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## Ship Structure Committee Case Study

This case study has been prepared by the Ship Structure Committee (SSC) as an educational tool to advance the study of ship structures. The SSC is a maritime industry and allied agency partnership that supports, the active pursuit of research and development to identify gaps in knowledge for marine structures. The Committee was formed in 1943 to study Liberty Ship structural failures and now is comprised of 8 Principal Member Agencies. The Committee has established itself as a world recognized leader in marine structures with hundreds of technical reports, a global membership of over 900 volunteer subject matter experts, and a dynamic website to disseminate past, current, and future work of the Committee. We encourage you to review other case studies, reports, and material on ship structures available to the public online at [www.shipstructure.org](http://www.shipstructure.org).

### *PRESTIGE: Complete hull failure in a single-hull tanker*

**Date:**

*Summary:*

Flooding in the ship's starboard #2 aft and #3 wing tanks caused a 25 degree list, which was counter-ballasted by flooding #2 aft port and #3 port ballast tanks. This resulted in an overstressed hull girder which failed after 6 days of exposure to heavy seas, causing the ship to break in two and sink.

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### Vessel Particulars

**LOA:** 243.5 m

**Breadth:** 34.4 m

**Depth:** 18.7 m

**Draft:** 14.0 m

**Gross Tonnage:** 42,820

**Deadweight:** 81,589 tonnes

**Design Speed:** 15.4 knots

**Builder:** Hitachi Shipbuilding and Engineering Co. (Maizuru Works), Japan

**Hull No.:** 4437

**Year Built:** 1976

**ABS ID No.:** 7603948

**IMO No.:** 7372141

**Flag:** Bahamas

**Port of Registry:** Nassau

**Registered Owner:** Mare Shipping, Inc., a Liberia corporation

**Manager:** Universe Maritime Ltd, Greece

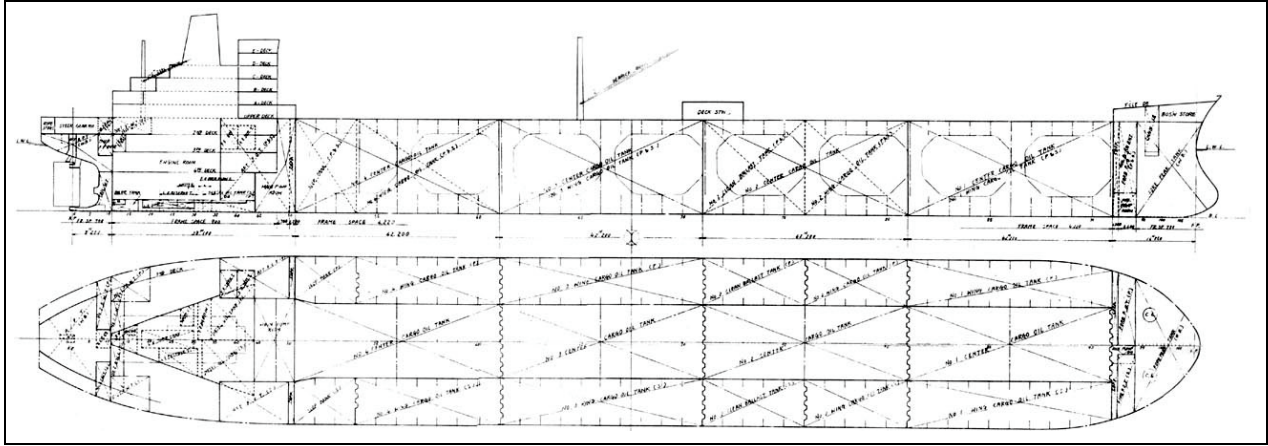
**P&I Coverage:** The London Steamship Owner's Mutual Insurance Association

**Vessel Type:** Single-hull tanker; Category 1 vessel under MARPOL 13G requirements; at time of incident, approved as CBT product tanker with 30 percent side protection

