Order Code IB93062

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

Updated October 6, 2003

Marcia S. Smith
Resources, Science, and Industry Division

CONTENTS

For more information on the **space shuttle** program, see:

CRS Report RS21408, *NASA's Space Shuttle Columbia: Quick Facts and Issues for Congress*

CRS Report RS21606, *NASA's Space Shuttle Columbia: Synopsis of the Report of the Columbia Accident Investigation Board*

CRS Report RS21411, *NASA's Space Shuttle Program: Space Shuttle Appropriations FY1992-FY2002*

CRS Report RS21419, *NASA's Space Shuttle Program: Excerpts from Recent Reports and Hearings Regarding Shuttle Safety*

For information on the **Orbital Space Plane**, which is not a launch vehicle, but a spacecraft, see CRS Issue Brief IB93017, *Space Stations*.

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 (EELVs), respectively. The U.S. space shuttle is the only RLV today. All other 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.

Since 1999, projections for launch services demand have declined dramatically, and NASA's efforts to develop a new RLV to replace the shuttle faltered. NASA announced plans to refocus its latest RLV development program, the Space Launch Initiative, towards building an Orbital Space Plane to take crews to and from the space station. It will be launched on an EELV rather than a new RLV. NASA also said it would continue to rely on the shuttle until at least 2015, instead of 2012.

On February 1, 2003, the space shuttle *Columbia* broke apart as it descended from orbit. All seven astronauts aboard died. How that will affect NASA's plans for the shuttle, and the space program as a whole, is difficult to assess at this time.

DOD's new EELVs (Atlas 5 and Delta 4) were successfully launched in 2002, but the companies that built the vehicles are seeking additional DOD funding to defray their costs in the wake of diminished commercial demand. DOD included $157 million in its FY2004 request for that purpose (as part of a total of $609 million requested for procurement of EELVs).

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. has leverage over how these countries compete because almost all commercial satellites are U.S.-built or have U.S. components, and hence require U.S. export licenses. Export of U.S.-built satellites to China is 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

On August 26, the *Columbia* Accident Investigation Board (CAIB) released its report on the space shuttle *Columbia* accident (see CRS Report RS21408 for detail on the accident and CRS Report RS21606 for a synopsis of the CAIB report). NASA's FY2004 budget request for the shuttle program is $4 billion. NASA also is requesting $550 million for building an Orbital Space Plane (OSP) to take crews to and from the space station, and $514.5 million for Next Generation Launch Technology (NGLT), both as part of the Space Launch Initiative (SLI). The FY2004 SLI request includes $550 million for OSP and $514.5 million for NGLT. OSP is not a launch vehicle; it is discussed in CRS Issue Brief IB93017. The House-passed FY2004 VA-HUD-IA appropriations bill (H.R. 2861) did not make any changes to the request for the shuttle or SLI programs. The Senate Appropriations Committee (S. 1584) fully funded the shuttle and SLI requests.

For FY2004, DOD requested $609 million for procurement of EELVs, of which $157 million is for "assured access to space"—essentially to provide more funding to the two companies that build EELVs (Boeing and Lockheed Martin) to ensure they remain in that business despite a constrained commercial launch services market. The FY2004 DOD appropriations act (P.L. 108-87) approves the request. In the FY2004 DOD authorization bill (H.R. 1588), the Senate added $60 million; the House approved the requested amount.

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. 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 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 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. Consequently, the Reagan Administration revised U.S. launch policy from primary dependence on the shuttle to a "mixed fleet" approach where a wide variety of launch vehicles are available. The shuttle is used principally for missions that require crew interaction, while ELVs are used for launching 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 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. Passage of the 1984 Commercial Space Launch Act (P.L. 98- 575), 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. But removing the shuttle as a competitor was the major factor in fostering the U.S. launch businesses.

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 of new reusable launch vehicles. The policy also sets guidelines for the use of foreign launch systems, the use of excess ballistic missile assets for space launch, and encourages an expanded private sector role in space transportation R&D.

George W. Bush Administration Activity

On June 28, 2002, President Bush ordered the National Security Council to chair a review of several U.S. space policies. The review of space transportation policy was due by December 31, 2002, but was delayed. It has been further delayed pending completion of the *Columbia* investigation and decisions on future U.S. space policy.

