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of the

Life and Microgravity Sciences and Applications Advisory Committee

MEETING REPORT

July 23-25, 2001

Huntsville, Alabama

Mark Uhran	**J. Milburn Jessup**
Executive Secretary	**Chair**

SPACE STATION UTILIZATION ADVISORY SUBCOMMITTEE (SSUAS)
Houston, Texas
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MEETING MINUTES
TABLE OF CONTENTS

Welcome and Opening Remarks		2
ISS Research Status-Early Increments		2
Telecon with Investigatorsq		3
Increments 1 and 2 Payload Operations Report		5
Jack Estes Memorial		5
ISS Program Overview		6
ISS Research Restructuring		7
ISS Payloads Office Status		8
Integrated Testing for External Sites		10
Russian Cosmonaut Participation		10
Internal Environment Update		11
Export Control Restrictions		11
Metrics Document Update		12
Payload Integration Benchmark Update		12
International Space Station Commercial Programs		13
Payload Training Status		14
Status of Non-Government Organization		15
Disposition of Prior Recommendations and Action Items		16
New Recommendations from this Meeting		
Appendix A	Agenda	19
Appendix B	Subcommittee Membership	23
Appendix C	Meeting Attendees	26
Appendix D	Subcommittee Findings and Recommendations	28
Appendix E	List of Presentation Material	31

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Monday, July 23

Welcome and Opening Remarks
Mr. Mark Uhran, Executive Secretary, welcomed members and attendees and reviewed the agenda and the current budget status. The program has been reengineered and redesigned over the past five months to fit into the president's budget. Congress is expected to provide the final budget in the September/October timeframe, and all indications to date from congressional committees and sub-committees are that there is strong Space Station support. Dr. J. Milburn Jessup, Chair of the SSUAS reviewed recommendations from the previous meeting.

ISS Research Status--Early Increments
Dr. John Uri provided a status report on research during the first ISS increments and discussed plans for later increments. The first payloads flew to ISS in September 2000 and since March 2001, when the international radiation suite was activated, research has been conducted continuously. Expedition 1 was considered a trial, with four experiments planned. Expeditions 2 and 3 have 18 experiments each, and with Expedition 4 the number will increase to 25. Three research racks are on-orbit and operational, and two more should arrive in the next few weeks. Approximately 200 crew hours have been spent on in-flight research to date. By the end of the year 10 research racks are scheduled to be on-orbit and 60 research projects either begun or completed.

On Expedition 1 there were 342 total utilization hours available, split evenly between NASA and Rosaviakosmos. Four Code M investigations were planned and 1 Microgravity. There were five Utilization SDTO's for Human Life Sciences. Two other investigations were flown prior to the start of Expedition 1: the Commercial Generic Bioprocessing Apparatus (CGBA) as a sortie on STS 106/2A.2B, and PCG-EGN launched on STS 102/2A.2B and returned on STS 92/3A. Along with MACE-II, these payloads went from flight opportunity to orbit in 9 months. Of the 171 hours allocated to NASA payloads on Expedition 1, 90.75 hours were needed to accomplish the limited scope of research and 47 were actually completed. Underestimation of station maintenance plus greater than expected volume of off-nominal activities were largely responsible for this. Of the five payloads planned, three were completed successfully. On Expedition 2 there were 704 total utilization hours available to be split evenly between NASA and Rosaviakosmos. Eighteen NASA investigations were planned. Early in the mission some science activities had to be re-planned around troubleshooting of anomalies with new hardware coming up such as some exercise equipment and the Ku-band antenna. It was challenging at times to make sure that payload activities had a high enough priority to get completed. During Shuttle and Soyuz visits, payload time was typically reduced, leading to deferment of some activities. Dr. Uri outlined accomplishments to date on Expedition 2. Of the three payload racks, only one was activated as scheduled. Of the 18 payloads planned for the expedition one has been successfully completed, 16 have been initiated and are in progress, returning data or processing samples. One payload, the CGBA, has failed and is returning on 7A. Estimates of crew time required for payload operations have been generally accurate or conservative. Assessment of crew time utilization and accomplishments has been difficult at times because they do not always report on what they have done. Of the allotted 352 hours about 200 to 220 hours have been spent on payloads. However, more research is being accomplished that indicated by this number. One reason is that estimates of time needed are conservative. Also, activation of the Human Research Facility rack was delayed almost two months. Because regular weekly checks were not needed time was saved. The Expedition 2 crew has been very supportive of the research program. At their request some science activities not performed as scheduled were added to their task list used during free time and weekends. The crew has been excellent about performing these activities when possible. Despite challenges, it is likely they will meet most objectives by the end of the expedition. Dr. Uri outlined the status of each rack involved in Expeditions 1 and 2 including research accomplishments, activation dates and anomalies. Expedition 3, scheduled to launch August 9, 2001, will be the first mission where the purchase of crew time

from the Russians takes effect. There should be 550 utilization hours available with 480 allocated to NASA and 69 allocated to Rosaviakosmos. Eighteen NASA investigations are planned with eight of them new to the program. Expedition 4 is scheduled to launch November 29, 2001. Total utilization hours available are 1050, with 919 hours allocated to NASA and 131 to Rosaviakosmos. In response to recent changes in crew rotations and flight sequence, re-planning of the research program for Expeditions 5-7 is underway. For Expedition 8 challenges include continuing changes to the assembly sequence, crew rotations, changing increment boundaries and flight sequences and crew time, because the ISS Program has underestimated the resources it takes to operate ISS. There will be times when powered Middecks are not available because of solar array reconfigurations.

The Increment Research Team (IRT) provides science direction to the Payloads Operations and Integration Center (POIC) for implementation. It is led by the Lead Increment Scientist and includes membership from all research programs and investigator teams as well as the Lead Increment Scientist Representative and the POIC cadre position. During real-time operations, the IRT holds daily weekday telecons to discuss the status of science and planning/re-planning activities. A weekly telecon is held post and pre-increment. For the foreseeable future, crew time will be the most limiting resource to payloads. Addition of future elements plus aging of existing ones will likely exacerbate this problem. This issue is being handled jointly by the Payloads Office, ISS Mission Operations, and the Mission Operations Directorate at the Johnson Space Center. Despite challenges, ISS research remains more or less on track. Dr. Uri expressed gratitude to the current crew for dedicating personal time to payload activities. Internal payloads processes have been working well as evidenced by successful handling of re-planning efforts. Expedition 1 and 2 crewmembers have commented that payload procedures are well written. Dr. Jessup asked whether the structures of crystals grown at different times could be used to characterize the ISS microgravity environment compared to others, such as the Shuttle. Dr. Uri responded that it was too early for a full answer because only a limited number of crystals have been grown, but that early signs are that the microgravity environment looks good. Dr. Jessup also asked how stable EXPRESS Racks 1 and 2 are and what effect that had on the one failed experiment. Dr. Uri explained that the failure was internal to the hardware itself and not related to the rack but that there are concerns about the stability of the racks. Rack 1 was of greatest concern because it contains continuously powered payloads. Anomalies are being studied. In response to questions about on-call status of PIs, Dr. Uri explained that they are always on call during windows when work on their experiments could occur. However, the CGBA PI missed two calls from Jim Voss while he was on-orbit because they were unplanned and not related to scheduled CGBA work. Responding to questions about Russian research, Dr. Uri said that despite several joint meeting in recent years, there is not always as much information about Russian science available as they would like. The planning process has been successfully integrated with the Russians, but Rick Cissom noted that NASA does not receive information regarding talks between Russian crewmembers and the ground.

Telecon with Investigators

Investigators on experiments that have flown or are flying briefed the Subcommittee on their experiences. Jim Allen, with Boeing, reported on ARIS-ICE, a series of experiments to characterize the ARIS isolation performance. ARIS actively isolates the payload rack from the station structure using a computer and hardware that counteract disturbances detected by accelerometers on the rack. There have been hardware problems but they have been pleased with the limited results so far and the ARIS system is performing well, though currently operating with a reduced actuator set. The next step will be longer duration tests. In response to a question from Dr. Jessup, Dr. Allen stated that preliminary data shows that station disturbance levels are low, on the order of a few microGs at low frequencies below 1 Hz, and about 30 microGs at higher frequencies about 100Hz. More data is needed before the ISS microgravity environment can be properly characterized. Responding to a question from Dr. Oman regarding generic lessons learned so far, Dr. Allen stated that getting payloads on-orbit is a painful process at times but that everybody is learning to make this process more efficient.

Dr. Howard Levine, with Dynamac, reported on the seeds project, which was essentially part of the Jason Expedition and involved growth of corn and soybean plants under light and dark conditions. Astronauts downlinked photos of the plants for access by students. Due to communication problems with crewmembers such as delays in reporting experimental results, parts of the experiment were unsuccessful Watering procedures, for instance, were not accurately followed. Dr. Levine stated that an improvement to

the system would be for investigators to have direct access to crewmembers for training purposes because relatively simple protocols are harder to explain via printed or electronic instructions. In response to a question from Dr. Musgrave, Dr. Levine said that based on his experience he would foresee problems in doing intricate operations particularly if feedback from the PI team was required because of significant delays involved in such exchanges.

