United States General Accounting Office

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Report to the Ranking Minority Member, Subcommittee on Oversight of Government Management, Committee on Governmental Affairs, United States Senate

July 1994

SPACE STATION

Update on the Impact of the Expanded Russian Role

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July 29, 1994

The Honorable William S. Cohen
Ranking Minority Member, Subcommittee on
Oversight of Government Management
Committee on Governmental Affairs
United States Senate

Dear Senator Cohen:

In response to your request, we examined the impact of Russian participation in the National Aeronautics and Space Administration's (NASA) space station program. On June 21, 1994, we provided you with an interim report on whether expanded Russian participation will (1) reduce space station funding requirements by $2 billion, as estimated by NASA and (2) improve the station's capabilities for conducting research.[1] As requested, we have updated the information in our June 1994 report on the funding impacts of Russian participation. The information in our June report on the research impacts is included as appendix I.

BACKGROUND

In March 1993, the President directed NASA to redesign Space Station Freedom. The President also directed NASA to consider using Russian space assets and bringing Russia into the international space station partnership that already included Europe, Japan, and Canada. The space station configuration developed by NASA during the summer of 1993 redesign process was called Alpha and included hardware to be purchased from Russia. The major Russian hardware included the FGB energy block spacecraft (also referred to as a space tug) for propulsion, guidance, navigation, and control; Soyuz capsules for assured crew return vehicles or "lifeboats"; and systems for docking the shuttle to the station.

Under the Alpha program, the first piece of station hardware was scheduled to be launched on the space shuttle in

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[1]Space Station: Impact of the Expanded Russian Role on Funding and Research (GAO/NSIAD-94-220, June 21, 1994).

September 1998, with completion of assembly in September 2003. In September 1993, NASA estimated that, under a $2.1-billion annual funding cap imposed by the administration, the Alpha design would require $19.4 billion in funding for fiscal years 1994 through 2003.[2]

On September 2, 1993, the United States and Russia agreed to expand cooperation in human space flight. By November 1, 1993, NASA and the Russian Space Agency formally agreed on a three phase plan to bring Russia into the space station program as a full partner. Phase I activities involve up to 10 shuttle flights to Russia's existing Mir space station and up to 24 months of astronaut crew time on Mir between 1995 and 1997. The shuttle flights and astronaut time are intended to help develop techniques for assembly, operation, and utilization of the planned space station in such areas as command and control, flight operations, logistics support and resupply, extravehicular activity, rendezvous, proximity operations, and docking. Phase II activities would combine U.S. and Russian hardware to create the crew-tended capability of the space station. Phase III would build on Phase II and complete the international space station with additional U.S., Russian, European, Japanese, and Canadian elements.

The new space station configuration was renamed the International Space Station Alpha (ISSA). NASA stated that, compared with the Alpha program, the ISSA program with expanded Russian involvement

-- increases total crew size from four to six;

-- accelerates the first shuttle assembly flight to December 1997 and completion of assembly to June 2002;

-- enables earlier research opportunities, beginning with the existing Mir space station;

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[2]NASA estimated that funding for fiscal year 1993 and prior years totaled about $10.3 billion, excluding civil service costs. All funding levels stated in this report are expressed in current dollars. Unless stated otherwise, all projected increases or reductions in funding requirements are based on NASA-provided estimates. In some cases, funding amounts in this report differ from those in our previous report because of updated information and changes in requirements.

-- increases resources available to support research, such as crew time, electrical power, and pressurized volume;

-- enables dual access to the station for human space flight and logistics;

-- reduces some U.S. hardware requirements and enhances system robustness; and

-- reduces funding requirements by $2 billion (from $19.4 billion to $17.4 billion) through the completion of space station assembly.

According to space station officials, $1.6 billion of the $2-billion net savings would be achieved by completing assembly 15 months earlier--funding for operations and utilization between July 2002 and September 2003 would no longer be counted in total funding to complete assembly. In order to achieve this earlier schedule, NASA would need to fund the development program at an accelerated rate. However, because station funding is limited to $2.1 billion a year, any increased funding needed to accelerate the program would have to be offset by reduced funding or savings in other areas. According to space station program officials, anticipated savings that would enable NASA to fund the program at an accelerated rate would come primarily from Russian contributions of hardware.

