

GAO

Report to the Chairman, Subcommittee  
on National Security, Committee on  
Appropriations, House of  
Representatives

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June 1998

# EVOLVED EXPENDABLE LAUNCH VEHICLE

## DOD Guidance Needed to Protect Government's Interest



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**United States  
General Accounting Office  
Washington, D.C. 20548**

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**National Security and  
International Affairs Division**

B-277970

June 11, 1998

The Honorable C.W. Bill Young  
Chairman, Subcommittee on National Security  
Committee on Appropriations  
House of Representatives

Dear Mr. Chairman:

The primary purpose of the Department of Defense's (DOD) Evolved Expendable Launch Vehicle (EELV) program is to develop a family of vehicles that will (1) reduce the costs of launching satellites into space and (2) at a minimum, maintain the reliability, operability, and capability levels of current launch systems. As you requested, we reviewed the EELV program, with emphasis on DOD's revised acquisition approach. We specifically reviewed whether (1) DOD's goal of reducing recurring space launch costs could be achieved, (2) DOD's planned investment would result in commensurate benefits, and (3) there are risks that could affect the program.

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## Background

In 1994, by congressional direction, DOD developed a space launch modernization plan (known as the Moorman study) that led to the EELV program. In 1995, the Air Force entered a low-cost concept validation phase with four competing contractors. In 1996, the Air Force proceeded into the current pre-engineering and manufacturing development phase with two competing contractors—McDonnell Douglas Aerospace, which later became part of The Boeing Company, and Lockheed Martin Astronautics. In June 1998, the Air Force plans to proceed into the final development phase with the primary purpose of fabricating launch vehicles and activating the launch sites.

DOD's initial acquisition strategy was to select one contractor for final development and production. For development, the plan was to issue a cost-plus-award-fee contract, whereby the government would have paid all of the approximate \$1.5 billion in development costs. However, in November 1997, DOD approved a revised acquisition approach designed to maintain the ongoing competition between the two contractors for final development and production. The revised approach was based on forecasts that growth in the commercial space launch services market would support more than one U.S. contractor. Also, the approach anticipates that DOD and the contractors would share in the cost of

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developing the EELV system, which the Air Force defines as the launch vehicles, infrastructure, support systems, and interfaces. DOD's cost share is planned to be fixed at an amount not to exceed \$1 billion—\$500 million for each contractor. The contractors are expected to contribute their own funds, as necessary, to complete EELV development.

To provide the contractors sufficient flexibility in financing their share of development costs, the Air Force is proposing to use an acquisition instrument that is referred to as an "other transaction." Such instruments, which are authorized under 10 U.S.C. 2371, are agreements other than contracts, cooperative agreements, or grants.<sup>1</sup> Consequently, other transaction instruments are not subject to federal procurement laws or the regulations that specifically govern contracts, cooperative agreements, or grants. They (1) permit a deregulation of the government research and development system and allow rules and regulations to be applied by agreement on a selective basis if deemed to add value and (2) allow significant flexibility in negotiating terms and conditions with recipients. They are, however, subject to certain laws that have general applicability, such as civil rights and trade secret statutes.

With the signing of two other transaction instruments (one for each development contractor), the Air Force intends to concurrently (1) award one or two firm-fixed-price initial launch service contracts for 30 or more satellite launches that are to occur during fiscal years 2002 through 2005 and (2) execute leasing, licensing, and base support agreements for launch site and facility use. According to the Air Force, this approach is intended to establish an interdependency among the instruments, contracts, and agreements to better ensure that a full family of vehicles—medium-lift, intermediate-lift, and heavy-lift—is developed. The Air Force believes that the contractors would not develop this family of vehicles if the contractors were not concurrently obligated to provide a full range of launch services.

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## Results in Brief

DOD's goal in acquiring the Evolved Expendable Launch Vehicle system is to reduce recurring production and launch costs by at least 25 percent (in fiscal year 1995 dollars) for fiscal years 2002 through 2020 from the costs that would be incurred if the existing Delta, Atlas, and Titan launch

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<sup>1</sup>From a federal government perspective, standard business arrangements use (1) contracts, which are characterized as acquisition instruments to acquire goods and services for the direct benefit of the government or (2) cooperative agreements and grants, which are characterized as assistance instruments to stimulate or support a public purpose, rather than to acquire goods or services for the government. "Other transactions" are referred to as nonstandard business arrangements and are characterized as either (1) assistance instruments to carry out research projects or (2) acquisition instruments to carry out prototype projects directly relevant to weapons or weapon systems.

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vehicles were used. Using DOD's methodology, we estimated that the program would exceed the 25-percent goal. However, the number, type, and timing of launches specified in the vehicle's mission model have continued to fluctuate, making a cost reduction estimate, based on the model, uncertain.<sup>2</sup> The major reasons for the fluctuations were that (1) satellites were assigned to the wrong type of launch vehicle, (2) launch requirements were unverified, and (3) satellite downsizing has changed launch requirements. The Air Force is in the process of developing a new launch cost baseline and cost reduction estimate, based on the most current EELV mission model, in preparation for the DOD milestone II review in June 1998.

More importantly, the Air Force's recurring cost methodology does not adequately measure the economic benefits of the program. The reason is that nonrecurring investment costs, which DOD plans to incur to develop the system in order to achieve a cost savings, are not included. The standard criterion for deciding whether a government program can be justified on economic principles—the primary purpose of this program—is net present value, which would include both recurring and nonrecurring costs and the time value of money.<sup>3</sup> DOD has not yet officially performed a net present value analysis and has not identified all government costs to do so. For example, DOD has not identified the amount of independent research and development costs related to the system that the contractors could charge, through an overhead rate, to government contracts.<sup>4</sup> Each contractor could invest between \$800 million and \$1.3 billion, a portion of which could be reimbursed by the government. Until the government's total costs are determined, the net program savings will be unknown.

The use of other transaction instruments for Evolved Expendable Launch Vehicle development will challenge DOD in determining how best to protect the government's interests. The reason is that (1) in general, other transaction instruments are not subject to federal procurement laws or regulations and lack prescribed guidance from DOD and (2) specifically, the

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<sup>2</sup>This mission model extrapolates launches for fiscal years 2011 through 2020 based on the Air Force Space Command's national mission model, which is a long-range, semiannual, requirements plan that projects U.S. space launches through 2010.

