

September 1997

# SPACE STATION

## Cost Control Problems Are Worsening



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**National Security and  
International Affairs Division**

B-276834

September 16, 1997

The Honorable Dale Bumpers  
United States SenateThe Honorable John Dingell  
House of Representatives

As you requested, we have updated certain aspects of our July 1996 report on the International Space Station (ISS), which is being developed by the United States and others.<sup>1</sup> Specifically, this report addresses the Russians' performance problems and the National Aeronautics and Space Administration's (NASA) reaction to them, including the additional cost and cost risk assumed by NASA; cost and schedule experience under the prime contract; and the status of and outlook for the program's financial reserves. You also asked us to identify actions taken by NASA to keep the space station program's funding within certain limits through the completion of the station's assembly.

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**Background**

NASA and its international partners—Japan, Canada, the European Space Agency (ESA), and Russia—are building the ISS as a permanently orbiting laboratory to conduct materials and life sciences research under nearly weightless conditions. Each partner is providing station hardware and crew members and is expected to share operating costs and use of the station. The NASA Space Station Program Manager is responsible for the cost, schedule, and technical performance of the total program. The Boeing Corporation, the station's prime contractor, is responsible for ISS integration and assembly. As of June 30, 1997, the prime contractor reported that over 200,000 pounds of its station hardware was being built or had been completed. According to NASA, by the end of fiscal year 1998, hardware for the first six flights will be at Kennedy Space Center for launch processing.

In our July 1996 report and subsequent testimony,<sup>2</sup> we noted that the cost and schedule performance of the space station's prime contractor had deteriorated and that the station's near-term funding included only limited financial reserves.<sup>3</sup> We also identified an emerging risk to the program: the

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<sup>1</sup>Space Station: Cost Control Difficulties Continue (GAO/NSIAD-96-135, July 17, 1996).

<sup>2</sup>Space Station: Cost Control Difficulties Continue (GAO/T-NSIAD-96-210, July 24, 1996).

<sup>3</sup>Financial reserves are used to fund unexpected contingencies, such as cost growth, schedule delays, or changes in project objectives or scope.

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indications of problems in the Russian government's ability to meet its commitment to furnish a Service Module providing ISS power, control, and habitation capability.

For several years, the space station program has been subject to a \$2.1 billion annual funding limitation and a \$17.4 billion overall funding limitation through the completion of assembly, which until recently had been scheduled for June 2002. According to NASA, these funding limitations, or caps, came out of the 1993 station redesign. Previous redesigns had been largely financially driven and the caps were intended to stabilize the design and ensure that it could be pursued. However, the caps are not legislatively mandated, although references to them in congressional proceedings and reports indicate that NASA was expected to build the space station within these limits.<sup>4</sup> When the caps were first imposed, the program had about \$3 billion in financial reserves.

In our July 1996 report, we concluded that, if program costs continued to increase, threats to financial reserves worsened, and the Russian government failed to meet its commitment in a timely manner, NASA would either have to exceed its funding limitation or defer or rephase activities, which could delay the space station's schedule and would likely increase its overall cost. In June 1997 testimony, we said that, if further cost and schedule problems materialized, a congressional review of the program would be needed to determine the future scope and cost level for a station program that merits continued U.S. government support.<sup>5</sup> Over the past several months, NASA has acknowledged that the potential for cost growth in the program has increased.

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## Results in Brief

In May 1997, NASA revised the space station assembly sequence and schedule to accommodate delays in the production and delivery of the Service Module. This revision occurred after more than a year of speculation regarding Russia's ability to fund its space station manufacturing commitments. To help mitigate the adverse effects of the Russian's performance problems and address the possibility that such problems would continue, NASA developed and began implementing step 1 of a 3-step contingency plan. NASA has budgeted an additional

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<sup>4</sup>These limitations apply only to the station budget line providing funds to support development, utilization, and operation activities. This budget line does not cover all station and station-related requirements, including NASA personnel and personnel-related activities, space shuttle launch support, and shuttle performance improvements needed to meet station requirements.

<sup>5</sup>Space Station: Cost Control Problems Continue to Worsen (GAO/T-NSIAD-97-177, June 18, 1997).

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\$300 million from other NASA activities for the space station program to cover the hardware costs under step 1. NASA will also incur other costs under step 1 that have not yet been estimated. Significant additional cost growth could occur in the station program if NASA has to implement steps 2 and 3 of its contingency plan.

The cost and schedule performance of the station's prime contractor has continued to steadily worsen. From April 1996 to July 1997, the contract's cost overrun quadrupled to \$355 million, and the estimated cost to get the contract back on schedule increased by more than 50 percent to \$135 million. So far, NASA and prime contractor efforts have not stopped or significantly reversed the continuing deterioration. The station program's financial reserves have also significantly deteriorated, principally because of program uncertainties and cost overruns. The near-term reserve posture is in particular jeopardy, and the program may require additional funding over and above the remaining reserves before the completion of station assembly.

To date, NASA has taken a series of actions to keep the program from exceeding its funding limitations and financial reserves. NASA is accounting for these actions in ways that enable it to report its continuing compliance with the funding limitations. However, to show continuing compliance in some cases, NASA has had to redefine the portion of the program subject to the funding limitations. Thus, the value of the current limitations as a funding control mechanism is questionable.

