Annual Report

2016–2017

सत्यमेव जयते

Department of Scientific & Industrial Research

Ministry of Science & Technology

http://www.dsir.gov.in

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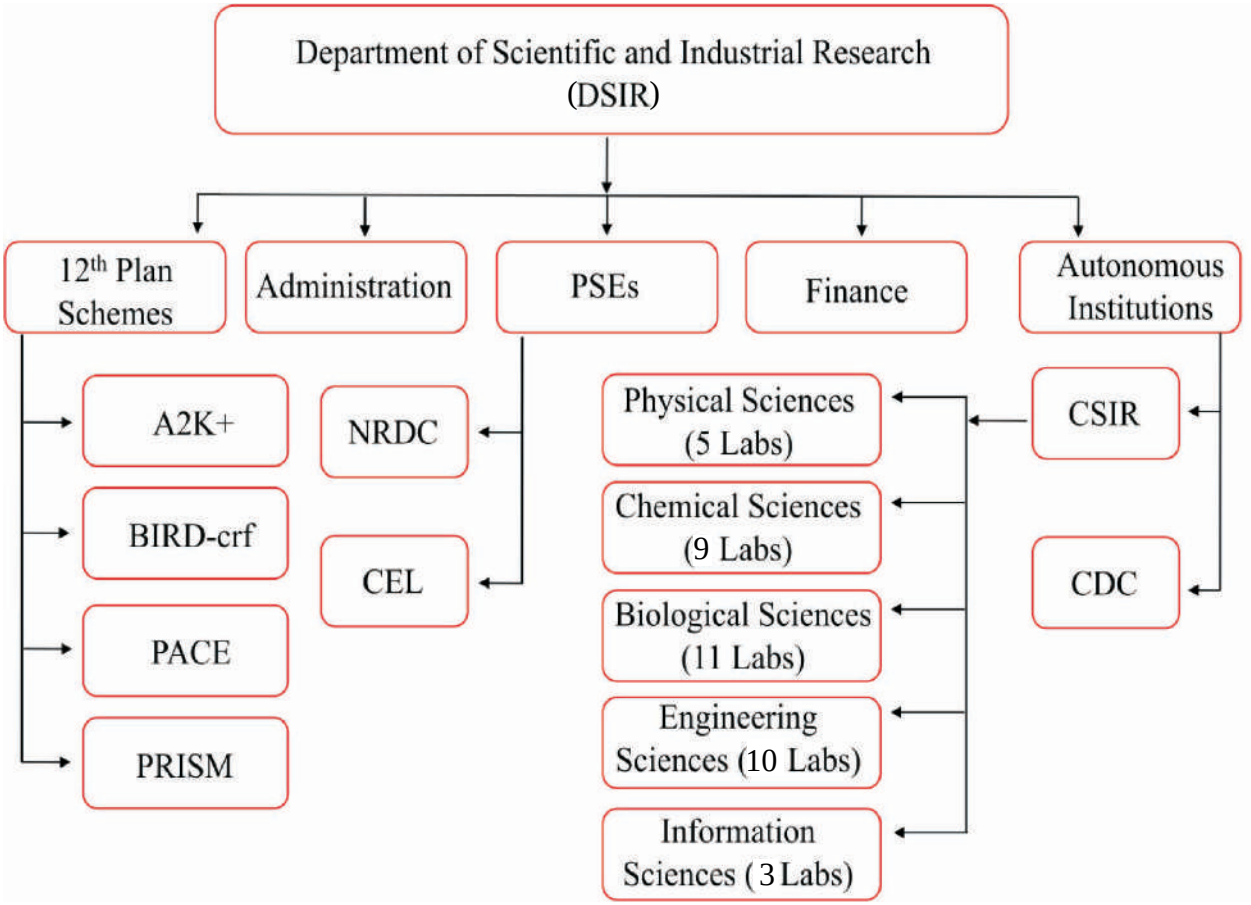
FUNCTIONAL STRUCTURE



A2K+	Access to Knowledge Development and Dissemination.
BIRD-crf	Building Industrial Research & Development and Common Research Facility
PACE	Patent Acquisition and Collaborative Research and Technology Development
PRISM	Promoting Innovation in Individual, Start-ups and MSMEs
PSEs	Public Sector Enterprises
NRDC	National Research Development Corporation
CEL	Central Electronic Limited
CSIR	Council for Scientific and Industrial Research
CDC	Consultancy Development Centre