<sup>3</sup>Net present value is computed by assigning monetary values to benefits and costs, discounting future benefits and costs using an appropriate discount rate, and subtracting the sum total of discounted costs from the sum total of discounted benefits. See Office of Management and Budget Circular No. A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs.

<sup>4</sup>Independent research and development is defined as a contractor-initiated, -funded, and -managed technical effort that (1) consists of projects falling within the areas of basic and applied research, development, and systems, and other concept formulation studies and (2) is not sponsored by, or required in performance of, a government contract or grant.

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use of such instruments for prototype projects are relatively new. The two proposed instruments (one to each contractor), with a government cost share of \$500 million each, could be among the largest other transactions for prototype projects, in terms of dollar value, that DOD will have negotiated. In December 1996, the Under Secretary of Defense for Acquisition and Technology provided some criteria for the use of such instruments for prototype projects in what he characterized as a relatively unstructured environment. More recently, the DOD Inspector General (1) expressed concern about the lack of controls over the other transaction process, including the lack of government audit authority, and (2) emphasized the need for DOD to issue regulations on the use of these instruments, as required by 10 U.S.C. 2371(g). The significance of the proposed cost share and the lack of DOD regulations for other transactions increase the fiduciary responsibility of DOD officials who are authorized to negotiate and monitor such instruments.

Risks are inherent in the program. Under DOD's revised acquisition approach, the contractors are not willing to guarantee system performance because their financial risk would be open ended and DOD's investment would be limited. Despite this position, the Air Force is counting on the contractors to provide launch services to satisfy the government's requirements, based on their financial interest in a growing commercial market for launch services. If this scenario is not fulfilled, the government could face some risk of not having its launch requirements satisfied. In addition, Air Force planning documentation states that the primary program risk is in meeting launch site facility preparation schedules. Other Air Force planning documentation shows the continued use of certain launch facilities for several months after the facilities are scheduled to undergo site preparations for the vehicle.

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## **Analysis of Recurring Costs Is Not the Preferred Measure of EELV Program Savings**

DOD's goal of reducing the cost of launching satellites into space is measured in terms of recurring production and launch costs. However, fluctuations in the contents of the EELV mission model make the results of analyses, based on the model, uncertain. More importantly, the methodology itself is inadequate for measuring potential program savings because it does not include the investment costs that DOD plans to incur in EELV system development to achieve cost savings. A net present value (NPV) analysis, which would use total program costs, is preferred.

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## Methodology Used for Measuring Recurring Cost Reduction

The Air Force's methodology for measuring recurring cost reduction is described in the following way: EELV recurring costs, meaning production and launch costs, should be a minimum of 25 percent less, with an objective of 50 percent less, than the recurring costs of using existing expendable launch vehicles—the Delta, Atlas, and Titan class systems. To measure this goal, estimated recurring costs for the EELV system, which are provided by the competing contractors, are subtracted from the equivalent recurring costs for existing vehicles, which is known as the launch cost baseline. These costs are based on projected government launch requirements for fiscal years 2002 through 2020. The launches from 2011 through 2020 are extrapolations, therefore less certain, and are done solely for EELV program purposes.

To illustrate this methodology, we estimated the launch cost baseline for existing launch vehicles to be about \$15.4 billion (in fiscal year 1995 dollars) by using a total of 164 launches through fiscal year 2020.<sup>5</sup> If the minimum 25-percent cost reduction goal were achieved, the estimated savings would be about \$3.9 billion through fiscal year 2020; if the objective 50-percent cost reduction goal were achieved, the estimated savings would be about \$7.7 billion for the same period.

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## Fluctuations in Mission Model Contents Make Cost Savings Uncertain

Since program inception in 1995, the total number, type, and timing of launches contained in the Air Force's EELV mission model have fluctuated considerably, making a cost reduction estimate, based on the model, uncertain. The major reasons for the fluctuations were (1) assignment of satellites to the wrong type of launch vehicle, (2) inclusion of unverified launch requirements, and (3) reductions in the number of heavy-lift launches because of satellite downsizing. The total number of launches has varied from 169 to 204, with the current Air Force estimate at 183. The most significant fluctuations occurred for fiscal years 2011 through 2020.

A credible EELV mission model is fundamental to assessing the program's principal stated purpose—reducing recurring production and launch costs. Because the mission model is also provided to the development contractors to estimate EELV costs, its accuracy is essential for an assessment of initial launch service costs. In commenting on a draft of this report, DOD stated that the Air Force is in the process of developing a new launch cost baseline, built around the most current EELV mission model, in preparation for the milestone II review.

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<sup>5</sup>See appendix I for how we derived at 164 launches.

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On the basis of 164 launches, we estimated that the reduction in recurring costs through 2020 would be about \$5.7 billion (in fiscal year 1995 dollars), or 37 percent. Although our estimate exceeds the minimum EELV program goal of 25 percent, there is still uncertainty regarding this estimate because of persistently questionable launch requirements.

Fluctuations in the number of launches can also have a significant effect on the launch cost baseline of existing vehicles. Heavy-lift vehicle costs are particularly sensitive to quantity changes because the cost to launch a Titan IV can decrease substantially as the number of launches decreases, depending on when the launches occur. Although such a cost decrease initially appears counter-intuitive, it is because of the high cost associated with operating and maintaining Titan IV launch capabilities. For example, an Air Force analysis shows that the nine Titan IV launches currently in the mission model would cost about \$473 million each, or \$4.3 billion, but seven launches would cost about \$395 million each, or \$2.8 billion. Thus, two Titan IV launches could change the launch cost baseline by \$1.5 billion. The overall effect would be to lower the savings from 37 percent to 32 percent. Given this degree of cost sensitivity, a credible mission model is essential.

A detailed listing of the composition and fluctuations in the EELV mission model is shown in appendix I.

