



# The KEYSTONE CANYON

<sup>1</sup> OMS is now part of the Washington State Department of Ecology's Spill Prevention, Preparedness, and Response Program

## OVERVIEW

On October 26, 1994 at about 1300 hours, the KEYSTONE CANYON, a U.S. flagged tank vessel, was blown off Pier One in Astoria, Oregon, parting or paying out all her mooring lines. After several failed attempts by the Master to regain control and maneuver the vessel, the vessel allided with the Astoria-Megler Bridge then grounded along the west side of the bridge.

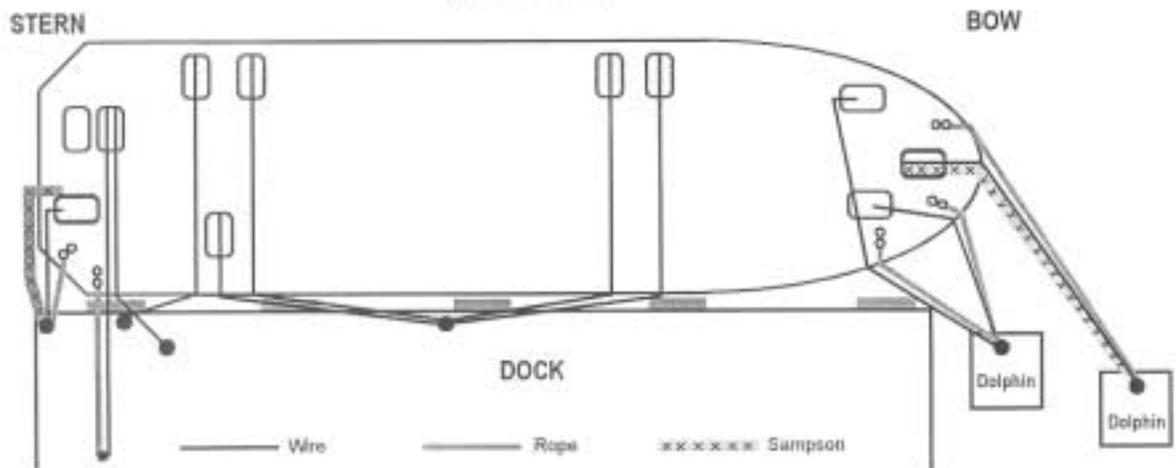
The KEYSTONE CANYON was in ballast at the time of the grounding, but was carrying approximately 14,676 barrels of bunker "C" fuel oil, 1,212 barrels of diesel oil, and 3,800 barrels of slops (oily water). The incident resulted in no loss of oil and no injury to crew members. Two bridge abutments received minor damage.

The vessel had docked in Astoria on the morning of October 25, 1994 to undergo an Inspection for Certification and the Critical Area inspection. At the time of the incident three Coast Guard Marine inspectors and about 16 shipyard workers were aboard.

Damage to the vessel consisted of a four-foot gash, three inches wide, at frame 34 in number 1 port ballast tank, an upset deep web frame at frame 42 in number 2 port cargo tank. The bulwark on the main deck near the bow on the port side received minor structural damage.

### KEYSTONE CANYON Mooring Configuration

(Not to scale)



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## PROBABLE CAUSE

The Office of Marine Safety (OMS) determined that the probable cause of the allision and subsequent grounding was high wind causing the KEYSTONE CANYON mooring lines to part resulting in the vessel blowing off Pier One in Astoria, Oregon. The stern of the vessel came off the dock before the bow, causing the vessel to blow across the channel sideways. The Captain was unable to regain control of the vessel and chose to ground the vessel in the soft mud bank on the north side of the channel. The Captain's decision minimized damage to the vessel and to other structures. Contributing factors to the casualty included mooring procedures, weather monitoring, and vessel organizational procedures.

## SAFETY ISSUES

Safety issues discussed in this report are:

- Monitoring weather while a vessel is in port;
- Mooring practices and procedures;
- Procedures to limit vessel freeboard in heavy wind conditions;
- Sufficient watch personnel dedicated to vessel operations and safety systems; and
- Adequacy of mooring facilities to accommodate vessels.

## VESSEL INFORMATION

### General Characteristics of the KEYSTONE CANYON

Length: 855.5 feet	Deadweight Tons: 124,500
Breadth: 173.13 feet	Gross Tons: 81,776
Depth: 78.5 feet	Horsepower: 26,700

The vessel's summer waterline is 47.42 feet and when fully loaded has a capacity of 905,970 barrels.

