CHAPTER-10

SCIENCE AND TECHNOLOGY

1 It is well recognized that technological innovation lies at the heart of a nation's ability to sustain and accelerate the developmental efforts in the increasingly knowledge-based global economy. India has made substantial progress in a number of areas - reasonably high rates of economic growth, considerable food security, substantially high average life expectancy, growing literacy rates, success in higher education etc. Significant progress has also been made in the various spheres of science and technology over the years and India can now take the pride of a strong network of S&T institutions, trained manpower and innovative knowledgebase. Annual Plan 2002-03 being the first year of the Tenth Five Year Plan, the plans and programmes of various central scientific departments/agencies have been re-oriented in line with the Tenth Five Year Plan approach and policy with focus on important areas of basic research, technology development, demonstration and dissemination including strengthening and creation of infrastructural facilities, development of skilled and trained manpower and providing technology for societal benefits in the fields of space sciences, nuclear sciences, ocean sciences, biotechnology, scientific & industrial research and science & technology. Salient features of the achievements during the Annual Plan 2001-02 and the programmes/activities envisaged in each of these sectors during the Annual Plan 2002-03 have been highlighted in the following paragraphs.

DEPARTMENT OF ATOMIC ENERGY (R&D SECTOR)

Review of Achievements during the year 2001-02

2 The Research and Development (R&D) efforts of the R&D units of the Department of Atomic Energy (DAE) are aimed at harnessing indigenous nuclear fuel resources for power and developing various non-power applications of nuclear technology. Self-reliance has been achieved in the design, construction, operation and maintenance, including repair technology of nuclear reactors of Pressurised Heavy Water Reactors (PHWRs) and associated front and back end technologies. Development of the new reactor systems having potential for breeding and for exploiting the vast reserves of thorium is being pursued vigorously. Engineering design and development activities related to Advanced Heavy Water Reactor (AHWR), which aims to utilize vast reserves of thorium in our country, has made significant progress during the year. Studies are in progress to evolve a process flow sheet for the reprocessing of AHWR fuels. Work on the critical facility for conducting reactor physics experiment for AHWR and 500 MWe PHWRs has picked up and its civil construction has commenced. Work on High Temperature Reactor was also continued. In order to design the in-core shielding for intermediate sodium heat exchangers of the 500 MWe Prototype Fast Breeder Reactor (PFBR), a series of intricate experiments were carried out by extensively utilising APSARA for optimization studies and validation of computational codes available at IGCAR by incorporating a Converter Assembly (CA) made of depleted uranium.

3. Bhabha Atomic Research Centre (BARC) developed Fuel Handling Control Training Simulator for Kaiga and handed over two Fuelling Machine heads for 220 MWe PHWRs and miniature CCTV camera for visual inspection of pressure tubes to Nuclear Power

Corporation of India limited (NPCIL). In addition, cable winch drive mechanisms for adjuster rods, control rods and shut-off rods for Tarapur Atomic Power Plant (TAPP-3 & 4) were designed by BARC incorporating a number of advanced features. The Facility for Integral System Behavior Experiments (FISBE), which was commissioned, is being utilized for experimental simulation of accident scenarios and operational transients in PHWRs. A conceptual design has been worked out for the development of a new sensor for eccentricity measurement between the metallic tubes for the Integrated Garter Spring Repositioning System Version - 2S (INGRES) and development of universal waterproof umbilical cable for INGRES was completed and successfully tested. In addition, a special machine (Guide Sleeve Cutting Machine), which is remotely operable from a distance of 50 meters, has been developed to cut the guide sleeve of the Power Reactor fuelling machine in emergency situation. A flow sheet for separation of plutonium and uranium from the product stream containing both the components after the co-decontamination extraction cycle was demonstrated at Trombay using the remote precipitation set-up and a compact ceramic melter for vitrification of high-level liquid waste was commissioned with inactive trials. An important breakthrough in technology development has been the in-house development of ultra high-speed helium turbo expanders that will enable BARC to establish helium-cryo technology hitherto not available in the country.

4. At Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam, Fast Breeder Test Reactor (FBTR) Mark-I core, made of uranium carbide-plutonium carbide fuel developed at BARC and fabrication of Mark-II core progressed well. The design of 500 MWe sodium cooled pool type Prototype Fast Breeder Reactor (PFBR) also approached completion. Miniaturized ultra-sensitive devices and facilities for precise analytical work were successfully developed and 3D modeling of various PFBR components was carried out for animation of various sub-systems. A simulation platform was also commissioned at Kalpakkam for the full scope replica operator-training simulator of PFBR. In addition, a number of remote handling devices were developed for inspection of reactor components and a Six Axis Multi-Purpose Robot (SAMPRO) was designed and developed with the help of Indian industry for various industrial applications.

5. At Variable Energy Cyclotron Centre (VECC), Kolkata, the superconducting cyclotron reached advanced stages of construction. Fabrication of the 100 tonne main magnet frame was completed. The ECR Heavy ion source was operated to develop new ion beams for the cyclotron. Some front line experiments in the field of surface sciences were carried out. All components of the new injection line between this source and the cyclotron were fabricated. A 40 kW, 35 MHz Radio Frequency (RF) transmitter was commissioned and full power tests were conducted. The low power level and phase control circuit for the same was also successfully developed and tested at Society for Applied Microwave Electronic Engineering and Research SAMEER, Mumbai.

6. The 450 MeV synchrotron radiation source Indus-1 at Centre for Advanced Technology (CAT), Indore, operated satisfactorily. Out of the six beamlines for Indus-1, three are now operational. Significant progress was made in the construction of Indus-2, a 2.5 GeV electron storage ring with the designing of several components and two beamlines. Construction of the superconducting LINAC booster of the Pelletron accelerator at Mumbai, also progressed well. Under the CERN-India collaboration for the Large Hadrons Collider, 250 super conducting corrector magnets, Precision Magnets Positioning Jacks, 60 Quench Projection Heater Power Supplies, 8 Quench Protection System Circuit

Breakers were delivered to CERN. Development of a 2W diode pumped solid state laser, assembly of a table-top terawatt laser with microprocessor based control system and a laser setup for laser cooling and trapping of atoms were some of the other noteworthy achievements of CAT.

