



FACT SHEET

XSS-11

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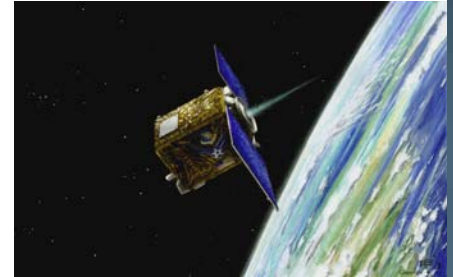
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Primary Mission¹

Demonstrate new autonomous satellite features during encounters with six or seven spent rocket stages and inactive U.S. satellites. XSS-11 is also designed to test technologies that could allow quick visual examinations or maintenance of spacecraft in orbit.

Specific Mission Elements

- ◆ Monitor performance of proximity guidance, navigation and control system.
- ◆ Identify command and control techniques for proximity operations including safety and verification procedures.
- ◆ Rendezvous with six to eight objects, including the Minotaur upper stage after separation.



Artist impression of XSS-11 . Artist: Phil Smith.

Launch

April 11, 2005 aboard Orbital Sciences Corporation (OSC) Minotaur from Vandenberg Air Force Base, California. XSS-11 was the primary payload.

Operator

Managed by the Air Force Research Laboratory (AFRL) Space Vehicles Directorate Integrated Space Experiments Division and operated by the Air Force Space and Missile Systems Center's Detachment 12.²

Manufacturer and System Integrator

XSS-11 was manufactured by Lockheed Martin Astronautics in concert with the AFRL Space Vehicles Directorate, Kirtland Air Force Base, New Mexico.²

Specifications

- ◆ Orbit: 800 kilometers by 850 kilometers (500 miles by 530 miles) 39.8° inclination
- ◆ Mass: 138 kilograms (304 pounds)
- ◆ Dimensions: Roughly one meter by one meter
- ◆ Design life: 12-18 months
- ◆ Cost: \$56 million (spacecraft) and \$6 million (operations), sometimes \$80 million used.^{3,4} One AFRL source quotes a \$70 million price tag.⁵ At least two sources indicate that Lockheed Martin's contract was valued at \$21 million.^{6,7}



This Orbital Sciences Corporation Minotaur launch vehicle carried XSS-11 into space on April 11, 2005 from Launch Complex 8, Vandenberg Air Force Base, California. Photo: USAF.

Mission Details

Like its predecessor XSS-10, XSS-11 is part of the Experimental Spacecraft System series (XSS). XSS consists of a small fleet of microsats designed and operated by the Air Force Research Laboratory based in Kirtland Air Force Base, New Mexico. These microsats are expected to demonstrate technologies and procedures for inspection, maintenance, and repair services for orbiting spacecraft. The objective is to provide these various services at lower cost and more quickly than an alternative program in which a replacement platform is launched from Earth. The XSS program will focus on close-proximity inspection, responsive, on-orbit and beyond-orbit services, and maintenance and repair activities that will extend the life and performance of orbital assets at lower cost than ground based programs.⁸

XSS-11 was designed to autonomously plan and rendezvous with space objects. This capability is considered another "tool" for the Air Force's space toolbox. "We're a lab. Our job is to demonstrate technologies," Harold "Vern" Baker, AFRL's XSS-11 program manager said, referring to AFRL. According to Baker, "The job of XSS-11 is to add another tool to the tool box that military space commanders can consider incorporating. There are a number of possibilities for servicing, inspection, repair...there's just a wide list." XSS-11 was expected to conduct rendezvous maneuvers with six to eight objects, the first of which was the upper stage of the Minotaur rocket that carried it into space. These maneuvers would allow the Air Force to test the feasibility of servicing and inspecting military satellites in space, including its own. Baker's team also helped the National Aeronautics and Space Administration (NASA) officials develop rendezvous scenarios for the Hubble Space Telescope (HST).⁹

NASA is also interested in using proximity maneuvering technology and spacecraft autonomy software for a Mars-sample-return mission, so that a lander would be able to dock autonomously with a mother ship after a visit to the surface. Spacecraft autonomy is one of the requirements set forth in President George W. Bush's Vision for Space Exploration (VSE).



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Controversy

According to a NewScientistTech.com interview with Theresa Hitchens, vice president for the Center for Defense Information (CDI), results from tests using the XSS-11 satellite could provide input for the development of space-based weapons. Satellites proficient at proximity maneuvering could approach other satellites, she says, and could adjust its speed and ram into the satellite, damaging it or knocking it off course. This is especially problematic because small satellites like XSS-11 are very difficult to detect.¹¹

During the Carnegie International Non-Proliferation Conference held in Washington, D.C. in November 2005 and chaired by Hitchens, the issue of addressing international concerns regarding XSS-11 and other similar systems in space was addressed. Michael Katz-Hyman from the Henry L. Stinson Center started the discussion by asking panelists what they think should be done to allay any fears that a satellite like XSS-11 is designed to pursue a non-belligerent mission.

Ambassador Paul Meyer, Canadian Department of Foreign Affairs and International Trade said "one way would be a transparency, a confidence-building measure presumably of inviting states to observe a launch or two, get a briefing on the nature of the system, and if indeed it is so benign that that would be a way of allaying concerns. There was the old—also, I suppose functional—observe the difference and the extent to which it carry capacities that might be less benign. Maybe that would be evident." Brigadier General Simon Warden added that it was "a very good question because I think that this kind of gets to the point. I think there can be agreements on the— the focus really on space situation awareness, and it's where— that is where the U.S. focus is now. And I suspect that there is considerable opportunity here."

Richard Garwin from IBM added that he thought the problem could be addressed by a legal regime prohibiting the deployment of space mines, and that a mission like XSS-11 would presumably be authorized under some sort of transparency and confidence building measure (TCBM) clause: "Well, it's a difficult problem and I propose that the main threat is space mines and those are satellites that would sit next to other satellites for a long time ready to destroy them. So there was some satellite that visited another satellite for a short time. It might be announced in advance. I haven't thought that out, but a ban on space mines, a ban on space weapons would go a long way. A country would then be violating its undertaking if it actually deployed space mines."¹²

Status

The spacecraft is no longer operational. During the American Institute of Aeronautics and Astronautics (AIAA) 2007 annual conference, the XSS-11 team received the AIAA *Space Systems Award* for accomplishing one of the most impressive space missions in the history of Air Force Research Lab. The award was presented to Harold Baker, the XSS-11 program manager.¹³



An image taken by XSS-11 of its spent Minotaur upper stage at a distance of approximately 500 meters.
Photo: USAF.

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