

# UNITED STATES COAST GUARD

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## REPORT OF INVESTIGATION INTO THE ALLISION OF THE COSCO BUSAN WITH THE DELTA TOWER OF THE SAN FRANCISCO-OAKLAND BAY BRIDGE IN SAN FRANCISCO BAY ON NOVEMBER 7, 2007



MISLE ACTIVITY NUMBER: 3095030



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**MAR 02 2009**

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WITH THE DELTA TOWER OF THE SAN FRANCISCO-OAKLAND BAY BRIDGE  
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**ACTION BY THE COMMANDANT**

The record and the report of the investigation convened to investigate the subject casualty have been reviewed. The record and the report, including the findings of fact, analysis, conclusions, and recommendations are approved subject to the following comments.

**ACTION ON RECOMMENDATIONS**

Recommendation 1: Recommend a copy of this report be provided to the following entities:

- The Government of Hong Kong.
- Regal Stone, Ltd.
- Fleet Management, Ltd.
- The International Maritime Organization (IMO)
- Germanischer Lloyd
- The U.S. Maritime Administration (MARAD)
- San Francisco Bar Pilots (SFBP)
- The State of California, Office of Spill Prevention and Response (OSPR)
- The State of California Board of Pilot Commissioners for the Bays of San Francisco, San Pablo and Suisun
- The Harbor Safety Committee of the San Francisco Bay Region
- The Cities of Oakland and San Francisco

District Endorsement: Recommend the report be made widely available to all interested parties via the FOIA Electronic Reading Room through the administrative process.

Action: We concur with this recommendation. We will provide copies of this report to the organizations listed in this recommendation and make it available to the general public.

Recommendation 2: Recommend Regal Stone Ltd., owners, and Fleet Management, Ltd., operators of the COSCO BUSAN, review the Safety Management System (SMS) Procedures for pre-underway equipment tests, crew familiarization, and navigation in restricted visibility.

District Endorsement: Concur.

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Action: We concur with this recommendation. We will forward a copy of this report to Regal Stone, Ltd. and Fleet Management, Ltd. and recommend that they consider implementing this recommendation, as appropriate.

Recommendation 3: Recommend the Captain of the Port (COTP) San Francisco work with the San Francisco Bay Harbor Safety Committee to develop a risk-based decision making job aid for mariners sailing in restricted visibility

District Endorsement: Concur. Recommend Acceptable Action.

Action: We concur with this recommendation. We note the action already taken by the Sector San Francisco's Vessel Traffic Service (VTS), working with the San Francisco Bar Pilots and the San Francisco Bay Harbor Safety Committee. They have developed protocols for periods of reduced visibility that includes: (1) limiting vessels greater than 1600 gross tons from getting underway when visibility is less than 1/2 mile; (2) adding an additional radar operator at the VTS when visibility is less than 1/2 mile; and (3) enhanced in-house training and re-certification for VTS operators. We will review the procedures developed for the San Francisco Bay area and determine if the development of similar protocols would be appropriate for other VTS Areas.

Recommendation 4: Recommend Vessel Traffic Service (VTS) San Francisco develop procedures for exercising and enforcing Coast Guard authority under the Ports and Waterways Safety Act (PWSA) to implement the procedures developed per Recommendation 3.

District Endorsement: Concur.

Action: We concur with this recommendation. We note the action already taken by the Sector San Francisco's Vessel Traffic Service (VTS), through its work with the San Francisco Bar Pilots and the San Francisco Bay Harbor Safety Committee that resulted in the development of the protocols developed per Recommendation 3 and the procedures to implement them through the exercise of Coast Guard authority under the Ports and Waterways Safety Act (PWSA). We will review the procedures developed for the San Francisco Bay area and determine if similar actions would be appropriate for other VTS Areas.

Recommendation 5: 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 portable pilotage system with an AIS pilot port feature should be a mandatory, minimum standard for all pilots.
- Whether personal portable pilotage units 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.

District Endorsement: Concur.

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Action: We concur with this recommendation. We note that the San Francisco Bar Pilots, in conjunction with the State of California Board of Pilot Commissioners, have established a Technology Committee to further evaluate the use of hand-carried laptop computers for all pilots. We will forward a copy of this report to the San Francisco Bar Pilots, asking them to have this new committee consider the four areas noted in the recommendation, as appropriate.

Recommendation 6: Recommend the Commandant of the Coast Guard amend the existing standards in Marine Safety Manual (MSM) Volume III, for medical professionals performing mariner physicals, to ensure that physicals are performed only by designated physicians with a thorough understanding of the physical and mental demands of a mariner's position.

District Endorsement: Concur in principle. Consideration should also be given to amending the Code of Federal Regulations, 46 CFR Part 10, in the same regard.

Action: We partially concur with this recommendation. We agree that medical professionals performing marine physicals on merchant mariners should have an understanding of the physical and mental demands of a mariner's position. Navigation and Vessel Inspection Circular (NVIC) 04-08, published on September 15, 2008, provides new and substantial guidance for medical professionals performing marine physicals that describes physical and mental requirements a mariner must meet and specifically references how they relate to the shipboard tasks, functions, events and conditions a merchant mariner can be expected to encounter. We believe the guidance provided in NVIC 04-08 is sufficient to provide medical professionals with the necessary understanding of the occupational demands of mariners to perform marine physicals and do not intend to revise our existing requirements.

Recommendation 7: Recommend the Coast Guard National Maritime Center (NMC) issue a comprehensive work instruction for the review and handling of annual pilot physicals, including requirements for documenting the review in the MMLD system.

District Endorsement: Concur.

Action: We concur with this recommendation. The National Maritime Center (NMC) has such a work instruction in place and has been using it over the past few months. The review of pilots' annual physicals is conducted in much the same manner as other physical examination reviews. Once one arrives at the NMC, it is documented in the Merchant Mariner Licensing and Documentation (MMLD) system, establishing accountability, and tracked from its arrival through completion of the review when a fitness for duty determination is made.

Recommendation 8: Recommend the Coast Guard National Maritime Center (NMC) expedite the replacement of NVIC 2-98, Physical Evaluation Guidelines for Merchant Mariner's Documents and Licenses.

District Endorsement: Concur. Recommend Acceptable Action.

Action: We concur with this recommendation. The National Maritime Center (NMC) published Navigation and Vessel Inspection Circular (NVIC) 4-08, "*Medical and Physical Evaluation*

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*Guidelines for Merchant Mariner Credentials*” on September 15, 2008. In addition, revisions are being made to the Coast Guard’s Merchant Marine Personnel Physical Examination Report (Form CG-719K) and Merchant Marine Certification of Fitness for Entry Level Ratings (Form CG-719K/E) to bring them up to date with the policies and procedures in the new NVIC. We are awaiting final approval from the Office of Management and Budget (OMB) before publishing the new forms. We believe the use of the new forms will ensure the NMC is provided with the medical information necessary for it to carry out its review of mariners’ medical and physical fitness.

**Recommendation 9:** 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.

**District Endorsement:** Concur. Additionally, recommend each pilot association within the State establish the same procedures for their members, if not already established. Pilots operating within other California ports are operating under the jurisdiction of their Federal pilot’s license. These pilots are organized by associations and aren’t regulated by a state agency or commission.

**Action:** We concur with this recommendation. We agree that the Board of Pilot Commissioners for the Bays of San Francisco, San Pablo, and Suisun consider taking action on this recommendation. We also concur with the District’s recommendation in its endorsement that other pilot associations within the State establish the same procedures for their members. However, we also believe such procedures should include reporting of any changes in a pilot’s health or medication usage that may pose a maritime safety risk to the Coast Guard’s National Maritime Center (NMC). In such cases, the procedures should note that consultation between the NMC and the Board and/or medical professionals will be required and that the NMC is to retain final authority for the determination of medical fitness. We will provide a copy of this report to the Board of Pilot Commissioners for the Bays of San Francisco, San Pablo, and Suisun, and other pilot associations within the State of California asking them to consider this recommendation, as appropriate.

**Recommendation 10:** 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.

**District Endorsement:** Concur.

**Action:** We concur with this recommendation. The Seafarers Health Improvement Program (SHIP) is an international program with the goal of improving mariner health. The current Guidelines for Physical Examination for Retention of Seafarers in the U.S. Merchant Marine are

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from 1986 and are similar in scope to those found in the recently cancelled Navigation and Vessel Inspection Circular (NVIC) 02-98, "*Physical Evaluation Guidelines for Merchant Mariner's Documents and Licenses.*" We will forward a copy of this report to the U.S. Maritime Administration asking them to consider taking action on this recommendation and that a mechanism is put in place to resolve any discrepancies that may arise between any revisions to its guidelines proposed by SHIP and our new NVIC 04-08, "*Medical and Physical Evaluation Guidelines for Merchant Mariner Credentials.*"

**Recommendation 11:** Recommend that the Commandant of the Coast Guard review current Vessel Traffic Service (VTS) radiotelephone practices nation-wide concerning methods of communicating with Pilots while engaged in pilotage duties on vessels. Following this review, the Commandant should determine whether the development of nation-wide standard pilot-VTS communications protocols or guidelines is necessary.


**District Endorsement:** Concur. Clear, consistent communication from VTS and Vessel Movement Centers are essential to safe navigation. National VTS standard operating procedures should be finalized and SOP for VMCs should be addressed. The procedural guidance should address use of assertive communications in appropriate circumstances.

**Action:** We partially concur with this recommendation. We will conduct a review of the current Vessel Traffic Service (VTS) radiotelephone practices nation-wide concerning methods of communicating with Pilots while engaged in pilotage duties on vessels. Upon completion of the review, we will determine whether the development of nation-wide standard pilot-VTS communications protocols or guidelines is necessary.

The District Commander made the following additional recommendation.

**Recommendation 12:** Recommend Commandant provide the capability for marine investigators to collect and analyze Voyage Data Recorder (VDR) information. Marine investigators need hardware, software, policy and training to rapidly and effectively retrieve critical evidence contained in a VDR. The capability to review and analyze VDR data at each investigating office is essential to completion of professional marine investigations.

