National Aeronautics and Space Administration

International Space Station Advisory Committee

May 14, 2018
NASA Headquarters
Washington, DC

OPEN MEETING REPORT

Original signed by

Lt. General Thomas P. Stafford, USAF (Ret.)
Chairman

Original signed by

Mr. Patrick T. Finley
Executive Director

NASA INTERNATIONAL SPACE STATION ADVISORY COMMITTEE

May 14, 2018
NASA Headquarters
Washington, DC

TABLE OF CONTENTS

NASA INTERNATIONAL SPACE STATION ADVISORY COMMITTEE

MEETING REPORT

May 14, 2018
NASA Headquarters
2:00 PM ET

Executive Director Patrick Finley: *From 29 January - 1 February 2018, the International Space Station Advisory Committee met with the Roscosmos Advisory Expert Council as a Joint Commission and held a fact-finding session in Moscow, Russia. The purpose of the Joint Commission is to review ISS operations, with a focus on crew safety and utilization.*

The Joint Commission heard briefings by U.S. and Russian specialists covering a broad range of topics, including presentations on the status of the ISS Program, a medical operations and Human Research status update, and an update on ISS contingency planning. Additionally, the Joint Commission was updated on ISS Joint Research, an anomaly during the Progress 68P cargo resupply mission, an update on the Functional Cargo Block module, and an overview of efforts to utilize the ISS to demonstrate new technologies. Experts from Roscosmos, RSC Energia, Khrunichev Space Center, TsNIIMash, the Institute of Biomedical Problems, and NASA's ISS Program Office participated in the meeting and gave presentations.

With that introduction, I will now turn the meeting over to our Chairman, General Thomas Stafford, to review the results of our recent fact-finding meeting in Houston.

General Stafford: *Good afternoon and thank you for participating in this open meeting of the NASA International Space Station Advisory Committee. For our meeting today, we will be discussing information we gathered from the January fact-finding meeting in Houston. I will summarize each of the main areas that we reviewed, and then allow time for Committee members to ask questions and discuss each topic.*

ISS Program Overview

To begin the Joint Commission meeting, NASA and Roscosmos representatives provided overview presentations on the ISS Program. These presentations covered the wide range of technical and operational topics currently underway on ISS. We are pleased to note that an initiative long-championed by this group, micro-meteoroid orbital debris shielding for the Service Module, Soyuz, and Progress vehicles, have been successfully implemented. We commend NASA for introducing a system to make progress on providing information on U.S. commercial vehicles to its international partners, but notes the Russian side has open requests for information. We will seek an update from NASA at the next meeting.

The USOS overview briefing began with a review of the ISS flight plan and discussed recent and future operations. The briefing noted the busy and dynamic operations ongoing onboard the ISS, reported that consumables levels were robust and could last for more than six months without resupply, and described upcoming crew assignments. NASA explained that U.S. commercial vehicle uncrewed demonstration tests are currently planned for August. Demonstrations flights

with U.S. crew onboard are planned for launch dates at the end of the year. While NASA plans for these demonstration missions, NASA's biggest priority is maintaining U.S. presence on ISS in case the commercial crew launch dates slip. As of this meeting, NASA didn't have a final decision, but was working with Russian colleagues to determine a solution. NASA agreed to provide an update at the next meeting.

The USOS briefing also included information on upcoming launches planned for the ISS. On the 13th SpaceX commercial resupply services mission, SpaceX had its first re-flight of the booster, or first stage, for a NASA mission. NASA has previously approved SpaceX re-used dragon cargo capsules, but this was the first re-flight of the first stage. Requirements were placed on SpaceX to ensure the hardware was ready to launch, and NASA will allow re-used boosters on future flights on a case-by-case basis. The first stage also had to be used on a previous ISS mission, and not just any SpaceX launch. Additionally, NASA reviewed any anomalies the rocket had on its first flight, as well as on the post flight. The first stage operated very well on SpaceX's 13th commercial resupply services mission, and NASA expected SpaceX to request to use a previously flown first stage on its 14th commercial resupply services mission.

NASA provided an update on the Bigelow Expandable Activity Module (BEAM). BEAM was certified for a two-year life on orbit to undergo testing onboard ISS. As time went on without any issue for the BEAM, NASA worked with Bigelow to convert BEAM into a stowage module. Over time, as the Partnership continues to execute research and utilization, the need for stowage capacity has increased. NASA hoped to be able to store more than 100 cargo transfer bags in BEAM, and intended to have this stowage role certified by February 2018.

