

**SUBCOMMITTEE ON SPACE AND AERONAUTICS
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES**

***The International Space Station: Lessons from the Soyuz Rocket Failure and
Return to Flight***

Wednesday, October 12, 2011
2:00 p.m. – 4:00 p.m.
2318 Rayburn House Office Building

Introduction

On August 24, 2011, a Russian *Progress* unmanned cargo vehicle carrying supplies to the International Space Station (ISS) crashed during launch from the Baikonur Space Center, Kazakhstan. The crash was caused by a malfunction of the Soyuz-U third stage booster, which is nearly identical to the Soyuz-FG booster used to launch astronaut crews in the Soyuz capsule to the ISS. As a result, use of the Soyuz launch vehicle for astronaut transportation to the ISS has been suspended until the Russian Federal Space Agency (Roscosmos) completes its failure investigation, and the international partners reach agreement on recertification and return-to-flight plans. Both NASA and Roscosmos would like to launch two unmanned Soyuz boosters before recertifying the system to fly humans.

The launch failure highlights the risks of dependence on non-US means for the strategically important capability of access to space. Since the termination of the Space Shuttle program, the Soyuz rocket with its Soyuz crew capsule is the only way to transport NASA and international partner crews to the ISS. The Soyuz crew capsule also serves as a lifeboat for ISS crews. Even with the Shuttle (which could only stay at the ISS for about two weeks), ISS crews relied on the Soyuz capsule to serve as a lifeboat in the event of an emergency to return to Earth.

The purpose of the hearing is to review the impacts of the Soyuz launch vehicle failure on the safe operation and utilization of the ISS, the current status of the Roscosmos' accident investigation, recertification and return-to-flight plans, and the implications of de-crewing the ISS. The hearing will also examine the basis for NASA's decision to resume use of the Soyuz for transportation of its astronauts, including the advice it is receiving from external advisory bodies.

Witnesses

Mr. William H. Gerstenmaier, Associate Administrator, Human Exploration and Operations Mission Directorate, National Aeronautics and Space Administration

Lieutenant General Thomas P. Stafford, USAF (Ret.), Chairman, International Space Station Advisory Committee

Vice Admiral Joseph W. Dyer, USN (Ret.), Chairman, Aerospace Safety Advisory Panel

Overarching Questions and Concerns

- What is the status of Roscosmos' Soyuz launch vehicle failure investigations, and what are the milestones for the Soyuz return-to-flight activities?
- How much insight and influence do NASA and the Aerospace Safety Advisory Panel have into the Russian return-to-flight plans?
- What are the effects of a reduced three-person crew on ISS operations and scientific utilization?
- What are the contingency plans of NASA and the international partners if there are further delays in the Soyuz return to flight efforts?
- If the ISS is fully de-crewed in November, can it be maintained in a safe condition and for how long?
- What are the biggest risks associated with a de-crewed station?

Background and Timelines (All dates in Kazakhstan time)

August 24 - The Russian *Progress 44* unmanned cargo vehicle crashed during launch from the Baikonur Space Center in Kazakhstan. Roscosmos initiated an investigation into the cause of the Soyuz-U third stage failure.

August 29 – Roscosmos attributed the Soyuz-U third stage failure to a malfunction in the engine's gas generator. The cause of the malfunctioning gas generator was not announced. However, the commission concluded the reason for the failure was specific to that engine and not a fleet-wide problem. Since the Soyuz rocket design has flown over a thousand successful flights, the malfunction was presumed to be caused by human error in the manufacturing or assembly process.

Russian news reports cited possible reasons for a decline in quality and workmanship as low salaries, an aging workforce, and lack of investment, coupled with an increased workload that requires manufacturing four Soyuz spacecraft per year to support a six person ISS crew (during the Shuttle program only two Soyuz per year were required).

As a result of two unrelated failures of military satellite launches in December 2010 and February 2011, Roscosmos's chief Anatoly Perminov was forced to resign and Russian news media reported that a number of other senior space industry officials were fired. On September 22, 2011 the Russian News and Information Agency, RIA Novosti, reported that the recent failed launches were a reflection of the agency's management problems and quoted the new head of Roscosmos, Vladimir Popovkin saying, "*We have found the causes [of the failures] and we are trying to identify the people who are responsible...But the troubles go much deeper to the level of management and control within the organization.*" Russian Prime Minister Vladimir Putin has ordered tougher quality controls of all Russian space hardware, including a quality review of all hardware currently in Roscosmos' possession.

