



Space Tugs

user manual

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Disclaimer

This software is provided as it is without any warranty of any kind.

The project has been developed to be used as an add-on for Orbiter Space Flight Simulator by Martin Schweiger (www.orbitersim.com). Designed for Orbiter 2006 Edition, patch 1 (build 060929).

Introduction

Space Tugs are the upper stages (towing vehicles) intended for towing various types of payloads into a working orbit.

This package consists of several parts:

1. Smerch space tug.
2. DM-2 space tug.
3. Buran-T container.
4. Transorbital space tug Tranzit.
5. Payload example – a geostationary platform of communication SkyLinkSat.
6. Payload example – the Deep Star space ship.



For more details about SkyLinkSat and Deep Star see the separate manuals.

Acknowledgements

I would like to thank the following people whose materials have been used:

Christophe Chabot – for the excellent *realExhaust* textures which have been re-made and used as the texture for the exhaust of DM2 space tug.

Andrew Farnaby – the texture files *Mir2_Airhatch.dds* and *Mir2_Radiator.dds* have been borrowed from his project Project Alfa ISS.

Alexander Blass – for the *max2msh* export script.

Installation

There are 2 variants of Space tugs delivery: as a part of *ENERGY project* or as a separate product. In both cases the program-installer works. In the first case follow the installation instructions to ENERGY project setup.

In the case of a separate delivery just wait when the program-installer ends.

Requirements and limits

Be sure that *ScnEditor* module is activated at *Modules* tab in *Orbiter Launch pad* dialog. The *Scenario Editor* is required for configuring Space Tugs.

The *Limited fuel* checkbox in *Parameters* tab in *Orbiter Launchpad* dialog should be switched on.

The current version is not full compatible with *Orbiters Flight recorder*.

The scenario *TX with Buran-T* requires the *TX winged space launcher* addon. It can be downloaded from here: www.orbithangar.com/searchid.php?ID=421

The scenario in *Tranzit spacetug* folder requires the *Mir-2 Space station* addon. It can be downloaded from here:

<http://www.orbithangar.com/searchauth.php?search=yury%20kulchitsky>

Quick start

Start the *Orbiter*, go to the *Space Tugs* folder and select one of these scenarios:

SkyLinkSat scenarios

The scenarios in *SkyLinkSat* subfolder are the similar. The *Smerch* space tug with a heavy space communication platform *SkyLinkSat* are in a *Buran-T* aerodynamic container. The altitude is about 200 kms, the which is below the orbital velocity (this condition corresponds to the moment of the *Energia* separation from the second stage). After container shutters disclosing and separation of the space tug with the *SkyLinkSat* platform it is necessary to complete the insertion into a steady circular orbit. After that try to put the *SkyLinkSat* platform into a geostationary orbit (a piece of information – the radius of geostationary orbit is 42163.8 km). After the end of all the maneuvers press **[J]** key to jettison the *SkyLinkSat* satellite. In 60 seconds after the jettison, the satellite will be automatically deployed. The aerals and solar batteries will be disclosed. The autopilot will orient the satellite vertically. You can switch the autopilot off with **[V]** key. You can also close the aerals and solar arrays using **[D]** key. If all the maneuvers are executed correctly and economically, *Smerch* will have enough fuel to sink it in the atmosphere. Remember that the quantity of the main engine starts does not exceed 10 times. Good luck!

Deep Star scenarios

In *Deep Star* folder you can see the scenarios with *Deep Star* exploration spacecraft. This is a probe for exploring the outer Solar system space. The probe has the ion engine. Try to leave the Solar system using the 2-staged space tug “train”. For details about *Deep Star* spacecraft see the manual *Doc\Space Tugs\DeepStar.pdf*.

Tranzit spacetug scenario

In *Tranzit spacetug* folder you can find the scenario with *Tranzit* vehicle. The mission is to dock the *Solaris* module to the *Mir-2* space station. *Solaris* is passive, *Tranzit* is active. Be sure that *Mir-2 Space station* addon is installed (<http://www.orbithangar.com/searchauth.php?search=yury%20kulchitsky>).

TX with Buran-T

This scenario has been created specially for the fans of hypersonic *TX* carrier. In this scenario we have the *Buran-T* with the *Smerch* space tug and *SkyLinkSat* satellite as a payload for *TX* carrier. *TX* is ready for a take-off at a *SRC* – Space port runway.



Note that this scenario works properly only with the latest *TX winged space launcher* release (the release number is 5). It can be downloaded from here: www.orbithangar.com/searchid.php?ID=421

Mind, that the payload in the given configuration has the weight of 105 tons, therefore cannot be placed into a steady orbit as the carrying capacity of *TX* is about 50 tons.

The major purpose of this scenario is a demonstrating one. It is aimed at demonstrating the Space Tugs line back compatibility, as well as the usage of the space tug Buran-T which enables a user to place in any payload.

Smerch space tug

The heavy hydrogen space tug **Smerch** has been specially developed for working with the Energia rocket. The Smerch is intended for performing a wide range of tasks. Putting of the heavy satellites into working orbits (including the geostationary ones), space vehicles delivery to the Moon, Mars trajectories as well as other planets of the Solar system, including distant planets. The Smerch project was cancelled together with Energia project.



The author has not used any detailed Smerch designs. Therefore the exterior of the space tug is mostly the author's own invention, but it seems true to life. The rest is borrowed from the real-life project description: technical specifications, overall dimensions, fuel and engine specifications.

