Attachment 6

MARINE CASUALTY REPORT

COLLISION INVOLVING THE SS ARIZONA STANDARD AND SS OREGON STANDARD AT THE ENTRANCE TO SAN FRANCISCO BAY ON JANUARY 18, 1971

U.S. COAST GUARD MARINE BOARD of INVESTIGATION REPORT and COMMANDANT'S ACTION

ACTION BY NATIONAL TRANSPORTATION SAFETY BOARD

DEPARTMENT OF TRANSPORTATION
WASHINGTON D.C. 20591

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SS ARIZONA STANDARD AND SS OREGON STANDARD
COLLISION ON 18 JANUARY 1971

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NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON, D.C. 20591

COLLISION INVOLVING THE SS ARIZONA STANDARD AND SS OREGON STANDARD AT THE ENTRANCE TO SAN FRANCISCO BAY ON JANUARY 18, 1971

ACTION BY NATIONAL TRANSPORTATION SAFETY BOARD

This casualty was investigated by a U. S. Coast Guard Marine Board of Investigation convened at San Francisco, California, on January 25, 1971. A Member of the National Transportation Safety Board attended the proceedings as an observer. We have reviewed the investigative record and considered those facts which are pertinent to the Board's statutory responsibility to make a determination of cause or probable cause and to make recommendations to prevent recurrence of such a casualty.

SYNOPSIS

The tankships ARIZONA STANDARD and OREGON STANDARD, both owned by Standard Oil Company of California and operated by Chevron Shipping Company, collided at about 0140 P.s.t.~/ on January 18, 1971, several hundred yards west of the Golden Gate Bridge in San Francisco Bay, California. No persons were killed *or* injured as a result of the collision. Both vessels were extensively damaged. Approximately *800,000* gallons of bunker fuel escaped from the ruptured cargo tanks in the OREGON STANDARD. The oil spill caused extensive pollution of the Bay and the adjacent coastline.

The collision occurred in a dense fog. The fully laden ARIZONA STANDARD was inbound *en* route from Estero Bay, California, to Long Wharf, the Standard Oil dock in Richmond, California. The OREGON STANDARD carried a full load of bunker fuel, was outbound en route from Long Wharf to Bammerton, British Columbia.

The National Transportation Safety Board determines that the cause of this collision was the failure or inadequacy of four different systems or subsystems, any one of which could have prevented the collision had it functioned adequately.

~/ All times used herein are Pacific standard time based on a 24-hour clock.

The regulatory system prescribed by the Inland Rules of the Road failed in that neither vessel complied with the rules by keeping to its starboard side of the channel. This non-compliance was contributed to by immoderate speed **for prevailing conditions on the part of both vessels, failure of both vessels to use the radar capabilities available to maintain an accurate plot, and the absence of a positive indication of the center of the main ship channel through the Golden Gate.**

The radar system by which the vessels could have avoided each other failed because the ARIZONA STANDARD did not obtain and evaluate correctly information from radar pertaining to the movements of the OREGON STANDARD, and the OREGON STANDARD did not check periodically at least one of the radarscopes, set on a sufficiently long range scale, to ensure the prompt detection of the ARIZONA STANDARD.

The whistle signal system of avoiding collision failed because neither vessel heard the other vessel's fog signals. A contributing factor was the high noise level caused by the diaphone and fog horns located on the Golden Gate Bridge.

The Harbor Advisory Radar system was inadequate to prevent the collision. The inadequacy arose from the decision of the OREGON STANDARD not to guard channel 18A, which precluded its participation in the system, and the prohibition of Harbor Advisory Radar operators from providing interpretative information or direction to vessels. The underlying and most significant inadequacy of the Harbor Advisory Radar was the lack of authority of the Coast Guard to regulate this traffic, which prevented a publicly financed facility from protecting the public against loss.

SUMMARY OF FACTS

The ARIZONA STANDARD departed Estero Bay, California, at 1230 on January 17, 1971. The weather was fine and her northbound voyage was uneventful until approximately 2221. As the vessel approached San Francisco, visibility was greatly reduced by a dense fog which blanketed the entire Bay area. The tide was flooding and the set and drift of the current was NE at approximately 1.5 to 2 knots. The master ordered the engines to be placed on maneuvering speed status and the fog signals to be sounded.

At 0049, the ARIZONA STANDARD **heard, on VHF channel 18A, the OREGON STANDARD report to Harbor Advisory Radar (HAR) that the OREGON STANDARD was departing Long Wharf, Richmond, bound for sea. At 0058, the ARIZONA**

STANDARD advised HAR that she was entering the Main Ship Channel bound for Point Orient. (See Attachment A, a chart depicting the area.)

Upon arrival at the Main Ship Channel at approximately 0100, the ARIZONA STANDARD reduced speed to approximately 13.5 knots. (All speeds referred to in this report take into account the effect of the current and are stated in terms of speed over the ground.) The master was conning the vessel, the chief mate was manning the radar, the second mate was handling the engine order telegraph, and the lookout was posted on the wing of the bridge. Visibility was very limited. The white lights of the buoys on the port side of the channel were visible, but the red light of the buoys on the starboard side could not be seen. The channel is approximately 2,000 feet wide. While the vessel was transiting the channel, the lookout was sent forward to the bow.

The base course steered as the vessel proceeded through the Main Ship Channel and while approaching Mile Rocks was 069 T. At 0120, HAR advised the ARIZONA STANDARD that the OREGON STANDARD was passing north of Alcatraz Island bound for sea. At 0125, the ARIZONA STANDARD changed course to 065° T. Her average speed between the Main Ship Channel Buoy No. 2 and a Position abeam and one-half mile off Mile Rocks Light, was approximately 13.5 knots. The master sighted the loom of Mile Rocks Light at approximately 1 mile.

At about 0127, the chief mate of the ARIZONA STANDARD observed a contact, the OREGON STANDARD, on the radarscope at a range of 6 miles. The contact was about one-half mile south of Point Blunt. The mate plotted three positions of the contact on the face of the radarscope. No times were recorded or noted. The positions were about 250 to 300 yards apart. No further plots were made. The only information the mate obtained from these plots was that the relative motion line was approximately parallel to the OREGON STANDARD's course, and that the closest point of approach (CPA), would be 1 mile. The mate continued to observe the movement of the contact on radar for approximately 6 minutes before it disappeared from the scope. At the time of disappearance, the OREGON STANDARD was east of Pt. Cavallo and approximately 1 mile northeast of the center of the Golden Gate Bridge. The mate testified that he did not see the OREGON STANDARD on the radarscope again prior to the collision. At 0130, HAR advised the ARIZONA STANDARD that the OREGON STANDARD's position was 1 mile east of the Golden Gate Bridge. HAR did not provide the ARIZONA STANDARD any further advisory reports concerning the position of the OREGON STANDARD. The ARIZONA STANDARD made several attempts to contact the OREGON STANDARD on channels 18A, 10, and 16. None of the attempts was successful.

When Mile Rocks Light was abeam at a range of one-half mile at approximately 0130, the ARIZONA STANDARD changed course to 056° T. At 0132, she reduced speed to approximately 11.5 knots. The helmsman reported that he was having difficulty steering and had to use 15 to 20° of both left and right rudder in order to keep the vessel headed close to the course. This speed was maintained until just before the two vessels collided at about 0140. The ARIZONA STANDARD's average speed during this 10-minute period was about 11.4 knots. Adherence to the course of 056° T. would place the vessel in the middle of the channel as she passed under the Golden Gate Bridge. A natural range which could be observed on the radarscope was used to determine whether the vessel was making good the desired course of 056° T. The range consisted of the Harding Rock Buoy as the front range marker and the offshore rocks just south of Point Blunt as the rear range marker. At 0134, the ARIZONA STANDARD again tried to contact the OREGON STANDARD without success.

At approximately 0136, the master, upon hearing the mid-channel signal, which is located on the center span of the bridge, slightly to port, ordered the helmsman to come right to 058° T. At 0138, HAR advised the ARIZONA STANDARD that HAR has been unable to contact the OREGON STANDARD on channel 18A. The ARIZONA STANDARD advised HAR that the ARIZONA STANDARD was about to pass under the Golden Gate Bridge. Prior to the helmsman's steadying on the new course, at about 0139, the master observed the red navigation light of the OREGON STANDARD one to two points on the starboard bow at approximately 200 yards. The master ordered hard left rudder and stop all engines. The collision occurred at approximately 0140 hours (as noted on the ARIZONA STANDARD). The bow of the ARIZONA STANDARD penetrated the port side of the OREGON STANDARD in way of the Nos. 2, 3, and 4 port tanks just forward of the deckhouse, at about a 45° angle.

The OREGON STANDARD departed Long Wharf, Richmond, California, at 0024 on January 18, 1971, bound for Bammerton, British Columbia. At 0049, she reported her departure to HAR on channel 18A. She then shifted her receiver to channel 10. As a result, despite numerous attempts by both HAR and the ARIZONA STANDARD, neither was able to establish contact with the OREGON STANDARD on channel 18A until after the collision.

She cleared Southampton Shoal Channel at 0053 steering 168° T. at a speed of approximately 8.5 knots. The master was conning the vessel, using the Raytheon radar, the second mate was assisting the master and observing the Decca radarscope, the lookout was posted in the bow, engines were on maneuvering speed status, and fog signals were being sounded. The fog was thick and reduced visibility to 200 to 300 yards. Speed was increased to approximately 11.5 knots at 0054. When abeam Southampton Shoal Light, the course was changed to 170° T. At 0108, speed was reduced to approximately 9.5 knots. At 0111, with Pent Blunt abeam to starboard at 0.6 mile, the vessel came right slowly, rounded the Point and steadied up on course 260° T. Speed was increased to approximately 11 knots at 0116.

