INTERNATIONAL SPACE STATION UPDATE

Station flight controllers complete power tests

Last month, International Space Station flight controllers in Mission Control Centers in Houston and Moscow put the on-orbit segment through a series of tests. These were designed to determine the maximum amount of power that can be delivered to the U.S. segment by Zarya's electrical power system and the associated Node 1 shell heating rate.

A design deficiency in Zarya's charge-discharge units, known by the Russian acronym MIRTs, key components in the electrical power system which track the state of charge of each battery, made pre-flight estimates of power generation capabilities suspect and drove the need for the tests. The tests were conducted while the station's orbital environment was similar to that in which it will be when the Space Shuttle *Discovery* is docked to the station during STS-96.

The STS-96 crew is scheduled to replace the MIRTs during an in-flight maintenance procedure, but until the MIRTs are fully functional, flight controllers must use the system as is to provide for all electrical energy needs of the ISS. The most significant of these needs is the power required to heat up Unity prior to the crew's ingress during the STS-96 mission.

"The objective of these tests is to demonstrate that in the beta angle we will fly for STS-96, we can the run the power system as high as we need to run it in order to warm up the Unity module so that we can send the crew in on time," said Paul S. Hill, lead ISS flight director for STS-96.

Test one, completed April 2, gathered insight in how best to plan for warming the ISS modules prior to *Discovery*'s docking with the station during STS-96. It demonstrated that higher power usage in the current configuration provides adequate battery margins in the Zarya module while warming Unity's shell temperatures, which is necessary before the shuttle docks to the station and the crew climbs inside. The test involved gradually increasing the power used aboard Unity by turning on several heaters to gather insight to plan the best method for warming the module.

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NASA International Space Station Flight Director Paul S. Hill and Elaine Goddard, United Space Alliance power, heating, articulating, lighting and control officer, discuss requirements prior to the second power test.

Analysis of this first test showed that Zarya can deliver at least 900 watts of continuous power to Unity in its normal operating position, thereby simplifying the operations planning for the shuttle flight. Since launch, the station systems have been operating on about 600 watts of power.

This test required extensive interaction between the control centers in Moscow and Houston to plan and conduct.

"The process of preparation for the test took two weeks," said Khrunichev Flight Director Yuri Budnik, who observed the first test from Houston and worked with the team in preparing for the second test. "It was very important that there was a Moscow support group in Houston and a Houston support group in Moscow. And thanks to the close interaction of the specialists, we managed to reach a very good understanding."

The second power test aboard the ISS was completed April 16, setting the stage for the arrival of *Discovery*. The test involved repositioning the station to point the Zarya solar arrays more directly at the sun to increase power generation. The test demonstrated the ability of Zarya to deliver 1,700 watts of power to Unity after docking.

With the power levels demonstrated in these tests, the ISS flight control team gained confidence that the combination of heating before and after docking will allow the Unity shell temperature to be raised to about 66 degrees Fahrenheit to allow the crew to enter the module.

"In order to ingress the Unity module, we have to heat up its shell to a certain level to prevent condensation," said Leena Joshi, Barrios thermal operations resources officer.

The third and final test planned prior to STS-96 was carried out May 12. On April 29, the Russian flight control team uplinked an update to on-board software permitting use of only the small thruster jets on the Zarya module. This update prevents Zarya's 40 kilogram thrusters from firing during maneuvers while the shuttle is in proximity or docked to the ISS. During the test on May 12, Zarya was maneuvered through the sequence planned for shuttle docking to ensure the motion control system performs as expected with the software update. ■

ISS viewing opportunities from the ground can be found on the Internet at: http://spaceflight.nasa.gov/realdata/sightings/

Application deadline nears for NASA astronaut selection

NASA is currently accepting applications for mission specialist and pilot astronaut candidates to join the agency as it enters the era of International Space Station and continues the exploration of space. The deadline to submit an application is July 1. Applications received after July 1 will not be considered for this selection cycle but will be considered for future selection cycles.

An application package may be obtained by contacting the Astronaut Selection Office at 281-483-5907 or by writing to NASA-Johnson Space Center Astronaut Selection Office, Mail Code AHX, Houston, TX, 77058-3696.

