OFFICE OF THE UNDER SECRETARY OF DEFENSE

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31 March 1983

POLICY

MEMORANDUM FOR THE SPACE LAUNCH POLICY WORKING GROUP MEMBERS

SUBJECT: Coordination of report on ELV Commercialization

Attached is the coordination draft of the Working Group's report on the commercialization of Expendable Launch Vehicles (ELVs) and the proposed National Security Decision Directive. Please provide your agencies' formal comments to me by noon on 7 April.

A working group meeting will be held in Room 5026 (OSTP) of the New Executive Office Building at 0930 on 8 April to review agency comments for incorporation into the final report.

The final report will be submitted to the Interagency Group (Space) by 12 April for their consideration.

Tom Maultsby

Maj T. E. Maultsby
Co-Chairman

COORDINATION DRAFT

SPACE LAUNCH POLICY WORKING GROUP

DRAFT REPORT ON

COMMERCIALIZATION OF U.S. EXPENDABLE LAUNCH VEHICLES

March 31, 1983

COORDINATION DRAFT

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Interagency Space Launch Policy Working Group Report on Commercialization of U.S. Expendable Lauanch Vehicles

Introduction

The National Space Policy encourages the expansion of United States private sector investment and involvement in civil space activities. It also identifies the Space Transportation System (STS) as the primary space launch system for U.S. Government (USG) missions. Based on the projected capabilities of the STS, the USG has begun to phase out its procurement and operation of the Expendable Launch Vehicle (ELV) systems.

The U.S. private sector has expressed interest in continuing the production and operation of these ELVs as commercial ventures. Prospective commercial ELV producers/operators are seeking policy guidance in this area from the USG. The need for a prompt response from the USG has been driven by two principal factors: a) the interested corporations must decide whether to continue ELV production as the USG orders are completed and b) the competition for the Intelsat VI class of communication satellites. The Intelsat selection of one or more launch vehicle systems will be made in the June 1983 time frame. For these reasons, timely

government action is required to provide the information the private sector needs to make business decisions.

The Space Launch Policy Working Group, (see Appendix C) was chartered by the Interagency Group (Space) to determine what the US National Space Launch Policy should be with regard to (a) the increasing foreign space launch capabilities and competition, (b) US commercial launch systems and operations, and (c) maintenance and development of a capability to satisfy USG current and projected requirements.

During the course of the study, the Working Group met with many of the companies that have expressed interest in commercial ELV operations. Their commercialization plans, business concerns, production status, assessments of the potential market, and the potential benefits to the USG and the nation were all factors in the study. The Working Group also reviewed the results of a NASA study on ELV commercialization. The impact of commercial ELV operations on the USG shuttle operations was also specifically examined.

This report is organized into four major sections. Section I presents the Working Group's principle findings and recommendations. Section II contains the proposed National Security Decision Directive. Section III

examines the factors pertinent to the USG decision on commercialization of existing U.S. ELVs. Finally, Section IV explores the issues that were addressed in developing a strategy to facilitate the commercialization of ELVs.

The Appendices contain supporting information. Appendix A provides the detailed analysis and data that supports the conclusions regarding the impacts on the USG Shuttle program of the loss of commercial and foreign payloads. Appendix B contains additional details on International Law and domestic licensing processes. Appendix C lists the Space Launch Policy Working Group members.

I. FINDINGS AND RECOMMENDATIONS

This section presents the Working Group's principal findings and recommendations.

Findings

- A US commercial ELV capability would benefit both the USG and the private sector and is consistent with the goals and objectives of the U.S. National Space Policy

- The potential increases in total cost to the USG of the STS program as a result of the loss of commercial and foreign payloads were considered minimal and were believed to be offset by the benefits of commercial ELV operations.

- International legal obligations and domestic concerns, including those relating to public safety, require the USG to authorize, supervise and/or regulate U.S. private sector space operations.

- No new legislation for the regulation of private sector space operations is required at this time.

- The use of existing licensing procedures, if streamlined, is adequate for the interim; however, as commercial launch operations develop and proliferate a revised process will be needed.

- The most effective means for the USG to ensure safe commercial ELV operations and compliance with treaty obligations is to encourage the use of existing USG launch ranges.

Recommendations

- The USG should encourage and facilitate the commercialization of US ELVs.

- Commercial ELV operators should be encouraged to use USG launch ranges.

MAY HAVE TO?

- The USG should continue to make the STS available for all types of payloads in all markets to the extent that it serves the best interests of the USG.

- **The Department of State** should be designated **as the USG lead agency** for the coordination of all commercial ELV requests. They should chair an interagency group to coordinate and define the process for the licensing, supervision and/or regulation of commercial ELV operations, to include specific government agency responsibilities.

- The USG should not subsidize the commercialization of ELVs. USG facilities and services should be made available for commercial use where practical and priced in a manner that will facilitate and encourage commercial operations. The USG should not seek to recover ELV design and development costs, or investments associated with launch facilities.

- The USG should retain priority use of facilities that are jointly shared with the private sector. Commercial operators must provide adequate insurance to reimburse the USG should they damage equipment or facilities

- The USG should (must) review and approve any proposed commercial launch facility and range and as a minimum oversee the operation of the flight safety/command destruct system.

- The USG should require commercial operators to obtain sufficient insurance to cover potential damage to third party persons and property.

II. DRAFT NATIONAL SECURITY DECISION DIRECTIVE

National Security Decision
Directive Number _____

Commercialization of Expendable Launch Vehicles

I. INTRODUCTION

The USG encourages domestic commercial exploitation of space capabilities, technology, and services for US National benefit. The basic goals of US space launch policy are to (a) optimize the management, operation, and support of the STS program so as to achieve routine, economical access to space; (b) exploit the unique attributes of the STS to enhance the capabilities of the US space program; (c) ensure a flexible and robust US launch posture to maintain space transportation leadership; (d) encourage the US private sector development of commercial launch operations.

II. POLICY FOR COMMERCIALIZATION OF EXPENDABLE LAUNCH VEHICLES

The USG fully endorses and will facilitate the commercialization of Expendable Launch Vehicles (ELV).

The USG will license, supervise, and/or regulate

US commercial ELV operations to the extent required to **meet its national and international obligations and to ensure public safety.**

The USG encourages the use of its National Ranges for US commercial ELV operations. The USG will identify and make available facilities, equipment, tooling, and services that are required to support the production and operation of US commercial ELVs.

The USG will have priority use of joint-use USG facilities and support services to meet national security needs and critical launch windows. The USG will make all reasonable efforts to minimize impacts on commercial operations.

US commercial launch operations conducted from non-USG launch facilities **must be certified** by the USG. The USG will take measures necessary to ensure **flight safety** for all launch operations from USG and US commercial launch sites.

MUST BE CERTIFIED for safety ?

The USG will price the use of its facilities, equipment, and services consistent with the goal of encouraging viable commercial ELV launch activities.

III. IMPLEMENTATION

The Department of State will be the USG focal point for all private sector contact/questions on commercial ELV activities.

The Department of State will establish and chair an interagency group to coordinate and define the process for licensing, supervision and/or regulation of commercial ELV operations, to included specific government agency responsibilities. Existing agency capabilities and expertise will be used to the maximum extent possible.

IV. RELATIONSHIP OF STS AND COMMERCIAL ELVS

Notwithstanding the USG policy to encourage and facilitate private sector ELV entry into the space launch market, the USG will continue to encourage the use of the Space Shuttle and all of its unique capabilities by all potential users.

IMPLEMENTING GUIDELINES FOR COMMERCIALIZATION
OF EXPENDABLE LAUNCH VEHICLES

A. Required Actions

NASA and DoD, for those functions over which they respectively have cognizance, shall:

1. identify data, documentation, processes, procedures, tooling, ground support equipment and facilities that are available for commercial use;

2. identify the support services and facilities necessary for commercial launches from the USG National Ranges;

3. identify the joint-use tooling, ground support equipment and facilities that the USG can make available for commercial launch operations;

4. determine the transition means and schedules for making available appropriate USG equipment, facilities and properties;

5. as requested, provide technical advice and assistance in operations;

6. negotiate and contract for, on a reasonable reimbursable basis, their portion of the USG services, facilities and equipment requested by the private sector for commercial launch operations.

