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SPACE SHUTTLE

Upgrade Activities and Carryover Balances

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Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to discuss two aspects of the National Aeronautics and Space Administration's (NASA) space shuttle program—upgrade activities and carryover balances.

In May 1997, the House Science Committee expressed concern about NASA's plans to take $190 million from the space shuttle program to help offset additional costs in the International Space Station program. According to NASA, the funds were available for transfer because of the high carryover balances projected to be available at the end of fiscal year 1997. The funding transfer was made, with a significant portion of the funds coming from the safety and performance upgrade portion of the shuttle program. Pursuant to the Committee's request, we agreed to review (1) the effect of the funding transfer on major shuttle upgrade projects and the status of those projects, (2) the role carryover balances had in the transfer and in funding upgrades, and (3) funding for future upgrades.

Background

The space shuttle is the United States' only means for transporting humans to and from space and NASA considers safe operation of the shuttle as its top priority. The shuttle has flown 86 missions over the past 16 years. It will be required well into the next century for space station assembly and operations support and other human space flight missions. Upgrades will be a necessary part of the program until the space shuttle is replaced. NASA's strategy is to identify and prioritize upgrades to meet the program goals of (1) improving system safety, (2) supporting the flight manifest, (3) improving system supportability and reliability, and (4) reducing system operating costs.

NASA began a new supportability upgrade program in fiscal year 1997 to combat obsolescence in, and improve the reliability of, the space shuttle. This program involves updating and modernizing shuttle components, such as the checkout and launch control system at Kennedy Space Center. According to NASA, supportability upgrades are required to help ensure continued safe shuttle flight operations.

Future plans for the shuttle that could influence upgrade decisions are currently being formulated. At the direction of the Office of Management and Budget (OMB), NASA is developing a space transportation strategy. In support of that strategy, NASA is also developing a common space transportation technology development plan. Taken together, these plans

are intended to guide decisions related to future investments in space transportation systems. The strategy is to be coordinated with both the Department of Defense and the commercial sector to ensure an integrated approach to U.S. space transportation in the 21st century. These documents are to accompany NASA's fiscal year 1999 budget submission to OMB.

NASA's budget for the space shuttle in fiscal year 1997 was $3.15 billion, including $636 million in the safety and performance upgrades line item. Space shuttle funding is available for obligation over a 2-year period. Funding that cannot be used in the year it is appropriated can be carried over to help cover program costs in the next fiscal year. Carryover includes unobligated funds as well as funds that have been obligated for goods and services but for which costs have not been incurred. The amount of carryover at the end of a fiscal year is determined by the total budgetary resources available less the costs incurred that year. Total budgetary resources consist of carryover from the prior year plus new budget authority.[1]

Summary

The $190 million funding transfer to the space station program did not adversely impact current or near-term upgrade projects. Four current projects, which account for about 91 percent of the total funding provided for upgrade activities in fiscal year 1997, could not have used the transferred funds. Even though they experienced technical problems and associated schedule slips, the projects' financial reserves were sufficient to fund the problems experienced. The transferred funds were also not needed for supportability upgrades because they began more slowly than planned due to a longer-than-anticipated approval process. As a result, only about $40 million of the $70 million in funds allocated in fiscal year 1997 to the new supportability upgrade effort will be used; the remainder will carry over to support fiscal year 1998 activities.

The $190 million transferred to the space station program was available because of the large amount of carryover within the shuttle program. Without the transfer, the shuttle program would have had about a $600 million budget carryover at the end of fiscal year 1997. However, shuttle program managers estimated that they would need only $395 million in carryover at that time.

[1]For a discussion of carryover balances, see NASA Budget: Carryover Balances in Selected Programs (GAO/NSIAD-96-206, July 16, 1996) and (GAO/T-NSIAD-96-207, July 18, 1996).

NASA has used carryover to fund upgrades in the past and plans to continue doing so in the future. For example, NASA designated $70 million in fiscal year 1996 carryover funds to initiate the new supportability upgrade effort, and it plans to use another $95 million for this purpose in fiscal year 1998.[2]

Depending on the future upgrades selected, costs could range from hundreds of millions to several billions of dollars. NASA is presently defining an upgrade program to keep the shuttle a viable space transportation system at least through the planned mission life of the space station—about 2013. Other planning assumptions include increasing the shuttle's flight rate from about 8 to 15 times a year, obtaining other customers, and operating the shuttle to 2030. In addition to annual funding requests for safety and performance upgrades and the continued use of excess carryover, NASA plans to use any savings that are generated within the shuttle program to fund its upgrade activities. However, the extent to which these sources will be available in the future is uncertain.

Funding needs for future upgrades will be driven by a number of questions for which answers are not yet apparent. These questions are related to such issues as how long the shuttle will be required and whether viable alternatives can be developed to support space station operations and other human space flight requirements.

Funding Transfer Did Not Adversely Impact Current and Near-Term Upgrade Projects

Transferring funds from the shuttle program had no impact on ongoing upgrades because reserves available in those projects were sufficient to fund the technical problems experienced. Likewise, the funds would not have benefited the supportability upgrade effort because it took longer than planned to initiate those projects.