RESULTS IN BRIEF

Our analysis shows that there are no net savings from Russian participation that could be used to fund other areas of the program and accelerate the schedule. To the contrary, due to lower than anticipated contributions of Russian hardware, Russian participation would add a net $0.4 billion in funding requirements to the space station program. NASA still believes that it can meet its assembly schedule and $17.4 billion funding target. However, NASA will have to find substantial savings from other sources to offset the Russian-related funding increases and accelerate the schedule. NASA is in the process of identifying these other savings.

Russian participation would also increase funding requirements for other NASA programs that support the space station by at least an estimated $1.4 billion. The estimated increases are to fund a contract with the Russian Space Agency for space station-related activities, improvements in the shuttle's ability to support space station assembly, and two additional shuttle flights to

assemble ISSA. These increased requirements, which are funded in other parts of NASA's budget, would largely offset the $2 billion reduction NASA is currently pursuing in the space station program. NASA recently identified additional shuttle improvements that will be needed as a result of Russian participation, which could further increase space station-related funding requirements.

RUSSIAN PARTICIPATION WOULD LIKELY INCREASE SPACE STATION PROGRAM FUNDING REQUIREMENTS

Russian participation will reduce funding requirements in some areas of the station program and increase them in other areas. Since our June 1994 report, revised estimates of Russian contributions have eliminated some of the reductions that NASA originally anticipated. With these changes in contributions, our analysis indicates that Russian participation would likely result in a net increase of $0.4 billion in direct station funding requirements. Therefore, Russian participation will not provide any savings that could be used to accelerate the program schedule. NASA still believes that it can accomplish the ISSA program for $2 billion less than the Alpha program by pursuing savings from sources other than Russian participation. Table 1 presents only those funding reductions and additions within the space station program that we believe should be attributed to Russian participation. Amounts in the table reflect estimates that have been revised since our June report.

Table 1: Impact of Russian Participation on Space Station Program Funding Requirements (Current dollars in billions)[a]

Funding requirement	Estimated impact
Reduced	
FGB energy block	$-0.3
Other	-0.2
Subtotal	-0.5
Added	
Shuttle-Mir support	0.2
Mir flight demonstrations	0.1
Solar cells/control moment gyros	0.1
Increased operations capability	0.2
Fourth solar array	0.1
Russian integration activities	0.1
Other	0.1
Subtotal	0.9
Net impact	$0.4

[a]Amounts rounded to nearest $100 million.

Russian participation would likely reduce funding requirements in some areas by about $0.5 billion. The United States was responsible for providing the FGB energy block under both the Alpha and ISSA programs. However, the estimated funding for acquiring the FGB energy block from the Russians under ISSA has been reduced by $0.3 billion (from $0.6 billion under Alpha) because of changes in the space station configuration. The exact amount of the FGB procurement is still to be negotiated. NASA hopes to have the negotiations completed by October 1994. According to a space station program official, the $0.2 billion estimate for other reductions includes requirements that were eliminated for propellant resupply and orbital replacement units. NASA is negotiating with the Russians to resupply the propellant needed to reboost and maneuver the space station. Configuration changes due to Russian involvement have reduced the number of items that NASA will have to maintain and replace on orbit once the station is operational.

Russian participation would likely add $0.9 billion in funding requirements to the space station program. The estimates in table 1 for Shuttle-Mir support, Mir flight demonstrations, and part of the solar cells/control moment gyros estimate are related to the 10 shuttle flights to the Russian Mir space station during Phase I. The estimates for increased operations capability, fourth solar array, Russian integration activities, and the rest of the Solar cells/control moment gyros estimate include additional funding for Russian involvement in Phases II and III of the ISSA program. According to a space station program official, the $0.1-billion estimate under the other category was primarily to fund activities that would be needed in the event that Russian participation falls through.

NASA Will Not Achieve Some Previously Anticipated Reductions

Some of the reductions that NASA originally anticipated from Russian participation will not be achieved. In particular, NASA had estimated a $0.5-billion reduction because it expected Russia to provide the Soyuz vehicles that NASA would have bought from Russia under the Alpha program. These vehicles were to serve as the assured crew return vehicle. The Russians have agreed to provide the Soyuz as the crew return vehicle only through completion of station assembly. NASA will still be responsible for providing a crew return vehicle to be available when the station's assembly is complete. NASA is considering several options for a crew return vehicle and has not yet estimated the funding requirements for this element.

One of the other reductions that NASA had anticipated was an estimated $0.1 billion for high pressure gas resupply and carriers. NASA assumed that the Russians would supply all the oxygen and nitrogen for the station. Recently, the Russians have agreed to only supply gases for the space station modules. Consequently, NASA will still have to fund the resupply of gases and carriers for payloads in the U.S., European, and Japanese laboratory modules.