Technical Specifications

Length	16 m
Diameter	5.5 m
Dry mass	6 mT
Main fuel mass	70 mT
RCS fuel mass	1.5 mT
Full starting mass	77.5 mT
<u>Payload mass:</u>	
to geostationary orbit	18-19 mT
to L1 Moon Lagrange point	23-29 mT
to near Moon orbit	21.5-23 mT
Main engine fuel	LOx/LH2
Main engine thrust	10 mT of force
Number of main engine starts	up to 10



How to change the quantity of the engine starts see the *Configuring* topic below.

The frontal projection and the perspective image of the space tug are shown below. The projections are given without a payload adapter. The kind of adapter depends on a placed payload.



DM-2 space tug

DM-2 is a low-weight space tug. The original design name of the tug is unknown, in the sources, the author has based on, the DM-2 tug appears as an “advanced DM block”. Probably, a part of the Soviet lunar rocket N-1 was meant. DM-2 is intended either for an additional heavy cargoes entering into a low and middle transfer orbits or for cooperative working with Smerch block as the second stage of a space tug.

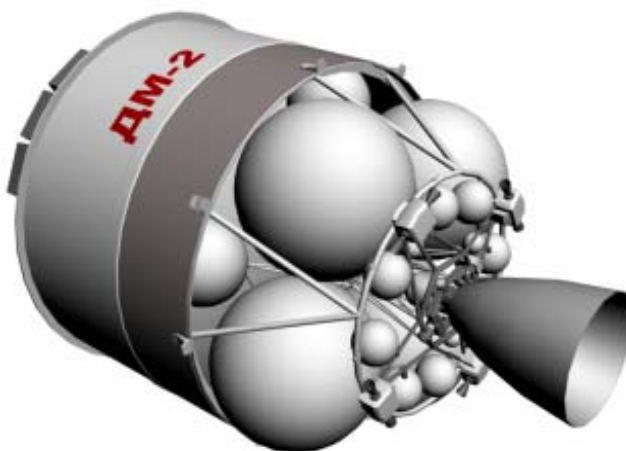
Technical Specifications

Length	5.56 m
Diameter	3.7 m
Dry mass	3 mT
Main fuel mass	14-15 mT
RCS fuel mass	1.5 mT
Full starting mass	19.5 mT
<u>Payload mass:</u>	
to 200 kms circular orbit	88 mT
to 600 kms circular orbit	81 mT
Main engine fuel	N2O4/UDMH
Main engine thrust	8.5 mT of force
Number of main engine starts	up to 7



How to change the quantity of the engine starts see the *Configuring* topic below.

The frontal projection and the perspective image of space tug are shown below. The projections are given without a payload adapter. The kind of adapter depends on the placed payload.



Payload container Buran-T

Buran-T is an aerodynamic container intended for protecting a payload from the influences of an atmosphere. The container has been developed to be used with the Energia heavy rocket.

The real prototype of the container (bearing the same name) is a far more complex device. For example, it is reusable, and the container shutters have to be jettisoned during an active flight. Thus, the author is presenting the simplified variant of the Buran-T system.

The container opens automatically in 40 seconds' time after its separation from the carrier.

Technical Specifications

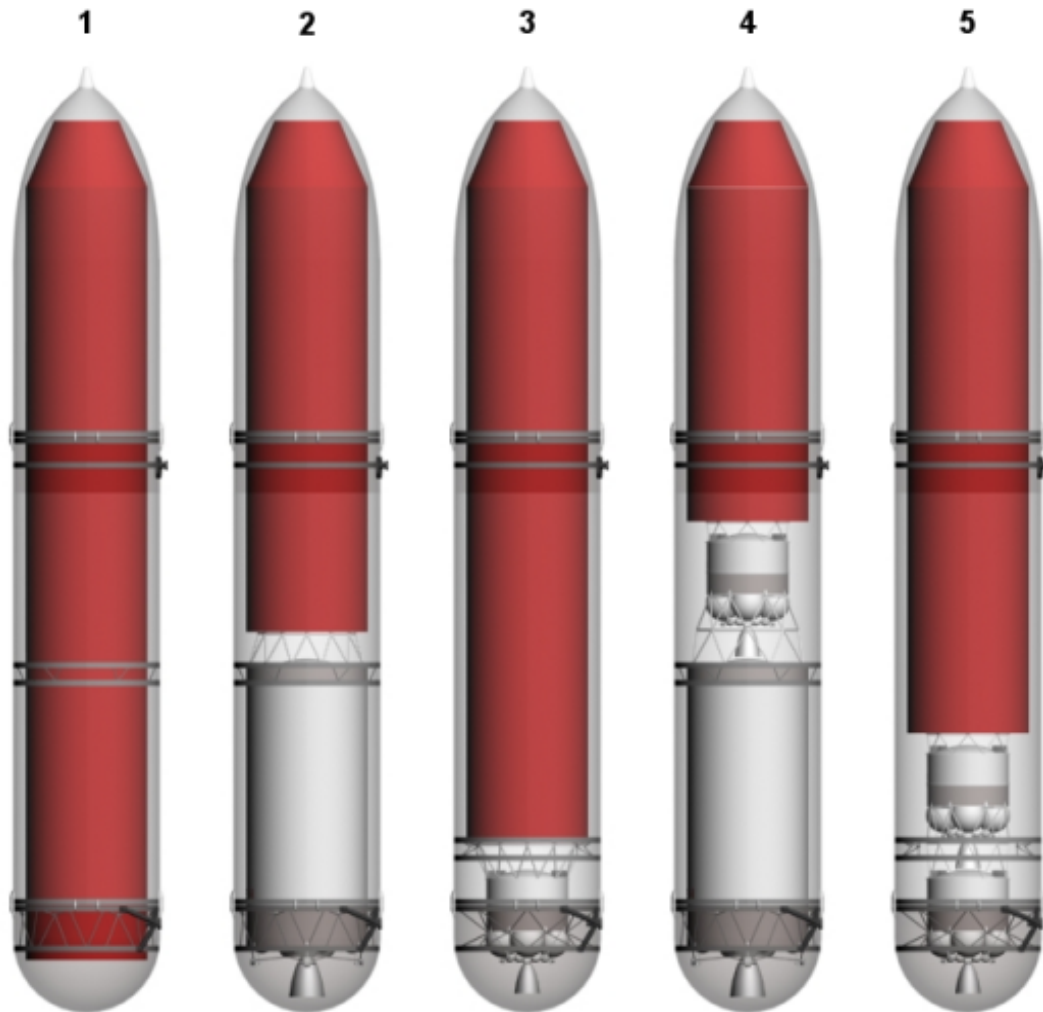
Length	42.5 m
Diameter	6.7 m
Mass	6.0 mT
Maximum payload dimensions	5.8 m in diameter, 35 m in length

