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Space Launch Vehicles: Government Activities, Commercial Competition, and Satellite Exports

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CONTENTS

Space Launch Vehicles: Government Activities, Commercial Competition, and Satellite Exports

SUMMARY

Launching satellites into orbit, once the exclusive domain of the U.S. and Soviet governments, today is an industry in which companies in the United States, Europe, China, Russia, Ukraine, Japan, and India compete. In the United States, the National Aeronautics and Space Administration (NASA) continues to be responsible for launches of its space shuttle, and the Air Force has responsibility for launches associated with U.S. military and intelligence satellites, but all other launches are conducted by private sector companies. Since the early 1980s, Congress and successive Administrations have taken actions, including passage of several laws, to facilitate the U.S. commercial space launch services business. The Federal Aviation Administration (FAA) regulates the industry.

During the mid-1990s, demand for launching commercial communications satellites was forecast to grow significantly through the early 21st Century. Those forecasts sparked plans to develop new launch vehicles here and abroad. In the United States, NASA and the Department of Defense (DOD) created government-industry partnerships to develop new reusable launch vehicles (RLVs) and "evolved" expendable launch vehicles (ELVs), respectively. The U.S. space shuttle is the only operational RLV today. All other operational launch vehicles are expendable (i.e., they can only be used once). Some U.S. private sector companies began developing their own launch vehicles without direct government financial involvement, although some have sought government loan guarantees or tax incentives. H.R. 2177 would create tax incentives.

Since 1999, projections for launch services demand have decreased dramatically, however. At the same time, NASA's main RLV program, X-33, suffered delays and on March 1, 2001 NASA decided to end the program. Companies developing new launch vehicles are reassessing their plans, and NASA has initiated a new "Space Launch Initiative" (SLI) to broaden the choices from which it can choose a new RLV design. Some of the SLI funding is going to companies that have been trying to develop their own new launch vehicles. Separately, DOD has been reassessing its EELV program in light of the lower market forecasts.

Until a replacement is developed, NASA will rely upon the space shuttle for launching humans into space, including to the International Space Station. Safe operation of the shuttle remains a top NASA concern.

In the commercial launch services market, U.S. companies are concerned about foreign competition, particularly with countries that have non-market economies such as China, Russia, and Ukraine. The U.S. signed bilateral trade agreements with each of those countries setting forth the conditions under which they can participate in the market, including quotas on how many launches they can conduct. The agreement with China expires in 2001; discussions have begun between the two countries on whether to renew it. The Clinton Administration ended quotas for both Ukraine and Russia in 2000. The U.S. has leverage because almost all satellites that require launch are made in the United States or have U.S. components and hence require U.S. export licenses. Export of U.S.-built satellites has become an issue in terms of whether U.S. satellite manufacturing companies provide militarily significant information to those countries in the course of the satellite launches.

MOST RECENT DEVELOPMENTS

The FY2002 VA-HUD-IA appropriations bill (H.R. 2620) was signed into law on November 26 (P.L. 107-73). Regarding NASA's space launch programs, Congress cut $10 million from the $475 million requested for the Space Launch Initiative; increased shuttle safety upgrades by $20 million, for a total of $207 million, with a requirement that NASA report to Congress by March 2002 on the upgrade program; deleted $50 million for a project (which NASA already had decided to cancel) that was to have developed a new type of advanced auxiliary power unit for the space shuttle; and added $25 million for repairs to the Vehicle Assembly Building at Kennedy Space Center.

The FY2002 Commerce, Justice, State appropriations bill (H.R. 2500) was signed into law November 28 (P.L. 107-77). It requires 15 days notification to Congress before the State Department expends funds to process an application to export a satellite (or components) to China.

The House passed its version of the FY2002 DOD appropriations act (H.R. 3888, H.Rept. 107-298), reducing EELV funding by $20 million: $10 million from the $98 million requested for procurement, and $10 million from the $320 million requested for RDT&E. The Senate Appropriations Committee (S. Rept. 107-109) recommended full funding. The Senate passed the FY2002 DOD authorization bill (S. 1438) on October 2. The House passed its version (H.R. 2586) on September 25. Both fully fund the EELV program.

BACKGROUND AND ANALYSIS

U.S. Launch Vehicle Policy

The National Aeronautics and Space Administration (NASA) and the Department of Defense (DOD) have each developed expendable launch vehicles (ELVs) to satisfy their requirements. NASA also developed the partially reusable space shuttle. DOD developed the Atlas, Delta, and Titan families of ELVs (called expendable because they can only be used once) from ballistic missile technology. NASA developed Scout and Saturn, both no longer produced. Atlas and Titan rockets today are built by Lockheed Martin. Delta is built by Boeing. Private companies also have developed ELVs: Pegasus and Taurus (Orbital Sciences Corporation), and Athena (Lockheed Martin). Which launch vehicle is used for a particular spacecraft initially depends on the size, weight, and destination of the spacecraft.

From "Shuttle-Only" to "Mixed Fleet"

In 1972, President Nixon approved NASA's plan to create the first reusable launch vehicle, called the space shuttle, and directed that it become the nation's primary launch vehicle, replacing all the ELVs except Scout (later discontinued for unrelated reasons). This would have made NASA and DOD dependent on a single launch vehicle, but the resulting high launch rate was expected to reduce the cost per flight significantly. The shuttle was first launched in 1981, and was declared operational in 1982. The phase-out of the ELVs began,

but in 1984 the Air Force successfully argued that it needed a "complementary" ELV as a backup to the shuttle for "assured access to space" and initiated what is now known as the Titan IV program. Production lines for the Delta and Atlas began to close down, and it was expected that only the shuttle, Scouts, and Titan IVs would be in use by the mid-1980s.

Everything changed on January 28, 1986, however, when the space shuttle *Challenger* exploded 73 seconds after launch. The space shuttle program had enjoyed 24 successful missions prior to *Challenger*. Apart from the human tragedy, the *Challenger* accident deeply affected U.S. space launch policy, demonstrating the vulnerability of relying too heavily on a single system. Many military and civilian satellites had been designed specifically to be launched on the shuttle, and could not have been transferred to ELVs even if the ELVs were not already being phased out. The few remaining ELVs had their own problems in 1986. A Titan exploded in April and a Delta failed in May, which also grounded Atlas because of design similarities. As a result of these failures, U.S. policy was significantly revised from primary dependence on the shuttle to a "mixed fleet" approach. The country once again has a wide variety of launch vehicles from which to choose. The shuttle is used principally for missions that require crew interaction, while ELVs are used for other spacecraft.