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### Methodology Is Inadequate for Measuring Potential Program Savings

Although measuring a reduction in recurring costs is one method of assessing potential program savings, this method is inadequate because it does not include nonrecurring investment costs that DOD plans to incur to achieve cost savings. The standard criterion for deciding whether a government program can be justified on economic principles is NPV, which would include both recurring and nonrecurring costs, as well as the time value of money. Programs with positive NPVs are generally preferred whereas programs with negative NPVs should generally be avoided.

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### All Government Costs Not Available for NPV Analysis; Thus, Savings Are Unknown

Our initial NPV analysis showed that DOD would achieve a positive return on its investment in the EELV program. However, our analysis does not include all government costs because the total development costs are unknown. DOD does not know the total costs because the effect of reimbursing the competing contractors for their independent research and development (IR&D) costs, as a result of using an other transaction instrument, has not been determined. Considering that each contractor could invest between



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\$800 million and \$1.3 billion in an EELV system, a portion of which could be reimbursed by the government, the potential program savings could be substantially lower.

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### Initial NPV Analysis Shows a Cost Savings

We performed an NPV analysis based on 164 launches. We then determined the program's net savings through 2020 using DOD's total planned development costs of \$1.4 billion, which includes \$1 billion in incremental costs starting in June 1998.<sup>6</sup> We also determined, separately, the net savings of DOD's planned \$1 billion incremental investment—\$500 million per contractor—to determine whether it was economically prudent to continue with the program.

We repeated these two approaches, based on launch projections through 2010, to eliminate the period of greater launch uncertainty that extends from 2011 through 2020. Both the Air Force Space Command's national mission model and the Department of Transportation's Commercial Space Transportation Advisory Committee's commercial mission model only make launch projections through 2010 because of uncertainties in making longer range forecasts. In addition, a shorter time period would be consistent with what an Air Force official stated was the contractors' expectations for recouping their investments.

Table 1.1 shows that the NPV, using total planned development costs, would be \$1.8 billion through 2020. Based only on the planned incremental costs starting in June 1998, the NPV would be \$2.3 billion through 2020. The analysis of incremental costs results in a larger NPV because, by definition, prior year costs are not included in the cost calculation, but the benefits remain the same. The year in which costs equal benefits (referred to as investment payback) is 2006 and 2004 for total and incremental development costs, respectively.

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<sup>6</sup>For the EELV program, the net savings would be the difference in the discounted costs to launch the satellites listed in the mission model compared with the discounted costs to launch the same satellites using existing launch vehicles.

**Table 1.1: NPV Based on Planned Total and Incremental Program Development Costs (in billions of fiscal year 1995 dollars)**

<b>Development costs</b>	<b>Fiscal year period</b>	<b>NPV</b>	<b>Percent of discounted savings<sup>a</sup></b>
Total	1995-2020	\$1.8	19
costs of \$1.4	1995-2010	\$0.7	11
Incremental	1998-2020	\$2.3	21
costs of \$1.0	1998-2010	\$1.0	14

<sup>a</sup>The percentage of savings represents the change between the discounted launch cost baseline and the discounted EELV costs. The NPV analysis for incremental costs also reflects \$200 million in planned program office costs.

Also, table 1.1 shows the NPV based on a shorter time period. If total planned development costs were considered, the NPV would be \$693 million through 2010. If incremental costs only were considered, the NPV would be \$984 million through 2010. The investment payback for both calculations also would be 2006 and 2004, respectively.

Regarding DOD's \$1 billion incremental investment cost, Air Force officials informed us that they determined this amount in two ways. First, they estimated that government launches will represent about one-third of the U.S. commercial launch market and that the investment amount should be proportionate to this market. Therefore, about \$500 million a contractor, or one-third of about \$1.5 billion estimated per contractor to develop its version of the EELV system, was considered reasonable. Second, the officials stated that the contractors advised the Air Force that about \$500 million each was needed to ensure a competitive corporate rate of return on investment. The officials stated that without the DOD investment, the contractors would not develop an EELV system to meet the full range of DOD's launch requirements or within the planned time period to transition from existing vehicles to an EELV.

Using NPV analysis, the net program benefits are positive when these planned incremental costs are considered. Such an analysis for an EELV system should be positive, given that DOD's primary program objective is to actively reduce costs and not simply break even on its investment. However, DOD does not know what its total costs will be because the effect of reimbursing the competing contractors for their IR&D costs, as discussed in the following section, has not been determined. Until the total costs are determined, the net program savings will be unknown.

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## Contractors' IR&D Could Affect DOD's Expected Savings

As a matter of policy, DOD recognizes contractor costs incurred for IR&D projects as a necessary cost of doing business and considers the projects as a valuable contributor to DOD's overall research and development effort. Generally, when a contractor charges an allowable cost to IR&D, the cost is accumulated as overhead and later applied as an overhead rate to government contracts. According to an Air Force document, IR&D costs could include, under Federal Acquisition Regulation 31.205-18(e), the costs contributed by the contractors for work under the EELV other transactions instrument.

Air Force and EELV contractor representatives have discussed charging all or a portion of the contractors' share of planned EELV development costs to IR&D. In addition, Air Force documentation indicated that the value of prior research and development funded projects could be part of the contractors' IR&D efforts. As stated in our March 1996 report on acquiring DOD research by nontraditional means, accepting the value of prior research in lieu of concurrent financial or in-kind contributions may not accurately depict the relative financial contributions of the parties. (The scope of the report did not include prototype projects.)<sup>7</sup> In May 1996, the Senate Committee on Armed Services provided clarifying comments on the use of other transactions authority for research (not prototype projects) under 10 U.S.C. 2371. It stated that

“. . . the committee intended that the sunk cost of prior research efforts not count as cost-share on the part of the private sector firms. Only the additional resources provided by the private sector needed to carry out the specific project should be counted.”<sup>8</sup>

The amount of IR&D costs associated with the EELV program has yet to be resolved within DOD. According to a DOD representative, the amount could be quite high, considering that each contractor could invest between \$800 million and \$1.3 billion. To the extent that IR&D costs would be reimbursed by the government, the result would be to decrease the EELV contractors' investment and reduce the government's savings. An Air Force document indicates that it is important to determine the IR&D amount in order to reduce the risk of a dispute regarding the allowance of such costs. The usual means of doing this under a contract is with an advance agreement. Determining the amount also would assist DOD in performing an NPV analysis to estimate EELV program savings.