U.S. Launch Vehicle Programs and Issues

NASA's Space Shuttle Program

The Space Transportation System—the space shuttle—is a partially reusable launch vehicle and is the sole U.S. means for launching humans into orbit. It consists of an airplane-like Orbiter, with two Solid Rocket Boosters (SRBs) on each side, and a large, cylindrical External Tank (ET) that carries fuel for the Orbiter's main engines. The Orbiters and SRBs

are reused; the ET is not. NASA has three remaining spaceflight-worthy Orbiters: *Discovery*, *Atlantis*, and *Endeavour*.

A total of 113 launches have taken place since April 1981. Two of those missions ended in tragedy, each killing seven astronauts. In 1986, the space shuttle *Challenger* exploded 73 seconds after launch because of the failure of a seal (an O-ring) between two segments of an SRB. In 2003, the space shuttle *Columbia* disintegrated as it returned to Earth from a 16-day science mission. Congress is now debating issues stemming from the *Columbia* tragedy, discussed in CRS Report RS21408. The *Columbia* Accident Investigation Board released its report on August 26, 2003 (see [http://www.caib.us]). A synopsis is available in CRS Report RS21606. The Board found that the tragedy was caused by technical and organizational failures, and made 29 recommendations to fix the program. It concluded that the shuttle is not inherently unsafe, and supported its return to flight at the earliest opportunity consistent with the overriding consideration of safety. Fifteen of the 29 recommendations must be completed before the shuttle returns to flight. NASA Administrator O'Keefe says NASA will comply with CAIB's recommendations "to the best of our ability." He established a "Return to Flight" (RTF) Task Group chaired by two former astronauts, Tom Stafford and Dick Covey, to oversee NASA's implementation of the CAIB recommendations as they relate to RTF. The Task Group plans to complete its work one month before RTF, and not to address management and "culture" changes recommended by CAIB, because they are outside its charter. Questions remain about who should oversee implementation of the latter recommendations, and 27 "observations" made by CAIB. H.R. 3219 (Hall) would establish an independent panel of the National Academies of Science and Engineering to provide that oversight. NASA hopes to return the shuttle to flight status in 2004. Construction and operation of the International Space Station (see CRS Issue Brief IB93017) is one factor driving the desire for an expeditious resumption of launches.

Although 87 successful shuttle launches were conducted between the two tragedies, there were persistent concerns that cuts to the shuttle budget, personnel reductions, and NASA's 1995 decision to turn most shuttle operations over to a "single prime contractor," could impact shuttle safety. (Shuttle appropriations levels for FY1992-FY2002 are in CRS Report RS21411.) The "single prime contractor" is the United Space Alliance (USA), a limited liability company owned 50-50 by Boeing and Lockheed Martin, created to pull together the 86 separate contracts with 56 different companies under which the shuttle program was then operating. NASA signed a $7 billion, 6-year Space Flight Operations Contract (SFOC) with USA on September 26, 1996 with the goal of reducing shuttle operational costs while ensuring safety. On August 2, 2002, NASA exercised the first of two 2-year options, extending the contract to September 30, 2004. NASA asserts that SFOC has saved the agency approximately $1 billion per year.

NASA and USA statistics showing reduced "in-flight anomalies," and several instances where USA grounded the shuttle fleet after discovering potential problems, seemed to indicate that safety was not being eroded. But safety concerns were expressed by review panels, particularly the Aerospace Safety Advisory Panel (ASAP), and an internal NASA review commissioned after a 1999 mission (STS 93) suffered two serious anomalies during launch. Called the Shuttle Independent Assessment Team—see CRS Report RS21419 for excerpts—it concluded that NASA needed to augment the resources available to the shuttle program to ensure safety.