President Reagan also decided that commercial payloads could not be flown on the shuttle unless they were "shuttle-unique" (capable of being launched only by the shuttle or requiring crew interaction) or if there were special foreign policy considerations. That action facilitated the emergence of a U.S. commercial space launch industry whose participants had long argued that they could not compete against government-subsidized shuttle launch prices. The White House and Congress had taken steps beginning in 1983 to assist in developing a commercial space launch services business, including President Reagan's 1983 designation of the Department of Transportation as the agency responsible for facilitating and regulating the commercial space launch sector, and passage of the 1984 Commercial Space Launch Act (P.L. 98- 575). But removing the shuttle as a competitor was the major factor in fostering the U.S. launch businesses. Passage of the Commercial Space Launch Act Amendments of 1988 (P.L. 100-657) and the Commercial Space Act of 1998 (P.L. 105-303) also have helped.

Clinton Administration Policy

On August 5, 1994, President Clinton released a National Space Transportation Policy that gave DOD lead responsibility for improving ELVs and NASA lead responsibility for upgrading the space shuttle and technology development and demonstration of new reusable launch vehicles. The policy set guidelines for the use of foreign launch systems and components, the use of excess ballistic missile assets for space launch, and encourages an expanded private sector role in space transportation R&D. Unless exempted by the President or his designee, U.S. government payloads must launched by U.S. manufactured launch vehicles. On September 19, 1996, the Clinton Administration released a comprehensive space policy, covering civil, military and commercial space activities.

U.S. Launch Vehicle Programs and Issues

NASA's Space Shuttle Program

The space shuttle is a partially reusable launch vehicle (the large, cylindrical external tank is not reused) and is the sole U.S. means for launching humans into orbit. The 1986 *Challenger* accident and occasional shuttle launch delays have led to questions about the reliability of the shuttle system. *Challenger*, however, is the only failure so far in more than 100 launches since 1981. Nonetheless, concerns remain that cuts to the shuttle budget and associated personnel reductions, and NASA's decision to turn much of the ground operations of the shuttle over to a "single prime contractor," could affect shuttle safety. NASA signed a $7 billion, 6-year Space Flight Operations Contract (SFOC) with United Space Alliance (USA)—a joint venture between Boeing and Lockheed Martin—to serve as single prime contractor on September 26, 1996 with the goal of reducing shuttle operational costs. The total shuttle budget for FY2001 is $3.1 billion. For FY2002, NASA requested and received $3.3 billion.

NASA is still deciding what the future holds for the shuttle. The 1994 Clinton policy directed NASA to pursue technology development and demonstration efforts to support a decision by the year 2000 on developing a new reusable launch system to replace the shuttle. This led to the X-33 program (see below). Meanwhile, NASA outlined and began implementing a four-phase "shuttle upgrades" program to improve shuttle reliability, performance, and longevity. Initial upgrades (Phases I and II) were designed to combat obsolescence and ensure shuttle safety, while longer term upgrades (Phases III and IV) were to be implemented if a replacement for the shuttle was not anticipated soon. When 2000 arrived, it was clear that the X-33 program would not meet its deadlines and NASA initiated a new development program (SLI, see below) and pushed the decision point on the future of the shuttle to 2005. More recently, NASA has referred to it as a "mid-decade" decision. NASA also abandoned the 4-phase upgrade concept and instead added $1.3 billion to what it had planned for shuttle upgrades in FY2001-2005, for a total of $1.86 billion for "safety and supportability" upgrades. Shuttle advocates insist that the four space shuttle orbiters are less than 30% through their useful life and NASA says the shuttle will be one of the competitors in the mid-decade decision on what vehicle NASA should use in the future.

Last year, NASA emphasized that one of the most critical upgrades needed was a new, safer type of auxiliary power unit (APU) powered by electricity. However, NASA now has terminated that program because of development cost and schedule concerns. Although the House Appropriations Committee recommended keeping $20 million of the $50 million budgeted for FY2002 in the program for technology development, the conference version of the FY2002 VA-HUD-IA appropriations bill (H.R. 2620) removes all $50 million. As enacted (P.L. 107-73), the bill adds $20 million for space shuttle safety upgrades, for a total of $207 million. NASA may reallocate some of that funding to other shuttle needs only if it outlines to Congress in a FY2002 operating plan to which the House and Senate appropriations committee agree why changes are necessary to support NASA's stated priority goals for the shuttle, of which safety is first. The conference report on the bill requires NASA to submit a report by March 15, 2002 on the shuttle upgrade program.

The independent Aerospace Safety Advisory Panel (ASAP) oversees safety in NASA human spaceflight programs. For several years, ASAP has expressed concern about the loss of critical skills and experience in the shuttle workforce after years of downsizing and the transition to the single prime contractor. In August 2000, GAO released a report (GAO/NSIAD/GGD-00-186) that echoed the ASAP concerns. In its most recent report (February 2001), ASAP strongly recommended that NASA acknowledge that the space shuttle will be the primary U.S. launch vehicle to take crews to the International Space Station (ISS) through the station's lifetime and implement a program to ensure the shuttle's safe operation through that time frame.

Future Launch Vehicle Development Programs

Despite hopes that the space shuttle would reduce the cost of reaching orbit, U.S. launch systems remain expensive and less efficient and reliable than desired. Thus, efforts continue to reduce costs for both expendable and reusable U.S. launch systems. DOD and NASA initiated several efforts in the late 1980s and early 1990s to develop a new ELV system (see below), but each was terminated in turn because Congress or the agencies themselves were not convinced that the required investment had sufficient priority. In response to the 1994 Clinton policy, two programs were initiated: DOD's Evolved Expendable Launch Vehicle (EELV) program and NASA's Reusable Launch Vehicle (RLV) program.

DOD's Evolved Expendable Launch Vehicle (EELV) Program. The EELV program is the successor to several failed attempts to begin new ELV programs since 1985. DOD began what is now known as the EELV program in FY1995 (P.L. 103-335) with a $30 million appropriation. EELV was first formally identified in DOD's FY1996 budget. EELV's goal is to reduce launch costs by at least 25%.

