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REPORT IN BRIEF

The Role and Training of NASA Astronauts in the Post-Shuttle Era

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As the National Aeronautics and Space Administration (NASA) retires the Space Shuttle and shifts involvement in International Space Station (ISS) operations, changes in the role and requirements of NASA's Astronaut Corps will take place. At the request of NASA, the National Research Council (NRC) addressed three main questions about these changes: What should be the role and size of Johnson Space Center's (JSC) Flight Crew Operations Directorate (FCOD); what will be the requirements of astronaut training facilities; and is the Astronaut Corps' fleet of training aircraft a cost-effective means of preparing astronauts for NASA's spaceflight program? This report presents an assessment of several issues driven by these questions. This report does not address explicitly the future of human spaceflight.

Background

The United States has been launching astronauts into space for more than five decades and, for a majority of those years, astronauts have been selected and trained through NASA's Astronaut Corps. Since its inception in 1959, the Astronaut Corps—which is based at the Lyndon B. Johnson Space Center (JSC) in Houston, Texas—has experienced periodic fluctuations in size and training emphasis based on various program demands. Currently, NASA has retired the Space Shuttle and is shifting its involvement in ISS operations.

Role and Size of the Flight Crew Operations Directorate

Recent changes to Space Shuttle and ISS programs are affecting the role and value of certain activities, such as astronaut training, that are managed by the JSC's FCOD. This is subsequently reducing the size of the Astronaut Corps—defined in this report as the number of astronauts qualified to fly into space. As of May 2011, the Astronaut Corps consisted of 61 people, compared with a peak size of nearly 150 people in 2000. NASA uses a model for projecting minimum ISS manifest requirements. Using the model on the next page, NASA has projected that the Astronaut Corps will need a minimum of 55-60 astronauts to meet ISS crew requirements through 2016. These crewmembers will also need to be trained in several tasks, including an aptitude for robotics, extravehicular activities (EVA) and Russian language proficiency.

In addition, the U.S. is required to perform astronaut training for ISS international partners such as Europe, Japan and Canada.
NASA is also transitioning to only long-duration ISS missions. Such missions have medical consequences; for example, a relatively new medical condition called papilledema, a swelling of the optic disk, has resulted in the

medical disqualification of several members of the Astronaut Corps. However, the current plan for the size of the Astronaut Corps, which accounts only for a theoretical minimum to meet ISS crew requirements, does not have the flexibility to accommodate unexpected increases in attrition due to such medical problems or other uncertainties.

In order to meet the minimum manifest requirements for ISS, NASA's current 25% management reserve is too low and should be increased. In addition, NASA should ensure that the FCOD continues to serve as a national resource for U.S. human spaceflight experience and knowledge.

Role and Value of Training Facilities

Ground-based simulators for space flight missions—for example, the Neutral Buoyancy Laboratory and the Shuttle simulators—represent approximately 90% of crew training. These mission-specific facilities, which are maintained by the JSC's Mission Operation Directorate (MOD), are currently shifting from Shuttle and ISS assembly training to ISS operations and ISS maintenance and emergency response training. These preparations will be critical for flight crews to safely and successfully respond to future on-orbit problems. These facilities are also required to enable the U.S. to properly provide skills proficiency and training for international partner astronauts.

A small portion of astronaut training, known as Spaceflight Readiness Training (SFRT), takes place in an operational environment to prepare crew for some of the aspects of physical stress and fast-paced decision making experienced during spaceflight. Therefore, a small portion of crew training takes place in a T-38N Talon two-person jet (shown on the next page). The purpose of this two-seat, high-performance training aircraft is to help develop and strengthen cooperation skills in a stressful environment that cannot currently be replicated by other means. The pilot works in coordination with the back-seater, who can oversee various duties such as navigation, communication, crew resource management and other tasks, including occasionally flying the aircraft.

NASA currently has a fleet of 19 T-38Ns for astronaut training with plans to downsize to 16 in 2012 as a result of Astronaut Corps reductions. The FCOD should continue to use the T-38Ns in the short-term as they are the most cost-effective and efficient means for training crewmembers in disorientation, rapid fluctuation in G-forces and complex task performance in a potentially life-threatening environment. In the long term, new technologies could emerge that would be more effective.

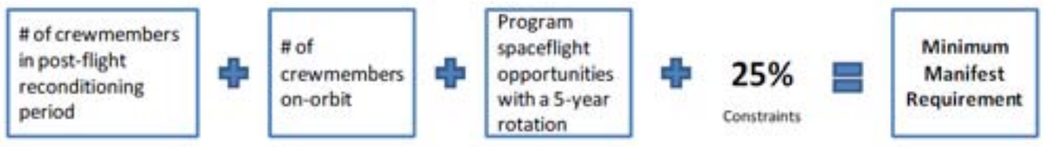

Figure ES 1.1 Minimum Manifest Requirement formula. (Source: NASA White Paper)

Conclusion

As the U.S. astronaut program has evolved over the decades to meet the needs of NASA's activities, astronaut training and required crew qualifications have changed as well. Now, as the Shuttle is retired and ISS has entered a fully operational phase, NASA is undergoing an uncertain transformation. NASA's Astronaut Corps continues to serve as a vital resource for present U.S. space capabilities. In addition, as commercial and international opportunities arise, NASA is in a unique position to provide valuable experience and skills in roles outside of the Astronaut Corps. In light of these recent changes, the proven approaches to crew training currently in use by NASA serve as a firm foundation upon which to prepare for an otherwise uncertain future.

