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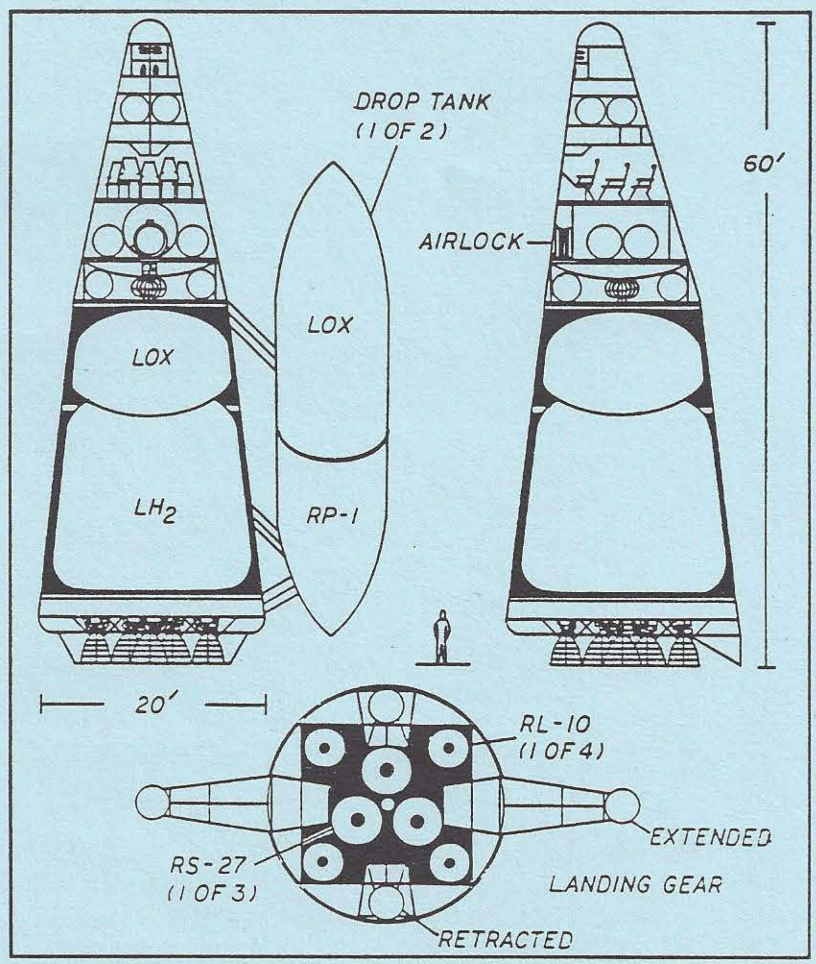
World Space Foundation Proposes New Low-Cost Space Transportation System

The World Space Foundation (WSF) is proposing development of a reusable, vertical-takeoff-and-landing (VTOL), manned space transportation system. The vehicle, called the Vertical Launch/Landing Space Transport (VLST), is intended to transport about two tons of personnel and cargo to low earth orbit at an estimated cost per flight of $10-15 million.

Primary missions would include passenger transportation, servicing of satellites and space platforms, and use of the vehicle as an orbital research facility.

The VLST, shown in the illustration below, has a gross lift-off weight (GLOW) between 547,000 and 631,000 lbs., depending on vehicle configuration. The vehicle has a bi-conic external shape based on designs for maneuvering warhead reentry vehicles and other aerobraking spacecraft. This shape allows the VLST, which reenters flying forward like an aircraft, enough lift to permit a considerable crossrange capability. The engines are located at the aft end, and shielded from reentry heating by a protective flap (all illustrations, by Michael R. Draper, are copyright 1989, World Space Foundation)



The VLST is designed to carry a payload of about 4,500 lbs. In its primary, personnel-transport configuration, this works out to two crew members and five passengers, along with their personal gear and supplies for seven days. In an alternate cargo mode, the payload would be two crew members, 1,900 lbs. of cargo, and supplies for five days.

