

**National Aeronautics and Space Administration**

**International Space Station Advisory Committee**

**March 1, 2016  
NASA Headquarters  
Washington, DC**

**OPEN MEETING REPORT**



*Original signed by*

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

*Original signed by*

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Mr. Patrick T. Finley  
Executive Director

# NASA INTERNATIONAL SPACE STATION ADVISORY COMMITTEE

March 1, 2016  
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# ***NASA INTERNATIONAL SPACE STATION ADVISORY COMMITTEE***

March 1, 2016  
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## **MEETING REPORT**

Mr. Patrick Finley, Executive Director of the NASA ISSAC, opened the meeting, called the roll and made the following remarks:

**Patrick Finley:** *From 7-11 December 2015, the ISS Advisory Committee met with the Roscosmos Advisory Expert Council as a Joint Commission and held a fact-finding session in Houston, Texas, at NASA's Johnson Space Center. The purpose of the Joint Commission is to gather information on the viability of the ISS, with a specific focus on crew safety and utilization issues.*

*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, the Bigelow Expandable Activity Module Deployment Sequence, the NASA Commercial Crew Program Overview, and an ISS Life Support and Medical Status Report. Additionally, the Joint Commission was updated on the Orbital-3 Accident Investigation, the SpaceX-7 Accident Investigation, the summary of the Progress 59P Accident Investigation, and the status of the Functional Cargo Block Module. Experts from RSC Energia, the Khrunichev Space Center, TsNIIMash, NASA's ISS Program Office, and NASA's Commercial Crew Program Office participated in the meeting and gave presentations.*

*I will now turn the meeting over to General 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 December 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**

*The meeting began with ISS Program Overview presentations from the NASA Deputy ISS Program Manager and the Rocket and Space Corporation Energia Vice President for Business Strategy, Development, and International Activity. The briefings were comprehensive and provided status updates on the full array of operations onboard the ISS.*

*The USOS overview briefing reviewed the ISS flight plan charts, crew members for current and upcoming increments 45 and 46, ISS consumables status, utilization crew time, ISS reconfiguration status, and visiting vehicles mission status updates. In addition, there was an update on planned U.S. Commercial Cargo flights in 2016, an update on the commercial resupply services 2 contract status, and a review of the ISS Program risk matrix.*

*The ISS flight plan chart highlighted the successful launch of the OA-4 cargo mission on an Atlas-V launch vehicle, the first cargo mission for Orbital ATK following the October 2014 launch failure of Orbital-3. Data was presented on the status of total consumables on the ISS, and consumable levels were determined sufficient to maintain nominal operations. Four sets of data were presented based on a variety of scenarios that accounted for the success or failure of the OA-4 and Progress 62P cargo missions. The goal of 35 hours of crew utilization time per week was successfully achieved during the review period, and the ISSPO is hopeful that discussions with TSNIMASH will lead to an increase in the amount of crew time that can be spent on joint utilization. The Joint Commission welcomed a decision between NASA, TSNIMASH, and Roscosmos the previous week to remove a cap on Cosmonauts of 5 hours of science utilization crew time.*

*The USOS overview also reviewed plans for ISS reconfiguration to support commercial crew docking. The objective is to establish two docking and two berthing ports on the USOS to support additional crew and cargo vehicles. The JC also received information on U.S. Commercial Cargo flights in 2016. SpaceX-8 is scheduled to deliver the BEAM module and return hardware from the ISS for study. OA-6 will launch, out of sequence, utilizing almost exactly the same configuration as OA-4, including a Cygnus capsule with an Atlas-V booster. OA-5 will launch later from the Wallops Island launch site with a new configuration, consisting of a Cygnus capsule with an Antares launch vehicle equipped with an RD-181 engine.*

