NATIONAL TRANSPORTATION SAFETY BOARD
Office of Marine Safety
Washington, D.C. 20594

OPERATIONS GROUP FACTUAL REPORT

DCA 08 MM 004

A. ACCIDENT

Vessel:	*Cosco Busan*
Date:	November 7, 2007
Time:	0830 PST (UTC -8)
Location:	40° 27.0' N, 073° 48.0' W
Owner:	Regal Stone Limited, Hong Kong
Managing Operator:	Fleet Management Limited, Hong Kong
Charterer:	Hanjin Shipping Company Limited, Seoul, Korea
Complement:	24 crew members

B. OPERATIONS GROUP

Larry D. Bowling, NTSB Chairman
Washington, DC

Rick W. Holly, State of California, Department of Fish and Game
Office of Spill Prevention and Response
Fairfield, CA

Gary Toledo, State of California, Department of Fish and Game
Office of Spill Prevention and Response
Sacramento, CA

Scott D. Schaefer, CDR, USCGR, Eleventh Coast Guard District
Deputy Chief, Incident Management Branch
Alameda, CA

Steven D. Brown, Captain, American Pilots Association
Portland, OR

M. S. Nagarajan, Captain, General Manager, Fleet Management Limited on behalf of Regal Stone Limited
Hong Kong

Richard A. Hurt, Captain, San Francisco Bar Pilots Association
San Francisco, CA

Patrick A. Moloney, Captain, State of California, Board of Pilot Commissioners
San Francisco, CA

Gerald R. Wheatley, USCG, Sector San Francisco
Senior Investigating Officer
Alameda, CA

C. SUMMARY

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

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

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

The pilot stated that as the *Cosco Busan* continued to make its way out of the Inner Harbor Entrance Channel, he could see the No. 4 and No. 6 buoys pass by and noted that their lights were visible. He kept the vessel to the high side of the channel as

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

he departed the estuary in anticipation of the flood current he would encounter. He stated that the visibility again diminished, and that he could not see the No. 1 buoy marking the northern boundary of the entrance to Bar Channel as the vessel passed by. At this time, the vessel was making approximately 10 knots.

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

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

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

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

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

D. DETAILS OF THE INVESTIGATION

The Operations Group convened in Oakland, California, on November 11, 2007, at 1800. The group examined records and interviewed personnel from the San Francisco Bar Pilots Association, Fleet Management Limited, U.S. Coast Guard Sector San Francisco Command Center, and the Vessel Traffic Service.

1. Vessel History:

Construction of the *Cosco Busan* began in June 2001 as hull number 1381 at Hyundai Heavy Industries Company at Ulsan, Korea. The construction was financed by Conti Reederei.[2] The *Cosco Busan* was one of four containerships of common design and the capacity of 5,500 TEU[3] built at the Hyundai shipyard between 2001 and 2002 for the Conti Group. The other vessels of this class were the *Conti Goteborg, Conti Helsinki,* and the *Conti Taipei.*

Upon its delivery from the shipyard in December 2001, the vessel was placed under long-term charter to Hanjin Shipping Company, Limited, of Seoul Korea. The company entered the vessel into its main pendulum service,[4] calling in various ports of Europe, Asia, and the west coast of the United States, specifically the Ports of Long Beach and Oakland, California. At that time, the vessel was owned by Conti Cairo (M.I.) Shipping Limited, Buxtehude, Germany, which was a corporation under the Conti Group, and was managed by a partner of the Conti Group, Niederelbe Shiffahrtsgesellschaft GmbH & Company, Buxtehude, Germany (NSB).[5] The vessel was initially registered under the flag of Germany on December 17, 2001. It was subsequently deleted from the registry at the owner's request on December 27, 2001.[6] On that same date, the vessel was issued a Provisional Certificate of Registry to operate under the flag of the Republic of the Marshall Islands as the *Hanjin Cairo.*[7]

Hanjin Cairo made its maiden call to the Port of Long Beach, California, on February 25, 2002, and continued operations in this pendulum trade route until March 14, 2003, making a total of 10 port calls in the Port of Long Beach and 9 port calls in

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[2] Conti Reederei, <www.conti-shipping.com>, is part of the Conti Group. The Conti Group, founded in 1970 by five entrepreneurs in Munich, Bavaria, was originally established to provide private capital for the financing of ship building and real estate projects. Today, the organization is based in Germany and specializes in technical project design, financing and project management of shipbuilding, commercial ship management, and ship operations.

[3] Container capacity is often expressed in *twenty-foot equivalent units*, or TEU. The 20-ft container is a common container worldwide and is 20 feet long and 8 feet wide. The height varies depending on container type.

[4] *Pendulum service* is a term used in the international shipping trade to describe a rigidly structured trade route from one continent to another and involves regular service to certain ports.

[5] Germanischer Lloyds, Maritime Services E-mail dated January 15, 2008.

[6] Bundesstelle fuer Seeunfalluntersuchung (BSU) Certificate of Registry dated December 17, 2001 and Certificate of Deletion dated December 27, 2001.

[7] Telephone Interview with assistant counsel, International Registries, Incorporated, Marshall Islands, January 28, 2008.

Oakland, California. On March 18, 2003, the ownership changed the vessel's registry back to the Germany, and the vessel did not call upon any U.S. ports for several years.[8]

On September 9, 2006, while moored in the port of Hamburg, Germany, and conducting cargo operations, the *Hanjin Cairo* was struck by the 340-foot, 3,828-gross-ton, Finnish-flagged containership *Klenoden,* which had experienced a steering casualty. At slow speed, the bow of the *Klenoden* struck the bow of the *Hanjin Cairo* at an approximate 45° angle. The *Klenoden* sustained heavy damage to the bow, and the *Hanjin Cairo* sustained only slight damage to the stem, but the steel plate on the uppermost portion of the bulbous bow was torn open and required repairs.[9] On November 30, 2006, the owners changed the vessel's name to *Cosco Busan*.[10]

After more than a 3-year absence from ports of the United States, the vessel resumed operating on the established Europe, Asia, and west coast pendulum trade route, and again called upon the Port of Long Beach on December 29, 2006.[11] On October 24, 2007, the vessel was sold to Regal Stone Limited, Hong Kong, a vessel ownership company established by Synergy Marine Limited, Nicosia, Cyprus. The new ownership appointed Fleet Ship Management Limited, British Virgin Islands, as the technical and crew managers of the vessel. Fleet Ship Management Limited then sub contracted the technical management to Fleet Management Europe Limited. Fleet Management Europe Limited is incorporated and based in England and is a branch of Fleet Management Limited. Fleet Management Limited is incorporated and based in Hong Kong and specializes in full technical ship management.[12] Fleet Management Limited is a member of the larger Noble Group Limited, Hong Kong, which is an investment holding company that specializes in the supply of raw materials, vessel chartering, and related operations.[13] The vessel was reflagged to the national flag of Hong Kong. Throughout the changes in flag, ownership, and managing operator, the vessel remained under charter to Hanjin Shipping Company, Limited, Seoul Korea, and under class with Germanischer Lloyd (GL)

From the time the vessel resumed trade in the United States on December 29, 2006, until the time of the casualty on November 7, 2007, the vessel had made a total of 13 port calls in the Port of Long Beach, California, and was outbound from its 9th port call in Oakland, California. In total, it was the vessels 18th port call upon the Port of Oakland, and there were no records of previous casualties or mishaps within U.S. waters. On January 11, 2008, while the vessel was undergoing permanent hull repairs in China, the vessel was renamed *Hanjin Venezia*.[14]

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[8] Bundesstelle fuer Seeunfalluntersuchung (BSU) Certificate of Registry dated March 18, 2003.
[9] Federal Bureau of Maritime Casualty Investigation (Germany), Report 474/06, *Collision of CMV Klenoden with CMV Hanjin Cairo.*
[10] Bundesstelle fuer Seeunfalluntersuchung (BSU) Notification of Name Change Certificate November 30, 2006.
[11] U.S. Coast Guard, Ships Arrival Notification System (SANS) Vessel Details.
[12] Letter from Fleet Management Limited April 1, 2008.
[13] Noble Group Limited, Annual Results 2006,< www.thisisnoble.com>, and <www.fleetship.com>.
[14] E-mail from General Manager, Fleet Management Limited, dated January 24, 2008.

2. Safety Management System (SMS):

2.1. SMS General

The objectives of Chapter IX, "Management for the Safe Operation of Ships," International Convention for Safety of Life at Sea (SOLAS), and the *International Safety Management (ISM) Code for the Safe Operation of Ships and for Pollution Prevention* are to ensure safety at sea, prevent the occurrence of human injury or loss of life, and minimize the risk of environmental or property damage.[15] The provisions of both SOLAS and ISM Code applied to the vessel *Cosco Busan* as a cargo ship over 500 gross tons engaged in international trade.