Crew Rotation

The immediate issue facing the ISS crew is not lack of supplies. The recent – and final – Space Shuttle mission (STS-135) delivered enough to support a six person crew through next year without being resupplied. However, the limiting factor governing the crew time on ISS is the certified lifetime of the Soyuz capsules that are docked to the station. Soyuz capsules are certified to spend no more than 200 days attached to the ISS because the peroxide thruster system degrades over time. The second issue affecting crew time on ISS are the lighting conditions and weather at the Soyuz landing site in Kazakhstan. The times when a Soyuz capsule can land are dictated by its path over the landing site and the weather conditions at the landing site. Severe weather exists across much of Kazakhstan during the winter months from December to February, making recovery impossible. There are extended periods of time when the orbit only passes over the landing site in darkness, which also make recovery impossible.

The dates governing the landing decisions are as follows:

September 19 to October 27 – Period of darkness at the Soyuz landing site.

October 16 – 200 day certification limit of first Soyuz capsule (TMA-21).

November 22 to December 27 – Period of darkness at the Soyuz landing site.

December 24 – 200 day certification limit of second Soyuz capsule (TMA-02M).

Space Station is Partially De-Crewed

September 16 – As a result of balancing the above requirements, the first Soyuz capsule (TMA-21) returned to Earth with American crewmember Ron Garan, and Russian crewmembers Andrei Borisenko, and Alexander Samokutyayev.

The other three crewmembers, Russian Sergei Volkov, American Mike Fossum, and Japanese Satoshi Furukawa remain on the ISS with the second Soyuz capsule.

October 2 – An unmanned Soyuz-2 rocket, which is similar but not identical to the one that failed in August, successfully launched a GLONASS-M navigation satellite from Russia's Plesetsk launch site. This was one of two uncrewed Soyuz rockets that Roscosmos is using to recertify the rocket for crew.

October 30 – Planned launch of the unmanned Soyuz/Progress 45P to ISS from Baikonur Space Center, Kazakhstan. Again, this version of the Soyuz launch vehicle is similar, but not identical to the failed Soyuz-FG used for crew.

This would be the second of two unmanned Soyuz flights paving the way for the first crewed launch since the original failure.

November 14 – Planned launch of the first crewed Soyuz (28S) since the accident. This mission would carry American crewmember Dan Burbank, and Russian crewmembers Anatoly Ivanishin,

and Anton Shkaplerov to the ISS on November 16th, restoring the crew size back up to six persons for only one week.

November 22 – Planned landing of the second ISS-based Soyuz capsule (27S) carrying Russian Sergei Volkov, American Mike Fossum, and Japanese Satoshi Furukawa. This landing is timed to occur before the beginning of the darkness period.

De-Crewing the Space Station

If the November 14th launch is successful, the ISS would be left with three new crewmembers. If the November 14th launch is delayed, the ISS will be de-crewed, in which case it will be operated autonomously from the ground.

December 26 – Planned launch of Soyuz 29S with three crewmembers. If the ISS is de-crewed in November, this will be the first opportunity to return crew to the ISS.

January 26, 2012 – Planned launch of an unmanned Progress 46 resupply craft.

March 30 – Planned launch of Soyuz 30S with a three person crew.

Potential Effects of De-Crewing the Space Station

As mentioned above, if Roscosmos is unable to resume Soyuz flights by the middle of November, NASA will have to de-crew the ISS. NASA has contingency plans in place to configure ISS for extended autonomous operations without crew. In that case, NASA claims the ISS could be autonomously operated from the ground. According to NASA, the ISS has sufficient propellant aboard to maintain a stable orbit for an extended time. Prior to de-crewing, the habitation and research modules would need to be isolated and the structural hooks holding the unmanned Progress supply vehicles would need to be undone so that Progress vehicles could be undocked and docked autonomously. Debris avoidance maneuvers and reboosting could be accomplished from the ground.

Potential Effects on Research from De-Crewing the Space Station

The biomedical and human physiology research is among the most important for understanding and mitigating the effects of long duration space flight necessary to enable exploration missions to destinations beyond low Earth orbit. This is the research that is most dramatically affected by de-crewing the ISS because this research depends collecting samples and data from crewmembers. On the current Expedition 28 there were more than 25 different investigations into human physiology. If the ISS must be de-crewed many of the biomedical projects that depend on multiple crew samples will be adversely impacted. Further, unanticipated malfunctions that require real-time diagnosis and repair will also be impacted by reduced crew size.