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SPACE STATION

U.S. Life-Cycle Funding Requirements

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Mr. Chairman and Members of the Committee:

We are pleased to be here today to discuss U.S. funding requirements for the National Aeronautics and Space Administration's (NASA) International Space Station program.[1] Our testimony today will summarize the results of recent work we completed at the request of the Senate Committee on Commerce, Science, and Transportation focusing on the station's development, assembly, and operations costs.[2] Where applicable, we will (1) compare the current estimate with the estimate in our June 1995 report[3] and (2) provide information on potential cost increases, current program reserves, the prime contractor's cost and schedule performance, and the impact of recent revisions to the assembly sequence.[4]

The majority of our analysis is based on NASA's fiscal year 1999 budget submission and the assembly sequence characterized by NASA as Revision C.

Summary

Based on NASA data and our analysis, we estimate that the U.S. cost to develop, assemble, and operate the space station has increased to almost $96 billion.[5] Further, we identified a number of program changes that could significantly increase this estimate, such as the potential for additional schedule slippage and the need for shuttle launches to test and deliver the crew return vehicle. As we have reported previously, we continue to be concerned about the adequacy of program reserves to deal with changing program needs. Over 3 years ago, the space station program had more than $3 billion in financial reserves to cover development contingencies. In March 1998, with almost 6 years until completion, the net unencumbered financial reserves were down to about $1.1 billion.

[1]NASA and its international partners—Japan, Canada, the European Space Agency, and Russia—are building the International Space Station as a permanently orbiting laboratory to conduct materials and life sciences research under nearly weightless conditions.

[2]International Space Station: U.S. Life-Cycle Funding Requirements (GAO/NSIAD-98-147, May 22, 1998).

[3]Space Station: Estimated Total U.S. Funding Requirements (GAO/NSIAD-95-163, June 12, 1995).

[4]Space Station: Cost Control Problems Continue to Worsen (GAO/T-NSIAD-97-177, June 18, 1997); Space Station: Cost Control Problems Are Worsening (GAO/NSIAD-97-213, Sept. 16, 1997); Space Station: Deteriorating Cost and Schedule Performance Under the Prime Contract (GAO/T-NSIAD-97-262, Sept. 18, 1997); and Space Station: Cost Control Problems (GAO/T-NSIAD-98-54, Nov. 5, 1997).

[5]All dollar estimates in this testimony have been adjusted for inflation.

After we completed this work and issued our May 1998 report, NASA and its international partners revised the station assembly sequence again, resulting in further schedule slippage and one additional shuttle flight. Additional costs will be incurred as a result of these changes.

Estimate of Total Space Station Costs Has Increased

Since June 1995, total space station estimated costs have increased from $93.9 billion to $95.6 billion. In particular, the development cost estimate has increased by more than 20 percent, in-house personnel costs have more than doubled, and eight shuttle flights have been added to the development program. However, shuttle support costs are lower because NASA is projecting a significant reduction in the average cost per flight. Appendix I compares the space station costs we reported in June 1995 with our latest estimate of April 1998. Following are key points regarding the life-cycle cost estimate presented in our latest report:

- The higher development costs—$21.9 billion versus $17.4 billion—are attributable to schedule delays, additional prime contractor effort not covered by funding reserves, additional crew return vehicle costs, and costs incurred as a result of delays in the Russian-made Service Module.
- The increased in-house personnel costs during development—$2.2 billion versus $0.9 billion—are attributable to a longer development program, higher estimated personnel levels, and a more inclusive estimating methodology.
- Regarding shuttle support, our 1995 estimate was based on 35 flights during development and 50 during operations. However, NASA's 1998 estimate was based on 43 flights during development, including 2 additional flights to the Russian space station Mir, 1 flight to test the crew return vehicle, and flights required by adoption of Revision C to the assembly sequence. NASA continues to estimate that 50 flights will be needed during operations.