B. Government Pricing Guidelines:

The price for USG facilities, equipment, and services, will be based on the following principals:

1. services should be priced based on those additional costs incurred by the USG;

2. the USG should not seek to recover ELV design and development costs or investments associated with launch facilities.

3. standard tooling, equipment and residual ELV hardware on hand at the completion of the USG's program should be priced at a fair market value or USG cost.

C. Commercial ELV Operator Requirements

1. maintain all facilities and equipment leased from the USG to a level of readiness and repair specified by the USG;

2. provide adequate insurance to cover the loss of or damage to USG owned systems, equipment, facilities used by the private sector ELV operators;

3. provide adequate insurance to cover the USG liabilties for damage to both domestic and foreign persons and property;

4. abide by range safety criteria and not hold the USG liable for damage incurred by the operator resulting from USG safety actions (e.g. command destruct);

5. agree not to hold the USG liable for losses resulting from scheduling delays related to joint-use facilities and range support services;

6. comply with applicable international, national, state, and local laws and regulations including security, safety, and environmental requirements.

III. FACTORS AFFECTING THE USG DECISION ON COMMERCIALIZATION

The development of a USG rationale for endorsing commercialization of ELVs requires a complete examination of the advantages and disadvantages to the USG of commercial ELV operations. Consideration should also be given to the existing national policies which establish a framework for any new policy recommendations. This section addresses these topics in more detail, including the U.S. private sector's perspective where appropriate. An economic analysis of the potential impacts of commercial ELVs on STS program costs is also summarized.

A. Policy Background.

The USG has examined the issue of commercialization of space and space related activities on several occasions within the last three years. The results of these government efforts are documented in National Space Policy, (National Security Decision Directive (NSDD)-42), Space Assistance and Cooperation Policy (NSDD-50), and Shuttle Orbiter Production Capability (NSDD-80). These policies concentrate on the general concept of government encouragement of private sector space activity, not on particular proposals to commercialize a specific system or capability. They establish the boundary conditions for this study of commercial ELVs. The following paragraphs provide excerpts of the policy documents as they apply to the commercialization of ELVs:

1. National Space Policy, (NSDD-42)

a. An objective of the national space program is to "...expand United States private sector investment and involvement in civil space and space-related activities."

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b. The United States encourages domestic commercial exploitation of space capabilities, technology, and systems for national economic benefit. These activities must be consistent with national security concerns, treaties, and international agreements.

c. The United States Government will provide a climate conducive to expanded private sector investment and involvement in civil space activities, with due regard to public safety and national security. Private sector space acitivties will be authorized and supervised or regulated by the government to the extent required by treaty and national security.

d. The United States Space Transportation System (STS) is the primary space launch system for both national security and civil government missions. STS capabilities and capacities shall be developed to meet appropriate national needs and shall be available to authorized users--domestic and foreign, commercial, and governmental.

e. The first priority of the STS program is to make the system fully operational and cost-effective in providing routine access to space.

f. The United States is fully committed to maintaining world leadership in space transportation with an STS capacity sufficient to meet appropriate national needs.

g. Expendable launch vehicle operations shall be continued by the United States Government until the capabilities of the STS are sufficient to meet its needs and obligations. Unique national security considerations may dictate developing special-purpose launch capabilities.

2. **Space Assistance and Cooperation Policy, (NSDD-50)**

Pertinent economic objectives established by NSDD-50 are:

a. To maximize economic benefit by:

(1) enhancement of the competitive position of the US aerospace industry;

(2) ensuring a reasonable return on the American investment in space technology; and

(3) promoting positive effects on domestic employment and our balance of payments.

b. Increased export and trade, through foreign purchases of goods and services, and through increased utilization of space and space technology.

c. To seek opportunities to enhance our overall competitive position in space technology.

d. To enhance the cost-effectiveness of space systems through increased and more effective use.

3. Shuttle Orbiter Production Capability, (NSDD-80)

"It is my (President Reagan's) intent that the full potential of the shuttle concept as originally envisioned is acheived and commercialization of space becomes a reality."

4. Summary.

These policy statements consistently reflect several points:

a. the intent to expand and encourage private sector activity with due regard to national security,

b. the need to authorize, supervise or regulate private sector space activities,

c. the intent to realize full potential of the STS concept and to use the STS as the primary space launch system for USG payloads,

d. the desire to obtain maximum economic benefit from space programs and seek enhancement of US competitivie position.

With these policies as background, the central question is whether the commercialization of U.S. ELVs contribute significantly to achieving these objectives.

B. Domestic and Foreign ELV Survey

As part of its study on commercialization of ELVs, the IG (Space) Working Group solicited the views of aerospace companies considering commercial manufacturing or operation of new or existing U.S. ELVs. The working group received formal presentations on commercial Titan from representatives of Martin Marietta, Aerojet, and United Technologies, and on commercial Atlas from representatives of General Dynamics' Convair Division. Written inputs were provided by Space Services Incorported of America (SSI) and Transpace Carriers, Inc. on the commercialization of the Delta. In all instances, no specific private sector cost data was provided because of its commercial sensitivity and the uncertainty of pricing for U.S. Government facilities and services. Each contractor also provided a specific list of benefits to the USG of commercial ELVs. Their general consensus was that commercialization of ELVs (1) would enhance national security by providing a Shuttle backup; (2) provide a domestic ELV backup to the STS and an alternative to foreign ELVs for commercial users, thereby reducing the loss of commercial payloads to foreign competitors; and (3) retain high technology industrial jobs.

1. TITAN

The Titan contractors' market assessment projects payload demand in excess of a four orbiter STS capability. Expectations are for 2 to 4 commercial Titan launches per year beginning in 1986 with a minimum of 2 flights per year required to financially break even. In addition, the

outcome of the current Intelsat VI competition for launch of 5 communications satellites in 1986-87 is considered important to the early success of a commercial Titan program. The contractors view the continued availability of a U.S. expendable launch vehicle as a needed alternative to the French-dominated Ariane launch system. The contractors have identified a program goal to provide a common payload interface for both Shuttle and commercial Titan; this would offer great flexibility as a backup to the Shuttle, and could enhance its position in the commercial market. Under the assumptions that the U.S. Government will not seek to recover sunk costs, would lease existing launch facilities and production equipment at a nominal fee, and provide U.S. Government launch range services at a fair incremental price, the contractors feel that commercial Titan can compete effectively with Ariane on a price and assured availability basis.

2. ATLAS

General Dynamics, the manufacturer of the Atlas launch vehicle, provided the most detailed world market demand projection. Their forecast shows market demand beyond the launch capability of the four orbiter STS fleet. In addition, their assessment of the world communications satellite market for 1986-1995 indicates that the current Atlas capability already addresses nearly 75 percent of this market. With the planned General Dynamics' development of the Atlas IIB/Centaur, they can compete beginning in 1987 for approximately 85 percent of this market. Their discussions

with 26 users/satellite manufactures indicated general agreement with their outlook, and many declared a definite interest in using Atlas if availability is assured and the price is close to Ariane and the Shuttle. General Dynamics anticipates 2 or more flights per year, with a financial break even point of approximately 2 flights per year. As in the case of a commercial Titan, selection as the contractor for launch of the Intelsat VI series satellites would provide a strong impetus for the commercial Atlas program.

3. DELTA

NASA has received letters from SSI and Transpace Carriers expressing interest in commercializing the Delta. SSI projects 4 flights annually after transition to commercial Delta operations and believes the Delta is a viable backup to the STS and a strong competitor for potential Ariane payloads. Transpace Carriers, Inc. has proposed to take over Delta operations in October 1983 and would launch the remaining USG and commercial missions now scheduled plus any new customers.

