

ISS gains momentum after successful Shuttle Space flight

Astronauts complete tough mission

by Clive Simpson

The Space Shuttle Atlantis touched down safely in the pitch black of an early Florida morning on 21 September 2006 ending a 12 day mission to re-start construction of the International Space Station (ISS). "Nice to be back. It was a great team effort and assembly is off to a good start," said commander Brent Jett after the landing.

It was the third safe re-entry since Columbia disintegrated during its attempted landing in February 2003 after its heat-shielding was compromised by debris that struck that vehicle during launch.

The first two missions after that were test flights to attempt to get under control a problem with foam insulation popping off the external tank and hitting the delicate heat-shielding in the first moments of flight.

NASA now plans to stage 15 more flights to finish construction of the ISS, with the next mission set for December. NASA is currently attempting to advance Discovery's launch one week from 14 to 7 December, a move that would allow the mission to be completed, if all goes well, before Christmas so employees can spend the holiday season at home with families.

The STS-115 mission succeeded in re-starting assembly of the ISS after the crew delivered and installed the massive P3/P4 truss, an integral part of the Station's backbone, and two sets of solar arrays.

"The truss in its launch configuration is about 45 feet long, but once on orbit with the solar arrays deployed, has a wingspan of almost 240 feet," said Robbie Ashley, Space Station mission manager for the STS-115 mission.

"The P3/P4 element will be installed on what is now the end of the P1 port truss segment already on orbit," he explained before the launch. "It's going to provide two primary capabilities, the first being power. The power module will provide the capability to generate, store, distribute and regulate power for the space station. It's going to supplement the capability that is up there now with the P6 element.

"In addition, the P3 half of the truss has a mechanism that's going to rotate all of the

outboard truss segments, including the solar arrays, to allow them to stay pointed at the Sun for optimal power-generation capability."

The S0 Truss, the centre segment of 11 integrated trusses, was attached to the top of the Destiny Laboratory on 11 April 2002 and it acts as the junction from which external utilities are routed to the Space Station's pressurised modules.

These utilities include power, data, video and ammonia for the Active Thermal Control System. The truss also provides a mounting point for electronic equipment such as the Main Bus Switching Units, four of the DC-to-DC Converter Units and four Secondary Power Distribution Assemblies. Also mounted on S0 are the Station's four GPS antennas and two Rate Gyros.

Launch day

Atlantis was launched into an almost clear Florida sky on 9 September 2006 for an 11 day mission marking the return to assembly of the ISS. It was first time in almost four years that a major new Space Station component had been launched, and was the first in a series of complex Station expansion flights amongst some of the most challenging ever undertaken.

The fuel cut-off sensor system, which malfunctioned and delayed Atlantis' scheduled launch, performed normally. The engine cut-off (ECO) sensor is one of four inside the liquid hydrogen section of the Space Shuttle's external fuel tank.

Commander Brent Jett, pilot Chris Ferguson and mission specialists Heidemarie Stefanyshyn-Piper, Joe Tanner, Dan Burbank and Steve MacLean, a Canadian Space Agency astronaut, lifted off at 10:15 am CDT.

During the climb to orbit, Mission Control



A fish-eye camera view curves the fixed service structure toward Space Shuttle Atlantis as it hurtles past, propelled by columns of fire from the solid rocket boosters. Below, the smoke and steam billows across Launch Pad 39B. At the lower left is the White Room that, when extended against Atlantis, gave the mission crew access to the orbiter. NASA

asked the crew to reconfigure a cooling system that apparently had ice build up. This cleared the so-called Flash Evaporator System and it operated normally. Temporary ice in that cooling unit is not uncommon and has occurred on previous missions.

Moments after main engine cut-off, 8.5 minutes after lift-off, Tanner and MacLean used handheld video and digital still cameras to document the external tank after it separated. This imagery, as well as imagery gathered by cameras in the Shuttle's umbilical well where the tank was connected, were transmitted to the ground for review.

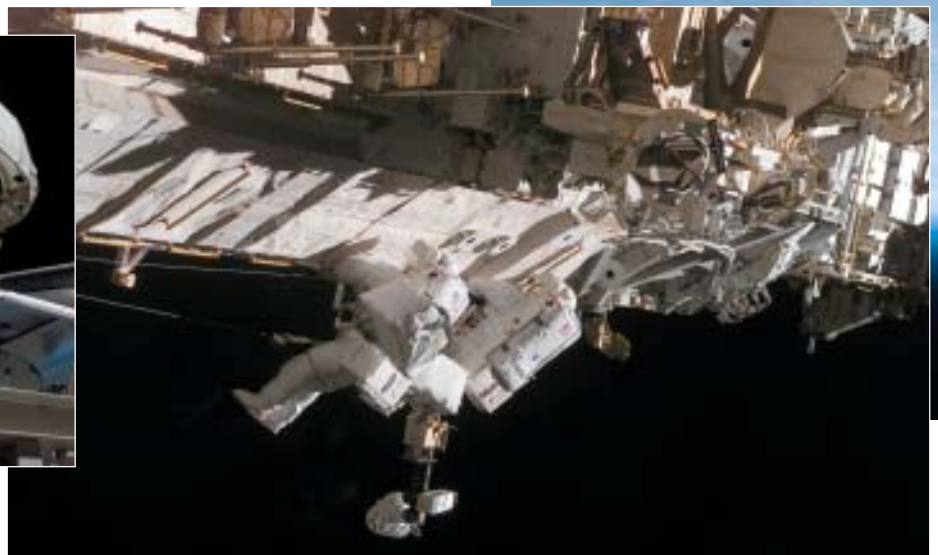
The flight was once again one of the most photographed Shuttle missions ever, with more than 100 high-definition, digital, video and film cameras documenting the launch and climb to orbit. Data from these images, as well as Station and Shuttle crew