In 1996, the Air Force selected Lockheed Martin and McDonnell Douglas (later bought by Boeing) for pre-engineering and manufacturing development contracts worth $60 million. Originally, one of those companies would have been selected in 1998 to develop the EELV. In November 1997, responding to indicators at the time that the commercial space launch market would be larger than expected, DOD announced that it would help fund development of both the Lockheed Martin and the Boeing vehicles (Atlas V and Delta IV, respectively). In October 1998, DOD awarded Boeing $1.88 billion for the Delta IV ($500 million for further development plus $1.38 billion for 19 launches). At the same time, it awarded Lockheed Martin $1.15 billion for the Atlas V ($500 million for further development plus $650 million for 9 launches). The companies are expected to pay the rest of the development costs themselves. The launches are scheduled to take place in 2002-2006. In 2000, however, new market forecasts showed a reduction in expected demand, and DOD reevaluated its EELV strategy. It reportedly has renegotiated the contracts with both companies, relieving Lockheed Martin (reportedly at the company's request) of the requirement to build a launch pad at Vandenberg AFB, CA, and shifting two of the launches previously awarded to Lockheed Martin to Boeing instead. Thus Boeing now has 21 launches while Lockheed Martin has seven. For FY2001, Congress authorized and appropriated $333 million for R&D and $283 million for procurement (a reduction of $5 million from the procurement request) for the EELV program. However, FY2002 DOD budget documents show $330 million for R&D and $280 million for procurement. The FY2001 supplemental appropriations (P.L. 107-20) adds $48 million for a test flight of the largest ("heavy") version of Boeing's new Delta IV launch vehicle. For FY2002, DOD

requested $320 million for R&D and $98 million for procurement. The House and Senate Armed Services Committee approved the request in their versions of the FY2002 DOD authorization bill (S. 1438). The Senate Appropriations Committee also recommended full funding in the FY2002 DOD appropriations bill (H.R. 3338), but the House cut $10 million from procurement and $10 million from R&D.

Government-Led Reusable Launch Vehicle (RLV) Programs. The 1994 Clinton policy gave NASA lead responsibility for technology development for a next-generation reusable space transportation system. NASA initiated the Reusable Launch Vehicle (RLV) program to develop and flight test experimental RLVs to form the basis for next-generation vehicles to replace the space shuttle and replace or augment ELVs. Proponents believe that RLV technology can dramatically lower the cost of accessing space.

The X-33 and X-34 Programs. From 1995 to 2000, NASA's approach to developing new RLVs was based on establishing new forms of cooperation with industry by sharing the costs of developing technology with the intent that industry take over development, operation, and financing of the operational vehicle. Two "X" (for "experimental") flight test programs were begun under this philosophy: X-33, a large RLV based on single-stage-to-orbit (SSTO) technology to demonstrate technologies in the Mach 13-15 range (13-15 times the speed of sound); and X-34, a small RLV "testbed" to demonstrate reusable technologies at Mach 8. The SSTO concept involves a rocket that can attain orbit with only one stage (instead of two or more as is common today) carrying people or cargo. The goal had been to develop a vehicle capable of being launched, returning to Earth, being serviced quickly, and flying again within a very short time.

In March 2001, NASA announced the termination of X-33 and X-34. X-33 was a cooperative program between NASA and Lockheed Martin. According to the contract signed in 1996, NASA's costs were fixed at $912 million (not including civil service costs, which raise NASA's cost to about $1.2 billion). Lockheed Martin says that by the end of the program it had spent $356 million of its own funding on the program. X-33 was a suborbital prototype of a vehicle which, if it had been built, would been called VentureStar. Technical problems with the X-33, particularly with its new "aerospike" engines and construction of its composite hydrogen fuel tanks, led to delays in test flights from 2000 to 2003. NASA concluded that the cost to complete the program was too high compared to the benefits and terminated its participation in the program. X-34 was a "technology testbed" being built under contract to NASA by Orbital Sciences Corporation. The program had begun as a cooperative program like X-33, but the companies (Orbital and Rockwell International) that partnered with NASA decided not to continue it under those terms. NASA later modified the program and signed a traditional contract with Orbital. As with X-33, NASA concluded that the cost to complete the program was too high relative to the value of the technologies to be demonstrated. NASA spent $205 million on X-34. Lockheed Martin and Orbital each approached DOD about continuing their respective programs, but DOD declined.

Space Launch Initiative (SLI). In its FY2001 budget request, NASA restructured its program to develop new space launch vehicles. The agency initially selected 2005 as the next point at which it would make a choice between the shuttle and a 2nd generation RLV, although NASA now refers to it as a "mid-decade" decision. NASA announced that in the meantime it would spend $1.86 billion (FY2001-2005) in "safety and supportability" upgrades to the space shuttle and $4.4 billion (FY2001-2005) in a new Space Launch Initiative (SLI).

SLI includes the 2nd generation RLV program, designed to encourage development of a variety of RLV technologies rather than focusing on a single concept such as SSTO as was done with X-33. Thus NASA hopes to have more than one competitor for a new RLV system in 2005. SLI also funds development of "NASA Unique" launch systems, i.e., for taking humans to or from space, which at this time is a uniquely NASA activity; and of "alternative access to the space station" to help private companies compete to service the space station. The failure of the X-33 and X-34 programs, and of the National AeroSpace Plane (NASP) program before them, has made some observers skeptical about NASA's ability to successfully develop a next generation space launch vehicle. Hence, the SLI program is expected to receive considerable scrutiny.

For FY2001, NASA requested and received $290 million for SLI. The FY2002 request is $475 million, a 64% increase, but less than the $610 million NASA had projected it would request for FY2002. The FY2002 VA-HUD-IA Appropriations Act (P.L. 107-73) cut the request by $10 million.

NASA requested bids from companies for SLI funds and the winners were announced on May 17, 2001. In total, 22 contractors will receive $767 million. The list of companies and universities that were awarded funding is available at [http://www.slinews.com/]. The awards are for 10 months, with options for one or more additional years.