The technical management company for the *Cosco Busan*, Fleet Management Limited, had a Safety Management System (SMS)[16] that defined roles and responsibilities of all personnel, provided safe practices in ship operation and navigation, and established safeguards against certain identified risks. As required by the ISM Code and outlined in the company's SMS, the ship's master was responsible for implementing the SMS on board, for motivating the crew in the observation of that policy, for verifying that applicable procedures and requirements were adhered to, for periodically reviewing the SMS for areas of improvement, and for reporting all deficiencies to the designated person ashore (DPA).[17] The company itself was issued a Document of Compliance (DOC) from Det Norske Veritas (DNV) based upon the results of an audit of the company's SMS that was completed on May 24, 2005.[18] At the time of the allision, the DOC was valid, and subsequent periodic verifications had been performed as required, with the most recent audit being completed by DNV on May 23, 2007, in Hong Kong.[19] The issuance of a DOC to Fleet Management Limited by DNV on behalf of Flag of Hong Kong indicated the company was in compliance with the requirements of the ISM Code.

Because the vessel had had a change of ownership and management on October 24, 2007, the vessel was operating under an interim Safety Management Certificate (SMC) issued by Germanischer Lloyd (GL) on October 25, 2007, after an audit of the vessel.[20] An interim SMC can be issued to a new vessel upon delivery from a shipyard, when a vessel comes under the operation of a new management company, or when a

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[15] A *Safety Management System* (SMS) is a structured and documented system enabling company personnel to effectively implement the company safety and environmental protection policy, International Safety Management (ISM) Code, and revised guidelines on implementation of the ISM Code.
[16] Chapter IX, "Management for the Safe Operation of Ships," International Convention for Safety of Life at Sea (SOLAS) 1974 as amended, Regulation 2.1.2.
[17] International Safety Management (ISM) Code, and revised guidelines on implementation of the ISM Code by Administrations, 2002 Edition, 5.1, and Fleet Management Limited, Company Policy, Chapter 3, Policy and Quality Statement, January 6, 2003, Revision 1.
[18] Document of Compliance, Fleet Management Limited, DNV Certificate #D192375/050524F/HKG dated May 24, 2005.
[19] Chapter IX, "Management for the Safe Operation of Ships," International Convention for Safety of Life at Sea (SOLAS) 1974 as amended, Regulation 6.1.
[20] Interim Safety Management Certificate, Fleet Management Limited, GL Certificate #130056/07-127276 dated October 25, 2007.

vessel changes flag. The issuance of an interim SMC to the vessel indicated that all key elements of the ISM Code were assessed by the auditor and demonstrated to be in place, that the master and officers were familiar with the company SMS and its planned arrangement for further implementation on board, and that Fleet Management Limited had scheduled an Internal audit of the vessel within 3 months. Both the valid interim SMC and a copy of the valid DOC were on board the *Cosco Busan* at the time of the allision and were required for the vessels' operation in waters subject to U.S. jurisdiction.[21]

To facilitate the transition from the previous ownership and management to the new ownership and management, Fleet Management Limited had dispatched a port captain and the superintendent engineer to board the vessel on September 27, 2007, as observers and to familiarize themselves with the vessel's vital equipment. On October 24, 2007, in Busan, Korea, the ownership and management change occurred, and the new crewmembers supplied by Fleet Management Limited reported to the vessel for duty. The crew, all of whom were new to the vessel and new to Fleet Management Limited, began training on the company's SMS and the ships security plan. They also began training on the operations and procedures specific to the vessel's vital systems and equipment under the supervision of the port captain and the chief engineer who had joined the vessel earlier. This initial training of the new crewmembers occurred simultaneously with ongoing cargo operations and with a visit from representatives of the vessel's classification society. These representatives were on board conducting audits of both the SMS and the security plan and conducting a survey of the material condition of the ship to verify compliance with SOLAS and other international treaties. Just after midnight on October 24, 2007, the GL representatives issued provisional or interim certificates to the vessel, indicating substantial compliance with the various regulations, laws, and treaties that govern the safe and secure operation of the vessel. On October 25, 2007, the *Cosco Busan,* departed Busan, Korea, for the Port of Long Beach, California, under the control of the new master and crew provided by Fleet Management Limited. The port captain and superintendent engineer remained on board the vessel to continue the training effort and facilitate the indoctrination of the new crew. On the morning of the date of the allision, the port captain had completed this training and indoctrination effort and had disembarked the vessel before its departure from Oakland Berth 56.

2.2. Navigational Safety

The SMS in place on the vessel provided several risk-mitigation checklists and specified the shipboard practices that were to be followed by the master and crew to enhance navigational safety. These risk-mitigation procedures and checklists were found within the company's *Bridge Procedures Manual.* They included requirements for the development, monitoring, and execution of a passage plan; the procedures for monitoring and oversight of the pilot's actions; and guidance covering navigation at safe speeds during periods of restricted visibility, such as fog.

[21] Title 33 *Code of Federal Regulations* (CFR) Part 96, "Rules for the Safe Operation of Vessel and Safety Management Systems."

2.2.1. Passage Planning

Per the SMS, the second officer had prepared a berth-to-berth passage plan on November 7, 2007, from Oakland, California, to Busan, Korea.[22] The passage plan was signed and acknowledged that same date by all members of the vessel's navigation team, including the master.[23] The passage plan identified 30 waypoints along the vessel's intended track and provided the bridge navigation team with detailed navigational information for each waypoint. This navigational information included a latitude and longitude for each waypoint, course to steer from each waypoint, distance of travel between each waypoint, remaining distance to go from each waypoint, under-keel clearance calculations, tidal information, as well as the minimum intervals and means for obtaining a position fix. The plan established 10 minutes or less as the minimum position fixing intervals for vessels transiting waters of the Bay area and indicated that these position fixes were to be taken by radar and visual means. Once the vessel was at sea, these minimum position fixing intervals increased to hourly fixes using the Global Positioning System (GPS) as a preferred tool. The company's SMS procedure regarding monitoring the position of the vessel stated that position fixing must "be carried out using at least two independent means," during coastal passages and, when approaching or departing port, by using any or a combination of means to include visual compass bearings, radar bearings and ranges, GPS, transit bearings, or sounding lines. [24] The same procedure stated that GPS was the "most favoured means" to be used for obtaining a position fix while at sea.

The guidance regarding the monitoring and execution of the passage plan stated that "close and continuous monitoring of the ship's progress along the pre-planned track is essential for the safe conduct of the passage." The plans also stated:

> It will be important for the Master to consider whether any particular circumstance, such as the forecasted restricted visibility in an area, where position fixing by visual means at a critical point is an essential feature of the navigation plan, introduces unacceptable hazard to the safe conduct of the passage and thus, whether that section of the passage should be attempted under the conditions prevailing, or not.[25]

2.2.2. Pilot Oversight

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[22] Fleet Management Limited, *Bridge Procedures Manual*, Section 1.3, "Passage Plan," November 1, 2004, Revision 1.
[23] Cosco Busan Passage Plan dated November 7, 2007, from Oakland, California to Busan, Korea.
[24] Fleet Management Limited, *Bridge Procedures Manual*, Section 1.3.7.4, "Monitoring," June 1, 2001, Revision 0.
[25] Fleet Management Limited, *Bridge Procedures Manual*, Section 1.3.6, "Execution," February 20, 2007, Revision 1, and Section 1.3.7, "Monitoring,"June 1, 2001, Revision 0.

The vessel's SMS also addressed the need to ensure that the pilot had been properly provided with the ship's particulars and that the pilot and master had adequately discussed and agreed upon the proposed passage plan and the pilot's intended course of action.[26] The procedure in the SMS specifically stated that the pilot "acts only as an advisor" and that "should the Master consider the pilot to be endangering the ship or contravening any law, rule or regulation, he shall reject the Pilot's advice and relieve him of this duties and assume control of the ship himself."

When the pilot arrived on the bridge the morning of the incident, the bridge watch officer provided him with a "pilot card" that contained ship characteristics and ship maneuvering performance data normally needed during piloting activities. The pilot acknowledged receipt of this information by signing the document, noting "rec'd only" next to his signature and citing the name of the assist tug to be used, "Tug – *Revolution*," just below his signature.[27] This same pilot card had a checklist at the bottom of the card for the crew to use during the pre-departure verification process to ensure that the ship's vital navigation, steering, and mooring gear were tested and operational. Despite the notation "rec'd only" entered by the pilot on the pilot card, his signing of the card indicated that all vital systems, including the vessel's radar, were "Aboard and Ready."

At 0630, the third officer completed an SMS form titled "Bridge Checklist – 4, Master/Pilot Information Exchange" indicating that the pilot had been provided with a pilot card affirming that the proposed passage plan, weather conditions, un-berthing procedures, and use of the assist tug *Revolution* had been discussed and agreed upon by both the pilot and the master. The checklist also indicated that the progress of the ship and the execution of orders would be monitored by the master and the officer of the watch.[28] This checklist was signed by the second officer and the master.