Program Costs Could Increase Further

We reported that a number of potential program changes could significantly increase the current estimate. First, development costs would increase if the assembly complete milestone slips beyond December 2003.[6] Second, it is likely that the program will ultimately require more shuttle flights than are included in our analysis. A recent independent assessment by NASA's Cost Assessment and Validation Task Force suggests that the

[6]Subsequent to our report, NASA revised the space station's assembly sequence. Assembly complete is now scheduled for January 2004.

program's schedule will likely experience further delays and require additional funding.[7]

Schedule Changes

We believe NASA and its partners face a formidable challenge in meeting the launch schedules necessary to complete assembly. Those schedules depend on the launch capacity in the United States and Russia and the program's ability to meet all manufacturing, testing, and software and hardware integration deadlines. Over 90 launches by NASA and its international partners will be needed for assembly, science utilization, resupply, and crew return purposes.

Delays in the development program would increase costs because, at a minimum, fixed-costs such as salaries, contractor overhead, and sustaining engineering would continue for a longer period than planned. Assuming NASA would continue to spend at the rate shown in its current estimate for fiscal year 2003, the program would incur additional costs of more than $100 million for every month of schedule slippage.

Additional Flights

The program could require more shuttle flights than are baselined in our estimate. For example, the baseline does not include additional flights that may be needed for crew return vehicle testing and eventual launches and some resupply flights. Depending on the ultimate life expectancy of the crew return vehicle, two additional flights could be needed. On the basis of NASA's estimate of average cost per flight for the shuttle, this could add about $1 billion to the total estimate.

It should be noted that the recent revision to the assembly sequence added an additional shuttle flight. However, that flight does not relate to the crew return vehicle.

Additions Suggested by Independent Assessment

Between November 1997 and April 1998, NASA's Cost Assessment and Validation Task Force examined the station program's past and projected performance and made quantitative determinations regarding the potential for additional cost and schedule growth. Reflecting many of the same areas we identified, the task force cited complex assembly requirements

[7]Our work and that of the independent assessment task force was performed between November 1997 and April 1998. Our work focused on aggregating the various components of the space station's life-cycle cost, based on NASA's current budget projections. The assessment task force focused on evaluating the program in terms of potential cost and schedule growth primarily for the program's development portion. Report of the Cost Assessment and Validation Task Force on the International Space Station, April 21, 1998.

and potential schedule problems associated with remaining hardware and software development and concluded that the program could require an additional $130 million to $250 million in annual funding. The task force also indicated that the program could experience 1 to 3 years of schedule growth.

Funding Reserves May Be Inadequate

We have previously expressed our concern with the adequacy of space station financial reserves.[8] We continue to be concerned. The program has used, or identified specific uses for, a significant portion of available reserves, with almost 6 years left before the last assembly flight is scheduled to be launched.

In January 1995, the space station program had more than $3 billion in financial reserves to cover development contingencies. Since then, reserve levels have steadily declined. In March 1998, the net unencumbered financial reserves available to the program were down to about $1.1 billion. In the past, reserves have been used to fund additional requirements, overruns, and other authorized changes. Some of the potential funding needs include those related to NASA's decision to add a third node to the station's design.

NASA has identified adequacy of reserves as one of the highest current program risks. We note that the current reserve status could be affected by additional schedule slips, contract disputes, manufacturing problems, or the need for additional testing. If the cost to resolve a problem cannot be covered by available reserves, program managers could be faced with deferring or rephasing other activities, thus possibly delaying the space station's development schedule or increasing future costs.

NASA/Boeing Adopt New Baseline to Measure Cost and Schedule Performance

In October 1997, NASA granted approval to Boeing to begin tracking cost and schedule performance using a new baseline. The revised ground rules permitted Boeing to reset its cost and schedule baseline to the actual cost incurred and work performed as of September 1997.[9] For reporting purposes, this had the effect of resetting cost and schedule variances to zero. NASA did so to incorporate current recovery plans into the new baseline. We asked officials of the space station program to provide us

[8]Financial reserves are used to fund unexpected contingencies, such as cost growth, schedule delays, or changes in project objectives or scope.

[9]At the end of September 1997, prior to resetting the baseline, Boeing reported a cost variance of plus $398 million and a schedule variance of plus $139 million.

with an analysis depicting a crosswalk back to the original baseline to understand the impact on previously reported overruns. That analysis shows that the February 1998 overrun would have been about $50 million higher than the $398 million Boeing reported prior to the change. Boeing's estimate of overrun at completion remains $600 million, while NASA's budget projections assume an $817 million prime contractor overrun at completion.

