Brazilian Space Agency

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National Program of Space Activities

2005 - 2014

National Program of Space Activities PNAE 2005 - 2014

Brasília, DF

2005

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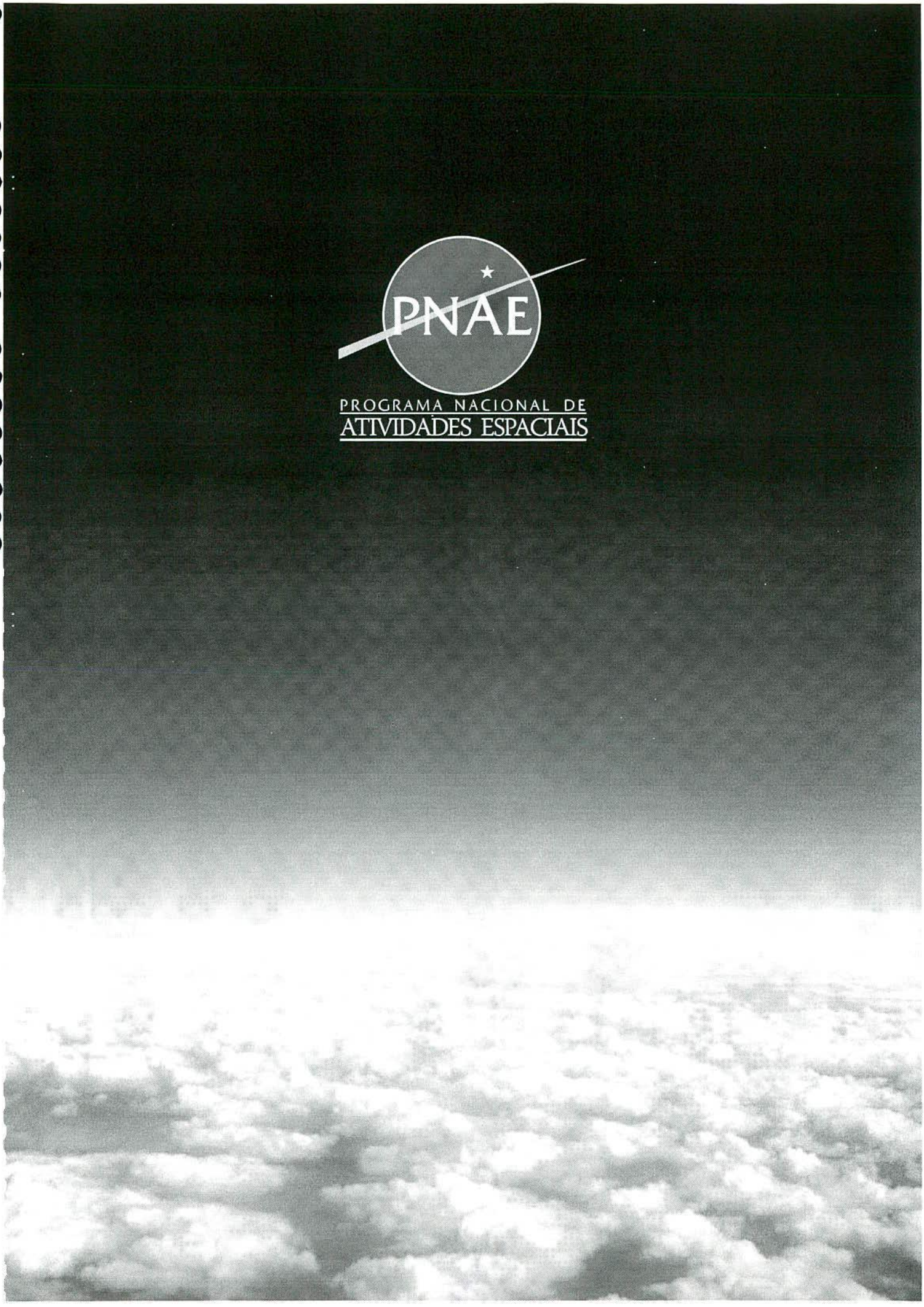

PNAE
PROGRAMA NACIONAL DE
ATIVIDADES ESPACIAIS

Foreword

The National Program of Space Activities – PNAE – is strategic for the sovereign development of Brazil. The importance of capacity building in the domain of space technology which, in a broader sense, includes launch centers, launch vehicles, satellites and payloads, arises from its relevance for the nation's future. No strategic technologies will be made available by third parties. These must be developed with domestic resources, in a widespread and integrated manner, in order to address the challenges posed by the era of satellite telecommunications and imaging.

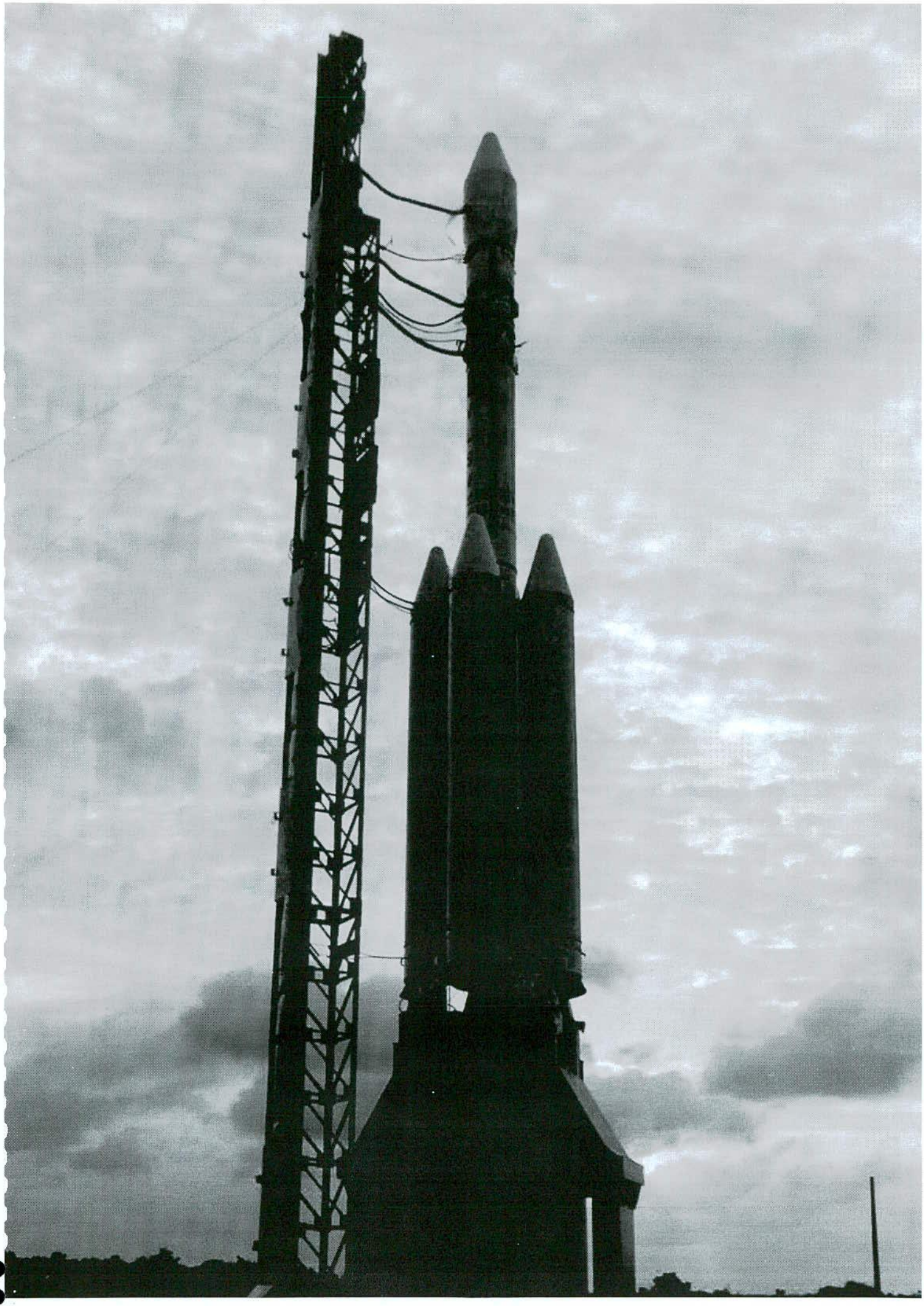
Only those countries that master space technology will have the autonomy to develop global evolution scenarios, which consider both the impact of human action, as well as of natural phenomena. These countries will be able to state their positions and hold their ground at diplomatic negotiating tables.

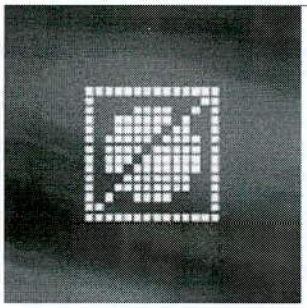
The third review of the PNAE, which covers the period between 2005 and 2014, has followed the above guidelines. The following text is the result of a public debate, which culminated at the Brazilian Space Program Review Seminar, held at the National Congress in December, 2004. This effort included the participation of representatives of the government, and the scientific, academic and business communities.

As shown by the review, during the administration of President Luiz Inácio Lula da Silva, a clear upward trend in investment has taken place with regard to the Brazilian space program, as a result of the Government's commitment towards the national development of science, technology and innovation. Full advantage of this opportunity will be taken, so that Brazil may become a member of the select group of countries possessing space technology.

I would like to thank all the institutions – especially the representatives of the Air Force Command, of the Ministry of Defence – that contributed towards the PNAE 2005–2014. This recognition I also extend to the Brazilian Space Agency and its Superior Council, who were ultimately responsible for this plan, which recognizes the capacity of the Brazilian people to look strategically into the future, reflecting the maturity of the Nation and its leaders.

Eduardo Campos
Minister of Science and Technology





Introduction

Space activity significantly contributes to the development of Brazil, by providing images and data acquired over the national territory, and by stimulating innovation in the effort towards the acquisition and development of technologies and knowledge considered critical to meet the needs of the National Program of Space Activities– PNAE, benefiting both industry and society.

Satellite, suborbital payload and balloon missions for Earth Observation, Meteorology, Space Science and Telecommunications meet the government needs to implement efficient and effective public policies and address national problems in those areas.

The development of launch vehicles, another important component the nation's autonomy regarding access to space, also allows the commercial exploitation of launch services.

The entire infrastructure overseen by the Program is extremely important in supporting all space vehicle production, integration, testing, launch and control activities, without which autonomous development would not be possible.

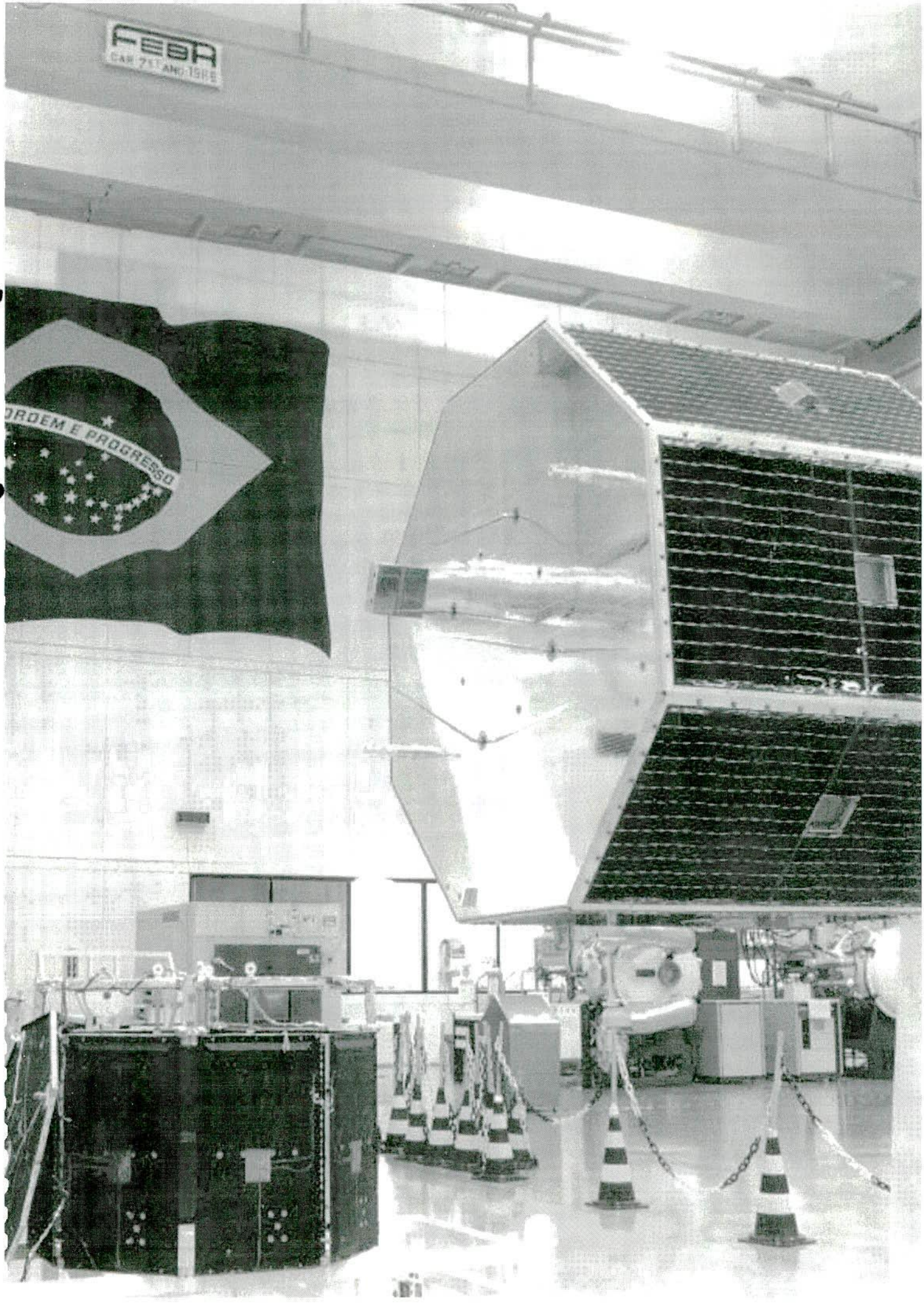
In order to face the technological challenges involved in large scale projects, PNAE has become, by way of R&D activities with the support of the academic community, a strong innovation fostering agent, which plays a fundamental role towards the leveraging of national industrial capacity and competitiveness, through the acquisition of strategic capacities and technology, of new work processes and methodologies, in compliance with international quality standards. This knowledge shall lead to the modernization and leveraging of the nation's entire productive sector, by way of technology absorption mechanisms.

VLS-1 at the Alcantara Launch Center

Supporting this entire effort are the human resources, comprised of those responsible for the critical competencies that make the implementation and development of the various activities of the Space Program possible.

This document, which is the third review of the National Program of Space Activities – PNAE, covering the period between 2005 and 2014, follows the guidelines of the National Policy for the Development of Space Activities– PNDAE, outlining the missions and actions aimed at attaining the established objectives. Also outlined are the priorities and directives that guide the implementation of all space activities, which also serve as a reference for all annual and pluri-annual planning of the components of the National System for the Development of Space Activities – SINDAE.

Sergio Gaudenzi
President of the Brazilian Space Agency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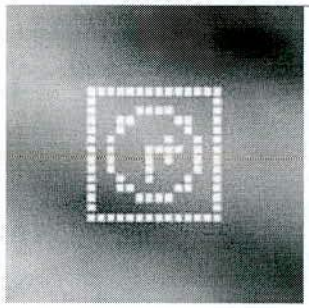


Strategy

Rationale

The aim of the National Program of Space Activities – PNAE – is to enable the country to develop and use space technology in order to address national problems in benefit of Brazilian society, contributing towards the improvement of the quality of life, by generating wealth and creating jobs, through scientific research, and by increasing awareness of issues regarding our territory and environment.

Practice has shown that space activities require a great deal of investment, which must be parsimoniously applied according to precise criteria. It was therefore essential to select technical aspects which were technologically advantageous to the Program, and that effectively meet the needs of society. Toward this end, the following activities were selected: Earth Observation, Technological and Scientific Missions, Telecommunications and Meteorology.

The efforts of PNAE towards the development of sounding rockets and launch vehicles, as well as their associated technologies, aim at assuring access to space, and are fundamental to enable orbital and suborbital missions, as established in the Program. Satellite, suborbital and orbital payloads, and balloon missions have been fundamental in providing the Brazilian government with important information, essential for the effective implementation of public policies aimed at the sustainable use and preservation of natural resources, to meet the needs of the productive sector and society at large in terms of information on climatic and environmental changes, and furthermore, information supporting scientific research towards the production of precise knowledge of our Planet and the Universe.

It should be pointed out that Brazil has achieved international recognition in the areas of Remote Sensing, Geo-processing, Space Sciences and Meteorology and, as a result, has added value and credibility to the data and information collected by our satellites, increasing the capacity to meet the growing market

Data Collecting Satellite (SCD-2) undergoing tests at LIT/INPE

demand for monitoring services. Furthermore, as a result of this capacity, it has been possible to establish international partnerships of great strategic value, which have helped place the country, in a sovereign manner, onto the international political and economic scenario. On the other hand, In the area of international relations, special attention has been given to cooperation initiatives with countries whose development level and difficulties are similar to our own.

VS – 30 Sounding rocket

Lastly, it is important to point out that all space research, rocket and satellite development and launch activities depend on two factors. On the one hand, indispensable ground equipment, systems and facilities, which include rockets, satellite vehicles and stratospheric balloon launch centers; specialized assembly, integration and testing laboratories; control and monitoring centers, as well as satellite data reception, handling and distribution centers. On the other, the available human resources, a select group of highly trained technicians and specialists in all areas of space technology, distributed throughout the governmental, academic and industrial sectors. The continuity and success of the Program necessarily depend on the preservation and strengthening of the strategic capacities and knowledge of this small space community.

Space Activities in the National Context

Organization

Space activities in Brazil are developed within the framework of the National System for the Development of Space– SINDAE, which was set up by Decree nº 1,953, of 10 July, 1996. The SINDAE groups various institutions, which play distinct roles:

I. The Brazilian Space Agency – AEB – acting as a central coordination agency, reporting to the Ministry of Science and Technology – MCT, and ministries and other governmental agencies, as well as entities of the civil society, represented at the Superior Council of the AEB;

II. As executive agencies, the National Institute for Space Research – INPE, reporting to the Undersecretariat for the Control of Research Institutes – SCUP, of the MCT, and the Research and Development Department – DEPED, an Air Force Command agency, under the Ministry of Defence. Subordinated to DEPED are: a) the Institute of Aeronautics and Space– IAE, through the Aerospace Technical Center – CTA; b) the Alcântara Launch Center – CLA; c) the Barreira do Inferno Launch Center – CLBI;

III. As participating organizations and entities, among others, the industrial sector and Brazilian universities conducting space research.

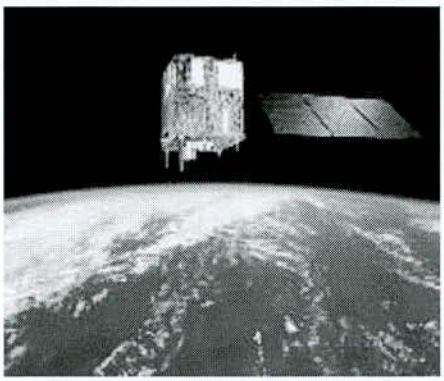
Current Situation of the Space Program

The National Program of Space Activities – PNAE – has consolidated an internationally recognized scientific community – a group of competent professionals comprising a solid base of engineering and space technology specialists, as well as researchers in space sciences, remote sensing and satellite meteorology.

In the area of space applications, our country has obtained expressive results as a consequence of a long term effort, aimed at the implementation of indispensable infrastructure, at human resources training, and the development of methodologies and tools to meet the demands of the Program. Consequently, orbital remote sensing techniques have been incorporated in to the various daily activities of high social and economic value, also promoting an increase in the number of service providers.

