NOTSNIK: The Navy's Secret Satellite Program

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July 1998

Introduction

Like the other branches of the United States military during the early years of the Space Age, the Navy's "space program" actually consisted of several, largely independent space projects run by different internal bureaus and laboratories. While the Navy Research Laboratory (NRL) ran the Vanguard program under the watchful gaze of the public, the Naval Ordnance Test Station (NOTS) at China Lake, California was secretly conducting an independent military satellite program whose existance was not acknowledged until 1994.

NOTS, under the direction of the Navy's Bureau of Ordnance (BuOrd), had been responsible for the development rocket-based weapons for the Navy since its inception in 1943. During the years leading up to the Space Age, engineers and scientists at NOTS were already busy performing research on suborbital and satellite ocean surveillance systems. With the launch of Sputnik, a NOTS team proposed an all-solid-fuel launch vehicle based on the motors in the Army's Sergeant missile. However, the Army turned down their request for the rocket motors.

Undetered, NOTS engineers went back to the drawing board and by early 1958 came up with a remarkably innovative means of orbiting a payload with available hardware. The new NOTS satellite proposal, called "Project Pilot", used a six-stage air-launched system capable of orbiting a 1.05 kilogram (2.3 pound) satellite. This system would serve as a technological pathfinder for the Navy's future rapid response reconaissance systems. The technical director of BuOrd's new space program office, John Nicolaides, approved the project and development immeadiately proceeded with a $300,000 budget and a four month deadline. Subsequently Project Pilot received the nickname "NOTSNIK" based on a combination of NOTS and Nicolaides' name but also partly as a play on the "Sputnik" moniker.

The NOTSNIK Launch Vehicle

The "first stage" of NOTSNIK was a specially modified Douglas F4D-1 "Skyray" jet fighter supplied by BuAer. When the F4D-1 entered service in 1956, it was the Navy's first carrier-based delta-winged jet fighter. The 13.9 meter (45.67 foot) long F4D-1 to be used for NOTSNIK, serial number 130745, was a specially modified, stripped down version used for high speed trial flights. With its Pratt and Whitney J57 P-2 turbojet on full afterburner, this plane was capable of attaining speeds of Mach 1.05.

The BuAer Douglas Skyray jet fighter with a NOTSNIK test article under its wing used for practice runs. (Photo courtesy of U.S. Navy)

The tight clearances and limited payload capability of the Skyray set the limits on the size and weight of the subsequent five stages of the NOTSNIK launch vehicle. This rocket had a total length of 4.38 meters (14.4 feet), a fin span of 1.65 meters (5.42 feet) and weighed only 950 kilograms (2,100 pounds). Even with the mass of the Skyray included, NOTSNIK is the smallest known system ever built to launch satellites. The rocket was mounted on a standard Aero 7A bomb rack under Skyray's port wing. A fuel tank of like mass was carried under the starboard wing to balance the load.

During a launch, the Skyray would proceed at an altitude of 10.7 kilometers (35,000 feet) to the airdrop zone located in the Navy's test range over the Santa Barbara Channel in the Pacific Ocean just west of Los Angeles. Before release the pilot would start a 2-G pullup at Mach 0.9 to start a "bomb toss" manuever. At an altitude of 12.5 kilometers (41,000 feet), the rocket would be released at a speed of 742 kilometers (461 miles) per hour and an angle of 50 degrees to the horizon. Three seconds later the first of the solid rocket stages would ignite.

The second and third "stages" of NOTSNIK made use of a common airframe. Each "stage" consisted of a pair of modified HOTROC motors like those used by the Navy's ASROC anti-submarine weapon and produced 126.4 kilonewtons (28,400 pounds) of thrust for 4.86 seconds. During ascent the burn of the second stage would be followed by a 12 second coast before the third stage ignited. After third stage burnout, the vehicle would coast for another 100 seconds. At an altitude of 79.4 kilometers (49.4 miles) the second/third stage structure was jettisoned and the fourth stage was ignited.

This stage consisted of an X-241 rocket motor manufactured by the Allegheny Ballistic Laboratory. Based on the X-248 motor developed for the NRL Vanguard rocket, the X-241 produced 12.11 kilonewtons (2,720 pounds) of thrust for 36 seconds. After another coast of three seconds, the fifth stage would come to life. This 14.9 kilogram (32.9 pound) motor was designed at NOTS and produced 5.14 kilonewtons (1,155 pounds) of thrust for 5.7 seconds. After this stage burned out, NOTSNIK was travelling at 8.44 kilometers (5.25 miles) per second in a near-polar orbit with a apogee of about 2,400 kilometers (1,500 miles). But with a perigee of about 60 kilometers (40 miles), this orbit would be very short-lived.

A small 568 gram (1.25 pound) solid rocket sixth stage integrated with the satellite payload would be fired 53 minutes and 20 seconds after release. Also developed at NOTS, this tiny motor produced 765 Newtons (172 pounds) of thrust for one second and would raise the NOTSNIK satellite's perigee to a safe 2,250 kilometers (1,400 miles) allowing the mission to begin.

