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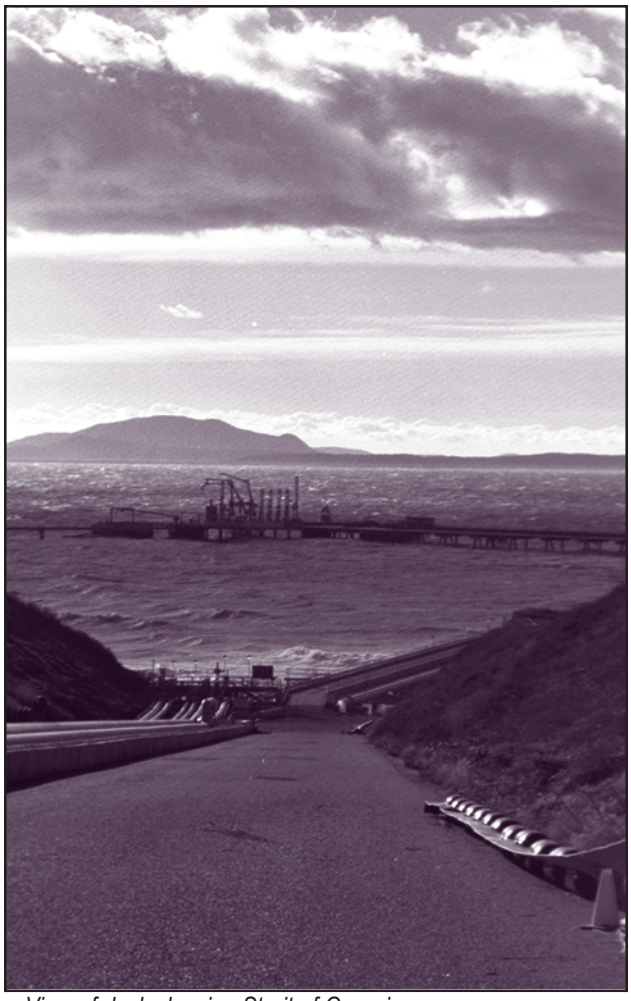
WASHINGTON STATE DEPARTMENT OF ECOLOGY

PREVENTION BULLETIN 03-01

The OVERSEAS WASHINGTON



View of dock showing Strait of Georgia.

OVERVIEW

On Friday, December 14, 2001, the T/V OVERSEAS WASHINGTON was discharging cargo at the south wing of the dock at a facility at Cherry Point, Washington. At about 0718, a combination of wind and wave action parted the two after-spring lines and the OVERSEAS WASHINGTON moved aft, damaging three loading arms. Because the vessel crew and the terminal operator recognized the deterioration of the weather, the loading arms had been drained and no significant amount of oil was spilled.

All times are approximate Pacific Standard time.

PROBABLE CAUSE

The immediate cause of the breakaway incident was the failure of the after-spring mooring lines. Factors that likely contributed to the incident include:

- The wind and sea-state experienced at the dock caused the vessel to roll and surge putting additional stress on the mooring lines.
- Inadequate preparation aboard the ship for heavy weather conditions at the berth.
- Lack of adequate policies and procedures aboard the ship regarding monitoring weather conditions while at berth and actions to take in preparation for heavy weather.
- Loading arm disconnect procedures that did not account for the combined effect of winds and seas.

VESSEL INFORMATION

The OVERSEAS WASHINGTON was a 90,515 deadweight ton, steam-powered tank ship built in 1978. The tanker was registered under the United States flag. Length overall was 272 meters.

