ARCHIVED REPORT

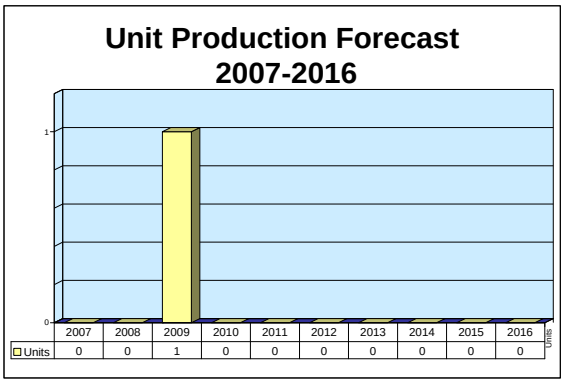
For data and forecasts on current programs please visit

www.forecastinternational.com or call +1 203.426.0800

VLS - Archived 12/2008

Outlook

- Brazilian Space Agency plagued by inadequate budget; needs more funding for repairs at the Alcantara launch site and for a new VLS
- Forecast International expects VLS-4 to launch no earlier than 2009



Orientation

Description. The VLS (Veiculo Lancador de Satelites) is a small, solid-propellant, expendable launch vehicle.

Sponsor. The Instituto de Aeronautica e Espaco (Aeronautical Technology Institute) (IAE), Sao Jose dos Campos, Sao Paulo, Brazil, is responsible for VLS development and operation of the Alcantara equatorial launch site, from which the VLS rocket will be launched.

Status. The first VLS launch in 1997 ended in failure, as did the second launch in December 1999. The third VLS launch scheduled for August 2003 exploded on the pad. The fourth attempt is planned for 2009.

Total Produced. Three

Application. The VLS rocket is designed to place a 200-kilogram payload into a 750-kilometer orbit.

Price Range. A VLS launch is expected to cost $9 to $10 million dollars. The rocket costs $300 million to develop.

Contractors

Prime

Instituto de Aeronautica e Espaco, IAE	http://www.iae.cta.br, 50 Praca Marechal Eduardo Gomes, Villa das Acacias, Sao Jose Dos Campos, Sao Paulo, 12228-904 Brazil, Tel: + 55 012 3947 6555, Fax: + 55 012 3941 2522, Prime (Development & Operation Of Alcantara Range)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

VLS

Technical Data

Design Features. The VLS is a three-stage vehicle flanked by four solid-propellant strap-on rockets. The design of the strap-ons and Stage 1 and 2 motors is derived from Stage 1 of Brazil's Sonda 4 sounding rocket.

The 9-meter-long S-43 strap-ons feature moveable nozzles providing up to 3° three-axis control. Stage 1 power is provided by an S-43TM motor, similar to the strap-on motor, but with a wider (1,200 mm vs 700 mm) nozzle for altitude operations. Stage 2 features an S-40TM motor, with an 800-mm nozzle and 3° of movement. Stage 3 uses an S-44 motor.

All four strap-ons ignite at liftoff and burn for about one minute before being jettisoned. Stage 1 ignition then occurs, lasting for one minute before the stage separates and Stage 2 ignites. The rocket's payload fairing separates at this time, followed by Stage 2 burnout 60 seconds later. Equipment bay separation and Stage 3 ignition take place nearly 15 minutes into the mission. Approximately 16 minutes after liftoff, Stage 3 is jettisoned and the satellite payload inserted into low-Earth orbit.

VLS missions originate at Brazil's Alcantara launch range at the Brazilian military air base at Alcantara, ideally located just two degrees south of the equator. Payloads placed into orbit from here get substantial advantage from the Earth's rotational spin and can achieve some propulsion savings or payload increases over other launch sites at higher latitudes. Alcantara is also used for sounding rocket launches.

