ESA Expedition Mission Overview: ISS Flight Engineer 2 Tasks

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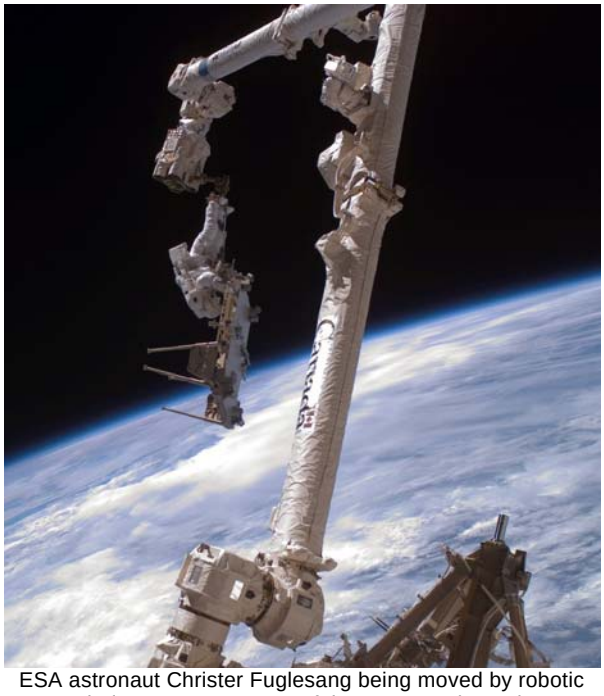
ESA astronaut Léopold Eyharts will undertake many tasks in his role as Flight Engineer 2 of the ISS Expedition 16 crew during his 7-8 week stay on the ISS before returning on the STS-123 Shuttle mission. As such he has trained in order to be able to carry out many functions, which utilise ISS systems and scientific hardware.

During the course of his mission, Eyharts responsibilities will involve carrying out any number of these tasks as and when required. These not only involve the utilisation of the relevant systems but can also involve the reconfiguration and repair of them using specially designed tools configured to the relevant equipment in the different sections of the ISS. These include:



ESA astronaut Christer Fuglesang being moved by robotic arm during an EVA as part of the STS-116 (12A.1) ISS assembly mission. (Image: NASA)

Space Station Robotic Arm Operation
Léopold Eyharts is qualified in the operation of the Space Station Remote Manipulator System (SSRMS) known as Canadarm 2, the Space Station's robotic arm used for ISS assembly and maintenance. During the STS-122 docked phase with the ISS he will be undertaking robotic arm procedures as part of the Columbus mission in relation to firstly docking Columbus to the ISS and secondly installation of European payloads on the Columbus laboratory.

For the second part of these activities he will be the operator of the robotic arm during the third EVA, which involves transferring an astronaut on the robotic arm from the Shuttle cargo bay to the Columbus External Payload Facility where the European EuTEF and SOLAR payload facilities will be installed by the spacewalking astronauts. He will also be the operator of the robotic arm during the same EVA for transferring an astronaut from External Stowage Platform 2 to the Shuttle cargo bay in order to transfer a failed Control Moment Gyroscope for return to Earth.

Eyharts will also be involved in robotic arm procedures during the 1J/A ISS assembly mission scheduled for launch in mid-March 2008.

Columbus Commissioning
Eyharts is qualified in the activation and commissioning of the Columbus laboratory and is one of the principal astronauts undertaking these activities along with fellow ESA astronaut Hans Schlegel and with support from NASA colleagues. Commissioning activities include: connecting utility lines (power, data, fluid etc) between Node 2 and Columbus; relocating experiment facilities from launch locations to on-orbit locations and connecting them to relevant ISS systems (power, data, cooling etc); installing facility equipment; activating the facilities; and carrying out the first runs of experiments in certain facilities (Biolab and Fluid Science Laboratory) to determine that they are functioning according to plan.

ATV, Soyuz, Progress Docking/Undocking
Scheduled to be onboard for the arrival of the first European Automated Transfer Vehicle (ATV), early in 2008, Eyharts is trained in the operation of the Russian docking mechanism and ATV docked operations. The Russian docking mechanisms are used on the unmanned ATV and Progress supply spacecraft for bringing regular supplies and scientific equipment to the ISS and removing waste from the ISS, and on the Soyuz TMA spacecraft for bringing crewmembers to and from the ISS. Eyharts is also trained as Flight Engineer for the Soyuz TMA spacecraft, which act as an emergency escape vehicle for the Expedition Crews.