*The Joint Commission also received a brief update on the status of NASA's commercial cargo resupply services contract award process. The draft CRS-2 request for proposals (RFP) was released in June 2014 and a pre-solicitation conference with industry was held in August 2014, with 23 different organizations participating. The final RFP was released in September 2014, and final selection had not been made at the time of this meeting. The Joint Commission also reviewed information on the ISSPO risk matrix. The biggest risk presented was lack of assured access to ISS, which is resulting in a decision on whether to purchase more Soyuz seats due to delays in the CRS-2 contract and external budget reductions to the ISS affecting NASA's Commercial Crew Program.*

*The Russian Segment overview briefing reflected on a very busy launch schedule in 2015 and highlighted the importance of such near-term objectives as crew landing and launch operations, as well as the 62P cargo mission launch, all scheduled before the end of 2015. Due to budget reductions, Roscosmos plans to reduce Progress cargo resupply missions from four to three per year. Roscosmos is looking into alternative ways to provide the necessary cargo upmass, to include potential barter with ISS partners. Moving forward, Russia is transitioning to a new launcher, called Soyuz-2. The 62P, 63P, and 64P cargo missions will serve not only to resupply the ISS, but as the testing requirement for the new launch vehicle. If the Progress launches are successful, Roscosmos intends to eventually transition crewed Soyuz spacecraft launches to the new Soyuz-2 booster as well.*

*The RS overview briefing confirmed the USOS presentation on ISS consumable status, assuring the JC that levels of oxygen, water, and propellant are sufficient for 2016 – even when accounting for a reduction in Progress cargo missions. One area of interest to RS planners was water consumption aboard ISS. Crew members have been consuming water at roughly 3L per day, but plans called for crew to consume closer to 2.5L of water per day. Plans for future RS reconfiguration were also presented. After 2016, plans call for continued assembly of RS,*

*including three new modules – the Multipurpose Laboratory Module, the Node Module, and the SPM (power module). The MLM is scheduled for deployment in 2017 and the SPM remains under development.*

*An update was also provided on the Russian human spaceflight program for 2016-2025. Plans call to begin launching vehicles from the Vostochny Cosmodrome by 2020, but plans also call to continue launches from Baikonur beyond 2020. 2016-2019 were described as complicated years due to changes anticipated in and upgrades in several space launch systems. By 2021, Russia is expected to create a new vehicle. There is a desire to test the new vehicle with flights to the ISS and this underlines why Russia is interested in the experience NASA will gain flying U.S. commercial vehicles to ISS in the near future. The proposed crew transport vehicle will not have a separate crew compartment to allow for decompression, which may negatively impact the ability to perform extra-vehicular activities in the vicinity of the Moon, but including such a compartment would have added size and cost. The vehicle is envisioned to be docked to some type of orbital facility, but since a new heavy launch vehicle has not yet been funded, Russia will have to consider multiple smaller launches to deliver spacecraft to orbit.*

*The ISS Program Overview presentations were of the highest quality and included detailed descriptions of all technical and operational aspects on station. The Joint Commission notes that the experience of jointly overcoming the consequences of the three cargo resupply accidents over the last year has strengthened the ISS partnership, and the JC commends the effort to overcome these logistics challenges. Generally, the status of the ISS program appears to be robust and is achieving its targeted science utilization rate. The ISS appears not only technically sound but seems to be expanding functional and operational capability.*

*I will now open up the floor for Committee questions or discussion regarding the ISS Program overview. There were no comments or questions.*

#### Bigelow Expandable Activity Module (BEAM) Deployment Sequence

*The NASA ISSPO provided a presentation on the operational aspects of expansion and deployment of the Bigelow Expandable Activity Module (BEAM). The BEAM technology demonstration mission is designed to last approximately 2 years, with four primary objectives: Demonstrate a commercial expandable module on the ISS for the first time; increase human-rated expansion Technology Readiness Level to 9 (test level); address NASA Space Technology Roadmaps; and prepare for future deep space and surface habitat mission architectures. BEAM will not have a life support system and electricity from the ISS will be required to power the deployment sequence. The JC also learned NASA will deliver BEAM to the ISS on the SpaceX-8 vehicle.*