Dr. Weijia Zhou from the University of Wisconsin, Madison reported on Advanced Astroculture, which operates autonomously after being turned on and involves two Middeck units. Objectives for the study, sponsored by Space Explorer, a private company, are to determine whether *arabidopsis* can complete its life cycle from seed to seed, to see if the final chemistry of the seeds produced in space. Future experiments will also include gene expression studies and may require crew time for sample preparation. Both scientific and engineering results will be used to develop a commercial product called Orbital Laboratory, which is an Internet-based curriculum targeted for 8th grade through college. The hardware has worked extremely well with no anomalies and the science has also gone well. For this species there are no indications that microgravity slows development.

Dr. Douglas Watt of McGill University in Montreal, Canada, discussed problems associated with his work on H-REFLEX and the ISS in general. H-REFLEX is a human physiology experiment intended to measure changes in spinal cord excitability and has worked well. Dr. Watt complimented the crewmembers and stated his belief that they are being abused by the system through unreasonable demands both in training and on-orbit. The training period and the training time for individual tasks is too short and their hours are too long. Dr. Watt pointed to lack of opportunity as the biggest problem with ISS, stating that if he submitted a proposal for an experiment now he would probably be retired before it flew, which discourages senior people from getting involved in the program.
[DR. WATT CONTINUED ON WITH A LIST OF HIS CONCERNS WITH THE PROGRAM, BUT WAS CUT OFF DUE TO PHONE TROUBLES. HE AGREED TO SUBMIT THE LIST IN WRITING.]

Dr. Arthur Bailey of Harvard reported on the Physics of Colloids in Space (PCS) project, which uses laser light scanning to examine the behavior of eight colloids in microgravity. The experiment has worked perfectly so far, though not all features have been tested. Dr. Bailey stated that he has been impressed with the ISS process so far but that the duration of the proposal process was a problem. His group had trouble changing from the samples originally proposed but no longer of current interest to samples that would be more current. In response to a question from Dr. Jessup, Dr. Bailey stated that the PCS experiments were not a good measure of the quality of the microgravity environment because changes on the order of tens of microGs would not have a discernible effect on the samples. Responding to a question from Mr. Uhran, Dr. Bailey explained that the resistance to sample changes was mainly due to safety issues, specifically whether new samples would need to be re-certified. They were able to demonstrate that the changes were small enough that they would not be a concern.

Dr. David Klaus, of the University of Colorado, Boulder, reported on the Commercial Generic Bioprocessing Apparatus (CGBA), which is a mostly autonomous single locker where microorganisms that produce the antibiotic compound actinomycin D grow. It is designed to study why, as shown during previous experiments on other platforms, bacteria are more productive in space, but it failed due to hardware problems. The experiment is sponsored by Bristol-Myers. Dr. Klaus commended all involved for outstanding support during the troubleshooting process. He suggested as an improvement to the program that a single contact be established for scientists as currently they are required to interact with a daunting number of personnel and receive a high volume of email, sometimes not even related to their payload.

Dr. Rory Ninneman, of the Air Force Research Laboratory, reported on the Middeck Active Control Experiment Reflight (MACE II) program, which is a modification of hardware originally flown on STS 67 in 1995 and is designed to study the effects of vibrations on structures in space and how to minimize them. When first activated he was notified that it was "broke" but was not able to get the necessary details until three weeks later. Dr. Ninneman stated that his team sent a list of questions to the astronauts but does not feel they reached him because they continued to receive the response "it's broke." The problem was corrected and the limited data received looks good. Dr. Ninaman outlined these criticisms: 1) Despite STS

certification their hardware had to be re-certified for ISS which was a frustratingly difficult process. 2)MACE II is a 28-volt system, but there was no certified converter readily available to adapt it to the station's 128-volt service. The group did find someone with a waivered converter but they then had trouble getting waivers for the three others they needed. Others had similar problems as they are now using the same converters. 3) There was no access to the astronauts for training save one 30-minute session for safety. They used Computer-Based Training and their STS procedures were not valid for ISS so they had to start over. 4) The data they received was corrupted somewhere in the process after downlink to Houston and was unusable. To get around the problem they are getting the raw data from Houston, but receipt is sporadic. 5) Many operations were delayed without explanation, and they were often not notified of operations until after they have happened. 6) Crew inadvertently aborted the experiments early and in response to a question from Dr. Oman Dr. Ninaman stated that the lack of face-to-face training undoubtedly was a partial cause of such problems.

Increments 1 and 2 Payload Operations Report

Mr. Rick Cissom briefed the SSUAS on the current on-orbit operational status. Though original plans called for support to begin on delivery of the US Lab, MSFC was requested to support Increment 1 prior to this and without full capability of the POIC. Support relied on voice and fax communications because command and telemetry capabilities were not yet in place. For increment 1, Payloads got approximately 3% of total crew time. No payloads were planned for the increment until less than 9 months before. The Payload Operations Center was commissioned February 2, 2001. The POIC and Cadre began supporting 24x7 Payload Operations with the launch of 5A.1. Distributed Operations was implemented from the start, and ten remote sites are connected to the POIC. No PDs were required to come to Huntsville to operate. Command and Telemetry services have been stable. Video from Houston has been lost but repair work is underway. Tests should be done soon and by November, video should be distributed to the user community again. In response to a question from Mr. Uhran, Mr. Cissom stated that the number of remote sites will increase to almost 150 US sites once all three laboratories are on-orbit.

There were 115 hours of training for the Expedition 2 crew. All occurred on stand alone trainers with no integrated training available and ground observations show that this was sufficient to meet the objectives. In response to questions from the Subcommittee Mr. Cissom stated that with the Expedition 2 crew very few on-orbit hours had to be spent getting them up to speed on procedures. The procedure is that if it is the crew's first time doing an activity or if because of safety reasons review of onboard training is required, it is scheduled for their nominal science time. If the crew wants to refresh themselves they do that in off time or free time.

HRF was the first payload rack delivered to orbit and its activation was delayed due to early issues such as limited crew time and problems with the Ku-band antenna. Rack 1 and its sub-racks have met all payload requirements for continuously powered payloads even when auxiliary power was required due to a communication problem between Russian and US computers. Rack 2 had a software bug that Boeing is working to fix and a data flow problem that leads to lockups is still under investigation. Numerous workarounds were required on the ground and Increment 2 started with 65 vehicle/rack workarounds, all of which were successfully implemented. Russian payload deliveries have been received late in the integration process making it difficult to support Baseline Increment Preparation Processes. Initial vehicle problems have been resolved or workarounds are in place to allow progress and successful planning. Mr. Cissom also commended the Increment 2 crew and noted that the Task List has provided much needed flexibility in the ability to execute payload operations.

Responding to concerns raised during the investigator telecon, Mr. Cissom stated that Dr. Ninneman's group is the only one that has had problems with data corrupted in transit from Houston and that several of the other problems discussed came about because the experiments flew early before some basic capabilities were in place.

Jack Estes Memorial

Mr. Uhran asked for a moment of silence to recognize the contributions of Jack Estes. John-David Bartoe presented the text of a proposed plaque to be placed on the Window Observation Research Facility on the ISS. The proposed text, which was unanimously endorsed, reads: In memory of professor Jack Estes,

internationally recognized leader in remote sensing research and an early and tireless crusader for the addition of an Earth viewing window on the International Space Station.

ISS Program Overview

Mr. Tom Holloway provided a status update on the ISS Program and budget issues. Last year exceeded expectations and things went incredibly well. There were 14 flights to ISS, including four Progresses, and all went reasonably well, most exceptionally well. The next Progress is scheduled for launch between August 21st and the 23rd. The solar array was launched on November 30, 2000 and the flight went almost perfectly. The array got stuck during deployment, but the problem was solved by the crew. The problem is being analyzed to prevent a recurrence. In February, the US Lab was launched and 92 of 93 systems operated properly. The problem was a CO_2 scrubber, which is now working at half capacity until a valve can be replaced. The first logistics flight, with the Multi-Purpose Logistics Module (MPLM) and the Expedition 2 crew, was in March 2001 and the flight went very well. The deployment of Canadarm 2 went well, but during initial operation there were several anomalies, the worst of which was caused by a known bug in a chip that the Canadians were not aware of. The problem has been solved and the arm is functioning properly. Also on the 6A flight there was a problem with one of the three Command and Control computers, which was corrected with a replacement hard drive sent on 7A. The problem related to a mechanical mass memory unit. Solid-state memory units are currently being developed and two will be launched on 7A.1. Within a year, all mechanical mass memory units should have been replaced with the solid-state versions.