At 0125, when abeam of Harding Rock Buoy at 0.2 mile, the vessel came left to a course of 231° T. About 6 to 7 minutes later when 0.3 mile off Pt. Cavallo, the master realized the vessel had been set to the north of the desired trackline, and ordered the helmsman to come left to 220 T. At 0134, he reduced speed to approximately 9 knots. Approximately 1 minute later, 0135, with Lime Point abeam as determined by the sound of the Lime Point fog horn, the master ordered hard right rudder and told the helmsman to steer 265° T. The vessel passed under the Golden Gate Bridge at approximately 0138. The mid-channel diaphone on the center span of the bridge was heard overhead as the vessel passed under the bridge. Speed was reduced to approximately 4 knots at 0138.2.

The OREGON STANDARD was approximately 0.1 mile east of the Golden Gate Bridge when the master observed a contact, the ARIZONA STANDARD, on the Raytheon radarscope (range scale l 1/2 miles) at about 0.8 mile bearing 25° on the port bow. At approximately 0140, the two white and one green navigation lights of the ARIZONA STANDARD were observed at about 250 yards approximately 25° on the port bow. Full astern was ordered and the general alarm was sounded. The vessels collided at approximately 0141 (as noted on the OREGON STANDARD).

Subsequent to the collision, the two vessels remained locked together and drifted on the flood tide under the bridge into the inner bay. Using one of the OREGON STANDARD's anchors, the vessels anchored off Point Knox, Angel Island. During the next 7 hours, numerous barges, tugs, oil booms, and various types of oil removal equipment arrived in the area and proceeded to off-load cargo and contain and clean up the spilled oil. Approximately 800,000 gallons of oil spilled from the OREGON STANDARD. No cargo was lost from the ARIZONA STANDARD. After sufficient off-loading had been accomplished to allow the vessels to free themselves, they proceeded to Long Wharf at Richmond.

The subsequent tides carried the oil several miles to sea. As the oil spread up and down the coastline, beaches became fouled as far south as Half Moon Bay (approximately 25 miles south of the Golden Gate Bridge) and as far north as Kellam Beach (approximately 20 miles north of the bridge). Hundreds of birds perished, despite extensive efforts to collect and clean them. It is estimated that only about 3.5 percent of the birds which were coated with oil survived. The damage, if any, to shellfish and other sea life has not been determined and may not be known for several years, if ever.

Standard Oil of California, many Federal, State, and local government agencies, and hundreds of volunteers coordinated their efforts to contain and clean up the oil spill in an effort to minimize the environmental damages. It is estimated that Standard Oil of California spent over *$4,000,000* in efforts to reduce and rectify damages caused by the spill.

The U. S. Coast Guard operates a Harbor Advisory Radar (HAR) system in the San Francisco Bay area as an experiment to evaluate the desirability of such systems. Participation is on a voluntary basis. The system's radio net consists of vHF radios using the 156.9 MHz frequency which is designated channel 18A, Navigation Channel. The HAR operator provides traffic information to participating vessels in the various areas included in the system, in terms of the position and general direction of movement of vessels observed on the radarscope. He does not provide interpretative information such as CPA, course, speed, etc. Participating vessels report their identification, movement information, position, and destination each time they enter or depart the system. The U. S. Coast Guard has no statutory authority to require vessels to participate.

Both vessels were standard T-2 type tankships. They were 10,553 gross tons, 504 feet in length, 68.2 feet in breadth, 39.2 feet in depth, with steam turbo-electric propulsion of 6,000 hp.

Each vessel was equipped with two radar sets. *One set* was a Decca Type RM 426 and the other was a Raytheon Mariners Pathfinder. The Decca radar has eight range scales from one-half mile to 48 miles. The Raytheon radar has four range scales from 1 1/2 miles to 50 miles. Both of the radar sets *were* in operation on each vessel at the time of this casualty.

The vessels were also equipped with similar vHF radio equipment. The equipment has a 10-channel capability which included channels 10 (156.50 MHz), 16 (156.80 MHz), and 18A (156.90 MHz). Channel 10 is the working frequency for conducting company business, channel 16 is the calling and distress channel, and channel 18A is the navigation channel and the one used in the HAR system. Both vessels were continuously monitoring channel 16. The ARIZONA STANDARD also was guarding channel 18A continuously except when she tried to contact the OREGON STANDARD on channel 10. The OREGON STANDARD guarded channel 10 in lieu of 18A. It is the Standard Oil Company's policy that all its tankships participate in the HAR system.

The masters of both vessels testified that all their navigational, electronic, propulsion, and steering equipment was operating normally.

The master of the ARIZONA STANDARD holds a master's license endorsed for any gross tons, any ocean, radar observer and first-class pilot on San Francisco Bay. He has held a master's license for 12 years, the pilot's endorsement for 10 years, and has been master of the ARIZONA STANDARD for 2 years. The master of the OREGON STANDARD holds a master's license with the same endorsements plus first-class pilot for many additional pilotage waters on the west coast. He has sailed in the capacity of master for 22 years and has 40 years of experience at sea.

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The chief mate of the ARIZONA STANDARD holds a master's license endorsed for any gross tons, any ocean, radar observer and first-class pilot on San Francisco Bay. He has been sailing in a licensed capacity since **1945. He has been the chief mate of the ARIZONA STANDARD for 6 years. The second mate of the OREGON STANDARD holds a second mate's license endorsed for any gross tons, any ocean, radar observer, and authorization to serve in the temporary capacity of chief mate, any gross tons, any ocean. He has been sailing for about 45 years, the past 17 years with Standard Oil Company.**

ANALYSIS

Position of COlliSiOn

There is little conflict in the evidence with respect to the movements of each vessel as each approached the ultimate point of collision. The testimony of the masters does conflict with respect to the position of the vessels at the time of collision. The master of the ARIZONA STANDARD testified that his best estimate of the position at which the collision occurred was 175 to 600 yards southwest of the center span of the Golden Gate Bridge. His estimate was not based upon ranges or bearings taken at the time of collision. The southwesterly direction was based upon the direction of the sound of the diaphone on the center span of the bridge. The master of the OREGON STANDARD testified his best estimate of the position of the collision was approximately 450 yards due west of the center span. His estimate apparently is based upon his belief that the OREGON STANDARD, on a course of 270° T., passed directly under the center of the bridge.

The HAR system photographs the radarscope every 3 minutes. (See Attachments B-1, -2, and -3.) The photograph taken at 0141:58 shows the two radar pips representing the ARIZONA STANDARD and OREGON STANDARD merged in a position 300 yards due west of the center of the bridge. The 0139:02 photograph indicates the OREGON STANDARD had just passed under the bridge and was approximately 150 yards southwest by west (236° T.) of the center of the bridge. This same photograph revealed the ARIZONA STANDARD was in a position approximately 900 yards west southwest (247° T.) of the center of the bridge.

The 0139:02 photograph indicates that the OREGON STANDARD was actually a little south of the center of the channel. The master testified that he had commenced his turn to starboard to swing under the bridge when he determined, by listening to the fog horn, that Lime Point was abeam. The 0136:08 photograph indicates that Lime point was actually abaft the beam before the vessel changed course to 270° T. The master testified that he had slipped further south than he had intended. Although the more accurate method of using a radar range and bearing off Lime point was available, the master determined his position abeam Lime point by listening to the fog horn. Also, due to the northerly set encountered off Point Cavallo, the vessel approached the bridge on a course of 220° T. in lieu of the normal course of 231° T. As a result, a sharper turn to starboard was required to pass under the bridge. The advance of the vessel during the turn may have contributed to the fact that the vessel proceeded further south than would normally be anticipated.

The ARIZONA STANDARD's position, as depicted by the 0139:02 photograph, is approximately 150 yards north of its intended trackline. In view of the

northeasterly set of the approximately 2-knot flood current and the fact that, according to the chief mate, the radar range was always kept open with the pip of the rocks off Point Blunt never appearing to the right of the heading flash, a northerly deviation from the desired trackline would be expected.

Despite slight differences in the observed times of the collision and the times of the radarscope photographs, plus any errors which may exist in interpreting the photographs, it is concluded that the collision occurred approximately in mid-channel, 300 to 450 yards to the seaward side of the Golden Gate Bridge. Each vessel failed to keep to its starboard side of the channel. The masters' desire to keep well clear of the bridge abutments, the absence of a direct or readily available indication of the center of the channel in the vicinity of the bridge, and the failure to plot accurately their positions contributed to the fact that each vessel did not favor its starboard side of the channel.

Speed in Fog

The speed of the ARIZONA STANDARD is well documented. Between the time the vessel was abeam buoy No. 2 in the Main Ship Channel (0104) and abeam Mile Rocks Light (0130), she traveled a distance of approximately 5.85 nautical miles in 26 minutes at an average speed of about 13.5 knots. From 0130 until 0140, the time of collision, the vessel traveled approximately 1.9 nautical miles at an average speed of about 11.4 knots. Vessels in a fog are required to proceed at a "moderate speed." The generally accepted definition of "moderate speed" is a speed at which a vessel is capable of stopping within one-half the distance of its visibility. The Board concludes that a speed in excess of 11 knots was not necessary to maintain steerage way and, under the existing condition of reduced visibility (less than 500 yards), the speed of the ARIZONA STANDARD was immoderate.

The OREGON STANDARD was abeam buoy 2SS Southampton Shoal Channel at 0053 and was abeam Point Blunt Light at 0111. Her average speed for this distance of 3.1 nautical miles was about 10.5 knots. Between Point Blunt (0111) and Harding Rock (0125), a distance of approximately 2.2 nautical miles, the vessel averaged about 9.5 knots. Between Harding Rock (0125) and a position approximately 0.3 mile off Point Cavallo (about 0131), her average speed was about 11.5 knots. Between Point Cavallo and when she passed under the bridge (0138), she averaged about 7 knots. For the 3 minutes just prior to the collision the vessel's average speed was about 4 knots. Taking into consideration the prevailing conditions of very restricted visibility and the failure to use fully the radar capabilities which were available, the speed of the OREGON STANDARD was immoderate.