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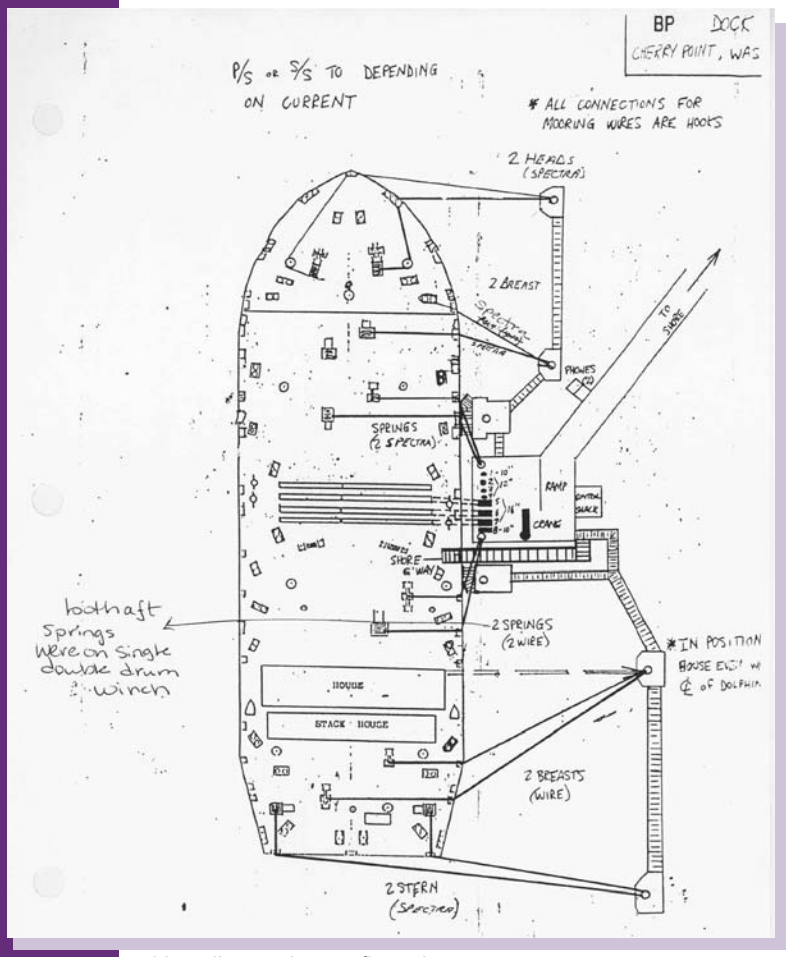
The OVERSEAS WASHINGTON



Vessel's mooring configuration.

The OVERSEAS WASHINGTON was carrying crude oil loaded at Valdez, Alaska. The ship's draft was 14.4 meters upon arrival in Washington.

The OVERSEAS WASHINGTON had a mixture of synthetic fiber and wire rope mooring lines. The mooring configuration on December 14th was two Spectra (synthetic fiber) head lines, one polypropylene foreword breast line (up on the forecastle made up to bits because the port side winch used for the breast line just aft of the forecastle was out of service), two Spectra headsprings, two wire rope after-springs, two wire rope after breast lines, and two Spectra stern lines. The vessel was using a combination of synthetic lines and wire rope as an interim arrangement while the old wire rope lines were in the process of being changed out to Spectra lines.

View of south dock loading platform.

FACILITY INFORMATION

The refinery was located on the Eastern shore of the Strait of Georgia. There were two dock wings, referred to as North and South Wings, at the end of an approach pier. The dock wings were about 640 meters from the shore. Each dock wing comprised a loading platform, four breasting dolphins (two on each side of the loading platform), plus two mooring dolphins north and south of the breasting dolphins. The berthing surface against the fendering system was 114 meters in length and the distance between the outermost mooring dolphins was 295 meters.

The South Wing was used primarily for discharging crude oil from tank vessels while the North Wing was used primarily for loading and discharging refined product. Transfers at the South Wing employed eight Mechanical Loading Arms (MLAs) and one vapor recovery arm. The Nos. 2, 3, & 4 arms handled clean product. The Nos. 5, 6, & 7 arms handled crude. At the time of the incident, the facility had three arms connected to the vessel, Nos. 5, 6, and 7. The south dock was oriented WNW-ESE.

ENVIRONMENT

The National Weather Service forecast for the night of December 13th and the morning of the 14th called for gale force winds SE at 35 knots becoming SW to NW and rising to 45 knots. Wind waves were forecast to build to 8 feet (2.4 meters).

The location of the facility made it vulnerable to wind waves when the wind blew from the West or Northwest, as there is a long fetch in that direction. Wave height prediction tables, reviewed post-incident, predict wave heights ranging from 6.7 feet for a 50 knot wind blowing from the WNW for 1 hour to 13 feet for the same wind blowing for 4 hours.[1]

At the time of the incident the tide was high and the current slack.

