National Aeronautics and Space Administration

NASA Advisory Council Task Force
on
International Space Station Operational Readiness

July 26, 2001
NASA Headquarters
Washington, DC

MEETING REPORT

Original signed by

Philip J. Cleary
Executive Secretary

Original signed by

Thomas P. Stafford
Chairman

NASA ADVISORY COUNCIL TASK FORCE ON INTERNATIONAL SPACE STATION OPERATIONAL READINESS

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MEETING REPORT

Mr. Philip Cleary, Executive Secretary of the NASA Advisory Council (NAC) Task Force on International Space Station Operational Readiness (IOR), welcomed the participants to the open meeting. He explained that this meeting was being held to review the results of the joint fact-finding sessions conducted by the NAC IOR (Stafford) Task Force and the Rosaviakosmos (Anfimov) Advisory Expert Council (TF-AEC) Joint Commission.

Task Force Chairman Lt. General Thomas P. Stafford, USAF (Ret.), added his greetings to the participants and stated that the TF-AEC had been tasked by NASA Administrator Daniel Goldin and Rosaviakosmos General Director Yuri Koptev to assess the safety and operational readiness of the Expedition 3 mission. General Stafford requested that Dan Heimerdinger, Ph.D., review the results of the meetings.

Dr. Heimerdinger stated that the Joint Commission agreed that: the ISS is safe and operationally ready to support the continued permanent presence of humans in space; the Expedition 3 crew is fully prepared to successfully perform their long-duration mission; and the American and Russian flight control teams (Mission Control Center-Houston/Mission Control Center-Moscow) are focused and ready to support the flight.

Background

The Joint Commission's assessment began by meeting with NASA's experts in the United States at the Johnson Space Center on June 12 – 14, 2001. The Joint Commission continued its deliberations in Russia from July 25 – 27, 2001, by meeting with experts from RSC-Energia, Khrunichev SRPC, GCTC, TsNIIMash, TsUP (MCC-M), and IBMP. In performing its assessment of the Expedition 3 mission, the Joint Commission received briefings on the following subjects:

- Space Station Remote Manipulator System (SSRMS)
- ISS Software
- ISS Laptop Computers
- Treadmill with Vibration Isolation System (TVIS)
- ISS Batteries
- ISS Atmosphere
- ISS Acoustic Conditions
- Crew Training
    - Crew Interviews
    - American and Russian Segment Trainers
- Crew Medical Support
- Mission Control Center Readiness
- ISS Launch Schedule for 2001

Dr. Heimerdinger reviewed the details of each of the subjects reviewed:

Space Station Remote Manipulator System (SSRMS)
Following the initial activation of the SSRMS, three significant issues were identified with the redundant string: 1) wrist roll resolver-to-digital converter built-in test failure (single occurrence); 2) Arm Control Unit brake voltage error during brake release; and, 3) Shoulder Pitch Joint Electronics Unit.

As a result, the STS-104 (7A) launch was delayed until July 12, 2001, and the Expedition 3 mission was delayed to the now planned launch date of August 9, 2001.

The cause of the SSRMS anomalies are currently under investigation. However, a successful software patch to allow the shoulder pitch problem to be overcome was implemented. The result was the successful installation of the ISS Airlock on July 15, 2001.

The Joint Commission will continue to follow this subject until there is an understanding of this issue.

ISS Software
The Integrated Flight Load certification is progressing satisfactorily. The testing time-line is adequate to support an August 9, 2001, launch date.

The TF-AEC Joint Commission concurs with the plan outlined in the April 2001 Joint Program Review protocol that states that the ISS program shall adopt a single ISS Integrated Local Area Network (LAN). Consistent with this, the Joint Commission recommends that this protocol statement be maintained and that the Ops LAN not be adversely impacted during the Expedition 3 flight by any planned network modifications.

The Joint Commission recognizes that an unlikely and previously unenvisioned series of events led to the Command & Control Multiplexer-Demultiplexer failure during Expedition 2. The Joint Commission recommends that the ISS Program Office take steps to determine the root cause for the hard disk failure to ensure that there is no similar recurrence.

ISS Laptop Computers
The ISS laptop units have had problems on-orbit with the failure of commercial off-the-shelf hardware and with operating system software interface compatibility. The Program Office is currently working this issue.

The Joint Commission recommends that the program implement more stringent acceptance testing of the hardware and software in its in-flight configuration prior to commitment to launch. Additionally, the Joint Commission would like to review the corrective action plan.