Use of Radar

On the ARIZONA STANDARD, the chief mate was assigned to the radar set to provide information to assist the master in safely piloting the vessel into Long Wharf at Richmond. The mate testified that he considered his primary responsibility was to observe the natural range of Harding Rock Buoy and the rocks off Point Blunt on the radarscope to determine whether the vessel was making good its desired course. He initially observed the OREGON STANDARD as a contact on the scope at a range of approximately 6 miles. He plotted on the face of the scope three positions of the OREGON STANDARD. However, these were of little value since times were not recorded. Hence, no determination of course or speed of the OREGON STANDARD was made.

The mate stated the last time he observed the pip of the OREGON STANDARD was when the OREGON STANDARD was approximately 1 mile northeast of the center of the Golden Gate Bridge in the vicinity of Yellow Bluff. This raises the question of whether a contact will blend into the image of the Golden Gate Bridge and, if so, at what distance. No expert witnesses were called to testify concerning such a blending effect. The testimony of the two masters, the chief mate of the ARIZONA STANDARD, and the second mate of the OREGON STANDARD all indicated such a phenomenon does occur. Their estimates as to how close a contact had to be to the bridge before it would blend with the image of the Golden Gate Bridge varied from 200 to 400 yards.

Exhibits 33-A and 34-c (photographs of HAR radarscope) show a definite radar pip for the OREGON STANDARD when it is approximately 100 yards west of the bridge. (See Attachment B-2.) The bridge image is approximately 150 yards wide. Any target on the HAR scope whose pip width is less than 150 yards will momentarily disappear as it passes under the bridge.

Neither the testimony nor the exhibits substantiate the fact that a loss of a contact 1 mile from the bridge was the result of the contact blending with or being hidden by the bridge image. Thus, such a phenomenon is not considered to have been a causal factor in this casualty. Nevertheless, there is insufficient evidence in the record to determine positively how much of a blending or blocking effect exists and whether it could create a potentially hazardous condition for the mariner.

On the OREGON STANDARD, the master was using the Raytheon radar set to pilot the vessel through the Bay. Upon departure and until the Harding Rock Buoy was approximately 4 points (45°) on the port bow, the radar presentation was kept on the 5-mile range scale. At this point, the ARIZONA STANDARD would have been slightly more than 5 miles away and

therefore could not have appeared as a target on the scope. The master then switched to the 1 1/2-mile scale and kept the set on that scale until the vessel was about to pass under the bridge. On this scale the ARIZONA STANDARD would not have appeared as a target until the OREGON STANDARD was off Lime Point. The master testified that at that time he was attempting to line up the bridge piers, determine when he was abeam of Lime Point, and make his course change to pass under the bridge. Being so preoccupied, the master could have failed to note the ARIZONA STANDARD's image on the edge of the 1%-mile scope presentation even if the image was in fact present.

The second mate was observing the Decca radarscope. He had the presentation set on the 3-mile or l 1/2-mile range scales from buoy 2SS, Southampton Shoal Channel, until the vessel was near Harding Rock Buoy. The ARIZONA STANDARD was over 5 miles away during this period and would not have appeared as a target on the scope. When the OREGON STANDARD was off Harding Rock, the presentation was placed on the 6-mile range for about 2 or 3 minutes. During this interval, the ARIZONA STANDARD was close enough to appear on the scope. The mate testified that he did not observe the ARIZONA STANDARD on the radar. However, he also testified that he was very busy logging bearings and distances off important navigational points, supervising the helmsman, tending the engine order telegraph, listening for fog signals, acting as an extra lookout, and performing other duties of a deck watch officer. As a result, he said, "I don't think I was on the radar too much." He also said that he observed some cluttering along the starboard side of the heading flasher. This clutter disappeared when he switched to the 3-mile scale. Between Harding Rock Buoy and Point Cavallo, the set was on the 3-mile range. It is very questionable whether the ARIZONA STANDARD was close enough during this interval to appear as a target on the outer edge of the scope. When the OREGON STANDARD was off point Cavallo, the mate switched to the 1 1/2-mile range scale. As a result, both the Raytheon and the Decca radar sets were on the 1 1/2-mile scale until just prior to passing under the bridge.

The most probable reasons for the failure of the master and second mate to observe the ARIZONA STANDARD as a target on either of the OREGON STANDARD's radar sets were: 1. The fact that neither set was placed on a range scale greater than 6 miles. As a result, most of the time, the ARIZONA STANDARD was at too great a distance to appear as a target on the scopes. 2. The fact that both officers were occupied with other tasks which included determining the vessel's position and maintaining the desired trackline.

The problems encountered in observing, collecting, and evaluating data from the radar on both vessels illustrate the need for development and implementation of more sophisticated electronic systems to assist the operating personnel in solving such problems. Such a system would be one which would sound an alarm to alert the operator of an impending dangerous situation, provide continuously updated courses, speeds, and CPA's of other vessels in the area, and provide a simple, easily understood, visual presentation of the movement of all targets in the area. This type of system would alert the pilot or watch officer of a dangerous situation if he were otherwise occupied and failed to observe the target on radar. It would also eliminate the need for time-consuming manual plotting in order to extract all useful information from the radarscope. The Board made similar recommendations in its special study of "Collisions of Radar-Equipped Merchant Ships and Preventive Recommendations."

Radiotelephone Communications

The role of the VHF radiotelephone in this casualty is of particular interest. Despite the fact that the Standard Oil Company policy stated all of its vessels were to participate fully in the voluntary Harbor Advisory Radar System, the OREGON STANDARD elected not to guard the designated frequency (channel 18A) during its outbound transit of the Bay. The master testified that he switched to channel 10 because he had no traffic or pips on his radarscope. As a result, neither HAR nor the ARIZONA STANDARD was able to establish communications with the OREGON STANDARD. This collision may well have been prevented if the vessels had established radio contact and informed each other of their position and intentions. The Safety Board has noted in previous collisions, such as the one involving the UNION FAITH and WARREN J. DOUCET and the one involving the AFRICAN STAR and MIDWEST CITIES, that the vessels did not have a common frequency available, which precluded establishment of communications. In both of those casualty reports, we indicated the need for and our support for the bill recently passed by Congress, which requires a radiotelephone on certain vessels navigating upon specified waters of the United States. This casualty illustrates the need for the specific provision of the enacted bill which makes the guarding of the designated frequency mandatory.

The OREGON STANDARD was guarding channels 10 and 16. Despite this fact, the ARIZONA STANDARD was unable to establish contact with her on either of these two frequencies. Since all the evidence available indicates the radio equipment on both vessels was functioning properly, possible reasons for the failure that were not ruled out by the investigation were either the volume was turned down too low, or the bridge personnel were preoccupied with the navigation of the vessel.

Harbor Advisory Radar System

The Coast Guard established the Harbor Advisory Radar as a test for evaluation purposes. This casualty has provided an evaluation; namely, that due to lack of authority, the system was unable to prevent the collision. There are two inherent weaknesses in the HAR System, both of which were contributory factors to the inability of the system to prevent the collision. The first is the voluntary nature of the system. As soon as the OREGON STANDARD shifted from channel 18A to channel 10, a breakdown in the desired system operation occurred. The master of the OREGON STANDARD testified that he did not guard channel 18A because he did not observe any traffic on his radar, so he did not think HAR's assistance was necessary. As a result of the master's failure to participate, the primary purpose of the system was defeated. The voluntary nature of the system also means that there may be vessels within the working area of the system which are not providing position and movement information. If the HAR operator cannot identify the targets on his radarscope, he cannot warn them of impending dangerous situations nor can he advise participating vessels of the intentions of the nonparticipating traffic.

The second weakness in the system is the limitation as to the type and amount of information the HAR operator is allowed to provide the vessels. He is allowed to provide only a word picture of the position and general direction of movement of vessels which he observes on the radar. He is not allowed to provide any interpretative information. The HAR operator, when questioned as to why he did not provide the ARIZONA STANDARD with any more position reports on the OREGON STANDARD after his 0130 report, testified:

> "I had reported it (the OREGON STANDARD) to the ARIZONA STANDARD so she could identify it on her radar. I brought it to her attention and she had identified it, and I had done my job."

Apparently, the instructions which prohibit the operators from providing any interpretative information influenced his decision. Since the ARIZONA STANDARD had acknowledged the operator's reports concerning the OREGON STANDARD, he felt he had done all he was allowed to do. This situation points out the weakness of the HAR system in that it is a completely passive one which does not allow the operator to direct or regulate traffic movements in any manner or even provide interpretative information.

These weaknesses exist in the system due to a lack of statutory authority for the Coast Guard to operate such traffic regulation systems. If the HAR operator had been authorized to direct or regulate traffic, the

collision probably would have been avoided. This casualty illustrates the need for such authority and the establishment of effective systems in the congested ports and waterways in the United States.

Fog Signals

Despite the fact that both vessels were sounding fog signals, neither vessel heard the other's signal. The signals of the powerful diaphone and two fog horns located on the bridge, which the personnel on each vessel were specifically listening to, undoubtedly contributed to the failure of the vessels' signals to be heard. A vessel, upon hearing apparently forward of her beam a fog signal of a vessel whose position is not ascertained, is required to, as circumstances permit, stop her engines and then navigate with caution until danger of collision no longer exists. The effectiveness of this requirement is nil if a vessel's fog signal is not heard. This casualty is another example of the inadequacies of the whistle signal system and the need for more positive and reliable means for vessels to determine the position and intentions of other vessels in their vicinity. The Board previously noted the inadequacies of the whistle signal system in its report on the collision of the SS UNION FAITH and the M/V WARREN J. DOUCET.

