# Columbus Completes Development

## The Mission Manager's Perspective

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#### Introduction

Europe's key research contribution to the ISS is the Columbus laboratory module, planned for launch with its payload aboard Shuttle assembly Flight 1E in late 2006. Getting ready for 1E involves preparing four major elements:

- the Flight Segment of the module and its payloads;
- the Ground
  Segment of the
  Columbus Control

For the first time, all the elements of Columbus are together for combined testing ...

- Centre (COL-CC) and the User Support Operations Centres (USOCs);
- the operations procedures and products;
- the crew training.

The tragic loss of Shuttle *Columbia* in February 2003 caused shockwaves throughout the Shuttle and Station schedules, and Columbus has been severely affected.

### **Readiness of the Flight 1E Elements**

The Columbus module, under the prime contractorship of EADS-ST in Bremen (D), has passed its Qualification Review 1 (QR1) and is now finishing its test campaign to support the Final Qualification Review in September-October. At launch, Columbus will be carrying four research rack facilities inside: Biolab, the European Physiology Modules (EPM), the Fluid Science Laboratory (FSL) and the European Drawer Rack (EDR); plus two external payloads: the European Technology Exposure Facility (EuTEF) and the SOLAR observatory. The



Shuttle will carry the last two in its cargo bay for installation by EVA on Columbus once at the Station.

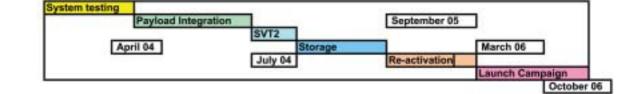
The Columbus Control Centre, being built under DLR prime contractorship in Oberpfaffenhofen, has passed its System Design Review 2, and the Qualification Review is planned for September.

The USOCs are a set of decentralised centres that will each operate an

individual rack in Columbus. The initial four will grow to five when Columbus is fully operational. Their development recently began under ESA contracts with the host national agencies.

Preparing for 1E flight operations is the responsibility of DLR at Oberpfaffenhofen, including control procedures, displays, handbook flight rules, training operators and conducting simulations.

Columbus crew training is led by the European Astronaut Centre in Cologne (D), in conjunction with prime contractor EADS-ST (Bremen). The work



The second System Validation

together for the first time.

CD-MCS: Columbus Distributed Monitor & Control System

DaSS: Data Services Subsystem EGSE: electrical ground support

FRC: Facility-Responsible Centre GSOC: German Space Operations

HOSC: Huntsville Operations Support

USOC: User Support Operations Centre

HRM: High Rate Multiplexer IGS: Interconnection Ground Subnetwork MCS: Monitor & Control System

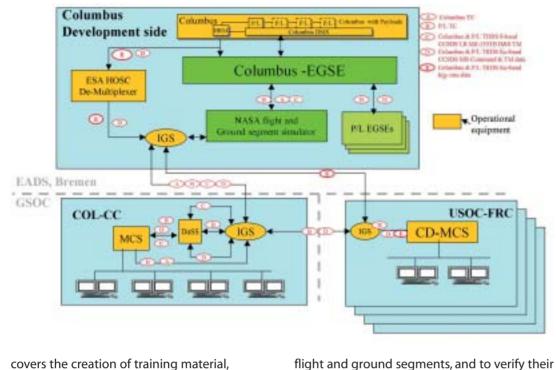
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Centre

Center

P/L: pavload

Test will bring all the elements of Columbus



covers the creation of training material, instructor lessons and sessions for basic, advanced and Increment-specific training. Instructors are based at EAC

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contracts and could identify interface issues well before the new launch date, thus reducing technical risks in the programme. Payload integration with Columbus began in mid-April and is expected to take 2 months. Each of the four racks will prove its compatibility with Columbus before there is an overall Integrated System Test. Once payload integration is completed, the space-ground interface will be verified by System Validation Tests. SVT1 will use the Columbus Electrical Test Model working through the ground segment, while SVT2 will see the flight Columbus and its research racks working with the Control Centre and the USOCs. SVT2 is the first test on the assembled major elements. It is so challenging that its achievement will be a major milestone.

interfaces. This minimises the impact on

#### **Storage and Reactivation**

Following SVT2, the four racks will be shipped back to their contractors for refurbishment and updates, and Columbus will be readied for storage. In order to reduce the risks even further, additional work could include end-toend testing of the external payloads and extended software endurance testing.

Thirteen months before launch, the module and its payload will begin a second round of integration and testing to prepare for shipping to the Kennedy Space Center and the 7-month launch campaign.

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The two Columbus external payloads NASA's will be carried separately for launch. Johnson Space Center in Houston. Basic and advanced lessons have been certified, and the Increment-specific curriculum is in the certification process.

#### Flight 1E Integration

The 2-year delay for Columbus caused by the Shuttle's grounding has forced considerable replanning by ESA. However, instead of slowing development, ESA has decided to complete the