At a House Science Subcommittee hearing on June 20, GAO testified about the results of a study (GAO-01-826T) it conducted on the X-33 and X-34 programs, and cautioned NASA against making similar mistakes with SLI. GAO cited a lack of "realistic cost estimates, timely acquisition and risk management plans, and adequate and realistic performance goals" with X-33 and X-34. It identified three critical areas to be addressed by the SLI program: the technical complexity of SLI requires realistic cost estimates and risk mitigation plans and appropriate funding; NASA must ensure that the numerous interrelated, complex efforts involved in developing the technology move forward with effective coordination and communication; and performance measures must be implemented and periodically validated.

Private Sector RLV Development Efforts. In addition to the government-led programs, several entrepreneurial U.S. companies have been attempting to develop RLVs through private financing. The companies have encountered difficulties in obtaining financing from the financial markets, and have been seeking government loan guarantees or tax credits. Some (e.g. Kistler Aerospace and Universal Space Lines) were included in the SLI contract awards announced on May 17, 2001 (see above), so will receive direct government funding. H.R. 2177 (Calvert) would provide tax incentives to investors in private sector companies attempting to develop commercial space transportation systems with significantly lower costs than those in use today. H.R. 2443 (Lampson) would provide, *inter alia*, loan guarantees for developing transportation systems needed for space tourism.

U.S. Commercial Launch Services Industry

Congressional Interest

The 107th Congress is debating several issues involving satellite export issues (discussed below) and the domestic launch services industry, many of which also were debated in the 106th Congress. Several bills are pending in the 107th Congress. One issue is what the government should do to stimulate development of new launch vehicles by the private sector. Debate has focused on whether tax incentives or loan guarantees should be created for companies attempting to develop lower cost launch vehicles. In general, companies developing launch vehicles with high initial capital costs have sought loan guarantees, while companies developing smaller vehicles with lower initial capital costs have sought tax incentives. Tax incentive advocates argue that loan guarantee programs allow the government to pick winners and losers; loan guarantee advocates argue that tax incentives are insufficient to promote necessary investment in capital intensive projects. In the 106th Congress, S. 469 (Breaux) would have established a loan guarantee program, while H.R. 4676 (Cook) would have created tax incentives. There was no action on either bill. In the 107th Congress, legislation somewhat similar to the Cook bill, H.R. 2177 (Calvert), has been introduced. No bill similar to the Breaux bill has yet been introduced in the 107th Congress, but H.R. 2443 (Lampson) would provide loan guarantees specifically for developing transportation systems needed for space tourism. It also would provide tax incentives for space tourism companies.

Other commercial space transportation issues have also been the subject of hearings or legislation. In the 106th Congress, the House Science Committee held hearings on barriers to the commercial space launch industry (June 10, 1999) and modernization and privatization of the nation's space launch sites or "ranges" (March 24; June 29,1999, jointly with the House Armed Services Committee; and September 28, 2000). Commercial space launch companies use Air Force launch ranges in Florida and California, raising issues about who should pay for range improvements now that commercial launches outnumber those for the government. The Clinton Administration released a range management and use plan in February 2000. Several states also have or plan to establish "spaceports" for commercial space launches; spaceports are licensed by the FAA. Bills to make spaceports, like airports, eligible for tax exempt bonds were introduced in the 106th Congress, but there was no action on them. They have been reintroduced in the 107th Congress (H.R. 1931/S. 1243).

One difficulty facing entrepreneurial companies attempting to develop new launch vehicles, and existing launch service providers, is dramatically changed market forecasts for launch services. In the mid- to late-1990s when many of the entrepreneurial companies emerged, a very large market was predicted for placing satellites into low Earth orbit (LEO), particularly for satellite systems to provide mobile satellite telephony services. Many of the entrepreneurial companies targeted the LEO market, but it has shrunk markedly in the intervening years with the bankruptcies of two satellite mobile telephone companies, Iridium and ICO. Though both were later brought out of bankruptcy, many investors remain skeptical about the prospects for such systems. The latest annual launch market forecasts published by FAA (available at [http://ast.faa.gov]) reflect this skepticism. Last year, the FAA showed a sharp decline in LEO launches over the next decade, and this year's forecast shows another decline. The market for traditional geosynchronous satellite (GSO) launches

had been expected to grow over the next decade, but the FAA forecasts now show a market with little growth over a 10 year period. One factor is that technological advances permit longer satellite lifetimes and enlarge capacity, reducing the need for new satellites.

Foreign Competition (Including Satellite Export Issues)

Europe, China, Russia, Ukraine, India, and Japan offer commercial launch services in competition with U.S. companies. Most satellites are manufactured by U.S. companies or include U.S. components and hence require export licenses, giving the United States considerable influence over how other countries participate in the commercial launch services market. The United States negotiated bilateral trade agreements with China, Russia, and Ukraine on "rules of the road" for participating in the market to ensure they did not offer unfair competition because of their non-market economies. Launch quotas were set in each of the agreements, but President Clinton terminated the quotas for Russia and Ukraine in 2000. They remain in place for China (see below).

Europe. The European Space Agency (ESA) developed the Ariane family of launch vehicles. Ariane was first test-launched in 1979, and began operational launches in 1982. ESA continues to develop new variants of Ariane. Operational launches of Ariane 4 and Ariane 5 are conducted by the French company Arianespace, which is owned by the French space agency (CNES) and European aerospace companies and banks. Arianespace also markets Russia's Soyuz launch vehicle as part of a French-Russian joint venture, Starsem.

In 1985, a U.S. company (Transpace Carriers Inc.) filed an unfair trade practices complaint against Arianespace, asserting that European governments were unfairly subsidizing Ariane. The Office of the U.S. Trade Representative (USTR) investigated and found that Europe was not behaving differently from the United States in pricing commercial launch services (then offered primarily on the government-owned space shuttle). The incident raised questions about what "rules of the road" to follow in pricing launch services. In the fall of 1990, USTR and Europe began talks to establish such rules of the road and assess how to respond to the entry of non-market economies into the launch services business. The only formal negotiating session was held in February 1991.

