

CHAPTER 13

SCIENCE AND TECHNOLOGY

Science and Technology (S&T) have long been recognized as the motive force behind economic development and the rising living standards of the people and have in the process become so deeply embedded in the life of the people that none of the human activities can be said to be devoid of the developments in the field of Science and Technology. The developments in S&T have helped to overcome many of the problems faced by the mankind including eradication of some of the important communicable diseases, food and energy shortages etc. Today, however, with the advancement in S&T, many newer problems have posed greater challenges to the scientific community. Keeping pace with the developments, that have taken place in the field of S&T, across the globe, India has made significant progress in the various spheres of science and technology. S&T programmes during the Tenth Five Year Plan have been focused to strengthen application oriented research and development activities for technology generation; promote human resource development, especially attracting the brightest young students to take up science as career; encourage research and application of S&T for forecasting, prevention and mitigation of natural hazards particularly floods, cyclone, earthquakes, droughts and landslides etc.; integrate the developments in science and technology with all sphere of national activities; and harness them for improving livelihood, employment generation; environment protection and ecological security. All the schemes of various central scientific departments/agencies were subjected to Zero-Based Budgeting (ZBB) while formulating the Annual Plan 2003-04 and have been re-oriented in line with the Tenth Five Year Plan approach and policy. The ZBB exercise has not only helped in focusing the activities of these departments/agencies to avoid thin spread of scarce resources, but also in streamlining the funding mechanism by introduction of system of project based funding. Recognizing the changing context of the scientific enterprise, and to meet the present national needs in the new era of globalization, the "Science and Technology Policy – 2003" was announced by the Government. The vision of "Science and Technology Policy – 2003" is to build a new and resurgent India that continues to maintain its strong, democratic and spiritual traditions, that remains secure not only militarily but also socially and economically. The policy will be implemented so as to be in harmony with the world view of the larger human family all around and to ensure that S&T truly uplifts the Indian people and indeed all of humanity. Salient features of the achievements of various central scientific departments/agencies during the Annual Plan 2002-03 and the programmes/activities envisaged during the Annual Plan 2003-04 have been highlighted in the following paragraphs.

DEPARTMENT OF ATOMIC ENERGY (R&D SECTOR)

Review of Achievements during the year 2002-03

2. Department of Atomic Energy (DAE) pursues its mandate of harnessing energy from atom through all its five R&D units and 8 aided institutions. It also provides extra mural funding for research through Board of Research in Nuclear Sciences (BRNS). Under the Nuclear Power Programme – Stage-I, Bhabha Atomic Research Center (BARC) carried out several activities as a part of R&D support to the Pressurised Heavy Water Reactor (PHWR) programme. On a request from the International Atomic Energy Agency (IAEA), BARC extended the expert services of scientists along with the state-of-the-art in-house developed Aerial Gamma Spectrometry System (AGSS) and Survey Monitors to locate orphan radiation sources in Georgia. Superiority of indigenously developed AGSS at BARC compared to those offered by the advanced countries and the technical competence of BARC scientists has been highly acclaimed by both IAEA as well as the Ministry of Environment, Georgia.

3. Under the Nuclear Power Programme – Stage-II, Steam Generator Test Facility set up for the fast reactor was commissioned. Mark-I mixed carbide fuel with high plutonium content, developed at BARC for the first time in the world has enabled Fast Breeder Test Reactor (FBTR) at Indira Gandhi Center for Atomic Research (IGCAR), Kalpakkam to cross the desired burn up level. India is the only country in the world, using mixed Plutonium-Uranium (Pu-U) carbide fuel, and attaining this milestone, which demonstrates its competence in this high technology area.

4. As a part of the Nuclear Power Programme - Stage –III, engineering development activities related to Advanced Heavy Water Reactor (AHWR) Project were continued at BARC. The project report for setting up of a 300 MW(e) AHWR has been completed and is being subjected to a peer review. Detailed engineering of the fuel handling system and design validation of passive system are in progress. Studies are in progress to evolve a process flow sheet for the reprocessing of AHWR spent fuels. A new reprocessing facility at Trombay (Uranium Thorium Separation Facility) has become operational in August 2002 to separate Uranium –233 (U-233) from irradiated thorium fuel on a plant scale. This has established yet another vital link in the fuel cycle activities in India and the availability of U-233 will provide access to virtually inexhaustible source of energy from thorium in the country. For breeding fissile U-233 from thorium, development of Accelerator Driven Sub-Critical Systems (ADSS) for nuclear reactor is the latest addition to the nuclear power programme, and a broad road map for ADSS development has been prepared.

5. In the field of Radiation Technologies & Applications, the 40-year-old CIRUS reactor was re-commissioned after completion of the refurbishing work, giving a new lease of life to the reactor. Plutonium–236 (Pu-236), an important tracer for the environmental and biological studies, has been successfully produced for the first time. In the field of Nuclear Agriculture, a new large seeded confectionery variety of groundnut mutant has been added this year by BARC. A facility for low dose radiation processing of onions, named as "KRUSHAK" - KRUSHI UTPADAN SANRAKSHAN KENDRA, was commissioned by BARC at Lasalgaon, Nashik District, Maharashtra. Under the health care program, BARC has established a Medical Cyclotron coupled to a Positron Emission Tomography (PET) scanner at Radiation Medicine Centre (RMC), Parel for supplying F-18 labeled radio pharmaceutical 'Fluoro Deoxy Glucose' (FDG) for the first time in the country for diagnostic purposes. In addition, a vital myocardial blood flow imaging agent was developed and the technology of radiation-processed hydrogel for treating burn wounds and leprosy was transferred to the users. For the first time in the country, a 3D Cone Beam Tomography system has been developed by BARC for industrial and strategic applications with exceptionally high resolution. The first phase of inducting superconducting linear accelerator (LINAC) boosters has been successfully tested with Silicon beam, jointly by BARC and Tata Institute of Fundamental Research (TIFR) and has established the indigenous capability in the field of advanced accelerator technology based on superconductivity.

6. In the field of basic research, BARC has achieved a significant milestone by developing a 64 node Anupam P-IV parallel super computer giving a sustained speed of 72 giga flops (Floating Point Operation Per Second). Software verification tools for verifying critical softwares for Light Combat Aircrafts (LCA) have also been developed. Saha Institute of Nuclear Physics (SINP) has set up a National Facility for High Current Isotope Separator to provide enriched isotopes along with ion implantation. At the TIFR's National Centre for Biological Sciences, Bangalore, a detailed study of molecular regulation of apoptotic mechanisms in T-cell development has been the major hallmark. As a part of continuing research work on cancer, an Advanced Centre for Treatment, Research and Education of Cancer (ACTREC) has been set up at Navi Mumbai. Construction work of the buildings is nearing completion. At the Center for

Advanced Technology (CAT), Indore, major works relating to Studies of High Temperature High Density Plasmas produced with lasers and operation of the multibeam Neodymium:glass laser chain have been completed. Nickel-titanium-iron shape memory alloy components developed at BARC have passed all the stipulated airworthiness tests and have been successfully used in the light combat aircraft (LCA) test flights. Aeronautical Development Agency has accepted the supply of these components for several aircrafts.

7. The major projects supported by Board for Research in Nuclear Sciences (BRNS) included 'Advanced Seismic Test Facility' at the Structural Engineering Research Centre, Chennai, and 'Application of Radiation and Radiotracer Techniques in Agricultural Research and Multi-location Testing of BARC Crop Varieties' at Jawaharlal Nehru Krishi Vishwa Vidyalay (JNKVV), Jabalpur. A gamma scintillation camera was installed by BRNS at the Bombay Veterinary College (BVC), Mumbai. This center, first of its kind in Asia, will provide diagnostic facility for various animal diseases.