4. ARIANE

The primary foreign competition to the U.S. Space Shuttle and ELVs is the European Space Agency's Ariane. Ariane represents a series of ELVs which are being marketed by Arianespace, a commercial entity established to provide Ariane launch services to customers. To date, the Ariane has completed five launches resulting in three successes and two failures. Arianespace has firm contracts with twelve customers including 3 U.S. firms -- GTE, Western Union, and Southern Pacific. Ariane is primarily being marketed as a vehicle for placing satellites

into geosynchronous orbit. While the reliability of the Ariane system is still unproven, Arianespace has been successful in marketing the vehicle as the only long term alternative to the U.S. Space Shuttle. Ariane has established a goal of at least a 25 percent share of the world space launch market.

The Ariane launch schedule as of March 1, 1983 shows a rapid buildup from 3 flights in 1983 to 9-10 flights annually in 1985-86. To achieve its goal of capturing 25 percent of the world market, Ariane has aggressively priced their launch services. The already favorable Ariane prices are further complemented by favorable financing arrangements. While the Shuttle requires progress payments begining 33 months in advance with total payment due prior to launch, Ariane requires only 20 percent pre-payment with the remaining 80 percent payable after launch with favorable financing by French and German banks. NASA has estimated the value of this financing to be approximately $4.0M for a Delta class payload.

5. Other Foreign Competition

The Indian SLV-3 and the Japanese N-I/N-II/H-1 space launch vehicles are also capable of providing commercial launch services. The Japanese presently launch only their own satellites with their launch vehicles. They are bound by agreement to obtain U.S. government approval before launching satellites for third parties using launch vehicles developed with U.S. assistance.

The Soviets also have the capability to provide commercial launch

services; they could enter the commercial market for either political or economic reasons.

These countries are not now actively promoting their launch vehicles as worldwide commercial competitors, but the potential exists if it appears attractive.

6. CONCLUSIONS

All potential U.S. commercial ELV operators expressed confidence that they would capture 2 to 4 launches annually. The Working Group felt that it was unlikely that there would be 2 to 4 commercial launches available per year for each of the U.S. ELV operators in the 1986-88 time frame, unless the market expands. This would be resolved by open competition and would not require USG resolution.

The working group identified significant benefits to the USG that could result from the commercialization of ELVs. National security could be enhanced by having an alternative launch capability for selected, critical national security missions in the event of a generic problem that could ground the entire STS fleet or during potential international situations where the risk of losing an orbiter and crew could jeopardize launching satellites on demand. There would also be national economic benefits resulting from domestic commercial exploitation and operation of USG developed ELV capabilities, technologies, and systems. These occur in the form of: (a) tax revenues derived from the provision of launch services; (b) assumption by the private sector of overhead for ELV

production and launch operations previously borne by the USG; (c) a positive impact on the U.S. balance of payments to the extent that losses of launches to foreign competitors are reduced; (d) complement to the Shuttle program to meet the demand of many commercial users to to have a U.S. backup to the Shuttle to preclude impacts caused by schedule perturbations; (e) an alternative for hazardous payloads or payloads that are technically or economically not feasible to manrate to satisfy Shuttle safety requirements.

Additionally, by approving the commercialization of existing ELVs, the USG could avoid some, if not all, close-out costs associated with the termination of the present USG ELV contracts. Commercial launch operations could stimulate the U.S. economy and contribute to a more effective and flexible U.S. space launch capability. This would directly contribute to maintaining U.S. leadership in space transportation.

The only disadvantage of ELV commercialization that was identified was the potential economic effects commercialization could have on the STS program. These economic effects are summarized in the next section.

C. Economic Effects of Commercial ELVs on the STS

One of the primary considerations associated with a United States Government (USG) decision to encourage and permit the private sector to commercialize ELVs is the potential impact on the total cost to the USG for STS operations. If the loss of commercial and foreign users from the STS to commercial ELVs poses a significant handicap to cost effective STS operations, then the option to encourage commercialization becomes less attractive to the USG.

The Interagency Working Group conducted an economic analysis of the impacts on the change in total cost to the USG of incremental losses of Commercial and Foreign (C&F) flights from the shuttle mission model. A complete documentation of the analysis and the model used is provided in Appendix A.

The following assumptions were used to construct an economic model to allow a static sensitivity analysis to be performed:

-- current USG planning will result in a capability for 24 flights per year; this capability will be retained regardless of increases or decreases in commercial or foreign demand.

-- the average variable cost per flight is essentially equivalent to the additive cost per flight proposed as one of the NASA pricing options and remains unchanged over the range of 18 to 24 flights per year.

-- the projected NASA budget figures represent the total cost of STS operations; no costs for Vandenberg operations were included in the NASA budget number even though the mission model includes flights from Vandenberg.

NASA's most recent STS mission model of 233 flights (191 USG missions and 62 commercial and foreign) over the 12-year period from 1983 to 1994 was used as a baseline for the analysis. Additionally, the three NASA pricing options described in Table 1 and referred to as Additive Cost, Out-of-Pocket Cost, and Average Total Cost were used to portray the impact of losing commercial and foreign flights from the mission model.

For the period encompassing 1983 to 1985, NASA will charge commercial and foreign users $18M (75$), and this figure was used to calculate revenue over this period.

In the 1986 to 1988 timeframe, NASA is proposing to charge commercial and foreign users $38M (75$), and this value was used to calculate revenue over this period.

A parametric analysis which used each of the NASA pricing options was performed. The analysis assumed an annual loss of an average of 1, 2, 3, 4, 5, and finally all 52 commercial and foreign flights over the 1986 to 1994 period. No commercial or foreign flights were assumed to be lost from 1983 through 1985 since the first commercial ELV is not projected until 1986.

The case of losing half (an average of 3 flights per year) of the commercial and foreign flights was selected as a representative example to illustrate the results obtained from the analysis.

The first result noted is that the loss of commercial and foreign flights in any scenario based on additive cost pricing has no effect on total cost of operations to the USG since the revenue produced only equals the additional costs incurred. No contribution to the USG fixed cost base is made under this pricing option, and the total cost of operations to the USG remains constant.

If the price for commercial and foreign users is based on the 1986-88 Out-of-Pocket costs, an average loss of 3 flights

a year (between 1986-94) results in a total increase in USG costs over the 12-year period of $460M (75$) or 4.2%. This represents an increase of about $38M (75$) per year.

Finally, if Average Total Cost is charged and an average of 3 commercial or foreign flights a year (between 1986-94) are lost, the total increase in USG costs over the 12 years is $537M (75$). This is a 5.1% increase in overall costs and equates to an increase of about $46M (75$) per year.

In terms of the overall ability of the shuttle to compete with ELVs, the Average Total Cost price is least competitive and increases the probability of losing commercial and foreign missions. The Out-of-Pocket price creates a more competitive price, and it is reasonable to assume the loss of commercial and foreign flights would be limited. While beyond the scope of this study, consideration must be given in the long run to the nature and extent of STS pricing competition with U.S. commercial launch operations.

There are several additional factors that must be considered to fully identify the effects on the STS program of ELV commercialization. These factors

include the impact of commercial and foreign flights on the useful life of the orbiter and the costs associated with potential major orbiter inspection and repair. Costs for orbiter depreciation and for major inspections are not included in the fixed cost base used in the analysis, as accurate figures on these costs were not available. However, these costs would have to be considered when examining the long-term impact on total cost to the USG of non-government shuttle flights.

In the first case, each orbiter has a design life of 100 missions. If the price of a commercial and foreign flight does not recover a sum above average total cost, government costs increase because a finite resource is being expended. This resource will eventually have to be replaced at some cost. Second, during the Working Group evaluation of the need for a fifth orbiter, it was estimated that major periodic inspection and repair could be required after approximately 25 missions. Potential reductions in commercial and foreign flights postpone both the cost of the orbiter repair and replacement.