Since our June 1997 testimony, further cost and schedule problems have materialized and NASA has acknowledged that the potential for cost growth in the program has increased. More complete estimates of the cost and schedule impacts of ongoing and planned changes to the program are scheduled to be available later this year. This information is expected to provide a more complete and current picture of the cost and schedule status of the program and clarify some of the major future cost risk it faces. We believe the program has reached the point where the Congress may wish to review the entire program. Such a review should focus on obtaining congressional and administration agreement on the future scope and cost level for a station program that merits continued U.S. government support. In view of the expected availability of revised cost estimates, the first opportunity for such a review would be in conjunction with NASA's fiscal year 1999 budget request.

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## Russian Performance Problems Cause Additional NASA Activity

As a partner, Russia committed to making a variety of contributions to the ISS. These contributions include (1) the Service Module to provide crew habitation during assembly; (2) the Science Power Platform to help maintain the station's orientation; (3) launch services to reboost and resupply the station, including the provision of propellant; and (4) Soyuz spacecraft to provide crew return capability during station assembly.<sup>6</sup>

In late 1995, NASA became concerned about Russia's ability to provide steady and adequate funding for its commitments. According to the NASA Administrator and station program officials, the Russian government said repeatedly that the problem would be resolved, despite mounting evidence to the contrary. Finally, in the fall of 1996, Russia formally notified NASA that funding difficulties would delay the completion of the Service Module, which is a critical component for early assembly. Subsequently, NASA designed a three-step recovery plan. Step 1 focuses on adjusting the station schedule for an 8-month delay in the availability of the Service Module and developing temporary essential capabilities for the station in case the Service Module is further delayed by up to 1 year. Major activities in this phase include delaying the launch of station components that are to precede the Service Module into orbit and building an Interim Control Module to temporarily replace the Service Module's propulsion capability. Step 1 is underway; the new or modified hardware being developed will be completed even if Russia maintains the Service Module's revised schedule and delivers it on time. NASA officials told us that Russia has resumed its financial commitment, the Service Module assembly has restarted, and significant progress is being made.

Step 2 is NASA's contingency plan for dealing with any additional delays or the Russian government's failure to eventually deliver the Service Module. This phase could result in permanently replacing the Service Module's power, control, and habitation capabilities. NASA will decide later this fall on whether to begin step 2. Under step 3 of NASA's plan, the United States and other international partners would have to pick up the remaining responsibilities the Russian government would have had, such as station resupply and reboost missions and crew rescue during assembly. A decision on step 3 is planned for sometime next year, at the earliest.

In addition to their effects on space station development activities, these recovery plan steps place additional requirements on the space shuttle program. Under the plan, the space shuttle may be needed to launch and

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<sup>6</sup>Russia is also receiving funds under contract to build the U.S.-owned Functional Cargo Block to provide the ISS' initial guidance and navigational control capability.

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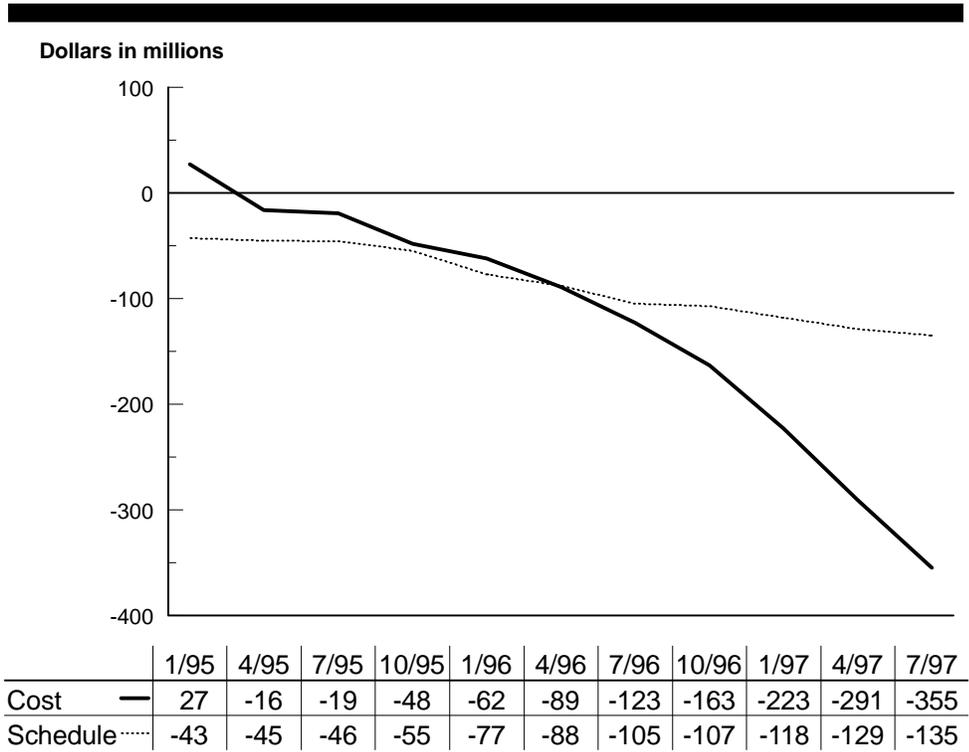
deliver the Interim Control Module and perform station resupply missions now expected to be done by Russia. Although the full impact of the recovery plan on the space shuttle program is not yet known, the plan has already resulted in the addition of two shuttle flights during the station's assembly.