In April of 2001, the Soyuz docked with Dennis Tito aboard. There will be passengers on future flights. This is good for the ISS because it is allowing the Russians to finance their flights. The airlock flight has just been completed and went very well with only minor problems. On one spacewalk out of the airlock the new pre-breath operation, which takes just two hours and 20 minutes compared to the standard 12-hour process, was used. Currently there are about 250,000 pounds on orbit, compared to 60,000 pounds one year ago. The gyroscopes in the US Lab have been controlling attitude almost continuously, though there have been minor data problems with two of them. There are nine increment crews, including the two that have flown, in the training process currently. In response to a question from Dr. Jessup regarding interaction between American and Russian computers, Mr. Holloway explained that only data of common interest such as attitude is shared. Barring any major upsets, the schedule for the next two years can be met within about a month. The biggest challenges are software and multi-area integration testing.

The budget is an unfortunate, complicated and difficult subject right now. The main questions being asked are why are we in this situation and why didn't we know about it earlier. Indicators of the budget problem have been there from the beginning. Mr. Holloway stated that in his judgement the station program can not finish the assembly sequence nor operate on the amount of money that is currently allotted. Several factors contributed to the current situation. Boeing's initial contract had a $600 million deficit but they signed due to pressure from NASA. Since that time they have overrun by about $1 billion and that money came out of the system. In response to a question from Dr. Jessup, Mr. Holloway said Boeing signed the contract assuming they would be able to solve the deficit in the process of integrating the two older contracts it replaced. Russian economic troubles have forced them to spend extremely conservatively on the ISS and when possible NASA takes up the slack. A great deal of money has also been spent to mitigate dependence on the Russians. For instance, $325 million was spent on the ICM, but that has been put on the shelf based on the current belief that the Russians can provide propellant. The schedule has slipped four years since the beginning of the program, but the associated inflation is not accounted for in the budget. In the beginning of the program there was a fairly large engineering technology budget to pay for labs, support and facilities. That budget has been drastically reduced and so the program ends up paying on the order of $100 million for those things at facilities such as JSC and MSFC. The original budget left out either overtly or inadvertently some costs for meeting safety standards. NASA's effort to save money has involved shifting some bills to programs, resulting in large unexpected costs. Unforeseen new requirements such as the right kind of carriers to get logistics to orbit that are too big to fit in MPLM have also been a problem, as have overoptimistic estimates of the number of staff that would be required by the program. Mr. Holloway stated that he thinks people did know about the budget problem earlier but felt the difference would eventually be made up through under-running budgets. Once it became obvious there was a significant problem various reviews were initiated starting in September of 2000. Steps have now been taken to

minimize the budget such as canceling the US Hab and putting ICM on standby. To operate the current system about $2.3 billion is needed through this budget cycle. His hope had been that nothing difficult or expensive to start over would be cancelled this year, but they were directed to delete the Crew Return Vehicle (CRV) program and others. The 2002 budget now includes $40million to keep such programs on track, but about $150million is needed to do that.

Mr. Holloway outlined the requirements for augmenting crew size from three to six or seven and discussed options for fulfilling these requirements such as purchasing at least some hardware, including a Soyuz, from the Russians. This could be used as an interim solution, but it would take money away from the primary plan and there is the danger it could then become the permanent plan. Another possibility is using the Shuttle as temporary accommodations, but this would provide a relatively small gain. Responding to a question from Dr. Jessup, Mr. Holloway discussed possibilities under discussion for additional contributions from other foreign partners. International partners are concerned that if crew size is not increased their on-orbit time will be severely limited. In response to questions, Mr. Holloway stated that he did not know of any way to truncate the program, as has been suggested, and still meet commitments to international partners and to research.

ISS Research Restructuring

Dr. Kathie Olsen joined the meeting via telecon from NASA Headquarters to brief the Subcommittee on issues related to restructuring the research program to deal with budget cuts. The two budgets involved are the Office of Biological and Physical Research (OBPR) budget, which is Code U for ground-based and some flight-based research, and the ISS Research budget, which will be transferred back to Code U from Code M starting October 1. It was reduced by 36% to cover some of the budget problems. Dr. Olsen stated that she believes, based on the importance of research and our relationship with International Partners, that a six or seven-person crew will be achieved. ISS really is the Hubble for biological and physical research and will allow for the first time multiple generations of cells, plants and other organisms in space. For the assembly stages, about 100 experiments were chosen that could be carried out with limited facilities and three crewmembers. The work of researchers in correlating their work with on-orbit capabilities is commendable. The House bill provides 65 million additional dollars for research. Of that $35 million is targeted for combustion and fluids. The rest is untargeted and the Subcommittee's help is requested setting priorities for this money. The president's budget includes cuts of roughly 36% from what was previously in the budget for ISS Research from 2002-2005. Attempts at eliminating the Space Station are likely in both the House and Senate. Last year it was not debatable, this year we are expecting a struggle. A group is now preparing talking points to highlight the value of ISS research. There have always been senators and representatives on both extremes of support for ISS, but some of the strong supporters are dropping off and there are more people who are in between.

There are two approaches to dealing with the proposed reductions. 1) Focus available resources on a selected set of facilities and equipment, suspending work on others or 2) Distributing the available resources more evenly, keeping the entire set alive and deferring facility availability dates. The reason the ISS Research account is being transferred to Code U is so that further reductions can not be taken out of that account and to align it with research activities. There is language in the Senate bill that says OBPR needs to balance their ground-based and flight-based research programs with the return to Code U. Crew health and safety, biotechnology and fundamental research have been identified as near-term priorities based on availability of on-orbit resources. These will be revisited once crew size increases. Regarding timing of research impacts based on reductions, the first ten racks are already completed or nearly completed and planning has long assumed a three-person crew early in assembly. The first indefinitely deferred racks were planned for deployment in February 2005. Funding for PI's based on capabilities now in question will have to be re-evaluated. Work is being done to minimize the impact on the PI community by seeing if some experiments can be done using ground-based facilities or seeing if they can do similar work with ISS capabilities that will be available. The longer term impact will be a reduced scope of disciplines and reduced future selection of flight investigations. Questions currently under consideration by the Biological and Physical Research Advisory Committee (BPRAC) for a response by August 3, 2001are whether there is a more effective way to deal with the funding shortfall, deciding what process should be used to suspend ISS research in specific disciplines, if necessary, and what is the most effective process for

the scientific community to help define the post assembly phase research priorities. Dr. Olsen suggested that the National Research Council could also assist in laying out guidelines for research.

The President's budget for FY2002 would not support EXPRESS Racks 7 and 8, which include the Fluids and Combustion Facility-2, X-Ray Diffraction, and others. Fundamental Biology has been severely curtailed by aligning the research and the facilities partly because of the delay of the Centrifuge Accommodation Module (CAM) and partly because 6-7 crew are needed to carry out much of the research. The President's budget would include the Incubator, Insect Habitat (CSA) and Aquatic habitat (NASDA) as well as the Habitat Holding Rack 1, and the Life Sciences Glovebox. The centrifuge is being delayed but is till in and on track. Dr. Olsen stated that her personal belief was that hardware such as the Cell Culture Unit, the Advanced Animal Habitat and the Plant Research Units should be priorities for restored funding in part because the technologies involved are so complex that development needs to continue. The International Partners' ministers will be meeting in November along with NASA representatives. They will discuss increasing funding so that some of their experiments can fly earlier than planned. In response to a question from Dr. Marty Israel regarding the status of external payloads, Dr. Olsen said the Alpha Magnetic Spectrometer (AMS) and the Low Temperature Microgravity Physics Facility (LTMPF) are on-track. The Brazilian external payload sites will be discussed in briefings later in the meeting. In response to a question from Dr. Jessup, Dr. Olsen stated that the President's budget is split roughly 50-50 between research programs and utilization support. Dr. Olsen outlined the specific responses to most recommendations from the last SSUAS meeting. Information has been gathered from PIs regarding issues related to improving the proposal system. Transferring the ISS Research Budget to Code U should help end the deferral of scientific research and experimental hardware funding. A new education and outreach plan is under development. Though XTF is a priority there are not currently sufficient funds, but the hope is to buy that back in time. Russian participation in experiments has increased. We are working with the State Department and others to get a presidential order stating that research is not part of the detailed export restrictions and that university scientists and related parties would be deferred.

ISS Payloads Office Status

Mr. Rick Nygren provided a status report on the research program. The Interim Rev. F Assembly Sequence, which goes through flight 10A, has been agreed to by the Program as well as IPs and is currently working well. Finalization is expected in the next few months. With the worst-case assembly sequence scenario based on the current budget assembly would stop after the IP Labs are delivered, there would be no Node 3, Advanced ECLSS, CRV or Hab and the crew would remain at three until augmentation is available. There would be five Logistics and Resupply flights per year in 2006 and 2007. All IPs have rejected this option as not viable. Mr. Nygren noted that Mr. Holloway has not taken any money out of research as Program Manager and instead has been a staunch advocate of research and has "fenced" research resources in order to mitigate the erosion of resources due to changes in systems requirements. The following minimum requirements have been set below which Program Manager approval is required. 20 hours per week crew time, training at 400 hours per increment for non-Russian partners, five Middeck lockers per flight and 500W Middeck transportation power. This approach has already protected some previously threatened resources. A Crew Time Tiger Team has been established to evaluate ways to increase crew time for research and to meet the minimum 20 hours/week. The situation is improving and systems tasks no longer take automatic priority, however, achieving 20 hours/week remains difficult. The team has developed a system of priority codes. A Red week means only crew time required to keep payloads alive is available, such as during an EVA or docking. During a Yellow week, more crew time is available, but the bulk of the time is dedicated to preparation for an upcoming event such as docking. Green weeks should involve as much research time as possible, somewhere between 20 and 30 hours, though time allocations are still in negotiation. At 20 hours, time allotted to some IPs is very small. Canada, for instance, would get 0.5 hours and this situation has to be improved.

