Airflow Sciences Corporation

# The Role of CFD Modeling in a Legal Proceeding

**Case Study**

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In legal cases that rely on technical details, engineers are often called upon to perform engineering analysis or testify as expert witnesses. This can strengthen a client's case significantly and ensure that legal arguments are scientifically sound. Airflow Sciences Corporation (ASC) provided engineering services and expert testimony in a legal case regarding the explosion of a commercial boat. ASC was asked to evaluate the conditions of the explosion and explore possible design modifications in the vessel.

An investigation determined that the cause of the explosion was an accumulation of gasoline vapor in the hull of the vessel, which also housed the fuel tank. ASC engineers evaluated the design of the enclosed hull and proposed two modified designs to evaluate through computer simulation.

The original, as-built design of the vessel (Figure 1) consists of an enclosed hull that is not exposed to outside air except through two small tubes, each 1 9/16 inches in diameter. ASC proposed two separate design modifications (Figures 2-3) that replaced the tubes with two larger vent pipes that face forward and aft. Figure 2 shows a 4" vent design and Figure 3 shows a 6" vent design. The modified designs were used in a modeling scenario to see if it was possible to properly vent the hull through natural airflow.

The modified vents are positioned such that the front vent opening is forward to allow outside air to enter the hull whenever the vessel is underway. The resulting pressure differential causes the gasoline vapor to evacuate the hull through the rear vent, which faces aft.

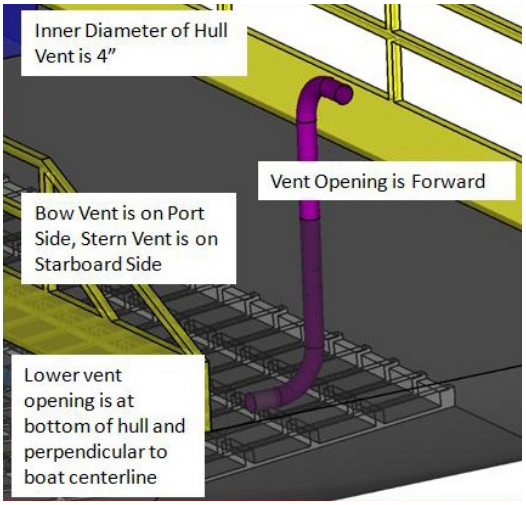

*Figure 2: Design modification with 4-inch vent*

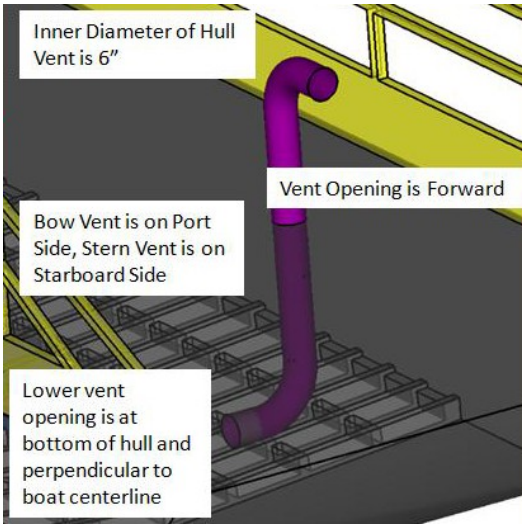

*Figure 3: Design modification with 6-inch vent*

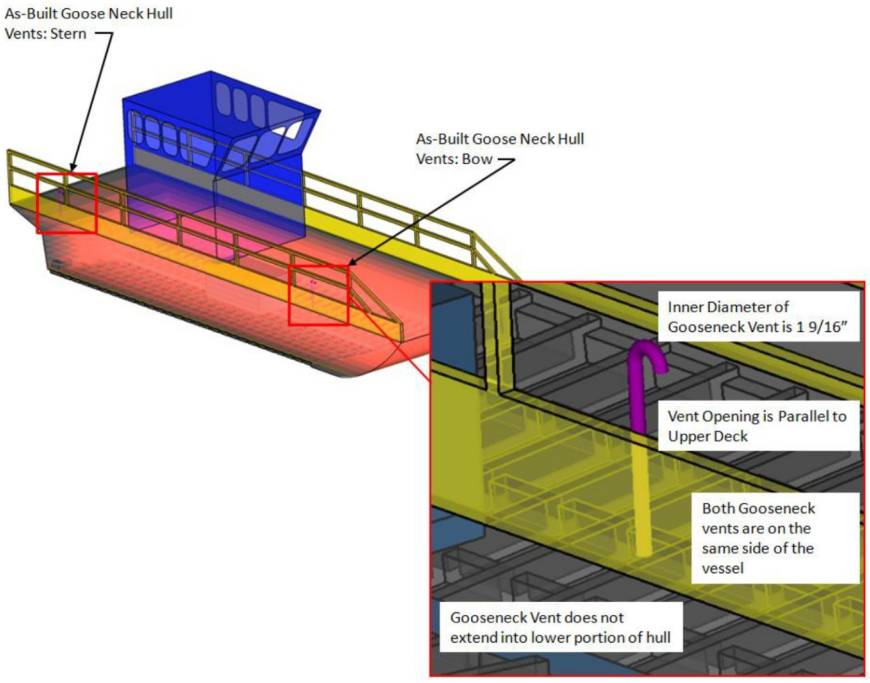

*Figure 1: The original, as-built design of the vessel includes two gooseneck tubes. The pink color indicates the presence of gasoline vapor inside the hull.*

