

Mission Summary

Christer Fuglesang will also be undertaking an experiment programme for the European Space Agency as part of the Celsius Mission though this is not currently fixed to a specific day in the mission timeline.

Flight Day 1 - Launch

- Launch from Kennedy Space Center.
- Shuttle to On-orbit configuration
- Activation of Spacehab
- Activation of Shuttle robotic arm

Flight Day 2

- Test the Space Shuttle's robotic arm
- Checking the Space Shuttle heat shields using robotic arm
- EVA preparation including testing EVA suits
- Preparations for docking with the ISS

Flight Day 3 - Docking

- Rendezvous and dock with the ISS including Shuttle backflip manoeuvre to check heat shields
- Hatches opened
- P5 truss moved out of Shuttle cargo bay to overnight parked position using Shuttle and ISS robotic arms
- Transfer equipment from Shuttle to airlock
- Checks on EVA suits. EVA tools prepared
- Fuglesang and Curbeam sealed in airlock for the night to help flush nitrogen out of the blood pre-EVA

Flight Day 4 – EVA 1 (Fuglesang/Curbeam)

- EVA prep
- P5 truss moved to installation location with Station robotic arm
- Solar arrays fixed in position
- EVA: Attach P5 truss to P4 truss, relocate grapple fixture on P5, and remove and replace camera on S1 truss

Flight Day 5

- Transfer cargo between Shuttle and ISS
- Switch over power responsibilities from 4B solar array on P6 truss to 4A solar array on P4 truss
- Retract 4B solar array
- Activate Solar Alpha Rotary Joint for rotating solar arrays on P4 truss section
- Fill and activate port-side cooling loop
- Fuglesang and Curbeam sealed in airlock for the night to help flush nitrogen out of the blood pre-EVA

Flight Day 6 - EVA 2 (Fuglesang/Curbeam)

- Switch ISS systems to power channels 1 and 4
- Shut down power channels 2 and 3
- EVA: Reconfigure power on power channels 2 and 3 around S0 and Z1 truss sections. Activate port-side thermal control system, Activate power channels 2 and 3. Relocate Crew and Equipment Translation Aid (CETA) carts from starboard to port-side of Mobile Transporter.

Flight Day 7

- Transfer cargo between Shuttle and ISS
- Fill and activate starboard cooling loop
- Curbeam and Williams sealed in airlock for the night to help flush nitrogen out of the blood pre-EVA

Flight Day 8 EVA 3 (Curbeam/Williams)

- Switch ISS systems to power channels 2 and 3
- Shut down power channels 1 and 4
- EVA: Reconfigure power on power channels 1 and 4 around S0 and Z1 truss sections. Activate starboard thermal control system, Activate power channels 1 and 4. Stow debris protection panels on mating adapter outside of ISS Node 1. Install grapple bar on thermal box

Flight Day 9

- Configure port and starboard thermal control power supply
- Transfer last items to Shuttle

Flight Day 10 - Undocking

- Hatch Closure
- Undock
- Station flyover
- Thruster burn

Flight Day 11

- Late inspection of Shuttle heat shields

Flight Day 12

- Landing preparations
- Shuttle to landing configuration

Flight Day 13 - Landing

- Landing preparations
- Deorbit burn
- Reentry
- Landing at Kennedy Space Center

Flight Day 1: Shuttle Configuration for On-Orbit Activities

Shortly after the external tank detaches and, if the light conditions allow, Fuglesang's first duty is to get out the photo and video cameras for the documentation of the external tank. He will pass the photo camera to Curbeam who will take still images of the external tank while Fuglesang will record the video footage. This imagery will be analysed to see if anything has fallen off the tank during launch and ascent such as insulation foam.



STS-115 external tank after separation from the Space Shuttle Atlantis on 9 September 2006. A crew member onboard the shuttle recorded the image with a digital still camera. (Image: NASA)

Fuglesang's next duty is to organise the work of converting the Space Shuttle from a launch vehicle into a cargo transporter, workplace and home for the astronauts during their time in space. The seats are stowed away, containers and boxes that were installed in a launch configuration are moved around, spacesuits are taken off and packed away and normal clothes put on, the galley and the toilets are activated, the hatches to Spacehab are opened.



NASA astronaut Joseph Tanner prepares to remove a launch and entry seat on mid deck of Atlantis soon after the Crew reached Earth orbit on flight day 1 of the STS-115. (Image: NASA)

Other activities taking place will include the activation of the Spacehab module and the Shuttle robotic arm. Fuglesang's final duty on flight day 1 will be to connect and boot up the local computer network of seven-eight laptops, a printer and diverse communication modules with Sunita Williams.



NASA astronauts David Wolf, Piers Sellers, and Jeffrey Ashby during sleep on the middeck of the Space Shuttle Atlantis on the STS-112 mission in October 2002. (Image: NASA)

Approximately five hours after launch the astronauts start the first sleep period. The majority sleep on the middeck, with some perhaps in the Shuttle airlock or in the Spacehab module.

Flight Day 2: Shuttle Heat Shield Checks and EVA Preparations

After eight hours sleep the crew are woken up by music transmitted from Ground Control, often chosen by relatives of the crew. On the first full day in space for the crew, one of the major tasks is to test the Space Shuttle's robotic arm and, thereafter, spend a large part of the day checking the Space Shuttle's heat shields to make sure that nothing has damaged them during the launch.

Along the outside of the left-hand side of the cargo bay lies the 15 m long robotic arm, which is controlled from the flight deck. Along the outside of the right-hand side of the cargo bay is an equally long robotic arm extension or boom with camera equipment at one end.



