

Commercial Space Transportation

QUARTERLY LAUNCH REPORT

Special Report:

U.S. Advanced Launch Vehicle Technology Programs



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Special Report

U.S. Advanced Launch Vehicle Technology Programs

U.S. firms and U.S. government agencies are jointly investing in advanced launch vehicle technology. This Special Report summarizes U.S. launch vehicle technology programs and highlights the changing roles of government and industry players in picking technologies and providing funding. It also reports on the role of the FAA Office of Commercial Space Transportation (OCST) in advanced launch vehicle programs and on the joint National Space Transportation Policy Implementation Plan recently released by the Department of Transportation (DOT) and the Department of Commerce (DOC).

The U.S. National Space Transportation Policy

U.S. investment in advanced launch vehicle technology is guided by the National Space Transportation Policy (NSTP). The policy, released on August 5, 1994, is intended to return the U.S. launch industry to the dominant world position it occupied in the 1960's and 1970's. This is to be accomplished through a partnership between government and industry in two separate launch vehicle development efforts: the high-risk NASA Reusable Launch Vehicle (RLV) program and the lower-risk Department of Defense (DoD) Evolved Expendable Launch Vehicle (EELV) program.

Beyond creating development programs the NSTP has more general commercial implications, directing the Departments of Transportation and Commerce to foster government-industry cooperation in both the RLV and EELV programs. The Implementation Plan described below is a response to this directive. The NSTP also addresses other commercial issues, clarifying the conditions under which military missiles may be used as launch vehicles and providing guidelines for

the use of foreign launch systems and components in government-sponsored launch vehicles.

DOT/DOC Joint NSTP Implementation Plan

The Departments of Transportation and Commerce have released a joint National Space Transportation Policy Implementation Plan with their vision and implementing actions. The vision of the Departments of Transportation and Commerce is for the U.S. space transportation industry to capture a dominant share of the global launch market by encouraging the development of a more internationally competitive launch vehicle fleet and supporting infrastructure.

The Implementation Plan notes that achieving this goal will require a coherent effort by the private and public sectors to foster a significantly more internationally competitive launch vehicle fleet by the turn of the century. DOT and DOC, in cooperation with Federal agencies, state and local governments, and industry, will develop and implement innovative partnership arrangements.

The Plan emphasizes the need for market-driven solutions that address commercial as well as government needs for launch vehicle development and infrastructure improvements. It identifies industry preferences for anchor tenancy, termination liability, and public-private partnerships (especially R&D limited partnerships) as the most effective measures to attract private capital. The Plan also discusses loan guarantees, tax deferments, exemptions, and credits, and a range of innovative partnership options such as consortia, space service brokerages, leveraged foreign investments, contracted partnerships, and government prizes.

The Plan notes the government's intention to continue the interagency process involving DOT, DOC, DoD, and NASA that was initiated under the NSTP. DOT and DOC will continue to support the U.S. Trade Representative in negotiating, analyzing, and monitoring commercial space launch trade agreements with countries with economies in

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transition, and to participate in the Working Groups on Information. The Working Groups are chaired by DOT and include representatives of DOC, the Department of State, and other agencies. They assess launch markets (supply, demand, bids, contracts, prices, terms, and conditions) and monitor compliance with the space launch trade agreements.

The Implementation Plan concludes by noting that achieving its goal of a dominant market share for the U.S. space launch industry will require a significantly more internationally competitive U.S. launch industry, and that it will also require cooperation between the private and public sectors to develop new or improved launch vehicles and infrastructure.

The Reusable Launch Vehicle Program

The Reusable Launch Vehicle (RLV) Program is the high-risk portion of the National Space Transportation Policy's launch vehicle development plan. Its goal is the demonstration of technologies for a vehicle that will provide "routine and affordable" access to space. This vehicle should achieve launch costs that are about one tenth of current prices or about \$1000 per pound to low Earth orbit. It should also provide "airplane-like operations" that allow flexibility of the sort expected in aircraft operations but not yet seen in launch vehicles and spacecraft.

The RLV program includes three different flight vehicles as well as a series of ground-based technological demonstrations. These three vehicles are the DC-XA, the X-33, and the X-34. Each of these attempts to explore a different aspect of the technology and operations envelope in which an RLV would function. It is through these practical demonstrations that the government and its industry partners hope to enable the private commercial development of an RLV to serve as a next generation launch vehicle and possible shuttle replacement.

The RLV program has a strong commitment to the goal of commercial development and operation of reusable launch vehicles. OCST is participating in

the RLV program to aid in achieving this goal. Frank Weaver, the Associate Administrator for Commercial Space Transportation will serve on the Source Selection Board that convenes in May for the X-33. OCST is also represented on the non-advocate review board that is meeting through the procurement process to ensure that program deadlines, performance standards, and budgets are effectively addressing the long-term goals of the program and that the program continues to attract the appropriate level of private sector involvement. In addition, the OCST staff is working with NASA, DoD, the Department of Commerce on other aspects of the program to help ensure that commercialization goals are met.

DC-XA

The McDonnell Douglas Delta Clipper Experimental (DC-X) was a non-orbital technology demonstrator for initial aspects of a single-stage-to-orbit launch vehicle. It first flew in August of 1993 as a Ballistic Missile Defense Organization project. Following a series of eight test flights it was turned over to NASA on July 7, 1995 for use in the RLV program. The DC-XA was produced by replacing a number of the original DC-X components with new components testing various X-33/RLV technologies. Chief among these replacements were an aluminum-lithium oxygen tank, a graphite composite hydrogen tank, and a graphite composite intertank between them. Such lightweight structures are required if the RLV is to succeed and they will be proven on the DC-XA in time to incorporate them in the X-33 technology demonstrator.