Highlights of Annual Report 2016-17

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Highlights of Annual Report 2016-17

i. The department has successfully completed a total of 15 projects supported under PRISM (Promoting Innovations in Individuals, Start-ups and MSME's) / erstwhile TePP (Technopreneur Promotion Programme). Some of the successfully completed projects are Cost-effective bio-material for wound care, Mechanical Hoe, Development of low cost sequence embroidery machine for Zari and Zardozi work, Development and commercial production of bio-product from bio-mass, Partial replacement of Sand by Foundry Waste to make M30 grade concrete.

ii. A2K+ -Events program received 56 proposals. In A2K+ Studies program, 10 studies on various subject areas were recommended by the Technical Advisory Committee. Among 10 proposals, four studies were approved. Under Technology Development & Utilization Programme for Women (TDUPW), 5 proposals were recommended by TAC and 3 projects were ongoing.

iii. CRTDH programme had set up 2 hubs in the sector of Affordable health at CSIR-IHBT, Palampur and CSIR-CCMB, Hyderabad and 1 hub in the sector of Environmental interventions at CSIR-NIIST, Thiruvanthapuram. Durring the current year, Department is in the process of inviting applications from enterprises to work in these hubs.

iv. DSIR is the nodal department for granting recognition to In-house Research and Development centres of industry. As on 30th November, 2016, there were 1880 In-house R&D centres with DSIR recognition, of the 115 companies incurred an annual (R&D) expenditure of over Rs. 50 crores each, 509 companies incurred an annual (R&D) expenditure in the range of Rs. 5 crore to Rs. 50 crores and 411 industries incurred an annual (R&D) expenditure in the range of Rs. 2 crore to Rs. 5 crores.

v. Public funded research institutions, Universities, IITs, IISc and NITs registered under PFRI program of DSIR can avail Customs Duty and Central Excise Duty exemptions under notifications 51/96-Customs and 10/97-Central Excise as amended from time to time. During the period under report 12 such institutions were newly registered with DSIR and 162 institutions were granted renewal of registration.

vi. 48 new Scientific & Industrial Research Organisations (SIROs) were recognized by DSIR during the period under report.

vii. Secretary DSIR, designated as the Prescribed Authority accorded fresh approvals to **110** companies under section 35(2AB) of Income-tax Act, 1961. The detailed R&D expenditure of the approved companies has been examined by DSIR and **485** reports valued at **Rs. 13774 crores** have been forwarded to Chief Commisioner Income Tax (Exemption) in Form 3CL, as required under the IT Act.

viii. DSIR played an active role in APCTT's functioning, particularly relating to its programmes and policies. DSIR has extended programme support towards the APCTT project entitled, "Promotion of National Innovation Systems (NIS) in Countries of the Asia-Pacific Region – Phase II" which concluded in 2016.

ix. IT-eG division progressively implements e-Governance in the Department, which is in conformance to the National eGovernance Action Plan. A project entitled 'Design, Development, Implementation of Enterprise Application and Maintenance Support Services for DSIR' is ongoing.

x. The Right to Information Act 2005 has been implemented successfully in the department. The proactive disclosures are regularly updated and available on the DSIR Website. DSIR has received 193 Applications during 2016 and all the applications were registered and disposed off on RTI Request & Appeal Management Information System.

xi. CSIR, an autonomous organization is placed at 84th among 4851 institutions worldwide and is the only Indian organization among the top 100 global institutions (Scimago Institutions Ranking World Report 2014). CSIR holds the 17th rank in Asia and leads the country at the first position. From research output perspective, CSIR is ranked 72 in a global context, according to the Nature Index 2014, published by Springer Nature in December 2015.

xii. CSIR-IIP and GAIL have jointly developed a technology that can convert one ton of broken buckets, mugs, toothpaste tubes, bottle caps and other Polyolefin products into 850 litres of the cleanest grade of diesel. The development makes possible manufacture of diesel conforming to Euro-5 specifications in sulphur content.