The frontal projection and the perspective image of container are shown below.



Possible payload configurations

Five payload configurations in Buran-T container are given below.



Red color indicates the payload volume.

Configuration 1

The payload occupies all accessible volume of the container – with the diameter of 5.8 m, length of 35 m. The weight of a payload can reach 95 tons.

Configuration 2

The payload weighing up to 18-19 tons uses Smerch as the upper stage.

Configuration 3

The payload weighing up to 80-82 tons uses DM-2 tug as the upper stage.

Configuration 4

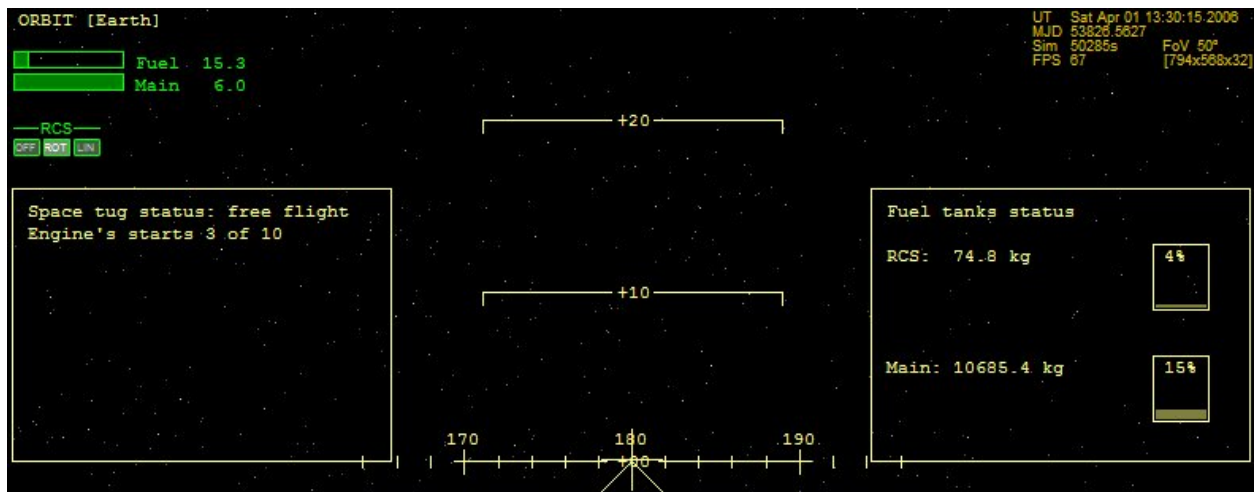
The payload weighing up to 5-15 tons uses 2-staged tug system – Smerch + DM-2.

Configuration 5

The payload weighing up to 40-50 tons uses 2-staged tug system – DM-2 + DM-2.

HUD

To provide some flight information the space tugs are equipped with a special HUD, see the picture:



On left side:

The current spaceship status and the remained amount of main engine starts.

On right side:

Fuel tanks status both for main and RCS.

Keyboard interface

While working with space tugs Smerch and DM-2, in addition to the usual keyboard Orbiter combinations, it is possible to use the following keys:

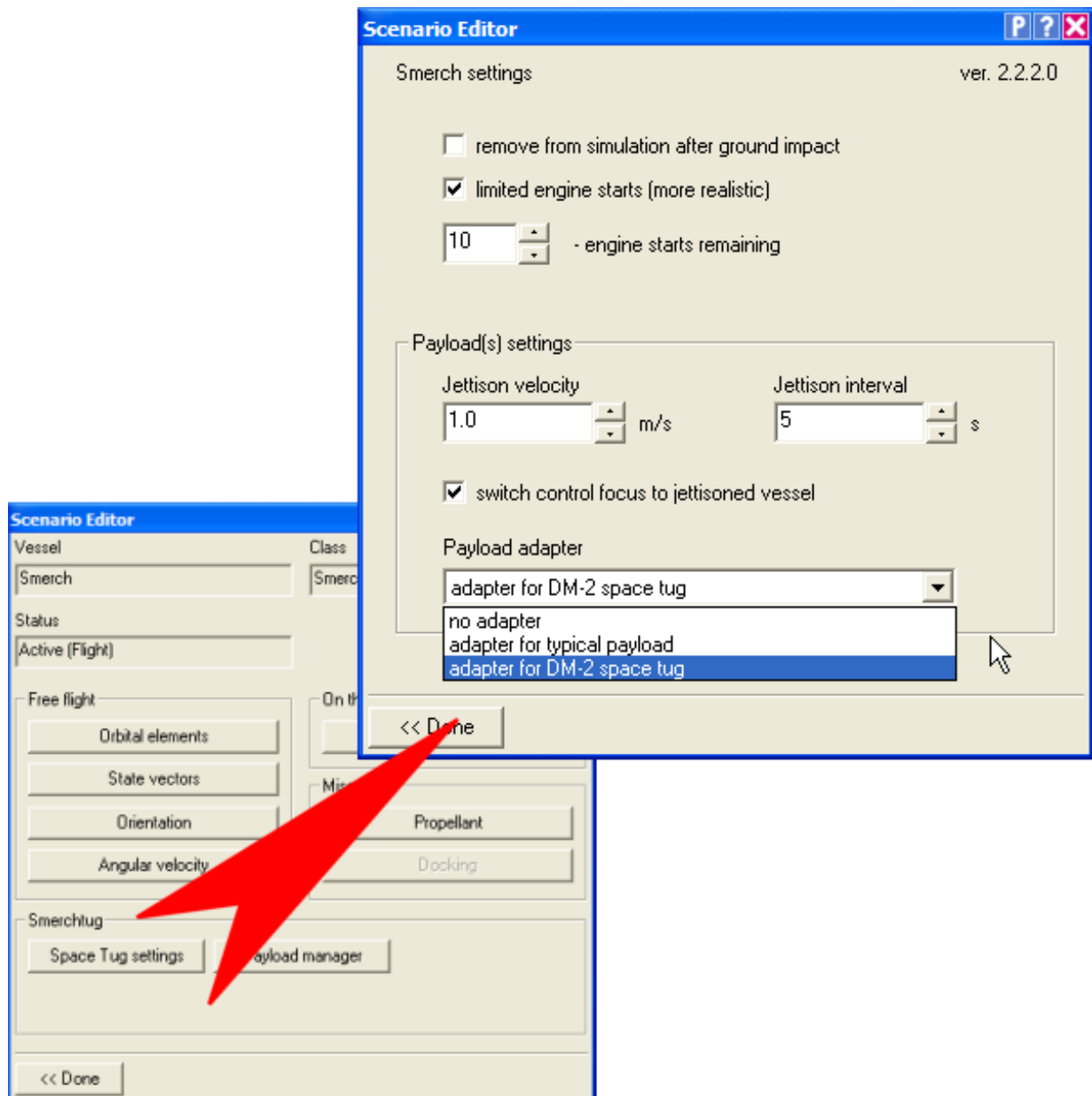


Payload jettison

Configuring

Space tugs vessel (Smerch, DM-2 or Buran-T) can be tuned with Orbiter's *Scenario Editor* (read more about Scenario Editor in *Doc\ScenarioEditor.pdf* manual).

See the example on this picture, the Smerch space tug has a special configuration page in Scenario Editor:



If *remove from simulation after ground impact* checkbox is checked the space tug will be deleted from simulation after falling on the ground.



Be careful with *remove from simulation after ground impact* checkbox. Some addons can't work properly in case of unexpected deleting vessels from simulation.

By default the space tugs has a limited amount of main engine starts. The Smerch main engine can be started not more than 10 times and for DM-2 – not more than 7 times. You can set the remaining amount of starts in *engine starts remaining* field. Also you can unlimit the engine starts – switch off the checkbox *limited engine starts*.

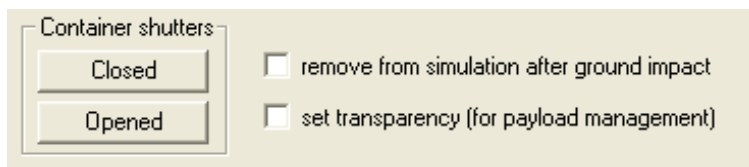
In *Payload(s) settings* section you can tune the payload jettison. Velocity which payload vessel receives during jettison is defined in *Jettison velocity* box (the minimum value is 1 m/s, maximum value is 10 m/s).

The time interval between payloads separation (in case the space tug carries more than one payload) defines the *Jettison interval* box (the minimum interval is 5 s and maximum is 30 s).

After payload separation the control focus can be switched to a payload vessel. It is determined by *switch control focus to jettisoned vessel* checkbox.

You can define the payload adapter using the *Payload adapter* listbox.

