

**COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515**

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

Hearing on
Commercialization of Expendable Launch Vehicles
Room 2325 RHOB; 1:30 p.m. - 4:00 p.m.
May 18, 1983

WITNESS LIST

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May 18, 1983

STATEMENT OF
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before the
SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

Mr. Chairman and Members of the Subcommittee:

Mr. Chairman, it is a privilege to appear before this distinguished Subcommittee on behalf of General Dynamics to participate in this series of hearings on commercial activities in space. My comments today will be focused on launch vehicle issues which have resulted from two years of very serious assessment and analysis activities by our company including numerous interactions with potential customers and responsible U.S. Government organizations. These hearings are very timely in light of the near term nature of key milestones and solutions that we feel must be met before management and implementation responsibility of current U.S. Government space programs can be transferred to the private sector.

We are awaiting the final signature of the President on the Space Policy covering Commercialization of Expendable Launch Vehicles that the Senior Interagency Group (SIG) - Space has been diligently preparing. As you will see, the timeliness of the release of this policy and subsequent negotiation of agreements has a major impact on our ability to transition our existing systems and their derivatives to the private sector in a cost effective manner.

Our company's involvement in space programs parallels the entire span of space activity over the past quarter century. The first flight of the Atlas rocket in 1957 occurred a few months before the Soviet Union successfully launched the first Sputnik. Our Atlas missions include such outstanding U.S. space programs as MERCURY, RANGER, MARINER, SCORE,

OGO, TIROS, NOAA, NAVSTAR and others. More than 25 years later 471 Atlases have flown, 190 of them as space launch vehicles.

Shortly after the first Atlas flight, work began on this nation's, and the free world's, first cryogenic high energy upper stage-Centaur. In the more than 20 years since its first flight, Centaur has been the upper stage on 60 Atlas/Centaur vehicles and on seven Titan/Centaurs. Many scientific and nearly all planetary and interplanetary missions by the United States have been launched on either, or both, Atlas and Centaur. Such highly successful programs as SURVEYOR, PIONEER, OAO, MARINER, HEAO, HELIOS, VIKING and VOYAGER were launched by these systems.

This nation has launched 69 commercial communications satellites, one third of which have been on the Atlas/Centaur. At this very moment, Atlas/Centaur number 61 is poised on launch pad 36B at Cape Canaveral, ready to launch spacecraft number 6 of the INTELSAT V commercial communication satellite series on Thursday evening. This will be the twentieth consecutive launching for INTELSAT on Atlas/Centaur vehicles, beginning with the first INTELSAT IV in January 1971. In addition, Atlas/Centaur has successfully placed five military FLTSATCOM communication satellites in geosynchronous orbit.

With the advent of the Space Shuttle era, General Dynamics has continued to contribute to the United States space effort. We are proud of our role in designing and building the Mid-fuselage for the Space Shuttle Orbiter. The Mid-fuselage for OV-104, the ATLANTIS, was delivered on schedule less than two weeks ago. We are also on schedule with the modification of Centaur for use as an upper stage in the Space Shuttle for NASA planetary missions GALILEO and ISPM. In addition the DOD is jointly involved in this program and we will be providing Shuttle/Centaurs for key military missions that require high energy performance.

These comments on the background and current status of General Dynamics' participation in space programs are intended to provide some insight into the factors which have led us to today's discussions - a strong belief that there is a continuing need for the mature, proven launch vehicle systems which have performed so well over the years. What I would like to do today is to put the question of commercialization of Expendable Launch Vehicles (ELVs) into a broader context - how the commercialization of space-related activities can further enhance the United States' space program, national security and economy.

There appear to be three broad commercial areas where space is already, or soon will be, playing a major role. These areas are: information transfer, materials processing, and energy. In some cases, involvement either with the Space Shuttle, or possibly, permanent manned platforms. The Space Shuttle itself was envisioned from the beginning as only one element of a complete space system which includes manned space stations, orbital transfer vehicles and possibly large geosynchronous platforms.

The Space Shuttle was conceived as a reusable vehicle that could transport crews and payloads to low earth orbit. In addition to the Space Shuttle's role as an important national asset, it provides a unique capability by virtue of its very large payload capacity, on-orbit versatility and recovery agility. The presence of man increases the Space Shuttle's flexibility for mission implementation. Extra-vehicular activity, problem solving and on-orbit repair capability are significantly increased. Only a vehicle such as the Space Shuttle could make possible the prospect of convenient space station logistics support, retrieval and return to earth of low altitude spacecraft, commercially produced products such as pharmaceuticals, or valuable test samples which had been left in orbit.

As a corollary to the planned development of the Space Shuttle, the U.S. Government made a conscious decision to phase down and eventually terminate ELV programs with the expectation that the Space Shuttle would be able to handle all available traffic at a cost and schedule to satisfy all potential customers. In other words, the ELVs were destined to "go out of business" by the early 1980's.

Projected space launch traffic demands have been thoroughly examined by several U.S. Government and private groups. There is a rapidly expanding launch demand for the class of satellites particularly well suited for ELV's, the geosynchronous communication satellites. Based upon General Dynamics' continuing reviews of these various mission models and numerous discussions with both foreign and domestic users, we conservatively project the need for launch service for approximately 245 commercial communication satellites between 1986 and 1995. This market represents over \$10 billion in potential launch vehicle revenue over this ten year period. Schedule flexibility and reliability are ranked more important than launch costs by most commercial communication satellite users.

When commercial communication satellite launch requirements are considered in conjunction with the planned DOD, NASA and other U.S. Government missions; the demand exceeds the supply capability of the Space Shuttle in both near and far term. This near term overflow was also projected by James E. Beggs, NASA's Administrator, during these hearings two weeks ago. This represents a classical "supply deficiency" which has always offered the private sector an incentive to participate.

