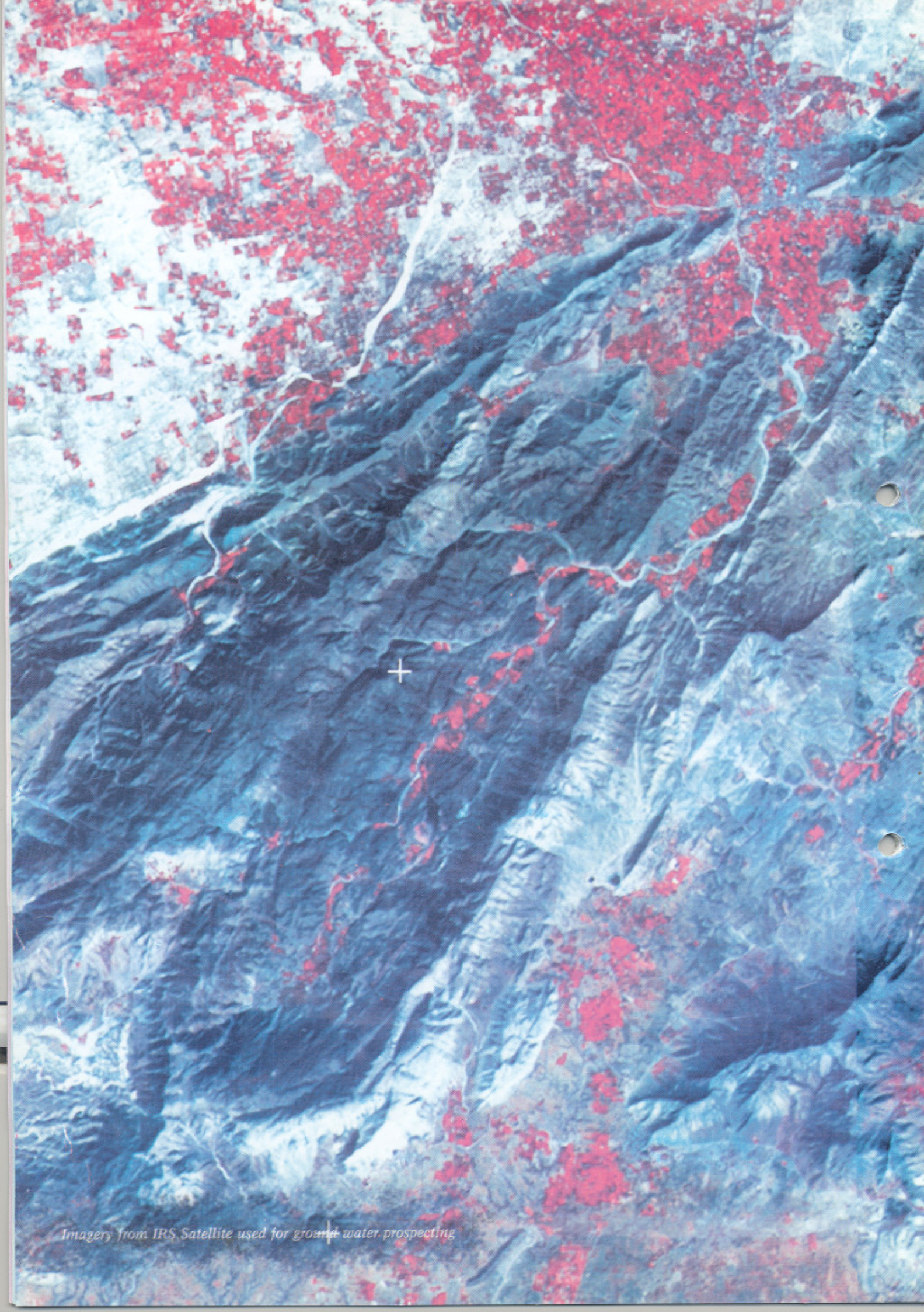
April-June 2002

SPACE india

INDIAN SPACE RESEARCH ORGANISATION



Imagery from IRS Satellite used for ground water prospecting

Cover Page :
ISRO Logo

SPACE india

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Space Industry Meet 2002

The Space Industry Meet 2002 was organised by ISRO in association with the Confederation of Indian Industry (CII) on June 5, 2002 at Bangalore. Several industry representatives and ISRO personnel interacted with each other during the one-day meet to assess and expand the association between ISRO and the Indian industries. Dr K Kasturirangan, Chairman, ISRO/Secretary, Department of Space inaugurated the meet. Shri A U Rijhsinghani, Managing Director & CEO, Walchandnagar Industries Ltd, presided. 280 delegates representing 230 industries from all over India took part in the deliberations.

