United States General Accounting Office

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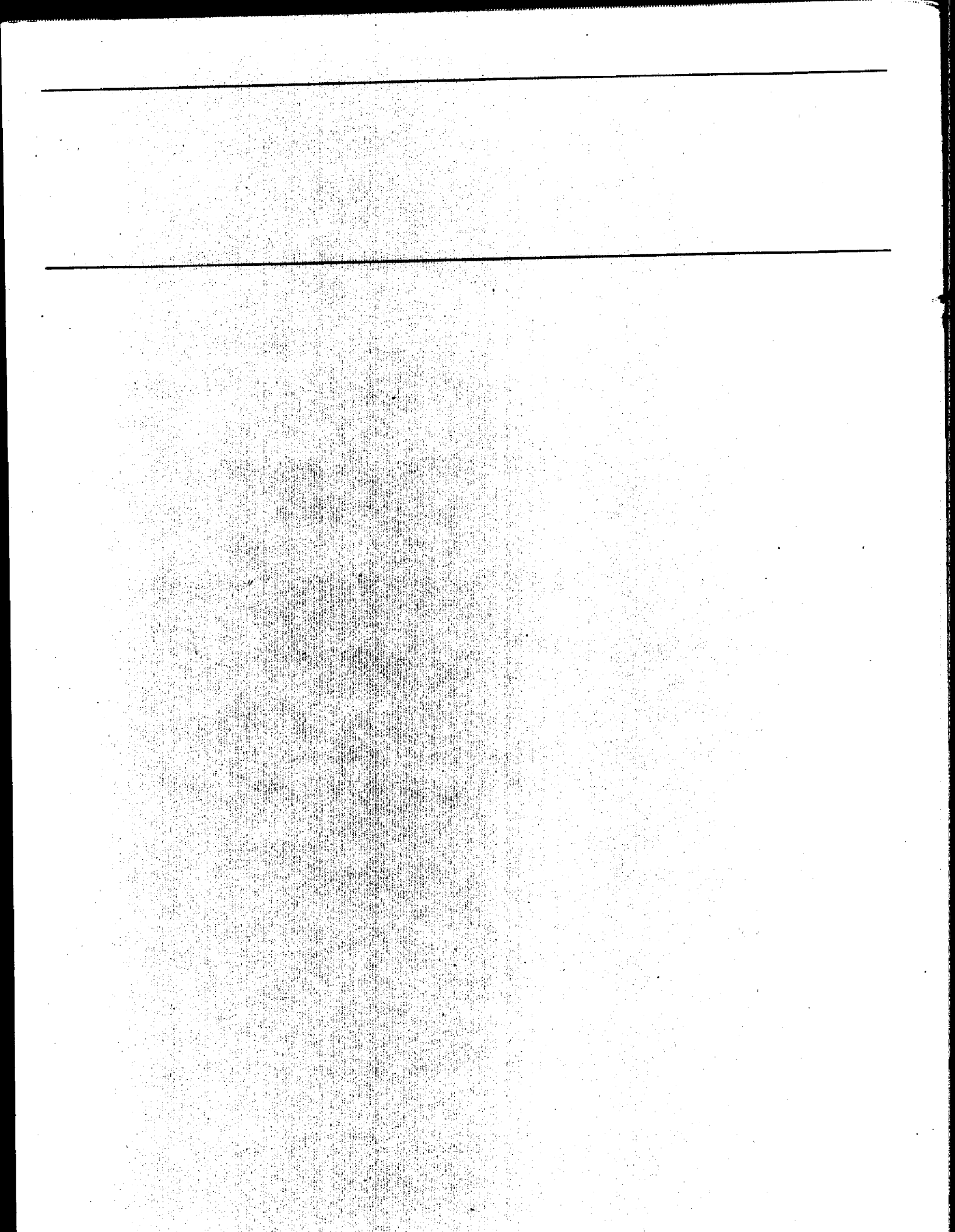
Report to Congressional Requesters

June 1995

SPACE STATION

Estimated Total U.S. Funding Requirements

GAO/NSIAD-95-163



GAO

United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-261547

June 12, 1995

The Honorable Dale Bumpers
United States Senate

The Honorable Dick Zimmer
The Honorable Gerald Solomon
House of Representatives

As you requested, we have reviewed the current estimated costs of the National Aeronautics and Space Administration's (NASA) space station program. More specifically, we estimated the total U.S. funding requirements for the program and identified program uncertainties that may affect those requirements.