POLICIES AND PROCEDURES

The facility had policies and procedures relating to weather conditions and vessel movement during cargo transfer. These policies and procedures provided the dock operator with operational limits, consequences of deviation, and action required. Under the policies and procedures, high winds, defined as sustained winds equal to or greater than 45 mph (39 knots), required the dock operator to cease loading/unloading operations and drain the loading arms. Sustained winds greater than or equal to 50 mph (43 knots) required the dock operator to disconnect the loading arms, unless the wind speed was great enough to cause damage to the arms during the disconnect process. Additional policy regarding vessel movement during cargo transfer stated “If the weather conditions be such that the ship would be firmly against the dock and rolling and there is excessive dock vibration, cease transfer.”

The ship had policies and procedures regarding severe weather that directed the Master to monitor the weather and decide what precautions should be taken. Specifically, in port the Master was directed to consider the following options: increase moorings, cease cargo operations and disconnect, and/or proceed to sea.

CHRONOLOGY

The following chronology was derived from a variety of sources.

The ship commenced cargo discharge at 1654 on December 13th. The Chief Mate (C/M) was aware of the weather, but had not reviewed the available weather forecasts and no additional lines or vessel securing precautions were taken. At 2000, the ship log recorded the winds from the SE at Force 7 (28 to 33 knots). At 2130, the C/M became concerned about the wind force and contacted the Third Mate (3/M) on duty for wind speed and direction. The ship’s officers began checking wind speed and direction from the bridge readout and comparing it to the dock’s wind speed indicator at this time.

The North Wing wind speed log recorded the wind speed as approximately 38 knots at 2200 on December 13th (wind direction was not recorded on this log). At 0000, winds were again recorded aboard the ship as SE at Force 7.

[1] *Marine Weather for Western Washington. Kenneth E. Lilly. Location 7, near the center of the Strait of Georgia (9nm SE of Point Roberts),*

At 0624 on December 14th, the Second Mate (2/M) reported to the C/M that the wind had shifted towards the bow and it was "blowing hard, the seas were picking up, and the vessel was rolling and surging". The C/M called the dock operator at 0630 and, after conferring and determining the transfer to another ship at the North Wing had already shut down, it was decided to shut down cargo operations and drain the loading arms.

At approximately 0700 the C/M went to the vessel's bridge to check the anemometer. The wind at this time was gusting to 50 knots and about 30 degrees off the port bow (NW to WNW). The C/M informed the Master that the vessel had shut down cargo operations and drained lines. The C/M was waiting at this time for the dock to finish draining the shore lines before disconnecting. According to the dock operator's report to the Coast Guard, the arms were pumped out at 0715 and were ready to be disconnected by 0725.

At approximately 0720 (the dock operator reported it as 0730) one of the two after spring wire mooring lines parted. The ship began moving aft along the dock face. Two or three minutes later the second after spring wire mooring line parted.

Ship personnel attempted to activate the emergency disconnects on the MLAs. The No. 7 MLA was successfully disconnected, but, the Nos. 5 and 6 MLAs were not and broke at the swivel and flange respectively.

The 2/M on the bow dropped the port anchor and 1 ½ to 2 shots of anchor chain in the water. The ship had moved aft approximately 30 feet. The after breast wire ropes were acting as spring lines. At approximately 0730 one of the after breast lines parted at the pennant, a length of fiber line attached to the wire rope at the eye and the mooring system on the dock and designed to act as a shock absorber in the mooring arrangement.

At 0730 the Master called for steam to the engines. At 0745 a tug made fast aft. At 0750 steam was available and the engine was brought dead slow ahead to help maintain the ship's position. At 0800 another tug made fast forward. The ship's mooring lines were slacked, the anchor was raised, the mooring lines released, and the ship left the dock for a nearby anchorage. At 0841, with the OVERSEAS WASHINGTON about 200 yards off the dock, the line to the after tug parted. The vessel swung, but missed the dock. At this time the wind was blowing so hard, the crew reportedly had to hold on to something on the bow to stand. Seas were estimated at 12 to 15 feet. The North Wing wind speed log at 0900 showed gusts up to 45 knots. At 0936, the port anchor was let go in the anchorage area.