**Action:** We concur with this recommendation. We will establish policies and procedures to enable investigating officers to collect and analyze VDR information. In the interim, we will continue to work with the National Transportation Safety Board to ensure that VDR information is provided to investigating officers.

  
W. D. Rabe  
By direction

## **Executive Summary**

At 0748<sup>1</sup> 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 boatswain was on the bow, serving as lookout and prepared to drop the anchor. The master, as the senior person on the bridge, retained full authority for the safety of his vessel. Visibility at departure 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<sup>2</sup> and entered the 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 vessel exited the estuary and proceeded outbound, the pilot ordered increases in engine RPM's and the vessel reached a speed of more than 10 knots. At 0827, a watchstander at Vessel Traffic Service (VTS) San Francisco contacted the pilot, Captain [REDACTED] because the VTS display indicated the vessel's course over ground was about 235 degrees True, which is approximately parallel to the bridge, and was setting up to pass well southwest of the intended track. 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 0830, the COSCO BUSAN, which had been traveling at a speed of more than 10 knots, 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.

### **1.0 Findings of Fact**

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<sup>1</sup> All times are Pacific Standard Time (PST) and based on a 24-hour clock.

<sup>2</sup> Throughout this report the term "Estuary" refers to the Inner Harbor Entrance Channel, ending approximately at Lighted Buoys "5" and "6."

## 1.1 Vessel Data

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, Ltd.
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

### 1.1.1 Vessel Certificates

All regulatory certificates for the COSCO BUSAN were valid and properly endorsed as of November 7, 2007 (ECN 3095030 #051 [REDACTED]).

### 1.1.2 Vessel Boarding History

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 during 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.

### 1.1.3 Safety Management System (SMS)

Regal Stone, Ltd. is a Hong Kong based company that took ownership and control of the COSCO BUSAN on October 24, 2007. Regal Stone hired Fleet Management, Ltd. to crew and manage the vessel. To assist the transition of the crew to a new vessel, Fleet Management assigned a "training master" and a chief engineer to the vessel on September 27, 2007, while the vessel was still being operated by a German crew under its previous owner. The purpose of this procedure was to familiarize Fleet Management personnel with the vessel and procedures used by the previous crew so they could train the new crew.



The vessel received an interim Document of Compliance for its Safety Management System (SMS) (ECN 3095030 #020 [REDACTED]) from [REDACTED] on October 25, 2007, only 24 hours after the new crew joined the vessel. During this period the vessel was engaged in cargo operations, which likely interfered with vessel familiarization. Nevertheless, each officer completed the SMS Checklist for Crew Familiarization on October 24, 2007 (ECN 3095030 #028 [REDACTED]), attesting to more than a dozen requirements, including the following:

- 1) Familiarization with all shipboard documents pertaining to the 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 a 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 that they held all required certificates.

#### 1.1.4 Crew

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 (ECN 3095030 #008 [REDACTED]). All crewmembers met the minimum requirements of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) (ECN 3095030 #017 [REDACTED]). The following crewmembers are mentioned by title in this report:

<u>Name</u>	<u>Position</u>	<u>Role</u>
[REDACTED]	Master	On Bridge/In Command
[REDACTED]	Chief Officer	Bow Lookout
[REDACTED]	Second Officer	Navigation Officer
[REDACTED]	Third Officer	On Bridge Watch
[REDACTED]	Boatswain	Bow Lookout

The entire crew joined the ship in Pusan,<sup>3</sup> 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, nor could it be determined how well the crew, particularly the bridge management team, worked together.

#### 1.1.5 Language

<sup>3</sup> Pusan is also known as Busan; either usage is correct.

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. Since the commands were properly executed in a timely manner it is apparent that the crew understood the commands.

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. Other than the master, it is unlikely any other member of the crew would have been able to have any meaningful discourse with the pilot.

#### 1.1.6 Carriage of Fuel

The COSCO BUSAN carries fuel oil in a combination of double bottom tanks, wing tanks, and specific purpose tanks (sumps, settling tanks, etc.) (ECN 3095030 #007 [REDACTED]). 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..." (ECN 3095030 #010 [REDACTED]).

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 MARPOL regulation took effect concerning 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. New 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.

#### 1.1.7 Electronic Chart Display and Information Systems (ECDIS)

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

distributers. 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 ENC's 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 (ECN 3095030 #031 [REDACTED]). ECDIS chart displays can provide increasingly detailed and complex chart overlays and other supplemental information as the user 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 raster<sup>4</sup> charts in those areas where an ENC has not been developed. The ECDIS also permits the operator to quickly retrieve electronic chart data regarding displayed information and aids to navigation such as buoys and lights. 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.

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.

### 1.1.8 Voyage Data Recorder (VDR)

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

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<sup>4</sup> Raster charts are exact scanned images of official charts.

COSCO BUSAN was a simplified VDR and captured data from the X-band, 3 centimeter Automatic Radar Plotting Aid (ARPA),<sup>5</sup> 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 and marked as ECN 3095030 #026 [REDACTED].

The U.S. Coast Guard has ample authority to seize and use VDRs and the information that they contain. It does not currently have a centralized state-of-the-art facility to analyze VDR data and frequently relies on the National Transportation Safety Board (NTSB) to perform the analysis. When VDRs were adopted in the marine transportation industry, the NTSB applied rules similar to those used for aircraft cockpit voice recorders and flight data recorders. In this case, since both NTSB and Coast Guard are authorized by statute to investigate, the NTSB released the VDR radar images to the Coast Guard and assisted the Investigating Officer in listening to the VDR audio recordings.

#### 1.1.10 “Pilot Plug”

In recent years many U.S. Pilot Associations have begun using portable pilotage units, loaded with electronic chart software of their preference, to pilot ships. These systems have varying degrees of sophistication, but in their basic form the units are connected to the ship’s AIS using an IMO approved AIS pilot port 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 pilotage unit is not mandated by Federal regulation, the State of California, or the San Francisco Bar Pilots. The COSCO BUSAN was fitted with an AIS pilot port 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.<sup>6</sup>

#### 1.2 San Francisco-Oakland Bay Bridge (Bay Bridge)

The following information is taken in part from Coast Pilot 7 (ECN 3095030 #034 [REDACTED]) and an e-mail from the Chief of the Eleventh Coast Guard District Bridge Branch (ECN 3095030 #044 [REDACTED]).

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

<sup>5</sup> An Automatic Radar Plotting Aid (ARPA) can create tracks using radar contacts and can calculate the tracked object’s course, speed, and Closest Point of Approach (CPA).

<sup>6</sup> The estimated usage of portable pilotage units by San Francisco Bar Pilots was obtained via informal survey by the Port Agent.

and was in good condition on November 7, 2007. Racons<sup>7</sup> 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 (ECN 3095030 #001 [REDACTED]).

### 1.3 Vessel Traffic Service (VTS) San Francisco

VTS San Francisco is operated by the Waterways Management Division of U.S. Coast Guard Sector San Francisco, and is located on Yerba Buena Island. The VTS operates 24 hours per day, 365 days per year, with multiple watchstanders providing safety information to vessels transiting San Francisco Bay. On November 7, 2007 all VTS watchstanders were fully qualified (ECN 3095030 #011 [REDACTED]).<sup>8</sup>

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 contacts (such as recreational or fishing vessels), unidentified contacts 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 contacts that may affect another vessel's transit (ECN 3095030 #033 [REDACTED]).

The VTS can, when necessary, issue measures or directions to vessels to enhance navigation and vessel safety through existing authority under the Ports and Waterways Safety Act (PWSA) (33 USC 1223(a)(4)) and 33 CFR Part 161. This includes authority to require a vessel to 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 using this authority at the time of the accident.<sup>9</sup>

### 1.4 Environmental Conditions

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,

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<sup>7</sup> A racon is a radar beacon which returns a specifically coded Morse Code signature signal indicating range and bearing when triggered by a radar interrogator. The term is derived from the words **radar beacon**.

<sup>8</sup> All VTS Watch stander Qualifications (PQS) are created locally due to the inherently unique geographical characteristics of each port. At the time of the accident, there were no Coast Guard-wide PQS Standards in place.

<sup>9</sup> Since the accident, the VTS working in conjunction with the San Francisco Bar Pilots and the San Francisco Bay Harbor Safety Committee have developed 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 in the VTS when visibility is less than ½ mile; and, (3) enhanced in-house training and re-certification for VTS operators.

with visibility  $\frac{3}{4}$  mile in mist or thin fog. Winds were variable at three knots and the air temperature was 52 degrees Fahrenheit (ECN 3095030 #016 [REDACTED]). 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 (ECN 3095030 #016 [REDACTED]). The tidal current at Yerba Buena Island, west of mid-channel, was 1.2 knots with a direction of 168 degrees True (ECN 3095030 #042 [REDACTED]).

## 1.5 Pilotage

History is essential to an understanding of pilotage and its legislative treatment. The word “pilot” is derived from the Dutch expression describing a lead weight attached to its sounding line. In early days, vessels used this device to determine the depth of water, and the person in charge of the vessel was called the pilot. By the time of adoption of the U.S. Constitution, many of the thirteen colonies had pilotage regulations, and Congress continued those laws through the Act of August 7, 1789, which stated:

That all pilots in the bays, inlets, rivers, harbors, and the ports of the United States shall continue to be regulated in conformity with the existing laws of the States, respectively, wherein such pilots may be, or with such laws as States may respectively hereafter enact for purpose, until further legislative provision shall be made by Congress. 1 Stat. at Large, 54.

Congress acted on pilotage for the first time on March 2, 1837 to resolve problems caused by conflicting state regulations in ports where a river or harbor formed a common border between states. The 1837 Act permitted a vessel to take a pilot licensed or authorized by the laws of either state.

On February 28, 1871 Congress acted for the first time to reduce the scope of state pilotage control when it enacted 16 Stat. at Large 440, Chapter 100, which stated in part:

...every coastwise<sup>10</sup> seagoing steam vessel...not sailing under register,<sup>11</sup> shall, when under way, except on the high seas, be under the direction of pilots (licensed by the United States).

That law has remained unchanged, and established the dual pilotage system currently 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

<sup>10</sup> Coastwise trade refers to the carriage of cargo from one U.S. port to another U.S. port, and is restricted by the Jones Act to U.S. flag vessels.