Background

The space station program was initially approved in the mid-1980s. Since then, NASA has had to redesign the station several times to meet decreasing budgets. The most recent redesign was done in late 1993 to compensate for additional funding cuts and bring Russia into the program as a full partner with Japan, Canada, the European Space Agency, and the United States.

NASA estimates that the International Space Station can be built and completely assembled in orbit by June 2002. NASA said that the International Space Station would provide more research capacity, support more crew, and cost less than prior space station configurations. NASA is currently planning a 10-year operational life for the space station following completion of assembly.

The program is divided into three phases. The first phase involves seven space shuttle flights to the Russian Space Station MIR on the orbiter Atlantis to provide flight experience, demonstrate joint procedures with the Russians, reduce technical risk during space station assembly, and conduct scientific research and operations. The second phase comprises the launch and assembly of the first elements of the space station on seven shuttle flights to establish crew capability for three persons and the initial laboratory environment. The second phase also consists of Russian flights to launch the functional energy block, service module, a Soyuz rescue

vehicle, universal docking module, and two science platforms. The last phase involves the completion of the development and assembly of all international partners' hardware and the habitation module to establish the station's permanent six-person crew capability.

Results in Brief

We estimate U.S. funds required to design, launch, and operate the International Space Station will total about $94 billion through 2012 (about $77 billion in fiscal year 1995 constant dollars).[1] This total may decrease to the extent NASA accomplishes its goal for achieving station operational efficiencies over the period 2003 to 2012, or efficiencies currently being studied in the space shuttle program materialize.

The program has made major progress since last year in defining its requirements, meeting its schedule milestones, and remaining within its annual operating budgets. Nevertheless, the program faces formidable challenges in completing all its tasks on schedule and within its budget. The program estimates through fiscal year 1997 show limited annual financial reserves—about 6 percent to 11 percent of estimated costs. These reserves are even lower when reduced by the estimated value of pending items that have a medium to high probability of being added to the program. Inadequate reserves would hinder program managers' ability to cope with unanticipated technical problems. If a problem could not be covered by available reserves, program managers could be faced with either spending more than planned on the program or deferring or rephasing other activities, thus possibly delaying the space station's development schedule or increasing its future cost.

In addition, the space station's current launch and assembly schedule is ambitious, and the shuttle program may have difficulty supporting it. Moreover, the prime contract target cost could increase if the contractor is unable to negotiate subcontractor agreements for the expected price. NASA plans to complete an independent internal assessment of space station program costs later this fiscal year.

U.S. Funding Requirements for the Space Station

Estimating total funding requirements requires aggregating past spending, current budgets, and estimated future funding needs related to the development and operation of the space station. As shown in table 1, we estimate U.S. funding requirements for the design, launch, assembly, and

[1]Constant 1995 dollars do not include estimated future years' inflation. All dollar estimates in this report include inflation unless stated in 1995 dollars.

10-year operation of the International Space Station at about $94 billion—over $48 billion to complete the assembly in June 2002 and almost $46 billion to operate and conduct research for 10 years thereafter.[2] The $94 billion estimate is discussed by program component after the table.

[2]These amounts represent NASA's funding requirements and do not include the value of the international partners' contributions to the International Space Station program. A NASA official estimated the contributions to be about $9.4 billion through June 2002, exclusive of Russia's contribution.

Table 1: Estimated U.S. Funding Requirements for Space Station

Current dollars in billions

	Requirement	
Program component		
Contract and in-house costs from 1985 through 1993	$11.2	
Current development budget from 1994 to June 2002		
Development[a]	$8.1	
Utilization support[b]	0.7	
Operations[c]	3.0	
Payloads[d]	2.6	
Financial reserves	3.1	$17.4[e]
Station-related requirements through June 2002		
In-house personnel	$0.9	
Principal investigator support	0.3	
Contract with Russia	0.4	
Shuttle performance enhancements	0.3	
Shuttle launch support	17.8	$19.6
Subtotal—requirements through June 2002		**$48.2**
U.S. requirements after assembly is completed[f]		
Operations/utilization	$13.0	
Shuttle launch support	32.7	$45.7
Total		**$93.9**

Note: Totals may not add due to rounding.