DAMAGE

As a result of the incident, MLAs and couplers Nos. 5, 6 and 7 were damaged. The facility's gangway was also damaged. In addition, damage was sustained to the ship's headers, the portion of the vessel's piping which connects to the facility piping.

ANALYSIS

The first wire after-spring line to part, parted just above the swaged fitting, a metal device used to clamp the free end of the wire to create an eye, or loop in the line. The second wire parted approximately 4 feet further up from its swaged fitting. A destructive pull test was performed on the two after-spring lines that parted. The wires, rated at 170,800 lbs. when purchased, parted at 132,100 and 182,600 pounds respectively. Post-incident testing did not, however, analyze the manner or method of strand failure. Lack of this information precluded a determination of whether the line failed from tensile load, fatigue or damage (mechanical or corrosive) in the strands.

Oil Companies Marine International Forum (OCMIF) recommends that wire mooring lines be lubricated every two or three months. According to the publication, *American Iron & Steel Institute's Wire Rope User's Manual:* "Like any machine, it (wire rope) needs proper care and maintenance for optimal safety and long service life."

Post-incident correspondence with the operators of the OVERSEAS WASHINGTON regarding the mooring lines revealed the following:

- The company did not have policies or procedures covering the maintenance of ships' mooring lines.
- The after-spring wires were installed on the vessel in 1997. The spring wires were last slushed (or lubed) in 1999.
- There were no records available for when (or if) the wires were end-for-ended or the wear points changed to prolong the useful life of the wire.
- The company planned to exchange all wire rope mooring lines for Spectra lines, but the exchange had not been completed due to the ship's schedule.
- At the time of the incident, the ship was using a mixture of Spectra and wire.

A dynamic mooring analysis was completed at the terminal following the incident by an engineering consultant on behalf of the operator for the OVERSEAS WASHINGTON. The report highlighted the importance of monitoring weather and wave conditions at the dock, and indicated that a fetch of about 100 miles existed at this facility when winds were from a northwesterly direction. The report also indicated that:

- Wind- and sea-induced surge and drift at the facility could place high tension loads on the ship's spring lines (approximately 20 long-tons);
- The tension loading on the ship's spring lines could be doubled by wave-induced loads;
- Individual mooring line tensioning was "very important" when the ship was subject to wave action; and
- Proper mooring line tensioning, lead, and tending practices under dynamic loading conditions were very important.

LESSONS LEARNED[2]

- Mooring systems are safety-critical systems, and should be treated as such under the ship operators' Safety Management Systems (SMS).
- International guidelines for mooring system design and maintenance should be adhered to.
- Ship's officers and facility operators must be continually alert for changes in environmental conditions and should take pro-active steps to ensure the safety of the ship and the transfer operation.
- Facility and ship operators should cooperate to provide ship and facility personnel with the best information they can in regard to environmental conditions at the facility and should have policies and procedures written to encourage personnel to stay ahead of developing situations.

[2] *Many of the Lessons Learned and Prevention Recommendations found in this prevention bulletin echo those found in The Arco Texas Prevention Bulletin and The Keystone Canyon Bulletin. For a copy of The Arco Texas Prevention Bulletin please contact Washington State Department of Ecology and ask for publication # 01-08-006. For a copy of the Keystone Canyon Bulletin ask for publication #00-08-009.*

PREVENTION RECOMMENDATIONS

To tanker owners and operators:

