

**Open Meeting of the**  
**NASA ADVISORY COUNCIL**  
**TASK FORCE ON THE SHUTTLE-MIR RENDEZVOUS AND DOCKING MISSIONS**

**Lyndon B. Johnson Space Center**  
**Houston, Texas**

**January 14, 1998**

**SUMMARY**

The NASA Advisory Council's Task Force on the Shuttle-Mir Rendezvous and Docking Missions met from 1:00 p.m. until 3:00 p.m. Central Standard Time in Room 920L at NASA's Lyndon B. Johnson Space Center in Houston, Texas. Attachment A contains the agenda. Attachment B lists the Task Force Members, NASA employees, and members of the public who attended the meeting in person or via teleconference. Attachment C lists the members of the Task Force Red Team. The presentation material is on file and available from the Executive Secretary upon request.

**Introductory Remarks**

Lieutenant General Thomas P. Stafford (USAF, Ret.) opened the meeting by greeting the Task Force members and other meeting participants. General Stafford explained that this is a significant meeting as it is the last safety assessment the Task Force will conduct for a Shuttle flight carrying a U.S. astronaut to Mir for a long duration stay. The Shuttle-Mir program will conclude when Andy Thomas returns from Mir on STS-91 in May 1998.

General Stafford said that for the STS-86 assessment, the Task Force Red Team conducted detailed analyses on: the status of the Mir systems; the level and type of redundancy in the Mir systems; the cause of the on-board fire; and the cause of the collision with the Progress resupply vehicle. As a result of this assessment, the Task Force recommended to the NASA Administrator that NASA go forward with the launch of STS-86 and the long duration stay of Dave Wolf. The Mir has been in a stable, productive condition since the Task Force conducted its safety assessment for STS-86, which has allowed Dave Wolf to focus on his science experiments. Given the stable condition of Mir, the Task Force has not conducted the kind of detailed system-by-system analysis that it conducted for STS-86. Instead, the Task Force has sought and received satisfactory updates on the status of those systems, and has focused its attention on the few safety and operations issues that have arisen since the STS-86 assessment.

General Stafford said the Task Force was meeting today to get a final update on the status of the Mir systems and recent repairs and to hear from General Jacobson on his Red Team assessment and recommendation.

### **Mir Systems and Repair Status**

Jim Medford, NASA-JSC, Code MOD, began the presentations with an overview of the Mir life support systems:

#### Kvant-1 Elektron (Oxygen generation)

Mr. Medford explained that the Kvant-1 Elektron unit, which had been experiencing problems with the sensor that measures the hydrogen content in the oxygen delivery line due to an alkali buildup, has been cleaned and replaced. The Kvant-1 is now running satisfactorily and the sensors are reconnected. The unit initially shut down during the reactivation, which was a result of air in the supply water. That problem was addressed and the unit performed nominally on subsequent reactivation.

#### Urine Water Recovery System

Mr. Medford said that this system had been shut down to save power when the Mir experienced problems with the motion control computer on January 2, 1998. The power situation was alleviated and the unit was restarted on January 5, 1998. However, the crew was unable to drain the brine, left after the urine is distilled, from the system. This is likely the result of a pump malfunction or a clog in the loop. This unit experienced a similar problem in September 1997. Mr. Medford stated that the crew would perform diagnostics on the system after the Extra Vehicular Activity (EVA), scheduled for January 15, 1998.

#### Vozdukh (CO2 Removal)

Mr. Medford explained that there are currently two operational Vozdukh units onboard. The older unit is located in the Kvant-1 module. The newer unit was installed in the core module and activated on December 31, 1997. Due to an air conditioning problem in the core module, the newer Vozdukh unit is dumping moisture overboard along with carbon dioxide in order to aid in humidity removal. However, operating in this mode results in a reduction in the amount of water that can be recovered for drinking. Normally, three liters per day are recovered, but that has gone down to 1.6 liters while the Vozdukh operates in its current mode. Mr. Medford explained that there is still adequate water for consumables and this is not a concern.

#### Thermal Control

The heating loop located in the core module was repaired on December 9, 1997. This unit has continued to hold pressure since the repair and is running well.

## Air Conditioner

On December 19, 1997, during the replacement of a compressor which had reached the end of its service life, 0.5 kg of Freon 218 leaked into the atmosphere. The leak was attributed to a failed check valve. Until the crew is able to replace the Freon, the air conditioner will remain unusable. There is a space compressor onboard; in addition, STS-89 Shuttle mission will bring up a new air conditioner and an additional new compressor.

To scrub the Freon from the atmosphere, the microimpurity filter was activated in the core module. It is estimated that a concentration of less than 10 grams per meter<sup>3</sup>, well below the SMAC level of 85, leaked out. By using the filter, the Freon should be removed from the atmosphere in 10-14 days. There are no concerns about toxicity.