Systems Failures and Traffic Regulation

In the past, such causal factors as failure of the vessels to keep to their starboard side of the channel, immoderate speed, and failure to utilize fully the radar generally have been attributed to or classified as personnel errors. These factors also can be classified as systems failures.

However, the important question is, why were these errors committed and what can be done to prevent the repetition of such errors in the future?

The problems of determining a vessel's position and ensuring that the vessel remains in and to its side of the channel become much more difficult when a dense fog is encountered and visibility is reduced to a matter of a few hundred yards. A strong fair tide, such as the one the inbound ARIZONA STANDARD was experiencing, compounds these problems.

The initial decision, which must be made when such adverse conditions are encountered, is whether to initiate or continue the voyage or to delay departure or heave to and await more favorable conditions. Traditionally, this has been the decision of the master. Despite the fact that company policy may, and in this casualty did, indicate the

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ultimate decision to sail or continue a voyage rests with the master, and that the safety of the vessel should be the paramount factor considered, other factors influence the master's decision. The economic aspects such as maintenance of schedules and adherence to **ETA's may tend to influence the decision.**

Perhaps in the past, leaving the decision entirely up to the master was appropriate. Today, with the tremendous increase in the size and speed of vessels, the proliferation of hazardous cargoes, and the much greater traffic density, the risk levels have increased enormously. In this casualty involving two small, 10,000 GT, World War II vintage tankers, over **800,000 gallons of bunker fuel escaped into the Bay.**

The master alone should no longer be required or allowed to bear the burden of such decisions. He should receive assistance and, when necessary, authoritative direction in making the decision. Traffic regulation systems with mandatory participation, shipboard collision avoidance systems, and mandatory bridge-to-bridge radiotelephone communications are some methods which are available to provide the desired assistance or regulation. Such systems have proven effective in the Great Lakes, the St. Lawrence River, Rotterdam, and several other areas throughout the world.

Pilothouse Workload, Task Organization, and Organization of Controls

In this accident, there were no fewer than four elements in the sequence of events which raise questions of the adequacy of the organization of the responsibility for tasks on the bridge of the vessels involved, the workload, and the organization of the pilothouses for the performance of the controller's tasks. When the master of the OREGON STANDARD was attempting to determine the timing of his turn, he relied upon the sound of the fog horn at Lime Point, a relatively inaccurate indication, and he did not rely upon the available radar. Obviously, the master could not be on the wing of the bridge to listen for the fog horn and in the wheelhouse observing the range and bearing of Lime point on radar at the same time, yet he **apparently failed to assign either task to the second mate. When the radar in the OREGON** STANDARD was set on the 6-mile range, there would have been an opportunity to observe that the ARIZONA STANDARD was ahead in the channel; however, the mate of the OREGON STANDARD testified that he was busy with many other conflicting duties, some of which, under many bridge layouts, cannot normally be accomplished while within view of the radar screen. when, later, the OREGON STANDARD detected a target at a range of 0.8 miles, the master attempted to raise the **ARIZONA STANDARD on the radiotelephone, but he** erroneously set **the radio on channel 6. Rather than take the time to**

switch channels and try again, he returned to the conning of his vessel in an effort to avoid the collision. He could not continue his efforts to contact the other vessel because the normal bridge layout does not allow simultaneous talking and visual search, and he did not assign either task to someone else.

Aboard the ARIZONA STANDARD, three officers were at work on the bridge during the approach to the Golden Gate, one of whom was placed on duty for the specific reason that the task was considered to require three persons. In addition, it was known that the OREGON STANDARD was somewhere in San Francisco Bay and would be exiting through the channel. This represented a hazard to the **ARIZONA STANDARD, as was indicated by its repeated efforts to raise the OREGON STANDARD on normal radio channels. Despite the presence of three officers on the bridge to man the radar and corm the vessel, no plot was made of the vessel's track in the channel. The question is whether the plotting of position could have been accomplished, even by the three officers on the bridge, under the conditions of the n-knot speed of the ARIZONA STANDARD, or whether the task was accomplishable, but** simply not performed.

There is enough evidence available to imply that there may have been underlying difficulties in task organization, bridge layout, and workload, but there is not sufficient evidence to draw definite conclusions.

Close study of this aspect of the accident *beyond normal* investigation seems most desirable because of the general questions concerning task Organization, workload, and bridge design which have been raised by general studies in recent years. Studies by competent students of the man-machine relationship and human factors in operational safety have indicated that there are many shortcomings in traditional operations and bridge layout, if judged by the practices developed in other fields. These problems are discussed in great detail in the recent study, "Human Factors in Ship Control." This study was made in 1969 by General Dynamics for the Maritime Administration.

It is at least appropriate to raise these questions, since the organization of authorities, tasks, and controls has developed only by step-by-step changes, not analysis, and is strongly influenced by the traditional arrangement of command authority on vessels. For example, it is traditional that the master or other senior on watch remain standing during the whole time he is on the bridge. If it is assumed that the master is always on his feet, then it might be considered not illogical that he be required to circulate over the entire scope of the bridge wings, pilothouse, and chartroom in order to perform the necessary tasks of operation. Comparisons have been made between this form of organization

and the control organization of a large transport aircraft. In the aircraft, the organization of instruments and controls is analytically developed to allow rapid scanning, observation of a great many instruments in sequence, and instantaneous response. The pilot of the airborne vessel can observe any of his key instruments at any moment, simply by glancing at them, and he can simultaneously communicate with other vessels or the aircraft control tower while maintaining surveillance.

The absence of this form of rapid, close-at-hand, virtually simultaneous surveillance, control, and communication in the marine field has sometimes been justified by the statement that the much slower speeds of marine vessels do not require it. This accident affords scant support for that rationale.

The design of aircraft control work stations has been subjected to many cycles of development, and aviation accident investigations routinely search out very detailed errors in workspace arrangement and task organization which could have contributed to accidents.

Development of such aspects when they appear in marine accidents is also important because analytical design of some marine vessel controls has been initiated, and the need for the concept is being closely observed. The pilothouses of some naval minesweepers now tend to resemble, in internal arrangement and external appearance, a typical centralized airport control tower rather than the elongated room having widely distributed instruments and controls, placed athwartships, which represents the most frequent bridge designs.

SUMMARY

Ecological losses which affect the general population, in addition to the economic losses incurred by the vessels' operators, resulted from this casualty. The results might have been even more catastrophic if two supertankers of more than 100,000 GT had been involved, or if the cargo of the OREGON STANDARD had been gasoline in lieu of bunker fuel.

These damages are suffered to a large extent by the third party or innocent bystander, which was the general public in this casualty. Potential losses which would follow casualties to large tankers would also impinge to a large degree on the general public.

The current theory of control of vessel movements in harbors relies strongly upon the presumption that individual masters are competent and that by employing their skills in their own best interests, they will succeed in avoiding collision. However, the fact that economics also

enter into master's decisions is inescapable. Both vessels were moving at immoderate speeds, determined necessary by the masters for their own reasons, and the individual efforts of each master were insufficient to prevent an enormous loss to the general public. The fact that this type of accident is repeatable, and on a far larger scale, makes valid the question of what degree of public control is necessary. Does service to the public welfare still properly permit **such decisions, fraught with great public risk, to be made only by the two privately motivated individuals, or is a firmer degree of control, responsible to the general interest, necessary?**

In this casualty, four different systems or subsystems were in effect which could have avoided the collision, had any one of them functioned properly. Under the control system prescribed by the Inland Rules of the Road, the vessels could have avoided each other by keeping to their starboard side of the channel, establishing their positions by their own radar. They could have avoided each other by seeing each other on radar, and maneuvering accordingly to insure a safe passage. They could have avoided each other by hearing the whistle signals and then maneuvering accordingly. They could have avoided each other by voluntarily employing the services of the Harbor Advisory Radar. None of these systems operated to achieve the function needed for individual reasons already described.

The most significant of these systems, the Board believes, is the potentially controlling Harbor Advisory Radar. The HAR is a publicly funded facility which lacks the corresponding public authority needed to insure that the weaknesses of privately operated systems or private motivations would not produce great public loss. This potentially protecting public radar system should no longer be placed in the position of recording the minute stages of a public disaster while powerless to prevent it. The Safety Board believes that, responsive to the public interest, the authority to control this traffic should be provided.

PROBABLE CAUSE

The National Transportation Safety Board determines that the **cause of** this collision was the failure or inadequacy of four different systems or subsystems, any one of which could have prevented the collision had it functioned adequately.

The regulatory system prescribed by the Inland Rules of the Road failed in that neither vessel complied with the rules by keeping to its starboard side of the channel. **This** non-compliance was contributed to by in-moderate speed for prevailing conditions on the part of both vessels, failure of both vessels to use the radar capabilities

available to maintain an accurate plot, and the absence of a positive indication of the center of the main ship channel through the Golden Gate.

The radar system by which the vessels could have avoided each other failed because the ARIZONA STANDARD did not obtain and evaluate correctly information from radar pertaining to the movements of the OREGON STANDARD, and the OREGON STANDARD did not check periodically at least one of the radarscopes, set on a sufficiently long range scale, to ensure the prompt detection of the ARIZONA STANDARD.

The whistle signal system of avoiding collision failed because neither vessel heard the other vessel's fog signals. A contributing factor was the high noise level caused by the diaphone and fog horns located on the Golden Gate Bridge.

