



Marine Accident Reconstruction Case Histories - Course 1

An Online Continuing Education Course for Engineers

Course Number: F-6001

Credit: 6 Hours / 6 PDH / 6 CPD

CASE STUDY #1:

MARINE DISASTER: THIRTEEN (13) PEOPLE DIED WHEN PASSENGER TOUR BOAT SUNK DUE TO SMALL DEFICIENCIES

Summary of the accident:

On May 1, 1999, a World War II vintage amphibious passenger vehicle named “Miss Majestic”, departed with one operator and 20 passengers on a regular excursion tour, and entered the calm waters of Lake Hamilton, one of the scenic lakes of the Hot Springs National Park. These amphibious vehicles are commonly known as DUKW (this was the military designation: D = 1942; U = Utility; K = Front Wheel Drive; and W = Two Rear Driving Axles).

The DUKW has wheels and a propeller, hence, it can be used on land or water, and although it is an open boat, it is covered with a canopy, which is supported by close spaced stanchions or support posts. The canopy is built with an overhead rack to hold life preservers.

DUKW's are 2 ½ ton six-wheel-drive truck chassis and an overall hull length of 31 feet. They have a five-speed transmission and a GMC 170 cubic inch, six cylinder gasoline engines. They can carry a payload of 5,000 pounds and travel at speeds of 5 to 6 knots on the water.

After 7 minutes in the water, the “Miss Majestic”, sunk in less than half a minute from the time the operator realized that there was a problem, in 51 feet of water, resulting in 13 deaths.

The main problem - Primary cause of the accident:

The DUKW has one engine that drives both sets of wheels and the propeller shaft. Two days before the accident, the driver noticed water in the bilges and took the DUKW to the shop. After the accident, it was found that the rubber seal of one of the shafts was improperly installed, allowing it to leak water into the bilges, but the DUKW

was not tested after it left the shop, prior to the accident, and the driver did not take any action to verify that the leak no longer existed when she drove the DUKW into the water after the repairs.

Early indications of trouble:

Within a few minutes of entering the water, the driver (pilot) noticed that the DUKW was taking a small list to port and directed some passengers to move to seats on the other side of the DUKW. She also noticed that the bilge pumps were discharging water overboard. These two observations should have alerted the driver that something was not right. There was no deckhand or other person to assist the driver.

When the driver realized that the DUKW was taking on water, she tried to grab the radio and turn back to shore, but the DUKW sank as soon as she tried to turn around. The DUKW sank within 15 seconds from the time the driver asked people to move to the starboard side.

Last few seconds:

The DUKW sank by the stern. One passenger escaped thru the back before the DUKW became totally submerged. The operator was able to get out thru the window as the DUKW was descending deeper (to 51 feet) to the bottom of the lake, and six passengers were able to get out and swim to the surface. The remaining 13 passengers, including 3 children lost their lives.

Most of the victims' bodies were found inside the boat.

Contributory causes for the large number of deaths:

After the DUKW was salvaged, an inspection revealed the following:

- a). The DUKW did not have a bilge alarm.
- b). As water started collecting in the bilges, the DUKW was trimming by the stern. The driver could not see the loss of freeboard at the stern until it was too late, just 15 seconds before the DUKW went underwater. The rear view mirrors available to the driver did not allow observing the freeboard at the stern, and,

since the driver is operating in an environment similar to the driver of a school bus, her vision astern was largely obstructed.

c). The driver's seat (pilot seat) was located too low and this position allowed the driver only a limited forward vision. The driver could only see a small side portion of the stern thru a rear view mirror, but not the freeboard of the hull.

Because of the normal low freeboard, the trim aft (created by the water entering the bilges) was not noticed until the transom was submerged. Once the transom started becoming submerged, it took a few seconds for the DUKW to sink by the stern.

d). The life preservers were stored in an overhead rack under the canopy. The spaces on the rack to store 20 life preservers were too small. Therefore, the life preservers were jammed in the rack, requiring a major muscular effort to pull any of the life preservers out of the rack.

e). The canopy over the boat was improperly designed, having support posts too close to create narrow windows, and may have kept most of the riders from escaping thru the windows. The passengers that were able to don life jackets could not escape thru these windows, and the passageway to reach the stern was extremely narrow and being blocked by passengers trying to pull the life preservers from the rack. It was almost impossible for most people to get out of the DUKW thru the front or the sides, except in a couple of windows close to the stern.

Forensic Conclusions:

a). The failure to do proper repairs to a leaking rubber seal of a shaft and to test the DUKW after repairs, was the main cause of this disaster.

b). The deficient design of the canopy with close spaced support posts, and badly built life preservers rack were a large contributory cause of multiple deaths, because people could not remove the life preservers fast enough from the rack and could not get out of the DUKW thru the narrow windows, even without using the life preservers.

c). Besides the failure of the owner to adequately repair, maintain and test the DUKW, it was found that the U. S. Coast Guard contributed to the unsafe condition of the Miss Majestic, because they failed to provide adequate oversight.

Amphibious vessels are subject to the Subchapter T of the U.S.C.G. Regulations, which govern passenger vessels under 100 tons and carry between 7 and 149 passengers. The USCG failed to inspect the Miss Majestic as required by the regulations.

d). The improper design of the pilot seat and rearview mirrors prevented the driver from monitoring the change of attitude of the DUKW.

Lessons learned:

Many small deficiencies in the design, construction and maintenance of the Miss Majestic, and the USCG oversight had a large influence in the lost of so many lives:

Primary Cause:

Improper repair and maintenance

Contributory Causes:

1. Improper design of the canopy stanchions or support posts
2. Improper design of the life preservers rack
3. Lack of bilge alarm
4. Improper design of the pilot seat
5. Improper rear view mirrors
6. Improper USCG oversight