2.2.3. Safe Speed in Restricted Visibility

The vessel's SMS conveyed the management company's position regarding sailing delays due to fog and relayed the company's expectations of the master in making prudent decisions whether to sail in periods of restricted visibility. The guidance stated:

> The Company does not wish their ships unduly delayed, but still less do they wish them to be damaged. A few hours gained will not compensate for weeks of repair work. The Company relies on their Masters to navigate prudently in restricted visibility. In fog or other conditions of restricted

[26] Fleet Management Limited, *Bridge Procedures Manual*, Section 1.5.8, "Pilotage, Pilots," June 1, 2007, Revision 1.
[27] Pilot card, *Cosco Busan*, November 7, 2007.
[28] Fleet Management Limited, "Bridge Checklist – 4, Master/Pilot Information Exchange," BCL-4, Rev 2/Feb 2005, dated November 7, 2007.

visibility, Master should ensure that the vessel proceeds at SAFE SPEED.[29]

At 0700, the second officer completed a form titled "Bridge Checklist – 10, Restricted Visibility" indicating that proper lookouts had been posted and that the Convention on the International Regulations for Preventing Collisions, 1972, were being complied with, "particularly with regard to proceeding at a safe speed."[30] At the time of the vessel's allision with the corner of the fender system of the Delta tower, the AIS data from the vessel, as recorded by VTS San Francisco, indicated the speed over ground as approximately 10.1 knots, which was in agreement with the GPS data captured on the vessel's Simplified Voyage Data Recorder (S-VDR). The radar data recorded by the vessel's S-VDR logged the speed at 7.9 knots over ground.

3. Harbor Safety Committee of the San Francisco Bay Region

3.1. History and Background

Spurred by the large oil spill that occurred off Huntington Beach, California, on February 7, 1990, when the single-hulled tank ship *American Trader* ruptured its hull with its own anchor, the California legislature enacted the Lempert–Keene–Seastrand Oil Spill Prevention and Response Act of 1990 (OSPRA).[31] This act mandated the creation of a Harbor Safety Committee (HSC) in the San Francisco Bay area and in other harbors within the State of California, with the stated purpose of developing recommendations "for the safe navigation and operation of tankers, barges, and other vessels within each harbor."[32] The membership of the HSC of San Francisco Bay Region comprises key maritime stakeholders from both the public and private sectors who meet regularly, usually monthly, in a public forum. Maritime safety recommendations from the HSC and other guidance are captured in a *Harbor Safety Plan* (HSP), which must be reviewed annually and submitted to the administrator of the Office of Spill Prevention and Response (OSPR) for comment and acceptance.

Recommendations found in the HSP are considered "best practices" by all port stakeholders and are not enforceable unless such recommendations become either Federal or State regulations through the respective regulatory processes. All Federal regulations cited within the HSP are enforced by the U.S. Coast Guard, and all California Code of Regulations (CCR) cited within the HSP are enforced by either the California State Lands Commission or the California Department of Fish and Game.

There are five distinct working groups within the HSC, each with a different focus that supports the fundamental aim of the HSC to reduce risk within the waterways of the

[29] Fleet Management Limited, *Bridge Procedures Manual*, Section 1.5.10, "Navigation in Restricted Visibility/Fog," June 1, 2007, Revision 0.
[30] Fleet Management Limited, "Bridge Checklist – 10, Restricted Visibility," BCL-10, Rev 1/May 2001, dated November 7, 2007.
[31] California Department of Fish & Game web site,< www.dfg.ca.gov/ospr/spill/nrda/nrda_amtrader.html>.
[32] HSC San Francisco Bay Region, Harbor Safety Plan (HSP) dated June 14, 2007, *Introduction*.

San Francisco Bay area. The work groups are Tug Escort, Navigation, Ferry Operations, Prevention Through People, and Physical Oceanographic Real Time System *(P.O.R.T.S.)*.[33]

The HSC of the San Francisco Bay Region held its first meeting on September 18, 1991, and produced its first approved HSP on August 13, 1992. Per State law, the HSC administrator is required to appoint a "representative of the pilot organizations within the harbor" and a "designee of the Captain of the Port from the United States Coast Guard, the United States Army Corps of Engineers, the National Oceanographic and Atmospheric Administration, and the United States Navy to the extent that each consents to participate on the committee."[34]

3.2. Harbor Safety Plan (HSP) for 2007

The current HSP for San Francisco, San Pablo, and Suisun Bays was approved on June 14, 2007. In the HSP, the membership of the HSC addressed various risks commonly encountered upon the local waterways, including a section on adverse weather titled, "Safety Considerations in Adverse Weather Conditions."[35] The guidance in that sections states:

> Reduced visibility during periods of fog requires that mariners observe caution. During reduced visibility, vessels may remain docked, reduce speed if underway or anchor in or near a channel to await improved conditions. Extra vigilance must be used in reduced visibility, particularly in or near navigation channels. Vessels within the Bay at a dock or at a safe anchorage should not commence movement if visibility is less than .5 nautical miles throughout the intended route, unless the operator's assessment of all variables is that the vessel can proceed safely. The operator's local knowledge should include an understanding of historic weather patterns during that time of year, current weather reports, and checking with reporting stations along the route. This guideline acknowledges that the Bay region is a series of bays and rivers, in-Bay distances are long and that there is not a single Bay region climate, but a series of microclimates with variable fog. The Captain of the Port has the authority to prohibit movement of vessels within all or portions of the Bay during adverse weather conditions.

The HSP also outlines various outreach and partnership programs within the maritime community as a way of sharing "professional information in order to foster a team approach to the issue of navigation safety within the San Francisco Bay Area."[36] One such effort is the VTS–Pilots Issue Committee, or (VPIC). This committee, which

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[33] San Francisco Marine Exchange web site,<www.sfmx.org>.
[34] Title 14 California Code of Regulations (CCR), § 800.6(a)(7) & (12) and 8670.23(c)(9)
[35] HSC San Francisco Bay Region, HSP dated June 14, 2007, Section II, *General Weather, Currents and Tide.*
[36] HSC San Francisco Bay Region, HSP dated June 14, 2007, Section XII, *Vessel Traffic Service.*

comprises the VTS San Francisco operations director, operations administrator, training coordinator, and members of the San Francisco Bar Pilots Association, meets every quarter to discuss how VTS and the pilots can better serve one another. The VPIC meetings, which serve as a forum in which both groups can review interactions from their respective points of view, has been credited with automating the exchange of information about vessel arrivals and departures and refining and enhancing the reports provided to mariners that pertain to construction in the Bay area that may affect vessel movement.

4. Vessel Traffic Service (VTS) Sector San Francisco:

4.1. VTS General

The U.S. Coast Guard uses a wide range of activities and tools to achieve order and predictability upon the waterways of the United States, including establishing aids to navigation, implementing vessel routing systems and navigation rules, and operating VTSs. Coast Guard management of the waterways is accomplished on two distinct levels that may be categorized as "passive" or "active."[37] *Passive* management is a form of vessel traffic management in which the waterway user is solely responsible for compliance, such as that which would occur in a Regulated Navigation Area (RNA) or a vessel traffic separation scheme.[38] *Active* management is used primarily when passive management is deemed inadequate to meet the desired level of safety or protection of the environment. Active management involves direct interaction between a representative of the U.S. Coast Guard and the waterway user to ensure compliance. VTS is the most common active management tool used by the U.S. Coast Guard.

The Port of Liverpool, England, is generally credited with being the first port to use shore-side radar to manage ship movements, having used it as early as 1949. In the United States, this concept was first instituted by the U.S. Coast Guard in 1968 as a research and development project in the San Francisco Bay area to evaluate the use of land-based radar to control vessel traffic. The research project was named The Harbor Advisory Radar Project, or HARP.[39] Participation in this early system was voluntary, and many vessels transiting the waters of San Francisco Bay did not participate. On January 18, 1971, the circumstances surrounding the collision of tank ship *Arizona Standard* and the tank ship *Oregon Standard* under the Golden Gate Bridge spurred the development and passage of two laws designed to enhance overall maritime safety. The first law was 33 U.S. Code §1201, also known as the Bridge to Bridge Radiotelephone Act of 1971, which required positive means whereby the operators of approaching vessels could

[37] U.S. Coast Guard, *Marine Safety Manual*, Volume VI, Chapter 4

[38] A Regulated Navigation Area, or RNA, is a water area within a defined boundary for which regulations for vessels navigating within the area have been established under 46 CFR, Part 165, *Regulated Navigation Areas and Limited Access Areas.* RNAs may be used in an area of the waterway which is determined to have hazardous conditions to control vessel traffic and may include specific times of entry or departure, size, speed or draft limitations, or any other measure considered necessary for the safe operation of the vessel under the circumstances. 46 CFR 165.10 and 165.11.

[39] U.S. Coast Guard, District 11 Public Affairs Fact Sheet, November 19, 2007.

communicate their intentions to one another through voice radio. The second law was 33, U.S. Code §1221, also known as the Port and Waterways Safety Act of 1972 (PWSA), which gave the U.S. Coast Guard the authority to construct, maintain, and operate VTSs within waters subject to U.S. jurisdiction. Shortly after Congress passed the PWSA in 1972, the U.S. Coast Guard established both VTS San Francisco and VTS Puget Sound.[40]

VTS San Francisco is an element of the U.S. Coast Guard Sector San Francisco Command. The Vessel Traffic Center (VTC) is located on the highest point of Yerba Buena Island in San Francisco Bay and is staffed continuously by 33 trained civilian and military personnel with the stated mission of coordinating "safe, secure and efficient transit of vessels in San Francisco Bay, including its approaches and tributaries, in an effort to prevent accident or terrorist actions, which could result in the loss of life, damage to property or the environment."[41] This mission is accomplished by integrating a variety of sensors and communications systems, such as radar, closed-circuit television (CCTV), VHF radio, and Automated Identification System (AIS) data, into a traffic image that can be used by VTS controllers to manage the risk associated with vessel movement in the congested waterways of the Port of San Francisco, the Port of Oakland, and the Carquinez Straight where many marine oil terminals are located. VTS San Francisco used the U.S. Coast Guard VTS software from the early 1990s to integrate these sensors and communication devices into usable traffic imagery for the watchstanders. VTS San Francisco has also partially deployed the Lockheed Martin Corporation-developed Marine Traffic Management (MTM-200) System, which launched under the Port and Waterways Safety System (PAWSS) project in 1997.[42]

Figure 1. VTS San Francisco VTS controller station.