A three-person crew without Extended Duration Orbiter (EDO) missions will have time to handle about seven racks worth of science during an increment. An EDO mission would allow the equivalent of two more racks throughout an increment because the Shuttle crew would undo a number of maintenance items, freeing up increment crew time. A 20-day EDO would also enable racks worth of short-duration science, and increasing the EDO duration would allow completion of additional science, however this would also require more cryo and, hence, less research materials. EDO's would provide some short and long-term

benefits, but these would be dwarfed by 7-person crew capabilities. The President's budget included a $1 billion reduction from 2002-2007 for the ISS. The approach for handling this was to first reduce as much as possible the research infrastructure costs associated with, for instance, KSC Processing and the Payload Operations Integration Center (POIC). After that, discipline-specific programs had to be reduced to meet the overall $1 billion target. The POIC is the key to maintaining research throughput. It was originally scaled to support the complete rack complement 24x7. Scaling operations are not linear as you still need the basic structure regardless of whether there are 15 racks or 37. You have to either accept that you can only bring it down so far and pay that overhead until you can grow the program back up to support 25-30 racks, or you need to shut the doors and come up with a new concept. You can not take the current infrastructure down to only supporting six or seven racks. However, to make sure what we are doing is the best use of funds there will be an independent assessment to look at the infrastructure. The President's budget would allow outfitting of 18 racks, but there are currently only spaces for eight. Five of them were bartered. The IPs could add additional slots as would the CAM or HAB. Those 18 racks are based on budget constraints, rather than prioritization of science. We said with the budget we have and with the racks that we are currently building, which ones can we do. Mr. Holloway outlined the specific racks, facilities etc., currently included in the budget and those which would be excluded. His office has recommended 16% reserves, though that is viewed as still too low. The guidelines coming back from Headquarters now show reserves at about 10%due to addition of content into the program. If the additional $65 million in research funding is approved by Congress, the $30 million not earmarked could be used to increase the reserve to a safer level. If it is used to add more content the programs could be at risk. Mr. Uhran noted that if there are not sufficient reserves, when reserves are needed it could force cuts from payloads making a bad situation and that it would therefore make more sense to get the proper reserve level now. In response to a question from Dr. Jessup, Mr. Nygren stated that reserves can be carried over from one year to the next, as can underruns within the programs.

In December Brazil advised the ISS Program Manager that the EMBRAER proposal to produce the Express Pallet exceeded Brazil's total ISS budget, so NASA provided Brazil's Space Agency (INPE) with a downsized set of requirements. Brazil was scheduled to report to NASA in April whether they could produce the Pallet. They notified Mr. Holloway recently that they would not be able to do that until August. The Microgravity Science glovebox is still on track for a UF2 launch. The flight unit will be delivered in September, 2001. The Minus Eighty Degree Freezer (MELFI) is scheduled for delivery to KSC in November, 2001. Though this would allow a ULF1, launch is being deferred to UF3 for budget reasons. Based on the Centrifuge Rotor PDR, NASDA indicated that their was too much risk in their design. Tiger teams resolved six of the seven issues responsible. The remaining issue was an upmass problem that may have been solved. In May NASDA indicated that the system risk is still too high and have therefore proposed a reduction from eight to four habitats, elimination of the Low Temperature Loop and reduction of allowable habitat mass/cg offsets. Dr. Jessup noted that at the recent BPRAC meeting some members expressed concern that going to a four-rotor centrifuge would be undesirable. NASA is working with NASDA to find an appropriate solution. Negotiations continue with Rosaviakosmos to develop a policy for tracking crew time. Off-hours crew work from the task list makes tracking barter fulfillment difficult. RSC has requested an increased allocation of crew time on Increment 3 due to their perception that they received a shortage of crew time on Increment 2. But this is not a viable concept because of the planning involved in an increment. Any repayment of time would have to occur later in the timeline. The first Multilateral Payloads Control Board face-to-face meeting was held in Europe June 19-20, 2001. Previously meetings were held via telecon once per month with bilateral meetings periodically. The board consists of all Partners' Utilization Offices and controls issues associated with research planning, resources, rack deployment, rack interfaces, integration processes, operations, etc. At the meeting, several key documents such as the Cryo System Joint Implementation Plan were finalized and it was decided that such meetings would be held regularly. The next is scheduled for September 13-14, 2001 and will also include the Multilateral Operations and Integration Control Board. In conjunction with the budget exercise, a cold stowage assessment was performed. After RFI review of cold stowage is complete within NASA by both the engineering and scientific communities, proposals will be written and submitted for competitive procurement of necessary equipment. This is expected for late November 2001, for target availability in 2003.

Tuesday, July 24

Integrated Testing for External Sites

Maynette Smith gave a presentation to the Subcommittee on the current state of external payload site development via telecon from KSC. Attached payload and truss element compatibility is done through a series of step-wise tests in order to ensure than an attached payload will operate properly on-orbit. Standalone truss element testing is done through verification and acceptance testing of items relating to attached payloads such as the P3 Unpressurized Carrier Common Attached System (UCCAS). Some truss elements also receive Multi-Element Integration Testing (MEIT), which verifies element-to-element interface compatibility, system end-to-end operability and functionality and executes flight operational scenarios using flight-like procedures. MEIT of attached payloads did not occur as there were no attached payloads at the appropriate level of maturity. The P3 Truss has a number of verification requirements related to the Unpressurized Carrier Common Attached System (UCCAS), including 1) UCCAS Operation 2) UCCAS Payload Interface Verification, which includes a UCCAS EVA Deployment Test that has been deferred pending resolution of interference between the Active UMA and the clevis bracket on truss longeron 3) EVA bolt engagement force-break torque test and 4) EVA functional test. With the exception of the EVA deployment, these verifications have been done for the P3 Truss. Robert Ashley, also joining by telecon from KSC, noted that some of the force-break torque testing and functional testing has been deferred until the EVA deployment. The S3 Truss Passive Attach System (PAS) functionality acceptance test verification requirements are similar to those for the P3 and are scheduled for August 2001.

The ISS Payloads Office has established that attached payloads will undergo verification testing in the Payload Rack Checkout Unit (PRCU) at KSC. The PRCU allows verification of both rack and attached payloads and both the Active Common Attach System (ACAS) Simulator and the EXPRESS Pallet Simulator can be used with it and the KSC Payload Test and Checkout System (PCTS). The EXPRESS Pallet is required to undergo final Acceptance Testing in the PRCU. The EXPRESS Pallet will be connected to the ACAS Simulator, which is attached to the PTCS for a high fidelity simulation of the ISS for payloads. The Subsystems-to-ISS Interface check is then performed and then attached payloads will be physically integrated on the EXPRESS Pallet for individual Payload-to-EXPRESS Pallet interface testing and the Joint Operations Tests, which involves testing the Pallet with all attached payloads powered up in concert. If the Pallet or any payload has direct interfaces to the Orbiter, those will tested in CITE and once installed in the Orbiter. Incorporation of a test of the Berthying Camera System into the ACAS Simulator to verify compatibility with the docking Camera System on the payload is currently planned. For an EXPRESS Pallet Resupply Flight an Attached Payload with adapter is installed on an EXPRESS Pallet Simulator which is in turn connected to PTCS via a ground cable/connector and tested. Payloads such as AMS will be tested in much the same way as for an EXPRESS Pallet initial flight. For US Payloads flying on the JEM EF, KSC will have an Exposed Facility Simulator which will interface to the PRCU and PTCS for testing in a similar fashion to previous scenarios. Provisions are being made to secure a Columbus External Site simulator, which would likely be interfaced with PTCS for testing. Truss EMI testing is incorporated into MEIT which includes EMI conducted emissions and voltage ripple measurements tested at the UCCAS payload interface, some of which were completed in June 2001 while others are scheduled for no earlier than November 2001. In response to a question from Dr. Israel, Johnny Mathis, also via telecon, stated that integrated testing of a large attached payload such as AMS would probably take on the order of two to three weeks. Dr. Uhran asked how the problems experienced with EXPRESS Rack 2 on-orbit got through the testing net, and how such problems might be prevented in the future. Dr. Smith stated that some of the problems were seen on the ground but at the time it was determined they could probably be handled through operational workarounds.