The Harbor Advisory Radar system was inadequate to prevent the collision. The inadequacy arose from the decision of the OREGON STANDARD not to guard channel 18A, which precluded its participation in the system, and the prohibition of Harbor Advisory Radar operators from providing interpretative information or direction to vessels. The underlying and most significant inadequacy of the Harbor Advisory Radar was the lack of authority of the Coast Guard to regulate this traffic, which prevented a publicly financed facility from protecting the public against loss.

RECOMMENDATIONS

The National Transportation Safety Board concurs in the action planned by the Commandant with respect to Recommendation No. 2 of the Marine Board. With regard to Recommendation No. 1, this is the third major marine casualty report in which the safety Board has commented upon the need for legislation to require bridge-to-bridge radio. In our special study of "Collisions of Radar-Equipped Merchant Ships and Preventive Recommendations," we referred to the effectiveness of this type of communications on the Great Lakes.

The Safety Board commends Congress for the recent passage of the "Vessel Bridge-to-Bridge Radiotelephone Act." This Act will provide a very helpful tool for the prevention of collisions.

The Safety Board further recommends that:

1. Congress enact legislation such as the proposed "Ports and Waterways Safety Act of 1971" (H.R. 8140) which would

provide explicit statutory authority for the U.S. Coast Guard to establish and operate marine traffic regulation systems in the congested port waters of the United States.

2. The Coast Guard continue to develop the Marine Traffic System in San Francisco Bay. Successful development of this system should lead to the eventual establishment of similar effective systems in other congested ports and waterways in the United States.

3. The Coast Guard study the feasibility of developing a method of traffic separation for inbound and outbound traffic in the Golden Gate Channel,

4. The Radio Technical Commission for Marine Services actively support and encourage the maritime and electronic industries' efforts to develop and utilize collision-avoidance systems.

5. Vessel operators, the American Institute of Merchant Shipping, and the Society of Naval Architects and Marine Engineers give due consideration to the development of coordinated bridge workspace arrangements and task assignment in the formulation of vessel specifications and designs as highlighted in the recent General Dynamics study.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

Adopted this 28th day of July, 1971:

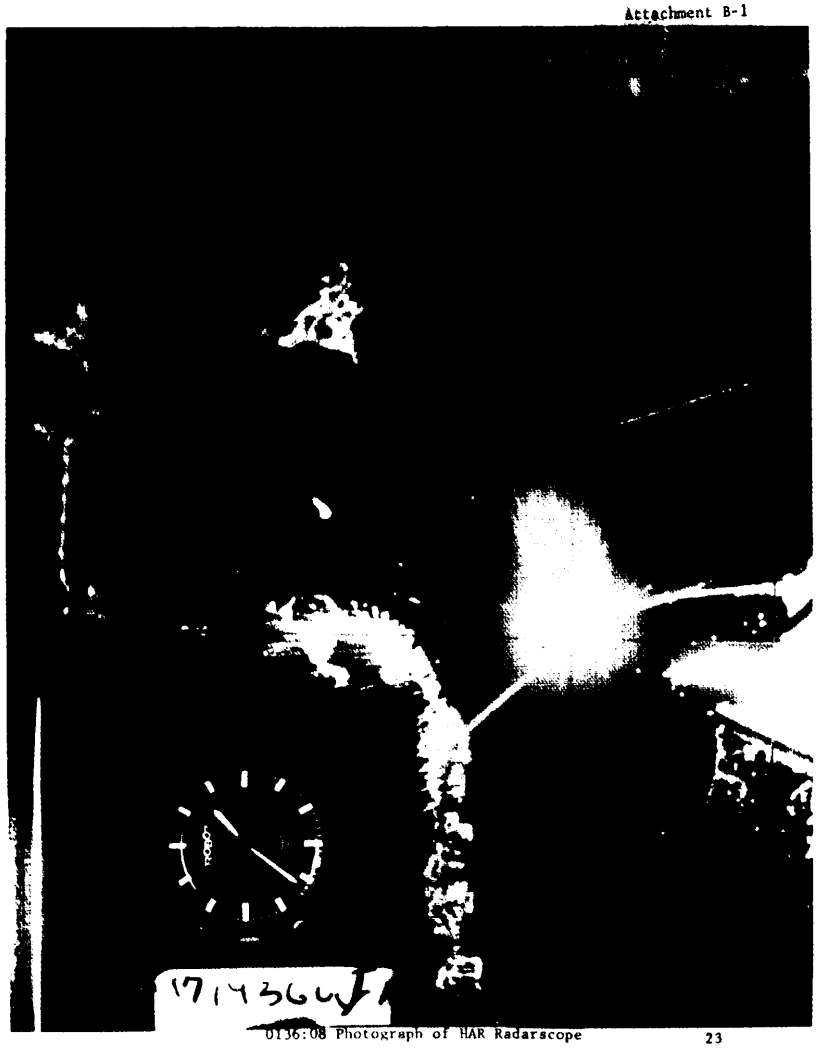
Oscar M. Laurel, Member

Francis H. Mc Adams, Member

Louis M. Thayer, Member

Chairman Reed and Member Burgess were-absent, not voting.

Attachment B-1



0136:08 Photograph of HAR Radarscope 23

Attachment B-2

0139:02 Photograph of HAR Radarscope 24

Attachment B-3

Photograph of RAP Radarscope

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDANT (MVI-3)
U.S. COAST GUARD
WASHINGTON, D.C. 20591

21 APR 1971
5943/ARIZONA STANDARD - OREGON STANDARD
C-12 Bd

Commandant Action

on

The Marine Board of Investigation convened to inquire into the circumstances surrounding the collision between the SS ARIZONA STANDARD and SS OREGON STANDARD at the entrance to San Francisco Bay on 18 January 1971

1. The record of the Marine Board of Investigation convened to Investigate subject casualty has been reviewed, and the record, including the Findings of Fact, Conclusions and Recommendations, is approved subject to the following comments and the final determination of the cause of the casualty by the National Transportation Safety Board.

SYNOPSIS OF FINDINGS OF MARINE BOARD OF INVESTIGATION

1. **During the early morning of 18 January 1971 at the entrance of San Francisco Bay, the arriving loaded tankship** ARIZONA STANDARD **and the departing loaded tankship OREGON STANDARD collided in dense fog. Each vessel was severely damaged.** There was extensive pollution.

2. These ships, each **T-2 type tank vessels, were equipped with two radar installations, multi-channel radiotelephone, and other similar navigational aids. All equipment was in good operating condition. Viability in the heavy fog at the time of the collision** was estimated to be **200-300** yards.

3. The OREGON STANDARD departed Standard Oil Dock, Richmond, California, at 0021 on 18 January 1971. At 0049 the radiotelephone was used to inform Harbor Advisory Radar that the vessel was underway and departing the dock. The radiotelephone channel was changed to one used to communicate with the home office and so remained until just prior to the collision. The extremely poor visibility permitted only

one aid, the Southampton Shoal Lighted Bell Buoy No. 1, to be sighted visually. After this time the vessel was piloted on various courses by use of radar ranges and bearings.

4. At 0135 the course of the vessel was altered to 270 degrees and the scale on the radar PPI scope was changed from l 1/2 miles to five miles. A contact, later identified as the ARIZONA STANDARD, was seen bearing two points off the port bow at an approximate range of eight-tenths' mile. The Master intended to make a port to port passing with the ARIZONA STANDARD. Fog signals were being sounded by the OREGON STANDARD. The Master determined that his vessel was in the middle of the channel when passing under the Golden Gate Bridge. He had intended to be much further to the right during the passage of this channel. When the ARIZONA STANDARD was first sighted visually coming out of the fog at a distance of about 250 yards, two points on the port bow, collision was imminent and impact occurred at 0140.

5. Bridge personnel of the ARIZONA STANDARD heard the departure report of the OREGON STANDARD transmitted to Harbor Advisory Radar on the radiotelephone at 0049. No further communication was heard from the OREGON STANDARD. At 0058 the ARIZONA STANDARD, advised Harbor Advisory Radar of its ETA and approach to San Francisco Bay. Harbor *Advisory* Radar repeatedly called OREGON STANDARD via radiotelephone without any response. The ARIZONA STANDARD was informed by Harbor Advisory Radar of the OREGON's position at 0120 and 0131.

6. Shortly before the ARIZONA came abeam of Mile Rocks a contact later identified as the OREGON STANDARD was observed on the PPI scope. Attempts by the ARIZONA to raise the OREGON on various channels of the radiotelephone were unsuccessful. The ARIZONA continued to track the OREGON until the contact was lost from the radar screen in the return of the Golden Gate Bridge. The ARIZONA had been sounding fog signals in accordance with the Inland Rules of the Road. No signals were heard from the OREGON. At about C139 the navigation lights of the OREGON came into view on the starboard bow at an estimated distance of 300 yards. The collision occurred about one minute later with the ARIZONA on a heading of 055 degrees and the OREGON on a heading of 270 degrees.

7. The ARIZONA had reduced engine speed *to* half ahead from full ahead at 0130 when abeam of Mile Rocks. From the point of speed reduction until the moment of collision the average speed over the bottom was 10.5 knots including an estimated 2.3 knot current caused by the flooding tide. The OREGON made successive engine speed changes from full ahead to half ahead at 0134, half to slow ahead at 0138 and from slow ahead to full speed astern at 0140. The *average* speed over the ground determined by Harbor Advisory Radar from 0130:16 to 0139:08 was 8.2 knots.

8. There was extensive damage to each vessel with resulting pollution from the oil spilled from the damaged cargo tanks on the OREGON. There were no injuries or loss of life.

9. The experimental Harbor Advisory Radar installed for use in San Francisco Bay and operated by the Coast Guard is being tested and evaluated. The track of the OREGON was followed by HAR from the oil dock in Richmond until the collision. The ARIZONA STANDARD was observed by HAR upon entering the main ship channel to San Francisco Bay until the collision.