X-33

The X-33 is the linchpin of NASA's RLV program. It will demonstrate the technology necessary to produce an operational RLV. It is intended to reduce the risk of developing that RLV to the point where it can be done commercially without further government aid.

The X-33 Program is unique in that it is jointly funded by government and industry. NASA is

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requiring substantial financial expenditures by its industry partners. NASA is also acting as a contractor to industry and is including in the X-33 program government agencies that are responsible for commercial aspects of space, such as OCST. The X-33 program is an organizational, as well as a technological, demonstration. If it succeeds it will have strong implications for the future of government/industry relationships in aerospace.

Proposals for X-33 are due on May 13, 1996. The Source Selection Board for X-33 proposals will convene to begin evaluation, and will include experts who can assess the commercial and competitive aspects of the proposals as well as their technical quality. Frank Weaver, Associate Administrator for Commercial Space Transportation of the Federal Aviation Administration, will serve on the board, as will Keith Calhoun-Senghor, Director of the Office of Air and Space Commercialization of the Department of Commerce, and other government and industry experts.

The X-33 program consists of three phases. Phase I (the initial design work) is nearly complete. Phase II proposals are due on May 13, although firms may submit additional technical information through June 3, 1996. Phase II will involve the selection of one team's design for construction and flight testing; this decision is expected by July, 1996. Once the X-33 vehicle is completed NASA plans a series of up to 15 flights between March and December of 1999 to prove the RLV concept. The program objective is to sufficiently demonstrate RLV technologies and capabilities with these flights so that industry will continue with Phase III and develop an operational RLV without further government support.

The three current participants in the X-33 program are:

- Lockheed Martin with a vertical takeoff/horizontal landing wingless lifting body design. This design also makes use of innovative aerospike engines (currently involved in an SR-71 based test program).

- McDonnell Douglas/Boeing with a larger version of the DC-X's basic configuration that will takeoff vertically and land vertically.. In mid-March of 1996 Boeing reduced its involvement in this design partnership and may not take part in the X-33 construction phase at all.
- Rockwell International with a winged vertical takeoff/horizontal landing vehicle vaguely resembling the shuttle orbiter (also a Rockwell design) but of considerably more advanced design.

X-34

The X-34 program is currently aimed at providing a relatively near-term testbed technology demonstration vehicle for X-33 technology, with a NASA investment in the range of \$60 million. The program is using a very flexible procurement mechanism, a NASA Research Announcement (NRA), to enable proposing firms to specify the project structure, the relative investments of NASA and industry, development milestones, and incentives. The first round of X-34 proposals is due by May 10, 1996.

The NRA replaces an earlier arrangement that was intended to produce an operational commercial launch vehicle, rather than the technology testbed currently planned. The vehicle was to have been a reusable suborbital stage with an additional stage to propel a payload into orbit. Use of the X-34 was to have provided experience in the operation of a reusable launch vehicle that could be used in the development of the X-33. (Orbital Sciences Corporation (OSC) and Rockwell International were chosen in March 1995 from three bidders to develop the X-34. In February of 1996, however, Rockwell withdrew from its partnership with OSC and OSC subsequently withdrew its X-34 bid as being unprofitable to operate as a commercial launch vehicle.)

The Evolved Expendable Launch Vehicle Program

The Evolved Expendable Launch Vehicle (EELV) Program is the lower-risk development program

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coming out of the NSTP. It is run for the Department of Defense by the Air Force and is intended to produce an improved launch vehicle family. EELV is expected to cut launch vehicle life cycle costs by 25 to 50 percent through increased production rates and decreased launch overhead. EELV will use existing technology or components in order to reduce cost, time, and development risks.

Unlike the RLV program (in which the ultimate vehicle size and design is left up to industry) the EELV program is intended to fill current design slots. The Atlas, Delta, and Titan IV ELVs currently used by the Air Force will be replaced by the results of the EELV program.

While launcher classes to be filled are not subject to contractor choice, almost everything else is. The four contractors, Boeing, McDonnell Douglas, Alliant Techsystems, and Lockheed Martin all have very different approaches to the design of a EELV:

- Boeing is developing a design in which space shuttle main engines are used in a reusable propulsion module and are recovered after launch.
- McDonnell Douglas is studying a Delta 4 configuration as a candidate; Delta 4 would combine the planned Delta 3 cryogenic upper stage with a new booster.
- Alliant Techsystems is planning to use a modified Ariane V core vehicle that will be built in the U.S.
- Lockheed Martin has selected the RD-180 Russian derivative as the baseline engine for its EELV design.

The teams are currently involved in a 15 month, \$30 million concept validation phase of the EELV program. This will be followed by a 17-month pre-engineering and manufacturing development phase in which two contractors will compete and two will be dropped. Finally, the winning contractor will receive an estimated \$1.5 billion contract to provide launch services over an eight year period. The contractor will be expected to make an initial launch of the light lift vehicle around the year 2000 with the first medium lift vehicle around 2003 and the first heavy lift vehicle around 2005.

Highly Reusable Space Transportation Study

Finally, NASA's Office of Space Access and Technology is looking toward launch vehicle evolution beyond EELV and RLV. The Highly Reusable Space Transportation (HRST) project addresses the long-term challenge of reducing space launch costs to approximately \$100 to \$200 per pound payload to low Earth orbit. The HRST program consists of industry-identified technology research and development projects with relevance to

identification and definition of new concepts for civil space activities across the full spectrum of NASA transportation interests. The program is intended to support efforts to identify, define, and analyze innovative new concepts and to perform necessary laboratory scale experiment studies to validate physical performance characteristics for these concepts. NASA plans to issue a Cooperative Agreement Notice on or about April 5, 1996. Receipt of proposals is planned for on or about May 6, 1996.