Each side has been concerned about how much the respective governments subsidize commercial launch operations, but another controversial topic (not formally part of the talks) is whether Arianespace should be able to bid for launches of U.S. government satellites, which now must be launched on U.S. launch vehicles as a matter of U.S. policy. Arianespace wants that restriction lifted. France and other European governments do not have written policies requiring the use of Ariane for their government satellites. However, the member governments of ESA agreed to pay a surcharge of as much as 15-20% if they chose Ariane. The surcharge led some cost-conscious European governments to buy launch services from other (notably U.S.) suppliers. In the fall of 1995, ESA's member governments reached agreement with Arianespace to reduce the surcharge to encourage use of Ariane. (ESA itself does give preference to using Ariane, but is not legally constrained from using other launch vehicles.)

China. The People's Republic of China offers several versions of its Long March launch vehicles commercially. China poses special issues not only because of its non-market

economy, but because of technology transfer and political concerns. Launch services are offered through China Great Wall Industry Corp. (CGWIC).

U.S.-China Bilateral Trade Agreements for Launch Services. In 1989, China and the United States signed a 6-year bilateral trade agreement restricting the number of Chinese commercial space launches to ensure China, with its nonmarket economy, did not unfairly compete with U.S. companies. A new agreement that was reached in 1995 and amended in 1997 will expire on December 31, 2001. Under the existing agreement, China is allowed to launch up to 20 foreign satellites to geostationary orbit (GEO). There are no numerical limits on the number of launches to low Earth orbit (LEO), but if China, Russia, and Ukraine combined launch more than 50% of any individual LEO system, the United States would consider that cause for concern. GEO launches must be priced on a par with Western prices. If the price is within 15%, it will normally be considered consistent with this obligation. Prices more than 15% below will be examined in detail. LEO launches must be priced on a par with Western LEO launch prices. Discussions about whether to renew the agreement began in March 2001.

U.S. Satellite Exports to China: 1988-1997. In September 1988, the U.S. government agreed to grant three export licenses for satellites manufactured by Hughes to be launched by CGWIC. Two were Optus communications satellites (formerly called AUSSAT) built for Australia and the third was AsiaSat 1, owned by the Hong Kong-based Asiasat Co. (of which China's International Trust and Investment Corp. is a one-third owner). The Reagan Administration granted the export licenses on the conditions that China sign three international treaties related to liability for satellite launches and other subjects; agree to price its launch services "on a par" with Western companies; and establish a government-to-government level regime for protecting technology from possible misuse or diversion. China met the conditions and the two countries signed a 6-year agreement in January 1989. The now-defunct Coordinating Committee on Multilateral Export Controls (COCOM) approved the licenses that March.

On June 5, 1989, after the Tiananmen Square uprising, President George H. Bush suspended all military exports to China. At the time, exports of communications satellites were governed by the State Department's Munitions List. The satellites counted as military exports and the licenses were suspended. Then Congress passed language in the FY1990 Commerce, Justice, State and Judiciary appropriations (P.L. 101-162) and the 1990-91 Foreign Relations Authorization Act (P.L. 101-246, Section 902) prohibiting the export of U.S.-built satellites to China unless the President reported to Congress that (1) China had achieved certain political and human rights reforms, or (2) it was in the national interest of the United States. In December 1989, President Bush notified Congress that export of the satellites was in the national interest and the licenses were reinstated. AsiaSat-1 became China's first commercial launch of a U.S.-built satellite in April 1990. Final export approval for Optus 1 and 2 was granted in April 1991. They were launched in 1992.

A different issue arose in 1990. China signed a contract to launch an Arabsat Consortium satellite for $25 million, much less than what many consider "on a par" with Western companies. The main competitor was Arianespace, which turned to both the French and U.S. governments to prohibit export of the satellite (the prime contractor was French and it included American components). No formal action was taken by the United States. In 1991, the Arabsat Consortium terminated the contract with the Chinese and signed an

agreement with Arianespace, so the case became moot, but the issue of what constituted "on a par" remained. China argued that because its costs are so low, it could offer lower prices and still adhere to international norms as to what costs are included in setting the price. Yet another issue arose in 1991 — linkage of satellite export licenses with U.S. concern over China's ballistic missile proliferation policies. On April 30, 1991, the Bush Administration approved final export licenses for Optus 1 and 2, and for U.S. components of a Swedish satellite called Freja (launched by China in October 1992). To emphasize its concern about Chinese missile proliferation, however, the White House disapproved export of U.S. components for a satellite China itself was building (Dong Fang Hong 3). Then, on June 16, the White House announced that it would be "inappropriate for the United States to approve any further export licenses for commercial satellite launches at this time." On July 17, the State Department identified CGWIC as one of two Chinese entities engaged in missile technology proliferation activities that require the imposition of trade sanctions in accordance with the Arms Export Control Act, including denial of license applications for export items covered by the Missile Technology Control Regime (MTCR). Although the MTCR does not cover satellites (only satellite launch vehicles, which are close cousins of ballistic missiles), the identification of CGWIC as a cause of concern complicated China's marketing plans. China agreed to adhere to the MTCR, and the sanctions were lifted on February 21, 1992.

China's fortunes improved. In May 1992, the International Telecommunications Satellite Organization (Intelsat) agreed to launch at least one of its satellites on a Chinese launch vehicle. On September 11, 1992, the State Department notified Congress that it was waiving legislative restrictions on U.S. exports for six satellite projects with China: APSAT, AsiaSat-2, Intelsat 7A, STARSAT, AfriStar, and Dong Fang Hong 3. The first five were satellites China wanted to launch; the sixth was for satellite components for which export was disapproved in April 1991. (The satellite was launched in 1994, but failed once it was in orbit). Many observers saw the move as a conciliatory gesture in the wake of the U.S. decision to sell F-16s to Taiwan.

On August 25, 1993, however, the U.S. government again imposed sanctions against China for ballistic missile proliferation activities, and the State Department said that satellite exports would not be permitted. The State Department announced October 4, 1994 it would lift the sanctions after China pledged to abide by the MTCR. During this period, U.S. tensions were acute between those who view the sanctions as harmful to U.S. business interests (notably satellite manufacturers Hughes and Lockheed Martin), and those who want to prevent sensitive technology from reaching China and/or to punish China for MTCR infractions. The debate centered on whether the satellites should continue to be governed by export guidelines of the State Department (Munitions List) or the Commerce Department (Commerce Control List). Some responsibility for export of commercial communications satellites was transferred from the State Department to the Commerce Department in 1992, and in October 1996 primary responsibility was transferred to Commerce.