ISS Guidance and Control
Operating the onboard computer and equipment control systems in the Russian section of the ISS. At the heart of these systems is the ESA-developed Data Management System (DMS-R).

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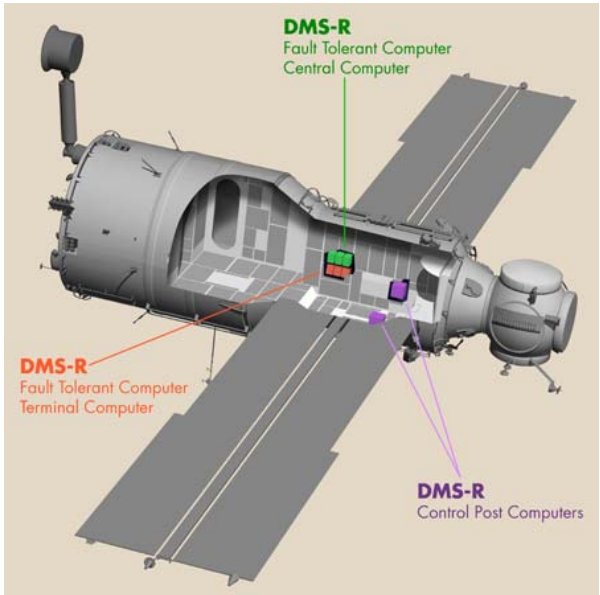
ATV during acoustic test campaign (Image: ESA/S.Corvaja)

This is used for control of the entire Russian section of the ISS and can be used for reconfiguring equipment. Eyharts is also trained in the command and data handling systems in the US section of the ISS.



The European developed Data Management System (DMS-R) computer provides Command and Control for Zvezda and the entire Russian segment of the International Space Station. In addition it provides Guidance, Navigation, Control and mission management to the whole station. (Image: ESA/D. Ducros)

Operating the guidance, navigation and motion control systems for the Station in the Russian section of the ISS. As such Eyharts could undertake tasks such as adjusting the attitude of the ISS, or undertaking debris avoidance manoeuvres. Eyharts is also trained in the Motion Control Systems in the US segment of the ISS. These two systems interact with each other and receive information from GPS, GLONASS and ISS Control moment gyroscopes in order to determine the position, velocity and attitude of the ISS and any point in time.

Environment Control

Operating the US and Russian Environmental Control and Life Support Systems, and the thermal control systems. Environmental Control and Life Support will cover areas such as water recycling and purification, oxygen generation and

Astronaut Donald Pettit, completes a Water Resource Management and Contingency Water Container function on the ISS on 22 January 2003. (Image: NASA)

purification, air conditioning, atmospheric pressure, and even fire detection and suppression. Thermal control systems not only help to help to maintain a comfortable working environment for astronauts in the ISS, it helps to remove heat from equipment in order to prevent overheating. This includes air filters, water loops and radiators on the external surface of the ISS.

Electrical Power

Operating US and Russian electrical power systems. The equipment is used for power generation (via solar arrays attached to the ISS), energy storage, power management, and distribution. These kind of operations can be used for distribution of electrical power between different experiment facilities or ISS systems.

Crew Health and Safety

Operating systems in the Russian and American sections of the ISS such as the Crew Health Care

