National Aeronautics and Space Administration

NASA Advisory Council Task Force
on
International Space Station Operational Readiness

January 12, 2000
Johnson Space Center
Houston, Texas

MEETING REPORT

Original Signed By:

Philip J. Cleary
Executive Secretary

Original Signed By:

Thomas P. Stafford
Chairman

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Johnson Space Center
Houston, TX

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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

Mr. Cleary stated that the purpose of the meeting is to review the results of the Joint Task Force/ Advisory Expert Council (AEC) meetings that took place October 13-22, 1999. During that week, fact-finding meetings were held at the Johnson Space Center (JSC) in Houston, Texas; two Boeing facilities and the Dryden Flight Research Center in California; and at the Kennedy Space Center (KSC) in Florida. Additionally, the Task Force's ISS Software Working Group (SWG), chaired by Dr. Daniel Heimerdinger, presented their findings to date.

Major General Joe Engle, USAF (Ret.), Technical Advisor to the TF, stated that as a result of the meetings held in October, the TF-AEC Joint Commission agreed to take the following actions that were reflected in the protocol signed by TF Chairman Thomas Stafford and AEC Chairman Vladimir Utkin.

October 1999 Joint Task Force-Advisory Expert Council Protocol

ISS Air Quality

Background:
During a crew debriefing after the 2A.1 mission, some crewmembers reported there might be a problem with the ISS air quality. Two crewmembers experienced flushing, headaches, and lightheadedness after working behind the Functional Cargo Block (FGB) panels for several hours. No ambient air samples were taken at the time and the problem was reported post mission.

General Engle stated that a full understanding of the air quality issue on flight 2A.1 is unlikely since no samples were taken in the FGB during the timeframe when some crewmembers experienced ill effects. During the October meetings, the TF-AEC determined that during future missions, the activation of the FGB portable fans should be delayed until samples are taken.

After the fact-finding meeting, Dr. Craig Fischer met with Jim Van Laak to discuss procedures for taking air samples. They agree that a satisfactory procedure would be to have the crew take air samples as soon as the hatch is opened and also periodically throughout the mission. Additionally, if panels are opened, grab samples should be taken prior to anyone entering the area and before the panels are closed.

Mr. Joe Cuzzupoli asked if the Russians work to an outgassing requirement and whether it is similar to the U.S. outgassing requirement. General Engle stated that the Russians have an

outgassing requirement similar to ours, but some of the numbers are slightly different. Mr. David Mobley asked if the Russians do any outgassing testing prior to launch and, if so, do they close up the module and then take the samples. General Engle said that he understands that they will do testing and take samples prior to launch. Mr. Mobley stressed that he believes it is very important to close the vehicle for several days and perform the test at operating temperature.

ISS Acoustics

The current acoustic level in the Service Module (SM) is 71 – 74 decibels (dB) with a target of 65 dB. There is a program in place to put blankets on the SM fans and to improve the ducting. The TF will continue to monitor these efforts to mitigate acoustics in the SM.

Dr. Craig Fischer had recommended that the acoustics be no greater than 65 dBs during normal operation and 55 dBs during the sleep periods. General Engle said that during sleep periods, they plan to power down equipment in order to reach the desired sleep period level of 55 dB.

Mr. Benjamin Cosgrove asked if the SM acoustics are being tested on the ground. Mr. Mark Thiessen, TF Technical Advisor, stated that the Russians have a mock up to trouble shoot anomalies, but not to test acoustics. General Engle suggested that the acoustics may be different once the SM is on-orbit and stated that some of the acoustic problems are related to the Treadmill with Vibration Isolation System (TVIS). When the TVIS is not in operation, the noise level is greatly abated, but the TVIS will be in use during most of the crew's waking hours.

TVIS

The first TVIS was delivered to the Russian Institute for Biomedical Problems (IBMP) in October 1999, but there has not been any feedback on their evaluations. The second TVIS is currently being shipped to the Gagarin Cosmonaut Training Center (GCTC). As previously stated by General Engle, the TVIS acoustics remain a concern. However, the TVIS acoustics were tested while in the lab and out in the open rather than in the SM "pit", where it will be installed and used while on orbit. General Engle explained that once the TVIS is operational in the SM, the acoustics might test at a lower level. There are no plans to reopen the SM and test the TVIS while the SM is on the ground, as the TVIS is not launched in the SM, but taken up later in the Space Shuttle.