7. A wide variety of reactor produced radioisotopes for application in medicine, industry, agriculture and research were processed and supplied. Two new radiopharmaceuticals have been cleared for treatment of arthritis and a radioisotope with high specific activity and excellent radio-nucleic purity suitable for use in palliative therapy of bone pain due to metastasis was developed. Clinical trial reports of hydro-gel dressings have been received from the user hospital certifying the satisfactory performance of hydro-gels as wound dressings. Gamma scanning was successfully employed for trouble shooting of one 9.5 m diameter column of Mangalore Refinery & Petrochemicals Limited (MRPL), Mangalore, leading to avoiding of huge production losses due to reduced shutdown period. Clearance for radiation processing of sea foods (fresh, dried and frozen form) and pulses for domestic consumption and export has been received form Ministry of Health and Family Welfare. The construction of Electron Beam (EB) Centre at Kharghar, Navi Mumbai is in advanced stage and the development of accelerators is also progressing well.

Major programmes for the year 2002-03

8. During the Annual Plan (2002-03), major activities of BARC include: completion of development of various systems and components of AHWR under the Advanced Reactor Development Programme; procurement, fabrication and construction for critical facility for AHWR & 500 MWe PHWRs; refurbishing and re-commissioning of CIRUS; construction of the Steam Generating Test Facility (SGTF) in all respects; completion of various R&D activities related to the validation of design of PFBR; commissioning of the Facility for Uranium-233 Separation (FUS) after safety clearances; revamping and augmentation of Waste Management Facilities at Trombay, Kalpakkam and Tarapur to enhance the overall performance of the existing facilities; commissioning of Organic Waste Treatment Facility (OWTF) at Trombay to treat spent organic wastes from reprocessing plant; etc.

9. At CAT all the components and sub-systems of INDUS-2 would be developed/ procured and assembly of its storage ring would be nearing completion. All the vacuum chambers would be ready by middle 2002 and their chemical treatment and vacuum degassing would be completed by end of December 2002. The entire RF system is expected to be tested. CAT proposes to take up a major programme to develop a high current proton synchrotron for Accelerator-Driven Sub-critical Systems (ADSS). Design of the Linear Accelerator (LINAC) and two additional beam lines on INDUS-2 are expected to be completed during the period.

10. At VECC radioactive Ion Beam Facility-Phase I and final assembly of the two detector array namely charged Particle Multiplicity Filter and BaF2 array will be completed and will be tested with the heavy-on beam from VEC. Superconducting cyclotron building will be complete in all respect by December 2002. Cryogenic delivery system will be ready and the helium plant will be shifted from the present temporary location to the new building. Photon Multiplying Detector (PMD) will be fabricated and installed during 2002-2003 at Brookhaven National Laboratory for the STAR experiment. In addition, Vision Systems Facility for Materials Characterisation and Automated Inspection, performance,

testing and field trials of Artificial Visual Systems, Automatic Inspection and Machine Vision Systems will be completed.

11. Other important R&D activities of DAE during the Annual Plan 2002-03 include: procurement of lead cell equipment; design and development of equipment for Post Irradiation Examination (PIE); setting up of ultra high vacuum facility for preparation of ultra pure niobium metal; standardization of methods for trace & ultra trace analysis of nuclear & strategic materials and quality assurance; development of synthetic procedures for organo-metallic precursors of antimony and indium; synthesis of gram quantities of the precursor compounds for chemical vapor deposition of the metals; development of required critical equipment for decontamination plant, turbo-expanders, helium compressors for 1 kW refrigeration plant and cryo heat exchangers, cold box etc.; construction and commissioning of Nuclear Desalination Demonstration Plant (NDDP) at Kalpakkam; upgradation of Isotope Hydrology Laboratory; computer aided tomography, for advanced industrial non-destructive testing (NDT); fabrication & supply of detector array system; civil construction of Electron Beam Centre (EBC) for radiation processing of high technology products; and the commissioning of 750 kV DC accelerator along with the material handling system which would be used for irradiation studies on various materials. The radiotherapy machine based on 12 MeV Microtron will also be commissioned during this period and the 10 KW, 10 MeV LINAC will be in its final stage of assembly.

DEPARTMENT OF BIOTECHNOLOGY

Review of Achievements During The Year 2001-2002

12. During the Annual Plan 2001-02, National Centre for Plant Genome Research (NCPGR), National Brain Research Centre (NBRC) and National Bio-Resource Development Board (NBDB) have been made fully operational. The National Bioresource Development Board (NBDB) has adopted resource based as well as region-based approaches to make digitized inventories of economically important species other than medicinal plants. Major programmes on genomics including microbial, structural, functional and computational genomics and DNA micro array tool to understand differential expression of genes, silk worm genome, sequences of rice chromosome and sequencing of pathogens have received a big fillip. The guidelines for transgenic plants for Research and Development have been revised and the ethical policy document on “Human genome, genetic research and services” has been published for use by the scientists. National Facility for Containment and Quarantine of Transgenic Planting materials, Patent Facilitating Cell, International Depository Authority for micro organisms and National facility for virus diagnosis of tissue culture raised plants have also been made operational. Technology for diagnostics kits for HIV, Hepatitis-C, Dengue, Japanese Encephalitis, Alfafeto-protein, Hepatitis-A, Reproductive hormones and Banana Bunchy Top virus have been transferred to industries. In addition, several packages for bio-fertilizers, plant tissue culture protocols and bio-remediation technologies have also been given to industries for commercialisation. Recombinant candidate anthrax vaccine for use in humans is being upscaled by one of the industries. Biotechnology programmes for societal benefits have been focused in order to help the target population in rural areas particularly women, SC/ ST and weaker sections. The Women Biotechnology Park at Chennai and a Bio-Village at Mocha, Gujarat have made significant progress.

13. In Agriculture Biotechnology, two molecular diagnostic tools for rapid detection bacterial disease in cotton have been developed. Effective modules/packages that are cost effective, sustainable and eco-friendly have been developed through a network programme on Integrated Pest Management and Integrated Nutrient Management for increasing agriculture productivity in existing cropping systems of various agro-climatic zones. About 50,000 farmers benefited through training programmes and extension activities and around 1600 handouts in regional languages were released. Several biopesticide technologies have been developed based on the large-scale field efficacy. Patents have been filed for the mass production technologies of biocontrol agents and their product formulations. Twenty tissue culture protocols of forest, horticultural/plantation crops have been standardized and ten have been scaled up for large-scale production and commercialization More than 10 million plantlets of tree species have been field planted in an area of 8500 ha. The vegetation mapping and landscape biodiversity characterization of the Andaman and Nicobar islands have been undertaken. Twenty-four genes with implications on stress tolerance have been isolated and a novel cold resistant gene has been identified. US patents have been filed for both of them.

