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Paper Session III-A - Space Launch Commandos: An Alternate Spproach to how the Military Currently Conducts Space Launch

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SPACE LAUNCH COMMANDOS
An Alternate Approach To How The Military Currently Conducts Space Launch

by Daniel P. Lewandowski
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A. SUBJECT AND PROBLEM STATEMENT

The United States is becoming increasingly dependent on space assets for the conduct of peacetime and wartime military operations. The Gulf War was the first "space-age" war in which space based assets played critical roles in communications, navigation, weather prediction, missile launch detection, and intelligence gathering. Future military actions will all depend heavily on space based assets.

Access to space for national security payloads is provided via space launch complexes located at Cape Canaveral Air Station in Florida and Vandenberg Air Force Base in California. Polar or retrograde orbiting satellites, such as the Defense Meteorological Satellite Program weather satellites, are launched from Vandenberg Air Force Base[1]. Low inclination and geostationary satellites, such as Global Positioning System navigation satellites and Defense Satellite Communications System Phase III communications satellites, are launched from Cape Canaveral Air Station[2].

This paper discusses the current role, practices and problems associated with DoD managed space launch. A discussion of benchmarks used to demonstrate better methods of conducting space launch follows. Next is a summary of the actions needed to improve national security launch capability. And finally, details for a totally military launch capability are outlined.

The President's Policy on Space Transportation reaffirmed the DoD role to provide space launch capability for national security missions[3]. This paper is consistent with the President's policy while it addresses problems of high cost, low flexibility and response, and inefficiencies with regard to current space launch practices. These problems stem from three causes. The first cause is the large number of personnel required to complete a launch campaign. The multiple layers of personnel consist of government, government funded, and contractor organizations who watch the actual contractor do the work. For a launch or launch preparation activity, there could be personnel from Air Force Materiel Command, Air Force Quality, Air Force Space Command Safety, Air Force Space Command Operations, Aerospace Corporation, and the contractor's own quality control office, who are observing the work being accomplished. Each organization has its own justifiable reasons for wanting to participate. Unfortunately, many are adding little or no value to the process.

The second cause is the fact that the current launch vehicles are all derivatives of Intercontinental Ballistic Missiles (ICBMs) designed more than 20 years ago. I use the B-52 bomber as an example. The B-52 has accomplished the bombing mission for about 30 years. Over time, the B-52 has been modified and modified again. It can perform the mission, but it cannot go beyond the basic limitations of the air frame. The Atlas, Delta, and Titan are boosters with similar basic limitations. They can do the mission, but they are not representative of what we could do with a new launch vehicle. Because of modifications and pushing the limits, our launch vehicles basically operate at their limits with little or no margin for error. By way of comparison, some of the Russian launch vehicle are so robust that you can hit them with a sledge hammer and not harm them.

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[1] Interavia Space Directory, 1990-1991, pages 178-179
[2] Interavia Space Directory, 1990-1991, page 180
[3] Air Force Space Launch Modernization, White Paper, February 1995

The third cause is the fact that space launch is still considered high tech research and developmental by many. As such, it is acceptable for each payload and booster configuration to be different from another. Some payloads, and the way they interface with the booster, are not very different. But other payloads are very different. Using the B-52 analogy again, imagine having to modify the B-52 every time ordnance is loaded on to the B-52 because none of the ordnance is standardized. The same holds true with the Atlas, Delta, and Titan launch vehicles. For every nearly every launch, the booster is modified somewhat so that there is a proper payload/booster interface. Additionally, the booster engine performance, avionics, and software are modified to fit different payloads.

The objective, therefore, is to conduct the national security space launch mission while reducing the number of personnel involved, maintaining or improving reliability, maintaining or improving safety, maintaining or improving security, and reducing the cost of space launch operations.

B. CURRENT MILITARY AND NATIONAL SPACE LAUNCH PRACTICES

The direction given to the military in the 1990s regarding Air Force Space Command (AFSPC) involvement in launch operations began with a 1990 letter from the Secretary of the Air Force, the Honorable Donald B. Rice. Mr Rice directed a transfer of space launch operations from Air Force Systems Command (now Air Force Materiel Command) to AFSPC. He stated further that "This change in assignment of roles and missions further normalizes space operations and pursues our corporate commitment to integrate space power throughout the full spectrum of Air Force operational capabilities."[4]

In 1993, a memorandum of agreement between the AFSPC and the Air Force Materiel Command (AFMC) delineated responsibilities. AFSPC is responsible for operating and maintaining space launch bases, managing launch base processing, and operating and maintaining booster systems. AFMC is responsible for sustaining engineering, launch of developmental test and engineering, and research and development payloads, acquiring and providing flight-worthy equipment, and providing validated processing procedures.

