

The ARCO TEXAS

PREVENTION BULLETIN 01-02

OVERVIEW

On Sunday, June 27, 1999, the T/V ARCO TEXAS was discharging crude oil through two loading arms to a refinery in Ferndale, Washington. At approximately 1345, a combination of tidal current and wind overcame the holding capacity of its winches and the ARCO TEXAS drifted away from the terminal dock causing both loading arms to fall into the water. Approximately 300 gallons of crude oil were released into Washington waters as a result of the damaged loading arms.

All times are approximate Pacific Daylight Time (PDT). Courses are referenced from True North.



Figure 1. Picture shows damaged Mechanical Loading Arms and gangway at the Ferndale dock. View is to the north, showing dry-bulk dock in background. Note tugs moored off end of dry-bulk dock.

PROBABLE CAUSE

The probable cause of the breakaway and subsequent spill was the inadequate holding capacity of the ARCO TEXAS' aft mooring winches under the environmental load experienced. Factors that likely contributed to the breakaway include:

- A maintenance program for the ARCO TEXAS' mooring winches that did not require scheduled and documented inspections of the mooring winch brakes; and,
- A maintenance program for the ARCO TEXAS' mooring winches that did not include

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industry-recommended testing procedures for brake holding capacity. This lack of testing precluded any way for the crew to know the required brake tightness needed to establish the recommended holding capacity (60 percent of the maximum breaking load of the mooring line in use, as recommended by the Oil Companies International Marine Forum — OCIMF). Even if the brakes were 'hand-tight,' there was no way, absent test results, for the crew to know if the brakes would hold to the industry specification. Winch brake testing was especially important in light of the problem experienced aboard the ship of maintaining the winch brake bands squarely on the drums.

VESSEL INFORMATION

The ARCO TEXAS was a 91,394 deadweight ton, steam-powered, tank ship built in 1973; its forebody was replaced in 1981. The tanker was registered under the United States flag. Length overall was 247 meters (899 feet), with a beam of 32 meters (106 feet).

The ARCO TEXAS was carrying crude oil loaded at Valdez, Alaska. The ship's draft was 47 feet 9 inches upon arrival in Washington.

The ARCO TEXAS was fitted with nine mooring winches. The winches were steam powered. Winches 1, 3, 5 and 7 were located on the starboard side. Winch numbers 2, 4, 6 and 8 were located on the port side. Winches 1 through 8 led athwartship. Winch number 9 was located on the centerline at the stern and leads aft.

The rated brake capacity of the mooring winches was 154,350 lbs. (68.9 long tons).



Figure 2. No. 1 mooring winch on bow of ARCO TEXAS. Note the dual (storage and working) drum design and the 2-inch Spectra® line. Two-prong handle at center is winch brake tightening mechanism.

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The 1981 addition of a new forebody at Newport News Shipbuilding, Newport News, Virginia included the delivery of new winches for the vessel.

A mooring analysis for a vessel of the size of the ARCO TEXAS (90,000 d.w.t.) at the terminal at Ferndale indicated the typical mooring arrangement for a tanker includes nine lines of 2-inch Spectra® line. The typical arrangement was two forward spring lines, two after spring lines, three stern lines, and two head lines.

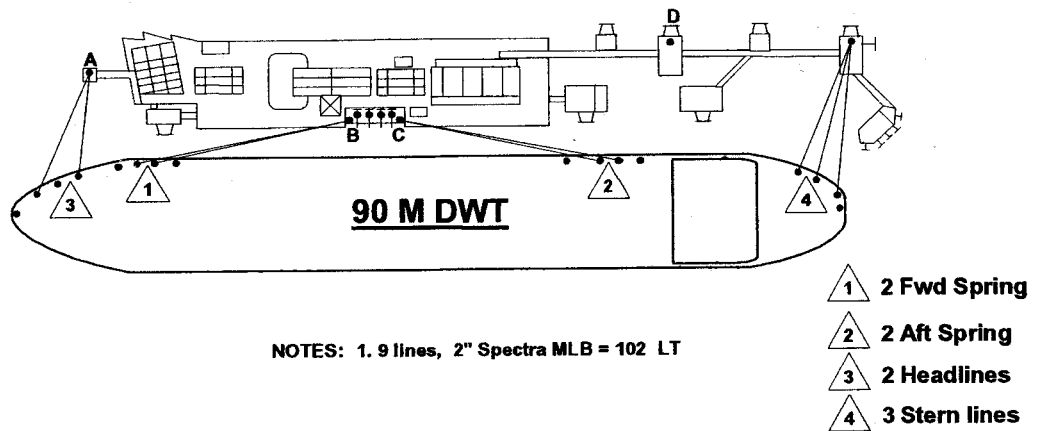


Figure 3. Mooring configuration for a tanker the size of the ARCO TEXAS. [From the facility's Marine Terminal Safety & Operations Manual.]