Tanner pictured working his way along the Station during the first spacewalk.
NASA



Heidemarie Stefanyshyn-Piper pauses for a moment during the first EVA.
NASA



Daniel Burbank (left) and Steven MacLean during the second of the three spacewalks.
NASA

inspection, helped to clear Atlantis' thermal protection system for return only two and a half days after launch.

As Atlantis launched, the Space Station was 220 miles above the northern Atlantic ocean, between Greenland and Iceland. Aboard the outpost were Expedition 13 commander Pavel Vinogradov, a Russian cosmonaut; flight engineer and NASA science officer Jeff Williams; and flight engineer Thomas Reiter of ESA.

After days of waking up in quarantine on Earth, the crew of Atlantis woke up in weightlessness for its first full day in space.

Jett and Ferguson started the day with a burn of the orbiter manoeuvring system to help position the Shuttle on its course to the ISS. Later Ferguson worked with Burbank and MacLean to survey Atlantis' thermal

protection system, grappling and unberthing the 50 foot orbiter boom sensor system, a crane extension for the Shuttle's robotic arm.

The extension uses two lasers and a high-resolution television camera to examine the Shuttle's leading wing edges and nose cap for any signs of damage that may have occurred during launch.

Tanner and Stefanyshyn-Piper checked out the spacesuits and tools that they, Burbank and MacLean were to use during the mission's three scheduled spacewalks.

Docking and spacewalks

After two days of orbital catch-up the Atlantis crew entered the ISS complex on 11 September at 7:35 am CDT with a wave and

smiles to Mission Control operators on the ground.

"Station, we see you have visitors. Tell them to give us a wave," said astronaut Pam Melroy, serving as CAPCOM for the Space Station.

Prior to docking some one hour and 40 minutes earlier, Jett had flown Atlantis through the now customary orbital back-flip while stationed about 600 feet below the Space Station, allowing the Expedition 13 crew to take a series of high-resolution photographs of the orbiter's heat shield.

After docking, Ferguson and Burbank attached the Shuttle's robotic arm to the 17.5 ton P3/P4 truss, lifted it from its berth in the payload bay, and manoeuvred it for



The ISS from Atlantis taken shortly after undocking, showing the ISS' new pair of solar wings attached to a new section of truss.
NASA

handover to the Station's Canadarm2.

The day ended with a "campout" in the Quest airlock for Heide Stefanyshyn-Piper and Joe Tanner who slept there to prepare for the next day's spacewalk. The "campout" protocol is designed to help rid astronauts of nitrogen in their blood streams and shortens their final spacewalk preparations.

The process reduces the "pre-breathe" time during which nitrogen is purged from the astronauts' systems and air pressure is lowered so the spacewalkers avoid the condition known as the bends. On each of the three spacewalks, the astronauts were able to perform more than the number of

Spot the astronaut in this view from the ISS taken during the second spacewalk. Daniel Burbank can be recognised by the broken red stripe on each leg of his EVA space suit but not so readily visible is Steven MacLean just above and to the right of Burbank.
NASA





Atlantis pictured after it undocked from the Space Station on 17 September 2006. NASA

scheduled activities.

At about 1 am on 12 September Steve MacLean and Jeff Williams used the Station's Canadarm2 to begin the process of moving the truss to its new position at the end of the P1 truss segment where four bolts would attach it.

In the first phase of their spacewalk, Tanner and Piper moved to P3/P4 where Tanner connected power cables whilst Piper worked nearby to release launch restraints on the Solar Array Blanket Box. The two then worked together to release other restraints on the Beta Gimbal Assembly, the structure between the truss electronics and the Solar Array Wings. Next, they worked on configurations of the Solar Alpha Rotary Joint, including the installation of drive lock assemblies.

Tanner's final task involved connecting the electrical cables in the upper utility tray and removing two other circuit interrupt devices, which is necessary for the upcoming STS-116 mission.

Both crews had a busy fifth day (13 September) as they brought to life the new addition to the Space Station.

During the second spacewalk of the STS-115 mission, first-time spacewalkers Dan Burbank and Steve MacLean devoted the day to the final tasks required for activation of the Solar Alpha Rotary Joint (SARJ), a car-sized joint that allows the Station's solar arrays to turn and point toward the Sun.