Major programmes for the year 2003-04

8. During the Annual Plan 2003-04, development of critical equipments like cold box, cryo heat exchangers, Helium compressor for 1 KW refrigeration machine, turbo expanders etc. required for enhancing the safety of PHWRs and allied facilities, will make further progress. Civil works for the setting up of experimental facility for studying light water reactors will be in advanced stage. Procurement of various systems/components will commence for Health Safety & Environment programme that is geared towards assuring radiation safety of the occupational workers and public residing in the vicinity of any nuclear installation. The facility for the removal of uranium from High Level Waste (HLW) and demonstration of actinide partitioning will be erected at Waste Immobilisation Plant (WIP), Trombay. Prototype for cold crucible will be set up for code validation and design verification and development/procurement of high frequency induction power supply will be initiated.

9. The operation of FBTR will be continued and the reactor power would be further raised with a view to reach nominal power level in a phased manner. Procurement of equipment for characterization of Plutonium based fuels will be taken up by BARC and refurbishment of FBTR fuel pin production facility will be taken up. Validation of design of Prototype fast Breeder Reactor (PFBR) and Civil, electrical and works related to air-conditioning & ventilation etc. for augmentation of facilities for Plutonium based fuels will be completed during the Annual Plan 2003-04. Equipment installation for developing fabrication & reprocessing methods for Plutonium & Thorium based fuels will also be taken up.

10. The Engineering development activities for AHWR (Nuclear Power Programme – Stage-III) will be completed and the civil works for facilitating reactor physics experiments, needed to confirm the design of AHWR and 500 MWe PHWR, would be continued. Detailed engineering for developing reactor core of advanced reactors will be completed and the design and development work on inspection cum rehabilitation system for Heavy Water Reactors will be taken up at BARC. As a part of Thorium Fuel Cycle development programme, the R&D activities for development of co-processing and co-conversion flow sheets for reprocessing AHWR fuels and U-233 cleanup work will continue at BARC, besides commencement of design and procurement of equipment/components for development of advanced nuclear reactors. Studies on development of materials vital for Nuclear Power Programme Stage-III, like, thorium alloys, inter metallics & compounds, and refractory metal alloys will also be taken up at BARC.

11. Center for Advanced Technology (CAT) will be engaged in the design of normal conducting as well as superconducting proton LINAC for the High Current Proton LINAC & Synchrotron, besides, completion of Semiconductor Laser project and taking up activities

relating to Radiation Processing Facility, development of Self Shielded Accelerator for industrial purpose, and Industrial Applications of CO₂ Laser. Under the Accelerator Programme Expansion, it is expected that all the components and sub-systems of INDUS-2 would be developed and assembly of Indus-2 Storage Ring would be completed. Fabrication of the plasma chamber, magnets and other vacuum components will be undertaken at the Variable Energy Cyclotron Center (VECC), Kolkata with the procurement of Power Supplies, and Ion source assembly.

12. In order to promote Research Education Linkage, a Centre for Knowledge-based Engineering would be set up in collaboration with University Institute of Chemical Technology (UICET) to carry out and develop reliable design and scale up procedures to improve the existing nuclear, chemical, refining and bio-chemical plants/processes. SINP would be setting up physics and biology laboratories for undergraduate and graduate students and an advanced experimental hands-on workshop for graduate students.

DEPARTMENT OF BIOTECHNOLOGY

Review of Achievements during the year 2002-03

13. Some of the significant achievements of the Department of Biotechnology during the Annual Plan 2002-03 include: establishment of Nuclear Magnetic Resonance (NMR) facilities at TIFR, Mumbai and Indian Institute of Science (IISc.), Bangalore jointly with other Science Departments for structural studies on components and molecules and important drug design; Bio-resource Development Unit for conservation, characterization and sustainable utilization of plant and microbial resources of Western Himalaya; Butterfly park at Bangalore; Aerosol facility for challenging animals to develop tuberculosis vaccine; Supercomputing facility for in-silico studies in genomics, proteomics and drug design at IIT, Delhi; and Micro-array facilities at Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad and National Brain Research Centre (NBRC), Gurgaon. Microbial Type Culture Collection Facility at IMTECH, Chandigarh was notified as International Depository Authority by World Intellectual Property Organization (WIPO) in October 2002 under the Budapest treaty. Under the Human resource Development Programme, support was extended to M.Sc. course at Pune University, M.Tech at IIIT-Allahabad, PhD at JNU and one more Post-M.Sc. Diploma course for development of high quality human resource in biotechnology.

14. With the completion of a high quality draft sequence of rice genome under the International Rice Genome Sequencing Project (IRGSP) announced in December 2002, Indian scientists have completed the international obligation in the record time of 2¹/₂ years. Several significant leads have been obtained in germplasm characterization and linkage analysis of coffee. Biodiversity characterisation through remote sensing was completed for North East, Western Ghats and Western Himalayas and a Web enabled database & maps on spatial and landscape level information was prepared and launched online during the science congress-2003. A network project on development of efficient strains of biofertilisers through transgenesis has been launched at 11 centres.

15. In the areas of vaccines and diagnostics, development of DNA probes for tuberculosis, vaccine for Japanese encephalitis and PCR-based immune diagnostics for tuberculosis were in advanced stages of validation and/or technology transfer. Recombinant cholera vaccine is likely to complete extended phase-I clinical trials. Efforts were also made for initiating dog and human trials with DNA rabies vaccine. Indo-US Vaccine Action Programme (VAP) was extended for five years from August, 2002 to July, 2007. Phase-I clinical trials of rotaviral diarrhoea vaccine, and pre-clinical evaluation of vaccines for HIV, malaria and Japanese encephalitis etc. were initiated.

16. Major programme on genomics, covering expression profiling, structural and computational genomics and proteomics was initiated at IISc, Bangalore. A mission-mode programme has also been initiated on food and nutritional security. A technology for growing human lens epithelial cells has been developed, which has the potential in the development of anti-cataract drugs and therapies. Diagnostic kit for detection of pathogens in the young tea plant roots and bio-formulations for better yield of tea have been developed at University of North Bengal, Siliguri. Lucknow city has been declared as 'Biotechnology City'. In order to generate awareness on the importance of Intellectual Property Rights (IPR) in biotechnology, seminars and refresher courses were organized in collaboration with WIPO. Center for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad signed MOUs with State/Central Forensic Science laboratories to popularize DNA fingerprinting technology. National Brain Research Center (NBRC) has completed some of the construction activities and has shifted its interim laboratories to the new facility and the centre has been recognized as a Deemed University by the UGC.

Major programmes for the year 2003-04

17. During the Annual Plan 2003-04, efforts would be made to generate innovative technologies to meet the Indian needs and to preserve, protect and add value to India's indigenous resources, its vast biodiversity and rich traditional knowledge. International collaboration will be further strengthened for technology upgradation and enhancing competitiveness. In the area of Human Resource Development, support would be extended to six new post graduate teaching programmes, post M.D. /M.S training course and diploma in specialized subject areas. Some Distributed Information Centres (DICs) under the Bio-informatics programme would be upgraded into centres of excellence for undertaking advanced research and for conducting M.Sc./Ph.D programmes in Bioinformatics. Establishment of centers of excellence on bioresources and programmes to create awareness on bioresources at different levels in society would also be continued.

18. In the areas of plant biotechnology, collaborative programmes relating to functional genomics of rice and other cereals involving development of molecular markers and genes; biotechnology for improvement of semi-arid crops and other crops; post harvest biotechnology for improved shelf life; micro-propagation, genomics and biotransformation of medicinal and aromatic plants for conservation and sustainable utilization; etc. would be undertaken. Under environmental biotechnology, national facility of endangered animal species like tiger, lion, etc. will be jointly supported with other S&T agencies, besides undertaking a network programme on steel industry waste treatment.