In this case, there was one forward breast line each on winches nos. 1 and 2, plus an additional forward breast line made fast to bitts. The two after leading spring lines were on winches nos. 3 and 4, and the two forward leading spring lines were on winches nos. 5 and 6. The three aft breast lines (stern lines) were led to winches nos. 7, 8 and 9.

FACILITY INFORMATION

The refinery's marine terminal was located along the Strait of Georgia about 10 miles northwest of Bellingham, Washington. The dock was accessible by a causeway that extends over 1,000 feet from land to a water depth that can accommodate tankers up to 60 feet draft at mean lower low water. The dock ran roughly south-southwest from the causeway, and was 785 feet long and 96 feet wide.

Transfers on the outside berth employed mechanical loading arms (MLA). There were four loading arms located at the dock's outside berth. Crude oil was transferred using the 16-inch diameter, Nos. 3 and 4 MLAs.

According to Ecology records, 84 tankers had made 601 calls at the Ferndale dock between April 1993 and the incident. No incidents like the ARCO TEXAS breakaway were reported to Ecology in that time.

PERSONNEL

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The Port Relief Mate (PRM) was on watch at the time of the incident and was the Person-in-Charge

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(PIC) for the ship. Able Bodied Seaman (AB), Number 1 (AB1), was standing the 1200-1600 watch. He said he was tending lines on deck (forward).

AB, Number 2 (AB2), was standing the 1200-1600 watch. He said he was standing by the #4 center tank with the PRM.

The ship's Pumpman was standing by the #1 center tank.

The Chief Engineer (CE) was in his room when the breakaway began.

The First Assistant Engineer (1AE) was on the dock talking on the pay phone (located on the east-west portion of the dock near the gate) prior to the incident.

The Second Assistant Engineer (2AE) was in the engine room.

The Master of the ARCO TEXAS took the conn of the tanker during the breakaway.

Facility

The Marine Terminal Operator (MTO) was the terminal/shore representative and PIC for the facility. He was on the dock during the incident.

The facility's pollution control representative (PCR), an independent contractor, was aboard the ARCO TEXAS during the transfer operation. He came on duty at 0000 for another vessel transfer, and was sleeping during a break when the breakaway occurred.

Tugboats

The tug ARTHUR FOSS and its crew were at a buoy about one mile north of the facility dock when the incident occurred.

The tug BRIAN S and its crew were alongside a barge at the facility dock's inner berth when the incident occurred.

ENVIRONMENT

Predicted Tides & Tidal Currents

On June 27, 2000 at 1330, the predicted tide at Ferndale was 0.7 feet (mean lower low water, MLLW) and was predicted to rise another 0.8 feet to 1.5 feet by 1400. The total tidal range was 9.8 feet for that portion of the tidal cycle.

Predicated currents for the area were for a nearly slack current turning to flood. Flood currents at the dock flow to the north, ebb currents to the south.

Observed Tidal Currents

The 1AE of the ARCO TEXAS noted that he thought the tidal current was "excessive" and "...quite strong, and it caught my attention." He later stated to Ecology investigator, that the current was about the speed he could walk, estimated at two or three knots.

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The "Official Log" of the ARTHUR FOSS contained an entry at 1200 that indicated an ebb current. The "Initial Oil Spill Report (Notification)" from the ARTHUR FOSS, with a report time of 1358, indicated one knot of flood current.

The PCR noted that the current was setting to the north (flooding) and was "strong." He estimated the current speed to be about one knot and that it was about 15 degrees off the starboard quarter of the ARCO TEXAS. It was not clear as to when he made his observation of current.

