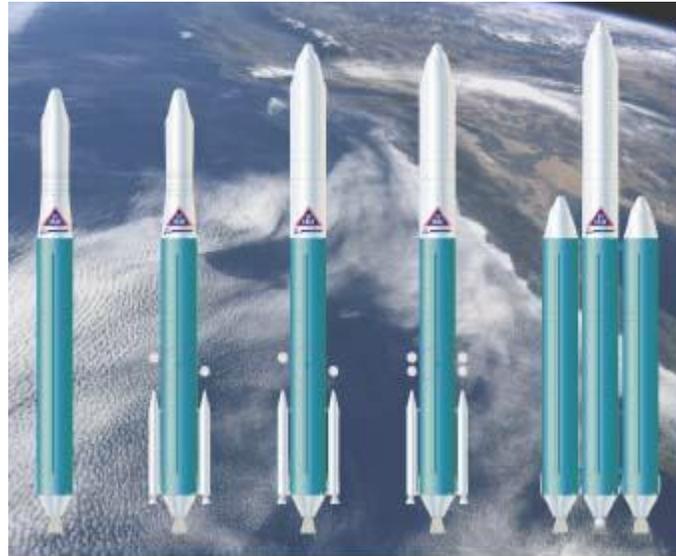
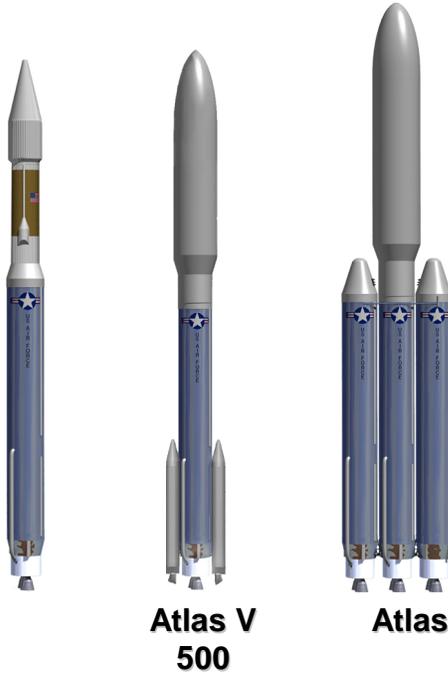


EVOLVED EXPENDABLE LAUNCH VEHICLE (EELV)



Delta IV Medium Delta IV Medium + (4,2) Delta IV Medium + (5,2) Delta IV Medium + (5,4) Delta IV Heavy

Air Force ACAT ID Program

Total Number of Systems:	181
Total Program Cost (TY\$):	\$17.3B
Average Unit Cost (TY\$)	\$95.8M
Full-rate Production:	3QFY03

Prime Contractor

Boeing and Lockheed Martin

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010

The Evolved Expendable Launch Vehicle (EELV) will be a family of expendable launch vehicles that will execute the National Mission Model (planned launches) currently served by Titan II, Delta II, Atlas II, and Titan IV. EELV will support military, intelligence, and civil mission requirements. EELV will be developed as an evolutionary improvement to existing, expendable launch systems and their components. The EELV system includes the launch vehicles, infrastructure, support systems, and interfaces. The goal of EELV is to reduce the annual and life cycle costs of launch by 25-50 percent. Payload interfaces, launch pads, and infrastructure will be standardized so that all configurations of a contractor's EELVs can be launched from the same pad. Current planning envisions configurations to support both medium- and heavy-lift requirements. The current competing concepts are evolutionary outgrowths of the Boeing Delta II and Lockheed Martin Atlas II launch vehicles. The acquisition strategy is to retain both contractor versions of EELV throughout the life of the program.

As an evolutionary space launch system, EELV is based on *technological innovation* to secure our nation's assured access to space. EELV will consist of two families of vehicles that can deliver medium and large payloads to precise orbits from 100 miles to 22,000 miles and higher above the earth. This launch capability will enable the U.S. to take the high ground of space and help achieve the military concept of *full-dimensional protection*.