The effort put into the development of satellites was rewarded by the success of the Data Collecting Satellite -SCD – and the China-Brazil Earth Resources Satellite – CBERS – programs, which significantly contributed towards the use of space information in governmental management and new business ventures.

The development of Sounding Rockets and the Satellite Launch Vehicle – VLS-1 – has allowed our country to consolidate knowledge regarding propulsion, materials and processes, control and guidance, and scientific experiments which has significantly increased the participation of industry and scientific research in the space area.



The China-Brazil Earth Resources Satellite (CBERS)

A large support infrastructure has been deployed, comprised of the Alcântara Launch Center -CLA, the Barreira do Inferno Launch Center -CLBI, the Testing and Integration Laboratory -LIT, the Satellite Tracking and Control Center -CRC, the Coronel Abner Propellant Plant -UCA, as well as many other observatories and research laboratories, and technological niches in the private sector. The industrial sector has contributed significantly towards the development of the PNAE projects, demonstrating the highly qualified technical capacity of their staff, similar to that of the SINDAE research institutes.

Despite the favourable scenario outlined above, the Program has accumulated, in recent years, serious annual budget restrictions, creating obstacles in the maintenance and re-staffing of technical teams, as well as in project procurement. This situation became all the more evident as a result of the accident that took place during the launch campaign of third Satellite Launch Vehicle, VLS 1-03, in 2003. This situation led AEB to propose a series of measures aimed at revitalizing the Space Program, which have been implemented with governmental support, fully aware of the strategic importance of the Program for the nation.

Space Activities in an International Context

The globalization of governmental space activities, through international cooperation agreements, and represented by the International Space Station, of which Brazil is a part, has changed the way outer space has been exploited in the last decade. Internationally, large space exploration projects have been undertaken in recent years. While the United States and Europe have placed exploratory robots on Martian soil, and have announced future missions to Mars and the Moon, China has further developed its manned space program, and plans future exploration of the Moon. India and Japan have independently disclosed their intention of sending unmanned missions to the Moon, and Russia has hinted at sending a mission to Mars.

Thus, a scenario which was gradually phased out and substituted by smaller projects aimed at obtaining return on investment has, in the short run, been reinstated and revitalized, with the return of mega-projects aimed at the exploration of the Solar System.

Terrestrial exploration has also been conducted, with large international observation and monitoring projects, such as Global Precipitation Measurement - GPM, carried out by the United States and Japan, and the GEOSS (Global Earth Observation System of Systems) which includes more than 50 countries.

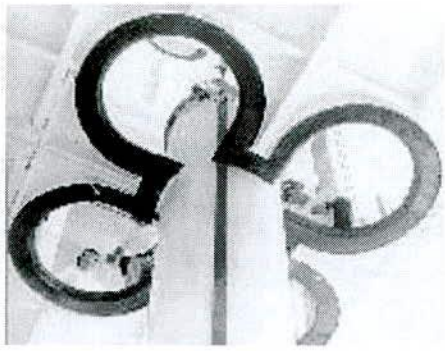
Also, manned suborbital flights have been sponsored by private companies in the United States, opening the doors to a new reality that will make space flight available to the general public.

This situation is the result of the current international state of affairs, in which countries possessing space technology have increased their budgets an average of 7% a year since 2002, with annual growth of 2% to 5% projected for the future.

The context described above and the apparent lessening of tensions brought about by the end of the cold-war have not significantly affected the national scenario with regard to the acquisition and transfer of critical technology.

On the contrary, certain technology transfer obstacles, initially based on a cold-war East-West logic, remain in force, in what has currently turned into a North-South logic.

In Brazil, there has been an increasing interest in the Alcântara (MA) center as a launch site. To this end, a Treaty was approved and signed with Ukraine in 2004 for commercial launches, under the responsibility of a bi-national corporation, created by the agreement. This model is expected to be used in future agreements with interested countries.



VLS-1 launch vehicle - 1 at the Mobile Integration Tower (TMI)

The National Program of Space Activities -PNAE Implementation Strategy

Principles

An assessment of the national and international contexts, which on the one hand points toward an increase in space activities in Brazil, and on the other outlines the enormous technological barriers that need to be overcome, requires careful planning so that the country may be securely conducted towards the desired autonomy in the space domain. This requires the coordinated effort of all those involved – government, academy and industry. Therefore, an implementation strategy for the National Program of Space Activities must be established, soundly based on the following principles:

1. Focus on meeting the needs of the public users of space goods and services.
2. Autonomy in the area of small satellites and respective launch vehicles.
3. Adoption of quality and safety standards compatible with international norms.

4. Search for financial sustainability in space activities, through the commercialization of space goods and services.

5. Integration of industry and universities with those institutions involved in the implementation of PNAE.

6. Strengthening of those institutions directly or indirectly involved in the implementation of PNAE, emphasizing:

   I. Training, capacity building and allocation of human resources toward technological innovation and better management;

   II. Utilization of knowledge management methods, techniques and tools generated within these institutions; and

   III. Utilization of technological and strategic planning methods, techniques and tools for the space area.

Priorities for the Decade

Based on the principles established above, the following priorities have been identified for PNAE for the next decade:

1. To continue the development of the Satellite Launch Vehicle -VLS and its successors, increasing the participation of the industrial sector, and the expansion of the launch infrastructure, including the Alcântara Launch Center – CLA.

2. In all missions, whenever possible, a Data Collecting payload shall be included aimed at the maintenance and updating of the Brazilian Data Collecting System, eliminating the need for specific satellites.

3. Conclusion of the Multi-mission Platform and its payloads.

4. Continuation of the CBERS satellite program and the processing and distribution of images.

5. Promotion of the commercialization of means of access to space, through the implementation of the full infrastructure of the Alcântara Launch Center, including commercial launch sites.

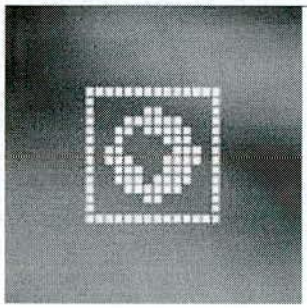
6. Investment in research and development aimed at critical technologies, with the participation of the industrial and academic sectors.

7. Execution of mobilizing projects in order to meet domestic demands regarding Earth Observation, Technological and Scientific Missions, Telecommunications and Meteorology, including the development of geostationary satellites, synthetic aperture radar – SAR – observation satellites, and scientific missions with satellites, balloons and sounding rockets.

8. Maintenance and industrial production of the successful sounding rocket program.

9. Increase in the participation of the Brazilian industry in the development of projects and activities called for by the Program, including the transfer of technologies generated by INPE and CTA.

10. Promotion of international cooperation agreements which involve technology transfer and meet national interests.



Earth Observation

Rationale

Outer space is the only place from which the Earth can be seen from a global perspective. Thus, with regard to issues such as global changes, tropical forests and climate, the use of observation satellites is the only way to obtain data on a systematic and consistent basis.

Given its continental dimensions, Brazil is a country that can only be effectively observed through orbitral instruments such as satellite images. Control by observation satellites is, in practice, the only fully effective way of monitoring certain areas, given their economic importance, strategic border control requirements, persistent environmental degradation, or surveillance requirements, such as the Amazon region, the largest tropical forest in the world, comprising approximately 5 million km², or the 200 nautical miles of the country's 8,000 km coastline, representing a total area of nearly 3 million square kilometers.

In addition, as a result of the constant growth of the area occupied by the Brazilian agribusiness sector, the use of satellite imaging to obtain information which is useful to agriculture and cattle raising has increased, providing more detailed knowledge regarding land use, its spatial and temporal dynamics and related environmental impacts.

The use of satellite images is also fundamental when there is a need for information on events whose location and time is difficult to predict, such as natural disasters (e.g. floods, cyclones, among others), human induced events (e.g. forest fires or oil spills), or crisis management.

In the area of cartography, satellite images may substitute or complement aerial surveys, as long as they are used on an adequate scale for each type of data.

CBERS Image of Rio de Janeiro

Missions

Remote Sensing Satellite Program - SSR

For Brazil, as far as ecological, economic and strategic aspects are considered, environmental protection and adequate control of land use and natural resources is extremely important. The issue here concerns the need to control the rapid and sudden changes frequently brought about by natural events, such as floods and droughts, but also by human intervention, such as fires, farming, deforestation, lumber extraction and mining.

These and other similar events require the availability of an efficient monitoring system which provides rapid access to relevant information, on a frequent basis. Toward this end the Remote Sensing Satellite Program – SSR was established. With equatorial or polar orbits, the satellites of the Program will use the Multi-mission Platform – PMM, a multipurpose satellite bus. Payload instruments are to be added to these modules, with optical and non-optical sensors, through standardized interfaces, so that the entire platform constitutes an operational satellite, according to the specified application.

The Sino-Brazilian Program

The China-Brazil Earth Resources Satellite - CBERS Program, in its initial phase, from 1988 to 2003, called for the production and launching of two remote sensing satellites. The first satellite, launched in October, 1999, operated successfully until August, 2003, surpassing its designed operational life by almost two years. While in operation, the satellite produced images that were routinely used in both China and Brazil. The second satellite, launched in October, 2003, in spite of being a replica of the first, was nevertheless improved, generating images that were superior in quality to those produced by the CBERS-1.

Based on the success of these two satellites, Brazil and China initiated the second phase of their partnership in November, 2002, with a new Protocol of Cooperation, which calls for the production of two more satellites, CBERS-3, and CBERS- 4, more advanced than the previous ones.

Given the wide acceptance of images generated by CBERS-2, and the need to

minimize the risk of interruption of the supply of images, the development of CBERS-2B satellite, a replica of CBERS-2, was decided in July, 2004. The infrared imaging camera of the first version was substituted by a new and improved camera in the visible region, with spatial resolution of 2.5m, which significantly increases the range of applications of the generated images.

Imagem do Distrito Federal - Satélite CBERS

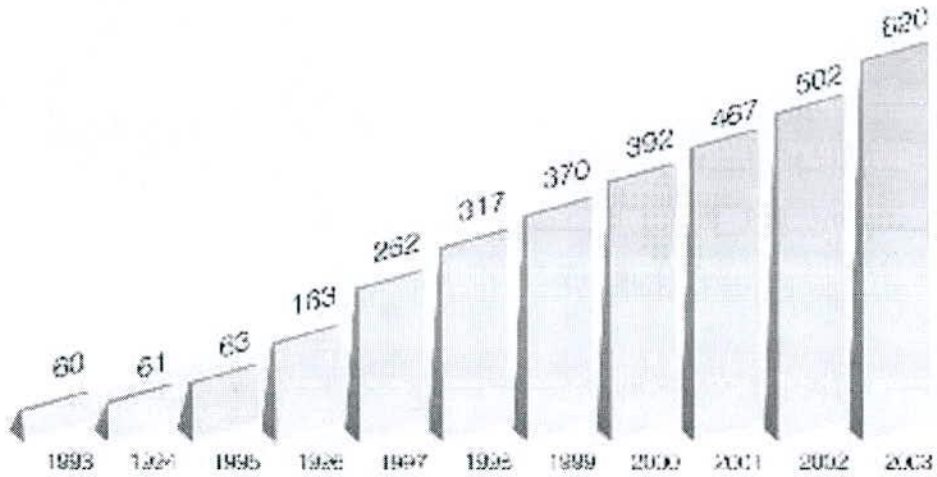
The Data Collecting Program

The Brazilian Environmental Data Collecting System began with the launching of the satellite SCD-1 in 1993. With a design life of one year, the o SCD-1 has been operational for more than eleven years, and needs to be substituted urgently. The system's operational capacity was expanded with the launching of the satellites SCD-2, in 1998; CBERS-1, in 1999, which operated until August, 2003; and CBERS-2, in 2003. This capacity will be maintained and expanded with the inclusion of data collection payloads in all future PNAE satellites.

The system provides environmental data on the various regions of the country, through the Data Collecting Platforms. Local environmental data are collected by the platforms from various sensors, which are retransmitted by the system's satellites to the receiving stations at Cuiabá and Alcântara. The data are then processed by the Cachoeira Paulista (SP) Mission Center and made available to users via Internet. The main applications are in the areas of meteorology and hydrology.

By the time SCD-1 was launched, the initial network of data collection platforms comprised approximately 60 installed units. By the end of 2003, the number of platforms had reached 600, reflecting the growing and continued interest of users. This interest derives mainly from the operational and economic

advantages offered by the system for the collection of data on a national basis.



Evolution of the number of Data Collecting Platforms

Synthetic Aperture Radar Program - RADAR

The aim of the RADAR satellite is to provide Brazilian users with high spatial resolution images, regardless of the weather conditions, through Synthetic Aperture Radar – SAR – techniques.

This satellite will allow the scanning of the entire national territory producing images which may be used in thematic and cartographic mapping, as well as other important applications in various sectors that depend on the permanent monitoring of their specific areas of interest, such as in oceanography, mining,

agriculture, forest and environmental, disaster management, and many others.

RADAR satellite control, as well as the reception and processing of data is the responsibility of the Ground Segment, subdivided into two areas: the Tracking and Control Ground Segment which shall use the infrastructure available at INPE, after being adapted for the satellite; and the Mission Ground Segment by way of a mission center and image receiving stations, that shall process the generation, correction and calibration of the data, ensuring the quality of the final product.

The RADAR Satellite service platform may be contracted with the Brazilian industry, which should maximize its participation in the development of the payload through an R&D program in the area of Synthetic Aperture Radars.

The RADAR program shall also include the development of specific applications software as well as user training.

Actions

Reception, Processing and Distribution of Satellite Images

The capacity to receive, process, distribute and effectively use national or international satellite images is fundamental for the development of the country, and must not only be maintained, but expanded as well. It is also essential that this be done in a coordinated way, to avoid the overlapping of efforts between governmental agencies, and to provide more cost-effective images to private or government users.

In this context, the Remote Sensing Data Center is being established to provide users with access to the satellite image data bank maintained by INPE.

Geo-processing Technologies

Open source technologies, developed by INPE (SPRING and TerraLib) are available to Brazilian users of remote sensing.

SPRING is INPE's main geo-processing tool, used by a large number of Brazilian institutions. A free version of this software (source code) is available at www.dpi.inpe.br/spring.

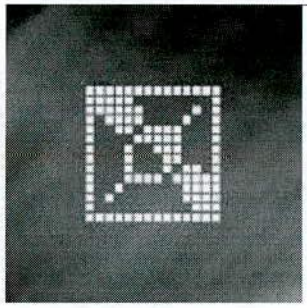
TerraLib is an open source library, available at http://www.terralib.org, allowing the generation of geo-processing applications that integrate space data (images and maps) with database management systems (DBMS).

Innovative and functional, TerraLib aims at expanding national scientific and technological autonomy in the area of geographic databases, so that researchers may creatively utilize experience acquired by INPE, thus benefiting the entire Brazilian society.

CBERS Data Distribution Policy

Data produced by CBERS images are available to any country or organization, and are internationally distributed, at an operational fee, through licensees that operate land reception and processing stations. Stations operated by Brazil and China shall have full access to all data.

In Brazil, the free access policy for national users aims at maximizing the use of CBERS remote sensing images by the Brazilian community, in accordance with the Federal Government's digital inclusion objectives. With this policy, it is expected that CBERS will be the main remote sensing satellite used in Brazil.



Scientific and Technological Missions

Rationale

A space mission is considered scientific if it involves scientific experiments conducted and launched on platforms – satellites, sounding rockets, satellite launch vehicles, recoverable orbital platforms or balloons – able to operate in the upper atmosphere (stratosphere and upper layers) or in outer space. On the other hand, a mission is considered technological if conducted to test, in outer space, the performance of new space components, systems or subsystems.

Traditionally, the high standards of performance and precision required of the systems, subsystems and components of scientific missions, as well as the intensive mobilization required in attaining scientific objectives, have induced technological innovation for a wide range of applications.

The objective of the scientific and technological missions, as established by the PNAE 2005-2014, is to ensure the means to conduct successful orbital and suborbital experiments, which can also include the involvement of new academic groups in Brazilian space activities. Intense international cooperation is also desired, with a propitious exchange of scientific and technological knowledge.

Missions

Equatorial Atmosphere Research Satellite - EQUARS

The EQUARS Project calls for the development of a small scientific satellite, with a mass of approximately 100 kg, to be launched into a low-altitude equatorial orbit.

Sounding rocket VS-40

The satellite is designed to observe atmospheric phenomena in the equatorial region, phenomena such as luminescence, electrical discharges, particle fluxes and the abundance of atmospheric constituents.

Information collected by EQUARS will be usable for the global monitoring of the vertical profile of humidity in the tropics, and in numerical weather prediction models, as well as for the global monitoring of the ionosphere for space weather forecasting.

Data transmitted by EQUARS will be collected by a receiving station located at Alcântara (MA), dedicated to PNAE scientific and technological missions, as well as other international scientific cooperation missions.

X Ray Imager and Monitor - MIRAX

MIRAX is a small scale satellite weighing approximately 200 kg designed for the astronomy of x-rays. This first Brazilian astronomical satellite will include the country in the select group of nations that has developed and launched satellites to observe the Universe. The objective of the mission is to observe important regions of the Universe that emit x-rays, such as the constellations of Cygnus, Vela-Centaurus, and the Clouds of Magellan.

X-ray telescopes allow us to "see" details imperceptible in the visible light spectrum, significantly increasing the quantity of information that may be obtained.

Actions

Suborbital Platforms

The suborbital platforms launched by sounding rockets are extremely useful and cost effective in research of the atmosphere, ionosphere and gravitational or magnetic fields, as well as of new processes and materials in microgravity environment. Sounding rockets – technology that Brazil has a full control of – will be routinely used to conduct scientific and technological experiments of

interest to the Brazilian industrial and academic communities.

Recoverable Orbital Platforms

Amongst many of the innovative alternatives used in microgravity experiments, recoverable orbital platforms are of particular interest. During the decade, the Atmospheric Re-entry Satellite Project – SARA – will be implemented, in which a reusable platform of this type will be developed, able to carry a functional payload of up to 55 kg, for 10 days of microgravity.

Long Duration Stratospheric Balloons

The use of stratospheric balloons will be stimulated as a low cost alternative for scientific experiments in satellites. Besides allowing scientific experiments to be performed, stratospheric balloons may play an important role in the testing of space equipment and technology.

International Space Station

The International Space Station – ISS – a collaborative effort of 16 countries, involving the space agencies of the United States, Russia, Canada, Japan, Italy, Brazil, and the European Space Agency – ESA, is expected to become the largest orbital laboratory ever.

Research in the area of physics, chemistry, biology, human physiology, as well as technological experiments will be carried out in its microgravity environment. The ISS will also allow research in Earth observation and space science.

The participation of Brazil in the ISS places the country in the context of manned missions and of long duration scientific experimentation in microgravity, with the training and flight of the Brazilian astronaut.

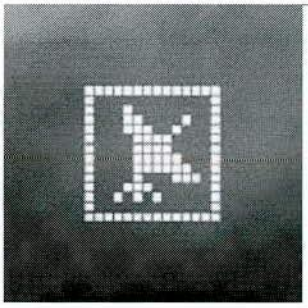
International Space Station - ISS

The Microgravity Program

Microgravity conditions are created by orbital and suborbital flights, such as those by sounding rockets, recoverable orbital platforms and, in the near future, the

International Space Station. These conditions allow experiments in the areas of biotechnology, pharmaceuticals, human physiology, combustion, including the improvement of ground-based power generators, and materials science, including semiconductor production processes, glasses, metal alloys, ceramics, and others.

The Microgravity Program establishes that Announcements of Opportunity be issued, on a regular basis, to conduct experiments involving microgravity, provided by Brazilian sounding rockets and, in the future, by the quota allowed Brazil by the International Space Station agreement. The program is made possible through the collaborative efforts of the AEB, INPE, IAE/CTA and the Brazilian Academy of Sciences – ABC – as well as Brazilian universities.