Basically, AFMC acquires and delivers boosters and DoD payloads to the space launch base. The National Reconnaissance Office (NRO) is responsible for acquiring and delivering payloads to the launch base. At the launch base, contractors for AFMC receive and process the hardware. Various Air Force and NRO personnel oversee the processing of the payload and booster while the contractors do the hands-on work. In essence, with the exception of operating the range, transfer of responsibility from AFMC to AFSPC has not taken place as directed since contractors for AFMC still do the work.

Space launch processing begins with planning for the arrival of flight hardware. Hardware can arrive via aircraft, truck, or even ship is some cases. Documentation is reviewed and updated to support the effort. Hardware arrives and is off-loaded at the receiving inspection facility. Once the hardware passes basic inspections, it is either stored or moved to a processing facility. At the processing facility, preparation of the hardware for launch begins. Build up and checkout takes place, various new checks are made to the built up hardware, and computer programming takes place. The hardware is moved to the launch pad and the spacecraft is mated to the booster. Destruct ordnance can be installed before hardware is moved to the launch pad or installed at the launch pad. Solid rocket motor boosters are also mated either just prior to the move to the pad (Titan) or while on the pad (Delta). Checks are conducted and the vehicle is basically ready for launch. This processing takes 35 (Delta) to 180 (Titan) days for a nominal timeline, but can vary considerably depending on how many modifications must take place for the specific payload being launched.

[4]Letter from Secretary of the Air Force (Donald B. Rice) to ALMAJCOM-SOA on Air Force Space Policy, 12 Jun 90

C. SUMMARY OF BENCHMARKS USED

Sometimes, the best way to solve a problem is to take great ideas from many different sources and combine them into a new larger idea. This paper does just that.

The different benchmarks used in this paper begin with Arianespace, the organization responsible for executing the goals of the European Space Agency. Its "Centre Spatial Guyanais" is located in French Guiana, near the city of Cayenne. I choose Arianespace as a benchmark since "In the world of commercial launches, Arianespace is king."[5]

The Air Force's own Civil Reserve Air Fleet (CRAF) provides a model for using civilian capabilities in day-to-day and surge (wartime) environments. "Under CRAF, civil air carriers commit personnel, services, and aircraft to support the Pentagon when needed, in return for contracts to transport military personnel and goods."[6] The CRAF has been instrumental in ensuring the needed troops and supplies get where they are needed when they are needed by using civilian capabilities to augment military capabilities.

With the fall of the iron curtain, the United States is getting its first glimpses of how the Russians conduct space launch operations. With their extensive experience in space launch operations it should come as no surprise the Russians are good at what they do. "From a logistics perspective, the Russian Zenit spacelift system, is without question, the worlds most operational system."[7] Hence, their practices become a blueprint for success.

The idea of a totally military launch capability is not new in the United States. Military personnel currently run all Intercontinental Ballistic Missile (ICBM) operations and they have done so for decades. Using principles and practices that are tried and true in ICBM operations, the space launch "business" can similarly "normalize" operations.

The Federal Aviation Administration standardizes air travel and runs airports for commercial airline use. State port authorities standardize and run shipping ports. These practices represent an approach to doing business wherein the government can ensure a level playing field and ensure the safety of the general public, while not actually flying the airplanes or sailing the ships. Their examples can be used should a similar approach be applied to the Eastern and Western Launch Ranges.

D. SUMMARY OF ACTIONS RECOMMENDED FOR A DoD LAUNCH CAPABILITY

The actions to accomplish a totally military space launch capability are many and may seem overwhelming. They actually are not. In fact, implementation of this entire approach would either cost the government very little more money than it already plans to spend, or even save some money.