BACKGROUND INFORMATION

The low-cost concept validation phase of the EELV program began in 1995. Contracts were awarded to Alliant Techsystems, Boeing Defense and Space Group, Lockheed Martin Astronautics, and McDonnell Douglas Aerospace (now Boeing). Selection of two contractors in 1997 resulted in the retention of Boeing and Lockheed Martin as the two primary contractors. Original plans for further reduction to a single contractor were changed to include retaining both EELV design teams for the duration of the program. One factor in this decision is the growing commercial market for EELV which supports increased contractor cost sharing for EELV development, thus making dual development costs affordable to the government. Of comparable importance are the future cost savings expected from continuing competition between the two contractors for launch business. An initial launch services contract, for 28 launches in FY02-FY06, was awarded in October 1998, with the contractors' shares determined by competitive source selection. Beginning in FY07, follow-on launch service contract awards will normally occur at one- or two-year intervals (the longer interval may be chosen if its larger number of launches provides significant economies of scale). Past operational and cost performance will be significant factors in the selection process for each follow-on launch service contract.

The EELV program is being conducted according to the Secretary of Defense's February 1994 Acquisition Reform Mandate. This mandate directs that commercial practices and streamlining initiatives be used to the maximum extent feasible; and that they be consistent with prudent management. Government insight entails a more open and collaborative relationship with the contractor than the traditional government oversight process with its parallel system engineering effort and highly formalized review processes. Since the EELV acquisition strategy allows each contractor to have maximum design flexibility and responsibility, the government will work closely with the contractors to gain an understanding of their processes and progress throughout the program.

TEST & EVALUATION ACTIVITY

The EELV TEMP describes a test strategy that relies almost exclusively on combined DT/OT. The OT community will participate continuously with the Program Office and each of the contractors to design test programs that meet each of their needs. The test strategy includes extensive use of models and simulations to predict individual sub-system and total system performance. Despite the ostensibly commercial nature of the program, the government needs to evaluate system performance, interoperability, standardization, and the ability of each launch system to support the National Mission Model in war and peace using only two national launch ranges. There is a particular concern that the increasing pace of military, civil, and commercial launches is placing so much stress on the launch ranges and their infrastructures that they will lose the flexibility and responsiveness needed to manage national surge requirements without disrupting entire launch schedules.

DOT&E considers the currently approved T&E strategy to be adequate, but cautions that it is the minimum level of effort required to adequately evaluate the EELV system, especially in light of recent

launch failures. There are no test articles or test events planned for the sole purpose of OT, a unique situation for a major defense acquisition program. It is therefore incumbent upon everyone involved in the program to ensure that the contractor tests and government evaluations are comprehensively planned, fully funded, and vigorously executed to answer all developmental and operational test community concerns.

Two OAs are planned for each contractor. The first, from FY97-FY98, supported the Milestone II decision in September 1998. The second, from FY99-FY02, will provide an assessment to support the Air Force Space Command launch readiness decision for the government's first medium-lift flight planned for FY02. The first heavy-lift flight is planned for FY03 and will be included as part of the system IOT&E. Each EELV rocket will carry an operational payload.

Dedicated IOT&E will begin with the first government launch and is scheduled to be conducted from FY02-FY03, and will include the second OA period. Eight operational EELV flights are projected during the IOT&E timeframe. Several commercial flights are planned prior to and during the government IOT&E period; additional data will be collected during some or all of these commercial flights to augment government launch OT data.

AFOTEC concluded the first OA in March 1998. Both Boeing and Lockheed Martin EELV systems were reviewed. The purpose was to assess the potential operational effectiveness and suitability of each contractor's EELV system and determine whether their programs were ready to enter the Development and Initial Launch Services phase of acquisition.

Operational test activities in FY99 were limited. The operational test community observed early engine hot-fire testing, participated in numerous design reviews, and began a process of updating its planning for future test activities.

TEST & EVALUATION ASSESSMENT

AFOTEC assessed, and DOT&E concurred, that both the Boeing and Lockheed Martin EELV programs were potentially effective and suitable when measured against three Critical Operational Issues:

- Does EELV effectively place specific payloads into their specified orbits?
- Does EELV maintain operations to support the intended launch schedule?
- Does EELV meet standardization requirements?