19. In the area of vaccines and diagnostics, development of improved vaccines and diagnostics for major emerging diseases; molecular characterization and upgradation of indigenous animal breeds and their genetic diseases; and transgenics in large farm animals for expression of new genes and production of novel proteins; etc. would be continued. DNA rabies vaccine and Cholera vaccine are expected to complete all the evaluation and trials and are expected to be commercialised, specially the DNA rabies vaccine for animals. The Malaria, Rota viral and HIV vaccines will enter phase-I trials and activities relating to evaluation, clearances and commercialisation of Anthrax vaccine are also expected to be completed. Programmes for development of diagnostic molecular tools for infectious diseases, drugs through combinatorial chemistry and high screening throughput, detection and management of respiratory infections, basic research on diarrhoeal diseases, sequencing and molecular typing of infectious agents, neuro-degenerative diseases, edible vaccines, reproductive human health and contraception, etc. would be initiated in the field of medical biotechnology.

20. Among the autonomous institutes, the National Institute of Immunology (NII), New Delhi, would be taking up activities relating on signal trans-direction, upgradation of electron/scanning trans-microscope facility, and construction of staff quarters etc., besides continuation of research in major areas of interest. At the National Center for Cell Sciences (NCCS), Pune, activities of cell repository, human resource development and R&D on transgenic mice, proteomics and exploitation of micro-array technology for understanding of disease and immune response will be continued. NBRC, Gurgaon and National Center for Plant Genomic Research (NCPGR), New Delhi will continue construction and the research activities as per their mandate. The Institute of Bioresources and Sustainable Development (IBSD) is likely to be fully operational. Institute of Life Sciences, Bhubaneshwar would be taking up research activities in biomedical sciences, infectious diseases, cancer and plant sciences.

OCEAN SCIENCES

Review of achievements during the year 2002 – 2003

21. The XXI Indian Scientific Expedition to Antarctica was launched from Cape Town, South Africa for undertaking new scientific experiments such as: monitoring of green-house gases and radiation at Maitri and boundary-layer at ice-air-ocean interface over the India Bay; surface isotopic variation and mixing in the fresh snow in Antarctica; sedimentological studies of glacial sediments in Schirmacher Oasis; and hydrographic surveys in the Antarctic waters. R&D projects in the field of Polar Remote Sensing in collaboration with Space Application Centre (SAC), Ahmedabad were also initiated. Under the Polymetallic Nodules (PMN) Programme, resource assessment survey of nodules using multi-frequency exploration system was carried out at a closer grid of 5 km in selected marginal blocks. Updating geo-statistical resource evaluation in selected blocks was also taken up. A mining system capable of operating at 6,000m depth with a capacity of 25,000 tonnes/year was designed jointly by National Institute of Ocean Technology (NIOT) and University of Siegen, Germany and a pilot plant to process at 500 kg/day polymetallic nodules for extraction of metal values from nodules was commissioned at Hindustan Zinc Limited (HZL), Udaipur.

22. Under the Ocean Observations and Information Programme 20 data buoy network was established by deployment of 8 multi parameters buoys in the coastal and deep waters of seas around India. 12 ARGO (Array of Global Geo-strophic Oceanography) Profiling floats were deployed in the northern Indian Ocean for real time acquisition of temperature and salinity profiles up to a depth of 2000m periodically for every 10 days. A set of eight fully indigenously built buoys was deployed in the Arabian Sea and Bay of Bengal. In addition, 10 drifting Buoys, 300 Extended Bathy Thermographs (XBTs) and 3 current meter arrays were deployed and surface meteorological data were collected in 5 cruises as a part of sea truth campaigns for validation of Remote Sensing Satellite IRS-P4 sensors. Integrated Potential Fishing Zone (PFZ) advisories were provided to the fishing community in a mission mode, using Ocean Color Monitor (OCM) of IRS-P4 and Sea Surface Temperature (SST) from Advanced Very High Resolution Radiometer (AVHRR). Several innovative steps have been taken to make this information a part of the value chain of the fishing community. A MOU was signed by 19 Organizations from 10 Countries in the Indian Ocean Region to create and actively participate in a regional alliance of Indian Ocean Global Ocean Observing System (IOGOOS)

23. Under the Integrated Coastal and Marine Area Management (ICMAM) programme, a prototype Decision Support System (DSS) for Chennai has been developed as a stand alone package. Training programmes on ICMAM and application of GIS for critical habitats were conducted for different stakeholders such as the Coastal States/Pollution Control Boards, academic institutions, etc. Data collection relating to hydrodynamics, water quality and

biological parameters was carried out, for two seasons, to determine No Impact Zone in Pulicat Lake in Tamil Nadu and Coringa in Andhra Pradesh

24. National Institute of Ocean Technology (NIOT) conducted several tests on the Ocean Thermal Energy Conversion (OTEC) system as a part of pre-commissioning tests/ trials. The necessary hazardous installation studies were also conducted and emergency procedures were evolved. A Reverse Osmosis based desalination plant with a capacity of 10,000 litres was established at wave energy plant and experiments were conducted to check the speed of the turbine and output voltage from the alternator.

Major programmes for the year 2003-04

25. During the Annual Plan 2003-04, the activities under polar science would be relating to planning, co-ordination and execution of the XXII Indian Scientific Expedition to Antarctica and to undertake a multi-institutional and multi-disciplinary cruise of about 100 days duration in the Southern Ocean by chartering an ice-class vessel with facilities for acquisition of oceanographic data and retrieval of sediment cores. Under the Polymetallic Nodules Programme, survey would be carried out along the selected profiles using multi-frequency exploration system, for identifying and validating the trends of higher abundance of nodules at the retained area at Central Indian Ocean Basin (CIOB). Underwater mining system would be deployed for collecting manganese nodules, besides development of collector, crusher and associated subsystems.

26. Under the Ocean Observations and Information Programme, the Indian Ocean ARGO Programme would be continued for deployment of 30 ARGO floats to acquire temperature-salinity profiles on near real time basis. Pilot scale study of Experimental Ocean State Forecast would be carried out, besides initiation of Semi-operational Ocean State Forecast to cater to the needs of potential users. Under the Coastal Ocean Monitoring and Prediction System (COMAPS), periodically exercises for data collection on chemical and biological pollution and other parameters, intensive monitoring of hot spots, and modeling of movement of pollutants in the coastal waters of selected locations, would be continued.

27. Preparation of base maps and integration of satellite data with the base maps in Geographical Information System (GIS) for 3 Critical Habitats viz., Andaman & Nicobar islands, Lakshadweep Islands and Goa would be taken up under the ICMAM programme. NIOT would be engaged in commissioning and testing of 1MW OTEC plant. In addition, activities relating to fabrication of water injector vacuum desalination plant, design and fabrication of wave-powered buoys and wave powered Reverse Osmosis plant, etc. would be taken up. An engineered version of stand-alone echo sounder, a spin off of the Integrated Underwater Survey System (IUSS) project, will be developed and field-tested and integrated with the GPS receiver. Studies would be carried out for identifying the most potential areas for detailed survey of Gas Hydrates and swath bathymetry would be undertaken in the potential areas. Marine geophysical survey would be carried out in the Laxmi basin to determine the crustal characteristics and development of crustal model.