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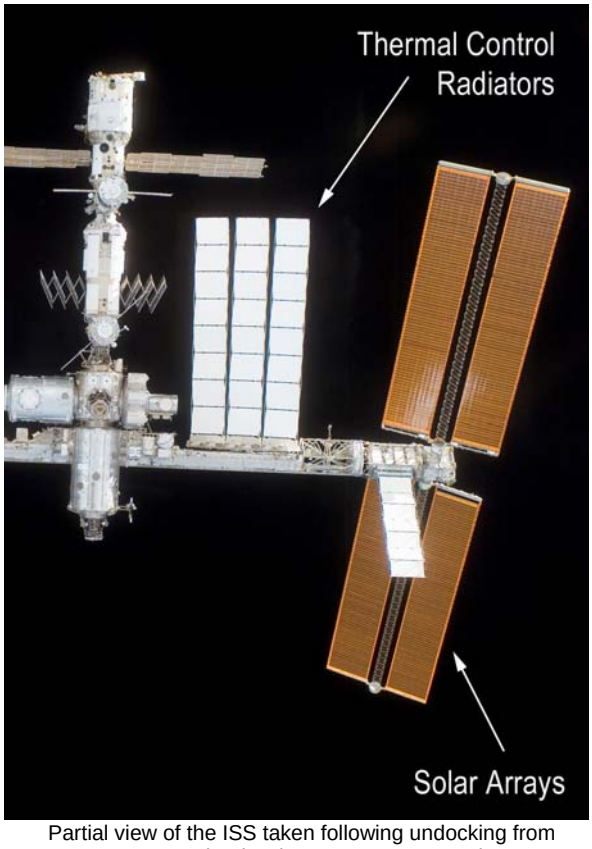

Partial view of the ISS taken following undocking from STS-120 Space Shuttle Discovery on 5 November 2007. Solar arrays and thermal control radiators are clear to see. (Image: NASA)

System (CHeCS) in the American Destiny Laboratory, the Flight Crew System covering House keeping and trash management and the ISS food supply.

Maintenance Operations: Expedition 12 Commander Bill McArthur preparing to remove the Avionics Air Assembly from the Crew Health Care System (CHeCS) rack on 9 December 2005. (Image: NASA)

Communication
Operating of the ISS onboard communication and tracking systems and the onboard audio and video equipment. This provides two-way audio and video communications among ISS crew, between crew and Mission Control, and between crew and Earthbound scientists via Ku-band, S-band, and UHF frequencies.

EVA Operations
This includes undertaking generic EVA operations in both sections of the ISS as well as using EVA-related hardware such as airlock systems for depressurisation and repressurisation and Russian and American EVA suits.

ESA astronaut Thomas Reiter (centre) during training with the Expedition 12 Crew, Valery Tokarev (left) and Bill McArthur. 3 June 2005. (Image: NASA)

Scientific Hardware
Due to the nature of his mission, Eyharts is specialist qualified in all of the Columbus experiment facilities: Biolab, dedicated to biological experiments, the Fluid Science laboratory for experiments in fluid physics, the European Physiology Modules for experiments in Human Physiology and the European Drawer Rack, which can cover a range of different scientific disciplines. Eyharts is also qualified in commissioning of the Protein Crystallisation Diagnostics Facility (a subrack facility of the European Drawer Rack).

In addition to these experiment facilities in Columbus, Eyharts is specialist qualified in a range of European-developed scientific facilities in the US Destiny laboratory. This includes the European Modular Cultivation System dedicated to biological experiments, the Microgravity Science Glovebox (MSG) for materials,

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NASA astronaut and Expedition 13 Flight Engineer Jeffrey Williams inserts a sample into the Minus Eighty Degree Laboratory Freezer for ISS (MELFI) on the International Space Station on 2 Aug. 2006. (Image: NASA)

combustion, fluids and biotechnology experiments, and the Minus Eighty-degree Laboratory Freezer for the ISS (MELFI). He is also specialist qualified in various elements of the Human Research Facility including the Pulmonary Function System, which was jointly developed by ESA and NASA.

Former ESA astronaut Pedro Duque works on the PROMISS experiment inside the Microgravity Science Glovebox during the Cervantes mission in October 2003. (Image: ESA/P. Duque)

ESA astronaut Thomas Reiter during Human Research Facility training at the Johnson Space Center on 1 June 2005. (Image: NASA)

Emergency Operations

Each crewmember needs to be capable of reacting correctly and expeditiously to emergency situations. These situations are trained over and over again during the years of preparation and include crew responses to fire, depressurisation and to toxic atmosphere. In such cases it has to be decided, if the cause of the problem can be located and properly handled, in order to ensure the crew's survival on-board the ISS. However, if there is either insufficient time to fight the problem or the emergency cannot be confined, the crew might have to abandon the station and perform an emergency reentry using the Soyuz-capsule as a rescue vehicle.

The five crewmembers on the ISS go through the usual contingency evacuation drill. ESA astronaut André Kuipers is out of frame. 21 April 2004. (Image: ESA)