Shuttle Discovery robotic arm and boom during the STS-114 mission on 28 July 2005. (Image: NASA)

NASA astronaut Nicholas Patrick will grip the non-camera end of the boom with the robotic arm and then slowly sweep the other end of the boom with the camera equipment, along the Shuttle's wings and nose and around and underside of the Space

Shuttle. The robotic arm and heat shield survey tasks will be carried out principally by Patrick, Oefelein and Polansky.

Other major tasks that will take place on flight day 2 relate to the EVAs that will take place during the mission. Christer Fuglesang and Robert Curbeam will have the main responsibility for carrying out these tasks, which includes testing the EVA or spacewalk suits known as Extravehicular Mobility Units or EMUs.



NASA astronaut Dominic Gorie with EVA suits on Shuttle Endeavour's mid deck during the STS-108 mission on 7 December 2001. (Image: NASA)

In addition the crew will prepare for docking with the ISS on the following day.

Flight Day 3: Rendezvous, Docking and Unloading P5 Truss



Shuttle Discovery carrying out a backflip manoeuvre on 28 July 2005 prior to docking with the ISS during the STS-114 mission. (Image: NASA)

On day 3 the Shuttle starts rendezvous and docking procedures. This takes about 6 hours until docking. One major procedure that does occur during rendezvous with the ISS is that the Shuttle carries out a backflip manoeuvre so that ISS Crew can photograph the underside of the orbiter to check that there is no damage to the heat shields. In the final stages of rendezvous and docking the whole crew is involved carrying out duties from taking photographs to carrying out independent distance and speed measurements. Fuglesang's main responsibility is the docking system itself: starting it up and making sure it functions as it should.



Space Shuttle Atlantis docked with the International Space Station on 12 Sept. 2006 during the STS-115 mission. (Image: NASA)

The Shuttle docking mechanism is located inside the forward section of the Shuttle's cargo bay. This mates to the Pressurised Mating Adapter on the front of the ISS Destiny laboratory. Once leak checks on the hatches have been successfully completed by Fuglesang and Curbeam on the Shuttle side and ESA astronaut Thomas Reiter on the ISS side, the hatches are opened and

greetings take place between the Shuttle Crew and the ISS Expedition 14 Crew: ESA astronaut Thomas Reiter, NASA astronaut Michael Lopez-Alegria and Russian cosmonaut Mikhail Tyurin. The Shuttle crew will, hereafter receive a Space Station safety briefing.

Preparations now start for the following days EVA to attach the P5 truss to the ISS. The Shuttle's robotic arm attaches to a grapple fixture on the P5 truss section in the Shuttle's cargo bay. A signal is now sent from inside the Shuttle to release the special latches that hold the truss in place. The Shuttle robotic arm removes the truss section from the cargo bay and the Space Station robotic arm attaches to another grapple fixture on the P5 truss section. Once attached the Shuttle's robotic arm detaches from the truss section and the ISS robotic arm moves the P5 truss section to an overnight parked position close to the cargo bay in preparation for the following day's activities.

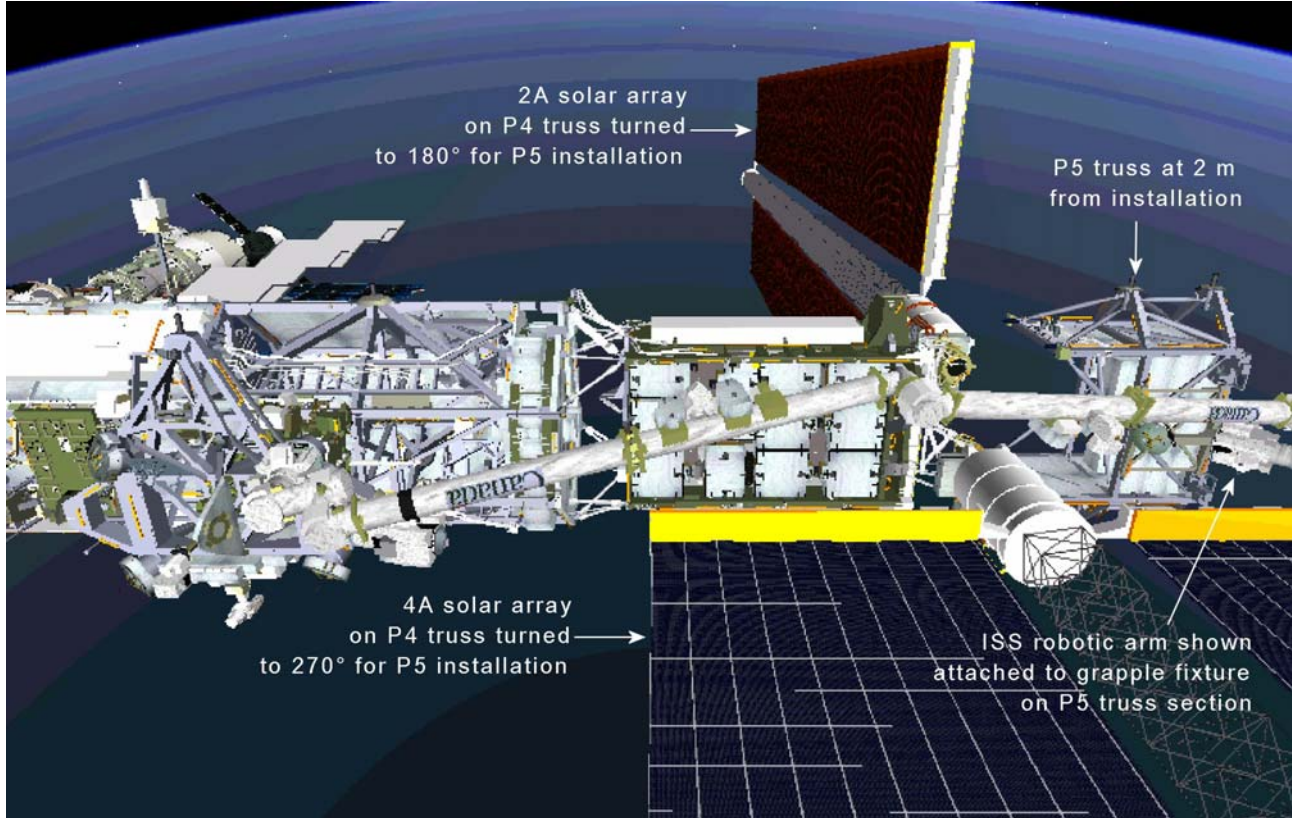


The S0 truss being moved outside of Space Shuttle Atlantis' cargo bay by the ISS robotic arm during the STS-110 mission on 11 April 2002. (Image: NASA)

