

# **The Journey Back into Space: Orbiter Processing at the Kennedy Space Center**

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FADE IN:

EXT - COLUMBIA ORBIT AND RE-ENTRY

Columbia re-enters the Earth's atmosphere from the black of space and glides toward the Shuttle Landing Facility. The characteristic twin sonic booms resound as it reenters the atmosphere.

NARRATOR

The poet T.S. Eliot wrote:

"We shall not cease from exploration  
And the end of our exploring  
Will be to arrive where we started  
And know the place for the first time."

EXT - COLUMBIA FLYOVER OF KSC

Columbia flies over the Kennedy Space Center.

NARRATOR (cont)

The orbiter Columbia returns from its exploration to arrive where it started—home, NASA's Kennedy Space Center, where it will be processed, refurbished, and returned once again to explore and work in space.

Built in the early 1960's for the Apollo program, Kennedy Space Center is responsible

for readying each Shuttle from landing to launch.

#### EXT - SLF

Columbia approaches and lands at the Shuttle Landing Facility.

#### NARRATOR (cont)

First launched in 1981, Columbia is the oldest orbiter in the Shuttle fleet. She has made the trip from space to Earth and back over 20 times—and, with the care she receives during orbiter processing, she is expected to make many more voyages.

#### INFOGRAPHIC - COLUMBIA

Dissolve from still of Columbia touching down to infographic. Potential stats for infographic: OV-102, first flight 4/81, 20 flights, 77.5 million miles flown, 2,944 orbits, 177 days in space (as of STS-79).

#### NARRATOR (cont)

Throughout history, the name Columbia has been synonymous with American firsts. The first American ship to circumnavigate the globe, the command module for the first lunar landing—and now the first reusable spacecraft all share that name.

However, on the ground, Columbia goes by a more prosaic name: Orbiter Vehicle 102.

#### EXT- SLF

Columbia taxis to a stop. Ground crews safe the orbiter, hook up purge and cooling lines, assist the astronauts in leaving the orbiter, and prepare her for towing.

#### NARRATOR (cont)

Orbiter processing begins at the three-mile long Shuttle Landing Facility—one of the longest runways in the world. (Columbia lands unpowered. Its steep, high-speed glide home must be perfect the first time. )

Here Columbia's crew hands her over to the Orbiter Recovery team to begin her journey back into space.

Columbia is towed to the Orbiter Processing Facility within hours of landing.

EXT - OPF

Columbia is being towed into the OPF.

INFOGRAPHIC/CUTAWAY - OPF

Dissolve from still of Columbia being towed into OPF to OPF infographic or to cutaway of OPF showing bays and cranes.

NARRATOR (cont)

The Orbiter Processing Facility, or OPF, can process 3 orbiters at a time. Each of its high bays has two 30-ton bridge-type cranes and a complex series of platforms that permit access to the orbiter.

INT - OPF

Columbia is brought into one of the OPF bays, jacked up off its landing gear, and leveled. Workstands are moved into place. The orbiter is connected to power, coolant, purge air, and the Launch Processing System. Both deservicing from the last flight and preparation for the next flight is being done. Technicians hook up purge, vent, and drain lines. SCAPE-suited technicians deservice hypergolic systems. Engine heat shields and aft access doors are removed. Main engine gimbal locks and covers are installed.

NARRATOR (cont)

This facility is where Columbia is inspected and repaired from the previous mission and prepared for the next one.

First, crews safe the orbiter. That is, they purge, vent, and drain various systems and remove ordnances.

The payload bay doors are opened, and the payloads from the previous mission are removed.

NARRATOR (cont)

Then, they remove Columbia's payloads from the previous mission and meticulously

inspect, test, and refurbish the orbiter for her next mission.

Engineers inspect the TPS, tires, and other systems.

NARRATOR (cont)

One of the systems inspected at this time is Columbia's Thermal Protection System, or TPS. The TPS is the network of tiles, fillers, and insulation blankets that protect the orbiter from the searing heat of launch and reentry as well as the cold of space. Each tile has an expected life of 100 missions.

Technicians inspect, remove, and repair an orbiter component, such as an OMS/RCS pod or SSME.

NARRATOR (cont)

Columbia's propulsion system is also serviced at this time. The main engines—assisted by the Solid Rocket Boosters—provide thrust for liftoff. The maneuvering engines fire to insert Columbia into the proper orbit and to make adjustments while in orbit.

Safing, payload removal, inspection, and maintenance take up approximately two-thirds of the orbiter's time between missions. The remainder is spent installing and checking out payloads for the next mission.

A horizontal payload is being installed.

NARRATOR (cont)

Some payloads, such as the European Space Agency's Spacelab, are installed in the OPF while the vehicle is horizontal. (These payloads are received, assembled, and integrated in the Operations and Checkout Building in KSC's industrial area. )

#### EXT - VERTICAL CANISTER-TRANSPORTER

The transporter carries a vertical payload canister from the Vertical Processing Facility to the Payload Changeout Room. The canister is positioned below the retracted RSS and hoisted/locked into place. The environmental seals of the room are inflated against the sides of the canister and canister is purged with clean air.