*BEAM will launch to ISS in a compact, deflated, mode and will be expanded while on orbit after delivery to the ISS. The ISSPO noted the module was tested and certified to the same specifications of other ISS modules through the ISS Safety Review Process. Like other modules, BEAM underwent an off-gassing test and performed well within allowable parameters. The original deployment plan involved an aggressive, full BEAM inflation in a very short time. Such rapid deployment was reviewed and a decision was made to develop a new approach to expand the module. The new approach is designed to be slower and incrementally expand the BEAM using a series of valves that can control air flow, and provides observation and confirmation of*

*each incremental step. The time to fully expand BEAM is now planned to occur over one full daylight pass, or approximately 40 - 45 minutes.*

*I will now open up the floor for Committee questions or discussion regarding the BEAM Deployment Sequence. There were no comments or questions.*

### NASA Commercial Crew Program Overview

*The NASA CCPO provided a top-level briefing on the NASA Commercial Crew Program. First, the CCPO presented the Boeing CST-100 (Starliner) crew capsule concept of operations, noting that Boeing is in the midst of its Critical Design Review phase. Boeing will launch the Starliner on an Atlas-V launch vehicle. Mission control will take place at a contractor site on JSC, and landing will take place on land in the U.S. using a parachute system. Boeing will soon complete construction of the crew access tower at the United Launch Alliance Space Launch Complex 41. It will still take almost a year to completely instrument and supply the tower to prepare it for launch operations. The crew capsule has a requirement from NASA for four crew members, but Boeing will be construct it to accommodate up to seven.*

*CCPO also provided a top-level briefing on the SpaceX Dragon crew capsule concept of operations. The capsule will launch on the SpaceX Falcon 9 launch vehicle from a facility at Kennedy Space Center. SpaceX recently completed a hangar facility at Pad 39a at KSC. Mission control will be located at SpaceX's center in Hawthorne, California. SpaceX is set up for a water landing. The CCPO described SpaceX as being currently in the midst of the Critical Design Review phase. CCPO closed by explaining that SpaceX makes much of the information on the Dragon capsule and Falcon 9 launch vehicle publically available on the internet.*

*The Russian side asked for more information and detailed data from NASA on the two vehicles. NASA acknowledged the plan to provide more information on CCP, but noted that several questions on CCP are still open, and in some cases, necessary information is not yet available. NASA has established a process to facilitate communication on CCP to the ISS partners. A new position has been established in CCP to specifically focus on this critical task, which highlights NASA's recognition of the importance and urgency of providing information to ISS Partners on commercial vehicles to support safety and operations preparations.*

*I will now open up the floor for Committee questions or discussion regarding the Commercial Crew Program Overview. There were no comments or questions.*

### ISS Life Support and Medical Status Report

*The Joint Commission also heard a briefing from the NASA Human Research Program, with input from the Institute of Biomedical Problems (or IBMP) with updates on biomedical research related to the one-year mission. The briefing noted that the ISS is a solid platform that allows researchers to receive new knowledge and experiences in the area of space exploration, and this research supports new pathways for medical discovery for humans in space as well as for medical applications on Earth. For the one-year mission, the US and Russian medical community worked together to identify data needed for future deep space exploration missions. The three categories of concern for long-duration spaceflight being investigated during the one-year mission through multilateral collaboration are:*

- *Medical Events (e.g. renal stones, visual impairment) – establishing a likelihood of negative events which change over time;*
- *Physiological deconditioning (e.g. muscle atrophy, bone loss) – establishing efficacy of countermeasures for missions longer than ISS; and*
- *Behavioral & Performance – characterizing trends over time or validating countermeasures to decreases in performance.*

*There is a considerable amount of unknown risk associated with space travel to Mars. The Multilateral Human Research Panel for Exploration was chartered in 2013 to facilitate multilateral investigations and explore some of these risks. The panel believes it is possible to reduce the risk of going to Mars by continuing investigations on ISS. As such, the NASA HRP presented an Exploration Risk Matrix, which seeks to characterize risks associated with space exploration beyond low-earth orbit. Joint investigations during the one-year mission are focused on these risks by investigating impacts on Fine Motor Skills, Cognition Sleep Monitoring, etc.*

