



#### Profile:

Launching the space shuttle *Atlantis* from Cape Canaveral into orbit for rendezvous with the *International Space Station* (ISS). After jettison of the external tank at the end of the ascent phase and an OMS-2 burn to achieve a first stable orbit, the shuttle performs three more orbit corrections to match better the ISS orbit. A transfer orbit to the ISS synchronizes the shuttle and the ISS within 22 hours. After approaching and docking to the ISS, Atlantis will stay docked for nearly four days (94 hours).

After undocking the shuttle will drift away from the ISS before performing the de-orbit burn about 15 minutes later. The re-entry trajectory is set for a return to Cape Canaveral. After re-entry, starting at a speed of around 3500 m/s, the shuttle uses its RCS and an aerodynamic glide to cross the last 600 km to the runway. The shuttle will then land at the landing site.

#### Remarks / Caveats / Bugs:

- The complete mission only works with the Atlantis shuttle that comes with the Orbiter 030303 base distribution. I guess it is the in-built autopilot in the newer versions of the shuttle that prevent REDSHIFT from performing a re-entry. I found no way to deactivate that autopilot, so unless you know how to do that (in that case: please drop me a note), stick with the Orbiter Atlantis. If you want to use a newer version of the shuttle (only re-entry seems to fail), you have to modify the scenario files yourself.
- There is one glitch when using the standard Orbiter Atlantis during launch: If you watch the countdown from cockpit view, the shuttle will start firing SRBs and main engines, but it will never lift-off. I have no idea what happens, but the work-around is simple: When the countdown starts, simply switch to external view (F1) and watch the shuttle take off; you can then switch back to cockpit view if you want (but the launch looks more interesting from the external view anyway).

#### Files:

(relative to Orbiter installation folder)

Flight Operations Plan: .\FOP\Atlantis.fop

Scenario folder: .\Scenarios\REDSHIFT\Manned Missions\Shuttle\_ISS

#### Add-ons needed:

- none

#### Add-ons recommended:

- KSC scenery



#### Launch

00:15:18

Atlantis\_Launch

The scenario starts on Mon, Nov. 24<sup>th</sup>, 2003 at 13:40 UTC, around 14 minutes before launch. After lift-off the shuttle ascends with its normal launch attitude; the launch is complete at a height of 15 km.

	Description	User interaction
<b>Start-up</b>	Select FOP for mission	Select " <b>Manned Missions</b> ", " <b>Shuttle Atlantis to ISS</b> " and " <b>Launch from Cape Canaveral</b> " in the FOP tree list.
<b>Countdown</b>	Waiting for launch	When the count-down starts and you are in cockpit view, switch to external view with the F1 key.
<b>Lift-off</b>	Shuttle is off the pad	You can switch back to cockpit view if you want (F1)

#### Ascent

00:07:48

After reaching an altitude of 15 km after launch, the shuttle then follows a predefined ascent profile. The ascent is a direct insertion into the orbital plane of the target (ISS) and tries to keep the relative inclination between the orbital planes at a minimum.

The ascent is complete when the achieved (initial) orbit is touching the Earth surface at periapsis. The external tank is jettisoned (and will re-enter the atmosphere and splash down in the Indian Ocean) and the shuttle is ready for the OMS-2 burn.

	Description	User interaction
<b>MECO</b>	Initial orbit achieved	Jettison external tank with the 'J' key.

#### OMS-2 burn

00:09:37

Atlantis\_OMS2

The scenario starts nearly seven minutes before OMS-2 burn. When the shuttle reaches apoapsis of the initial orbit, the main engine is fired prograde to lift periapsis to a save altitude (150 km). After MECO the shuttle is in a stable orbit around Earth.

	Description	User interaction
<b>Start-up</b>	Select FOP task	Select " <b>Manned Missions</b> ", " <b>Shuttle Atlantis to ISS</b> " and " <b>OMS-2 burn</b> " in the FOP tree list.



#### Adjust orbit with ISS

01:27:05

Atlantis\_Align

The scenario starts about 38 minutes before the first orbit correction manoeuvre. The orbit is adjusted to a periapsis distance of 6700 km and an apoapsis distance of 6760 km. After completion of the corrections the shuttle is on an orbit "similar" to that of the ISS.

	Description	User interaction
<b>Start-up</b>	Select FOP task	Select " <b>Manned Missions</b> ", " <b>Shuttle Atlantis to ISS</b> " and " <b>Adjust orbit with ISS</b> " in the FOP tree list.