REMARKS

1. Concurring with the Marine Board of Investigation, it is considered that the primary cause of the casualty was the failure of the SS ARIZONA STANDARD and the SS OREGON STANDARD to proceed at a moderate speed during a period of reduced visibility, thus violating Article 16 of the Inland Rules of the Road.

2. In further concurrence with the Board's Conclusion No. 2, it is considered that it was particularly essential in view of the reduced visibility for each vessel to keep on its own side of the channel. Failure to do so is a violation of Article 25 of the Inland Rules of the Road.

3. Various frequencies on the radiotelephone to communicate with the ARIZONA STANDARD and the Harbor Advisory Radar were available to the Master of the OREGON STANDARD. Failure on the part of the Master of the OREGON to fully utilize all navigational aids, particularly radiotelephone, to safely navigate and position his vessel constitutes evidence of negligence.

4. It is further concluded that failure to use radar information correctly on both vessels contributed to the casualty.

ACTION CONCERNING THE RECOMMENDATIONS

1. Legislation for bridge-to-bridge voice radio communication between vessels is now pending in Congress.

2. A program exists to continue the experimental Harbor Advisory Radar in San Francisco Bay. The title of the operation is being changed to Marine Traffic System anticipating involvement with future harbor traffic control. There are plans that call for the installation

of new equipment (radar, computer, and visual display) specifically designed for traffic control capability. Mandatory voice radio communication is essential to the success of the present or planned system.

3. Further investigation under the administrative procedures provided by the Suspension and Revocation Proceedings Regulations concerning the evidence of negligence and violations of the Inland Rules of the Road has been initiated.

CR. BENDER

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

Address reply to:
COMMANDER
TWELFTH COAST GUARD DISTRICT
630 SANSOME STREET
SAN FRANCISCO, CALIFORNIA 94126

5943/Mar. Board,
OREGON **STANDARD-**
ARIZONA STANDARD,
12 March 1971

From: Marine Board of Investigation
To: Commandant (MVI)

Subj: SS OREGON STANDARD, SS ARIZONA STANDARD; collision at entrance to San Francisco Bay, 18 January 1971; No Loss of life

1. At or about 0140 (PST) on 18 January 1971, the outbound loaded tanker OREGON STANDARD and the inbound loaded tanker ARIZONA STANDARD, navigating in dense fog, collided in mid-channel at the entrance to San Francisco Bay, approximately .2 of a mile west of the Golden Gate Bridge. Both vessels sustained extensive damage and the Oregon Standard lost approximately 20,000 barrels of her cargo of bunker fuel. There was no loss of life or injury to personnel.

2. VESSELS INVOLVED

Name	SS ARIZONA STANDARD	SS OREGON STANDARD
Official No.	248736	246773
Service	Tankship	Tankship
Gross Tons	10,553	10,448
Net Tons	6,361	6,301
Length	504 Ft.	504 Ft.
Breadth	68.2 Ft.	68.2 Ft.
Depth	39.2 Ft.	39.2 Ft.
Year Built	1945	1944
Propulsion	Steam, Turbo-electric, 6,000 HP	Steam, Turbo-electric, 6,000 HP
Document	Consolidated Cert. of Enrollment and License, Permanent, No. 45, **issued at San Francisco, Calif., 11 October 1970**	Certificate of Registry, Permanent, No. 33, issued at San Francisco, Calif., **15 January 1971**
Owners	**Standard Oil Company of California 225 Bush St., San Francisco, Calif. 94104**	**Standard Oil Company of California 225 Bush St., San Francisco, Calif. 94104**
Operators	**Chevron Shipping Co. 555 Market St., San** Francisco, California	**Chevron Shipping Co. , 555 Market St., San** Francisco, California

Master	Harry Hamilton Parnell, License No. 361511, Master, Steam and Motor vessels, any gross tons, any oceans, radar observer; First class pilot on San Francisco Bay and Tributaries, Issued on 17 April 1969 at San Francisco, California. USMMD Z-743825, endorsed for any unlicensed rating in the deck dept. including able seaman.	Morris Emerson English License No. 384228, **Master, Steam and Motor vessels, any gross tons, any ocean, radar observer; First class pilot, Honolulu Harbor to sea and return; San Pedro Bay; Los Angeles Harbor; San Francisco Bay; Puget Sound and adjacent *in-*** land waters between Seattle and Angeles Point via main ship channels; Columbia River, Astoria to sea; Waters of Resurrection Bay, Prince William Sound to **Valdez** and Cordova; Southwestern Alaska to and including Dutch Harbor; Issued 12 August 1969 at San Francisco, California. **USMMD** Bk. 053551 endorsed for any unlicensed rating in the deck dept. including able seaman.
Last Inspected for Certification:		
Date	26 August 1970	23 October 1970
Port	San Francisco, Calif.	San Francisco, Calif.
Capacity of cargo tanks	141,158 Bbls	141,158 **Bbls**

Both ships were standard T-2 tankers, essentially unchanged since built, inspected and certificated for carriage of grade "A" liquid in cargo tanks and grade "E" in the deep tanks. Each ship was divided by transverse bulkheads into 9 cargo tanks numbered from forward to aft. #1 tank was divided into port and starboard compartments by a centerline bulkhead and the other tanks were divided into port, center, and starboard compartments by two longitudinal bulkheads.

Both ships are capable of a maximum speed of approximately fifteen knots. The pitch of the propeller of each ship was 17.6 feet. The following revolutions per minute of the propeller were used for maneuvering. Full 80, Half 60, Slow 40, Dead Slow 20.

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3. RADAR

Each vessel was equipped with two radar installations. On both ships a DECCA, Type **RM 426 was** located near the forward wheelhouse bulkhead on the port side and a RAYTHEON MARINERS PATHFINDER was installed in a similar location on the starboard side.

RADAR DATA

DECCA, Type RM 426
10 1/2 inch (265mm) effective diameter screen
Gyro Stabilized

RANGE SCALES	**CALIBRATION RINGS**
0.5 NM	*0.25* **N M**
0.75NM	*0.25* **N M**
1.5 NM	**0.25 NM**
3.0 NM	**0.5 NM**
6.0 NM	**1.0 NM**
12.0 NM	**2.0 NM**
24.0 NM	**4.0 NM**
48.0 NM	**8.0 NM**

RAYTHEON Mariners Pathfinder
Screen Size: 7 inch diameter cathode ray tube
Range Scales: 1.5, 5, 15, and 50 miles
Ranging: Range marks spaced 1,000 yards, 1 mile, 3 miles, and 10 miles

4. Radio Telephone:

Each vessel was equipped with a RAYTHEON VHF Radiotelephone (Mod. Ray. 40) located in the wheelhouse. Both were fitted for channels "A" through "J" and capable of automatically monitoring channel 16, 156.80 MHZ, the calling and distress frequency. The OREGON STANDARD was also fitted with channel "K". The channels *were* marked on the vessels' radio equipment as follows:

LETTER	**NUMBER**	**FREQUENCY (KHz)**
A	19A	156.95
B	7A	156.35
C	18A	156.90
D	10	156.50
E	*6*	156.30
F	*16*	156.80
G	*26*	156.30
H	*28*	157.30
I	12	156.60
J	13	156.65
K	Blank	Weather (No frequency marked)

5. WEATHER AT THE TIME OF THE CASUALTY

Heavy fog; calm seas; light ESE airs; flood tide, current approximately 2 knots.

6. The SS OREGON STANDARD completed loading operations at the STANDARD OIL DOCK at Richmond, California shortly before midnight on 17 February *1971.* **The cargo consisted of** 103,349 **barrels of heavy bunker fuel destined for Bamberton, British Columbia. All tanks were full with the exception of number 6 center and number 8 port and starboard, which were empty, and numbers 3 and 5, port, center, and starboard, which were slack. The draft was 30'-01" forward and 32' aft.**

All navigation gear was tested by the chief mate and 2nd mate and found satisfactory. The deck and engine room clocks were synchronized and the "course recorder time was adjusted. The radars were then tuned and made ready for use. The master was called at 2340 and after discussing the weather and tide with the 2nd mate he ordered the ship made ready to sail. Visibility at this time, was two or three hundred yards due to heavy fog. The master was aware that the ARIZONA STANDARD was due at Point Orient at 0200 or 0230.

At 0006 the cargo hose was disconnected, the mooring lines were taken in and at 0021 the vessel, with the mooring master aboard, left the dock assisted by two tugs. At 0048, when the OREGON STANDARD was shaped up on her course in Southampton Shoal Channel, the mooring master and the tugs departed and the vessel proceeded outbound stemming the flood tide at half speed ahead with the master at the corm. At 0049 the master contacted Harbor Advisory Radar on VHF channel 18A and advised that the OREGON STANDARD had departed Richmond Long Wharf, bound for sea. The radio telephone was later switched to channel 10, the channel used for communicating with the owner's office.

At 0053, Southampton Shoal Lighted Bell **Buoy No. 1 SS (LL 804) was abeam. This was the only aid to navigation observed visually on the passage outbound. As the vessel went by it the second mate saw its qreen flash from the starboard bridge wing. Navigation from that point on was by radar ranges and bearings. The master for the most part conned the vessel by information obtained from the Raytheon radar and from the 2nd mate who assisted in the navigation. The duties of the 2nd mate included answering the telephone, logging bells in the bell book, logging aids passed and courses steered, observing the helmsman and, as time permitted, observing the scope of the Decca radar on the port side of the bridge. The helmsman, was steering true courses by hand telemotor.**

At 0054 speed was changed to full ahead. Southampton Shoal Light (LL 795) was abeam to port at 0.6 mile at 0103. At 0108 speed was reduced to half ahead. When Point Blunt was abeam to starboard at 0111, at a distance of 0.6 mile, the master started a right turn to 260° to pass north of Harding Rock. The bow lookout stationed on the foc'sle head at departure from the dock was relieved at 0115.

