STS-134: PRCB Baselines Penultimate Shuttle Flight to Take AMS to Station

June 28th, 2009 by Chris Gebhardt

NASA mission planners have officially baselined the final two scheduled missions of the Space Shuttle Program, STS-133 and STS-134 – of which STS-134 is expected to fly first, in July 2010, based on an expected Change Request (CR) to move the flight that will deliver the Alpha Magnetic Spectrometer (AMS) to the International Space Station (ISS) ahead of the STS-133 logistics flight.

Opening Assessments:

Assuming no major shake-ups to the flight manifest – and the approval of the expected CR – STS-134 will be the 133rd flight of the Space Shuttle Program (SSP) and the 25th and final voyage of the orbiter Endeavour, which began service in May 1992 on STS-49.

Carrying an ISS mission designation of ULF-6 (Utilization and Logistics Flight 6), STS-134 was officially baselined into the Flight Definition and Requirements Document (FDRD) on June 25 – initiating production of flight processes to support a No Earlier Than launch date of July 29, 2010. (STS-133 and STS-134 baseline presentations available on L2).

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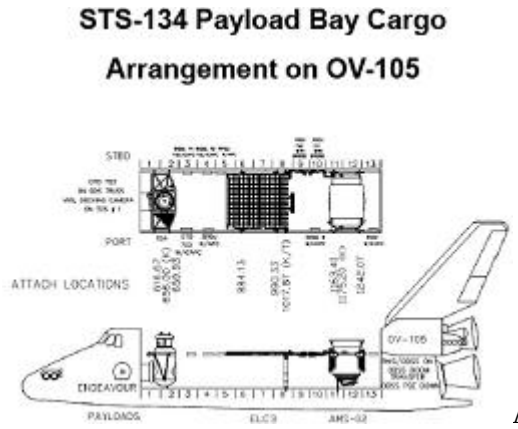
However, should the CR be denied, STS-134 would then be flown by orbiter Discovery in mid-September 2010 and subsequently become the final flight of the Space Shuttle Program. If this were to happen, Endeavour would be given the STS-133/ULF-5 flight to deliver, among other things, a Pressurize Logistic Module to the ISS in the July 2010 launch window.

In all, the official approval of the CR needs to come prior to October 5, 2009 in order to prevent flight production and training requirements confliction for STS-134 and STS-133. However, the CR is expected to be approved long before that date based on ISS requirements and a desire to maximize up-mass on the final Shuttle flights to the orbiting research laboratory.

For STS-134 (launching in July 2010), orbiter Endeavour will use External Tank-137, SRB BI-144, and Reusable Solid Rocket Motor set 112.

The mission, which will also serve as the rescue flight for STS-132 (which, at this time, is scheduled to use orbiter Atlantis with a targeted launch date in May 2010), will be a 12+1+2 day flight with 3+1 EVAs (Spacewalks), with a total of six crewmembers.



Among the multitude of payloads Endeavour will carry to orbit with her are the Alpha Magnetic Spectrometer 2 (AMS-02), Express Logistics Carrier 3 (ELC-3), Materials on International Space Station Experiment 8 (MISSE 8), an Orion Rendezvous Detailed Test Objective (DTO) kit, and a GLACIER freezer module for one of the Station's science laboratories.

Endeavour will also return the MISSE 7a and 7b experiments to Earth as well as perform four Department of Defense payloads of opportunity: MAUI, SEITI, RAMBO-2, and SIMPLEX.

Also, Endeavour's crew will leave the OBSS (Orbiter Boom Sensor System) on the ISS to allow the following Shuttle crew to use the inspection boom once they reach the Station, as previously revealed by this site.

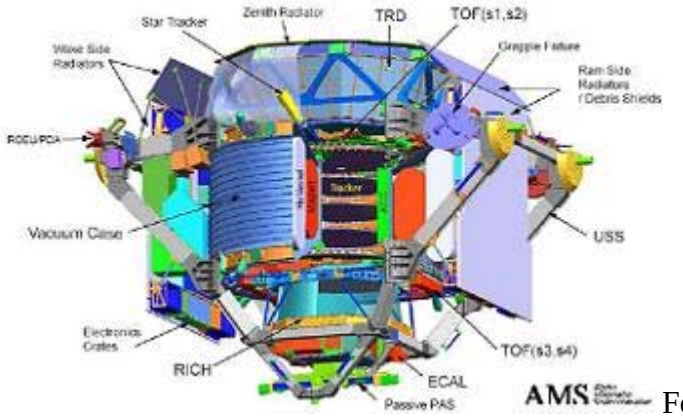
The desire to leave the OBSS on the ISS for the STS-133 crew (and future ISS expeditions) relates to the desire to gain as much up-mass potential as possible for the final scheduled Shuttle flight.

Also, leaving the OBSS behind after the completion of the Shuttle program will provide a work tool or platform for future ISS expeditions should a repair of

one of the Station's solar arrays (or similar issue) require the use of a platform to extend the working capability/reach of the Station crew.