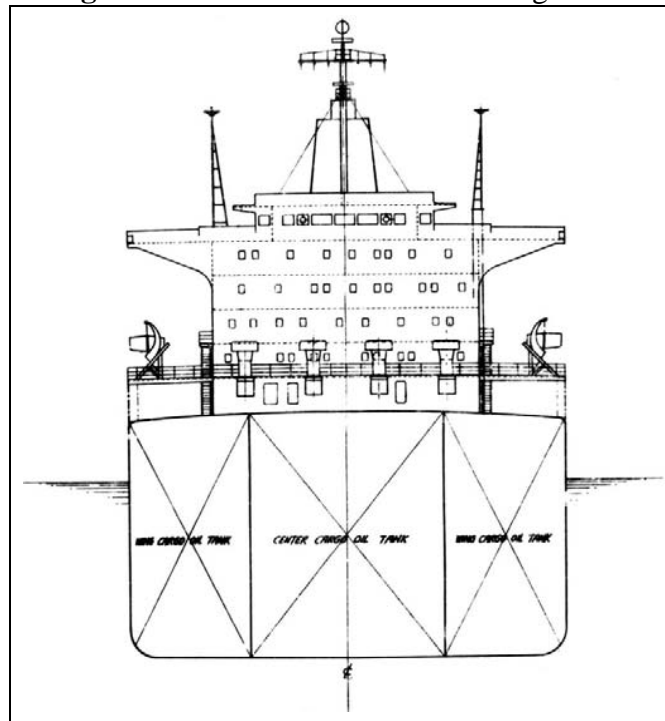
**Hull Material:** Mild steel, subject to IACS Enhanced survey program

**Arrangement:**

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**Figure 1.** PRESTIGE General Arrangement.



**Figure 2.** PRESTIGE general arrangement.

## Background

### Events leading to failure

On November 13, 2002, the PRESTIGE was 30 miles off the Northwest coast of Spain, underway from St. Petersburg to discharge in Singapore when she developed a list of approximately 25 degrees to starboard. The list was a result of the #2 starboard aft and #3 starboard wing tanks flooding. The crew reported that the flooding was preceded by a sudden vibration or severe shudder.



**Figure 3.** PRESTIGE with significant list.

With such significant list, the PRESTIGE lost propulsion and began to drift. Three hours after the starboard tanks flooded, #2 and #3 port wing tanks were counter-flooded. This brought the vessel to a list of three degrees to starboard.



**Figure 4.** Prestige after counter-ballasting.

After being subject to heavy wave pounding for several hours, a piece of the already-damaged side plating broke loose, damaging the plating on a cargo tank as it did so. Cargo was spilled as a result of this damage and, in fear of polluting their coast, Spanish authorities refused to allow the PRESTIGE safe harbor, instead ordering that she be towed at least 120 miles off of the Spanish coast. In hopes of finding calmer waters in order to salvage the cargo, the PRESTIGE was towed south by her stern to minimize further damage from waves.

On the morning of November 19, 133 nautical miles off the coast of Spain in international waters, the PRESTIGE broke in two and sank. [Back to Table of Contents](#)



**Figure 5.** PRESTIGE after hull separation.

## **Detailed Description of Structural Failure**

### Initial Damage

The cause of the initial damage to the PRESTIGE is not known, and as the wreck lies under nearly two miles of water, it is not likely that it will be examined extensively, or that any conclusion will be made with regard to the initial damage. ABS made extensive technical analyses of the PRESTIGE after the incident, but the lack of physical evidence prohibited them from reaching a definite conclusion. The vessel was properly loaded and the as-built hull structure met the 1973 ABS Rule requirements as well as the 2003 ABS Rule and IACS Unified Rule. Some as-built structural details failed the 2003 ABS requirements for fatigue, but ABS maintains that this is not a probable cause of the hull failure, as the PRESTIGE operated in a gentler environment than the criteria were developed for, and “most of the side longitudinals... having insufficient fatigue life were renewed at the 4<sup>th</sup> and 5<sup>th</sup> Special Hull Surveys” (ABS 2003: 4).

In its intact state, the PRESTIGE was under the allowed values for still-water bending moment and shear force. According to their technical analyses, ABS believes that “a weakened section in the side shell or supporting framing in the vicinity of frame 71” caused the initial damage and flooding (ABS 2003: i).