<sup>11</sup> A vessel sailing under “register” is engaged in international trade, vice coastwise trade.

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 (ECN 3095030 #010 [REDACTED]).

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 (ECN 3095030 #010 [REDACTED]). Section 1178 of the Code requires that persons applying for an original license have "proper federal endorsements."

### 1.5.1 Pilot of the COSCO BUSAN

The state pilot of the COSCO BUSAN was Captain [REDACTED] [REDACTED]. Captain [REDACTED] 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. He sailed on deep draft vessels and tugs in various capacities world wide, before returning to San Francisco in 1977 to begin working on 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. He currently holds a master of Steam or Motor Vessels not more than 1600 Gross Tons with a First Class Pilot Endorsement.<sup>12</sup>

Captain [REDACTED] 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 (ECN 3095030 #054 [REDACTED]):

Bridge Resource Management	California Maritime Academy	November 11, 2001
Ship-Handling Tug Course	Grenoble, France	August 23, 2003
Fatigue, Sleep and Medications	MITAGS <sup>13</sup>	June 6, 2005
Ship Simulator Course	MITAGS	June 8, 2005
Emergency Ship-Handling/Bridge Resource Management for Pilots	MITAGS	June 11, 2005

According to an article published in the *San Francisco Chronicle* on December 7, 2007, the California State Board of Pilot Commissioners for the Bays of San Francisco, San Pablo and Suisun filed charges against Captain [REDACTED], seeking suspension and/or revocation of his state pilot's license. A hearing on the matter was initially set for September 2, 2008. In the interim, Captain [REDACTED] notified the Board on June 23, 2008, of his intent to retire as a state licensed pilot

<sup>12</sup> Captain [REDACTED] Federal License has been on Voluntary Deposit with Sector San Francisco since December 21, 2007 pending resolution of his pending physical incompetency issues.

<sup>13</sup> MITAGS is the Maritime Institute of Technology and Graduate Studies, located in Linthicum Heights, Maryland.

effective October 1, 2008. In light of this request, the state and Captain [REDACTED] entered into a Stipulation and Order to Dismiss the Action against him conditioned on the premise that he does not withdraw his retirement request.

## 1.6 Pre-Departure Actions

The second officer produced a paper chart that a previous crew had used, and placed it on the chart table without verifying any of its waypoints or plotted courses.<sup>14</sup> 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” (see Appendix 1). The space between racons “B” and “Y” is 0.3 nautical miles. The charted course of 313 degrees True is just 0.05 nautical miles (approximately 300 feet) northeast of the Delta tower, extremely close for a prudent passage. While inbound, San Francisco Bar Pilot [REDACTED] [REDACTED] reviewed the vessel’s paper chart and noted that the common inbound/outbound trackline was too close to the Delta Tower. He pointed this out to the crew, but the trackline was not revised prior to departure as recommended by [REDACTED].

A passage plan was not prepared in accordance with the SMS procedure for sailing in restricted visibility on the day of the accident. The second officer did not enter any waypoints, intended tracklines, wheel over points, or any other navigational information or alarms into the ECDIS for the outbound transit. The master’s standing orders required position fixes be taken every five minutes in pilotage waters.

Captain [REDACTED] 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 (ECN 3095030 #001 [REDACTED], ECN 3095030 #035 [REDACTED], and ECN 3095030 #036 [REDACTED]). Captain [REDACTED] examined the radars and requested the crew to adjust the radars. Captain [REDACTED], the master, and the third officer spent 45 to 60 minutes adjusting the radars until Captain [REDACTED] was satisfied with the radar picture and the ability to acquire and track contacts. Captain [REDACTED] and the crew had a difficult time getting both ARPAs to acquire and track contacts, but Captain [REDACTED] was ultimately satisfied. The ARPAs were tested after the casualty and found to be working properly. The VDR images of the ARPA display indicated significant interference and excessive radar return. Expert testimony from a Sperry Marine representative attributed any distortion in the radar’s image to abnormally high radar gain settings. The gain adjustment was made by the ship’s crew while tuning the radar alongside the pier. Testimony by Captain [REDACTED] and the ship’s crew indicated that they had considerable difficulty adjusting and tuning the radar. The proximity of the shoreside container cranes and the radar interference they would create likely contributed to the radar tuning problems and resultant degraded ARPA display.

Beyond the discussions surrounding Captain [REDACTED] dissatisfaction with the radar images and

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<sup>14</sup> The ship was using British Admiralty Chart 588, San Francisco Bay Golden Gate to Alameda, which was corrected and up-to-date.



tracking of contacts, 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 a passage plan. Captain [REDACTED] did not examine the trackline laid out on the paper navigation chart. There was no discussion of the frequency or methods for taking fixes or reporting the fixes to the master or pilot. Captain [REDACTED] also did not discuss his intended plan for the outbound transit with the master or navigational team.

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 (ECN 3095030 #003 [REDACTED]). The third officer completed a pre-underway checklist as required by the SMS, which was signed at an unknown time by the master (ECN 3095030 #018 [REDACTED]). 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) (ECN 3095030 #002 [REDACTED]).

At 0636, Captain [REDACTED] checked in with VTS San Francisco via VHF radio and was advised of inbound vessel traffic and low visibility conditions. At 0713, Captain [REDACTED] reported a delay in departure due to paperwork, and was advised of an inbound tug. At 0743, Captain [REDACTED] 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 [REDACTED] and the master about whether the vessel should remain at the pier until visibility improved. There was, however, conversation among the crew on the bridge 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 by administrative issues and while waiting for the two inbound tugs to pass. There was no pressing need for the berth to be vacated for another vessel.

During his subsequent testimony, the master did express some concern over the possibility of the COSCO BUSAN not sailing on schedule at 0700, contradicting his earlier statements. This was based upon his erroneous presumption that since the "Port Authority" hadn't closed the port, he was obliged to sail as scheduled. He believed that if he didn't sail, the vessel/company would incur additional costs and if it was his unjustified reluctance (the port wasn't closed) to sail under the conditions which caused the loss, he stated he was concerned that he could lose his job with Fleet Management.

## 1.7 The Casualty

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<sup>15</sup>).

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<sup>15</sup> The person with the "conn" is the person giving the engine and helm commands. Although the pilot had the conn, the Master, as the senior person on the bridge, had ultimate authority and responsibility for the vessel.

At 0748, the last line was singled up, and at 0806 Captain [REDACTED] reported the COSCO BUSAN was underway. Captain [REDACTED] 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 [REDACTED] navigated the COSCO BUSAN out of the estuary using radar and visual observations of Lights "7" and "8" and Lighted Buoys "5" and "6." At 0822, while underway in the estuary, Captain [REDACTED] 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 [REDACTED] 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 [REDACTED] was not carrying a personal laptop with familiar chart software, which might have helped him decipher the meaning of symbols on the ECDIS display. Neither Captain [REDACTED] nor the ship's crew utilized the full informational query capabilities of the ECDIS as it operated as an ECS. By moving the cursor to any electronic chart symbol, an operator can easily query that chart symbol and be provided with an exact description of the symbol's characteristics, including such data as its name, description, size, shape, color and position. This would have clearly assisted Captain [REDACTED] and the ship's crew to quickly and easily understand exactly what they were looking at and would have answered Captain [REDACTED] question.

As the vessel continued outbound, Captain [REDACTED] 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 [REDACTED] attempted to maintain a distance of .33 nautical miles off Yerba Buena Island using the radar Variable Range Marker (VRM), 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. At 0824, when the COSCO BUSAN was nearly abeam of Lighted Buoy "1" and .33 nautical miles from Yerba Buena Island, it was on a heading of 270 degrees True and swinging to port. To continue as planned, Captain [REDACTED] 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 also could have directed an appropriate heading to make good a course to racon "Y," which was visible on the ARPA he was using. However, at 0823 Captain [REDACTED] initiated a swing to port by ordering the helm 10 degrees to port. At 0825, Captain [REDACTED] ordered the rudder midships, but this order did not check the vessel's port swing. At 0827, a watchstander at Vessel Traffic Service (VTS) San Francisco contacted Captain [REDACTED] because the VTS display indicated the vessel's course over ground was about 235 degrees True, which is approximately parallel to the bridge, and was setting up to pass well southwest of the intended track.

Captain [REDACTED] 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 (ECN 3095030 #001 [REDACTED]). 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 [REDACTED]. Yerba Buena Island presented a clear radar image. The radar's VRM was set to .33 nautical miles and remained there

throughout as directed by Captain [REDACTED] 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.

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, as laid out on the chart (see Appendix 1). According to VDR data, at this time the vessel's heading was 282 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. In fact, the AIS trackline record shows the COSCO BUSAN was never closer than 200 yards of the 0820 position marked on the chart by the third officer.<sup>16</sup> 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" (ECN 3095030 #011 [REDACTED]).

The COSCO BUSAN was steady on a course of between 282 and 284 degrees for less than four minutes as the vessel entered the Bay and approached buoy #1. At 08:23:21 Captain [REDACTED] gave a helm command of 10 degrees port rudder to initiate a turn to port. This command, as well as all helm and course commands during the voyage, was quickly and effectively answered by the helmsman. The pilot maintained the 10 degree port rudder for about a two minute period. Interestingly, at 08:24:49 the helmsman called out that the rudder was 10 degrees port. This was answered in the affirmative by Captain [REDACTED] as he replied, "Yeah, 10 port". At 08:25:30 Captain [REDACTED] gave the helm command to place the rudder midship. At that time the ship's heading was 253 degrees True and the vessel was swinging smartly to port. Very shortly thereafter and in rapid succession, Captain [REDACTED] gave the helmsman course commands and ordered him to steer 250, and then 245 degrees. At that time the vessel was swinging to port past the headings of 247 and then 243 degrees True. The vessel reached a maximum heading deflection to port of 241 degrees True at 08:26:33 as Captain [REDACTED] gave the helm commands of starboard 10, followed almost immediately by starboard 20 and then ordered the engine full ahead at 08:26:54.