Typically, successful applicants for the mission specialist astronaut positions have significant qualifications in engineering or science, while pilot candidates must have extensive piloting experience in high-performance jet aircraft.

Following an intensive six-month period of evaluation and interviews, the final selections will be announced in early 2000. Successful applicants will report to JSC as astronaut candidates in the summer of 2000 to begin more than one year of training in anticipation of future space flight assignments. ■

Additional information on selection criteria and application forms is available electronically through the Astronaut Selection Office Web site at http://www.jsc.nasa.gov/ah/jscjobs/aso/ascan.htm

Space program and the economy: *Onward and upward*

By Jim Lovell

As long as there has been a space program, there have been detractors. "What are we doing up in space when we've got real problems right here on earth?"

I welcome that question since it gives me a chance to list the multitude of innovations we use every day that were first developed for space exploration. And that list keeps getting longer and longer.

Just last week I used a new ear thermometer to check the temperature of a squirming grandchild. The handy device is based on metal coatings technology developed for space helmets.

Smoke detectors, hand-held vacuum cleaners, water filters and ergonomic furniture are just some of the many household items first developed for use in space. The highly efficient foam insulation used in new homes was first used to insulate fuel tanks on liquid-fueled rockets.

Portable X-ray machines, programmable pacemakers and many surgical tools were all pioneered as part of the space program. Concentrated baby foods as well as the freeze-dried instant mixes we feed our kids were first consumed in space. Many of the biofeedback techniques used to reduce stress were first developed for use by astronauts.

Satellites have revolutionized telecommunications and the global positioning system can help navigators on land, in the air or on the seas find their position to within 10 feet anywhere in the world.

The list goes on and on. Studies have shown that for every dollar spent on space development, $7 has been returned to the economy in the form of a new product or service. But one space-program spin-off is paying dividends greater than anyone ever imagined.

> *'What are we doing up in space when we've got real problems right here on earth?'*

While the economy in many parts of the world is in shambles, the U.S. economy keeps humming along. Americans are earning more money than ever before. Unemployment is at an all-time low. And, amazingly, inflation is virtually nonexistent.

Why is the American economy so strong? Economists, not generally known for brevity, answer with a single word: productivity. Since 1990, productivity increases in the U.S. have averaged 2.1 percent each year.

Besides our fabled work ethic, what is it that makes American workers so productive? Computers. American workers know how to use computer technology to work better and smarter. And you can thank the space program for those computers.

During the 1950s, computers were the size of a supermarket. To travel into space, however, we needed computers that could fit into a phone booth. Companies like Fairchild and Intel experimented with ways to reduce the size of computers. The result was the microprocessor.

Every one of the tiny computer chips found in personal computers, network servers, airplanes, manufacturing equipment, cars, toaster ovens, washing machines, toys, alarm clocks and thousands of other products can trace its heritage back to those integrated circuits first developed for the space program.

Thirty-five years ago, critics called the newly invented microprocessors "novelties" and "toys." Today, the cost of developing these "toys" has been returned a billion-fold, if not more.

NASA accounts for a mere 1 percent of the federal budget – an amazingly small amount when you consider the profound effect the agency's work has had on the quality of our lives. Ironically, while the R&D budgets for other government agencies is increasing, NASA's continues to decline – this in spite of its extraordinary track record.

We must continue investing in technology and the space program. We should encourage our children to study math and science. If anything, we should invest more in science education. Standard & Poors DRI estimates that if our productivity and innovation continue at their present rate, real wages could rise by 9 percent over the next decade. Corporate earnings could rise as much as 54 percent.

Scientific growth means economic growth. The evidence is irrefutable. Let's not turn our backs on progress. There is still so much to discover – new medicines, new ways to protect the environment. ■

Jim Lovell, commander of Apollo 13, is the founding chairman of the Space Awareness Alliance's Advisory Board. The Alliance's public awareness campaign encourages Americans to learn about the many life-enhancing benefits brought to us from space. Readers may post electronic-mail messages for Mr. Lovell at www.SpaceConnection.org on the World Wide Web, or may write to Mr. Lovell at 2860 South Circle Drive, Suite 2301, Colorado Springs, CO, 80906.