NASA added some personnel and funding, but both remained constrained. Efforts to upgrade the shuttle to improve safety and combat obsolescence were cut after individual projects proved more expensive and/or technically challenging than expected. In the February 2002 budget request for FY2003, NASA Administrator O'Keefe reduced funding for upgrades in the FY2002-2006 time period by 34%—from $1.836 billion to $1.220 billion. In November 2002, however, Mr. O'Keefe submitted a FY2003 budget amendment shifting more funds into the shuttle program ($470 million for FY2003-2007) and announcing that NASA would continue to use the shuttle longer than planned—until at least 2015, and perhaps 2020 and beyond, instead of replacing it in 2012. NASA created a new line in its FY2004 budget for a "Shuttle Service Life Extension Program" (SLEP) that incorporates funding previously identified for shuttle upgrades. At the same time, Mr. O'Keefe restructured the Space Launch Initiative, which had been developing technologies to build a replacement for the shuttle (see below), to focus on building an Orbital Space Plane (OSP) to take crews to and from the Space Station. The OSP is not meant as a replacement for the shuttle (it could provide only a very limited capability to take cargo to orbit, for example), but rather to augment it, and to provide a "lifeboat" capability for the space station (see CRS Issue Brief IB93017 for more on OSP and the space station).

Less than three months later, however, the *Columbia* tragedy forced NASA to reassess its space transportation strategy. Final action on the FY2003 budget was pending at the time of the tragedy. The amended FY2003 shuttle request was $3.2 billion. Congress approved that level, and added $50 million for the *Columbia* investigation and other accident-related expenses, and exempted the shuttle program from an across-the-board rescission applied to most other government programs. (NASA's FY2004 budget justification documents show $3.786 billion as the expected FY2003 funding level because it is expressed in "full cost accounting," which includes personnel and facility costs that previously were accounted for separately.) The FY2004 full cost accounting request of $3.968 billion was formulated prior to *Columbia.* The House made no changes to the shuttle request in the FY2004 VA-HUD-IA appropriations bill (H.R. 2861), pending release of the report on the *Columbia* accident. The Senate Appropriations Committee (S. 1584) fully funded the shuttle.

New U.S. Expendable and Reusable Launch Vehicles

U.S. expendable and reusable launch systems remain expensive and less efficient and reliable than desired. DOD and NASA initiated several efforts in the late 1980s and early 1990s to develop new systems, 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 EELVs—the Delta IV and Atlas V—are now in service although how much they will reduce costs is not clear. NASA's efforts to develop a "2nd generation" RLV to replace the shuttle (which is the 1st generation RLV) have not fared well. Private sector efforts to develop new RLVs also have encountered obstacles.

NASA's Efforts to Develop New Reusable Launch Vehicles (RLVs). 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.

X-33 and X-34. 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 and X-34. X-33 was a joint program with Lockheed Martin to build a subscale prototype of a large RLV based on single-stage-to-orbit (SSTO) technology. 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. X-34 was a small RLV "testbed" to demonstrate reusable two-stage-to-orbit technologies, which was being built under a traditional contract with Orbital Sciences Corporation. (Initially, X-34 also was a government-industry cooperative effort with Orbital and Rockwell International, but those companies withdrew from the cooperative agreement. NASA then signed a contract with Orbital for a scaled-back program.) NASA terminated X-33 and X-34 in March 2001. NASA spent approximately $1.2 billion on X-33, and Lockheed Martin said that it spent $356 million of its own funding. Technical problems with the X-33, particularly 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. X-34 was terminated for similar reasons. NASA spent $205 million on X-34.

Space Launch Initiative (SLI). Recognizing the problems in the X-33 and X-34 programs, NASA restructured its RLV program in 2000 (as part of its FY2001 budget request) and initiated the Space Launch Initiative (SLI). NASA now has restructured that program, too (see below). Originally, the SLI program was working with the private sector and universities to develop new technologies to allow a decision in 2006 on what new RLV to develop. The goal of the program was to develop technology for an RLV that would be "10 times safer and crew survivability 100 times greater, all at one-tenth the cost of today's space launch systems." NASA initially specified that it expected the private sector to pay some of the development costs, but later conceded that market conditions made it unlikely the private sector would do so. SLI was budgeted at $4.8 billion from FY2001-2006. For FY2001, NASA requested and received $290 million. For FY2002, NASA requested $475 million and received $465 million. The original FY2003 budget request was $759.2 million.