From this and other cases documented in Appendix A, the following conclusions can be drawn:

- Additive cost pricing offers no economic advantage to the USG, regardless of reductions in average cost per flight.

- The Average Total Cost per flight figure is not a relevant measure of cost to the USG unless the price for shuttle flights is based on full cost recovery.

- Both Out-of-Pocket and Average Total Cost pricing options would produce revenues that exceed the additive cost for each commercial and foreign flight and therefore would serve to reduce the total cost of operations to the USG.

- Out-of-Pocket pricing does not represent major cost recovery to offset the cost to the USG for shuttle operations. Its advantage is that it allows the shuttle to compete favorably with Ariane.

- Average Total Cost recovery would decrease total USG costs, but would make the shuttle less competitive with ELVs.

The conclusion of the Working Group was that, regardless of the NASA pricing strategy, the potential increase in total cost of operations to the USG for the shuttle program as a result of the loss of commercial and foreign flights does not justify discouraging ELV commercialization.

D. STS and ELV Comparisons

Based on the information provided by the prospective commercial operators, ELVs appear to be cost competitive with the STS at $38M per flight. It should be recognized that this only compares their relative costs for a fixed level of effectiveness -- specifically, the boost mission -- since this is the only mission that ELVs can perform.

The STS, on the other hand, was designed and developed to perform a much more sophisticated range of missions--manned experimentation and interaction, recovery and repair of satellites, space based construction, etc. Had the volume of traffic projected for the STS materialized, perhaps the STS would have even proven cheaper for all missions. But, as the traffic model was reduced, the financial advantages of using the STS for simple boost missions decreased. By the time this occurred, the USG was committed to the STS and it was necessary to discontinue the expense of continued, concurrent production and operations of both the STS and the ELVs.

With the proposals to commercialize ELVs, the USG is presented with an option that could allow continued, cost-effective ELV operations without the financial burden of maintaining the contractor's overhead, sustaining manpower, and production base. This burden, along with the fixed operations costs and facility maintenance costs, would be borne by the commercial ELV operators.

This effectively preserves the U.S. ELV launch capability at little or no cost to the USG.

As a result, the USG could concentrate on optimizing the STS for its own requirements while enjoying a more robust and flexible national space launch capability. The entry of U.S. private industry into this field could ensure aggressive marketing and increase the benefit to the U.S. economy.

The STS is currently the only U.S. spacecraft capable of supporting the continuation of our manned space program. The shuttle provides the USG with a flexible manned platform from which to develop new techniques and experience.

These activities are necessary if we are to attempt new missions such as construction or a variety of potential space-based services such as refueling satellites or extensive on-orbit repair capabilities. Most importantly, it provides the opportunity to expand our knowledge of the use and function of man-in-space.

Finally, the ability of the STS to support internationally manned missions offers the U.S. a unique political advantage. With the exception of the Soviet Union, no other nation can offer countries the opportunity to participate in manned space exploration. The cooperative exploitation of space for peaceful purposes is an advantage that is difficult to measure in economic terms but is certainly valuable in our international relations.

These unique STS capabilities should be considered when comparing the relative effectiveness of the STS and ELVs; the full effects of the strengths and weaknesses of the STS and ELVs should be a key part of any comparisons. The Working Group

believes that the potential impacts on overall STS costs resulting from the loss of commercial and foreign payloads to ELVs could be more than offset by the benefits of commercial ELVs.

E. Conclusion

The Working Group concluded that commercialization of US ELVs is totally in consonance with existing national policies and offers a net benefit to the nation. The effects of commercial ELVs on the costs of the STS program were considered minimal and were believed to be offset by the benefits offered by commercial ELV operations.

The Working Group unanimously concluded that the commercialization of ELVs is in the best national interest and should be endorsed by the USG.

IV. APPROACH TO COMMERCIALIZATION

In order to determine the proper approach to facilitating the commercialization of ELVs, a number of policy issues were examined. These included the international and domestic laws which govern space activities and the use of USG services and facilities by commercial operators. The legal background as well as the major issues, are presented in the following parts of this section.

A. International Law.

Existing multilateral space conventions impose on the United States five primary obligations that are relevant to commercializing ELV's. Specifically, the USG must (1) authorize and supervise private space activity, (2) ensure compliance with the principles governing uses of outer space, (3) provide notice to certain States, (4) assume absolute liability for damage caused by these activities, and (5) arbitrate claims for damage to foreign entities.

1. Authorization and supervision. ARTICLE VI of the 1967 Outer Space Treaty (Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial bodies) imposes a general "obligation to authorize and supervise" the activities of private launches:

"The activities of nongovernmental entities in outer space, including the moon and the other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty."

This obligation does not, however, require the US to adopt an elaborate regulatory framework. The USG is required to perform some supervision to ensure compliance with the treaty obligations described below.

2. Compliance with Principles Governing the use of Outer Space. Article VI of the Outer Space Treaty requires that States bear "international responsibility" for assuring that "national activities carried on by governmental agencies or nongovernmental entities" are "carried out in conformity with the provisions set forth in the present Treaty."

Most of the provisions of the Outer Space Treaty impose obligations on States, not their nationals. The USG would require private space launch vehicle operators to comply with the principle enunciated in Article IV, to undertake only peaceful purposes and to refrain from stationing weapons of mass destruction in space.

3. Notice to certain states. Article IV of the Outer Space Treaty requires a government to consult with other states if they have reason to believe that private space launch vehicle operators will undertake acivity that "would cause potentially

harmful interference with activities of other States' parties in the peaceful exploration and use of outer space." Similarly, under Article 4 of the US-USSR agreement on Measures to Reduce the Risks of Outbreak of Nuclear War, the US must notify the USSR of "any planned missle launches if such launches will extend beyond its national territory in the direction of the (USSR)"

In addition, the USG must register space objects with the United Nations in accordance with the 1976 Convention on Registration of Objects Launched into Outer Space.

4. International liability. Both the Outer Space Treaty and the Liability Convention establish US liability to contracting parties, their corporations and nationals, for damage caused by space launches from US territory. The Outer Space Treaty sets no standard of liability; the liability Convention specifies that liability is absolute.

5. Arbitration of claims. The Liability Convention prescribes that damage claims shall be adjudicated by an ad hoc arbitral tribunal, the Claims Commission. The tribunal's determinations are recommendatory unless parties to a dispute agree to make them binding.

B. National Concerns

In addition to the responsibilities imposed by international law the USG has other obligations and requirements which can be grouped according to the following broad categories:

1) national security
2) technology transfer
3) public safety

No unique national security concerns were identified with the proposed commercialization options. However, those potential commercialization options that included launches from platforms in international waters or launches from foreign territories generated some indirect concerns. These centered basically on physical security. Specifically, the USG loses control over the ELV and its launch support equipment once it is beyond US territorial boundaries.

The potential of hijacking or capture on the open seas of an ELV with its launch support systems poses a concern relative to terrorism or third world aggression. The same concern exists for launches from foreign soil; under these circumstances the USG would have limited control to prevent the conversion of a peaceful space launch system to an offensive ballistic missile system. Any capability to launch commercial ELVs from outside U.S. territory was considered to be potentially disadvantageous to the interests of the USG.

Adequate procedures were thought to exist to allow USG control over proposed launches from outside U.S. territory.

Specifically, an export license would be required before the ELV and its support systems could be taken outside the U.S. This provides positive USG control and would permit a careful review of any such requests on a case-by-case basis.

Technology transfer issues related to potential ELV commercialization center on similar concerns. Space launch systems have the inherent ability to serve as ballistic missles. The USG must ensure not only that no such systems physically fall into the wrong hands but that the technology to independently acquire such systems is carefully controlled.