14. In the field of medical biotechnology, the three PCR based diagnostics for tuberculosis have been validated and are ready for commercialisation. A unique mechanism of transport of anti-malarial drug has led to identification of molecules as a possible new drug target. A combined physical and genetic map of whole of the genome of *Shigella dysentery* has been constructed for the first time. Twenty-one diagnostic technologies have been developed and twelve have been transferred to industries for upscaling and commercialisation. Two HIV diagnostic test systems and one Hepatitis-C diagnostics test system have been launched in the market. Significant progress has been made on developing technologies for vaccines for Rabies, Cholera, Malaria, Tuberculosis, Japanese Encephalitis and HIV infections. A formulation consisting of DNA and small amount of protein from the tissue cultured grown rabies virus has completed trials in dogs and cattle and is likely to be made available soon in the market to control rabies in dogs. Under the Indo-US Vaccine Action Programme, the rota virus candidate is ready for clinical trials following clearance from the Drugs Controller General of India. A technology for heat killed whole cell vibrio vaccine, which elicited a strong immune response in shrimp, has been transferred to industry. Immunodiagnostic kits have been developed for detection of four bacterial fish pathogens. A demonstration bioreactor plant for biotreatment of gold ores and concentrates was established at Hutti Gold Mines. This has paved the way for commercial utilization of the bioleaching process for gold recovery and also for other metals like silver, cobalt, copper and zinc.

15. The autonomous institutions namely National Institute of Immunology (NII), New Delhi: National Centre for Cell Science (NCCS), Pune; Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad, National Centre for Plant Genome Research (NCPGR), New Delhi and National Brain Research Centre (NBRC), Gurgaon are involved in pursuing basic and applied research leading to generation of new knowledge, products, patents and publication of papers with high impact factor. During the year, an Institute of Bioresources and Sustainable Development (IBSD) has been established at Imphal, Manipur to develop and utilize the rich bioresources of NE India using tools of Biotechnology.

Activities and Programmes for the Year 2002-2003

16. Besides the ongoing programmes of human resource development, new Post Graduate courses in industrial, environmental, medical and marine biotechnology will be started. New sophisticated biotech facilities like NMR, microarrays, transgenic containment facilities and centers of excellence in biomedical research, marine biotechnology and plant sciences will be taken up and the International Depository Authority would be made fully operational.

17. In agriculture biotechnology, the rice genome sequencing programme would continue and network projects on abiotic stress in rice, improvement of crops like sorghum and chickpea, multi-centric programmes related to buffalo genome, transgenics in farm animals, diagnostics for animal disease, network programme on development of transgenic microbial biofertiliser inoculants, biological Control of pests and diseases of stored grains and food, development of insecticides of plant origin and use of pheromones and improving shelf life of horticulture crops would be initiated. National Bio-resource Development Board would continue its projects on digitized inventories of animal, plant and microbial resources. Leads obtained from bioprospecting and herbal product development programmes would be pursued further for product and process development. Plant Tissue culture consortia would be established net working all existing facilities, besides, Large scale micropropagation and cultivation of medicinal and aromatic plants, coffee, tea, spices, apple and citrus for high quality planting material for cultivation by farmers.

18. In medical biotechnology, research and clinical trials for development of vaccines related to rabies, cholera, malaria and HIV/AIDS will be pursued for logical conclusion for generation of vaccines. New programmes on advance research in stem cell biology and clinical applications will be undertaken. Projects on new drugs through combinatorial chemistry and high sequencing throughput by molecular tools, diagnostics of respiratory disorders and basic research on mechanism of infection will be taken up. Special projects on molecular approaches to understand disorders like diabetes, coronary heart diseases, regenerative diseases and cancer will be initiated. Programmes under human genome and genetic analysis such as pharmacogenomics, molecular genetic studies relating to cancer, microarray studies of gene expression and gene therapy research will also be started.

19. In the area of environmental biotechnology, new projects relating to cleaner technologies and substitution of non-renewable resources and pollution monitoring will be taken up. In the field of microbial and food biotechnology, new projects pertaining to microbial biodegradation of plastic waste, testing of genetically manufactured foods, DNA chip etc., would be taken up. Bioinformatics programme would continue with increased thrust on development of software and R&D.

20. At National Institute of Immunology (NII), New Delhi and National Centre for Cell Science (NCCS), Pune besides continuing the major research activities, new R&D programmes and facilities in health care will be taken up. Centre for DNA Fingerprinting and Diagnostics (CDFD), Hyderabad would continue its major service component involving DNA fingerprinting of forensic cases, besides establishing a disaster management cell. The building construction of National Brain Research Centre (NBRC), Gurgaon and National Centre for Plant Genome Research (NCPGR), New Delhi would be continued and networking of neuroscience laboratories will be further strengthened.

OCEAN SCIENCES

Review of Achievements During the Year 2001-2002

21. One of the major events during 2001-02 was India's election as Vice-Chairman of Inter-governmental Oceanographic Commission and participation in several international meetings relating to Antarctica, Polymetallic nodules etc. The XXI Indian Scientific Expedition to Antarctica was launched from Cape Town, South Africa. The major scientific objectives of this expedition encompassed a wide spectrum of pure and applied sciences, ranging from atmospheric sciences and meteorology to biological, environmental, medical and earth sciences. Besides continuing some of the ongoing scientific and logistics projects initiated during the earlier years, the XXI expedition initiated some new scientific experiments which include 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, hydrographic surveys in the Antarctic waters etc. Under the drugs from the sea programme, rodent toxicity testing of three candidate preparations was completed.