SPACE SCIENCES

Review of achievements during 2002-03

28. The successful launch of Meteorological Satellite (METSAT-1) onboard Polar Satellite Launch Vehicle (PSLV – C4) on September 12, 2002 was an important achievement during the year. This launch, which was the sixth successive successful flight of PSLV, also demonstrated the geo-synchronous launch capability of PSLV. METSAT satellite carries a Very High Resolution Radiometer (VHRR), which is designed to obtain images of earth cloud cover in the

visible, thermal, infrared and water vapour channels enabling continuous round-the-clock monitoring of weather system. The Data Relay Transponder (DRT) in the satellite enables collection of meteorological data from remote and inaccessible area over land, which is used for weather analysis including flood forecasting. The payload fabrication & testing for Indian Remote Sensing Satellite (IRS-P6) – Resources at satellite has been completed

29. The satellite GSAT-2 for the second development flight of GSLV-D2 was integrated with the launch vehicle and checkout operations were completed. The GSLV-D2 incorporates an improved version of liquid strap-on L-40 enhancing the payload capability of GSLV. The GSAT-2, an experimental communication satellite, will augment the INSAT system capacity with additional 6 transponders in C/Ku band and Mobile Satellite Services, besides carrying several technological and scientific payloads.

30. A significant milestone in the Cryogenic Upper Stage (CUS) programme was achieved with the successful test firing of the indigenously developed cryogenic engine for its full flight duration of 720 seconds on March 30, 2002 as a part of a series of long duration testing programme. The last long duration hot test was successfully conducted on September 14, 2002 for a duration of 1000 seconds. The Second Launch Pad has also made significant progress (95% completed) and the civil works at site are nearing completion. The erection of major structures like umbilical tower, lightning protection towers, mobile launch pedestal have been completed and realisation of mechanical, electrical, control and process instrumentation was in progress.

31. As a part of Tenth Five Year Plan programme, the Indian National Satellites-INSAT-4A & 4B, GSAT-3 & 4 satellites, Geo-Stationary Launch Vehicle (GSLV) continuation programme have been approved by the Government. GSAT-3 has been conceived as Educational Satellite (EDUSAT) - a satellite dedicated for Education at all levels covering a large part of the country including North-East region. GSAT-4 is an experimental communication satellite for Ka band data broadcast applications. The GSLV Mk- III has also been approved by the Government in April-May 2002 and the work is progressing as per schedule. The GSLV MK III, is intended to develop a cost-effective launch vehicle capable of launching 4T INSAT type of satellites to Geo Transfer Orbit (GTO). There has been significant progress in other ongoing projects namely, INSAT-3D & 3E and Cartography Satellites (Cartosat) -1&2, commensurate with their launch schedule.

32. One of the important applications of IRS during the year has been in the area of identification of potential zones for drinking water. Under the National Drinking Water Mission, the ground water prospects maps were prepared using the satellite imageries for the states of Andhra Pradesh, Madhya Pradesh, Karnataka, Kerala, Rajasthan and Chattisgarh. Over 1300 ground water prospect maps have been provided to these States and the feedback from users in Karnataka, MP, AP and Rajasthan indicate that several wells have been drilled successfully using these maps. Initial forecast of Snow melt run-off based on satellite data has been provided for Bhakra-Beas management board. Bio-diversity characterisation at landscape level using the satellite data has been completed for the Western Ghat region. Satellite data has also been used for in-season multiple crop forecasts.

33. One of the most recent applications of space technology initiated by ISRO is tele-medicine to bring health care to the remote locations by linking super-specialty hospital in a city with a hospitals/health care centres in remote location through INSAT satellites. About 17 hospitals in 8 States (including A & N and North-East) have been connected through INSAT satellite to provide the tele-medicine services and more than 10,000 patients have been treated using the tele-medicine facilities. The installation and commissioning of tele-medicine project connecting District Hospital, Leh and All India Institute of Medical Sciences (AIIMS), New Delhi

is in progress. Significant progress has also been achieved in the expansion of the GRAMSAT satellite based network for developmental applications.

Major programmes for the year 2003-04

34. The multi-purpose satellite INSAT-3A was successfully launched on 10th April 2003 by Ariane from French Guyana. INSAT-3A is a multi-purpose satellite for tele-communication, broadcasting and meteorological services. It carries 24 transponders (in C, Ext-C and Ku bands) augmenting the INSAT space segment capacity significantly for fixed and broadcast satellite services. It also carries a Very High Resolution Radiometer (VHRR), a Charge Coupled Device (CCD) based Camera and Data Relay Transponders for weather services. The satellite is also equipped with Search and Rescue payload as a part of international satellite based search and rescue operations programme.

35. The main thrust of INSAT programme during 2003-04 will be to launch and operationalise INSAT-3E satellite to augment the INSAT system capacity and to initiate work on fourth generation INSAT-4A & 4B satellites. Substantial progress is also targeted in the development of advanced meteorological payload for INSAT-3D and Space Capsule Recovery Experiment (SRE). Launch and operationalisation of Resourcesat-1 (IRS-P6) satellite to provide continuity of remote sensing data will be an important target during the year under IRS programme. Most of the work on assembly, integration and testing of Cartosat-1 (IRS-P5) satellite is also planned to be completed during the year leading to launching of the spacecraft in early 2004. Launch and operationalisation of GSAT-3 (EDUSAT), a satellite dedicated for spreading education at all levels in the country, is another important target for the year.

36. In the area of launch vehicles, commissioning and testing of Second Launch Pad at Sriharikota is one of the important targets for the year. Under the indigenous CUSP project, it is planned to realise the Cryogenic flight stage after completion of engine testing programme and fabrication of additional engines. Significant progress is also expected in respect of development of GSLV Mk III with the completion of preliminary design, finalisation of contracts for establishment of major test and fabrication facilities and initiation of fabrication work at industries. Third development flight of GSLV-D3 carrying GSAT-3 (EDUSAT) and the operational flights of PSLV to launch Resourcesat-1 and Cartosat-1 are important milestones in the launch vehicle area, for 2003-04.

37. In the area of Space applications, the focus of the efforts will be to expand the GRAMSAT network covering more number of States and enlarge the Tele-medicine network. Operationalisation of National Natural Resource Management System (NNRMS) and application of space technology in education and health would be taken up during the Annual Plan 2003-04. Work on various application missions such as National Drinking Water Mission, Crop production and acreage estimation, Bio-diversity characterisation and drought/ flood monitoring will also be continued.

SCIENCE AND TECHNOLOGY

Review of Achievements during 2002-03.

38. The Department of Science & Technology (DST), which is the nodal department for coordinating S&T activities in the country, has constantly been engaged in promotion of new areas of Science & Technology to search for new knowledge, through the mechanism of Science & Engineering Research Council (SERC). Applied research & technology development is another area of focus for converting usable knowledge into usable products and services to industries, socio-economic departments and public at large. The activities of the department

are primarily focused towards scientific research, technology development, socio-economic development, scientific services, international cooperation and supporting autonomous S&T institutions. In addition, project mode support is also provided to the State S&T Councils to tackle state specific problems.

39. The Science & Engineering Research Council (SERC) continued its support to research projects in challenging and promising fields of Science & Engineering and under its R&D programme sanctioned 265 projects. Some of the new projects supported were in the areas like: organic synthesis, condensed matter physics, materials science and engineering, phase transition, bio-organic chemistry, plasma physics, non-linear dynamics, lasers, optics, electrical & computer engineering, biomedical engineering etc. A number of training programmes and SERC schools were also supported in the areas of soft computing, precision engineering, chronobiology, atomic & molecular physics, atmospheric modeling, etc. A new scheme for awarding Scholarships to Women Scientists & Technologists was started during the year. The National Initiative on Nano Science & Technology launched last year has attracted a wide spectrum of researchers from various R&D institutions. Some of the major national research facilities approved during the year include: 800 MHz Nuclear Magnetic Resonance (NMR) facility at Tata Institute of Fundamental Research (TIFR), Mumbai; Centre for Display Technology at Indian Institute of Technology (IIT), Kanpur; Nuclear Dynamics and Structure Studies Facility, at Nuclear Science Center (NSC), New Delhi; Low Temperature- High Magnetic Facility at Inter University Center for Department of Atomic Energy Facilities, Indore; Design & Development of Materials for Photonic Applications at Regional Research Laboratory (RRL), Thiruvananthapuram; and National Facility for Protein Sequencing at IIT Mumbai. In the area of drugs and pharmaceuticals projects were sanctioned for screening of novel anti-tubercular and anti- bacterial compounds, development of a novel immuno adjuvant, development of novel anti-cancer agents, and design synthesis and testing of new chemical entities as potential anti fungal agents etc. Two national facilities are also being set up viz. National Centre for bio-availability at National Institute of Pharmaceutical Education and Research (NIPER) – Chandigarh and National Centre for Pharmacokinetics and metabolic studies at Central Drug Research Institute (CDRI) – Lucknow.

