National Aeronautics and Space Administration

NASA Advisory Council Task Force
on
International Space Station Operational Readiness

August 4, 1999
NASA Headquarters
Washington, DC

MEETING REPORT

Original signed by
Philip Cleary
Executive Secretary

Original signed by
Thomas P. Stafford
Chairman

NASA ADVISORY COUNCIL TASK FORCE ON INTERNATIONAL SPACE STATION OPERATIONAL READINESS

August 4, 1999
NASA Headquarters
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Meeting Report

Assembly and Identification of Participants

Mr. Philip Cleary, Task Force (TF) Executive Secretary, welcomed everyone to the Open Meeting and identified the participants who attended the meeting in person or via teleconference.

Opening Remarks

Lt. General Thomas P. Stafford, USAF (Ret.), Chairman of the TF, expressed his appreciation to those participating in the meeting. He stated that the purpose of the meeting is to prepare for the plenary meetings that will take place August 18 –27, 1999, in Moscow, Russia, with members of the Russian Advisory Expert Council (AEC) and to discuss the TF/AEC Joint Final Report on the ISS Phase 1 Program.

Micrometeoroid Orbital Debris (MMOD) Detection and Protection

Major General Joe Engle, USAF (Ret.), Technical Advisor to the TF, expressed his desire that the TF, in conjunction with the AEC, work to resolve issues associated with MMOD modeling and come to an agreement during the upcoming TF/AEC meetings in Moscow. He then introduced Mr. Nick Johnson, Chief Scientist and Program Manager for the Orbital Debris Program Office, who gave a detailed summary of the Orbital Debris Engineering Model (ORDEM96).

Mr. Johnson explained that ORDEM96 has been accepted by the ISS Program and other non-NASA programs. It is acknowledged as the best understanding of the orbital debris environment.

ORDEM96:

- It is a semi-empirical engineering model, heavily based on radar observations (debris > 1 mm) and *in situ* data (debris < 1 mm).
- It supports NASA, U.S. government, and commercial orbital debris risk assessments.
- It was accepted by the ISS Program as the official orbital debris environment definition and was embedded in the BUMPER II risk assessment model.
- It has been internationally peer-reviewed prior to adoption and was later reviewed by two National Research Council committees.
- Its foundation data was recently reviewed by the Inter-Agency Space Debris Coordination Committee (IADC) and was accepted for the report on orbital debris by the United Nations Committee on the Peaceful Uses of Outer Space.
- For the ISS orbit, observed orbital debris flux is divided into approximately equal

populations:
  - Nearly circular orbit: derived from terrestrial radar observations
  - Elliptical orbit: derived from *in situ* measurements, especially Long Duration Exposure Facility (LDEF)
- It closely matches data from both populations.
- The SM augmentation shield affords protection from both the circular and orbital flux and the majority of the elliptical orbital flux.

General Stafford asked if the Russians agree with the model. Mr. Johnson explained that the Russians have repeatedly reviewed the data, have accepted it, and do not disagree with any individual parts of it.

General Stafford stated that the Russians say that the Mir has never been hit by orbital debris of significance. Mr. Johnson agreed with the Russian's assertion and said that the issue is the confidence in the reliability number. Although both the Russian and U.S. assessments agree that the Mir has a 50% chance of on-orbit penetration to date, the ISS does not allow for a 50% quality answer. In order to have greater confidence, greater shielding of the ISS is necessary.

Major General Ralph Jacobson, USAF (Ret.), asked for a brief description of the data that is received from the Haystack and the Goldstone radar systems. Mr. Johnson explained that an S-band and KU-band beam is used to detect individual particles. As the particles are detected, range, altitude, inclination and size are recorded. He added that this method has been evaluated by a number of blue-ribbon panels and has received exemplary evaluations. The Orbital Debris Program Office is confident in its data and notes that the information is the same year after year. Solar activity is embedded in the model and the Program Office states that they are getting exactly what was expected.

Mr. Joe Cuzzupoli questioned why there is an ongoing discussion with the Russians on shielding requirements for the SM when they agree with the model. Mr. Johnson explained that the Russians do not have any ground or space-based systems that can evaluate the environment at the U.S. model's particle level, so there are questions from the higher-ranking Russian engineers as to the accuracy.

General Stafford pointed out that the statistics on the charts (see Attachment C) appear very convincing. Mr. Johnson said that the Russians agree with the model and are very familiar with it. However, though they agreed to shielding on the SM, they are having second thoughts. Dr. Daniel Heimerdinger stated that he discussed this issue with Dr. Yuri Grigoriev of RSC-Energia. Dr. Grigoriev wanted to know the impact of putting the error in the model. General Engle stated that this reinforces the idea that perhaps it is more of a communications rather than a technical issue.