The four largest ongoing shuttle upgrades represent about 91 percent of the $636 million funding for upgrades in fiscal year 1997. These projects involve the design and development of the (1) alternate high pressure turbopump (AHPTP), (2) super lightweight tank (SLWT), (3) large throat main combustion chamber (LTMCC), and (4) multifunction electronic display system (MEDS). Each of these projects has remained within its initial funding profile because each project has sufficient financial reserves to cover the costs of development problems and schedule delays they have experienced so far. Two of the projects, SLWT and LTMCC, are essentially

[2]The $70 million for upgrade activities in fiscal year 1997 included $50 million for supportability upgrades and $20 million for studies of long-term upgrades. For fiscal year 1998, NASA plans to use $75 million for supportability upgrades and another $20 million for continued study of long-term upgrades.

complete and NASA officials do not anticipate any more development problems. It is still possible that the other two projects could experience further development problems, exhaust their remaining financial reserves, and require additional funding. However, NASA officials believe that reserves would be available elsewhere within the shuttle program if the projects' remaining reserves are insufficient. Table 1 summarizes the cost and schedule status of the four largest upgrades currently underway. Additional information on the status of the four upgrades is in appendix I.

Table 1: Cost and Schedule Changes for Four Largest Shuttle Upgrades

Upgrade projects	Initial funding estimate[a]	Current funding estimate[a]	Funding estimate Change[a]	Initial schedule (month/year)	Current schedule (month/year)	Schedule changes (months)
AHPTP	$1,056	$971	$-85	10/97	7/98	+9
SLWT	173	156	–17	12/97	5/98	+5
LTMCC	118	77	–41	10/97	1/98	+3
MEDS	230	206	–24	2/98	1/99	+11

[a]Dollars in millions.

Activities under the new supportability upgrade program have begun more slowly than planned because projects took longer than anticipated for approval. Before work begins, upgrades must be approved through the shuttle Program Requirements Control Board. Proposals to modify the shuttle are thoroughly reviewed through a very formal process before they are approved by the Board. As a result, only about $40 million of the $70 million allocated to the new supportability upgrade effort will be used in fiscal year 1997; the remainder will carry over to support fiscal year 1998 activities.

High Carryover Balances Enable Transferring Funds and Funding Upgrades

The $190 million transferred to the space station program was available because of the large amount of carryover within the shuttle program. Without the transfer, the carryover in the shuttle program would have been about $600 million at the end of fiscal year 1997. In contrast, between fiscal year 1993 and 1996, carryover in the shuttle program averaged about $400 million annually. Two factors contributed to much higher than average estimated carryover at the end of fiscal year 1997. First, the $467 million carryover from fiscal year 1996 into 1997 was higher than normal. Second, shuttle program costs in fiscal year 1997 were less than originally estimated. NASA initially estimated program costs for fiscal

year 1997 at about $3.1 billion, but its most recent estimate is now almost $100 million less.

In May 1997, shuttle program officials indicated that they would like to have a carryover balance of $395 million at the end of fiscal year 1997—for forward funding on contracts ($200 million), reserves for estimating uncertainties ($100 million), and supportability upgrades ($95 million). NASA's estimated fiscal year 1997 carryover of about $400 million is consistent with the program's average annual $400 million carryover for the four preceding fiscal years. However, it is substantially higher than the $138 million that NASA officials had projected last summer would be carried over from fiscal year 1997 to fiscal year 1998. The $138 million estimate did not include carryover for reserves or supportability upgrades and assumed a much lower carryover from fiscal year 1996.

In July 1996, NASA estimated that its carryover balance in the shuttle program would be about $152 million on September 30, 1996. However, the actual carryover balance on September 30, 1996, was over $467 million. The large increase was due to NASA not using all of its program reserves ($122 million), underspending or underrunning costs in some program elements ($185 million), and reserving funds to cover costs associated with the transition to a single space flight operations contract for the shuttle ($19 million).

NASA has used carryover to fund shuttle upgrades in the past and plans to continue doing so in the future. NASA designated $70 million in fiscal year 1996 carryover funds to initiate a new effort involving supportability upgrades in fiscal year 1997, and it plans to use another $95 million for this purpose in fiscal year 1998. Beginning in fiscal year 1999, supportability upgrades will be funded as a part of the safety and performance upgrade portion of the shuttle program's budget. Some of the supportability upgrades approved so far include upgrading the checkout and launch control system. Funds are also being used to study potential long-term upgrades such as liquid flyback boosters.

Issues Warrant Consideration Before Funding Future Upgrade Requirements

NASA is presently defining an upgrade program to keep the shuttle a viable space transportation system at least through the planned mission life of the space station, about 2013. Additional planning assumptions include operations until 2030, a flight rate of 15 per year, and use of the shuttle by both the Department of Defense and commercial customers.

