dinner the night before and got seven hours sleep, arising at 0415. A 96-hour work/rest history was completed during an interview with Captain Cota on November 27, 2007. Captain Cota also disclosed his current health and medication use.

** There are numerous human factors in Captain Cota's life which may contribute to fatigue, decreased alertness, impaired sensory perception, impaired short term memory, and impaired cognitive ability. These factors include lack of exercise; health problems; poor dietary habits; erratic work schedule; side effects from prescribed medications; and excessive daytime somnolence due to poor sleep hygiene.

** The Coast Guard requested 96-hour work/rest histories for the crew of the COSCO BUSAN, but they were never provided.

** While aboard the vessel in September, the Training Master noted the crew was not using the 3 centimeter radar. Based on this observation, Fleet Management had the 3 centimeter radar serviced in Long Beach, California, just prior to its San Francisco port call. The magnetron was replaced and the radar was fully functional.

** The following equipment was tested or inspected after the casualty and found satisfactory:

- Coast Guard Aids to Navigation Team San Francisco surveyed Pier D North Buoy (LLNR 4450), Pier D South Buoy (LLNR 1455), and Yerba Buena Light/Sound Signal (LLNR 4595) and found all three aids on station and watching properly.
- The gyro, ARPAs, and ECDIS were tested by a manufacturer's representative and found working properly.
- An inspection of the RACON "Y" for the center of the Delta-Echo Span conducted by CALTRANS found the RACON on station and operating normally with no alarm conditions.
- The engine room automation alarm printout did not reveal any alarm conditions related to the main engine, steering gear, or electrical system during the outbound voyage.

** 46 CFR 10.709 requires that first class pilots of vessels greater than 1600 gross registered tons provide the Coast Guard with a copy of their annual physical "upon request." By a Notice published in the Federal Register on September 28, 2006 the Coast Guard exercised this existing authority to require the submission of the annual physicals each year, no later than 30 calendar days after completion of the physical examination. The Federal Register Notice also states:

> The report of physical examination will be reviewed by the Coast Guard in accordance with the standards in 46 CFR 10.205(d), as well as supplemented by the guidance contained in Navigation and Vessel Inspection Circular (NVIC) 2-98, "Physical Evaluation Guidelines for Merchant Mariner's Documents and Licenses" or any superseding NVIC revising or replacing NVIC 2-98.

** Guidance for the evaluation of medical conditions at the time of the accident was contained in several references:

(1) Chapter 4 of Marine Safety Manual (MSM) Volume III, Marine Industry Personnel (Revised 1999);
(2) Navigation and Vessel Inspection Circular (NVIC) 2-98, "Physical Evaluation Guidelines for Merchant Mariner's Documents and Licenses";
(3) Various NMC Work Instructions; and
(4) Draft NVIC XX-07, "Medical and Physical Evaluation Guidelines for Merchant Mariner Credentials, Revised 11/06.

** The MSM, NVIC 2-98, draft NVIC, and work instructions were used by Coast Guard personnel at Regional Examination Centers (REC) and the National Maritime Center (NMC). NVIC 2-98 was primarily intended to assist medical professionals in examining merchant mariners. The MSM identifies conditions that may be waived locally by the Officer in Charge Marine Inspection, and requires that medical conditions that are beyond the scope of the REC to evaluate be referred to the NMC.

** At the time of the accident, the NMC was managing a project to restructure and centralize the Coast Guard's Mariner Licensing and Documentation program. The

project, upon completion, would consolidate the functions of 17 independently operating RECs into one credential processing center located in Martinsburg, West Virginia. The goal of this effort is to improve customer service, decrease credential processing time, and improve consistency of the NMC's products and services, including the evaluation of mariner medical conditions.

** After completion of the restructuring and centralization of the Mariner Licensing and Documentation (MLD) program, all medical evaluations will be centrally performed at the NMC by trained medical personnel qualified to review mariner physicals and medical information. To accomplish this, a Medical Evaluation Branch was established at the NMC in December 2006.

** Prior to October 17, 2007, mariner physicals were forwarded to the Medical Evaluation Branch by the 17 RECs at the discretion of the REC Chiefs. On October 17, 2007 detailed internal criteria for submitting mariner physicals to the NMC for review was released to the RECs. Prior to that date most mariner physicals, including some annual pilot physicals, were not forwarded to NMC for review. The physicals that were not forwarded to the NMC were reviewed by non-medical personnel at the RECs.

** Sections 1175 and 1176 of the California Harbors and Navigation Code address physical examination requirements for state pilots. Section 1175(b) requires that "The person is of good mental and physical health and good moral character." Section 1176 requires pilots to undergo annual physicals in accordance with standards prescribed by the Board of Pilot Commissioners (the Board).

** The Board relies on the report of the physician to determine whether the applicant or pilot is fit for duty, not fit for duty, or permanently not fit for duty.

** There are currently four doctors who are approved by the San Francisco Bar Pilots that give pilot physicals and use the 1986 Reference Guide for Physicians titled "Physical Examination for Retention of Seafarers in the U.S. Merchant Marine". This guide was developed by a collaborative group of seafarers, shipping associations, and federal agencies called the Seafarer's Health Improvement Program (SHIP). SHIP was formed after Congressional Hearings in 1978 that concluded that greater attention be given to the health of U.S. seafarers.

** On October 1, 1981 the U.S. Public Health Service withdrew from all maritime direct health care. In response, SHIP developed and published recommendations for Entry Level Physical Qualifications. The 1986 Physical Examination Guide was intended for physicians responsible for evaluating an individual's suitability for retention in the U.S. Merchant Marine. Although there are provisions for review and modification of the Guide, it has not been amended or revised since it was issued.

** The Guide places the ultimate responsibility for determining the duty status of a mariner on the examining physician. The Guide lists "Absolute Exclusions" which render a seafarer "Permanently Not Fit for Sea Duty," as well as conditions which are

disqualifying during or for a period following treatment. There is yet another list of conditions which require "further in depth evaluation." The guidance for medications is limited to anticoagulant drugs, antabuse, steroids, addiction to or dependence on Schedule I or Schedule II drugs, psychotropic drugs, and immunosuppressant agents. There is no guidance on the evaluation of sleep disorders.

** The Board does not receive information on the pilot's health conditions or medications, and does not have a medical professional on staff or on retainer to review the physical results. The only information provided by the Doctor is a fill-in-the-blank form letter with the following language:

> I have examined the above named applicant on the date indicated below. After reviewing his/her history, physical examination, laboratory results and special studies, and in accordance with the Board's Seafarers Health Improvement Guidelines, (emphasis theirs), I have found this applicant physically:
>
> _____ FIT FOR DUTY
>
> _____ NOT FIT FOR DUTY
>
> _____ PERMANENTLY NOT FIT FOR DUTY

** The Board does not have a written policy that requires pilots to report changes in their health between physicals, nor do they require that pilots inform the association when they begin taking a medication that can affect their performance or ability to do their job. The Board relies solely on the pilot's own judgment in determining whether he or she is fit for duty on any given day due to illness, medications, or other factors.

** The Federal Aviation Administration (FAA) has a robust Aviation Medical Examiner System, outlined in FAA Order 8520.2F, revised October 25, 2007. This Order sets minimum standards for medical professionals performing examinations of aviation pilots in qualifications, credentials, training, and experience. The order also establishes procedures for designation, oversight, and termination. Under the System, designated medical examiners must perform a minimum number of examinations per year and undergo periodic training and re-designation. This System ensures that medical professionals performing physical examinations of aviation pilots have and maintain the requisite knowledge and understanding of the physical requirements for aviation pilots.

** By contrast, Coast Guard policy concerning Qualified Medical Personnel is limited to a single paragraph in Section 4.B. of MSM Volume III, which reads as follows:

> B. Qualified Medical Personnel.
> *Physician* will be used in this chapter to mean a licensed medical doctor (including doctors of osteopathy (D.O.)), a licensed physician assistant, or a licensed nurse practitioner. The above medical personnel must be licensed by a state in the U.S., a U.S. possession, or a U.S. territory. Foreign medical licenses

are not accepted. A chiropractor is not acceptable as a physician; see 46 CFR 10.205(d).

** The guidance provided to qualified medical personnel is limited to that contained on Form CG-719K, which refers the physician to the guidelines in NVIC 2-98. The form does not refer to the Physical Examination for Retention of Seafarers in the U.S. Merchant Marine (1986).

** The following information is based on an interview of Dr. Charles E. Calza, MD on January 9, 2008.

** There are four doctors approved by the San Francisco Bar Pilots to give pilot physicals, one of whom is Dr. Calza. At the time of the accident, he had a copy of the Physical Examination for Retention of Seafarers in the U.S. Merchant Marine (1986), and is familiar with it. Dr. Calza is a primary care physician in a practice with five other physicians and treats primarily adults.

** At the time of the accident, Dr. Calza not an occupational medical specialist, nor is he board certified in any other discipline. He was in the Air Force for a period of time and did some work with recruiting physicals in the Vietnam era, but he was not a flight surgeon. He has some past experience in emergency medicine.

** At the time of the accident, Dr. Calza had never been designated as a FAA medical examiner. He has performed two or three physicals per year for commercial drivers and 10-20 mariner physicals (mostly San Francisco Bar Pilots) per year for 15-20 years. Dr. Calza stated that he followed the criteria on Form CG-719K when performing physicals, and that he is familiar with the form.

** At the time of the accident, Dr. Calza did not have a copy of NVIC 2-98 and could not recall reading it or seeing a reference to it on the CG-719K. He does not as a practice, provide a copy of the CG-719K form to the Pilot Association.

** Dr. Calza does not see pilots as patients, but he asserted that he is familiar with the duties and physical demands of being a pilot, particularly getting on and off ships away from a pier. He understood the importance of mental acuity and cognitive ability for a pilot. He estimated that he has found a pilot unfit for duty four times over the 15-20 years he has been doing the physicals, mostly for heart problems. He spends one to two hours with each pilot, interviewing them about changes in their health and any new medications they are taking, including supplements and over-the-counter medications. He stated that he does a complete "drug work-up."

** Dr. Calza vividly recalled his last physical with Captain Cota (January 19, 2007), which he described as "adversarial," something he had never experienced before. He stated that Captain Cota reported some medical conditions and prescription medications that he had not revealed during previous physicals. It caused Dr. Calza to probe deeper into Captain Cota's newly reported conditions. Dr. Calza stated that Captain Cota

became agitated and left the office, stating he needed to consult his attorney. He returned later to continue the interview.

** Dr. Calza said that he very pointedly warned Captain Cota that he should not take some of the medications he had been prescribed within 24 hours of working, and that Captain Cota assured him that he did not.