Payload Overview:

Given the rather large payload up-mass for Endeavour's mission – totaling 36,740lbs of payload (including middeck payload and crew equipment weight) – the FDRD baseline of the STS-134 mission details several specific notes about each of the mission's primary payloads.



For AMS-02 – weighing 15,300lbs – the mission planning document notes that this payload will have four longeron payload latches and one active keel latch for its attachment to the payload bay sidewalls of Endeavour.

Additionally, once on orbit, Remotely Operated Electrical Umbilicals (ROEU) will provide AMS-02 with 124V of power for its heaters and avionics. Prior to liftoff, this power will be provided via the T0 umbilicals on the launch pad.

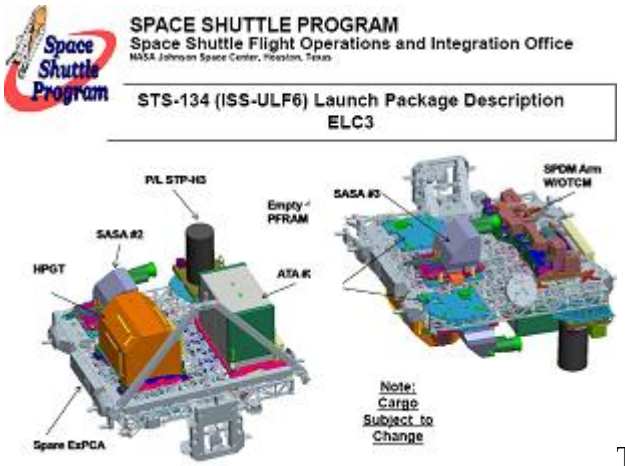
These T0 umbilicals will also allow launch personnel to monitor the health of AMS-02 prior to liftoff and make sure that Launch Commit Criteria for the AMS-02 are not breached.

The AMS-02 unit, which up until about a year ago was without a ride to orbit until the United States Congress mandated its addition to the Shuttle manifest, will be attached to the Starboard 3 Upper Inboard Command Attach System (CAS) on the ISS.

According to the baseline document, the AMS-02 unit is a "particle physics detector" which contains a large, cryogenic super-fluid helium superconducting magnet. The AMS-02 unit is designed to "search for antimatter and the origin and structure of dark matter."

Furthermore, the baseline notes that AMS-02 is a complex payload that will require significant testing and payload processing before liftoff.

The payload will also require significant "power usage and data downloads after launch until deployment from the Payload Bay," notes the baseline document – available for download on L2.



The second primary payload (ELC-3) will also have four active longeron latches as well as two passive longeron latches and one passive keel latch.

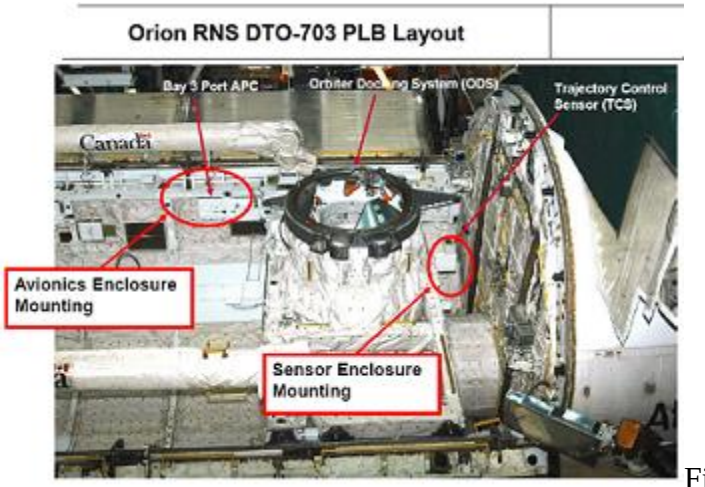
A ROEU will also provide ELC-3 will 28V of electricity for its heaters. A Payload Power Switching Unit will provide additional electricity and inhibit ability as needed for ELC-3.

Additionally, ELC-3 will be attached to the Port 3 Upper Outer CAS on ISS. With ELC-3, NASA will continue its effort to bring as many spare components to the ISS as possible before the retirement of the Shuttle fleet.

Attached to ELC-3 will be an Ammonia Tank Assembly, a Special Purpose Dextrous Manipulator Arm with Orbital Replacement Unit change-out mechanism, a spare ELC pallet controller avionics box, S-Band Antenna Sub-System #2 & 3, High Pressure Gas Tanks, and Space Test Program Houston 3 Department of Defense payload.

In addition to this manifested and baselined payload on ELC-3, the ISS program is looking at an additional 1,481lbs of payload that they would like on ELC-3 – payloads that are currently not listed on the mission baseline or accounted for in the mission's up-mass weight.

The Baseline further notes that the deployment and attachment of ELC-3 must be accomplished prior to any activities with AMS-02 since "Orbiter is not protecting for the worst-case forward ballast scenario which would result in a contingency undocking and landing."