The SLI program has been under scrutiny since its beginning. Congressional testimony by GAO in 2001 (GAO-01-826T) on lessons learned from X-33 and X-34 cautioned NASA against making similar mistakes with SLI. A September 2002 GAO report highlighted the challenges facing the SLI program (GAO-02-1020). 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 develop a second generation RLV.

NASA Administrator O'Keefe and the Bush Administration apparently agree. The November 2002 amended FY2003 budget request significantly changed the SLI program. Mr. O'Keefe was quoted as calling the SLI goal of sharply reducing launch costs "a bumper sticker" and that he knew of no technology that could achieve that goal. The Administration's budget documentation said a new RLV lacks economic justification because the commercial launch market is too uncertain, and it is premature to base new requirements on future DOD or NASA missions. It also says that although the SLI program

had estimated the cost of a new RLV at $10 billion (not including the funding spent on SLI), a new estimate by the SLI program office was $20 billion, and four independent estimates sponsored by NASA suggested $30-35 billion. Thus NASA concluded "the economic case for a new RLV is in doubt for the foreseeable future."

Therefore, the Administration decided to shift $2.133 billion away from SLI (from $3.899 billion to $1.766 billion) over the FY2003-2007 period. The name SLI will continue, but the focus of the program is dramatically changed. SLI now has two components: building an Orbital Space Plane (OSP) to take crews to and from the space station, and developing "Next Generation Launch Technology," with a decision in 2009 on what new launch vehicle to build. **Despite being part of SLI, OSP is not a launch vehicle.** It is a spacecraft to take crews to and from the space station, and will not be discussed further in this report—see CRS Issue Brief IB93017 (*Space Stations*) instead.

NGLT comprises the remaining funding for the 2nd generation RLV program plus funding allocated for "3rd generation" technologies (an existing line item in the NASA budget, which includes hypersonics, an area in which DOD is interested). Whatever new launch vehicle is developed through NGLT would be for cargo only. For FY2003, NASA proposed $879 million for SLI, of which $584 million was for NGLT. Congress generally approved the restructured program in the FY2003 Consolidated Continuing Appropriations resolution (P.L. 108-7), but cut $40 million from SLI. NASA's FY2003 initial operating plan shows $448 million for NGLT. The FY2004 request for NGLT is $514.5 million. The FY2004 figure represents "full cost accounting," and is not directly comparable to FY2003 figures. The House made no change to the NGLT request in the FY2004 VA-HUD-IA appropriations bill (H.R. 2861) pending release of the report on the space shuttle *Columbia* accident. The Senate Appropriations Committee (S. 1584) recommended full funding, but expressed concern that NASA was not controlling the program adequately.

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 some 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 received direct government funding, but financial hurdles remain. Some companies now are focusing on building suborbital rockets instead of those that can reach orbit, anticipating that space tourism will be a substantial market. A Senate Commerce subcommittee held a hearing on commercial human spaceflight on July 24, 2003.

DOD's Evolved Expendable Launch Vehicle (EELV) Program. 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. Two EELVS were developed in joint government-private sector programs: Boeing's Delta IV and Lockheed Martin's Atlas V. Both vehicles were successful in their first launch attempts in 2002. The goal of the EELV program is to reduce launch costs by at least 25%.

In 1996, the Air Force had 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 Atlas V and Delta IV. 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), and awarded Lockheed Martin $1.15 billion for the Atlas V ($500 million for further development plus $650 million for 9 launches). The companies were expected to pay the rest of the development costs themselves, which they expected to recoup through sales, in particular, of commercial launch services. In 2000, however, new market forecasts showed a reduction in expected commercial demand, and DOD began reevaluating its EELV strategy. It renegotiated the contracts with both companies, shifting two of the launches previously awarded to Lockheed Martin to Boeing instead, and relieving Lockheed Martin (reportedly at the company's request) of the requirement to build a launch pad at Vandenberg AFB, CA. (Most U.S. launches take place from Cape Canaveral, FL or Vandenberg. The two coastal sites were selected so the rockets would not overfly populated areas enroute to their orbital destinations. Spacecraft going to high inclination orbits are launched from Vandenberg, those going to lower inclination orbits are launched from Cape Canaveral.) The companies then approached DOD to obtain additional government funding because of the downturn in the commercial market. This has come to be known as "assured access to space" in the sense of assuring that both companies remain in the EELV business so DOD has redundancy in capability should one of the launch vehicles experience difficulties.