The actions have already begun in at least one area. The Evolved Expendable Launch Vehicle (EELV) is in the early stages of development as a replacement for the military's current launch booster fleet. Given the right direction from the military, the EELV could become the standardized launch booster for military, commercial, national, and civil (NASA) payloads.

New space launch facilities will be needed for EELV. Establishment and modernization of well engineered processing and launch facilities will greatly reduce processing time and personnel while maintaining or increasing reliability and maintainability.

Conversion of the launch Ranges from military to civilian government management would separate commercial space launch from military space launch much like the way commercial and military aviation is separated at airports run by the Federal Aviation Administration. Military access to the ranges would be guaranteed by the federal agency running the Ranges, while military involvement

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[5] Air Force Magazine, "How Ariane Does It", February 1995, pages 66-71

[6] Air Force Magazine, "CRAF Dollars Increase", December 1995, page 20

[7] Russian Launch Operations Overview Trip Report, Submitted to the Foreign Space Launch Comparison Study for the trip which took place 24 August 1994 to 1 September 1994, section V

in commercial launches would cease. In times of crisis, like wartime, commercial space launch could augment military launch capabilities just like the CRAF currently augments airlift capability.

The current Air Force organizational philosophy and personnel system greatly facilitate the organization of a new unit at each range and the dismantling of all other military involvement in space launch operations on the Ranges. One relatively small, military space launch unit, with its own maintenance and operations personnel, using established Air Force Specialty Codes, can do the mission of national security space launch.

E. CURRENT UNITED STATES AIRLIFT CAPABILITIES AS COMPARED TO SPACE LAUNCH CAPABILITIES

The Air Force is responsible for the airlift portion of the United States Transportation Command mission. The Air Force Mobility Command accomplishes the airlift mission using military C-141, C-5, C-130, and C-17 aircraft. For additional airlift, the Air Force uses commercial airlift sector via the Civil Reserve Air Fleet (CRAF). CRAF contracts for fiscal year 1996 total more than $290 million and airlift planners estimate there will be an additional $321 million of unplanned civil air business.[8] With a projected total of more than $600 million in civilian augmentation, the AF obviously trusts and depends on the commercial sector for vital airlift support.

The Air Force should approach its mission the same way and stop supervising commercial space launch. The military should establish its own independent capability, with civilian augmentation. A lesson on proper military involvement can be learned from the history of airmail. In May 1918, at the request of the United States Post Office, the Army began airmail service.[9] By August of that same year, the government realized that it was a bad idea for the military to run a commercial operation. The government should realize that military oversight of commercial space launch should cease immediately. Let's look at how this can be accomplished more specifically.

First, establish two new military only launch pads at each of the military space launch bases. One pad might be enough if processing time were reduced to around 8 days like the Zenit, and the military and national payload launch rate remains around 7 launches per year. However, two pads are recommended so that 1) maintenance and upgrades can occur on one pad while the other launches and 2) a problem or failure at one pad does not completely halt launch operations (redundancy).

Second, turn over all other existing launch pads, as well as range facilities, to the United States Department of Transportation (DOT). These resources go to the DOT because it is already involved in the space launch business via its licensing requirements. The DOT also has extensive experience in enforcement of safety regulations, construction and maintenance of airports, and utilization of navigable air space via the Federal Aviation Administration.

Third, establish agreements between the DOT and the Air Force for joint use of the Eastern and Western Ranges. The Air Force already has many agreements between active duty units, reserve units, guard units and local airports. Many military and civilian organizations share common facilities and resources such as the agreement between the Colorado Springs Airport and Peterson Air Force Base in Colorado where they both share the same runway, but use separate facilities in preparation for takeoffs. Established agreements would ensure access to necessary resources for both commercial and military space launch from separate processing and launch pads, while using the same Range for launch. Additionally, multiple sources of income from the DOT, NASA, DoD, and commercial users would be able to support the massive infrastructure which is currently supported by about $279 million in Air Force funding, and about another $100 million in reimbursement. [10]

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[8] Air Force Magazine, "CRAF Dollars Increase", December 1995, page 20

[9] Encyclopaedia Britannica, 1981, Volume 7, page 395

[10] 45th Space Wing Mission Briefing as of 1 Dec 95

Fourth, like Air Mobility Commands' use of a CRAF, the Air Force Space Command should establish a Commercial Booster Reserve Capability (CBRC). The CBRC would be a contractual agreement exchanging Air Force funding for ensured compatibility between commercial boosters and military payloads. Then, should the EELV experience design problems or other anomalies which prohibit the vehicle from being flight-worthy, or should a war break out such that a launch surge is required, the military can easily convert to the use of commercial launch vehicles for its military payloads.