NASA also provided information on spacewalks since the previous meeting. Three spacewalks took place in October 2017. NASA has been focused on the operation of the robotic arm, which is critical to berthing for cargo vehicles as well as ISS maintenance. NASA has seen degradation on both the A and B sides of the robotic arm, including specific degradation on the latching end effector, or LEE, which is essentially the grapple or latching mechanism at the end of the arm. On the first EVA, NASA swapped out the LEE for an on-orbit spare, and stowed the old LEE on board for lighter operations. With this EVA, the ISS regained robotic arm capability. On the second EVA, crew lubricated the latching mechanism on the newly installed LEE. NASA has learned over time how important it is to lubricate this mechanism. On the third EVA, the main task was to replace a fuse on the dexterous arm. The hardware was not functional until this fuse was replaced. While outside, NASA upgraded the camera hardware to install advanced high-definition cameras. In January 2018, NASA continued work on the LEE, but this time with a focus on the B-side of the robotic arm. When the new LEE was installed, it would only power-up intermittently. As a result, it was determined best to reverse the previous solution and return to degraded capability. Luckily, the Canadian robotic arm team was able to determine a software patch that appears to have fixed the issue and removed the need for the planned EVA.

NASA specialists presented an update on the status of the ISS modules. NASA analysis has determined there is no technical need to end ISS before 2028. MMOD shielding upgrades for the Service Module, Soyuz, and Progress vehicles have been implemented that will add durability to the ISS structure. MMOD shielding was a concept initiated by our group, and we are pleased to see this implementation complete. NASA continues to evaluate ISS power augmentation, especially in light of plans for increases in utilization and commercialization. Meanwhile, NASA has observed degradation of the Solar Array performance and is exploring

opportunities to increase on-orbit power generation in the future. Russian experts noted that analysis on ISS operations beyond 2024 did not include the FGB module.

The Russian Segment overview began with a review of the ISS flight plan and discussed recent and future operations. In 2017, there were no significant anomalies or events that seriously threatened the ISS or its crew. The Russian side provided some detail on a minor issue in which the Soyuz capsule was impacted by the parachute latch on landing, but the crew was not determined to be at serious risk. The Russian side reported that consumables were at healthy levels, including propellant, food, and water. There were three Progress cargo resupply launches and four Soyuz crewed launches in 2017. In 2018, three additional Progress vehicles are scheduled to launch, followed by an increase back to four Progress launches in 2019.

The Russian side described plans to launch the Multipurpose Laboratory Module, or MLM, in December 2018, but noted that the launch date could slip. With the expected launch of the MLM, the Russian side plans to transition back to a three Russian crew rotation to prepare for the arrival of MLM, additional modules, and to conduct EVA. MLM delivery to ISS will mark an important milestone not just for ISS hardware, but also in relation to reviving Russian science and utilization. The Russian side reported making good progress on manufacturing for the Node module and the Science Power Module, which are expected to launch after MLM. Information was also provided on the next generation Russian crew vehicle, which will hold the same number of crew as US commercial crew spacecraft, in theory six or seven crew, but operations with four crew are more likely.

Finally, the Joint Commission was briefed on the NASA plan to integrate US commercial crew spacecraft in support of ISS operations beginning in 2018, which sparked a significant discussion. For years, we have observed delays in the development, flight test, and qualification milestones for commercial crew, and therefore we believe the current schedule is optimistic. Given these schedule risks, we recommend the partnership pursue plans to protect for a minimum crew capability to ensure ISS viability during the flight development phase. One potential option includes, but is not limited to, providing training to Russian crew members on USOS critical systems scheduled to fly on the September 2019 and March 2020 Soyuz vehicles. This proactive effort could allow safe USOS operations prior to sustained commercial crew rotation flights. We further identified that timely commercial crew integration is an issue of the highest priority, and believed NASA, with support of the partnership, should take action at the earliest possible date to resolve this critical issue. We will seek a presentation on this topic at the next meeting.

I will now open up the floor for Committee questions or discussion regarding the ISS Program Overview.
There were no questions and no discussion.

Medical Operations Update and Human Research Status

NASA and representatives from Russia's Institute of Biomedical Problems, known as IBMP, provided a medical and human research update and reported that there have been no significant medical issues affecting ISS crew since the June 2017 meeting. NASA and IBMP specialists also described the continuing post-flight effort to analyze data from the Kelly-Kornienko one-year ISS mission, and implement the Fluid Shift and Field Test investigations on subsequent ISS crew members. The NASA specialists favor pursuing additional one-year missions to ISS in an effort to build and validate data related to long-duration spaceflight missions. However, IBMP

specialists compared the Kelly-Kornienko data with previous Soviet-era data on long-duration spaceflight and determined a preference to pursue a series of ground-based analogue tests to develop countermeasures and protocols for combating physiological and psychological challenges at this time. We commend the ISS partner medical structures for assuring the health and efficiency of the crews.