Russian Cosmonaut Participation

Dr. Charles Sawin briefed the Subcommittee on participation of Russian crew members as experiment subjects. Through Assembly Complete, about half of the crew are cosmonauts so their participation in research is important to get significant subject time. It was difficult to discern early on if the concern was that cosmonauts wanted compensation for each study, as they had received with the MIR program, of if the concern was with health and safety. It is probably both. There was a real concern regarding who would cover compensation if a cosmonaut were injured doing non-Russian research. They were concerned that the Russian government would not do it adequately. The International Space Life Sciences Working Group (ISLSWG) asked ESA to negotiate a contract for liability coverage, and the ISS Payloads Office has now

reached an agreement for coverage to cosmonauts for Increments 3 through 8. A long-term solution is still under negotiation. Human subjects have to be free to decline participation in a given study. The Russians have their own programs and methods for determining scientific merit for experiments. If no astronauts are to be involved, then NASA's only concern is with safety issues. If astronaut involvement is desired, then NASA would also want to appraise the science. There is an agreement that no research will be conducted behind closed doors without partner knowledge. It is too soon to say whether there will be a problem in getting the participation desired. In response to a question from Ms. Stefanyshyn-Piper, Dr. Sawin answered that Russians have requested astronaut participation. For instance, the Russians have proposed a study to examine the contributions of various counter measures. A team at KSC is looking at the study and will later meet with the Russians to determine an appropriate plan. This kind of cooperation is critical because there can not be independent programs with only three or six subjects on board. Responding to a question from Dr. Oman, Dr. Sawin stated that it is assumed all Russian crewmembers are available for investigations. That is the objective.

Internal Environment Update

Mr. John-David Bartoe reported to the Subcommittee on research to date regarding the ISS internal environment. Early data indicates that the Russian Carbon Dioxide Removal Assembly (CDRA) is operating at specification. Two US CDRAs will be added. One is on-orbit but not yet operating. The current average CO_2 level is 0.57%. The research goal of 0.3% should be achieved when two or more CDRAs are operated simultaneously. Overall, expectations are being met. Ethylene levels are so far are below the detection threshold of 86 ppb. The desired optimum for plants is less than 50 ppb, and all present and planned plant chambers incorporate permanganate scrubbers capable of lowering the level from 86ppb to the desired level while removing plant-generated ethylene as well. In response to questions from Dr. Jessup, Dr. Musgrave noted that levels below 50ppb are measured using returned samples and that numerous sources of ethylene were found on MIR including humans, mold on walls, and fruit. Dr. Musgrave also stated that the ethylene levels are encouraging and much better than those found on MIR. The microgravity environment is measured using two systems. The first is the Microgravity Accerleration Measurement System (MAMS), a double middeck locker. Data is downlinked and available at http://tsccrusader.grc.nasa.gov/pims. MAMS data so far shows that the station is performing as expected and that it is a very low frequency environment. The second system is the Space Acceleration Measurement System (SAMS II), which primarily supports microgravity experiments, but is available for environment characterization as well. SAMS II data is available upon request from GRC. Sensors will be up for the life of the station and will be moved to different spots as components are added. Overall, predictions are in close agreement with measured data, though predictions are generally higher than observed. The reasons for that are still under investigation. Dr. Jessup asked whether higher frequency vibration has a greater impact on the microgravity environment. Mr. Bartoe said no and Dr. Crouch noted that, for instance, in cell cultures lower frequencies have more influence than higher ones. The research community has said that with higher frequency it is acceptable for the vibration to be higher. Mr. Bartoe noted that the data presented was without the isolation system operating as that data is not yet available. In response to a question from Dr. Oman, Mr. Bartoe said various transient events are being studied such as thruster firings and dockings. Preliminary data shows the ARIS control loop is stable, and though the test schedule has been delayed for ARIS-ICE, experiments are going well and will be extended.

Export Control Restrictions

Mr. Rip Nabors briefed the Subcommittee on current export restrictions and strategies for dealing with them. Exports are regulated by the Export Administration Regulation (EAR) which is administered by the Department of Commerce (DoC) and the International Traffic in Arms Regulations (ITAR), which is administered by the Department of State (DoS). Payloads may involve the Nuclear Regulatory Commission if you put a nuclear device up. Experiments that involve drugs could involve the Drug Enforcement Agency (DEA). EAR and ITAR are the main concerns. Planning is critical because approval and licensing is a long process. If you require a license, the DoC says it will take 60 days, but it could be much longer and so 120 days should be allotted. The DoS says 90 days, but their licenses generally take longer so 180 days should be allotted. The sooner you establish export classifications for hardware, software, etc, the better off you will be. The person who exports is the responsible person for the export. Transfer to a US citizen is not generally an export, but transfer to a US citizen representing a foreign government is an export. Customs is the final check for shipping. If the paperwork is not correct, the shipment does not go.

When you have foreign visitors it is considered an export when you talk to them about data and procedures. Websites and email are a way of putting information in the public domain and as such are controlled. Raw data is typically not controlled, how you obtained it, including equipment used, typically is. When you give a presentation with foreign nationals in the audience, you are exporting. Payload developers are required to classify their commodities. Element hardware such as the Nodes are classified ECCN9A004. ECCN=Export Control Classification Number, 9=space, A=hardware, 004 refers to reasons for control. Component hardware also falls under that classification, and this includes items such as racks that are integrated to the element hardware. Payloads that draw from the resources of the station using power, gases, etc, are classified on merits, which means you have to understand the product and how it meshes with export control regulations. Fundamental research experiments, which include most payloads, are not export controlled, but equipment used might be. The DoS controls the detailed design used to manufacture, operate, produce or maintain equipment. Information needed to prove your hardware or commodity functions as intended is exempt and designated EAR99. It can not be put in the public domain, but it can be given to anybody without export license excluding the Terrorist Seven. Points of Contact: Rip Nabors, MSFC (256-544-0688); Jennifer Mason-Korecki, JSC (281-483-2424); Sam Lewellen, KSC (321-867-4112); John Hall, HQ (202-358-2070. Mr. Nygren noted that CDR and PDR data packs have been an area of particular trouble. Because they contain enough detail on how to build , operate, and design them, they are controlled. Work on export issues should begin up to a year in advance. Mr. Nabors explained that HQ has an export control page with a template to follow that indicates how to classify items. Although most work, especially presentations, does not reach the level that is controlled, the classification process should still be followed.

Metrics Document Update

Mr. John-David Bartoe presented the new International Space Station Research Capability Metrics Document, which is an updated version of a 1999 document. The metrics were agreed to by SUASS in 1997. They are updated periodically to look at trends in performance and capability of the station. Mr. Bartoe requested comments on the document, particularly whether the metrics still seem appropriate.

Payload Integration Benchmark Update

Mr. Jim Scheib briefed the Subcommittee on the study of the amount of work required to integrate an experiment onto the ISS from the PI/PD perspective as well as on the new Small Pressurized Payload class. As an example, Mr. Scheib presented three metrics for EXPRESS Rack Payload Developers. The integration product metric covers the number and timing of the integration products and is based on the EXPRESS Rack Payload template (SSP 57057), which is currently being updated. Improvements include: 1) Elimination of one formal CoFR review eliminated 2) Shortening of the Payload Engineering Integration (PEI) process and 3) Reduction in the operations and training template of approximately four months based on the approval of "fenced resources" including ground-based crew training guaranteed inside of six months. Both the update to the template and the metric will be completed in late 2001. The second metric was the amount of data required from PDs, and is based on the number of data fields in the payload databases that have to be filled out. One key database is the Payload Data Library (PDL), an update of which will be released next week that will make it web-based and is expected to be easier to use. It also updates the KSC Support and Technical Requirements and Ground Data Services Data Sets. The updates have deleted many data fields as redundant or unnecessary. The PDL will be continually updated as tools are updated. The final metric involves the amount and timing of verification products associated with the interface requirements. It represents the maximum amount of verification submittals required by the Verfication Requirements Definition Sheets (VRDS) based on a complex payload with all requirements designated applicable. This is an attempt to shift with changes to the PEI template. Since January there have been two updates in an attempt to shift with the proposed shortened PEI process. Verification submittals will be moved 1.5 to 2 months closer to launch. The number of deliverables has actually increased, but should decrease some when PEI updates their documentation.

The ISS Payloads Office is currently creating a new payload class called Small Pressurized Payloads, which are non-rack mounted and not associated with EXPRESS or other facilities. The goal is to create a more streamlined process with additional integration support compared to other payloads. OZ2 is establishing a Small Payload Integration Team. Examples of Small Payloads are PCG-EGN, DreamTime, and EarthKAM. Qualifications include a maximum mass of 120 pounds, a maximum of two hours of crew

training, and no ISS or Shuttle resources required except a maximum of two hours per week on-orbit crew time. Exceptions to the criteria will be approved by the PCB with the baselined Payload Integration Agreement. The Small Payload Integration Team will work with a Small Payload Developer to assist them in producing the required operations and engineering integration products. The goal is for Small Payloads to be approved for flight and begin its formal integration at approximately L-12 months. Another objective is to significantly reduce the number and complexity of required Integration deliverables. The existing Small Payload PIA Blank Book requires the PD to submit some verification data, most of it associated with Human Factors. An update to the Small Payload PIA will attempt to reduce further or eliminate the need for verification deliverables because safety addresses most concerns and "hard" human factors requirements on this class of payload may be overly conservative. Not many people currently qualify for this class of payload, but once it is available, the hope is that more people will work toward it. In response to a question from Dr. Crouch, Mr. Scheib said that Small Payloads would typically have low priority.