## Atmosphere

In late December 1997, the humidity was elevated to approximately 50%, while temperature was measured at 29-32 degrees Celsius in the core module, 39-41 degrees Celsius in the Kvant-2 module, and 34-36 degrees Celsius in the Priroda module. Mr. Van Laak explained that, while this relatively high temperature in the living quarters would normally cause concern, some of the high temperature readings are caused by the location of the sensors (e.g. next to the batteries) and the high beta angle that places the Kvant-2 module in the sun for extended periods. The ground has been in constant contact with the crew to assess their comfort, and the crew has repeatedly stated that the temperature is not a problem. With the decrease of the beta angle, along with the activation of the second Vozdukh, the humidity levels have been brought back down to the nominal range.

Dr. Craig Fischer said that medical personnel have assured him that there has been no danger for the crew and that the crew can retreat to cooler areas in the Mir. At the time of this meeting, the humidity was measured at 37-40%, the core module temperature was 28 degrees Celsius, Kvant-2 was 32 degrees Celsius and Priroda was 28 degrees Celsius.

## Motion Control System

Keith Zimmerman (JSC-DO) gave a presentation on the current status of the Motion Control System (MCS). He explained that 10 of 12 gyrodines onboard are operational. The propellant module at the end of the boom, used for roll and attitude control, is down to 145 kg of fuel (as of 1/13/98). Typically this module uses about 2 kg per week. Mr. Zimmerman estimated that the propellant module should run out in early March. A new propulsion module is scheduled to be sent to Mir in mid March and installed in early April. The Priroda jets will provide roll control during the early March to early April time frame. There are 25 to 30 weeks of propellant available in the Priroda jets to cover the estimated one month period needed until the new propulsion module is up and operative.

## Motion Control System Failure (January 2, 1998)

Mr. Zimmerman explained that there was a failure of the Central Exchange Module (TsMO) on January 2, 1998. The TsMO provides data exchange between the MCS central computer (TsVM) and the sensors, actuators, and other systems with which it interacts. The TsMO failure resulted in a failure of the entire system, causing a two-day power-down mode and one-day recovery. While the system was down, the crew replaced the Voltage Code Transformer (PNK) in Kvant-2. This unit had not failed, but had exceeded its lifetime. It can only be replaced while the system is down. Rather than wait for a malfunction of that unit, resulting in another power-down of the system, it was decided to replace the unit while the system was already down.

During the recovery of the January 2<sup>nd</sup> MCS shutdown, three of the gyrodines (units #3, #5, and #6) failed to spin up nominally. Two of those units, #3 and #5, required replacement of electronic subunits and were reactivated successfully. Mr. Zimmerman assured the Task Force that although two of the twelve gyrodines available remain inoperable (#6 in Kvant-2 and #6 in Kvant-1), there are several spare units currently onboard.

Dr. John Fabian asked about the history of the gyrodine failures and pointed out that there appears to be a significant number of shutdowns in these units. Mr. Zimmerman explained that the electronics boxes seem to be the part of the gyrodines that require the most replacement – particularly if they go through a number spin-ups and slow downs. He added that many spare electronic boxes are kept onboard. This is a maintenance item the crew is very familiar with.

#### Equipment Being Delivered to Mir on STS-89

Mr. Van Laak reviewed some of the systems and replacement units to be included in the next Shuttle launch: Central Exchange Module, the electronics unit for the gyrodines, the air conditioning unit, a compressor for the air conditioning unit, and possibly a new Salyut computer.

#### Consumables Status

Mr. Zimmerman reviewed the status of consumables onboard as of January 14, 1998:

- 54 days of oxygen if both Elektrons fail
- 69 days of water with the urine recovery system failed
- 20 days of LiOH cans if both Vozdukhs fail
- 42 days of food

If the Mir-25 is postponed, then the consumable status increases by 21 days because there will be three less crew members onboard:

- 75 days of oxygen if both Elektrons fail
- 86 days of water with the urine recovery system failed
- 41 days of LiOH cans if both Vozdukhs fail
- 63 days of food

General Stafford asked what consumables STS-89 will be delivering. Mr. Van Laak reviewed some of the logistics that mission would provide (water, food, and transfer science). He explained that there is a tight time frame for coordinating the upcoming transfer of crew and logistics by having the Soyuz, Progress, and Shuttle launches scheduled closely together. He noted that there is a tremendous amount of lessons learned from Phase 1 for ISS regarding keeping the consumables at a comfortable level during transfers.

### **Mir Deorbit**

Mr. Joe Cuzzupoli asked about the plans to deorbit Mir. Mr. Van Laak explained that the Russians have two proposed scenarios: one in which they bring it down in August of 1999 and the other in June of 2000. Mr. Van Laak had a recent discussion with the Russians where they mentioned examining the use of a tether to bring the Mir down. General Stafford suggested that Dr. Daniel Heimerdinger be included in examining the option of using tethers, as he has some expertise in this area.

### **EVA Status**

Milt Heflin, Deputy Manager, EVA Project Office, discussed the current EVA that would take place with Dave Wolf on January 14, 1998 (the day of this meeting). Mr. Heflin explained that the outer hatch was examined on the previous EVA. It is believed that one of the ten primary latches is not functioning properly. There are ten automatic and ten manual latches. It is not clear from the EVA whether the manual latches were properly torqued down. It has been concluded that the risk to Dave Wolf on this EVA is no more than that of previous EVAs and the crew is trained to use the other airlock in Kvant-2 if there is a problem.