The commercialization of ELVs will potentially expose many more foreign customers directly to US ELV production and operations technology. The national policy on Space Launch Assistance (NSDD-50) provides the methods to handle these technology related issues. Therefore, existing procedures were again judged to be adequate to permit the USG to prevent the loss of critical technologies that might be associated with commercial ELV operations.

The USG's public safety concerns relate primarily to the licensing, supervision, and regulation of the inherently hazardous activities associated with ELV operations. The hazards may be divided into two general categories--ground safety and flight safety. Commercialization of ELVs can be grouped into operations conducted from USG national ranges or from newly created, commercial launch sites.

The operation of either existing or new ELVs from the national ranges represents the most straightforward case. The USG could provide ample assurrance of public safety by controlling the hazardous ground operations and flight safety for commercial operations according to the same criteria now used for its own operations. Commercial operators would not have to provide the substantial capital investment required to establish, equip, and operate a range to government standards. The USG could provide these services on a reasonable, reimburseable basis. This would also make maximum use of the facilities, equipment, and services already in place on the existing national ranges.

The USG should encourage commercial opeators to use the national ranges principally because it offers the USG the best and most efficient means of fulfilling its national and international legal commitments and public safety concerns.

While it is possible for the USG to fulfill these commitments for operations from a private range, the minimum acceptable standards that a commercial operator would have to meet are not presently defined. One test launch in this category has already been approved, i.e., the Conestoga test flight from Matagorda Island. The ad hoc requirements established as a result of this specific case are discussed more fully in section D.

The acceptability of commercial operations from private launch ranges was considered beyond the scope of this study. We recommend that the USG's requirements for the establishment and approval of a commercially operated space launch range be separately studied and defined in an interagency forum. Neither the USG or the private sector can intelligently consider this option until these criteria are clearly defined and documented.

C. USG Services and Facilities in Support of Commercial ELV Operations.

For the commercialization of ELV's to be most successful and practical, the USG would have to provide selected support services, equipment, and facilities.

Since the existing ELVs were developed for the use of the USG, portions of the facilities,tooling, assembly fixtures, and test equipment are owned by the government. The USG would have to identify those items that are no longer of direct use to the USG as well as those items that could be used for other purposes. These items encompass design, processing, procedures, data, and software; test and transportation equipment; production fixtures, jigs, and tooling; facilities to manufacture, assemble, test, modify, control, maintain and launch the vehicle; and ancillary facilities to support servicing of the vehicle and preparation of payloads.

Since the USG no longer intends to maintain the production and operational base required for continued ELV operations, it could elect to scrap, surplus, or redistribute the equipment associated with this effort. The commercialization proposals described by the present ELV contractors would require that the USG make a large percentage of this equipment available for their use in continuing commercial production. In effect, these contractors would assume the financial burden of maintaining the sustaining production base as well as the operations and maintenance of the launch facilities that the USG has carried up until now. In return, the contractor would require the continued use of USG equipment and facilities on an economical basis.

This would maintain an ELV option as a back-up to the STS at little or no sustaining cost to the USG. The USG could exercise this option by maintaining or developing spacecraft that are dual compatible, as the commercial industries are doing, and purchasing commercial launch services as required. The USG could conceiveably negotiate a favorable ELV back-up option as consideration for the continued economical use of USG equipment and facilities.

The ELV facilities on the national ranges will no longer be required after the USG discontinues ELV operations in the mid to late 80's. Facilities that are used solely for ELVs, such as launch complexes could be leased, consigned, or licensed to the commercial operator with appropriate consideration given to the benefits derived by both the USG and the private concern.

Those facilities that would be used by the USG even after the discontinuation of USG ELV operations, could be shared with commercial ELV operators. For such joint-use facilities, the USG should control the integrated scheduling of both the USG and commercial activites and retain priority right-of-use to support critical national security or limited launch opportunity missions (e.g., planetary windows). The USG should make every reasonable effort to minimize impact on the commercial operators in joint-use facilities.

The USG should also make available, on an equitable reimbursement basis, all range support services necessary to conduct launch

operations from the national ranges. All ELV operators using the national ranges should be required to comply with the basic ground and flight safety standards; their launches would be constrained by the same flight safety requirements as USG launches.

As a condition of using the national ranges and USG facilities, the commercial ELV operators would have to agree to be bound by the USG's ground and flight safety requirements and understand that the USG would destroy their vehicles if they violated flight safety criteria. The contractors would have to agree to not hold the USG liable for schedule delays resulting from conflicts in joint-use facilities or range support services; the USG would not be liable for the commercial operators loss if it became necessary for the USG to destroy the vehicle for range safety reasons.

The USG should require each commercial operator to obtain adequate insurance to replace any USG property that might be damaged as well as third party liability insurance. The commercial operators should maintain all USG property in accordance with the contractual agreements negotiated for the specific facilities.

NASA and DoD should individually identify those facilities, equipments, etc. that could be made available for commercial ELV production and operations. Each agency should negotiate the specific reimbursements for its respective facilities, equipment, and services since their regulations, accounting systems, and procedures may vary.

However, the following general principals should be followed by both agencies. The USG should not attempt to recover the costs associated with the design and development of ELVs that were required to meet national needs. The USG's interests are best served if an ELV capability can be maintained at little or no cost to the USG. Consequently, launch facilities and equipment leased or otherwise made available to commercial operators should be priced in a manner that encourages viable commercial operations and serves the best interest of the USG. Standard tooling and equipment, ELV hardware, long-lead materials, components, or assemblies on-hand at the completion of the USG's programs should be priced at fair market value or USG cost.

The benefits that the USG could receive from the commercialization of ELVs should be considered in the determination of prices. These benefits include the USG's recovery of costs of residual flight hardware, avoidance of program close-out costs and the disposal of excess property, maintenance of high technology critical aerospace skills, an expanded cost base at the National Ranges, and maintenance of a USG emergency/back-up access to space.

D. Domestic Laws Pertinent to Commercial ELV Operations

With the initial request for the approval of a private space launch by the USG, the Department of State chaired an ad hoc interagency group to determine the proper requirements and procedures. The conclusions are documented in a DoS report entitled Private Space Activity. This report concluded that "existing laws and regulations are adequate for the USG to control private launches from US territory or export of satellites and launch vehicles generally from the US for launch abroad. In light of the infancy of the private space launch industry, the creation of new legislative and regulatory framework and supporting bureaucracy is not justified."

The principal features of the ad hoc process established to handle commercial launch operations can be summarized as follows.

1. Launch Vehicles

Under the current process a commercial ELV operator is currently required to obtain three primary approvals for a launch: (a) an Arms Export Control license from the State Department; (b) an experimental radio license from the FCC; and (c) an exemption or clearance from the FAA for use of controlled airspace.

a. **Arms Export Control License.** The Arms Export

Control Act and its implementing regulations on the International Traffic in Arms (ITAR) presently furnish the primary mechanism for controlling launches and any attendant transfer of technology. The State Department administers these procedures.

Under the Act, the State Department designates defense articles, services, and technical data that constitute the Munitions List. No item on the Munitions List may be exported or imported unless the State Department issues a license that authorizes its export or import. Violators are subject to criminal sanctions. Rockets, launch vehicles, payloads, specifically designed associated equipment, and related technical data are all on the Munitions List. The State Department deems launches to be "exports" since that term means "the sending or taking taking out of the United States in any manner, any article, equipment or technical data on the Munitions List." The State Department has authority to deny, revoke, suspend or amend licenses if it believes such action would not further world peace, foreign policy, or national security; or because it believes the applicant has violated the Act or the International Traffic in Arms Regulations (ITAR). License decisions may be appealed to a Hearing Commissioner of the State Department and to an Appeals Board of the Commerce Department. The ITAR provides a mechanism for considering the range of

concerns that indirectly affect foreign policy, including vehicle safety and liability coverage. To avoid vehicle hazards that could have foreign policy consequences, the State Department consults NASA, the FAA, and DoD on vehicle safety. To facilitate this process, license applicants may be required to provide "all pertinent documentary information regarding the proposed transaction." Similarly, in order to assure some compensation to foreign governments, the State Department may secure compensation commitments in the form of insurance and/or indemnification.

b. Federal Communications Commission (FCC) license. Under the Communications Act of 1934, as amended, and its implementing regulations, the FCC allocates and issues licenses for the radio frequencies necessary for commercial space launch operators to monitor telemetry, track, and destroy errant vehicles.