[40] U.S. Coast Guard, Vessel Traffic Services Fact Card, <www.uscg.mil/hg/g-cp>.
[41] Harbor Safety Committee of San Francisco Bay Region, Harbor Safety Plan, June 14, 2007.
[42] U.S. Coast Guard Professional Paper, *Systems and Equipment in use at U.S. Coast Guard Vessel Traffic Services*, B. Tetreault, Commander, USCG, dated December 11, 2007.

In addition to the sensors, equipment, and software already noted, VTS San Francisco and other VTSs utilize a Vessel Movement Reporting System (VMRS) to monitor and track vessel movements. This system requires that waterway users provide a *sailing plan*, *position report* and a *final report*, to the VTS.[43] The sailing plan, which must be provided to VTS via VHF radio 15 minutes before a vessel navigates in VTS waters, must include the vessel name, vessel type, current position, time and point of entry into VTS-controlled waters, vessel destination, intended route of travel, estimated time of arrival at destination or exit from VTS-controlled waters, and any dangerous cargo, if applicable.[44] The position report is required upon a vessel's actual entry into VTS-controlled waters, at designated points within a VTS area, and as directed by the VTC.[45] The final report is required upon a vessel's arrival at its destination or when leaving a VTS area, and it must include the vessel's name and position.[46] Although these regulations afford certain exemptions for vessels on published routes or vessels that operate within a small nautical area, vessel participation in the VRMS is mandatory for all power-driven vessels of 40 meters or more, all towing vessels of 8 meters, and all passenger vessels carrying 50 or more passengers.[47] The information provided from the vessel to VTS is entered into an electronic form called a "Universal Track Data Card," or UTDC, and these data can be retrieved or displayed by the VTS controller as the vessel transits the coverage area.

The local waterways actively monitored by VTS San Francisco include all of the waters of the San Francisco Bay region, south of the Mare Island Causeway Bridge and the entrance markers of the Petaluma River, the San Joaquin River as far east as the Port of Stockton, the Sacramento River as far north as Sacramento, and all seaward approaches to the San Francisco Bay area.[48] Because the area subject to VTS control is so large, it is divided into two sectors: the Offshore, or Ocean/Delta, Sector and the Inshore, or Central Bay Sector. The two areas are managed separately by watchstanders or VTS controllers .

Watch sections at VTS San Francisco normally consist of three VTS controllers and a VTS watch supervisor. The three VTS controllers rotate every 80 minutes through the two sector control positions as well as through a third position, known as watch assist administrator, with the entire watch section being rotated every 8 hours. The VTS watch supervisor is assigned to oversee each 8-hour watch section and is responsible for ensuring that all watch positions are properly manned and that all VTS controllers perform in accordance with established standards, policies, and procedures.[49] Communications for the Ocean portion of the Ocean/Delta Sector are managed by a controller using VHF channel 12, and the portion known as Delta Sector are managed

[43] Title 33 CFR 161.15.
[44] Title 33 CFR 161.19.
[45] Title 33 CFR 161.20.
[46] Title 33 CFR 161.22.
[47] Title 33 CFR 161.16 and 161.23.
[48] Title 33 CFR 161.50.
[49] VTS San Francisco *Operational Policies Manual,* VTSSFINST M5401.2, dated March 18, 1999.

on VHF channel 14. The Central Bay Sector is managed by a controller using VHF channel 14. In addition to the management functions of the VTS watch supervisor, that position also handles internal communications between VTS and the Sector Command Center, as well as monitoring VHF channels 10, 12, 13, 14, and 16. The watch assist administrator acts as an assistant to the watch supervisor, performing various functions as directed.

4.2. Authority and "Continuum of Control" Concept

The grounding of the tank ship *Argo Merchant* southeast of Nantucket Island, Massachusetts, on December 15, 1976, and the subsequent oil spill that occurred when the vessel broke apart 6 days later, prompted the development and passing The Port and Tanker Safety Act of 1978. The act gave the U.S. Coast Guard, via the Secretary of Transportation, the authority to order any vessel to operate or anchor in a manner directed by Coast Guard if, in the interest of safety, such directive was justified because of weather, visibility, sea conditions, port congestion, or other hazardous circumstances.[50] This authority is delegated from Coast Guard commandant to the commander, Sector San Francisco, as the captain of the port, and eventually to the VTS controller, subject to the supervision of the captain of the port and the commander, Eleventh Coast Guard District.[51] Specific guidance to the VTS controller at VTC San Francisco in exercising this authority is found in several documents, including a *Standard Operating Procedures* and *Operational Policies Manual,* and sections of the *Marine Safety Manual*.[52]

The State of California and the Coast Guard specifically addressed the authority of a VTS as a waterways management tool to prevent marine pollution in a memorandum of agreement, or MOA, signed February 26, 1997. That document, titled, *Memorandum of Agreement on Oil Pollution Prevention and Response Between the Commander, Eleventh Coast Guard District and the State of California*," had the stated purpose of ensuring that:

> …the Parties exercise their respective authorities regarding oil spill prevention, planning, and response in a manner so as to avoid unnecessary duplication and conflict and to ensure best achievable protection from the impact of pollution incidents for the navigable waters of the United States which are within or may impact the State waters of California; subject to each Party's statutory, regulatory, and policy requirements.[53]

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[50] Title 46 U.S. Code § 3703.
[51] Title 33 CFR 160.5.
[52] U.S. Coast Guard, Marine Safety Manual, Volume VI, Chapters 1 & 4, VTS San Francisco *Standard Operating Procedures* dated May 15, 2007, and VTS San Francisco *Operational Policies Manual,* VTSSFINST M5401.2, dated March 18, 1999.
[53] *Memorandum of Agreement on Oil Pollution Prevention and Response between the Commander, Eleventh Coast Guard District and the State of California* dated February 26, 1997*,* Section II,"Purpose of the Agreement."

In Section VI, “Prevention of Oil Spills,” the concept of a VTS is addressed. The MOA states:

> The Federal system of VTS is designed and empowered to inform, advise, and direct marine traffic in designated areas. Federal VTSs require the participation of certain classes of vessels and may direct the movement of those vessels to reduce navigational risks.[54]

At VTS San Francisco, the authority to direct vessel movement is applied using the concept of “continuum of control.” Within the continuum of control concept are four levels of control that the VTS controller can exert over a vessel operating within the system. The four levels of control are *monitor*, *inform*, *recommend*, and (the highest level of control) *direct*.[55] At the *monitor* level of vessel control, the VTS controller is simply using the sensors and VHF radio to track vessel movement within the waterway. At the *inform* level, a VTS controller disseminates information of navigational significance or relevance to vessels within the system. At the *recommend* level, the VTS controller serves as an extension of the vessel’s bridge team and, based upon data from the VTS system that is not available on board a vessel, may offer navigational suggestions or alternatives for consideration by the master or pilot. In this case, the VTS controller has determined that a certain action is necessary to mitigate a perceived risk, but the decision whether or not to take a specific action remains with the master or pilot. At the *direct* level of control, a VTS controller who has determined that a certain vessel action is “necessary to enhance navigation and vessel safety, and protect the environment” will provide the master or pilot with clear and specific action(s) that must be taken to mitigate the risk.[56] These directions or control measures include “imposing vessel operating requirements,” but they do not include specific vessel operational orders such as helm or rudder commands.[57] In times of “restricted visibility, adverse weather, or other hazardous circumstances, a VTS may control, supervise, or otherwise manage traffic, by specifying times of entry, movement or departure to, from, or within a VTS area.”[58]

In the internal VTS San Francisco *Operational Policies Manual*, controllers are instructed to use the highest level of vessel control needed to address perceived incidents “that have the potential to drastically affect the transit of one or more vessels, cause damage to property and the environment, or cause injury or loss of life.”[59] In external documents provided to the public and waterway users, this level of authority is conveyed as, “on rare occasions (and during heightened security conditions) VTS will direct movement or actions of a participant. Direction would be given in cases when the

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[54] *Memorandum of Agreement on Oil Pollution Prevention and Response between the Commander, Eleventh Coast Guard District and the State of California* dated February 26, 1997, Section VI, “Prevention of Oil Spills.”
[55] VTS San Francisco *Standard Operating Procedures* dated May 15, 2007.
[56] Title 33 CFR 161.11(a) and VTS San Francisco *Standard Operating Procedures* dated May 15, 2007.
[57] Title 33 CFR 161.11(a)(2).
[58] Title 33 CFR 161.11(b).
[59] VTS San Francisco *Operational Policies Manual,* VTSSFINST M5401.2, dated March 18, 1999, Chapter V, *Incidents*.