#### Synchronizing orbits

22:20:00

Atlantis\_Sync

The scenario starts about 40 minutes before the main engines fire to put the shuttle onto a transfer orbit to the ISS. The transfer orbit will synchronize the orbits so that the shuttle will meet with the ISS within 24 hours. The process will "lock" for interception at a distance of 65 km (from the ISS); the approach will start at a distance of 15 km.

	Description	User interaction
<b>Start-up</b>	Select FOP task	Select " <b>Manned Missions</b> ", " <b>Shuttle Atlantis to ISS</b> " and " <b>Synchronizing orbits</b> " in the FOP tree list.

#### Approach to ISS

00:29:27

+06:20

Atlantis\_Approach

The scenario starts when the shuttle is still on its transfer orbit and about 65 km away from the ISS. The approach should start six minutes later at a distance of 15 km and will end when the shuttle is 1000 meter away from the ISS with nearly no relative velocity.

	Description	User interaction
<b>Start-up</b>	Start SyncOrbit MFD	SHIFT-Y, set target to ISS (SHIFT-T)
	Wait for approach distance	Watch the distance to ISS displayed on the SyncOrbit MFD. If distance is 15 km, start the approach.
	Start approach	Select " <b>Manned Missions</b> ", " <b>Shuttle Atlantis to ISS</b> " and " <b>Approach to ISS</b> " in the FOP tree list.



#### Docking with ISS

00:07:46

Atlantis\_Dock

The shuttle is 1000 meter away from the ISS (with no relative velocity) and is ready for the final approach and docking manoeuvres.

	Description	User interaction
<b>Prepare</b>	Prepare for docking	Open the bay doors (docking port is inside payload bay) with the 'K' key (if not already opened)
<b>Start-up</b>	Select FOP task	Select " <b>Manned Missions</b> ", " <b>Shuttle Atlantis to ISS</b> " and " <b>Docking to ISS</b> " in the FOP tree list.

#### Docked

93:57:00

Atlantis\_Docked

The shuttle has just docked to the ISS. Guess it is time to open the airlock and to have some fun onboard the ISS.

#### Undocking from ISS

00:06:03

Atlantis\_Undock

The scenario starts about six minutes before undocking from the ISS. Last chance to check if you have anything forgotten onboard the ISS – airlocks will close soon...

	Description	User interaction
<b>Start-up</b>	Select FOP task	Select " <b>Manned Missions</b> ", " <b>Shuttle Atlantis to ISS</b> " and " <b>Undocking from ISS</b> " in the FOP tree list.
<b>Completion</b>	Undocking complete	Close the bay doors with the 'K' key.



#### Re-entry

01:03:36

Atlantis\_Reentry

The scenario starts about twelve minutes before the de-orbit burn will begin. After de-orbiting the shuttle will follow the re-entry trajectory until it hits the upper layers of the atmosphere. It will keep a defined AOA (Angle Of Attack) until velocity is reduced to 3500 m/s – at that moment the shuttle is about 600 km away from the landing site with an altitude of approx. 60 km.

	Description	User interaction
<b>Prepare</b>	Prepare for re-entry	Bring up the Map MFD with the 'M' key. Select the landing site (Cape Canaveral) as target base ('T' key)
<b>Start-up</b>	Select FOP task	Select " <b>Manned Missions</b> ", " <b>Shuttle Atlantis to ISS</b> " and " <b>Reentry</b> " in the FOP tree list.

#### Landing at Cape Canaveral

00:05:30

Atlantis\_Landing

The scenario starts when the shuttle has finished re-entry and is 3500 m/s fast. Its distance to the landing site is around 600 km with an altitude of 60 km. The shuttle will only use RCS to keep a glide attitude that uses aerodynamic "flying" to bring the shuttle close to the base. The final approach lines up the shuttle with the runway and will land the shuttle with a touch-down (still not working properly, runway is normally missed and the touch-down can be a rough one).

If you start the mission by loading the scenario at this point, make sure you get the first two task of the following list done as quick as possible – the vessel is not in a stable flight attitude and the landing processor should be in control "immediately".

	Description	User interaction
<b>Prepare</b>	Prepare for re-entry	Bring up the Map MFD with the 'M' key. Select the landing site (Cape Canaveral) as target base ('T' key)
<b>Start-up</b>	Select FOP task	Select " <b>Manned Missions</b> ", " <b>Shuttle Atlantis to ISS</b> " and " <b>Landing at Cape Canaveral</b> " in the FOP tree list.
<b>Final approach</b>	Altitude: 1000 m	Bring down landing gear with the 'G' key.