NASA Is Pursuing Funding Reductions That Are Not Related to Russian Participation

NASA is still attempting to reduce station funding requirements by $2 billion and continues to plan for the first shuttle assembly flight in December 1997 and completion of assembly in June 2002. To achieve its funding target of $17.4 billion, NASA is considering funding reductions in areas largely unrelated to Russian participation. For example, NASA's Office of Life and

Microgravity Sciences and Applications is attempting to reduce its space station payloads and utilization budget for fiscal years 1995-99. The office is considering soliciting additional facility contributions from other international partners and developing some research facilities in-house. In addition, a cost-reduction team convened by the space station program office has identified several hundred million dollars in potential funding reductions that involve deleting hardware and deleting or reducing testing of space station components. Most of these reductions are not specifically related to Russian participation.

RUSSIAN PARTICIPATION WOULD LIKELY INCREASE STATION-RELATED FUNDING REQUIREMENTS BY AT LEAST $1.4 BILLION

The estimated $1.4 billion increase in space station-related funding includes: (1) $400 million for a contract between NASA and the Russian Space Agency, (2) $44 million to outfit a second orbiter and increase the number of shuttle flights to Russia's existing Mir space station from 6 to 10, (3) $185 million or more for some performance enhancements needed in the shuttle to support station assembly with the Russians in a different orbit, (4) $746 million for two additional shuttle flights needed to support the current assembly schedule, and (5) $10 million to $20 million for increasing the probability of launching the shuttle within a smaller launch window due to the change in orbit. NASA officials disagreed that these funding requirements should be included in evaluating the total estimate for space station or the impact of Russian participation.

NASA Has Finalized the $400 Million Contract With the Russian Space Agency

Tasks included in NASA's contract with the Russian Space Agency are related to the space station and should be included as additional funding requirements related to Russian participation. On June 21, 1994, NASA finalized a contract that calls for payment of $400 million to the Russian Space Agency for Phase I and Phase II activities of the space station program.

-- Phase I activities will require an estimated $335 million in funding. These activities will include extending the life and expanding the capabilities of Mir to conduct science research, technology validations, and systems validations. According to the contract, the science and engineering research program under this contract is critical for the success of future efforts on ISSA and is a test bed for research activities to be carried out in

Phases II and III. The technology demonstrations and systems validation program are intended to use Mir as an ISSA test bed to ensure successful ISSA operation by implementing a risk mitigation program. This will include (1) demonstrating and testing components and systems, interfaces, and integrated operations and (2) validating equipment designs and operations and verifying models to be used in the ISSA program.

-- Phase II activities will require an estimated $65 million in funding. These activities include management and technical integration, launch package elements definition and modification, joint Russian Space Agency/NASA systems studies and development, and joint operations planning. Management and integration will include testing, safety, reliability, and quality assurance activities for Russian space station elements. Launch package definition and modification will include definition and preliminary design of the Russian FGB energy block, service module, and science power platform. Joint Russian/NASA developments include systems for joint extravehicular activity, an airlock; solar dynamic demonstration; life support; habitation; guidance, navigation, control; and propulsion. Joint operations planning involves developing plans, documentation, and training for operating ISSA.

Flying 10 Shuttle Missions to Mir Would Likely Increase Funding Requirements

In November 1993, NASA and the Russian Space Agency agreed to conduct up to 10 shuttle flights to the Russian Mir space station. However, the current ISSA estimate includes funding for only six flights to Mir. This funding is needed to modify an orbiter to allow it to dock to Mir, and for shuttle and payload integration and mission support operations. Increasing the number of flights to 10 would require that a second orbiter be modified and would increase the funding needed for related shuttle and payload support. The total increase in funding needs associated with expanding the number of flights to Mir would likely be about $44 million, according to a preliminary NASA estimate.

One orbiter has already been modified as part of an October 1992 agreement between the United States and Russia for one shuttle-Mir docking mission to exchange an astronaut and cosmonaut. This agreement predates the current Russian involvement, and the modification of this orbiter was approved prior to the increased Russian role.

According to NASA officials, the 10 shuttle flights to Mir are important risk reduction activities for building ISSA. The time required to prepare an orbiter for its next flight limits it to flying about two missions a year. As a result, flying 10 missions to Mir over a 3-year period requires that a second orbiter be modified to allow it to dock to Mir, with funding estimated at $23 million.[3] The additional funding required for the shuttle and payload mission integration and support associated with the increased number of flights is about $21 million.