Medical specialists from IMBP also provided information on the Scientific International Research in Unique Terrestrial Station, or SIRIUS, ground-based analogue experiment underway at IMBP facilities in Moscow. The main goal of the experiment is to assess psychological and physiological conditions of long-duration isolation. Currently, there is four-month dry run study underway. Eventually, this will be increased to eight months, with a goal of achieving a year-long study. The new facility at IMBP is designed to isolate six crew members of different genders and ages. In September 2017, IMBP ran a sample experiment for 17 days with an international crew. Results from the 17-day experiment were discussed at the U.S.-Russian Joint Working Group on Biomedical Sciences in December 2017 in Moscow. The IMBP research is focused on psychological and physiological experiments to prepare for long-duration space flight missions. The promising research from the new facility will provide information to assist with deep space exploration.

I will now open up the floor for Committee questions or discussion regarding the Medical Operations Update and Human Research Status.
There were no questions and no discussion.

ISS Contingency Planning

NASA representatives also provided a briefing on international ISS contingency planning efforts. The ISS Partners have worked together to finalize a contingency planning document, but Roscosmos has requested additional time to close out some remaining analyses related to costs for implementing activities envisioned in the plan. The remaining ISS partners have signed this document, but in late 2017, Russian specialists sent a list of comments to the document, especially focused on the "international partner contributions" portion of the document. This section specifies that de-orbit costs will be separated and shared based on mass, which was established in principle with a 2013 technical understanding. NASA is working to reconcile these edits with Russian colleagues.

The ISS partners continue to analyze a number of contingency situations, including FGB Propellant maintenance at vacuum. NASA worked closely with Russian experts, and there is an intent to utilize FGB propellant even in the event of cabin depressurization. Analysis suggests some avionics will not survive a vacuum, but there is forward work to ensure the proper trigger to release this propellant is understood and in place. Analysis teams feel a reconfiguration to Service Module control is important to ensure the ISS could remain functional in a depressurization situation. This would ensure access to the propellant in a contingency situation. A reconfiguration would improve the fault tolerance and increases likelihood of access to the propellant. We will continue to monitor progress on this effort.

I will now open up the floor for Committee questions or discussion regarding the ISS Contingency Planning.
There were no questions or discussion.

ISS Joint Research Update

NASA briefed us on ISS joint research, and reminded us that international collaboration increases science return for research because it expands the expertise of the science teams, provides more access to resources, and expands access to research data. NASA noted that two major resources – crew time and facilities – typically limit research potential. International collaboration provides an opportunity to balance these resources in an effort to overcome these limitations. In a positive development, NASA reported an increased level of participation by Russian organizations at a variety of medical and research fora, such as the Multilateral Human Research Panel for Exploration, the ISS Program Science Forum, and at bilateral meetings. NASA has been informed that the Russian side is having trouble scheduling any time for new joint research, but perhaps they may schedule new activities in a mid-increment update. NASA is asking for only 11 hours of cosmonaut time to finalize the research on the final three subjects in the Fluid Shifts investigation, and hopes a solution can be found.

Unfortunately, the level of joint U.S.-Russian research has declined a lot over the past year, and there have not been any additional or new joint research opportunities identified since early 2017. Currently, there is no new joint research on the horizon, and it would take 12-18 months to prepare for new investigations. The Russian side acknowledged the reduction of available crew time for joint research, but insisted this is a temporary situation and will improve after the planned increase in Russian crew. We believe that joint utilization and research on ISS is one of the most important aspects of the international partnership and request Roscosmos conduct an analysis to determine if there are ways to increase joint utilization despite crew time constraints. We will seek an update on this issue from Roscosmos at the next meeting.

I will now open up the floor for Committee questions or discussion regarding the ISS Joint Research Update.
There were no questions or discussion.

Progress 68P Anomaly

Roscosmos provided a summary on an anomaly on the Progress 68P cargo resupply mission in October 2017. A commission was established to determine the cause of the event, but has not yet concluded its findings. Initial analysis indicates the anomaly was associated with the Soyuz 2.1a launch vehicle, and several missions have flown successfully on this launch vehicle since the anomaly occurred on the 68P mission. We also mentioned a Russian Segment control computer malfunction when the MS-05/51S vehicle was docked to the ISS in December 2017, and requested a briefing at the next meeting to provide a review of any findings and planned mitigation steps.

I will now open up the floor for Committee questions or discussion regarding the Progress 68P Anomaly.
There were no questions or discussion.