	Metric	U.S.
Dimensions		
VLS Overall Length	19 m	62.5 ft
Strap-on Length	9.0 m	29.5 ft
Stage 1 Length	8.1 m	26.6 ft
Stage 2 Length	5.8 m	19.0 ft
Stage 3 Length	1.8 m	6.0 ft
Strap-on & Stage 1-3 Diameter	1 m	3.2 ft
Weights		
VLS Overall Weight	50,000 kg	110,230 lb
Strap-on Weight (each)	8,550 kg	18,850 lb
Stage 1 Weight	8,720 kg	19,219 lb
Stage 2 Weight	5,664 kg	12,487 lb
Stage 3 Weight	1,025 kg	2,260 lb
Performance		
Strap-on Burn Time	59 sec	
Stage 1 Burn Time	58 sec	
Stage 2 Burn Time	56 sec	
Stage 3 Burn Time	68 sec	
Strap-on Average Thrust (vac)	303 kN	68,122 lb
Stage 1 Average Thrust (vac)	320 kN	72,090 lb
Stage 2 Average Thrust (vac)	208.4 kN	46,847 lb
Stage 3 Average Thrust (vac)	33.2 kN	7,474 lb
Payload to 750-km equatorial orbit	200 kg	440 lb

Variants/Upgrades

VLM. This is a smaller version of the VLS-1 without the strap-on boosters. It is intended to launch micro-satellites into low-Earth orbit. The VLM is a four-stage, all-solid-propellant launch vehicle and comprises the S43 motor as the first stage, the S40 motor as the second stage, the S44 motor as the third stage, and the S33 motor as the fourth stage. The guidance and control scheme matches that of the VLS-1. The VLM is presumably no longer in development, nothing has been heard of it since the 2003 VLS accident, and Brazil's intent to proceed with the Southern Cross program would seem to deliver the coup de grace for VLM development.

Southern Cross. This is a program to develop five new launchers based on the VLS by 2022. The solid propellant third and fourth stages will be replaced by a single liquid-fuel stage. The first Southern Cross launcher – Alpha – is projected for liftoff in 2009.

A VLS shown at the Alcantara launch site.

Source: IAE

Program Review

Background. Brazil has lagged behind countries such as China and India in space launch systems development. The Latin American country has taken a stepping-stone approach to space, with its hopes for some degree of space industry self-sufficiency first geared toward acquiring the capacity and knowledge to design and build satellites.

Until earlier this decade, Brazil's efforts to develop the VLS rocket were hampered by the country's refusal to join the Missile Technology Control Regime (MTCR). The VLS would provide Brazil with the means to place its own relatively small satellites in LEO. But the MTCR, an agreement signed by more than two dozen countries, limits missile-related technology that can be exported to non-signatories, such as Brazil. Consequently, outside technology needed to develop the VLS had been difficult to obtain.

Brazil switched gears in 1994, announcing that it would follow the guidelines of the MTCR. In 1995, Brazil decided to join the MTCR, opening the way for VLS-related technology transfer, primarily from British, French, and other European countries.

Brazil's efforts to join the exclusive launch vehicle club were dashed over the Atlantic Ocean off the coast of Maranhao in November 1997. One of four engines on the VLS booster failed to ignite, prompting controllers to send a destruct signal to the rocket. Also lost in the mishap was Brazil's second data gathering satellite (SCD-2), which was to have collected information on the environment. Brazil's Space Research Institute built the remote sensing satellite for about $5 million.

In December 1999, the second launch attempt of the VLS ended in failure when the second stage failed to ignite. The vehicle and its payload were destroyed by

mission control. The launcher was carrying SACI-2, a science satellite built by INPE to replace SACI-1, which had failed in orbit shortly after its launch. As a result, INPE has canceled the SACI program.

Alcantara Launch Site. Success of the VLS program is intertwined with the commercial development at Alcantara. In June 2000, the government of Brazil decided to invest $40 million on seaport facilities to foster commercial use of Alcantara. Foreign companies will then be able to ship rockets and payloads directly to the Alcantara site. Profits made at Alcantara will be used for upgrades at the launch center, VLS development, and satellite development.