NARRATOR (cont)

Other payloads, such as deployable satellites and satellite retrieval missions, are installed vertically at the launch pad.

INT - OPF

The aft engine compartment is closed after a successful leak check. The payload bay doors are closed. The orbiter is then weighed to determine its center of gravity, and GSE/access equipment is removed.

NARRATOR (cont)

After testing is complete and the payload bays are closed, Columbia is towed to the Vehicle Assembly Building for integration with the other Shuttle components.

EXT/INT - VAB

Columbia is towed into the VAB transfer aisle through the north door.

INFOGRAPHIC - VAB

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NARRATOR (cont)

Built to vertically assemble the mammoth Apollo/Saturn spacecraft, the Vehicle Assembly Building is one of the largest buildings in the world.

INT - VAB

The SRBs are stacked on the MLP, and then the ET is brought in and mated to the SRBs.

NARRATOR (cont)

Here the orbiter Columbia becomes the Shuttle Columbia. While the orbiter is being refurbished in the OPF, first the solid rocket boosters and then the external tank are

stacked and mated on the Mobile Launcher Platform.

The two Solid Rocket Boosters provide the main thrust to lift the Shuttle off the pad and up to an altitude of about 150,000 feet. The boosters are recovered soon after launch and then refurbished and reused.

The external tank contains the liquid hydrogen fuel and liquid oxygen oxidizer for the orbiter's main engines during lift-off and ascent. When the main engines shut down, the external tank is jettisoned. It is not recovered.

Columbia is brought in. When it's in position, lifting beams and erection slings are attached and the orbiter is lifted with its landing gear retracted. Cranes rotate the orbiter into the vertical position and transfer it to the Space Shuttle Assembly Area in High Bay 1 (or 3). Columbia is then lowered and mated to the external tank and solid rocket boosters on the mobile launcher platform. Extendible platforms move in around the Shuttle to provide access for integration and final testing. After checkout is complete, platforms move back and the VAB doors open. The crawler-transporter is driven into position under the MLP.

NARRATOR (cont)

Columbia is mated to the external tank at three attachment points, one fore and two aft. Umbilicals carry fluids, gases, and electrical power between the orbiter and tank.

The SRBs carry the entire weight of the Shuttle on the launch platform. Four attach posts on the aft skirt of each SRB fit into counterpart posts on the MLP to hold and support the Shuttle on the platform. During launch, explosive nuts release the giant studs linking the support posts, freeing Columbia.

After the orbiter is mated and umbilicals are connected, the Launch Processing System verifies all electrical and mechanical connections. This computer system located in the Launch Control Complex monitors all Shuttle assembly, checkout, and launch operations.

After final testing, the Shuttle Columbia is ready for rollout to the launch pad.

#### EXT - CRAWLER-TRANSPORTER

The crawler-transporter rolls the MLP with Columbia aboard out to the pad.

NARRATOR (cont)

The crawler-transporter moves the unfueled Shuttle and the MLP—a load of 11 million pounds—down a specially constructed 130-foot wide roadway that links the VAB and

the pads. The four-mile trip takes approximately 5 hours.

## INFOGRAPHIC - MLP/CRAWLER-TRANSPORTER

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### EXT - LAUNCH PAD

The crawler-transporter sets its load down on the launchpad pedestals and backs down the ramp. The rotating service structure wraps around the Shuttle. The Shuttle is connected electrically and mechanically to the pad and powered up. Engineers install a vertical payload from the payload changeout room.

#### NARRATOR (cont)

The launch pad is made up of the fixed service structure and the rotating service structure. The fixed structure is an open framework permanently fixed to the pad surface. The rotating service structure wraps around the orbiter, providing protected access to it for the changeout and servicing of payloads at the pad. Vertical payloads, such as satellites and experiments, are loaded onto the Shuttle from the Payload Changeout Room under clean room conditions.

Countdown begins 43 hours before launch. At T minus 11 hours, the rotating service structure is retracted and propellants are loaded into the external tank.

Liquid hydrogen from the storage tank on the northwest corner of the pad and liquid oxygen from the storage tank on the northeast corner flow through their respective pipelines into the MLP and then into the external tank and orbiter. Monomethylhydrazine and nitrogen tetroxide flow from their respective tanks on the southeast and southwest corners of the pad to the fixed service structure and then into the rotating service structure's hypergolic umbilical system.

#### NARRATOR (cont)

Her crew boards Columbia during the final hours of the countdown.

We follow Columbia's launch from T minus 5 or 6 seconds (when SSMEs fire) through SRB separation. We hear the sounds of an actual countdown and launch. The ET falls away and burns up in the atmosphere. Columbia fires its OMS/RCS to insert into orbit.

### EXT - SPACE/EARTH ORBIT

We see Columbia in space deploying a satellite (or other mission-related activity).

NARRATOR (cont)

Columbia returns to work in space once more— while back home, at the Kennedy Space Center, her sister ships—Atlantis, Endeavor, and Discovery—are being prepared for their next missions.

Against the backdrop of Earth, we end on this quote:

*"We do not realize what we have on Earth  
until we leave it."*

*Jim Lovell, Apollo Astronaut.*