VTC observes obvious violations of regulation or an obvious and immediately dangerous condition of which the participant is not or does not seem to be aware.*"*[60]

4.3. VTS and San Francisco Bar Pilot interaction

In the early morning hours of November 7, 2007, while the *Cosco Busan* was conducting cargo operations at Hanjin Terminal, Berth 56 in the Port of Oakland, the fog had begun to set in on portions of the local waterway. As early as 0022 in the Carquinez Strait, which connects San Pablo and Suisun Bays, the bridge sergeant for the Carquinez Bridge contacted the VTS San Francisco watch supervisor on the 2200 to 0600 shift and stated that he was activating the bridge's fog signal. The VTS watch supervisor acknowledged this report and logged this action in the VTS watch supervisor's log, but he noted that the camera on Mares Island indicated that that segment of the waterway still had visibility.[61] At 0510, the same watch supervisor noted and logged the visibility as having reduced to less than 1 nautical mile throughout the VTS coverage area, and he implemented the reporting procedures for low visibility conditions. Per the standard operating procedures, the low visibility condition reporting procedures required VTS controllers to report to the master or pilot on board a vessel all acquired radar targets that could affect that vessel's transit. The procedures also required a "read back" of the sailing plan or sailing plan deviation reports to ensure that all information had been properly communicated.[62] About 0530, the outgoing and the incoming watch sections began the relief process, at which time the incoming VTS watch supervisor standing the 0600 to 1400 shift noted the visibility in the entire VTS coverage area to be between1/4 and 1/8 nautical mile.[63]

On board the *Cosco Busan* around 0600, the deck officer on watch recorded the completion of cargo operations and noted in the vessel's deck log book that there was "heavy fog near the vessel*.*"[64] That same officer recorded the arrival of the pilot on the bridge of the vessel at 0620. At 0638, the pilot, using the radio call sign "Romeo," contacted the VTS on the designated VHF channel to provide an initial sailing report. The pilot told VTS that he intended to depart Oakland Berth 56, proceed outbound via the Inner Harbor Entrance Channel, Bar Channel, then pass through the Delta-Echo span of the Bay Bridge into San Francisco Bay, then proceed westbound in the San Francisco Bay Traffic Lane to sea.[65] The pilot also asked VTS for a report of the visibility near Alcatraz Island and the Golden Gate Bridge. Below is the transcript of these communications.[66]

Speaker	Time	Transcript of communication
Unit Romeo	06:38:42	*Traffic, Romeo,* Cosco Busan*.*

[60] VTS San Francisco, *User's Manual,* 2005.
[61] VTS San Francisco, *Watch Supervisor's Log*, November 6, 2007, 2200 to November 7, 2007, 0600.
[62] VTS San Francisco *Standard Operating Procedures* dated May 15, 2007.
[63] Statement of VTS San Francisco Watch Supervisor dated November 30, 2007.
[64] *Cosco Busan*, Deck Log Book, Voyage 13W, November 7, 2007.
[65] VTS San Francisco, Vessel Movement List, November 7, 2007.
[66] Time noted is based upon time stamped material provided by VTS San Francisco which is + 2 minutes and 2 seconds different from the time stamped data captured by the VDR on board the *Cosco Busan*.

VTS	06:38:50	*Romeo on board the* Cosco Busan *good morning.*
Unit Romeo	06:38:53	*Hey, good morning. Preparing to depart Oakland 56 for sea. Deep draft, 40 feet, 4 inches. Ah, probably use 19 alpha for tugs, and ah, what's the visibility around Alcatraz and ah, the Golden Gate Bridge?*
VTS	06:39:15	*It's a, Romeo, an eighth to a quarter, over.*
Unit Romeo	06:39:21	*All the way to the Golden Gate Bridge?*
VTS	06:39:23	*That's correct.*
Unit Romeo	06:39:26	*Where's 7 now?*
VTS	06:39:28	*Main ship channel.*
Unit Romeo	06:39:31	*OK. Thanks.*
VTS	06:39:34	*You're welcome. Ah, Romeo,* Cosco Busan*, Oakland 56 for sea, Delta-Echo deepwater at, correction, what are your ah, Oakland Bay Bridge and Central Bay lane intentions?*
Unit Romeo	06:39:42	*Yeah, you got it right. Delta-Echo and deepwater*

At 0650, the pilot again contacted VTS to inquire about vessel traffic in the Bar Channel and was provided information relevant to his request. At 0712, a VTS controller attempted to raise the pilot to confirm that he had heard the transit intentions of a towing vessel called the *Solana*, which was transiting in the VTS system. For unknown reasons, the controller failed to establish contact with the pilot. About 0745, the pilot contacted VTS to perform a final check of vessel traffic and stated his intention to prepare the *Cosco Busan* for getting underway within VTS-controlled waters. He informed the controller that he was switching from channel 14 VHF down to channel 7A VHF to begin positioning the assist tug to maneuver the vessel away from the berth.

Speaker	Time	Transcript of communication
Unit Romeo	07:45:11	*Traffic, Romeo.*
VTS	07:45:13	*Yeah, Romeo, Traffic.*
Unit Romeo	07:45:15	*Do you have somebody coming in astern of the* Solana*?*
VTS	07:45:20	*Ah, yeah, Romeo, Traffic, ah, negative. Ah,* Solana *is the only thing checked in, and I don't see AIS for anyone astern of her. Ah, Unit 12 on the* SH Bright*, is abeam Point Diablo intending Eastbound Lane, ah, still determining whether he'll go to anchor or proceed on to Sacramento. Over.*
Unit Romeo	07:45:48	*OK, fine, I'll let the* Solana *get by the, ah, so we'll be getting underway. I can see the other side of the Estuary, so. Ah, I'm on 7A now for tugs.*
VTS	07:46:00	*Roger, 7 Alpha for tugs. Thank you. Break.* Solana*, did you copy yet Romeo? Over.*

The vessel bell book indicated that all lines were cast off 0748.[67] The pilot's next contact with VTS occurred at 0808 when he informed the controller that the *Cosco Busan* was underway. He received acknowledgement of his intention to depart the berth and begin the outbound voyage per the sailing plan he had provided to VTS.

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

The VTS controller responsible for vessel traffic in the Central Bay sector then began to actively monitor the outbound voyage of the vessel. At 0829, after the vessel had departed the Bar Channel, the VTS controller stated that he became concerned with the track of the vessel because of his "perception of where the vessel was at in relation to the Delta-Echo span" of the Bay Bridge. The VTS controller then contacted the pilot to confirm his intentions.[68]

Speaker	Time	Transcript of communication
VTS	08:29:26	*Unit Romeo, Traffic.*
Unit Romeo	08:29:32	*Traffic Romeo.*
VTS	08:29:35	*Roger Captain, are you still proceeding out?*
Unit Romeo	08:29:47	*Traffic.*
VTS	08:29:50	*Unit Romeo, Traffic. AIS shows you on a 235 heading. What are your intentions? Over.*
Unit Romeo	08:29:59	*Um, I'm coming around, I'm steering 280 right now.*
VTS	08:30:06	*Roger, understand you still intend the Delta Echo span. Over.*
Unit Romeo	08:30:17	*Yeah, we're still Delta Echo.*
VTS	08:30:23	*Uh, roger Captain.*

[67] *Cosco Busan*, "Deck Manoeuvring Log*"* entry, November 7, 2007.
[68] Interview with VTS Operations Specialist on Central Bay sector watch, dated November 14, 2007.

No further communication occurred between VTS personnel and the pilot on board the *Cosco Busan* before the vessel's allision with the bridge support tower. The VTS watch supervisor stated that, based upon the pilots "calm" demeanor and the known slight time lag in the display of a ship's position on the VTS controller's screen, VTS personnel did not question the pilot further. The VTS watch supervisor stated:

> on my display, I was able to zoom in to kind of follow his track. And it was apparent to us, I mean to me, that [it] was extremely close. But, again, not having that kind of definition, you really couldn't tell whether he had actually hit the bridge or not. The next call we got was from Unit Romeo indicating that he had touched the bridge and that he would…proceed to, to the anchorage.[69]

The vessel allided with the fender system of the Delta tower of the Bay Bridge at about 0830, after which the pilot reported this contact via VHF to the VTS controller and informed the controller of his intention to anchor the vessel in Anchorage 7.

Speaker	Time	Transcript of communication
Unit Romeo	08:32:16	*Traffic we just touched the Delta span. I'm gonna go to trying to get our anchor, Anchorage 9 uh, Anchorage 7.*
VTS	08:32:24	*Roger, Unit Romeo, at the Delta Echo span diverting to Anchorage 7. Break, Ferry San Francisco, Ferry* Intintoli*, did you copy? Over.*

Upon receipt of this radio communication, the VTS watch supervisor contacted the situational unit controller in the Sector San Francisco Command Center via telephone to report the limited information the pilot had provided regarding the incident The report initiated the unit's response phase to the incident. At 0834, the VTS watch supervisor notified the California Department of Transportation, or Caltrans, of the incident.

At 0838, using his cellular telephone, the pilot on board the *Cosco Busan* followed up on his VHF report to VTS regarding the allision and provided additional information, including his preliminary assessment of damage to the fender of the Delta support tower. A VTS controller managing the Offshore Sector answered this telephone call.