Explosion Rocks Jungle Launch Pad

On August 22, 2003, over 700 experts, technicians, and Army personnel at the Alcantara launch base were working around the clock to complete the 65-foot VLS rocket. Just three days before launch of VLS-3, the planning and preparations were abruptly and violently brought to an end as more than 21 Brazilian space technicians and engineers were killed and another 20 injured in a massive rocket explosion. The explosion destroyed the Brazilian VLS rocket and two satellites. The accident was a severe blow to Brazil's burgeoning space program as the victims included the country's most experienced technicians.

It is thought that during routine pre-launch preparations, one of the Brazilian-designed VLS-1 VO3 rocket's four S-43 strap-on boosters ignited, triggering an explosion that destroyed the launch pad.

Timetable

Month	Year	Major Development
Nov	1997	First VLS launch ends 65 seconds after liftoff when solid rocket booster fails to ignite
Dec	1999	Second VLS launch attempt with SACI-2, a science satellite, ends in failure
Aug	2003	VLS-3 explodes on the Alcantara pad
	2009	End of construction of the Integration Moving Tower
	2009	Planned launch of VLS Alpha with Equars spacecraft

Forecast Rationale

In November 2004, the Brazilian Space Agency established a Memorandum of Understanding (MoU) with the Russian Space Agency, which would allow for the creation of a new launch-vehicle family capable of carrying larger satellites, as well as a liquid-propellant powered version of the VLS. The Southern Cross Program, as this development project is known, will attempt to build five new satellite launchers (Alpha, Beta, Gamma, Delta, and Epsilon) by 2022.

The Alpha launcher will be based on the VLS-1 launcher, but the solid-propellant third and fourth stages will be replaced by a single liquid-fuel stage. The first launch of Alpha is projected for 2009. The subsequent rockets in the family will utilize liquid-fuel engines developed and manufactured in Brazil, presumably with Russian cooperation. The MoU also provided for the development of ground infrastructure at the Alcantara Launch Center, including telemetry and tracking systems.

Cooperation with Russia will help Brazil meet goals outlined in its National Space Activities Program (PNAE) for 2005-14, which reportedly indicates three stages for the VLS launcher program: 1) the completion and launch of a VLS-1; 2) the development of an updated version called the VLS-1B, which would use liquid propulsion and be capable of carrying 800 kilograms to low-Earth orbit; and, 3) the development of a launcher able to reach geostationary orbit carrying 800 kilograms.

Details are emerging regarding the reformation of the Alcantara site, which will lower its military status and allow a variety of people access to the site, including the academic community, politicians, business representatives, and even tourists. This should be great for the site and will serve to globalize Alcantara at a time when it desperately needs positive international attention. The project is expected to take five years, but Forecast International expects that the plans will ultimately be scaled back considerably. The reason? In the current configuration, the Alcantara plan will cost $259 million over a five-year period, approximately $52 million per year. This level of funding for Brazil's space program is

unheard of, and the prospects of getting the budget approved are grim; even if it is approved, dispersing the funds will be another trick in and of itself.

The critical thing for the Brazilian space program will be to establish the Alcantara site in its most basic form to allow launches of the Ukrainian Cyclone and to get some launch victories under its belt. If Brazil and Ukraine can launch Cyclones from Alcantara, it will go a long way toward not only calming potential clients but also attracting some as well. Getting revenues in from Alcantara is crucial now, as delays in opening the facility have already cost Brazil millions, and the Cyclone can help in this regard. We are not currently forecasting production beyond the VLS shown in 2009, which represents the Alpha rocket.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	**High Confidence**					**Good Confidence**			**Speculative**			
	Thru 2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
Instituto de Aeronautica e Espaco												
VLS												
	3	0	0	1	0	0	0	0	0	0	0	1
Total	3	0	0	1	0	0	0	0	0	0	0	1