The European Ariane launch system has emerged as formidable competition to U.S. systems with an advantageously sized booster system, progressive financing strategies, substantial financial backing from governments and aggressive marketing. Ariane should not be allowed to take over the ELV business unchallenged. Commercializing today's proven U.S. ELVs will provide a capability to accommodate the overflow in launch requirements in direct competition with Ariane.

Besides the obvious desire to keep America first in space as the free world's space launch source, we must also consider how a back up capability can be provided for the Space Shuttle. Our own experience over 25 years shows that unforeseen delays caused by technical problems or untimely hardware anomalies can inject schedule perturbations unacceptable to either the DOD or NASA. Commercial ELVs can provide a ready source of back up.

I support the views stated by Dan Fink, Chairman of the NASA Advisory Council, in his testimony before the Subcommittee two weeks ago on the subject of ELV/Space Shuttle competition. As you recall, he noted that commercial success of the ELVs will create "some unloading of" the Space Shuttle manifest, but that this should be viewed as an encouraging event since it will open up greater opportunities for using the unique properties of the Space Shuttle: its size, the use of man, and its servicing and retrieving capabilities.

In the longer view, it would appear that the application of the Space Shuttle to those missions for which its unique capabilities are required will result in the generation of sufficient demand to fully utilize the STS Orbiter fleet. There are also certain subclasses of payloads, such as the emerging Direct Broadcast Satellites (DBS), for which adequate commercially viable, upper stages for the Space Shuttle do not currently exist. These satellites, which are too heavy for the smaller perigee kick stages currently employed with the Space Shuttle are good matches for Atlas/Centaur. Spacecraft designers have traditionally designed to utilize existing, proven launch capability.

It has also been argued that in the general spirit of free enterprise on which so much of this Nation's progress has been built, co-existence of both the Space Shuttle and U.S. ELVs will have the beneficial result of making both systems operate more competitively, and hence, more efficiently. We certainly feel that this principle will be in full force among the various ELV options which will be available in the event commercialization is permitted to proceed; indeed, we do not ask for, nor wish to see, any "favored status" of one system over another.

As I stated at the beginning of my remarks, we, at General Dynamics, have been pursuing the possibility of commercializing our current Atlas/Centaur system and derivatives for two years. In April of 1982, after one year of assessment and analysis, we expressed our interests in proceeding with such a venture in letters to both NASA and the U.S. Air Force. This was followed by a formal proposal to NASA in January, 1983, to continue the Atlas/Centaur on a commercial basis. The positive cooperation of NASA and the U.S. Air Force, as well as the encouragement we received from the State Department, OMB, and staff members of the White House has been helpful in our efforts. We also appreciate the difficulties of making this transition of valuable national assets and capabilities to the private sector and the magnitude of the effort the many

U.S. Government agencies must expend in order to assure that this process is orderly and in the best interest of the United States.

What we do hope to see is a positive U.S. Government policy regarding commercialization of U.S. ELVs. If such a policy is not forthcoming in a timely manner, much of the opportunity and business incentive will pass from the U.S. to foreign interests. If private sector commercial operation does not take over the tools, facilities, and equipment used to manufacture, test, and launch the ELVs, this entire capability will be lost to the United States. The U.S. Government is already clearly on record as planning to terminate this activity. We will produce our last Atlas/Centaurs in 1985 and have already begun receiving parts from vendors for these vehicles. Vendor production lines for our system are scheduled to close down this year. In addition to the loss of these capabilities there will be substantial reductions in the work force, both for the prime producers and their suppliers. The existence of a foreign competitor will, as already demonstrated, result in American communications satellite operators electing to procure their launch services outside the United States. We in the private sector are offering to maintain, operate, and preserve this national asset at no additional cost to the U.S. Government.

Additionally, we have proposed that we reimburse the government for those added costs directly incurred in support of commercial operations from U.S. Government facilities, such as the range costs at the Eastern Space and Missile Center. While it is theoretically feasible for private operators to build and operate a launch range independent of the current U.S. Government-owned and operated sites, this course of action would not only be prohibitively expensive but would result in the same loss of existing capability that will result if all ELV operations are terminated as planned.

We are encouraged by the recent actions of SIG Space which will soon result in issuance of a policy directive. Implementation of the policy is crucial with direction to the several U.S. Government agencies involved to take the necessary actions to make it happen, e.g., definition of range support and facility usage costs to be charged for commercial launches. A simplified regulatory process, along the lines already outlined by pending legislation, would be welcome. We do not feel, however, that any significant new U.S. Government organization or structure is required. Adequate expertise to provide the necessary management already exists in several branches of the government.

Mr. Chairman, precedents have been set for private operation of U.S. Government developed assets. This practice has been well established in the aircraft, railroad, steel and other industries. Now, we believe that there is an excellent new

opportunity to encourage the "privatization" of a valuable national resource which has taken many years and many millions of dollars to develop, and thus, preserve it for long term benefit to the economy and security of our country. It is our sincere belief that the Space Shuttle and ELVs can comfortably coexist, and do so to the benefit of the nation, each providing the services for which it is best equipped. Commercialization of the ELVs by General Dynamics, and other firms, will be an important step toward a broader base of industrial space-related activity.

Mr. Chairman, we solicit the support of this Subcommittee toward these ends, and I appreciate the opportunity to present our views. I will be pleased to respond to your questions. Thank you.

W.F. Rector, III

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Statement
of
Mr. Peter B. Teets
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Martin Marietta Denver Aerospace

Before

Subcommittee on Space Science and Applications
Committee on Science and Technology
U. S. House of Representatives

May 18, 1983

Mr. Chairman and Members of the Committee:

Martin Marietta Aerospace welcomes the opportunity to address this committee on the commercial development of space. We feel that a viable commercial United States space industry will yield important benefits for decades to come. Martin Marietta has already made commitments to foster the commercial space business and we applaud your efforts to encourage the private sector in this important national endeavor.