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<sup>7</sup>DOD Research: Acquiring Research by Nontraditional Means (GAO/NSIAD-96-11, Mar. 29, 1996).

<sup>8</sup>National Defense Authorization Act for Fiscal Year 1997, Committee on Armed Services, U.S. Senate Report 104-267, May 13, 1996, pp. 313-314.

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## Revised Acquisition Approach Contains Challenges, Risks, and Benefits

The use of a relatively new acquisition method, called other transactions, will challenge DOD in determining how best to protect the government's interests. Also, risks are inherent in the program because of (1) DOD's plan to limit its investment and the contractors' resulting unwillingness to guarantee a system to meet the government's launch requirements and (2) a chance that certain launch facilities may not be available as currently scheduled. However, to the extent that the risks can be mitigated, the primary program benefit is expected to be reduced costs to the government.

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## Other Transaction Instruments Will Challenge DOD to Protect Government's Interests

Initially, under DOD's revised acquisition approach, the Air Force planned to award firm-fixed-price contracts to both EELV contractors for the development effort. However, after the Air Force released a draft request for proposal in late November 1997, EELV program officials stated that both contractors were unwilling to accept firm-fixed-price contracts.<sup>9</sup> According to these officials, the contractors' unwillingness was because of the resulting risk to corporate financing—a situation whereby the contractors' long-term contractual liability would require committing their share of EELV development costs in advance.

As a result, the Air Force is proposing to use other transaction instruments, instead of standard government contracts, to develop the EELV system. The specific other transactions authority cited by the Air Force is section 845 of the National Defense Authorization Act for Fiscal Year 1994 (P.L. 103-160, Nov. 30, 1993), as modified by section 804 of the National Defense Authorization Act for Fiscal Year 1997 (P.L. 104-201, Sept. 23, 1996). These sections provide DOD with authority, under 10 U.S.C. 2371, to carry out prototype projects that are directly relevant to weapons or weapon systems proposed to be acquired or developed by DOD. The authority, however, is very broad because it includes not only prototype systems but also lesser projects such as subsystems, components, and technologies. Also, the authority is temporary, expiring on September 30, 1999.

In December 1996, the Under Secretary of Defense for Acquisition and Technology notified the secretaries of the military departments and the directors of defense agencies about the use of other transaction instruments for prototype projects. He mentioned the flexibility associated with using such instruments as alternatives to contracts, listing 19 statutes

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<sup>9</sup>Firm-fixed-price contracts place maximum risk and full responsibility on the contractor for all costs and resulting profit or loss.

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that apply to contracts, but which are not necessarily applicable to other transactions. He emphasized that the use of such instruments should incorporate good business sense and appropriate safeguards to protect the government's interest, including assurances that the cost to the government is reasonable, the schedule and other requirements are enforceable, and the payment arrangements promote on-time performance. He also emphasized that DOD officials who are delegated the authority to use such instruments should have the level of responsibility, business acumen, and judgment to enable them to operate in this relatively unstructured environment.

In a March 1997 report, the DOD Inspector General's office identified problem areas in awarding and administering other transactions. The office reviewed 28 randomly selected other transactions valued at \$1.2 billion that were issued by the Defense Advanced Research Projects Agency—4 were section 845/804 prototype projects and 24 were for research. In general, the report stated that no guidance existed for (1) evaluating proposed contributions, (2) monitoring actual research costs, or (3) including an interest provision in other transaction instruments.<sup>10</sup>

In March 1998, the Inspector General testified about a continuing concern regarding the lack of controls over the other transaction process since normal rules and procedures generally do not apply.<sup>11</sup> The Inspector General emphasized that although 10 U.S.C. 2371 requires the Secretary of Defense to issue regulations on other transactions, none have been published. On the basis of the 1997 report, the Inspector General stated that there is a need to (1) ensure that cost-sharing arrangements are honored, (2) monitor the actual cost of work against the funds paid, (3) place funds advanced to recipients into an interest bearing account until used, and (4) standardize the audit clause. She also testified that a more current review of 78 other transactions had found problems similar to those in the 1997 report.

With regard to an audit clause, the Under Secretary of Defense for Acquisition and Technology identified 10 U.S.C. 2313 in his December 1996 memorandum as being an inapplicable statute for other transactions. This statute provides audit authority to a defense agency awarding certain

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<sup>10</sup>Award and Administration of Contracts, Grants, and Other Transactions Issued by the Defense Advanced Research Projects Agency (DOD Inspector General Report No. 97-114, Mar. 28, 1997).

<sup>11</sup>Statement of Eleanor Hill, DOD Inspector General, before the Subcommittee on Acquisition and Technology, Committee on Armed Services, U.S. Senate, Mar. 18, 1998.

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types of contracts and to the Comptroller General for defense contracts awarded other than through sealed bid procedures. Safeguards, such as government audit authority, that are common to government contracting would not be available under other transaction instruments unless such authority was negotiated as part of the instrument. An official of the Inspector General's Office of General Counsel emphasized the importance for the government to be able to verify and audit certain aspects of other transactions. He stated that a prudent business practice would provide for audits to verify contribution valuation, cost share, performance milestones, and final costs.

In commenting on our draft report, DOD stated that because (1) the government is providing funding to private contractors to develop a commercial item and (2) the government's funding is significantly less than the contractors' funding, the contractors do not intend to provide, and the government does not expect to get, visibility into corporate investment and financing. DOD stated that this unique situation is not reasonably subject to audit requirements that generally apply to contracts. DOD, instead, emphasized the importance of government insight into the contractors' development efforts, stating that a methodology will be established to audit the accomplishment of milestones prior to disbursing funds.