xiii. Dr. Harsha Vardhan, Hon'ble Minister of Science & Technology and Earth Sciences, launched "Ksheer Scanner", a technology platform to detect adulterated milk. The technology has been developed by the CSIR-CEERI. The technology has been transferred to Rajasthan Electronics & Instruments Ltd. (REIL) and Alpine Technologies, Surat, Gujarat, for commercialization.

xiv. CSIR-CEERI has developed a grid-connected micro-inverter, powered by photovoltaic panels, a high definition 3D endoscope and mercury free VUV/UV lamp with a novel structural design which are highly useful for water sterilization.

xv. A new herbal drug is named BGR-34 has been launched, which has been jointly developed by CSIR-NBRI and CSIR-CIMAP. The drug is targeted at type II diabetes – the majority of Indians are suffering from this type of diabetes. BGR-34 costs Rs 5 per tablet and works by controlling blood sugar and limiting the harmful effects of other drugs. CSIR has transferred the rights and technical know-how to Aimil Pharmaceuticals (I) Ltd to produce and market the new drug

xvi. CSIR-IGIB has reported a non-invasive application of nucleic acid therapeutics for cutaneous disorders.

xvii. CSIR- IICT has developed a technology to manufacture hydrazine hydrate, which is used in agrochemicals, pharmaceuticals and water treatment.

xviii. CSIR-IMMT in collaboration with Tata Steel has developed a process for the production of graphene from natural graphite.

xix. CSIR-SERC has developed a construction technology that promises to make buildings blast-proof.

xx. A study published by CSIR-CCMB in the *Proceedings of the National Academy of Sciences, USA*, describes a novel potential drug target for development of new antibiotics.

xxi. CSIR-CDRI developed New Herbal Medication for Bone Health Standardized Extract of Dalbergia sissoo (Brand name: Dalzbone) for accelerated fracture healing and management of post-menopausal osteoporosis and licensed it to Pharmanza Herbal Pvt. Ltd., Gujrat in April 2015.

xxii. CSIR-IMTECH has shown that intracellular thiol reductive stress induces cellulose-anchored biofilm formation in *Mycobacterium tuberculosis*.

xxiii. CSIR-CLRI and CSIR-NCL have prepared fullerene-based copolymer by using "click" polymerization method for solar cell device fabrication.

xxiv. CSIR- CSMCRI won a long-drawn patent battle that saw its novel iodising agent finding use in iodised salt finally being granted a patent.

xxv. CSIR-AMPRI has developed "Thermo responsive & magnetic shape memory materials and devices for engineering applications.

xxvi. CSIR-CGCRI has identified and characterized natural sponges from sea as potential bioscaffolds stand alone in combination with Insulin Like Growth Factor-1 (IGF-1) and Bone Morphogenetic Protein-2 (BMP-2) on the *in vivo* bone healing performance in rabbit model.

xxvii. CSIR-NAL has developed a technology for production of NiTi shape memory alloys in 20-40 kg melt capacity in collaboration with HAL and MIDHANI.

xxviii. CSIR-NISTADS studied under Indian S&T and Innovation Policy (ISTIP) project provided evidence based analysis of the nature and extent of research and innovation need and capability of the country.

xxix. Tracing the strength of the southwest monsoon using boron isotopes in the eastern Arabian Sea, was carried out by CSIR-NIO.

xxx. Consultancy Development Centre (CDC) undertook projects from Ministries/ Departments of the Government of India. CDC aims at fostering and promoting intellectual cross-fertilization of knowledge and ideas at regional and sub- regional levels within the country and interaction at the international level as well.

xxxi. The National Research Development Corporation (NRDC), a Public Sector Enterprise under DSIR was assigned 47 new processes, signed 21 licence agreements and Agreement / Memorandums of Understanding with 13 new organizations for assigment of technolgies developed by them. Corporation had a gross income of Rs. 1968.77 lakhs during financial year 2015-16.

xxxii. Central Electronics Limited (CEL) is a Public Sector Enterprise under DSIR, has been the pioneer in the country in the different areas of manufacturing & proprietary manufacturer of the many strategic electronic components for use by defense organizations in the country. During the year the Company recorded production of Rs. 215.32 Crore and sales of Rs. 211.18 Crore.