My comments today are organized into three parts. First, I will address the national benefits of a successful commercial space industry. Next I will discuss the status of our efforts to produce and launch Titan vehicles on a commercial basis. Finally, I will review specific government actions that will help stimulate an emerging commercial space industry.

National Benefits of a Successful Commercial Space Industry

The national benefits of a U. S. commercial space industry are numerous. The development of such an industry serves many of the federal government's stated policies. One theme of President Reagan's economic policy has been to improve the economy by reducing the role of government and emphasizing private sector initiatives. The development of a commercial space industry will directly help the economy. A proven lower cost alternative to foreign space launch systems will reduce imports and contribute to our balance of trade. Likewise, the acknowledged U. S. leadership in space technology will be enhanced by commercial launch capabilities without burdening the federal budget. These activities directly translate into increases in high-technology jobs with the usual multiplier effects on employment in other sectors of the economy.

A commercial space industry has national security value. Titan, in particular, can provide a backup capability to Shuttle for certain national security payloads. Moreover, Titan can launch a satellite under conditions of international tension or conflict in which it would be undesirable to launch

an orbiter. Our national defense will be further served by the maintenance and expansion of the high technology industrial base. Mobilization of this base during times of conflict will be much faster if a commercial space industry is in place.

Another benefit of commercial Titan, in particular, will accrue directly to the Air Force. A commercial Titan business provides the potential for Air Force recoupment of its investment in residual Titan boosters and components. In addition, the commercial Titan business can be a consumer of residual Titan II propellants, thereby solving an environmental and safety problem facing the USAF.

We feel that expendable launch vehicles, especially Titan, complement the Space Shuttle. Titan will provide a back-up capability to the Shuttle for non-military payloads in the event of schedule delays or priority DoD missions. Moreover, Titan will provide domestic supplementary launch capability during periods of peak civil and military demand. As well as launch capability for hazardous payloads and payloads that are neither technically nor economically feasible to upgrade to man-rated standards. The economic viability of Shuttle will be enhanced by Titan through the provision of attractive launch backup for commercial users.

Since we are discussing the relationship between Shuttle and Titan, I would like to digress momentarily to address the potential for Shuttle and Titan competition. Let me assure you that Martin Marietta has no intention to allow commercial Titan vehicles to compete with the Shuttle. We are pursuing the commercial Titan business because we believe both programs are mutually reinforcing and we believe that launch demand will exceed the Shuttle capacity. Titan launches will compete for this excess demand which otherwise would be forfeited to the Ariane. There is no question that the Shuttle is the dominant and most important United States launch system, but we are convinced that there will be at least one expendable launch vehicle co-existing in the world. The question is will we build Titan in America or will the French build Ariane in France. We estimate that that there are

approximately 6,000 jobs for 220 Titan suppliers in 25 states at stake on this question.

The benefits of a commercial space industry to the United States are large and diverse. Some might argue that these benefits could warrant a significant amount of government investment to stimulate the industry. However, we do not see the need for any government investment to commercialize Titan. What is needed is that no institutional barriers preclude our implementation. I will discuss some specifics on this subject in the last section of my testimony, but let me talk first about our commercial space activities.

Martin Marietta's Commercial Space Business Activities

Martin Marietta's endeavors in commercial space have focused on two distinct product lines. They are the Titan expendable launch vehicle and orbital transfer vehicles. Today, I intend to limit my discussion to the Titan business venture.

The United States has been building Titans since 1955. Some 466 Titans have been built and 293 have flown. The Titan is indeed a mature launch vehicle. It has evolved through ten distinct configurations, including the man-rated Gemini. The success record of Titan has been unparalleled by any other expendable launch vehicle. In the last 5 years, there have been 23 Titan IIIs launched and the success rate has been 100%. In the operational Titan III series, there have been 122 launch attempts and 119 successes -- a 97.5% success rate. Today, the Titan has more payload capacity than any other expendable launch vehicle in the free world; some 31,000 lbs. to low-earth orbit.

At the present time many American products are being criticized for lack of quality. That is clearly not the case with Titan. Americans can be extremely proud of the performance of Titan over the last 28 years. However, the Air Force is phasing out the Titan program and the last government-owned Titans are currently in production. As a result, last summer we took an

in-depth look at the market for commercial satellite launches and developed a conviction that the total launch demand will exceed the capabilities of the Shuttle. The development of the Ariane expendable launch vehicle and its intended use by some American satellite firms has further reinforced this view.

Encouraged by the results of our market analysis, we decided to pursue the commercial launch vehicle business using the Titan vehicle. Our major associate contractors - - the Chemical Systems Division of United Technologies Corporation (UTC) and the Aerojet Liquid Rocket Company - - made a similar decision. In October, 1982, all three companies signed a memorandum of intent with the Space Transportation Company, Inc. (SpaceTran) to act as our agent for commercial Titan sales. Since then, the Titan team of SpaceTran, Martin Marietta, UTC and Aerojet have worked together to establish this business.

Since establishing a market base is critical to long term success, the majority of the team's resources have been devoted to the preparation of a bid to the International Telecommunications Satellite Organization (INTELSAT) for the launch of their INTELSAT VI satellite series. Our proposal to INTELSAT involves a bid for the launch of two satellites, designed to be a complement to the Shuttle and a direct competitor to the Ariane. Production of the Titan vehicles will begin in 1983 and they will be available for launch in 1986. Our belief is that INTELSAT will select the Shuttle as well as one expendable launch vehicle to implement their total launch strategy.

INTELSAT received bids from NASA, Ariane, General Dynamics and SpaceTran. A final decision by INTELSAT is expected in June, and we are confident that the technical merits and performance record of Titan will weigh heavily in our favor.