The NOTSNIK Satellite

With a mass of 1.05 kilograms (2.3 pounds) and a diameter of 20 centimeters (8 inches), the doughnut-shaped NOTSNIK satellite is among the smallest orbital payloads ever launched. This battery-powered satellite was constructed at NOTS China Lake facility and carried a single instrument - an infrared "television" scanner. Similar to the units supplied by the Navy for the USAF lunar orbiters, this simple imager was hardly a "television" in the usual sense. A small mirror focused light onto an infrared detector which would use the rotation of the satellite to scan a line in the scene. The forward motion of the satellite itself would then allow a picture to be built one line at a time. While the crude images produced by this system would have little intelligence value, the experienced gained would be valuable in developing more capable follow-on systems.

NOTS technical director Dr. William McLean (left) and Navy Director Captain Hollister (right) inspecting first NOTSNIK satellite on July 2, 1958. (Photo courtesy of U.S. Navy)

The images produced by the satellite would be transmitted to a network of about a half dozen portable MINITRACK stations scattered around the globe. Because of the small size of the satellite, the system would only operate for about three orbits before the batteries were depleted, long enough to verify that orbit had been achieved and attempt to secure some images.

Since orbital reconnaissance was a touchy subject at the time, NOTSNIK and its mission were kept top secret. Except for those with a need to know, NOTSNIK's "cover story" was that it was to conduct radiation measurements in support of Project Argus which would assess the effects of nuclear detonations in space. The satellite's small size and short lifetime made it unlikely that it would be detected by anyone outside the program.

Hardware development proceeded at a rapid pace during the spring of 1958. But before actual flights of the system, a pair of ground-launched test flights were to be performed to assess the modifications made to the HOTROC motors. A NOTSNIK rocket mockup with two live HOTROC motors was prepared for launch from the G-2 test range at China Lake on July 4, 1958. In an unintended

Independence Day fireworks display, the rocket exploded one second after launch. An investigation of the failure indicated that a crack in the solid rocket motor's grain was at fault. A second ground test firing two weeks later was even less successful. With eight seconds left in the countdown, a glitch in the electrical system caused the rocket to blow up on the test stand. Despite the two failures, project managers proceeded with an orbital attempt based on their engineers' past experience and their faith in this simple launch system.

NOTSNIK Launch Attempts

On July 25, 1958, only a week after the last unsuccessful NOTSNIK ground test, Navy Pilot Commander William W. West climbed into the cockpit of the BuAer Skyray carrying a NOTSNIK rocket in the first all-up test flight. Once Commander West reached the the drop zone, he performed the required pullup maneuver and released the rocket. Because of the sudden loss of weight from his port wing, West's Skyray banked sharply to the right making further observations of the rocket difficult. With the sudden burst of smoke and flame from the ignition of the second stage, West and the pilot of the chase plane lost sight of the rocket and assumed it had failed.

While most of the tracking network shutdown after the apparent failure, the station in Christchurch, New Zealand did not and reportedly detected the NOTSNIK satellite in orbit. While no useful images could be extracted from the weak signal, it did appear that the launch was successful afterall. NOTSNIK thus became the first air-launched satellite - almost 32 years before the first Pegasus launch.

With a success under their belt, a second orbital attempt was made on August 8, 1958. The HOTROC motors blew up on ignition ending the mission. Another pair of ground tests were conducted on August 16 and 17 to once again verify the design. Both flights failed about three seconds after ignition when their stabilizing fins broke free. Obviously the structure had difficulties with the stresses of launch and required changes.

With little time left before the end of the program, the remaining four NOTSNIK rockets were prepared for launch in rapid succession. The third orbital attempt on August 22, 1958 started well with the accelerating rocket observed disappearing over the horizon. Later signals were received by the New Zealand station during the scheduled first and third orbital passes apparently confirming that orbit had been achieved. As with the first mission, the signals were too weak to obtain usable images.

The second successful NOTSNIK satellite launch shortly after ignition on August 22, 1958. (Photo courtesy of the U.S. Navy)

The next mission flown on August 25 ended 3.75 seconds after release when one of the HOTROC motors exploded. The following day the fifth attempt ended when the rocket failed to ignite and fell into the Pacific. The final NOTSNIK orbital attempt on August 28 ended when the rocket broke up after a second stage HOTROC motor failed to ignite. With this last flight, the first phase of the NOTSNIK program drew to a close.

Postscript

Plans for additional NOTSNIK flights were not approved and development efforts instead shifted towards upgrading the existing rocket design. One project, called Caleb, sought to build an improved air-launch system but was eventually cancelled because of political pressure from the USAF who wanted to monopolize military space launches. While it would not launch payloads into orbit, Caleb did fly as part of the Navy's secret high altitude "Hi-Hoe" program with the last flight in 1962 reportedly reaching an altitude of 1,167.3 kilometers (725.5 miles). Another follow-on program, called NOTSNIK II, sought to develop an anti-satellite capability. This still-secret program is thought to have made at least two test flights during the early 1960s.

The NOTSNIK rocket was not the only part of the program to continue development. The infrared scanner carried by the NOTSNIK satellite also flew on the ill fated USAF lunar probes as part of Operation Mona. After these failures to return usable data, the design was eventually flown as a secret secondary experiment on some early flights of the Navy's Transit experimental navigation satellite. The camera operated satisfactorily and returned usable images, thus vindicating its design and providing useful data for future imaging systems.

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