International Space Station Commercial Programs

Mr. Uhran briefed the Subcommittee on the current status of commercial payloads. There is a great deal of momentum for commercial programs, which originated with passage of the Commercial Space Act of 1998. A commercial development plan with a series of initiatives was released a few weeks later, and virtually all have been completed. Congress wanted to know what commercial opportunities NASA would provide. The answer was that proposals on anything would be accepted, but there were a number of caveats. A second congressional response was for a list of commercial proposals received. Excluding requests for government contracts, there had only been one proposal in a two-year period to do something new, which now defines an entrepreneurial activity. Finally, Congress requested an outside review of the commercial potential of ISS, which was contracted to KPMG. Their report, which is available publicly, concluded that there was potential for long-term return on investment in the 5-10+ years range. It also found potential for short-term return in virtually unprecedented markets such as tourism, advertising, merchandizing and multimedia. The ISS Commercial Development Demonstration Program was established in July 1999. It used market-based pricing, had a marginal cost floor and there were waivered provisions of that marginal cost if the work was related to the primary uses of the station. So you could not get a waiver for advertising, for instance, but you could for education. Any receipts above marginal costs would be re-invested into the Space Station Program, the idea being that private investment could grow the Station beyond Assembly-Complete. Historically, the private sector's main complaint with commercial space development has been that no prices were set, making business plans difficult or impossible. In response, working with Congress and the White House, a price structure and schedule was therefore developed, which was released in February 2000. ISO 9000 was used to establish a process for registering and tracking commercial ideas once they developed to the point that they could become a valid proposal. This was in response to a private sector concern that the proposal process was not established. A third commercial concern was for protection for intellectual property (IP). The IGAs and MOUs for the Space Station set out a very clear set of principles that all partners agreed to that would protect IP on the Station and released them publicly as a guidebook. Two announcements were placed in the Commerce Business Daily; one for market and multimedia products and services in December 1999 and another to cover all other concepts, advertised broadly as NASA-Industry partnerships in February 2000, which is being reissued annually. A Multilateral Consultative Working Group was established in November 1999 to coordinate policies on public-private partnerships with the International Partners. This team was re-chartered in July 2001 with one member from each partner's agency. It's goals include producing Commercial Guidelines for ISS and focusing multilateral communications on potential commercial projects that might have an adverse effect on other partners. Recently Dan Goldin initiated formation of a taskforce to determine what US policy should be, and their draft policy, which must now be approved through the inter-agency process. Each partner is supposed to have a national policy established in time for a September meeting. These will form the basis for negotiations on controversial topics such as tourism and sponsorships.

The Commercial Space Center Program is not a technology transfer program, but instead is driven by commercial objectives. Capital markets, therefore, should be selecting projects rather than the government. So, proposals where proposals with the highest ration of industry to NASA funding receive highest priority. Because a ratio rather than absolute dollars is used larger projects are not necessarily favored. All of the

Commercial Space Centers (CSCs) are at non-profit organizations, principally universities. All lead consortia of commercial, academic and/or government entities in space research and development projects and are established by cooperative agreements with NASA. They function much like marketing agencies to educate industry about potential advantages of commercial space and then work with industrial companies to help them through Payload Integration. Historically, there is about a 90% success rate for experiments. This is acceptable to the private sector and significantly lowers costs compared to developing equipment that is 99.999% reliable. CSCs are not earmarks. They are reviewed every three years and ten have already been cancelled. Ten new CSCs have been brought on in the past ten years as well. Recent budget cuts have had little effect on the CSCs because, at 50 million dollars per year total, they require relatively little funding. The average contribution from an industrial affiliate is $300,000 per year. The ratio of non-NASA to NASA funding approaches five to one. To ensure consistency in program policies and decisions, a set of Program Principles has been established that was approved by the Commercial Advisory Subcommittee and CSC Directors in the last quarter of 2000. Over 60 product lines have been established and the top ten lines represent more than $84 million in private investments to date. Nine of the top 25 R&D investors, as ranked by R&D magazine, are CSC industrial partners. The formal process for CSC selection and the Commercial Selection Criteria for Flight Research Approval have been publicly documented. A Product Development Evaluation Metric has also been established to consider factors other than the funding ratio. Criteria include Time-to-Market, Required Flight Activity and were used to design a weighted scoring technique to aid in decisions such as the order experiments will fly which should be put to use in the future. Space Product Development now produces an Annual Report and an In-Reach Briefing to NASA Management. All information associated with the CSC program will soon be available on-line. The broad website for information related to this presentation is http://commercial.nasa.gov. If the allotted 30% of the ISS was filled with commercial projects and all associated marginal costs paid (around $20 million/rack site) there is no danger that the allotment would then increase. Instead, once that market level is reached, the more likely result would be commercial interests spinning off onto private spacecraft. In response to a question from Dr. Oman, Mr. Uhran stated the main reason CSCs close is they have not identified an industrial company that is sponsoring a commercial product. Responding to a question from Dr. Musgrave, Mr. Uhran explained that CSCs can work on intermediate projects such as education and marketing while developing their commercial product line, but these can not be the main focus.

Payload Training Status

Ms. Julie Sanchez briefed the Subcommittee on the status of payload training programs including recent changes and improvements. A major recent accomplishment was development of a training allocation for non-Russian payloads, which is 400 total crew hours for the prime crew and 175 for the backup. Training for Increments 3-6 are within those allocations for prime crews, but backup crews started training late for Increments 4 and 5 so training had to be reduced. Payload training streamlining, outlined at the last SSUAS meeting, has led to crew hour reductions of 104 hours for Increment 3, 50 for Increment 4, and 155 for Increment 5. The training template has been moved to the right four months, which allows more time for development and maturity of operations and projects. Budget constraints have led to changes in Payload Trainer Requirements. Standalone trainers will be required at JSC vs. the Space Station Training Facility (SSTF) integrated trainers. This reduces the number of trainers that must be developed, costs through trainer simplification and facility loading because training is no longer limited to one location. Integration into the SSTF will only be required if safety or time critical operations training is required for ground support personnel. Increment 3 Payload Training is complete and Baseline Data Collection continues. Increment 4 is at I-4 months. The last payload crew training rotation will be complete September 21, 2001. Backup crew training is on schedule. For Increments 5 and 6 prime and backup payload crew training is proceeding as planned. For Increments 7 and 8, payload training requirements are in development.

With implementation of the payload training allocation, it is easier to evaluate On Board Training (OBT) needs because trainers can determine up front if training requirements can be met or if OBT will be needed for first time training. A Media Requirements Document has been developed to define requirements for onboard training for seven types of media. There are 18 On Board Computer Based Training (OCBT) Lessons developed and manifested. Most are non-required refreshers available if needed. If no computer-based training is available, crew receive a procedure review prior to first operation of a payload activity. For Expedition 1 there was positive feedback for the MACE OBT. Several OCBTs were on the Expedition

2 crew task list, but feedback is not yet available. In response to a question from Dr. Jessup, Ms. Sanchez stated that crew evaluations and on-board performance are used to evaluate training effectiveness. Instructors, who in many cases are Payload Developers and Principal Investigators, also evaluate how training went after lessons. Dr. Jessup asked how the training process prepares crewmembers for dealing with unexpected problems. Ms. Sanchez responded that astronauts are matched to payloads based on who has the most applicable background and experience. Payload Developers also train the astronauts on alternate procedures that can be used in case of a malfunction. Ms. Stefanyshyn-Piper noted that when problems arise, the crew will call the ground. The crew is not generally the first to diagnose a problem. Instead, problems usually appear in pictures or data coming down and then an applicable procedure is uplinked.

Status of Non-Government Organization

Mr. Uhran briefed the committee on current work to explore the NGO concept. The internal study team's report is not yet available but should be within a few weeks. The team included representatives from nine affected organizations including program offices, research program offices and HQ. A main objective for the team was to define the total functionality, without regard to funding source, associated with utilization of the Station, focusing on the US share including US function that involve integrating across partnerships. Functions were examined at the top level, the intermediate level, which illuminate differences between the responding organization, and a third level which was the actual statement of work elements or WBS elements various projects are using. The report also captures the dollars associated with functions. Next, the team examined which functions could never be, which might be, and which definitely could be transferred. The study identified the two extremes of transferred functions, but the team did not attempt to describe the best balance of transferred functions. The most significant recommendation is that we should not proceed directly to a single source procurement but should instead go through a one-year definition phase with multiple organizations proposing alternate concepts. NASA needs to consider a variety of options to narrow in on the desired balance of transferred functions. No final decision on an acquisition strategy has been made. Much communication at the senior level will be required and should include not only program offices, but the Office of Science and Technology Policy, Congressional staff and others. There is some language coming out of Congress proposing that NASA award one or more definition studies in FY2002, which was already the intended schedule but could become a Congressional mandate.