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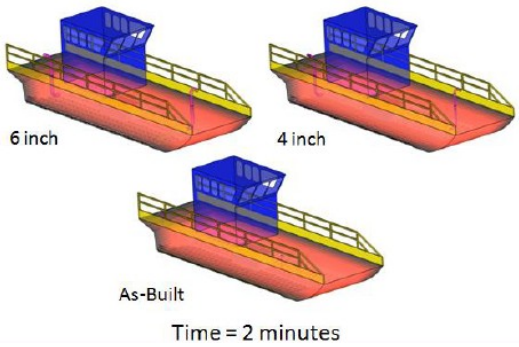


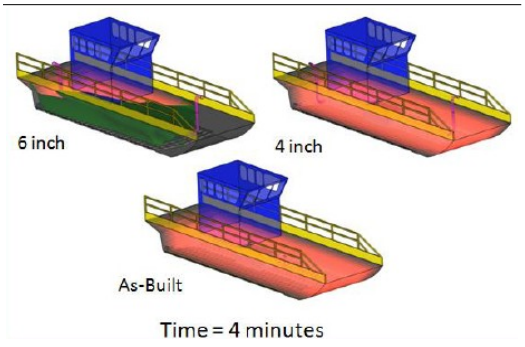


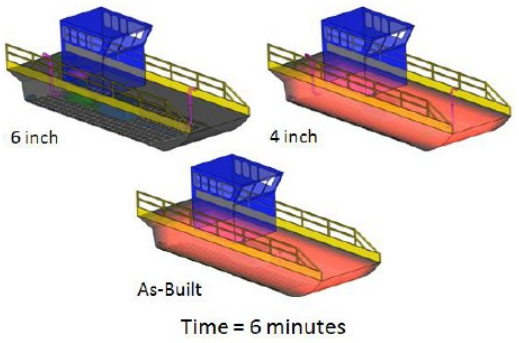


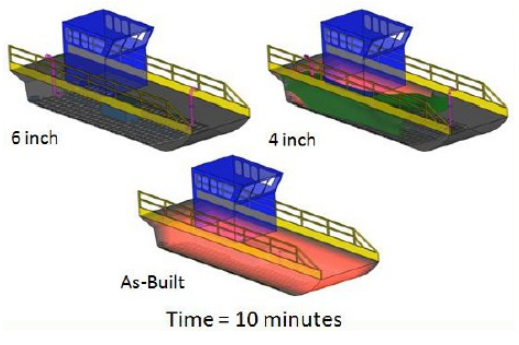


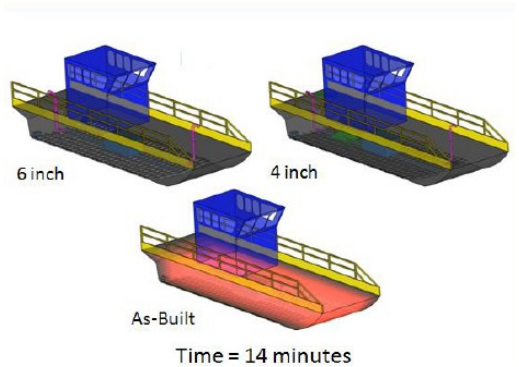


ASC performed computational fluid dynamics (CFD) simulations (left) of both the as-built hull design and two modified designs with a 4” vent and a 6” vent. The pink color indicates the presence of gasoline vapor inside the hull. A simulation of the vessel moving at 20 mph showed that the 6” vent design was likely to clear gasoline vapor from the hull in 6 minutes. The 4” vent design was likely to clear gasoline vapor in 15 minutes. In the same simulation, the as-built design was unlikely to allow any fresh air into the hull, even after 15 minutes or longer, causing gasoline vapor levels to persist.

The simulation results showed that natural ventilation could be possible in a vessel of this type. The simulation also showed that the as-built design was ineffective at eliminating gasoline vapors from the vessel hull. CFD modeling was a powerful tool in communicating technical data in the legal setting and was used in conjunction with engineering handbook calculations and wind tunnel testing to ensure accuracy. ASC presented the analysis results through scientific reports, graphics, and videos that animated the simulation of vapor dispersion inside the hull. Senior engineer James Paul, P.E. provided expert testimony with support from Dr. Kevin Linfield, P.E. and Dr. Jeff Franklin, P.E., which resulted in a favorable outcome for the client.