Functional Cargo Block (FGB) Module Sustainment

Russian specialists provided an update on the status and operations of the Functional Cargo Block, or FGB module, and noted the age of the parts on the module have required several to be replaced in recent years. The Russian side noted several examples of recent hardware issues on FGB and is looking for the next opportunity to send spare equipment to the ISS. While NASA

and Roscosmos signed a protocol for Roscosmos to continue sustaining the FGB through December 2020, the agencies are still in the process of finalizing a contract for this activity.

I will now open up the floor for Committee questions or discussion regarding FGB Module Sustainment.
There were no questions or discussion.

ISS Utilization – Technology Demonstration

NASA presented on the ISS partner effort to develop technology onboard station to support future exploration beyond low-Earth orbit. Agencies are utilizing the unique environment on ISS to test a range of technologies that will be required for exploration, such as: radiation, crew health and performance, and environmental control and life support systems. NASA specialists noted that many experiments, especially those external from ISS do not require much or any crew time. In the event crew time is required, NASA works with schedulers to work these experiments into crew utilization time. The international partners have their own crew allocation and manage their own resources. The ISS Program has successfully demonstrated numerous technologies and systems needed to reduce risk and costs to enable future exploration missions. Many additional demonstrations are in work for ISS execution in the coming years. The longer these demonstrations are allowed to run, the greater the achieved risk reduction for future exploration. Even with these successes, there remains additional opportunities to enable future exploration missions with reduced risk and cost. Continuing to take advantage of ISS for exploration is a valuable investment in human spaceflight's future. NASA is working to develop a way to measure risk buy-downs, but it requires knowing what risks are being addressed. In the absence of a formal program, specialists do not have specific requirements beyond better, lighter, and more efficient. Instead, they have established analytical minimums for reference Mars and lunar missions, and we are trying to design to those standards. We believe the ISS Program should strive for more specific and targeted technology needs so it is possible to affect and impact technology development investments. We support these efforts and believe the international partnership should further refine technology development to ensure these investments directly map to future exploration missions.

I will now open up the floor for Committee questions or discussion regarding ISS Technology Demonstration.
There were no questions or discussion.

Conclusion

In summary, we commend the ISS Program for safely operating the ISS and strongly encourage coming to a positive conclusion on future crew rotation and U.S. crew transportation issues. The Joint Commission will meet again in Moscow in fall 2018 to continue its review of safety and utilization issues on the ISS.

Given the information we discussed today, do the Committee members have any objections to the findings of this report?
There were no objections to the finding of the report.

Based on the recent fact-finding meeting in Houston and this discussion, the ISS Advisory Committee concurs with the assessment outlined here today. Thank you all again for the

expertise you bring to our Committee. Now, I'll turn this over to the Executive Director to wrap things up.

Patrick Finley: *Thanks again to the Committee for all the hard work on this assessment. I look forward to your participation at future meetings. I look forward to see all of you, and our Russian counterparts, in Moscow later this year. This meeting is adjourned at 2:35pm.*

Attachment A

NASA International Space Station Advisory Committee

NASA Headquarters
Washington, DC
May 14, 2018

ADVISORY COMMITTEE MEMBERSHIP

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

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Col. James Adamson, U.S. Army (Ret.)
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Mr. Joseph Cuzzupoli
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Technical Advisors

Maj. Gen. Joe Engle, USAF (Ret.)
Maj. Bob Maiberger, U.S. Army (Ret.)

Executive Director

Mr. Patrick Finley

Dep. Executive Director

Ms. Holly Stevens

Attachment B

NASA International Space Station Advisory Committee Meeting

NASA Headquarters
Washington, DC
May 14, 2018

Meeting Attendees

NASA International Space Station Advisory Committee
Lt. Gen. Thomas Stafford, USAF (Ret.)
Col. James Adamson, U.S. Army (Ret.)
Mr. Hal Bell
Mr. Joseph Cuzzupoli
Dr. Charles Daniel
Dr. Michael Foale
Dr. Michael Greenfield
Dr. Daniel Heimerdinger
Dr. Ronald Merrell
Dr. Josef Schmid
Col. Jeff Williams, U.S. Army (Ret.)

Executive Director
Mr. Patrick Finley
Ms. Holly Stevens

Technical Advisers
Gen. Joe Engle
Mr. Robert Maiberger

NASA Attendees
Rebeccah Buckles, MSFC Payload Ops
Meredith McKay, NASA HQ
Kevin Metrocavage, NASA HQ
Stephanie Schierholz, NASA HQ

Industry
Nithya Pathalam, SpaceX

Media
Jeff Foust, SpaceNews
Brian Harvey, Author

General Public
Marchel Holle, Space Studies Board