Dr. Yang asked what the objective for the NGO is and what problems it might solve. Mr. Uhran responded that key objectives would be to find the best approach for integrating the science, the technology and the commercial projects so that they approach their maximum productivity and to increase advocacy for the Space Station. Others would include making the complex operating environment of the Station transparent to end users and shortening the cycle time from announcement of an opportunity through equipment development to publication of post-flight results or production of a product. An NGO could be a very effective advocate, for instance in pushing for a budget increase. The intention is not to change any strategic planning for utilization of the Station. On September 30th of this year, we are required by law to submit an implementation plan to Capitol Hill. In response to a question from Dr. Oman, Mr. Uhran responded that the preponderance of opinion on the team was that the Institution could do this work itself. Dr. Jessup asked if the NGO is a foregone conclusion and Mr. Uhran answered that support for the concept in both the legislative and executive branches is extremely high, but nothing is a foregone conclusion in the US government. Dr. Jessup then asked if there is an estimate of what the cost effects would be. Mr. Uhran responded that that would depend on which functions would be transferred, which is still an open question, but that it would likely be in the hundreds of millions of dollars. It is not clear whether or not this would be carved from the NASA budget. It has been suggested that a workshop to identify desirable characteristics of an NGO to manage ISS utilization be conducted in conjunction with the AIAA meeting in Cocoa Beach, Florida in October.

Disposition of Prior Recommendations and Action Items

Dr. Jessup reviewed the disposition of the recommendations and action items from the last SSUAS meeting:

R1 (Support for Research) - There is no more deferral to the right of the research facility hardware funding. Funding is now in Code U and it is not part of Code M. This recommendation is closed, however, the committee acknowledges continued concern regarding this issue.

R2 (Capturing the Public Imagination) - There is a need to close some recommendations. This item is not as critical as others. This recommendation is closed.
R3 (New Enterprise for Biotechnology Facilities) - This is now a moot point. This recommendation is closed.
R4 (External Payload Sites) - With the April 1 decision deadline long passed, the recommendation is now irrelevant, but the concern remains as Brazil has not yet made a decision on construction of the EXPRESS Pallet, and NASA does not have a back-up plan for construction if Brazil can not proceed. This recommendation is closed, but will be revised in the form of a new recommendation.
R5 (Integrated Testing for External Payloads) - This has been handled. The committee commends all involved for the presentation on this matter given earlier by Maynette Smith. This recommendation is closed.
R6 (Participation of Russian Crewmembers) - This topic has been covered. The recommendation is closed.
R7 (Export Control Restrictions) - This topic has been covered. The recommendation is closed, though concerns remain that will be re-evaluated at a later meeting.
Recommendations from July 2000 that remained open
R1 (Research Vision) - This recommendation remains open.
R2 (Crew Training) - This has not yet been handled. It was discussed at this meeting. This recommendation is closed, but will be updated taking into account new regulations on crew access for training.
R3 (Payload Integration) - This recommendation was closed in January, but the committee requested a progress report, which was given at this meeting.
R6 (MELFI/Cryo Resources) At the next meeting there should be an analysis of what resources will be available when. The committee requests a briefing at the next meeting and the recommendation remains open.

New Recommendations from This Meeting

The SSUAS commended the performance of both the astronaut crew and the payload integration and support teams for performing extremely well during Increments 1 and 2. The SUASS noted that the complexity, number of intricately timed launches and the connection of the various components have stirred the imagination of the country. The SSUAS was also very encouraged by the early return of research findings during what is predominantly a construction phase of the International Space Station (ISS). This research was often performed by crew during their own time and is very much appreciated by the SSUAS. The committee was also pleased to see that the initial indications based on data from Increment 2 are that the plan for controlling the microgravity environment of ISS is meeting design specifications, as this establishes the ISS as a true microgravity laboratory.

The SSUAS developed new recommendations on the following topics: science prioritization, use of commercial and DARPA resources, budget administration within Code U, external payloads (replacing the prior recommendation), research grants management, persistent funding incursions, seven-member crews, and the financial reserves. The SSUAS is was by Code U's plans to curtail progress toward developing important facility-class hardware to support Fundamental Biology and Microgravity research on ISS and therefore recommended that Code U develop a long-term science prioritization plan. The SSUAS noted the recommendation from BPRAC that commercial and DARPA resources be used to fill in the current shortfalls in hardware development for ISS. It cautioned against blanket substitution of commercial hardware for the facility-class hardware planned for ISS, and recommended that science advisory groups be consulted prior to making short term plans for hardware substitution. The SSUAS was concerned that moving the budget of the ISS research program from Code M to Code U places the AA of Code U in the difficult position of allocating ISS research budget between internal Code U science and work that supports programs of other enterprises. SUASS therefore recommended that NASA should develop a process to ensure that appropriate input from affected parties is effectively weighed in deciding the allocation of budget resources. The Subcommittee was concerned that NASA no longer has an alternative plan to build EXPRESS pallets for external attached payloads if Brazil is unable to and recommended that NASA develop plans for effective and timely utilization of the external attach points as soon as they become available. The SUASS has previously expressed concern that the NASA grants program does not have clearly defined timelines and has not yet substantially improved contact with grants management offices in academic institutions. It recommended that NASA improve its grants management service. The SSUAS

applauded the decision of NASA to move the ISS research budget into the OBPR enterprise but is still concerned that there are threats against the ISS research budget for facilities that are in the critical period of development. It therefore recommended that NASA fence the ISS research budget against further incursion. The Subcommittee felt that the current plans for three crewmembers for the foreseeable future is a major constraint for ISS research and concluded that seven crewmembers are necessary at Assembly Complete for the performance of a productive research program. The SSUAS was alarmed by dangerously low reserve levels in the current budget plan for ISS research and recommended should secure and guard a reserve of 15-20% for the research program.

New Action Items
1) Report on logs and their usage
2) Telecon with Principal Investigators
3) Report on the internal environment, including the microbiotic environment

Future Meetings
Details on the next meeting will be determined at a later date. The committee discussed the problem of low attendance at meetings. Mr. Uhran suggested that possible solutions would be to increase the size of the committee or to come up with a process for retiring people before their 2-year tenure is up if they are not attending meetings. Dr. Israel suggested that members should be people with a stake in ISS research.

The committee opted not to brief Headquarters on the draft recommendations and action items via telecon. Dr. Jessup adjourned the meeting at 11:30.

SSUAS SUMMER WORKSHOP
Monday, July 23, 2001
Marshall Space Flight Center

MORNING

0800	Welcome and Opening Remarks	M. Jessup, M. Uhran
0815	Meeting Objectives and Overview	M. Jessup, M. Uhran

Research Operations

0830	Research Report on Increments One and Two	J. Uri
0930	Telecon with Investigators	Principal Investigators
1030	Break	
1045	Operations Report on Increments One and Two	R. Cissom
1200	Lunch	

AFTERNOON

Executive Presentations

1300	ISS Program Overview	T. Holloway
1400	ISS Research Restructuring	K. Olsen (via telecon)
1600	Break	
1715	Adjourn	

EVENING

1800 Group Dinner

SSUAS SUMMER WORKSHOP
Monday, July 23, 2001
Marshall Space Flight Center

MORNING

Responses to Prior Recommendations

	*Research Vision**	K. Olsen*
	*Support for Research**	K. Olsen*
	Capturing the Public Imagination	K. Olsen*
	*Facilities to Support the New Enterprise for Biotechnology**	K. Olsen*
	*External Sites**	R. Nygren*
	Export Control Restrictions	Deferred
0800	*Integrated Testing for External Sites*	M. Smith (via telecon)
0830	*Participation of Russian Crewmembers as Subjects*	C. Sawin

Responses to Prior Actions

	*Updates on CRV and Alternatives**	T. Holloway*
	*Space Product Development Initiatives Status**	M. Uhran*
	*Computer-based Payload Training Status**	J. Sanchez*
	*Increment 2 Science Operations Status**	J. Uri, R. Cissom*
	*Dedicated Shuttle Missions vs. Subrack Experiments**	M. Uhran*
	*Cold Stowage Update**	R. Nygren*
0900	*Internal Environment Update*	J-D Bartoe
0930	Break	
1000	Metrics Document Update	J-D Bartoe
1030	*Payload Integration Benchmark Update*	J. Scheib
1100	Committee Discussion	K. Jessup
1200	Lunch	

AFTERNOON

Special Topics

1300	Status of Space Product Development Initiatives	M. Uhran
1400	Computer-Based Payload Training Status	J. Sanchez
1430	Break	
1500	Status of Non-Government Organization	M. Uhran
1600	Reserve	
1700	Adjourn	