[a]Includes funding for the prime development contract and other contracts to develop operational ground-based and on-orbit capability.

[b]Includes funding to provide the capability to support researchers and use station resources.

[c]Includes funding to provide the capability to conduct ground and on-orbit sustaining engineering for maintaining and operating the space station.

[d]Includes funds for developing the primary space station research facilities, such as the centrifuge and furnace; flying payloads to the MIR during the first phase; and modifying the shuttle and acquiring docking hardware for the MIR missions. This portion of the space station program is managed by NASA's Office of Life and Microgravity Sciences and Applications.

[e]NASA agreed that it could design and develop the space station for this amount under a $2.1 billion annual funding cap imposed by the executive branch in June 1993.

[f]Does not include funding for in-house personnel to operate and utilize the station, station disassembly and disposal, or any development activities after June 2002.

Contract and In-House Costs From 1985 Through 1993

NASA spent $11.2 billion designing and developing earlier versions of the space station during fiscal years 1985 through 1993, including contractor costs and the cost of NASA's civil service staff working on the program. When the International Space Station design was adopted, NASA estimated that about 75 percent of the previously prepared design work could be incorporated into the new configuration.

Current Development Budget From 1994 to June 2002

During the past year, program managers refined their development estimate for the program's elements. However, while cost estimates for the individual elements changed, NASA's total development estimate remained at $17.4 billion. As a result of the refinements, NASA program managers recognized significant increases in the costs of flight hardware items that they had excluded from prior budgets and increased total financial reserves. The managers also identified cost reductions by negotiating with contractors, economizing and modifying user requirements and operating methods, delaying the procurement of some spares and replacement parts, and reducing the amount of testing.

For example, in one case, program managers identified about $93 million in savings in the utilization support category by eliminating the requirement for developing payload analytical software. This requirement was eliminated when station managers opted to make station users—that is, principal investigators (researchers)—responsible for developing the software needed to run their experiments. The research community's representative to the space station program office generally concurred with these changes. However, users may require additional support to finance their software development activities.

Program managers also reduced budget estimates by transferring management responsibility for developing station hardware to organizations that are more directly responsible for carrying out such missions. For example, officials of NASA's Office of Life and Microgravity Sciences and Applications agreed to manage the development of some laboratory support equipment and a rack to accommodate small payloads. Transferring these items decreased the value of the space station program's utilization support budget by about $151 million but increased the program's payload category by $99 million, a tentative savings of about $52 million. However, precise equipment needs are still being studied.

Station-Related Requirements Through June 2002

In addition to NASA's space station development budget and prior year costs, we included in our life-cycle estimate other funding requirements that are related to the International Space Station program. These total about $19.6 billion through June 2002 and are discussed as follows.

In-House Personnel

NASA estimated that approximately 1,285 civil service staff will be required annually through the completion of assembly at approximately $77,000 per year—a total of $892 million. NASA expects some reductions in the number of in-house personnel during the assembly period, but estimates of such reductions are not yet available.

Principal Investigator Support

NASA plans to conduct scientific research during the space station's development and assembly. NASA estimates it will spend about $134 million through 2000 to fund principal investigators' preparation of scientific experiments to be flown on the partially assembled station and on flights to MIR during the first phase. We extrapolated NASA's estimates for the remaining 2 years of the development program, for a total of about $300 million.

Contract With Russia

Before bringing Russia into the space station program as a full partner, NASA negotiated a $400 million contract with the Russian government for hardware and managerial and technical expertise useful to space station development.

Shuttle Performance Enhancements

The space shuttle program is funding shuttle upgrades to provide additional lift capability needed to support station element launches to the space station's 51.6-degree inclination orbit. Enhancements, currently estimated about $300 million, include the super lightweight external tank and other modifications and operational changes to increase the shuttle's performance.[3]

Shuttle Launch Support

The space station's development program requires 35 shuttle flights to carry out all three phases. The sequence consists of 7 flights to MIR as part of the technology development program during the first phase, 6 utilization flights to the partly completed space station to begin conducting research, and 22 station assembly flights. At estimated average costs, these flights total about $17.8 billion.