Telecommunications

Rationale

The growth of the international telecommunications market has generated new opportunities for the development of Brazilian industry. With the privatization of the Brazilian market, and given the vast number of applications currently in use in the telecoms area, the growth of domestic demand for these systems has led to the use of capacity available on foreign satellites.

These considerations justify a national capacity building effort in this area so that Brazilian industry may participate on this market. The development of a complete Brazilian system, which could also meet the needs of a meteorological mission, is a direct response to the PNAE objectives of capacity building and increase in competitiveness of the national industrial sector.

Missions

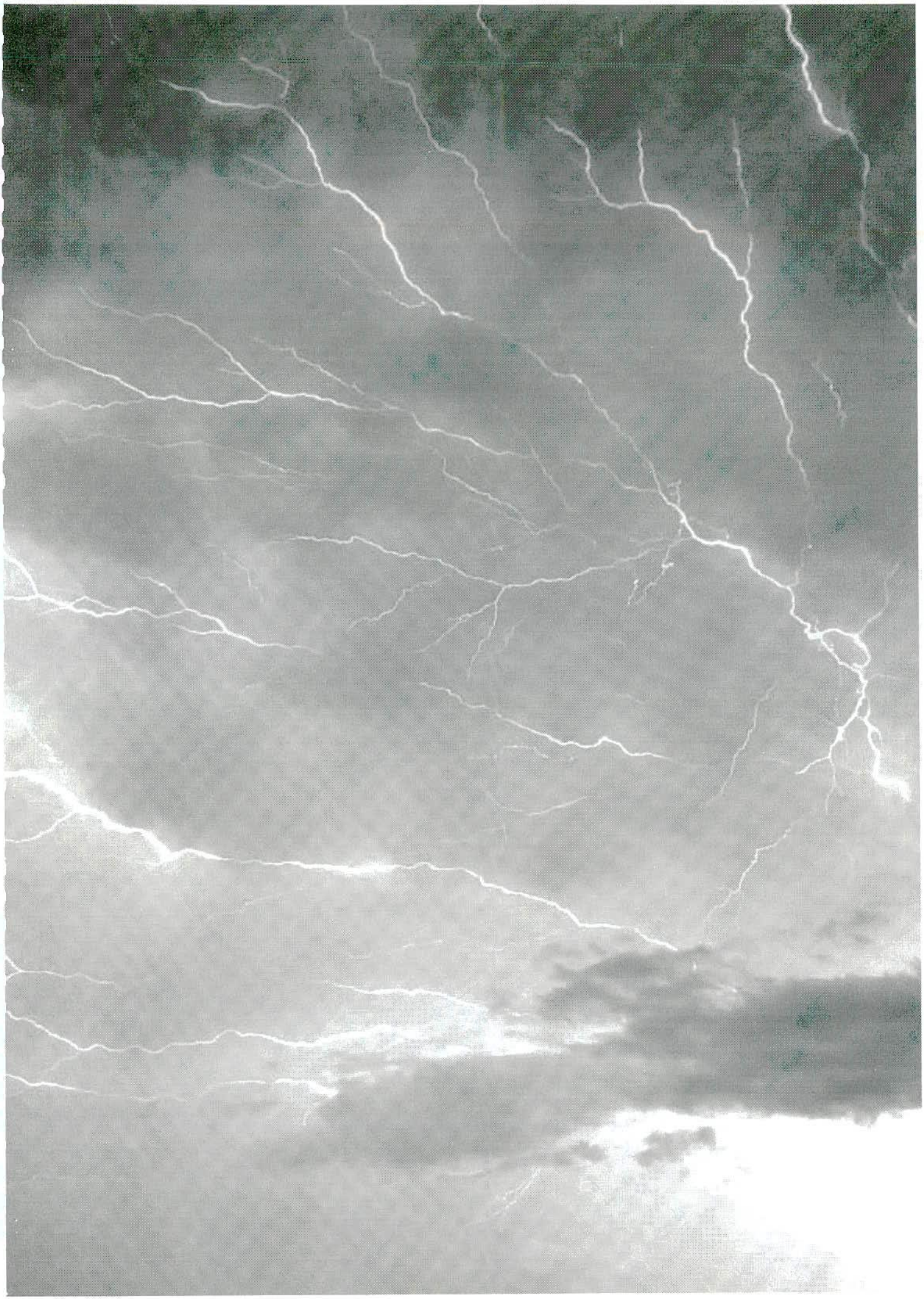
The Brazilian Telecommunications Satellite

The aim of the telecommunications mission is the development, in Brazil, of geostationary satellites in order to meet the objectives and needs of government in the areas of secure communications, meteorology, and air traffic management.

Actions

Geostationary Orbital Positions

Given the wide coverage of the National Program of Space Activities, any decision regarding the use of geostationary orbits is of interest to the Brazilian Space Agency. The AEB will therefore monitor the control of the use of the Brazilian orbital positions for commercial telecom services, although this activity is under the responsibility the National Telecommunications Agency – ANATEL.



Meteorology

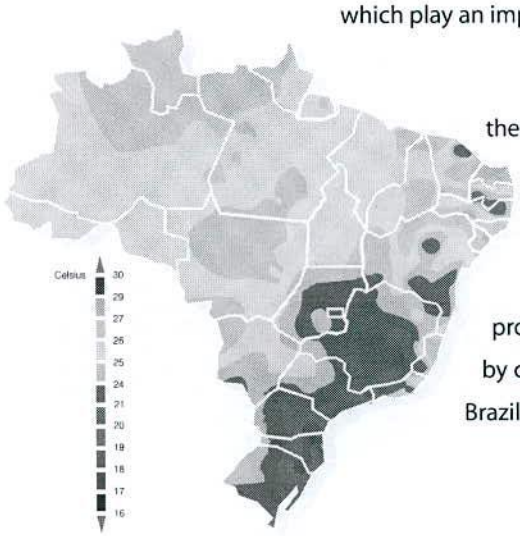
Rationale

Climate has a direct impact upon practically all sectors of the economy, especially with regard to agriculture, aerial and maritime navigation, and electric power generation and transmission. Moreover, no country is safe from natural disasters – droughts, storms, hurricanes, cyclones – currently responsible for extensive human and material losses.

In Brazil, serious social and economic problems are caused either by prolonged droughts in the semi-arid regions of the Northeast, or by heavy rains in densely populated areas, such as large cities. Extra-tropical cyclones have also been registered, with unusual frequency, along the southern coast. Therefore, quick and correct weather reports are extremely important to plan actions or mitigate the effects of these natural phenomena.

Meteorological information, obtained from satellite data and images are of fundamental importance for efficient and precise global weather forecasts. Meteorological Satellites, in geostationary or low-Earth orbits, are capable of monitoring clouds, cyclone formation and movement, and oceanic conditions, which play an important role in global weather.

Temperature climatology
January/February/March
Source: INMET



However, Brazilian users of these satellites cannot fully utilize their resources, due to operational routines and data distribution policies of the countries that own the geostationary meteorological satellites covering this region of the globe.

A Brazilian meteorological satellite would ensure the provision of this type of information, not satisfactorily provided by current international systems, with the availability required by Brazilian institutions.

Missions

Meteorological Payload on-board a Geostationary Satellite

The main objective of this mission is the high temporal frequency (15 minutes) imaging of the national territory, both visible and infrared, to support weather forecasting, climate monitoring, and severe storm warnings, in order to eliminate the dependence on the operational routines and meteorological information dissemination policies established by foreign institutions.

The main users of this data will be weather forecasting centers, civil and military aviation support systems, riverine and maritime navigation support systems, as well as public agencies in the areas of agriculture, civil defence, environment and water resources.

The orbital position that meets the needs of the great majority of these clients is located between longitudes 40°W and 70°W, with the ideal position being 55°W, in a geostationary orbit.

Global Precipitation Monitoring

Atmospheric precipitation is one of the main climatic variables, and information regarding its spatial distribution is of fundamental importance for climate monitoring. However, precise and reasonably frequent precipitation measurements are difficult to obtain, since they depend essentially on an adequate surface and high altitude observation network.

The southern hemisphere comprises an extensive oceanic area, as well as vast uninhabitable areas that are difficult to access. Therefore, satellite data are essential to complement those of the existing network.

The most adequate electromagnetic spectrum region to measure precipitation is that of microwaves. Therefore, it is considered that a satellite equipped with a sensor in such range will significantly contribute toward this end.

This satellite may also be part of the Brazilian contribution towards the Global Precipitation Measurement program -GPM, increasing the national capacity to monitor precipitation. It must be pointed out that Brazil already possesses

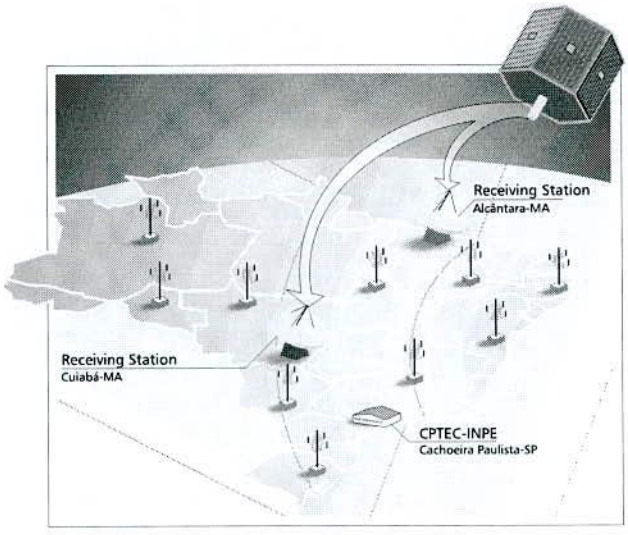
microwave radiometer technology, having taken part in the development of the Humidity Sounder for Brazil - HSB, on-board NASA's EOS PM-1 satellite, and may also develop, through partnership, specific technology for GPM. Moreover, a satellite of this type may use wide field cameras, similar to CBERS WFI (Wide Field Imager) and a small-scale platform such as the Multi-mission Platform - PMM.

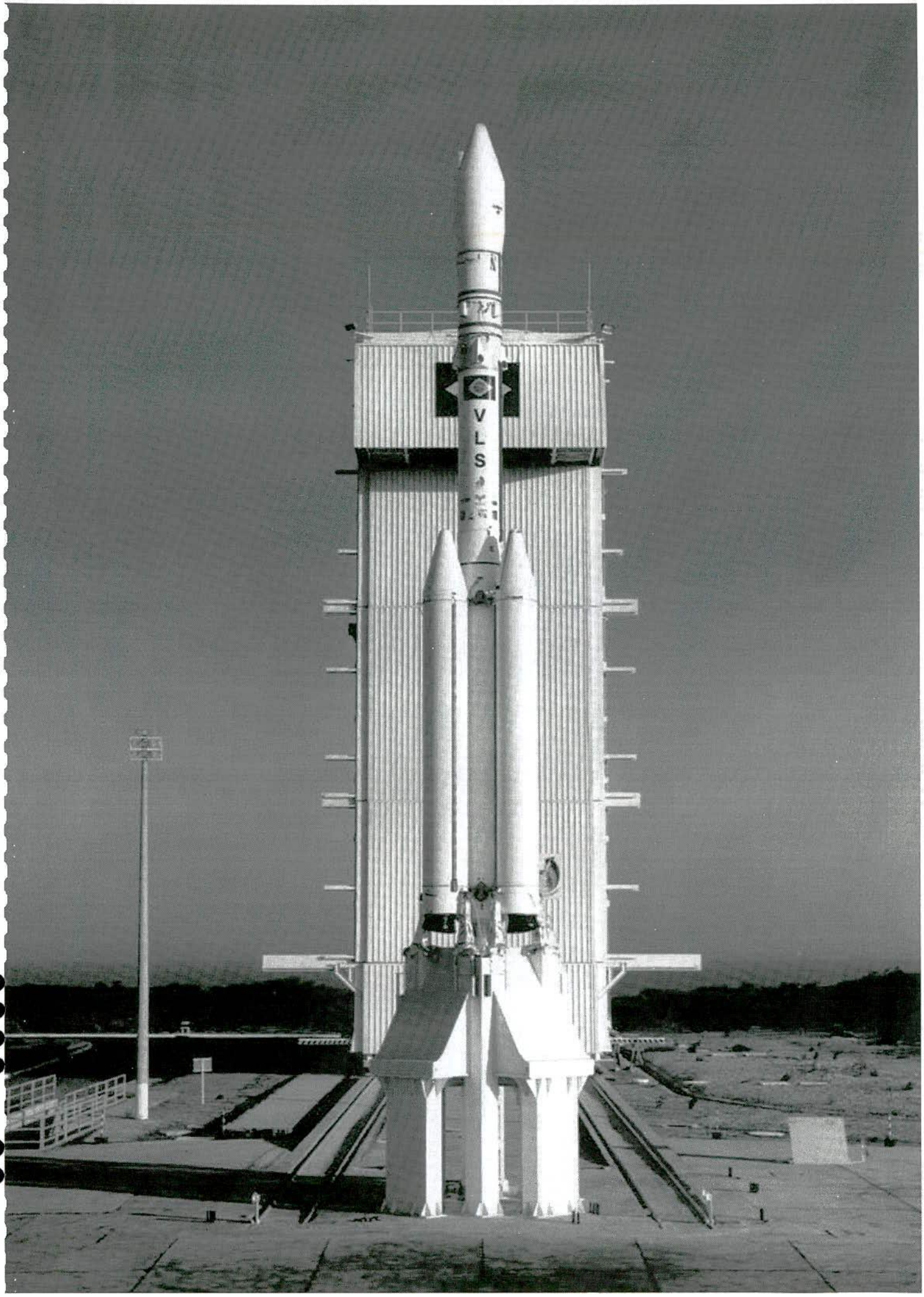
Actions

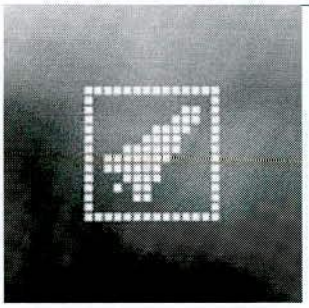
Data Collection

In order to ensure the country's satellite capacity to retransmit hydro-meteorological and environmental data collected by the Data Collection Platforms - PCDs, on the ground or on oceanographic and meteorological buoys, all Brazilian satellites to be developed under PNAE, mainly the equatorial orbit satellites, such as SSR, EQUARS and the GPM satellite, will be equipped with data collection payloads.

Data collection system




VLS



Access to Space

Rationale

The development of orbital and suborbital launch vehicles is of strategic importance, to ensure the country's autonomy with regard to the access to space.

Brazil, through the Institute of Aeronautics and Space - IAE, the Aerospace Technical Center - CTA, and the Brazilian aerospace industry, has conceived and produced a successful set of sounding vehicles, including the SONDA series, and the VS rockets. These rockets have allowed Brazilian universities and research centers to develop a series of scientific and technological experiments and have attracted the attention of foreign users interested in benefiting from the microgravity environment provided by these suborbital flights.

The acquired sounding vehicle technology has contributed towards the development of a small satellite launcher, the Satellite Launch Vehicle VLS-1. This is a four-stage vehicle, able to inject satellites ranging from 100 kg to 350 kg, into orbits between 200 km and 1,000 km.

The next stage of the Program calls for the development of liquid fuel technology, which will allow the development of mid and large scale launch vehicles, aimed at geostationary orbits.

It is also expected that the outsourcing of launch systems and subsystems to national companies, as well as the commercialization of launch services, will foster the generation of highly skilled jobs, and produce space technology spin-offs that will affect other areas of economical activity

The development of launch vehicles will be done autonomously, or through international partnerships, according to the following directives:

1. To design, develop and build launch vehicles capable of accomplishing

VLS-1, the first Brazilian Satellite Launch Vehicle.

the missions established by PNAE.

2. To ensure Brazilian independence with regard to the capacity of launching low-Earth-orbit satellites, as established by PNAE, and the ability to compete in this segment on the international market.

3. To provide the country with sounding vehicles that are competitive on the international market.

4. To promote space transportation system design and production capacity in the national industrial sector, mainly with regard to sounding vehicles, including components, equipment, subsystems and complete systems.

5. To pursue launch operation and related system cost reductions, in order to promote the use of launch vehicles for suborbital or orbital scientific experiments by universities and research centers.

6. To develop a national capability in liquid propulsion, initially to be used in precision in-orbit injection stages, and subsequently to integrate main stages, in order to increase the capacity of launch vehicles to compete on the international space transportation market.

7. To promote the production of large solid fuel boosters, to be used in heavy lift launch vehicles.

Missions

Sounding Vehicles

Sounding vehicles are small launchers, used for suborbital space exploration missions, able to carry payloads for scientific and technological experiments.

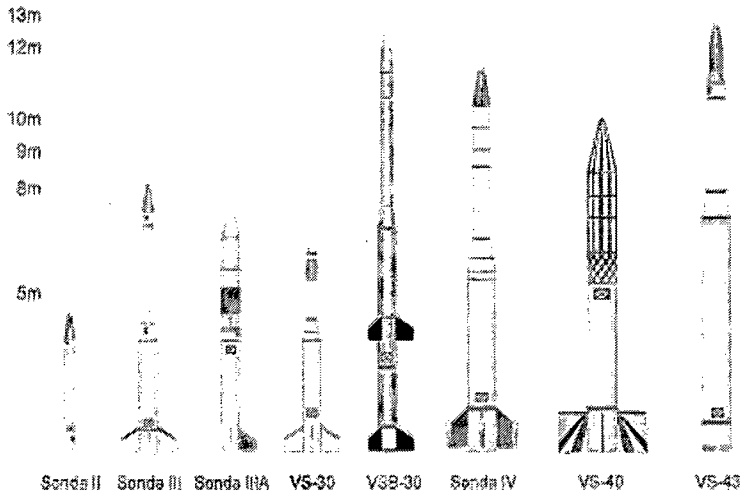
Brazil has operational sounding vehicles that meet current needs, with a successful launch record. However, the closer involvement of universities and research centers in the space program will increase the demand for this type of vehicle, therefore justifying their continued production, estimated to be at least two vehicles per year. The production of the sounding vehicles will gradually be transferred to the national industrial sector, to meet the needs of scientific

and technological missions.

The table and figure below provide a short description of these vehicles.

Sounding Rockets

Series	Use	Performance	
		Mass (kg)	Altitude (km)
Sonda I	Upper atmosphere studies.		Discontinued
Sonda II	Validation of technological innovations regarding thermal protections, propellants, electronic parts, and scientific studies.	30	100
		100	60
Sonda III (2 stages)	Validation of technological innovations regarding instrumentation, stage separation, 2nd stage ignition, tele-destruction, payload 3 axis payload attitude control, payload recovery, technological payload data acquisition during flight, and other electronic devices.	50	700
		150	400
Sonda IV	Introduction of composite materials, ultra high resistance steel, propellants, thrust vector control, 1m diameter motor, on-board electronics, beltjettison separation system analog and digital control systems, ground systems and experiments devoted to VLS program..		Discontinued
VS-30	Sonda III first stage	200	185
		400	110
VSB-30	Vehicle comprising a VS-30 and a S-31 booster, acting as a first stage.	300	340
		500	230
VS-40	Used to test the VLS forth stage in vacuum environment, besides other experiments devoted to the VLS program	200	1250
		400	750
VS-43	One stage vehicle with attitude control, using the S43 booster (VLS 2nd stage).		Under development



Brazilian sounding rockets

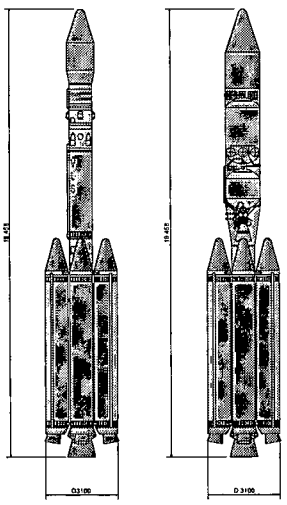
Small Launchers: VLS-1 and VLS-1B

VLS-1 is a small launcher able to inject payloads ranging from 100 kg to 350 kg, into orbits between 200 km and 1,000 km.