ABS considers lightering damage to be the most likely cause of the side shell weakening. For 17 months prior to the incident, the PRESTIGE was used in lightering service for vessels up to 280,000 DWT. According to the ABS analysis, with these lightering operations, “permanent deformations of side longitudinal Nos. 32 to 34 and the transverse frames and transverse bulkhead could have occurred in the vicinity of frame 71” (ABS 2003: 4). In fact, a sister ship of the PRESTIGE sustained side shell damage from lightering in 1989.

ABS also suggests that the welded structure's robustness could have been weakened by residual stresses in welded plates.

### Hull Break-up

The break-up of the hull can be attributed to the continuous wave impact and internal sloshing the vessel incurred as it was towed out to sea. According to the calculations made by ABS, after the vessel was counter-flooded, the still-water bending moment was 154 percent of the allowable value and the shear force was 93 percent of the allowable value. The hull structure, even in its counter-flooded condition, was capable of remaining intact, and did so for six days as it was under tow. The additional dynamic wave loads, however, augmented the bending stress, and once the deck plate reached its buckling strength, the structure broke in two.

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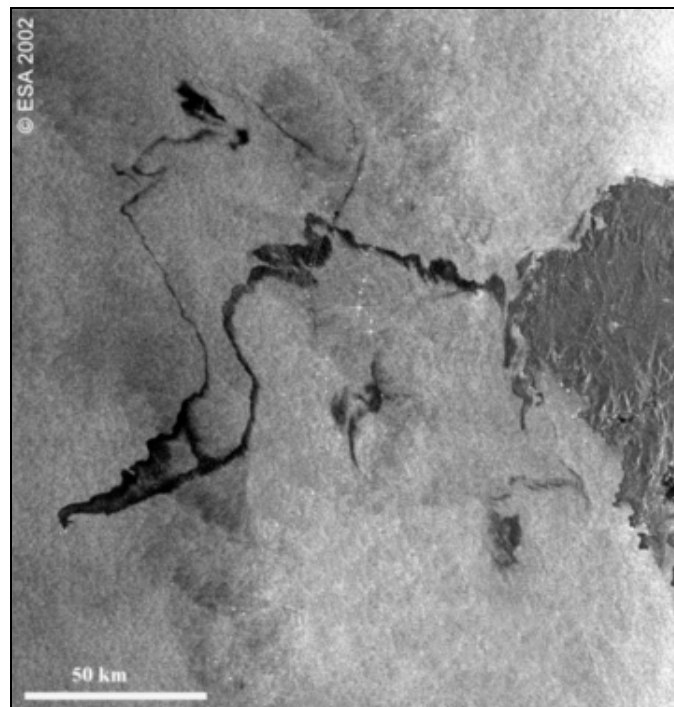
**Figure 6.** PRESTIGE just before sinking.

### End Result

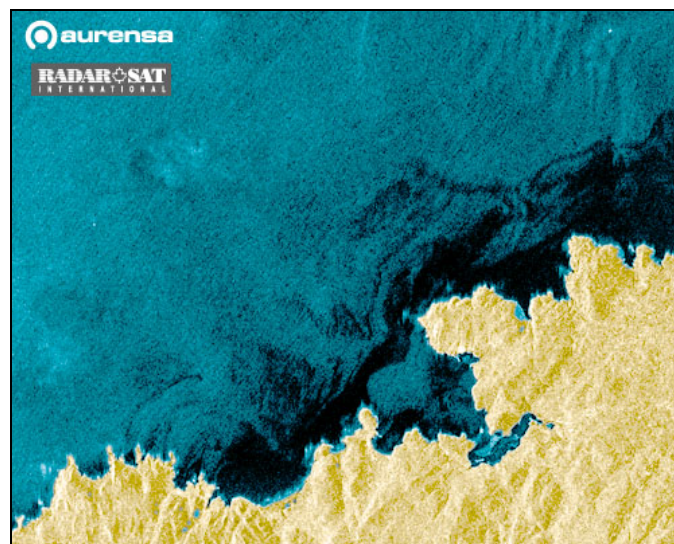
While the cause of the initial damage to the PRESTIGE remains unknown, the event underscores the need for meticulous inspections so that any damage, regardless the cause, may be repaired before it becomes a serious threat to the vessel.