SM Micro-Meteoroid Orbital Debris (MMOD) Shielding

General Engle stated that the Russians agree that there is a need for augmented MMOD shielding for the SM. They have arrived at a design solution that will increase the shielding but not impact any Extra Vehicular Activity (EVA) paths. Prior to additional analyses, there was some concern that the shielding could effect the EVA paths, but General Engle explained that the shielding panels will be in the proximity of the solar panel joints – an area that is off limits for an EVA path. The Program Office is considering an early deployment of these shields in late-2000 (Flight 7A.1) versus mid-2002 (Flight 1J/A).

Dr. Heimerdinger stated that there had also been some concern about additional drag on the ISS due to the shielding. During the fact-finding meetings he requested additional analyses on the amount of propellant to be used should the shielding necessitate a reboost. In light of the additional analyses, it has been determined that the drag is negligible and there would be minimal

impact on logistics. Dr. Heimerdinger explained that the amount of propellant would be small and, due to the angle of the solar arrays relative to the flight path, there is no significant change in the ballistic coefficient.

Mr. Joe Cuzzupoli asked if provisions are in place to attach the shields to the SM. General Engle said that the fittings are currently installed. He added that the concern has moved from total protection to a focus on isolation of a penetration and emergency plans in the event of a penetration.

Crew Training

General Engle stated that during the October fact-finding meetings, General Yuri Glazkov gave a presentation on concerns related to the contingency crew's mission readiness. Due to the launch schedule slip, he stated that those concerns have been mitigated.

Other crew training concerns are: the fidelity of the simulators in Russia; the inability to adequately schedule training and training personnel time off due to the lack of a firm launch date; and some software related issues. *(Crew Training software issues are covered by Dr. Heimerdinger during his presentation on the Software Working Group's activities).* General Engle said that the Task Force will continue to monitor all these issues.

Proton Launch Failure Update

Background:
At the time the attached protocol was written, only the July 1999 Proton failure had occurred. The TF is currently awaiting the October 27, 1999, Proton Launch Failure assessment from Academician Utkin's review team.

The Task Force's Working Group on the Proton Launch Failures will travel to Moscow in late February 2000 to receive detailed briefings on the assessment results of the most recent failure. Joint meetings will be held with the AEC to review the Russian's findings on the probable causes and evaluate the procedures to prevent a Proton failure during the launch of the SM.

Mr. Cosgrove asked if the Russians have any Proton launches scheduled prior to the current SM launch date. General Engle said that at this time the Russians are planning to launch an ILS payload in February, followed by a military launch. These launches will take place with no modifications to the current configuration.

SM Status

Testing of the SM has been completed. Due to the delayed launch schedule, follow up testing is now taking place.

Y2K

There were no reported Y2K incidents related to the TsUP, vehicles, or during subsequent testing.

Software Working Group (SWG) - ISS Software Status
Background:

In September of 1999, Daniel Heimerdinger, Ph.D., was tasked by General Stafford to chair the Task Force's ISS Software Working Group. This group evaluated the ISS software development, test, verification and validation process as it relates to the safety and operational readiness of the ISS.

Dr. Heimerdinger explained that the SWG has participated in a series of meetings in Moscow, Kennedy Space Center, Johnson Space Center, and two Boeing facilities in California -- essentially touring most of the ISS software facilities in Moscow and the United States.

Crew Training Software Issues

The SWG determined that the program has made great progress on the training product for the onboard computer. The trainers understand the anomalies in the software and are making sure that the astronauts are being trained to recognize the output they should be getting. The Program Office has been working diligently to correct the anomalies. Problem Reports have been submitted and are being addressed.

SM

Dr. Heimerdinger explained that the team assessed the development of the four box test and is confident that the 5A software is being adequately tested. The SWG is pleased with the attention that the Program Office has given to the development of: an avionics software integration lab (ASIL); an independent assessment process; a series of comprehensive hardware and software matrices; and an ongoing risk assessment based on probabilistic risk assessment (PRA) and fault tree analysis.

Additionally, the SWG has been tracking issues related to command/control and has determined that progress is being made with the launching of an additional satellite into the Altair constellation. The SWG will continue to monitor the progress of the development of hardware and software modifications to ground stations and Moscow Mission Control (MMC).

Questions and Answers on the Software Assessments

Mr. Cosgrove asked when the integrated lab would be operational. Dr. Chuck Daniel said that part of it is operating now and that they will continually add to the lab's capability. He stated that Bill Panter's organization will make a presentation to the Program Office showing a strategic plan, including budget and scheduling. That presentation is expected to be ready in March 2000.

Dr. Shawn Rahmani asked for a status report on the fidelity of the simulation system used for ASIL. Dr. Daniel stated that the fidelity of the simulations is the same as simulations being used for flight qualification testing (FQT).