** Despite this warning, by his own admission after the casualty, Captain Cota took at least one of the medications that Dr. Calza told him he should not take while working on the morning of the casualty. Since Captain Cota had received training from MITAGS in June 2005 in "Fatigue, Sleep and Medications," and was clearly warned by Dr. Calza not to use the medication he took on the day of the casualty, he most certainly was well aware of the possible impact of his actions on his ability to perform his duties.

** Over the course of this investigation, NVOC 04-08 was finalized and approved for use on September 15, 2008. Enclosure (3) of the NVIC contains a non-exhaustive list of medical conditions subject to further review and supplemental medical data that should be submitted for such medical review. Enclosure (4) contains information about illegal substances and intoxicants, and a non-exhaustive list of medications that may be subject to further medical review. Several of the medications that Captain Cota was taking at the time of the accident and reported on his January 19, 2007 Physical are included on that list and would have triggered further review by the NMC.

** Regional Exam Center (REC) San Francisco provided licensing services to Captain Cota for his Coast Guard-issued Merchant Mariner's Credentials.

** Captain Cota's renewal application dated July 26, 1999 included a Merchant Marine Personnel Physical Examination Report (CG-719K) that documented health issues that required medical evaluation by the NMC. This form was signed by Dr. Calza, who checked the box "competent" in response to this question: Considering the findings in this examination, and noting the duties to be performed by the applicant aboard a merchant vessel of the United States of America, I consider the applicant: competent; needs further evaluation; not competent. Attached to the CG-719K was a form letter addressed to the State Board of Pilot Commissioners, which was also signed by Dr. Calza and which also found Captain Cota "fit for duty".

** The REC evaluator forwarded the 1999 physical to the NMC for medical evaluation as required by the MSM. On November 30, 1999, an employee of the NMC sent an e-mail to the REC stating, "A waiver is granted for Mr. Captain Cota's condition. Please include a waiver statement on his license when it is issued". The e-mail provided no further explanation of which of Captain Cota's medical conditions or medications was being waived.

** The REC interpreted this e-mail to mean that all conditions documented on the CG-719K were waived. The REC did not place a waiver statement on Captain Cota's license as requested in the e-mail and as required by Section 4.F. of the MSM. The

waiver statement should have read, “Any deterioration of a waivered medical condition shall be immediately reported to the nearest REC.”

** Captain Cota applied for renewal of his license in 2004 using a CG-719K dated January 30, 2004 and signed by Dr. Calza, who again found Captain Cota “competent”. This physical documented changes in Captain Cota’s health, but was not submitted to the NMC for review. The license was re-issued, again without a waiver statement. The evaluator did not request a medical review from the NMC before re-issuing the license.

** Captain Cota submitted a copy of his annual physical (January 18, 2006) in accordance with the Notice published in the Federal Register on September 28, 2006. Captain Cota’s January 18, 2006 physical was nearly identical to the January 30, 2004 physical, and was again signed by Dr. Calza, who found Captain Cota competent.

** There is no evidence in the Coast Guard licensing file or in the Merchant Mariner Licensing and Documentation (MMLD) System that the physical was reviewed by an evaluator at REC San Francisco, nor were there any records indicating the physical was sent to the NMC for a medical review. However, at the time of the accident, there were no specific policies or work instructions requiring an entry in the MMLD system, or any other method of recording review of annual physicals.

** On January 19, 2007 Captain Cota submitted a copy of his annual physical to the REC. The physical was signed by Dr. Calza, who again found Captain Cota competent. However, this physical included significant information affecting Captain Cota’s qualifications as a pilot that were potentially disqualifying, and should have been referred to the NMC for medical evaluation.

** There was no evidence in the Coast Guard licensing file or in MMLD that the physical was reviewed by an evaluator at REC San Francisco, and there was no record of the physical being sent to the NMC for a medical review.

** In 2006 the NMC issued verbal guidance to REC Chiefs at a conference instructing them to review pilot annual physicals using the guidelines in draft NVIC XX-07, “Medical and Physical Evaluation Guidelines for Merchant Mariner Credentials” (revised 11/06) in addition to the guidelines in the existing NVIC 2-98.

** The Chief of REC San Francisco stated in an interview that he was unaware of a requirement to review pilot annual physicals, and that he did not have a copy of the draft NVIC. He stated that he was not authorized to apply a draft document, and was not aware that the NMC had sought and obtained permission from Coast Guard legal personnel to apply the guidelines in the draft NVIC while the document was in review.

** Rule 6 of the Inland Navigation Rules states:

> Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance

appropriate to the prevailing circumstances and conditions.

In determining a safe speed the following factors shall be among those taken into account:

(a) By all vessels:

(i) the state of visibility;

(ii) the traffic density including concentration of fishing vessels or any other vessels;

(iii) the maneuverability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions;

(iv) at night, the presence of background light such as from shore lights or from back scatter of her own lights;

(v) the state of wind, sea, and current, and the proximity of navigational hazards;

(vi) the draft in relation to the available depth of water.

(b) Additionally, by vessels with operational radar:

(i) the characteristics, efficiency and limitations of the radar equipment;

(ii) any constraints imposed by the radar range scale in use;

(iii) the effect on radar detection of the sea state, weather, and other sources of interference;

(iv) the possibility that small vessels, ice and other floating objects may not be detected by radar at an adequate range;

(v) the number, location, and movement of vessels detected by radar; and

(vi) the more exact assessment of the visibility that may be possible when radar is used to determine the range of vessels or other objects in the vicinity.

** There was no discussion of safe speed during the Pilot-Master exchange, nor did the Master at anytime express concern about the vessel's speed to Captain Cota. AIS data shows that the speed of the COSCO BUSAN increased steadily after departure, and especially after entering the Bay, reaching a peak of 11.4 knots at 08:28:03.

** Rule 5 of the Inland Navigation Rules states:

Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all means available appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision.

** The phrase "…by all means available…" has a long established meaning to include proper use of collision avoidance equipment of all kinds, including radar, ARPA, AIS, and ECDIS.

** Rule 2 of the Inland Navigation Rules states:

(a) Nothing in these Rules shall exonerate any vessel, or the owner, master, or

crew thereof, from the consequences of any neglect to comply with these Rules, or of the neglect of any precaution which may be required by the ordinary practice of seaman, or by the special circumstances of the case.
(b) In construing and complying with these Rules, due regard shall be had to all dangers of navigation and collision, and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger.

This Rule is known as the "rule of good seamanship." The Rule requires the exercise of skill and care which are ordinarily to be found in a competent seaman, and would include the expectation that a seaman will comply with the Inland Navigation Rules.

** While the Master and deck officers completed the SMS Checklist for Crew Familiarization on October 24, 2007, the Master and deck officers of the COSCO BUSAN failed to follow the SMS procedures on the day of the accident indicating they were either unfamiliar with the SMS procedures or willfully failed to follow them.

** The SMS contained a procedure for navigation in restricted visibility, which was followed with respect to required equipment use and lookouts. However, the SMS procedure did not include a requirement for periodic position fixes to ensure that the vessel remained on course. Only that portion of the Passage Plan preparation requiring the creation of a chart with applicable tracklines for the voyage was prepared and only by utilizing a pre-existing chart and track lines which were not verified.

** The SMS procedure for limited visibility emphasized that a delay to the ship, either by delaying departure or reducing speed, was preferable to an accident. The Master was either unaware of the language in the procedure, or chose to ignore it. The Master did not discuss the possibility of waiting at the pier for better visibility with the Pilot.

** The crew partially completed SMS Checklist #3, preparations for getting underway prior to departure, but did not complete Checklist #10, procedures for getting underway in limited visibility before departure.

** SMS Checklist #3 was completed by the Third Officer and signed by the Master after the allision on November 7, 2007. Checklist #3 did not include tests of the emergency batteries or standby/emergency generators as required by 33 CFR 164.25. The crew relied on the SMS procedure and were apparently unaware of additional U.S. requirements.

** The failure to complete Checklist #10 prior to departure and the failure to comply with the pre-departure test requirements of U.S. regulations is evidence of the failure of Fleet Management, Inc. to properly train and indoctrinate the crew.

CONCLUSIONS:

1. The primary cause of this casualty was navigational error on the part of the Pilot of the COSCO BUSAN, who navigated the vessel at an unsafe speed in near zero visibility, failed to properly monitor the vessel's position and progress, and lost situational awareness.

2. Contributing to the cause of this casualty was the failure of the Master of the COSCO BUSAN to adequately monitor the navigational actions of the Pilot and to maintain sufficient situational awareness to question or correct navigational errors made by the Pilot.

3. Contributing to the cause of this casualty was the failure of the Pilot and Master to conduct a proper pilot-master exchange prior to getting underway, in particular the failure of the pilot and master to consider the possibility of waiting at the berth for better visibility.

4. Contributing to the cause of this casualty was the failure of the Master to adhere to the restricted visibility procedure in the vessel's Safety Management System (SMS), which suggested that the preferred course of action was to remain at the berth until visibility improved.

5. Contributing to the cause of this casualty was the failure of the crew to adhere to the COSCO BUSAN's SMS by failing to develop and have the Master approve a Berth-to-Berth Passage Plan before departure. Moreover, this failure was compounded by the crew's failure to discuss any transit plans (voyage intentions) with the Pilot before departure.

6. Contributing to the cause of this casualty was the failure of the Pilot and the COSCO BUSAN's crew to employ proper bridge management team principles. The Pilot never discussed his intended outbound transit nor reviewed the courses laid down on the chart. The Master never inquired about the Pilot's intentions and the crew did not report the vessel's location after plotting a GPS position on the chart.

7. Since the COSCO BUSAN was engaged in a starboard turn at the time the VTS Operator contacted the vessel and inquired of the Pilot's intentions, he would not have been confused by the Operator's reference to the vessel's COG as their "heading" of 235 vice their actual "heading" at the time of the call of 261 (reported by the Pilot as 280). Since the Pilot knew that he was engaged in a turn, and his heading was swinging right, he reasonably would have expected that the VTS's reported information would be behind what he was looking at on the vessel's bridge displays. Thus, it is unlikely that the VTS's report would have caused confusion. In fact, a report from the VTS that the COSCO BUSAN's "heading" was 235 vice 280, should have resulted in the Pilot being more aggressive with his starboard turn and would have actually helped him avoid hitting the bridge.

8. There is substantial evidence that the Pilot has significant health problems and takes medications that individually had the potential to medically disqualify him to hold Coast Guard-issued Merchant Mariner Credentials. The degree to which these contributed to the cause of this casualty is unknown, but the multiple examples of impaired sensory perception, impaired cognitive processing, and impaired short-term memory failures by the Pilot are suggestive of impaired performance caused by medical and pharmacological human factors. These medical conditions and medications are known to cause significant decreases in human performance and affect a mariner's ability to safely Pilot a vessel.