NASA plans 21 station assembly flights, but it has not included a flight to launch the crew rescue vehicle, a necessity to outfit the space station for

[3]This estimate excludes funding requirements that are already included in NASA's average cost-per-flight estimates.

permanent habitation. The launch vehicle for the crew rescue vehicle is yet to be determined, but providing the crew rescue capability at the completion of assembly is NASA's responsibility. Program officials told us they are taking steps to negotiate with the international partners the provision of the crew rescue vehicle and its launch requirement, which could reduce the U.S. portion of total funding requirements. However, since no agreement has yet been reached, we included an extra station assembly flight in our estimate.

Costs of shuttle launches are based on NASA's estimates of the average cost per flight.[4] Because NASA has budgeted to launch seven shuttle flights a year, the average cost per flight has increased over prior years' estimates as total shuttle costs are averaged over fewer flights. NASA estimates that the average shuttle flight will cost over $475 million in fiscal year 1998, when the shuttle begins launching space station hardware.

We have used average launch costs as the basis for costing shuttle launches instead of marginal costs.[5] Marginal costs are expenses that are incurred or avoided when one flight is added to or deleted from the shuttle program. The use of average launch costs is appropriate because the majority of shuttle flights will be devoted to the space station for many years. The space station either lengthens the life of the shuttle program, requiring ground support facilities to be operated for additional years, or displaces years of shuttle flights devoted to other uses.

U.S. Requirements After Assembly Is Completed

NASA estimated that the space station will require an average of $1.3 billion annually for operations, research, and utilization support during the 10 years after completion of assembly. NASA is studying how to reduce operating costs to approximately $800 million annually. If NASA achieves these station operational efficiencies, total estimated development and operations costs of the space station would drop to about $89 billion.

NASA planning models predict that an annual average of five of seven available shuttle flights will be needed to support or use the space station.

[4]NASA's average cost of a shuttle flight includes the estimated cost of safety and performance upgrade projects of a recurring nature. NASA estimated the average cost of a shuttle flight for each year up to 2000. For subsequent years, we inflated the average cost per flight using the gross domestic product inflation index.

[5]See Space Station: Program Instability and Cost Growth Continue Pending Redesign (GAO/NSIAD-93-187, May 18, 1993); Space Transportation: The Content and Uses of Shuttle Cost Estimates (GAO/NSIAD-93-115, Jan. 28, 1993; and Questions Remain on the Costs, Uses, and Risks of the Redesigned Space Station (GAO/T-NSIAD-91-26, May 1, 1991).

At estimated average costs, shuttle launch support during this period totals about $32.7 billion. NASA is currently studying how to further reduce its shuttle operations costs. The station-related funding requirements would decrease further if additional shuttle program efficiencies were realized. NASA has not yet estimated these potential shuttle operations savings.

When using average costs per flight, total shuttle launch costs to support the space station during assembly and 10-year operational life are an estimated $50.5 billion, or about 54 percent of the total space station funding requirement.

Major Challenges to the Program's Cost and Schedule

Since 1994, station managers have made progress in better defining requirements and identifying potential costs and risks. However, they still have a difficult task in completing the program on schedule and within the estimated budget. Among their challenges are (1) the low financial reserves for the next few years; (2) significant cost, schedule, and technical risk for the shuttle program in supporting the space station's assembly schedule; and (3) the lack of final agreements between the prime contractor and all its major subcontractors.

Financial Reserves Low in Certain Years

Maintaining adequate financial reserves for the space station program appears prudent to compensate for unanticipated program requirements. However, low reserves in fiscal years 1996 and 1997 raise questions as to whether NASA can implement the program within the $2.1 billion annual funding cap the administration established in June 1993.

NASA is planning to hold about $3 billion of the total development estimate of $17.4 billion as financial reserves. However, as shown in table 2, the estimated reserve levels for fiscal years 1996 and 1997 are 0.3 and 5.3 percent, respectively, after deducting possible cost increases that program officials believe have a medium to high likelihood of occurring. Because the funding requirements for many of these potential increases are not well defined, the actual remaining reserves could be less. The estimated value and a brief description of these potential increases are discussed in appendix I. NASA officials pointed out that these estimates represent only a point in time and are considered internal planning numbers.

Table 2: Estimated Status of Financial Reserves

Current dollars in millions

	Fiscal year							
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Station program baseline[a]	$2,159	$1,819	$1,600	$1,217	$1,097	$929	$802	$584
Financial reserves	98	102	182	525	621	603	534	394
Potential cost increases	52	97	97	121	170	377	280	79
Balance of reserves	46	5	85	404	451	226	254	315
Reserves as a percent of station program baseline	4.5	5.6	11.4	43.1	56.6	64.9	66.6	67.5
Reserves as a percent of station program baseline after potential cost increases	2.1	.3	5.3	33.2	41.1	24.3	31.7	53.9

Note: Percentages have been rounded.