At 08:27:24, VTS San Francisco contacted Captain [REDACTED] by radio and initiated the following exchange (ECN 3095030 #026 [REDACTED]):

<u>Time</u>	<u>Party</u>	<u>Verbatim Transcript</u>
08:27:24	VTS	Unit Romeo <sup>17</sup> , Traffic.
08:27:45	Romeo	Traffic, Romeo <sup>18</sup> Did you call?

<sup>16</sup> The third officer erased the 0820 and 0830 GPS plots after the casualty and before the Coast Guard seized the chart. Fortunately the first Coast Guard Investigating Officer to arrive took a photograph of the chart before the erasures.

<sup>17</sup> Unit Romeo is Pilot Captain [REDACTED]

<sup>18</sup> The Coast Guard Radiotelephone Handbook (COMDTINST M2300.7A) lists the "Transmitting the operator's personal sign or name" as a "Forbidden Practice". It is unclear if the use of a Pilot's personal identifier violates this rule. As a result of recent testimony, it was suggested that the use of the vessel's name might be a better alternative,

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, the Operator was well aware that his display only gave him the Course Over Ground (COG) information transmitted to the VTS via the Automatic Identification System (AIS). It did not actually provide him with the vessel's gyrocompass heading information.

The vessel's heading is a static measurement typically taken from the vessel's gyrocompass 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.

Captain [REDACTED] moved to the adjacent ECDIS display and asked the master a second time whether the red triangle symbols marked the center of the bridge. The master replied "yeah, yeah." At 08:28:13, after receiving this confirmation from the master, Captain [REDACTED] ordered the rudder hard starboard and responded to the VTS, "Yeah, we're still Delta-Echo."

At 08:28:42 Captain [REDACTED] 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 chief officer had been on the bow during the undocking, but then moved aft to rest and was not on the bow at the time of the allision as the master believed. The master and Captain [REDACTED] both saw the column seconds later. Captain [REDACTED] responded by ordering the rudder midships at 08:29:26; hard port at 08:29:31; and midships at 08:30:07. Captain [REDACTED] 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 [REDACTED] 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 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 also 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 [REDACTED] anchored the COSCO BUSAN in Anchorage 7. Another pilot boarded and

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especially when dealing with vessels where the crew has limited English skills. By using the name of the vessel as opposed to the Pilot Identifier would more likely alert all crew members hearing the call to respond or alert other crewmembers, including the Master and/or the Pilot.

relieved Captain [REDACTED], 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.

### 1.7.1 The Tug REVOLUTION

After assisting with undocking, Captain [REDACTED] 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 [REDACTED] 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 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 (see Figure 5). As the speed of the COSCO BUSAN increased, the tug had difficulty keeping up, and the tug's operator was forced to slip more line. At about 0829 the operator 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 (ECN 3095030 #002 [REDACTED]). 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. The pilot did not contact the REVOLUTION during the outbound transit until after the accident.

### 1.7.2 Damage

The Bay Bridge sustained damage to the wood and plastic fender system and concrete tower support (ECN 3095030 #044 [REDACTED]). 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 \$1.5 to \$2 million (See Figure 7, with additional photos located in ECN 3095030 #022 [REDACTED]).

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 (ECN 3095030 #001 [REDACTED] and ECN 3095030 #013 [REDACTED]). Temporary repairs were completed in San Francisco at an estimated cost of \$1 million (ECN 3095030 #038 [REDACTED]). Permanent repairs were completed outside the U.S., at an estimated cost of \$1.5 million (See Figure 8, with additional photos located in ECN 3095030 #023 [REDACTED]).

### 1.7.3 Pollution

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) (ECN 3095030 #009 [REDACTED]). 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 (ECN 3095030 #009 [REDACTED]). One witness reported that a "substantial flow of oil" was pouring out of the after part of the damaged area as late as 0852 (ECN 3095030 #055 [REDACTED]).

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 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 (ECN 3095030 #056 [REDACTED]).

## 1.8 Drug and Alcohol Testing

After the COSCO BUSAN had been anchored, a pilot boat delivered another pilot, who went to the bridge and met Captain [REDACTED]. Although untrained in its use, Captain [REDACTED] 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 [REDACTED] for the presence of alcohol. Captain [REDACTED] was then transported ashore, 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 [REDACTED] (ECN 3095030 #015 [REDACTED]).

A Coast Guard Investigating Officer administered breath alcohol tests to the master, chief engineer, third officer (officer on watch), and able seaman (helmsman) between 1124 and 1130. All tests were [REDACTED] (ECN 3095030 #005 [REDACTED]).

A properly trained and certified collector (ECN 3095030 #049 [REDACTED]), 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. Thus, 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 officer (lookout), third officer (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 ██████████ (ECN 3095030 #006 ██████████, ECN 3095030 #007 ██████████, ECN 3095030 #016 ██████████, ECN 3095030 #017 ██████████, ECN 3095030 #018 ██████████, ECN 3095030 #019 ██████████, ECN 3095030 #020 ██████████, ECN 3095030 #021 ██████████, ECN 3095030 #021 ██████████, and ECN 3095030 #014 ██████████).

## 1.9 Fatigue

Captain ██████████ 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 ██████████ 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 ██████████ reported lifestyle is relatively inactive. When not working he relaxes at home reading or watching television. Captain ██████████ 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. He stated that he ate dinner the night before and got seven hours sleep, arising at 0415. A 96-hour work/rest history<sup>19</sup> was completed during an interview with Captain ██████████ on November 27, 2007 (ECN 3095030 #053 ██████████). Captain ██████████ also disclosed his current health and medication use (ECN 3095030 #052 ██████████). Specific medical information is protected by privacy laws and therefore it is not included in this summary.

There are numerous human factors in Captain ██████████ life which may contribute to fatigue, decreased alertness, and 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 have not been provided.

## 1.10 Equipment Tests

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

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<sup>19</sup> A 96-hour work/rest history is good for short-term rest evaluation, but is inadequate to evaluate long-term sleep deprivation.

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 (ECN 3095030 #043 [REDACTED] and ECN 3095030 #050 [REDACTED]).
- The gyro, ARPAs, and ECDIS were tested by a manufacturer's representative and found working properly. (ECN 3095030 #005 [REDACTED]).
- 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. (ECN 3095030 #022 [REDACTED]).
- 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. (ECN 3095030 #041 [REDACTED]).

## 1.11 Pilot Physical Examinations

### 1.11.1 Federal Requirements

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 (ECN 3095030 #004 [REDACTED]) the Coast Guard exercised this existing authority to require the submission of the annual physical 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" (ECN 3095030 #003 [REDACTED]);
- (3) Various National Maritime Center (NMC) Work Instructions (ECN 3095030 #007 [REDACTED]); and
- (4) Draft NVIC XX-07, "Medical and Physical Evaluation Guidelines for Merchant Mariner



Credentials, revised 11/06 (ECN 3095030 #005 [REDACTED] and ECN 3095030 #006 [REDACTED]).<sup>20</sup>

The MSM, NVIC 2-98, draft NVIC, and work instructions (ECN 3095030 #007 [REDACTED]) were used by Coast Guard personnel at Regional Examination Centers (REC) and the 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, will 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. Until 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.

### 1.11.2 State Requirements

Sections 1175 and 1176 of the California Harbors and Navigation Code address physical examination requirements for 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 (ECN 3095030 #010 [REDACTED]). 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 (ECN 3095030 #012 [REDACTED]). 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" (ECN 3095030 #059 [REDACTED]). This guide was developed by a collaborative group of seafarers, shipping associations, and federal agencies

<sup>20</sup> 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 [REDACTED] 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.

called the Seafarer's Health Improvement Program (SHIP). SHIP was formed after Congressional Hearings in 1978 that concluded that greater attention needed to 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.

### 1.11.3 Aviation Medical Examiner System

The Federal Aviation Administration (FAA) has a robust Aviation Medical Examiner System, outlined in FAA Order 8520.2F, revised October 25, 2007 (ECN 3095030 #009 [REDACTED]). 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).

1.11.4 Captain ██████ Physicals

The following information is based on an interview of Dr. ██████, MD on January 9, 2008, that is documented in ECN 3095030 #011 ██████.

There are four doctors approved by the San Francisco Bar Pilots to give pilot physicals, one of whom is Dr. ██████. He has a copy of the Physical Examination for Retention of Seafarers in the U.S. Merchant Marine (1986), and is familiar with it. Dr. ██████ is a primary care physician in a practice with five other physicians and treats primarily adults. He is 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. Dr. ██████ has 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. ██████ stated that he follows the criteria on Form CG-719K when performing physicals, and that he is familiar with the form. He does 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 provide a copy of the CG-719K form to the Pilot Association. Dr. ██████ 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. ██████ vividly recalled his last physical with Captain ██████ (January 19, 2007), which he described as "adversarial," something he had never

experienced before. He stated that Captain █████ reported some medical conditions and prescription medications that he had not revealed during previous physicals. It caused Dr. █████ to probe deeper into Captain █████ newly reported conditions. Dr. █████ stated that Captain █████ became agitated and left the office, stating he needed to consult his attorney. He returned later to continue the interview. Dr. █████ said that he very pointedly warned Captain █████ that he should not take some of the medications he had been prescribed within 24 hours of working, and that Captain █████ assured him that he did not. Despite this warning, by his own admission after the casualty, Captain █████ took at least one of the medications that Dr. █████ told him he should not take while working on the morning of the casualty. Since Captain █████ had received training from MITAGS in June 2005 in "Fatigue, Sleep and Medications," and was clearly warned by Dr. █████ 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.

#### 1.11.4 Coast Guard Review of Captain █████ Physicals

REC San Francisco provided licensing services to Captain █████ for his Coast Guard-issued Merchant Mariner's Credentials. Captain █████ 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. █████, 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. █████ and which also found Captain █████ "fit for duty" (ECN 3095030 #023 █████).

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 █████ condition. Please include a waiver statement on his license when it is issued" (ECN 3095030 #023 █████). The e-mail provided no further explanation of which of Captain █████ 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 █████ 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 waived medical condition shall be immediately reported to the nearest REC."