In January 1995, the launch of the Hughes-built APStar-2 satellite failed in-flight. Falling debris killed 6 and injured 23 on the ground. On February 6, 1996, President Clinton approved the export of four satellites to China for launch (2 COSAT satellites, Chinasat 7, and Mabuhay) despite concerns about China exporting nuclear weapons-related equipment to Pakistan. The COSAT (now Chinastar) satellites are built by Lockheed Martin and the first was successfully launched on May 30, 1998. Chinasat 7 was built by Hughes, and Mabuhay (now Agila 2) by Loral. The 6-year trade agreement signed in 1989 expired at the end of

1994. A new 7-year agreement was signed on March 13, 1995. On February 14, 1996, a Long March 3B rocket carrying the Intelsat 708 communications satellite built by Loral malfunctioned seconds after liftoff impacting the ground and spreading debris and toxic fumes over the launch site and a nearby village. The Chinese reported 6 dead and 57 injured, but other reports suggested a higher figure. After this second Chinese launch failure involving fatalities, some customers, including Intelsat, canceled contracts.

In May 1997, USTR stated that it believed China violated the pricing provisions of the bilateral agreement for the launching of Agila 2 (formerly called Mabuhay) for the Philippines. Chinese officials disagreed. On September 10, 1997, the *Washington Times* published a story that Chinese and Russian entities (including CGWIC) were selling missile technology to Iran. China denies the allegations.

Satellite Exports to China: 1998-2000 (Including the "Loral/Hughes" Issue, the Cox Committee Report, and Lockheed Martin). On February 18, 1998, the President notified Congress that it was in the national interest to export Loral's Chinasat 8 to China. On April 4, 1998, the *New York Times* reported that a 1997 classified DOD report alleged that Space Systems/Loral (part of Loral Space & Communications) and Hughes Electronics' satellite manufacturing division (then a subsidiary of General Motors; now Boeing Satellite Systems) provided technical information to China that improved the reliability of Chinese nuclear missiles. The assistance was provided in the wake of the February 1996 Intelsat 708 launch failure (see above). The Intelsat satellite was built by Loral, which participated in an inquiry into the accident at the request of insurance companies seeking assurances that the Chinese had correctly diagnosed and solved the cause of the failure. Loral formed a review committee that included representatives of other satellite companies, including Hughes. According to Loral, the review committee did not itself investigate the accident, but listened to Chinese officials explain their investigation and then wrote a report. Loral conceded that a copy of the report was given to the Chinese before it was provided to the State Department, in violation of Loral's internal policies. Loral says it notified the State Department when it learned that the Chinese had been given a copy. According to media sources, DOD's 1997 report says that the companies provided technical information in violation of the export license that allowed the export of the satellite to China for launch. The companies insist they did nothing that violated the export license. The Justice Department investigated the allegations and reportedly expanded the probe to include Hughes' response to the 1995 APStar-2 failure. A grand jury reportedly was empaneled in 1999. On December 11, 2000, the *Los Angeles Times* reported that the grand jury had adjourned and the government was exploring a plea agreement that "would probably include monetary penalties. Loral and Hughes continue to deny any wrongdoing." The *Wall Street Journal* reported on August 31, 2001, that the government and Loral were close to reaching a civil settlement, and a similar settlement was expected for Hughes.

Many hearings on the "Loral/Hughes" issue were held by various House and Senate committees. In addition, the House established the Select Committee on U.S. National Security and Military/Commercial Concerns with the People's Republic of China chaired by Representative Cox to investigate the issues. The Cox committee unanimously adopted its report on December 30, 1998, but public release was delayed until May 25, 1999 pending preparation of an unclassified version. The Cox committee concluded that Hughes and Loral deliberately transferred technical information and know-how to China during the course of accident investigations. The committee investigated other cases of China acquiring technical

information from the United States and made 38 recommendations (see CRS Report RL30231), including that the United States should increase its space launch capacity.

The FY2000 DOD authorization Act (P.L. 106-65) included language implementing many of the Cox committee recommendations. In brief, the Department of Justice must notify appropriate congressional committees when it is investigating alleged export violations in connection with commercial satellites or items on the munitions list if the violation is likely to cause significant harm or damage to national security with exceptions to protect national security or ongoing criminal investigations; companies must be provided with timely notice of the status of their export applications; enhanced participation by the intelligence community in export decisions is required; adequate resources must be provided for the offices at DOD and the State Department that approve export licenses; individuals providing security at overseas launch sites do not have to be DOD employees, but must report to a DOD launch monitor; and DOD must promulgate regulations concerning the qualifications and training for DOD space launch monitors and take other actions regarding those monitors and the records they maintain.

In February 1999, the Clinton Administration denied Hughes permission to export two satellites for the Asia Pacific Mobile Telecommunication (APMT) system to China for launch. Export permission for APMT had been granted in 1997 (the President notified Congress on June 25, 1997), but Hughes changed the spacecraft design, necessitating new export approval. That application was denied. On May 10, 2000, the White House made its first certification to Congress under the new process detailed in the FY1999 DOD authorization bill, approving the export to China of satellite fuels and separation systems for the Iridium program. On August 18, 2000, the State Department stated it would continue the suspension of a technical assistance agreement for Loral regarding launch of Chinasat 8 because the concerns that initiated the suspension in December 1998 have not been rectified. In January 2001, *Space News* reported that the Chinasat 8 export application was returned to Loral without action. Loral President Bernard Schwartz was subsequently quoted by *Reuters* (March 29, 2001) as remaining optimistic about ultimately getting approval to export Chinasat 8, however.

In April 2000, it became known that Lockheed Martin also was under investigation, in this case for performing a technical assessment, without an export license, of a Chinese "kick motor" used to place a satellite into its final orbit. On June 14, 2000, the State Department announced it had reached agreement with Lockheed Martin involving $13 million in penalties — $8 million that the company will pay over a 4-year period and $5 million that was suspended and that the company can draw upon to fund a series of remedial compliance measures specified in the consent agreement.