ISRO has established a strong infrastructure to provide space-based services. These include the Indian National Satellite (INSAT) system for telecommunication, television, meteorology and the Indian Remote Sensing (IRS) satellite system for resources monitoring and management. ISRO has also commissioned the Polar Satellite Launch Vehicle (PSLV), which is not only used for launching IRS satellites, but also, now offered to launch satellites of other space agencies. The Geo-synchronous Satellite Launch Vehicle (GSLV) has already completed its first successful flight and, after another successful test

At the panel discussion (left to right) - RV Perumal(ISRO), Dr. H Ramakrishna(BEL), Mr. Inderpal Singh(Godrej), Mr. P Ravindra Reddy(MTAR), Mr. G Madhavan Nair(ISRO), Dr. K Kasturirangan(Chairman ISRO), Mr. M Lakshminarayana(CII), Dr. PS Goel(ISRO), Mr. AK Saxena(HAL) and Mr. PM Mehta(L&T)

flight, it will also enter into operational service. Over the years, ISRO has established an elaborate infrastructure for design, development and launch of satellites and launch vehicles. An elaborate network of ground stations has been set up for telemetry, tracking and command operations for launch vehicles and satellites.

In the last three decades ISRO had 34 satellite missions and 15 launch vehicle missions. Today, the organisation has 9000 technical personnel who have expertise in various disciplines – Electronics, Computers, Control Systems, Mechanical, Materials, Chemicals, Aeronautics, Flight Dynamics, Telecommunication, Remote Sensing Applications, etc.

Since its inception, ISRO has closely interacted with the Indian industries in realising the various space systems and services. The ISRO industry association, which started at a modest level, has increased significantly over the years, especially, in the industry-intensive launch vehicle area. The space programme today has involved more than

Some of the technologies licensed to industries for commercialization

- Slip Rings.
- PARAS Software.
- Burst Modulator.
- MSS RT & Hub station.
- MSS RT & IF Demodulator.
- Mechatronic Hydraulic Valve.
- Automated Coating machine.
- Synchronous PC Add-on Card.
- Chromium black coating process for fabrication of precision optical masks.
- Opto-electronic apparatus for Static and Dynamic Measurements.
- PC based accessories for synchronous data transmission.
- Automatic Tensile Testing machine.
- L&C Band Quadrifiler helical antenna.

Confederation of Indian Industry (CII)

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the growth of industry in India, partnering industry and government alike through advisory and consultative process. It is a non-government, not for profit, industry led and industry managed organisation, playing a proactive role in India's development process. Founded over 100 years ago, it is India's premier business association, with a direct membership of over 4150 companies from the private as well as public sectors including SMEs and MNCs and indirect membership of over 50,000 companies from 200 national and regional sectoral associations.

CII catalyses change by working closely with government on policy issues, enhancing efficiency, competitiveness and expanding business opportunities for industry through a range of specialised services and global linkages. It also provides a platform for sectoral consensus building and networking. Major emphasis is laid on projecting a positive image of business assiting industry identity and execute corporate citizenship programmes.

With 30 offices in India and nine overseas (Australia, Austria, France, Hungary, Israel, Singapore, South Agrica, UK, USA and the tenth office in Hong Kong (SAR) to be operational shortly) and institutional partnerships with 191 counterpart organisations in 92 countries, CII serves as a reference point for Indian industry and the international business community.

Some of the technologies in the pipeline for transfer to industries

- Finite Element Analysis of Structure Software
- SPACELUBE (Solid Film Lubricants)
- Thermal Protection System
- Surface Acoustic Wave Filters and Delay lines
- Angular Motion Simulator
- Polyurethane foot
- Acramid dental prosthesis
- Software for production planning & control
- DSDB Receiver
- Electroplating/Surface finishing technologies
- Electroless Nickel Plating
- Dry Lubrication coatings

500 industries — small, medium and large scale — either through procurement contracts, know-how transfers or provision of technical consultations. Through its association with the space programme, the Indian industry is now in a position to meet greater challenges in terms of adopting advanced technologies or handling complex manufacturing jobs. Today a major part of the Indian space budget flows into the industry.

So far, 245 technologies developed under the Indian space programme have also been transferred to industries for commercial exploitation. These include software programmes, satellite services, mechanical and hydraulic components, testing machine, surface-coating machines and microwave components.

During the 10th Five Year Plan, ISRO plans to undertake 20 satellite missions and 16 launch vehicle missions besides a substantial developmental initiatives like those required for advanced GSLV versions (GSLV-MK III), microwave remote sensing and scientific missions. This will certainly open up new vistas for the Indian industries to participate in the Indian space programme on a much larger scale, either on individual industry basis or through a consortia. Industry participation in terms of taking up assembly, integration and even testing of satellites and launch vehicles systems is one of the potential areas for Indian industries to venture into in the near future. In this regard, ISRO has already adopted an industry participation policy that will enable realising higher levels of aggregates of hardware and software systems and services from industry. The policy also envisages use of production facilities in industry as far as possible and avoid investment for such facility, inhouse. It commits ISRO to buy-back hardware and components from industry on a long term basis, allow opportunities for use of ISRO facilities by industries, allow ISRO personnel to work in industry to take up R&D activities.