### **Microorganisms**

Major General Ralph Jacobson, USAF (Ret.) requested that Dr. Fischer address the issue of microorganisms in the Mir. Dr. Fischer said that this issue has been studied in great detail and it has been determined that there are no health concerns on the Mir due to microorganisms. Mr. Benjamin Cosgrove stated that he understands that there are no indications that the microorganisms will affect the health of humans, but asked if there was any chance the microorganisms could damage wiring or other hardware. Dr. Fischer was not familiar with any known microorganisms that could affect hardware.

**Red Team Review**

General Jacobson, tasked by General Stafford to chair the Red Team, stated that his team had determined that there is no more risk in this mission than that which has been encountered in the past. He stated that the Red Team recommends that the mission to send Andy Thomas to the Mir continue. General Stafford asked if any members present had any issue with the Red Team assessment. Hearing none, he thanked General Jacobson and his team for leading this assessment.

**Task Force Schedule**

Mr. Dennis McSweeney stated that the last Shuttle-Mir mission for which this Task Force will conduct a readiness assessment will be in May of this year when the Shuttle returns to the Mir to bring back Andy Thomas. After that mission, the Task Force will release a summary report, which will complete the work of the Task Force. Mr. McSweeney noted that the NAC Task Force on International Space Station Operational Readiness, which General Stafford also chairs, is just beginning to get ramped up as it conducts its first in-depth program assessment (on the issue of training for the initial ISS crews).

**Conclusion**

General Stafford concluded the meeting by thanked everyone for their help in conducting the readiness assessment for STS-89. The meeting adjourned at 3:20 p.m.

*[Original signed by]*

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Mr. Dennis McSweeney  
Executive Secretary  
Task Force on the Shuttle-Mir  
Rendezvous and Docking Missions

*[Original signed by]*

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Lt. General Thomas P. Stafford  
Chairman  
Task Force on the Shuttle-Mir  
Rendezvous and Docking Missions

**ATTACHMENT A**

**NASA Advisory Council  
Task Force on the Shuttle-Mir Rendezvous and Docking Missions  
Room 920L  
Lyndon B. Johnson Space Center  
Houston, Texas**

**January 14, 1998**

**AGENDA**

- |   |                                |
|---|--------------------------------|
| I. Introduction                           | General Stafford               |
| II. Mir Systems and Repair Status Update  | Jim Metford<br>Keith Zimmerman |
| • Life Support                            |                                |
| • Thermal Control                         |                                |
| • Atmosphere                              |                                |
| • Motion Control System                   |                                |
| • Issues                                  |                                |
| III. Mir Consumable Status                | Keith Zimmerman                |
| IV. EVA Repair Summary                    | Milt Heflin                    |
| V. Red Team Results                       | General Jacobson               |
| VI. Review of Actions/Task Force Schedule | Dennis McSweeney               |

## **ATTACHMENT B**

**NASA Advisory Council  
Task Force on the Shuttle-Mir Rendezvous and Docking Missions  
Room 920L  
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**January 14, 1998**

### **ATTENDANCE**

#### Task Force Members

Thomas Stafford, Chairman  
James Adamson  
Benjamin Cosgrove  
Joseph Cuzzupoli  
Charles Daniel  
John Fabian (via teleconference)  
Craig Fischer (via teleconference)  
James M. Heflin  
Daniel Heimerdinger  
Ralph Jacobson  
Mike Lopez-Alegria  
Ronald Merrell (via teleconference)

#### Executive Secretary

Dennis McSweeney  
Holly Stevens, Assistant

#### Technical Advisors

Joe Engle  
Jim Snowden

#### NASA Personnel

Loretta Garza, Office of the Inspector General, Johnson Space Center  
Connie Webb, Office of the Inspector General, Johnson Space Center  
James Medford, Johnson Space Center, MOD  
Keith Zimmerman, Johnson Space Center, MOD  
Jim Van Laak, Johnson Space Center, YA

## ATTACHMENT C

### **NASA Advisory Council Task Force on the Shuttle-Mir Rendezvous and Docking Missions**

#### Stafford Task Force Red Team for STS-89 Readiness Assessment

##### Chairman

Major General Ralph H. Jacobson, (USAF, Ret.)  
President Emeritus, The Charles Stark Draper Laboratories

##### Members

Joseph W. Cuzzupoli, Vice President and Deputy Program Manager,  
Kistler Aerospace Corporation

Benjamin A. Cosgrove, Aerospace Consultant

Craig L. Fischer, M.D., President and CEO, Fischer Starke Associates

John M. Fabian, Ph.D., President and CEO, ANSER

Daniel J. Heimerdinger, Ph.D., Vice President, Aerospace Research  
Engineering and Management Corporation

Ronald C. Merrell, M.D., Professor and Chairman, Department of  
Surgery, Yale University School of Medicine