9. There is evidence that the Pilot failed to adapt to the development of important new technology for the safe navigation of ships. He does not own a laptop computer which may have helped him navigate the vessel. Consequently, he did not make use of the Pilot Plug on the COSCO BUSAN on the day of the accident, although one was available. More importantly, he did not understand the meaning of symbols on the ENC on the COSCO BUSAN prior to its departure..

10. The Third Officer's plotting errors and apathetic attitude raise questions about his training and qualifications under STCW. The Third Officer did not report a GIS position he plotted at 0820 that placed the vessel 200 yards off the intended trackline, considering the error "reasonable." If the Third Officer had reported this plotted position to the Pilot or Master it is believed they likely would have dismissed it immediately, since the vessel was near Lighted Buoys "5" and "6," which were visible as the vessel passed. Nevertheless, proper bridge management team procedures require the reporting of all relevant navigation information, especially in restricted visibility.

11. There is evidence that the Coast Guard's procedures for review of annual pilot physicals at the time of the accident were inadequate. After publication of the Federal Register Notice requesting pilots to submit their annual physicals, the NMC did not issue new policy or work instructions specifically for review of these physicals. RECs were expected to follow the same work instructions for review of physicals submitted with original, renewal, or upgrade applications.

12. Over the course of this investigation, NVIC 04-08 was finalized and approved for use on September 15, 2008. Enclosure (3) of the NVIC contains a non-exhaustive list of medical conditions subject to further review and supplemental medical data that should be submitted for such medical review. Enclosure (4) contains information about illegal substances and intoxicants, and a non-exhaustive list of medications that may be subject to further medical review. Several of the medications that Captain Cota was taking at the time of the accident and reported on his January 19, 2007 Physical are included on that list and would have triggered further review by the NMC.

13. The guidelines contained in the SHIP publication "Physical Examination for Retention of Seafarers in the U.S. Merchant Marine" (1986) are outdated; lack guidance

on sleep disorders, and contain inadequate information on medications that may affect human performance. These outdated guidelines were a factor in the physician's determination that the Pilot was physically competent.

14. There is evidence that the San Francisco Bar Pilots' procedures for determining and monitoring the medical competence of its members at the time of the accident were inadequate. Likewise, the State of California Board of Pilot Commissioners' procedures for monitoring the medical competence of Pilots they evaluate were inadequate. Pilots were not required to report changes in their health or the taking of medications that may impair their performance. The San Francisco Bar Pilots (and hence the Commission) relied wholly on the determination of four approved physicians, who used the outdated and inadequate guidelines of the Physical Examination for Retention of Seafarers in the U.S. Merchant Marine (1986). The San Francisco Bar Pilots received only a form letter attesting to a member's physical competence, and lack a written procedure for further review when deemed appropriate. The lack of a comprehensive medical monitoring program contributed to the pilot of the COSCO BUSAN remaining on the job after he should have been found not fit for duty.

15. There is evidence that the physician performing the physical evaluations of the Pilot of the COSCO BUSAN did not adequately explore the Pilot's significant, performance affecting health conditions. The physician relied on the guidelines contained in the SHIP publication "Physical Examination for Retention of Seafarers in the U.S. Merchant Marine" (1986), which are outdated, lack guidance on sleep disorders, and contain inadequate information on medications that may affect human performance. The physician did not have a copy of the Coast Guard's NVIC 2-98 and was not familiar with its contents.

16. The Coast Guard does not currently require health care providers examining mariners to prove that they have the requisite understanding of the duties and responsibilities of the mariner to accurately recommend them as medically and physically "competent." The CG-719K physical examination form merely states on Page One that health care providers should be familiar with NVIC 2-98. There is no training or orientation program to educate examiners on the medical human factors with the potential to affect maritime safety.

17. There is substantial evidence that the Pilot failed to observe Rule 2 (Responsibility), Rule 5 (Lookout), and Rule 6 (Safe Speed) of the Inland Navigation Rules, operated the vessel in a manner that endangered, life, limb, or property, and thereby apparently violated 46 United States Code 2302(a) and the Navigation Safety Regulations.

18. There is evidence that the crew of the COSCO BUSAN did not conduct all of the pre-underway tests and inspections required by 33 CFR 164.25; specifically, tests of the emergency batteries or standby/emergency generators were omitted. However, this did not contribute to the casualty.

19. There is evidence that the Safety Management System (SMS) of the COSCO BUSAN was inadequate with respect to bridge management team principles, voyage planning, crew indoctrination, and procedures for navigation in restricted visibility.

20. There is no evidence of equipment failures contributing to this casualty. The propulsion, steering, and navigation systems of the COSCO BUSAN operated properly. All Coast Guard aids to navigation were on station and watching properly, and the bridge RACONs also operated properly.

21. All equipment at Coast Guard Vessel Traffic Service (VTS) San Francisco was operating properly and all watchstanders were fully qualified. The watchstanders reacted immediately and appropriately in accordance with existing protocols when the COSCO BUSAN appeared to stray off course.

22. There is no evidence that use of dangerous drugs or alcohol contributed to this casualty. There is substantial evidence that the Pilot was taking legally prescribed medications with side effects that may have affected his alertness or mental acuity.

23. It could not be positively determined whether fatigue contributed to this casualty, but the effects of the Pilot's medications and medical conditions make it a probable causal factor.

24. There is substantial evidence that acts of incompetence, negligence, and/or lack of professionalism committed by the Pilot contributed to the cause of this casualty.

25. There is evidence that acts of negligence and/or lack of professionalism committed by the master and crew of the COSCO BUSAN contributed to the cause of this casualty.

26. There is no evidence that any act of misconduct, incompetence, negligence, lack of professionalism, and/or willful violation of law committed by any officer, employee, or member of the Coast Guard contributed to the cause of this casualty.

27. There is substantial evidence that the Pilot committed acts that could subject him to administrative, civil or criminal penalties under the laws of the United States.

27. There is substantial evidence that Fleet employees, with COSCO BUSAN crewmember knowledge and/or assistance, committed willful violations of law.

RECOMMENDATIONS:

1. Recommend Regal Stone Ltd., owners and operators of the COSCO BUSAN, review the Safety Management System (SMS) Procedures for pre-underway equipment tests, crew familiarization, and navigation in restricted visibility.

2. Recommend the San Francisco Bar Pilots conduct a study of technological advances in use by pilots in other jurisdictions. At a minimum, the study should address:

- The pros and cons of systems currently used by other Pilot Associations with respect to conditions in San Francisco Bay.
- Whether use of a laptop with AIS "plug-in" feature should be a mandatory, minimum standard for all pilots.
- Whether personal laptops used by pilots should undergo annual testing and certification by an independent servicing company.
- Set a minimum training and qualification process for any system adopted.

3. Recommend the Board of Pilot Commissioners for the Bays of San Francisco, San Pablo, and Suisun establish procedures for the following:

- Review of pilot physicals by a medical professional.
- Immediate reporting of changes in a pilot's health.
- Immediate reporting by pilots taking medications of any kind that have known detrimental effects on human performance.

4. Recommend the U.S. Maritime Administration (MARAD) convene the Physical Standards Work Group of the Seafarers Health Improvement Program (SHIP) to review and modify (as needed) the Guidelines for Physical Examination for Retention of Seafarers in the U.S. Merchant Marine (1986). If the group is now defunct, recommend formation of a new work group to accomplish this task.

U.S. Department of Homeland Security

United States Coast Guard

Commanding Officer
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16732
January 23, 2009

Dr. John S. Spencer
Director, Office of Marine Safety
National Transportation Safety Board (NTSB)
490 L'Enfant Plaza East, S.W.
Washington, DC 20594

Dear Dr. Spencer:

In accordance with 49 CFR 831.14 and 49 CFR 845.27, I hereby submit the following as a Coast Guard Party Submission in the matter of the investigation of the M/V COSCO BUSAN allision with the San Francisco-Oakland Bay Bridge on November 7, 2007.

We appreciate this opportunity to provide additional input and comments relative to the NTSB investigation of the incident. In particular, the Coast Guard submits the following information in an effort to further clarify and explain the operations of the Vessel Traffic Service (VTS) in San Francisco Bay. We believe that a comprehensive understanding of the VTS's operating procedures, protocols, capabilities, limitations, responsibilities and policies are essential to understanding VTS's role in this incident.

The Ports and Waterways Safety Act (PWSA) (33 USC 1223) serves as the primary authority for the operation of the Coast Guard Vessel Traffic Service (VTS). The statute states in pertinent part:

> "[The Coast Guard] may control vessel traffic in areas subject to the jurisdiction of the United States which the Secretary determines to be hazardous, or under conditions of reduced visibility, adverse weather, vessel congestion, or other hazardous circumstances by-
>
> (A) specifying times of entry, movement, or departure;
>
> (B) establishing vessel traffic routing schemes;
>
> (C) establishing vessel, size, speed, draft limitations and vessel operating conditions; and
>
> (D) restricting operation, in any hazardous area or under hazardous conditions, to vessels which have particular operating characteristics or capabilities which he considers necessary for safe operation under the circumstances;"

This authority is further delineated more specifically to the VTS in 33 CFR 161.11 which states:

(a) A VTS may issue measures or directions to enhance navigation and vessel safety and to protect the marine environment, such as, but not limited to:

(1) Designating temporary reporting points and procedures;

(2) Imposing vessel operating requirements; or

(3) Establishing vessel traffic routing schemes.

(b) During conditions of vessel congestion, restricted visibility, adverse weather, or other hazardous circumstances, a VTS may control, supervise, or otherwise manage traffic, by specifying times of entry, movement, or departure to, from, or within a VTS area."

As the Coast Guard has pointed out on previous occasions, the VTS system of operation is significantly different than the Federal Aviation Administration's (FAA) operation of the air traffic control system. Under FAA rules, all Class A commercial air traffic is handled through direct control of the aircraft (i.e., courses, speeds, altitudes) from the time it departs the gate until it lands at the next airport and arrives at its assigned gate.

Conversely, Coast Guard VTS systems operate under a "continuum of control". Their current charge is to execute their mission by **monitoring** vessels movements, informing mariners of other vessels and potential hazards, **recommending** action when a situation develops that the mariner may not have seen, and **directing** the outcome of the situations when necessary to prevent disasters. The VTS spends the great majority of its time in the first two levels of the continuum of control. As a result of its success, along with mariner's skills and the myriad of safety measures in the waterways system (including rules of the road, aids to navigation, routing measures and regulations), the Coast Guard has rarely needed to use the highest level of "control". Moreover, when direction is issued, it typically is issued in the form of an outcome vice course and speed commands. There are many reasons for this:

(a) The ultimate responsibility for safe navigation of the vessel belongs to the master.