40. During the year TIFAC has prepared reports on upcoming and frontier technologies like Biochips, Nutraceuticals & fuel cells and retrofitting existing buildings to make them earthquake resistant. TIFAC has also nucleated a mission mode project for Bamboo products. Under the Instrumentation Development programme, some of important instruments/systems developed include: Atomic Force Microscope, Temperature Controlled Microwave Histoprocessor, Rheometer, etc. Technologies/know-how for portable spectrophotometer, water quality testing kits, bio reactors, sulphur dioxide analyzer, portable stack opacity monitor, magnetic sensor for material characterization etc. were transferred to the industry.

41. Scientific services in the area of meteorology, survey and mapping has been provided to the user agencies through the Indian Meteorological Department (IMD), Survey of India (SOI), National Atlas and Thematic Mapping Organization (NATMO) and National Center for Medium Range Weather Forecasting (NCMRWF). IMD has commissioned one of the Doppler Radars at Chennai and the other at Kolkata will be commissioned shortly. An indigenous Doppler Weather Radar, developed in collaboration with Indian Space research Organisation (ISRO) has been installed at Shriharikota. Ten High Wind Speed Recorders (HWSR) of ultrasonic type have been installed at meteorological offices at Balasore, Chandbali, Puri, Visakhapatnam, Pondicherry, Nellore, Karaikal, Adirampattinam, Machlilipattinam and Ongole. Fifty Strong Motion Seismographs have been procured for installation in the National Seismological Network for micro-zonation related field studies. Sixteen seismological field stations and Central Recording Station at IMD, HQ, New Delhi has become operational under the Delhi Telemetry System for near real time monitoring of seismicity in and around Delhi. Procurement action has also been

taken up in respect of equipment facilities at national/ international airports for safe and efficient air navigation, seven strong motion accelerographs for installation at field stations, etc.

Major programmes for the year 2003-04

42. In contrast to discipline based Science Departments, SERC is the single organisation that cuts across all sciences and addresses basic research in both biological (including medical) and physical sciences. Through its multi level peer review system, which has been rigorous in its scrutiny of the academic worth of the project and the transparency with which it executes all levels of activity, it has gained a high reputation amongst the scientists of the country. It is being felt that, it requires a new system of governance, which ensures a greater freedom for choice of research areas, faster utilization of funds and quicker disbursement to investigators. It is, with this objective in mind that restructuring of the 'Science & Engineering Research Council (SERC)' mechanism into the National Science & Engineering Board (NSEB), as an autonomous body, would be taken up during the Annual Plan 2003-04, to provide directions to basic research in the country, in all its aspects, so that India attains its true potential as a giant in basic research. Special emphasis would be on fundamental research projects in the academic sector and about 350 programmes are likely to be supported during the year. The new initiative on nano science & technology will be continued, besides setting up centres of excellence in nano science and technology. Efforts would also be made to bring together industry and experts in academics working in this area. Some of the S&T facilities proposed to be set up include: Beam lines for INDUS-2, Centre for Geochronology and Isotope Geosciences, Catalysis Centre, Orientation & Texture imaging microscopy, Structural Chemistry Centre, Large Gamma Ray Detector Facility, etc. In the area of drugs & pharmaceuticals, it is proposed to set up a Drugs & Pharmaceuticals Research and Development Fund at a cost of Rs.150 crore for supporting various R & D programmes in this field on a continuous basis. Efforts would be continued to support collaborative research projects leading to drug development against diseases of importance to our country like tuberculosis, leprosy, malaria, leucoderma, gastrointestinal disorders, diabetes, hypertension, cardio-muscular disorders and other prevalent infectious diseases. It is also proposed to set up national facilities in selected areas like containment facilities for screening of anti-viral activity, national facility on proteomics, etc. Development of veterinary drugs will also be promoted through collaborative projects. In addition programmes relating to seismology, FIST, societal programmes, etc. would be further strengthened.

43. The activities of the Survey of India, IMD, NATMO, and NCMRWF would be continued to provide services to the socio-economic ministries. The facilities available at IMD and SOI require modernisation in order to provide accurate forecast on meteorology, cyclone, seismology, mapping, etc. As a part of this programme, installation/commissioning of: equipments for new earth stations for INSAT-3A; Digital Meteorological Data Dissemination (MDD) equipments at 40 stations; 10 Laser Ceilometers at airports and 10 Weather Bureau Radio Theodolites (WBRTs) at upper air stations (including three in Himalayas); Automatic Message Switching System (AMSS) computer systems at three airports, Automatic Weather Station (AWS) in the Himalayas for mountain meteorology under project PARVAT; 100 nos. of digital Cyclone Warning Dissemination Systems (CWDSs) in Andhra Pradesh, etc. would be taken up during Annual Plan 2003-04. Action will also be initiated for integration and establishment of optimum seismo network, procurement of Doppler Weather Radars (DWRs) for installation in AP state under the World Bank aided project, and replacement of 11 X-band wind finding weather radars and 6 nos. of storm detection radars, besides implementation of 'Integrated Telecom System Network' for all major forecasting offices.

SCIENTIFIC AND INDUSTRIAL RESEARCH

Review of Achievements during the year 2002-03

44. Technology Promotion, Development and Utilisation (TPDU) is an important scheme of the Department of Scientific and Industrial Research (DSIR). The scheme aims at promotion of industrial R&D; and to provide support to development and acquisition of new technologies, management of export of technology, development of consultancy capabilities and information systems in the country. In addition, the department is also responsible for coordinating the activities of the Council of Scientific and Industrial Research (CSIR) and two Public Sector Enterprises, namely National Research Development Corporation (NRDC) and Central Electronics Limited (CEL). The TPDU scheme has several components, namely Research and Development by Industry (RDI), Programme Aimed at Technological Self Reliance (PATSER), and Scheme to Enhance the Efficacy of Transfer of Technology (SEETOT). During the Annual Plan 2002-03, 16th National Conference on in-house R&D in industry was organized and 8 National Awards for outstanding in-house R&D achievements were presented. 75 new in-house R&D Units and 20 new Scientific and Industrial Research Organizations (SIROS) were recognised for the purpose of granting customs duty exemption on imports made for R&D and other tax deductions/exemptions. 20 new projects of industrial units were supported for technology development and demonstration.

45. CSIR through its chain of 38 National Laboratories continued to provide S&T inputs for development of socio-economic sectors. On the Industrial front, CSIR provided important technological inputs to the Indian industry enabling it to face global competition, particularly, Leather industry, Steel, Petro Chemicals, Drugs & Pharma etc. The R&D activities of CSIR also helped in catalysing domestic civil aircraft industry for locating newer avenues through design and fabrication of civil aircraft. The sophisticated, and indigenously developed 14 seater multi-role transport aircraft (SARAS) was rolled out on 4th February 2003. National Aerospace Laboratory (NAL) delivered three HANSA aircrafts to the Ministry of Civil Aviation. Institute of Genomics and Integrative Biology (IGIB), New Delhi has developed an expression system for producing large amount of protective antigen protein of anthrax toxin and the technology developed for anthrax vaccine has been transferred to Panacea Biotech (P) Ltd. Under the programme of Discovery, development & commercialization of new bioactives and traditional preparations, out of more than 4000 plant and microbial extracts screened, nearly 400 extracts showed in vivo activity for 21 diseases of global importance. In short, 44 lead extracts were obtained, 3 new bioactive molecules were found and 25 international patents have been filed.