Dr. Rahmani also asked what key features of the lab are above and beyond what currently exists. Dr. Daniel said it was the fact that they will have hardware. Today they use simulators and eventually they plan to grow this to an emulator and then to flight equivalent hardware.

Dr. Rahmani asked how this compares to the Multi-Element Integrated Test (MEIT) facility at KSC. Dr. Daniel said that MEIT is specifically an interface check on the vehicles that are going to fly. This facility would enable code validation and sustaining engineering on orbit. Final flight software certification will rely on the completion of tests at this facility. He added that today they have Russian computers, flight code and simulators in their test environment. At the current time they do not have the electrical simulator, which is in Russia. All of their processors in the ISS will

be in this environment as well as many of the firmware controllers that exist in the ISS.

Dr. Rahmani asked if there are any plans to tie this lab to the ground systems for any type of testing. Dr. Daniel responded that as part of the normal certification process, there is an interactive test component between Mission Control Center in Houston (MCC-H) and the Software Development and Integration Laboratory (SDIL) facility at JSC. It will be tied to the Mission Evaluation Room (MER), the sustaining engineering analysis activity, so that anomalies can be investigated.

Col. Jim Adamson, U.S. Army, (Ret.) said that when the TF began its evaluation of these issues, the concern was the software's ability to support the schedule and crew training. He asked if there is any process in place regarding future reconfiguration scheduling. Dr. Daniel replied that he believes the objective of ASIL is to increase the fidelity in the confidence of the software operability, not to increase the speed in which the software can be reconfigured. He recommended that the SWG ask the Program Office about that issue.

Mr. Joe Cuzzupoli interjected his belief that the Program Office needs to pay a great deal of attention to configuration control issues. Dr. Heimerdinger said that the SWG had received detailed briefings on the overall management process, including configuration management.

Ms. Susan Minor asked who did the independent assessment. *That information was not readily available during the meeting, but was subsequently determined to be Averstar, Inc.* Ms. Minor said that NPD 2820.1 covers NASA Software Policy and states that software must be ISO 9000 compliant or have an independent assessment software rating of 3.0 or above. She asked if the ISS software is moving toward that level. Dr. Heimerdinger responded that they are moving in that direction, but he does not know what level they are at now. Mr. Percy Baynes added that the SWG had a briefing on the overall process, but the group has not assessed it to the Software Engineering Institute - Capability Maturity Model (SEI-CMM) level.

Dr. Rahmani stated that one of the main concerns is the criterion for software flight readiness, including software verification. He asked if there is a specific resolution to that. Dr. Heimerdinger explained that one of the processes being developed by the Program Office involves the assessment of risk that is being developed by Futron Corporation. Dr. Heimerdinger expressed an interest in the SWG tracking the progress of that program currently led by Bryan O'Connor.

Dr. Heimerdinger concurred with Dr. Rahmani's comments and reiterated that the SWG will continue to work with the Program Office to see that the software is verified and that the criterion for flight readiness is based on a comprehensive risk assessment. He added that Mr. Panter and the Program Office should be commended for taking the first step in getting a handle on this process. The four areas –the avionics software integration lab, the independent assessment process, the development of the hardware/software negation matrices and the ongoing risk assessment - will continue to be monitored, but the SWG is pleased that these activities are well underway.

Mr. Cleary thanked Dr. Heimerdinger and the other members of the SWG for their assistance and stated that a letter will go to General Stafford reflecting the scope of their work and findings.

The meeting concluded at 11:55 a.m. Central Standard Time.

Attachment A

NASA Advisory Council
Task Force on International Space Station Operational Readiness

January 12, 2000
Johnson Space Center
Houston, TX

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

January 12, 2000
Johnson Space Center
Houston, TX

Meeting Attendees

Stafford Task Force Representatives
Col. James Adamson, U.S. Army (Ret.)
Mr. Percy Baynes
Mr. Benjamin Cosgrove – via teleconference
Mr. Joseph Cuzzupoli
Dr. Chuck Daniel
Mr. J. Milt Heflin - via teleconference
Dr. Daniel Heimerdinger
Mr. David Mobley
Dr. Shawn Rahmani – via teleconference

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

Task Force Executive Secretary
Mr. Philip Cleary

Task Force Asst. Executive Secretary
Ms. Holly Stevens

NASA HQ
Ms. Susan Minor, Office of the Inspector General

NASA JSC
Mr. Dennis Coldren, Office of the Inspector General
Mr. Bruce Luna, ISS Program Office