The financial commitments of the Titan team have been substantial. Significantly larger financial hurdles remain ahead. Funds will be needed for the development/modification effort and for actual production of the vehicles. Our marketing successes in the next few months will be crucial to our decision to move forward with this project. The success of our INTELSAT bid plays a central role in that decision.

There should be no mistake about the uncertainties associated with this commercial space venture. The opportunity to successfully commercialize Titan will only exist for a limited number of months. If commercial contracts are not signed in the near future, then the Titan production line will be closed. Personnel will be reassigned and machinery will be dismantled. It will be extremely costly to regain these production capabilities. Moreover, the investment capital needed to support a commercial Titan venture will not be available unless there is some evidence of near-term sales. Delays in government approval/support would be fatal to commercial Titan. Conversely, any action that the Congress can take to show support for the commercial space launch business would be extremely helpful. I will next review the status of Government actions in the last section of my testimony.

Government Actions

We are encouraged to hear that the President has approved a new Space Policy encouraging private sector entry into the expendable launch vehicle business. Our understanding is that the policy states clearly that the U. S. Government will encourage and facilitate the licensing and/or use to the private sector of those expendable launch vehicle systems that it previously operated. This support will include designs, tooling, ground support equipment, facilities and property that is being phased out. The policy states that government will not seek to recover sunk costs. Moreover, the policy encourages and facilitates the use of national ranges by the private sector. We feel it is only reasonable for the government to retain priority access to joint-use facilities, support services, and private sector ELV launch vehicles for national security or launch opportunity-critical missions. We believe that NASA and DoD should be encouraged to charge private sector ELV operators on an additive cost basis for joint use facilities and support services.

Private sector operators of ELVs must coordinate with the Department of State to assure compliance with applicable national and international laws and treaties. At the same time, ELV operators must meet all applicable security, safety and environmental requirements and regulations. With regard to insurance, ELV operators will need to indemnify the USG, up to appropriate limits, against liability for damage/injury and will indemnify the USG against loss or damage to USG owned equipment and facilities. On the other hand, ELV operators should expect that the USG would provide assistance to private sector ELV operators in any disputes concerning other nations. We do not believe that there is a need to establish any new agency, regulatory authority, or commission.

In your invitation to testify, Mr. Chairman, you asked for views on The "Space Commerce Act" proposed by Mr. Akaka (HR 1011). We applaud the motivation and direction of the Space Commerce Act. It encourages the private sector to pursue expendable launch vehicles as a business venture. In fact, the findings and purposes of the bill parallel today's discussion. A question, however, is whether additional legislation is necessary. Our legal staff has found that existing legislation appears adequate. The Air Force, for example, has the authority to grant the use of Launch Complex-40 at the Eastern Test Range. In an approval in principal letter, Secretary Orr has acknowledged this fact. Nonetheless, he deferred final approval to us pending the on-going executive branch review of commercial ELVs.

The Space Commerce Act seems to be focused primarily on institutional arrangements necessary for centralized control. It centralizes the entire licensing process to expedite the approval process. However, there are some issues that the Act omits. The Act does not direct DoD and NASA to allow private sector use of any government launch facilities. Nor does it encourage the DoD and NASA to allow use of government design and tooling without recapturing sunk development costs. Finally, there do not seem to be adequate safeguards that will prevent premature launch attempts without sufficient development and testing of the launch vehicle system.

This concludes my prepared remarks. We believe the United States would be well served by the development of a commercial space industry. The actions that the government needs to take involve little or nothing in the form of budget outlays, but what actions are required must be taken quickly. The companies involved in commercial space technologies cannot afford long delays in government policy-making or implementation. Production lines and key personnel involved will be lost if commercialization is not successful in the very near future.

Thank you very much for giving me the opportunity to testify before you today.

COMMERCIAL SPACE TRANSPORTATION:
OPPORTUNITIES AND ISSUES FOR U.S. LAUNCH SYSTEMS

TESTIMONY OF DR. KLAUS P. HEISS

THE SPACE TRANSPORTATION COMPANY INC.

(SPACETRAN)

PRINCETON, NEW JERSEY

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

COMMITTEE ON SCIENCE AND TECHNOLOGY

UNITED STATES HOUSE OF REPRESENTATIVES

MAY 18, 1983

Mr. Chairman:

Thank you very much for the opportunity to present my views on the question of commercial space transportation issues and opportunities. My own involvement in this and related questions dates back to the late 1960's and early 1970's.

In the late 1960's and early 1970's, I directed the economic studies that led to - among other considerations - the space shuttle decision of early 1972; in the mid-1970's, I had the privilege of developing the framework of economic principles that ought to underly the space shuttle user charge policy of NASA; in February of 1979, I formed the first United States company whose sole objective it was to bring about the private organization and financing of space transportation systems; and since then, I have been very active in market leased initiatives of both the space shuttle and U.S. expendable launch vehicles - the Titan launch vehicle system in particular.

The issues and opportunities in the commercialization of space transportation are several, among them:

- (1) are commercial opportunities of the space shuttle system such that the private sector, rather than taxpayers, ought to be asked for the funding of an additional space shuttle orbiter;
- (2) should one create a government monopoly in U.S. space transportation or should one follow a market oriented, competitive

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approach between any U.S. space launch systems willing to risk private funds in commercial enterprises;

(3) can and should ELV's compete with the space shuttle in world space transportation markets, and why; and finally

(4) what are economically efficient roles for commercial ELV's and the space shuttle system to fairly - and efficiently - compete in world markets in the 1980's and 1990's.

To explore these questions, I have prepared a rather comprehensive written statement, which I submit with your permission for the record.

The key findings in the prepared statement include:

(1) Estimated Demand for Non-U.S. Government Space Transportation

- The key space shuttle issue identified in 1971 was the need for a strong U.S. space science and applications program to make use of the space shuttle in the 1980's. Such a program - parallel to the shuttle development - was not created in the 1970's. As a result, we see today a substantial reduction in the government demand - and possibly commercial demand as well - for space transportation flights for the rest of this decade.