Captain █████ applied for a license renewal in 2004 using a CG-719K dated January 30, 2004 and signed by Dr. █████, who again found Captain █████ "competent" (ECN 3095030 #024 █████). This physical documented changes in Captain █████ 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 █████ 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 █████ January 18,

2006 physical was nearly identical to the January 30, 2004 physical, and was again signed by Dr. [REDACTED], who found Captain [REDACTED] competent. There is no evidence in the 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 [REDACTED] submitted a copy of his annual physical to the REC (ECN 3095030 #025 [REDACTED]). The physical was signed by Dr. [REDACTED], who again found Captain [REDACTED] competent. However, this physical included significant information affecting Captain [REDACTED] 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 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.<sup>21</sup> 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.

## 2.0 Analysis

### 2.1 Actions of the Pilot, Master, and VTS

The numerous failures of Captain [REDACTED] warrant close examination, beginning with his failure to engage the master in a proper pilot-master exchange. Captain [REDACTED] arrived at the vessel more than one hour before departure and had plenty of time to review the vessel's chart, and maneuvering characteristics, and discuss his own plans with the master. This is the first step in the formation of a bridge management team. Instead, Captain [REDACTED] simply provided the master with a San Francisco Bar Pilots' pamphlet and received the Pilot Card. The Pilot Card contains detailed information concerning the ships' size, drafts (fore and aft), equipment and other maneuvering and navigational particulars. It is not known whether either of them read the information provided to the other, but the pamphlet provided by Captain [REDACTED] to the master was

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<sup>21</sup> 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 [REDACTED] 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.

silent with respect to low visibility procedures. He spent the remainder of the time before getting underway trying to tune the ARPA's with the master and third officer. He did not review the ship's chart, and did not discuss his own plan with the master. After the casualty, Captain [REDACTED] explained this conduct by stating that he never uses the ship's passage plan and thus would have no reason to review one that might have been onboard COSCO BUSAN. He likened piloting a ship from the estuary to sea as the equivalent of "driving a bus from my driveway." Captain [REDACTED] extreme confidence was based on his 27 years of experience as a San Francisco Bar Pilot.

Captain [REDACTED] also failed to consider the possibility of remaining at the pier to await better visibility. He had discussions with the master about delays and waiting for an inbound tug and barge to pass, but he did not ask the master whether he was comfortable getting underway in the low visibility. Captain [REDACTED] decided to sail in part because visibility in the estuary had improved to the point where he could see across the estuary, a distance of at least one quarter mile. But during these delays Captain [REDACTED] was on the bridge and most certainly heard nearly constant radio traffic between vessels, and between vessels and the VTS, discussing visibility as low as 400 feet in the Bay and decreasing. Here again Captain [REDACTED] decision was influenced by overconfidence based on his experience sailing in the frequent fog in San Francisco Bay. The consideration of staying at the pier was simply not part of his paradigm. He exercised a bias toward getting underway as soon as possible. Captain [REDACTED] was so confident that he did not even discuss low visibility precautions with the master until after getting underway, and then only asking whether there were lookouts forward. There was no discussion about taking more frequent position fixes or how those fixes were to be taken.

Captain [REDACTED] intended to navigate the COSCO BUSAN to sea using the same procedure he had used for 27 years, turning the vessel to port at Lighted Buoy "1" and then turning slowly right, to a heading of 313 degrees True, to maintain a .33 nautical mile distance off Yerba Buena Island. This plan would take the COSCO BUSAN under racon "Y," marking the center of the outbound channel.

While still in the Inner Harbor Entrance Channel, Captain [REDACTED] asked the master for the first of two times about the meaning of the red triangle symbols on the ECDIS display. It is not known whether Captain [REDACTED] was pointing to a specific symbol on the display, but that is irrelevant since all of the red triangle symbols represent red aids-to-navigation. Those with a teardrop symbol are lighted aids and those without are buoys (see Appendix 1). Captain [REDACTED] was told by the master that the symbols were on the bridge.

At 08:27:33 the VTS asked Captain [REDACTED], "Unit Romeo, Traffic. AIS shows you on a 235 heading. What are your intentions? Over." Captain [REDACTED] responded that, "Um. I'm coming around. I'm steering 280 right now." Based on radar images captured by the VDR, at the time that Captain [REDACTED] told the VTS he was "...steering 280 right now" the ARPA's gyro repeater indicated a heading of 268.8 degrees. The ARPA's gyro repeater is real time information, and clearly shows the vessel was not "...steering 280 right now." It appears Captain [REDACTED] was surprised to hear from the VTS that the COSCO BUSAN was on a heading of 235 degrees, and he had significantly lost situational awareness. It is also clear that Captain [REDACTED] had forgotten that the tug REVOLUTION was still made up to the COSCO BUSAN's stern.

While talking to the VTS, Captain [REDACTED] moved from the ARPA to the adjacent ECDIS display, allegedly because the ARPA image had deteriorated. Afterward, Captain [REDACTED] claimed the radar image of the bridge suddenly widened to three quarters of a mile, obscuring Yerba Buena Island and the racons. Here again the ARPA images captured on the VDR contradict Captain [REDACTED] claims. The "Y" racon, marking the mid-channel of the Delta-Echo span, was clearly visible on the ARPA Captain [REDACTED] had been using before moving a few steps to his right to the ECDIS display. At 0828, Captain [REDACTED] asked the master the same question he had asked earlier about the red triangle symbols on the ECIDS display, a highly unusual question for a pilot of any experience to be asking the master, let alone twice within six minutes. It appears that Captain [REDACTED] intended to ask about the center of the channel, but was understood by the master to be asking about the geographic center of the bridge. Since these buoys in fact are near the geographic center of the bridge, the master's affirmative answer to the question, as it was posed by Captain [REDACTED], was correct. Afterward, the master stated that he would have responded differently if Captain [REDACTED] had asked about the center of the channel, but he also questioned why a pilot should need to ask about the center of the bridge or the center of the channel. The master made a valid point. Captain [REDACTED], as a highly trained and licensed pilot with 27 years experience, should not have needed help from the master to identify the center of the channel or to interpret the buoy symbols on the ECDIS display. This may be an example of impaired cognition that is not explainable by lack of experience. Repeating the question he had asked only minutes earlier about the red triangle symbols could indicate a lack of short term memory, or complete confusion on his part.

The vessel's heading and swing to port, as well as the fact that the distance off Yerba Buena Island was quickly opening and exceeding the intended .33 nautical mile distance, was easily detectable on the ARPA Captain [REDACTED] had been using. The vessel's course over ground was nearly parallel to the bridge and its position was plainly further to the left and well southwest of Captain [REDACTED] intended track. These same displays were available to the master, yet he took no action when the vessel clearly departed from the intended trackline. He never questioned the pilot's orders or the vessel's increasing speed prior to the casualty.

Captain [REDACTED] became aware of the looming Delta Tower ahead on the port bow of the COSCO BUSAN less than one minute before the allision. How he could have been so detached and unaware while navigating in near zero visibility is inexplicable, and proof of a failure to maintain a proper lookout by all available means. He executed emergency orders to swing the vessel's stern to starboard, away from the fender system and tower. These orders likely mitigated damage to the ship and the fender system. Captain [REDACTED] at first was hopeful that he had avoided the allision, but reports of damage and an oil spill led to him confiding to others that "I never should have left the pier."

Among Captain [REDACTED] most serious errors was the failure to operate the COSCO BUSAN at a safe speed. Considering the flood tide, he could have easily maintained steerage at a slower speed. Although he had not received a position report since departure, was underway in near zero visibility at a speed of more than 10 knots, lacked confidence in the ARPA, and was apparently baffled with the ECDIS symbols, Captain [REDACTED] remained calm and was completely

relaxed in the final seconds before the collision. The crew reported that Captain [REDACTED] showed no signs of extreme stress or panic throughout the transit, even as he executed the emergency maneuvers.

## 2.2 Inland Navigation Rules

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 [REDACTED]. All the data show that the speed of the COSCO BUSAN increased steadily after departure, and especially after entering the Bay, reaching a peak of over 10 knots. Despite Captain [REDACTED] initial concerns about the radar images, he stated that the speed of the COSCO BUSAN was appropriate, even given the fog. He stated he had no concerns because there was no other vessel traffic,<sup>22</sup> and that bare steerage (about six knots) was not sufficient to counter the flood tide that would set the vessel to the southwest upon departing the estuary. He also stated he likes to have more water going over the

<sup>22</sup> VTS San Francisco was in fact tracking several other vessels in the Bay during the COSCO BUSAN's outbound voyage, including passenger ferries. Captain [REDACTED] was informed of these vessels by VTS San Francisco.



rudder (i.e. more speed) when passing under the bridge because currents there require greater speed to maintain control.

Captain ██████ statements about the need for additional speed do not make sense. If the COSCO BUSAN had turned as Captain ██████ planned to pass under the Delta-Echo span in the centerline of the channel, the vessel would have been heading into the flood tide (stemming the tide), which would increase water flow over the rudder and improve maneuverability. Thus he could have proceeded at a slower speed and the tidal current would have augmented maneuverability while passing under the bridge. If transit at the slower speeds required by the visibility was insufficient to counter the current, as Captain ██████ claims, then the correct decision was to remain at the pier until visibility improved to the point where additional speed could be prudently applied. The speed of the COSCO BUSAN was clearly too fast to allow proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions. If the COSCO BUSAN had been operated at bare steerage, Captain ██████ would have had more time to evaluate the vessel's position when he felt that the radar image was insufficient and had allegedly deteriorated. Although it could be argued that the vessel's turn rate increases with speed, the key to safe navigation in zero visibility lies in always anticipating the potential hazards, knowing the vessel's position relative to those potential hazards, and planning accordingly so that radical evasive action is unnecessary. Slower speeds allow more time to evaluate the circumstances and adjust as needed. In this case, had the COSCO BUSAN proceeded at bare steerage, the pilot and master would have had more time to react to emergent circumstances and either abort the Delta-Echo approach or correct the course for a center passage under the Delta-Echo span.

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. There is ample evidence in this case of the failure of the pilot and crew of the COSCO BUSAN to maintain a proper lookout, the most obvious being the fact that no one was aware of the ship's relative position to the bridge until the boatswain notified the bridge that the tower was ahead less than one minute before the collision.