(b) VTS operators cannot know the specific vessel maneuvering characteristics, which vary widely from vessel-to-vessel, of every vessel that they are monitoring. Maneuvering characteristics are affected by vessel size, load condition, draft, trim, propulsion and steering equipment, and a myriad of other factors.

(c) VTS operators are not privy to the vessel's bridge dynamics, including crew interactions, bridge team management processes, and the use of navigation and control equipment.

(d) VTS operators will not have information about hazards not detected by VTS sensors, including smaller pleasure craft, swimmers, and debris.

(e) VTS operators will not have the instantaneous knowledge of the many forces (wind, current, tide, etc.) acting on a vessel as would the vessel's master or pilot.

(f) There is a slight lag in the VTS receiving sensor information, relative to what the pilot or master is experiencing on the bridge.

Based upon our experience, this approach has served the Coast Guard and waterways users well in helping to ensure the safety and security of maritime commerce throughout the nation.

While the Coast Guard firmly believes that VTS operational guidance and procedures in place on the day of the accident were both sufficient and appropriate, it is understandable that speculation will occur regarding whether the VTS should have issued additional direction to the COSCO BUSAN during the final minute before the allision.

Enclosure (1) provides an extensive timeline of critical communications between the VTS and the pilot on the M/V COSCO BUSAN on the day of the accident, which began soon after the pilot boarded the vessel and continued until after the COSCO BUSAN struck the Bay Bridge and was later safely moored in Anchorage 9. A summary of those pertinent communications is as follows:

The communications dialog on the day of the accident began shortly after the pilot arrived on board at 0620. At approximately 0630, the pilot initiated the first of several conversations with VTS prior to the 900 foot long COSCO BUSAN's departure, basically "checking into the VTS system".[3] This conversation was followed a short time later at 0715, when the pilot called the VTS to inform them that the COSCO BUSAN's sailing would be delayed due to paperwork.[4] At approximately 0745, the pilot contacted VTS again and advised them that they would wait until the SOLANO passed the COSCO BUSAN's position before getting underway.[5] At approximately 0808, the pilot on the COSCO BUSAN called the VTS and advised them that they were "underway" with the intent to utilize the Delta-Echo Deepwater Channel for their passage outbound.[6] The VTS took this opportunity to advise the pilot on the COSCO BUSAN of additional traffic in the area as they were departing. The pilot on the COSCO BUSAN acknowledged the transmission. This was the last transmission between the VTS and the pilot on the COSCO BUSAN until the VTS contacted the pilot on the COSCO BUSAN in order to revalidate his intentions. At approximately 0825, the pilot ordered the COSCO BUSAN's rudder to 10 degrees port and initiated a swing to port. The rudder remained at 10 degrees port for over two minutes until the pilot ordered the rudder to midship. During that two minutes, the helmsman notified the pilot that the rudder remained at 10 degrees port, and the pilot acknowledged. The heading of the COSCO BUSAN swung from 282 degrees to 253 degrees at the time of the midship rudder order and continued to swing to port to a maximum port heading of 241 degrees after the pilot ordered 20 degrees starboard rudder and full ahead on the engine.

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[3] The time of the communication is based upon Mr. Perez's interview with the NTSB. Because various time references are used throughout the investigations, the actual time could be slightly earlier or later.
[4] VTS Transcript of VHF call between the VTS and the COSCO BUSAN.
[5] VTS Transcript of VHF call between the VTS and the COSCO BUSAN.
[6] VTS Transcript of VHF call between the VTS and the COSCO BUSAN.

At approximately 0828, the VTS Central Bay Operator noticed that the COSCO BUSAN appeared to be out of position (essentially traveling approximately parallel to the bridge)[8] to make its previously announced Delta-Echo passing under the Bay Bridge.[9] Based upon the position of the vessel, the operator thought that the pilot may have changed his mind and was intending to head to Anchorage 9 as opposed to transiting out as originally announced by the pilot. At that time, the COSCO BUSAN was at an approximate heading of 261 degrees and beginning to answer the starboard 20 rudder order by swinging to starboard. The VTS operator immediately contacted the pilot and asked "What are your intentions?"[10] The pilot responded by reiterating his previously stated intent to pass under the Delta-Echo span and immediately ordered "hard starboard."[11] After ordering the "hard to starboard" rudder command, the pilot asked the master about where the center of the Bridge was a second time.

At approximately 0829, the Chief Mate on the bow issued the warning "the bridge column, the bridge column" to the master.[12] Almost immediately, the pilot ordered the helmsman to shift his rudder to "hard to port" in order to lift the stern of the vessel away from the Bridge Pier. At approximately 0830, the COSCO BUSAN allided with the fendering system of the Delta Tower of the Bay Bridge which resulted in the discharge of more than 53,000 gallons of Intermediate Fuel Oil (IFO).

When considering if there were alternative actions that the VTS could have taken to change the ultimate outcome, there are several items that must be considered:

> (a) Immediately following the communication exchange between the VTS and the COSCO BUSAN at 0827:42, when the pilot stated that he was "coming about steering 280", the VTS Bay Sector Operator also noted that the COSCO BUSAN's radar target had begun to separate from the AIS symbol. Both pieces of information gave the VTS operator confirmation that the pilot was affecting a turn commensurate with his stated intentions of transiting through the Delta-Echo Span of the Bridge.[13] The pilot's

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[8] After turning into the Bar Channel, the COSCO BUSAN essentially remains approximately parallel to the Bay Bridge for almost 3 minutes (8:24:37 to 8:27:37) before beginning their turn to starboard to transit the Delta-Echo span.

[9] Enclosure 3 shows the communication between the Pilot and the VTS commenced at 08:27:48 and lasted until 08:28:04.

[10] At this point, the COSCO BUSAN's Course Over Ground (COG) is approximately 235 at a speed of more than 11 knots and is less than ½ mile from the Bridge.

[11] According to the Master's interview in December 2008, he did not hear the VTS call the Pilot and question his intentions, or if he did, he was not paying attention to the conversation.

[12] During NTSB interviews in December 2008, it was clarified that it was not the Chief Mate that called the Master but rather the Boatswain.

[13] At the time of the final communication before the allision, the COSCO BUSAN was traveling in excess of 11 knots at more than 60 RPM. At that point, the COSCO BUSAN was approximately ½ mile away from the Bridge. Based upon the Maneuvering Characteristics for the COSCO BUSAN, under ideal conditions of calm weather, wind less than 10 knots, calm seas, no current, water depth twice as deep as the vessel's draft, clean hull and normal trim, if the Pilot had immediately placed the vessel's engines in full astern with minimum rudder application, the COSCO BUSAN would have taken more than 5 minutes and over ¾ of a mile to come to a full stop.

transmissions were clear and confident and conveyed no indication of concern or lack of situational awareness on his part.

(b) The VTS watch had no indication of the confusion that existed on the bridge of the COSCO BUSAN, of the pilot's queries to the master about the location of the center of the bridge, nor of any alleged equipment abnormalities.

(c) Radar produces a single plane representational display and targets may appear much larger or quite different than the actual object. Additionally, VTS operators exhibit a degree of caution when issuing direction out of concern that they might exacerbate the situation. For example, in this case, it is very likely that if a VTS direction to "come left and abort your approach to the bridge" had been issued and followed, a very likely outcome might have been a far more disastrous "stem on" allision. A less specific direction, (e.g. "abort your approach") specifying a desired outcome, would have added to the existing confusion on the ship's bridge as the pilot/crew attempted to determine the best way to comply. At the time of the last VTS transmission, only positive immediate action, determined and executed by the pilot and the crew, could have improved the outcome.[14]

(d) VTS and the San Francisco Bar Pilots have a long history of working together. During this time a culture has developed in which there is an established understanding to avoid causing distractions while a pilot is engaged in a complex maneuver such as lining up for a bridge or narrow channel entrance. Additionally, there also exists a well-earned confidence and professional respect for the pilot's ability. Taken collectively, there is an understandable deferment on the part of the VTS operator to the ability and the authority of the pilot, especially during a time of critical maneuvering.

Finally, during the course of the interviews of the Chinese crewmembers in December 2008, the master suggested that because the VTS's practice is to communicate directly with pilots using their respective call signs, members of the crew may not have been aware of all communications between the VTS and the COSCO BUSAN. His suggestion was that perhaps instead, the VTS should utilize the vessel's call sign instead of the pilot's call sign such that it would be more likely that all crewmembers within hearing distance of the radio would hear the call and ensure that the master or pilot, or both, were aware of the communication and responded in a timely fashion.

An informal survey of all 12 of the Coast Guard VTSs nationwide was taken by Coast Guard Headquarters shortly after this comment was made. The results of the survey indicated that there is no uniform policy throughout the Coast Guard as to how VTSs must communicate with pilots while engaged in pilotage duties. Some VTSs almost exclusively use the vessel's name when communicating. Others tend to use the vessel name and the pilot call sign for some initial communications. Once reliable communications are established with the pilot, most follow-on communications are via the pilot call sign. In cases where there are difficulties with raising the piloted vessel using the pilot call sign, the vessel name is always used. While there is no specific

[14] Enclosure 2, Figure 4 and COSCO BUSAN Maneuvering Characteristics.

guidance from the International Maritime Organization (IMO), the general tendency concerning this issue is to defer to local custom. The International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) VTS Committee has advocated for the use of the vessel name, message markers and Standard Marine Communications Phrases (SMCP) in order to facilitate inclusion of the entire bridge team and help overcome language difficulties.

Although the Coast Guard firmly believes that the VTS operational guidance and procedures in place on the day of the accident were both sufficient and appropriate, the Coast Guard has in the wake of the COSCO BUSAN allision, implemented a series of changes designed to further enhance the operation of the VTS in San Francisco Bay. These changes include:

(a) The Coast Guard, the San Francisco Bar Pilots and the San Francisco Bay Harbor Safety Committee worked together to draft low visibility guidelines, which limit vessels of 1600 GT or greater from getting underway in visibility of less than ½ Nautical Mile (NM), or when their transit will require them to transit through certain critical maneuvering areas in San Francisco Bay. The San Francisco Bay Harbor Safety Committee approved the guidelines on March 13, 2008, and the VTS began enforcing the guidelines immediately thereafter.

(b) The VTS now calls onto the watch floor an additional operator when fog limits visibility to less than ½ NM and places their displays on a smaller scale for better anomalous traffic recognition.

(c) The VTS, through in-house training, has changed the operating paradigm in the traffic center to encourage more proactive prevention through concise communications, in order to better prepare operators to switch from the lower modes of traffic management to the more assertive directional modes when the need arises to prevent an accident.

(d) The VTS has also implemented a re-qualification program to ensure continuity of competence in its veteran operators.

(e) The VTS worked with the San Francisco Bar Pilots, Port Partners and the San Francisco Bay Harbor Safety Committee to better define inclement weather procedures within San Francisco Bay. In doing so, the group defined what inclement weather means to vessel operators, identified high risk areas of the Bay and assembled mitigating best practices and standards for operating in the San Francisco Bay during periods of high winds and seas.