- A substantial commercial and world market exists for space transportation services, estimated by us at between \$10 billion to \$15 billion from 1983 to 1995. Without an economically efficient

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U.S. space transportation system, this market will increasingly be serviced by foreign launch systems.

- An assessment of the potential commercial demand for space transportation is summarized in Figure 1.1-1 and Table 1.1-2 of the prepared statement: a total of 183 commercial payloads from 1985 to 1995 are projected. These projections assume competitive operations costs and user charges.
- A more uncertain and exciting part is the demand for shuttle unique capabilities by the commercial sector. The most immediate of these - material processing in space - may range from a low of 42 payloads up to 234 payloads through the end of the century.

(2) Commercial Orbiter Opportunity

- The funding of Orbiter V is a pivotal issue to the shuttle and space program. When the nation decided in 1972 to proceed with the development of a new Space Transportation System, a minimum of five and possibly as many as nine orbiters were considered necessary for the 1980's and 1990's.
- Given the relative lack of U.S. Government demand for space transportation in the 1980's, the U.S. Government need for additional orbiters in the 1980's is uncertain.

- Given the commercial and worldwide space transportation market, and with the establishment of a reliable, fully operational government fleet of four orbiters over the next few years, the private sector can afford to fund one or more orbiters in the 1980's and 1990's. If Orbiter V were funded by the private sector, the terms and conditions will have to be on an additive cost basis for orbiter vehicle costs and the cost per flight reimbursement to the (government) operator of the space shuttle fleet throughout the life of Orbiter V.

(3) Commercial ELV Initiatives

- In the near term, the commercialization of U.S. expendable launch vehicles (ELV's) - such as the Titans, Atlas Centaur, and Delta, among others - will allow the U.S. to capture a significantly larger share of the world space transportation market. At the same time, such commercialization will discourage and delay the full development of foreign competition.
- A "Mixed Fleet" (space shuttle and ELV's) will capture a substantially larger share of the world space transportation market than either a "shuttle only" or "commercial ELV only" approach.
- The space shuttle share in world markets may be substantially larger with commercial U.S. ELV's (Titans in particular) since this would allow commercial payload users to grow to larger spacecraft

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sizes - a launch capability wherein the United States today has a monopoly.

- No new government funding is required to bring about the commercialization of U.S. ELV's. Let the market determine which system finds what role in worldwide competition. However, government decisions are needed right now to give U.S. ELV's a chance to compete efficiently in world markets.

(4) Competitive Cost and Pricing Issues

Basic to the success of commercial U.S. space transportation ventures is a fair, efficient, equitable and "market oriented" government policy on user charges - costs and prices. Fundamental therein is the requirement to have the space shuttle compete efficiently in world markets.

Mr. Chairman and members of this Committee: You may rightly question whether all these "adjectives" and objectives can be met by any policy, however well intentioned. Nevertheless, a rather straightforward policy is suggested:

- The delay in Orbiter V procurement and the concurrent reduction of the demand for space transportation have made a four-orbiter fleet cost inefficient throughout the 1980's: a "freeze" of the shuttle fleet at four orbiters for the rest of this decade will make the shuttle fleet non-competitive through possibly 1995.

- The operations cost per flight of a four-orbiter fleet will be at least \$120 million (1983 dollars) averaged over a 12-year period - and may be even higher. An increase of the shuttle user charge from \$71 million (1986 to 1988) to \$120 million (12-year average operations cost per flight) will leave most of the commercial space transportation market to foreign ELV's.
- An additive cost ("out-of-pocket," incremental, marginal cost) pricing policy will have to be applied throughout at least the 1980's if the United States is not to lose world space transportation markets to foreign competition. In the 1986 to 1988 period, even "out-of-pocket" costs for the space shuttle will have to be partly subsidized by the government to meet the projected \$71 million user charge for space shuttle flights.
- The user community should be asked to make the same contribution - per payload carried - to the recovery of costs of government facilities and services whether carried on the space shuttle or commercial ELV's.
- As long as space shuttle commercial user charges do not make any contribution to government facilities and services above real (actual) "out-of-pocket" launch costs, commercial ELV's should have similar - i.e., no cost - access to such facilities.
- The "out-of-pocket" user charge policy for the space shuttle and for ELV use of government facilities and services may have to be

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continued as long as foreign ELV's are competing on that same basis (or less) in world markets.

The United States cannot afford any other policy without seriously endangering its market share in worldwide space transportation in the 1980's and 1990's - a \$10+ billion market.

Beyond the question of commercial space transportation activities is an affirmation of government and industry cooperation to realize the full potential for U.S. space enterprise in the next two decades.

The retrenchment of the U.S. space program in the 1970's - leading to the questions and issues of today - needs to be reversed by a forward-looking government space program, including a new space goal, that will make use of the technical capabilities created by the expendable launch vehicle technology of the 1960's and by the space shuttle of the 1980's. For the United States to advance and capture its part in space enterprise in the 1990's, government initiatives and private sector initiatives have to go forward jointly. The private sector can make its contribution with full government cooperation and efficient rules for the transition to more expanded commercial, private sector initiatives - including space transportation.

The U.S. aerospace industry has been the most dynamic and innovative sector of U.S. industry in world markets and is the largest contributor to net trade (exports minus imports): for every \$1 of sales, the aerospace industry makes a net trade contribution of more than 20c; and

for every \$1 of sales, aerospace spends 20¢ on research, development and testing (see the table in prepared statement).

The aerospace industry has been for some time an example of successful government and industry cooperation. Let us continue this example in space matters: the economic stakes for the United States are enormous. Too much time has already past.