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## Prime Contractor's Cost and Schedule Performance Continues to Deteriorate

The prime contractor's cost and schedule performance on the space station, which showed signs of deterioration last year, has continued to decline virtually unabated. Since April 1996, the cost overrun has quadrupled, and the schedule slippage has increased by more than 50 percent. Figure 1 shows the cost and schedule variances from January 1995 to July 1997. Cost variances are the differences between actual costs to complete specific work and the amounts budgeted for that work. Schedule variances are the dollar values of the differences between the budgeted cost of work planned and work completed. Cost and schedule variances are not additive, but negative schedule variances can become cost variances, since additional work, in the form of overtime, is often required to get back on schedule.

**Figure 1: Cost and Schedule Variances on the Space Station Prime Contract**  
(Jan. 1995 to July 1997)



Note: The zero line represents meeting planned cost and schedule. Negative schedule variances are the estimated cost of work to get back on schedule.

Between January 1995 and July 1997, the prime contract moved from a cost underrun of \$27 million to a cost overrun of \$355 million. During that same period, the schedule slippage increased from a value of \$43 million to \$135 million. So far, the prime contractor has not been able to stop or significantly reverse the continuing decline.

In July 1996, independent estimates of the space station’s prime contract cost overrun at completion ranged from \$240 million to \$372 million. Since then, these estimates have steadily increased, and by July 1997 they ranged

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from \$514 million to \$610 million.<sup>7</sup> According to program officials, some financial reserves will be used to help cover the currently projected overrun.

Delays in releasing engineering drawings, late delivery of parts, rework, subcontractor problems, and mistakes have contributed to cost overruns. NASA's concern about performance problems under the prime contract is evidenced by its recent incentive and award fee actions. In March 1997, NASA directed Boeing to begin adjusting its biweekly incentive fee accruals and billings based on a higher cost estimate at completion than Boeing was officially reporting. On the basis of an internal review, Boeing subsequently increased its estimate of cost overrun at completion from \$278 million to \$600 million. The increase in Boeing's estimate potentially reduces its incentive award by about \$48 million over the remainder of the contract period.

Boeing was also eligible for an award fee of nearly \$34 million for the 6-month period ending in March 1997. However, citing significant problems in program planning, cost estimating, and hardware manufacturing, NASA concluded that Boeing's performance did not warrant an award fee. NASA also directed Boeing to deduct almost \$10 million from its next bill to refund the provisional award fee already paid during the period.<sup>8</sup>

Boeing is implementing a corrective action plan for each identified weakness and has outlined a number of actions to improve the performance of the entire contractor team, including changing personnel, recruiting additional software engineers and managers, and committing funds to construct a software integration test facility. Boeing also presented a cost control strategy to NASA in July 1997. According to NASA officials, the strategy includes organizational streamlining and transferring some roles to NASA.

Station officials assessed Boeing's efforts to improve its performance as part of the midpoint review for the current evaluation period. They

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<sup>7</sup>Cost reports include internal and independent assessments of total program cost variance at completion. Methodologies include statistical calculations and analyses using a software program developed by the Department of Defense for analyzing contractor-reported cost data. Independent estimates are developed by NASA and the Department of Defense's Defense Contract Management Command (DCMC).

<sup>8</sup>Under the terms of the contract, Boeing could receive a previously denied award fee after NASA's final assessment at the end of the contract.

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concluded that, while there was some improvement, it was insufficient to permit resumption of provisional award fee payments.

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## Financial Reserves Are Dwindling

When NASA redesigned the space station in 1993 and brought Russia into the program as a partner, the program had approximately \$3 billion in financial reserves to cover development contingencies. Since then, the program reserves have been significantly depleted. In June 1997, the financial reserves available to the program were down to about \$2.2 billion. NASA estimated that, by the end of fiscal year 1997, the remaining uncommitted reserves could be less than \$1 billion.

Financial reserves have been used to fund additional requirements, overruns, and other authorized changes. By June 1997, a station program analysis indicated that fiscal year 1997 reserves might not be sufficient to cover all known threats. More recently, station officials have estimated that a small reserve surplus is possible in fiscal year 1997, but concerns are growing regarding the adequacy of fiscal year 1998 reserves.

NASA has already identified threats to financial reserves in future years that, if realized, would outstrip the remaining reserves. For example, program reserves have been identified to cover additional cost overruns; crew rescue vehicle acquisition; hardware costs, in the event that ongoing negotiations with partners are unsuccessful; and additional authorized technical changes. Thus, with up to 6 years remaining until on-orbit assembly of the station is completed, NASA has already identified actual and potential resource demands that exceed the station's remaining financial reserves. Unless these demands lessen and are not replaced by other demands of equal or greater value, or NASA is able to find offsets and efficiencies of sufficient value to replenish the program's reserves, the space station will require additional funding.

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## NASA Acts to Stay Within Funding Limitations and Replenish Its Financial Reserves

NASA has been able to consistently report compliance with funding limitations and avoid exceeding its financial reserves, despite significant programmatic changes and impacts that have increased station costs. To enable it to do so, NASA has implemented or initiated a variety of actions, including those summarized below:

- The space station program is negotiating with ESA, Canada, and Brazil to provide station hardware. Under proposed offset arrangements, the ISS partners—ESA and Canada—would build hardware associated with the

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U.S. commitment in return for launch services or other considerations. Under a cooperative arrangement, Brazil would receive a small allocation of the station's research capacity in return for any U.S. equipment it would agree to build. NASA estimates that \$116 million in U.S. station development costs could be saved through these arrangements. Space station officials have scheduled a threat of \$100 million against the program's financial reserves in case the negotiations are unsuccessful. However, according to program officials, most of the negotiations are nearly completed.