The Buran-T setting are little bit different, see the picture:



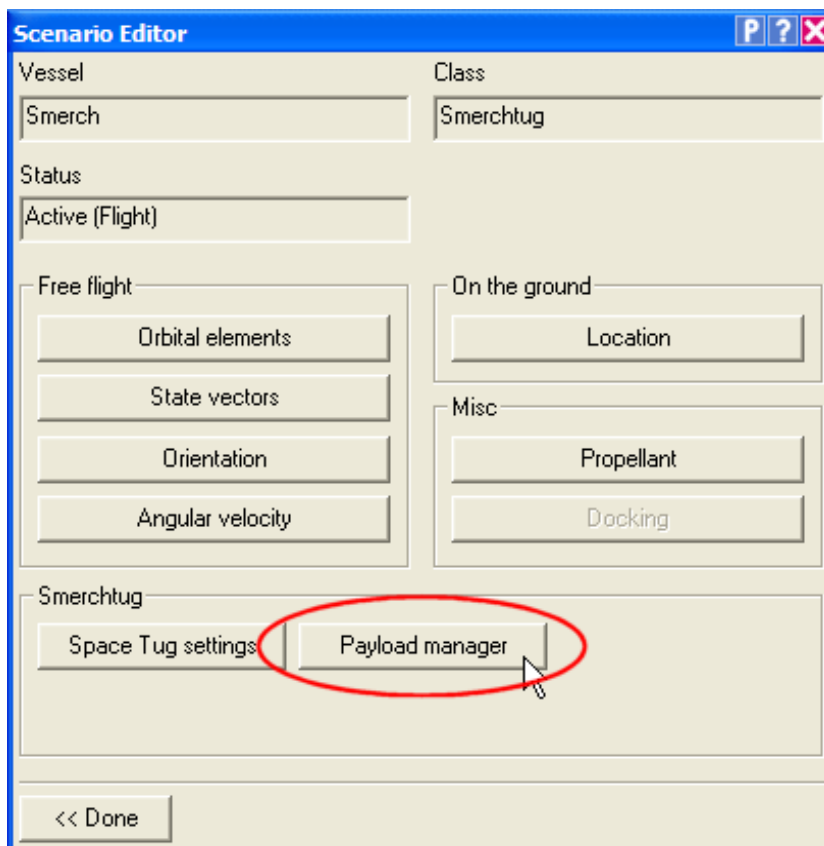
You can set the shutters state. To open the shutters click the *Opened* button, to close the shutters click the *Closed* button. To make payload management easier switch on the *set transparency* checkbox. The Buran-T will become transparent to help you to place the payload more accurate.



Transparency feature can be useless due to Orbiter rendering limitations.

Payload management

You can select any another vessel as a payload for Space Tugs vessel. Payload setup is provided by *Payload Manager*. You can access it via *Scenario Editor* in the Smerch (or DM2) configuration page:



How to use the Payload Manager read the manual `\\Doc\\Payload Manager\\PayloadManager_user.pdf`

new !

Transorbital spacetug Tranzit

Tranzit is a big unmanned space vehicle. Tranzit is intended for docking and redocking of large passive payloads, transorbital tug missions and etc.

Technical Specifications

Length	18 m
Diameter	6 m
Dry mass	9.3 mT
Main fuel mass	24 mT
Full starting mass	33.3 mT
Fuel	N2O4/UDMH
Maximum main engine thrust	5000 N per engine
Maximum RCS engine thrust	3000 N per engine



Tranzit is equipped with two docking ports therefore it can to carry two other vessels. The propulsion system of Tranzit is adaptive and allows you comfortable operating irrespective of position of center of gravity.

HUD

Tranzit has a special HUD, see the picture:



On the left side you can see the indicator of solar panels and radiator state, on the right – fuel level indicator.

Keyboard interface

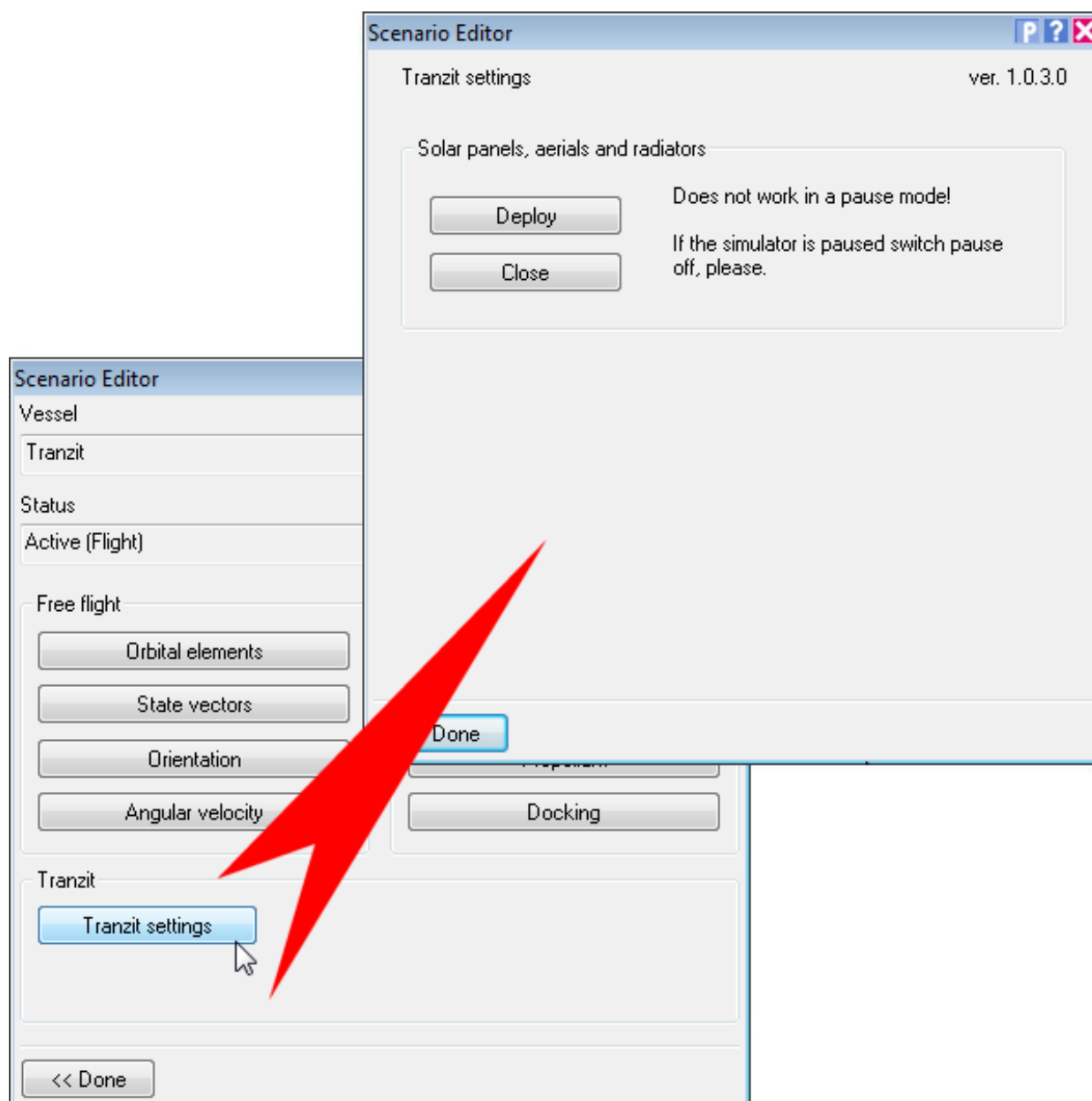
In addition to the usual keyboard Orbiter combinations you can use:

 **D** Deploy/retract the solar panels, radiators and aerial

Configuring

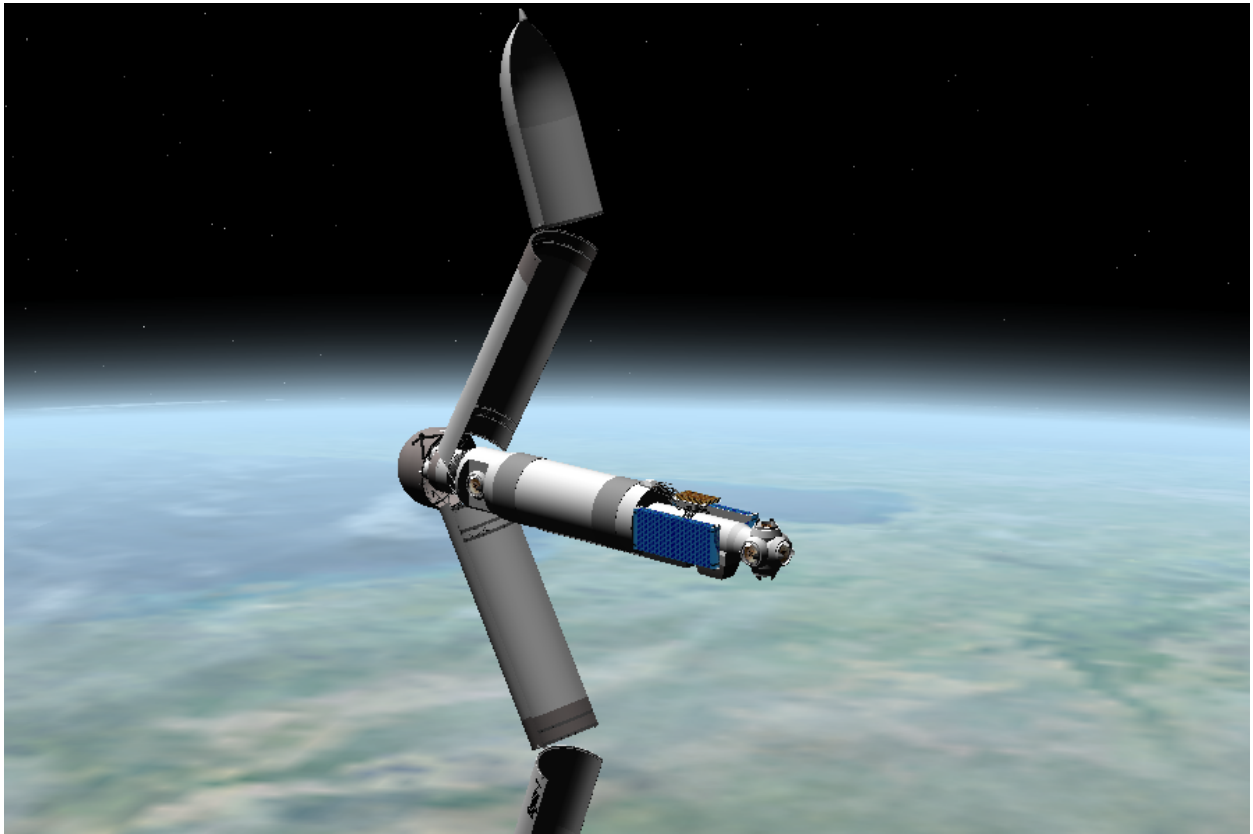
You can configure the Tranzit vessel via Orbiter's *Scenario Editor* (read more about Scenario Editor in *Doc\ScenarioEditor.pdf* manual).