F. THE BOOSTER, MODERNIZE

A few years ago, the Air Force correctly determined that although the current fleet of C-141, C-130, and C-5 aircraft are capable of completing the airlift mission, a new aircraft was needed. The Air Force could have ordered more C-130 or C-5 aircraft, but that option was not taken. All three existing aircraft have undergone modifications to increase their capabilities, and could have been modified again. But that action was not taken either. A new aircraft, a modernized aircraft, was necessary. The concept of the C-17 was born. Today, the C-17 is operational. It blossomed into an airlift asset that is not only capable of meeting the mission needs of the military, but provides the United States a competitive edge in the combat arena. The United States, and the Air Force specifically, now have capabilities that no other nation in the world can match.

Like Air Mobility Command, the Air Force Space Command needs a new lift vehicle. Our current fleet is based on 1950's technology and thinking. The first Titan was flown on 8 April 1964.[11] The first Delta was flown on 13 May 1960.[12] And the first Atlas was flown on 11 June 1957.[13] It is time to stop modifying, and start modernizing with an entirely new space launch vehicle.

For years, NASA and the Air Force pursued the National Launch System, the Advanced Launch System, and the Spacelifter.[14] However, development of a new launch vehicle was deemed too costly with the $8 billion price tag. A new concept, the Evolved Expendable Launch Vehicle (EELV), with a price tag of only $2 billion, is gaining support from every military service and congress. In fact, up to $560 million could be saved between the years 2000 and 2020 when you compare the costs of the current fleet to the expected costs of a new launch vehicle. [15]

On 24 Aug 95, the Air Force took the first true step towards a new space launch vehicle. Four contracts for $30 million each, were awarded to begin development of an EELV. Over the next 15 months, these contractors will develop their concepts under the contracts just awarded. In 1998, the Air Force expects to select one of the four for full scale development. [16]

Which contractor wins and the exact approach they use is not what's most important. What is most important is that the Air Force continue the EELV effort and ensure proper integration into the rest of the recommendations of this paper. The Air Force cannot allow for the EELV to be developed in seclusion from all else that is needed to properly conduct military space launch operations.

G. THE PROCESSING, AUTOMATE AND STANDARDIZE

Automation and standardization are keys to the Russian Zenit launch vehicle. Below are examples of how launches of the Zenit, about one and a half times the size of an Atlas booster, are automated and standardized. [17]

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[11] A Historical Look At United States Launch Vehicles, AN SER'S International Aerospace Division, 994, page 11.C-21
[12] A Historical Look At United States Launch Vehicles, ANSER'S International Aerospace Division, 994, page 111.A-17
[13] A Historical Look At United States Launch Vehicles, ANSER'S International Aerospace Division, 994, page H. B- 17
[14] Air Force Magazine, "How Ariane Does It", February 1995, page 69
[15] Air Force Times, "Developing a New Rocket", 25 Sep 95, page 40
[16] Air Force Times, "Developing a New Rocket", 25 Sep 95, page 40 and other various sources
[17] Russian Launch Operations Overview Trip Report, Submitted to the Foreign Space Launch Comparison Study for the trip which took place 24 August to 1 September 1994, section IV

Example #1: Prior to arrival at the launch base: "The Russians test extensively at the manufacturing location and not at the pad. They have chosen to automate for this system to take personnel errors out of the system."

Example #2: At the launch base: "Most vehicle assembly is done horizontally with minimum crane operations. Most operations are standardized and not unique 'one of a kind'. Fueling operations (via autocouplers) are minimum manned and for the Zenit system they avoided handling any hypergols and solid rocket motors."

Example #3: For launch: "The Zenit Launch Commander explained that he had about 60 people in the control room and no personnel on the pad at transporter arrival or erection. The whole process was not personnel dependent."