VTS	*VTS San Francisco, [VTS controller] speaking.*
Unit Romeo	*Yeah ah, this is Unit Romeo on the* Cosco Busan*. We just hit the Delta-Echo span, ah kind of glancing blow, but it definitely did damage. I'm going to put the ship at anchor and then, ah, stand by to see what goes from here.*
VTS	*Alright, so, alright, ah, hold on one moment please.*
Unit Romeo	*Yeah.*

(At this point, the VTS controller put the call on hold for about 12 seconds, and the VTS watch supervisor then picked up the conversation with the pilot.)

[69] Interview with VTS Watch Supervisor dated November 14, 2007.

VTS	*Captain, [VTS watch supervisor], can I help you?*
Unit Romeo	*Yeah, I just, I'm the pilot on the* Cosco Busan*.*
VTS	*Ok.*
Unit Romeo	*We touched the Delta-Echo pier.*
VTS	*Right, as far as the ship goes right now, is there, they conducted soundings on the ship and everything's fine, or?*
Unit Romeo	*Well I, I'm just going to anchor now, I don't, ah, I'll have to check, ah, I just wanted to let you guys know right away.*
VTS	*Right, right, yeah we got the call there and then um, so were you able to ascertain any type of damage to the pier itself, or, I realize its not immediately important, but?*
Unit Romeo	*What that?*
VTS	*Were you able to determine any type of damage to the pier of to the ship at this point, or?*
Unit Romeo	*Ah well to the pier, it kinda, we kinda glanced off the, I guess it would be the south corner of it.*
VTS	*Ok.*
Unit Romeo	*So, you know, we went down the side of it*.
VTS	*Ok, Ok, so its just more of a brushing type?*
Unit Romeo	*Oh yeah, the bridge is fine, we just got, I mean we hit, we knocked some timber off, but we didn't hit the concrete or anything.*
VTS	*Ok, Ok Captain. Ok, we'll let you get back to the ship and anchor and appreciate the report. (pause with background noise) Pardon? Ah, well let you get back to the ship to anchor. Can I get your, your telephone number, do you have a cell?*
Unit Romeo	*Yeah ah, ### ### ####.*
VTS	*####. Ok Captain, I'll let you get back to ah, to working the ship there.*
Unit Romeo	*I'll anchor it and then I'll stand by to stand by.*
VTS	*Gotcha Captain. Thank you for the call.*
Unit Romeo	*Ok, bye.*
VTS	*Bye.*

The call ended about 0840. In the minutes that followed, VTS personnel monitored and coordinated the flow of 33 other vessels within the traffic system and additionally accepted several VHF communications from vessels reporting either debris or oil in the nearby waters. They also managed multiple telephone calls relative to the incident, both internally from watchstanders in the Sector Command Center and externally from other members of the San Francisco Bar Pilots and marine stakeholders in the area. One such call came in about 0849 from the president of the San Francisco Bar Pilots Association, also known as "Unit 17," who had been notified of the incident by a telephone call from the pilot . After learning of the incident, he had embarked one of the San Francisco Bar Pilot's small boats, *Golden Gate,* along with three other pilots and the vessel's crew, to assess damage to the Delta tower. He reported to VTS that the *Cosco Busan*'s fuel tank had been ruptured and reported debris in the water.

VTS	*Coast Guard Vessel Traffic, [VTS watch supervisor]. Can I help you?*
Unit 17	*Yes, good morning. This is [SFBPA president], ah, with the SanFrancisco Bar Pilots.*
VTS	*Yes, Captain*.
Unit 17	*We're just, I just talked to [COTP]. There is, ah, fuel in the water, ah, in the vicinity of, ah, Delta Tower.*
VTS	*Okay.*
Unit 17	*He did puncture a fuel tank. We need to, if, ah, someone there could call the Corps of Engineers, there's going to be debris floating around down at Anchorage 9 area.*
VTS	*Okay.*
Unit 17	*And we're heading to the ship now. Do you know whether he's, ah, has he reported that he's anchored yet?*
VTS	*Has not reported he's anchored. He's just in the northern portion of Anchorage 7, though, so he should be, ah, but he's got a good headway on right now. He's still making the five knots, but has not reported anchored yet.*
Unit 17	*Okay. Okay, we'll, go ahead.*
VTS	*Okay, Captain. Yeah, I'll give the Corps of Engineer a call and we'll let them know right away, then.*
Unit 17	*Okay, thank you.*
VTS	*Thank you much for the call.*
Unit 17	*All right. Bye, now.*

That telephone call ended at approximately 0850. About 0852, the pilot on the *Cosco Busan* contacted VTS via VHF radio to report the vessel's arrival at Anchorage 7 his intention to deploy the vessel's anchor.

Speaker	Time	Transcript of communication
Unit Romeo	08:52:50	*Traffic. Romeo.*
VTS	08:52:57	*Unit Romeo, Traffic.*
Unit Romeo	08:52:59	*Yea, we're gonna drop the anchor here in Anchorage 7. We're gonna put five in the water. I'll give you a call here when we're all stretched out.*
VTS	08:53:06	*Roger. Thank you.*

At 0852, the president of the San Francisco Bar Pilots Association and other personnel on the small boat *Golden Gate* arrived on scene at Anchorage 7 and began idling the small boat along the port side of the *Cosco Busan,* at which time he reported seeing "substantial oil coming out of the hull."[70] At 0855, he contacted VTS via his cellular telephone and reported this information.

VTS *Coast Guard Vessel Traffic, [VTS watch supervisor). Can I*

[70] Interview of President, San Francisco Bar Pilots Association dated November 18, 2007.

	help you?
Unit 17	*Yeah, [VTS watch supervisor]. (SFBPA president).*
VTS	*Yes, Captain.*
Unit 17	Ah, *with the Bar Pilots. Hey, ah, we need to ask, we need to get the spill responder going. This guy's dumping fuel into the water.*
VTS	*He's still pumping fuel in the water, then?*
Unit 17	*Yeah.*
VTS	*Okay, okay.*
Unit 17	*It's not a ton of fuel, but quite a bit. There's a lot of damage to the ship, as well, so --*
VTS	*Okay.*
Unit 17	*he's not going to be leaving the Bay, so --*
VTS	*Understood. Understood, Captain. Yeah, we'll (indiscernible) that up right now.*
Unit 17	*Okay. And we're putting Unit 37 out there, as we speak. We'll have another pilot out there. The other guy's going to be too rattled, so --*
VTS	*Right, right. Understand, Captain. Thanks for the call.*
Unit 17	*Okay, thank you. Bye.*

The call ended at 0856. About 0857, the pilot on board the *Cosco Busan* contacted VTS, this time by cellular telephone, after the vessel was anchored in Anchorage 7 and informed VTS that he suspected one of the vessel's fuel tanks had been ruptured and that an oil slick was forming around the vessel. The VTS controller managing the Central Bay sector answered that call,

VTS	*This is Traffic Service San Francisco, [VTS controller].*
Unit Romeo	*Yeah, ah, this is Unit Romeo again on the ah,* Cosco Busan*.*
VTS	*Yes sir. Let me put the Sup on with ya, the supervisor. Hold on please.*
Unit Romeo	*Yeah, Ok*.

(This telephone call was accepted by the VTS watch supervisor within about 8 seconds, who then addressed the pilot.)

VTS	*Yes Captain,[VTS watch supervisor], Can I help you?*
Unit Romeo	*Yeah, I ah just, we just got to anchor and I see this oil around the ship, so we might have punctured a hole in a fuel tank or something, but its starting to, a slick is starting to form around the ship.*
VTS	*Ok, yeah, we talked um, I already talked to um, [SFBPA president] and he said ah yeah, he already got ah, he was aware of that apparently, and then he called me, ah, the Coast Guard is responding for the fuel, um, and also the debris. We're getting hold of the Corp of Engineers for anything to, so.*

Unit Romeo	*Yeah, Ok, yeah, and I just, ah, told the Captain that, you know he hasn't found where it is yet, but.*
VTS	*Ok, so their still trying to isolate where the damage is and try to get that fuel source secured then?*
Unit Romeo	*What's that?*
VTS	*Were you able to determine any type of damage to the pier of to the ship at this point, or?*
Romeo	*Yeah, well, their gonna try, I guess they'll try and transfer fuel. I don't know where its coming from, but...*
VTS	*Ok.*
Romeo	*there's definitely oil in the water.*
VTS	*Right, right, yeah, we're getting some reports from the ferry boat to that nature.*
Unit Romeo	*Ok.*
VTS	*Ok Captain. Thank you for you for the call and I understand Unit 37 will be boarding here with you shortly then too.*
Unit Romeo	*Who?*
VTS	*Ah, Unit 37, [SFBPA pilot]. Apparently he's going to board also.*
Unit Romeo	*Ah, Ok. I'll just standby here. I gave you my phone number and I'll just wait, ah, till everybody shows up I guess.*
VTS	*Ok Captain, thanks for the call.*
Unit Romeo	*Alright.*
VTS	*Ok, no problem, bye-bye.*

The call ended about 0900. At 0901, VTS began broadcasting Sector San Francisco's first safety-related radio transmission, or *Securite* broadcast.[71] This radio broadcast established a minimum wake zone and wide berth around the *Cosco Busan* while it was at anchor in Anchorage 7. Additionally, the relief pilot using the radio call sign "Unit 37" reported to VTS via VHF radio that he was on board the *Cosco Busan* and was remaining on board for the duration of the incident. No further communication relevant to the incident occurred between the accident pilot and VTS San Francisco personnel at that time. Multiple VHF radio communications and telephone calls regarding oil sightings and the locations of oil accumulation along various portions of the waterway continued to come into the VTS center throughout the morning hours and into the early afternoon.