[a]This baseline excludes financial reserves, and the payload funding requirements managed by NASA's Office of Life and Microgravity Sciences and Applications.

Inadequate reserves would hinder program managers' ability to cope with unanticipated technical problems. If a problem could not be covered by available reserves, program managers could be faced with either exceeding the annual cost cap or deferring or rephasing other activities, thus possibly delaying the space station's development schedule or increasing its future cost.

Other Possible Significant Challenges

NASA's list of potential cost increases does not include at least two items that could have significant future cost and/or schedule impacts. These items are (1) the possibility that the prime contract target cost could increase if the contractor is unable to reach agreement with its major subcontractors for the expected price and (2) the ability of the shuttle program to support the space station's launch requirements.

In January 1995, NASA and the prime contractor signed a contract for $5.6 billion, about $600 million less than the original target figure agreed to in August 1994. However, because the prime contractor had not completed negotiations with all of its major subcontractors, the contract contains a clause that allows an increase in the target cost if the prime contractor is

unable to negotiate subcontractor agreements within the $5.6 billion price. The prime contractor has reached agreement with two of its three major subcontractors and is continuing negotiations with the third. If the prime contractor is unsuccessful in negotiating a price with this subcontractor that is within the $5.6 billion figure, the contract costs could increase. Any increase would have to be funded by available financial reserves or by reductions made elsewhere. However, program managers are not considering this possibility on the list of potential cost increases. Thus, any increase in the contract price could further erode the already slim margin of reserves in the early years and further decrease program managers' flexibility to deal with unanticipated program cost increases. The prime contract contains incentive features that encourage the prime contractor to effectively manage its subcontract negotiations and costs.[6]

The ability of the space shuttle program to adequately support its planned station assembly schedule is uncertain, particularly in view of the ongoing efforts to reduce program costs. A February 1995 NASA workforce review concluded that the cost reductions had increased the risk that NASA could not meet future flight schedules.[7] A space shuttle program official told us in May 1995 that the shuttle program would be facing its most demanding operational challenge—supporting the space station's assembly schedule—at a time when, due to budget cuts, it will have lost much of its flexibility to adjust for contingencies. In addition, any problems with the modifications needed to increase the shuttle's lift capacity so that it can support assembly of the station at the 51.6-degree inclination orbit would also adversely impact the station's assembly schedule. We will be issuing a report later this year that provides more detail about the shuttle program's requirements for supporting the station. NASA managers said that the shuttle program is committed to meet the challenge and that the current performance upgrade program is proceeding well with adequate technical, schedule, and budget margins. As evidence, the managers said that they recently canceled two of the higher cost hardware items (lightweight booster and extended nozzle) because they were not needed.

NASA is planning to complete an independent assessment of the space station program's cost estimate by the end of fiscal year 1995. This assessment is being done to provide the NASA Administrator's Program

[6]The contract allows for adjustment of the contractor's potentially available fee. The available fee is adjustable based on the outcome of negotiations at a rate of 25 percent of any increase or decrease in target subcontract costs. For example, an increase in target subcontract costs would result in the amount of potentially available fee being reduced by 25 percent of such increase.

[7]NASA Budgets: Gap Between Funding Requirements and Projected Budgets Has Been Reopened (GAO/NSIAD-95-155BR, May 12, 1995).

Management Council[8] an independent internal review of the program's technical and financial status.

Agency Comments and Our Evaluation

In commenting on a draft of this report, NASA said that our report implied that a significant portion of the total life-cycle cost estimate would represent budget savings if the space station was canceled. NASA said that unless the space shuttle program was also terminated, a substantial life and microgravity sciences effort would be conducted aboard the shuttle in the event of the termination of the space station program. We have previously reported that we believe that space shuttle costs should be included in any life-cycle cost estimate for the space station program. We continue to believe it is appropriate to include requirements related to the space shuttle. The use that might be made of the space shuttle should the space station program be terminated would have to be separately considered.

NASA's complete comments and our evaluation of them are reprinted in full in appendix II.