Full speed ahead was resumed at 0116.2. At 0125 Harding Rock Lighted Buoy (LL 653) was abeam to port at 0.2 mile. After passing Harding Rock the master ordered a course of 231 degrees. At about 0131 the master found by radar observation that the vessel had been set somewhat to the north of the intended track and was 0.3 mile off Point Cavallo. The course was changed to 220°. When three tenths of a mile off Lime Point the fog horn on the point (LL 646) was heard. At 0134 the engine order telegraph was put on half ahead. At 0135 the master ordered the rudder hard right for a course change to 265 degrees and almost immediately thereafter amended that order to 270 degrees. While making this turn the master switched the Raytheon radar from the 1 1/2 mile scale to the 5 mile scale and the contact later identified as the ARIZONA STANDARD was observed on radar at range of .8 mile, approximately two points off the port bow. The radar presentation of the Raytheon radar, which was not gyro stabilized, was somewhat blurred by the swinging ship. The OREGON STANDARD was on heading of 270 degrees by 0138 when it was under the Golden Gate Bridge. The master intended to make a port to port passing with the ARIZONA STANDARD. The yellow loom of the lights on the bridge span was visible and the diaphone (LL 645) located in the center of the bridge span was heard overhead. The horn on the south pier of the bridge (LL 643) was also heard.

At 0138.2 speed was reduced to slow ahead. The vessel had up to this point been sounding fog signals in accordance with the Inland Rules of the Road on automatic. Switching the fog signal from automatic the master went to the port wing of the bridge and began blowing fog signals by hand. The master was joined by the second mate who advised him that the contact on radar was on the port bow approaching rapidly and that the bearing was not changing. He had intended to be well north of the center but found himself in the middle of the channel. After obtaining a flashlight from the second mate the Master went over to the VHF radio telephone, switched it from channel 10 to channel 16 so he would have been able to call the ARIZONA STANDARD. The approaching vessel appeared out of the fog at a distance of approximately 250 yards about 2 points on the Port bow. Two white lights, the masthead and range lights, were seen first and then the green running light. Full astern was rung and the general alarm was sounded. The collision occurred at 0141 with the OREGON STANDARD making approximately three knots headway. No whistle signals were heard from the ARIZONA STANDARD.

7. The ARIZONA STANDARD was bound from Estero Bay, Calif. to Richmond, Calif. with a cargo of San Joaquin Valley Heavy crude oil and a draft of 31 feet forward, 31 feet aft. After encountering fog down the coast about 25 **miles south of San Francisco the ship started sounding one prolonged blast every two minutes. The vessel continued to sound this fog signal prescribed by the international rules of the road until she passed the line of demarcation into inland waters and started sounding one prolonged blast every minute. The ARIZONA STANDARD continued to sound this fog signal in accordance with the inland rules of the road until the time of collision. After passing** Mile **Rocks the fog signals were blown by hand by the second mate.**

The approach to the main ship channel was made **on course** *343* **degrees True. The engine speed was reduced from full ahead to the full ahead maneuvering speed of 80 revolutions per minute. At 0049, the ARIZONA STANDARD heard the OREGON STANDARD report to Harbor Advisory Radar on VHF Channel 18A that she had departed Richmond Long Wharf for sea. At 0058 and 30 seconds, the ARIZONA STANDARD advised Harbor Advisory Radar on Channel 18A that she was entering the main ship channel, bound for Point Orient. At 0059 and 30 seconds, Harbor Advisory Radar called the OREGON STANDARD on Channel 18A, but there was no response. A repeated attempt to call the OREGON STANDARD on Channel 18A at 0059 and 50 seconds was also unsuccessful.**

At 0100 with San Francisco Main Ship Channel lighted Whistle Buoy #2 (LL 625) approximately one-half mile on the starboard **beam the ARIZONA STANDARD started a starboard turn to enter the channel. At 0104 the ARIZONA STANDARD was in the main ship channel with Buoy #2** abeam to her starboard. At 0107, San Francisco Main Ship Channel lighted Buoy #4 (LL 627) was abeam. At 0110, San Francisco Main Ship Channel Lighted Buoy #6 (LL 629) was abeam. At 0114, San Francisco Main Ship Channel Lighted Buoy #8 (LL 631) was abeam. While transiting the channel the red lights of the buoys on the south side could not be seen visually, however the white lights of the buoys on the north **side** *were* **observed.**

At **0116 and 50 seconds, Harbor Advisory Radar again called the OREGON STANDARD, but there was no reply. An attempt by Harbor Advisory Radar to call the OREGON STANDARD was repeated at 0117 and 10 seconds. At 0120, Harbor Advisory Radar advised the ARIZONA STANDARD that "Radar Shows The OREGON STANDARD Passing North of Alcatraz, Bound for Sea". The course of the ARIZONA STANDARD was at this time, changed to 065 degrees True, to line up with the channel under the Golden Gate Bridge. At 0125 the lookout reported the loom of a flashing light** *on* **the starboard bow. The master determined that the loom was from Mile Rocks Light (LL 640),** which was at a range of 1 mile on , radar, three points on the starboard bow. Approximately two minutes later, before coming abeam of Mile **Rocks, a contact**

later identified as the OREGON STANDARD was observed on radar in a position approximately one-half mile off Point Blunt. The chief mate of the ARIZONA STANDARD made a plot of three positions of the OREGON STANDARD with a grease pencil on the PPI scope, at increments of less than one-half mile. The times of these observations were not noted; however they indicated a relative movement line of 264 degrees. Attempts by the ARIZONA STANDARD to contact the OREGON STANDARD on channel 18A, channel 10 and channel 16 were unsuccessful.

At 0130 the ARIZONA STANDARD had Mile Rocks Light abeam at one-half mile. The course was changed to 056 degrees True, and the engine was reduced to half ahead. Further unsuccessful attempts to call the OREGON STANDARD were made by Harbor Advisory Radar at 0130 and 30 seconds and 0130 and 40 seconds. At 0131 and 10 seconds Harbor Advisory Radar advised the ARIZONA STANDARD that "The present position of the OREGON STANDARD is east of the Golden Gate Bridge 1 mile". Soon thereafter, when the OREGON STANDARD was approximately three tenths of a mile off Point Cavallo the contact disappeared from the radar scope of the ARIZONA STANDARD. By this time the ARIZONA STANDARD had passed abeam of Mile Rocks and was about three-tenths of a mile further along her track line towards the center of the Golden Gate Bridge span.

At 0138 and 50 seconds Harbor Advisory Radar advised the ARIZONA STANDARD that they "had been unable to contact the OREGON STANDARD on 18A". At 0139 and 20 seconds (By Harbor Advisory Radar Time) the ARIZONA STANDARD advised Harbor Advisory Radar that her position was one half mile west of the Golden Gate Bridge and that she had been trying to contact the OREGON STANDARD. Soon thereafter the masthead light, range light and red running light of the OREGON STANDARD were observed approximately two points on the starboard bow at a range of about 300 yards. A hard left rudder order was then given. The collision occurred approximately one minute later (at 0140 by the ARIZONA STANDARD'S clock). At 0143 the engine of the SS ARIZONA STANDARD was placed at half astern. No whistle signals were heard from the OREGON STANDARD.

8. The impact as the vessels came together was described as a soft grinding crunch. It was not severe enough to cause crewmembers of either vessel to lose their footing nor were any injuries sustained on either vessel as a result of the collision. The ARIZONA STANDARD, on a heading of about 055 degrees, struck the OREGON STANDARD on a heading of about 270 degrees, just aft of the foc'sle head, penetrating the port side of the ship and rupturing #2 port, #3 port and #4 port tanks. Numbers 3 center and 4 center remained intact. The cargo from the damaged tanks spilled into the bay. Number

1 port and #3 center lost a small amount of oil through fractures. The overhang of the bow of the ARIZONA STANDARD slid aft, shearing ullage trunks and external fittings from the deck of the OREGON STANDARD. Damage to the ARIZONA STANDARD was in way of the lower bow areas forward of the collision bulkhead. The cargo tanks of the ARIZONA STANDARD remained intact but there was some minor flooding in way of the forward dry cargo space.

Immediately after the impact the foredecks of both vessels were illuminated and the crews were ordered to lay out fire hose. The crew of the OREGON STANDARD cleared lifeboats, ready for launching. Harbor Advisory Radar and the Company office were notified of the incident by radio telephone. Communication between the vessels was then established. After examination of the damage the masters attempted to back free without success. The vessels were securely locked together, and drifting toward Angel Island on the flood tide. The starboard anchor of SS OREGON STANDARD was let go with 9 shots of chain out. The vessels continued to drift toward Point Knox, dragging anchor until the arrival of several tugs which held them clear of shallow water. Shortly thereafter barges and oil removal equipment arrived and an oil retention boom was rigged around the ships. The effectiveness of the boom was at first impaired due to the wheel wash of the maneuvering tugs which caused oil to be washed from the boom enclosure. The skimmers and the vacuum barges began to remove oil from the surface of the water immediately after their arrival on the scene.

About 7 hours after the incident both vessels had shifted or off loaded sufficient cargo to change trim enough to permit them to be separated. The ARIZONA STANDARD went to the Standard Oil Dock to off-load. The OREGON STANDARD waited off Point Knox for a favorable tide and then went to the Standard Oil Dock to off-load preparatory to gas freeing and repairs. While at the refinery the boom was re-rigged around the vessel to protect against further oil pollution.

