A FLIGHT SIMULATOR WITH SEA LEGS

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How do you “back up” in a **flight simulator**?

Visual system engineers at Textron’s TRU Simulation + Training (Booth N3032) in Montreal are working on that dilemma in the development of the world’s first level-D **seaplane flight simulator**. When docking a float-equipped Twin Otter, pilots often reverse the aircraft, somewhat like parallel parking your automobile, except on water and with 1,200 horsepower and a 65-foot wingspan. Once alongside the dock, the aircraft nose is pointed toward the lake or sea, ready for the next takeoff.

Before the aircraft reaches that berth, there’s another simulator challenge. The Twin Otter pilot, when landing on water, typically opens the side window of the cockpit and looks straight down when preparing to land on a water surface. “You have to look underneath the airplane to see what the water’s doing. Part of every approach is a landing site inspection at about 500 feet. It isn’t possible with a typical level-D display to see any of that,” explained David Reid, senior production pilot for Viking Air and Pacific Sky Aviation.

Viking is the Canada-based aircraft manufacturer that resurrected the DHC-6 Twin Otter in 2010 after a more than 20-year hiatus. The Viking Series 400 incorporates Honeywell Primus Apex integrated avionics, more powerful Pratt & Whitney Canada PT6A-34 engines and some composite structure.

When the Twin Otter Series 400 simulator is ready for acceptance early in 2016, extra visual display screens will allow pilots to lower the window, as in the aircraft, literally stick their head out, and look straight down or toward the rear of the aircraft. “The pilot needs to understand and learn

from every angle. There can’t be any blind spots,” Reid said.

Sea Testing

Reid and Pacific Sky corporate pilot Rob McIntyre flew the maneuvers for the flight-test program. They were guided by Anthony Brown of the National Research Council (NRC) Canada Flight Research Laboratory, which was contracted to collect the data necessary for TRU to develop the flight simulation models.

Testing for the wheeled version of the Series 400 was not unlike that for other fixed-wing aircraft and took place around Ottawa last spring. Water-based landing, taxi and takeoff tests in a variety of weather conditions–from glassy smooth to wave heights up to about one to 1.5 meters (Sea State 4) in 15-knot winds–were conducted near Viking’s modification facility on Vancouver Island, British Columbia. “When landing on water, you can have waves and water currents, which are completely different from the air currents and which are not necessarily viewable from the air; this requires a fair bit of sea-based testing to characterize,” said Sion Jennings, NRCCanada flight mechanics and avionics group leader.

The test aircraft was fitted with various sensor equipment to capture data about engine performance, atmospherics, control surfaces and “everything the pilot touches,” about 200 parameters. To highlight the look-down and look-back perspectives, Reid said they used a GoPro video camera positioned near the pilot’s eyepoint during the water landing inspection and docking scenarios.

“There are some differences between aircraft certification testing and simulator testing,” Jennings noted. “In simulator testing, we’re really interested in getting, not rough notions of controllability, but a very fine and precise understanding of the exact control response of the aircraft. That requires a higher data rate and maybe some different maneuvers.”

The matrix of nearly 800 test maneuvers did not include snow and ice scenarios, which are not required by Transport Canada. Nor did they stress the Twin Otter for beyond-stall or unusual-attitude conditions. Indeed, Transport Canada does not have any seaplane-specific simulation qualification test guide, so TRU engineers are working with the agency to write the template. “The physics are well known, though: fluid dynamic calculations, buoyancy, the density differences between fresh water and salt water,” said George Karam, vice president and general manager of TRU’s Air Transport division.

TRU will also provide a new low-speed aerodynamic model for the high-lift, low-wing-loaded aircraft, which will simulate the wobble from wind gusts impacting the fuselage when the aircraft is on the ground.

One of the unusual aspects of landing a seaplane involves side-loading on touchdown. A wheeled aircraft might skid a little. But, Reid said, “If you touch down a little bit crooked on the floatplane, you’re not putting a small rubber tire with a small footprint onto the water. You’re putting a keel onto the water, and keels are designed to go in a straight line. If you touch down with a little bit of a side-load on the Twin Otter, you’re going to feel a sideways dig. For folks who are inexperienced and in weather that is approaching the limits of the aircraft’s capability, that side-load can start a chain of reaction, which might end up with the wingtip digging the water (which has happened quite a bit in training using the airplane) and you might end up cartwheeling the airplane. Reid said they were able to sample the dig effect during the flight data tests and will reproduce it in the simulator “so folks can feel what it’s like and be able to work recovery techniques for it as well.”

Michael Coughlin, chief executive of Viking sister company Pacific Sky, said the success of the Series 400 in opening new markets such as China, Vietnam and Russia is driving the business case for the level-D simulator. Most Twin Otter pilots are trained in the aircraft, “which is not very effective” because there is limited exposure to critical failure scenarios. It can take at least three to four years to build sufficient experience to transition to the left seat. Pacific Sky hopes the highly capable simulator will significantly compress the time required to develop Twin Otter captains “so the lack of crews is not a limitation to the aircraft’s growth.”

Pacific Sky will offer the full gamut of training and type ratings, from ab initio to commercial and air transport pilot licenses for both wheeled and float-equipped DHC-6 Series 400s. They expect to train about 200 pilots a year in Vancouver.

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