

Sikorsky

Sikorsky performs line and component sizing studies to ensure safe fuel jettison and in flight refueling

About Sikorsky

As a leading designer and manufacturer of helicopters, Sikorsky supplies aircraft to more than 40 countries for commercial, industrial and military uses, as well as within all five branches of the U.S. military.

Sikorsky plays a particularly prominent role in the intermediate to heavy weight range of helicopters where its products are recognized through the world, most notably the UH-60 Black Hawk and SH-60 Seahawk. Furthermore, Sikorsky is leading the production of both the civil S-92 and military-equivalent H-92, which FAA executives have called “the world’s safest helicopter”.

Flowmaster at Sikorsky

Flowmaster was first introduced at Sikorsky in 1998 and was adopted to help them model fuel systems in programs like the Black Hawk, Comanche and later, the S-92 as well as the U. S. President’s Helicopter, Marine One. Sikorsky has expanded its use of Flowmaster, continuing to use it to assist in the



design of fuel system, but also for environmental control systems (ECS), bleed air systems, avionics cooling and transmission lubrication systems.

Tony Cutting, Senior Design Engineer and the Flowmaster expert at Sikorsky, uses Flowmaster as part of his fuel systems responsibilities. Recently Tony applied Flowmaster towards the design of both the Emergency Fuel Jettison and Hover In Flight Refueling (HIFR) systems for the Canadian version of the H-92 Superhawk, the Canada CH-148 Cyclone. Canada has ordered 28 Cyclones to replace their fleet of Sikorsky CH-124 Sea Kings and is expecting delivery to begin in 2008.

The Emergency Fuel Jettison system serves to jettison a controlled amount of fuel, in emergency situations, or alternatively to reduce the weight of the helicopter to enable the aircraft to hold more cargo or to pick up additional passengers.

The HIFR system enables the helicopter to refuel without the need for landing. Landing a helicopter on a ship deck can be extremely dangerous, especially in turbulent water, and the option to avoid a hazardous landing is extremely valuable. During a HIFR operation, the refueling nozzle is hoisted from the ship to the helicopter and fuel is pumped from the ship fuel supply.

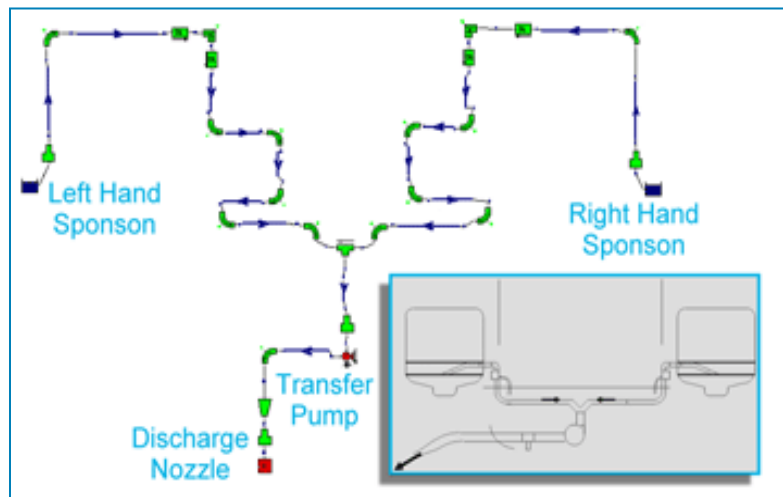


Figure 1: Jettison system shown modeled in Flowmaster with CAD schematic

For both the Emergency Fuel Jettison and HIFR systems, it was important to validate the systems to ensure that they met necessary flow requirements as system failures in a critical situation must be designed for and prevented. To achieve this, a Flowmaster model of each system was built in order to establish the proper line and component sizes and to ensure that satisfactory pump operation was achieved.

Emergency Fuel Jettison

The Flowmaster model for the jettison system was studied under a number of different scenarios:

- Two pipe line sizes
- Two fuel conditions at different elevations and temperatures
- Three fuel pumps.

The primary goal of this study was to ensure that cavitation, which could damage the fuel pump, did not occur, while maintaining the minimum required jettison fuel flow.

Using Flowmaster, it was possible to generate a pressure loss vs. flow curve that represented the system at the different line sizes and compare it back to the supplied pressure vs. flow from the selected pumps. From this study, it was apparent which of the 3 pumps was appropriate as one was not able to meet the minimum flow required for jettison; a second far exceeded the required flow, and the third exceeded the required flow, but at a lower power requirement than the second.

It was then possible to examine the NPSHa for the selected pump in order to select the appropriate line size. The system was run at sea level and 10000 feet at standard and high temperatures. With the test, Flowmaster predicted that the NPSHa was less than the NPSHr for the pump at the smaller line size, but was suitable with the larger pipe diameters, providing a clear choice for which line size was appropriate.

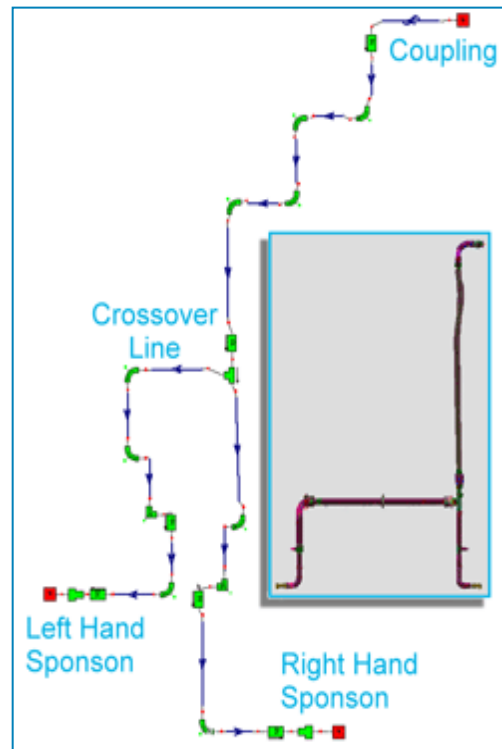


Figure 2: HIFR system shown modeled in Flowmaster with CAD Assembly

Hover In Flight Refueling

The purpose of the HIFR system model was to make sure the minimum required flow could be delivered to the left and right sponsons on the helicopter. Using Flowmaster, the system model was built and a flow analysis performed. To better balance the flow distribution to the left and right sponsons, the crossover line size was modified and it was observed that the total flow to the helicopter exceeded the minimum required flow even at the elevated hover level.

Conclusions

Using Flowmaster, Tony noted that “Both the Emergency Jettison System and HIFR system flow models resulted in a rapid determination of fuel lines/hoses and component sizes necessary to achieve required flow rates. Line routing options can be analyzed quickly thereby optimizing the design.” By using Flowmaster to model and study the Emergency Fuel Jettison system, Sikorsky was able to successfully choose the appropriate system components and observe the impact the smaller line sizes have on their systems. Within the HIFR system, they were able to ensure that the necessary fuel delivery rate was met in order to successfully refuel the helicopter.

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