9. The total amount of oil spilled from the SS OREGON STANDARD was estimated at 20,000 barrels. There was no loss of oil cargo from the SS ARIZONA STANDARD. Due to the flooding tide at the time of the collision oil flowed into and contaminated portions of San Francisco Bay. Subsequent tidal action dispersed the oil and caused contamination of adjacent coastal areas. Surface and aerial surveys by the Coast Guard on-scene commander indicated that oil contamination in the Bay extended eastward from Yellow Bluff through Raccoon Strait to Bluff Point and eastward from Yellow Bluff to a line between Point Blunt and Alcatraz Island and from there to North Point in San Francisco. Traces of oil were observed in South Bay extending to the Hunters Point area. The northernmost movement of oil along the coastline was to Double point near Kellam Beach in the Point Reyes National Seashore area. The southernmost point was off Pillar

Point in Halfmoon Bay. The seaward extremity of oil contamination west of the Golden Gate was approximately eight miles to the east of the Farallon Islands.

Cleanup of the oil which reached the shore was effected by crews hired by the vessel's owners, local authorities and by volunteers. Methods **used varied from employment of laborers using hand tools and straw to vacuum trucks and bulldozers. The work involved removal of oil from beaches and waterfront areas and delivery of contaminated waterfowl to designated treatment centers. On** *20* January the total labor force controlled by the vessel's owners was in excess of 350 hired laborers and 450 volunteers. There were numerous other volunteers working under the auspices of local authorities and conservationist groups. Additional manpower and equipment were provided by nearby military commands. Control and operation of waterborne equipment including barges, skimmers and vacuum barges was also exercised by the owners of the vessels. Surveillance of Bay and offshore areas was conducted several times daily by Coast Guard, company chartered aircraft and other military aircraft.

The regional and national response teams were activated in accordance with the Hazardous Material Contingency Plan and coordinated assessment, evaluation, and recording of the effects of the spill and the progress of the cleanup operations were made by the primary agencies. The persons principally involved in notification, containment, countermeasures, cleanup, disposal, and restoration included representatives of the Commander, Twelfth Coast Guard District, Environmental Protection Agency, California Fish and Game Department, and the regional Water Quality Control Board. There was concerted participation by a great number of national and local agencies and organizations. Other interested agencies were kept advised of events by daily situation reports.

10. **Average speeds of the ARIZONA STANDARD and the OREGON STANDARD while navigating various reaches of the channel and bay have been calculated from approximate positions, distances, and running times established by the evidence. These speeds are set forth in tabular form below:**

ARIZONA STANDARD AVERAGE SPEED OVER GROUND

AID	TIME	AID	TIME	MIN	MILES	AV SP
BUOY R'2'	0104	Buoy R"8'	0114	10	2.12	12.7
Buoy R"8'	0114	Mile Rk Lt.	0130	16	3.75	13.8
Mile Rk.	0130	Collision Pt.	0140	10	1.8	10.5

OREGON STANDARD AVERAGE SPEED OVER GROUND

AID	TIME	AID	TIME	MIN	MILES	AV SP
BUOY R2SS	0053	Southampton Shoal light	o103	10	1.6	9.5
Southampton Shoal light	0103	Pt. Blunt	O111	8	1.5	11.2
Pt. Blunt Buoy	O111	Harding Rk	0125	14	2.3	9.75
Harding Rk	0125	Pt. Cavallo	O131	6	1.23	12.5
Pt. Cavallo	0131	Collision Pt.	0141	10	1.0	6.0

11. The movement of the OREGON STANDARD as observed by Harbor Advisory Radar and photographs of the radar scope presentation were taken at intervals of approximately three minutes. The ARIZONA STANDARD also appeared in the radar scope when she approached the Golden Gate Bridge and came into range of the inner harbor radar. The average speed of the OREGON STANDARD calculated between observations recorded by Harbor Advisory Radar are set forth in the following table:

OREGON STANDARD AVERAGE SPEED OVER GROUND BY HARBOR ADVISORY RADAR PLOT

TIME		RUNNING TIME	DIST	AV SPEED
0118:23	0130:16	11 Min 53 Sec	2.1 Mi	10.9
0130:16	0133:11	2 Min 55 Sec	.5	10.2
0133:11	0136:07	2Min 56 Sec	.4	8.
0136:07	0139:08	3 Min 1 Sec	.32 Mi	6.2

Harbor Advisory Radar, operated by the Coast Guard as an experiment to investigate the desirability of Harbor Advisory Systems in the United States, maintains surveillance over San Francisco Bay and the Bay channel approaches. Vessel movement information within the Harbor Advisory Radar area of responsibility is provided over the navigation radio channel (18A) from U. S. Coast Guard Harbor Advisory Radar Operations Center located at Pier 45. In general, traffic information is provided for the channel segment which vessels are about to enter and in response to vessels reporting their departures or passing a reporting point. Additional information will be provided only upon request from a vessel or, if in the interest of safety, such information is felt to be particularity meaningful to the vessel. Voluntary position reports are essential for satisfactory operation of the Harbor Advisory Radar which must be able to compare a position report with a contact in order to identify that contact. There is no requirement that vessels stand watch on VHF channel 18A. The Harbor Advisory Radio Operations Manual recommends however, that the set be switched on and tuned to the navigation channel (18A) in order that contact can be made with any vessel sighted and a safe passing arranged. The masters of both the SS OREGON STANDARD and the SS ARIZONA STANDARD were aware of the provisions of the HAR operations manual.

CONCLUSIONS

1. **The casualty was caused by faulty** navigation of the **SS ARIZONA STANDARD and the SS OREGON** STANDARD. Both **vessels proceeded at an immoderate speed in dense fog and failed to keep to the starboard side of the channel prior to the collision. There were several other factors that may have contributed to the casualty.**

a. **Failure to establish radio-telephone communication.**

Although the vessels were equipped with compatible radio equipment, and both masters were aware that the other vessel would be navigating in the area, the radio-telephones were tuned to different channels.

b. Navigating narrow channel in dense fog.

Both vessels were committed to navigation in the channel by the masters, also acting as pilots, with full knowledge of the conditions of reduced visibility.

c. **Failure of OREGON STANDARD to make timely radar contact.**

The OREGON STANDARD was approximately 1/10 of a mile from the Golden Gate Bridge before the ARIZONA STANDARD was observed on radar at a range of approximately 8/10 of a mile. The sharp right turn of the OREGON STANDARD before passing under the Golden Gate Bridge may have been a contributing factor in the failure of that vessel to pick up the ARIZONA STANDARD on the Raytheon Radar which was not gyro stabilized, however, the presentation of the gyro stabilized Decca Radar should not have been blurred by the swinging of the ship.

d. Loss of radar contact by ARIZONA STANDARD.

At a position about 1 1/2 miles from the Golden Gate Bridge the ARIZONA STANDARD lost radar contact with the OREGON STANDARD at a range of approximately 2 1/2 miles. There is no evidence of radar equipment failure and the interference by the bridge span as the radar images of vessels passing under the Golden Gate Bridge **merge with the image of the bridge span is only momentary. The blanking effect on the radar presentation of the inbound vessel caused by the high land** mass at **Lime Point near the north end of the bridge** was **not a material factor in this case since the vessels were in line of** sight. **This masking effect persists until the ship is approximately 1 1/2 miles from the Golden Gate Bridge when Pt. Cavallo shows up as a single distinct pip resembling a ship contact.**

2. There is evidence of negligence on the part of the masters of both the ARIZONA STANDARD and the OREGON STANDARD for failure to go at a moderate speed in fog, and for failure to remain on the starboard side of a narrow channel. Failure *to go* at a moderate speed in fog is a violation of Article 16, of the Inland Rules of the Road, and failure to keep to that side of the fairway or channel which lies on the starboard side of a vessel is a violation of Article 25 of the Inland Rules of the Road. This evidence of negligence and violations of the Inland Rules of the Road has been referred to the Commander, Twelfth Coast Guard District for appropriate action under the Revocation and Suspension provisions of RS 4450, as Amended.

3. The casualty might have been prevented:

a. If the master of the OREGON STANDARD had started his right turn to line up with the channel under the bridge in sufficient time, or had otherwise directed his course to assure that his vessel would remain on the starboard side of the channel instead" of in the middle of the channel.

b. If the master of the ARIZONA STANDARD had set his course to take his vessel closer to the South pier of the Golden Gate Bridge, instead of making good a course down the middle of the channel.

c. If communications on the radio-telephone had been established in order that the vessels could have ascertained the course and intentions of the other. This would have allowed the vessels to take evasive action to prevent both vessels from passing under the Golden Gate Bridge *in* the center of the channel at the same time.

do If the ARIZONA STANDARD had been picked up on radar at a distance greater than 8/10 of a mile, in sufficient time for the OREGON STANDARD to take evasive action. Closer attention to the PPI *scope,* better adjustment of the radar, operation of the radar at intervals on a greater range scale, and an additional radar observer may have facilitated earlier radar contact.

RECOMMENDATIONS

1. That effort be continued to obtain legislation requiring the installation and use of bridge-to-bridge radio-telephone equipment on all merchant vessels in the navigable waters of the United States.

2. That the Harbor Advisory Radar be continued if legislation is passed to require bridge-to-bridge radio-telephone communications. The value of such Harbor Advisory Radar is greatly enhanced when it is used in conjunction with radio-telephone communications between vessels.

3. That further investigation be conducted under the Revocation and Suspension provisions of RS 4450, as Amended, concerning the licenses of the masters of the SS ARIZONA STANDARD and the SS OREGON STANDARD.

CAPT J. E. GOULD, 3387, USCG
Chairman

CAPT C. T. NEWMAN, 5024, USCG
Member

CDR F. E. STEWART, 4276, USCG
Member & Recorder

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