- Consider the mooring systems to be critical safety systems as defined in the International Safety Management (ISM) Code Section 7: "The Company should establish procedures for the preparation of plans and instructions for key shipboard operations concerning the safety of the ship and the prevention of pollution. The various tasks involved should be defined and assigned to qualified personnel." The policy and procedure should cover the entire mooring system – including the maintenance, inspection, and replacement of the mooring lines, in keeping with industry standards for specific equipment.
- Ensure each tanker has a mooring analysis for docks frequented that incorporates the best environmental information available, taking into account the location of the facility and the possibility of wave-induced motion of the ship placing additional loads on the mooring lines.
- Ensure company procedures require that there are at least two properly trained persons on duty specifically dedicated to tending mooring lines during transfer operations. The training should include what to do, and not do, if the vessel is rolling or surging at its moorings, which lines receive the greatest load during different conditions at the dock, and how to recognize when conditions are getting dangerous.
- Limit the use of mixed and short mooring lines to the maximum extent possible and ensure each line is equally loaded.
- Ensure company policies and procedures require officers to monitor weather forecasts and developing weather situations during transfer operations. Adequate emphasis should be placed on taking early steps to prepare the ship for high winds, seas, and current.
- If not already equipped, consider installing wind speed and direction displays in the vessel's cargo control room to facilitate monitoring.

To owners and operators of oil-handling facilities:

- Ensure that mooring analyses for tankers that tie up at your facility adequately reflect the potential conditions at the facility. If necessary, design a procedure to inform vessels of conditions that may be unique to your facility.
- Mooring analyses submitted by vessel operators should be carefully reviewed by facility engineers and marine terminal personnel and corrections or suggestions made before they are approved.
- Ensure that dock operators understand the importance of their role in communicating to vessel personnel information that may bear on shipboard safety decisions.
- If not already equipped, consider installing quick release hooks with load cells. These, along with the interconnecting wiring and display and alarm console, form a system to indicate and record mooring line loads. The loads can be manually or automatically monitored during environmental conditions which may cause excessive loading in the mooring lines, and the information can be used by operating personnel in deciding when it is safe for the vessel to remain at the berth.
- If not already equipped, consider installing and maintaining equipment to monitor weather, current and wave observations at the dock.

View of dock.

- Ensure company policies and procedures require dock operators to monitor weather forecasts and developing weather situations during transfer operations. Adequate emphasis should be placed on taking early steps to prepare for high winds, seas, and current.

In reviewing the OVERSEAS WASHINGTON incident the vessel operator and facility operator have:

- Conducted an extensive joint investigation into this incident for the purpose of determining the causes, contributing factors and lessons learned. A 6-person team worked for a month on the investigation and submitted recommendations to both operators. The operators have since taken actions, which they believe, will prevent such incidents from occurring in the future.

In reviewing the OVERSEAS WASHINGTON incident, the facility operator has implemented the following:

- The facility no longer accepts mooring line analysis to reduce the minimum number of mooring lines and instead follows the OCIMF Mooring Guidelines.
- The facility has reviewed the pros and cons associated with installing a mooring load monitoring system. Due to future anticipated changes in vessel size and shape, several aspects of the dock will need to be modified. In lieu of installing a mooring load measurement system at this time, the Operating Manuals and Procedures to Shut Down and Disconnect have been modified from 50 mph to 35 mph sustained wind speed, and a maximum sea condition of 5 feet or excessive vessel movement has been established. Should it be decided at a later date to increase the critical wind speed, considerations will again be given to installing load measurement devices.
- Fixed VHF radios equipped with weather channels have been installed at each dock wing to facilitate early wind warnings. Weather information can also be obtained through the refinery phone system. The anemometers have been moved to a location where they are not blocked by ships moored at the dock. Wind speed and direction information is fed into the Total Distributed Control (TDC) computers with readouts at each dock shelter.
- A refresher-training course in safe mooring practices has been given to dock technicians and foremen. In addition, during the pre-transfer conference with each ship, current conditions and communication protocol are reviewed.
- The pros and cons of installing a weather buoy with automatic broadcast capabilities have been researched. Concerns include initial installation costs and ongoing maintenance costs, as well as the reliability of data from a system owned, operated, and maintained by the facility which is outside the facility core business and experience base. The facility feels the ideal solution would also be the most efficient and effective tool for all marine business in the immediate area, and if an opportunity to share the costs and experience with other facilities/ industries develops, the idea will revisited.
- During each ship's pre-arrival communications, and also the ship/shore pre-transfer conference, any anticipated extreme weather conditions are now discussed as well as the potential impacts to operations that are unique to the facility.

More Prevention Bulletins

- ☐ PB 01-01: The ARCO TEXAS (WDOE#01-08-006)
- ☐ 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
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