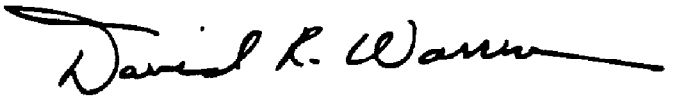
Scope and Methodology

We reviewed NASA program planning and budgeting documents and interviewed officials in the Space Station Program Office, the Space Shuttle Program Office, the Office of Human Space Flight, the Office of Life and Microgravity Sciences and Applications, and the Office of the Comptroller. We reviewed actual to-date costs, budget and future-year cost information for fiscal years 1995 through 2002, and estimated future cost information through the current design life of the project. The information provided in this report is based on NASA estimates. We performed our review from March to June 1995 in accordance with generally accepted government auditing standards.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from its issue date. At that time, we will send copies of this report to appropriate congressional committees, the NASA Administrator, and the Director of the Office of Management and Budget. We will also make copies available to others on request.

[8]The Program Management Council is composed of the Associate Administrators of NASA and is chaired by the Deputy NASA Administrator. The council annually reviews major NASA programs throughout their life cycles and makes recommendations to the Administrator.

Please contact me at (202) 512-8412 if you or your staff have any questions about this report. Major contributors to this report were Frank Degnan, James Berry, and Vijay Barnabas.



David R. Warren
Director, Defense Management and NASA Issues

Contents

Abbreviations

CLDF	Clear Lake Development Facility
EESII	element-to-element systems interface integrity
FGB	Functional Energy Block
NASA	National Aeronautics and Space Administration

Potential Program Cost Increases That Threaten Space Station Financial Reserves

Table I.1 shows the space station reserves and the items that managers categorize as having a medium or high likelihood of having to be incorporated into the space station program and funded. A brief explanation of each item follows the table.

Table I.1: Potential Cost Increases That Threaten Space Station Financial Reserves

Current dollars in millions

	Fiscal year								
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**Total**
Financial reserves	$98	$102	$182	$525	$621	$603	$534	$394	**$3,059**
Threats against reserves									
Crew rescue vehicle	0	0	0	0	112	237	181	56	**586**
Logistics and maintenance	1	23	19	44	3	100	83	17	**290**
Prime contract changes	20	20	20	24	0	0	0	0	**84**
EESII implementation[a]	1	24	18	12	10	0	0	0	**65**
Centrifuge accommodations	1	1	1	5	15	22	10	0	**55**
Shuttle integration	0	10	12	5	11	7	3	3	**51**
FGB[b]	0	5	10	5	0	0	0	0	**20**
Pending changes	1	1	1	9	2	2	0	0	**16**
Water unit processes	2	2	0	14	14	6	0	0	**38**
International partners	5	9	13	0	0	0	0	0	**27**
Freedom closeout	21	0	0	0	0	0	0	0	**21**
CLDF[c] operations and maintenance/liaison office support	0	2	3	3	3	3	3	3	**20**
Subtotal	**52**	**97**	**97**	**121**	**170**	**377**	**280**	**79**	**1,273**
Balance	**$46**	**$5**	**$85**	**$404**	**$451**	**$226**	**$254**	**$315**	**$1,786**

[a]Element-to-element systems interface integrity.

[b]Functional energy block.

[c]Clear Lake Development Facility.

Crew Rescue Vehicle

As we reported in 1994, the National Aeronautics and Space Administration (NASA) initially anticipated that Russia would provide Soyuz vehicles that would serve as crew return vehicles.[1] However, Russia

[1]Space Station: Update on the Impact of the Expanded Russian Role (GAO/NSIAD-94-248, July 29, 1994).

has agreed to provide Soyuz vehicles only through the completion of station assembly. NASA will be responsible for providing a crew return/rescue capability after assembly is completed. NASA is studying various options to determine the best way to provide this capability. The $586 million estimate is based on a contractor's estimate for using an Apollo-era capsule as the return vehicle. However, if a different option is chosen, the estimate may change. NASA is also considering purchasing Soyuz vehicles from Russia or having the European Space Agency develop and provide a crew rescue vehicle. According to space station program control office personnel, NASA has time to decide which option to pick because development does not have to start until 1998 for the vehicle to be available in 2002.