Thank you for the opportunity to comment on these important issues.

Sincerely,

G. R. Wheatley

G. R. WHEATLEY
Coast Guard Party Spokesperson

Enclosures: (1) M/V COSCO BUSAN Timeline
(2) M/V COSCO BUSAN Appendix I
(3) M/V COSCO BUSAN Appendix II
(4) M/V COSCO BUSAN Maneuvering Characteristics
(5) Coast Guard VTS VHF Communications Transcriptions

M/V COSCO BUSAN CRITICAL TIME LINE

BACKGROUND:

On September 27, 2007 Captain Singh and a Chief Engineer from Fleet Management joined the COSCO BUSAN (previously the HANJIN CAIRO) to observe operations in anticipation of the transfer of the vessel to the new owners, Regal Stone Limited. During operations by the crew, Captain Singh noticed the crew was not using the 3 CM radar.

On October 24, 2007, ownership of the COSCO BUSAN was transferred from Synergy Marine Limited to the new owners Regal Stone Limited. Fleet Management is employed as the technical manager of the vessel and is tasked with providing a crew for the vessel. The designated crew of 24 reported to the COSCO BUSAN on October 24, 2007. Upon reporting aboard, the crew is engaged in cargo operations as well as training on the various aspects of the vessel's Safety Management System (SMS), under Captain Singh's direction. On October 25, 2007, COSCO BUSAN received its interim SMS certification from the Class Society, Germanischer Lloyd. COSCO BUSAN departed Pusan, Korea on October 25, 2007 and arrived at Long Beach, CA on November 3, 2007. According to CAPT Singh, the voyage was uneventful. While in Long Beach, Fleet Management had a technician inspect the 3 CM radar and the magnetron was replaced. COSCO BUSAN departed Long Beach, CA on November 5, 2007 and arrived at Oakland – San Francisco, CA later the same day. The San Francisco Bar Pilot for the inbound transit is CAPT Nyborg. His transit into San Francisco is uneventful, visibility is excellent, but the transit is slowed by vessel traffic. He notes that the track line laid down on the Electronic Chart Display and Information System (ECDIS) has the vessel transiting west of the center of the D-E Span, very near the "D" Tower. He mentions the issue to the Master before departing.

VESSEL PARTICULARS:

Type Vessel: Container
Deadweight: 68, 086.5
Length Overall: 900.9 ft
Breath: 131.2 ft
Depth: 79.3 ft
Draft: 40' 4" (Upon Departure)
Speed: 25.0 Knots
Air Draft: 143' 9"
Horsepower: 77,600 SHP at 104 RPM
Propeller Type: Fixed
Bow Thruster: Yes
Propulsion Type: Diesel, slow speed
Fuel Type/Capacity: HFO / 7,500 Metric Tons
Ballast Water: 14,490 Metric Tons
Fresh Water; 521 Metric Tons
Crew Makeup: 24 (4 Deck Officers, 5 Engineering Officers, 14 crew, 1 cadet)
IMO Number: 9231743
Call Sign: VRD16

Vessel Speed Conversion Table:

Command	RPMs	Speed (Loaded)
Navigation Full	104	27.3
Full	65	16.9
Half	50	13.0
Slow	35	9.1
Dead Slow	24	6.2

NOVEMBER 7, 2007 – THE DAY OF THE ALLISION:

0615: Captain Singh departs the vessel for the airport to return to Hong Kong. The original Chief Engineer, who joined the vessel with Captain Singh in September, remains onboard. This is the vessel's first evolution without the Training Master onboard.

0620: Pilot arrives at COSCO BUSAN after getting confused as to location of vessel (first went to Berth 58 vice 56). COSCO BUSAN is scheduled to sail at 0630 from Oakland Berth 56.

0625: COSCO BUSAN logs that Pre-Tests of engines, telegraph, and steering gear are complete. Master and Pilot discuss prevailing weather conditions (fog) and agree to delay the vessel sailing.

0625 to 0725: Pilot and Master and possibly the 3rd Mate adjust radars and discuss the Electronic Chart Display Information System (ECDIS) (specifically symbols for the Bay Bridge). Pilot is satisfied with radar and ECDIS.

0645: Pilot has initial communications with operator of the assist tug REVOLUTION.

0648: Tug REVOLUTION made fast to the port quarter.

0730: Visibility has improved to approximately ¼ mile (Pilot can now see across the estuary which is 1/8 of a mile wide) and after consulting with the Master, the COSCO BUSAN prepares to get underway.

0745: Pilot does preliminary check-in with Vessel Traffic Service (VTS).

0748: Last line taken in, COSCO BUSAN is underway. Pilot uses bow thruster and tug to breast-out to mid-channel in the Oakland Estuary.

0800: Tug REVOLUTION shifts from port quarter to centerline stern chalk

0808: First ahead engine order is given, COSCO BUSAN is making way. As the COSCO BUSAN departs, the Pilot can see Buoys 6 & 4 to port and the breakwater and beacon to starboard.

0815: COSCO BUSAN departs the Oakland Estuary at Lights 7 & 8 heading 290 degrees True at 5.7 knots.

0820: 3rd Mate takes initial fix and notes the vessel is 200 yards left of the intended track (per track laid on the chart) but fails to advise the Master or the Pilot. Outbound track line appears to be the same as the inbound track line laid down by the 2nd Mate on the chart prior to entering San Francisco – Oakland.

0825: COSCO BUSAN is at Bar Channel Lights 1 & 2A as vessel begins her turn to port. Heading is now 279 and speed has increased to 10.8 knots. COSCO BUSAN ultimately turns "hard to port".

0827: COSCO BUSAN is steady on southwesterly heading. Heading is reported by AIS as 239 and the vessel speed is 10.7 knots. Engine ordered from Half Ahead (50 RPMs) to Full Ahead (65 RPMs)

0828: Pilot reports that the both radar displays become unreliable and he shifts navigation of the vessel to the ECDIS. Heading is now 238 degrees and speed is 11.4 knots (59 RPM).

0829: Pilot receives a radio call from VTS reporting that they see his heading as 235 and inquire as to his intentions. The Pilot responds that he still intends the D-E Span and that he is coming right and that his heading is 280. The Captain receives a radio call from the lookouts on the bow reporting that the bridge is "very close". Heading is now 264 and the speed is 11.0 knots.

0830: COSCO BUSAN strikes the "D" Tower Pier of the San Francisco – Oakland Bay Bridge holing port wing tanks 2, 3 and 4 between frames 128 and 150. Port tank 2 is a ballast tank. Port tanks 3 and 4 are fuel oil tanks. Heading is now 306 degrees and speed has slowed to 9.1 knots (66 RPM) after the bridge strike.

0832: Pilot reports the allision to VTS and advises them he is heading to Anchorage 7.

0855: COSCO BUSAN is safely anchored in Anchorage 7.

0858: Tug REVOLUTION is released.

0900 (Est): Pilot Coney witnesses Pilot Cota perform an alcohol test strip and times it. The test results were negative (i.e., no stripe developed after the requisite time period).

0945: Pilots Cota and Coney depart COSCO BUSAN headed to the Pilot Station at Pier 9 San Francisco.

1020: Anchor is away and COSCO BUSAN heads to Anchorage 9.

1029: Pilot Cota arrives at Pilot Station and immediately submits to a breathalyzer test conducted by Global Alcohol and Drug Screening the contracted collector for the Pilots Association. The test result is 0.00% BAC.

1035: Pilot Cota provides a drug test sample to the contract collector. The sample subsequently tests negative.

1038: COSCO BUSAN transits the A-B Span of the San Francisco – Oakland Bay Bridge enroute to Anchorage 9.

1105: COSCON BUSAN is safely anchored in Anchorage 9.

1112: Coast Guard Investigators (IOs) arrive at the COSCO BUSAN.

1124 – 1130: Coast Guard IO conducts a breathalyzer test of the Master, 3rd Mate, Able Seaman (Helmsman), Chief Engineer and Chief Mate. All crew members test 0.00% BAC.

1506: Master submits a drug test sample to National Safety and Compliance Company collector, the designated sample collector for Fleet Management. The sample subsequently tests negative.

Appendix 1

Figure 1. Coast Guard photo of the navigation chart from the M/V COSCO BUSAN, with tracklines placed by the Second Officer prior to arrival. Note the "X" and "0820" (near the center of the photo) and "0830"notations, which are GIS positions plotted by the Third Officer while underway. This photo was taken before the Third Officer erased these positions after the casualty.