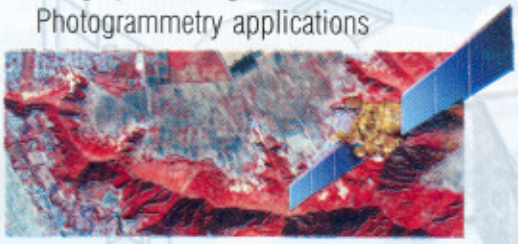
The Space-Industry Meet 2002 at Bangalore was aimed at identifying areas where industry participation could be enhanced for mutual benefit. In the plenary session held immediately after the inaugural function, the industry was appraised of the ISRO's satellite programme, satellite applications, launch vehicles programme and ISRO's industry policy. The activities of Antrix Corporation, the commercial front of ISRO were also highlighted. In the afternoon, parallel sessions were held on the following topics:

- Aerospace Engineering covering structures, propulsion stages, control systems, materials, chemicals and thermal systems.
- Avionics covering inertial systems, electronic fabrication, spacecraft integration, solar panels and batteries.
- Software systems for mechanical, electrical and thermal systems, flight dynamics, image analyses and vehicle & spacecraft checkout.
- Components & electro-optics covering spacecraft electronic parts, optical elements,etc.
- Ground systems covering launch infrastructure propellant processing, launch vehicle and spacecraft checkout systems, environmental facilities and ground stations.

OPPORTUNITIES FOR INDUSTRIES

Space-based Remote Sensing

- Hardware & software development for data processing/image analysis
- Fabrication, Test & Evaluation support for space & ground systems
- Data product generation & Value addition
- Image processing, GIS, GPS and Photogrammetry applications

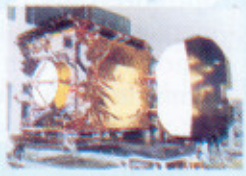


Space-based Communications

- Service Distribution to Cable TV Head End
- Internet Backbone and Service
- Long Distance Telephone
- Mobile Satellite Communication
- Vehicle Navigation
- DAB & DTH TV
- VSAT Network
- E-Commerce
- Distance Education
- Telemedicine
- Radio Networking

Satellite Hardware

- Spacecraft structure
- Antenna reflectors
- Solar panel substrates
- Spacecraft tankages
- Thrusters
- Optical payloads
- Inertial systems
  - Momentum Wheels
  - Solar array drive assembly
- Deployment mechanisms
- Electronic packages
- Transponders
- Multi layer insulation blankets (sq.m)
- Spacecraft batteries



Launch Vehicle Hardware

- Solid propellant motor segments
- Liquid engines
- Cryo components
- Control components
- Thrusters
- Gas bottles
- Interstages
- Propellant tanks
- Equipment bay

All the technical sessions were well attended by the relevant industries. At the end of the parallel sessions, a panel discussion was held which was chaired by Dr Kasturirangan. Suggestions were put forth for a closer interaction between ISRO and industry including use of ISRO's facilities by industry, formation of industry consortiums for optimum use of capacities and capabilities, policy framework to simplify procedure for framing out jobs to industry, etc.

As part of the ISRO-Industry Meet, an exhibition was also organised in which ISRO showed some of the hardware, that could be fabricated by industry. A few industries also displayed the hardware they are already fabricating for ISRO.

The Space-Industry Meet 2002 is an important step towards developing a strong space industry in the country that will meet the growing demand for space based services, especially in the areas of telecommunications, television broadcasting and its applications in emerging fields like tele-medicine, meteorological services, disaster management and remote sensing for resources monitoring.

GSLV Mk III Development Approved

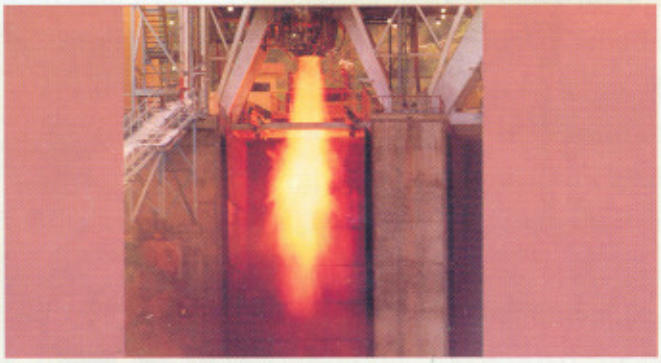
The Indian Government has given the go-ahead for the development of an advanced version of ISRO's Geo-synchronous Satellite Launch Vehicle, known as GSLV-Mk III, which will have a capability to launch four tonne satellites into GTO. The development will take about 6 years. GSLV-Mk III will be a three-stage vehicle with a 110 tonne core liquid propellant stage and strap-on stage with two solid propellant motors each with 200 tonne propellant. The upper stage will be a cryogenic stage with a propellant loading of 25 tonne. GSLV-Mk III will have a lift off weight of about 630 tonne and will be 42.4 m tall. The payload fairing will have a diameter of 5 meter and a payload volume of 100 cubic metre.