Logistics and Maintenance

The logistics and maintenance figure represents the procurement of flight hardware spares. Funding for many spares was deferred during a prior cost-reduction exercise until spares' requirements could be better defined. However, program managers recognize that it may be preferable to purchase spares while the manufacturer has an ongoing production capability. Purchasing spares once the production line has been shut down could be more expensive and, in some instances, not feasible (for example, if the manufacturer went out of business). The $290 million is an estimate; the actual amount of spares to be purchased is under study using a Navy-developed computer model.

Prime Contract Changes

Although NASA and the prime contractor signed the contract in January 1995, they had not agreed on certain technical requirements for developing the space station. At issue was the amount of analysis necessary to verify that the hardware provided by international partners could be effectively integrated with U.S. components. To avoid further delaying the program, both parties agreed that the contractor would continue studies to determine if any additional integration and verification work was necessary. An amount of $24 million was set aside to support these efforts. Program managers also reserved about $60 million to fund additional technical requirements, if necessary.

EESII Implementation

EESII tests and analyses are required to ensure that all the interfaces in the flight hardware will function as planned. During cost-reduction exercises in 1994, some of this testing was eliminated. However, program managers have since realized that it would be required. The $65 million estimate is

based on earlier estimates of the resources required to conduct such testing. NASA teams are currently studying how much testing will actually be required and the best way to accomplish it. A better estimate of required funding may also result from the teams' work. Space station program control officials told us that this item would be incorporated into the program and funded during the next budget cycle.

Centrifuge Accommodations

NASA will have to provide housing for the centrifuge facility and is reviewing four options: a duplicate U.S. laboratory module provided by Boeing-Huntsville, a Spacelab "long module" provided by McDonnell Douglas, a Spacelab double module provided by McDonnell Douglas, and an additional Mini Payload Logistics Module provided by Alenia Spazio of Italy. Space station program officials told us that the $55-million figure is based on a rough order of magnitude estimate from the various competitors, and that this item would be incorporated into the program and funded during the next budget cycle.

Shuttle Integration

Currently, station and shuttle program managers are evaluating requirements and the allocation of costs among programs. Station program managers have estimated that up to $51 million of reserves would be needed if requirements cannot be reduced. NASA headquarters officials plan to include these integration issues in the fiscal year 1997 budget formulation process for resolution.

FGB

The FGB spacecraft will be the first space station element to be launched. It will provide the initial propulsion, guidance, navigation, and control functions for the space station. The FGB is a Russian-built spacecraft that NASA is purchasing, and funding for it is included in the space station development budget. The $20-million threat against reserves is for installing a backup command and control ability for the FGB in the mission control center in Houston, Texas, and changing the FGB specifications so that it can function in a depressurized environment. According to NASA officials, this amount decreased from an initial estimate of $25 million because NASA will not have to pay for a remote manual docking capability.

Pending Changes

The $16 million shown represents several modifications that need to be included in the baseline but have not been approved by space station program management.

Water Unit Processes

The amounts shown for fiscal years 1995 and 1996 are to fund flight experiments during the shuttle flights to the Russian MIR space station to verify the design for the water processing system that will be used in the U.S. habitation module. The total amount of $38 million also includes funds earmarked in later years for any design changes that may be needed based on the results of the early flight experiments.

International Partners

The $27 million is for purchasing, modifying, and repairing components provided by international partners.

Freedom Closeout

The $21 million shown reflects an indirect rate issue with Boeing-Huntsville related to the closeout of the space station Freedom contract for Work Package 1. This issue is pending resolution by the Defense Contract Audit Agency.

CLDF Operations and Maintenance/Liaison Office Support

NASA plans to build the Neutral Buoyancy Laboratory, a large underwater facility for simulating a weightless environment, at the newly acquired CLDF near the Johnson Space Center in Houston, Texas. The new laboratory will be used to train astronauts for space station assembly and other space shuttle operations and will replace an older facility at Johnson. Currently under negotiation is the station program's share of the new facility's operations and maintenance costs and the program's share of the costs to support liaison offices in international partner countries. Program managers have earmarked $20 million for these purposes.

Comments From the National Aeronautics and Space Administration

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001

Reply to Attn of: MR

JUN 6 1995

Mr. David R. Warren
Director, Defense Management and NASA Issues
General Accounting Office
Washington, D.C. 20548

Dear Mr. Warren:

I have read GAO's draft report on international Space Station lifecycle costs and would like to comment on a number of substantive inaccuracies in the report.