Observed Weather

Various weather observations from log book entries and witnesses put the weather as partly cloudy with southeast to southwest winds between 10 and 20 knots.

CHRONOLOGY

This chronology is derived from a variety of sources.

On June 27, 1999, at 0000, the PCR came on duty at the Ferndale dock to oversee the ongoing transfer between the facility and a tanker. This transfer ended at 0200 and the tanker departed the outside berth.

At 0515, the ARCO TEXAS put its first line ashore to the facility dock. The MTO came on duty for a 12-hour shift as the PIC for the facility at 0530. The ARCO TEXAS was all fast, starboard side to the dock, by 0545 on a heading of 013 degrees alongside the dock. The PCR boarded the ship, inspected the moorings and asked that the ship's crew shift a head line from a forward mooring winch to the bits.

Between 0605 and 0630, Nos. 3 and 4 MLAs were connected to the ARCO TEXAS. Winds were recorded as southeast at six knots. The sky was overcast.

By 0700 gauging of tanks was completed and the ship was ready to commence cargo operations. The Third Mate of the ARCO TEXAS signed the Declaration of Inspection (DOI) while shore tanks were gauged. By 0740, the process was complete and a radio check was conducted before the ARCO TEXAS started discharging its cargo of crude oil. During this time the PCR made rounds of the deck before heading to some breakfast aboard the ship. By 0830 the PCR had completed breakfast and stayed aboard the ship to rest.

At 0845 the PRM signed the DOI and took over the cargo watch. Between 0845 and noon the MTO and PRM made rounds of the facility and ship, respectively, checking the water around the dock and ship for any signs of oil.

Noon weather was logged as partly cloudy with southerly winds at 10 to 15 knots. Aboard the ARTHUR FOSS, an ebb current was noted.

At 1335, the CE, in his stateroom aboard the ARCO TEXAS, noticed the ship shuddering. Soon after he heard the cargo pumps shut down. After being notified by an AB of a spill on deck, he headed for the engine room.

The events between 1340 and 1350, as the stern of the ship pulled away from the dock, were

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recalled as follows:

AB1 was tending lines on deck (forward), had tightened the breast line forward "...a little bit..." and was heading aft. He said he was called by the PRM, who said "...we're far from the dock...", just as he noticed it. He witnessed the after spring line feeding out with the brake on. The brake smoked while it paid out the mooring line. He could not see the stern winches. He said the loading arms were still attached, that the ship continued to move from the dock, and saw the gangway lift as the ship moved from under it.

AB2 was standing by the No. 4 center tank with the PRM. He said the PRM called AB1 on radio and asked "...can you do something about it..." He said the PRM shut down the cargo operation. He said he received an order from the PRM to close the No. 4 center main and stripper valves and two others. AB2 said he then ran aft to the stern to look at the winches. He said when nothing could be done there he ran to the bow to ready the anchors, assisted in making fast to a tug on the bow, then went aft to "...clean up the mess."

The PRM was standing with AB2 by No. 4 center tank at about 1345. She said she "...noticed, or thought she noticed the vessel moving aft..." She said she then went to the starboard side and confirmed the ship was moving. She said she "...called the Pumpman, who was standing by [No.] 1 center tank valves that we had to shut-down..." She said she then went to the top of the pump room and began securing pumps, and called the engine room via phone and notified the engine room of the problem and the shut-down. She said she returned to the deck and told the pumpman "...to shut down everything..." She said she ran into a third AB (AB3) on her way to the deck office to call the Master. She said she told AB3 to get all hands out on deck, which AB3 was already proceeding to do. She called the Master and Chief Mate from the deck office, and spoke to the Master, but could not get the Chief Mate. She said she again returned to the deck to see "...the vessel had pulled away from the dock, the chocks [loading arms] had stretched, then pulled away..." She said the Chief Mate and AB1 "...proceeded to the bow..." She said she went to the stern with AB3 and a fourth AB to stand by for the tug.

Meanwhile, the 1AE was on the dock talking on the pay phone. He said he noticed the current and wind from the south and called the current "excessive" and "quite strong." He said he got off the phone about 30 seconds before the ship came off the dock.

The MTO said he had radio contact with the ARCO TEXAS and that he received a call for a shut-down. He said he thought "...it sounded urgent..." The MTO said he saw the stern of the vessel coming off the dock as he walked out of the dock office. He said he told the ship they needed to stop their pumps.