46. A pilot plant for preparation of feedstock for microcrystalline waxes was put to pre-commissioning trial runs and is being regularly operated by the Assam Oil Division (AOD) refinery since then to produce distillate – feedstock for microcrystalline wax. Some of the other important achievements of CSIR were relating to: design and development of 4mx8m autoclave; fabrication of 12.88 m dia dome for ISRO's Doppler weather radars; desiccation tolerance generation for tea seeds; and development of nutraceutical products, plant based remedy for liver ailments, polymer magnet & thin conducting films, epoxy – tar based coating formulation, zeolite based reforming catalyst for aromatic production, palm oil processing technology, arsenic analyzer etc.

47. A New Millennium Indian Technology Leadership Initiative (NMITLI) Scheme was launched to attain global leadership position in a few select niche areas. Some of the important achievements are relating to development of next generation bio-informatics software, high performing catalyst for desulphurising diesel, and a new liquid crystal display device for flat panel display system with higher contrast ratio.

48. On the intellectual property front, CSIR continued to be the leader in India in filing patents, CSIR had filed 417 patents in India and 718 abroad. During the year it has been granted 146 US patents, which is a record of all times. CSIR has also pioneered globally the concept of according traditional knowledge due recognition and privileged position in the intellectual property rights (IPR) domain.

Major Programmes for the Year 2003-04

49. The Department of Scientific and Industrial Research (DSIR) would continue to act an important link in the technological innovation chain through 'Technology Promotion, Development and Utilization' programme by providing leveraging support to new technology development projects in industry, supporting technology innovations, design engineering centres, etc.

50. CSIR would continue various R&D projects in a networked mode, with the objectives to develop technology based on high science, rooted, wherever feasible, in India's rich heritage of knowledge; promoting excellence in science – science that will lead and not follow; developing technological solutions of local relevance - finding holistic and optimal solutions to the pressing problems of the people; and to act as an important instrument in the total innovation chain in all spheres of activities, ranging from science to technology management to financing. Besides the programmes relating to National S&T Human Resource Development; Intellectual Property and Technology Management; R&D Management Support; New Millennium India Technology Leadership Initiative (NMITLI); infrastructure; and renovation and refurbishing of CSIR laboratories, the National Laboratories of CSIR have proposed to undertake 57 programmes/projects in identified areas.

51. Under the Scheme New Millennium Indian Technology Leadership Initiative, major activities would pertain to development of linux based simple office computer; integrated proton exchange membrane fuel cell for laboratory evaluation; process for separation of cellulose, hemi cellulose and lignin from bagasse; and scientific evaluation of pharmacological characteristics of 'Ashwagandha'.

52. CSIR would continue to upgrade extra mural human resources in diverse discipline of S&T by providing appropriate fellowships in trans-disciplinary areas. CSIR will endeavor to inculcate a spirit of entrepreneurship in research scholars to establish their own R&D enterprises. Further to attract bright school leaving children to pursue science it would enlarge the scope of CSIR Programme for Youth Leadership in Science (CPYLS). The Shyama Prasad Mukherjee awards recently created would also be enlarged in its scope.

53. The details of the scheme wise plan outlays/expenditure for various S&T Departments and the State wise S&T plan outlays/expenditure are given in Annexure-13.1 and 13.2 respectively.

Annexure 13.1

**Central Scientific Departments
Progress of Plan Expenditure**

(Rupees in Crore)

S. No.	S&T Departments/Agencies	Annual Plan 2001-02 Actuals	Annual Plan 2002-03 BE	Annual Plan 2002-03 RE	Annual Plan 2003-04 Outlay
1	2	3	4	5	6
1	Department of Atomic Energy (R&D Sector)	419.71	535.00	434.33	464.00
2	Deptt. of Ocean Development	119.18	175.00	150.00	175.00
3	Deptt. of Science and Technology	384.92	625.00	562.87	800.00
4	Deptt. Of Bio-technology	174.67	225.00	205.00	260.00
5	Scientific & Industrial Research	327.16	440.00	375.00	520.00
6	Department of Space	1592.54	1950.00	1850.00	2050.00
	Grand Total	3018.18	3950.00	3577.20	4269.00

Annexure 13.1 (Contd.)

Scheme wise Plan Outlays/Expenditure
Department of Atomic Energy (R&D Sector)
(Rupees in Crore)

S. No.	PROGRAMMES	Annual Plan 2001-02	Annual Plan 2002-03		Annual Plan 2003-04 BE
			BE	RE	
1	Bhabha Atomic Energy Research Centre (BARC)	Actuals 117.35	186.00	120.00	140.00
2	Indira Gandhi Centre for Atomic Research (IGCAR)	49.07	32.00	25.50	35.00
3	Centre for Advance Technology (CAT)	49.87	45.00	45.88	50.00
4	Variable Energy Cyclotron Centre (VECC)	17.68	26.00	21.48	23.00
5	Atomic Mineral Division (AMD)	7.44	6.37	6.37	15.00
6	Tata Memorial Centre (TMC)	27.00	27.00	34.20	35.40
7	Tata Institute of Fundamental Research (TIFR)	30.80	38.00	33.10	35.00
8	Saha Institute of Nuclear Physics (SINP)	11.93	17.00	17.13	18.00
9	Institute of Physics (IOP)	4.92	3.94	2.07	3.10
10	Institute of Mathematical Sciences (IMS)	4.35	1.30	1.03	2.50
11	Harish Chandra Research Institute (HRI)	2.89	3.41	1.77	2.50
12	Institute of Plasma Research (IPR)	38.75	62.00	50.00	28.00
13	DAE Projects	2.78	1.33	1.82	2.00
14	Atomic Energy Regulatory Board (AERB)	3.19	4.00	3.93	2.50
15	Grant-in-Aid	31.83	42.40	53.80	50.00
16	Directorate of Construction, Services & Estate Management (DCSEM)	19.86	39.25	16.25	22.00
	GRAND TOTAL	419.71	535.00	434.33	464.00

Annexure 13.1 (Contd.)

Scheme wise Plan Outlays/Expenditure
Department of Ocean Development

(Rupees in Crore)

Sl. No.	Programmes	2001-02 Actuals	2002-03		2003-04 BE
			BE	RE	
1	Polar Science	18.52	26.50	20.00	24.00
2	Polymetallic Nodules Programme	11.08	20.00	20.00	22.00
3	Ocean Observation and Information System	14.15	25.00	24.00	35.00
4	Marine Research & Technology Development	4.33	24.85	22.75	21.50
5	National Institute of Ocean Technology	30.30	24.15	23.40	25.00
6	Coastal Research Vessel (CRV)	3.89	5.00	5.00	5.00
7	Delineation of Outer Limits of Continental Shelf	25.00	18.00	18.00	8.00
8	Marine Living Resources	1.05	0.00	0.00	0.00
9	Marine Non-living Resources	1.04	0.00	0.00	0.00
10	ICMAM	4.38	0.00	0.00	0.00
11	COMAPS	2.15	0.00	0.00	0.00
12	Drug from Sea	1.62	0.00	0.00	0.00
13	International Cooperation	0.52	0.00	0.00	0.00
14	Comprehensive Swath Bathymetric survey of Indian EEZ	0.00	14.00	5.25	12.00
15	Gas-hydrate Exploration & Technology Development for Exploitation	0.00	8.50	4.50	18.00
16	Acquisition and operation of new Research Vessels	0.00	2.00	0.10	2.00
17	Geo-physical Study of Laxmi Basin	0.00	7.00	7.00	2.50
18	Direction & Admn.	1.15	0.00	0.00	0.00
	TOTAL	119.18	175.00	150.00	175.00

Annexure 13.1 (Contd.)