India has already commissioned the Polar Satellite Launch Vehicle (PSLV) which is being used to launch the Indian Remote Sensing Satellites in the 1000-1200 kg weight class into 800 to 900 km Polar sun-synchronous orbit. With six flights so far, PSLV is also offered for commercial launch services. It has already launched four foreign satellites – two German and one each of Belgian and Korean space agencies in the last two flights as piggy back payloads while the primary payloads were Indian remote sensing satellites. PSLV capability is constantly being upgraded. It is also being used for launching India's meteorological satellite, METSAT, weighing 1000 kg into geo-synchronous transfer orbit.

The successful maiden development flight of Geo-synchronous Satellite Launch Vehicle (GSLV Mark-I) on April 18, 2001 has demonstrated Indian capability to place satellites of 1500 kg class in GTO. This capability will be augmented to about 2000 kg progressively in the ensuing flights planned during 2002-2004 through GSLV Mark-II, which will employ the Indian developed Cryogenic stage.

The Government's approval for GSLV-Mk III signifies India's resolve to have commensurate launch capability for its heavier satellites to be launched in the coming years.

Cryogenic Engine Tested



Cryogenic Engine Test

The development of Cryogenic Upper Stage for ISRO's Geo-synchronous Satellite Launch Vehicle (GSLV) crossed an important milestone on March 30, 2002 with the successful test firing of the cryogenic engine for a duration of 12 minutes at the Liquid Propulsion Systems Centre (LPSC) Test complex at Mahendragiri in Tamil Nadu.

The turbo-pump fed regeneratively cooled cryogenic engine produces a nominal thrust of 7.0 tonne in vacuum. The test facilities have been established specifically to test the cryogenic engine, which comprise the feed systems for handling liquid oxygen and liquid hydrogen, instrumentation and data acquisition system with attendant safety devices. Several chill-down trials and simulation tests were also conducted before the actual hot firing of the engine.

Higher-performance Solid Motor for PSLV

An optimized version of solid motor for third stage of PSLV was successfully tested on March 30, 2002 at ISRO's SHAR Centre, Sriharikota. This is the second consecutive test of the 2-meter diameter composite third stage motor. The motor has optimized motor case and nozzle as well as increased propellant loading. The motor has a nominal burn time of 112 seconds and a maximum sea level thrust of 19 tonnes.

During the test, about 270 parameters like pressure, strain, temperature, displacement, vibration etc., were monitored.

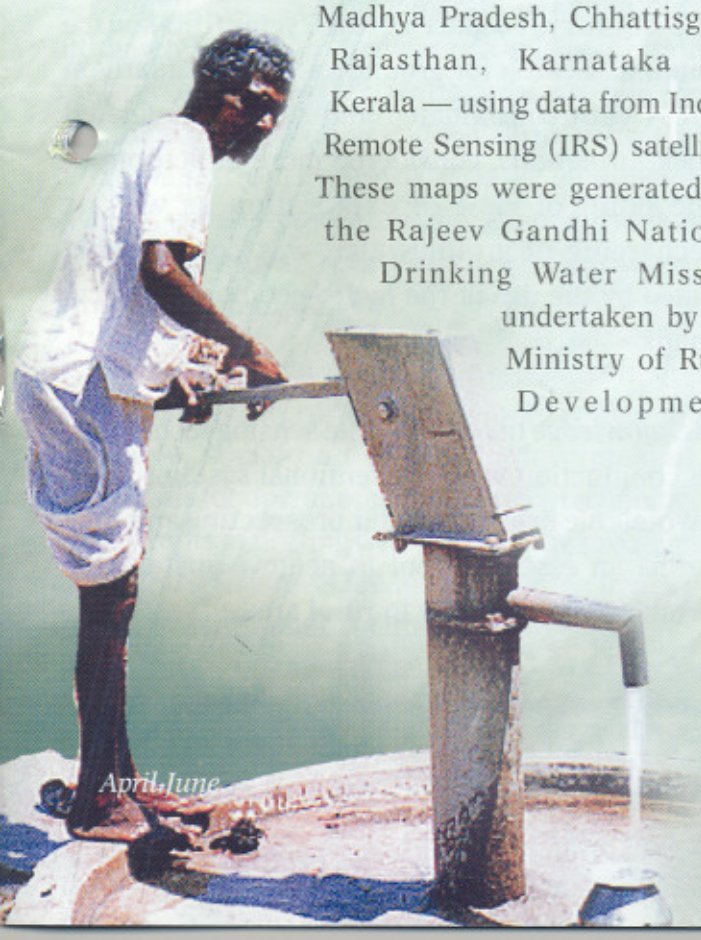
The new motor is expected to increase the payload capability of PSLV by about 70 kg. The motor will be used in the next PSLV flight (PSLV-C4) to launch ISRO's METSAT into a Geo-Synchronous Transfer Orbit (GTO) mission.