An Overview

1. Introduction

2. DSIR Programmes

3. RTI Act 2005

4. Autonomous Institutions

5. Public Sector Enterprises

AN OVERVIEW

1. INTRODUCTION

The Department of Scientific and Industrial Research (DSIR), one of the departments of the Ministry of Science and Technology, was set up through a Presidential Notification, dated 4th January, 1985 (74/2/1/8 Cab.). The mandate of DSIR includes promotion of industrial research for indigenous technology promotion, development, utilization and transfer.

The Allocation of Business for the Department is as follows:

- All matters concerning the Council of Scientific and Industrial Research (CSIR).
- All matters relating to National Research Development Corporation (NRDC).
- All matters relating to Central Electronics Limited (CEL).
- Registration and Recognition of R&D Units.
- Technical matters relating to UNCTAD and WIPO.
- National register for foreign collaborations.
- Matters relating to creation of a pool for temporary placement of Indian Scientists and Technologists.

The primary endeavour of DSIR is to promote R&D by the industries; support industrial units to develop state-of-the-art globally competitive technologies of high commercial potential; catalyze faster commercialization of laboratory-scale R&D; augment technology transfer capabilities; enhance the share of technology intensive exports in overall exports; strengthen industrial consultancy and establish a user-friendly information network to facilitate scientific and industrial research in the country. The DSIR has two public sector undertakings viz. National Research Development Corporation (NRDC) and Central Electronics Ltd (CEL) and two autonomous organizations viz. Council for Scientific and Industrial Research (CSIR) and Consultancy Development Centre (CDC). The Department also provides host facilities and assistance to a regional institution of the United Nations Economic and Social Commision for Asia and Pacific (UN-ESCAP) viz. Asian and Pacific Centre for Transfer of Technology (APCTT) as the focal point in the country.

2. DSIR Programmes

The Technology Promotion, Development and Utilization (TPDU) Scheme in 11th Five Year Plan was aimed at promoting technology development and industrial research in the country and encouraging its utilization by various sections of economy including industry, academic/research/scientific institutions and the society at large. The components of the TPDU programme were:

- Industrial R&D Promotion Programme (IRDPP)
- Technology Development and Demonstration Programme (TDDP)
- Technopreneur Promotion Programme (TePP)
- Technology Development Utilization Programme for Women (TDUPW)

During the 12th five year plan, the DSIR has initiated four schemes focusing on innovations, after the recommendation of the Steering Committee on Science and Technology, in-principle approval of the planning commission and approval of the Standing Finance Committee have been obtained. The four schemes are:

(i) Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM) - This scheme primarily focuses on supporting individual innovators, start-up companies, incubatee companies in public funded technology business incubators and MSMEs besides supporting the approved 11th Plan projects related to Technopreneur Promotion Programme (TePP) spilling over from the 11th five year plan.

(ii) Patent Acquisition and Collaborative Research & Technology Development (PACE) - This is a new scheme focusing on technology acquisition and its development and demonstration for commercialization.

(iii) Building Industrial Research & Development and Common Research Facility (BIRD-crf) - This is a new scheme which focuses on creation of common research facilities for micro and small enterprises and subsumes components of the 11th Plan scheme, viz., Industrial R&D Promotion Programme, Information Technology and e-Governance (ITeG) and Asian and Pacific Centre for Transfer of Technology (APCTT).

(iv) Access to Knowledge for Technology Development and Dissemination (A2K+) - This is a new scheme focusing on facilitating access to scientific journals by In-house R&D units of industry and Scientific and Industrial research Organizations (SIROs). The scheme subsumes the 11th Plan component scheme on Technology Development and Utilization Programme for Women (TDUPW) and DSIR Building and Infrastructure. Besides, the scheme supports the approved 11th Plan projects related to Technology Develop-ment and Demonstration Programme (TDDP) spilling over from the 11th five year plan.

Present report includes only the committed liabilities of 11th Plan Technology Promotion, Development and Utilization (TPDU) Scheme.