The flight qualification of this vehicle began with the launch attempt of the first prototype, in November 2, 1997, followed by two other prototypes between 1999 and 2003, when an accident occurred during the third launch attempt.

Currently, the VLS-1 project is undergoing a critical review, and the fourth prototype is scheduled to be launched by 2007.

An upgraded version of the VLS-1, named VLS-1B, is currently in its preliminary studies phase. This rocket will have a liquid fuel third stage, which will enable injection of 850 kg satellites into 750 km low-Earth orbits – LEO.



VLS-1 and VLS- 1B

Medium and Large Launchers

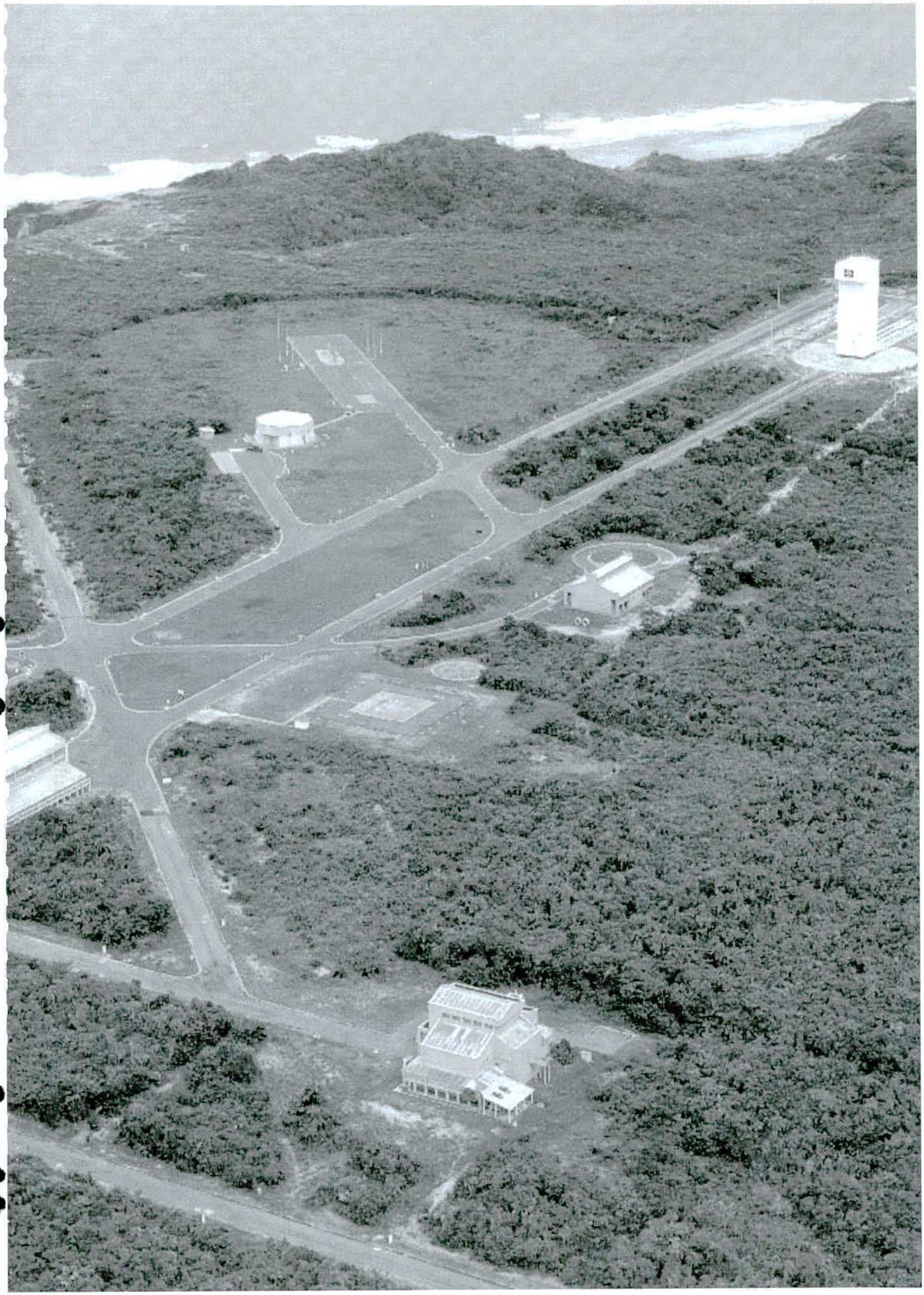
The development of medium scale launch vehicles aims, at first, to inject satellites into low-Earth orbits, and subsequently, into medium and geostationary transfer orbits, so as to meet the needs of PNAE satellites.

In order to ensure the capacity of the mid-sized vehicle, VLS-2, the project must meet some essential requirements, including:

- Flexibility for different types of mission;
- Low development, production and operational costs;
- Short development period;
- High reliability;
- Security for launches across the entire inclination range;
- Preferential use of non-toxic propellants;
- Possibility of evolution to larger vehicles.

The VLS-2, currently under study, is expected to use liquid fuel in all of its stages, perhaps with solid fuel in the first stage boosters, and it is aimed at injecting payloads weighing 1700 to 2200 kg into geostationary orbits - GEO, at an altitude of 36,000 km.

The large scale launcher, VLS-3, also in the study phase, will use liquid fuel in all of its stages, with the capacity to place payloads of over 2200 kg in geostationary orbits.



Infrastructure

Rationale

The Space Infrastructure comprises a series of laboratories, centers, installations and equipment providing support to space activities, namely the development, testing and operation of satellites and launch vehicles, including the research activities set forth by the Program.

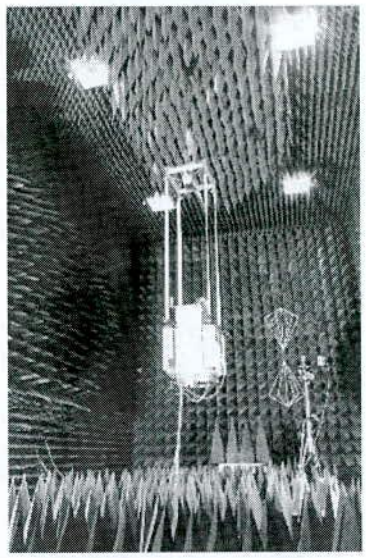
The main objectives of the Program, regarding infrastructure, are:

1. To set up a fully operational launch center which, exploiting the advantages of its equatorial location, will offer a wide range of internationally competitive services;
2. To implement up-to-date laboratories and a production capacity, in order to meet both the basic and strategic needs of the Program;
3. To ensure and improve the operational capability to launch suborbital payloads, corresponding to scientific and technological experiments;
4. To consolidate the necessary infrastructure for the assembly, integration and testing of satellites;
5. To promote the intensive use of the Brazilian space infrastructure, even by non space related activities, considering the high initial investment and rapid obsolescence typical of this type of installation;
6. To ensure access to world-class quality services, needed for the comprehensive use of space information, images and data by society at large.

Aerial view of the Alcantara Launch Center - CLA

Support Infrastructure for the Development and Operation of Satellites

Integration and Tests Laboratory - LIT



Anechoic chamber, LIT

The Integration and Test Laboratory – LIT, of the National Space Research Institute – INPE, the only one of its type in Latin America, was conceived and established in São José dos Campos (SP), to develop and implement assembly, integration, functional and qualification testing and validation activities, for satellites and other orbital systems, as well as to perform space parts fault analysis.

Besides meeting the needs of the PNAE space projects, the Laboratory has other important objectives as well, among which, the technology transfer through test and analysis, on all levels, from parts to integrated space systems; promote the national industry participation in space activities, and participating in international development programs aimed at intensifying the exchange of technology.

LIT activities may include parts and material engineering, procurement, parts qualification and acceptance tests, as well as qualification and acceptance of complete integrated systems.

LIT is also responsible for the promotion of ongoing training and capacity building efforts aimed at the adequate implementation of the proposed activities.

Associated Combustion and Propulsion Laboratory - LCP

The Associated Combustion and Propulsion Laboratory – LCP, of the National Institute for Space Research– INPE, located at Cachoeira Paulista, has installed research and operational capability for the development and provision of catalysts used in thrusters operating by catalytic decomposition of hydrazine, commonly used in satellite attitude and orbit control.

The LCP is responsible for the development and supply of the catalysts used in the attitude and orbit control system for the Multi-mission Platform – PMM, and is directly involved in the qualification of the national thruster for that satellite.

During the 10-year period, the main actions required to meet the needs of the space program, regarding LCP, are the implementation of a quality assurance program for the test benches and laboratories, as well as the establishment of an update and maintenance routine for software and equipment used in LCP. It will also be necessary to increase the capacity of the test benches and adapt the procedures for the testing of motors using non-polluting fuels.

Satellite Tracking and Control Center - CRC

The Satellite Tracking and Control Center – CRC – is an arrangement of ground systems which enables INPE to control and monitor satellites in orbit, as well as to provide support services to foreign satellites.

The control and monitoring activities carried out by the Center have unique characteristics, since they must be uninterrupted and totally reliable. Therefore, support to current and future PNAE missions require the continuous update of equipment, along with the provision of spare parts and test and maintenance equipment.

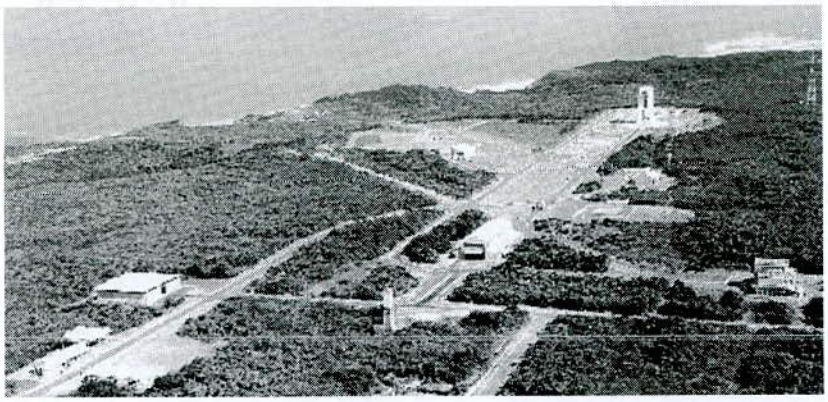
The CRC is comprised by the Satellite Control Center, in São José dos Campos (SP), and two ground stations, located in Cuiabá (MT), and Alcântara (MA), where an additional station will be set up, for the control of scientific satellites. Also programmed is the acquisition of a new ground station to provide support to satellites CBERS 3 e 4. The Dedicated Data Communication Network – RECDAS, connects all these stations and the Control Center.

Support Infrastructure for the Development and Operation of Launch Vehicles

Alcantara Space Center - CEA/AEB and Alcantara Launch Center - CLA/ DEPED

The Alcantara Launch Center - CLA, located in Alcântara (MA), provides vehicle launch services, in the equatorial region, for suborbital and orbital missions.

VLS-1 Launch site



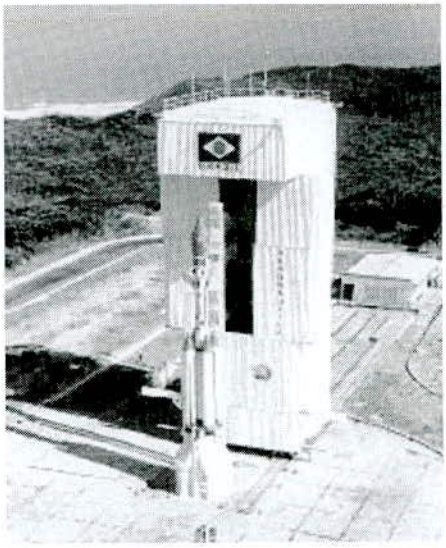
Proximity to the equator makes the CLA a privileged satellite launch site, ensuring safer launches and significant fuel reduction.

Regarding the government missions established by PNAE, all activities comprising space vehicles launching and tracking are conducted by the Alcantara Launch Center - CLA, under the responsibility of the Research and Development Department - DEPED, of the Air Force Command, as provided for by the National System for the Development of Space Activities-SINDAE.

In order to provide support for commercial launch activities as established in the PNAE, the Alcantara Space Center – CEA will be set up, and will be directly subordinated to the Brazilian Space Agency.

The establishment of the Alcantara Space Center is essential for the accomplishment of the commercial launch operations foreseen with Ukraine, and other interested countries. The CEA installations will provide the necessary means and utilities for the launch sites, such as electric power, water, natural gas, highway

access and port, as well as staff housing and support services, schools, hospitals to national and international technical teams involved in the launch operations. Installations will also be provided to other governmental agencies directly involved in the operations and activities, including the reception, inspection and preparation of rocket and satellite parts and components. Advanced university centers, laboratories, biomass and bio-diesel plants will also be established at the Center, as well as companies associated to the space sector and other technological activities. Actions directed to environmental protection, fostering of tourism activities, and support to the local population, contributing towards local development, are foreseen, as well.



VLS-1 at the launch platform

Barreira do Inferno Launch Center - CLBI/DEPED

With regard to orbital launches, especially equatorial, the CLBI, subordinated to the Research and Development Department – DEPED, of the Air Force Command, will continue to be the main support station for the monitoring and control of vehicles launched from the CLA. This service is currently being provided by CLBI to support foreign agencies, which is an important factor for the deployment of the Launch Vehicle Tracking and Control Network.

The current capacity of CLBI will be preserved through maintenance and improvement activities required to operate sounding vehicles. The updating of operating systems, technical support and logistics will be considered a priority during the 10-year period.

Coronel Abner Propellant Plant - UCA

The Coronel Abner plant, for the production of solid and composite propellants, was planned to meet the demand for propellants for the vehicles envisaged at the outset of the space program. The original design foresaw the possibility of expanding the plant, to produce boosters with greater diameters or at a higher production rate. This expansion will take place to meet the needs of the planned launch vehicles.

Actions

Laboratory Facilities and Improvements

In order to support the activities scheduled for the ten-year period, the following facilities will be put in place at the Institute of Aeronautics and Space - IAE, of the Technical Aerospace Center –CTA: the Laboratory of Fluid Propulsion and the Laboratory of High-Speed Aerodynamics. The Laboratories of Qualification of High-Performance Thermal Protection, of Hybrid Simulation, of Inertial Sensor Tests, of Mass-Property Measurements and the 105 kN System for Vibration Tests will be upgraded and updated.

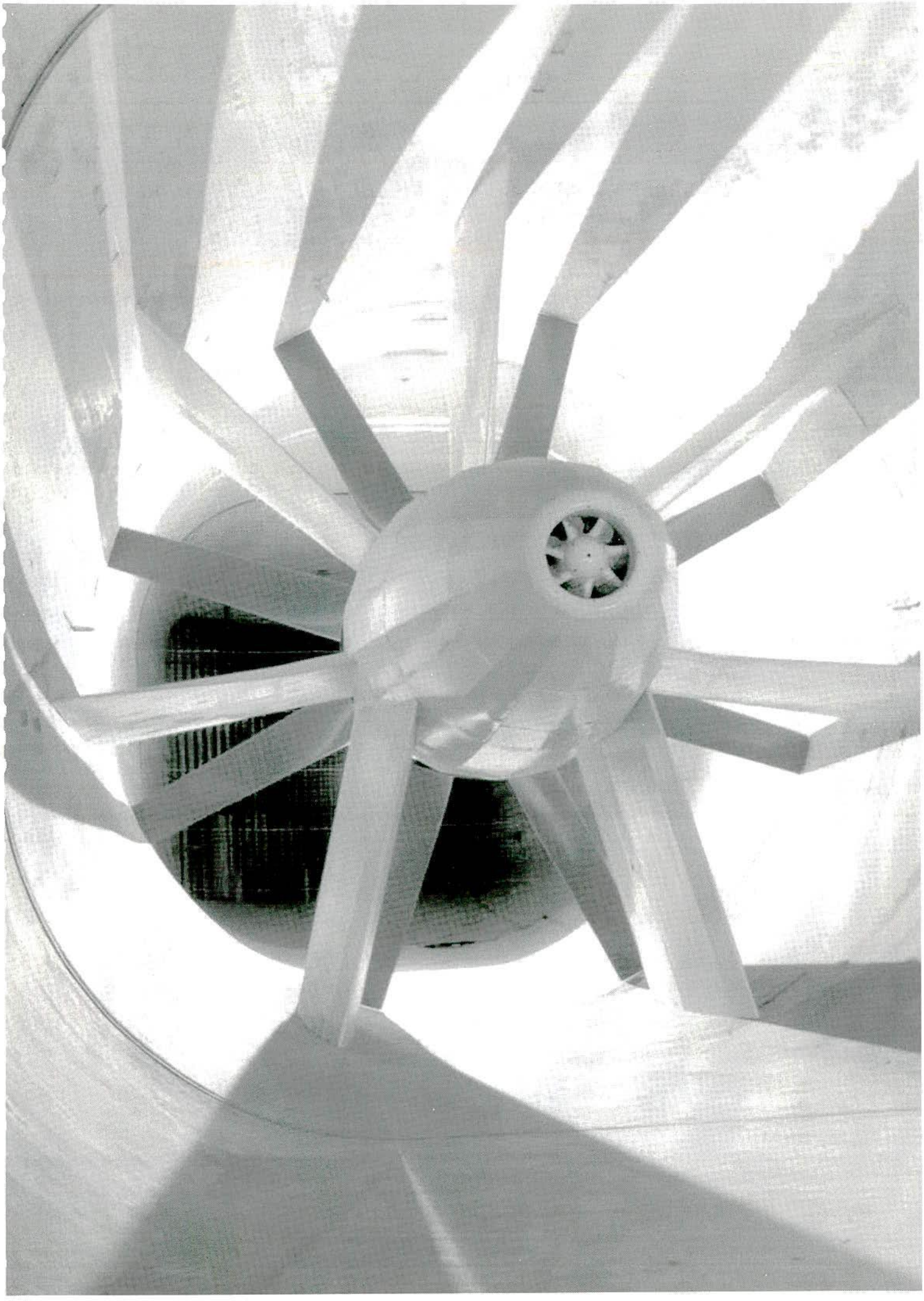
Completion of the Overall Infrastructure of the Alcantara Launch Center

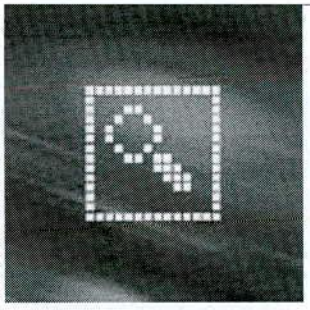
For a long time it has been understood that it is desirable to exploit the idle capacity of the Alcantara Launch Center - CLA, originally designed for a level of operational occupancy that surpasses the current perspectives of the Brazilian Space Program, and its competitive advantages mainly deriving from the equatorial location and from the safety conditions, due to the local geography, for the supply of launching services for the international community, on a commercial basis.

The ongoing discussions between Brazil and countries that are interested in the commercialization of the services delivered by CLA open perspectives of

cooperation in the domain of high capacity launchers and the commercialization of the Alcantara Launch Center.

This option would represent an important source of revenues to complement the funding of the Center and also to contribute for the implementation of R&D efforts. Nevertheless, it should be noted that the Center was primarily conceived for the development of governmental space activities, in the implementation of the PNAE, and this founding objective should remain in force.