The robotic arm procedures will involve Patrick, Higginbotham, Polansky and ISS Commander Lopez-Alegria. The remaining Shuttle crew will transfer equipment: EVA suits and tools etc. to the Quest Airlock (See section: EVA Support Information). Checks are carried out on the EVA suits and the EVA tools are prepared.

After review about the EVA tasks and procedures by the crews, Fuglesang and Curbeam are sealed into the airlock for the night at 70% of normal atmospheric pressure i.e. 0.7 bar with a higher % oxygen level. This is to help flush nitrogen out of the body and reduce the risk of decompression sickness in connection with the EVA they will carry out.

Flight Day 4: EVA 1 – P5 Truss Attachment and Additional Tasks



Graphic representation of the front, left-hand (port) side of the ISS during EVA procedures.

Higginbotham and Williams use the ISS robotic arm to move the P5 truss section from its overnight position closer to its installation location at the end of the P4 truss section. A ground command fixes the solar arrays in specific positions and there is a shutdown of power supply to the P4 truss in order to attach relevant cabling during the EVA.



Canadian Space Agency astronaut Steven MacLean works at the controls for the ISS robotic arm during P3/4 truss installation procedures on 12 September 2006 as part of the STS-115 mission. (Image: NASA)

Fuglesang and Curbeam carry out additional EVA preparations, with the help of Oefelein and Lopez-Alegria, including putting on their EVA suits and airlock decompression (See section: EVA Support Information). Oefelein will also guide the spacewalk from the Space Shuttle flight deck. On complete decompression the hatch is opened and the scheduled 6 hr 15 min EVA begins.

The P5 truss section is moved to a pre-install position about two metres from where it attaches to the P4 truss section. This happens as the crew are leaving the airlock. Curbeam and Fuglesang then make their way to the installation location, the furthest away from the airlock that any crew has ever been on orbit during a spacewalk. Fuglesang will work on the attachment corners facing the Earth and Curbeam on the attachment corners facing away from the Earth.

The first EVA task is to attach the P5 truss to the P4 truss section. Fuglesang and Curbeam will watch the P5 truss very carefully as it is manoeuvred slowly to within 20 cm of its final position by Higginbotham and Williams inside the

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ISS using the ISS robotic arm. This is essential as the truss section will come within cms of delicate electronics boxes on the P4 truss section. As they can't see properly inside the ISS, the EVA crew will communicate with the robotic arm operators in order to avoid any misalignment and to keep the P5 truss on the correct path for mating with the P4 truss section.

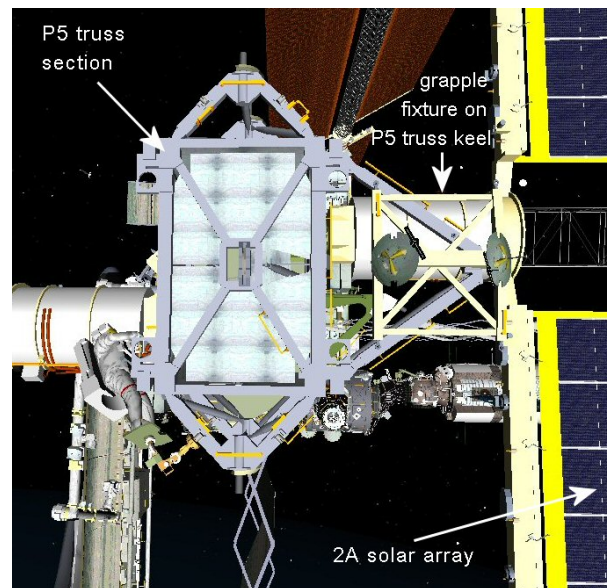
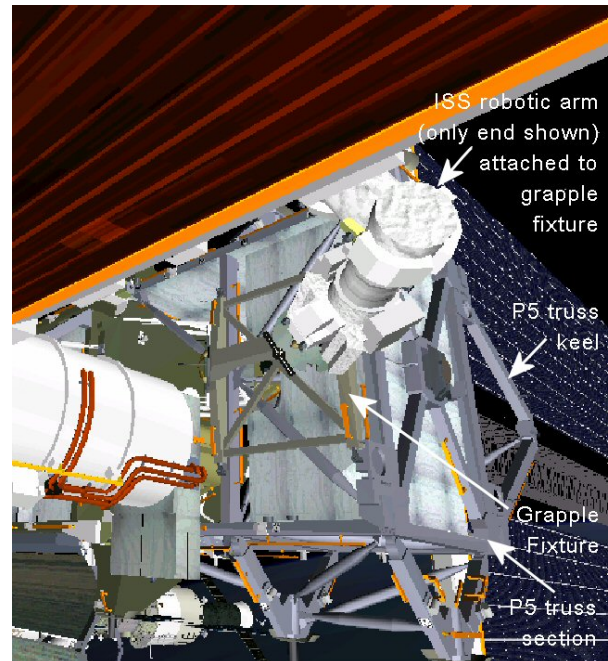
At 20 cm from the attachment location, launch locks are removed from the primary attachment bolts of the P5 truss. This is completed about 1½ hours into the EVA. The truss is now manoeuvred into its mating position. The attachment bolts are screwed into position by Fuglesang and Curbeam using a Pistol Grip Tool, a kind of battery driven ratchet tool.