PSLV Higher-performance Solid Motor Test

Groundwater Prospect Maps from IRS Data

Mr. M Diwakar Babu, Mr. Srinivasa Reddy, Mr. N Chandrababu Naidu, Mr. M Venkaiah Naidu, Mr. Digvijay Singh, Dr. K Kasturirangan and Dr. R R Navalgund

The National Remote Sensing Agency (NRSA), Hyderabad has compiled Ground Water Prospects Maps for six States – Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Rajasthan, Karnataka and Kerala — using data from Indian Remote Sensing (IRS) satellites. These maps were generated for the Rajeev Gandhi National Drinking Water Mission undertaken by the Ministry of Rural Development.



The Minister for Rural Development Mr M Venkaiah Naidu released the maps to the six states at a function held on June 11, 2002 at NRSA, Hyderabad. Mr N Chandrababu Naidu, Chief minister of Andhra Padesh and Mr Digvijay Singh, Chief Minister of Madhya Pradesh were the guests of honour. Dr K Kasturirangan, Chairman, ISRO presided. Dr R R Navalgund, Director NRSA welcomed the gathering. Mr Digvijay Singh, Chief Minister of Madhya Pradesh, Mr Srinivasa Reddy, Minister for Rural Development, Andhra Pradesh, Mr M Diwakar Babu, Minister for Rural Water Supply, Karnataka, Mr T M Jacob, Minister for Water Resources, Kerala and Mr Gangaram Baghel Minister, P.H.E.D, Chhattisgarh received the maps from Mr M Venkaiah Naidu for their respective states. Mr U M Bhandari, Sr. Geologist Ground Water Department, received the maps for Rajasthan.

Pledge for Using Remote Sensing for Ground Water Prospecting

During the function organised at NRSA, Hyderabad, for releasing the Ground water prospect maps for the six states, a declaration was adopted by the participating agencies to use Groundwater Prospecting for Sustainable Rural Drinking Water Supply. The declaration reads as follows:

Hyderabad Declaration on Remote Sensing Applications Towards Groundwater Prospecting for Sustainable Rural Drinking Water Supply

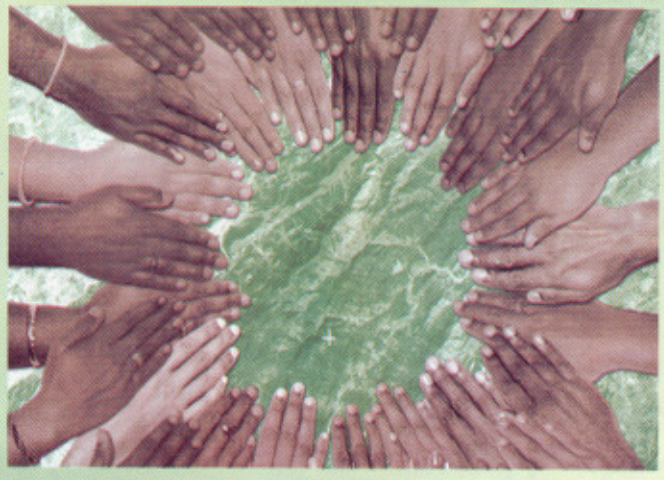
Whereas, We the Minister of Rural Development, Government of India; the Chief Ministers of Andhra Pradesh and Madhya Pradesh; the Ministers from the State Governments of Andhra Pradesh, Chhattisgarh, Karnataka and Kerala; the Chairman, Indian Space Research Organisation (ISRO)/Secretary, Department of Space; and Secretary, Department of Drinking Water Supply, Ministry of Rural Development; participated in the National Workshop on Remote Sensing Applications for Groundwater Prospecting under Rajiv Gandhi National Drinking Water Mission (RGNDWM) project, held in Hyderabad on June 11, 2002;

Whereas, we recall the address of the President of India to the joint sitting of both Houses of Parliament that the Department of Drinking Water Supply in the Ministry of Rural Development will implement a programme to provide clean drinking water to all villages in the next five years. The Nation is committed to provide safe drinking water facilities to all the rural habitations in the country. The strategy to achieve this ambitious plan revolves around the following three distinct but inter-related issues:

- Accelerating the **coverage** of remaining 'Not Covered' and 'Partially Covered' habitations with safe drinking water systems.
- To tackle the problems of water quality in affected habitations and to institutionalise water **quality** monitoring and surveillance systems.
- To promote **sustainability**, both of systems and sources, for ensuring continued supply of safe drinking water in covered habitations.