Satellite Exports to China: 2001. In July 2001, Senators Helms, Thompson, Shelby, and Kyl wrote to President Bush reportedly asking the President not to grant waivers for the export of satellites to China. As noted earlier, such waivers are required under the FY1990-91 Foreign Relations Authorization Act (P.L. 101-246). According to a July 9 *Space.com* story, two European companies (Astrium and Alenia Spazio) have built satellites for two multinational satellite organizations (Intelsat and Eutelsat, respectively) that are scheduled for launch by China. The satellites contain U.S. components, and therefore require U.S. export licenses. The companies reportedly already received State Department approval to ship the satellites to China, but waivers still are needed. In late August, Intelsat canceled its contract with Astrium for the APR-3 satellite, citing several factors including the delay in

obtaining U.S. export approval. Other satellites being manufactured by U.S. companies, such as Chinasat 8 and another being built by Loral (Apstar-5, for APT Satellite Co.), or containing U.S. components also may require waivers in the future (see CRS Report 98-485 for a list of pending satellite exports). The FY2002 Commerce, Justice, State Appropriations Act (P.L. 107-77) requires 15 days notice to Congress before processing licenses for exporting satellites. H.R. 2581, discussed in the next section, also has specific provisions regarding the launch of satellites from China.

Agency Jurisdiction Over Satellite Export Licenses. Between 1992 and 1996, the Bush and Clinton Administrations transferred responsibility for decisions regarding export of commercial satellites from the State Department to the Commerce Department. A January 1997 GAO report (GAO/NSIAD-97-24) examines that decision. In response to concerns about the Loral/Hughes issue, Congress directed in the FY1999 DOD authorization bill (P.L. 105-261) that export control responsibility be returned to the State Department effective March 15, 1999. Which agency should control these exports remains controversial. In the 106th Congress, Representative Gejdenson introduced a bill to return control to the Commerce Department. A hearing on the issue was held by the Senate Foreign Relations Committee on June 7, 2000. The Department of Commerce witness called for Commerce to regain jurisdiction over these exports. The State Department's witness said State neither sought nor welcomed the decision to return jurisdiction to them, but the department is committed to administering those responsibilities. The Security Assistance Act (P.L. 106-280) called for a reexamination of the jurisdiction question.

Some of the controversy reflects concerns of the aerospace and space insurance industries in the United States and abroad that the new regulations are being implemented too broadly and vigorously and exports for launches on non-Chinese launch vehicles (such as Europe's Ariane) also are being affected. DOD officials and others have cited potential harm to the U.S. defense industrial base if U.S. exports are stifled, too. One of the concerns is the length of time needed to obtain a State Department approval, one factor being whether State has sufficient export license examiners. Section 309 of the FY2000 State Department authorization act (incorporated into the FY2000 Consolidated Appropriations Act, P.L. 106-113) directed the Secretary of State to establish an export regime that includes expedited approval for exports to NATO allies and major non-NATO allies. The State Department announced those new rules in May 2000; they took effect July 1. Also in May 2000, the State Department reportedly notified France that it would not apply strict technology export control on satellites to be launched by Ariane (*Space News*, May 29, 2000, p. 1). Other reforms to broader U.S. export controls for NATO allies also were announced the same month. The Security Assistance Act (P.L. 106-280) reduces from 30 days to15 days the time Congress has to review decisions on exporting commercial communications satellites to Russia, Ukraine, and Kazakhstan, making the time period the same as for NATO allies.

H.R.2581, as ordered reported from the House International Relations Committee on August 1, 2001, would return jurisdiction over commercial satellite exports to the Commerce Department, which would be required to consult with the State and Defense Departments and other appropriate departments and agencies. The Director of Central Intelligence shall be consulted as appropriate. Within 30 days of such referral, the department or agency would have to make a recommendation to approve or deny the license; no response would be deemed as approval. If the agencies cannot agree, the dispute would be resolved by the President within 60 days. "Defense services" provided in connection with a satellite launch

from China or by Chinese nationals would be subject to section 38 of the Arms Export Control Act and Congress must receive a presidential certification 30 days before any export license or technical assistance agreement is so approved. The language is a modified version of H.R. 1707 (Berman).

GAO released a report (GAO-01-528) in June 2001 concluding that the length of time required to process export license applications through the Department of Commerce versus the State Department is similar. The report notes, however, that the type of commodity being exported can have a significant impact on processing time. It includes launch vehicles, military and space electronics, and space systems and technology among those items that require the longest processing times at State. The Satellite Industry Association (SIA) released figures in May 2001 showing U.S. satellite manufacturers losing market share to foreign companies. SIA and others attribute that loss in part to the shift in jurisdiction to State, which they assert creates uncertainty for satellite customers over when and whether export licenses will be approved.

Russia. Following the collapse of the Soviet Union, interest developed in loosening U.S. policy to permit export of U.S.-made satellites to Russia for launch. In June 1992, President George H. Bush said he would not oppose Russia launching an Inmarsat (International Maritime Satellite Organization) satellite and the United States would negotiate with Russia over "rules of the road" for future commercial launches. Discussions were held in the fall of 1992, agreement in principle was reached in May 1993, and the agreement was signed on September 2, 1993, after Russia agreed to abide by the terms of the MTCR (see below). On January 30, 1996, the countries amended the agreement. Prior to Russia's first launch of a U.S.-built satellite, an agreement to protect American technology was reached. For subsequent launches, an exchange of diplomatic letters extended that agreement, but the State Department decided in 1998 that a formal Technology Safeguard Agreement was needed. The agreement, among the United States, Russia, and Kazakstan (where the launch site is located) was signed in January 1999. A similar agreement for launches from Russia's Plesetsk, Svobodny, and Kapustin Yar launch sites was signed in January 2000.

The 1993 agreement was signed only after Russia agreed to comply with the MTCR in a case involving a Russian company, Glavkosmos, that planned to sell rocket engine technology to the Indian Space Research Organization (ISRO). The United States declared it violated the MTCR and imposed 2-year sanctions against Glavkosmos and ISRO. In June 1993, the United States threatened to impose sanctions against Russian companies that did business with Glavkosmos. The two countries finally agreed that Russia would cease transferring rocket engine technology (the engines themselves were not at issue) to India.