- NASA dropped the centrifuge from the station budget and opened negotiations with the Japanese government to provide it.<sup>9</sup> Also, the space station's content at the assembly completion milestone was revised to exclude the centrifuge. This change enabled NASA to maintain the then-current June 2002 assembly completion milestone, even though the centrifuge and related equipment would not be put on the station until after that date.
- NASA transferred \$462 million from its science funding to the space station development funding in fiscal years 1996 through 1998. NASA has scheduled the payback of \$350 million—\$112 million less than the amount borrowed—through fiscal year 2002. NASA is also planning to transfer another \$70 million in fiscal year 1999.<sup>10</sup> All of these funding transfers are within the \$17.4 billion funding limitation through assembly completion.
- NASA transferred \$200 million in fiscal year 1997 funding to the station program from other NASA programs to cover costs incurred due to Russian manufacturing delays.<sup>11</sup> Congressional action is pending on the transfer of another \$100 million in fiscal year 1998. These funds will be accounted for outside the portion of the program subject to the funding limitations.
- NASA uses actual and planned reductions in its fiscal year funding requirements to help restore and preserve its actual and prospective financial reserves. Typically, these actions involve rephrasing or deferring activities to future fiscal years. For example, the agency's current reserve posture includes actions such as moving \$20 million in spares procurement from fiscal years 1997 to 1999 and \$26 million in nonprime efforts from fiscal year 1997 to various future fiscal years.<sup>12</sup>

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<sup>9</sup>The centrifuge is a crucial piece of research equipment for the space station. NASA recently listed a threat against future years' reserves in the event that the negotiation is unsuccessful. However, NASA told us that an "agreement in principle" is expected soon.

<sup>10</sup>NASA expects to make these funds available by employing a new approach to doing materials research that will not initially require a facility-class level Furnace Facility.

<sup>11</sup>The House and Senate Appropriations Committees concurred in the transfer of almost all of this amount from the space shuttle program.

<sup>12</sup>The nonprime part of the space station program involves a large number of relatively small contracts for developing the ground-based and on-orbit capabilities to use and operate the space station.

## Additional Costs and Cost Threats Are Not Yet Estimated

The cost impact of the schedule delay associated with step 1 of the Russian recovery plan is not yet fully understood. During congressional testimony in June 1997, the NASA Administrator stated that NASA was assessing the cost effects of a later assembly completion date. Any delay in completing the space station assembly would increase the program's costs through the completion of assembly because some costs would continue to accumulate over a longer period. When NASA redesigned the station in 1993, it estimated that Russia's inclusion as a partner would reduce program costs by \$1.6 billion because the station's assembly would be completed by June 2002—15 months earlier than previously scheduled.<sup>13</sup> NASA has recently acknowledged that the completion of the station's assembly will slip into 2003, but it has not yet scheduled the revised assembly completion milestone. If the scope and capability of the program under the June 2002 assembly completion milestone remain the same, the new milestone date will be set for the latter part of 2003. Consequently, most, if not all, of the reduced costs claimed by accelerating the schedule would be lost.

NASA estimated the additional hardware costs associated with step 1 of the Russian recovery plan at \$250 million. When the estimate was made, the specific costs of many of the components of the plan were not known. For example, NASA's initial estimate includes \$100 million for the Interim Control Module, but NASA now estimates that the module will cost \$113 million.<sup>14</sup> The total of \$300 million in additional funding for the space station program in fiscal years 1997 and 1998 includes financial reserves. The most recent cost estimate for the Interim Control Module already indicates threats to those reserves.

NASA plans to use the extra time created by the schedule slip to perform integration testing of early assembly flight hardware at the Kennedy Space Center. As of June 1997, the cost of this testing had not been fully estimated. However, NASA is currently budgeting \$15 million in reserves for the effort.

If NASA initiates further steps in the recovery plan, new or refined cost estimates would be required. Step 2 provides for the development of a permanent propulsion/reboost capability and modifications to the U.S.

<sup>13</sup>For a discussion of the costs related to Russia's inclusion in the ISS program as a partner, see *Space Station: Impact of the Expanded Russian Role on Funding and Research* (GAO/NSIAD-94-220, June 21, 1994) and *Space Station: Update on the Impact of the Expanded Russian Role* (GAO/NSIAD-94-248, July 29, 1994).

<sup>14</sup>A further refinement of the cost estimate for the Interim Control Module is expected shortly.

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Laboratory to provide habitation. According to the NASA Administrator, the effort under this step could be funded incrementally, thus limiting the up-front commitment. NASA's initial cost estimate for step 2 is \$750 million.

Step 3 of the plan would result in the greatest overall cost impact on NASA because it assumes that Russia would no longer be a partner and that NASA, along with its remaining partners, would have to provide the services now expected from Russia. For its share of the mission resupply role, NASA would have to use the space shuttle or purchase those services from Russia or others. In addition, the United States would have to purchase Soyuz vehicles from Russia or accelerate the development of the six-person permanent crew return vehicle. NASA has not officially estimated the cost of step 3, but it clearly would be very expensive: the potential cost of shuttle launches or purchased launch services alone over the station's 10-year operational life would be in the billions of dollars. NASA expects to have more refined cost estimates for the contingency plan later this year.