The amount of government funds planned to be used to develop the EELV system through other transaction instruments raises a question of materiality. There are indications that most of DOD's other transactions for prototype projects, historically, have been relatively small in dollar value. For example, the Inspector General testified that for fiscal years 1990 through 1997, she believed that 59 other transaction agreements for prototype projects were valued at \$837 million. Although no cost-sharing breakout between the government and the recipient was provided, the average value per agreement was about \$14 million. In a DOD report on cooperative agreements and other transactions entered into during fiscal year 1997 that was submitted to the congressional defense authorizing committees, we noted that of 50 other transactions for prototype projects, the government's contribution on the largest 1 was \$60 million. These data contrast sharply with DOD's intentions to negotiate two EELV other transaction instruments with a government contribution of \$500 million each. The significance of these proposed amounts and the lack of DOD regulations for other transactions not only increase the fiduciary responsibility of DOD officials who are authorized to negotiate such

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instruments but also may necessitate that some degree of government audit authority be established.

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## Program Risks Are Inherent

According to Air Force documents, the two contractors are not willing to guarantee system performance under a firm-fixed-price contract or an other transaction instrument for EELV development. This unwillingness is because DOD's financial risk is to be capped at \$500 million per contractor, while the contractors' financial risk would be an open-ended commitment. As a result, the contractors would only agree to provide a "best effort" in developing the EELV system, meaning that they would not guarantee a launch vehicle capability to meet the government's requirements.

One DOD representative indicated a possible inconsistency between such a system development agreement and the expectation that the contractors would subsequently deliver fully functional launch services. Such an inconsistency could create a risk to the government of not satisfying its launch requirements. However, the Air Force is relying on the contractors being motivated by a compelling financial interest in an expected lucrative international commercial launch services market. Also, the Air Force intends to negotiate performance-based milestones that represent significant activities under the development effort and to pay the contractors based on completing each milestone. In the case of nonperformance, the Air Force should withhold payment because no payment would be earned.

In our June 1997 report on the EELV program, we identified three factors that could create a risk in achieving a smooth launch facility transition at the Cape Canaveral and Vandenberg launch ranges in Florida and California, respectively.<sup>12</sup> They were (1) conflicts associated with existing facilities that the contractors expected to use or that would be affected by an EELV system, (2) completion of environmental regulatory requirements before funds can be committed to engineering and manufacturing development, and (3) the amount of time needed for facility modification and new construction. We did not reassess these factors for this report; however, current Air Force planning documentation identifies meeting launch site facility preparation schedules as the primary program risk. The reason is that construction must begin shortly after the milestone II decision in June 1998 to support the first EELV launch in fiscal year 2002. Other Air Force planning documents show the continued use of certain

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<sup>12</sup>Access to Space: Issues Associated With DOD's Evolved Expendable Launch Vehicle Program (GAO/NSIAD-97-130, June 24, 1997).

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launch facilities for several months after they are scheduled to undergo site preparations for EELV. In commenting on our draft report, DOD cited a Titan IV launch complex as an example.

We also reported on vehicle propulsion, systems integration, and software as technical risk factors that could adversely affect program cost and schedule goals. Current Air Force documentation also identifies these three factors as risks common to both contractors and indicates that mitigation efforts are underway.

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## Program Benefits Are Expected

The primary benefits to the EELV program are expected to culminate in lower costs, whether they are measured in terms of recurring production and launch costs or NPV. Before revising its acquisition approach, DOD was planning on a natural synergy between the federal government and the commercial space industry because of a common requirement for space launch. In our June 1997 EELV report, we discussed DOD's interest in seeing the EELV used for commercial purposes in order to expand the customer base and help lower costs. At that time, DOD was planning to pay for all development costs—about \$1.5 billion—but the contractors indicated a willingness to invest in EELV development. We recommended that the Secretary of Defense devise a cost-sharing mechanism for EELV development to help reduce the government's investment, particularly in view of the expected compensating benefits to the winning contractor to enhance its competitive position in the international commercial launch services market.

In July 1997, the House Committee on Appropriations noted that while partners share benefits, they also share costs, and it suggested that the Air Force aggressively pursue commercial cost sharing.<sup>13</sup> In August 1997, DOD responded to our report by agreeing with the recommendation and stating that the cost-sharing issue would be reviewed as the acquisition strategy was developed over the next 12 months. In September 1997, the Conference Committee on the fiscal year 1998 DOD appropriations bill suggested that the Air Force require a successful bidder to share in the EELV development cost.<sup>14</sup> In November 1997, when DOD approved the Air

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<sup>13</sup>DOD Appropriations Bill, 1998, Report of the Committee on Appropriations, House of Representatives Report 105-206, July 25, 1997, p. 202.

<sup>14</sup>Making Appropriations for the Department of Defense for the Fiscal Year Ending September 30, 1998, and for Other Purposes, Committee of Conference, House of Representatives Report 105-265, Sept. 23, 1997, pp. 128-129.



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Force's proposal to revise the acquisition strategy, contractor cost sharing was one of the requirements.

With the Air Force's proposal for the government's share to not exceed \$1 billion for the two contractors, about \$500 million in DOD development costs were expected to be avoided, based on the original \$1.5 billion estimate. However, this cost avoidance will be reduced by the need to acquire two additional launches with procurement funds under the initial launch services contracts. The Air Force had originally planned to acquire these two launches for test purposes using development funds. Thus, the net cost avoidance is expected to be about \$295 million, with the remaining \$205 million to be shifted to a procurement account.

In our March 1996 report on DOD research by nontraditional means, we discussed the importance of leveraging the private sector's financial investment by using other transactions and cooperative agreements. In doing so, DOD can first stretch its research and development funds by having commercial firms contribute to the cost of developing technologies with both military and commercial applications. Second, cost sharing is appropriate and a matter of fairness when commercial firms expect to benefit financially from sales of the technology. Third, a cost-sharing arrangement demonstrates a commitment to the project, enabling less rigid government oversight requirements. These three elements appear to exist in the case of the revised EELV acquisition approach.

Air Force officials emphasized that more recent information regarding the projected growth in the commercial launch services market, primarily based on the expected growth in commercial communication satellites, was a key factor in revising the EELV acquisition approach. The recent projection contrasts sharply from DOD's 1994 space launch modernization plan whereby the commercial market was not considered to be nearly as promising. As a result, the Air Force concluded that this growing market was sufficient to support two EELV contractors, instead of one. Two contractors would ensure more effective competition for future government launch requirements and would result in a change from cost-based contracting to price-based contracting, using the commercial market for launch services.