Recognise that remote sensing based hydro-geomorphological maps prepared under the Rajiv Gandhi National Drinking Water Mission, during eighties, have been the major source of information that helped immensely in locating prospective groundwater sites around problem habitations in the country, as part of the 'scientific-source finding'. Search for groundwater, particularly in areas with consolidated and semi-consolidated rock formations, considered more difficult from the point of view of exploration as well as recharging of groundwater, was considerably aided by the use of the hydro-geomorphological maps;

Acknowledge that the remote sensing technology in conjunction with conventional systems plays pivotal role in groundwater prospecting and thus forms an essential tool to achieve sustainable drinking water supply in rural areas;



Hereby affirm that we

1. **emphasise** the essential role of remote sensing applications to groundwater prospecting in terms of identifying suitable sites for groundwater targeting and recharge;

2. **agree** that it is essential to use remote sensing applications to groundwater prospecting as a part of rural drinking water projects in the country;

3. **agree** that there is an urgent need to institutionalise the appropriate mechanisms for accelerating the use of remote sensing technology applications in the field of groundwater prospecting to achieve sustainable rural water supply;

4. **commit** ourselves to generate dynamic data ultimately leading to highest possible resolution so that each aquifer underground can be identified on the ground and to institute effective implementation, monitoring and evaluation systems, which would internalise the use of remote sensing inputs related to groundwater prospecting; and

5. **share** the vision for providing safe drinking water facilities in rural areas for achieving more equitable, social and economic development, which calls for operational use of space technology applications in dealing with some of the problems at the grassroots level facing the country, in order to improve the quality of life.

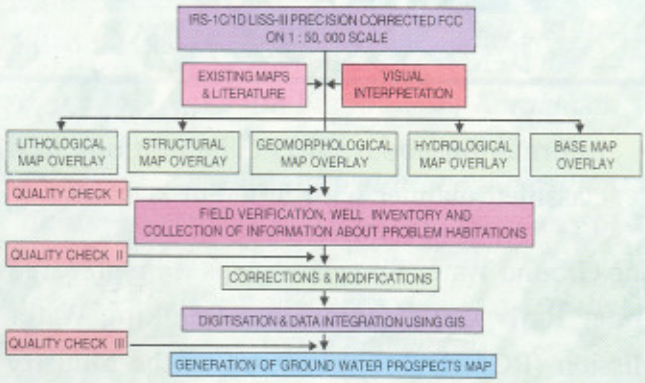
The maps contain the following details:

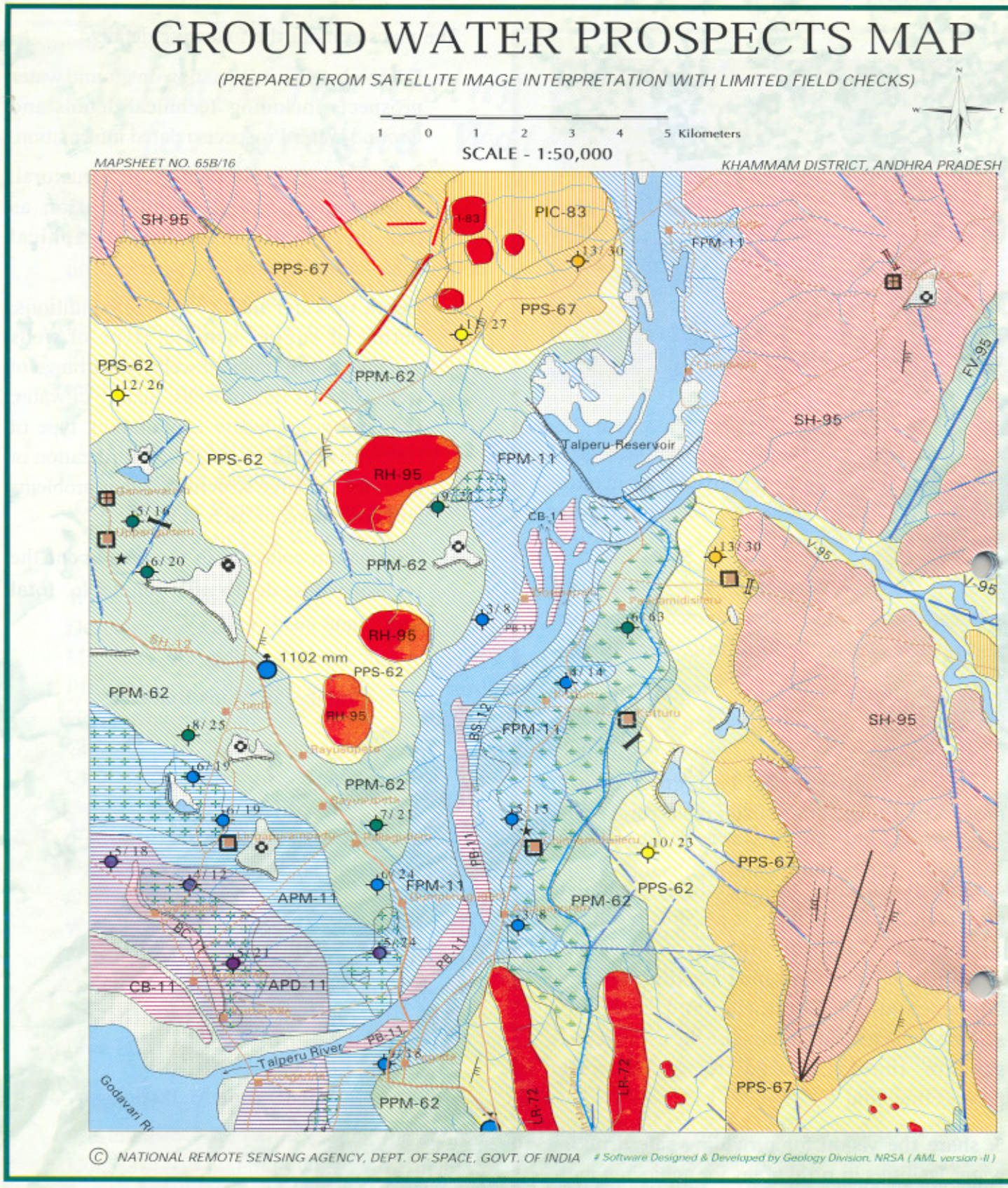
- Comprehensive information on ground water prospects including Technical details and Ground Water Prospects related information.
- Geological, Geo-morphological, Structural, Hydrological and Base information as five layers integrated in Geographical Information System.
- Depth of water table, recharge conditions, nature of aquifer material, type of wells suitable, depth range of wells, yield range of wells, success rate of wells, quality of water, status of groundwater exploitation, type of recharge structures suitable, prioritization of areas for recharge structures, other problems and limitations in each unit.
- Information collected in the field about the type of wells, depth of water table, total depth, and yields etc.