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## Conclusions and Recommendation

Some of NASA's actions to reinforce its financial reserves and keep the program within its funding limitations have involved redefining the portion of the program subject to the limitations. Such actions make the value of the current limitations as a funding control mechanism questionable. Therefore, we recommend that the NASA Administrator, with the concurrence of the Office of Management and Budget, direct the space station program to discontinue the use of the current funding limitations.

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## Matters for Congressional Consideration

More complete estimates of the cost and schedule impacts of ongoing and planned changes to the program will be available later this year. This information will help provide a more complete and current picture of the cost and schedule status of the program and clarify some of the major future cost risk it faces. After this information is available, the Congress may wish to consider reviewing the program. This review could focus on reaching agreement with the executive branch on the future scope and cost level for a station program that merits continued U.S. government support. In view of the expected availability of revised cost estimates, the first opportunity for such a review would be in conjunction with NASA's fiscal year 1999 budget request.

At the end of the review, if the Congress decides to continue the space station program, it may wish to consider, after consultation with NASA,

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reestablishing funding limitations that include firm criteria for measuring compliance.

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## Agency Comments and Our Evaluation

In commenting on a draft of this report, NASA said that the report was a good representation of the program's performance and remaining major challenges, but NASA was concerned that the report did not provide sufficient detail for the reader to appreciate the progress the space station program has made or understand the factors that have influenced the decisions already made and those that will be made in the future.

NASA agreed with our recommendation. NASA said that it had consistently taken the position that the flat funding cap, while a fiscal necessity, was inconsistent with a normal funding curve for a developmental program. NASA added that the flat funding profile resulted in the deferral of substantial reserves to later years, instead of being available in the program's middle years.

NASA said that the station's financial reserves were not intended to cover the unanticipated costs of the Russian contingency activities, but rather were largely intended to protect against U.S. development uncertainty.

In response to NASA's comments, we added more information to the report, including information on the status of the program and the origin of the funding caps. However, the question of what the station's financial reserves were largely intended to cover is not relevant to our assessment, which focused on whether the funding cap was an effective cost control mechanism. Moreover, the central theme of our report is that funding requirements have been rising and additional funds may be needed. We do not suggest what the source of those funds should be.

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## Scope and Methodology

To obtain information for this report, we interviewed officials in the ISS and space shuttle program offices at the Johnson Space Center, Houston, Texas, and NASA Headquarters, Washington, D.C. We also interviewed contractor and DCMC personnel in Huntsville, Alabama, and Houston. We reviewed pertinent documents, including the prime contract between NASA and Boeing, contractor performance measurement system reports, DCMC surveillance reports, program reviews, international partner agreements, independent assessment reports, and reports by NASA's Office of Safety and Mission Assurance.

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We performed our work from January to July 1997 in accordance with generally accepted government auditing standards.

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We are sending copies of this report to the NASA Administrator; the Director, Office of Management and Budget; and appropriate congressional committees. We will also make copies available to other interested parties on request.

Please contact me at (202) 512-4841 if you or your staff have any questions concerning this report. Major contributors to this report are Thomas Schulz, Frank Degnan, John Gilchrist, and Fred Felder.



Allen Li  
Associate Director, Defense  
Acquisitions Issues

# Comments From the National Aeronautics and Space Administration

National Aeronautics and  
Space Administration  
**Office of the Administrator**  
Washington, DC 20546-0001



SEP 8 1997

Mr. Louis J. Rodrigues  
Director  
Defense Acquisition Issues  
National Security and International Affairs Division  
General Accounting Office  
Washington, DC 20548

Dear Mr. Rodrigues:

Thank you for the opportunity to review and comment on the recent draft report entitled, "Space Station - Cost Control Problems Are Worsening." This letter is to clarify and update a number of points made in the report as well as to provide a more indepth perspective on several of the problems discussed so that this information can be included in the final report.

Overall, the report is a good representation of the program's performance and remaining major challenges, all of which NASA has previously conveyed to Congress. However, NASA's concern with the report is that it lacks sufficient detail for the reader to appreciate the significant progress that has been made on the program or to understand the factors which have significantly influenced decisions to date and will do so in the future. Given that this report will characterize the program's performance for a large audience beyond Senator Bumpers and Congressman Dingell, who jointly requested the report, NASA desires to provide additional clarification. In addition, many of these individuals will not have the same level of insight into the program as these two senior congressional representatives and may misinterpret the data in the report. Unfortunately, this has already been evidenced from the press articles and news accounts resulting from this report's premature release on Capitol Hill last month. The Space Station program continues to make progress as evidenced by the flight hardware now at the Kennedy Space Center (KSC). By the end of FY 1998 the flight hardware for the first six flights will be at KSC.

Enclosed you will find specific and general observation comments for your consideration. Please contact Robert Soltess at 358-1895, if further assistance is required.

Sincerely,

  
J. R. Dailey  
Acting Deputy Administrator

Enclosure

See p. 12.

See comment 1.

**Appendix I  
Comments From the National Aeronautics  
and Space Administration**

**GENERAL OBSERVATIONS TO:  
GAO REPORT ON SPACE STATION COST CONTROL PROBLEMS**

We have completed our review of the draft GAO report entitled "Space Station - Cost Control Problems Are Worsening," and would like to make some general observations and comments in addition to specific comments which are enclosed.