With P5 attached, four grounding straps are connected between the P4 and P5 truss sections. These are to help deal with electrical charging on the outside surfaces of the ISS. Fuglesang and Curbeam now attach cabling from the P4 truss section to the P5 truss. This will be used to transfer the primary power supply generated by the solar arrays on the P6 truss section, when it is relocated to the end of the P5 truss on a future assembly mission and for transferring secondary power for, for example, carrying out ISS robotic arm work on the truss. The EVA is almost halfway complete.



NASA astronaut Joseph Tanner connecting cables on 12 September 2006 during STS-115 mission, which installed the P3/4 truss onto the International Space Station. (Image: NASA)

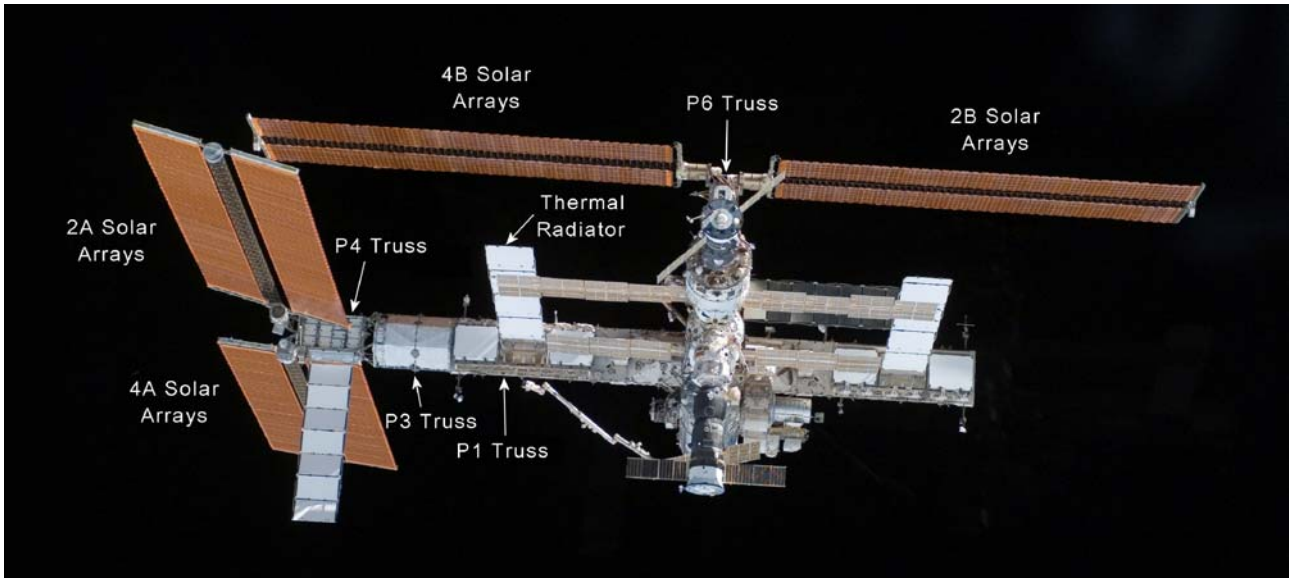
The grapple fixture that was used by the Station's robotic arm to hold and move the P5 truss is now removed by the EVA astronauts from the front face of the P5 truss and relocated to the keel on the back face of the P5 truss to allow the P4 solar arrays to rotate. This task takes about an hour.



Graphic representations of: (Top) grapple fixture on front face of the P5 truss and; (Bottom) grapple fixture after relocation to the keel on the back face of the P5 truss.

The last task on the EVA will be to remove and replace an external TV camera on the Earth-facing side at the end of the S1 truss section. The new camera, which will replace a failed camera in this location, will provide highly desired camera views to assist with installation of the S3/S4 truss segment on ISS assembly flight 13A. Fuglesang and Curbeam now return to the airlock and close the hatch to signify the end of the EVA.

Flight Day 5: ISS Power Configuration and Equipment Transfer



International Space Station following installation of the P3/4 integrated truss section on 17 September 2006. (Image: NASA)

On flight day 5 the Shuttle and ISS crews are involved mainly with the task of moving cargo across from Discovery to the Station. Higginbotham is the logistics manager for the equipment coming out of the Spacehab checking that it ends up where it should on the ISS. Later, experiments, equipment and other cargo will be transferred from the ISS to the Spacehab, for return to Earth.

Major activities on day 5 in connection with ISS assembly will involve commanding the ISS from the ground. This will signify the start of the switch over of the ISS from its early power generation capabilities to its assembly complete power generation capabilities. Until this mission, the main source of primary power for the ISS was generated by the P6 truss, with its two sets of solar arrays: the 4B solar arrays currently pointing to the left (port) side of the ISS and the 2B solar arrays pointing to the right (starboard) side. The STS-115 mission in September 2006 installed the P3/4 truss section with additional solar arrays (2A and 4A) though these are not currently hooked up to the ISS power supply.

The first task switches over power production responsibilities associated with the 4B solar arrays on the P6 truss onto the 4A solar arrays on the P4 truss. With this complete, the 4B solar arrays are now retracted. This process will be closely monitored by the crew as the solar arrays

are composed of numerous parts, which have to fold into each other in order to fully retract.