In May 2003, Boeing revealed that it is under investigation by the Justice Department about whether it illegally obtained proprietary information about Lockheed Martin's EELV program in the 1996-1999 time frame. On July 24, DOD announced that it was suspending three Boeing business units were suspended from eligibility for new government contracts, shifting 7 existing launch contracts from Boeing to Lockheed Martin, and disqualifying Boeing from bidding for three new launch contracts (DOD plans to award them to Lockheed Martin). A DOD official estimated that the actions could cost Boeing $1 billion. Exceptions to the suspension are allowed if "compelling national need" can be demonstrated, and the government has awarded several contracts to those Boeing units despite the suspension, including one new launch contract. Lockheed Martin will build the launch pad (actually upgrading an existing Atlas 3 pad) for the Atlas 5 previously planned at Vandenberg. The company is expected to spend about $200 million, and the government will lease services from it. Just before DOD's announcement of the punitive actions, Boeing stated that it was withdrawing the Delta 4 from competition for commercial contracts because it could not successfully compete, and will focus entirely on the government market.

For FY2004, DOD requested $8 million for EELV R&D, and $609.3 million for procurement (of which $157 million was for assured access). The Senate added $60 million for assured access in the FY2004 DOD authorization bill (H.R. 1588). The House approved the requested amount. The final version of the FY2004 DOD appropriations bill (P.L. 108-283) funds EELV at the requested level for both procurement and R&D.

U.S. Commercial Launch Services Industry

Congressional Interest

Congress is debating issues involving the domestic launch services industry, many of which were debated in previous Congresses. Some are focused on satellite export issues

(discussed below). Another is the question of what the government should do to stimulate development of new launch vehicles by the private sector, particularly in a market that is stagnant or declining. That debate focuses on whether tax incentives or loan guarantees should be created for companies attempting to develop lower cost launch vehicles. 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. Congress created (Title IX, FY2003 DOD appropriations Act, P.L. 107-248 a loan guarantee program for companies developing commercial, reusable, in-orbit space transportation system), but such systems are not launch vehicles (they move satellites from one orbit to another) and are not discussed further here. In the 108th Congress, H.R. 2358 would create tax incentives. H.R. 644 would make spaceports eligible for tax exempt bonds. S. 1260 would extend until 2009 (from 2004) the period through which the government will indemnify commercial space launch companies from certain third-party claims, and require the Secretary of Transportation to study whether suborbital launch vehicles require separate regulation. H.R. 3245 would also extend the government indemnification until 2009, and would facilitate the nascent commercial human space flight industry that plans to use suborbital launch vehicles.

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. Three satellite mobile telephone companies (Iridium, ICO, and Globalstar), and a company that offered data services using LEO satellites (Orbcomm), all declared bankruptcy. Though Iridium and ICO were later brought out of bankruptcy, and Orbcomm was purchased at auction, many investors remain skeptical about the prospects for such systems. Another factor is that technological advances permit longer satellite lifetimes and enlarged capacity, reducing the need for new satellites. Launch forecasts published by FAA (available at [http://ast.faa.gov]) reflect the changing market conditions.

Foreign Launch 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. However, President Clinton terminated the quotas for Russia and Ukraine in 2000, and the agreement with China expired at the end of 2001.

Europe. The European Space Agency (ESA) developed the Ariane family of launch vehicles. The first test launch of an Ariane was in 1979; operational launches began in 1982. ESA continued to develop new variants of Ariane. Ariane 5 is the only version now in use. ESA also is developing a smaller launch vehicle, Vega, whose first launch is expected in 2005. Operational launches are conducted by the French company Arianespace, which is

owned by the French space agency (CNES) and European aerospace companies and banks. Arianespace conducts its launches from Kourou, French Guiana, on the northern coast of South America. Arianespace also markets Russia's Soyuz launch vehicle as part of a French-Russian joint venture, Starsem, and may build a launch site for Soyuz at Kourou.

