Appendix 14

Use of Surplus Minuteman Motors

An early concept for the Minuteman program was the projected use of combinations of the three stages as a tactical ballistic missile. While this idea was abandoned well before hardware was developed, with the retirement of Minuteman I and Minuteman II, combinations of the three stages was utilized in a variety of suborbital and orbital missions.

Space Vector Corporation

Space Vector Corporation developed 15 space launch vehicles utilizing Minuteman I and II stages in both single stage and two stage combinations. The major programs were ARIES, Hera, Homing Overlay Experiment (HOE) and Payload Launch Vehicle (PLV).

ARIES

In 1971, the Naval Research Laboratory contracted with Space Vector Corporation, California, to develop a single stage sounding rocket using surplus Minuteman I Stage II motors. ARIES was a unique sounding rocket in that the flight path was controlled from lift-off to burnout. The Minuteman inertial guidance system was replaced with a Space Vector Corporation guidance system consisting of the MIDAS (miniature inertial digital attitude system which was developed for use on NASA sounding rockets) inertial reference platform which used three single axis rate gyros for stability augmentation, a pitch programmer, and analog control electronics.

The first flight carrying a dummy payload was on 17 October 1973 at White Sands Missile Range, New Mexico in the last flight was on 7 December 2006, launching a target from Kauai Island, Hawaii a total of 60 launches. Payloads varied from NASA and Air Force scientific payloads to use as a target launch vehicle for testing of the Navy's RIM-156B SM-3 and RIM-161 SM-3 anti-ballistic missile system (Figure 1).[1,2]

Hera

Space Vector Corporation subcontracted to Coleman Aerospace to combine Minuteman II Stage II SR19AJ and Stage III M57 to form the Hera target missile for the Terminal High Altitude Area Defense System and Patriot PAC-3 anti-ballistic missile system. The first flight took place on 24 April 1995, with 21 flights as of 21 March 2002.[3,4]

Figure 1. ARIES booster at White Sands Proving Ground. Courtesy of White Sands Missile Range Museum

Homing Overlay Experiment

The HOE program tested a non-nuclear hit-to-kill missile interceptor as part of the Strategic Defense Initiative. The HOE booster used a Minuteman II M55A1/M56A1 combination in a four flight program, beginning on the 7 February 1983 and ending with the last flight proving the hit-to-kill concept on 9 June 1984.[56]

Payload Launch Vehicle (PLV)

The PLV was a two-stage vehicle composed of Minuteman II Stage II SR19AJ1 and Stage III M57. There were 10 launches in the program, beginning on 23 June 1997 and ending on 11 December 2002.[7]

Orbital Sciences ATK (Northrop Grumman)

Minotaur

In September 1997, Orbital Sciences Corporation was awarded the contract to develop a launch vehicle for the Orbital Suborbital Program. The original program used surplus Minuteman II first and second stages in combination with Orbital Sciences Corporation's Pegasus and Taurus systems (Minotaur I and Minotaur I Lite, respectively), the program has been expanded to include surplus Peacekeeper motors.

While the Pegasus and Taurus vehicles were designed for air launch at 38,000 feet, the Minuteman booster stages required temperature control. Since the launch pad for the initial flight at Vandenberg, did not have a permanent gantry structure to provide thermal protection, an inflated insulated thermal blanket was devised which can either be removed prior to launch if weather conditions permit or if not, will fall away at launch.[8]

The developmental contract called for launch capability from Vandenberg Air Force Base, California; Florida Space Port Authority launch facilities at Launch Complex-46 Cape Canaveral, Air Station Florida; Patrick Air Force Base, Florida; Kodiak Island, Alaska; and the Mid-Atlantic Regional Spaceport at Wallops Island, Virginia.[9]

Minotaur I

Minotaur I can place up to 1,300 pounds into Low Earth Orbit or 700 pounds in a Sun Synchronous Orbit and has been used for 11 successful launches from 27 January 2000 to 20 November 2013 with launches from Vandenberg and the Mid-Atlantic Regional Spaceport (Figure 2).

Minotaur I Lite (Minotaur II)

According to the 2014 Minotaur User's Guide, the suborbital version of the Minotaur boost vehicle is referred to as Minotaur I Lite, a three stage vehicle using the Minuteman II motors as in Minotaur I, and the third stage of the Orion 50XL, which can boost a target payload of 1,000 pounds in a suborbital trajectory up to 4,800 nautical miles down range or 1,200 pounds 2,400 nautical miles down range with a reentry angle of 20 degrees.[10]

According McDowell's database, Minotaur II was the basic designation for the Orbital Sciences Corporation's booster combination used in the eight flight Target Launch Vehicle program launched from Vandenberg Air Force Base from 28 May 2000 to 24 September 2008. The last two launches used the Minotaur II+ booster which included the Minuteman III third stage.[11]

Figure 2. Minotaur I launch vehicle at Vandenberg AFB, CA. Courtesy of Orbital Sciences.

Endnotes

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6. *Ballistic Missile Defense: Records Indicate Deception Program Did Not Affect 1984 Test Results*, July, 1994; U.S. Senate: Report to the Chairman, Subcommittee on Federal Services, Post Office and Civil Service, Committee on Government Affairs, United States General Accounting Office, GAO/NSIAD-94-219.

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8. Scott Schoneman, Stephen J. Buckley, George Stoller, Luis M. Marina, and Christopher Blair Morris, "Orbital Suborbital Program (OSP) "Minotaur Space Launch Vehicle: A Low-Cost Space Lift for Small Satellite Using Surplus Minuteman Motors," AIAA 2000-5068, AIAA Space 2000 Conference and Exposition 19-21 September 2000, Long Beach, California, 1-11.

9. *Minotaur User's Guide, March 2002*, Release 1.0, (Orbital Sciences Corporation, 2002), Section 3, 2.

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11. McDowell.