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Spy in the Sky

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The Advanced Reconnaissance System

As the Cold War deepened in the 1950s, Americans developed an ever worsening case of paranoia about the Soviet Union. These fears were heightened not only by Soviet propaganda but also by the lack of any substantive information about Soviet forces deep behind the borders of this enormous and secretive country. Based on the sobering conclusions drawn during White House meetings between Eisenhower and his top science advisors, the USAF issued General Operational Requirement No. 80 on March 16, 1955. This document authorized the development several new systems to obtain photographs over Soviet territory.

One of the systems to be developed was called "Aquatone". Better known as the U-2, this jet-powered aircraft was designed to photograph the Soviet Union while flying out of reach of their air defense systems. While flights starting in July of 1956 returned much valuable intelligence, the aircraft was tracked from the start by Soviet radar and MiG fighters. USAF and CIA officials knew it would only be a matter of time before an incident stopped U-2 flights over the Soviet Union. With this and the threat of Soviet protests blowing the cover on this classified (and technically illegal) effort, Eisenhower eventually authorized only two dozen missions over Soviet territory through 1960.

The next new reconnaissance program became known as WS-117L (Weapon System-117L). Eventually run by the USAF's Western Development Division of the Air Research and Development Command under General Bernard A. Schriever, this program called for the development of a reconnaissance satellite capable of returning detailed images of the Soviet Union from orbit. Since the end of World War II there had been a number of studies performed on satellites and their uses including reconnaissance. The one that had the greatest impact was the classified "Project Feed Back" study of the Rand Corporation published on March 1, 1954. The culmination of a series of USAF-sponsored studies at Rand, the report outlined the development a television-equipped satellite that would orbit 480 kilometers (300 miles) above the Earth taking images that were 600 kilometers (375 miles) across with a resolution of 44 meters (144 feet). As this detailed study circulated through the USAF, it generated much interest and convinced many that a recon satellite was actually feasible.

America's First Satellite Program

With the need for more advanced studies, one year contracts were awarded to Lockheed, Glenn L. Martin Co., and RCA under the codename "Pied Piper" in 1955. By July 1956 the development plan for the covert WS-117L program (also known as the Advanced Reconnaissance System) was approved. This was two months before Vanguard was publicly chosen as America's "official" satellite program making WS-117L the nation's first (albeit secret) satellite program. In October 1956 Lockheed, who had also built the U-2, received the contract to develop the new recon satellite. But with an initial allocation of only $3 million, satellite reconnaissance was obviously still a low priority with military leaders.

Despite the lack of funds, the planning and system development for WS-117L proceeded. After it was shown that a television-based system would be inadequate for reconnaissance, the clearly preferred option became a film readout system launched on an Atlas ICBM. This system would expose its film and develop it in orbit for subsequent scanning and transmission to Earth. The satellite would also carry a signal intelligence package and later infrared sensors would be added to detect missile launches. A relatively easy to develop, spin-stabilized photographic system was also studied. Launched on

a Thor IRBM, this spacecraft would return exposed film inside a small return capsule and could provide an interim reconnaissance capability.

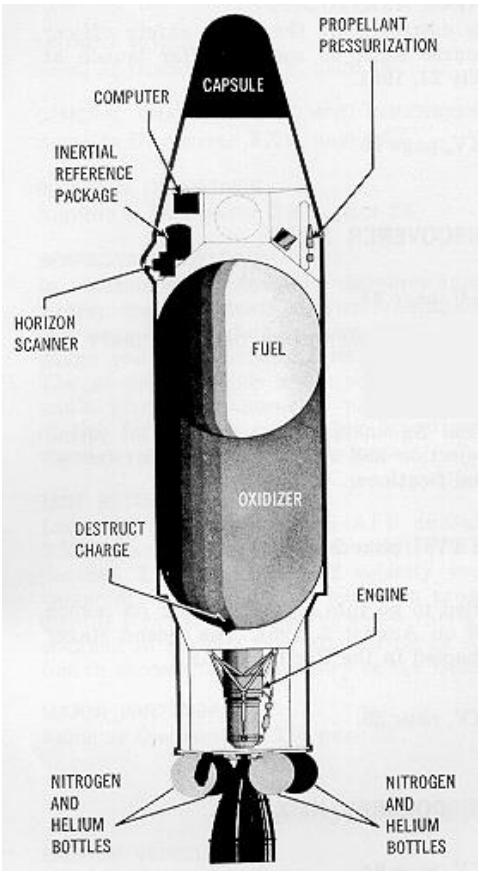
These recon payloads would be attached to a Lockheed-built propulsion system that would also serve as the final stage of the launch system. This propulsion system would employ a modified Bell 8000-series rocket engine originally designed for a RATO (Rocket Assisted Take-Off) and auxiliary power system for the B-58 "Hustler" bomber. This stage, which along with its engine was also initially nicknamed "Hustler", would burn the storable, hypergolic propellants UDMH (unsymmetrical dimethyl hydrazine) and IRFNA (inhibited red fuming nitric acid). Eventually this adaptable propulsion system design would be employed as an upper stage in other programs under its eventual designation, Agena.