See picture, the Tranzit has a special configuration page in Scenario Editor:

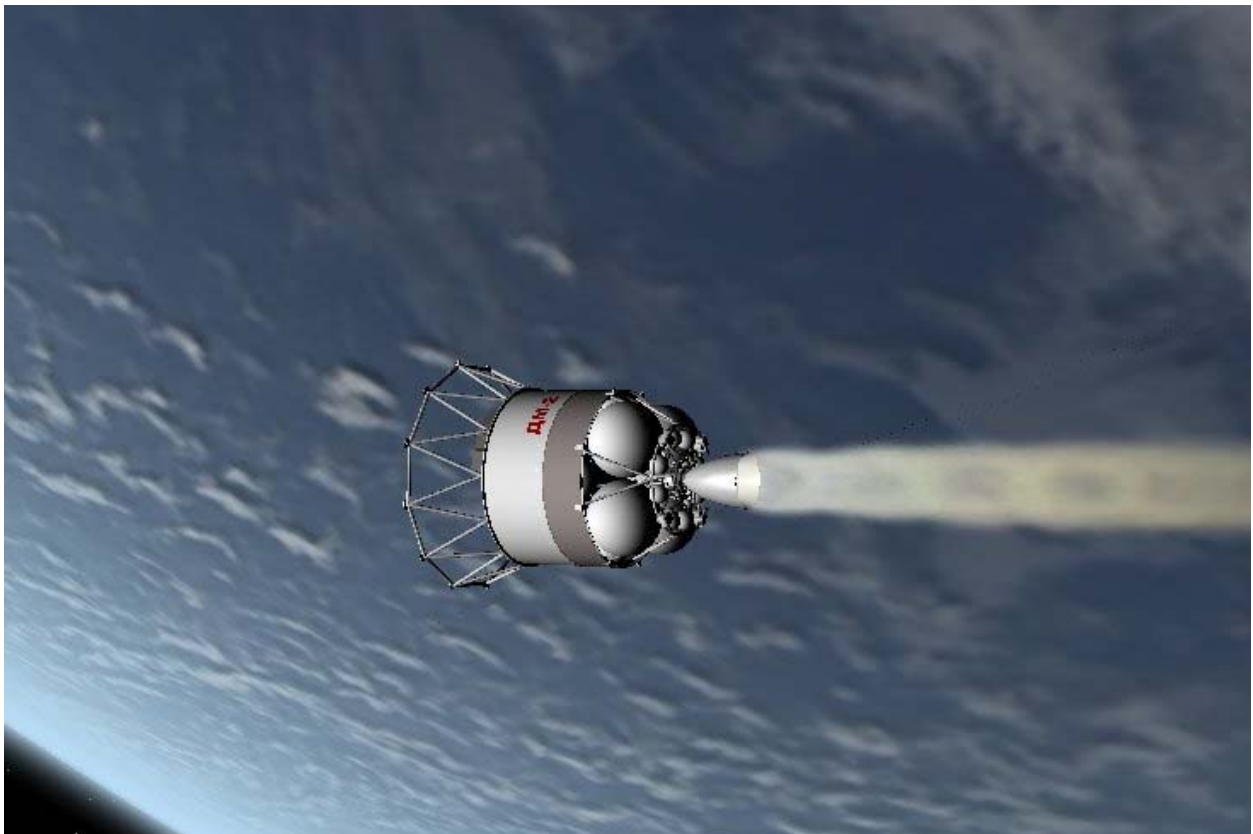


Here you can set the current state of solar panels, radiators and the aerial.

Screenshots



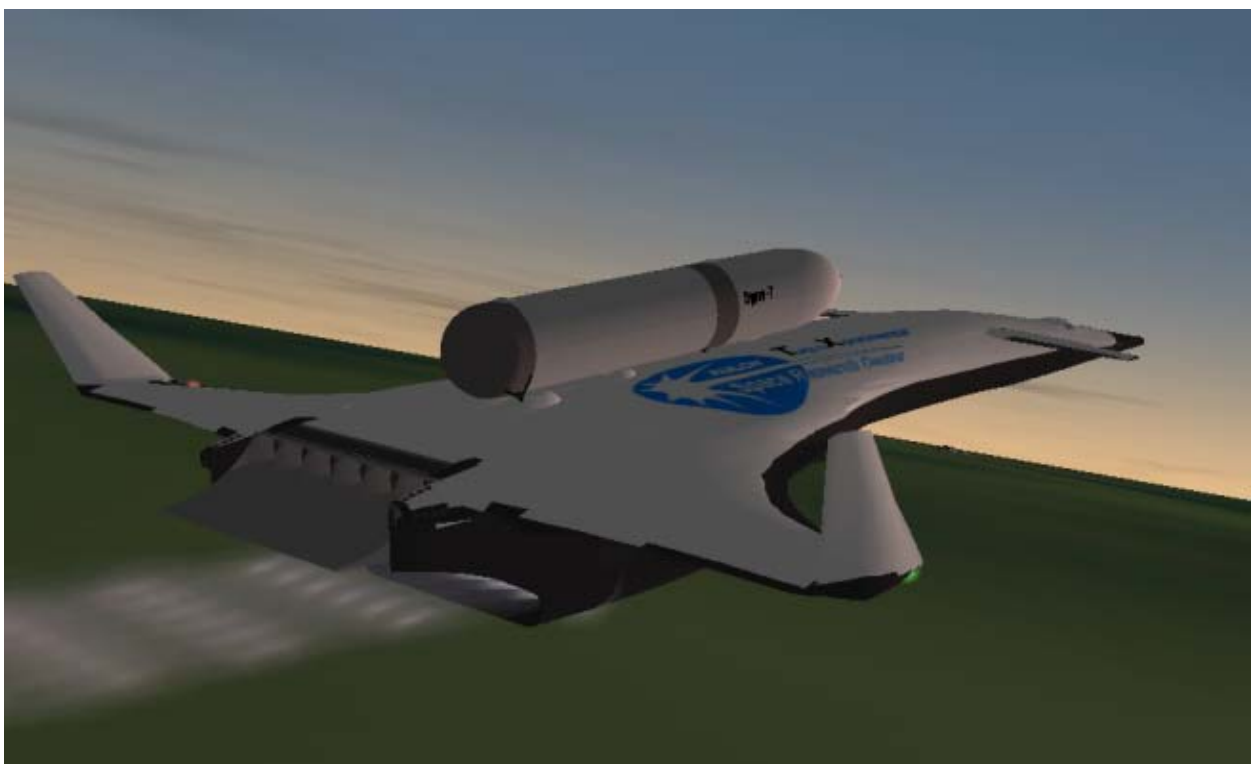
Disclosing of Buran-T container with DM-2 space tug and station Mir-2 core module