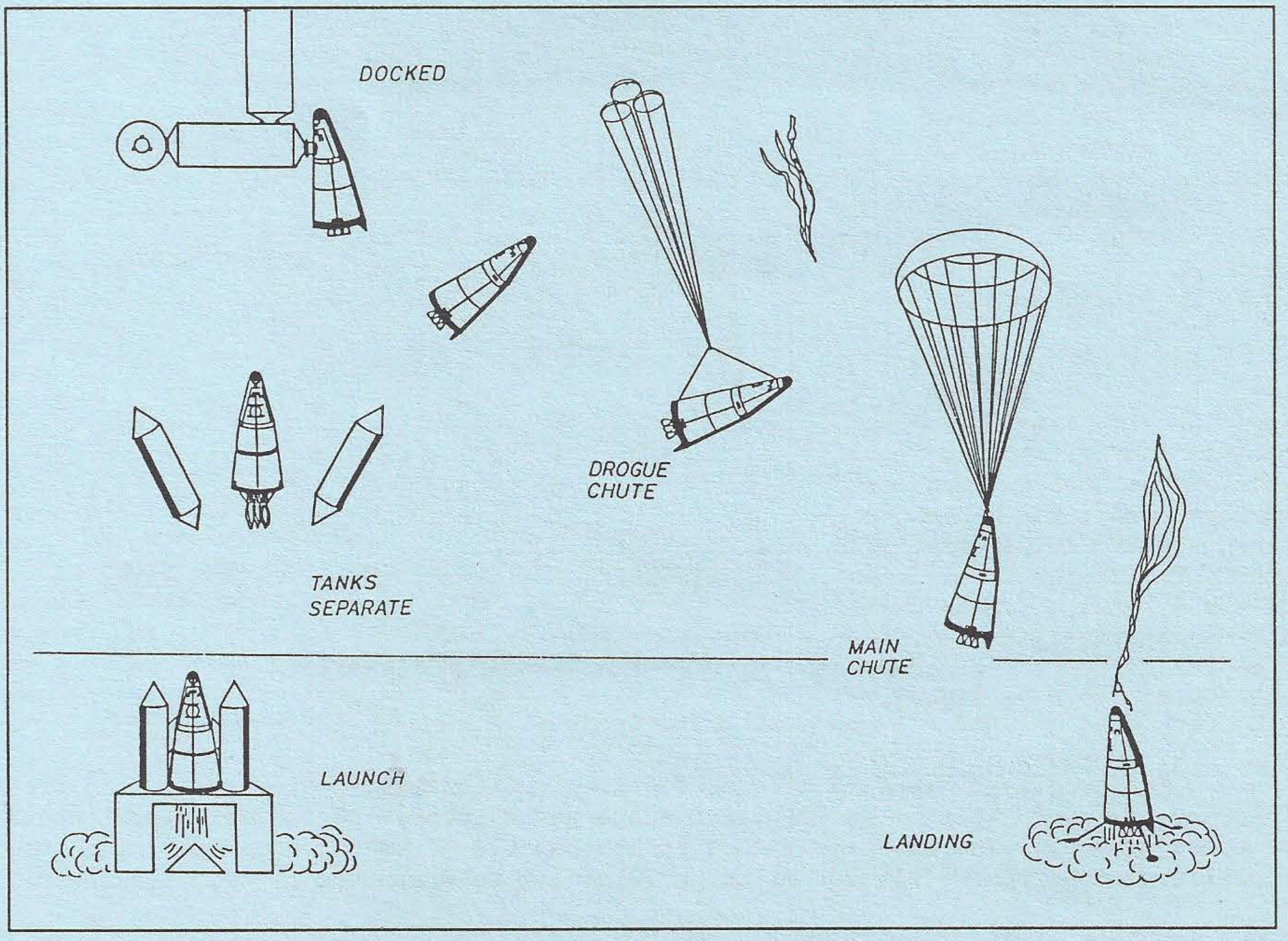
Two versions of the VLST are being studied: a drop tank version (the one shown in the illustrations), and a single-stage-to-orbit (SSTO) version. The SSTO configuration is identical to the core vehicle of the drop tank version, except that it is about 25% larger to accommodate the additional propellant. The drop tank version is more complicated, and operationally more expensive than the SSTO version, but has greater growth capability. Both versions have identical payloads.

The VLST is a mixed-mode vehicle, using liquid oxygen (LOX) and kerosene (RP-1) during the initial phase of the flight, and switching to LOX and liquid hydrogen for the remainder of the flight. In the drop tank version, LOX and RP-1 for the initial phase are carried in the two drop tanks. In the SSTO version, these propellants are carried in the vehicle itself.

The VLST is designed to use existing, off-the-shelf rocket engines: the Rocketdyne RS-27 (used on the McDonnell Douglas Delta) for the LOX/RP-1 flight phase, and the Pratt & Whitney RL-10A-4 (used on the General Dynamics Centaur) for the LOX/hydrogen flight phase. Both versions of the VLST use four RS-27s and five RL-10s (the illustrations, based on a light-weight design, show fewer engines).

Although not advertised as reusable, both engines have accumulated a considerable amount of long-duration burn experience. In static tests, the precursor to the RS-27--the H-1--accumulated up to 2000 seconds of full-thrust firing time with little or no engine rework. The RL-10 is currently qualified to 3960 seconds of firing time (these times represent about ten flights of the VLST). With parts replacement, accumulated firing times of up to an hour for the RS-27 and four hours for the RL-10 have been confirmed by tests.

A typical mission (see illustration below) would begin with liftoff from a simple "milkstool" type of launch pad. During the flight to orbit, the drop tank version would jettison its two external fuel tanks (recovery of these tanks is not



currently planned). If an emergency requires it, the forward cabin area of the VLST is designed to be separated from the rest of the vehicle and propelled to safety by solid rocket motors. The cabin would then be lowered by the main parachute to safety.