Number of Maps Released

Andhra Pradesh	244
Madhya Pradesh	458
Chhatisgarh	202
Rajasthan	491
Karnataka	267
Kerala	61
Total number	**1723**

Map Generation Methodology





- Information about NC/PC habitations in a classified manner with different symbols.

The Ground Water Prospects maps were prepared under Rajiv Gandhi National Drinking Water Mission (RGNDWM) sponsored by the Ministry of Rural Development. These maps are prepared by integrating the data derived from IRS satellites with ground survey data using Geographic Information System (GIS). The entire information is available in GIS database, which can be easily

Colour & Code	Groundwater prospects
BC-11	Very good scope for ground water development. Recharge structures not required.
CB-11	Very good scope for ground water development. Recharge structures not required.
PB-11	Suitable for further Ground water development. Casing is required.
APD-11	Suitable for further Ground water development. Casing is required.
APM-11	Further ground water development is suggested. Casing is required.
FPM-11	Further ground water development is suggested. Casing is required.
BS-12	Suitable for development
LR-72	Run-off Zone
PPS-67	Shale acts as aquiclude. Fracture zones are favourable.
PPM-62	Yields are uniform due to homogeneity. Fracture zones are favourable
PPS-62	Yields are uniform due to homogeneity. Fracture zones are favourable
FV-95	Highly Suitable for ground water development
V-95	Suitable for ground water development
RH-95	Run-off Zone
SH-95	Mainly run-off Zone. Prospects limeted to Fracture zones only
PIC-83	Inselbergs acts as run-off zone. Pediments parts are suitable for development.
I-83	Run-off Zone

Recharge structure

updated, edited, revised, transferred and integrated with other data sets for generating derivative maps and information. These maps are useful for narrowing down the target zones for selection of sites for drilling new wells based on follow-up ground surveys and prioritization of zones and identification of areas for planning recharge structures to improve the sustainability of drinking water sources. The maps will help the concerned departments for selection of well sites and planning recharge structures.

The maps also provide other technical data, useful for ground water resource estimation, budgeting, systematic development and management of ground water resource.

Rajiv Gandhi National Drinking Water Mission (RGNDWM)

Government of India and State Governments have attached great importance to provide safe drinking water to the rural areas ever since the first Five Year Plan. Momentum to this initiative was given by launching an Accelerated Rural Water Supply Programme program in 1972-73 to assist the State Governments and Union Territories to accelerate the pace of coverage of drinking water supply. Further, this programme was adopted as a Technology Mission on Drinking Water and related water management called the "National Drinking Water Mission (NDWM)" in 1986, which was renamed as ***Rajiv Gandhi National Drinking Water Mission (RGNDWM)*** *in 1991.*