Treadmill with Vibration Isolation System (TVIS)
Concern was expressed about medical countermeasure subsystems, specifically the TVIS, for performing physical exercise. The TVIS is currently working in a passive (non-motorized) mode due to a failed motor; however, the medical community has approved this mode until it can be repaired. A replacement motor for the TVIS is manifested for STS-105 (7A.1) and is scheduled to be installed during Expedition 3.

The Joint Commission will continue to follow these issues.

ISS Batteries
At the time of this meeting, seven battery units (assemblies) in the Service Module (SM) and all six battery units in the Functional Cargo Block (FGB) were operating nominally. Since February 2001, two battery anomalies have occurred in the SM:

- One battery unit failed to hold a full charge. The failed unit was changed out with a spare unit from the FGB. On STS-105 (7A.1), the failed unit will be returned to the manufacturer for analysis.
- During battery recycling in May 2001, a battery unit experienced a similar failure to the problems experienced in 2000. Specifically, a manufacturing problem during the welding process caused the PTAB to fail. The replacement PTAB will be delivered by flight 7A.1.

All battery units in the FGB were changed out in September 2000, after manufacturing problems were identified and corrected. Since that time, all FGB batteries have performed nominally.

ISS Atmospheric Conditions
The Environmental Control and Life Support Systems (ECLSS) in the ISS are functioning satisfactorily. The Vozdukh is currently using two out of three absorption beds to adequately support the Expedition (three-person) crew.

The Carbon Dioxide Remove Assembly (CDRA) is currently operating using one out of two absorption beds to provide backup to the Vozdukh system. The CDRA, running in "single bed" configuration, is capable of handling the CO_2 load of a three-person crew.

Finally, the SM pressure sensors have randomly indicated a rapid depressurization. RSC-Energia reported that the on-orbit problem was found to be due to Electromagnetic Interference/Electromagnetic Compatibility problem with a cable. RSC-Energia is currently testing a new cable design. In the interim, SM software has been modified to use the MDD sensors instead of the DDI sensors while the corrective action is tested.

The Joint Commission will continue to monitor these issues.

ISS Acoustic Conditions

Acoustic levels experienced by the Expedition 2 crew are an area of concern, but are not a constraint to the launch of the Expedition 3 crew. Onboard acoustics measurements are being conducted on a regular basis to better define the acoustics environment.

As previously noted by the Joint Commission, modifications to improve acoustic levels will be ongoing and include: blankets on interior panels, special casings on equipment, shock absorbers for air conditioners, development of low noise fans, and design changes to the TVIS and Velo Ergometer.

Until acoustic levels within the ISS can be brought to acceptable values, the crew is provided with personal hearing protection devices. These modifications are considered important steps in controlling noise levels and thus protecting the crew from permanent hearing loss as well as the onset of fatigue.

The Joint Commission will continue to monitor the corrective action plan until all of the noise abatement modifications are installed and the resulting noise levels are understood.

Crew Training

The Joint Commission had the opportunity to meet with the Expedition 3 Commander, Frank Culbertson, and listen to his views on the upcoming mission, including his crew's training readiness. The deliberations also included a meeting with members of the STS-100 (6A) crew and members of the future Expedition crews, who shared their impressions of crew training and the ISS's readiness to support continued crew habitation.

The Joint Commission notes that the Expedition 3 crew is well trained. Commander Culbertson expressed confidence in his crew, Col. Vladimir Dezurov and Mr. Mikhail Turin, to successfully perform their mission. He also stated that his crew has received excellent training, saying that, "…everyone is working very hard and communicating well." The meeting between the Joint Commission and Commander Culbertson was informative and the responses to questions were candid.

- He noted that some efficiency can be gained in the crew training regimen and that the trainers have been responsive to suggestions by the crew.
- Time constraints on-orbit and the challenge his crew will face to accomplish the 54 experiments they have trained to perform is a concern.
- The integrated Ops LAN is working fairly well.

Two members of the STS-100 (6A) crew also met with the TF-AEC Joint Commission and shared the following impressions of their stay on the ISS and their training and flight experiences:

- The crewmembers were satisfied with the condition of the ISS.