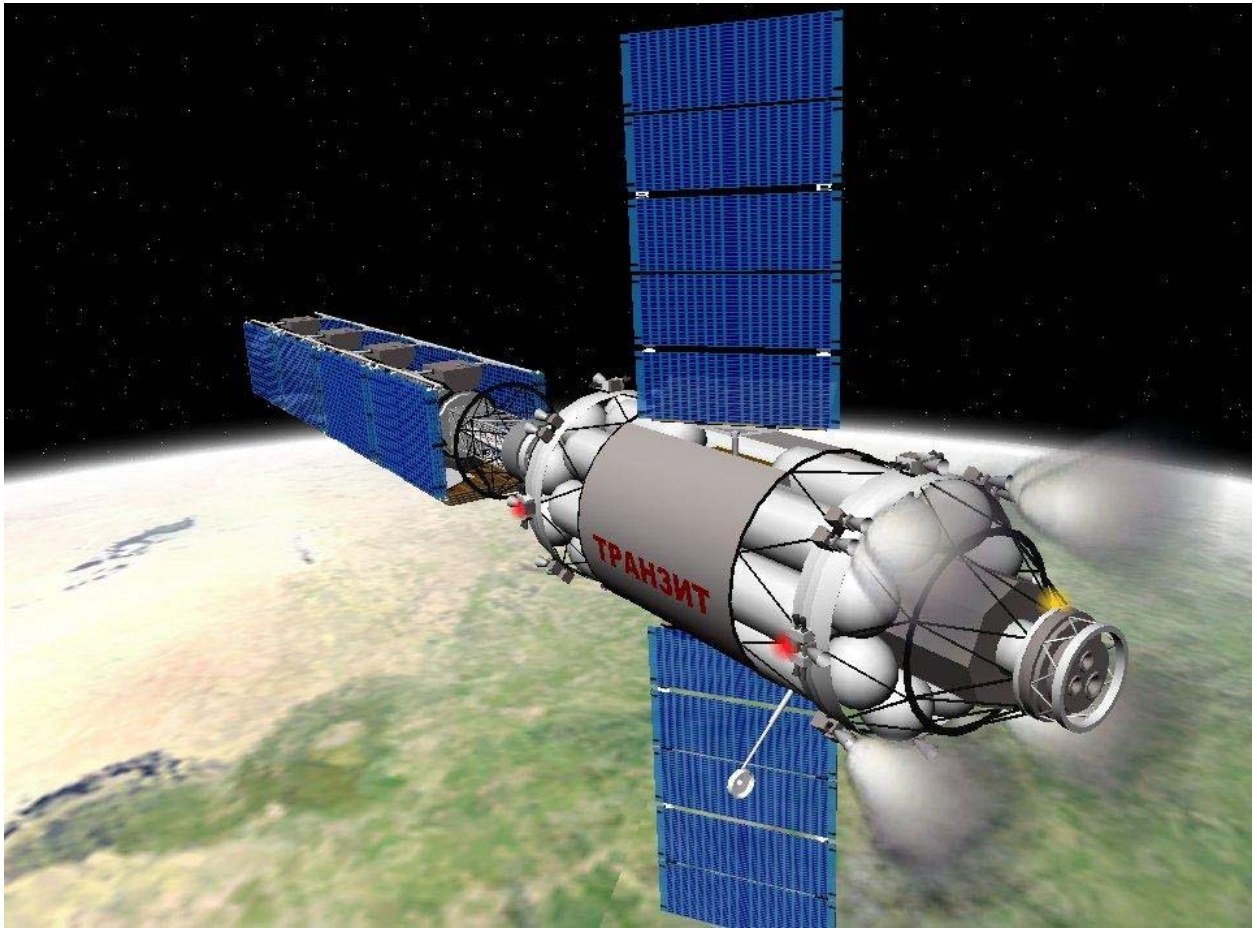
Sinking of DM-2 above Pacific Ocean



Launching the Titan service module



Astride on TX



Tranzit spacetug with Solaris module