After retraction of the solar arrays on P6, it is now possible for the P4 solar arrays (and the P4 truss section itself) to rotate around the end of the port side truss to help to point the solar arrays towards the Sun. This is done by activating a major rotary joint between the P3 and P4 truss sections, called the Solar Alpha Rotary Joint. The advantage of using the solar arrays on the P4 truss over the solar arrays on the P6 truss (where it is currently located) is that they can rotate around two axes, whereas the P6 solar arrays only rotate around one. This means that the P4 solar arrays can always be pointed towards the Sun without needing to change the orientation of the ISS itself.

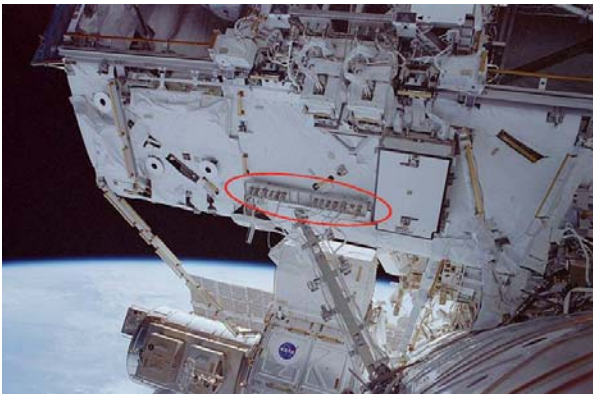
The next ground task activates the cooling loop on the port side truss. A rotary joint is activated on the back of the P1 truss. This rotates a beam housing three thermal radiators for dispersal of excess heat from the ISS (though only one radiator is deployed during this assembly mission). With the joint activated, the cooling loop on this side of the truss is filled with ammonia, the coolant used in the external cooling loops. It is filled from a tank on the backside of the P1 truss.

The power channel from the 4B solar arrays is now placed in a dormant state with the 4B batteries acting as a backup to the 4A supply.

Flight Day 6: EVA 2 – ISS Power Configuration and Crew and Equipment Translation Aid (CETA) Cart Relocation

On day 4 on the ISS the second EVA with Fuglesang and Curbeam takes place lasting 6 hr. The principle reason is to reconfigure half of the ISS power supply and the relocation of equipment situated on the truss. Preparations for the EVA will be the same as for the first EVA.

The ISS has four power channels: 1, 2, 3, and 4. Once all the solar arrays are installed in the future, these four channels will be supplied with power generated respectively by the eight solar arrays 1A/B, 2A/B, 3A/B, and 4A/B. With the attachment of the P3/4 truss section and solar arrays during the STS-115 mission, the Station needs literally 'rewiring'. This will be carried out in two halves in order to keep ISS systems up and running. This EVA will reconfigure power channels 2 and 3.

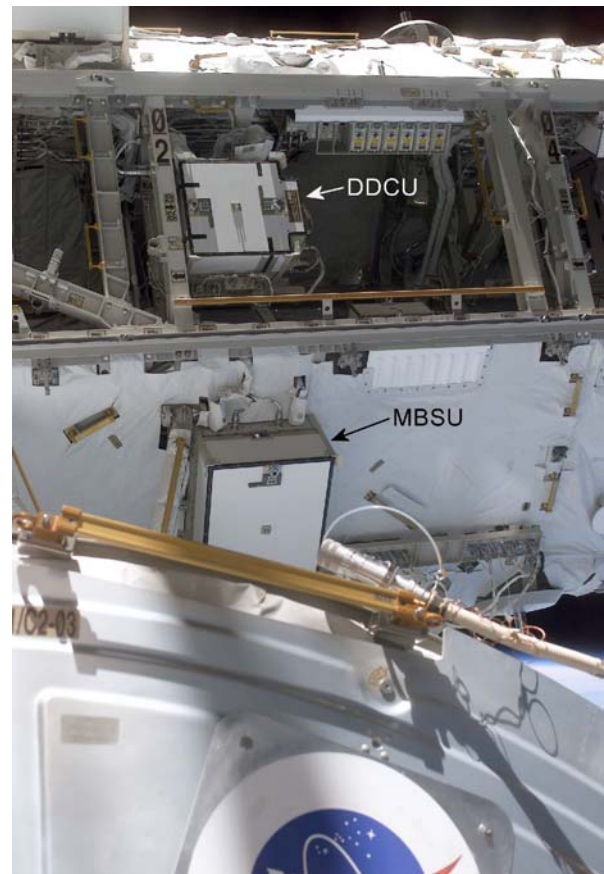


(Top) Connector panel on the S0 truss circled in red for reconfiguration of avionics. (Bottom) close up of left-hand side of connector panel. Power channels 2 and 3 configured through the two leftmost connectors shown during second EVA. Power channels 1 and 4 configured through the two rightmost connectors shown during third EVA. (Image: NASA)

Power channels 2 and 3 are powered down after switching power supply to ISS systems (Command and Data Handling; Environmental