2.1 Major Achievements

The major achievements of the various programmes of the Department during the period under report are as under:

2.1.1 Access to Knowledge for Technology Development and Dissemination (A2K+):

The twelveth five-year plan scheme of A2K+ has been evolved on the premises that access to knowledge is one of the most desirable inputs for any entrepreneur, innovator conceptualizing a business model to establish or run a company for wealth creation through innovative R&D interventions. The scheme includes the following programme components:

New Programme

(i) Access to knowledge for Industries and Institutions

(ii) Industrial Technology related studies (A2K+ Studies)

(iii) National and International conferences, exhibitions (A2K+ Events)

On-going Programme

(iv) Technology Development and Utilization Programme for Women (TDUPW)

(v) Technology Development and Demonstration Programme (TDDP)

The "Access to Knowledge for Technology Development and Dissemination - Events" programme of DSIR provides a platform for exchange of views leading to useful insights on issues relating to industrial research and technological innovation. The programme supports the organization of workshops, interactions, training programmes, exhibitions and other events to facilitate industry, consultancy organizations, academic and research institutions in identifying and developing tools and techniques to remain competitive in today's business climate.

The main objective is to provide a platform for exchange of views and sharing of useful insights and learnings from industry, academia, consultancy and research organizations. These events aim at increasing awareness and capacity building of stakeholders in various facets of industrial research and innovation, leading to strengthening of technological capabilities and competitiveness.

During the financial year, 56 proposals were received from different agencies to organize workshops, stakeholder meetings, interaction meets, training programmes, exhibitions and other events on topics related to promotion of industrial research and innovation and discussed in two Technical Advisory Committee Meetings held on 27 April 2016 and 30 September 2016 were received.

Technology Development and Utilization Programme for Women (TDUPW) is aimed to meet specific needs of women and to enhance their contribution towards technology capability building. Currently three projects were in progress and five proposals, recommended by the Technical Advisory Committee are at various stages of approval as on 31st December, 2016.

The Technology Development and Demonstration Programme (TDDP) is started in 1992, the department has supported 254 R&D projects of Industrial units with a total project cost of Rs. 750.60 crores in which DSIR support is Rs. 280.40 crores. The projects cover a number of industry sector and the share of these industry sectors in the project supported is: 32% engineering; 27% electronics; 21% Chemical; 7% energy and waste utilization and 13% Health & Pharma. The projects supported have been spread over 22 states of the country and the share of top five states in the number of project supported is: Andhra Pradesh 18%, Karnataka 15%, Maharashtra 13%, Delhi 10% and Tamil Nadu 10%.

88 technologies developed under the scheme have been commercialized and the department has received a cumulative royalty of around Rs.41.98 Crore during 1997-2016.

In the current financial year, progress of on-going projects was monitored and 3 projects were successfully completed.

2.1.2 Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM)

PRISM (Promoting Innovations in Individuals, Start-ups and MSMEs) scheme aims at to support individual innovator, which would enable them to achieve the agenda of inclusive development - one of the thrust area of XIIth five-year plan (2012-2017). It would also provide support to autonomous institutions or organizations or to society registered under the Societies Registration Act, 1860 or Indian Trusts Act, 1882 or other statues leading to development of state-of-art new technology solutions aimed at helping MSME cluster units.

The proposals are preferably considered in the following focus sectors: Green technology, Clean energy, Industrially utilizable smart materials, Waste to Wealth, Affordable Healthcare, Water & Sewage Management and any other technology or knowledge intensive area.

The financial assistance under the programme may vary from Rs. 2.00 lakh to Rs. 50.00 lakh. The department has also successfully completed 15 (fifteen) on-going PRISM/TePP projects supported during the period under report. Some of the successfully completed projects are Development of Autonomous Driving System for Ground Vehicles, A novel jacquard punched card reader for digitizing the woven designs, Improving the Existent Laser Tag to make it suitable for a varied spectrum of application, Design Development and Performance Evaluation of EcoTrapIn-3 (Waterless Urinal Technology), Design, development & testing of novel hollow clay brick manufacturing machine & accessories, Development and commercial production of bio-product from biomass and so on.