Potential Debris Tracking Costs Are Not Included

Due to its large size and long operational lifetime, the space station will face a risk of being struck by orbital debris. NASA plans to provide shielding against smaller objects and maneuver the station to avoid collisions with large objects.

The National Space Policy requires NASA to ensure the safety of all space flight missions involving the space station and shuttle, including protection against the threat of collisions from orbiting space debris. However, NASA has no debris tracking capability and must rely on the Department of Defense (DOD) to perform this function.

NASA recently updated its overall requirement for space debris tracking to include the ability to track and catalog objects as small as 1 centimeter. Studies by NASA and DOD indicate that the cost to achieve that capability could range from $400 million to about $5 billion. We reported that the sources of the funding for the system were undetermined. Also, while the more stringent requirement is related to the space station, other space activities would benefit from the ability to track 1-centimeter-sized debris. Since debris tracking is a NASA-wide requirement, and the agency relies on DOD to provide the service, the two agencies will have to work together to determine an appropriate funding arrangement.

Impact of Recently Announced Assembly Sequence

In late May 1998, NASA and its international partners revised the station assembly sequence. This new assembly sequence impacts the life-cycle analysis in our report in a number of ways, including the effects of schedule slippage, the cost associated with one additional shuttle flight, and the potential effects of more schedule compression.

Regarding schedule slippage, the new sequence shows an assembly complete date of January 2004, as compared with the previous completion date of December 2003. We stated in our report that each additional month of slippage at the end could result in an added cost of more than

$100 million. Also, our analysis included a number of areas of support costs such as for civil service personnel and principal investigators. These costs would also be higher because the assembly complete date is now in the second quarter of fiscal year 2004.

The cost of the additional flight would be added to our development phase estimate. The ultimate impact would be based on new average cost per flight calculations.

The new assembly sequence adds a flight and reduces the time frame to assemble the station. Thus, there may be additional stresses on the shuttle in achieving the new launch schedule. To that end, the need to achieve greater shuttle processing efficiencies is now even more relevant. If NASA is unable to achieve those efficiencies, there will be more schedule slippage.

Mr. Chairman, this concludes our statement. We will be happy to answer any questions you or Members of the Committee may have.

Estimated Space Station Costs

(Current dollars in billions)

Cost category	June 1995 estimate	April 1998 estimate
U.S. requirements through assembly complete[a]		
Contract and in-house costs from 1985 through 1993	$11.2	$11.2
Development cost from 1994 to assembly complete	17.4	21.9[b]
Station-related requirements		
In-house personnel	0.9	2.2[c]
Principal investigators	0.3	0.2[d]
Shuttle performance enhancements	0.3	0.2
Russian contract	0.4	n/a[e]
Shuttle launch support	17.8	17.7
Subtotal	**48.2**	**53.4**
U.S. requirements after assembly complete		
Operations/utilization	13.0	13.0
Principal investigators	Unavailable	0.7
In-house personnel	Unavailable	2.9[f]
Shuttle launch support	32.7	25.6
Station decommissioning[g]	Unavailable	Unavailable
Total	**$93.9**	**$95.6**

Note: Totals may not add due to rounding.

[a]We define assembly complete as December 2003, when the last assembly flight is currently scheduled.

[b]Includes station development, operations, and research activities through December 2003. Also includes funding reserves and costs associated with the crew return vehicle and U.S. missions to the Russian space station Mir. Costs associated with activities from October through December 2003 are prorated, based on the fiscal year 2004 budget planning estimate.

[c]Estimate was derived by dividing total personnel cost by the number of full-time equivalents (FTE). We then multiplied that result by the number of space station program FTEs. Our current estimate includes an allocation of all research and program management costs to the station program.

[d]NASA is continuously adjusting its plans for research as the availability of space station resources are better defined. NASA plans to increase its number of principal investigations consistent with resources available for space station utilization through assembly complete. For the operations period, the estimate assumes a flat or only slightly declining budget in the out-years.

[e]U.S. costs associated with the Russian Space Agency contract are included in the development estimate.

[f]Our estimate was derived by using the cost associated with station program FTEs in fiscal year 2003 and escalating that figure by 3 percent a year for 10 years.

[g]NASA plans to attach a propulsion vehicle to the station and perform a controlled deorbit into the ocean. The U.S. share of the ultimate disposal cost will depend on the propulsion vehicle chosen.