Funding Requirements for Shuttle Performance Enhancements Could Exceed Initial $185 Million Estimate

To take advantage of Russia's launch capabilities, the space station's orbital inclination will be increased from 28.8 degrees planned under Alpha to 51.6 degrees. The change in inclination reduced the shuttle's payload lift capability by about 13,000 pounds. Since approving a plan in March 1994 to regain the lost lift capability, NASA has determined that additional lift may be needed to satisfy space station requirements. Achieving the additional lift could result in significant additional funding requirements.

A November 18, 1993, memorandum from the space station program manager to the associate administrator for space flight requested the space shuttle program to implement modifications to provide performance enhancements. According to the memorandum, "The increased lift capability is critical in order to support Space Station assembly and maintenance operations at an inclination of 51.6°." In response to the space station program office's request, the shuttle program office developed a plan to improve shuttle lift capability by about 13,000 pounds on every station flight, with additional lift enhancements on specific flights. After the plan was developed, the shuttle program office determined that the shuttle would need an additional 1,100 pounds of lift gain beyond the 13,000 pounds already identified. The preliminary estimated total funding required for all the enhancements needed is $535 million, of which about $350 million is for the super lightweight fuel tank. Since this tank was planned under the Alpha program, only the remaining $185 million relates to increased Russian

[3]NASA estimates that total funding of $73 million is needed to modify the second orbiter, including about $50 million for an airlock that would also be needed for the shuttle to dock with ISSA. Funding for this airlock is already included in the ISSA funding estimate.

participation. A shuttle program official said that these other enhancements are being undertaken in order to support assembly of the station at the higher inclination.

During a shuttle program meeting on June 30, 1994, NASA identified (1) additional weight requirements to launch the shuttle to the higher orbital inclination and (2) potential reductions in the lift originally anticipated from the approved shuttle enhancements. The agency underestimated the orbiter performance requirements to support the space station and determined that about another 1,200 pounds of lift would be required. To achieve the required additional lift, the shuttle program office is considering a list of potential enhancements in addition to those already approved. According to shuttle program officials, NASA does not have firm funding estimates for all of the potential additional enhancements. NASA officials stated that they would try to implement several enhancements requiring the least funding, which together could provide the necessary lift. If these enhancements cannot be implemented, NASA may have to resort to using one of several more expensive enhancements, each of which could provide the lift needed. One of the more expensive enhancements includes use of disposable solid rocket boosters on two or more flights. Current estimates indicate that the funding associated with replacing hardware for two missions using disposable boosters would be about $150 million.

Also, potential problems with a number of approved enhancements, including the super lightweight tank, could result in reduced lift gain. Shuttle program officials told us that they believe the problems can be mitigated, but the full impact, if any, will not be known until October 1994, after the problems will have been thoroughly studied. If NASA is unable to correct or offset the potential lift reductions in approved enhancements, additional enhancements may be required.

Revised Assembly Plan Still Requires Two Additional Shuttle Flights

At the start of the redesign process, a March 9, 1993, memorandum from the NASA Administrator stated that a primary objective of redesigning the space station was to greatly reduce the number of shuttle launches required for deployment. In June 1994, we reported that the ISSA assembly sequence would require 21 shuttle launches, 2 more than the Alpha assembly sequence. NASA has revised the assembly sequence since then, but the revised sequence still requires the two additional shuttle flights, which would

likely increase station-related funding requirements by about $746 million.

NASA approved a revised assembly sequence for ISSA on July 12, 1994, that requires 20 shuttle launches. One shuttle assembly flight was eliminated because NASA officially included in the program baseline the European Space Agency's plan to launch its laboratory module on an expendable launch vehicle rather than on the shuttle. The option to launch this module on a European rocket was developed under the Alpha program and was under consideration at that time. If this option had been accepted, it would have also reduced Alpha launches by 1 flight, from 19 to 18, maintaining a difference of 2 assembly flights between Alpha and ISSA.

Our calculation of the funding associated with shuttle flights is based on NASA's estimated average cost of $373 million a shuttle flight in fiscal year 1999. NASA calculates the average cost per flight by dividing the annual recurring funding required to support shuttle operations by the planned number of flights for a given year. Space station officials disagreed that the additional flights should be valued at an average cost of $373 million each. NASA values shuttle flights at about $40 million a flight--the marginal cost for fuel and other expendable items. In prior reports, we have stated that the average cost per shuttle flight should be allocated to the space station program during the period when the shuttle system will be used predominately for the station's launch, assembly, and use.[4]

Shuttle Launch Probability Improvements Could Also Increase Funding Requirements

The change to a higher inclination orbit for ISSA also reduces the shuttle's window of opportunity to launch from 50 minutes to 5 minutes on a given day. NASA's preliminary estimate of the total funding needed to implement a strategy for increasing the probability of launching in the narrower window is $10 million to $20 million, with many improvements requiring little or no funding.