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. As has been discussed, the pilot and crew of the COSCO BUSAN failed in their responsibility to comply not only with the Inland Navigation Rules, but in other important areas as well, starting with the failure to await better visibility as suggested by the SMS. Other failures include the failure to create a berth-to-berth passage plan, the failure to amend the passage plan for restricted visibility, the failure to conduct a proper pilot-master exchange, the failure to take frequent fixes and monitor the vessel’s progress, the failure to maintain a proper lookout by all means available, and the failure to operate the COSCO BUSAN at a safe speed.

### 2.3 Safety Management System (SMS)

Although the master and deck officers completed the SMS Checklist for Crew Familiarization on October 24, 2007, the failure of the master and deck officers of the COSCO BUSAN to follow SMS procedures indicates they were either unfamiliar with the SMS procedures or willfully failed to follow them.

The SMS contained a procedure for navigation in restricted visibility (See Section 1.2.1 – Bridge Team) The SMS procedure did not include a requirement for periodic position fixes to ensure that the vessel remained on course. However, the master’s standing orders required position fixes every five minutes. Importantly, the SMS 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 SMS, or chose to ignore it, and he ignored his own standing orders. He did not discuss the possibility of waiting at the pier for better visibility with the pilot.

The crew completed SMS checklist #3, preparations for getting underway, but did not complete checklist #10, procedures for getting underway in limited visibility. Checklist #3 was completed by the third officer and was signed and dated November 7, 2007 by the master after the casualty. 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 Checklist #3 and were unaware of additional U.S. requirements. The failure to complete checklist #10 and the failure to comply with the pre-departure test requirements of U.S. regulations is further evidence of the failure of Fleet Management, Ltd. to properly train and indoctrinate the crew.

### 3.0 Conclusions

1. The cause of this casualty was the failure of the pilot of the COSCO BUSAN to properly direct the movement of the vessel, as he navigated it at a high, unsafe speed in near zero visibility, failed to properly monitor the vessel’s position and progress, and lost situational awareness, and 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.

2. 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 discuss and consider the possibility of waiting at the berth for better visibility.

3. Contributing to the cause of this casualty was the failure of the pilot and master to effectively communicate relevant navigational information with each other during the course of the voyage leading up to the casualty.

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 and did not review 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, the pilot should not have been confused by the Operator's reference to the vessel's COG as their "heading." Since the pilot knew that he was engaged in a turn, and his heading was swinging right, he reasonably should have expected that the VTS's reported information would lag 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 should 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 portable pilotage unit, which could help him navigate vessels. More importantly, he did not understand the meaning of symbols on the ECS on the COSCO BUSAN.

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 GPS 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 [REDACTED] 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." 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 and master 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 omission 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 racon 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.
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 substantial 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.
28. There is substantial evidence that Fleet Management, Ltd. employees, with COSCO BUSAN crewmember knowledge and/or assistance, committed acts that could subject them to administrative, civil or criminal penalties under the laws of the United States.

### 3.0 Recommendations

1. Recommend a copy of this report be provided to the following entities:
  - The Government of Hong Kong.
  - Regal Stone, Ltd.
  - Fleet Management, Ltd.
  - The International Maritime Organization (IMO)
  - Germanischer Lloyd
  - The U.S. Maritime Administration (MARAD)
  - San Francisco Bar Pilots (SFBP)
  - The State of California, Office of Spill Prevention and Response (OSPR)
  - The State of California Board of Pilot Commissioners for the Bays of San Francisco, San Pablo and Suisun
  - The Harbor Safety Committee of the San Francisco Bay Region
  - The Cities of Oakland and San Francisco
2. Recommend Regal Stone Ltd., owners and Fleet Management, Ltd., operators of the COSCO BUSAN, review the Safety Management System (SMS) Procedures for pre-underway equipment tests, crew familiarization, and navigation in restricted visibility.

3. Recommend the Captain of the Port (COTP) San Francisco work with the San Francisco Bay Harbor Safety Committee to develop a risk-based decision making job aid for mariners sailing in restricted visibility.<sup>23</sup>

4. Recommend Vessel Traffic Service (VTS) San Francisco develop procedures for exercising and enforcing Coast Guard authority under the Ports and Waterways Safety Act (PWSA) to implement the procedures developed per Recommendation 3.

5. 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 portable pilotage unit with an AIS pilot port feature should be a mandatory, minimum standard for all pilots.
- Whether personal portable pilotage units 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.

6. Recommend the Commandant of the Coast Guard amend the existing standards in Marine Safety Manual (MSM) Volume III, for medical professionals performing mariner physicals, to ensure that physicals are performed only by designated physicians with a thorough understanding of the physical and mental demands of a mariner's position.

7. Recommend the Coast Guard National Maritime Center (NMC) issue a comprehensive work instruction for the review and handling of annual pilot physicals, including requirements for documenting the review in the MMLD system.<sup>24</sup>

8. Recommend the Coast Guard National Maritime Center (NMC) expedite the replacement of NVIC 2-98, Physical Evaluation Guidelines for Merchant Mariner's Documents and Licenses.<sup>25</sup>

9. 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.

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<sup>23</sup> Since the accident, the VTS working in conjunction with the San Francisco Bar Pilots and the San Francisco Bay Harbor Safety Committee have developed protocols for periods of reduced visibility including (1) limiting vessels greater than 1600GT from getting underway when visibility is less than ½ mile; (2) adding an additional radar operator in the VTS when visibility is less than ½ mile; and, (3) enhanced in-house training and re-certification for VTS operators.

<sup>24</sup> The Coast Guard promulgated NVIC 04-08 Medical and Physical Evaluation Guidelines for Merchant Mariner Credentials on September 15, 2008.

<sup>25</sup> Ibid.

10. 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.

11. Recommend that the Commandant of the Coast Guard review current Vessel Traffic Service (VTS) radiotelephone practices nation-wide concerning methods of communicating with pilots while engaged in pilotage duties on vessels. Following this review, the Commandant should determine whether the development of nation-wide standard pilot-VTS communications protocols or guidelines is necessary.<sup>26</sup>

  
Senior Investigating Officer  
Sector San Francisco

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<sup>26</sup> The recently issued Coast Guard Radiotelephone Handbook (COMDTINST M2300.7A) seems to prohibit using Pilot personal identifiers (i.e., Unit Romeo) listing them as "Forbidden Practices" (Page 1-17). However, the Handbook does not specifically discuss communications with VTS users. The only real requirement for VTSs contained in the Handbook, is that they be able to communicate effectively with their users. Discretion is left to the local VTS, with input from their local maritime community, to develop their local communications procedures. An informal survey of all 12 of the Coast Guard VTSs conducted by CG-7413 produced mixed results with regard to standard communication procedures. Some VTSs almost exclusively use the vessel name. Others tend to use the vessel name and the pilot designator for some/initial communications. Once reliable communications are established with the Pilot, most follow-on communications are via the pilot designator. In cases where there are difficulties with raising the piloted vessel using the pilot designator, the vessel name is always used. While there is no specific guidance from IMO, the general tendency is to defer to local custom. The 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.



## Appendix 1

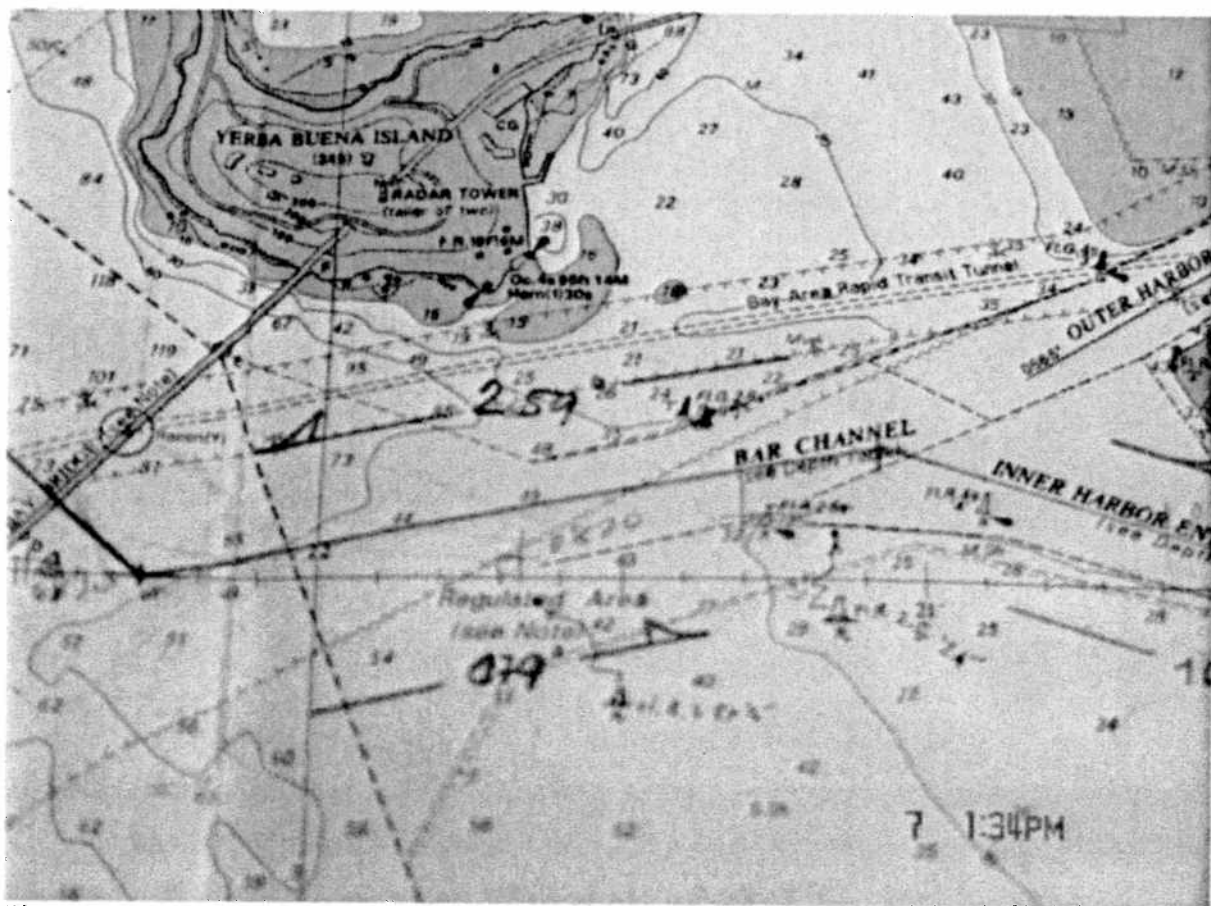


Figure 1. Coast Guard photo of the navigation chart from the M/V COSCO BUSAN. Note the "X" and "0820" (near the center of the photo) and "0830" notations, which are GPS positions plotted by the Third Officer while underway. This photo was taken before the Third Officer erased these positions after the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