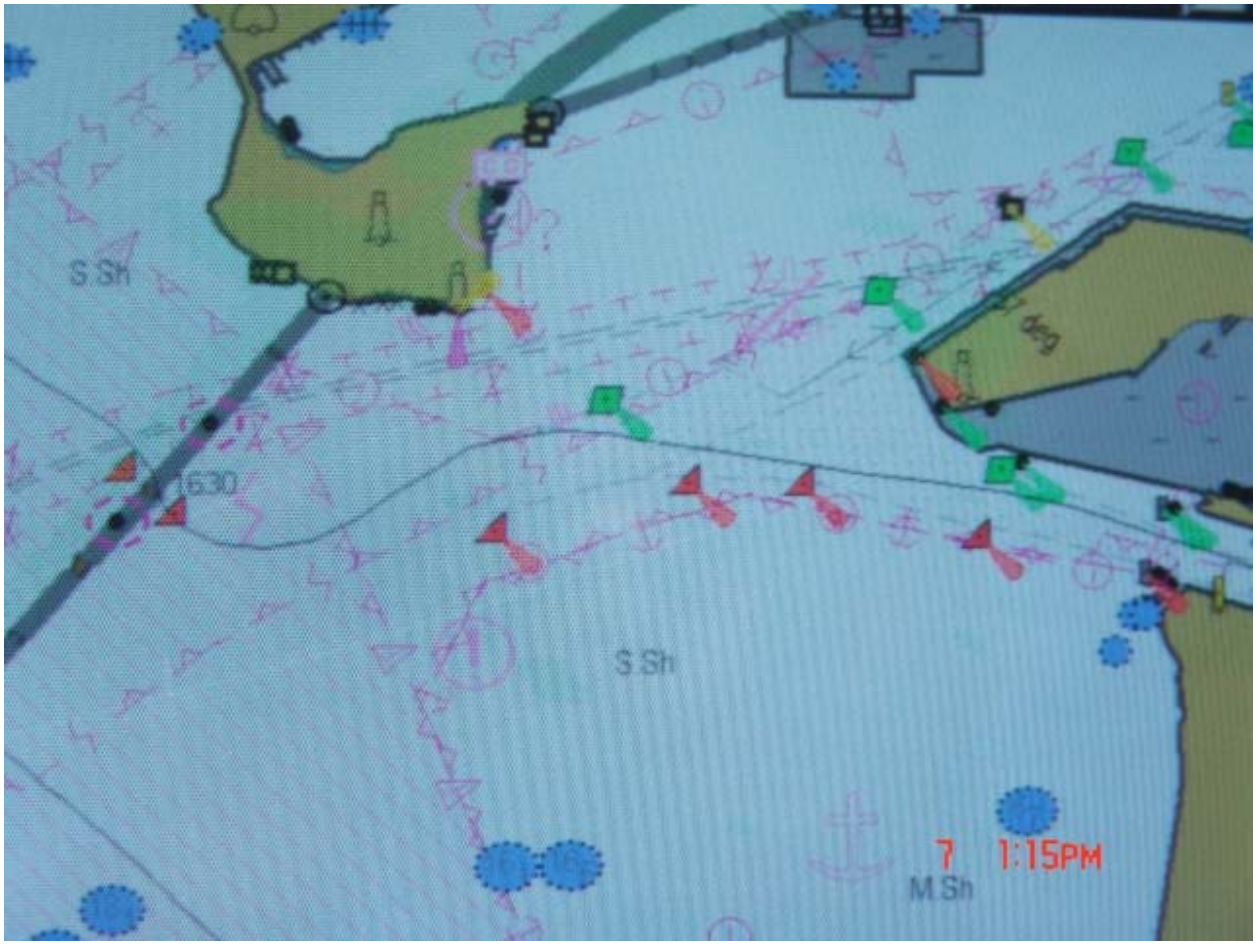


Figure 2. Coast Guard photo of the ECDIS display of the M/V COSCO BUSAN. Note the red triangle symbols with teardrops indicating lighted aids to navigation, and two red triangle symbols on either side of the Delta Tower Island, representing the buoys marking the Tower Island. The RACON symbols (dark circles with magenta broken halo) on the bridge are also clearly visible. The blue trackline is the vessel's AIS course.

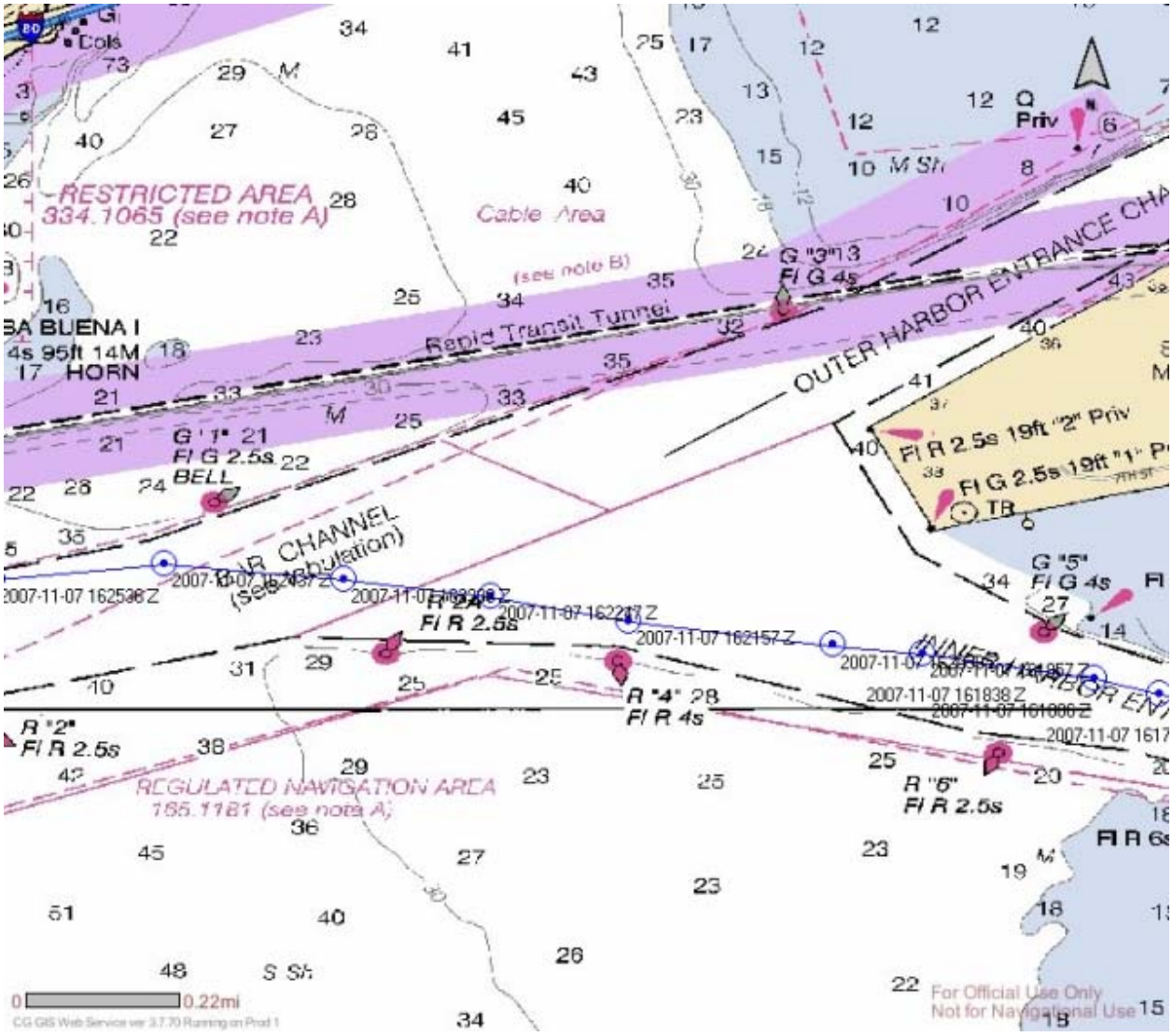


Figure 3. This image was prepared by the Coast Guard Office of Information Resources using AIS data at one minute intervals. Times shown are in Zulu (Greenwich Mean Time (GMT)), which can be converted to local time by deducting eight hours. This image shows the COSCO BUSAN's AIS trackline (indicated in blue) from Lighted Buoys "5" and "6" to Lighted Buoy "1."

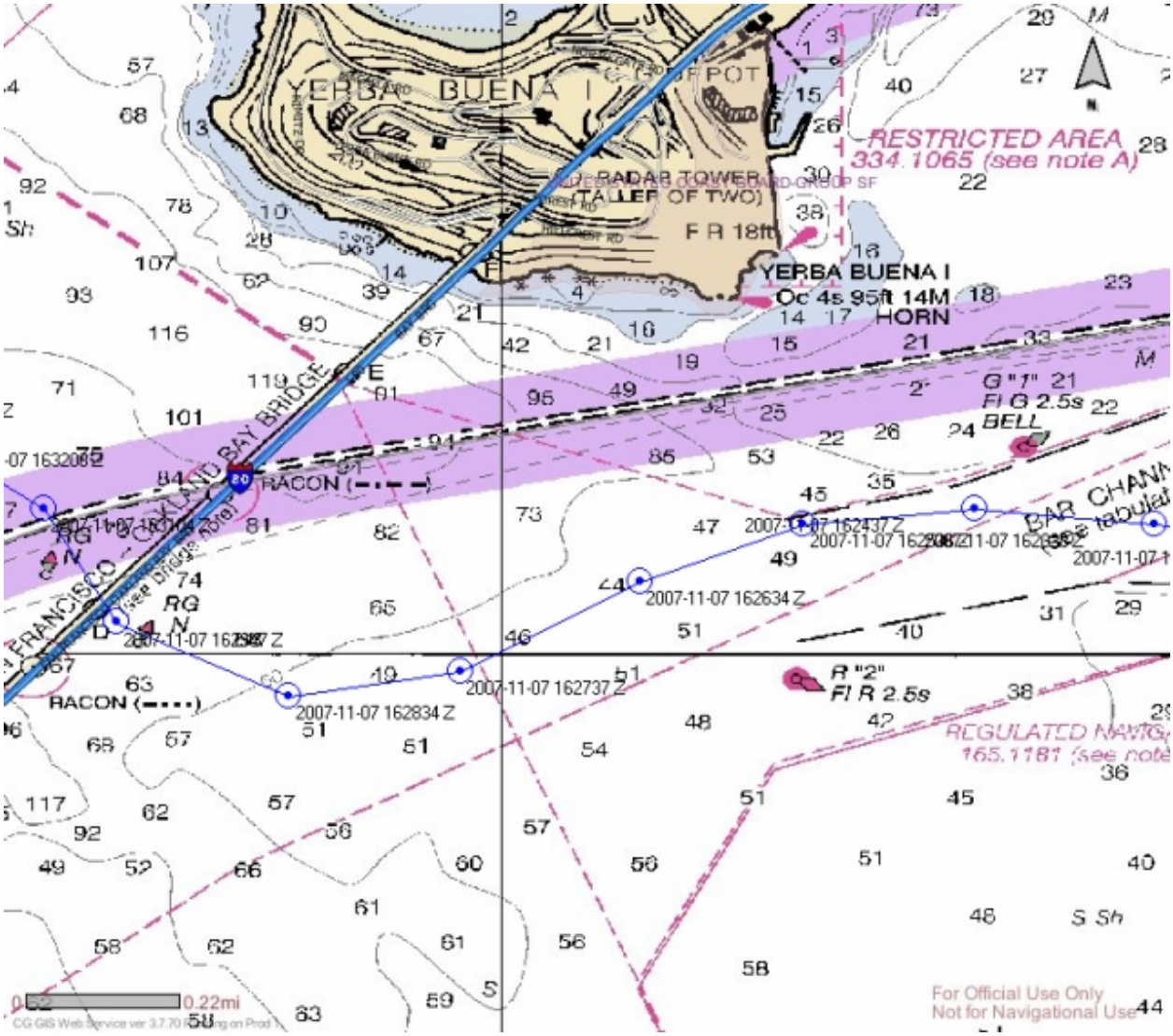


Figure 4. This image was prepared by the Coast Guard Office of Information Resources using AIS data at one minute intervals. Times shown are in Zulu (Greenwich Mean Time (GMT)), which can be converted to local time by deducting eight hours. This image shows the COSCO BUSAN's AIS trackline from Lighted Buoy "1" to a point northwest of the Delta Tower of the Bay Bridge, after the allision.