In its November 1994 implementation plan for national space transportation policy, DOD envisioned that the EELV system would (1) maximize common systems and components to reduce procurement costs and enhance production rates and (2) decrease the number of launch

complexes, launch crews, and support requirements to reduce operations costs. Although the gains envisioned may not be as large because two contractors are to be supported, the Air Force is still expecting standardization—launch pads configured for all EELV sizes (medium-lift, intermediate-lift, and heavy-lift) and standard payload-to-vehicle interfaces—that should help reduce overall costs and achieve more efficient launch operations than with existing vehicles. In addition, the availability of two launch vehicle manufacturers that use standard payload interfaces would better ensure that government satellites are launched if one contractor's fleet of vehicles were grounded.

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## Conclusions

DOD's revised EELV acquisition approach represents a significant departure from the standard government procurement approach. The revision was brought about primarily because commercial interests are expected to dominate the worldwide space launch service market. When making its investment decision in the EELV system, DOD should apply a market-oriented approach, using NPV analysis, to ensure that expected savings are suitable, including consideration for unforeseen future costs. This approach would help protect the government's interests and be consistent with the EELV program goal of reducing the cost of launching satellites into space.

The means by which DOD intends to negotiate an agreement with the competing contractors—other transaction instruments—calls for specific guidance to govern the EELV development effort. Such guidance is particularly important considering the general lack of DOD regulations on the use of such instruments. It is also important considering the high-dollar EELV development program that is to be executed in what is characterized as a relatively unstructured environment.

Assuming that the challenge in using other transaction instruments can be met and program risks can be overcome, the primary benefits associated with the EELV system should be reduced costs to the government. Reduced costs would include lower (1) short-term nonrecurring costs by forming a cost-sharing partnership with space industry contractors to develop a product that has mutual benefits for the government and commercial space launch sectors and (2) long-term recurring costs by designing a family of common launch vehicles, standardizing launch facilities and payload interfaces, and establishing price-based competition between two contractors for future launch services.

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## Recommendations

To protect the government's interest, and to be consistent with entering a business partnership with launch industry contractors for EELV development, we recommend that the Secretary of Defense take steps to ensure that an NPV analysis of the program is performed before making a milestone II decision. The analysis should include (1) DOD's total planned incremental investment costs for development, (2) the most current EELV costs from the contractors' proposals and DOD's estimate for launch services, and (3) a time period for which launch requirements can be verified and reasonably forecasted. The Secretary should (1) establish criteria for judging the results of the analysis that would provide a suitable margin for discounted savings and unforeseen future costs and (2) determine the amount of IR&D costs that need to be factored into the analysis. If the results of the NPV analysis do not meet the criteria, we recommend that the Secretary review the program to either (1) reduce the amount of the government's planned incremental investment or (2) rejustify the program on a basis other than cost reduction.

Because DOD has not prescribed regulations for other transactions, as required under 10 U.S.C. 2371(g), we recommend that the Secretary review the Air Force's planned use of other transaction instruments for EELV development to ensure that the government's interest is protected. Consideration should be given to (1) the criteria expressed by the former Under Secretary of Defense for Acquisition and Technology and (2) the DOD Inspector General's concerns regarding the other transactions process, including some degree of government audit authority.

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## Agency Comments

DOD agreed with our recommendation to perform a NPV analysis. DOD stated that such an analysis (1) was a more appropriate affordability measure for determining EELV program viability than the financial analysis performed to date and (2) would be presented during the milestone II decision process. DOD did not specify how the analysis would be used to support the decision. Our intent was to emphasize the importance of using such an analysis as a rigorous means of measuring economic benefits to the government, considering the unique business arrangement DOD is planning with launch industry contractors.

DOD also agreed with our recommendation concerning protection of the government's interest in the use of other transaction instruments for EELV development. DOD stated that adequate visibility into the contractors' progress would be obtained by a clause in the development agreements to provide insight into technical and schedule performance—for example, to

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verify the accomplishment of milestones prior to payment. Regarding the issue of government audit authority, or oversight, DOD differentiated between (1) other transactions for research projects that have a statutory requirement for cost sharing by the recipients to the extent the Secretary of Defense determines practicable and (2) other transactions for prototype projects, that have no such statutory requirement, thus leaving the determination of a fair and reasonable amount of government development funding for the EELV program up to the contracting officer.

Collectively, these statements imply that some degree of government audit authority may not be needed for the EELV program. Given that such matters are negotiable, our intent was to stress the importance of the Secretary of Defense giving due consideration to some degree of government audit authority because of the (1) significant amount of government development funds planned to be used for EELV and (2) lack of DOD regulations on the use of other transactions for either prototype projects or research.

DOD's comments on a draft of this report are reprinted in their entirety in appendix II. DOD also provided clarifying comments, which we have incorporated, as appropriate.

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## Scope and Methodology

To evaluate the Air Force's plans and progress in developing the EELV system, we examined acquisition planning documents, budget information, cost assessment methodologies, launch requirements, and information related to other transaction authority and guidelines.

We performed our work primarily at the Air Force Space and Missile Systems Center in El Segundo, California. We held discussions with representatives of the Office of the Secretary of Defense, the Department of the Air Force, the National Aeronautics and Space Administration (NASA), the Federal Aviation Administration, Washington, D.C., and the Air Force Space Command, Colorado Springs, Colorado. We acquired limited launch requirement information from the National Reconnaissance Office, Chantilly, Virginia. In addition, we held discussions with private industry representatives from Lockheed Martin Telecommunications, Sunnyvale, California, and Space Systems/Loral, Palo Alto, California; The Boeing Company, Huntington Beach, California; Hughes Space and Communications International, Inc., Los Angeles, California; and TRW Space and Electronic Group, Redondo Beach, California.

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Because we noted considerable fluctuations in the contents of the Air Force's EELV mission model during the past 2 years, we adjusted the latest mission model data based on discussions with Air Force satellite program office representatives and NASA representatives and a review of satellite program documentation. Specifically, we excluded 19 NASA and classified launches because they were not fully justified. We used the adjusted mission model data to analyze recurring costs and to perform an NPV analysis.