The financial assistance were extended to around sixteen (16) individual innovators for their innovation centric project proposals during the period ending 30th November, 2016. The details are as follows:

i. Biomass based environmental friendly incubator for hatching of Fertile Poultry Eggs

ii. Scaled prototype development for a functionally upgraded 72NM3/day Bio-CNG Plant Indian Conditions

iii. Solar multi-purpose handcart for hawkers

iv. Seven Omega Seven I.C. Engine

v. Development of cost-effective, technically modified Liquid Chromatography Counter

vi. Solar powered farm level Cold Storage with battery-less refrigeration and thermal storage (Phase-II)

vii. Prototype development of Analog and Digital RC Servo Motors for Autonomous Systems

viii. Multi Output Converter (MOC) for Utility Power Applications

ix. Design and development of affordable personal oral irrigator (3-in-1 Dental Jet) for prevention, control and treatment of dental cavities & gum disease for rural and urban population

x. Fully automated dry fruit slicer LED lantern with selectable beam pattern for PAYG

xi. Formulation and development of Keratinase treated feather waste based organic manure

xii. Development of counter irritant against contract dermatitis among cashew not women workers

xiii. Design and development of brake pad by using natural fiber composites and their behavior

xiv. Vision aid electronic wand

xv. Development and testing of vacuum insulated panels for high temperature storage

xvi. Design and development of a Tractor Operated Vegetable Transplanter for plug-type seedling

2.1.3 Common Research and Technology Development Hubs (CRTDHs)

The Department of Scientific and Industrial Research (DSIR) has a program for providing support to Common Research and Technology Development Hubs (CRTD-Hubs) that aim to enhance translational research and fostering industry institution interaction leading to growth of innovative capabilities targeted towards innovative products developments. This helps research institutes and companies to translate scientific knowledge, ideas and inventions into marketable products and services. Three such hubs have been approved under the program at three CSIR institutions, viz. Centre for Cellular and Molecular Biology (CCMB), Hyderabad, Institute of Himalayan Bioresource Technology (IHBT), Palampur and National Institute for Interdisciplinary Science & Technology (NIIST), Thiruvananthapuram, the first two dedicated to development of products for affordable healthcare and the third dedicated towards environmental interventions.

The main objectives of the scheme are to facilitate and encourage enterprises, start-ups and micro and small enterprises (MSEs) to access common research facilities having analytical equipment and pilot plant facilities.

Proposals have been invited from MSEs to work in the CRTDHs already set up. In the current financial year, the Department has invited proposals for setting up CRTDHs in the sectors of Low cost machining, New Materials/ Chemical Process and Electronics/ Renewable Energy.

2.1.4 Industrial R&D Promotion Programme

DSIR is the nodal Department for granting recognition to In-house Research and Development centres established by corporate industry. As on 30th November, 2016, there were 1880 In-house R&D centres with DSIR recognition. Of these, 115 companies incurred an annual R&D expenditure of over Rs.5000 lakhs each, 509 companies incurred an annual R&D expenditure in the range of Rs. 500 lakhs to Rs. 5000 lakhs and 411 companies incurred an annual R&D expenditure in the range of Rs. 200 lakhs to Rs. 500 lakhs.

Under the e-governance initiative of DSIR, department invites online applications for Industrial R&D Promotion Programme for greater accessibility and transparency of the department programmes / schemes. Department upload the barcode generated certificates for recognition, registration and its renewal of In-house R&D units of industries, Scientific & Industrial Research Organizations and Public Funded Research Institutions. Department is making efforts to make this programme paperless in future. During the period under report, 183 In-house R&D centres were accorded fresh recognition and recognition of 530 R&D centres were renewed.

Scientific research foundations in the areas of medical; agriculture; natural and applied sciences; and social sciences seek DSIR recognition and registration as Scientific and Industrial Research Organisations (SIROs) under the programme granting recognition to SIROs. The recognized and registered SIROs are eligible for availing Customs Duty exemption on imports and central excise Duty exemption on indigenous purchase of essential scientific and technical instruments, apparatus, equipment (including computers), accessories, spare parts thereof and consumables, required for R&D activities. During the period under report, 48 SIROs have been accorded fresh recognition.

Secretary, DSIR, Ministry of Science and Technology, is the Prescribed Authority to certify expenditures where higher rate of depreciation is to be allowed for the plant and machinery installed for the manufacturing of products using indigenous know-how as per provisions of rule 5(2) of IT Rules. During the year under report, one certificate was issued to M/s Bharat Electronics Limited by DSIR.

