

Appendix 3 – FALCON

ACKNOWLEDGEMENT

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BACKGROUND

The FALCON program is one of two projects appearing as shared demonstrations between the High Speed Hypersonics and Space Access pillars of NAI. This joint DARPA/Air Force program, called Force Application and Launch from CONUS (FALCON), grew out of Department of Defense (DoD) recognition that a means for applying force from the continental US that was responsive, reusable, flexible, survivable and economical would be of great value. However, it was recognized that the technology for such a capability was still very immature and required additional development. Thus a program was created to incrementally develop and demonstrate the technology for responsive launch and intercontinental hypersonic flight – providing a building block approach toward global hypersonic force application.

GOALS

The goal of the FALCON program is to develop and validate, in-flight, technologies that will enable both near-term and far-term capabilities to execute prompt global strike missions while at the same time, demonstrating affordable and responsive space lift.

KEY OBJECTIVES AND SUCCESS CRITERIA

The FALCON program is divided into two principal elements, the Small Launch Vehicle (SLV) and the Hypersonic Weapon System (HWS). The SLV is intended to demonstrate affordable and responsive space lift. The principal objective for the SLV is to lift a small satellite or other payload weighing about 1,000 pounds into a low Earth orbit (ideally sun-synchronous) at a total launch cost of under \$5 million, excluding payload and payload integration costs. The SLV could also serve as a launch system for HWS technology flight demonstrations.

The HWS element of the program has two vehicle components, the Common Aero Vehicle (CAV) and the Hypersonic Cruise Vehicle (HCV). The HCV represents the long-term vision for prompt global reach; to enable the capability for a reusable, aircraft-like vehicle to deliver 12000 lb of payload to ranges up to 9000 nautical miles (nm) from its launch site, taking no more than 2 hours to reach its destination. The HCV could carry CAVs and other payloads for global strike. A primary objective of the FALCON program is to demonstrate critical technologies required to enable a future HCV.

The CAV component of the HWS is an un-powered hypersonic glide vehicle. The program seeks to demonstrate both a near term vehicle that could fly 3000 nm carrying a payload of 1000 lb, and a longer term enhanced CAV that would fly 9000 nm and have a 3000 nm crossrange.

VEHICLE CONCEPT/CONFIGURATION

Preliminary vehicle concepts for the HWS and SLV are shown in **Figures FAL-1** and **FAL-2**. **FAL-1** shows the attributes for the near term capability desired from the combination of the SLV and CAV and the far term capability desired from a future HCV. These capabilities will be used to identify the critical technologies and required attributes of the flight demonstrators. Figure **FAL-2** shows the desired capabilities for the SLV.

CONCEPT OF OPERATIONS - FLIGHT TESTING APPROACH

The FALCON program plans an evolutionary development strategy. **Figure FAL-3** reflects the strategy for the SLV flight demonstration. A building-block test program will allow risk control through incremental demonstration of the SLV system starting with simple core motor tests and finishing with a demonstration of the integrated CAV/SLV vehicle. Similarly, **Figure FAL-4** illustrates the strategy for flight demonstration of the HWS. The program will begin with demonstration of a basic CAV, followed by an enhanced CAV providing higher aerodynamic performance. Finally flight experiments demonstrate critical technologies for the HCV.

TECHNICAL CHALLENGES

Since the FALCON program is only now completing its initial phase, the technical challenges for the various elements are still under study, but some are obvious from the nature of the program.

For the SLV, the critical issue is the production of a reliable rocket-based launch system for the target mission cost. This will likely depend on the ability to utilize existing technology and efficient design and manufacturing processes rather than new technology advancements.

The technical challenges for the CAV and HCV are more profound. Achieving the desired performance of the CAV will present substantial difficulties in the disciplines of aero/aerothermodynamics, structures and materials, guidance navigation and control, subsystems, sensors, and communications. Key items are lightweight and durable high-temperature materials, thermal management techniques, autonomous flight control and efficient aerodynamic shaping for high lift-to-drag vehicles.

The HCV will introduce additional problems beyond those of the CAV due to the fundamentally different nature of the vehicle. The issues for the aforementioned disciplines would be expanded and challenges in new disciplines added due to the requirements for a reusable vehicle and an integrated propulsion system.

TECHNOLOGY DEMONSTRATIONS

The technologies to be demonstrated in the FALCON flight demonstration program have not yet been identified.

DEVELOPMENT SCHEDULE AND MILESTONES

The FALCON program schedule is illustrated in **Figure FAL-5**. This is a three-phase project, which began in January 2004 and is currently in the system definition stage. During this phase participants are concentrating

on conceptual designs for the SLV and the HWS components (HCV, CAV, enhanced-CAV). The contractors are developing concepts for both operational systems and for the demonstration vehicles.

The second phase, design and development, is slated to last 36 months. This phase will include preliminary and critical design of the CAV and the first flight demonstration in 2006. The program is scheduled to accomplish the first SLV flight at the end of this phase, in Fiscal 2007.