Finally, the Orion Rel-Nav Sensor (DTO 703) will be mounted on the Orbiter Docking System (ODS) in Trajectory Control Sensor slot 1 and on an Adaptive Payload Carrier in bay 3 port of the Payload Bay.

“28 VCD for heaters and operation, GMT timing signal, Ethernet and RS-422 for command and telemetry via Payload General Support Computer” will be provided for this DTO.

For the Orion Rel-Nav Sensor DTO, Endeavour will fly a nominal Orbiter trajectory to and from ISS Pressurized Mating Adaptor-2.

The docking target on the ISS will be enhanced with reflectors to allow for the characterization of the Orion Rel-Nav sensors’ performance during rendezvous and proximity operations with the ISS.

These proximity operations will be tested during approach and docking, undocking, flyaround (time-permitting), and fly-out from the ISS.

In all, with all payload weight accounted for in the baseline and the time of year STS-134 is scheduled to launch in, Endeavour will have an Ascent Performance Margin of just 800lbs. Of course, this number will change as refinements to the mission and its payload are made in the coming months.

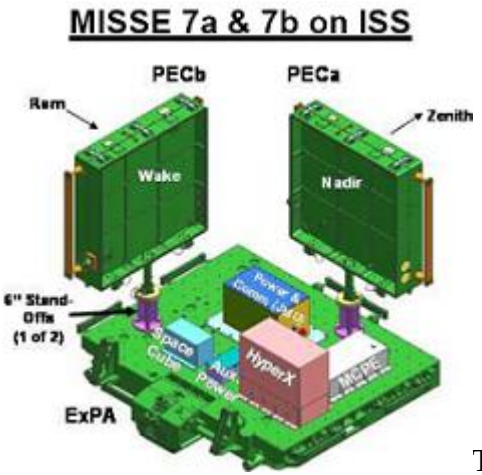
Additional Mission Objectives:

Once docked at the ISS, Endeavour’s crew will be tasked with the transfer of several hundred pounds of equipment from the Shuttle’s middeck to the ISS, and visa versa.

The primary middeck payload that will be hauled over to the ISS is the General Laboratory Active Cryogenic on ISS Experiment Refrigeration (GLACIER) unit.

Endeavour will carry one new GLACIER unit up to the ISS and return two GLACIER units to Earth.

Furthermore, in addition to installing AMS and ELC-3 to the external structure of the ISS, Endeavour’s crewmembers will be tasked with several other operations during the mission’s three baselined EVAs.



These EVA activities include cleaning and lubricating both the port and starboard Solar Alpha Rotary Joints (SARJs), transferring MISSE 7a and 7b (located in their Passive Experiment Container) from ELC-2 to Endeavour's Payload Bay, and attaching MISSE 8 and a Power Data Grapple Fixture (PDGF) to the ISS.

Tasks will also include installing the OBSS onto the S1 Truss On-Orbit Support Equipment stanchions – a piece of equipment that was previously used to house the OBSS on the station in between the STS-123 and 124 missions in 2008.

Because the OBSS will be left on the ISS, the STS-134 crew will have to perform the customary late-inspection of Endeavour's RCC Wing Leading Edge panels and Nose Cap before undocking from the Station.

This operation has been performed before on STS-123 before that crew also left the OBSS on the Station.

Following undocking, Endeavour's crew may perform several payloads of opportunity — the aforementioned MAUI, SEITI, SIMPLEX, and RAMBO-2.

Preliminary Flight Plan:

Launching on Flight Day 1 (FD-1), Endeavour's crew will spend FD-2 performing the now-standard post-launch inspection of Endeavour for any damage the vehicle's TPS (Thermal Protection System) might have incurred during liftoff.

After docking with the ISS on FD-3, Endeavour's crew will remove the ELC-3 from the payload and berth it to the ISS while also conducting transfer operations from Endeavour's middeck to the ISS.

FD-4 will see the deployment of AMS-02 from Endeavour and installation to the ISS.

EVA-1 will be performed on FD-5 – a spacewalk that will see the transfer of MISSE 8 to the ISS and the return of MISSE 7a and 7b from ELC-2 to Endeavour.

FD-6 will see any Focused Inspection work deemed necessary by imagery analysts on the ground as well as a Water Dump from Endeavour. This will be followed on FD-7 by EVA-2 – the cleaning and lubrication of the Port and Starboard SARJs.

FD-8 will see the crew perform the docked late-inspection of Endeavour with the OBSS before transferring the boom to the S1 truss of the ISS the following day during EVA-3. EVA-3 will also see a pair of spacewalkers install the PDGF to the ISS.

FD-10 will be an off-duty day for the crew as well as the stowage of the two GLACIER units for return to Earth. Also, at the end of FD-10, the hatches between Endeavour and the ISS will be closed for the final time.

Endeavour and her crew will undock on FD-11, perform the standard pre-landing checkouts of the Flight Control System and Reaction Control System for a landing at the Kennedy Space Center on FD-13.

L2 members: Documentation – from which the above article has quoted snippets – is available in full in the related L2 sections, now over 4000 gbs in size.

Tags: PRCB, STS-133, STS-134

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