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 is concerned about how much the respective governments subsidize commercial launch operations, but another controversial topic (not formally part of the talks) was 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 originally 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 gives preference to using Ariane, but is not legally constrained from using other launch vehicles.) Arianespace is currently encountering significant financial difficulties both because of the constrained market, and because of the failure of a new, more capable variant of the Ariane 5 in 2002. In May 2003, the ESA Council of Ministers adopted a European Guaranteed Access to Space (EGAS) program that includes providing 960 million euros for Arianespace to return the more capable version of the Ariane 5 to flight status, and to acquire Ariane 5 launch vehicles through 2009, a period when the commercial space launch business is expected to be slow.

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 7-year agreement was reached in 1995, and amended in 1997. The agreement expired on December 31, 2001. While the agreements were in force, they established quotas on how many commercial satellites China could launch each year, and included pricing provisions to try to ensure that China did not unfairly compete with U.S. commercial launch service providers because of its non-market economy.

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. W. 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, tensions were acute between those viewing the sanctions as harmful to U.S. business interests and those seeking to prevent sensitive technology from reaching China and/or to punish China for MTCR infractions. The debate centered on whether the satellites should 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; 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 satellites, now called Chinastar, 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.] 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 denied 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 Loral's export license. The companies insist they did nothing that violated the license. The Justice Department investigated the allegations and expanded the probe to include Hughes' response to the 1995 APStar-2 failure. A grand jury reportedly was empaneled in 1999. The government reacted a civil settlement with Loral on January 9, 2002 wherein Loral agreed to pay a $14 million civil fine, and spend $6 million on strengthening its export compliance program. On December 26, 2002, the State Department charged Hughes Electronics and Boeing Satellite Systems with 123 export violations. The companies settled with the government on March 5, 2003, accepting a civil penalty of $20 million in cash, and $12 million in credits for money already spent ($4 million), or that will be spent ($8 million), on export program enhancements.

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 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 had not been rectified. In January 2001, *Space News* reported that the Chinasat 8 export application was returned to Loral without action.

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-Present. 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). At the time, attention was focused on two European companies (Astrium and Alenia Spazio) that had built satellites for two multinational satellite organizations (Intelsat and Eutelsat, respectively) that were scheduled for launch by China. The satellites contain U.S. components. The companies reportedly had received State Department approval to ship the satellites to China, but waivers still were needed. In August 2001, Intelsat canceled its contract with Astrium for the APR-3 satellite, citing several factors including the delay in obtaining U.S. export approval. Eutelsat switched the launch of its satellite to Europe's Ariane. Other satellites being manufactured by U.S. companies, however, such as Chinasat 8 and another being built by Loral (Apstar-5, for APT Satellite Co.), or containing U.S. components 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), and the FY2003 Consolidated Appropriations Resolution (P.L. 108-7) require 15 days notice to Congress before processing licenses for exporting satellites to China.

Russia. U.S. policy prohibited U.S.-built satellites from being exported to the Soviet Union. Following the collapse of the Soviet Union, President George H. W. Bush said he would not oppose Russia launching an International Maritime Satellite Organization (Inmarsat) satellite and the United States would negotiate with Russia over "rules of the road" for future commercial launches. Discussions in the fall of 1992 led to agreement in principle in May 1993; 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, a Technology Safeguard 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 that might be engaged in illegal export activities. The United States imposed sanctions against seven of them on July 28 and three more entities on January 12, 1999. The State Department said the United States would not increase the quota on geostationary launches that Russia could conduct under the 1996 agreement unless Russian entities ceased cooperating 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 were not among those sanctioned. Lockheed Martin was anxious to have the quota raised to 20 and eventually eliminated. On July 13, 1999, the White House agreed to raise the quota to 20. The agreement that set the quotas was due to expire on December 31, 2000, but the White House eliminated the quota on December 1 (*Wall Street Journal,* December 1, 2000, p. A4).

Ukraine. Ukraine 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, 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.

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. Two test launches have been completed. The GSLV uses Russian cryogenic engines that were the subject of a dispute between the United States and Russia (discussed earlier).

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. H-2 was not cost effective, and encountered technical problems that led the Japanese government to abandon it in 1999. A new version, H2A, successfully completed its first launch in August 2001. In 2002, the Japanese government announced that it will privatize production of the H2A by 2005. Mitsubishi Heavy Industries has taken over development and marketing. H-2A launches are conducted from Tanegashima, on an island south of Tokyo. 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.