Certificate for claiming excise Duty exemption under Notification No. 13/99-CE dated 28th February 1999 were issued to M/s Troikaa Pharmaceuticals Ltd., Ahmedabad for Diclofenac Injection and M/s Venus Remedies Limited, Panchkula for (i) Ceftriaxone/ disodium edentate/sulbactam - ELORES (ii) Cefepime & Amikacin - POTENTOX (iii) Ceftriaxone & vancomycin - Vancoplus (iv) Aceclofenac- Achnil. During the year under report, five certificates were issued to two companies by DSIR.

DSIR is the nodal Department for registration of public funded research institutions (PFRI), Universities, IITs, IISc and NITs, for availing Customs Duty exemption and central excise Duty exemptions under notifications 51/96-Customs and 10/97-Central Excise and ammendments thereof. During the period under report, 12 such institutions were newly registered with DSIR; and 162 institutions were granted renewal of registration.

Secretary, DSIR is designated as the Prescribed Authority under section 35(2AB) of Income-tax Act, 1961. Fresh approvals were accorded to 110

companies by the prescribed authority. Agreements of co-operation for R&D were also signed with these companies. The detailed R&D expenditure of the approved companies have also been examined by DSIR and 485 reports valued at Rs.13774 crores have been forwarded to Chief Commisioner of Income Tax (Exemption) CCIT (E) in Form 3CL, as required under the IT Act.

2.1.5 Asian Pacific Centre for Transfer of Technology (APCTT)

Matters pertaining to the APCTT and UNESCAP are dealt with in cooperation with the Ministry of Commerce and Industry and the Ministry of External Affairs, Government of India. DSIR also plays an active role in APCTT's functioning, particularly relating to its programmes and policies. India being the host country has been providing institutional support to APCTT.

APCTT receives annual institutional support of US$ 200,000 in Indian Rupees (to meet local costs) from DSIR in addition to funding for building repairs, renovation work, and municipal taxes. DSIR has also extended programme support towards the APCTT project entitled, "Promotion of National Innovation Systems (NIS) in Countries of the Asia-Pacific Region - Phase II" which concluded in 2016.

The revised Statute of APCTT, adopted by the Commission at its Seventy second session in May 2016, through its resolution 72/3, stipulates among other things, that the Centre shall have a Governing Council consisting of a representative designated by the Government of India and no fewer than eight representatives nominated by other members and associate members of ESCAP elected by the Commission. The members and associate members elected by the Commission shall be elected for a period of three years but shall be eligible for re-election. The Council shall advise on the formulation and implementation of the programme of work of the Centre and review the administration and financial status of the Centre. The Executive Secretary shall submit an annual report, as adopted by the Council, to the Commission at its annual sessions. The Commission at its Seventieth session elected the following countries along with the host country, India, to be members of the Governing Council of the Centre for the period 2014 to 2017: Bangladesh, China, Fiji, Indonesia, Islamic Republic of Iran, Malaysia, Pakistan, Philippines, Republic of Korea, Samoa, Sri Lanka, Thailand and Viet Nam. The 11th Session of the Governing Council and Technical Committee of APCTT were held in New Delhi, India in December, 2015 in cooperation with DSIR.

2.1.6 Information Technology and e-Governance

IT-eG division implements e-Governance in the Department progressively that needs to be in conformance to the National eGovernance Action Plan. IT-eG Division operates on a separate IT Budget Head that came into effect in DSIR since FY 2004-05 for the implementation of an IT Action Plan.

The DSIR Website has been made compliant to the Guildelines for Indian Government of Websites (GIGW). The website has been regularly updated.

A project entitled 'Design, Development, Implementation of Enterprise Application and Maintenance Support Services for DSIR' is ongoing. The project has two RFPs, ie. RFP1 includes Enterprise Integration, Program Implementation and eService Delivery and RFP2 includes Office Automation Solution, Workflow Management, Record Management, and Data Warehousing.

An e-Book on DSIR Activities and Achievements (including CSIR, CDC, CEL and NRDC) has been prepared and uploaded on the DSIR Website.