The MTO said he went up the stairs to the catwalk behind the MLAs, received word that the ship's pumps were stopped and then closed the electronically operated valves (EOV). He said he went down the stairs on the south end of the catwalk and called for immediate assistance on the facility emergency radio frequency. He said he then aligned the evacuation pumps to the MLAs.

The MTO said that the No. 4 MLA (southern most 16-inch MLA) came off the ship's header when a hydraulic line broke. This, he said, caused a "...large spray of oil because the line was still under pressure..." He radioed on the emergency frequency that there was oil in the water.

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The MTO said he pushed the buttons for the EOV's on shore and could see the No. 3 MLA being over extended, breaking off at the dock, falling to the deck of the ship, and falling into the water. He then called the crew of the tug BRIAN S for assistance.

At 1350, with a heading of 025 degrees (12 degrees off the alignment of the dock), the rate of swing of the ARCO TEXAS away from the dock increased. The BRIAN S notified their dispatch of the situation and got under way to assist. The PCR aboard the ARCO TEXAS was awakened by the ship's general alarm.

The Master took charge of the situation from the bridge aboard the ARCO TEXAS at 1351 just as the ship was reaching an angle of 25 to 30 degrees from the dock. Meanwhile the ARTHUR FOSS, north of the dock, noted the ARCO TEXAS' problem and got underway to assist.

The PCR reached the deck and noted that the MLAs were already ripped off. He also noted that there were three head lines and two forward spring lines still in place from the ship to the pier. Tug BRIAN S began pushing on the port quarter of the ARCO TEXAS at 1355.

By 1357, the heading of the ARCO TEXAS reached about a 63-degree angle to the dock, as the ARTHUR FOSS noted southwest winds at 15 knots with a one-knot flood current.

At 1400, the CE called the bridge to inform them that the engines were ready for maneuvering. Shortly after the ARTHUR FOSS put a line up to the bow of the ARCO TEXAS.

The ARCO TEXAS reached an angle of about 90 degrees to the dock at about 1406, and its two forward spring lines and three head lines were still made fast to the dock, as its engines were put full astern.

With the BRIAN S pushing full its port quarter and the ARTHUR FOSS pushing on its port bow, the ARCO TEXAS was released from the remaining mooring lines from the dock. The last line was away at 1410.

With the tugs BRIAN S and ARTHUR FOSS still escorting the ship, the ARCO TEXAS safely anchored at 1510 at a nearby anchorage. The ARTHUR FOSS did a hull inspection of the ARCO TEXAS, with no hull damage noted.

DAMAGE

As a result of the breakaway incident the Nos. 3 and 4 MLAs at the facility dock were damaged. The No. 3 MLA was torn off the dock at its base (pedestal) and fell into the water. The No. 4 MLA was damaged and left hanging to the water. In addition, the dock's gangway and a fairlead on one of the mooring dolphins were damaged.

The ARCO TEXAS had substantial oiling on the deck and deck equipment. Some damage was done to the starboard side handrail of the ARCO TEXAS.

ANALYSIS

Witness statements regarding the strength of the current at the Ferndale dock did not fit well with the currents predicted for the area. The observed flood current of between one and three knots, was not

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reflected in the tidal current predictions for the nearest available prediction points which indicated a slack current turning to a weak flood at the time of the incident.

Historical data and post-incident measurements of tidal currents around the facility dock indicated currents as swift as 1.7 knots. Observation also indicated the presence of a tide line, marking a sharp increase in flood tidal current speed. It was not determined how often these tide lines occur at the dock.

The mooring criteria for vessels the size of the ARCO TEXAS (90,000 d.w.t.) at the facility dock was based upon a mooring study that assumed a maximum current speed of one knot. That assumption was incorrect, as shown by historical data and post-incident measurement of tidal currents that indicate currents exceeding one knot.