The March 1998 OA data was necessarily very limited in scope, consisting primarily of a review of contractor developmental test data, including modeling and simulation and EELV system design information available at program design reviews. However, this information indicated that neither contractor had programmatic voids at this phase of development that would preclude it from meeting requirements or threaten planned progress. Each contractor demonstrated appropriate progress for the pre-EMD module of their program.

Updates to EELV test planning documentation are needed in the near future. The 1998 TEMP should be updated immediately to reflect the current status of schedules and resources as EELV enters its second OA. An updated plan for the second OA is expected to be finalized no later than January 2000.

In July 1999, AFOTEC completed a scope/cost process to update its top-level planning for the remainder of the EELV test program. The result is a tasking order that outlines a restructured evaluation strategy for the second OA, lists essential testing activities, allocates internal AFOTEC responsibilities, defines deliverables and timelines, and allocates resources. The new evaluation strategy is an improvement because it explicitly communicates the importance of the support processes and associated infrastructure supporting the actual launch.

The strategy for the second OA has an enhanced operational focus. The OA will assess space launch operations, EELV operational effectiveness and suitability, and examine operational areas that impact spacelift support to the warfighter. The evaluation will focus on (1) the capability to deploy, sustain, and augment space-based capabilities supporting various government users; and (2) the deployment-on-demand responsiveness of the EELV system in support of contingencies and major theater war. The space launch supporting functions to be examined include launch vehicle preparation, payload preparation, launch control operations, logistics, surge launch rate, interchanging payloads, range preparation, and range post-launch recovery.

The system effectiveness and suitability assessment focuses more directly on the performance of the launch vehicle itself. The principal issues in the system evaluation are EELV's ability to: (1) place specific payloads in their specified orbits; (2) maintain operations to support the intended launch schedule; and (3) meet standardization requirements.

The lack of rapid access to contractor information under the government insight process has been a limiting factor for the operational test community. In theory, government insight requires that each contractor provide the government with complete and open access to all matters concerning their EELV program. Currently, access must be coordinated through the System Program Office (SPO), often a slow and tedious process. The process as carried out has effectively limited timely access to contractor technical information during the first OA. Open and timely access to information has improved little in the months since, despite the SPO having routine access to contractor data through electronic data system interfaces.

Both EELV contractors have defined and executed programs to certify their systems for Y2K compliance. These programs include verification that all in-house developed, commercially procured, legacy and support system software is Y2K compliant. Neither program uses dates in its flight software. The EELV Program Office completed a review of the contractor efforts in FY99, and determined that no open Y2K issues remain. The first EELV launch, which will be a government satellite, is planned for 1QFY02, almost two years after the millennium change. Additionally, at least one commercial EELV launch is anticipated prior to the first government launch.

CONCLUSIONS, RECOMMENDATIONS, LESSONS LEARNED

The recent series of mishaps in launch operations have involved EELV contractors and some of the sub-systems that will be used or modified for use in the EELV program. Root causes of the accidents have been varied, ranging from lapses in quality control to unforeseen consequences of ostensibly minimal design changes. The EELV program must pay close attention to the findings of the various review panels and investigation boards currently seeking explanations and preventive remedies for the

recent mishaps. Independent of these reviews, DOT&E recommends that careful consideration be given to the potential benefits of additional testing, inspection, or analysis whenever there is doubt about the performance of a component. Testing is not cost-free; however, in spacelift operations the cost of failure is extremely high and the tolerance for error is very low.

The TEMP must be updated by February 2000 to reflect recent progress and planned changes to each contractor's program, as well as reflect AFOTEC's planned improvements to overall operational test strategy. DOT&E considers AFOTEC participation to be essential to this program.

Procedures to improve the operational test community's access to contractor data must be developed immediately. AFOTEC and DOT&E must have full and rapid access to test data if a combined DT/OT approach is to be effective. Without rapid access, timely assessment and feedback are lost, along with the opportunity for the OT community to assist in early problem identification and resolution.