As noted, on September 10, 1997, the *Washington Times* published a story that Russian and Chinese entities, including the Russian Space Agency, were selling missile technology to Iran. In July 1998, Russia announced that it had identified nine entities, not including the Russian Space Agency, that might be engaged in illegal export activities. The United States imposed sanctions against seven of them on July 28 and three more on January 12, 1999. The State Department said the United States would not increase the quota of geostationary launches that Russia can conduct under the 1996 agreement unless Russian entities cease cooperation with Iran's ballistic missile program (see CRS Report 98-299). The launches are conducted primarily by a U.S.-Russian joint venture composed of Lockheed Martin and Russia's Khrunichev and Energia, companies that have not been sanctioned. Lockheed

Martin was anxious to have the quota raised to 20 and eventually eliminated. On July 13, the White House agreed to raise the quota to 20. A Senate Governmental Affairs Committee hearing was held on July 21, 1999. The agreement that set the quotas was due to expire on December 31, 2000. The *Wall Street Journal* reported on December 1, 2000 (page A4) that the White House decided to eliminate the quota. That action was taken even though Russia had informed the United States that, as of December 1, 2000, it would withdraw from a 1995 agreement to stop selling conventional arms to Iran.

Ukraine. Ukraine also offers commercial launch services, chiefly as part of the Sea Launch joint venture among Boeing, Ukraine's Yuzhnoye, Russia's Energomash, and Norway's Kvaerner. The Sea Launch vehicle consists of a Ukranian two-stage Zenit rocket with a Russian third stage. The vehicle is launched from a mobile ocean oil rig built by Kvaerner. The rig is stationed in Long Beach, CA, where the launch vehicle and spacecraft are mated, and then towed into the ocean where the launch takes place. The United States and Ukraine signed a bilateral trade agreement in February 1996 (see table), that would have expired in 2001, but President Clinton terminated it on June 6, 2000, in recognition of "Ukraine's steadfast commitment to international nonproliferation norms." The first successful commercial launch was in October 1999. In 1998, Boeing agreed to pay $10 million for not abiding by export regulations in its dealings with Russia and Ukraine.

Separately, Ukraine signed an agreement with the U.S. company Globalstar to launch its satellites on Zenit from Baikonur. The first attempt failed in September 1998, destroying 12 Globalstar satellites. Globalstar switched to Russian Soyuz launch vehicles (marketed through Starsem) for subsequent launches.

India. India conducted its first successful orbital space launch in 1980. Its ASLV and PSLV launch vehicles can place relatively small satellites in low Earth orbit. India conducted its first commercial launch (of German and South Korean satellites) using the ASLV to low Earth orbit in May 1999. India is developing a larger vehicle (GSLV) capable of reaching geostationary orbit. The first GSLV test launch was completed in April 2001. The GSLV uses Russian cryogenic engines that were the subject of a dispute between the United States and Russia (discussed elsewhere in this report). India has been seeking opportunities to launch satellites on a commercial basis, and Taiwan had planned to launch its Rocsat 2 remote sensing satellite on an Indian vehicle. Rocsat 2 is being built by Europe's Astrium, but contains U.S. components. According to *Space News* (July 16, 2001, p. 1,18), the United States will not grant an export license for the U.S. components because of economic sanctions imposed against India following nuclear weapons tests in 1998. Hence, *Space News* reports that Taiwan has selected a U.S. launch vehicle instead.

Japan. Japan successfully conducted the first launch of its H-2 launch vehicle in 1994, the first all-Japanese rocket capable of putting satellites in geostationary orbit. Previous rockets used for this purpose were based on U.S. technology and a 1969 U.S.-Japan agreement prohibited Japan from launching for third parties without U.S. consent. With the H-2, Japan was freed from that constraint. Japan's Rocket Systems Corp. (RSC), created in 1990, offers commercial launch services, but H-2 was not cost effective and encountered technical problems that led to the Japanese government abandoning the program in 1999. A new version, H2A, successfully completed its first launch in August 2001. RSC had contracts with two U.S. satellite builders, Hughes and Loral, for 10 launches each between 2000 and 2005, but Hughes canceled its contract in May 2000. In June 1997, the Japanese government

reached agreement with the fishing industry to allow more launches from Tanegashima. Fishermen must evacuate the area near the launch site during launches. The agreement extends from 90 to 190 the number of days per year that launches may be conducted, and permits up to eight launches a year instead of two.

LEGISLATION

P.L. 107-73 (H.R. 2620)

FY2002 VA-HUD-Independent Agencies Appropriations (including NASA). Reported from House Appropriations Committee July 25 (H.Rept. 107-159); passed House July 30. S. 1216 reported from Senate Appropriations Committee July 20 (S.Rept. 107-43); passed Senate August 2. Conference report (H.Rept. 107-272) filed November 6; passed House and Senate November 8. Signed into law November 26.

P.L. 107-77 (H.R. 2500)

FY2002 Commerce, Justice, State appropriations. Reported from House Appropriations Committee July 13 (H.Rept. 107-139); passed House July 18. Reported from Senate Appropriations Committee July 20 (S.Rept. 107-42). Conference report (H.Rept. 107-278) passed House November 14, Senate November 15. Signed into law November 28.

H.R. 1931 (D. Weldon)/S. 1243 (Graham)

Spaceport Equality Act. H.R. 1931 introduced May 22, 2001; referred to Ways and Means Committee. S. 1243 introduced July 25, 2001; referred to Finance Committee.

H.R. 2177 (Calvert)

Invest in Space Now Act. Introduced June 14, 2001; referred to Ways and Means Committee.

H.R. 2443 (Lampson)

Space Tourism Promotion Act. Introduced July 10, 2001; referred to Committees on Science, and Ways & Means.

H.R. 2581 (Gilman)

Export Administration Act of 2001. As marked up by the House International Relations Committee August 1, includes language that would affect satellite exports.

H.R. 3338 (Lewis)

FY2002 DOD appropriations act. Reported from House Appropriations Committee November 19, 2001 (H.Rept. 107-298)l; passed House November 28. Reported from Senate Appropriations Committee December 5 (S. Rept. 107-109).

S. 1438 (Levin)

FY2002 DOD Authorization Act. H.R. 2586 reported from Committee on Armed Services September 4 (H.Rept. 107-194); passed House September 25. Senate passed S. 1438 on October 2, and then passed S. 1419 substituting the text of Division A of S. 1438 (which includes the topics discussed in this report). (The Senate Armed Services Committee had reported S. 1416 on September 12, S.Rept. 107-62, but S. 1438 was subsequently

introduced). S. 1438 passed House October 17 after substituting the text of H.R. 2586. Conferees have met.