The commercialization of space transportation - particularly of ELV's - is not a "zero sum" situation where whatever the commercial sector gains, the government necessarily loses. Rather, like most economic issues, space in particular is a "positive sum" opportunity: if pursued jointly and fully, the United States' share in world space markets of the 1990's will be large indeed. Without such new direction, we may well repeat the mistakes of the 1970's, while other nations will catch up and overtake where the United States has led for so long.

In the context of such a new, forward-looking space program - centered around a new civil space goal, and an active policy of encouraging commercial enterprise in space transportation and space applications - the need for additional orbiters - including Orbiter V - will become obvious, and the private sector is willing to do its share to bring such funding about.

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"COMMERCIALIZATION OF SPACE"

TESTIMONY OF T. ALLAN McARTOR

FEDEX SPACE TRANSPORTATION COMPANY

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

MAY 18, 1983

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATION
TESTIMONY OF T. ALLAN McARTOR

Mr. Chairman:

It is a pleasure to address this Committee today and to represent Federal Express Corporation in its commercial space initiatives.

Much activity has taken place recently concerning commercial space ventures and the Federal Express involvement in particular.

With the Chairman's permission, I'd like to take just a moment and recap for you the recent turn of events.

As many in this room have been aware, Federal Express has been a minority equity partner in the Princeton based company, The Space Transportation Company, Inc.

As of last week, Federal Express and the Princeton group reached final agreement such that Federal Express would acquire 100% of SpaceTran's commercial Titan program and will continue to pursue that program under the name FEDEX SPACETRAN.

We took this step in order to present INTELSAT with the best possible proposal for launch services of INTELSAT VI spacecraft. As you are aware, INTELSAT will enter into launch services contracts in June.

Hearing, May 18, 1983

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Specifically...FEDEX Space Transportation Company will be a wholly owned subsidiary of Federal Express and will devote itself (as a service company) to the pursuit of commercial space initiatives. It is anticipated that I will assume the Chief Operating Officer position of FEDEX SPACETRAN and Fred Smith (the Founder, Chairman and Chief Executive Officer of Federal Express) will be Chairman of FEDEX SPACETRAN.

I will assure this Committee and the industry that our entry into the emerging commercial space arena is done with caution. This is not a philanthropic gesture nor simply an adventure! We intend to identify the appropriate niche for commercial involvement and to profit from it.

We do not intend to replace government nor to absolve government of its responsibilities in space operations. However, space transportation and the attendant services surrounding space transportation can begin to involve the private sector now.

We feel it is particularly appropriate for Federal Express to not only be involved in commercial space operations but to assist the government and the industry in developing appropriate policies, procedures, and controls so that this new frontier can provide new opportunities to those bold enough and imaginative enough to pursue them.

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Federal Express is very much involved in new technologies of all kinds including an ever increasing use of communications satellites. We operate our aircraft fleet to standards of unparalleled reliability, and our determination to provide totally reliable and predictable services make it only fitting that these management philosophies be transferred to the disciplines required of space operations.

FEDEX SPACETRAN is not, however, a traditional "aerospace" company and hence not burdened with a vested interest in a particular piece of space hardware. Rather, FEDEX SPACETRAN is a service company...able to look at the user community objectively and to provide services that are totally responsive to their needs.

Long range plans of FEDEX SPACETRAN might include launch services and marketing services for shuttle and ELV's, development and marketing of upper stages, financial and insurance programs, payload logistics, and other related services.

Our current activities involve our commitment to commercialize the Titan launch vehicle and to position the Titan as the most reliable and flexible ELV to augment the U.S. Space Transportation System.

We chose the Titan because of its throw weight capability, reliability, and flexibility...and because of its availability.

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How do we see the role of government?

If we can assume...and I believe all of us here can...that commercial space operations are certainly in the national good and are as strategic to our economy as energy exploration and other transportation infrastructures, then...

1. The government should provide, maintain, and operate launch facilities and ranges just as it does with harbors, canals, bridges, airports, highways, and other transportation "bases" that allow the commercial operator to access this "base" under some appropriate but not burdensome user fee basis.
2. The government should encourage private initiatives in space through tax incentives, loan programs, or even guarantees.
3. "Space development corporations" similar in design to SBIC's or MESBIC's might be set up to not only encourage initiatives, but to provide necessary start up capital.
4. An inter-agency group should be formed with the authority to develop appropriate oversight controls and to implement the government's commercial space program. Currently, no single agency has all the necessary skills to become the lead agency at this time...and it

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would take too long to educate any given one without delaying the commercial initiatives now underway! Plus, a special commission could operate on a new and streamlined basis.

NASA has all the space expertise, but the FAA has experience in licensing and administering controls, etc.

5. Each commercial space "launch" services company should apply for a license that includes a demonstration of technical competency and that pertains to a particular class of launch vehicle using specific fuels. These certificates would parallel the authorities granted air carriers today.

In closing, I would simply like to reiterate that in order for the United States to retain its supremacy in space operations and exploration, it must provide totally responsive services to meet the needs of the "space user" community. This industry that will approximate \$10 billion in only a decade has already expressed the necessity for a viable Space Shuttle program plus a reliable ELV, a broader based finance and insurance pool, and a streamlined process for accessing the space transportation network.

Federal Express Corporation, through its subsidiary FEDEX SPACETRAN, looks forward to making a positive contribution to the solution of these commercial space problems and to enhance this Nation's space transportation system.

STATEMENT OF

JAMES C. BENNETT
Vice-President of Government Affairs
Arc Technologies

before the

SUBCOMMITTEE ON SPACE SCIENCE AND APPLICATIONS

COMMITTEE ON SCIENCE AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

Mr. Chairman and Members of the Subcommittee:

I would like to begin by expressing on behalf of Arc Technologies and its president, Mr. Michael Scott, our gratitude for this opportunity to introduce our company to you this afternoon. Arc is very encouraged by the timely interest shown by the Committee in what is a new and rapidly accelerating commercial sector, the industrialization of space.