Research and Development

Rationale

In the quest to overcome the technological challenges presented by major demanding projects, the space activity must be supported by research and development actions, which in turn operate on the national industry as innovation fostering agents. These efforts, sustained by the academic sector, allow for the modernization and leverage of the industrial basis by means of technology absorption mechanisms, with direct consequences for the industry's capacity building and competitiveness, encouraging it to acquire strategic competences and technologies, new methodologies and work processes and leading it to adopt international level quality standards.

Space R&D efforts and activities are aimed at meeting the following specific objectives:

1. To encourage research activities directed to the development and the use of strategic technologies for space systems of national interest.

2. To establish partnerships with Brazilian universities to develop innovative technologies, products and processes necessary for the implementation of the missions established by the Program, particularly those that include the development of technological satellites and qualification of new technologies for national launchers.

3. To encourage research activities in Space and Atmospheric Sciences, especially in the domains of Aeronomy, Astrophysics, Geophysics, Space-Plasma Physics and Solar Physics.

4. To encourage scientific and technological experiments that exploit the characteristics of the orbital and suborbital environment, particularly micro-gravity.

Engine of the Wind Tunnel at CTA

5. To consolidate research areas on global-impact phenomena and processes defined as of particular interest for the country.

6. To develop research projects in areas related to space, such as the physics of materials, plasma and applied and computational mathematics, which may directly contribute for the progress of space science and technology.

Actions

Strategic Technologies

The National Program of Space Activities – PNAE – identifies as essential the increase of knowledge in strategic technologies and their transfer to the industrial sector, in order to ensure this sector the appropriate capabilities and better competitiveness, in meeting the demands of the international market.

In the domain of space platforms and satellites, the priorities include technologies related to attitude control, space sensors and actuators, in addition to nanotechnology, which will allow for drastic reductions in the physical volume, mass and in the power consumption of satellite equipment.

Due to their critical nature, it is deemed urgent to acquire the technologies related to mission payloads, which include high-resolution optical imagers and synthetic aperture radar.

In the domain of space vehicles and launchers, it is also indispensable to acquire technologies related to guidance and control, inertial systems, materials and processes, on-board computers and liquid-propulsion systems.

Space and Atmospheric Sciences

PNAE's activities in Space and Atmospheric Sciences concern basic and applied research related to phenomena that occur in the atmosphere and in outer space, with primary emphasis on the areas of Space Aeronomy, Astrophysics and Geophysics.

Design, development, qualification and launching of scientific payloads on-board stratospheric balloons, atmospheric sounding rockets and of satellites will be carried out, in the frame of PNAE, to support these research activities, along with the development of specialized scientific instruments and the establishment and maintenance of laboratories, observatories and other support facilities.

The important contribution of the Southern Regional Center for Space Research, of the National Institute of Space Research–INPE, with headquarters in Santa Maria (RS), is considered essential to the accomplishment of these activities. The Center's main objectives include research in the areas of aeronomy, space geophysics and radio-astronomy, in addition to fostering the expansion of space cooperation with the countries of the Southern Cone.

Global Change

The Program establishes this line of action with the purpose of supporting, at national level, research projects on Global Change, which are based upon the use of space means, techniques or products. In this case, the efforts always comply with the priorities established by the Inter-American Institute for Global Change Research - IAI, which has its headquarters in Brazil.

Micro-gravity

The use of the micro-gravity environment is deemed promising for experiments in a quite wide range of areas, which includes biological sciences and materials research.

With this line of action the Program aims to foster and also coordinate, in Brazil, research and development projects of scientific or commercial interest, based upon experiments in a micro-gravity environment provided by suborbital launches, manned flights and, especially, by the International Space Station - ISS.

Geopositioning

Applications of satellite navigation are expected to multiply and grow more sophisticated in the near future, as there is a trend of continued drop in the price of receivers and of significant increase in accuracy and in the guarantee of service availability for civilian uses of new international systems.

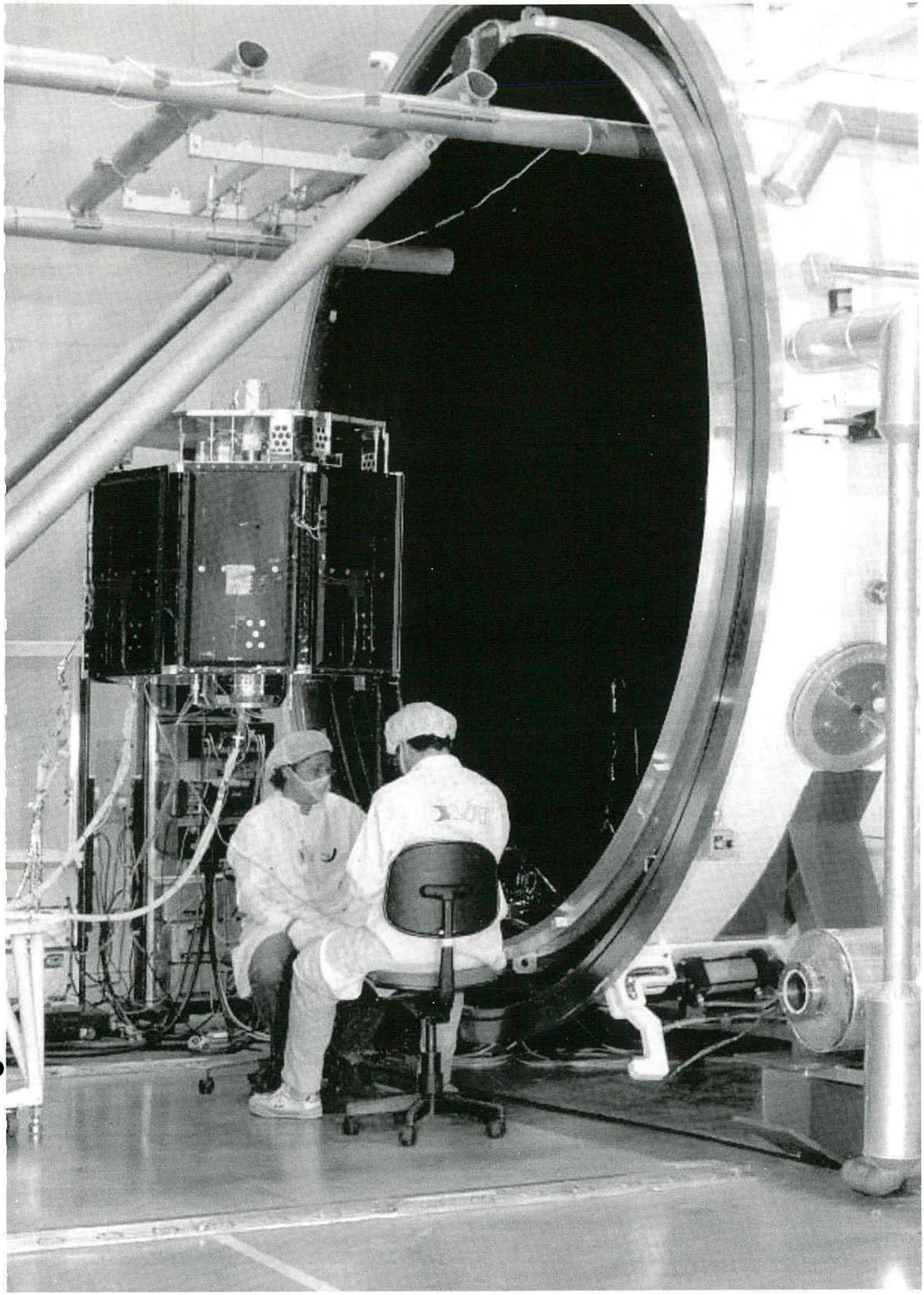
These applications reach such diversified areas as agriculture and geological prospecting, but the transportation industry is certainly a potential beneficiary. One such technology will increasingly allow for the optimization of systems such as public transportation, cargo movement and air navigation in all flight phases. In particular, in Brazil, the control of air traffic is already being updated so that, in the near future, it may benefit from Communication, Navigation, Surveillance, and Air Traffic Management -CNS/ATM - systems, which include communication, navigation and positioning satellites, intended for a much more efficient, effective and safe management of air traffic and of airport infrastructure.

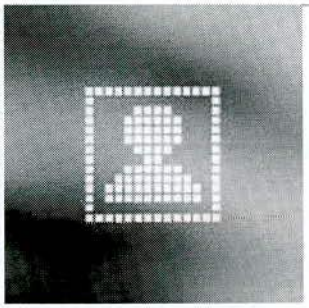
Given the strategic impacts of these systems for the country, it is extremely important to clearly state, in the appropriate international forums, the national interest in actively contributing not only to the achievement of such initiatives, but also, towards their formulation and implementation.

The Unispace Program

The Unispace Program is aimed at the creation and consolidation of specialized centers, located in universities and similar institutions, qualified to carry out studies and research and development activities of interest for the space sector.

The Unispace Program must be permanently encouraged and expanded, so as to become an instrument of cooperation, in view of the profitable exchanges between organizations within SINDAE and the academic sector, therefore contributing to Brazilian space activities, with the development of strategic technologies as stated by the Program.





Human Resources

Rationale

One of the major achievements of PNAE, in over four decades of history, was the creation of a community of researchers and experts with internationally recognized excellence.

The human capital in the space domain currently counts on approximately 3.100 professionals, working within government and industry, as shown in the table below. It is worth highlighting that this staff is insufficient to meet the current and future needs of the Program.

Human Resources PNAE 2005	
AEB	84
INPE	1.145
DEPED	1.035
Industry	873

From the point of view of competencies, all areas and disciplines necessary for the development of space activities, such as management, systems and subsystems engineering, quality assurance, integration and tests, are attended, both in government and in the private sector.

If it is possible to state, in a broad sense, that there are competent experts in nearly the whole chain of scientific and technological knowledge of the space sector, there is, however, at a restricted level, a shortage of professionals and experts trained in the following areas:

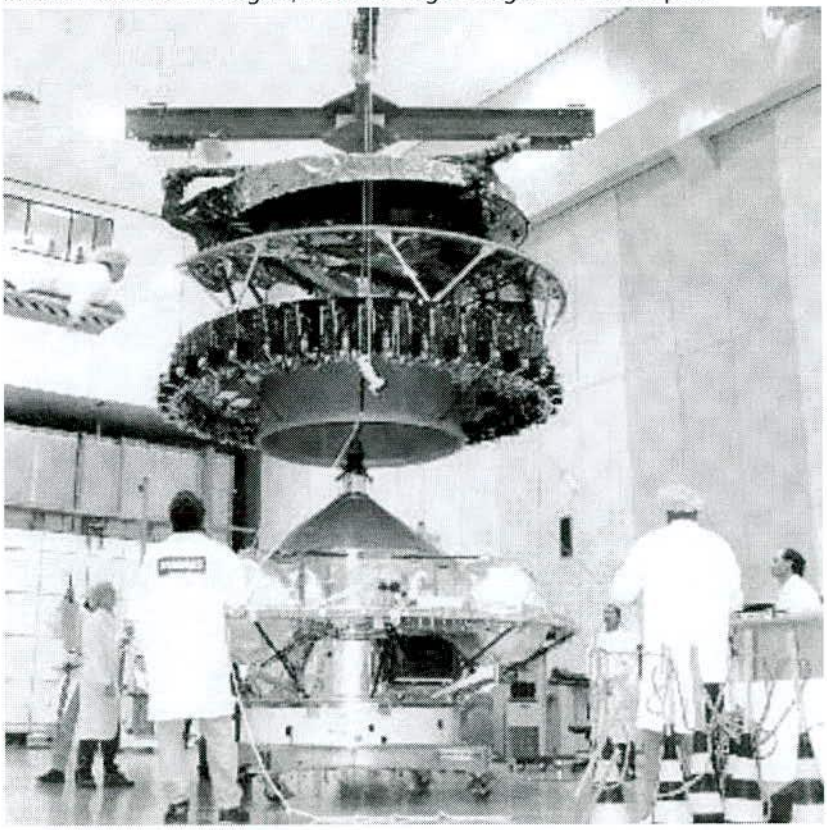
- materials and processes
- attitude and orbit control
- space sensors and actuators
- high-resolution optical imagers
- synthetic aperture radars - SAR
- nanotechnology
- liquid propulsion

Preparation of the SCD-1 for vacuum-thermal tests

Guidelines

In view of this picture, it is possible to infer that the success of the Program depends not only on the availability of material resources, but also on the re-composition, at levels compatible with the missions and other projects established by PNAE, of the human resources of institutions in charge of their implementation.

In order to achieve this goal, the following strategies will be adopted:



Integration of the Brasilsat - B1 satellite at LIT

1. To carry out a detailed survey, in quantitative and qualitative terms, of the human resources necessary for the development of the missions and other projects established in PNAE 2005-2014, and to put in place mechanisms for staffing them.

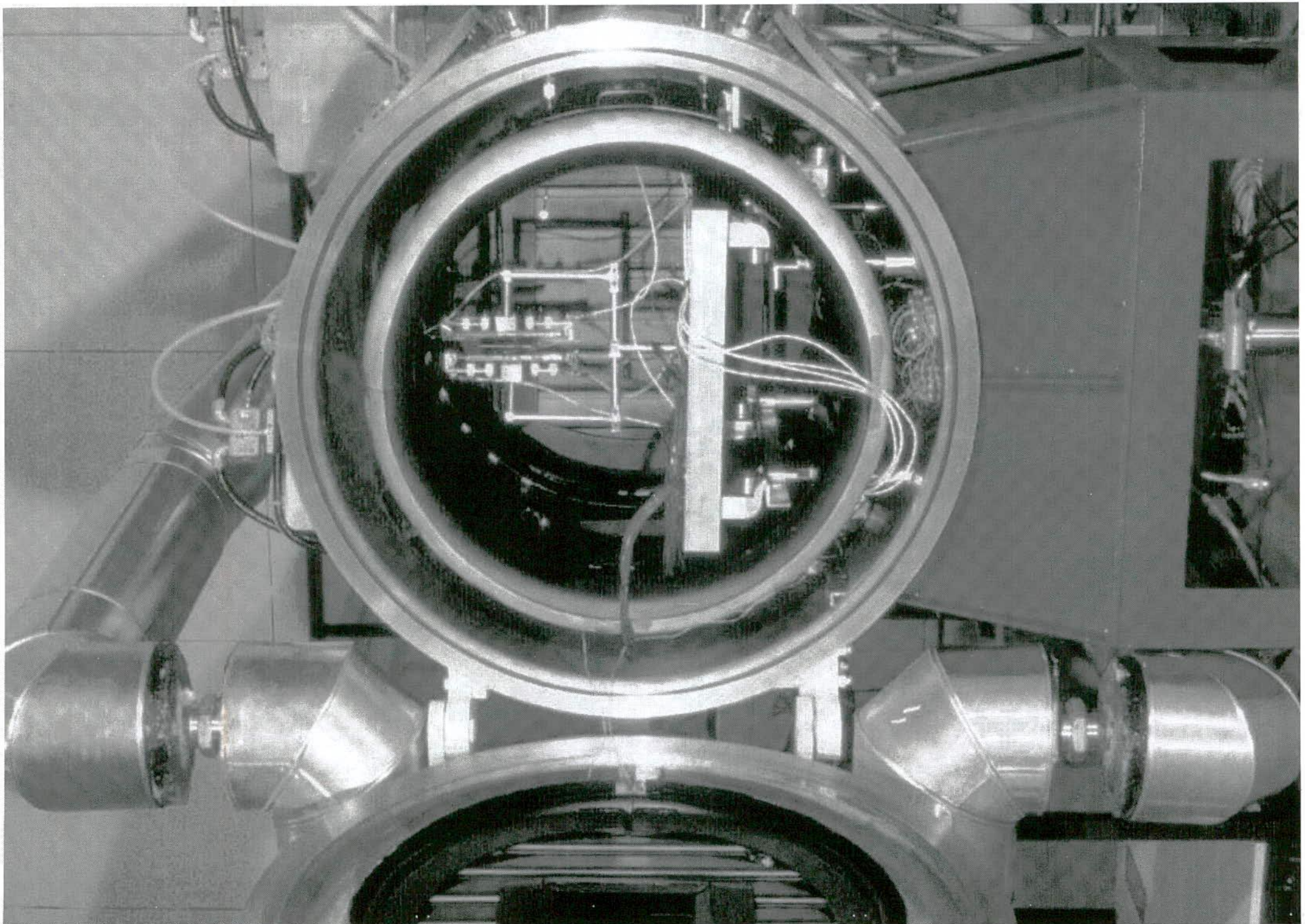
2. To invest, in partnership with the National Council of Scientific and Technological Development – CNPq – and the Coordination Office for the Development of University-Degree Personnel – CAPES, in master and doctoral degrees, by increasing the number of scholarships for the space sector in the national graduate study programs.

3. To invest in talent building and training, by means of professional courses and internship programs in relevant institutions and companies Brazil and abroad.

4. To maintain and increase the resources necessary for the implementation of the Unispace and Microgravity Programs, in order to turn them into effective instruments for the participation of Brazilian universities in PNAE.

5. To give priority to, in all previously listed strategies, the development of technological items in those fields identified above, in which there is a shortage of competences in the Program.

6. To invest in the nurturing of future talents in space-related fields, by means of capacity-building efforts for professors and actions aimed at increasing scientific literacy, geared to university-level, secondary and elementary educational institutions.



Industrial Policy

Rationale

Since the beginning of the Brazilian Complete Space Mission – MECB, Brazilian industry has participated, at a fairly stable level, in a proportion that ranges from 10% to 20%, in the National Program of Space Activities – PNAE.

The industrial base, mainly composed of small and medium-sized enterprises, provides a reasonable degree of support for space activities, since it is in charge of supplying components, systems and subsystems of satellites and launchers for the Program, which, in view of strategic needs, clearly expresses its priority in protecting and strengthening this segment.

When one takes into account the fact that space products have high added value and require considerable investments, it is admissible to recognize that a strict dependence should exist between this industrial base and its practically exclusive client, the Brazilian Government, at least at the stage of its consolidation. This situation, in consequence of the budgetary difficulties all governmental sectors have been experiencing throughout recent years, brings about a discontinuity in the flow of contracts and bidding procedures that has been harmful for the financial performance and for the technological updating of industries that participate in space activities.

The Program, taking into account this situation, indicates the need for adopting strategies aimed at the strengthening of the space industry and adds the following considerations:

1. Some technologies necessary for the development of certain components and subsystems for the missions and other projects of PNAE are not dominated in Brazil, in addition to the existence of restrictions to their transfer.

2. The space products supplied by the industrial sector are certified by the

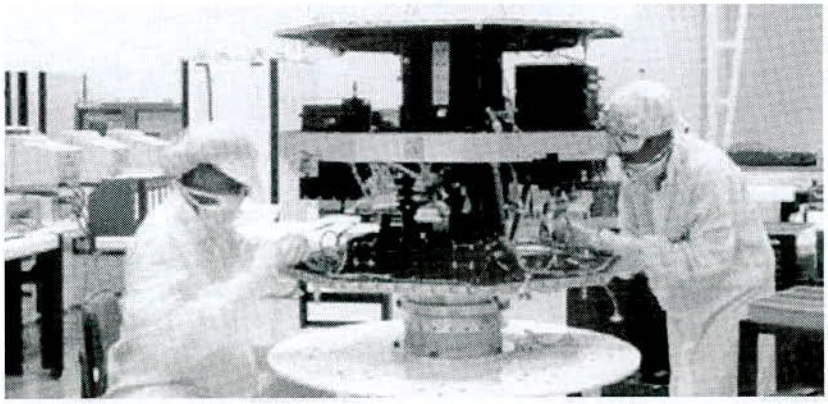
Thermal- vacuum chamber at LIT/INPE

sectoral organizations of SINDAE themselves, during their procurement process.

3. Some projects, although susceptible of being procured from Brazilian industry, are still being developed within the environment of research institutes, which brings about a low level of use of the installed capacity and of the qualified workforce of industry in the development of missions and other projects of PNAE.