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[4]Space Transportation: The Content and Uses of Shuttle Cost Estimates (GAO/NSIAD-93-115, Jan. 28, 1993); Space Station: Program Instability and Cost Growth Continue Pending Redesign (GAO/NSIAD-93-187, May 18, 1993).

The strategy that NASA is considering includes changing some weather-related constraints established in the event the shuttle has to return to the launch site after an abort, adding a day in which the shuttle could rendezvous with the space station, and building in an additional hold early in the launch countdown to address potential problems that may arise. If all the identified improvements can be implemented, NASA estimates that the probability of launch in the 5-minute window can be raised to the same probability of launch as in a 50-minute window.

SCOPE AND METHODOLOGY

We conducted our review at NASA headquarters, Johnson Space Center, Kennedy Space Center, and Marshall Space Flight Center. We compared the Alpha program (as documented in the September 1993 Program Implementation Plan) with the current ISSA program. We

-- interviewed NASA officials and reviewed pertinent documents from the space station program, space shuttle program, and science offices; super lightweight tank, main engine, solid rocket motor, and orbiter vehicle projects; and mission operations and flight crew operations directorates;

-- attended various NASA reviews on the design of the space station, including the Systems Requirements Review and the Systems Design Review;

-- attended meetings and reviewed reports of committees advising NASA on space station design and utilization issues, including the Advisory Committee on the Redesign of the Space Station; Space Station Science and Applications Advisory Subcommittee; National Research Council (NRC) Aeronautics and Space Engineering Board, Committee on Space Station; NRC Space Studies Board, Committee on Space Biology and Medicine; NRC Space Studies Board, Committee on Microgravity Research; Space Station Advisory Committee; and Aerospace Medicine Advisory Committee; and

-- analyzed and compared budget data for the Alpha and ISSA programs.

The foreign policy issues related to the Russian participation were not within the scope of our work. Further, we did not assess the risk to the space station program should Russian participation be terminated for any reason.

We performed our work between August 1993 and July 1994 in accordance with generally accepted government auditing standards. As requested, we did not obtain agency comments on this report. However, on several occasions, we discussed our findings with NASA personnel, including officials of the space station, space shuttle, and science offices, and included their comments as appropriate in this report.

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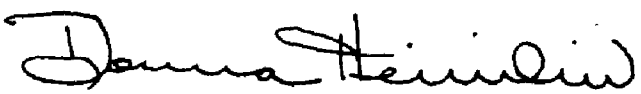
Unless you publicly announce the contents of this report earlier, we plan no further distribution of it until 10 days from its issue date. At that time, we will send copies of it to the NASA Administrator; the Director, Office of Management and Budget; appropriate congressional committees; and other interested parties upon request.

If you or your staff have any questions concerning this report, I can be reached at (202) 512-8412. Major contributors to this report are listed in appendix II.

Sincerely yours,



Donna M. Heivilin
Director, Defense Management
and NASA Issues

IMPACT OF THE EXPANDED RUSSIAN ROLE ON RESEARCH

Information on the impact of Russian participation on research to be conducted on the space station has not changed significantly since our June report. The material from that report is presented here unchanged.

RESEARCH POTENTIAL COULD BE ENHANCED, BUT SPECIFIC BENEFITS HAVE NOT YET BEEN FULLY DETERMINED

Increased Russian participation in the space station should provide more resources critical to research productivity, earlier research opportunities, and better access to the Russian research community. However, because specific allocations of the station resources must still be negotiated, it is not yet clear to what degree the U.S. research community will benefit. In addition, committees that advise NASA on space station research have not yet had an opportunity to review the details of increased Russian involvement and assess its impact on research planned for the station.

Space Station's Overall Research Potential Is Enhanced

Crew time has long been identified as the constraining factor for research productivity on the space station. The addition of two crew members, which would be made possible by adding the Russian service module, would be an important benefit to the research community. With only four crew members on the Alpha station, crew time for experiments would have been limited to two dedicated crew members; the other two would have had to operate and maintain the space station. With a crew of six aboard ISSA, NASA believes four crew members could be dedicated to research. The additional crew members would also increase the pool of subjects for life sciences research on the effects of long-duration space flight.