*One of the first issues being explored is the issue of visual impairment and intracranial pressure in space flight through the joint Fluid Shift Investigation. This investigation takes place inside the RS and requires relocation of U.S. hardware to the RS for experimentation. The research is focused on characterizing body fluid distribution in pre/in/post spaceflight phases. This is the most detailed and comprehensive body fluid shift investigation done to date. There is also a ground-based joint experiment currently underway called the Field Test, which focuses on understanding astronaut/cosmonaut impact on landing after prolonged spaceflight. Gennady Padalka was the first full participant in the test on his landing in September 2015, and more subjects will take part in the investigation at future Soyuz landing operations.*

*We commend the medical and research communities for their significant efforts in planning a multidisciplinary human research program in support of future deep space exploration that have been stimulated by the current one-year mission. We also commend the medical and research communities for the joint multidisciplinary human research program in support of future deep space exploration that maximizes the integration of RS and USOS resources and crew.*

*I will now open up the floor for Committee questions or discussion regarding the ISS Life Support and Medical Status Report. There were no questions or comments.*

### Orbital-3 Accident Investigation Status

*ISSPO also briefed on the status of the Orbital-3 accident investigation. The Orbital Antares launch vehicle failed shortly after liftoff on October 28, 2014. The U.S. Federal Aviation Administration formed an Accident Investigation Board, which included a NASA member. NASA also created an Independent Review Team to investigate the failure. The Orbital AIB report was provided to NASA. The AIB assessed (and NASA concurred) the most likely cause of the failure was due to AJ-26 engine turbo machinery. Shortly after failure, Orbital announced it would no longer utilize AJ-26 engines on the Antares launch vehicle and announced plans to transition the Antares rocket to the RD-181 engine.*

*Looking forward, Orbital ATK plans to conduct cargo mission OA-6 on the Atlas-V launch vehicle. This configuration will allow more lift capability and additional cargo load. On OA-4, Cygnus delivered 3500kg of cargo to the ISS. AJ-26 engines would have only allowed delivery of roughly 2500kg of cargo. The new configuration will provide Orbital ATK the ability to deliver roughly 3200kg of cargo to ISS. The Antares launch vehicle is currently projected to launch in mid-2016. The first two engines have been delivered and are being installed. Orbital ATK is preparing for integrated testing at the Wallops launch facility.*

*I will now open up the floor for Committee questions or discussion regarding the Orbital-3 Accident Investigation. There were no comments or questions.*

### SpaceX-7 Accident Investigation Status

*ISSPO also provided a briefing on the status of the SpaceX-7 accident investigation. The SpaceX-7 mission failed during the first stage of powered flight, roughly 138 seconds into flight, on June 28, 2015. From video and telemetry it appears the failure occurred at the front end of the second stage of the launch vehicle. Notably, from the first sign of anomaly to loss of telemetry data was less than one second. Per requirements by license from the FAA, SpaceX convened an Accident Investigation Team. The AIT consisted of SpaceX members as well as a voting member from the FAA, which was also responsible for ensuring SpaceX compliance with the investigation process. NASA, the U.S. Air Force, and the National Transportation Safety Board were also included in the investigation process, but as observers only. The ISSPO pointed out that there is no requirement that NASA representatives be included in the investigations of either commercial cargo failure.*

*The AIT created a detailed and exhaustive fault tree to systematically investigate all the systems of the vehicle. Significant analyses, simulations, and modeling was conducted to close elements of the fault tree. Little debris was recovered, which made it harder to complete hardware investigation, but SpaceX had a launch vehicle built at the same time and in the same processes in reserve to draw on as an analogue to the failed launch vehicle. NASA was included in all discussions during the investigation and its inputs were incorporated throughout even though it was officially only an observer. SpaceX identified that a structural member in the second stage likely failed at lower than expected load based on ground screening of similar parts. Failure of this strut (in tension) led to failure of the helium regulation system within the second stage and loss of the vehicle. The strut tension failed at about 2000 lbs when it should have held up to 9000 lbs according to specifications.*

