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X-37 Technology Demonstrator: Blazing the trail for the next generation of space transportation systems

In August 1998, NASA issued a research announcement soliciting proposals from the aerospace industry for "Future-X" -- a flight demonstrator vehicle to test and validate emerging technologies that could dramatically reduce the cost of space transportation.

The announcement called for proposals for flight demonstrations that required actual flight-testing as a critical step in validating and maturing space transportation technologies. Airframe system technologies to be developed and tested included propellant tanks, thermal protection systems, avionics and structures. Propulsion system technologies to be tested included main propulsion systems, propellants, and high-temperature materials.

In December 1998, NASA selected The Boeing Company of Seal Beach, Calif., for negotiations, leading to a July 1999 award of a four-year cooperative agreement to develop the X-37 advanced flight demonstrator. The cooperative agreement, valued at $173 million, included a 50/50 cost sharing agreement between NASA and Boeing. Over the four-year period, the government added approximately

$40 million to the agreement. Therefore, total value of the government share of the cooperative agreement was $125 million, including the U.S. Air Force contribution of $16 million for additional technology experiments, including advanced solar arrays and enhanced attitude controls needed to improve future military spacecraft. Boeing contributed approximately $67 million toward the cooperative agreement.

The X-37 was the third in a series of advanced reusable technology demonstrators, following the X-33 and X-34. While those demonstrators were designed to flight test technologies at lower altitudes and speeds, the X-37 would be the first to explore the orbital and re-entry phases of flight.

The reusable X-37 was designed to demonstrate a total of 41 embedded technologies and flight experiments aimed at significantly cutting the cost of space flight. It could be ferried into space via the Space Shuttle or launched aboard an expendable launch vehicle. The shape of the X-37 was a 120-percent scale derivative of the X-40, an unpowered Air Force vehicle that was a subscale atmospheric demonstrator for the Air Force Space Maneuver Vehicle program. The X-40 also was designed and built by Boeing. It was loaned to the X-37 project and modified, becoming the X-40A. In 2001, the X-40A flew seven successful unpowered approach and landing tests at Dryden Flight Test Center.

The X-37 modular design was capable of accommodating additional technologies for orbital testing such as advanced thermal protection systems, propulsion systems, advancements in avionics and other spacecraft systems.

In November 2002, the Boeing Company was awarded a new contract for $301 million to continue work on the X-37 flight demonstrator as part of NASA's Space Launch Initiative. The new contract included development of two vehicles – the X-37 Approach and Landing Test Vehicle (ALTV) and the X-37 Orbital Vehicle.

The Approach and Landing Test Vehicle (ALTV) will validate system performance of the approach, landing and turnaround operations needed for flight. It will demonstrate an integrated Flight Operations Control Center, as well as range and vehicle flight test operations. In addition, the vehicle will validate aerodynamic stability and structural integrity. The vehicle also will demonstrate automated operations in the approach and landing range environment. The X-37 ALTV will be released from a B-52 aircraft at altitudes of up to 40,000 feet to demonstrate descent and landing. The trajectory will duplicate to the maximum extent possible the expected reentry trajectory of the Orbital Vehicle. Five unpowered flight tests are scheduled to begin in 2004.

Based on the X-37 Approach and Landing Test Vehicle, the X-37 Orbital Vehicle will test key, embedded technologies and flight experiments in relevant environments of ascent, on-orbit, reentry and landing phases of flight. Technologies to be tested include thermal protection systems, advanced guidance, navigation and control, avionics, high temperature structures, conformal reusable insulation, and high-temperature seals. In addition, the X-37 Orbital Vehicle will demonstrate unmanned automated orbital flight, reentry and landing. The X-37 Orbital Vehicle is being designed to accommodate orbital operations of up to nine months. Several locations are being studied for the landing site. The orbital flight test is planned for late 2006.

The X-37 is approximately 27.5 feet long with a wingspan of approximately 15 feet, and it contains an experiment bay 7 feet long and 4 feet in diameter. The dry weight of the X-37 will not exceed 7,500 pounds.

The X-37 project is being conducted as a part of the Orbital Space Plane program. Information gained in X-37 technology demonstrations is directly applicable to the design and development of the future Orbital Space Plane.

The X-37 government team, led by NASA's Marshall Space Flight Center in Huntsville, Ala., also includes NASA's Ames Research Center in Moffet Field, Calif.; Kennedy Space Center, Fla.; Goddard Space Flight Center in Greenbelt, Md.; Johnson Space Center in Houston; Langley Research Center in Hampton, Va.; Dryden Flight Research Center and the U.S. Air Force Flight Test Center, both at Edwards Air Force Base, Calif.

For more information on flight demonstrators and the Orbital Space Plane program, visit the Marshall web site at **http://www.nasa.gov/marshall/**

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