4. The industrial sector does not use its flexibility for hiring in order to attract skilled professionals – particularly those recently graduated – in order to allow for the emergence of innovation in the corporate environment.

5. The incipient circulation of knowledge and the nearly non-existing exchange of experts among universities, research institutes and industry.



SCD-1 satellite integration at LIT

Directives

In view of the picture presented, some guidelines to be implemented during the 2005-2014 period are detailed below, as a contribution for the increase of the industrial participation in PNAE:

1. To procure, primarily from the national industry, complete satellite and launcher systems and subsystems.

2. To consider, in all missions and projects established in PNAE, the aspects concerning applications, capacity building and industrial participation, in consultation with all sectors involved.

3. To consider, before the decision on new investments in facilities, the use of the space infrastructure belonging to the industrial sector.

4. To approach the relevant organizations involved with Science, Technology and Innovation, in view of their benefiting from government programs such as the Program for Technological Innovation in Small Enterprises – PIPE, the Program of Support to Research Activities in Industry – PAPPE, and the Program on Human Resources for Strategic Activities– RHAE, in the capacity building of the Brazilian space industry in technologies deemed strategic for PNAE.

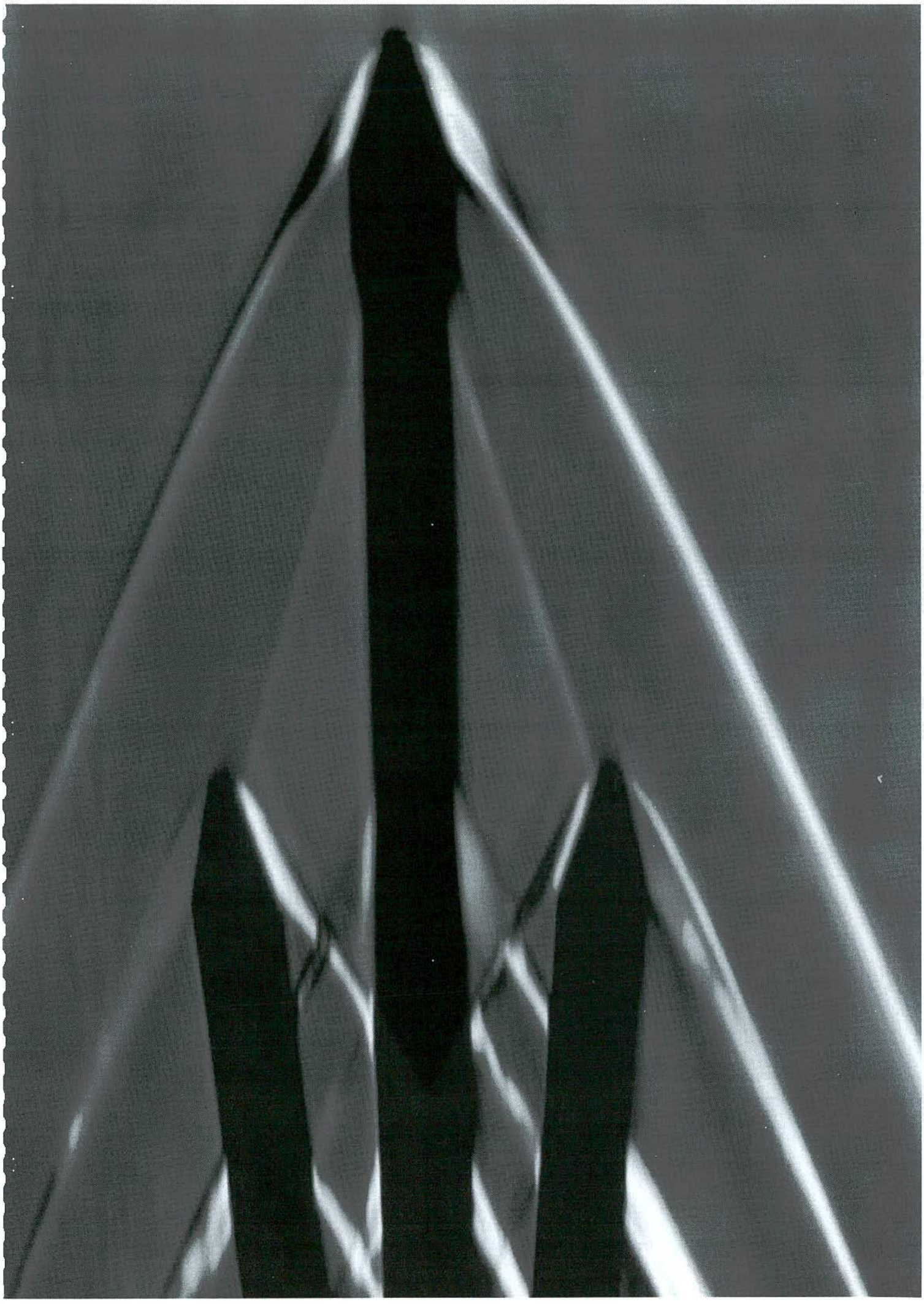
5. To carry out periodic surveys to identify technologies that are ready to be transferred from research institutes of the SINDAE to the Brazilian space industry, and to define and implement mechanisms allowing for this transfer.

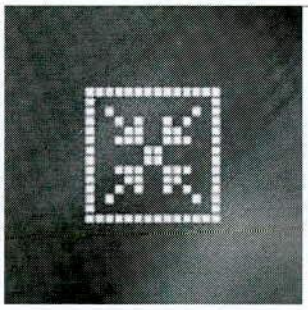
6. To use, whenever possible, the flexibility of the rules applied to industry labor hiring in order to retain young space professionals and foster innovation within the industrial environment.

7. To invest in programs aimed at quality enhancement, standardization and certification of space products.

8. To use the mechanisms defined in the Innovation Act to promote the exchange of specialized personnel and knowledge within the SINDAE institutions.

9. To periodically carry out studies and surveys to define strategies and mechanisms of technological updating for the industry.





Cross-cutting Issues

Rationale

The Cross-Cutting Issues cover those activities related, totally or at least partially, to the whole set of missions and actions of the Program, and that meet the goals of the National Policy for the Development of Space Activities – PNDAE.

This category includes activities on Normalization, Certification, Licensing and Authorizations and those related to Space Education.

Actions

Standardization and Certification

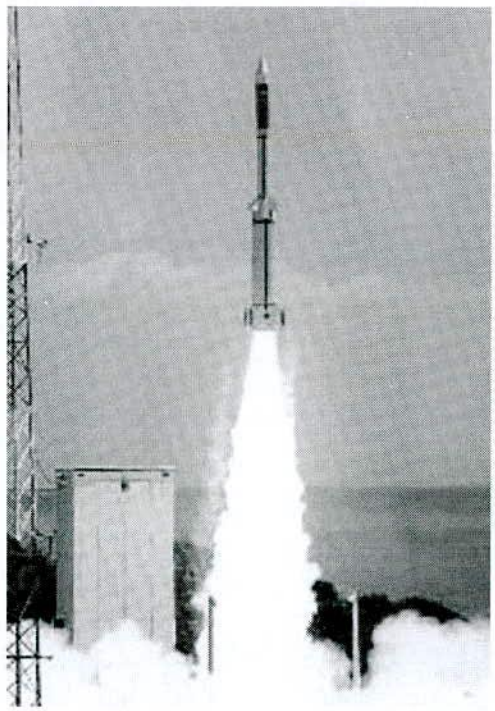
Many space projects are developed through international cooperation, bringing about an increasing trend towards the adoption of common technical standards, such as those established by the International Standardization Organization - ISO.

Accordingly, the National System for Compliance Evaluation in the Space Domain – SINACESPAÇO – is aimed at promoting the quality and safety of space activities in Brazil, by providing mechanisms of voluntary or mandatory certification by means of compliance evaluation with technical standards and regulations.

In order to enhance technical standards applicable to space activities, the Program for the Support of Standardization and Quality Control Activities in the Space Domain – QUALIESPAÇO has been created. This program aims at the establishment of normative documents and their use, primarily with a view to enhancing the quality, safety and reliability of space products (goods and services). Toward this end, some of the actions to be carried out by AEB are described below:

VLS model during
experiment in wind tunnel

1. To establish safety standards applicable to launch vehicles and commercial launch operations, as well as to verify their application.
2. To establish and operate centers aimed at providing access to and dissemination of technical standards.
3. To stimulate and support the work of the CB-08 Committee, of the Brazilian Association of Technical Standards -ABNT, as far as standardization in the space domain is concerned.



Sonda IV sounding rocket

4. To encourage Brazilian participation in the process of formulation of technical standards within the context of ISO.
5. To encourage SINDAE member organizations to achieve international independent certification.
6. To encourage the participation of SINDAE participants in SINACESPAÇO and QUALIESPAÇO programs.

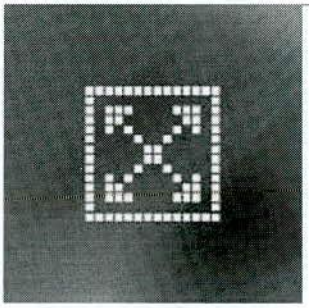
Dissemination and Education

Space activity generates knowledge and information that must be shared with society.

Initiatives related to space awareness and education are aimed at disseminating knowledge on space activities and at building awareness within society as to the importance and the benefits of space activity, in order to encourage the development of space-related research activities and to educate future generations.

In this context the "AEB-School" program was created, along with the cycle of conferences named "Space Thursdays", thematic exhibitions of the Space Program and, in the future, technical courses in partnership with universities.

All these activities put Brazilians in direct contact with the everyday life of space science and technologies, in addition to increasing the knowledge of Brazil's achievements in space.



Implementation

Rationale and Guidelines

The National Programme of Space Activities -PNAE is a multisectoral program, and its implementation complies with the National Policy for the Development of Space Activities -PNDAE, which establishes the guidelines and the ensuing actions. This implementation will take place in a decentralised manner within the National System for the Development of Space Activities - SINDAE.

As SINDAE's central organization, AEB is in charge of coordinating the formulation of proposals for the revision of the PNDAE and of elaborating and revising the PNAE, as well as of implementing, causing to implement and follow the actions of the Programme

As the main sectoral organizations of SINDAE, the National Institute of Space Research - INPE, of the MCT, and the Department of Research and Development -DEPED, of the Air Force Command – COMAer, of the Ministry of Defence, are in charge of the implementation of the main strategic projects and activities of the Program.

DEPED is the executive organization for launch vehicle projects, being in charge of the establishment and of the operational and maintenance activities regarding the associated infrastructure. Furthermore, it coordinates and implements R&D activities of interest for the systems of space transportation and associated subjects.

INPE is the executive organization for satellite and payload projects and applications, as well as for the establishment and of the operational and maintenance activities regarding the infrastructure associated to the development, integration, tests, tracking and control of satellites, and of the reception, processing and distribution of satellite data. Furthermore, INPE is also responsible for the coordination and implementation of research and development activities in the domains of science and space applications as well

as satellite and payload technologies and associated domains.

It is also AEB's responsibility to coordinate and establish the new Alcantara Space Center -CEA, deriving from a new concept of the launch center model, which includes its commercialization, using part of the area already expropriated by Decree number 7.820, of September 12th, 1980, for the establishment of the Alcantara Launch Center - CLA.

Within the coming ten-year period, national companies and university centers, which are also included among the members of SINDAE, shall deserve greater efforts aimed at increasing their involvement in the implementation of the space program.

In accordance with the PNDAE directives, the participation of Brazilian industries and companies in the implementation of PNAE shall be permanently sought by AEB, as the central organization, and by the sectoral executive entities of SINDAE, as a means of ensuring the maximum achievement of the potential benefits associated to the mastery of the technology and to the use of space means.

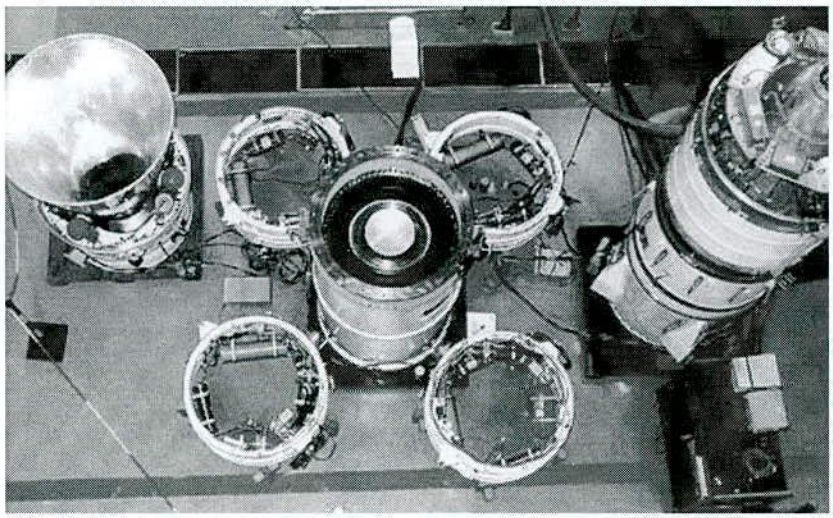
It is also expected that the Brazilian universities will not only play a fundamental role in specialized education, required by the space sector, but will act, preferably associated in cooperative research networks, contributing to the definition of the major Program priorities and increasingly preparing themselves for the implementation of PNAE projects, complementing the research and development activities of the sectoral organizations.

It is convenient that sectoral organizations subordinated to the different ministries and secretariats, at the different governmental levels, participate not only as users of the systems and of the space technology, but also contributing for the implementation and the funding of PNAE activities. In particular, the possibility of contractual counterparts that contribute to the development of Brazilian space activities, including public-private partnerships– PPP, should always be exploited on the occasion of the acquisition of space systems and

services by public organizations, even if for strictly commercial or service-delivery purposes.

Regarding the actions aimed at fostering science, technology and innovation, to reinforce technological development and knowledge acquisition for the space sector, funding resources will come from the Space Fund, created by Law number 9.994, of July 24th, 2000, as well as from the regular grants and lines of credit from the CNPq, FINEP and federal foundations that support scientific research.

Management of the Program



Simulation experiment in real time of the control system of the VLS

The improvement of the management capacity of the Brazilian Space Program will be one of the main challenges for the new horizon of PNAE.

The Multi-Year Investment Plan – PPA, defined for the National Program of Space Activities, is the basic managerial instrument, in consonance with the strategic directives of the government and in compliance with the Decree n. 5.233, of October 6th, 2004, which establishes the rules for the management of the 2004-2007 PPA and of its programs.

The impact indicators of the PNAE/PPA should be revised, as well as the correspondence among the current PPA actions, the missions defined for the

new decennial horizon of the PNAE, and the programming of the necessary financial resources for this new period.

Budget

The budget breakdown necessary for the Program in the ten-year period is presented in Table 1 and in Figure 1, while its distribution in terms of activities is presented in Figure 2.

These estimates are optimistic and presuppose a set of parallel coordination actions in the governmental sphere.

It is important to highlight that the feasibility of the Program will require the establishment of national partnerships with potential users such as ministries, secretariats, and other agencies, which will fund part of the projects that provide applications attending to their interest. International partnerships are considered as well, in order to share the high development costs and risks.

Furthermore, the commercialization of launching activities at the Alcantara Space Center – CEA – should provide part of the financial resources necessary for research, development and its own maintenance.

The partnership with development agencies is fundamental in order to leverage research and development activities and to contribute, together with AEB, for the establishment of lines of research and funding geared to innovation, mainly by generating cooperation projects among companies, universities and research centers related to the space field.

Table 1 Programming of the Necessary Investments
PNAE 2004-2014 (in million Reais)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Totais
Earth Observation	159,4	159,6	132,5	81,2	91,6	100,9	92,8	56,0	61,6	56,0	991,6
Scientific Missions	37,8	71,4	37,8	23,8	33,6	19,6	19,6	19,6	19,6	19,6	302,4
Meteorology	0,0	0,0	5,6	42,0	77,0	79,8	33,6	56,0	56,0	0,0	350,0
Telecommunications	0,0	70,0	70,0	140,0	210,0	140,0	70,0	70,0	70,0	0,0	840,0
Access to Space	42,5	68,0	168,2	150,6	152,4	157,4	148,2	123,8	118,8	123,8	1253,6
Infrastructure	149,9	243,2	297,7	322,1	94,6	90,4	91,3	84,2	69,3	65,5	1508,0
Research and Development	18,7	18,7	18,7	18,7	18,7	18,7	18,7	18,7	18,7	18,7	186,9
Human Resources	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	28,0
Capacity Building for the National Industry	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	2,8	28,0
Program Management	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	5,6	56,0
Total	419,5	642,1	741,6	789,5	689,0	618,0	485,4	439,5	425,2	294,7	5544,5

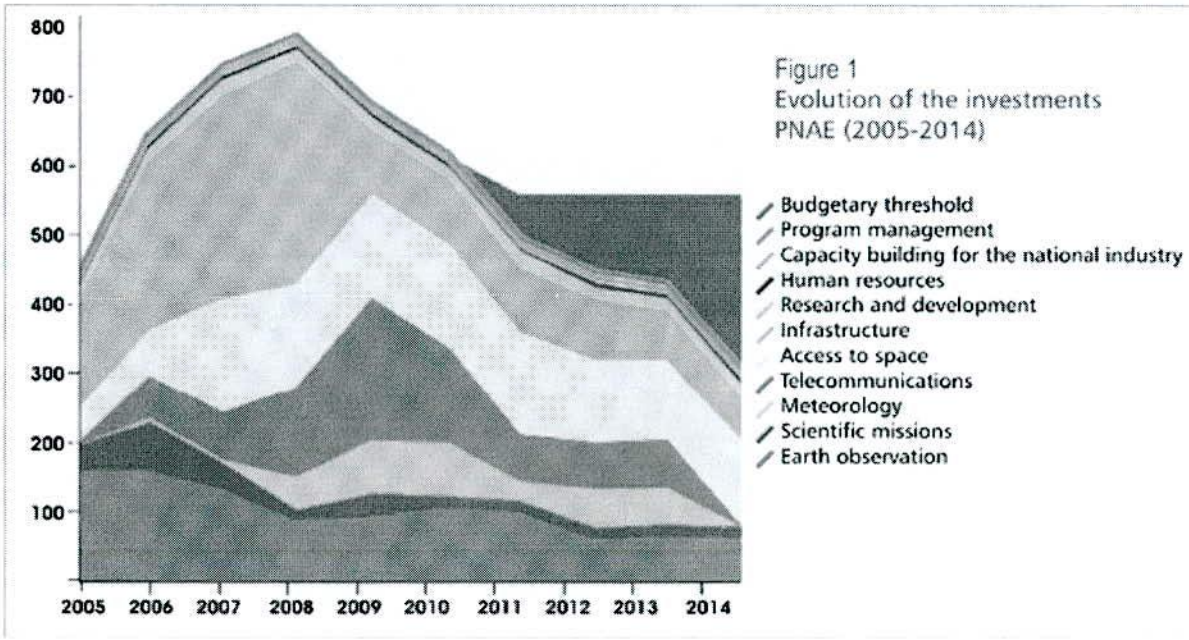


Figure 1
Evolution of the investments
PNAE (2005-2014)