Satellite Exports: Agency Jurisdiction and Other Continuing Issues. Between 1992 and 1996, the George H. W. 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 launch of satellites by China (discussed above), 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.

The 107th Congress considered, but did not pass, legislation on the agency jurisdiction question. The issue is being debated again in the 108th Congress. H.R. 1950 (the FY2004 State Department Authorization Act) as reported from the House International Relations Committee (HIRC, H.Rept. 108-105, Pt. 1) would have left the decision on agency jurisdiction to the President if the export is to a NATO country or major non-NATO ally, while exports to China would remain under State Department jurisdiction. The House Armed Services Committee rejected that language in its markup of H.R. 1950 (H.Rept. 108-105, Pt. 3). As passed by the House, H.R. 1950 does not include that language.

Some of the controversy reflects concerns of the aerospace and space insurance industries that the new regulations are being implemented too broadly and vigorously. DOD officials and others have cited potential harm to the U.S. defense industrial base if U.S. exports are stifled, too. One concern is the length of time needed to obtain State Department approval. 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 with expedited approval for exports to NATO allies and major non-NATO allies. The new rules took effect July 1, 2000. 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). The Security Assistance Act (P.L. 106-280) reduced 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, but H.R. 1950, as passed by the House July 16, 2003, changes that time period back to 30 days.

The Satellite Industry Association (SIA) released figures in May 2001 showing U.S. satellite manufacturers losing market share to foreign companies. SIA and others attributed 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. For 2001, however, U.S. companies won 19 of the 22 commercial satellite manufacturing contracts

world-wide (*Space News*, Jan. 21, 2002). U.S. companies won three of the four new satellites ordered world-wide in 2002 (*Space News*, January 13, 2003). A floor amendment to H.R. 1950 to exempt transfers of marketing information for commercial communication satellites from export license requirements for potential sales to NATO countries, Japan, Australia, and New Zealand was defeated. Similar language is included in S. 1161, the Foreign Assistance Authorization Act, as reported (S.Rept. 108-56).

LEGISLATION

H.R. 1588 (Hunter)

FY2004 National Defense Authorization Act. H.R. 1588 reported from House Armed Services Committee May 16 (H.Rept. 108-106). S. 1050 reported from Senate Armed Services Committee May 13 (S.Rept. 108-46). Respective bills passed House and Senate May 22. Conferees have met.

H.R. 1950 (Hyde)

FY2004-2005 State Department Authorization Act. Reported from House International Relations Committee (H.Rept. 108-105, Parts 1 and 2); from House Armed Services Committee (Part 3); and Energy and Commerce Committee (Part 4). Passed House July 16.

P.L. 108-87, H.R. 2658

FY2004 DOD appropriations act. H.R. 2658 reported from House Appropriations Committee July 2 (H.Rept. 108-187); passed House July 8. S. 1382 reported from Senate Appropriations Committee July 9 (S.Rept. 108-87). Passed Senate July 17. Conference report (H.Rept. 108-283) passed House September 24, Senate September 25. Signed into law September 30, 2003.

H.R. 2861 (Walsh)/S. 1584 (Bond)

FY2004 VA-HUD-IA appropriations act (includes NASA). Reported from House Appropriations Committee July 24 (H.Rept. 108-235); passed House July 25. Reported from Senate Appropriations Committee September 5 (S.Rept. 108-143).

H.R. 3219 (Hall)

Space Shuttle Independent Oversight Act. Introduced October 1, 2003. Referred to Committee on Science.

H.R. 3285 (Rohrabacher)

Commercial Space Act of 2003. Introduced October 2, 2003. Referred to Committee on Science.

S. 1161 (Lugar)

FY2004 Foreign Assistance Authorization Act. S. 1161 reported from Senate Foreign Relations Committee May 29 (S.Rept. 108-56). Incorporated into S. 925, Division B during Senate debate July 9.

S. 1260 (McCain)

Commercial Space Transportation Act of 2003. Reported from Senate Commerce Committee July 24, 2003 (S.Rept. 108-111).