Scheme wise Plan Outlays/Expenditure
Department of Science and Technology

(Rupees in Crore)

S. No.	PROGRAMMES	Annual Plan 2001-02 Actuals	Annual Plan 2002-03		Annual Plan 2003-04 BE
			BE	RE	
	A. CONTINUING SCHEMES				
1	R&D Support				
1.1	Multidisciplinary Research in Science and Engineering (SERC)	82.66	210.00	207.00	215.00
	TOTAL (1)	82.66	210.00	207.00	215.00
	Infrastructure Support				
2.1	Regional Sophisticated Instrumentation Centre (RSIC)	2.50	0.00	0.00	0.00
2.2	National S&T Management Information System (NSTMIS)	0.90	0.00	0.00	0.00
2.3	Natural Resources Data Management System (NRDMS)	2.58	0.00	0.00	0.00
2.4	Fund for Improvement of S&T Infrastructure in Universities & Related Academic Institutions	34.99	0.00	0.00	0.00
	TOTAL (2)	40.97	0.00	0.00	0.00
3	Technology Development				
3.1	Joint Technology Projects	2.26	0.00	0.00	0.00
3.2	Instrument Development Programme	1.99	0.00	0.00	0.00
3.3	Drugs and Pharmaceuticals	3.99	0.00	0.00	0.00
3.4	Patent facilitating Cell	0.90	0.00	0.00	0.00
3.5	Technology Development Programme	0.00	23.00	23.00	23.00
	TOTAL (3)	9.14	23.00	23.00	23.00
4	S&T Programmes for Socio Economic Development				
4.1	Science and Society Programmes	4.45	5.50	5.50	5.50
4.2	SCP for the Development of SC	1.76	2.50	2.50	2.50
4.3	Tribal Sub Plan	1.55	2.50	2.50	2.50
4.4	S&T Entrepreneurship Dev. Activities	7.45	14.00	14.00	14.00
4.5	S&T Communication & Popularisation	3.41	4.00	4.00	4.00
4.6	Women Component Plan	2.50	2.50	2.50	2.50
	TOTAL (4)	21.12	31.00	31.00	31.00

Annexure 13.1 (Contd.)
Scheme wise Plan Outlays/Expenditure
Department of Science and Technology (Contd.)
(Rupees in Crore)

S. No.	PROGRAMMES	Annual Plan 2001-02 Actuals	Annual Plan 2002-03		Annual Plan 2003-04 BE
			BE	RE	
5	International Cooperation Programmes				
5.1	Integrated Long Term Programme of Cooperation in S&T Between India and Republics of CIS (ILTP)	1.84	0.00	0.00	0.00
5.2	Indo-French Center for Promotion of Advanced Research (IFCPAR)	5.74	6.00	6.00	6.00
5.3	S&T Coop. with Developing Countries.	1.09	0.00	0.00	0.00
5.4	S&T Coop. with Developed Countries	2.81	0.00	0.00	0.00
5.5	Indo-US S&T Forum	2.70	3.50	3.50	3.50
5.6	S&T Coop. With other countries	0.00	10.50	8.50	10.50
5.7	Development Cooperation between India and UNDP	4.00	10.00	10.00	3.74
	TOTAL (5)	18.18	30.00	28.00	23.74
6	Science Based Services				
6.1	Survey Of India	4.75	20.00	18.38	17.00
6.2	National Atlas and Thematic mapping Organisation (NATMO)	0.59	1.00	1.00	1.00
6.3	India Meteorological Department (IMD)	42.14	60.00	64.49	65.00
6.4	National Center for Medium Range Weather Forecasting (NCMRWF)	16.88	10.00	10.00	9.00
	TOTAL (6)	64.36	91.00	93.87	92.00
7	Aided Institutions				
	Autonomous Institutions/Prof. Bodies	139.35	200.00	160.00	192.01
8	Others				
8.1	State Councils of S&T	7.99	10.00	10.00	10.00
8.2	Management and Administration	1.15	0.00	0.00	0.00
	Total (8)	9.14	10.00	10.00	10.00
	TOTAL (A)	384.92	595.00	552.87	586.75

Annexure 13.1 (Contd.)
Scheme wise Plan Outlays/Expenditure
Department of Science and Technology (Contd.)
(Rupees in Crore)

S. No.	PROGRAMMES	Annual Plan 2001-02 Actuals	Annual Plan 2002-03		Annual Plan 2003-04 BE
			BE	RE	
B	NEW SCHEMES				
1	Seismology	0.00	10.00	5.00	10.00
2	Technology for bamboo products	0.00	20.00	5.00	43.25
3	Pharmaceutical Research & Development Support Fund	0.00	0.00	0.00	150.00
4	Synergy Projects (O/o the Principal Scientific Adviser)	0.00	0.00	0.00	10.00
	Total (B)	0.00	30.00	10.00	213.25
	GRAND TOTAL	384.92	625.00	562.87	800.00

Annexure 13.1 (Contd.)

Scheme wise Plan Outlays/Expenditure
Department of Biotechnology

(Rupees in Crore)

S. No.	PROGRAMMES	Annual Plan 2001-02 Actuals	Annual Plan 2002-03		Annual Plan 2003-04 BE
			BE	RE	
A	S & T Sector				
1	Human Resource Development	10.74	10.00	11.62	13.00
2	Biotech Facilities, Centres of Excellence and Programme Support	11.00	21.00	21.00	20.00
3	Basic and Product Oriented R & D	80.12	104.00	80.50	114.00
4	Biotechnology for Societal Development	3.79	6.00	3.50	7.00
5	Biotech Process & Product Development	7.42	8.00	7.86	7.00
6	Bioinformatics	7.29	7.00	9.82	10.00
7	International Cooperation	4.45	6.00	6.00	8.00
8	Secretariat (Manpower)	1.11	0.00	0.00	0.00
9	National Instt. of Immunology	16.00	25.00	24.00	25.00
10	National Centre for Cell Science, Pune	8.75	9.00	9.90	9.00
11	Centre for DNA Fingerprinting & Diagnostics	10.25	8.00	8.00	8.00
12	National Brain Research Centre	8.00	11.00	11.00	11.00
13	National Centre for Plant Genome Research	5.50	7.00	7.00	7.00
14	Instt.of Bio Resources & Sustainable Dev.	0.25	2.00	1.30	2.00
15	Institute of Life Sciences	0.00	0.00	2.50	4.00
	Total - S&T Sector (A)	174.67	224.00	204.00	245.00
B	Industry & Mineral Sector				
1	BIBCOL	0.00	0.00	0.00	0.00
2	IVCOL	0.00	0.00	0.00	0.00
3	Technology Incubators & Pilot Level facilities, Parks and Biotech Dev. fund	0.00	1.00	1.00	15.00
	TOTAL - I & M SECTOR (B)	0.00	1.00	1.00	15.00
	GRAND TOTAL (A+B)	174.67	225.00	205.00	260.00

Annexure 13.1 (Contd.)