In performing our recurring cost analysis, we obtained current production and launch costs for Delta, Atlas, and Titan launch vehicles from the respective launch program offices. We obtained EELV production and launch costs from the EELV program office, which were based on contractors' proposals and the Air Force's evaluation during selection of the two contractors in 1996. (The Air Force is currently revising EELV cost estimates in preparation for the milestone II decision in June 1998.)

In performing our NPV analysis, we used our adjusted mission model data and the data we obtained for our recurring cost analysis. In addition, we obtained DOD's planned investment costs based on a combination of congressional appropriations and funds programmed by the Air Force for EELV development. We used the real discount rate of 3.7 percent, adjusted for forecasted inflation, based on marketable Treasury debt with maturity comparable to that of the EELV program.

We performed our review between August 1997 and April 1998 in accordance with generally accepted government auditing standards.

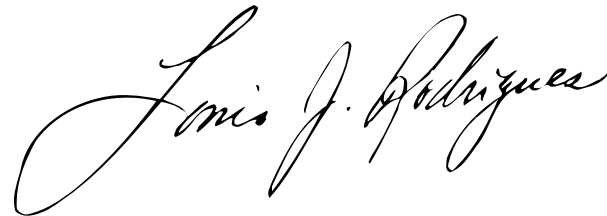
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We are sending copies of this report to the Ranking Minority Member, Subcommittee on National Security, House Committee on Appropriations; the Chairmen and Ranking Minority Members of the House Committee on National Security; and the Chairmen of the Senate Committee on Armed Services and the Subcommittee on Defense, Senate Committee on Appropriations. We are also sending copies to the Secretary of Defense and the Director, Office of Management and Budget. We will make copies available to others upon request.

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If you or your staff have any questions concerning this report, please call me on (202) 512-4841. Major contributors to this report are listed in appendix III.

Sincerely yours,

A handwritten signature in black ink that reads "Louis J. Rodrigues". The signature is written in a cursive style with a large, looping initial "L".

Louis J. Rodrigues  
Director, Defense Acquisitions Issues

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## Abbreviations

DOD	Department of Defense
EELV	Evolved Expendable Launch Vehicle
IR&D	independent research and development
NASA	National Aeronautics and Space Administration
NPV	net present value
SBIRS	Space-Based Infrared System



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# Composition and Fluctuations in EELV Mission Model

Since program inception in 1995, the total number of launches contained in the Air Force's Evolved Expendable Launch Vehicle (EELV) mission model has fluctuated from 171 to 194 to 204 to 169 to 183. The types of launch vehicles—medium-lift, intermediate-lift, and heavy-lift—and the timing of launches have also varied. The composition of, and fluctuations within, the model, including our adjusted model are shown in table I.1.

**Table I.1: Air Force EELV Mission Model and Our Adjusted Model**

Type of launch vehicle	Satellite system	Dec. 1995	Sept. 1996	July 1997	Mar. 9, 1998	Mar. 24, 1998	Our adjusted model
Medium	Space test satellites	7	6	6	5	5	5
	GPS	55	53	53	40	56	56
	DMSP	4	4	5	4	4	4
	NPOESS	9	9	8	6	5	5
	NASA satellites	6	7	3	2	2	0
	NASA-Discovery	9	9	5	5	5	0
	SBIRS-LEO	0	28	0	9	9	9
<b>Subtotal</b>		<b>90</b>	<b>116</b>	<b>80</b>	<b>71</b>	<b>86</b>	<b>79</b>
Intermediate	DSCS	2	2	2	2	2	2
	SBIRS-GEO	16	15	14	10	10	10
	SBIRS-LEO	0	0	29	0	0	0
	Advanced MILSATCOM	21	21	20	21	20	20
	Mission A/B/E	25	25	50	56	56	44
<b>Subtotal</b>		<b>64</b>	<b>63</b>	<b>115</b>	<b>89</b>	<b>88</b>	<b>76</b>
Heavy	Mission C/D	17	15	8	8	8	8
	DSP	0	0	1	1	1	1
<b>Subtotal</b>		<b>17</b>	<b>15</b>	<b>9</b>	<b>9</b>	<b>9</b>	<b>9</b>
<b>Total</b>		<b>171</b>	<b>194</b>	<b>204</b>	<b>169</b>	<b>183</b>	<b>164</b>

#### LEGEND

DMSP = Defense Meteorological Satellite Program  
DSCS = Defense Satellite Communications System  
DSP = Defense Support Program  
GPS = Global Positioning System  
MILSATCOM = Military Satellite Communications  
Mission A/B/C/D/E = Classified programs  
NPOESS = National Polar-orbiting Operational Environmental Satellite System  
SBIRS-GEO = Space-Based Infrared System-Geosynchronous Earth Orbit  
SBIRS-LEO = Space-Based Infrared System-Low Earth Orbit

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## Types of Vehicles

The number of medium-lift vehicles has fluctuated from 90 to 116 to 80 to 71 to 86. The major reasons were (1) incorrect assignment of 29 Space-Based Infrared System (SBIRS)-Low satellites for launch on intermediate-lift vehicles in the July 1997 model, rather than medium-lift vehicles; (2) a decision that after 2010, SBIRS-Low satellites would be launched on an existing commercial launch vehicle system, called Athena, which is smaller than a medium-lift EELV, and (3) the omission of 16 Global Positioning System satellites from the March 9, 1998, model.

The number of intermediate-lift vehicles has also fluctuated, from 63 to 115 to 89. The major reasons were (1) the incorrect assignment of 29 SBIRS-Low satellites for launch on intermediate-lift vehicles rather than medium-lift vehicles and (2) adding 31 classified satellites, of which 12 were not included in a launch summary document and were considered unverified requirements, according to Air Force Space Command representatives.

The number of heavy-lift vehicles has decreased almost 50 percent, from 17 to 9. The major reason was because of downsizing the number of satellites. This downsizing was stimulated by the high cost of launching heavy payloads on the Titan IV launch vehicle.