22. Under the Polymetallic Nodules programme, an additional 20% of the pioneer area was relinquished to the International Sea Bed Authority as a part of the International obligation. The required environmental impact assessment study prior to exploitation of nodules were continued. Under the Technology Development programme for mining, development of manipulator for underwater operation and testing of materials for deep sea operations etc. were carried out, besides testing of an upgraded version of Remotely Operated Vehicle (ROV), developed by Central Mechanical Engineering Research Institute (CMERI), at a water depth of 200 m off Chennai Port. Under the Metallurgy programme, the erection & commissioning of demonstration pilot plant at 500 kg/day capacity nodules throughput at Hindustan Zinc Limited (HZL), Udaipur, for validation of the flow sheet developed by Regional Research Laboratory (RRL), Bhubaneshwar and Bhabha Atomic Research Centre (BARC), Mumbai was in progress. Other studies relating to the extraction efficiencies for metals were also continued. Assessment of the levels of pollution at 34 locations including 12 areas of hot spots and determination of pollution dynamics in the coastal waters of Mangalore, Visakhapatnam and Paradeep was carried out under the Coastal Ocean Monitoring And Prediction System (COMAPS). Coastal Research Vessel (CRV) Sagar Purvi & Sagar Paschimi carried out 40 cruises for pollution monitoring both in the east and west coast and a special survey using multi beam eco sounder was conducted for Tuticorin harbour area as an aid for navigation. Some of the important achievements under the Integrated Coastal & Marine Area Management (ICMAM) programme include: development of Geographical Information System (GIS) for coastal habitats; determination of Waste Assimilation Capacity for Tapi estuary and Ennore coastal waters; development of Environmental Impact Assessment (EIA) guidelines for waste disposal and tourism; and preparation of Draft ICMAM plan for Chennai. Training programmes were also conducted on application of Geographical Information System (GIS) for the management of coastal habitats.

23. National Institute of Ocean Technology (NIOT) carried out studies on 1 MW Ocean Thermal Energy Conversion (OTEC) plant and a final report on the pilot scale demonstration of technology for 1 MW OTEC plant was prepared. A water desalination plant was also commissioned at Vizhinjam. The activities under deep sea technologies and ocean mining include: *In-situ* measurement of soil properties at Indian nodule mining site at

6000 meter water depth, mining applications development using underwater crawler vehicle, development of underwater thrusters, smart solids handling jet pump etc. Marine instrumentation development programme led to the development of second generation State-of-the-art Acoustic Tide Gauges, Prototype Acoustic Sub-system Profiler transducer with improved band width, deep-water prototype Acoustic Pinger system etc., besides establishment of test and calibration procedure for underwater transducers.

Activities And Programmes for the Year 2002-2003

24. During the Annual Plan 2002-03, XXII Indian Scientific Expedition to Antarctica would be launched and activities for setting up a second permanent Indian station in Antarctica would be initiated, besides development of core-competence and research programmes in the fields of Polar Remote Sensing, Southern Ocean Oceanography & Paleoclimatology. A multi-institutional and multi-disciplinary cruise of about 100 days duration would be undertaken in the Southern Ocean by chartering an ice-class vessel with facilities for acquisition of oceanographic data and retrieval of sediment cores. Under the Drugs from the sea programme the regulatory pharmacology and toxicology of the anti-diabetic and anti-diarrhoeal leads would be completed.

25. The activities under the Polymetallic Nodules programme would include: updating of geo-statistical resource evaluation in the retained area; survey using multi-frequency exploration system along the selected profiles for identifying and validating the trends of higher abundance of nodules at the retained area at Central Indian Ocean Basin (CIOB); EIA studies by collection of samples at the test and reference areas; deployment of underwater mining system for collecting manganese nodules including development of collector and crusher and its interpretation; detailed design of the soil tester; fabrication of mechanical frame, assembly and integration of hydraulic power pack, etc; development of design concept for underwater collection system and integrated deep-sea mining system for mining manganese nodules from 6000 m depth; modification of crawler hydraulics with adequate cooling arrangements; preliminary demonstration of performance of crawler in a suitable site and development of components / experimental investigations on deep sea technologies. Under the Remotely Operable Vehicle programme, activities such as preparation of a detail design report for ROV subsystems, Cage subsystems, Handling, Console subsystems and Control van subsystems, and their fabrication will be carried out. The National Metallurgical Laboratory (NML), Jamshedpur will continue the work on the process package development for extraction of manganese from the leach residue. In addition, a number of supporting studies refining the processing technologies for improvement of the recovery of metal values would be initiated.

26. Some of the other programmes envisaged during the Tenth Five Year Plan include: (i) Comprehensive Swath Bathymetry of entire exclusive economic zone (EEZ); (ii) Deep Sea Mineral Resources Exploration; (iii) Bay of Bengal Fan (BENFAN) programme.

SPACE SCIENCES

Review of Achievements During the Year 2001-02

27. The successful first test flight of Geo-synchronous Satellite Launch Vehicle (GSLV) from Sriharikota on April 18, 2001 was the most significant milestone of the Indian space programme. The launch unequivocally demonstrated India's capability to place satellites

into geo-synchronous transfer orbits. India is the sixth nation in the world to achieve such a capability. The launch of GSLV is the culmination of decade-long complex development efforts involving Cryo stage, which is first of its kind to ISRO.

28. Another important milestone during the year was the successful flight of PSLV-C3 on October 22, 2001 from Sriharikota. In this fifth consecutively successful flight, PSLV placed three satellites viz., India's Technology Experiment Satellite (TES), Belgian PROBA and German BIRD into their intended Polar sun-synchronous orbit. The flight has enhanced the reliability and established the capability of PSLV to launch multiple satellites into multiple orbits. The TES satellite incorporates a panchromatic camera providing a spatial resolution of up to 1 meter and has given further fillip to advance the technology of remote sensing in India. It has enabled testing of advanced spacecraft and payload technologies of relevance for future high resolution imaging systems.

29. The indigenous Cryogenic Upper Stage Project (CUSP) crossed a major milestone this year with the successful testing of the cryo engine for 12 minutes, which is equivalent to its flight duration in GSLV. This test is the culmination of design and development efforts in multiple disciplines by ISRO in close association with industry and academia and has established capability in this sophisticated and complex technology area. The work on Second Launch Pad is progressing well and the civil works including the erection of major structures like umbilical tower, lightning protection towers, mobile launch pedestal and realisation of mechanical, process and electrical, control and instrumentation equipment are nearing completion.

30. Another important technology development during the year has been the successful testing of the High Performance composite Motor (HPM) for third stage of PSLV. This HPM will enhance the payload lift of capability of PSLV required for launching METSAT into GTO. The work on Space Capsule Recovery Experiment and GSLV Mk III project have also been initiated during the year. The Space Capsule Recovery Experiment, to be flown on PSLV in 2003-04, is intended to develop critical technologies related to the re-entry and to conduct microgravity experiments. The configuration of GSLV MK III, intended to develop a cost-effective launch vehicle capable of launching 4T INSAT type of satellites has been finalised after extensive studies.