On the day of the incident, four other vessels requiring pilots were scheduled to sail outbound from berths in the Port of Oakland or to began inbound journeys from sea between the hours of 0600 and 0900. All of these vessels either delayed the scheduled sailing or aborted their transit and diverted to anchorage because of the poor visibility due to fog.[72] The pilot on board the *SH Bright,* a vessel that was inbound for the Sacramento Chemical Berth, experienced poor visibility off Fort Mason between

[71] A *Securite* radio call is used to alert stations and vessels that import safety information is about to be transmitted.

[72] San Francisco Bar Pilots Association "Sailings" schedule and associated documents dated November 7, 2007. Vessels noted were *Sea-Land Meteor, Sh Bright*, *Lihue* and *M. Emir Aksoy*.

Fisherman's Wharf and the Golden Gate Bridge. The pilot stated that because of the experienced poor visibility and reports of visibility between 1/8 and 1/4 nautical mile around the Bay Area, he elected to abort the remaining portion of the transit and anchor until visibility improved.[73] The pilot on board the *M. Emir Aksoy*, inbound for Redwood City, aborted the vessel's transit and anchored in Anchorage 9 around 0818 due to fog.[74] The pilot on board the *Sea-Land Meteor,* outbound for sea from Oakland Berth 23, delayed the schedule departure time of 0600 because the pilot felt he "did not have enough visibility to turn the vessel around."[75] The pilot on board the *Lihue,* outbound for sea from Oakland Berth 68, delayed they vessel's scheduled 0900 sailing "largely due to low visibility" and also because he was aware of the incident involving the *Cosco Busan* and he anticipated that, because of that incident, many smaller craft would be in the vicinity. He stated, "small vessels can be lousy radar targets and therefore I wanted reasonable visibility when dealing with them."[76]

[73] Statement of San Francisco Bar Pilot on board the *SH Bright*, undated.
[74] Statement of San Francisco Bar Pilot on board the *M. Emir Aksoy* undated.
[75] Statement of San Francisco Bar Pilot on board the *Sea-Land Meteor*, undated.
[76] Statement of San Francisco Bar Pilot on board the *Lihue*, dated March 10, 2008.

4.4. VTS Imagery

The following screen images were captured by VTS San Francisco's traffic management software. They display the recorded positions of the *Cocso Busan* and the assist tug *Revolution* at critical times during the outbound transit from Oakland Berth 56 on November 7, 2007. On the first image, red lines and text have been added to identify both the Delta" and Echo towers of the Bay Bridge. The VTS recorded date and time stamp is in the lower right corner of each screen image.

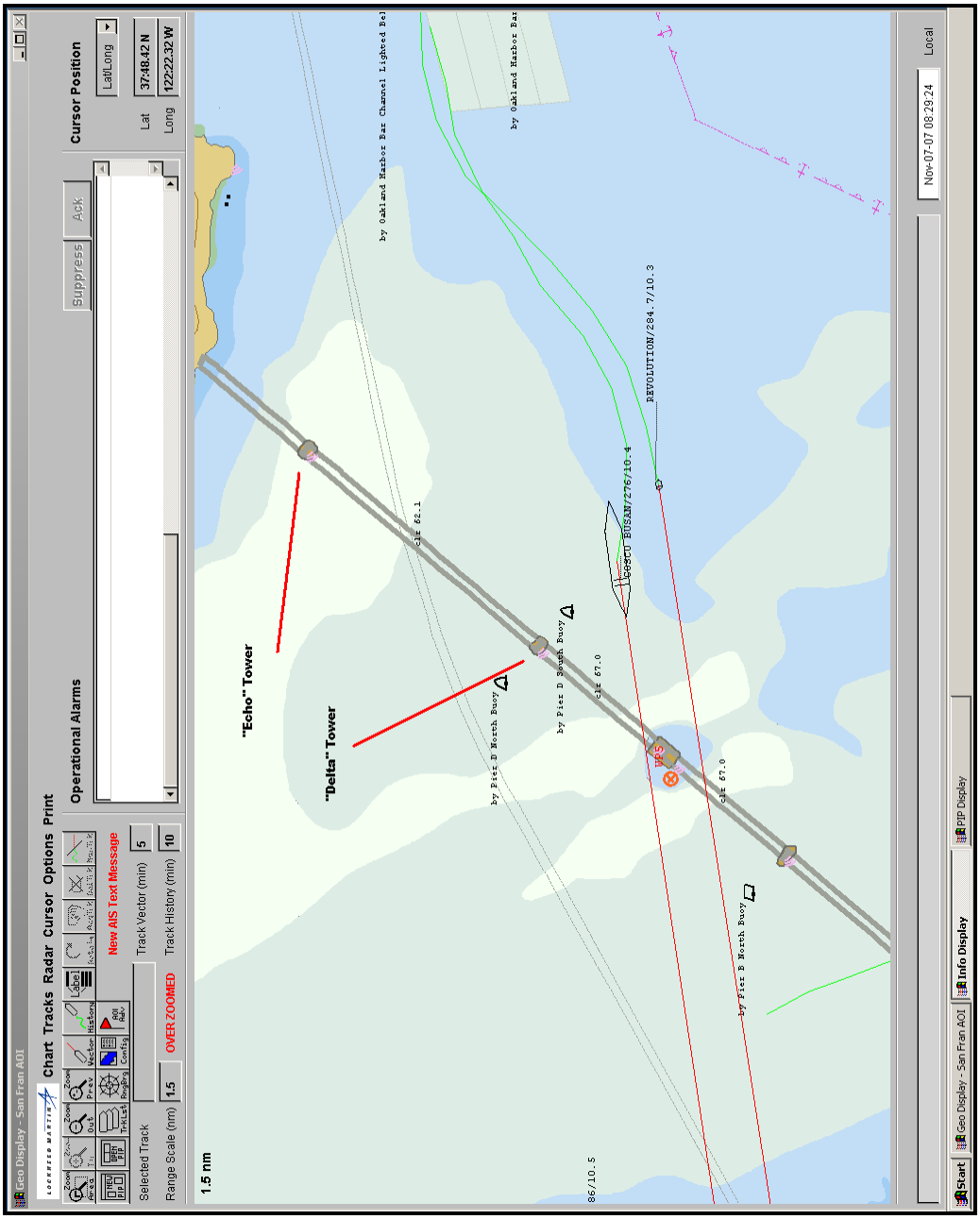

Figure 2. Time of VHF radio call from VTS controller to pilot on board the Cosco Busan regarding the pilot's intention.