The FCC has not designated frequencies for commercial space operations. Commercial ELV operators may obtain an experimental radio license which permits the liscensee to share assigned frequencies.

c. Federal Aviation Administration (FAA) clearance. Under the Federal Aviation Act of 1958, the FAA regulates navigable airspace and has promulgated special air traffic rules for unmanned rockets.

Initially, the unmanned rocket rules require 24-48 hours notice to the appropriate Air Traffic Control (ATC) facility. Second, unless the FAA waives application of the rule, certain

operations are prohibited including operations that (a) create a collision hazard, (b) in controlled airspace, (c) under specified conditions of limited visibility, and (d) within 150 feet of any person or property not associated with the operations.

2. Payloads. Payloads on the Munitions List are also subject to ITAR licensing procedures. These include all orbiting payloads.

3. USG Liability. USG liability is two-fold. First, under the Federal Tort Claims Act, the US is liable to national and foreign entities for damage caused by negligence in Federal participation in space launches; e.g., in abort-destruct execution. Second, the US is absolutely liable--liable without fault--to foreign governments, companies, and persons for personnel and property damage caused by space launches from US territory.

While the process used to provide the initial approval can unquestionably be streamlined and used in the interim, a more efficient long range regulatory plan should be developed to meet the anticipated nature and frequency of routine commercial ELV operations. These ad hoc requirements should be reviewed in light of the more complex and extensive ELV commercialization proposals.

The Department of State should be designated the lead agency for coordinating all U.S. commercial ELV requests within the USG. The Department of State is well suited to coordinate the political approval for commercial launches

which involve issues such as international agreements, national security concerns, and technology transfer issues. The operational concerns and supervision would be best handled by the cognizant technical agencies, such as DoD, NASA, FAA, and FCC.

E. Conclusions

1. The USG should proceed with the details necessary to support viable commercial ELV operations.

2. The Department of State should be designated as the lead agency to coordinate commercial ELV requests within the USG; the technical and operational expertise of the other government agencies (DoD, NASA, FAA, FCC, etc) should be used to the maximum extent practical.

3. DoS should chair an interagency study to define a more effective process to support routine, commercial ELV operations.

4. Existing procedures are adequate in the interim to handle occasional test launches by the private sector. More should be developed before the advent of routine commercial ELV operations.

5. The USG should encourage the use of its national ranges for existing and new commercial ELV. This represents the most effective means of fulfilling its domestic and international obligations.

6. An interagency study should be conducted to define the USG criteria and requirements for approving commercial launch sites and ranges.

APPENDIX A

Parametric Analysis of the Economic Effects on the STS Program of Losing Commercial and Foreign Missions

The input data for this analysis was provided by NASA. TABLE 1 summarizes, by year, the number of US goverment (USG), commercial and foreign and total STS flights over the 12 year analysis period. The average total cost per flight and the average variable cost per flight are shown by year. The price charged to commercial and foreign users over the 1983-85 period is also shown as well as the proposed price during the 1986-88 period. This data is based on a 233 flight mission model over the twelve years.

TABLE 2 shows annual and twelve year total cost, total fixed cost (and the percentage of total cost), and total variable cost (and the percentage of total cost).

TABLE 3 summarizes the baseline mission model costs for two pricing options. The "out-of-pocket" option assumes $18M per flight during the 1983-85 period, and $38M (the 1986-88 out-of-pocket estimate) for the period from 1986-94. The average total cost option uses $18M for 1983-85, $38M for 1986-88, and then assumes full cost recovery (average total cost) during

1989-94.

Total cost is used to describe actual costs required to fly a given number of missions; total cost to the USG is the cost to the US treasury after the receipt of the commercial and foreign revenues.

The twelve year sum of the total costs to the USG under the two pricing options is used as the baseline for the parametric analysis.

TABLES 4 and 5 summarize the results of the parametric analysis. Since commercial ELVs would not be available before 1986, no commercial and foreign flights were considered lost over the 1983-85 period. From 1986 to 1994, six scenarios were analyzed assuming an annual loss of an average of 1,2,3,4,5 and finally all 52 commercial and foreign flights. In these tables, the first number in each year (TC) represents the total annual cost; total cost was calculated by taking the baseline value from TABLE 3 and subtracting the number of flights lost times the average variable cost per flight for that year (taken from TABLE 1). The second value (R) is the commercial and foreign revenue which was calculated by multiplying the number of remaining commercial and foreign flights times the appropriate price per flight. The total cost to the USG (TC USG)

is simply the difference between the total cost and the revenue received.

TABLE 6 summarizes the total costs to the USG based on the out-of-pocket pricing scenario. Each of the parametric cases is summed and the baseline cost subtracted from each to identify the increase in the total costs to the USG over the twelve year period. These increases are shown at the bottom of the table along with the percentage increase each represents over the baseline costs. TABLE 7 shows the same data for the "average total cost" pricing secnario.

TABLE 1

BASELINE MISSION MODEL DATA
(M 75$)

SOURCE: NASA

YEAR	USG FLIGHTS	C&F FLIGHTS	TOTAL FLIGHTS	AVERAGE TOTAL COST	AVERAGE VARIABLE COST	C&F PRICE
83	3	2	5	155.0	35.0	18.0
84	7	3	10	96.0	31.0	18.0
85	7	5	12	80.2	28.0	18.0
86	12	5	17	62.4	24.7	38.0
87	16	5	21	56.2	23.0	38.0
88	18	6	24	50.0	21.8	38.0
89	18	6	24	49.4	21.3	N/A
90	18	6	24	48.7	20.4	N/A
91	18	6	24	48.2	19.6	N/A
92	18	6	24	47.8	18.9	N/A
93	18	6	24	46.4	18.4	N/A
94	18	6	24	46.0	17.9	N/A
TOTAL	171	62	233			

Table 2

CALCULATED FROM THE BASELINE DATA FOR EACH YEAR:

Total Costs = number of flights times Average Total Cost per flight

Variable Costs = number of flights times Average Variable Cost per flight

Fixed Costs = Total Costs minus Variable Costs

Year	Total Costs	Fixed Cost	Percentage of Total Costs	Variable Cost	Percentage of Total Costs
83	775	600	77%	175	23%
84	960	650	68%	310	32%
85	962	626	62%	336	38%
86	1061	641	60%	420	40%
87	1180	697	59%	483	41%
88	1200	677	56%	523	44%
89	1186	675	57%	511	43%
90	1169	679	58%	490	42%
91	1157	687	59%	470	41%
92	1147	693	60%	454	40%
93	1114	672	60%	442	40%
94	1104	674	61%	430	39%
TOTAL	13015	7971	61%	5044	39%

Over 12 Years:

Average Total Cost/Flight = $\frac{13015}{233}$ = 55.86M

Average Variable Cost/Flight = $\frac{5044}{233}$ = 21.65M

Table 3

BASELINE MISSION MODEL

Year	Total Costs	"OPC" C&F Price/Flt	"OPC" Total C&F Revenue	"OPC" Total Cost to USG	"ATC" C&F Price/Flt	"ATC" Total C&F Revenue	"ATC" Total Cost to USG
83	775	18	36	739	18	36	739
84	960	18	54	906	18	54	906
85	962	18	90	872	18	90	872
86	1061	38	190	871	38	190	871
87	1180	38	190	990	38	190	990
88	1200	38	228	972	38	228	972
		Out-of-Pocket			ATC		
89	1186	38	228	958	49.2	295	891
90	1169	38	228	941	48.7	292	877
91	1157	38	228	929	48.2	289	868
92	1147	38	228	919	47.8	287	860
93	1114	38	228	886	46.4	278	836
94	1104	38	228	876	46.0	276	828
TOTAL	13015			10859			10610