See p. 12.

First and foremost, NASA agrees with the GAO. The current funding caps evolved as an outcome of the 1993 redesign of the program, which was directed by President Clinton in 1993, in response to the prior history of redesigns that were largely financially driven. The configuration of the Station was stabilized, and the annual cap imposed to ensure that a consistent station design could be pursued. Since 1993, NASA has maintained its commitments and stayed within the budgeted annual and total funding caps. The program design has remained stable and over 200,000 pounds of flight hardware have been built. Major flight elements have already been transferred to the Kennedy Space Center for final test and integration in preparation for launch.

See comment 1.

The GAO recommendation would be stronger if the problems imposed by the flat annual funding cap were identified. NASA has consistently pointed out that the flat annual funding cap, while a fiscal necessity, was inconsistent with a normal funding curve for a developmental program. The flat annual funding profile has resulted in the deferral of substantial reserves into the later years that would normally be accessible in the mid-term to address maturing program content, developmental challenges, or contractor performance problems. This problem is exacerbated by the Russian driven delay to the assembly sequence because of the Service Module slip. As a result, the start of the assembly has been pushed into 1998, coinciding with NASA's peak period of manufacturing, testing and integration. During this time, the potential for unforeseen challenges is extremely high, with new threats continuing to appear. A reasonable adjustment to the program's funding profile over the next two years would effectively save tax-payer dollars in the long run by avoiding the deferral of work due to cost constraints.

See p. 12.

Additionally the GAO report infers that NASA reserves were intended to cover unanticipated cost that NASA spends on Russian contingency activities and associated Russian driven changes. NASA has requested that the costs associated with the Service Module delay be accounted for outside the \$2.1B, and this has been effected beginning in the FY 1997 budget. This is consistent with the basic content and ground rules which were established when the \$2.1B cap was agreed to between the Administration and Congress, which defined reserves as applicable to preserving the baseline U.S. portion of the ISS. It should be made clear that these reserves were largely intended to protect against U.S. development uncertainty. NASA assumed and expected full participation by all its partners when it committed to the \$17.4B total cap.

See p. 12 and  
comment 2.

Russian-generated changes have added costs to the Space Station program in terms of staff hours required for additional planning, engineering, integration, and operations, thus reducing available reserves. While GAO observes that having separate funding lines may obscure the total funding the U.S. is spending to make the ISS a reality, NASA believes that it increases visibility. With the separate line, it is clear how much money is being spent on Russian related contingencies and Russian driven changes.

NASA also takes issue with the report's implication that NASA gains little with Russian ISS involvement. The report focuses on the savings due to the schedule benefit of being able to complete the Station 15 months sooner, claimed by NASA when Russia was invited to participate in FY 1993. It does not emphasize the magnitude of the hardware, expanded capabilities, logistics transportation, and long experience that the Russians bring to the program. By focusing on the cost impacts of

See comment 3.

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**Appendix I  
Comments From the National Aeronautics  
and Space Administration**

schedule stretchout, the report diminishes the significance of replacing Russian hardware and capabilities, particularly at this stage of production and assembly of flight hardware designed specifically to incorporate them.

Finally, NASA would like the GAO to expand its background narrative to add content relative to ISS program accomplishments to date. The program, including both the U.S. and its international partners, has made significant progress that has not been mentioned by the GAO. While funding problems have existed in Russia, they have demonstrated their financial commitment in FY 1997 and have made significant progress on the assembly of the Service Module, the key element of Russia's on-orbit contribution to the Space Station. The U.S. program has also made tremendous progress in the development of flight hardware. Further, the challenges remaining before this program are, to a great extent, a reflection of its complexity and enormity. These challenges are significantly diminished, when compared to those the program faced four years ago.

See comment 1.

**SPECIFIC COMMENTS TO:  
GAO REPORT ON SPACE STATION COST CONTROL PROBLEMS**

1. RESULTS IN BRIEF , Page 3, Second Paragraph; and, PRIME CONTRACTOR'S COST AND SCHEDULE PERFORMANCE CONTINUES TO DETERIORATE, Page 4, Paragraph 1.

GAO Report

From April 1996 to May 1997, the contractor's overrun more than tripled to \$310 million

Space Station Comment

The Prime Contractor's cost variance has continued to grow. Much of this growth is due to overtime and additional staff to maintain schedule. Schedule variance is degrading at a much slower rate than cost variance. At this point the cost variance is approximately seven percent over targeted cost. Based on recent performance NASA has reduced the prime's incentive and award fees.

Boeing is addressing the technical problems identified to date and continues to solve the myriad of challenges encountered as the program moves through its qualification testing and production phase. They are continuing to make progress. The Prime has made personnel changes to strengthen its management team, put in place an incentive package to acquire and retain people with necessary software expertise, and committed over \$30M of Boeing capital investment to build a new systems/software integration facility. The Prime Contractor has also developed a monthly de-staffing plan which calls for a systematic reduction in staffing at the prime and product group locations.

NASA is also looking at areas of work content currently under the Prime scope of work which could be pulled out and performed less expensively. Recovery plans help to mitigate cost and schedule variances, but the continued cost growth and performance problems have strained near-term reserves and will continue to require the use of reserves in the future. NASA will continue to work closely with the Prime's corporate management to ensure that required corporate assets are available to this critical program and that the necessary levels of management experience and tools are applied.