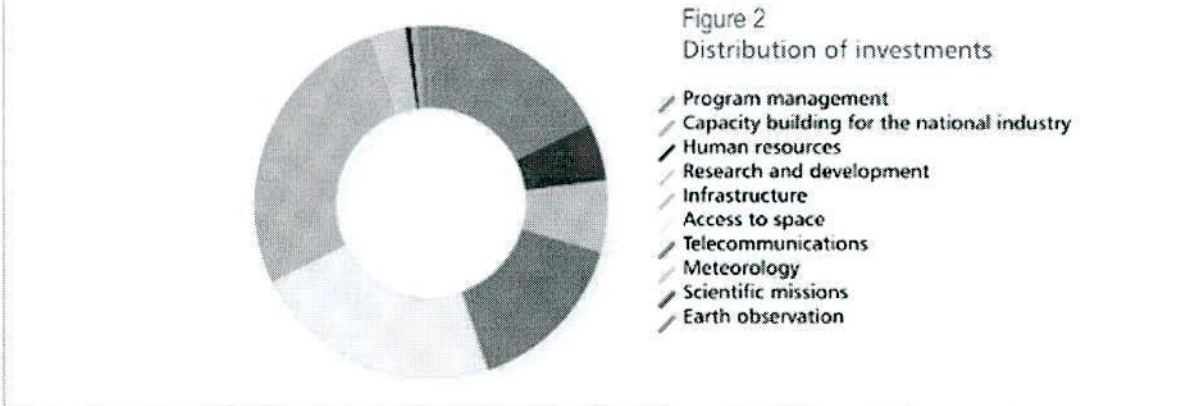
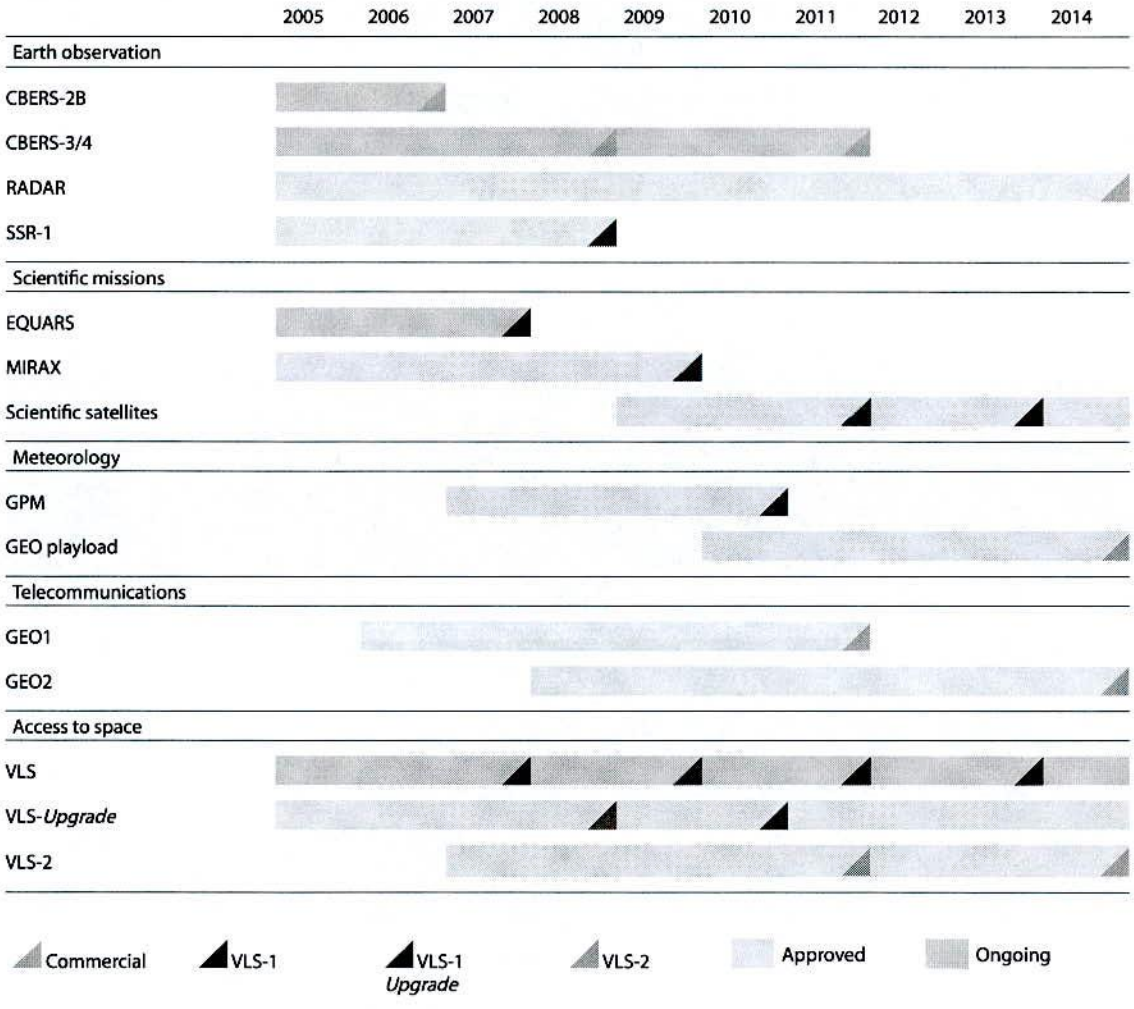


Figure 2
Distribution of investments

Chronogram

The chronogram of the planned missions within PNAE is presented below, grouped by mission objectives and showing the corresponding launchers.



ANNEX I

Legal Framework of Space Activities

The Space Era began on October 4th, 1957 with the launching by Russia of Sputnik I.

The Legal Framework, in terms of International Space Law, is the "Outer Space Treaty" [Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, Resolution 2222 (XXI) of the General Assembly of the United Nations], in force since 1967. This instrument contains the basic guidelines that were afterwards complemented by other treaties and conventions, such as:

- The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, Resolution 2345 (XXII) of the General Assembly of the United Nations, of December 19th, 1967, in force since December 3rd, 1968;
- The "Liability Convention" [Convention on International Liability for Damage Caused by Space Objects], Resolution 2777 (XXVI) of the General Assembly of the United Nations, in force since September 1st, 1972;
- The "Registration Convention" [Convention on Registration of Objects Launched into Outer Space] that derives from Resolution 3235(XXIX), of the General Assembly of the United Nations, in force since September 15th, 1976;
- The "Moon Agreement" [Agreement Governing the Activities of States on the Moon and Other Celestial Bodies], adopted by the General Assembly in its resolution 34/68, opened for signature on 18 December 1979, entered into force on 11 July 1984.

So far, Brazil has signed and ratified:

I. The Outer Space Treaty [Legislative Decree number 41/1968, enacted by Decree number 64.362, of April 17th, 1969];

II. The Agreement on the Rescue of Astronauts [Legislative Decree number 80/1972, enacted by Decree number 71.989, of March 26th, 1973] and,

III. The Liability Convention [Legislative Decree number 77/1972, enacted by Decree number 71.981, of March 23rd, 1973].

The Registration Convention, of which Brazil is a signatory, is still under the scrutiny of the National Congress.

Space Activities in Brazil

Space Activities in Brazil began with the enactment of Presidential Decree number 51.133, of August 3rd, 1961, on which occasion the Group for the Organization of the National Committee for Space Activities – GOCNAE was created. Later on, simply termed CNAE, subordinated to the then National Research Council – CNPq, the Committee carried out its activities at the Technical Center of the Air Force - CTA.

The Brazilian Committee on Space Activities – COBAE – was created by Presidential Decree number 68.099, of January 20th, 1971.

The Group for the Organization of the National Committee on Space Activities– GOCNAE – was extinct and the Institute of Space Research –INPE, was created by Presidential Decree number 68.532, of April 22nd, 1971, as the "main executive organization for the development of space research, at civilian level, pursuant the guidance of the Brazilian Committee on Space Activities –COBAE".

Within the Air Force, the Launch Center of Barreira do Inferno -CLBI was inaugurated by the Ministry of the Air Force, in 1965, in Natal (RN), devoted to the delivery of tracking and launching services for Brazilian and foreign sounding rockets.

In 1966 the Executive Work Group for Studies on Space Projects – GETEPE, was created, and in 1969 this group became the Institute of Space Activities – IAE. Part of the Aerospace Technical Center – CTA, in 1991 the IAE became the Institute of Aeronautics and Space.

The national initiatives in the domain of the space acquired new momentum starting from 1979 with the Brazilian Complete Space Mission – MECB. The first Brazilian space program with effective large-scale and long-term characteristics, MECB sets as targets the development of small application satellites (collection of environmental data and remote sensing) and of a launching vehicle compatible with the sizes and the missions of those satellites, as well as the establishment of the basic infrastructure required by those projects.

The construction of the Alcantara Launch Center – CLA, in the Municipality of Alcântara (MA), brought about by the MECB program, began in 1983 with the preparation of the project for the use of safety and support areas of the Center, which foresaw the clearing of about 234 Km^2, out of a total of 620 Km^2, which were expropriated by Decree number 7.820, of September 12th, 1980, of the Government of the State of Maranhão, and complemented by Presidential Decree without number, of August 8th, 1991.

In 1987, the G-7 (seven most industrialized countries) conceived the Missile Technology Control Regime – MTCR, a regime characterized by an agreement against the proliferation of missile technology.

In February, 1994, Brazil asserted its readiness to comply with the guidelines of the Regime and, accordingly, it reformed the domestic legislation on the control of exports of sensitive and dual-use goods in 1995.

Within this context, on February 10th, 1994, the Brazilian Space Agency – AEB was created.

Legal Framework of the AEB

The normative framework that created the Brazilian Space Agency is contained

in the provisions of Law number 8.854, of February 10th, 1994, which in its Article 1 reads: "The Brazilian Space Agency – AEB, is hereby created, as a civilian organization, a federal autonomous agency, related to the Presidency of the Republic, with the purpose of promoting the development of Space Activities of national interest".

The AEB is the successor of COBAE, pursuant to the provisions of Article 11, of the same law, "Article 11. The AEB will succeed COBAE in its rights and in its obligations deriving from national and international cooperation agreements and instruments".

Decree number 1.332, of December 8th, 1994, approves the revision of the National Policy for the Development of Space Activities – PNDAE, which establishes "the objectives and the guidelines that shall guide the actions of the Brazilian Government aimed at development of Space Activities of national interest".

Decree number 1.953, of July 10th, 1996, creates the National System for the Development of Space Activities – SINDAE, with the "purpose of organizing and carrying out space activities aimed at space development of national interest".

The following executive bodies constitute the SINDAE: the National Institute for Space Research – INPE, of the Ministry of Science and Technology – MCT, and the Department of Research and Development – DEPED, subordinated to the Air Force Command, of the Ministry of Defence. SINDAE also includes representatives of the industrial sector and of the academic community.

Decree number 4.566, of January 10th, 2003, subordinates the AEB to the Ministry of Science and Technology – MCT, separating it from the Presidency of the Republic.

The AEB has the legal obligation (Numeral III, of Article 3, of Law number 8.854, of 1994) to formulate and revise the National Program of Space Activities – PNAE, which covers ten-year periods subjec to reviews, which specifies the major lines for the implementation of actions and the strategic vision of the

Program.

Currently, the Regimental Structure and the Table of Appointed Positions and Functions of the AEB are defined in by Decree number 4.718, of June 4th, 2003. Its Article 2 specifies the Organizational Structure of the AEB:

"The AEB has the following organizational structure:

I. Higher Deliberation Bodies:

a. The Presidency and

b .The Superior Council;

II. Bodies of direct and immediate assistance to the President:

a. The President's Office;

b. The Federal Legal Department and

c. The International Cooperation Department;

III. Sectional Bodies:

a. Internal Audit and

b. Direction for Planning, Budget and Administration;

IV. Individual Specific Bodies:

a. Direction for Space Policy and Strategic Investments;

b. Direction for Satellites, Applications and Development and

c. Direction for Space Transportation and Licensing."

It is worth highlighting, due to its strategic relevance in the definition of policies for the space domain that are to be submitted to the approval of the MCT, the membership of the Superior Council of the AEB that counts, in addition to the President of the AEB, who presides over the Council, on the participation of the Ministries of Science and Technology; of Agriculture; of Communications; of Defense; of Development, Industry and Foreign Trade; of Education; of Finance; of the Environment; of Mines and Energy; of Planning, Budget and Management; and of External Relations.

The Superior Council of the AEB includes representatives of the Office of Institutional Security of the Presidency of the Republic; the Commands of the Air Force, Army and Navy, under the Ministry of Defense; of the National Council

of Scientific and Technological Development; and of the Funding Agency for Studies and Projects.

The membership of the Superior Council of the AEB also includes a representative of the Scientific Community and a representative of the Industrial Sector. The Regulation on its competence and operation was approved pursuant to the provisions of Resolution number 1, of 2004, of November 25th, 1994.

All the legal instruments mentioned herein are available at the AEB's website, http://www.aeb.gov.br/, under the heading Legislação.

Annex II

Law No. 8,854 of February 10, 1994.

Creates the Brazilian Space Agency (AEB)

as a civilian organization, and addresses related matters

The President of the Republic

I make it known that the National Congress decrees, and I sanction the following law:

Art. 1 The Brazilian Space Agency – AEB is created as an autonomous civilian organization, associated to the Presidency of the Republic, with the purpose of developing space activities of national interest.

§ 1. The AEB answers directly to the President of the Republic.

Art. 2 The AEB, granted administrative and financial autonomy, with its own patrimony and staff, is physically and legally located in the Federal District.

Art. 3 The functions of the AEB are:

I. Carry out, and cause to be carried out, the National Policy for the Development of Space Activities – PNDAE, in addition to proposing guidelines and implementing the consequent actions;

II. Propose the revision of the National Policy for the Development of Space Activities, and the actions to be taken for its implementation;

III. Elaborate and revise the National Space Activities Programs – PNAE, and the respective budget proposals;

IV. Promote relations with similar institutions both within the country and abroad;

V. Analyze proposals and sign international agreements and conventions, together with the Ministry of Foreign Relations and the Ministry of Science

and Technology, with the aim of cooperation in the field of space activities, and accompany the execution of such;

VI. Provide assessments of questions related to space activities under discussion in the international forum and, in coordination with the Ministry of Foreign Relations and the Ministry of Science and Technology, act as representative in such forums;

VII. Stimulate the participation of universities and other institutions of teaching, research and development in space-related activities;

VIII. Stimulate the participation of the private sector in space activities;

IX. Foment scientific research and technological development in activities of interest to the area of space;

X. Stimulate the access of national bodies to knowledge obtained by the development of space activities, aiming at their technological advancement;

XI. Articulate the joint use of space-related technical installations, with a view to the integration of available means and the rationalization of resources;

XII. Identify commercial possibilities for the use of space applications and technology, with a view to stimulating entrepreneurial initiatives in supplying services and products;

XIII. Establish norms and emit licenses and authorizations relative to space activities;

XIV. Apply standards of quality and productivity in space activities.

§ 1. In the execution of its activities, the AEB has the right to act, directly or indirectly, via contracts, conventions and agreements, both in the country and abroad, without prejudice to the content of item V of this article, and to the competence of the Office of the Solicitor-General of the Treasury[1].

Art. 4 Brazilian space activities will be organized in a systematic way, established by the Executive.

[1] Translator's Note: In the original "Procuradoria Geral da Fazenda Nacional"

§ 1. Within the system which is the subject of this article the AEB will hold the central position.

Art. 5 The AEB has the following basic structure:

I. President;

II. Superior Council;

III. Director-General;

IV. Department of Administration;

V. Department of Planning and Coordination;

VI. Department of Space Programs;

VII. Department of Technical and Scientific Development;

VIII. Department of Space Cooperation.

Art. 6 The Superior Council, of a deliberative nature, has the following composition:

I. The president of the AEB and the Director-General, as permanent members;

II. Representatives of the Ministries and Secretariats of the Presidency of the Republic with activities related to the space area;

III. One representative from the scientific community, and one from the industrial sector involved in the space area, with two year mandates.

§ 1º The members of the Superior Council referred to in item II, not less than ten, and not more than 18, in number, are designated by the President of the Republic.

§ 2º The Superior Council will be presided over by the president of the AEB or, in the absence of the latter, by the director-general.

§ 3º The president of the AEB will, after hearing the Ministries and Secretariats referred to in item II, submit the names of the indicated representatives to the

President of the Republic for his approval and designation.

§ 4º The Superior Council will approve the instrument which describes its competence and procedures.

Art. 7º The AEB will be administered by a president, a director-general, and five heads of department, nominated by the President of the Republic, and chosen from Brazilians of irrefutable moral standing and known technical and administrative competence.

Art. 8º The Executive is authorized to redistribute or transfer to the Brazilian Space Agency, the balance of the Armed Forces budget provisions destined for the Brazilian Commission on Space Activities – COBAE, maintaining the same sub-projects, sub-activities and budgetary groupings defined in Law No. 8,652, of April 29, 1993.

Art. 9º Also constituting AEB sources of income are:

I. - Financial designations included in the National Budget;

II. - Income of any nature resulting from its holdings or activities;

III. - Special credits designated by law;

IV. - Other resources obtained or designated.

Art. 10º The patrimony of the AEB shall be constituted by the properties it acquires, including donations and inheritances from individuals or legal entities.

§ 1. The Executive is hereby authorized to cede to the AEB, for its use, such properties of the Union as should be necessary for the exercise of its activities.

Art. 11º The AEB will succeed COBAE in its rights and obligations with respect to national and international agreements and instruments of cooperation.

§ 1. The Office of the Solicitor General of the Treasury will adopt the measures necessary to celebrate terms of addition, with a view to formalizing the determination of this article.

Art. 12 This law creates, within the permanent staff of the AEB, the civilian

post of President of the Agency, and the commissioned posts and patronage positions, foreseen in Annex 1 of this law, and in conformity with the budget provisions made for this purpose.

§ 1. The occupants of special or commissioned positions, as defined in Annex 1, will be freely chosen by the administration, and in conformity with the legislation in force.

Art. 13º This law creates, within the AEB, the civil service posts defined in Annex II of the law.

§ 1º Appointments to the positions referred to by this article require prior approval in public examination, in the terms of the legislation in force.

§ 2º The Executive will determine the regulations pertaining to the positions created by this article.

Art. 14º The values corresponding to the remuneration of the AEB posts are those shown in Annex II of Law No. 8.622, of January 19, 1993, with their subsequent alterations, including legal adjustments.

Art. 15º To the federal public servants placed at the disposition of the AEB, the remuneration and rights of the permanent position or post, including promotions, are guaranteed.

§ 1º The public servant under the conditions defined in this article will continue to contribute to the pension fund to which he is affiliated, without interruption, for the purposes of calculating his years of service in the organization or entity to which he belongs, for all purposes pertaining to the legislation relevant to labor and social security, including special laws and internal norms.

§ 2º The period during which the public servant remains in the service of the AEB shall be considered for all effects of the public service, as being time served in the position or post occupied in his organization or entity of origin.

Art. 16º Until a minimum of sixty percent of the total number of the AEB's permanent posts should be filled, any public servant occupying a permanent post or position may be designated to occupy a commissioned post.

Art. 17º The employees of the AEB shall receive the "activity gratification" defined under the law "Lei Delegada" No. 13, of August 27, 1992, at the level of 160 percent.

Art. 18º Within a period of 180 days from the date of publishing of this law, the Executive will make appropriate dispositions concerning the structure of the AEB.

Art. 19º The President of the Republic will decree the extinction of COBAE, as soon as the AEB has been set up and has entered into operation.

§ 1. Until the extinction of COBAE foreseen in this article, the directors and employees of COBAE will continue to exercise their present functions.

Art. 20º This law enters into effect on the date of its publication.

Brasília, February 10, 1994, in the 173rd year of Independence, and the 106th year of the Republic.

ITAMAR FRANCO
Celso Luiz Nunes de Amorim
Lélio Viana Lôbo
José Israel Vargas
Arnaldo Leite Pereira

Annex III

Decree No. 1,332, of December 8, 1994

Approves the revision of the National Policy for the Development of Space Activities – PNDAE

The President of the Republic, by the power invested in him by Article 84, Items IV and VI of the Constitution, and in view of the dispositions of Item II of Article 3 of the Law No. 8,854, of February 10, 1994,

Decrees:

Art. 1º That the revision of the National Policy for the Development of Space Activities – PNDAE described in Annex I of this Decree is approved.

Art. 2º This decree enters into effect on the date of its publication.