Figure 3.8 T-38N jets in flight over NASA's Dryden Flight Research Center in California. (Source: 2470 NASA Dryden Flight Research Center Gallery)

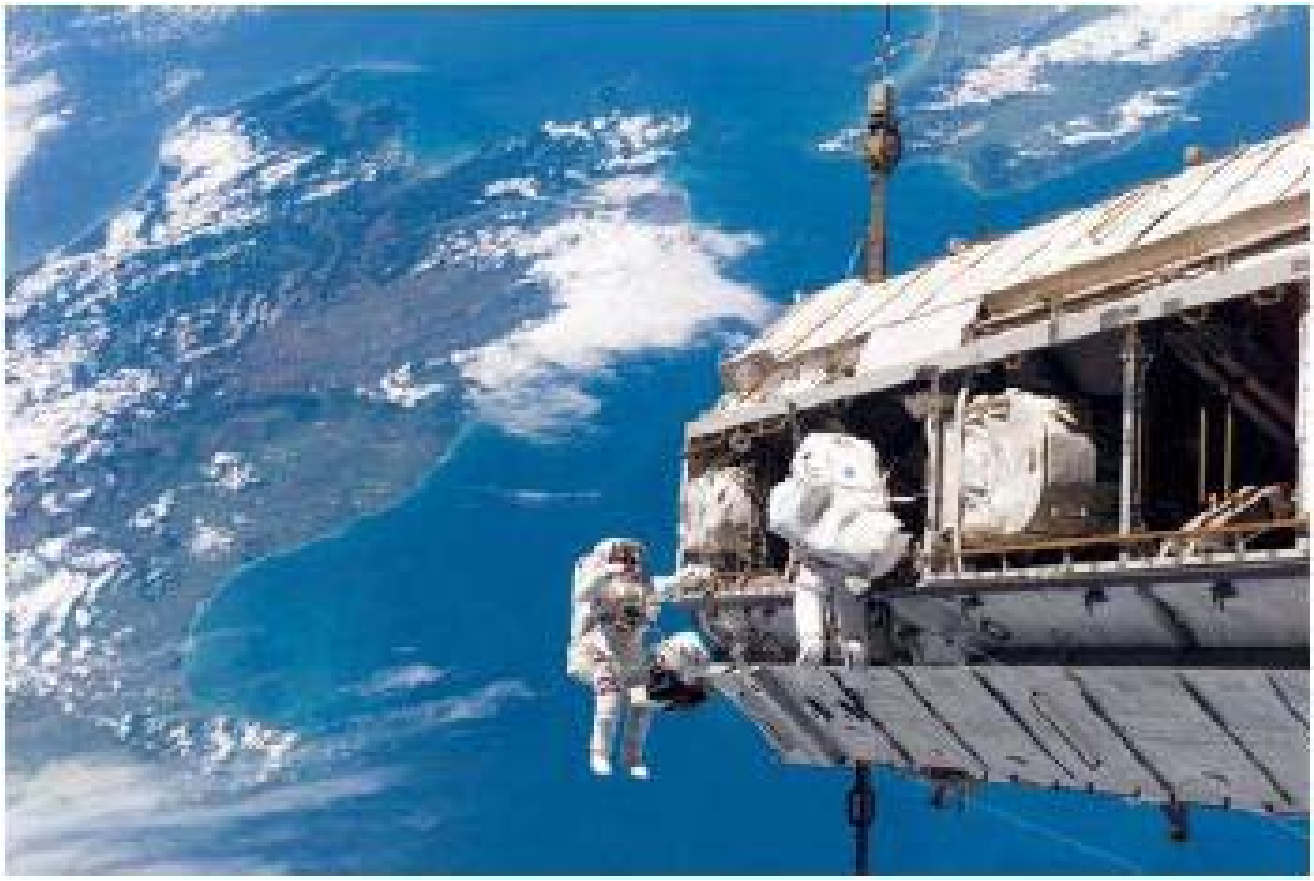

Figure 2.13 American astronauts participate in an extravehicular activity above New Zealand. The ability to conduct EVAs is one of several tasks for which astronauts train. (Source: NASA)

Committee on Human Spaceflight Crew Operations: Frederick Gregory (Co-Chair), Lohfeld Consulting Group, Inc.; Joseph H. Rothenberg (Co-Chair), Swedish Space Corporation; Michael J. Cassutt, University of Southern California; Richard O. Covey, United Space Alliance, LLC (Retired); Duane Deal, Stinger Ghaffarian Technologies, Inc.; Bonnie J. Dunbar, Seattle Museum of Flight, Dunbar International, LLC (President and CEO); William W. Hoover, Independent Consultant; Thomas D. Jones, Florida Institute of Human and Machine Cognition; Franklin D. Martin, Martin Consulting, Inc.; Henry McDonald, University of Tennessee at Chattanooga; Amy R. Pritchett, Georgia Institute of Technology; James D. Von Suskil, NRG, Texas; Richard N. Richards, Boeing Corporation (Retired)

Staff: Dwayne A. Day, Senior Program Officer, Study Director; Catherine A. Gruber, Editor; Amanda Thibault, Research Associate; Lewis Groswald, Research Associate; Dionna Williams, Program Associate; Michael H. Moloney, Director, Aeronautics and Space Engineering Board

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