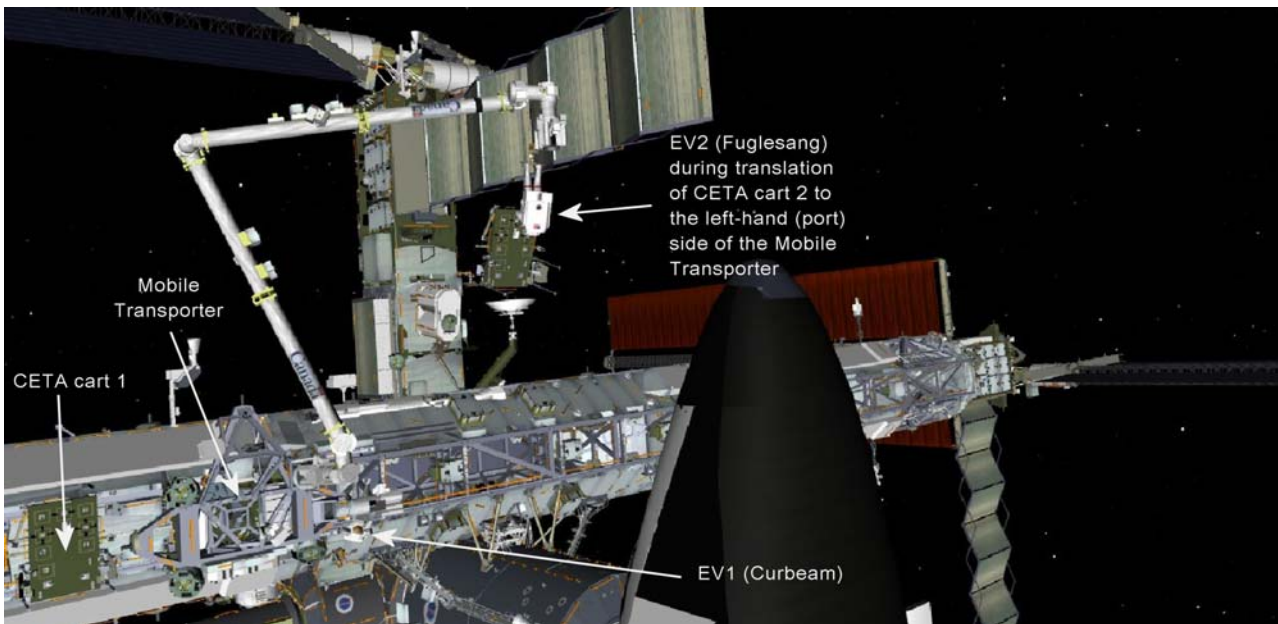
Control and Life Support; Guidance, Navigation and Control; and Communications and Tracking) over to power channels 1 and 4.

Following egress from the airlock Fuglesang and Curbeam will move around several sites around the S0 and Z1 truss sections, changing connectors. This will reconfigure avionics, reconfigure direct current-to-direct current conversion units (DDCUs) and reroute the primary 160 volt dc power supply generated through two Main Bus Switching Units, located on the S0 truss, associated with power channels 2 and 3. Main Bus Switching Units are routers that distribute the 160 volt direct current to DDCUs for converting to 124 volt direct current for use by ISS systems and experiment payloads. After connecting P5 and P4 truss section power through the switching units and connecting DDCUs, the switching units are activated. This is followed by activation of the Loop B thermal control system on the P1 truss via a ground control command.



S0 truss showing location of a dc to dc conversion unit and a Main Bus Switching Unit. (Image: NASA)

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Graphic representation of relocation of Crew and Equipment Translation Aid (CETA) cart 2 from the starboard side of the Mobile Transporter, from next to CETA cart 1 to the port side of the Mobile Transporter. This will be followed by relocation of CETA cart 1 to the port side.

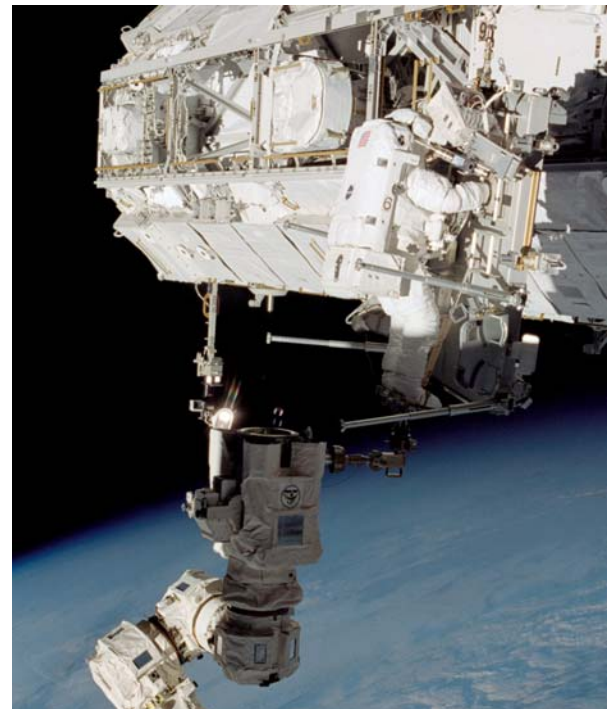
Prior to activation of the Loop B thermal control system, the astronauts translate to the Mobile Transporter on the truss, which has two Crew and Equipment Translation Aid (CETA) carts attached to the right-hand (starboard) side. The Mobile Transporter, on which the ISS robotic arm is situated, is a special platform that can move along the truss on special rails. The attached CETA carts are used to move EVA astronauts and equipment along the truss and act as an EVA work station.

The CETA carts need to be moved to the left-hand (port) side of the truss to provide clearance for the third EVA and to allow the Mobile Transporter to move to the very starboard on the S1 truss for installation of the S3/S4 truss section on ISS assembly flight 13A in February 2007.

Fuglesang will step onto a foothold mounting that he installs on the robotic arm. Higginbotham will manoeuvre Fuglesang to the CETA cart furthest away from the Mobile Transporter using the robotic arm. Curbeam will uncouple the cart and Fuglesang, now holding and attached to the cart, will be transported by the robotic arm to the other side of the Mobile Transporter. Curbeam who has moved to the new location connects the cart. This process is repeated for the second cart. At the same time ground commands are initiated to power back up power channels 2 and 3.

Following this relocation, the astronauts will work on the Z1 truss section where they need to reconfigure the power supply. The Z1 truss

currently receives power from DDCUs on the P6 truss. Relevant power supply will be powered down and the astronauts will reroute the power supply from P6 DDCUs to DDCUs on the S0 truss. Relevant power supply will then be reactivated. On completion Fuglesang and Curbeam will return to the airlock, concluding the EVA.