Table 4

PARAMETRIC ANALYSIS BASED ON OPC (38M)

Year		-1/Yr	-2/Yr	-3/Yr	-4/Yr	-5/Yr	-ALL
86	TC =	1035	1009	983	957	931	931
	R =	152	113	76	38	0	0
	TC_{USG}	883	896	907	919	931	931
87	TC =	1157	1134	1111	1088	1065	1065
	R =	152	113	76	38	0	0
	TC_{USG} =	1005	1021	1035	1050	1065	1065
88	TC =	1178	1156	1134	1112	1090	1068
	R =	190	152	114	76	38	0
	TC_{USG} =	988	1004	1020	1036	1052	1068
89	TC =	1160	1139	1118	1097	1076	1055
	R =	190	152	114	76	38	0
	TC_{USG} =	970	987	1004	1021	1038	1055
90	TC =	1149	1129	1109	1089	1069	1049
	R =	190	152	114	76	38	0
	TC_{USG} =	959	977	995	1013	1031	1049
91	TC =	1137	1117	1097	1077	1057	1037
	R =	190	152	114	76	38	0
	TC_{USG} =	947	965	983	1001	1019	1037
92	TC =	1128	1109	1090	1071	1052	1033
	R =	190	152	114	76	38	0
	TC_{USG} =	938	957	976	995	1014	1033
93	TC =	1096	1078	1060	1042	1024	1006
	R =	190	152	114	76	38	0
	TC_{USG} =	906	926	946	966	986	1066
94	TC =	1086	1068	1050	1032	1014	996
	R =	190	152	114	76	38	0
	TC_{USG} =	896	916	936	956	976	996

Table 5

PARAMETRIC ANALYSIS BASED ON ATC FROM 89-94

Year		-1/Yr	-2/Yr	-3/Yr	-4/Yr	-5/Yr	-ALL	
86	TC =	1035	1009	983	957	931	931	) Revenue
	R =	152	113	76	38	0	0	) based on
	TC_{USG} =	883	896	907	919	931	931	) 38M/flt
87	TC =	1157	1134	1111	1088	1065	1065	) for all
	R =	152	113	76	38	0	0	) C&F
	TC_{USG} =	1005	1021	1035	1050	1065	1065	) figures
88	TC =	1178	1156	1134	1112	1190	1068	)
	R =	190	152	114	76	38	0	)
	TC_{USG} =	988	1004	1020	1036	1052	1068	)
89	TC =	1165	1143	1122	1101	1080	1058	
	R =	247	198	148	99	49	0	
	TC_{USG} =	918	945	974	1002	1031	1058	
90	TC =	1149	1128	1108	1087	1067	1047	
	R =	244	195	146	97	49	0	
	TC_{USG} =	905	933	962	990	1018	1047	
91	TC =	1137	1118	1098	1079	1059	1039	
	R =	241	193	145	96	48	0	
	TC_{USG} =	896	925	953	983	1011	1039	
92	TC =	1128	1109	1090	1071	1053	1034	
	R =	239	191	143	96	48	0	
	TC_{USG} =	889	918	947	975	1005	1034	
93	TC =	1096	1077	1059	1040	1022	1004	
	R =	232	186	139	93	46	0	
	TC_{USG} =	864	891	920	947	976	1004	
94	TC =	1086	1068	1050	1032	1015	997	
	R =	230	184	138	92	46	0	
	TC_{USG} =	856	884	912	940	969	997	

Table 6

SUMMARY OF PARAMETRIC VARIATIONS ON TOTAL COST TO THE USG

Based on Out-of-Pocket Pricing (38M)

Year	Baseline	-1/Yr	-2/Yr	-3/Yr	-4/Yr	-5/Yr	-ALL	
83	739	739	739	739	739	739	739	)No flights
84	906	906	906	906	906	906	906	)lost over
85	872	872	872	872	872	872	872	)this period.
86	871	883	896	907	919	931	931	
87	990	1005	1021	1035	1050	1065	1065	
88	972	988	1004	1020	1036	1052	1068	
89	958	970	987	1004	1021	1038	1055	
90	941	959	977	995	1013	1031	1049	
91	929	947	965	983	1001	1019	1037	
92	919	938	957	976	995	1014	1033	
93	886	906	926	946	966	986	1006	
94	876	896	916	936	956	976	996	
TOTAL	10859	11009	11116	11319	11474	11629	11757	
Increase to USG	0	150	307	460	615	770	898	
% Increase	0	1.4%	2.8%	4.2%	5.7%	7.1%	8.3%	

Table 7

SUMMARY OF PARAMETRIC VARIATIONS ON TOTAL COST TO USG

Based on Average Total Cost for 1989-94

Year	Baseline	-1/Yr	-2/Yr	-3/Yr	-4/Yr	-5/Yr	-ALL	
83	739	739	739	739	739	739	739	) No flights
84	906	906	906	906	906	906	906	) lost over
85	872	872	872	872	872	872	872	) this period
86	871	883	896	907	919	931	931	) Based on
87	990	1005	1021	1035	1050	1065	1065	) price of
88	972	988	1004	1020	1036	1052	1068	) 38M/flight
89	891	918	945	974	1002	1031	1058	
90	877	905	933	962	990	1018	1047	
91	868	896	925	953	983	1011	1039	
92	860	889	918	947	975	1005	1034	
93	836	864	891	920	947	976	1004	
94	828	856	884	912	940	969	997	
TOTAL	10610	10721	10934	11147	11359	11575	11760	
Increase to USG	0	111	324	537	749	965	1150	
% Increase	0	1.0%	3.1%	5.1%	7.1%	9.1%	10.8%	

APPENDIX B

INTERNATIONAL LAW

Under the multilateral space conventions, the United States has four primary obligations that would relate to commercial ELV's. Generally, we must (1) authorize and supervise private space activity, (2) ensure their compliance with the principles governing uses of outer space, (3) notify foreign governments of launches and potential hazards, (4) assume absolute liability for damage caused by these activities, and (5) arbitrate claims for damage to foreign entities.

The conventions to which the United States is party include the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies, entered into force for the United States October 10, 1967 (18 UST 2410, TIAS 6347) ("Outer Space Treaty"); Convention on the International Liability for Damage Caused by Space Objects, entered into force for the United States October 9, 1973 (24 UST 2389, TIAS 7762) ("Outer Space Liability Convention"); Convention on Registration of Objects Launched into Outer Space, entered into force for the United States September 15, 1976 (28 UST 695, TIAS 8480).

1. Authorization and supervision. Article VII provides in part:

> "The activities of non-governmental entities in outer space, including the moon and the other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty."

The scope of this obligation is imprecise. It does not in itself require the U.S. to "regulate" activities; rather it impels the U.S. to take some affirmative action to ensure that private launches will, for the duration of their activities, comply with international law. We could have substantial debate over which international law, as defined by treaty obligations, apply not only to states qua states, but also to its private citizens.

Article VI of the Outer Space Treaty specifies that at least certain obligations of that Treaty apply to private activities:

> "States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the moon and other celestial bodies, whether such activities are carried on by governmental agencies or non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty."

(emphasis added).

2. Compliance with international law. We could construe the "peaceful activities" provisions to apply to private launches. Article III of the Outer Space Treaty contains a general injunction against non-peaceful space activity:

> "States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding."

Article IV specifically bans the stationing of weapons:

> "States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner."

Similarly, Article IX's terms on environmental hazards may be construed to apply to nationals, especially since it requires Parties to "adopt appropriate measures" to secure its objectives:

> "State Parties to the Treaty shall pursue studies of outer space, including te moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment resulting from the introduction of extraterrestrial matter, and, where necessary, shall adopt appropriate measures for this purpose."