See comment 1.

GAO's draft report implies that the Space Shuttle program will have difficulty meeting the Space Station assembly schedule. As the NASA official with ultimate responsibility for the Space Shuttle and international Space Station programs, I am fully confident that the current launch requirements for the Space Station program can be met by the Space Shuttle on schedule and within budget.

See comment 2.

GAO's lifecycle cost estimate of $97.9 billion includes $54.3 billion of Shuttle transportation costs. Even if the Space Station was canceled, the NASA budget would still contain these Shuttle costs, unless the Shuttle program itself was terminated. In addition, a substantial life and microgravity sciences effort would be conducted aboard the Shuttle in the event of the termination of the Space Station program. Therefore, any implication that significant money from these budget items could be saved by the cancellation of Station is erroneous.

See comment 3.

In calculating the cost of the Shuttle transportation costs above, GAO used the NASA "new start" index of 4.6% to escalate costs for inflation. Normally, this index is used for programs that are in the early stages of definition and development, referred to as Phase A/B. Since the international Space Station is well into its development, or Phase C/D stage, the correct escalation index is the Office of Management and Budget's (OMB's) Gross Domestic Product (GDP) inflator which is 3% for FY 1997 and beyond. The Office of Space Flight (OSF) uses the GDP inflator as guidance for all of our programs including Space Shuttle and Space Station.

See comment 4.

In the discussion of average cost-per-shuttle-flight, the report states that this average cost does not include about $30.2 billion spent through 1992 to develop the Shuttle, acquire reusable hardware and equipment, and construct and modify facilities. Cost-per-flight has never included, and should not include, these "sunk" costs. Including

these numbers implies that they should be allocated against Space Station when in actuality the Shuttle program will support a multitude of payloads, the majority of which will be non-Space Station payloads. Referencing this $30.2B is inconsistent with the purpose of this report.

See comment 5.

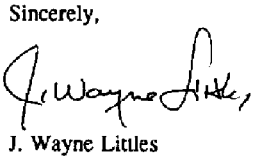
As NASA has clearly stated to Congress in all Space Station program documentation, including the Final Report to the Advisory Committee on the Redesign of the Space Station, the Program Implementation Plan (PIP), and the November 1993 Addendum to the PIP, the Station is being designed for a 10-year life. This lifetime is the baseline for all Space Station schedule and budget planning. While the Space Station's life may be extendible, no plans currently exist to exercise that option.

See comment 6.

Finally, I would like to comment on GAO's discussion of "threats" and reserve levels. When calculated as a percentage of the base program, Space Station development budget reserves represent about 28% of remaining costs through Assembly Complete, not 18% as indicated in GAO's draft report. NASA views the "threats" list as a management tool which is updated on a weekly basis as the program is better defined. Items are added as they require program managers' attention. Potential changes are evaluated, estimates refined, and then either eliminated or added to the baseline. The numbers GAO displays reflect a snapshot in time and should be considered internal planning numbers.

Thank you for the opportunity to review GAO's draft report informally. If you have any questions, please do not hesitate to contact me.

Sincerely,



J. Wayne Littles
Associate Administrator
for Space Flight

The following are GAO's comments on the NASA's letter dated June 6, 1995.

GAO Comments

1. We added this position to the report.

2. Our report addresses program life-cycle cost. We have included language in the report to recognize NASA's concerns and emphasized our reporting objectives.

3. We revised our estimate to use the gross domestic product inflation index. We initially used NASA's "new start" index to project future shuttle and other outyear costs principally because NASA used it to estimate average costs per shuttle flight through 2000.

4. Our purpose was to show that shuttle development costs were not part of the estimated cost to launch the space station and not to imply that these costs should be allocated to the space station program. To clarify, we deleted the footnote reference to shuttle development costs.

5. We revised the report to reflect that NASA has no plans to operate beyond the planned 10-year period. Accordingly, we did not include costs in our estimate of operating the space station longer than 10 years. However, it is possible that the space station life could be extended. In the event that Congress and the administration decide to continue using the station beyond the planned 10-year period, we estimate funding requirements would be about $5.1 billion a year. This is based on estimates of projected operations and launch costs at the end of the 10-year operations period.

6. We recalculated the reserves as a percentage of the space station baseline program. We also added language to reflect the tentative nature of these potential cost increase estimates.

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