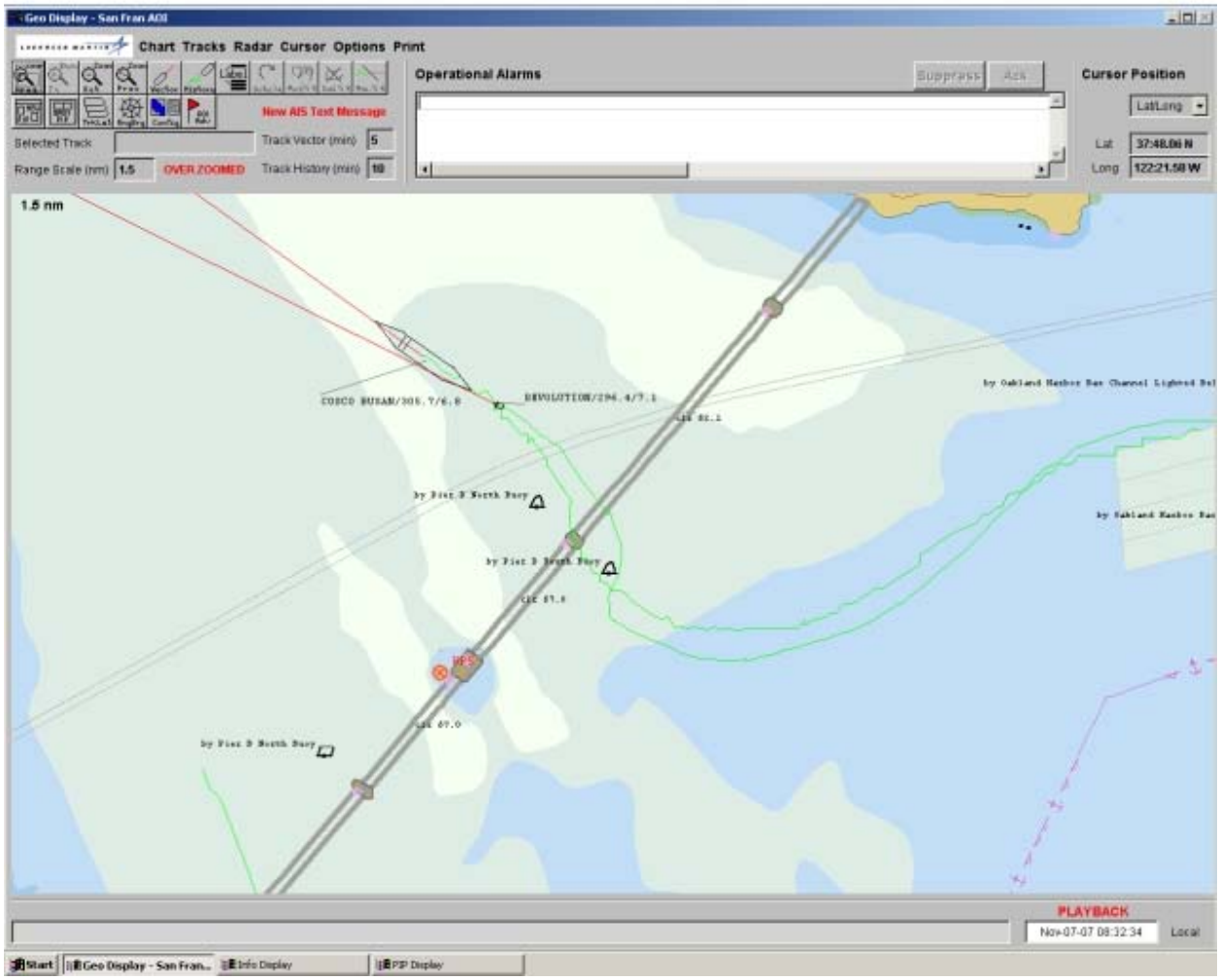


Figure 5. This image was recovered from the Coast Guard Vessel Traffic System (VTS) after the casualty. The green lines are the tracklines of the M/V COSCO BUSAN and the Tug REVOLUTION respectively. Note how the tug crossed the wake of the COSCO BUSAN as the ship maneuvered.

Figure 6. Aerial view of the Bay Bridge (Delta Tower) with the AIS trackline of the M/V COSCO BUSAN in blue.

Figure 7. Coast Guard photo of fender system damage to the Bay Bridge

Figure 8. Coast Guard photo of damage to the M/V COSCO BUSAN

Appendix 2

VDR				AIS				
Time	Event/Order	Heading	Speed	Time	Lat	Long	Heading	Speed
8:07:52	Dead Slow Ahead	285.2	0.0	8:07:37	37.79650 N	122.3215 W	195	0.1
8:07:56	Stop the Bow Thruster	285.2	0.0	8:07:37	37.79650 N	122.3215 W	195	0.1
8:08:03	285	284.0	0.1	8:08:08	37.79650 N	122.3217 W	238	0.1
8:08:32	287	283.0	0.2	8:08:28	37.79650 N	122.3217 W	256	0.2
8:09:02	288	284.3	0.6	8:09:08	37.79650 N	122.3218 W	269	0.7
8:12:00	289	288.2	3.8	8:12:08	37.79716 N	122.3248 W	288	3.9
8:14:22	288	289.5	5.5	8:14:18	37.79817 N	122.3285 W	289	5.5
8:16:51	285	288.5	6.5	8:16:48	37.79967 N	122.3337 W	287	6.5
8:17:51	283	285.3	6.9	8:17:49	37.80017 N	122.3360 W	289	6.9
8:20:00	Half Ahead	282.5	7.6	8:19:57	37.80117 N	122.3415 W	278	7.6
8:21:56	Pilot asks about red symbols	283.7	8.7	8:21:57	37.80183 N	122.3475 W	278	8.9
8:23:21	Port 10	282.3	10.1	8:23:16	37.80250 N	122.3520 W	279	10.1
8:25:30	Midships	253.5	10.3	8:25:27	37.80283 N	122.3602 W	272	10.9
8:25:41	250	253.5	10.3	8:25:43	37.80267 N	122.3610 W	267	10.8
8:25:50	245	247.3	10.1	8:25:47	37.80267 N	122.3615 W	266	10.7
8:26:23	Starboard 10	241.3	10.3	8:26:23	37.80183 N	122.3632 W	251	10.6
8:26:33	Starboard 20	241.2	10.5	8:26:34	37.80150 N	122.3638 W	248	10.6
8:26:54	Full Ahead	242.0	10.7	8:26:58	37.80083 N	122.3653 W	238	10.8
8:27:24	Unit Romeo(pilot) Traffic(VTS)	247.5	10.8	8:27:27	37.80000 N	122.3668 W	234	11.2
8:27:29	Traffic Romeo	247.5	10.8	8:27:27	37.80000 N	122.3668 W	234	11.2
8:27:37	Ease to 10	253.8	10.6	8:27:37	37.79967 N	122.3675 W	235	11.3
8:27:45	Traffic Romeo did you call?	261.5	10.3	8:27:43	37.79967 N	122.3677 W	235	11.3
8:27:48	Unit Romeo Traffic AIS shows you on 235 heading. What are your intentions, over?	261.5	10.3	8:27:47	37.79950 N	122.3680 W	234	11.4
8:27:57	Well I'm coming around. I'm steering 280 right now.	261.5	10.3	8:27:57	37.79933 N	122.3687 W	237	11.4
8:28:02	Starboard 20	268.8	9.9	8:28:03	37.79917 N	122.3688 W	238	11.4
8:28:04	Roger, understand. You still Intend Delta-Echo Span?	268.8	9.9	8:28:03	37.79917 N	122.3688 W	238	11.4
8:28:08	Pilot asks master "This is the center of the bridge, right?"	268.8	9.9	8:28:06	37.79917 N	122.3693 W	239	11.4
8:28:11	Master replies "Yeah, yeah"	268.8	9.9	8:28:14	37.79917 N	122.3697 W	242	11.4
8:28:13	Hard Starboard	276.2	9.6	8:28:14	37.79917 N	122.3697 W	242	11.4
8:28:15	Pilot to VTS: "Yeah, yeah, we're still Delta-Echo"	276.2	9.6	8:28:14	37.79917 N	122.3697 W	242	11.4
8:28:42	Midships	285.5	9.3	8:28:43	37.79917 N	122.3715 W	254	11.3
8:28:51	Starboard 20	297.2	8.6	8:28:47	37.79917 N	122.3718 W	257	11.3
8:29:01	Hard Starboard	307.2	8.0	8:29:03	37.79933 N	122.3725 W	264	11.0
8:29:09	Chief Off warns "The bridge column, the bridge column"	307.2	8.0	8:29:07	37.79950 N	122.3728 W	267	10.8
8:29:26	Midships	314.8	7.9	8:29:27	37.80000 N	122.3737 W	280	10.3
8:29:31	Hard Port	325.2	7.7	8:29:34	37.80017 N	122.3740 W	285	10.1
8:30:07	Midships	336.8	7.7	8:30:07	37.80133 N	122.3748 W	311	8.7
8:30:10	Dead Slow Ahead	336.8	7.7	8:30:14	37.80133 N	122.3748 W	314	8.5
8:30:12	Pilot reports allision to VTS	336.8	7.7	8:30:14	37.80133 N	122.3748 W	314	8.5

MANOEUVRING CH

M.V HANJIN CAI

MINIMUM STEERING SPEED

Normal Loaded Condition	5.25	Knots
Normal Ballast Condition	5.65	Knots

MAXIMUM AVAILABLE RUDDER ANGLE

Hard Right or Starboard	35	degrees
Hard Left or Port	35	degrees

AUXILIARY DEVICES

Bow thruster	
Vessel Speed	Effectiveness
0 to 1Knots	100%
1 to 2Knots	75%
2 to 4 Knots	50%
4 to 6 Knots	25%
above 7 Knots	0%

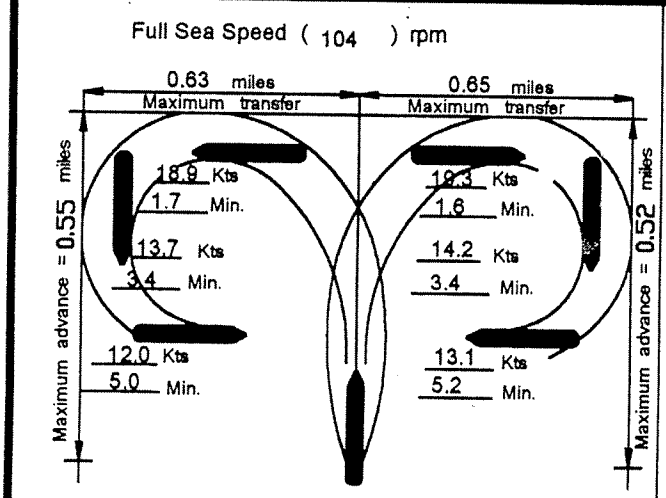
TIME AND DISTANCE TO S

o Using engines full astern and with minimum applic

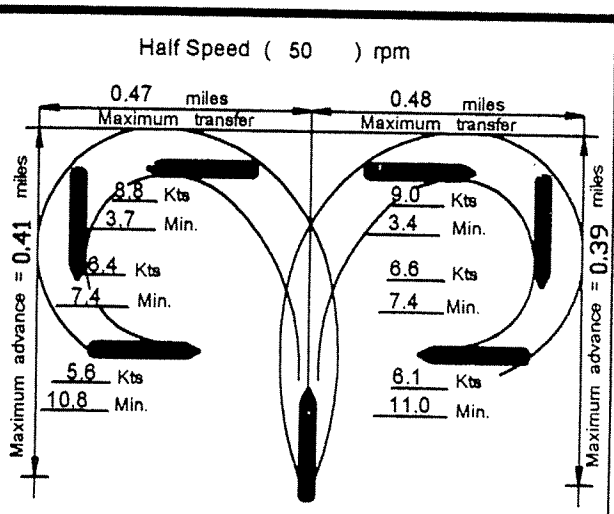
Manoeuvring Speeds	Normal Loaded Condition		Normal Ball
	Time	Distance	Time
Full Speed	7'-10" Minutes	1.17 Miles	5'-40" Minute
Half Speed	5'-05" Minutes	0.64 Miles	3'-55" Minute
Slow Speed	3'-15" Minutes	0.27 Miles	2'-20" Minute

TURNING CIRCLE DIAGRA

NORMAL LOADED CONDITION



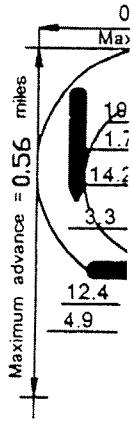
NOTES : -maximum rudder angle
-constant engine order or throttle setting.