31. The successful launching of INSAT-3C satellite on 24th January 2002 has been an important achievement during the year under INSAT programme. The spacecraft is functioning satisfactorily and has been put to operational use. INSAT-3C has augmented the INSAT space segment capacity significantly and provides fixed and broadcast satellite services and mobile satellite services for various users. Substantial progress has also been achieved in payload and spacecraft fabrication during the year for METSAT satellite, planned for launch onboard PSLV in early 2002. The satellite carries a very high resolution radiometer (VHRR) and is intended to provide meteorological data for Weather forecasts including Cyclone detection and warning.

32. The remote sensing applications continue to expand to several new areas. The data has been used to assess damage due to floods, earthquakes and for helping in relief operations. One of the important applications of IRS during the year has been the land slide hazard zonation along the important tourist and pilgrim routes in Himalayas, which was taken up to mitigate the hazards of land slides. Another important application area

during the year has been the Waste land mapping wherein the satellite imageries have been used to bring out a comprehensive wasteland atlas of India to facilitate strategic planning of wasteland development.

33. Significant progress has been achieved in the expansion of the GRAMSAT satellite based network for developmental applications. The expansion of the Jhabua network has been completed and the network now has almost 1000 Direct Reception Terminals (DRS) installed in three districts of Madhya Pradesh for developmental communications programme. GRAMSAT satellite based networks have been setup in Orissa, Gujarat, Karnataka and Goa also. The Tele-medicine mission, initiated last year, has been implemented in Karnataka and NEC also.

Activities And Programmes for the Year 2002-2003

34. The main thrust of INSAT programme during 2002-03 will be to launch and operationalise INSAT-3A and 3E satellites to augment the INSAT system capacity and to undertake work on fourth generation INSAT-4 series. While the Meteorological Satellite (METSAT-1) is planned to be launched and operationalised in 2002-03 for providing regular meteorological data, substantial progress is also targeted in the development of advanced meteorological payload for INSAT-3D. Realisation of Resourcesat-1 (IRS-P6) to provide continuity of remote sensing data will be an important target during the year under IRS programme. Substantial progress is planned in Cartosat-1 (IRS-P5) project and it is targeted to complete the assembly, integration and testing of the satellite leading to the launch of the spacecraft in early 2003. The work on Radar Imaging Satellite (RISAT-1), which is intended to provide all-weather capability for crucial applications including agriculture and disaster management support, is also planned to be initiated during the year.

35. In the area of launch vehicles an important target during the Annual plan 2002-03 is the realisation of Second Launch Pad at Sriharikota including integration, testing and commissioning of the Launch Pad. The Second Launch Pad will enable operational launch services with a quick turn around time, besides providing redundancy for the existing launch pad. Under the Indigenous Cryogenic Upper Stage project, the efforts will be directed towards realisation of additional engines, completion of engine test programme and proto-stage realisation. The second development flight of GSLV-D2 carrying GSAT-2 and the operational flights of PSLV to launch METSAT and Resourcesat-1 are other important milestones in the launch vehicle area planned in 2002-03. The work initiated last year on GSLV MK-III and Space Capsule Recovery Experiment will be progressed further commensurate with their realisation schedule.

36. In the area of Space applications, the focus of the efforts will be to expand the GRAMSAT network covering more number of States including Rajasthan, NE States, Andhra Pradesh, Uttaranchal, Andaman & Nicobar, Himachal Pradesh and West Bengal. 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. Significant progress in development of Space Science payloads for wide energy band X-ray observations for ASTROSAT mission is also planned during the year.

SCIENCE & TECHNOLOGY

Review of Achievements during the Year 2001-2002

37. The Department of Science & Technology has continued its efforts to accelerate the pace of implementation of R&D programmes in frontier and emerging areas of Science & Technology. Science & Engineering Research Council (SERC) supported a number of R&D programmes in challenging areas particularly those, which are inter-disciplinary in nature, involving multi-institutional programme and encouraging brilliant young scientists. Seven patents have been filed on SERC funded projects so far during the year with the assistance from the Patent Facilitating Cell (PFC). A new initiative in the area of Nano-materials has been launched, which aims at strengthening R&D in basic as well as application areas of nano-materials. 120 fellows received fellowships under the Kishore Vaigyanik Prothsahan Yojana (KVPY) and 115 new projects were supported under SERC Fast Track Scheme for Young Scientists. The analog controller for Permanent Magnet Brushless motor was commercialized in collaboration with industry and is presently used for CNC applications. Improved adsorbents have been developed with higher selectivity and capacity for the separation of nitrogen, oxygen and argon from air. A major project on Electron Beam Physical Vapour Deposition Technology for thick film and thin film coatings on sophisticated and complex components has been supported with partial funding from DRDO. Setting up several research facilities was also supported during the year which include: National facility for Electron Beam PVD System at ARC-Hyderabad; NMR Facilities at IIT-Mumbai & Chennai; and Single Crystal Diffraction Facility for Structural Chemistry at IISc-Bangalore. Establishment of Low Temperature-High Magnetic field facilities; Non-linear Dynamics Unit-Phase II; extension of National Single Crystal X-ray diffractometer facility at University of Hyderabad; Large Gamma Ray Detector facility etc. were also taken up.

38. More than 200 strong motion instruments have been set up in various parts of Himalaya at selected locations for structural response studies. These instruments have generated valuable data sets on the recent major earthquakes including the latest events of Chamoli (March 1999) and Bhuj (January 26th, 2001). In order to have near-real time access to the seismological data, a project for linking up the existing seismological network and National Seismological Data Center (NSDC), IMD, through V-SATs has been sanctioned to National Informatics Center Services Inc., New Delhi. Permanent Geographical positioning System (GPS) Stations at Hanle, Almorah, Koddaicanal, Leh, Dharmasala, Dehradun, Itanagar, Pune, Bhubaneswar and Trivandrum have already been established and the work is in progress at Lucknow, Jabalpur, Delhi, Shillong and Dhanbad. After the recent Bhuj Earthquake, the Department of Science and Technology has initiated an extensive programme for GPS campaign in the Rann of Kutchh to monitor the deformation of the region near the epicenter of the Bhuj Earthquake. An Earthquake Risk Evaluation Center is also being established at India Meteorological Department, New Delhi to collate and integrate all the existing seismological and collateral geophysical data and prepare the earthquake risk maps for the country.