Other treaties also impose obligations that could restrict private space activities, for example, the Convention on the Prohibition of Military or any Other Hostile Use of Environmental Modification Techniques, with Annex, entered into force for the United States January 17, 1980 (31 UST 333, TIAS 9614). Under Article I of this Convention, we must not "engage in military or any hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other State Party." Article II defines "environmental modification techniques" as "any technique for changing -- through the deliberate manipulation of natural processes -- the dynamics, composition or structure . . . of outer space." Article IV requires parties to enact laws necessary to prohibit Convention violations.

Some space activities could be proscribed by Article V of the 1959 Antarctic Treaty (12 UST 794, TIAS 4780), that "Any nuclear explosion in Antarctica and the disposal there of radio active waste material shall be prohibited." The treaty applies in the area south of 60° latitude (Article VI), and, Article X affirms that its principles shall apply to private parties.

3. Notification to foreign governments. If the U.S. has reason to believe that our private launchers will undertake activity that could harm the space activity of other states, it must consult with those states before the launch. Article IX of the Outer Space Treaty provides in part:

> "If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the moon and othe celstial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. "

In addition, under Article 4 of the US-USSR Agreement on measures to Reduce the risk of Outbreak of Nuclear War, entered into force September 30, 1971 (22 UST 1590, TIAS 7186), the U.S. must notify the USSR of "any planned missile launches if such launches will extend beyond its national territory in the direction of the [USSR]."

Finally, the U.S. must comply with registration requirements under Articles II and III of the Registration Convention.

4. International liability. Both the Outer Space Treaty and the Liability Convention establish US liability to other contracting parties and their natural or juridical persons, for personal and property damage caused by launches from US. territory or launches that the U.S. has "procured". The Outer Space Treaty sets no standard of liability; the Outer Space Convention specifies that liability is absolute.

Article VII of the Outer Space Treaty provides:

> "Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the moon and other celestial bodies."

Article II of the Liability Convention specifies that liability is absolute:

> "A launching State shall be absolutely liable to pay damage caused by its space object on the surface of the Earth or to aircraft in flight."

5. Arbitration of claims. The Liability Convention further prescribes that damage claims shall be adjudicated by an ad hoc arbitral tribunal, the Claims Commission. The tribunal's determinations are recommendatory unless parties to a dispute agree to make them binding.

CURRENT PROCESS

A commercial launcher now must obtain three primary approvals: (a) an Arms Export Control license from the State Department for boosters and payloads; (b) a radio license from the FCC; and (c) an exemption or clearance from the FAA for use of controlled airspace.

In addition, a commercial launcher provides documentation to NORAD for tracking purposes.

1. Arms Export Control License. The Arms Export Control Act, as amended, 22 USC 2751 et seq., and its implementing regulations on the International Traffic in Arms, 22 C.F.R. 121.01 ("ITAR") are the mechanisms through which the US controls export of munitions and attendant technology. The Act and its regulations are administered by the State Department's Office of Munitions Control, which issues the Munitions List and grants export licenses for items on the list.

Section 38 (a)(1) of the Act, 22 USC 2777 (a)(1), authorizes the President to designate defense articles and services that constitute the Munitions List, and to regulate the import and export of items on the list. Section 38 (b)(2) establishes the licensing requirement: "[N]o defense articles or defense services designated by the President under subsection (a)(1) may be exported or imported without a license for such export or import, issued in accordance with this Act and regulations issued under this Act. . . . " The regulations define "export" to mean "the sending or taking out of the United States in any manner, any article, equipment or technical data on the Munitions List." 22 CFR 121.19.

Category IV of the Munitions List covers boosters, launch vehicles, and all specificially designed associated equipment. Technical data related to this equipment are also on the list. 22 CFR 125.03 - 125.05.

Payloads come under Category VIII: "Spacecraft including named and unmanned, active and passive satellites."

Range equipment is also covered: Category VII covers gun and missile tracking and guidance systems, military infrared, image intensifier and other night sighting and night viewing equipment; range, position and height finders and spotting instruments; inertial and other weapons or space vehicle guidance and control systems; spacecraft guidance, control and stablilization systems.

Under the 22 CFR 123.05, the Department has broad authority for license denial, revocation, suspension or amendment. The Department may take such action if it believes that the action would further world peace, foreign policy, or national security; or because the Department believes the applicant has violated the Act, the ITAR; or the transaction or applicant has been "debarred" or specifically proscribed.

License decisions may be appealed at the administrative level, to a Hearing Commission of the State Department, and for Appeals Board of the Commerce Department under procedures set forth in 22 CFR Part 128. An aggrieved applicant would have difficulty obtaining further review of license decisions under the Administrative Procedure Act, 5 USC 500 et seq.

The ITAR provides some mechanism for considering the range of concerns that affect foreign policy, vehicle safety and liability coverage. To avoid vehicle hazards that could have foreign policy consequences, the State Department consults NASA, the FAA, and DOD on vehicle safety. To facilitate this process, license applicants may be required under 22 CFR 121.01 and 121.04, to provide "all pertinent documentary information regarding the proposed transaction." Similarly, in order to assure some compensation to foreign governments, and to provide further incentives for vehicles safety, the State Department may secure compensation commitments in the form of insurance and/or indemnification.

2. Federal Communications Commission ("FCC") license. Under the Communications Act of 1934, as amended, 47 USC section 151 et seq., and its implementing regulations 47 CFR Pts 0-99, the FCC allocates frequencies and issues licenses for the radio frequencies necessary for launchers to monitor telemetry, track, and abort or destruct.

The FCC allocates frequencies in 47 CFR Pt. 2. It has not designated frequencies for uses associated with space operations; such a designation would require a rulemaking and would be greatly contested. Administrative procedures would be required for issuing permanent licenses of those frequencies.

Space operations, including STS, therefore have been licensed under the provisions of 47 CFR Pt 5 for experimental licenses. Experimental licensees may share any FCC designated frequency, provided "[t]hat the need for the specific frequncy(s) requested is fully justified by the applicant." 47 CFR 5.203. Because frequencies for experimental licensees are shared and need not be reallocated, the licensing process can be expeditious. These licenses are generally issued for a period of about two years.

Experimental services licenses for "research" may be conferred for purposes which include: "experiments under contractual agreement with the United States Government, or for export purposes"; "communications essential to research projects"; and "technical demonstrations of equipment or techniques." 47 CFR 5.202. The FCC has construed these purposes broadly, and its practice has been to use these provisions to license government space operations, including STS.

3. Federal Aviation Administration (FAA) clearance. The Federal Aviation Act of 1958, as amended, 49 USC 1301 et seq., furnish the basis for economic and air safety regulation by the Civil Aeronautics Board and the FAA. The FAA regulates navigable airspace under 49 USC 1348, and implementing regulations 14 CFR 71-77.

The FAA has promulgated special air traffic rules for unmanned rockets. Initially, the unmanned rocket rules require 24-48 hours notice to the appropriate Air Traffic Control (ATC) facility. 14 CFR 101.25. Second, unless waived by the FAA under 14 CFR 101.3, certain operations are prohibited, including operations that (a) create a collision hazard, (b) in controlled airspace, (c) under specified conditions of limited visibility and (d) within 1500 feet of any person or property not associated with the operations. 14 CFR 101.23.

Other portions of the Act have not yet been deemed to cover spacecraft; and it would be difficult to assert that congress intended other regulatory portions of the act to apply to ELV's. However, the definitions of the Act are broad, eg. an aircraft is "any contrivance known or hereafter invented, used, or designed for navigation or flight in the air" 49 USC 1301 (5).

APPENDIX C

SPACE LAUNCH POLICY WORKING GROUP STUDY ON COMMERCIALIZATION OF EXPENDABLE LAUNCH VEHICLES

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