During the third phase, which emphasizes demonstrations, a single contractor would flight test a combined CAV/SLV in 2008, with enhanced-CAV and HCV critical technology flight demonstrations following in 2009.

Regarding recent program activities, as noted earlier, the system definition phase is nearing completion and the second design and development phase of the program should begin before the end of June 2004.

PARTICIPANTS

During Phase 1, nine contractors were selected to work on the SLV element of FALCON. They are: AirLaunch, LLC.; Andrews Space, Inc.; Exquadrum; KT Engineering; Lockheed Martin's [LMT] Space Systems Co.; Microcosm; Orbital Sciences Corp. [ORB]; Schafer Corp.; and Space Exploration Technologies. In addition, four contractors were selected to work on the HWS element. They are: Andrews Space, Inc.; Lockheed Martin Aeronautics Co.; Northrop Grumman's Air Combat Systems unit; and Boeing Co.

In addition to DARPA, government participants in the program include the Air Force Space and Missile System Center (SMC), several directorates of the Air Force Research Laboratory (AFRL), NASA, and the Sandia National Laboratories.

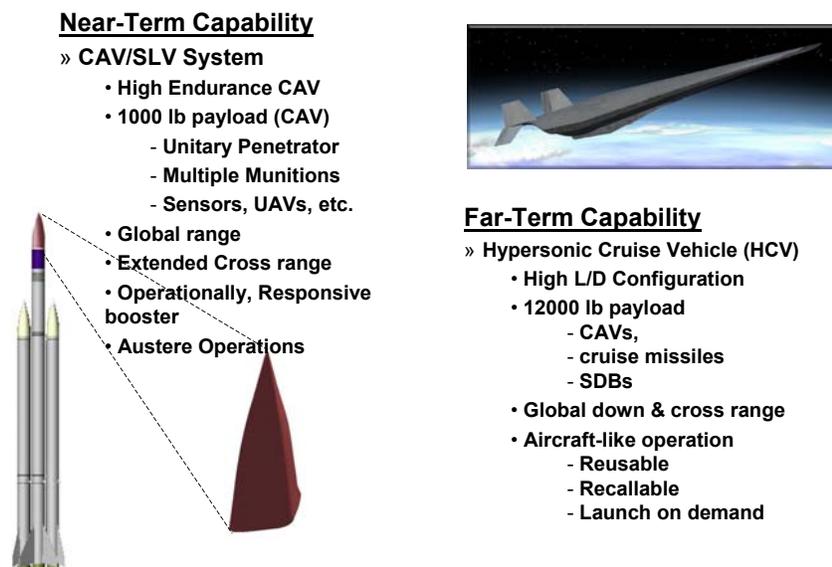
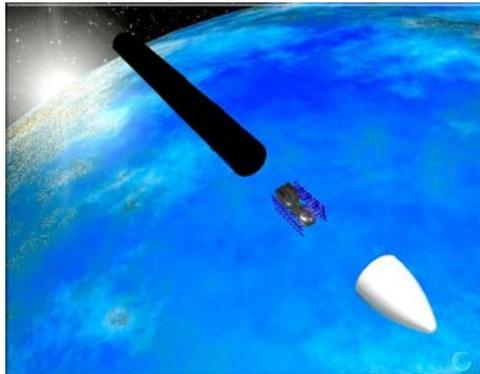


Figure FAL-1. Vehicle concepts for the FALCON Hypersonic Weapon System.



Operationally Responsive Spacelift Capability

- » Small ISR payloads to Sun Synchronous Orbits
- » Low Recurring Launch Cost
- » New Launch Operations Paradigm

Figure FAL-2. Vehicle concept for the FALCON Small Launch Vehicle.