39. Technology Development programme has led to the development of equipments like: Dispergraph for measurement of carbon black dispersion in rubber, Ceramic humidity sensor, Computer controlled system for mixed juice flow stabilization in white sugar manufacturing process; Portable analytical X ray imaging system, Electronic control for

creel of warping machine for shuttle looms, Electrofusion apparatus for immunotherapy and DNA transfusion, Anesthesia ventilator, Microprocessor based ECG simulator, Equipment for separation of contaminants in Indian cotton, etc.

40. India Meteorological Department received two Doppler Radars, one of which was installed at Chennai and installation of other at Kolkata was also taken up. Civil Works for one more indigenously fabricated Doppler Radar by ISRO was also completed at Shriharikota (A.P.). Under the World Bank Assisted Project for Andhra Pradesh, procurement of 3 Doppler Radars and 10 High Wind Speed Recorders (HWSR) was finalized. Ten High Wind Speed Recorder (HWSR) were installed in coastal stations and two sets of Skopgraphs were installed, one each at Delhi and Kolkata airports for automatic landing of aircrafts. Action is in progress for upgradation of existing Earth Station for METSAT and Earth Station for INSAT-3A. In addition, three seismographs were installed under Seismological Telemetery System. National Centre for Medium Range Weather Forecasting (NCMRWF) started **s**even days forecasts along with weekly cumulative rainfall forecasts since May 2001. Temporal range of daily location specific medium range weather forecast disseminated to 81 Agro-meteorological Advisory Services (AAS) units was increased from 3 days to 4 days in real time from April 2001. Weekly cumulative rainfall forecast is also being issued to 81 AAS units from April 2001. One more AAS unit was opened at Allahabad Agricultural Institute during the year, to make the total number of units as 82. NCMRWF also issued special forecast on clouds, precipitation, winds and temperature for the Indian Army Mountaineering Expedition to the Mt. Everest during 5 May- 28 May 2001. A 24-processor Cray SV1 system was installed in May 2001. Total number of Very Small Aperture Terminals (VSATs) operating on the network has been enhanced to 75. There are in all 81 Agro Meteorological Forecasting Units (AMFUs) that are currently functioning. An alternative solution based on internet was developed and successfully tested for communicating the forecast to AMFU.

Activities and Programmes for the Year 2002-2003

41. During the year 2002-03, the emphasis would be on supporting more fundamental research projects in the academic sector particularly in the universities, besides setting up of a number of national facilities and centers viz. National Centre for Clinical Trials; Facility for new applications of Flow-Cytometry and cell sorting in areas of Biotechnology; Low Temperature – High Magnetic field facilities; National facility for geo-chemical research; High Resolution NMR Facilities; National facility for Screening for Anti-viral Activity; Pharmacokinetic; Metabolic Studies etc. Support for basic research and application oriented programmes in nano-materials would be provided under Nano-material Science & Technology Mission. Under the Fund for Improvement of S&T Infrastructure in Universities and Higher Educational Institutions (FIST) Program, support would be provided for equipment, networking and computational facility and infrastructure facility and maintenance. Under the Natural Resource Data Management System (NRDMS), creation of new NRDMS database centres, development and dissemination of spatial data management tools, initiation of new R&D projects etc. would be taken up. Mission Mode Programmes on Bamboo Product technology and Instrument Development would be initiated, with the objective of developing technologies for utilization of bamboo and development of analytical/scientific instrumentation, medical instrumentation, instruments for environment/pollution monitoring and imaging technologies etc. Collaborative research projects in the areas of diseases like tuberculosis, leprosy, malaria, leucoderma, diabetes

etc. would also be supported besides development of veterinary drugs and herbal drugs. S&T Entrepreneurship Development Programme would focus on developing technology business incubators on mission mode, while continuing the on-going activities. It is also proposed to set up university chairs for promotion of teaching and research on S&T communication, besides setting up of a National Institute in S&T Communication and an autonomous Council for Astronomy and Space Science.

42. Major activities of India Meteorological Department would be : installation of ten sets of laser ceilometers at National/International airports for safe and efficient air navigation; procurement of three Doppler weather Radars, 100 Cyclone Warning Disaster Systems (CWDS) and ten High Wind Speed Recorders (HWSRs) for installation over east and west coasts under the World Bank aided Andhra Pradesh Project. In addition, three high frequency transmitters for efficient transmission of meteorological data would be installed, besides modernization of Air Pollution Laboratory at Pune. National Satellite Data Centre would be established at the IMD headquarters, New Delhi and the ground segment for reception and processing of meteorological data from INSAT-3D satellite would be installed. An Earthquake Risk Evaluation Centre would also be established at the IMD headquarters, New Delhi. The National Centre for Medium Range Weather Forecasting (NCMRWF) would be engaged in enhancing the spatial resolution, range and accuracy of forecasts and advisories by constantly improving the global/regional forecast models with optimal use of satellite data and interpretation techniques. Appropriate meso-scale models will be run operationally for site specific weather forecasts of smaller spatial scale for some of the Agro Meteorological Forecasting Units (AMFUs) and suitable meso-scale and cloud scales models would be developed and implemented for application in mountain meteorology and weather modification programmes. National Atlas and Thematic Mapping Organization (NATMO) would be engaged in activities relating to revision of National Atlas of India, Health & Disease Atlas of India, Satellite Atlas of India, etc., besides state atlases of Uttranchal, Chattisgarh and Jharkhand. Survey of India would be augmenting training facilities in digital cartography, digital photogrammetry and geodesy, besides modernization of its printing facilities.

SCIENTIFIC AND INDUSTRIAL RESEARCH

Review of Achievements during the year 2001-02

43. The Department of Scientific and Industrial Research (DSIR) is mainly concerned with promotion of industrial R&D, support to development & acquisition of new technologies, management & export of technology, development of consultancy capabilities and information systems in the country. The DSIR also provides administrative cover for the Council of Scientific and Industrial Research (CSIR) with its chain of national laboratories. Some of the important DSIR funded projects which were completed during the year include: development of in-plant material handling equipment, energy efficient drying system, 5-axes CNC internal grinding machine, process of manufacturer of furfuryl alcohol, nickel extraction technology etc. 73 new in-house R&D units and 22 new SIROs were recognized during the year. Around 50 public funded research organisations/institutions were registered with DSIR for purposes of availing Customs Duty Exemption on imports made for R&D and central excise duty exemption on domestic purchases for R&D. Under the Technopreneur Promotion Programme (TePP), tiltable innovative bullock cart, and bullock operated generator with accessories were developed.