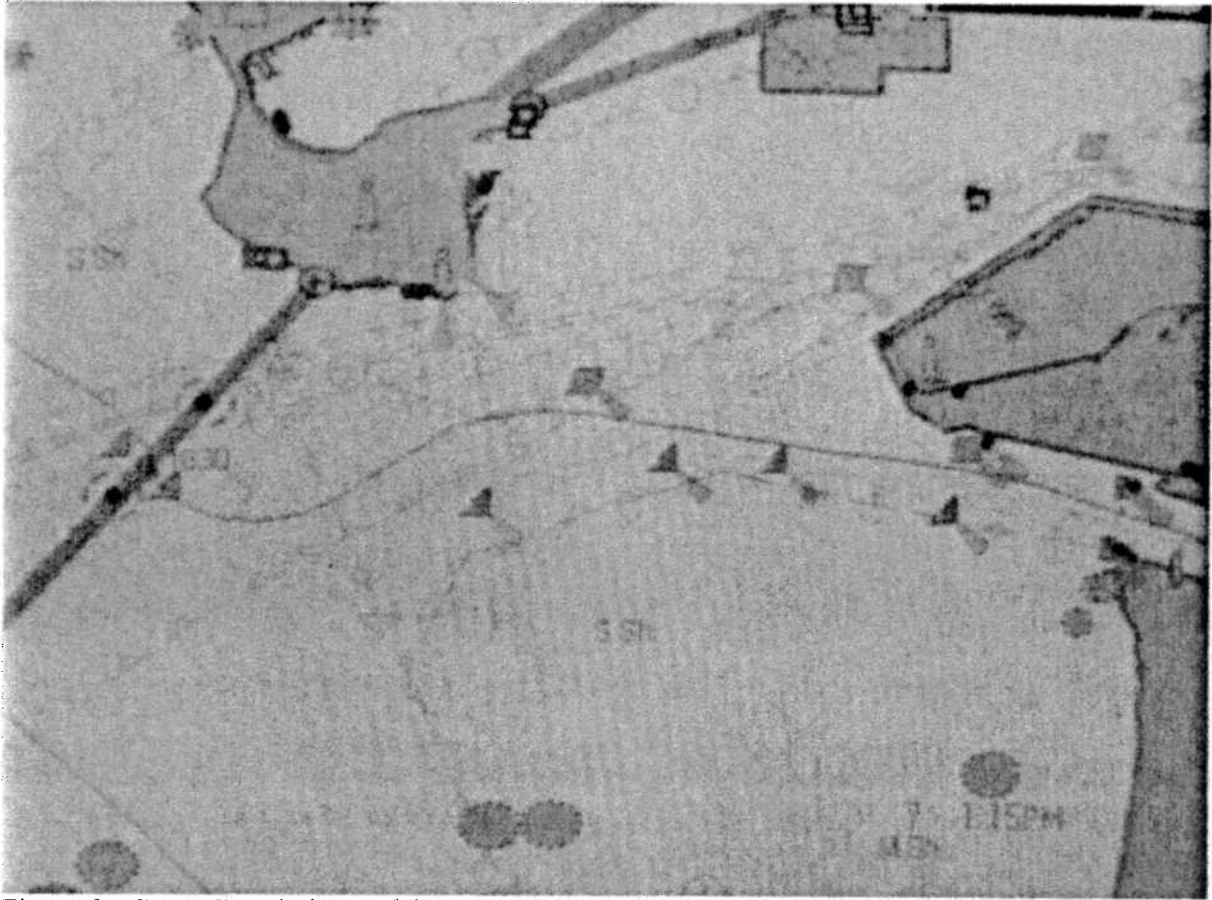


Figure 2. Coast Guard photo of the ECDIS display of the M/V COSCO BUSAN. Note the red triangle symbols with teardrops indicating lighted aids to navigation, and two red triangle symbols on either side of the Delta Tower Island, representing the buoys marking the Tower Island. The racon symbols (dark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

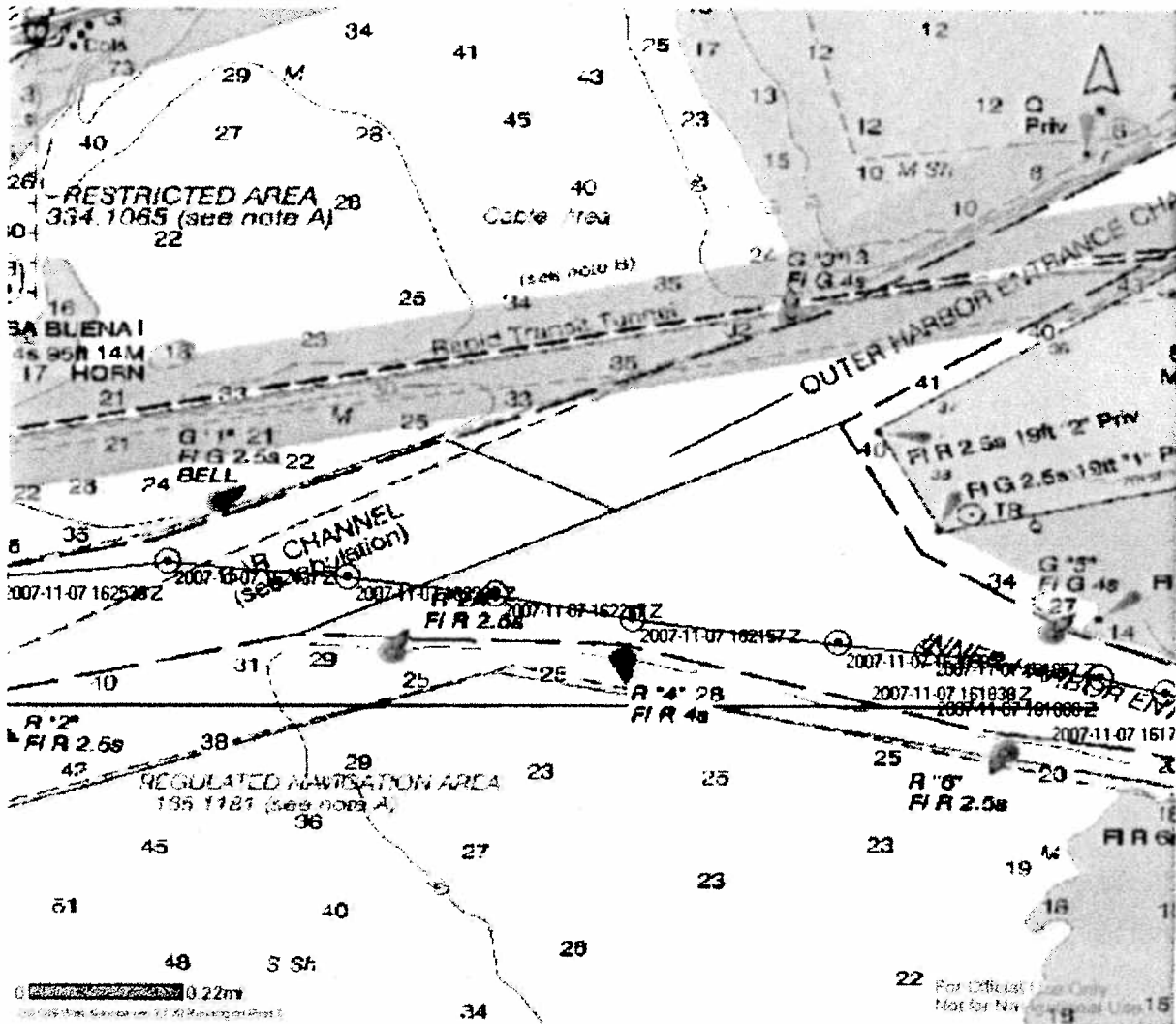


Figure 3. This image was prepared by the Coast Guard Office of Information Resources. Times shown are in Zulu (Greenwich Mean Time (GMT)), which can be converted to local time by deducting eight hours. This image shows the COSCO BUSAN's AIS trackline (indicated in blue) from Lighted Buoys "5" and "6"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