## POST ACCIDENT INVESTIGATION

On October 28, 1994 OMS personnel joined U.S. Coast Guard personnel aboard the KEYSTONE CANYON to conduct an investigation into the grounding. The OMS investigation found that the Master and other crew members responded quickly in attempting to control the vessel and minimize damage and danger to the vessel, the Astoria-Megler bridge, and the environment.

## Background

The KEYSTONE CANYON was at Pier One of the Port of Astoria to undergo a U.S. Coast Guard Certificate of Inspection and a Critical Area inspection. The Critical Area inspection includes the practice of filling tanks so that the cargo tanks can be rafted (filled with water and the water level varied) for inspection of internal structures. The Chief Mate was pumping water to and from the cargo and segregated ballast tanks subjecting the vessel's draft and freeboard to change with the varying water level in the tanks.

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All deck watch officers were involved at various times with some aspect of the Coast Guard inspection, internal tank inspections, or supervising the 16 shipyard workers from Commercial Iron Works on the day of October 26, 1994. The entire day was characterized as hectic for all deck officers, including deck watch officers.

At incident time, the KEYSTONE CANYON was in ballast with a draft of 13 feet forward and 20 feet aft. At this draft, about 46 feet of the stern and 53 feet of the forward section of the hull were above the pier and exposed to the wind. About 8 feet of the propeller was also out of the water. This would later play a role in reducing the propeller's efficiency as the captain tried to maneuver the vessel.

## **Weather**

The Captain of the KEYSTONE CANYON said neither he nor the company require deck watch officers to monitor the National Oceanic and Atmospheric Administration (NOAA) Weather Radio frequency while in port. At 1115 hours on October 26, 1994 the National Weather Service broadcasted a high wind warning, and a special weather bulletin upgraded the forecast from a Gale to a Storm warning, predicting wind gusts to 70 miles per hour. An updated weather forecast broadcast at 1140 hours on October 26, 1994 also included the high wind warning. Because there were no procedures to monitor or receive weather forecasts, neither the high wind warning nor the updated forecast were heard by the crew of the KEYSTONE CANYON.

The Third Mate, however, stated that he observed the winds building on his 0800 to 1200 watch on October 26. He logged the winds as southwest, force 7 to 8 and building, but did not notify the Captain nor anyone else about his observations. The Third Mate did not listen to the weather radio station on his 0800 to 1200 watch on October 26.

The National Weather Service telephoned and advised the Port of Astoria at 1123 hours on October 26 of the high wind warning, 90 minutes before the KEYSTONE CANYON blew off the dock. OMS investigators found that the Port of Astoria verbally notified the vessel crew of the impending weather conditions.

## **Mooring Lines and Facilities**

OMS investigators found that the use of wires and synthetic ropes on the same vessel is an industry-identified practice that needs special attention and procedures. To prevent the unequal loading of mooring lines, industry experts recommend that mooring lines leading in the same direction be as close to the same length as possible and be made of the same material as much as possible.

On the day of the incident, the KEYSTONE CANYON was moored with 18 lines – 11 wires and 7 synthetic ropes. Long lines were mixed with short lines, and wires and ropes were paired. The wires and two Sampson ropes were on winches and the other five ropes were on bitts. Statements from the KEYSTONE CANYON deck officers indicated the five ropes on bitts were not properly pre-tensioned. Due to

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the difference in elasticity caused by the mixed lines and the imbalance of tension caused by inattention to the 5 synthetic ropes, the 18 lines shared unequal loads against the 60 to 70 mile per hour winds. As increased tension began parting and paying out lines carrying the heaviest loads, fewer lines became available to secure the vessel. This cascading effect ultimately resulted in all lines parting or paying out and the vessel being blown from the dock. [The mooring configuration is shown on Page 1.]

During the morning of October 26, the vessel was constantly changing draft and trim as ballast water was shifted for the Critical Area inspection. The normal tidal actions plus removing and adding ballast water compounded the time and attention needed to tend lines.

The mooring facilities were not adequate for this size vessel in all weather conditions. The vessel's length in comparison to the available length of pier face caused the stern lines to be nearly perpendicular to the pier, thus assuming a disproportionate share of the load induced by the wind on the side of the ship.