We trust this hearing will be one of many exchanges between this Committee and new enterprises, such as Arc, in order to better explore the ways in which governmental policy can encourage more American activity in this high-risk but increasingly vital growth area.

It is our perception that space development is in the midst of a transition from an experimental and exploratory phase to an era in which more and more activity is undertaken on a commercial basis. Policy decisions made now by the federal government will impact this process, either positively or negatively.

Arc Technologies has held from its beginning that this transitional period can be facilitated by a Federal policy based on the principle of competitive privatization: the substitution of competitive privately-financed activities for governmental activities whenever possible; and allowing the market to guide decisions currently made by government fiat.

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The government has a valid, indeed, necessary interest in this area. However, instead of direct government involvement, what is required is a reaffirmation of the principle that the civilian space arena has been unequivocally opened to commercial activities. As a result, current involvement of private investors in areas such as space transportation, remote sensing, space industrial research, and advanced space-based communications will broaden into significant investment and entrepreneurial innovation. Once the government stands back and declares space open to business, our own activities will be testimony to the tremendous American entrepreneurial spirit of innovation (unequaled in the world) ready and eager to take on the foreign challenge in space.

As the field matures, space activity will separate into civilian space research and science, purely commercial activities, and defense spheres with activities carried out in each by appropriate sectors: a strong NASA dedicated to leadership in space science and exploration, a strong private sector seizing leadership in space commercialization and transportation, and a strong national security effort.

Arc believes that this emergence of market-driven decisions in the field of space transportation is the key to the development of a diverse, readily available, commercially oriented transportation segment in America's space arena. Arc expects to create its market niche in this area by developing and operating targeted transportation services developed to meet the special needs of customers.

We expect to derive cost-effectiveness through flexible and short turn-around decision-making, as well as some of the financing and marketing approaches common to other American high-technology entrepreneurial industries. This market-oriented, customer-sensitive approach, combined with reduced prices, can be expected to create a new level of demand and use of space by American industry across the board. To fill the void for a launch system tailored to meet the needs of customers, Arc went back to the drawing-board to design a new system intended to avoid the high labor, material, and capital costs

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associated with today's launchers which are oriented to military, manned, and exotic research missions.

Although its particular service may appear futuristic, Arc believes that its approach is very much within the renowned American tradition of entrepreneurial innovation. As shown by the range of witnesses who have appeared before this Committee, there is a growing community of private space firms eager to offer an entrepreneurial response to maintain this nation's preeminence in space technology.

The pressing need now is not for the commitment of large amounts of government funds in transportation or industrialization; rather the call is for private risk and reward through a policy committed to a clear mandate for private action in space. In so doing, business will look to government to keep regulations at the minimum needed to meet public security/national security objectives.

Arc Technologies was founded in early 1981 by a group of entrepreneurs in the San Francisco Bay Area with the goal of offering a variety of commercially financed and developed launch services. The company was founded with the view that the financial and business approaches which have proven so successful in the electronics industry, and which are now extending to biotechnology, can be applied to space development.

Over the past two years, Arc has worked at its business and technology development strategy, raised sufficient funding for its initial launch activities, and increased its staff to the level necessary for its current activity. We have brought on board senior management personnel, including Arc's President, Michael Scott, formerly president of Apple Computer, and other senior management and technical personnel from United Technologies, Lockheed, Ford Aerospace, and other well-established aerospace firms.

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Arc expects to succeed in this business by selecting the most cost-effective technical approaches rather than the most performance efficient technical approaches. By innovatively selecting alternative technical approaches with modestly lower technical performance, Arc expects to eliminate categories of cost and risk which are unavoidable using traditional launch technologies. Essentially, Arc will introduce a 'Mack truck' level of performance in space, rather than the current 'Porsche' level of technical efficiency. This emphasis on economic efficiency, rather than aiming for the limit of technical possibility, will enable Arc to achieve a high level of reliability quickly, with low development risk and at relatively low development cost.

Drawing on currently available technology, Arc is designing, assembling and fabricating its vehicles in house. We are employing aerospace subcontractors only for selected components and subassembly. We intend to rely as much as possible on commercial standards of operation and commercial business practices.

We have successfully conducted propulsion tests of engines of our own design and manufacture, including full scale flight-size engines, and have worked on the marketing, regulatory, legal and other aspects of this business.

Our development schedule calls for a flight test of our launch vehicle this year. Following the conclusion of flight testing, Arc will offer a sounding rocket */service on a commercial basis. Our long term objective, proceeding from a systematic effort to match our technology to meet changing customer needs, is to develop a launch system with orbital capability.

*/Sounding rockets are used for investigations in, among other areas, astrophysics and microgravity processing research. They carry packages of scientific instruments and experiments to altitudes from twenty to a thousand or so miles. A sounding rocket's effective lifetime until it drops back to Earth usually lasts no longer than several minutes. Its advantages to scientific and industrial users are several. It is the only vehicle which can perform investigations in the region from 30 to 100 miles above the Earth. Balloons cannot carry equipment above 30 miles and satellites are generally impractical to use below altitudes of 100 miles due to atmospheric drag. Above all, the relative ease (cont. on page 5).

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Although based on existing knowledge and materials, Arc's launch system has several innovative features. One of the more prominent of these is that the vehicle will be launched directly from the open seas. In fact, our test launch will be off the California coast. In order to minimize the risk from launch activities, it is probable that the launch site will be 200 miles or more out in the Pacific. The initial test vehicle, designated the 'Dolphin', will achieve an approximate altitude of 100 miles and a downrange trajectory of about 10 miles.

This test launcher will not be carrying a payload. We intend to recover both the booster and payload bay, which will be landed by parachute, retrieved and carried back to harbor for refurbishment.