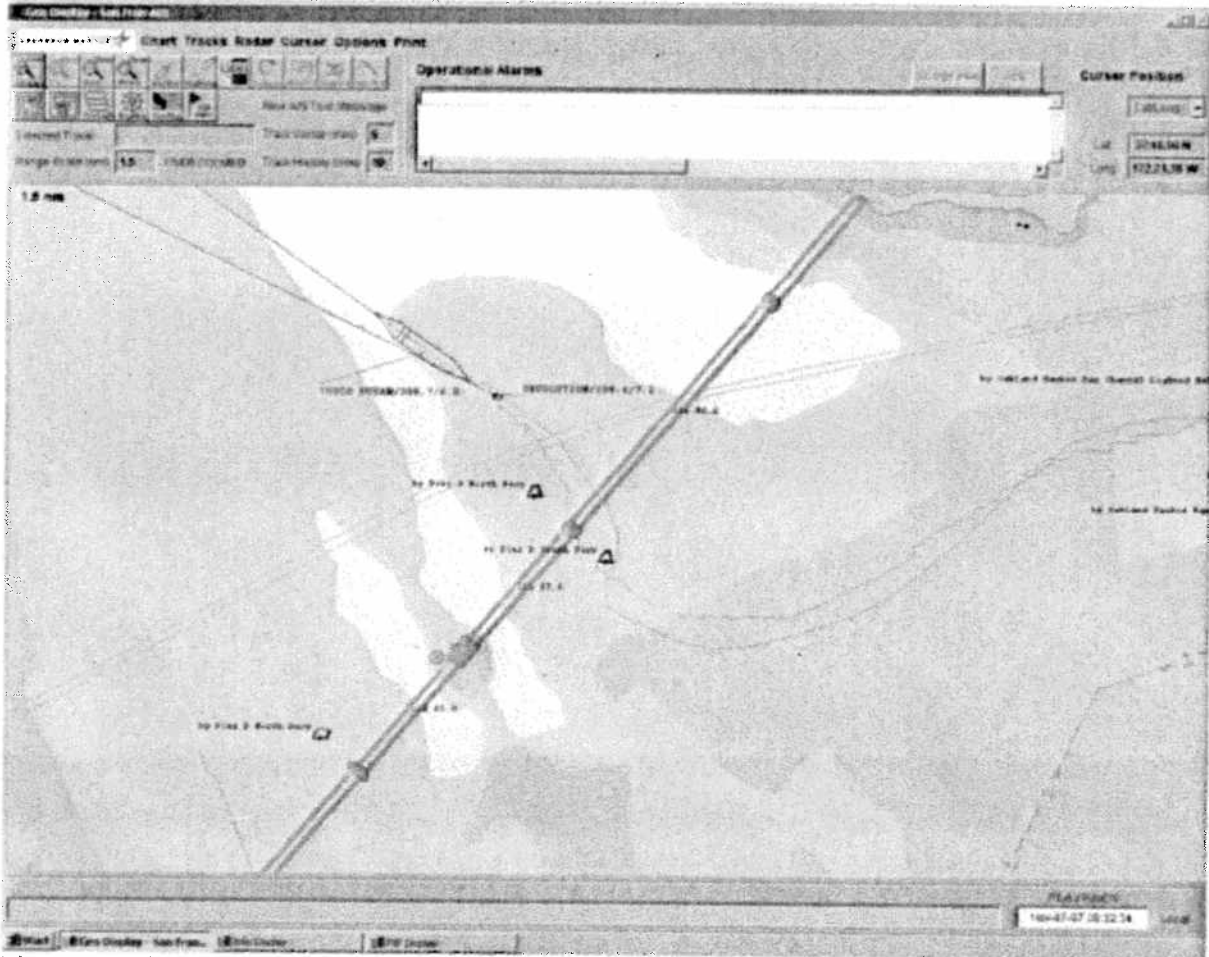


Figure 5. This image was recovered from the Coast Guard Vessel Traffic System (VTS) after the casualty. The green lines are the tracklines of the M/V COSCO BUSAN and the Tug REVOLUTION respectively. Note how the tug crossed the wake of the COSCO BUSAN as the ship maneuvered.

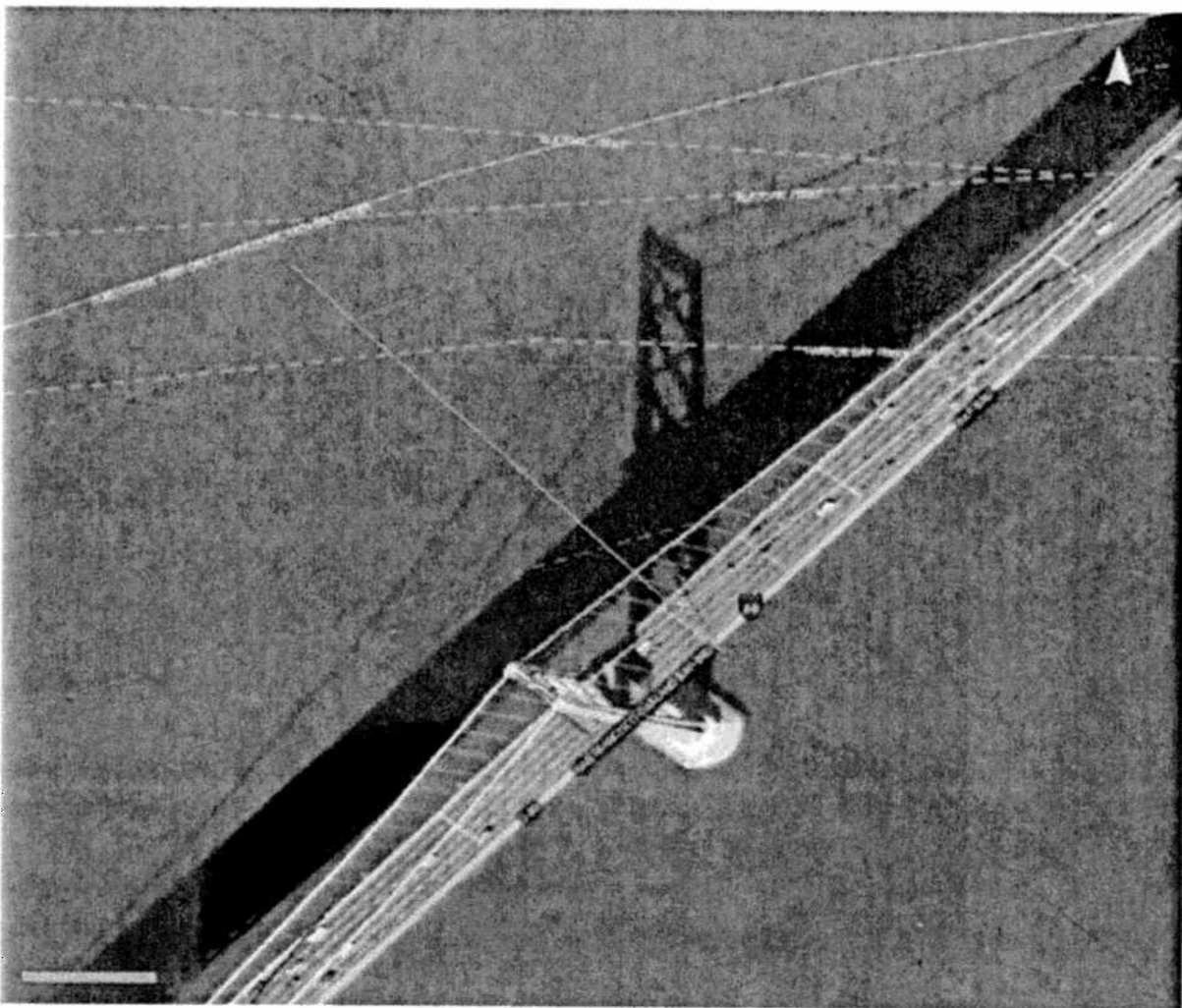


Figure 6. Aerial view of the Bay Bridge (Delta Tower) with the AIS trackline of the M/V COSCO BUSAN in blue.

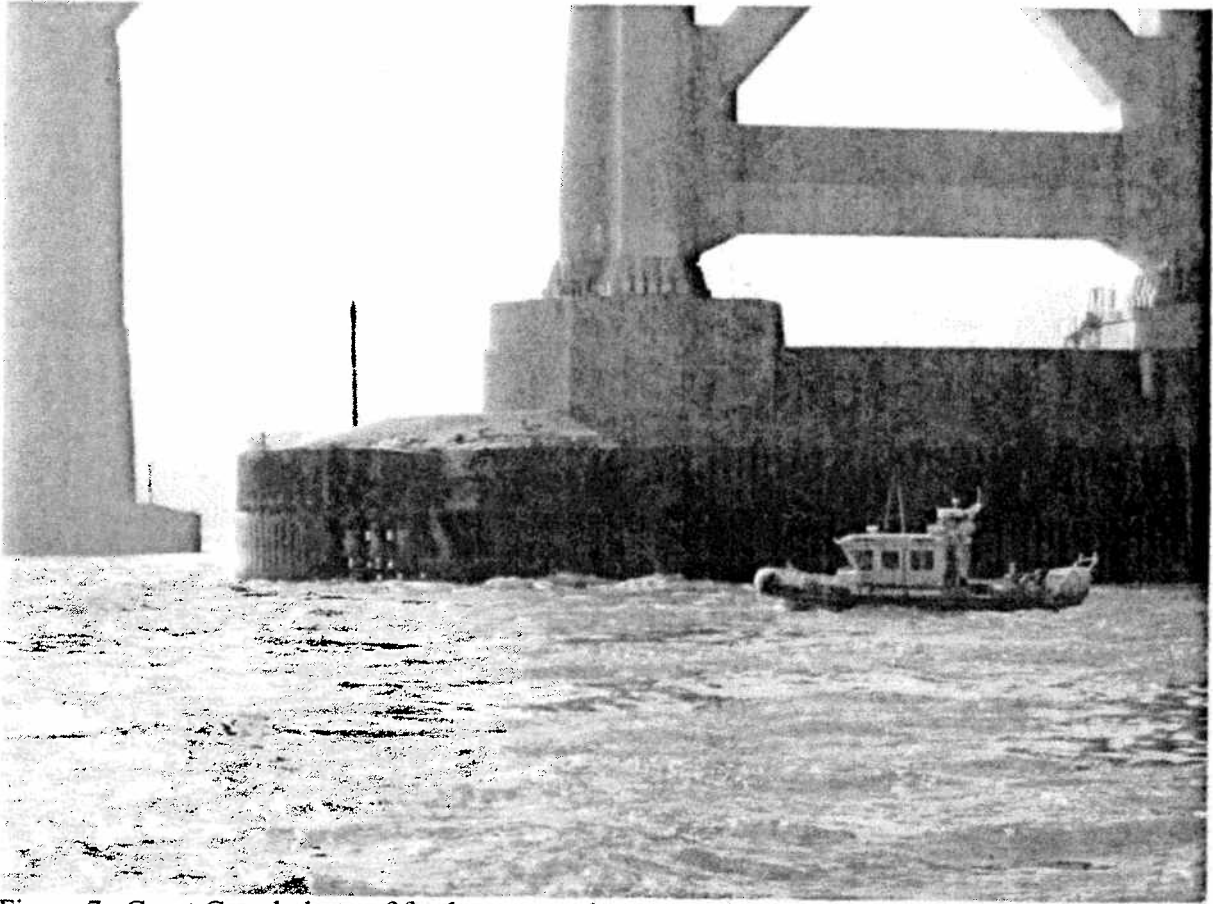


Figure 7. Coast Guard photo of fender system damage to the Bay Bridge



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