2. PRIME CONTRACTOR'S COST AND SCHEDULE PERFORMANCE CONTINUES TO DETERIORATE, Page 5, Figure 1.

The perceived large change in Prime contract cost performance as presented in Figure 1 is only a small percentage change in performance when considering the cost of total work performed. While accurate, it is not representative of the Prime's total level of performance. NASA would suggest inclusion of the graph below, in the current report.

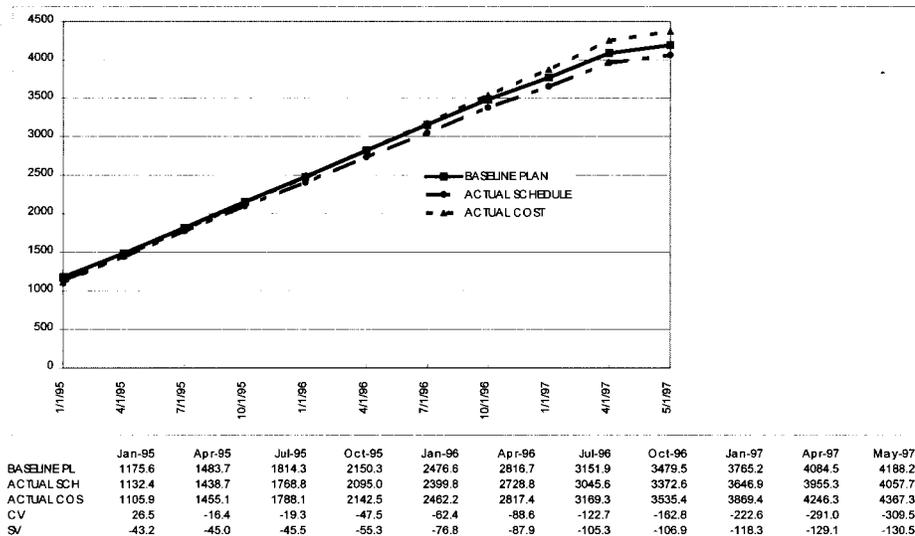
Now on p. 5.

See comment 4.

Now on p. 6.

See comment 5.

**Appendix I  
Comments From the National Aeronautics  
and Space Administration**



Now on p. 9,  
para. 1.

**3. NASA's ACTIONS TO REMAIN WITHIN FUNDING LIMITATIONS AND TO REPLENISH ITS FINANCIAL RESERVES, Page 7, last paragraph.**

GAO Report

NASA estimates that \$116 million in U.S. station development costs could be saved through these offset arrangements.

Space Station Comment

See comment 1.

It should be noted that offset negotiations have involved Canada, ESA, and Japan. The negotiations with Brazil would be classified as cooperative in nature (there is no preexisting obligation to offset). While the \$116 million is accurately stated, it is not representative of the total offsets negotiated by the program. Some of the offsets negotiated are considered by the program as "cost avoidance, and are not included in the \$116 million referenced.

Now on p. 9,  
para. 2.

**4. NASA's ACTIONS TO REMAIN WITHIN FUNDING LIMITATIONS AND TO REPLENISH ITS FINANCIAL RESERVES, Page 8, First Paragraph**

GAO Report

"NASA dropped the centrifuge from the station budget and opened negotiations with the Japanese government to provide it. Along with this change, the space station's content at the assembly complete milestone was revised to exclude the centrifuge."

**Appendix I  
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Space Station Comment

The statement that “the Space Station’s content at the assembly complete milestone was revised to exclude the centrifuge” requires some clarification. The program has considered assembly complete to be the point at which the capabilities of power, volume, crew habitation, and crew rescue are in place. The Centrifuge module was not in the baseline assembly sequence when the program was re-baselined and the \$17.4 billion voluntary commitment at assembly complete established. The Centrifuge itself was carried in the research budget. The overall research budget was rephased to be commensurate with the availability of resources. During this timeframe the Japanese expressed an interest in providing the Centrifuge hardware.

See comment 6.

Japan’s Science and Technology Agency approached NASA in February 1996 with a proposal to reimburse NASA for launching the Japanese Experiment Module (JEM) on the Space Shuttle with hardware contributions (i.e., offsets), rather than with cash. As a potential offset, Japan offered in May to provide a centrifuge rotor (CR), centrifuge accommodations module (CAM), and life sciences glovebox (LSG). NASA decided in June 1996 to suspend negotiations to procure this hardware from U.S. industry and initiated exploratory discussions with Europe and Japan. These discussions culminated in September with an affirmative commitment by Japan to negotiate an agreement on this offset. NASA would still own and operate the CAM, CR, and LSG equipment, and retain full authority and responsibility for allocating research access to these research facilities on the ISS. Signature of an agreement in principle is expected soon.

See comment 1.

NASA would suggest that the GAO replace this language with text describing why it is advantageous for the U.S. to have “no-exchange-of-funds.” This is in the best interest of the U.S. and is consistent with the original Space Station agreements signed in FY 1988 that encourage ISS partners to minimize exchange of funds. NASA policy states cost offsets must result in demonstrable benefit to NASA, which has and continues to be the case in all our offset negotiations. This is one of the key tools the Agency has at its disposal to minimize the cost to the U.S. taxpayer for the Space Station.

See comment 7.

5. NASA’s ACTIONS TO REMAIN WITHIN FUNDING LIMITATIONS AND TO REPLENISH ITS FINANCIAL RESERVES, Page 8, Second Paragraph

Now on p. 9,  
para. 3.