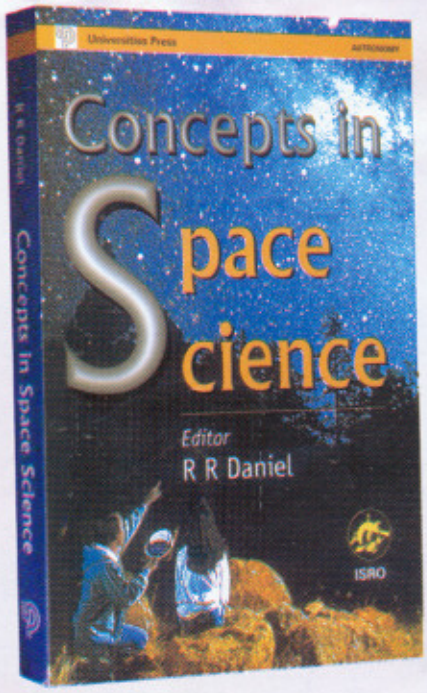
In order to achieve the objective of providing safe drinking water to all habitations by March, 2004, a separate Department of Drinking Water Supply was created in the Ministry of Rural Development in 1999. Till the end of November 2001, 87.89 percent habitations in the country have been provided access to adequate water (fully covered) with 40 litres per capita per day (lpcd). About 10.85 percent are partially covered and remaining 20,000 habitations are yet to be covered.

Department of Space (DOS) has undertaken a project for preparation of ground water prospects map on 1:50,000 scale using high resolution IRS satellite data (LISS-III data) for the RGNDWM. Under this project, maps are to be prepared for six states — Andhra Pradesh, Karnataka, Kerala, Madhya Pradesh, Chattishgarh and Rajasthan to find scientifically, source of drinking water for the 1.2 lakh non-covered and partially covered habitations.

A book to kindle the interest of students

Concepts in Space Science

At a brief function organised on May 31, 2002 in Bangalore, Dr K Kasturirangan, Chairman, Indian Space Research Organisation, released a book "Concepts in Space Science", edited by Prof R R Daniel. Dr H Narasimhaiah, President, National Education Society, Bangalore presided over the function.



The publication of the book was supported by ISRO as part of its effort to popularize Space Science, especially, among the student community. "Concepts in Space Science" is targeted at students at higher secondary and undergraduate level but is certainly interesting for all those who want to know the nuances of conducting scientific research in space. The articles for the book have been contributed by eminent scientists both in India and abroad. It has been written in a simple language and style. It is a unique book that covers a variety of topics. It starts with the chapter `Space — The Exciting Scientific Frontier' authored by Prof R R Daniel and Dr B V Sreekantan. The other topics bring out the stunning discoveries made in space sciences, especially, in the last century, and the opportunities and challenges it holds for the future. It conveys to the readers the excitement of conducting scientific research in space environment in varied disciplines like earth observation, solar systems, stars and galaxies, material science, human physiology in micro-gravity, astro-biology and extra-terrestrial life. Each one of the topics is dealt with in such a way as to kindle the interest of the readers. The book also has several illustrations including colour pictures.

The editor, Prof R R Daniel is a physicist having researched in cosmic rays and high energy astronomy. He did his research at the Tata Institute of Fundamental Research and, later, he was the Scientific Secretary of International Council of Scientific Union (ICSU) Committee on Science and Technology in Developing Countries. He was the first Chairman of the ISRO's Advisory Committee on Space Science and a member of the international Committee on Space Research (COSPAR) Bureau. He was also the first Chairman of the National Committee for the International Geosphere, Biosphere Programme (IGBP).

The book 'Concepts in Space Science' has been published by the Universities Press and distributed by Orient Longman Private Limited.

research, search, reach

ISRO Gets New Identity

ISRO has got a new identity with the adoption of a logo. The ISRO logo is a vibrant dynamic unit, which has a lot of energy and vitality. It is simple and direct in its appeal and explains the objectives and aspirations of ISRO in its essence.

The core of ISRO's research activities are of satellites and launch vehicles. The satellite is depicted in the logo through the two solar arrays providing energy. The pointed arrow, reaching upwards, signifies the launch vehicle for exploring new heights, searching the realms of space. It also visually depicts the upward mobility of ISRO. The arrow shooting upwards can break all barriers, be it of gravity or of mindsets.

The type sets are the Devnagari script and English. The English font is a stylised one called Prakrta resembling the Devnagari script to create a balance in the design. The Devnagari font has been created especially for the ISRO logo. The look and feel of the logo is totally Indian due to usage of these fonts.

In summary, the logo unit depicts the ambitions and aspirations of ISRO in the realm of space. It depicts the conquering of space and establishment of space systems for harmonious peaceful applications benefiting humanity.

What the Colours Represent

Orange: energy, attraction, self-control, organisation, self esteem, warmth, adaptability, vitality, joy, kindness, alertness, creativity, harvest, maturity.

Blue: healing, relaxation, peace, truth, wisdom clarity of expression, serenity, meditation, harmony calm devotion, spiritual understanding, introspection.

Industrialists expressing keen interest in the space hardware at the exhibition during space industry meet