NASA astronaut John Herrington on a mobile foot restraint on the ISS robotic arm installing a Crew and Equipment Translation Aid (CETA) cart during the STS-113 mission on 28 November 2002. (Image: NASA)

Flight Day 7: ISS Power Configuration and Equipment Transfer



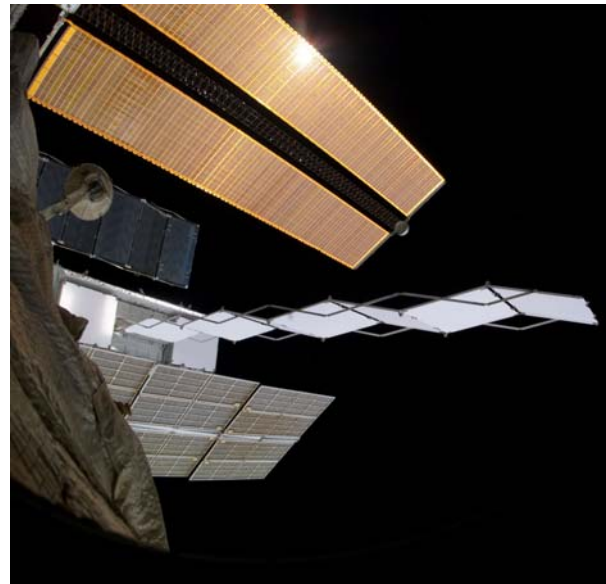
NASA astronaut Wendy Lawrence, who was in charge of the transfer operations, looks over an inventory checklist during STS-114 mission on 4 August 2005. (Image: NASA)

Flight day 7 is similar to flight day 5. The crew will spend most of their time transferring cargo between spacecraft. In addition the crew will take part in a twenty minute press conference with selected journalists on the ground and an official crew in-flight portrait is taken. Fuglesang will also adjust his EVA suit to fit Sunita Williams who will undertake the third spacewalk with Curbeam. This is in order to give Williams spacewalk experience in advance of her being 'lead' astronaut during an ISS EVA in the future.



ESA Astronaut Pedro Duque (below) and NASA astronaut Steven Lindsey in Spacehab single module in the Shuttle cargo bay during STS-95 mission on 4 November 1998. (Image: NASA)

Again similar to flight day 5, major activities in connection with ISS assembly will involve commanding the ISS from the ground. In preparation for filling of the thermal control loop on the starboard S1 truss (Loop A), the thermal radiator rotary joint on the S1 truss is activated. This joint rotates a beam on the backside of the truss that again houses three radiators used for dispersal of excess heat from the Station (though only one is deployed during this assembly mission).



Central radiator of the S1 truss section shown extended after installation of S1 truss on 14 October 2002. (Image: NASA)

With the joint activated, Loop A is now filled with ammonia. Loop A (just as Loop B) has been pressurised with nitrogen following its arrival at the ISS in November 2002 to verify the loop's pressure integrity. This nitrogen is vented shortly after Shuttle launch using a ground command.

Due to power reconfigurations, the control of the thermal radiator rotary joint on the P1 truss is switched from one Multiplexer/Demultiplexer to another. This is so that the rotary joint is still active after powering down electric supply on the following day's EVA.

The power supply is then switched for systems to run from power channels 2 and 3 and not from power channels 1 and 4.

Flight Day 8: EVA 3 - Power Configuration and Installation Tasks

During this final mission EVA of 6 hr 10 min, the other half of the electrical power supply needs to be configured as in EVA 2. As such power channels 1 and 4 are shut down after ISS systems are transferred onto power channels 2 and 3. Preparations for the EVA will be the same as for the first two EVAs.

After leaving the airlock, Curbeam and Williams, will move around several sites around the S0 and Z1 truss sections similar to EVA 2, changing connectors. This will once again reconfigure avionics, reconfigure direct current-to-direct current conversion units (DDCUs) and reroute the primary 160 volt dc power supply generated through two Main Bus Switching Units, located on the S0 truss, though this time associated with power channels 1 and 4. After connecting P5 and P4 truss section power through the switching units and connecting DDCUs, the switching units are activated.



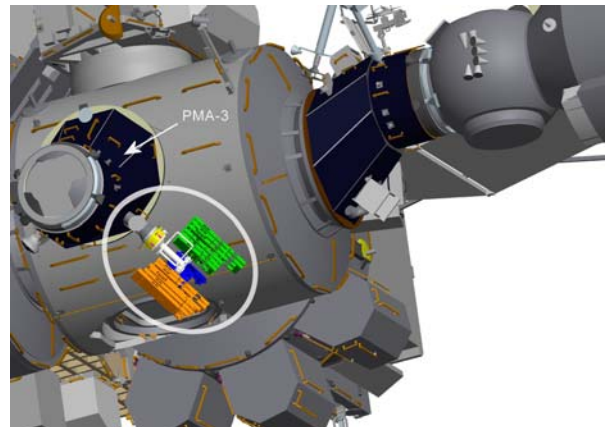
Bundle of Service Module Debris Panels held in fixation frame

After carrying out these tasks, Curbeam and Williams move to the Integrated Cargo Carrier pallet located at the back of the Shuttle cargo bay from which they remove three bundles of Service Module Debris Panels. These are protective panels which will be installed on the outside of the Russian Service Module during a future EVA, but for now will be temporarily stowed outside the ISS.

The panels will be attached to an adapter also on the pallet. Williams, who is attached to the Shuttle Robotic Arm will remove the adapter from the pallet and will be moved by the arm to Pressurised Mating Adapter 3 on the ISS Node 1 'Unity'. Curbeam will move across to the same location. Williams will install the panels on a

grapple fixture on the Pressurised Mating Adapter and Curbeam will latch the hardware together. At the end of this task Curbeam will carry out a reconfiguration of power supply on the Z1 truss similar to the last task on the second EVA.