44. CSIR through its chain of 39 National Laboratories continued to provide S&T inputs for development of socioeconomic sectors. On the Industrial front, it partnered Indian industry in the areas of : Leather, Steel, Petro Chemicals, Drugs & Pharma etc. It spearheaded newer avenues for industry for catalyzing of domestic civil aircraft industry through design & fabrication of civil aircrafts, Hansa – an all composite two-seat aircraft; and Saras - a unique, multipurpose 14-seat light transport aircraft. The know-how for manufacture of Hansa-3 trainer aircraft was licensed to a private sector firm and commercial production of the aircraft has commenced with the first order of five aircrafts. On the resources front, CSIR labs have assisted the nation in deriving enhanced and sustainable value from endogenous resources. India is now number one producer of Menthol Mint oil due to new high yielding mentha varieties developed at CIMAP. Similarly, development of technology for extraction of fresh ginger oil from fresh ginger has enabled the setting up of a processing plant producing ginger oil at 10ton/day in North-East. On the R & D front important contributions of CSIR include : development of DNA markers to detect male specific differences in papaya; development of a versatile universal polymer support, devoid of nucleotidic material and compatible with the existing methods of synthesis and deprotection of oligodeoxyribo and oligobionucleotides; development of a new plant based anti-malarial drug 'E-MAL' having rapid and short time fever clearance along with a new drug for treatment of recurring malaria 'Bulaquine' which has no side effects as observed with primaquine; a new herbal preparation 'Asmon' for treatment of Asthma which has received universal acclaim; a herbal hepato-protective formulation containing 18 herbs which is ready for commercialization; three herbal creams useful for treatment cracked heels, corns, eczema and cosmetic applications, etc. A software has been developed to tele-connect the PCs to the National Physical Laboratory Atomic Clock for automatically correcting the real time clock. In addition fly ash soil amendment technology has been developed and extensively demonstrated through field trials with varying proportions of fly ash under different agro climatic conditions and soil types in different parts of the country for cultivation of various cereals, roots, leguminous and vegetable crops. A head up display was also developed for display of vital flight parameters for the light combat aircraft and the technology has been transferred to Bharat Electronics Limited for commercial production. On the intellectual property front, CSIR has pioneered globally the concept of according due recognition and privileged position to traditional knowledge in the Intellectual Property Rights (IPR) domain. As a result, properly documented and codified traditional knowledge has now been accepted internationally for 'prior-art-search' in granting of IPR. CSIR also continues to be the leader in India in filing patents, with the filing of 410 patents in India and 583 abroad. On the Human Resource Development front, CSIR continued to provide yeoman services to attract, foster, sustain and help in upgradation of the stock of the highly specialized scientists, engineers and technologists required for R&D, in diverse disciplines of S&T, in the country. It has initiated a novel scheme - Shyama Prasad Mukherjee Fellowship, to recognize & reward creativity and innovative thinking at the post-graduate level. CSIR nurtured around 200 extramural research schemes, besides awarding 200 Junior and Senior Research Fellowships and Associateships. In the area of S & T for rural development, a water purification disc that can be fabricated by a village potter using red clay, sand, saw dust was developed for filtering turbid water. The disc can be fitted at the bottom of an earthen pot or a bucket and has a life of five years. In addition, a manually operated ultrapore membrane based water purifier was also designed and developed that can remove virus and bacteria.

Activities And Programmes for the Year 2002-2003

45. The schemes & programmes of DSIR act as specific and important links in the technological innovation chain. During the Annual Plan (2002-03), DSIR would pursue Technology Promotion, Development and Utilization programmes with the objective of providing leveraging support to new technology development projects in industry, management and trade of technology and related Services, etc. DSIR would also support two Public Sector Enterprises viz. Central Electronics Limited (CEL) and National Research Development Corporation (NRDC) for development of technologies for production of solar cells & SPV systems, electronic components, electronic systems etc. and promotion of domestic technology transfer, export of technology and invention promotion.

46. Council of Scientific & Industrial Research has drawn up its strategy to undertake programmes in a project mode during the Tenth Five year Plan and Annual Plan (2002-03) that would lead to: development of technology for the Indian industry to become globally competitive; finding holistic and optimal solutions to the pressing problems of the people; and innovation in all spheres of activities ranging from science to technology management to financing. The emphasis of the National Laboratories would be to carry out the programmes in networked mode. Fifty five programmes/projects are proposed to be taken up, which include : Asthmatic and allergic disorders mitigation mission; Spearheading design, development & manufacture of small civilian aircraft; Exploration and exploitation of microbial wealth of India for novel compounds and bio-transformation processes; Molecular biology of selected pathogens for developing drug targets; Study of mesozoic sediments for hydrocarbon exploration; Newer scientific herbal preparations for global positioning; Pollution monitoring & mitigation systems and devices; Special electron tube technologies for large scale applications; Comprehensive traditional knowledge digital documentation and library; and Environment friendly Leather Processing Technologies. CSIR has also proposed to implement programmes wherein laboratories strength would be synergised to realize the benefits from investments made in the past such as: Development of specialised aerospace materials; Toxico-genomics of polymorphism in Indian population to industrial chemicals for development of biomarkers; Medicinal plant chemotypes for enhanced marker and value added compounds; Coordinated programmes on catalysis & catalysts; Development of green technologies for organic chemicals; Development of Micro-electro-mechanical systems (Mems) and Sensors; Drug target development using in-silico biology; and Bio-mineral processing for extraction of metals from ores and concentrates. CSIR has also proposed few core programmes to address newer market opportunities and to partner Indian industry to be globally competitive. Some of the significant ones are: Development of globally competitive chemical processes and products; Development of key technologies for photonics and opto electronics; Development of custom tailored special materials; Comprehensive technology packages for disaster prevention and management in underground coalfields; Physico-mechanical, electrical and electronic standards; Acquisition of oceanographic research vessel; Establishment of Referral Centre for genetically modified foods; Establishment of world class drug research institute; Creation of advanced facility for safety evaluation of genetically modified/engineered drugs; etc.