Mr. Johnson said that the targeted Probability for No Penetration (PNP) for ISS is 0.9. In order to achieve 0.9 PNP for the ISS, SM shielding is necessary. He again stated that the model is highly data-based and has been determined by the international community to be the very best one available.

Dr. Chuck Daniel asked if the requirement would be met when the shielding is installed. Mr. Johnson replied in the affirmative, adding that there will still be a risk with the shielding, but the risk is mitigated.

General Jacobson asked if there is a procedure in place for patching holes in the event of penetration. Mr. Johnson stated that Marshall Space Flight Center (MSFC) has developed a system called Kit for External Repair of Module Impacts (KERMIt), which will allow holes as large as four centimeters to be patched. Dr. Daniel added that this is considered a temporary fix and there is still some question as to a permanent fix in order to reestablish a 10-year life on the modules. Dr. Daniel said that he would distribute documentation to the TF members regarding the milestones for the KERMIt project and would also check with Russian counterparts regarding their progress.

Colonel James Adamson, U.S. Army (Ret.), stated that the shielding creates a great deal of drag, which then requires additional fuel for reboost. He asked if other shielding designs and materials have been reviewed which would be equally as effective, but would create less drag. Dr. Daniel explained that the material is a kevlar fiber, and he believes we agreed to supply the Russians with the kevlar technology for that purpose.

While discussing the design of the shielding, Dr. Daniel expressed some concern about the SM shielding attach points. He suggested that since the SM is already at Baikonur, the attach points should be assessed for crew-friendliness during EVA. General Engle said that he would follow up on that issue as well as the modeling and effects of the drag on the ISS due to shielding.

Proton Launch Investigation

Mr. Cleary stated that Russian Aviation and Space Agency Director, Mr. Yuri Koptev, and NASA Administrator, Mr. Daniel Goldin, have requested that the TF/AEC assess the completed Russian investigation of the Proton rocket launch failure. They requested that the TF/AEC focus on the corrective actions and the safety process to be used prior to and during the launch of the SM. This will be discussed with the AEC during the upcoming Moscow joint meetings. Additionally, General Stafford appointed several members of the TF to serve on a Working Group that will likely travel to Moscow again in the September timeframe to review this issue with the AEC. Mr. Cleary told the TF that he would distribute copies of the translated Russian report on the Proton launch failure later in the week.

Treadmill (TVIS)

General Engle reviewed the progress on the Treadmill with the Vibration Isolation System (TVIS), which is required for use on the ISS. He explained that there has been a two-year delay with the design and development process, but the hardware has now been completed and has undergone thorough U.S. and Russian testing and evaluation. The hardware performed well, but the noise level is still above requirement limits. Corrective actions are being sought to dampen the acoustic level.

Additionally, the Russians brought up questions about higher metabolic rates using TVIS, as well as a problem with the TVIS handrail clearance. The handrail currently interferes with the

location of the tabletop (in the SM) when the tabletop is folded down. One other issue is the question of whether the treadmill can be used in the event of a power failure. The isolation device requires power to operate although the treadmill itself can still be used in the power-off mode. General Engle said that the TF will get a thorough briefing from the Russian Institute of Biomedical Problems (IBMP) on these issues during the joint meetings in Moscow and during follow up meetings with the AEC planned for October 1999.

General Stafford asked if the November SM launch date could still be met, considering the issues related to TVIS. General Engle said that the TVIS flight unit is at KSC and the launch date will be met, but because of the higher metabolic rate, there is some question as to whether it will keep the crew sufficiently conditioned from the skeletal/muscle considerations. Dr. Andrew Thomas added that there will be a resistive exercise device onboard as well.

Dr. Michael Greenfield suggested that reading material on the issues to be discussed in Moscow be provided prior to the trip. General Engle said that he will distribute material on the topics that will be covered once he has finalized the agenda with the AEC.

EVA Procedures and Training Status

General Engle said that the EVA procedures and training status for 2A.2 and the Science Power Platform (SPP) installation mission will be covered in depth by representatives from the Gagarin Cosmonaut Training Center (GCTC) during the August trip to Moscow.