- The air quality, humidity, and lighting were outstanding in all modules; ventilation was excellent; and the noise levels were acceptable (comparable to the Space Shuttle).
- The 6A crewmembers commented on how well the permanent and visiting crews worked together, emphasizing the benefit of pre-flight meetings in establishing how the integrated crew will work on-orbit.
- The crewmembers extolled the importance of on-orbit communications with the ground controllers to discuss real-time operations, such as the priority of accomplishing tasks. This extends to the American and Russian ground controllers communicating and jointly deciding upon and prioritizing on-orbit operations.
- They also discussed the expansion of the ISS and the possibility of the crew's time requirements exceeding the crew's time capabilities. Specifically, considerable time is required for repair and maintenance of the ISS. As more science experiments come onboard, the capabilities of a three-person crew will be exceeded. The ISS needs to preserve a six- to seven-person capability to accomplish its purpose as a world-class research facility.

In addition, the TF-AEC Joint Commission benefited from a meeting with members of future Expedition crews. The discussion focused on crew training and the goal of incorporating crew comments and lessons learned into the training template. During the meeting, the importance of concentrated training on critical tasks that pertain to emergency procedures was emphasized.

In summary, the Russian Crew Training Committee has certified the Expedition 3 crew (primary and backup) for flight on the Russian segment and Soyuz vehicle. The crew is currently at the Johnson Space Center completing their training and will be fully certified by their scheduled launch date of August 9, 2001.

The crew has trained for four EVAs during their mission and they have received certification to accomplish them in the Orlan suit. With regard to Progress and Soyuz vehicle dockings, the crew has performed over 200 simulations on the Teleoperated Rendezvous Unit (TORU), the manual docking system for the Progress and Soyuz vehicles, should a manual docking be required. TORU training will continue onboard ISS to maintain crew proficiency.

The flight trainers are doing a good job of training the flight crews and ground controllers. The delayed delivery of updated software loads is forcing the program to come up with workarounds to accomplish the required training. These workarounds include developing software patches on previous software loads, using different training facilities, and/or relying on a reduced number of certified flight controllers to accomplish training. The Joint Commission continues to stress the importance of the timely delivery of training hardware and software elements to ensure the effective training of flight crews.

General Stafford asked if the software workarounds were due to late delivery and if so, were the delivery delays the fault of the Russians or the U.S. side. Dr. Heimerdinger explained that both sides caused the delays.

Mission Control Center Readiness

The Joint Commission believes that the Russian and American flight control teams are fully prepared to perform the Expedition 3 mission. Flight procedures for the Expedition 3 mission are in place and have been thoroughly exercised. Both Mission Control Center facilities are in excellent working condition and fully staffed with certified controllers.

The Joint Commission observed the need for additional improvement in coordination/communication between the two teams to increase the safety and efficiency of the joint operations. This is particularly true in flight planning, where philosophical differences exist between the two teams.

The lead center handover from MCC–Moscow to MCC–Houston is pending. The Joint Commission advocates the continued discussion between the flight controllers from both countries in arriving at a plan that ensures the safe and transparent (to the crew) handover of command and control. After the lead function is transferred from MCC-Moscow to MCC-Houston, the role and responsibilities of the Moscow Support Group at MCC-Houston will become even more significant. The Joint Commission will continue to monitor this issue until its resolution.

Dr. Heimerdinger requested that Craig Fischer, M.D., review the crew medical support issues that were discussed during the joint assessments.

Crew Medical Support

The U.S. and Russian sides presented the following issues and recommendations associated with the ISS crew medical support:

- The flight crew of Expedition 3 is medically certified for flight. The medical team and systems are ready to support the mission.

- NASA and Rosaviakosmos specialists have established a weekly telecon of the Joint Medical Mission Management Team (MMMT) to resolve policy and practical implementation issues consistent with the agreed upon requirements for ISS medical support (ISS MORD). Progress is being made in resolving open issues.

- Spacecraft habitability, monitoring, and environmental control (toxicology, microbiology, noise, etc.) received special attention. Agreement has been reached on the process of ground preparation of cargo and in-flight sanitary and hygienic treatment in order to minimize spacecraft and atmosphere contamination.

- The medical teams from both sides addressed the medical infrastructure (personnel, resources, etc.) to support MCC-M and MCC-H as well as pre- and post-flight mission operations. Requirements and operations management have been reexamined and adjusted in order to maintain high quality medical support.

- Before returning to Earth, crewmembers that are completing a long-duration mission must regularly perform the appropriate countermeasures designed to maintain health and physical fitness.

The Joint Commission will continue to monitor the Crew Medical Support issues.