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## Our Adjusted Mission Model

On the basis of our analysis, we identified 164 satellite launches from 2002 through 2020. We determined these launches through discussions with Air Force satellite and launch vehicle program office representatives and National Aeronautics and Space Administration (NASA) representatives and from satellite program documentation.

Compared with the Air Force's March 24, 1998, EELV mission model, our adjusted model excluded seven NASA launches because NASA plans to downsize the satellites associated with these seven launches and use vehicles that are smaller than the EELV system. Our adjusted model also excluded 12 classified launches because they were considered to be optional; were not listed as launch requirements in a February 1998 launch summary; and according to Air Force Space Command representatives, were not based on validated requirements.

# Comments From the Department of Defense



ACQUISITION AND  
TECHNOLOGY

## OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON  
WASHINGTON, DC 20301-3000



MAY 14 1998

Mr. Louis J. Rodrigues  
Director, Defense Acquisition Issues  
National Security and International  
Affairs Division  
U.S. General Accounting Office  
Washington, DC 20548

Dear Mr. Rodrigues:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "EVOLVED EXPENDABLE LAUNCH VEHICLE: DoD Guidance Needed to Protect Government's Interests in Program", dated April 23, 1998 (GAO Code 707290), OSD Case #1593.

The detailed DoD comments on the draft report recommendations are provided in the enclosure. Suggested technical changes were separately provided to the GAO staff. The DoD appreciates the opportunity to comment on the GAO draft report.

Sincerely,

Gil I. Klfinger

Acting Deputy Under Secretary of Defense (Space)

Enclosure



GAO DRAFT REPORT - DATED APRIL 23, 1998  
(GAO CODE 707290) OSD CASE 1593

“EVOLVED EXPENDABLE LAUNCH VEHICLE: DoD Guidance Needed to Protect  
Government’s Interests in Program”

DEPARTMENT OF DEFENSE RESPONSES

**Recommendation #1:** To protect the Government’s interest, and to be consistent with entering a cost-sharing business partnership with launch industry contractors for the Evolved Expendable Launch Vehicle (EELV) development, the GAO recommends that the Secretary of Defense take steps to ensure that a net present value analysis of the EELV program is performed prior to making a Milestone II decision. The GAO asserted that the analysis should include (1) DoD’s total planned incremental investment costs for development, (2) the most current EELV costs from the contractors’ proposals and DoD’s estimate for launch services, and (3) a time period for which launch requirements can be verified and reasonably forecasted. In performing the analysis, the GAO also asserted that the Secretary should (1) establish criteria for judging the results of the analysis that would provide a suitable margin for discounted savings and unforeseen future costs and (2) determine the extent to which independent research and development (IR&D) that may be reimbursed by the government should be factored into the analysis. (pp 21-22/GAO Draft Report)

**DOD Response:** Concur with comments.

USD(A&T) Acquisition Decision Memorandum, dated December 11, 1996, directed that additional cost analysis be performed prior to the Milestone II decision. While the financial analysis to date has focused on percent savings / cost reduction for determining program viability, a more appropriate affordability measure is expressed in terms of Net Present Value (NPV) or Initial Rate of Return (IRR). The Air Force, in support of the Milestone II decision, will develop a Service Cost Position (SCP) which will include: 1) all Government investment in Low Cost Concept Validation (LCCV), Pre-Engineering Manufacturing Development (Pre-EMD), and Engineering Manufacturing Development (EMD), 2) the cost of launch services for launching the national mission model (NMM) through FY20, and 3) other government costs (non-contract).

In addition, the Air Force will perform additional analysis to include: 1) an EELV cost baseline (ECB) which is the total life cycle cost estimate of all LCCV, Pre-EMD, EMD, Production, and Operating & Support (O&S) costs regardless of source of funding/investment (capital financing, tax credits, IR&D, etc.) 2) a thorough investment/financial analysis to estimate fair market prices for EELV launch services; and 3) a comparison of the current launch cost baseline (LCB) (i.e. Delta, Atlas, Titan) with the EELV SCP to determine if the cost savings goal is met.

Now on pp. 16-17.

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**Appendix II**  
**Comments From the Department of Defense**

Now on pp. 16-17.

**Recommendation #2:** If the results of the net present value analysis does not meet the exit criteria, the GAO also recommended that the Secretary of Defense review the program to either (1) reduce the amount of the Government's planned incremental investment or (2) rejustify the program on a basis other than cost reduction. (p. 22/GAO Draft Report)

**DOD Response:** Concur with comments.

Affordability remains the cornerstone of the EELV program and to date all the financial analysis, including the GAO's own analysis (indicating a 37% cost reduction, page 7 of draft report) show that all the requirements will be met or exceeded. As they were at Milestone I, percent cost savings, Net Present Value (NPV) and Internal Rate of Return (IRR) values will be presented during the Milestone II decision process.

**Recommendation #3:** Because the DoD has not yet prescribed regulations for other transactions, as required by 10 U.S.C. 2371(g), the GAO further recommended that the Secretary of Defense review the Air Force's planned use of other transaction instruments for EELV development to ensure that the government's interest is protected. The GAO indicated that consideration should be given to (1) the criteria expressed by the former Under Secretary of Defense for Acquisition and Technology and (2) the DoD Inspector General's concerns regarding the other transactions process, including some degree of Government audit authority. (p. 22/GAO Draft Report)

Now on p. 17.

**DOD Response:** Concur with comments.

The OUSD(A&T) has worked closely with the Air Force in developing the EELV acquisition strategy, including aspects of the strategy that deal with protecting the government's interests. One of the government interests addressed is adequate visibility into contractor progress under the development agreement. The agreement will include a clause through which the contractor will agree to provide the government insight, into technical and schedule performance, adequate for the government's needs (e.g., verifying accomplishment of milestones prior to payment). The DoD IG concerns regarding cost-sharing and audit authority have primarily focused on other transactions for research that have a statutory requirement for cost-matching by the recipients, to the maximum extent practicable. The EELV is using an other transaction to conduct a prototype project, and is dealing with a different form of cost sharing. In the EELV situation, the contracting officer will make a determination prior to award that the amount of government funding under the other transaction is fair and reasonable.

# Major Contributors to This Report

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