During installation of the Service Module Debris Panels, ground control commands will activate the Loop A thermal control system on the S1 truss and thereafter power back up power channels 1 and 4.



(Top) Adapter for Service Module Debris Panels. (Bottom) Service Module Debris Panels fixed on adapter (circled), attached to Pressurised Mating Adapter 3 (PMA-3) on the ISS Node 1.

The last task on EVA 3 is to install an Adjustable Grapple Bar to a thermal box called the Flexed-hose Rotary Coupler. This bar has a grapple fixture on it that allows the thermal box to be handled by either the Shuttle or ISS robotic arms for on-orbit maintenance.

Flight Day 9: Final Equipment Transfer and Crew Free Time



On 16 September 2006, the day before undocking of Space Shuttle Atlantis, STS-115 and Expedition 13 crewmembers enjoy a light moment in the ISS Node 1. From the left are Roscosmos cosmonaut and Expedition 13 commander Pavel Vinogradov, NASA astronaut and Expedition 13 Flight Engineer 1 Jeffrey Williams, ESA astronaut and Expedition 13 Flight Engineer 2 Thomas Reiter, STS-115 pilot Christopher Ferguson; and STS-115 mission specialists Daniel Burbank (top) and Heidemarie Stefanyshyn-Piper (bottom right). (Image: NASA)

In connection with activities on flight day 7, control of the thermal radiator rotary joint on the P1 truss is switched back to the original Multiplexer/Demultiplexer so that it has a different power supply. The P1 rotary joint and the thermal loop pumps are configured on different power supplies in case of failure, so that either the rotary joint or pump is lost but not both. The same is true on the starboard side though in reverse.

The last items are transferred from the Shuttle to the ISS and everything that has to be transported to Earth is loaded into the Spacehab. There is also a further press conference and, time permitting, oxygen and nitrogen will be transferred from the Shuttle to the ISS and Fuglesang will carry out a session of the ALTEA experiment. The crew also get some official free time.

Flight Day 10: Undocking



Expedition 13 crew wave goodbye to departing STS-121 crew prior to hatch closure on 15 July 2006. From left to right Expedition 13 Commander Pavel Vinogradov, and Expedition 13 Flight Engineers: ESA astronaut Thomas Reiter and NASA astronaut Jeffrey Williams. (Image: NASA)

Undocking takes place on day 10. The crew is the same as for launch except that ESA astronaut Thomas Reiter who will have finished his tour of duty on the ISS will replace Sunita Williams in the Shuttle. It will now be about three days until the Shuttle lands.



International Space Station seen through a window on Space Shuttle Endeavour's aft flight deck on 15 December 2001 at the end of the STS-108 mission. Pictured are returning Expedition 3 flight engineer Vladimir Dezhurov (left) and STS-108 pilot Mark Kelly. (Image: NASA)

Oefelein as pilot is at the helm for undocking. The Shuttle's flight path is first straight out from the Space Station in the direction of its orbit around the Earth. After 100 m the Shuttle is manoeuvred up over the ISS, doing a circuit around the Station at a distance of approximately 200 m with the

crew taking photographs and video footage. After this circuit the Shuttle fires thrusters and puts distance between itself and the ISS.



The Space Shuttle Atlantis following undocking from the International Space Station on 17 September 2006 at the end of the STS-115 mission. (Image: NASA)

Later the same day, Fuglesang, deploys two US experiments (RAFT and MEPSI) that are situated on the Integrated Cargo Carrier in the Shuttle's cargo bay. This is carried out from the inside, by throwing a number of switches, after navigating the Space Shuttle into the correct position and preparing the photography and video filming equipment.



View of the International Space Station from Space Shuttle Atlantis following its undocking 17 September 2006 as part of the STS-115 mission. (Image: NASA)

Flight Day 11/12/13: Shuttle Heat Shield Checks and Preparation and Configuration for Landing

On flight day 11 an additional late inspection of Discovery's heat shields prior to re-entry is undertaken.

On flight day 12 a final US experiment (ANDE) is deployed. During the rest of the flight day the crew make preparations for landing the following day. Everything not needed anymore is stowed away and the orange spacesuits worn for the launch and landing are brought out. The seats are again installed.



NASA astronauts Stephanie Wilson (left) and Michael Fossum on the aft flight deck of the Space Shuttle Discovery on 16 July 2006, the day prior to landing as part of the STS-121 mission. (Image: NASA)

Reiter who has experienced six months of weightlessness, has a special seat where he can lie down. On Earth the body has to work harder against gravity to pump blood to the upper body. In space this is not the case and the body becomes desensitised with increased exposure to weightlessness. On return to Earth therefore, once again under gravity, astronauts are more susceptible to fainting the longer they have been exposed to weightlessness.

The others astronauts on Shuttle who have only been in weightlessness for ten days, will sit up, wearing G-suits under the spacesuits which, by pressing on the legs and around the waist, help to force the blood up into the upper body.

A last press conference is held from space during the day.

The final day, day 13, is solely concerned with the preparations for the actual landing. They are similar to the post-launch procedures but in reverse. Fuglesang is responsible for the work on the mid-deck. Everything is put into place and one by one the crewmembers put on their launch/landing spacesuits, beginning with the commander and the pilot, and get fastened into their seats.



Again attired in orange launch and reentry suit, STS-115 commander Brent Jett, Jr. 21 September 2006 looks over a procedures checklist prior to entry on the Space Shuttle Atlantis flight deck. (Image: NASA)

Fuglesang is the last to get fastened into position. About 1 hour prior to landing, following the order from mission control, deorbit and landing procedures will begin (See Launch to Landing Procedures).