"In summary, the Zenit system is a very simple, highly reliable, low maintenance, system which does not need large numbers of personnel to operate. "

Standardizing and automating the processing of space launch vehicles is not a new concept nor is it one that has never been used in the United States. Prior to Congress's forcing of DoD payloads onto the Space Shuttle, the Air Force had a "factory-to-pad" operation with the Titan III. This limitation of processing at the launch base was very similar to the current Zenit and Ariane approaches. "The Air Force's easily processed missions ended when military satellites were redesigned to fly on the shuttle." [18]

H. THE PERSONNEL, AIR FORCE OPERATORS AND MAINTAINERS

Personnel for space launch operations need to be looked at in terms of numbers, in terms of source, military versus contractor, and in terms of type, officer versus enlisted. The main objective of personnel selection is to ensure mission success, but other considerations such as cost minimization, public safety, and national security are important too.

Numbers. As incredible as it may sound, the EELV concept will actually reduce the number of personnel needed for space launch operations. Maj Gen Robert Dickman, director of Air Force's space programs at the Pentagon stated that as many as 2,500 jobs could be eliminated under EELV.'9 Arianespace provides a good example of how a modernized system can reduce manpower. "Ariane's data are displayed and analyzed by computers; US rockets still employ engineers in a back room reading strip charts from each sensor."[20] The mission is still assured, but technology is used so that extra personnel are not needed.

Also, assuming the Air Force gives up all other activities except its two launch pads on each coast, the number of Air Force personnel will drop. There are currently about 400 personnel in the Air Force's 45th Space Wing Operations Group at Cape Canaveral Air Station. If the east coast launch operations ran similarly to the Russian Zenit program as previously mentioned, only 120 personnel would be needed (60 for each launch pad). All the positions currently involved in the oversight of contractor operations would cease to exist. The number of contracting officers would be reduced. In short, an adoption of a military only launch capability, coupled with a new launch vehicle would result in less manpower.

Source. Studies show that, in general, military personnel cost more than civilians for a job. Hence, for non-combat jobs, many are filed with civilian personnel. Civilians are also used when experience is needed in a job. The Air Force uses civilian positions to maintain continuity and expertise with weapon systems. An example is found at Undergraduate Pilot Training where aircraft

[18] Air Force Magazine, "How Ariane Does It", February 1995, Page 70
[19] Air Force Times, "Developing a New Rocket", 25 Sep 95, page 40
[20] Air Force Magazine, "How Ariane Does It", February 1995, page 71

maintenance is performed by civilians. However, even in light of these good reasons for civilian personnel, the future of military space launch should make military personnel the preferred choice.

Before explaining the role of the United States military personnel in space launch of DoD and national payloads, let us look at two examples of how military personnel conduct space launch operations today. First is the Russian space launch operations at Baikonur Cosmodrome, home of the Soyuz/Progress and Zenit. "Launch operations are fully 'blue-suit'."[21] The Russians can mainly do this because "most officers spend 20 years on site," "officer personnel are engineers and graduates of the Russian Space Academy at Star City," and "the minimum tour is 10 years in various positions."[22] The Russians achieve continuity and do so at a minimal cost since their military personnel are not as expensive as those from the United States.

The second example comes from right here in the United States. Every day of the year, Air Force personnel repair space launch vehicles, operate the launch consoles, and regularly launch... with the Intercontinental Ballistic Missile (ICBM) fleet. The Air Force has proven that with proper training and documentation, enlisted personnel can prepare missiles for launch and maintain them. In fact, when missile maintainers from an ICBM base, or when any personnel with operations experience, come to Cape Canaveral Air Station, they laugh at the Air Force maintenance personnel stationed there because all they do is observe contractors performing the preparation activities. At FE. Warren Air Force Base, Wyoming, the missile maintainers, the 2MOXX career field, turn the wrenches, connect the wires, and even install nuclear warheads. At the Cape, the 2MOXX personnel simply observe a contractor do the work.

Expertise at the ICBM bases is maintained by keeping the personnel within the career field. Some noncommissioned officers (NCOS) have more than 20 years experience with the Minuteman system. Air Force personnel can definitely develop the expertise and continuity for launch operations at Vandenberg Air Force Base or Cape Canaveral Air Station just like they do at F.E. Warren Air Force base or any of the other ICBM bases.