Electrical power is another important resource that would increase under the ISSA design. Total annual average power on the station has increased from 69 kilowatts (kw) to 110 kw, with an increase to users from 42 kw to 73 kw. The increase in total power was achieved by adding a fourth solar array supplied by the United States, with the remainder coming from Russian solar arrays. Although power increased substantially at assembly complete, the power levels to users actually decreased during assembly. The Alpha design provided average power of about 13 kw to users during assembly. ISSA, however, only provides 8 kw or less during much of the initial research operations. NASA is studying ways to increase power to users during initial ISSA operations.

Russian participation could also provide research opportunities earlier than the Alpha program would have. First, the shuttle flights to Mir and astronaut stay-time aboard Mir during Phase I offer opportunities to conduct long-duration experiments 4 years earlier than under the Alpha program. The Mir missions can also serve as science risk reduction activities by allowing NASA to test and evaluate experimental facilities and procedures. Second, the ISSA station is scheduled to reach initial research capability 11 months earlier and assembly complete 15 months earlier. Third, under ISSA, crew will stay aboard the station after the shuttle departs starting in 1998 rather than 2003. While this is intended mainly for assembly purposes, NASA anticipates that the crew would also be available to conduct experiments between assembly activities.

NASA officials believe that increased Russian participation will result in better access to Russian researchers and research data. Although U.S. and Russian researchers have been sharing data for many years, space station cooperation will open the door to much wider and deeper access to the Russian research community, including areas of expertise that would be valuable to U.S. researchers such as space medicine, plant biology, and computational physics.

Other potential benefits include an increase in the volume of pressurized areas of the station, which provide a "shirt sleeve" environment for conducting experiments, as well as for storage and logistics to support research. The total pressurized volume aboard ISSA--1,202 cubic meters--would be about 50 percent greater than that on Alpha. In addition, the change to a higher inclination would also allow remote sensing of more of the Earth's surface and far more of its land mass. At this point, however, only one U.S. remote sensing payload has been identified as a candidate for the space station.

Allocation of Resources Must Still Be Negotiated

The allocation of resources such as crew time, power, and payload rack space is based on a formula agreed to by the international partners in memorandums of understanding under the intergovernmental agreement governing the space station. In allocating resources, the agreement takes into consideration research facilities and common infrastructure provided by each partner. For example, under Alpha, the United States, Europe, and Japan each were providing a laboratory module. Because the United States was contributing the infrastructure, such as the habitation module, truss structure, propulsion and guidance systems, and electrical power systems, the agreement allocated a fixed percentage of the laboratory space in the European and Japanese

modules to the United States. Under ISSA, the agreement must now consider the Russian contribution in terms of both laboratory space as well as common infrastructure, such as the service module to house the additional crew members.

NASA believes that the United States and current international partners will gain additional research resources as a result of Russian participation. However, until the intergovernmental agreement and memorandums of understanding are renegotiated, it will not be clear how much more, if any, of each resource will be allocated to the United States. For example, although total user power would increase by 31 kw under ISSA, NASA had estimated that 27 kw of that would be allocated to Russia, with the total power allocated to U.S. and other international partner users increasing by 4 kw. NASA officials expect negotiations on the agreement and the memorandums of understanding to be completed by the end of this year.

Advisory Committees Still Need to Fully Assess Impact of Russian Participation

Several committees with members from outside of NASA have been established to review NASA's plans for supporting space-based research. These groups represent some of the potential users and provide important advice to NASA on the space station's design and use from the researcher's perspective. When one of these committees, the Space Station Science and Applications Advisory Subcommittee, met in February, NASA officials were not able to provide sufficient details about increased Russian participation for the group to fully assess the impact on research utilization. The committee's subsequent report stated that the group was encouraged by the research potential added by Russian space assets, but was concerned that the specifics of the Russian partnership were not presented. The committee requested that NASA more fully present details at its next meeting. This committee, and several others, are scheduled to meet in June and July, after which they should be in a better position to assess the impact of Russian participation on planned research.

APPENDIX II

MAJOR CONTRIBUTORS TO THIS REPORT

NATIONAL SECURITY AND INTERNATIONAL AFFAIRS DIVISION, WASHINGTON, D.C.

David Warren
Frank Degnan
Richard Eiserman

ATLANTA OFFICE

Lee Edwards
John Gilchrist
Wendy Smythe

DALLAS OFFICE

Vijay Barnabas
Elaine Coleman

(709092)