***Subject is addressed in a presentation elsewhere in the agenda, by the indicated presenter**

SSUAS SUMMER WORKSHOP
Monday, July 23, 2001
Marshall Space Flight Center

MORNING

Recommendations

0800	Discussion and Development of Recommendations	M. Jessup
1130	Telecon with NASA Headquarters	M. Jessup
1200	Adjourn	

AFTERNOON

1300	Tour of Payload Operations Center
1500	Tour Complete

SPACE STATION UTILIZATION ADVISORY SUBCOMMITTEE (SSUAS)
MEMBERSHIP LIST
January 2001

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SPACE STATION UTILIZATION ADVISORY SUBCOMMITTEE (SSUAS)
Huntsville, Alabama
July 23-25, 2001

MEETING ATTENDEES

Subcommittee Members:

Jessup, J.Milburn "Kim" (Chair)	University of Texas Health Science Center
Crouch, Roger (Ex-Officio)	NASA Headquarters
Israel, Martin	Washington University
Musgrave, Mary	University of Massachusetts
Oman, Charles	Massachusetts Institute of Technology
Stefanyshyn-Piper, Heide	NASA/JSC
Uhran, Mark (Executive Secretary)	NASA Headquarters
Yang, Joseph	

NASA Attendees:

Anderson, Sherwood	NASA/MSFC
Baccei, Lou	NASA/MRPU
Bartoe, John	NASA/JSC
Davis, Jan	NASA/MSFC
Henderson, Robin	NASA/MSFC
Holloway, Tom	NASA/JSC
Inman, Tom	NASA/MSFC
Larson, Dave	NASA/SUNY-SB
Maples, Layne	NASA/MSFC
Mullins, Todd	NASA/MSFC
Nall, Mark	NASA/MSFC/FD35
Norris, Joy	NASA/JSC/OZ2
Nygren, Rick	NASA/JSC/OZ
Park, Betsy	NASA/GSFC
Perrin, Tom	NASA/MSFC
Pitelo, Gerald	NASA
Ramage, William	NASA/MSFC
Robinson, Keith	NASA MSFC
Rof, Lesa	NASA/JSC/OZ
Sanchez, Julie	NASA/MSFC
Sander, Doug	NASA/JSC/OZ5
Sawin, Chuck	NASA/JSC
Schafer, Craig	NASA/JSC/SAIC Houston
Scheib, Jim	NASA/JSC/OZ2
Shortz, Donna	NASA/HQ
Simons, Steve	NASA/GRC
Underwood, Debrah	NASA/MSFC
Uri, John	NASA/JSC
Vlasse, Marcus	NASA/MSFC
Williams, Willie	NASA/Code M RPO

Other Attendees:

Beard, James	GAO
Brooks, Don	CSA/University of British Columbia
Felder, Fred	GAO
Fountain, Jim	Boeing
Gilchrist, John	GAO
Gimol, K. Heinz	CSA
Gruendel, Doug	Biometrics
LaValle, Lynn	GAO
Matsumiya, Hiroyuki	NASDA/SPARC
McCullar, Ron	CSA
O'Neill, John	USFA
Peters, G.	ESA
Yanagawa, Koji	NASDA/JSC Liason

SSUAS RECOMMENDATIONS
July 23-25, 2001

Chairman's Introduction:

The SSUAS applauds the performance of both the astronaut crew and the payload integration and support teams that have performed extremely well during Increments 1 and 2. The complexity, number of intricately timed launches and the connection of the various components have stirred the imagination of the country. The SSUAS is also very encouraged by the early return of research findings during what is predominantly a construction phase of the International Space Station (ISS). This research was often performed by crew during their own time and is very much appreciated by the SSUAS.

Initial indications based on data from Increment 2 are that the plan for controlling the microgravity environment of ISS is meeting design specifications. This establishes the ISS as a true microgravity laboratory.

Recommendations:

1) Science Prioritization
Finding: The SSUAS is alarmed by Code U's plans to curtail progress toward developing important facility-class hardware to support Fundamental Biology and Microgravity research on ISS. Large sectors of the traditional flight research community will be disenfranchised from using ISS if this research restructuring takes place. These disciplines include research areas crucial to providing the basic knowledge to support safe human habitation in space, such as combustion and fluids research, experiments with small animal models, and studies with large plants that could provide renewable food and life support functions.

Conclusion: At this time, Code U's research priorities seem to be driven by expediency rather than by the initial premise of creating a multidisciplinary laboratory in space to enable high quality research in the microgravity setting.

Recommendation: Code U should develop a long-term science plan that includes its advisory committee members, key Headquarters staff as well as appropriate external experts to develop a plan for prioritization of science on ISS. This long-term prioritization plan should be used to guide near-term decisions on resource allocations.

2) Use of Commercial and DARPA Resources
Finding: The SSUAS notes the recommendation from BPRAC that commercial and DARPA resources be used to fill in the current shortfalls in hardware development for ISS.

Conclusion: Commercial hardware may have utility in case-by-case applications, but the SSUAS cautions against blanket substitution of commercial hardware for the facilities-class hardware planned for ISS because the capabilities and functionality of commercial hardware has not been specified by the scientific user community.

Recommendation: Well-informed science advisory groups representing the user community for the facility-class hardware should be consulted prior to making any short-term plans for hardware substitution.

3) Budget Administration within Code U
Finding: NASA is planning to move the budget of the ISS research program from Code M to Code U, effective at the beginning of fiscal year 2002.

Conclusion: This move places the AA of Code U in the difficult position of allocating ISS research budget between internal Code U science and work that supports programs of other enterprises, including space science and earth science, as well as the international partners.

Recommendation: NASA should develop a process to ensure that appropriate scientific programmatic input from all affected parties is effectively weighed in deciding on the allocation of budget resources. SSUAS requests a report at the next meeting.

4) External Payloads
Finding: It is still uncertain whether Brazil will commit to delivering the EXPRESS pallets for external attached payloads. While previously it had been NASA's commitment to build EXPRESS pallets if Brazil could not do it, we learned at this meeting that NASA no longer has an alternative plan to provide such capability. The EXPRESS pallet was planned as being one of the principal mechanisms for attaching science instruments to external attach points. Indeed, the SAGE instrument has been configured specifically for an EXPRESS pallet. OSS has recognized the potential value of attached payloads by opening current MIDEX AO to accommodate ISS attached payloads.

Conclusion: If Brazil fails to deliver the EXPRESS pallets, that would seriously degrade the capability of ISS to do science at external attach points. In view of the near-term lack of a full seven-member crew and the consequent serious reduction of science inside the pressurized modules, it becomes all the more important to utilize external attach points, which support science with very limited crew involvement.

Recommendation: NASA should develop plans for effective and timely utilization of the external attach points as soon as they become available and report those plans to the next meeting of SSUAS.

5) Research Grants Management
Finding: The SSUAS notes that NASA has increased its focus on the NRA program through the efforts of Gen. Armstrong and Ms. Fortunat whose purpose in part is to focus on grants management. A good grants management program is an essential means to maintain support for investigators.

Conclusion: The SSUAS has previously expressed concern that the NASA grants program does not have clearly defined timelines and has not yet substantially improved contact with grants management offices in academic institutions and commercial enterprises.

Recommendation: NASA should improve its grants management service in: (a) stability and magnitude of funding; (b) firm commitment to timelines for funding and activation of grants; and (c) improving its relationship with academic and commercial grants management offices.

6) Persistent Funding Incursions
Finding: History has shown that the ISS research budget has been used to offset the cost of vehicle construction. The SSUAS applauds the decision of NASA to move the ISS research budget into the OBPR enterprise.

Conclusion: The SSUAS is still concerned that there are threats against the ISS research budget for facilities that are in the critical period of development. Some of the remaining facilities have had severe degradations in their utility due to reductions to their experiment-unique equipment.

Recommendation: SSUAS recommends that NASA fence the ISS research budget against further incursions.

7) Seven Crewmembers
Finding: The SSUAS finds that the current plans for three crewmembers for the foreseeable future is a major constraint for ISS research because essentially all of the scheduled time would be occupied by maintenance and operations.

Conclusion: Seven crewmembers are necessary at Assembly Complete for the performance of a productive research program.

Recommendation: The SSUAS recommends that NASA support the infrastructure necessary to support seven crewmembers after Assembly Complete. This support includes completion of the Advanced ECLSS, appropriate crew return vehicles, sufficient habitation accommodation, and a restoration of the full ISS research budget.

8) Financial Reserve

Finding: The SSUAS has observed with appreciation the remarkable progress achieved in getting the ISS ready for the initiation of research projects in space by the ISS program staff and the astronauts. We also found that a critical component, necessary to effect this remarkable progress, was management reserves sufficient to address contingencies expeditiously while remaining within the budget.

The current budget plan for ISS research, however, includes dangerously low reserve levels.

Conclusion: Experience within the SSUAS suggests that a budget reserve of 15-20% is prudent. This percentage estimate is supported by the past experience of the Payloads Office.

Recommendation: In order to complete this historical project, the ISS Program managers should secure and guard a stable funding plan. Specifically, a reserve of 15-20% for the research program must be maintained in the future years.

New Action Items:

1) Report on logs and their usage
2) Telecon with Principal Investigators
3) Report on the internal environment, including the microbiotic environment