Spain, France and Portugal all denied PRESTIGE access to their harbors and shelter from heavy seas, which would have greatly limited the amount of cargo spilled. As a result of their technical analyses of the incident, ABS concludes that “the sustained dynamic wave loading for the period while the PRESTIGE was under tow subsequent to the initial casualty was the direct cause of the ultimate disintegration of the hull structure and subsequent sinking of the vessel” (ABS 2003: 6). The PRESTIGE casualty brought to light the need for comprehensive regulations on providing safe harbor to vessels in need.

The PRESTIGE casualty also raised questions of whether or not single-hulled tankers should be prohibited, but ABS claims that this is based on a misunderstanding of their rules, which require the same strength from both single- and double-hulled ships.



**Figure 7.** Satellite image of PRESTIGE oil spill from November 17, 2002.



**Figure 8.** Satellite image of PRESTIGE oil slick on coast, November 18, 2002.

The ecological result of the PRESTIGE casualty was a massive 70,000 ton oil spill that devastated the local fishing and tourism industries. Due to the toxic nature of the oil, it was predicted to cause pollution in the area for ten years subsequent to the initial spill, and was reported to be leaking twenty liters of oil per day from its location at the sea floor. Coating over one hundred miles of Spanish and French coastline with toxic oil, the spill had an estimated

clean-up cost of nearly three billion US dollars. The Spanish government filed suit against ABS, claiming that they were responsible for the damage because the flaw in the hull structure should have been caught by an ABS inspection. ABS denied the allegations, maintaining that the most probable cause of the damage was lightering operations after her most recent ABS inspection. As of July 2008, litigation is on-going.

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## Acknowledgements

### References:

- [1] American Bureau of Shipping, PRESTIGE Casualty – Information Update No. 3. Electronic document, <http://www.eagle.org/news/press/nov202002.html>.
- [2] American Bureau of Shipping, Technical Analyses Related to the PRESTIGE Casualty on 13 November 2002. Electronic document, <http://www.eagle.org/news/press/prestige/Tech%20Analysis%20final.pdf>.
- [3] The Bahamas Maritime Authority, The Bahamas Maritime Authority moves ahead with its PRESTIGE investigation. Press statement, January 29: <http://www.eagle.org/news/press/prestige/bma%20press%20statement.pdf>.
- [4] SMIT Salvage, Prestige News Updates 1 through 9. Electronic documents, <http://www.smit.com/sitefactor/page.asp?pageid=295>.
- [5] Vince, Gaia, Prestige oil spill far worse than thought. NewScientist.com news service, August 27: <http://www.newscientist.com/article/dn4100-prestige-oil-spill-far-worse-than-thought.html>.

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- [1] ABS: <http://www.eagle.org/news/press/nov202002.html>.
  - [2] ABS: <http://www.eagle.org/news/press/nov202002.html>.
  - [3] Environment News Service: <http://www.ens-newswire.com/ens/mar2003/2003-03-27-02.asp>. Galician Regional Environmental Authority
  - [4] SMIT: <http://www.smit.com/sitefactor/page.asp?pageid=295>
  - [5] SMIT: <http://www.smit.com/sitefactor/public/images/news/prestige9large.jpg>
  - [6] SMIT: <http://www.smit.com/sitefactor/public/images/news/prestige7large.jpg>.
  - [7] CERSAT: [http://cersat.ifremer.fr/news/highlights/the\\_oil\\_spills\\_of\\_prestige\\_tanker\\_observed\\_from\\_space](http://cersat.ifremer.fr/news/highlights/the_oil_spills_of_prestige_tanker_observed_from_space). ESA ESANHD7708D
  - [8] CERSAT: [http://cersat.ifremer.fr/news/highlights/the\\_oil\\_spills\\_of\\_prestige\\_tanker\\_observed\\_from\\_space](http://cersat.ifremer.fr/news/highlights/the_oil_spills_of_prestige_tanker_observed_from_space). RADARSAT