*Due to these findings, SpaceX has taken a number of corrective actions. SpaceX conducted a systematic review of all parts on the vehicle to identify any other areas that may have been at risk due to a similar failure. SpaceX replaced all the similar parts to the one that failed with new ones that have undergone additional testing and screening. No additional parts were identified as critical to replace prior to return to flight. SpaceX identified a number of areas for overall improvement on the vehicle as a result of the investigation. NASA conducted an independent investigation of the anomaly that determined the SpaceX identified failure scenario is credible. FAA will have to issue a new license before SpaceX will be allowed to resume flights. SpaceX will also have to complete a successful commercial launch before it will be allowed to fly a NASA mission.*

*I will now open up the floor for Committee questions or discussion regarding the SpaceX-7 Accident Investigation. There were no comments or questions.*

#### Progress 59P (M27-M) Accident – Summary of State Commission Findings

*Roscosmos provided a report on the investigation into the incident resulting in the loss of Progress 59P or M-27M on April 28, 2015. The same configuration of a Soyuz 2.1a launcher with the Progress spacecraft successfully returned to flight in December 2015 from the Baikonur Cosmodrome in Kazakhstan. We appreciate the effort by Roscosmos and the space manufacturers to model the accident and develop mitigation measures for future flights of the Soyuz 2.1a/Progress configuration.*

*I will now open up the floor for Committee questions or discussion regarding the Progress 59P Accident Summary. There were no comments or questions.*

#### Functional Cargo Block Module Status and Current Risks

*A representative from the Khrunichev State Research and Production Space Center provided an overview of the Functional Cargo Block Module and current risks. The FGB module is currently stable in terms of temperature, environment, and humidity. There were two refueling missions in 2015 and the total mass of propellant refueled equaled approximately 1200kg. In 2015, roughly 53 crew hours were devoted to servicing the FGB module, which was lower than the 100 crew hours allocated to FGB servicing per the module specification. Small systems malfunctions increased in 2015, due to age of FGB (17 years on orbit). Currently, NASA has not requested an analysis of the electrical system and so the status of the wiring and electrical systems on the FGB is unclear.*

*The JC asked about the status of Khrunichev's analysis regarding extension of FGB lifetime to 2024, and the response was that all hardware has been certified to sustain the FGB until 2024, and certification out till 2028 is currently being explored. The only outstanding issue is the sensor that monitors the bellows in the propellant tanks – which poses an issue with extending life beyond 2024. A very thorough analysis has been conducted on the design, and the issue is the vapor of the propellant in the tanks.*

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

#### Conclusion

*Once again, the Committee commends the ISS Program and the International Partners for the continued successful operation of the ISS and for maintaining an international crew with the existing flight vehicle assets. We also stress that continued vigilance is necessary to maintain safe and productive operations of the space station.*

*Given the information we discussed today, do any Committee members have any final questions or comments? There were no questions or comments. Do the Committee members have any objections to the findings of this report? There were no objections to the findings 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 for all of your hard work on this assessment. I would like to point out that this is a good date for our meeting: later this evening astronaut Scott Kelly and cosmonaut Mikhail Kornienko return after their year-long mission in space. This is a most auspicious day.*

*I look forward to your participation at future meetings. We have started planning for our next meeting in Moscow, tentatively scheduled for the summer of 2016. I look forward to seeing all of you, and our Russian counterparts, in Moscow this summer. This meeting is adjourned at 2:43 EST.*

**NASA International Space Station Advisory Committee**

NASA Headquarters  
Washington, DC  
March 1, 2016

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**NASA International Space Station Advisory Committee**

NASA Headquarters

Washington, DC

March 1, 2016

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Gen. Joe Engle (*via telecon*)

Mr. Robert Maiburger (*via telecon*)

**NASA Attendees**

Tabitha Thompson, Office of Communications

**Other Attendees**

Sara Barber, Staff, U.S. House of Representatives

Paola Castano, Staff, Smithsonian National Air and Space Museum