Contingency Crew Readiness

General Engle stated that the decision has been made to have a dedicated Russian crew for the contingency mission. If the SM is unable to automatically dock with the FGB, a crew of two Russians would be launched along with a Tele-operated Robotic Unit (TORU). They would rendezvous with the SM, ingress, and manually fly the FGB to dock with the SM. Dr. Thomas said that the contingency crew is training for some of the ISS Expedition 1 crew tasks and that this has become a sensitive issue. The contingency crew would then do some of the work that the ISS Expedition 1 crew would have done. Dr. Thomas stated that if the first crew has an extended stay, it becomes a politically charged issue. He speculated that even if the SM docks successfully, there may be delays in the lab; therefore, the SM could require a contingency crew to keep operations nominal due to delays in the NASA program. The Russians have also trained a back up contingency crew. Dr. Thomas stated that he believes it is important that the contingency crews receive the training, but added that NASA does not have insight into the details of the contingency crew's training.

Y2K compliance

Mr. Mark Thiessen, TF Technical Advisor, said that there has not been any significant changes in the Russian Y2K status since the TF reviewed it during the TF's Open Meeting in May of 1999. The Russians are expected to be compliant by September of this year.

SM Status

Mr. Thiessen reviewed the status of the SM, stating that it is currently at Baikonur and is on schedule for the November launch. Dr. Grigoriev will give the TF a detailed status during the August meetings in Moscow. He added that, according to NASA representatives in Moscow, the testing and verification is on schedule.

Mission Control Center-Moscow (MCC-M)

Mr. Thiessen stated that there are still some issues related to the software that will be used to communicate with the SM – primarily funding issues. Dr. Grigoriev will give the TF a full briefing on those issues during the August meetings.

Dr. Greenfield asked if there was a communication link that was lost last week with the Mir due to a Russian ground station problem. Mr. Milt Heflin said that there was a loss of the motion control system and the Russians contacted NASA in order to request U.S. ground system assistance with rebuilding their motion control.

Off Nominal Situations and Science and Experiment Verification for ISS

Discussion of both of these items came at the behest of Academician Vladimir Utkin, Chairman of the AEC. The TF will receive briefings from Russian experts on these two items during the August meetings in Moscow.

SFOG

General Engle reviewed the Solid Fuel Oxygen Generator (SFOG) situation as it relates to modification. This is the system that caught fire in 1997. Dr. Grigoriev has volunteered to provide us with a complete briefing on their proposed modifications. RSC-Energia engineers believe that the basic design is a good one and have not made any changes to it. They are going to reevaluate the propellant. One suggested corrective action would be to have some kind of blanket or shield that would cover the SFOG unit should a fire take place.

Software Test and Verification

Mr. Thiessen stated that software is going to continue to be an issue for the ISS. There is now an integrated software schedule.

Joint Report

Mr. Cleary reviewed the status of the ISS Phase 1 Joint Final Report. The first revision from the NASA Printing and Graphics Office is being reviewed. Additionally, based on his side-by-side review of the findings and recommendations made in the TF Final Report versus the Joint Final Report, he found no new findings or recommendations. Therefore, the open meeting chaired by Dr. Greenfield on January 28, 1999, meets the FACA requirement to deliberate in a public forum.

The ISS Phase I Joint Final Report will be ready for signature by Academician Utkin and General Stafford at the signing ceremony scheduled to take place in August.

Final Remarks

There were no additional questions or comments. Mr. Cleary concluded the meeting at 4:18pm (EST).

Attachment A

NASA Advisory Council
Task Force on International Space Station Operational Readiness

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Washington, D.C.

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. John Fabian
Dr. Craig Fischer
Dr. Michael Greenfield
Mr. J. Milt Heflin
Dr. Daniel Heimerdinger
Maj. Gen. Ralph Jacobson, USAF (Ret.)
Dr. Ronald Merrell
Mr. David Mobley
Dr. Shawn Rahmani
Dr. Andrew Thomas
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
Lt. Gen. Thomas Stafford, USAF (Ret.) - via teleconference
Col. James Adamson, U.S. Army (Ret.) - via teleconference
Mr. Joseph Cuzzupoli - via teleconference
Dr. Chuck Daniel - via teleconference
Dr. John Fabian - via teleconference
Dr. Craig Fischer - via teleconference
Dr. Michael Greenfield
Mr. J. Milt Heflin - via teleconference
Dr. Daniel Heimerdinger - via teleconference
Mr. David Mobley – via teleconference
Dr. Ronald Merrell - via teleconference
Dr. Shawn Rahmani – via teleconference
Dr. Andrew Thomas – via teleconference
Capt. John Young, USN (Ret.) – 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

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

NASA HQ
Ms. Susan Minor, Office of the Inspector General
Mr. Brett Davis, Huntsville Times