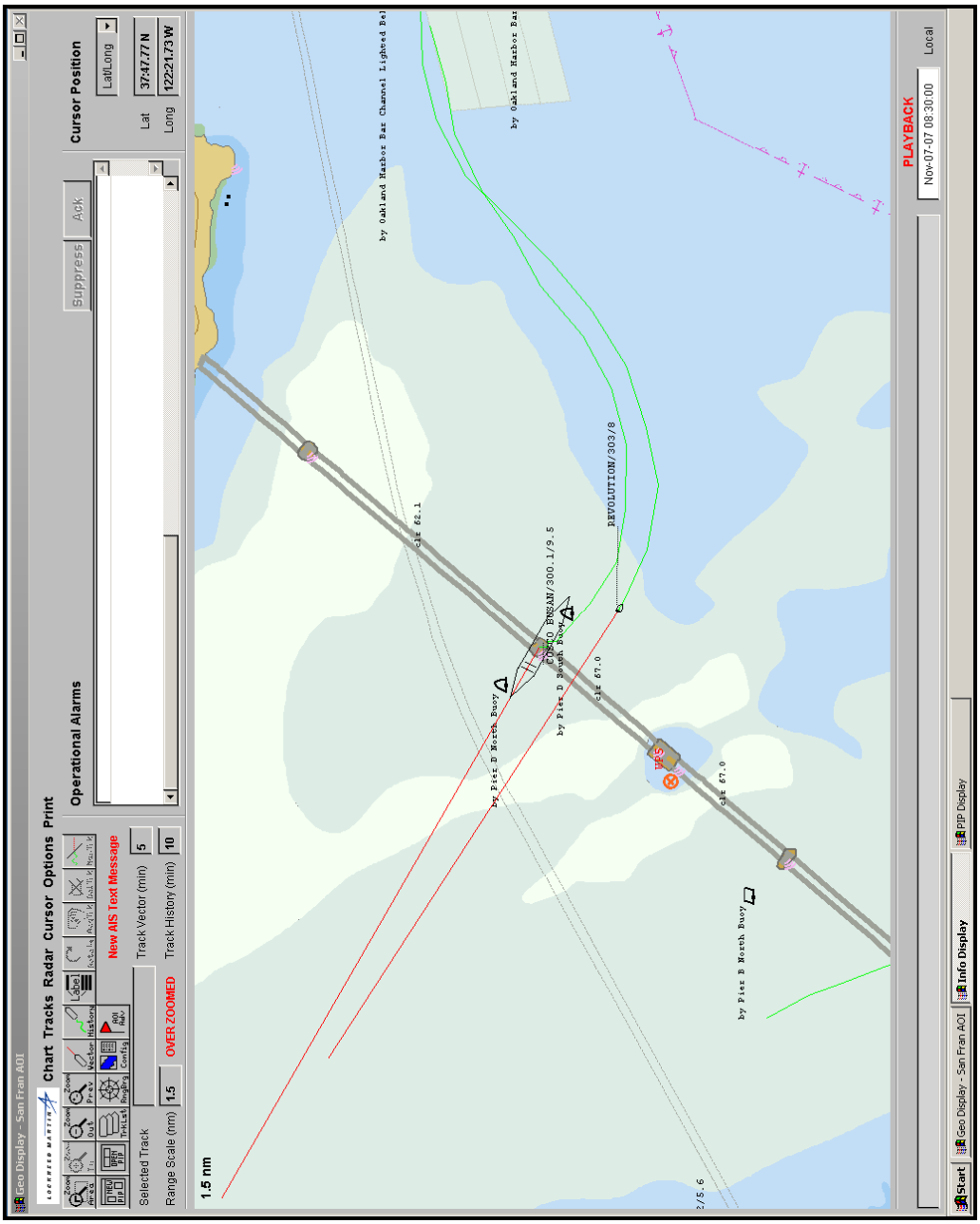

Figure 3. Time of vessel's allision with fender system of Delta support tower.

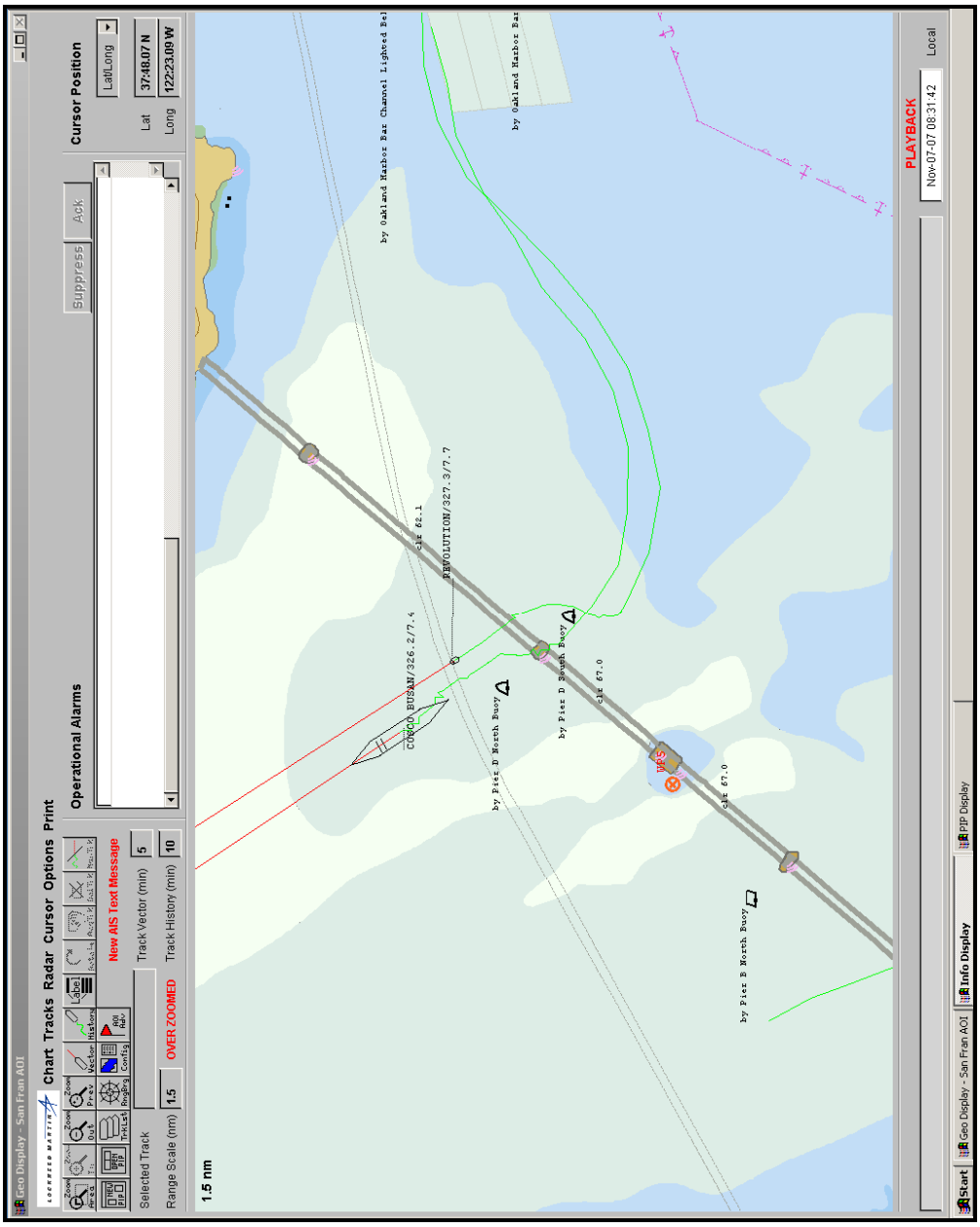

Figure 4. Time of VHF call from pilot on board Cosco Busan to VTS San Francisco reporting allision

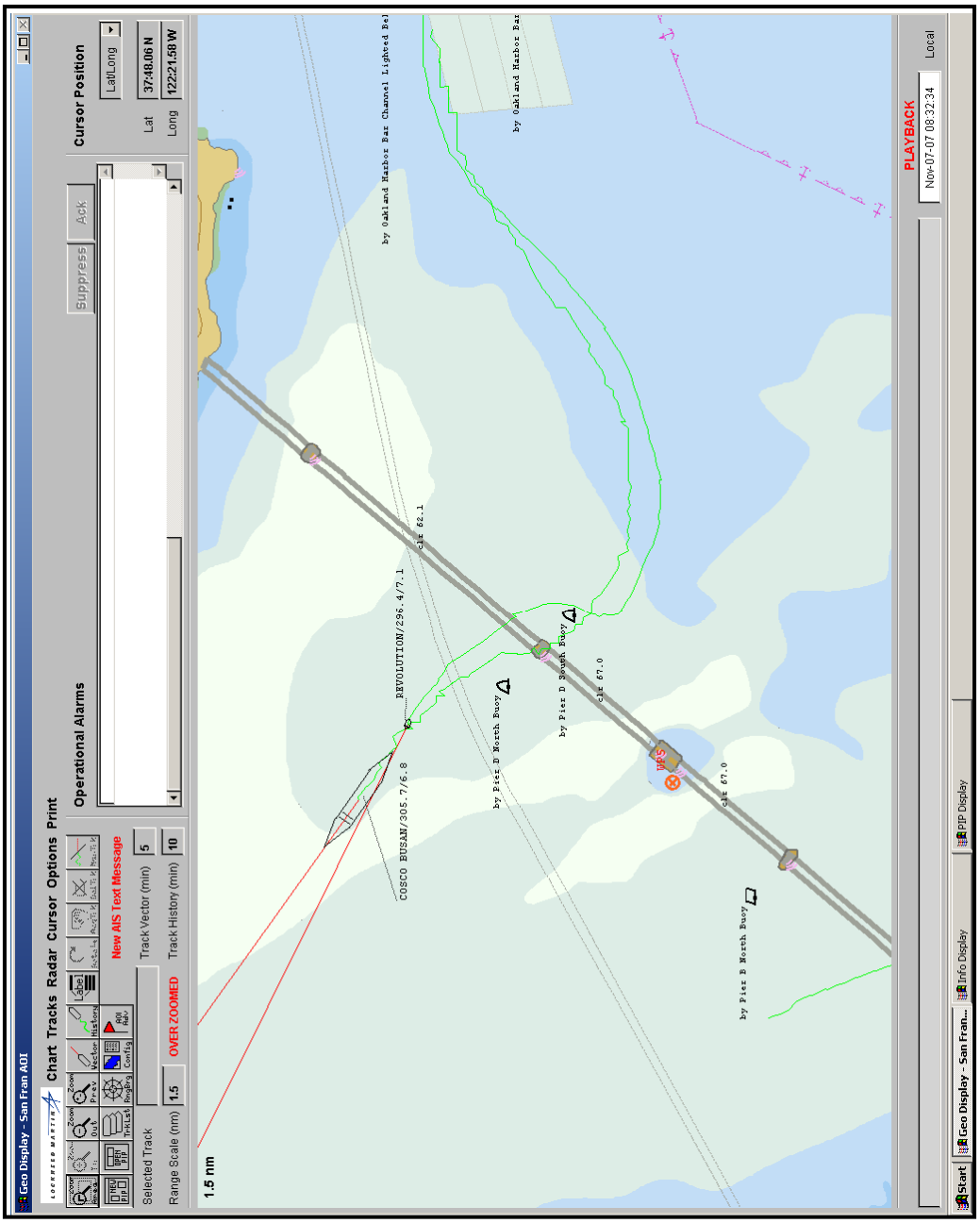

Figure 5. Record track lines of the *Cosco Busan* and the *Revolution*.