GAO Report

“NASA transferred \$462 million from its science budget to the space station development budget in fiscal years 1996 through 1998.”

Space Station Comment

NASA would suggest that the GAO provide more detail regarding this transfer.

As anticipated in moving through design and manufacture, NASA has found it necessary to make some design changes, to absorb additional content, and to hold reserves for other contingencies. With the flat \$2.1B annual funding cap, much of the program’s reserves budgeted to address these types of activities are not available until after our peak development years. At the same time, internal NASA studies determined that the utilization plans were not consistent with the Space Station resource availability. To maintain development schedules and remain within budget in FY 1996 through FY 1998, without the acceleration of reserves, it was necessary to take other action.

After evaluating various options, NASA determined that it was prudent to re-phase the budget available to develop payload hardware in a manner that would maintain their delivery consistent with

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NASA's ability to effectively use them. NASA involved the science community from the start, forming an intercommittee working group to review the principles and approach associated with rephrasing of the research. The NASA Advisory Council concurred that the program rephrasing was the best alternative given the circumstances.

NASA remains committed to meeting space station research requirements and is accommodating funding requirements for research capabilities. However, since the funds transfer, we have evaluated various approaches to meet these research requirements and have identified ways to maximize research program efficiencies. Ongoing discussions with the international partners will result in some U.S. research hardware being provided by other international partners to offset Shuttle launch costs for international partner hardware, thereby reducing the need for developmental research funding. After delivery, the United States will own and utilize this research hardware. Relative to the \$70M in FY 1999, the ISS Payloads Office is currently evaluating a new approach to conducting materials research onboard Station without an initial requirement for a facility-class level Furnace Facility. This approach is expected to deliver high quality materials science research without the very substantial investment anticipated in the current Furnace Facility, thus resulting in a savings of \$70M in FY 1999. NASA's optimization of research facilities deployment consistent with station capability evolution during the assembly process is regularly reviewed with external user advisory committees.

6. NASA's ACTIONS TO REMAIN WITHIN FUNDING LIMITATIONS AND TO REPLENISH ITS FINANCIAL RESERVES, Page 8, Fourth Paragraph

GAO Report

"NASA uses actual and planned reductions in its fiscal year funding requirements to help restore and preserve its actual and prospective financial reserves."

Space Station Comment

It is correct that NASA uses actual and planned reductions in the current operating year to preserve reserves. It is also true that many of these reductions are possible because of changes and reassessments of requirements which no longer demand current year expenditures. These kinds of decisions are typical of most NASA programs and are not unique to Space Station.

7. RECOMMENDATION, Page 10, Paragraph 3.

GAO Report

Matters for Congressional Consideration

"More complete estimates of the cost and schedule impacts of ongoing changes to the program will be available later this year."

Space Station Comment

Revised estimates are being developed at this time and will form the basis for developing the FY 1999 Budget request to Congress. Once the Agency, OMB, and the President determine the future funding levels for the program, NASA will initiate discussions concerning the Space Station budget requirements and the need for future funding caps.

See comment 1.

Now on p. 9,  
para. 5.

Now on p. 11,  
para. 5.

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The following are GAO's comments on the National Aeronautics and Space Administration's (NASA) letter dated September 8, 1997.

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## GAO Comments

1. We have modified the report based on NASA's comments.
2. The purpose and use of financial reserves is not the relevant issue. Our focus was on whether or not funding caps could be effective cost control mechanisms under circumstances where program content subject to the controls can be flexibly defined. In the past, NASA claimed the benefits of Russian participation on the program's cost and schedule, but now that Russian participation is having negative cost and schedule effects, NASA argues that the additional funding needed should be accounted for outside the portion of the program subject to the funding limitation. Doing so dilutes the cost control ability of a funding limitation.
3. NASA's claimed cost savings from including Russia as a partner was based mainly on a 15-month acceleration of the station's assembly completion milestone. Our purpose was to point out that the delay in the assembly completion date means that NASA will incur additional costs during the station's developmental period. Only the amount remains to be determined. In this report, we do not evaluate any of the claimed benefits, including cost reductions, of Russian participation in the program as a partner.
4. NASA correctly points out that the negative schedule variance under the prime contract is growing at a much slower rate than the negative cost variance, as shown by the slope of the lines in figure 1.
5. Figure 1 in the report accurately reflects cost and schedule variance changes and is directly relevant to supporting our point that NASA could experience additional cost growth if the deteriorating trend was not reversed or at least slowed because the final actual cost growth could exceed expected cost growth. After we completed our fieldwork on this assignment, the prime contractor reported that its estimate of the cost overrun at completion had more than doubled, from \$278 million to \$600 million.
6. NASA correctly notes that the centrifuge was not included in the development program when it was initially capped at \$17.4 billion. However, NASA subsequently budgeted the centrifuge within the program and scheduled it for launch before the June 2002 assembly completion

milestone. The centrifuge was later removed from the budget and NASA began negotiations with the Japanese to provide it. At that time, it was rescheduled for launch after the June 2002 assembly completion date. The centrifuge example helps to illustrate the leeway NASA has to change the content of the station program within the current cap. Such leeway undermines the cap's value as a cost control mechanism.

7. We were asked to identify those methods NASA had used to stay within its funding limitations, not to evaluate NASA's use of "no-exchange-of-funds" or "negotiated offset" arrangements.

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