The potential funding requirements for future shuttle upgrade activities could be substantial. NASA has identified about 70 potential modifications to the shuttle with an estimated total cost of $5 billion to $7 billion. Most of this estimated cost relates to development of the liquid flyback booster. Over 30 upgrades with an estimated total cost of about $322 million have already been approved for implementation or study.

NASA plans to use a variety of sources to fund these activities, including the safety and performance upgrade budget line, the continued use of excess carryover balances, and savings from the new space flight operations contract. Shuttle program officials are depending on the last two sources to build an account to help fund future upgrades. However, the extent to which all of these sources together will provide sufficient funding for upgrades is uncertain. For example, NASA's overall future budgets are currently planned at slightly reduced levels, but larger reductions may occur. Also, the continuing availability of sufficient excess carryover balances is questionable, and the level of any future savings under the space flight operations contract is unknown. Ongoing NASA studies, including the one directed by OMB, are expected to provide additional information about the shuttle's role in the Nation's space transportation strategy. The results of these studies will help initiate the necessary debate for shaping the U.S. government's future space transportation policy.

Funding needs for future upgrades will be driven by a number of questions for which answers are not yet apparent. These questions are related to such issues as (1) how long the shuttle will be required, (2) what upgrades will be needed to maintain the shuttle's safe operation, (3) whether there will be any savings from the space flight operations contract and excess carryover, (4) who should pay for required upgrades if the shuttle is privatized, and (5) whether there are viable alternatives to the shuttle to support space station operations and other human space flight requirements.

Mr. Chairman, this concludes our statement. We would be happy to answer any questions that you or members of the Subcommittee may have.

Status of the Four Largest Ongoing Shuttle Upgrades

The National Aeronautics and Space Administration's (NASA) four largest ongoing upgrade projects involve the design and development of the (1) alternate high pressure turbopump (AHPTP), (2) super lightweight tank (SLWT), (3) large throat main combustion chamber (LTMCC), and (4) multifunction electronic display system (MEDS).

Alternate High Pressure Turbopump

The AHPTP project is designed to upgrade the shuttle main engine's high pressure oxygen and hydrogen turbopumps. The turbopumps inject liquid oxygen and hydrogen fuel into the engine's combustion chamber where they mix and burn to generate power for shuttle launch. The oxygen turbopump has completed development and is operational on the shuttle. The hydrogen pump development was suspended in fiscal year 1992 and restarted in fiscal year 1994. The hydrogen pump is currently scheduled for its first flight in July 1998.

NASA officials told us that the technical difficulties associated with the hydrogen pump are due to design problems related to cracks in the housing and turbine blades. At this point, the solution is to redesign and retest to verify that the problems are resolved. According to NASA officials, currently available or planned funding reserves are adequate to cover any additional costs. As a result, NASA officials said that additional funding would not benefit the project.

Super Lightweight Tank

SLWT will provide the shuttle with additional lift capability to support space station assembly and operation. The tank is built from a new aluminum alloy that reduces the tank's weight and provides the shuttle with an additional 7,500 pounds of lift capability. SLWT is currently scheduled for its first flight in May 1998.

SLWT technical problems have been primarily associated with welding the new aluminum alloy. When welds intersect, cracks can occur which cause time consuming repairs. According to NASA officials, the problems are related to the manufacturing process, and solutions have been identified and implemented. SLWT has completed development and has been certified for flight. The first flight tank is currently being manufactured.

Project officials believe there are sufficient reserves to fund any unforeseen problems. The SLWT project completed development with about $20 million in reserves with another $12 million in reserves at headquarters.

Large Throat Main Combustion Chamber

Liquid oxygen and hydrogen fuel mix in the space shuttle main engine combustion chamber to generate the engine's power. LTMCC, which is an advanced design of the current combustion chamber, will reduce the operating temperature and pressure within the engine and thereby increase the engine's safety margins. LTMCC is on schedule and within estimated cost and is currently scheduled for its first flight in January 1998.

Multifunction Electronic Display System

The space shuttle orbiter currently provides flight control information to crew members through cathode ray tube displays, instruments, and meters. The current system consists of hardware based on 1970s technology, which creates ongoing logistics support problems because of wear, aging, and component obsolescence. MEDS is being designed to simplify orbiter operations, increase the life of the orbiter's displays, and increase the reliability of the system. MEDS is currently scheduled to become operational in January 1999.

MEDS has a development problem with the glass required for the displays. NASA attempted to develop a U.S. supplier for the glass. However, the supplier chosen was subsequently unable to meet program production requirements and could not meet the stringent quality standards for the severe operational environment of the orbiter. As a result, the U.S. supplier's contract has been terminated, and the glass is being purchased from a foreign source.

NASA estimates that obtaining a new glass supplier will add about $20 million to the cost of the project, but reserves have thus far been adequate. However, contract negotiations for the new glass supplier are not complete, and the contractor's proposal is $6.8 million more than available in program reserves. NASA officials told us that they hope to resolve this issue through contract negotiations. The officials said that, if negotiations are not successful and the increased cost materializes, they will use funds within the shuttle program to meet the additional funding requirement.

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