But as planning for WS-117L crawled along through 1957, it was becoming clear that the program was moving too slowly. Along with the anxiety generated by the first Sputnik launches, the project's security was compromised with press reports referring to the supposedly secret project as "Big Brother" and "Spy in the Sky". Wanting to avoid public discussion about the sensitive subject of overhead reconnaissance while at the same time accelerating recon satellite development, the Eisenhower administration had to take drastic action to get the program back on track and under wraps.

Project Corona

Over the course of the 1958, the satellite reconnaissance program was totally restructured. Along with all the other military space programs, ARPA (Advanced Research Projects Agency) took control of WS-117L when it was founded in February of 1958. In a bid to get a satellite reconnaissance capability at the earliest possible date, ARPA secretly spun-off the interim Thor-based film-return part of WS-117L on February 28 as a separate, highly classified program. Called "Project Corona", it would operate under the joint management of the CIA represented by Richard Bissell, Jr. and the USAF represented by Major General Osmond Ritland. Lockheed would continue as the prime contractor of this smaller, more focused effort. Itek was eventually chosen as the subcontractor for the camera while General Electric got the nod to develop the return capsule or SRV (Satellite Reentry Vehicle).

In the end spin stabilization was dropped in favor of a three-axis stabilized design. At the bottom of the stack was the Agena stage that would place the payload in orbit and provide attitude control during the mission. Next was an unpressurized compartment weighing about 115 kilograms (250 pounds) and shaped like a truncated cone that would house the model "C" camera. The Itek-built camera would take 70-degree wide photographic swaths with a resolution of 12 meters (40 feet) from an orbit with a perigee of about 190 kilometers (120 miles). As the camera's acetate film was exposed, it would be fed into the SRV at the top of the stack.



A schematic of the early Corona recon satellites launched at part of the Discoverer program. The secret camera payload was housed in the empty, unlabeled compartment below the return capsule. (Lockheed)

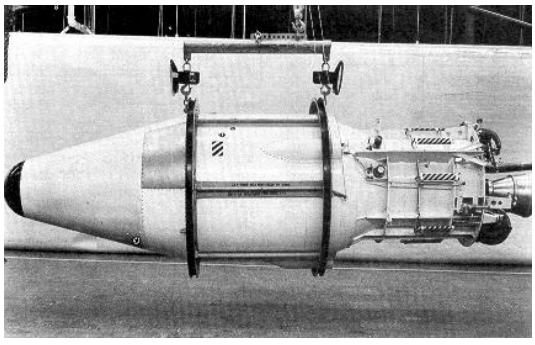
With a diameter of 83 centimeters (33 inches) a height of 69 centimeters (27 inches) and weighing about 135 kilograms (300 pounds), the SRV carried stabilizing spin rockets and a solid propellant retrorocket to start its descent from orbit. The exterior of the bowl-shaped SRV was coated with ablative material to serve as a heatshield during a nose first reentry. Inside was a "bucket" plated in

gold to reflect heat away from the cargo of film. After reentry, a parachute would open and pull the bucket clear of the heatshield for the final leg of the descent. Like the manned space program, a water recovery was preferred but there was a danger that Soviet submarines might get to the payload before American naval forces. To avoid this, recovery by air was proposed. A C-119 cargo plane trailing a special rig would grab onto the parachute of the descending SRV and haul it inside.

All together, the first Corona recon satellites would have an orbital mass of as much as 770 kilograms (1,700 pounds). Because of payload limitations, only enough film and other consumables were carried for a one-day mission. Launch would take place south over the Pacific from a modified Thor launch pad at the missile facilities at Cooke Air Force Base (renamed Vandenberg AFB in October 1958) into a near-polar orbit that allowed Corona to view Soviet territory in daylight during southward passes. This orbit also permitted the return command to be given as Corona passed over Alaska with the tricky air-recovery taking place in the Pacific south of Hawaii.

The First Discoverer Launches

As the USAF continued with the more complex WS-117L surveillance systems, development of the now independent Corona program proceeded at a frantic pace. While the small size of the Corona team made it easier to conceal the program from the public, by early 1959 launches would begin making it impossible to easily hide the program any longer. A cover story was needed and on December 3, 1958 ARPA announced the Discoverer program. According to ARPA, Discoverer was a test program to develop new technologies required for the future and study the space environment. Biomedical experiments would also be flown and techniques to recover payloads from orbit perfected.