Scheme wise Plan Outlays/Expenditure
Department of Scientific and Industrial Research Incl.
Council of Scientific and Industrial Research

(Rupees in Crore)

Sl. No.	Programmes	2001-02 Actuals	2002-03		2003-04 BE
			BE	RE	
A	DSIR				
1	Technology Promotion, Development & Utilization Programmes	13.21	17.00	13.35	15.00
2	National Research Development Corporation	2.68	3.00	3.00	3.00
3	Central Electronics Ltd.	3.00	8.00	6.00	10.00
	Total A	18.89	28.00	22.35	28.00
B	CSIR				
1	National Laboratories	181.91	310.00	291.65	392.00
2	National S&T Human Resource Mgt.	4.20	5.00	5.00	7.00
3	Modernisation	48.68	0.00	0.00	0.00
4	Intellectual Property & Technology Mgt.	8.00	15.00	15.00	17.00
5	R&D Management Support	9.73	10.00	10.00	11.00
6	Residential Building	5.77	0.00	0.00	0.00
7	New Millennium Indian Technology Leadership Initiative	49.99	45.00	30.00	35.00
8	Infrastructure Renovation& Refurbishing	0.00	27.00	1.00	30.00
	Total (B)	308.28	412.00	352.65	492.00
	Total (A+B)	327.16	440.00	375.00	520.00

Annexure 13.1 (Contd.)

Scheme wise Plan Outlays/Expenditure
Department of Space

(Rupees in Crore)

Sl.No.	Name of the Scheme/Project	2001-02 Actuals	2002-03		2003-04 BE
			BE	RE	
1	INSAT - 2 Satellites	66.17	0.00	0.00	0.00
2	GSAT - 1	5.79	0.00	0.00	0.00
3	IRS - P4 (OCEANSAT)	0.76	0.00	0.00	0.00
4	Technology Experiment Satellite	17.62	0.00	0.00	0.00
5	PSLV C4-C6	114.74	60.28	64.00	17.00
6	GSLV	63.23	101.13	85.13	70.00
7	Cryogenic Upper Stage Project (CUSP)	17.80	16.38	19.38	16.70
8	Space Capsule Recovery Experiment	0.00	20.00	8.65	31.43
9	Second Launch Pad (SLP)	127.83	45.00	70.00	20.47
10	IRS-P5 Cartosat	22.88	17.20	30.54	10.41
11	IRS-P6 Resourcesat	18.63	17.00	17.64	10.43
12	IRS-2 (Advanced Cartosat)	33.42	60.56	48.38	76.49
13	INSAT-3 Satellites & Launch Services	576.62	294.70	208.59	275.00
14	GSAT-2	14.04	10.00	13.00	10.00
15	METSAT-1	23.74	35.00	30.00	5.00
16	GSLV Mk III	0.00	180.00	175.00	280.00
17	GSLV Continuation (MKI/II)	0.00	25.00	34.80	100.00
18	PSLV C7-C12	0.00	0.00	0.00	50.00
19	INSAT-4 & Launch Services (excluding GSLVs)	0.00	435.00	546.27	185.00
20	GSAT-3&4	0.00	10.00	7.00	100.00
21	Advanced Communication Test Satellite	0.00	0.00	0.00	10.00
22	Radar Imaging Satellite	0.00	30.00	0.00	50.00
23	Oceansat-2	0.00	5.00	0.00	15.00
24	Resourcesat-2	0.00	0.00	0.00	5.00
25	ASTROSAT	0.00	12.00	0.00	10.00
26	Megha-tropiques	1.37	5.35	2.13	5.20

Annexure 13.1 (Concl.)

Scheme wise Plan Outlays/Expenditure
Department of Space (Contd.)

(Rupees in Crore)

Sl.No.	Name of the Scheme/Project	2001-02 ACT	2002-03		2003-04 BE
			BE	RE	
27	Planetary Mission	0.00	0.00	0.00	10.00
28	E O Applications	26.92	26.13	26.37	32.35
29	NNRMS & SNRMS	21.98	36.00	26.63	54.80
30	Disaster Management Support	8.48	10.00	2.80	10.00
31	SATCOM applications programme	10.51	42.20	31.18	61.53
32	Space Science and Environment	32.87	29.40	32.22	53.57
33	Small Satellite programme	3.00	3.00	3.00	5.74
34	Technology Development Programme / EO Technology Management Programme	55.49	56.57	39.18	52.84
35	Advance R&D Programme	12.23	11.15	11.09	10.47
36	Facilities Replacement/Augmentation/EO Ground Segment augmentation	72.5	87.18	88.16	132.42
37	Dev. Of Space materials/Components and Advance Actions/Parallel ordering	34.28	21.84	9.28	28.08
38	Industry interface and Productionisation	9.43	21.29	8.79	14.96
39	International Co-operation Programme	17.74	4.25	2.90	4.40
40	Sponsored Research	6.69	8.00	7.00	10.00
41	Technical and Auxillary Facilities Support	139.00	175.35	169.06	169.16
42	General Civil Works & Housing	36.78	38.04	31.83	46.55
	TOTAL	1592.54	1950.00	1850.00	2050.00

Annexure 13.2
S&T Plan Outlay under the State Plan
(Rupees in Lakh)

S. No.	States/UTs	2001-02 Actuals	10th Plan Outlay	2002-03 B.E	2002-03 R.E	2003-04 B.E
1	Andhra Pradesh	14.00	500.00	105.00	20.00	22.00
2	Arunachal	23.00	420.00	126.00	126.00	153.00
3	Assam	142.00	750.00	145.00	145.00	145.00
4	Bihar	0.00	0.00	0.00	0.00	20.00
5	Chattisgarh	0.00	300.00	48.00	48.00	73.00
6	Goa	20.00	175.00	35.00	35.00	57.15
7	Gujarat	4337.00 \$\$	29835.00 \$\$	6524.00 \$\$	6524.00 \$\$	7224.00 \$\$
8	Haryana	115.00	565.00	110.00	169.00	120.00
9	Himachal.Prade	101.00	592.00	128.00	108.00	45.64
10	Jammu	562.00	3619.00 *	576.00 *	576.00*	614.00*
11	Jharkhand	1298.00 +	33000.00+	6000.00+	6000.00+	4700.00+
12	Karnataka	150.00	1293.00	182.00	191.00	249.00
13	Kerala	1396.00 *	12000.00 \$\$	2500.00*	2000.00*	3750.00*
14	Madhya.Prades	123.00	858.00	172.00	190.00	192.00
15	Maharashtra	86.00	4325.00	23.00	23.00	270.00
16	Manipur	71.00	1227.00	195.00	195.00	502.00
17	Maghalaya	83.00	515.00	85.00	85.00	85.00
18	Mizoram	111.00	513.00	110.00	110.00	106.00
19	Nagaland	0.00	350.00	20.00	49.00	294.00
20	Orissa	553.00	2281.00 \$\$	320.00 \$\$	320.00 \$\$	875.52 \$\$
21	Punjab	55.00	3303.00	263.00	263.00	230.00
22	Rajasthan	58.00	753.00	215.00	65.00	77.00
23	Sikkim	64.00	600.00	75.00	75.00	175.00
24	Tamil Nadu	282.00	4735.00	204.00	165.00	186.79
25	Tripura	15.00	904.00	20.00	20.00	5.06
26	Uttar Pradesh	694.00	5950.00	825.00	350.00	416.00
27	Uttanchal	980.00	304.00	361.00	361.00	720.00
28	West Bengal	3468.00 \$\$	13831.00	3507.00 \$\$	489.00	329.00
	Total States	14801.00	123498.00	22874.00	18702.00	21636.16
	U.Ts.					
1	A&N Islands	26.82	212.00	35.00	35.00	20.00
2	Chandigarh	12.72	60.00	15.00	15.00	14.00
3	D & N Haveli	5.68	35.00	6.00	6.00	6.00
4	Delhi	301.00	700.00	130.00	80.00	150.00
5	Daman & Diu	10.74	80.00	13.00	13.00	15.00
6	Lakshadweep	35.65	307.64	63.00	63.00	75.00
7	Pondicherry	33.55	140.00	35.00	40.00	35.00
	Total UTs	426.16	1534.64	297.00	252.00	315.00
	Grand Total	15227.16	125032.64	23171.00	18954.00	21951.16

\$\$ Including Information Technology

* Including Ecology and Environment

+ Including Technical Education and Ecology & Environment