NOTES : -maximum rudder angle
-constant engine order or throttle setting.

NOTE : at slow speed transfer and advance about the same as half speed, but speeds proportionally less and times proportionally greater.

Full



NOT

WARNING

he response of MV"Hanjin Cairo" may be different om that listed above if any of the following conditions, upon hich the maneuvering information is based are varied:

Calm weather- wind 10 kts or less, calm sea
No current
Water depth twice as the vessel's draft or greater
Clean hull
Intermediate drafts or unusual trim

WARNING

The response of the M.V " HANJIN CAIRO " may be

any of the fol l owing conditions. upon which the manoeuvrir

1. Cal m weather-wind 10 knots or less.calm sea

2. no current 3. water depth twice the vessel's d

4. clean hull 5. intermediate drafts or unusual tr

JVRING CHARACTERISTICS

M.V HANJIN CAIRO

ME AND DISTANCE TO STOP
n and with minimum application of rudder

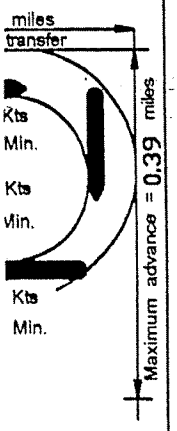
l Condition		Normal Ballast Condition		
Distance		Time	Distance	
1.17	Miles	5'-40" Minutes	0.96	Miles
0.64	Miles	3'-55" Minutes	0.49	Miles
0.27	Miles	2'-20" Minutes	0.19	Miles

ENGINE ORDER/RPM/SPEED TABLE

	Engine Order	Rpm	Speed (Loaded Cond.)	Speed (Ballast Cond.)
Manoeuvring Speeds	Full Sea Ahead	104	27.3	28.3
	Full Ahead	65	16.9	18.2
	Half Ahead	50	13.0	14.1
	Slow Ahead	35	9.1	9.8
	Dead Slow Ahead	24	6.2	6.7
	Dead Slow Astern	24		
	Slow Astern	35		
	Half Astern	50		
	Full Astern	65		

NING CIRCLE DIAGRAMS

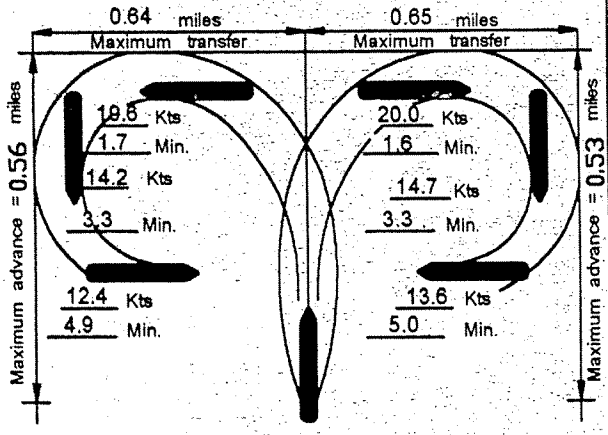
NORMAL BALLAST CONDITION



e setting.

ame

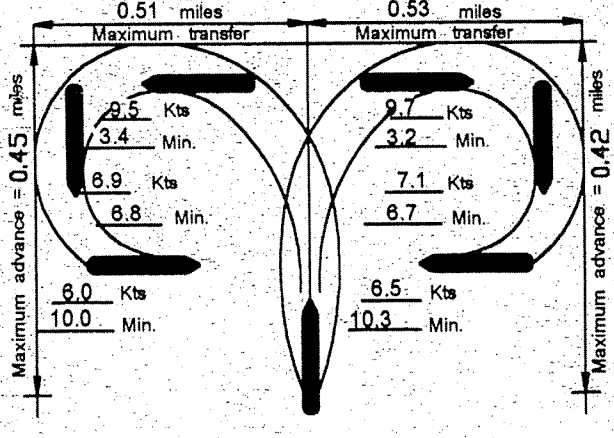
Full Sea Speed (104) rpm



p. 29.0 Kts
s. 29.0 Kts

NOTES : -maximum rudder angle
-constant engine order or throttle setting.

Half Speed (50) rpm



p. 14.0 Kts
s. 14.0 Kts

NOTES : -maximum rudder angle
-constant engine order or throttle setting.

NOTE : at slow speed transfer and advance about the same as half speed, but speeds proportionally less and times proportionally greater.

WARNING

.V " HANJIN CAIRO " may be different from that shown above if

conditions. upon which the manoeuvring information is based.are varied:

d 10 knots or less.calm sea

3. water depth twice the vessel's draft or greater

5. intermediate drafts or unusual trim

NOTE : This form is designed to comply with pertinent USCG regulation and IMO requirements.

11 07 07 - 07 43 45: Traffic report preparation underway

HB	07:43:46	Yeah, Traffic this is the Henry Brusco.
VTS	07:43:50	Henry Brusco, Traffic
HB	07:43:53	We're just getting underway at this time. Light tug from Berth 10 out to….star…Treasure Island, excuse me, anchorage, the, where we left the Number 9 Barge, OK.
VTS	07:44:09	Roger. Henry Brusco light tug departing Oakland 10 for TI east mooring. Uh, thank you. Traffic out.
FB	07:44:20	Traffic, San Francisco.
VTS	07:44:27	San Francisco, Traffic.
FB	07:44:30	Ferry Building back to Sausalito.
VTS	07:44:35	Roger San Francisco, departing Ferry Building for Sausalito. Mendocino passing Blossom Rock for the Ferry Building. Over.
FB	07:44:48	Copy, thank you. San Francisco.
VTS	07:44:54	San Francisco, also Bay Breeze is up bound Anchorage 9 for the Ferry Building.
FB	07:45:01	Copy, thank you, San Francisco.
VTS	07:45:04	Mendocino, Bay Breeze, did you copy San Francisco?
MEND	07:45:09	Mendocino, copy.
CB	07:45:11	Traffic, Romeo. (Bar Pilot aboard M/V COSCO BRUSCO).
VTS	07:45:13	Yeah, Romeo, Traffic.
CB	07:45:15	Do you have somebody coming in astern of the Solano?
VTS	07:45:20	Ah, yeah, Romeo, Traffic, ah, negative. Ah, Solano is the only thing checked in, and I don't see AIS for anyone astern of her. Ah, Unit 12 on the SH Bright, is abeam Point Diablo intending Eastbound Lane, ah, still determining whether he'll go to anchor or proceed on to Sacramento. Over.
CB	07:45:48	OK, fine, I'll let the Solano get by the, ah, so we'll be getting underway. I can see the other side of the Estuary, so. Ah, I'm on 7A now for tugs.
VTS	07:46:00	Roger, 7 Alpha for tugs. Thank you. Break. Solano, did you copy yet Romeo? Over.
SOL	07:46:10	Solano, copy.
VTS	07:46:13	Thank you. Traffic out. Traffic, Intintoli, Traffic.

11 07 07 08 08 35 – dialogue between VTS and the following stations:

Unit Romeo
Unit 12

Station Calling	Time	Transcript.
Unit Romeo	08:08:35	Traffic Romeo. We're underway.
VTS	08:08:40	Roger, Unit Romeo, CO…Roger Unit Romeo, COSCO BUSAN departing Oakland 56 for sea, Delta Echo, deepwater…, and Unit 12 on the SH BRIGHT passing Aquatic Park, they're going to divert, take Alpha Bravo span for Anchorage 8, the uh…yacht ELAN is just west of YBI transiting across to San Francisco 9. Over.
Unit Romeo	08:09:13	Uh. Somebody else was talking, he's going into Anchorage 9 you said?
VTS	08:09:18	Uh, Unit 12, SH BRIGHT passing Aquatic Park, intending Alpha Bravo span for Anchorage 8, and the uh…ELAN is just west of YBI for San Francisco 9. Over.
Unit Romeo	08:09:36	Yeah, what is that second boat?
VTS	08:09:40	Second boat is the recreational boat ELAN…actually you can disregard, he'll be across before you get there
Unit Romeo	08:09:51	Okay, thanks.
VTS	08:09:53	Thank you. Break. Unit 12, did you copy Unit Romeo underway? Over.
Unit 12	08:09:58	Uh, 12 copies Romeo.

11 07 07 08 29 26

Request to verify intentions of M/V Cosco Busan.

VTS	08:29:26	Unit Romeo, Traffic.
Unit R	08:29:32	Traffic Romeo.
VTS	08:29:35	Roger Captain, are you still proceeding out?
Unit R	08:29:47	Traffic.
VTS	08:29:50	Unit Romeo, Traffic. AIS shows you on a 235 heading. What are your intentions? Over.
Unit R	08:29:59	Um, I'm coming around, I'm steering 280 right now.
VTS	08:30:06	Roger, understand you still intend the Delta Echo span. Over.
Unit R	08:30:17	Yeah, we're still Delta Echo.
VTS	08:30:23	Uh, roger Captain.
Research Vessel Robert G. Brownlee	08:30:33	Traffic, Robert G. Brownlee. Ferry Point.
VTS	08:30:38	Robert G. Brownlee, Ferry Point for Southampton Shoal Light. Thank you. Call again when on station.
Research Vessel Robert G. Brownlee	08:30:46	Roger, thank you Traffic.