Orbit circularization would be accomplished by using one of the RL-10 engines in idle mode. Other orbital maneuvering would use thrusters burning storable propellants. After a de-orbit burn, the VLST is oriented nose-first and nose-high for reentry. Reentry maneuvering and stabilization is accomplished using thrusters and aerodynamic flaps.

At a velocity of about Mach 2, near the landing site, drogue chutes are deployed to orient the vehicle vertically for landing. A main chute is then deployed, which lowers the vehicle to the landing site. The landing legs are extended. Just before touchdown, at an altitude of about 50 feet, small solid-fuel motors burn for about one second, cushioning the final landing. The main engines are not relit (this basic landing method is also used by Soviet Soyuz manned space capsules).

The World Space Foundation estimates that the VLST could be developed for less than $400 million, and be operational in 1994. Typically, these figures are considered unrealistic by some aerospace "experts," but my years of work on the Phoenix supports the WSF estimates as being quite feasible.

According to the WSF, five VLST vehicles could meet the needs of commercial and government users through the remainder of the 1990s. If each vehicle flies 14 flights per year, at a price of $15 million per flight, annual revenues would exceed one billion dollars. Since my experience with reusable launch vehicles leads me to believe that VLST operating costs would in fact be far less than $15 million, it is likely that a considerable chunk of these revenues would be profits. This should make a VLST venture quite attractive to investors.

Current WSF financial plans call for raising $6 million in venture capital for the initial design effort. Another $370 million would be required to finish development and construct two flight prototypes.

Private Rocket Companies Land More Sounding Rocket Contracts

The University of Alabama in Huntsville (UAH) has selected Space Services, Inc. and Space Data Corp. to launch a continuing series of sounding rockets for the university's Consortium for Materials Development in Space (CMDS). The earliest of this new series of launches is scheduled to take place this fall. Payloads will include materials processing and biotechnical experiments.

The consortium is negotiating two scheduled launches with each company and formal contracts are expected to be completed within the next month. Included in the negotiations are options for two additional launches with each company.

Space Services, Inc. (SSI) will use its Starfire 1 sounding rocket to launch the consortium's "Consort 2" and "Consort 3" payloads (the first UAH CMDS payload, Consort 1, was successfully launched by SSI on March 29 as was described in last month's issue). The planned launch dates are fall 1989 and fall 1990, for Consort 2 and 3, respectively. As with the Consort 1 flight, the Starfire launches will take place at the U.S. Army's White Sands Missile Range in New Mexico. The payloads will be recovered on land elsewhere at White Sands.

The two-stage Starfire 1 is 52 feet long, with solid-fueled propulsion provided by a Morton Thiokol TX 664 first stage and a Bristol Aerospace Black Brant 5 second stage. The Starfire launchers are capable of taking their payloads to an altitude of approximately 200 miles, providing 6 to 8 minutes of weightlessness.

Space Data, an operating division of Orbital Sciences Corp., will use its one-stage "Prospector" rocket to launch the consortium's Joust 1 and Joust 2 payloads. The Joust 1 and 2 flights are scheduled for the summers of 1990 and 1991, respectively. The Prospector launches will take place at the U.S. Air Force Eastern Test Range in Florida. The payloads will be recovered from the Atlantic Ocean.

The Prospector launch vehicle will be propelled by a Morton Thiokol Castor IVA solid rocket motor. The Prospector will take its payloads to an altitude of approximately 600 miles, providing up to 15 minutes of weightlessness.

Space Data has extensive experience with sounding rocket launches, having designed, built, and launched over 600 suborbital launch vehicles weighing up to 70,000 lbs.

For More Information

Information in the VLST article is from a paper titled Crew Transportation For the 1990s: Commercializing Manned Flight With Today's Propulsion by Robert L. Staehle and J. R. French Jr. (President and Vice-President/Projects respectively of the World Space Foundation). The paper was prepared for the Symposium on Space Commercialization held in Nashville, Tennessee in March. The World Space Foundation is a non-profit organization active in a number of important space projects. These include (aside from the VLST) the Solar Sail Project, which is designing and developing spacecraft propelled by solar radiation, and the Asteroid Project, which supports efforts to discover and track new asteroids with particular emphasis on those which cross the orbit of the Earth.

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Note to subscribers: Excuse the dot-printed format--I have just completed moving my computer hardware to a different site and I no longer have easy access to a Laserwriter. Hopefully I can correct this before too long. The move also caused further delays in publishing as you can see by the "official" date at the beginning of the newsletter. As usual, I am giving the real publication date after my signature. It is tempting to simply change the official date to "July," and extend everyone's subscription by four months. Unfortunately, my computer and its homemade subscription software are likely to react by spitting subscribers out the disk slot, and a number of libraries and other institutional subscribers who try to keep track of months and volume numbers would become completely confused. Again, apologies for any problems these delays might be causing.

Until next time,

Tom Brosz
June 15, 1989

The Commercial Space Report (C.S.R.) is published monthly, and endeavors to report and analyze developments in the field of private initiatives in space transportation and exploitation.

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