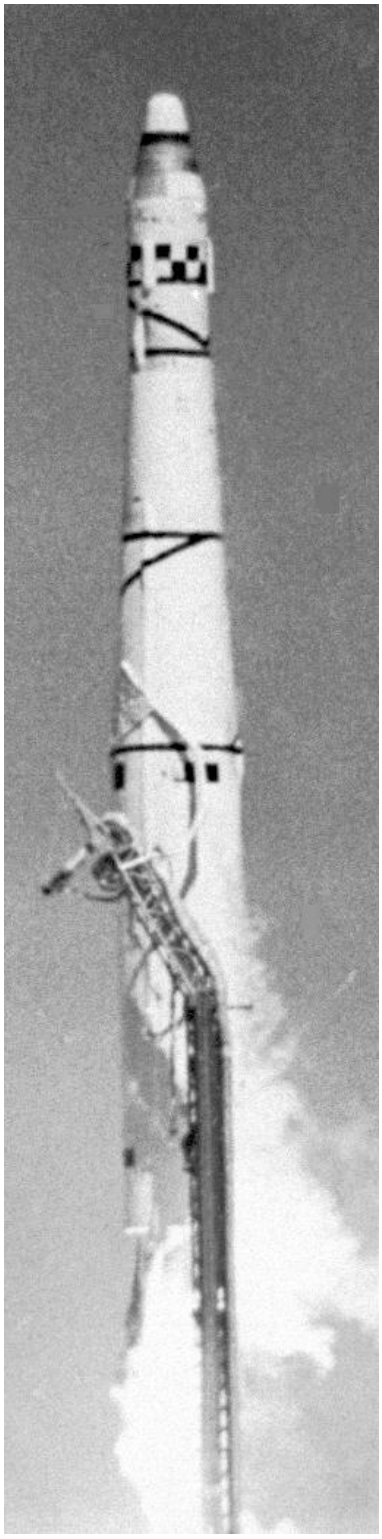
Discoverer 1 before it was mounted onto its Thor launch vehicle for the first Thor-Agena test. (USAF)

The first Discoverer was ready for launch on January 21, 1959. This first flight was meant to test the new Thor-Agena combination with only a light engineering payload. With an orbital mass of only about 590 kilograms (1,300 pounds), no SRV was carried on this flight and no recovery would be attempted. But as the countdown reached T-60 minutes, the launch was aborted when explosive bolts holding the Thor and Agena together accidentally detonated and the Agena's ullage rockets fired. While the incident left the rocket and payload intact, there was enough damage to scrub the mission.

The next flight, nicknamed "Flying Yankee", finally made it off the pad on February 28, 1959. As in the first attempt, Discoverer 1 was a simple engineering test and no recovery would be attempted. Everything seemed to have gone as planned but no transmissions from Discoverer 1 were ever received. Radar tracking hinted that it had achieved a 283 by 835 kilometer (176 by 519 mile) orbit and some engineers believed that the satellite's antennae were damaged when the payload shroud failed to cleanly separate. Despite this, it is now generally believed that Discoverer 1 failed to achieve orbit and crashed near the South Pole instead.

The next mission, Discoverer 2, was launched on April 15, 1959. Discoverer 2 was not equipped with a camera but it did have an SRV carrying a biomedical payload. For the first time, an attempt would be made to recover a payload from orbit. The SRV was ejected after 17 orbits as planned but a programming error caused the retrorocket to fire early bringing the capsule down near Norway's Spitsbergen Islands. Reportedly some residents of the island saw the descending capsule. There are also strong indications that the Soviets were able to quickly find and recover the capsule for themselves. Subsequent American-sponsored searches found nothing and were finally abandoned on April 23.

Discoverer 3, launched on June 3 carried a "crew" of four black mice but the countdown was stopped when the humidity inside the capsule read 100%. After it was determined that in fact the mice had urinated on the sensor (thus yielding a false reading), the launch proceeded. Unfortunately the Agena guidance system failed during ascent and Discoverer 3 never made it into orbit. Partly because of protests from animal rights activist over the death of these mice and other animals launched into space, this would be the last Discoverer mission to carry live passengers.



The launch of Discoverer 4 on June 29, 1959. This was the first attempt to launch a camera-equipped recon satellite. (USAF)

Bad luck continued to haunt the Corona/Discoverer program for the rest of 1959. Discoverer 4, launched on June 25, was the first to carry a camera but it failed to reach orbit when the Agena shutdown too early. Discoverer 5 launched on August 13 attempted the mission again. While the spacecraft made it into orbit, low temperatures caused the camera's battery to fail. The attempt to recover the SRV also failed. The spin rockets meant to stabilize the SRV did not ignite and the retrorocket fired in the wrong direction. Several months later the SRV was found in an elongated orbit around the Earth. During the Discoverer 6 mission six day later, the camera malfunctioned after two orbits and the SRV failed to separate for recovery. Discoverer 7 launched on November 7 went out of control when the Agena's attitude control propellant ran out after only two orbits. Discoverer 8 launched on November 20 did only slightly better. The Agena guidance system malfunctioned and placed Discoverer 8 into a highly eccentric orbit. Once again the camera failed but the SRV did attempt to come home after 15 orbits. Unfortunately the parachute failed and the capsule was lost again.

With a string of mission failures caused by a variety of malfunctions, many improvements would have to be made to the Corona/Discoverer spacecraft design. With much work ahead of them, a two month standdown was in effect until the reliability of this potential intelligence tool was improved.

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