Air Force officers, from the 13SXX career field, and Air Force enlisted personnel, from the 1C6XX career field, have been conducting space operations of one type or another for decades. In the middle 1980s, Air Force officers began operating satellites despite cries of "lack of experience" and "can't be taught something that complicated." Today, the Air Force not only accomplishes the satellite operations mission with "blue-suiters" but it does so with mostly enlisted and some officer personnel. Similarly, Air Force officers and enlisted personnel can be solely responsible for launch. Like the ICBM missile crew commanders, Air Force officers can be trained for launch operations. And like military satellite operations, enlisted personnel can take over most of the launch personnel requirements. A minimum time on station requirement of at least 4 years, just like missile officers, should be instituted. Additionally, a very serious training program, like the Russian Space Academy, should be a precursor to space launch duties. The training program should have high tech simulators and intensive instruction, just like the training program for Minuteman and Peacekeeper.

Lastly, continuity and expertise should be maintained via a new reserve unit at each coast Reserve military personnel stay in place for long periods of time and become very good at what they do. A reserve unit would also give the launch bases a surge capability during crisis situations while also being able to effectively stand-down during periods of scheduled pad maintenance or upgrades.

Type. When military satellite operations began, the only personnel considered for duty were officers with a engineering, math, or computer education. Once operations began, officers with no

[21] Russian Launch Operations Overview Trip Report, Submitted to the Foreign Space Launch Comparison Study for the trip which took place 24 August to 1 September 1994, section III

[22] Ibid., section III

technical background were deemed acceptable. Today, almost the entire crew is manned by enlisted personnel. Space launch should evolve the same way. Enlisted personnel are definitely capable of performing most of the work. An added bonus is the fact that enlisted personnel stay on station longer than officers thus providing better continuity than officers.

The last issue is that of National Security. The Department of Defense is responsible for providing space launch capability for national security missions.[23] By creating an internal capability, the DoD meets its responsibilities to a far greater extent than it ever could via a contractor. Contractor strikes would have no impact to launch activities. Security clearances are easier to validate. Control of personnel and resources is easier. Instead of trying to protect scores of launch related facilities, the Air Force would only need to protect a minimum number of launch pads and related processing facilities. The additional cost, if any because of reduced numbers, of military personnel is easily offset by the reduced security needed, the lack of any "strike" threat, the lack of overtime costs in a surge environment, and the simplification of command and control.

I. THE PAYLOADS, STANDARDIZE

One reason why today's United States space launch processing takes so much time is that each payload seems to be different. The process of mating the payload to the booster is not standardized and therefore great effort must be made at the launch base to first mate the payload to the booster, and then test the configuration. This processing is complicated by the fact that testing and mating occurs on the launch pad itself, unlike Ariane and Zenit.

The simple solution is to standardize payload to booster interfacing. Once the EELV is designed, require all future acquisitions of DoD and civilian payloads to comply with the standard EELV interface. In this way, when any payload arrives at the launch base, the personnel involved are familiar with the processing and mating of the two. Just like an automobile assembly line, keep the part coming in a standardized fashion, and the line moves rapidly. But if you introduce changes and differences along the assembly line, you can expect delays in processing.

J. THE RANGE, GIVE IT AWAY

Currently, the Air Force operates and maintains the Eastern and Western Ranges. The financial cost for operating the Eastern Range alone in 1994 was around $500 million.[24] This was Air Force money used to support commercial, NASA, national, and DoD launches. The Air Force is in essence subsidizing space launch by paying the cost to maintain entire launch Ranges. This is done by only charging the customer for Range use time, not for true costs associated with maintaining the Ranges. It is not customary for the DoD to subsidize any commercial activity.

The United States Department of Transportation (DOT) is entrusted with enforcement of safety regulations, construction and maintenance of airports, and utilization of navigable air space via the Federal Aviation Administration. Via the Federal Highway Administration, an agency of the DOT, national highway policies are made.[25] It is only fitting then that the responsibility for transportation to and from space on a regular basis become part of the DOT. If the government wants to subsidize space launch, let it do so via the DOT, not the DoD. The DoD will pay for use of range time just like it would pay tolls to drive on a tollway or landing fees at an airport.

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[23] President's Policy on Space Transportation. 5 Aug 94

[24] 45th Space Wing Mission briefing as of 1 Dec 95

[25] Encyclopaedia Britannica. 1981, Volume 15, page 901