## **Manning**

The KEYSTONE CANYON in-port deck watch consisted of three persons on watch, one licensed deck officer, and two able-bodied (AB) seamen. The licensed deck watch officer has overall responsibility for the vessel, but does not tend lines. One AB is customarily assigned to the gangway watch and is not available to tend lines. One AB was available to tend the mooring lines along with other duties. With only one seaman per watch available to tend lines, only the wires and two Sampson ropes were monitored on the day of the incident.

## **Ballast**

The Chief Mate did not have instructions to reduce the vessel freeboard or to discontinue cargo tank inspections during high winds. Nor did the Master have a plan to ballast down the vessel to reduce freeboard or request tug assistance if the weather became too extreme. Subsequently, a large portion of the propeller was out of the water when the vessel parted from the dock, significantly limiting maneuverability of the vessel.

## **LESSONS LEARNED**

### **Management Policies**

- **Sufficient personnel monitoring the safety of the vessel**

Statements from the deck officers indicated they were very busy assisting with Coast Guard inspections and supervising shipyard workers during the morning of October 26. In addition, a representative from the charterer and a KEYSTONE port engineer were on board the vessel, which may have further distracted the officers. The on-going inspections and repairs diverted the officers' attention from normal shipboard watch routines. The vessel was assumed to be safely moored while crew members focused on vessel inspections and repairs.

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## **Ballasting Operations**

- **Coordinating vessel ballasting operations with vessel safety**

The KEYSTONE CANYON lacked proper safety procedures to limit the freeboard of the vessel during hazardous weather conditions. The Chief Mate relied on the deck watch officer to provide weather reports and other important information affecting the vessel's safety. The KEYSTONE CANYON had no written procedures regarding frequency or type of information to forward to the Chief Mate, nor on determining when to limit freeboard for certain wind speeds.

## **In-Port Watch Practices**

- **Monitoring weather in port**

No formal procedures existed to monitor weather reports while the vessel was in port and no company policy required formal monitoring of in-port weather. Even though the Third Mate observed the wind speed increasing on the morning of October 26, 1994, neither the Captain nor any of the other deck officers were notified of his observations.

- **Notification of unusual weather conditions**

The National Weather Service telephoned and advised the port at 1123 hours on October 26 of the high wind warning. This warning was received approximately 90 minutes before the KEYSTONE CANYON was blown off the dock, but was not further communicated directly to the master of the KEYSTONE CANYON.

## **Mooring Procedures**

- **Proper line tending techniques**

The number of personnel available and procedures in place were inadequate to properly maintain the mooring lines under the conditions experienced. Two or more seamen were needed to properly tend the ropes and balance tension with the tension on the wire lines. The Third Mate stated that it was the responsibility of the Able-Bodied Seamen to tend lines, not the officer on watch. Thus, only one crew member was available to handle the lines, wires, and two Sampson ropes.

- **Adequate mooring facilities**

Vessel owners needed to carefully consider the adequacy of available mooring facilities with regard to operations to be conducted and potential seasonal weather conditions. Port authorities, likewise, needed to assess the capability of their facilities under severe weather conditions. If the port had concerns about the weather, these should have been communicated to the vessel's master or officer in charge.

## RECOMMENDATIONS

As a result of its investigation of this incident, the Office of Marine Safety makes the following safety recommendations.

### To Vessel Owners/Operators————

- Review each deck watch member's duties to ensure sufficient personnel are available to tend mooring lines during each watch, particularly during high wind conditions.
- Develop management practices that ensure sufficient watch personnel for all vessel operations and safety systems.
- Adopt procedures to monitor broadcast weather forecasts while vessels are in port. An individual should be responsible for monitoring weather forecasts and should make weather information available in a timely manner to the person-in-charge of cargo and ballasting operations.
- Develop a plan to limit vessel freeboard during high winds.
- Limit the use of mixed and short mooring lines to the maximum extent possible and ensure each line is equally loaded.
- Implement a training program for deck crew on proper mooring configuration and line tending.
- Develop procedures to evaluate the adequacy of mooring facilities in all weather conditions.

### To Port Authorities————

- When notified by the National Weather Service of severe weather, port authorities are encouraged to develop policies for communicating this information to the officer on watch.

Ecology is an equal-opportunity agency. If you have special accommodation needs, contact Mariann Cook Andrews at (360) 407-7211 or (360) 407-6006 (TDD).