Ronald Merrell, M.D., asked if the crew is able to perform the recommended amount of countermeasures for crew health in zero gravity. Dr. Fischer explained that the crew maintains a good schedule, but the TVIS is currently only available in the passive mode. Medical teams on both sides agree that the passive mode is adequate to maintain crew health and they have been getting their exercise as prescribed. Dr. Merrell asked if the recommended acoustic level is exceeded by the TVIS in passive mode. Dr. Fischer said it is still noisy, however ear defenders are being worn by the crew while TVIS is being used. Dr. Fischer stated that he did not have the data on the active versus passive mode dB levels for TVIS.

Dr. Merrell asked if the crew was experiencing any communications problems due to the ear protection devices. Dr. Fischer stated that there have been no communication problems reported among the crew and they have had no problems hearing the cautionary tones. He added that they do not wear the ear protectors at all times. Now that the ISS has expanded, there are some quieter modules where they can work without ear protection.

Dr. Merrell asked if the crew had any reports regarding decompression sickness. Dr. Fischer said that the three EVAs went without incident. Dr. Merrell asked what percentage of communication blackouts the ISS experiences. Dr. Heimerdinger stated that the TDRSS constellation and ground-stations provides a very high coverage of 65-75 percent per orbit.

In response to Dr. Merrell's question about the crew's general health, Dr. Fischer stated that there have been no medical issues at all.

<u>Conclusion</u>

Dr. Heimerdinger summarized the Joint Commission findings, noting that:

- The briefings provided to the Task Force Working Group on the ISS and crew preparations were comprehensive and complete. In response to questions submitted by the Working Group, open and candid discussions were achieved.

- The activities and issues that exist today are being effectively managed and the Working Group is confident that they will be satisfactorily addressed before Expedition 3's scheduled launch date of August 9, 2001.

He reiterated the Task Force Working Group's assessment that the Expedition 3 crew will be fully prepared to successfully perform their mission and the ISS will be ready to accommodate its newest crew by the scheduled launch date of August 9, 2001. Dr. Heimerdinger asked if there were any objections to the Working Group's findings. Hearing no objections, Dr. Heimerdinger thanked the participants and stated that the Working Group would contact NASA and the Task Force immediately should any concerns about the Expedition Crew 3 and its mission arise.

The meeting concluded at 12:30p.m. EDT.

Attachment A

NASA Advisory Council
Task Force on International Space Station Operational Readiness
July 26, 2001
NASA Headquarters
Washington, DC

Task Force Membership

Chairman

Lt. Gen. Thomas Stafford, USAF (Ret.)

Members

Col. James Adamson, U.S. Army (Ret.)
Mr. Percy Baynes
Mr. Benjamin Cosgrove
Mr. Joseph Cuzzupoli
Dr. Charles Daniel
Dr. Craig Fischer
Dr. Michael Greenfield
Mr. J. Milt Heflin
Dr. Daniel Heimerdinger
Maj. Gen. Ralph Jacobson, USAF (Ret.)
Cdr. Michael Lopez-Alegria, USN
Dr. Ronald Merrell
Mr. David Mobley
Dr. Arnauld Nicogossian
Dr. Shawn Rahmani
Captain John Young, USN (Ret.)

Technical Advisors

Maj. Gen. Joe Engle, USAF (Ret.)
Mr. Mark Thiessen

Executive Secretary

Mr. Philip Cleary

Asst. Executive Secretary

Ms. Holly Stevens

Attachment B

NASA ADVISORY COUNCIL TASK FORCE ON INTERNATIONAL SPACE STATION OPERATIONAL READINESS

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Meeting Attendees

Stafford Task Force Representatives
Chairman, Lt. Gen. Tom Stafford, USAF (Ret.), via teleconference
Mr. Percy Baynes – via teleconference
Mr. Joe Cuzzupoli – via teleconference
Dr. Charles Daniel – via teleconference
Dr. Craig Fischer – via teleconference
Mr. J. Milt Heflin - via teleconference
Dr. Daniel Heimerdinger – via teleconference
Dr. Ronald Merrell – via teleconference
Mr. David Mobley – via teleconference
Dr. Arnauld Nicogossian – via teleconference
Dr. Shawn Rahmani – via teleconference

Stafford Task Force Technical Advisors
Maj. Gen. Joe Engle, USAF (Ret.) – via teleconference
Mr. Mark Thiessen – via teleconference

Task Force Executive Secretary
Mr. Philip Cleary – via teleconference

Task Force Asst. Executive Secretary
Ms. Holly Stevens – via teleconference

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Susan Burch, Code Q
David Lengyel, Code Q
Jennifer McCarter, Code IH