Post-incident correspondence with the operators of the ARCO TEXAS regarding the mooring winches revealed the following:

- There were established maintenance procedures for the mooring winches, but not the winch brake bands, which were carrying the environmental load at the time of the breakaway.
- There was an existing problem prior to the breakaway incident with maintaining the winch brake bands squarely on the brake drums. This resulted in winch brake modifications implemented by the ship, without review by the company under their Safety Management System (SMS).
- Winch brake testing was not accomplished following the modification to the winch brakes implemented by the ship, contrary to OCIMF guidelines.
- Annual winch brake holding capacity tests, recommended by the OCIMF and ISGOTT (International Safety Guide for Oil Tankers and Terminals), were not accomplished.
- Records for the replacement of mooring winch brake bands were not maintained.

Review of the response to the breakaway by the ship's crew, the tug crews and the MTO, indicated the response was quick and professional.

The response to the spill by the facility and ship operators was timely and adequate.

LESSONS LEARNED

- Mooring systems are safety-critical systems, and should be treated as such under a company's SMS.
- International guidelines for mooring system design and maintenance should be adhered to.
- Ships' officers and facility operators must be continually alert for changes in environmental conditions that could affect the safety of the ship.
- Facility and ship operators, especially those engaged in oil transfers, should cooperate to provide ship and facility personnel with the best information they can regarding environmental conditions at the facility.

PREVENTION RECOMMENDATIONS

To tanker owners and operators:

- Ensure that tanker mooring analyses incorporate the best environmental information available. If necessary, undertake additional current monitoring study, in cooperation with

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facilities frequented by the tanker, to determine the maximum probable currents that will be experienced, and to characterize those currents.

- Ensure company maintenance procedures require inspections of the winch brakes prior to each mooring operation, and include checks derived from the winch manufacturer's manuals. Ensure that these checks are documented and that any problems noted are addressed quickly.
- Ensure company procedures require that there are at least two qualified persons on duty on deck specifically dedicated to tending the ship's mooring during transfer operations. These two persons should work together to ensure that the safety-critical mooring system is properly adjusted for the prevailing conditions.
- Review the mooring winch maintenance system for the company; ensure that maintenance is occurring in accordance with the established schedule. Regularly audit maintenance logs to ensure continued adherence to the schedule.
- Ensure that results of annual brake testing are readily available to those responsible for tending the ship's moorings.
- Revise company procedures to ensure that any permanent modifications to safety-critical systems, including mooring winches and brakes, are carefully considered and reviewed by company management prior to implementation. Ensure that any such modifications are documented in accordance with the SMS.
- Ensure that the company's SMS fully complies with Section 10.2.4 of the International Safety Management (ISM) Code.

To owners and operators of oil handling facilities:

- Ensure that mooring analyses for tankers that tie up at your facility adequately reflect the conditions at the facility. If necessary, undertake additional current monitoring study, in cooperation with tanker operators, to determine the maximum probable currents that will be experienced, and to characterize those currents.
- Review the role of the facility's representative to the ship. Ensure the representative is given adequate authority (and management support) to require a transfer shutdown should he/she detect an unsafe condition.
- Review the work hours of the facility's representative to the ship in light of their role. Consider the use of more than one representative during transfers exceeding 12 hours, so that a continuous oversight presence is maintained on deck.
- Consider the installation of permanent tidal current monitoring equipment at locations where current conditions warrant it.
- Review your company's process for accepting tanker mooring arrangements; ensure that the process adequately reviews the mooring arrangements in light of environmental conditions likely to occur at your facilities.

In reviewing the ARCO TEXAS incident the new vessel operator has:

- *Concluded that manning levels onboard are adequate. Note: The new operator has added an additional third mate on each vessel.*
- *Improved the maintenance program for the winches including annual brake testing and ensuring all lines are rove properly on the winch drums.*
- *Realized the importance of sharing information between vessel and terminal. This is done at each pre-transfer conference to find out if any ships have had problems staying alongside.*
- *Realized that the high level of training shipboard personnel had received helped minimize the severity of incident due to their quick response. Operator is committed to continue maintaining the same high level of training for all shipboard personnel.*

More Prevention Bulletins

- PB 01-01: The SUPER RUBIN (WDOE#01-08-002)
- PB 99-02: The MONCHEGORSK (WDOE#99-261)
- PB 99-01: The ANADYR (WDOE#99-250)
- PB 98-01: The ARCADIA (WDOE#98-253)
- PB 96-02: BARGE 101
- PB 96-01: The KEYSTONE CANYON
- PB 95-02: The VERBIER
- PB 95-01: The DONA V

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