Brasília, December 8, 1994;
in the 173rd year of independence and the 106th year of the Republic.
ITAMAR FRANCO
Mauro Motta Durante

Annex I

National Policy for the Development of Space Activities

I. Introduction

The current update of the National Policy for the Development of Space Activities (PNDAE), prepared by the Brazilian Space Agency, in fulfillment of Item II, Article 3, of Law No. 8,854 of February 10, 1994, and approved by the President of the Republic, establishes the objectives and guidelines which shall guide the actions of the Brazilian Government aimed at the development of space activities in the national interest.

II. Definitions

1. The term space systems is used to indicate systems, either designed to operate in space or to make feasible the operation in space of equipment designed to provide access to information or services. In this manner space systems will signify, generically, space stations, satellites, space platforms (or busses), payloads, represented by measuring, observing or telecommunications equipment, and rockets and space transport vehicles.

2. Space infrastructure is to be taken as the set of ground facilities, systems or equipment, together with the associated services, which provide the necessary support for the effective operation and utilization of space systems. Included in this category are launch centers for sounding rockets, satellite launch vehicles and stratospheric balloons, specialized laboratories for fabrication, integration and tests, stations and centers for tracking and control, and for the reception, processing and distribution of satellite data etc.

3. Space Activities are to be understood as the systematic effort to develop and operate space systems, as well as the essential corresponding infrastructure, with a view to allowing man to expand his knowledge of the universe, especially the planet Earth and its atmosphere, and to exploit, with utilitarian motives, the availability of these new devices.

4. A country's space activities are usually organized into programs, composed by subprograms, projects and activities of a continuous nature. It is customary to refer to the conjunction of these programs as the Space Program of the country. In analogous form, the National Space Activities Program (PNAE) is to represent the conjunction of initiatives put forward by the Brazilian Space Agency, and approved by the President of the Republic.

III. General Considerations

The principal considerations forming the basis for this policy are summarized as follows:

- Space Activities typically require large scale investments in long-term projects, but with substantial expected returns. Over the last four decades

of the recent world history of space activities, many direct and indirect economic and social benefits can be clearly recognized. These benefits stem directly from the application of artificial satellites to the solution of everyday problems, specially in the fields of telecommunications, weather and climate forecasting, inventory and monitoring of natural resources, navigation and science. The indirect benefits come mainly from the use of the resulting scientific and technological knowledge in innumerable areas of human activity, from medicine to the production of a wide range of goods and services, amongst which micro-electronics, computational technology and materials are outstanding examples.

- Brazilian investments in the field of space, over the past 30 years, have allowed the country to form competent teams of specialists, consolidate research and development institutions, set up important infrastructure installations, and initiate the formation of a Brazilian space industry. They have also made it possible to disseminate the techniques of satellite communications, navigation, remote sensing and meteorology, of great potential in the solution of innumerable problems confronting the nation.

- The Complete Brazilian Space Mission (MECB), started in 1979, represented the first major national program in the context of space, and the adoption of the universally accepted model of development via the taking on of projects which are both long-term and highly ambitious. MECB has been successful, and amongst its results should be emphasized the highly successful launch of the first satellite developed in Brazil, the SCD-1, the setting-up of the basic infrastructure for future Brazilian space missions, including the Integration and Tests Laboratory (LIT) and the Satellite Tracking and Control Center (CRC), both located at the National Space Research Institute of the Ministry of Science and Technology. Equally noteworthy are the setting-up of the Alcântara Launch Center (CLA) and the completion of the principal steps in the development of the Satellite Launch Vehicle, the VLS, both by the Research and Development Department of the Ministry of Aeronautics.

- As a result of Brazil's geo-economical characteristics, space technology

offers major potential for the solution of a wide range of national needs. Amongst these characteristics can be included the country's massive territorial extent, the concentration of its population in the coastal zone, its vast regions of tropical forest, large areas of difficult access and low population density, extensive borders and sea-coast, and the significant volume of natural resources as yet inadequately mapped.

- Brazil's location on the terrestrial globe makes it possible to conceive of specific space systems, economically advantageous for the solution of a number of problems of national importance, and which could be of interest to other neighboring or appropriately located countries.

- Geo-political changes in the international scenario have provoked changes in space programs all over the world, creating expanded opportunities for international cooperation, and greater importance for smaller, less costly programs, aiming at results with shorter lead-times.

- As a result of international tendencies, the technologies of small satellites and associated launch vehicles have come to be of greater importance, with a corresponding increase in the value of the experience gained with MECB, and in the opportunities for future initiatives.

- Space transport vehicles deserve special attention by virtue of the nature of the technology involved, the difficulties of international cooperation, and their strategic importance, guaranteeing autonomy to the country in the launch of satellites, platforms and payloads of national interest.

- Brazil's advances in the space sector need to be consolidated and extended. This requires the completion, maintenance and modernization of the existing infrastructure, the extension and updating of the human resources dedicated to space activities, increased institutional participation in space programs, and the creation of opportunities for the commercialization of space-related products and services. The institutional participation referred to here includes not only the government, but also the private sector and, especially, Brazilian industry.

IV Objectives

The general objective of the National Policy for the Development of Space Activities (PNDAE) is to advance the capacity of the country, according to appropriate criteria, to utilize space techniques and resources in the solution of national problems and in benefit to Brazilian society.

For the achievement of this general aim, the following specific objectives may be identified:

1. The establishment, in the country, of a technico-scientific competence in the area of space, permitting a genuine autonomy of action in:

- The selection of alternative technologies for the solution of Brazilian problems;
- The development of in-house solutions for problems specific to our territory or society, wherever more economical alternatives are either unavailable or cannot be guaranteed;
- The effective use of information of interest to Brazilian society, provided by space techniques;
- International negotiations, accords and treaties, involving material pertinent to space activities, or capable of benefiting from knowledge based on such activities.

2. Advancement of the development of space systems, together with the corresponding means, techniques and ground-based infrastructure, making necessary or desirable services and information available to Brazil.

3. Qualification of the Brazilian industrial sector to participate and become competitive in the supply of products and services related to space.

V. Guidelines

In the planning and execution of the programs consequent upon the objectives specified above, the following guidelines should be observed:

1. Priority for the Solution of National Problems

The resources available for the development of Brazilian space activities should be concentrated in initiatives aimed at seeking solutions to national problems, or problems of national interest, through the use of space techniques and the knowledge obtained from them.

2. Concentration of Efforts in High-Profile Projects

International experience has shown that progress in the space sector is most significant, and most appreciated by public opinion, when spearheaded by major high-profile programs, which concentrate efforts in clear objectives, of merit and consequence, which impose major scientific and technological challenges to the organizations and companies entrusted with their execution.

The Brazilian Space Agency, and the other organizations which form part of the National System of Space Activities, should permanently strive to conceive new initiatives, and to organize the activities under way in programs with the characteristics emphasized above.

3. Scope Defined by the Final Results

Government initiatives in the space area should be organized via programs conceived in such a way that the desired results will provide concrete benefits to Brazilian society.

As a consequence of this, the application programs should take into account all the segments necessary to guarantee the end-user access to the products and services made possible by the program. They should also take into account the availability of means for the full utilization of the new information available. In general, this directive implies the application of significant efforts in the processing and analysis of data, and in the development of technology for that purpose. It also involves the establishment and operation of suitable base structures, and a significant effort in technology transfer.

4. Critical Investment Analysis

Government investments in research and development in the space area should explicitly seek to achieve the objectives expressed in this policy. Additionally, it

should be required that programs and projects to receive government financing should be clearly characterized by their efficiency, and should:

- Prioritize initiatives involving a balanced temporal distribution of results, with guaranteed returns in the short and medium terms, diminishing the project's global risk, and facilitating decision taking with respect to investments and continuity;

- Submit program investment proposals to cost-benefit analysis, taking into account the results to be achieved.

5. Ensuing International Cooperation

Today, in view of the fact that such projects are extremely expensive, international cooperation is a natural choice for making space projects feasible. Nevertheless, it must be borne in mind that, in the technical area, international cooperation is not usually characterized by a free interchange of valuable information. Information sharing is limited to that strictly necessary to achieve the common objective. In this context, the following guide-lines should be followed:

- Proposals for international cooperation should state clearly and pragmatically the benefits to be accrued for the parties involved, and the basic interests on the Brazilian side should be within the framework of this policy;

- Cooperative scientific projects should be encouraged, seeking to establish favorable conditions for the interchange of personnel, equipment and data, as well as assuring beneficial participation for Brazil in the major international scientific programs;

- Opportunities for cooperation in space engineering, technology and systems, and the corresponding infrastructure, should be taken advantage of whenever within the interests of the country;

- Cooperative initiatives with countries which share problems and difficulties similar to those of Brazil should merit special attention;

- The establishment and adoption of international standards should be supported, so as to ease the interchange of information, and assure a growing compatibility in space systems between cooperating

organizations the world around.

6. Incentives for Industrial Participation

Participation by Brazilian industry in the development of space systems and technology is an essential condition for the effective absorption of the know-how resulting from these programs by the productive sector. This participation should be foreseen explicitly in proposals for new programs, which should:

- Promote the qualification of national industry, not only as suppliers of equipment and parts but, also, in the development and manufacture of complete systems and subsystems;
- Seek the integration of institutional research and development teams and their industrial counterparts, by the joint execution of technological development projects which include industry right from the start;
- Seek to establish long-term plans which allow Brazilian firms to decide on their participation in the national space program with reduced uncertainty.

7. Optimized Use of Resources

It should be recognized that human resources and infrastructure are scarce in Brazil and, consequently, their exceptional value should be recognized, preserved and used in the best way possible. In this context the following points should be kept in mind:

- The analysis of new proposals should take into account their needs for personnel and infrastructure, seeking at the same time to avoid not only duplication of efforts but, also, the overload and/or breaking-up of existing teams;
- Laboratory installations set up in government research and development institutes, to attend the needs of the National Space Activities Program, should be shared with universities and Brazilian industry, without prejudicing their primary functions.

8. Development of Capability in Strategic Technologies

Projects aimed at developing competence in new technologies should give priority to dominating techniques considered strategic for the country, following criteria which include:

- Their importance for space systems or services of major interest to the country;
- Difficulties existing with respect to imports;
- The potential commercial value of the technologies involved for Brazilian companies;
- The competence and facilities available within the country, in the context of possible innovative contributions to the state of the art.

9. Pragmatism in the Conception of New Space Systems

In conceiving new projects for the development of space systems, efforts should be directed, preferentially, to the solution of problems peculiar to Brazilian society or territory, and which are also of interest to the international community. The solutions sought after should preferentially be characterized by an attractive cost/benefit ratio, by the exploitation of comparative advantages inherent to Brazilian conditions, and by their potential for commercial exploitation.

10. Importance of Scientific Activities

The activities of scientific investigation or basic research in the area of space should be given due value, not only because they contribute to universal knowledge but, principally, because they contribute to national development.

11. Emphasis on Space Applications

The application of space technology to the solution of problems typical of a country with the geo-political characteristics of Brazil constitute the principal justification for government investments in the area. The planning of Brazilian space activities should consider the application of space technology to the

solution of problems such as communications in remote regions, environmental monitoring, surveillance of the Amazon region, border and coastal patrol, monitoring and inventory of natural resources, planning and monitoring of land use, crop forecasting, environmental data collection, climate and weather prediction, vehicle and accident location, and the development of industrial processes in the micro-gravity environment, as well as national defense and security. Government institutions involved in space activities should work to develop systems, products, processes and methods which make possible space applications and, wherever possible, should transfer to private firms the supply of services or products derived from these applications.

12. Coherence Between Autonomous Programs

The National Space Activities Program (PNAE) , which should plan actions to realize the objectives established in this Policy, should consist of scientific, technological development and applications programs, as well as programs aimed at the implantation, maintenance and expansion of, not only the operational infrastructure, but also that applicable to basic research and development. A coherent relationship must be maintained between these programs in both the short and long terms.

In this way, scientific or applications missions under way should be based on technology and facilities either already available, or in the acquisition or implantation phase. In counterpoint, the foreseeable long-term needs of scientific or applications programs should guide technological development programs.

In this manner, missions planned for the future will define parameters for satellite and payload technology development programs. These missions, and the needs of the satellites involved, will set the constraints for proposals for the development of space transport vehicle technology. Finally, proposals for expanding infrastructure, both for operational support and for research and development, should be based on the future needs of the other programs.

13. Conciliating Technological Objectives with Scientific Aims and Application Goals

The conciliation of the objectives of technological development of space systems with those of science and applications should be taken as fundamental in programming the development of space activities.

It must be recognized that, in many cases, technological development leads to the possibility of applications. On the other hand, the need for solutions to problems of national importance produces technological challenges. The direction to be taken by the space program should lie in the conjunction of these two aspects. In general, the purely technological goals are set by extrapolating the existing technological capacity linearly in time, always with the aim of perfecting existing technologies and incorporating new ones. One might say that the ultimate technological objective is to dominate the technology, not only for its own sake, but also as a national asset, as an investment for future needs not foreseen in the present program.

The scientific and application objectives, respectively, should be directed towards:

- The advancement of universal knowledge, which can both benefit and be benefited by the development of space activities, in the first case;
- The solution of problems of national scope, or of interest to the country, in the case of applications.

In this context, it is irrelevant whether the technology used was developed in the country, or acquired abroad, so long as the practical result is achieved.

14. Dual Use Technologies

A significant fraction of the technology developed for space applications can be classified as dual use technology. PNAE should take account of government policy and legislation on export controls on dual use material and related services, seeking, where appropriate, to coordinate the activities of the Agency with those of other federal organizations in respect of these goods and services.

15. Other Guidelines

In addition to programs, projects and activities related to scientific research and development, applications and specific technological development, the National Space Activities Program (PNAE) should also contemplate more general programs and activities, based on the following guide-lines:

- Promote the creation and further training of highly qualified human resources, together with the consolidation and strengthening of specialized research and development teams in national institutions, in all fields of space activities of national interest;
- Promote international cooperation at all levels, as a way of accelerating the acquisition of scientific and technological knowledge, guaranteeing access to data and making economically feasible the development of space systems of interest to the country;
- Promote greater integration between universities and Brazilian industry, via various mechanisms, such as industrial contracts for the supply of parts, equipment, subsystems and services, in the context of national space systems development programs, or fomenting the creation of specialized space technology centers in Brazilian teaching and research establishments. These measures will make it possible to extend the supporting base and human resources development in space activities, in addition to seeking a gradual and selective autonomy in the country in certain technological areas considered to be of high priority;
- Promote, with priority, the development of space systems which associate clearly defined objectives of technological and industrial development with essential scientific or utilitarian objectives;
- Promote the development and dissemination of space applications, in strict consonance with the government policies for the sectors to be directly benefited;
- Promote and encourage commercial participation in the financing of space systems aimed at providing commercial services;
- Encourage the commercial exploitation of services and products resulting

from or associated with space activities, giving priority to the private sector;

- Complete, maintain and make adequate the necessary infrastructure for space missions of national importance, including development, integration and tests and space systems laboratories, tracking and control centers and launch centers;
- Promote the dissemination and effective use of space-related techno-scientific information, with emphasis on that of normative nature.

Annex IV

Decree No. 1,953 of July 10, 1996

Creates the National System for the Development of Space Activities - SINDAE and other matters.

The President of the Republic, by the powers invested in him by Article 84, Item IV, of the Constitution, and in view of the dispositions of Article 4 of Law No. 8,854 of February 10, 1994,

Decrees:

Art. 1º The National System for the Development of Space Activities – SINDAE is created with the purpose of organizing and carrying out space activities aimed at space development of national interest.

Art. 2º SINDAE is constituted by a central body, responsible for its general coordination, by sectorial organizations, responsible for sectorial coordination and the execution of activities defined in the National Space Activities Program – PNAE, and other participating organizations, responsible for the execution of activities specific to PNAE.

Art. 3º Constituting SINDAE are:

I. As the central organization, the Brazilian Space Agency - AEB;

II. As sectoral organizations:

   a. The Department of Research and Development of the Ministry of Aeronautics – DEPED;

   b. The National Institute for Space Research of the Ministry of Science and Technology – INPE;

III. As participating organizations and bodies:

   a. The ministries and secretariats of the Presidency of the Republic,

when involved in the subject, by their representatives indicated by the competent authority;

b. The states and federal district and municipalities, where there exists interest, by their representatives indicated by the respective principal executive;

c. The private sector, as indicated by its legal representative.

§1° In any of the cases defined in Item III, participation in SINDAE will depend on the prior approval of the AEB's Superior Council.

§2° The participation in SINDAE by the organizations and bodies defined in Item III will be formalized by the signing of an agreement of participation.

§3° The agreements of participation should clearly establish the courses of action to be followed by the signatories, including those of a budgetary or financial nature, in such a way as to make possible the complete execution of PNAE, with the obtainment of greater benefit from the available resources.

Art. 4° The functioning of SINDAE shall be regulated by normative resolution, approved by AEB's Superior Council.

Art. 5° This decree enters into effect on the date of its publication.

Brasília, July 10, 1996; in the 175th year of independence and the 108th year of the Republic.

FERNANDO HENRIQUE CARDOSO

Clóvis de Barros Carvalho

List of Acronyms

ABNT
Brazilian Association for Technical Norms

ABC
Brazilian Academy of Sciences

AEB
Brazilian Space Agency

ANATEL
National Telecommunications Agency

CAPES
Coordination Office for the Development of University-Degree Personnel

CBERS
China-Brazil Earth Resources Satellite

CEA
Alcantara Space Center

CLA
Alcantara Launch Center

CLBI
Barreira do Inferno Launch Centre

CNAE
National Council for Space Activities

CNPq
National Council for Scientific and Technological Development

COBAE
Brazilian Commission for Space Activities

COMAer
Air Force Command

CNS/ATM
Communication, Navigation, Surveillance, and Air Traffic Management

CRC
Satellite Tracking and Control Center

CTA
Technical Aerospace Center

CT&I
Science, Technology and Innovation

DEPED
Research and Development Department

DLR
Deutschen Zentrum für Luft- und Raumfahrt (German Aerospace Agency)

EQUARS
Equatorial Atmosphere Research Satellite

FINEP
Project and Studies Funding Agency

GOCNAE
National Space Activities Commission Organization Group

GEOSS
Global Earth Observation System of Systems

GPM
Global Precipitation Measurement

GPS
Global Positioning System

HSB
Humidity Sounder for Brazil

IAE
Institute of Aeronautics and Space

IAI
Inter-American Institute for Global Change Research

INPE
National Institute for Space Research

ISO
International Organization for Standardization

ISS
International Space Station

LCP
Combustion and Propulsion Laboratory

LIT
Integration and Test Laboratory

MCT
Ministry of Science and Technology

MTCR
Missile Technology Control Regime

MECB
Complete Brazilian Space Mission

MIRAX
X ray Monitor and Imager

PAPPE
Business Research Support Program

PCD
Data Collection Platform

PIPE
Small Business Technological Innovation Program

PMM
Multi-mission Platform

PNAE
National Program of Space Activities

PNDAE
National Policy for the Development of Space Activities

PPA
Multi-annual Investment Plan

PPP
Public Private Partnership

RECDAS
Dedicated Network for Data Communication

RHAE
Human Resources Program for Strategic Activities

SAR
Synthetic Aperture Radar

SCD
Data Collecting Satellite

SGBD
Database Management System

SINACESPAÇO
National Space Certification System

SINDAE
National System for the Development of Space Activities

SSR
Remote Sensing Satellite

UCA
Coronel Abner Propellant Plant

VLS
Satellite Launch Vehicle

WFI
Wide Field Imager

pnae

National Program of
Space Activities

PNAE
PROGRAMA NACIONAL DE
ATIVIDADES ESPACIAIS

AEB
AGÊNCIA ESPACIAL BRASILEIRA

Ministério da
Ciência e Tecnologia

BRASIL
UM PAÍS DE TODOS
GOVERNO FEDERAL