Among other objectives, this flight test will demonstrate our operational capability: to take from the drafting board to development a privately financed and designed rocket, launch and recover it. A critical objective is to strive for a cooperative relationship with the appropriate government agency officials and, thereby, lay the basis for a launch permit review process which will accommodate the need for certainty and predictability required by investors and customers in routine commercial operations.

In the interests of achieving such a relationship with the government, last summer Arc initiated a low-key approach to acquainting officials with our company's background and goals. These discussions, which involved officials in the White House, State Department, Defense Department, NASA and FAA gave both the agencies and Arc a chance to explore the various issues generated by our business venture prior to actually seeking the government's approval to launch.

We are happy to report that so far all of our discussions and dealings with the agencies have been conducted in a spirit of mutual cooperation and encouragement. NASA Administrator, James Beggs, one of the first officials we briefed on our plans, set the tone for our subsequent talks with the government by offering his support and saying, 'Welcome to the club.'

*/(cont. from page 4)of launch and payload recovery operations give the user flexibility in terms of conducting an experiment at the time and place preferred.

Arc is in the midst of a governmental review of its request to launch and, thus, lacks sufficient information to make specific comments on the impact, adverse or otherwise, of regulations and agencies on private launch activities. Instead, we would like to provide a brief overview of the steps Arc is taking to obtain approval of its launch. We would then like to bring to the Committee's attention some general characteristics of a launch approval process whose incorporation would greatly assist in encouraging commercial space activities.

As a result of Arc's intention to move its launch vehicle from U.S. territory and launch it from the high seas, the company is required to obtain a temporary export license (under the Arms Export Control Act) from the Department of State's Office of Munitions Control (O.M.C.)^{**/} Because of the liability assumed by the U.S. in the event of damage to third parties (under the Outer Space Treaty and the Convention on the International Liability for Damage Caused by Space Objects), the Department of State has requested that launch operators obtain adequate insurance and agree to indemnify the U.S. for any damages that may result. In this regard, Arc is currently negotiating with a leading insurance broker for the necessary coverage.

Also, Arc intends to initiate the procedures for the issuance of notices to mariners and airmen, and has discussed with the Department of Defense procedures for DOD officials to be given prior notice of our flight testing.

To satisfy itself that Arc's launch procedures and operations do not pose undue risks to persons and property not directly involved in the launch activities, O.M.C. has referred our application to DOD, NASA and FAA for their technical input. During the past several months, we provided technical briefings to these agencies on our systems and launch plans. After completing their evaluations, the agencies will report back to O.M.C. with their comments. O.M.C. will then render its decision.

Although our view may change as we continue to seek an export license to launch, it appears that this approach will achieve launch approval as long as the operator is in a development, prototype stage. However, in order for investors and customers to have faith in the availability and predictability of private space

**/Also, the State Department has defined a launch per se as an export activity.

transportation, a long term regulatory structure oriented to commercial business practices must evolve. Although it is too early for us to define exactly what that system ought to be, we can make a number of general observations and recommendations:

- o first and foremost, the regulation of commercial space activities should be kept at the bare minimum required to meet public safety/national security objectives;
- o the federal government should reaffirm its commitment concerning the private sector's right to pursue activities in space and should support an even-handed approach to defining impartial, non-burdensome standards for meeting its concerns;
- o launch service operators should not be required to undergo redundant permit review processes. E.g., an operator should not be mandated to go through an export license review if another procedure for accomplishing the same goal has been established;
- o the government should avoid subsidizing, or in anyway unfairly supporting, one launch operator against another;
- o the government should not impose inflexible means for meeting public safety standards, especially when dealing with different types of launch technology. Nor should national range standards be automatically and universally applied to different launch operators;
- o in its deliberations on public policy in this area, the government should recognize that it can offer no more than an interim solution to coordinating private launch activities. Any long term approaches (e.g., designating a permanent lead agency and setting long term safety and security criteria) can only be developed in the light of growing operational experience.

In our view, the following characteristics should be incorporated into any government involvement in the commercial launch business:

- o the lead agency should have a mandate to promote space industry, as well as protect the public interest. If it rejects a launch permit request, it should be constrained to offer reasonable alternative approaches to obtaining approval;
- o it should be granted real preemptive powers to make decisions. To expedite the process and, thereby, protect all parties involved in the approval process, the federal government should seek to preempt state laws which might divide or dilute the lead agency's authority;
- o any regime overseeing private launches should be flexible enough to permit innovative approaches to meeting safety standards. E.g., the government could set the basic safety standards with an understanding that launch operators have the resident expertise to carry-out their own range safety review. It is our belief that the requirement for insurance coverage (to a level set by the government) would provide an incentive for operators to satisfy public safety concerns;
- o any attempt by the government to define safety standards should be based on the extent to which a launch activity poses an undue risk to persons and property not directly involved in the operations. This scrutiny should be related to the potential risk represented by the operator's particular launch technology, where the launch takes place, and so on. In this regard, mandatory insurance requirements should not be uniform;
- o the costs to the launch operator for meeting launch permit review requirements ought not to be unduly burdensome.

In summary, Arc Technologies is part of a growing number of entrepreneurs who have amassed the capital and talent necessary to undertake the risks associated with commercial space development. To date, the federal government has been most cooperative and supportive in our efforts to obtain permission to demonstrate our launch technology. However, if routine, commercial space transportation operations are ever to become established, the government must create an environment which fosters this nascent business rather than impedes or stifles it. We have suggested ways in which the government's launch approval process might be made more sensitive to the pressing needs of commercial space transportation operators for certainty and predictability.

To assist the Committee in its deliberations in this public policy area, Arc will be happy to keep you informed of our progress as we continue to seek approval for our demonstration launch this year.

At this point, I will try to answer any questions that you may have.