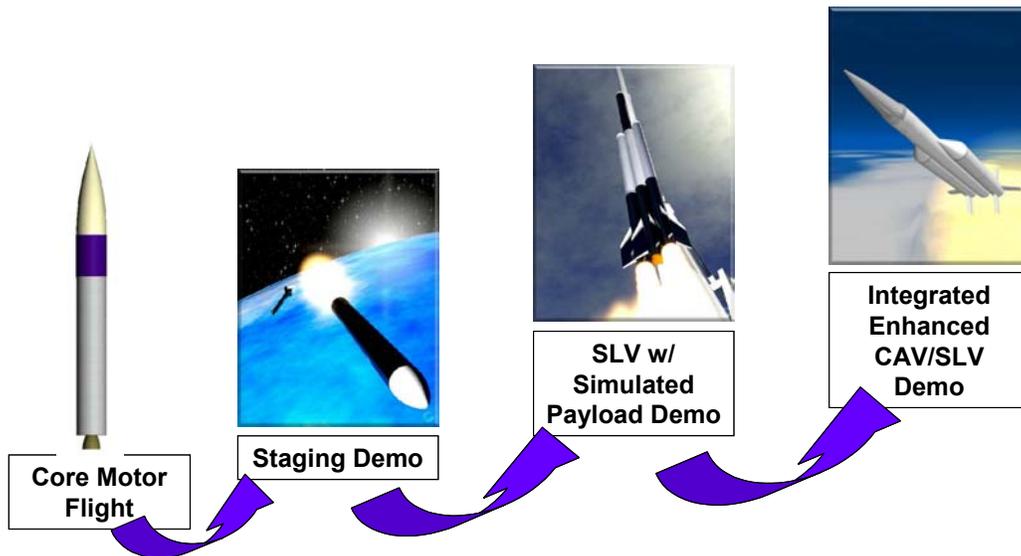


Figure FAL-3. Evolutionary demonstration strategy for the SLV.

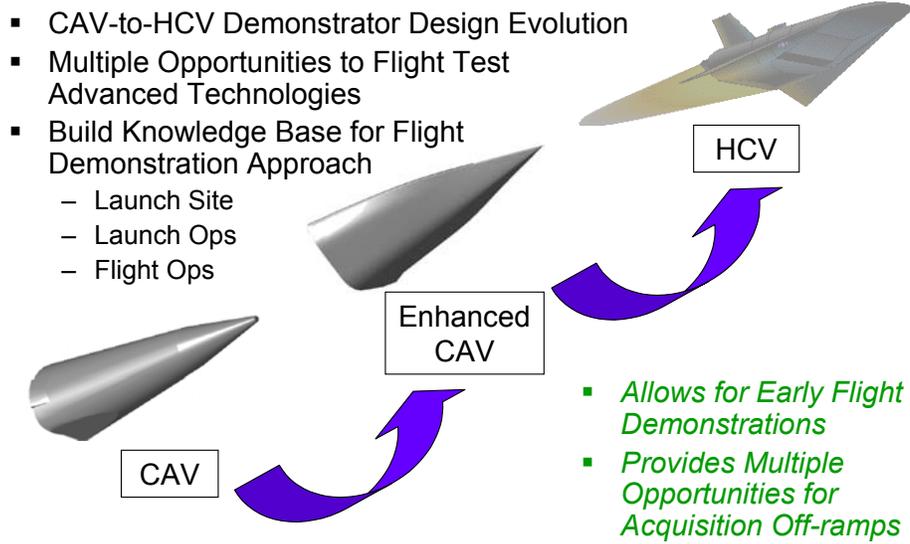


Figure FAL-4. Evolutionary demonstration strategy for the HWS.

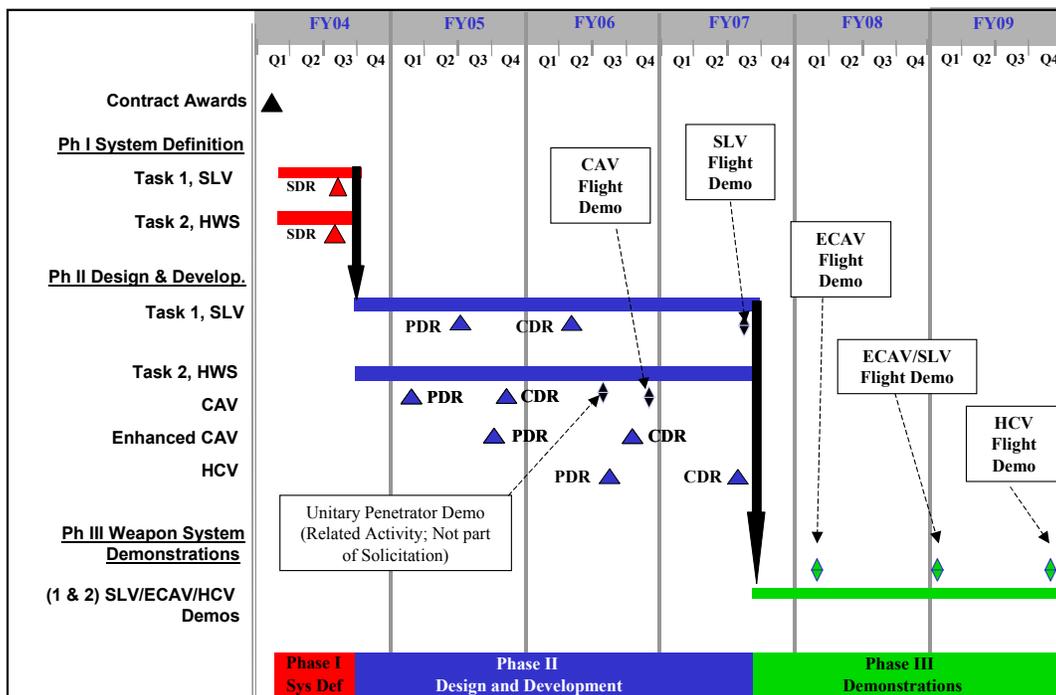


Figure FAL-5. FALCON program schedule.