47. Most of the CSIR laboratories are about four decades ago. The infrastructure presently available is not suitable for modern day globally competitive R&D especially in term of international systems of quality assurance such as GLP, ISO, NABL for

accreditation and certification. Therefore, a new scheme for 'Infrastructure Renovation and Refurbishment', would be initiated during the Annual Plan (2002-03).

48. CSIR has also been assigned the responsibility to conceptualise and manage the pioneering and far reaching initiative viz. 'New Millennium Indian Technology Leadership Initiative', which seeks to support innovation centered scientific and technological developments as a vehicle to attain for the country a global leadership position in some selective niche areas. CSIR through large scale national consultations and brainstorming in true 'Team India' spirit has initiated nine state-of-art projects encompassing 55 R&D institutions & 20 Industrial firms. Another eight projects would be taken up in 2002-2003.

49. The details of the plan outlays/expenditure for the S&T sector are given in Annexure-10.1 and 10.2.

Annexure 10.1

Central Scientific Departments Progress of Plan Expenditure

(Rupees in Crore)

S. No.	S&T Departments/Agencies	Ninth Plan 1997-02 Outlay	Annual Plan 2000-01		Annual Plan 2001-02		Ninth Plan 1997-02 A.E.	Annual Plan 2002-03 Outlay
			Outlay	Actuals	Outlay	RE		
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	Department of Atomic Energy (R&D Sector)	1500.00	420.00	367.89	459.00	417.86	1523.75	535.00
2	Deptt. of Ocean Development	510.62	135.00	79.89	142.00	120.00	452.93	175.00
3	Deptt. of Science and Technology*	1497.35	362.00	340.22	410.00	398.00	1515.40	625.00
4	Deptt. Of Bio-technology	675.00	125.00	140.90	175.00	175.00	622.05	225.00
5	Scientific & Industrial Research	1327.48	355.00	314.84	360.00	340.42	1369.27	440.00
6	Department of Space	6511.72	1700.00	1593.98	1710.00	1600.00	6622.80	1950.00
	Grand Total	**12022.17**	**3097.00**	**2837.72**	**3256.00**	**3051.28**	**12106.20**	**3950.00**

Annexure 10.2

S&T Plan Outlay for Ninth Plan (1997-2002) under State Plan

(Rs. in lakh)

S. No.	States/UTs	9th Plan (1997-2002) Outlay	2000-01 B.E.	2000-01 Actual	2001-02 B.E.	2001-02 R.E.	9th Plan (1997-2002) Anti.Expdr.	Annual plan 2002-03 Outlay
1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**
1	Andhra Pradesh	937.00	56.22	98.00*	20.00	96.00	830.00	105.00
2	Arunachal Pradesh	105.00	223.07	222.00	123.56!	124.00	404.63	126.00
3	Assam	1350.00	60.00	60.00	163.00	163.00	489.00	145.00
4	Bihar	2154.00@	300.00	0.00	79.55	30.00	687.00	0.00
5	Chattisgarh	0.00	0.00	0.00	0.00	47.00	47.00	48.00
6	Goa	308.00	65.00	56.00	25.00	25.00	187.00	35.00
7	Gujarat	3125.00	675.00$	272.00$	620.00$	6500.00$	8675.00	6524.00
8	Haryana	642.00	150.00	149.00	150.00	150.00	532.00	110.00
9	Himachal.Pradesh	600.00	146.00	146.00	N.A.	0.00	500.00	128.00
10	Jammu &Kashmir	320.00	74.37	63.00	76.87	614.00	823.80	576.00
11	Jharkhand	0.00	0.00	0.00	0.00	0.00	0.00	6000.00*
12	Karnataka	2500.00	170.00	167.00	156.00	156.00	1079.49	182.00
13	Kerala	7500.00*	1885.00*	1900.00*	1750.00*	1750.00*	8343.00	2500.00*
14	Madhya.Pradesh	935.00	162.00	134.00	170.00	170.00	663.00	172.00
15	Maharashtra	885.00	181.30	347.00	200.00	145.00	1285.00	23.00
16	Manipur	720.00	75.00	44.00	N.A.	223.00	469.00	195.00
17	Maghalaya	450.00	93.00	88.00	93.00	93.00	444.00	85.00
18	Mizoram	291.00	90.00	90.00	110.00	110.00	386.00	110.00
19	Nagaland	400.00	17.00	45.00	32.00	32.00	335.00	20.00
20	Orissa	1655.00	215.68	1034.00	167.47	539.00	2946.48	320.00**
21	Punjab	3619.00	138.70	46.00	131.10	56.00	480.19	263.00
22	Rajasthan	1051.00	100.00	96.00	60.00	60.00	579.00	215.00
23	Sikkim	800.00	70.00	80.00	N.A.	70.00	336.00	75.00
24	Tamil Nadu	2010.00	219.23	219.00	337.44	337.00	1268.93	204.00
25	Tripura	222.00	27.81	29.00	100.00	42.00	195.61	20.00
26	Uttar Pradesh	3080.00	462.00	400.00	462.00	462.00	2270.00	825.00
27	Uttranchal	0.00	0.00	27.00	0.00	60.00	87.00	361.00
28	West Bengal	988.01	155.00$	723.00$	329.30$	3753.00$	4988.00	3507.00
	Total States	**36647.01**	**5811.38**	**6535.00**	**5356.29**	**15807.00**	**23523.50**	**22874.00**
	U.Ts.							
1	A&N Islands	199.85	20.00	22.44	20.00	20.00	104.56	35.00
2	Chandigarh	37.00	18.00	16.50	32.00	32.00	85.97	15.00
3	D & N Haveli	30.00	6.00	7.50	6.00	6.00	32.19	6.00
4	Delhi	15.00	4.00	50.00	5.00	385.00	459.70	130.00
5	Daman & Diu	47.00	22.00	9.81	10.00	10.00	45.43	13.00
6	Lakshadweep	643.81	35.57	39.33	41.00	37.24	168.08	63.00
7	Pondicherry	60.00	35.00	25.53	35.00	35.00	120.65	35.00
	Total UTs.	**1032.66**	**140.57**	**171.11**	**149.00**	**525.24**	**491.34**	**297.00**
	Grand Total	**37679.67**	**5951.95**	**6706.11**	**5505.29**	**16332.24**	**29589.02**	**23171.00**

*Including Ecology and Environment, @ excluding Technical Education, ! Including earmarked outlay for TFC
$ excluding Information Technology., ** indicates proposed outlay, N.A. Not Available