Just before dawn in Florida the Space Shuttle Atlantis' main landing gear is about to touch down on runway 33 at Kennedy Space Center's Shuttle Landing Facility on 21 September 2006. NASA

Burbank and MacLean released locks that had held the joint secure during its launch to orbit aboard Atlantis. As they worked, the spacewalkers overcame several minor problems, including a malfunctioning helmet camera, a broken socket tool, a stubborn bolt and a bolt that came loose from the mechanism designed to hold it captive. The stubborn bolt required the force of both spacewalkers to finally remove it.

Burbank and MacLean spent seven hours and 11 minutes outside the Station and in addition to the SARJ work they completed several "get-ahead" tasks during their time outside.

Once the spacewalk was completed, Mission Control began a planned four hour activation and checkout of the SARJ, designed to ensure all primary and backup systems on the mechanism were operating well. Early in the checkout, controllers engaged the first of two drive lock assemblies, DLA-1, and rotated the massive joint 180 degrees.

Later they were unable to engage a second drive lock assembly (DLA-2) and had to temporarily delay starting the deployment

of the new solar arrays pending further work and checkout of the SARJ.

A new set of wings

All was well the next day and the Space Station was able to spread its second set of wings, giant solar panels that eventually will double the power generated aboard.

The power generated by the arrays will not be used by the Station until the next Shuttle flight in December. During that mission, the STS-116 astronauts will rewire the complex and activate a cooling system. The arrays are currently powering their own system, including batteries and other electronics equipment.

The solar panels have a wingspan of 240 feet attached on the port side of the Station. They can generate 66 kilowatts of power.

Unfurled one at a time, the wings were deployed halfway before being fully unfolded. During the unfurling, Atlantis' astronauts noted that some of the panels stuck. The phenomenon, called "stiction", also occurred when the Station's first set of solar panels was deployed during a Shuttle mission in late 2000.

On 15 September Joe Tanner and Heide



The STS-115 crew in front of Atlantis. Pictured are (from left): Daniel Burbank, Heidemarie Stefanyshyn-Piper, Steven MacLean, Christopher Ferguson, Brent Jett and Joseph Tanner. NASA

Stefanyshyn-Piper finished the third and final spacewalk of the mission, powering up a cooling radiator for the new solar arrays.

This time there had been a 45 minute delay in the airlock due to a depressurisation pump power problem.

In addition to their work with the radiator, Tanner and Piper also replaced an S-Band radio antenna. The antenna, which provides backup communication between the Station and the ground, will be needed during the next mission which will require a complicated power down of the Station to bring the new power systems on-line.

The couple also finished some tasks that will reduce the workload for future spacewalkers, including installing insulation for another communications antenna. Tanner took photos of the Shuttle's wings using an infrared camera to test the camera's ability to detect damage.

Landing preparations

After completing the three highly successful space walks the Atlantis astronauts got a much deserved day off on 16 September and, after seven days in space, had their first chance to sleep-in late.

They then joined the ISS crew for a press conference. During the morning, the crew were also interviewed by CBS News, NBC News and ABC News, and completed transferring the last of the supplies and equipment to the Station, including 90 pounds of oxygen, and removed the REBA, Rechargeable EVA Battery Assembly.

On 17 September Atlantis left a markedly different Space Station to the one to which it docked less than a week before.

With undocking at 7:50 am CDT they had completed six days, two hours and two minutes of joint operations. As they departed a new Space Station crew was in the final stages of preparation for launch that evening from the Baikonur Cosmodrome, Kazakhstan.

After Atlantis undocked from the Station, it did the first full fly-around of the facility since prior to the Space Shuttle Columbia accident. The manoeuvre helped ground crews get a better perspective on the Station's environment and overall exterior health.

On 19 September, with three crews in orbit on very different craft, a space age conference call linked them up. The three people aboard the Soyuz TMA-9 talked with the six Atlantis astronauts and the three man Expedition 13 crew aboard the ISS.

"It's a little crowded in the sky today,"

said Jeff Williams from the Station. "We look forward to having you guys on board," he told the Soyuz crew. "We'll see you back on Earth sometime soon," Atlantis commander Brent Jett told Expedition 13.

Space Shuttle managers then announced they had decided to extend Atlantis' stay in space to allow for additional inspections of the spacecraft. The decision was made after video from cameras aboard the Shuttle showed a piece of debris in close proximity to the vehicle.

Also, the weather forecast for a landing on 20 September had predicted poor conditions. Atlantis had plentiful supplies aboard and could have stayed in orbit until 23 September if necessary.

Engineers were concerned that the debris seen could be something that came loose from Atlantis and wanted extra time to verify the Shuttle was in good shape for the final leg of its trip home.

During the final inspection a shim and a spacer piece that had been seen protruding from thermal tiles on Atlantis earlier in the mission were found to be missing. But it is not known whether one of them was the item seen floating near Atlantis in video recorded the previous day.

By late on 20 September, following a day of inspections of the spacecraft's exterior, mission managers cleared Atlantis for a return to Earth the next day.