December 2014

AEROSPACE AMERICA

2014 IN REVIEW

TWO BAD DAYS
Questioning conventional wisdom after Antares, Virgin Galactic/Page 4

A PUBLICATION OF THE AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

The race to reusability

by Adam Dissel and Barry Hellman

*The **Reusable Launch Vehicles Program Committee** brings together experts to focus on leading-edge programs and developments in this area.*

Multiple development efforts are underway to achieve affordable, responsive spacelift and to address current budget pressures and launch market challenges. Interest in reusable launch vehicles as a solution to these challenges remains strong and the past year has seen marked progress by government and industry toward development of reusable spacelift and flight demonstrator systems.

In July, DARPA announced the start of work under the **Experimental Spaceplane** program, called XS-1, which seeks to develop a reusable, responsive first stage launch vehicle. The goal is to break the cycle of escalating space system costs and enable routine space access. Three Phase 1 awards were made earlier in the year to teams headed by Boeing, Northrop Grumman and Masten Space Systems.

Swiss Space Systems is moving forward with its **Soar** three-stage launch system development. The Soar concept is to use an airliner to air launch a reusable rocket-powered shuttle with an expendable final stage. In addition to its new U.S. headquarters in Washington, D.C., S3 opened offices at the Kennedy Space Center, Florida, and at NASA's Ames Research Center in California in preparation for a zero gravity commercial flight campaign with its first-stage Airbus aircraft and for Mach 0.8-2.8 wind tunnel tests on a 1:44 scale mock-up of the shuttle. Additionally, an agreement was signed with the city of North Bay and Canadore College's School of Aviation Technology in Ontario, Canada, which will support S3's 3:8 scale mock-up helicopter drop tests planned for late 2014 and early 2015. A preliminary design review is scheduled for the end of the year.

Virgin Galactic said it would continue with plans to offer suborbital tourist flights after a catastrophic test Oct. 31 when its **SpaceShipTwo** space plane broke up in flight and crashed in the Mojave Desert, killing one pilot and injuring the other. The breakup occurred shortly after the vehicle was released from the WhiteKnightTwo carrier aircraft. In November the company said construction of a second SpaceShipTwo is 65 percent complete. Virgin Galactic is also developing the LauncherOne system to address the small-lift orbital market by using the WhiteKnightTwo to release an expendable launch vehicle.

Generation Orbit is designing a small spacelift system in which an expendable rocket launcher is air-dropped from an executive jet carrier aircraft. The single-stage **GOLauncher 1** will support suborbital research projects while the two-stage GOLauncher 2 will launch small orbital payloads. In July the company completed captive-carry flight tests of a simulated launch stack on a Learjet carrier aircraft.

XCOR Aerospace is moving forward with development of the **Lynx** reusable suborbital space plane. The Lynx Mark I vehicle is expected to be ready by the end of 2014 and begin flight testing in early 2015. Once operational, the Lynx is expected to make multiple suborbital trips a day. Follow-on Lynx versions are being pursued to address small payload orbital flights.

SpaceX has moved into the next phase of testing for the development of a reusable **Falcon 9** first stage after completing eight flight tests of its Grasshopper vehicle. Two F9R airframes were available for testing. In August, a problem shortly after launch caused the first test vehicle to self-destruct on its second test flight in Texas. SpaceX has also completed several downrange landing tests of the first stage of its operational Falcon 9 system.

British company Reaction Engines Ltd. is continuing development of **SABRE**, its Synergetic Air-Breathing Rocket Engine, and entered a cooperative research and development agreement with the U.S. government to perform SABRE cycle analysis and assessment of applications toward future reusable launch systems.

ESA

Reaction Engine's Skylon concept highlighting the SABRE engine.

Swiss Space Systems

The Soar shuttle is carried by a modified airliner.