2.1.7 Patent Acquisition and Collaborative Research and Technology Development (PACE)

The scheme Patent Acquisition and Collaborative Research and Technology Development (PACE) aims

at facilitating acquisition of early stage technologies from academic and research institutions, including industry and other sources in India and abroad by Indian industries on an exclusive or a non-excusive basis with a view to manufacture "Made in India" products. The scheme also aims at supporting up-scaling of a lab-scale technology for development and demonstration of innovative products and processes that can be commercialized.

Following activities were completed or were in progress during the year under report:

- Efforts were continued with agencies such as CSIR-Tech, Frost & Sullivan etc. for facilitating technology acquisition to SMEs.

- Five technology development and demonstration projects from industries and collaborating partners (public funded Indian R&D organizations/ academic institutions/ universities) were monitored during the year. These projects involve a total project cost of Rs. 3807.30 lakhs for which, DSIR is extending a support of Rs. 1203.00 lakh as loan to industry and Rs. 202 lakhs as grant to collaborating partners.

- Two new agreements for technology development and demonstration projects from industries and collaborating partners were signed during the year involving a total project cost of Rs.1285.05 lakh. In these projects, DSIR would extend a support of Rs.552.50 lakhs as loan to Industry and Rs.52.24 lakhs as grant to collaborating partner.

- Support to technology development proposals of institutions (IITs and IISc.) under IMPacting Research INnovation and Technology (IMPRINT) scheme of Ministry of Human Resource Development (MHRD) in the Manufacturing and Water Resources domains was approved.

3. RTI ACT 2005

The Right to Information Act 2005, enacted on 15th June 2005, has been implemented successfully in the department. As per the provisions of the Act Nodal Officer, Appellate Authority, Transparency Officer, Central Public Information Officer and Central Assistant Public Information Officer are designated.

The proactive disclosures under Section 4 (1) (b) of the RTI Act 2005 enacted on June 15, 2005 are regularly updated [Last Update on 04/11/2016] and available on the DSIR Website at http://www.dsir.gov.in. DSIR has complied with the directives received from Central Information Commission. RTI Requests and First Appeals received and their responses are available on DSIR Website.

DSIR has received 193 Applications during 2016 [01/01/2016 to 15/12/2016] and all the Applications were registered and disposed off on RTI Request & Appeal Management Information System at https://rtinonline.gov.in/RTIMIS. During 2016 [01/01/2016 to 15/12/2016], 13 applications were registered as first appeal and 03 application was registered as second appeal.

DSIR has been effectively using various IT applications like RTI Request & Appeal Management Information System at http://rtionline.gov.in/RTIMIS, RTI Annual Return Information System at http://rtiar.nic.in wherein quarterly returns were uploaded regularly.

The Division provided technical support by way of lectures on 'RTI Online Portal, RTI Request & Appeal Management Information System, RTI Annual Return Information System, Proactive Disclosures under Section 4 (1) (b) of the RTI Act' during

- Training Programme on 'Good Governance and Transparency' organized by Council of Scientific and Industrial Research at CSIR-

Human Resource Development Centre, Ghaziabad on 18/02/2016.

- Training Workshop on 'RTI Online Portal for Nodal Officers' in alignment with the DoPT D.O. No. 01/Misc. Matters/2016-IR dated 5th October, 2016 regarding aligning the Public Authorities (PAs) under the DSIR with the RTI online portal of DoPT organized by Council of Scientific and Industrial Research at CSIR-Human Resource Development Centre, Ghaziabad on 10/11/2016.

4. AUTONOMOUS INSTITUTIONS

4.1 Council of Scientific and Industrial Research (CSIR):

The Council of Scientific & Industrial Research, constituted in 1942 is an autonomous body which is known for its cutting edge R&D knowledgebase in diverse S&T areas, is a contemporary R, D & E organization. CSIR has pan India presence through its network of 38 national laboratories which undertake well focused basic and applied research in diverse fields of science and technology. CSIR has also established 39 outreach centres, 3 Innovation Complexes and 5 units. CSIR's R&D expertise and experience is embodied in about 3700 active scientists supported by about 6000 scientific and technical personnel, as on 01-10-2015

CSIR carries out R&D in diverse areas of science and technology ranging from radio and space physics, oceanography, earth sciences, geophysics, chemicals, drugs, genomics, biotechnology and nanotechnology to mining, aeronautics, instrumentation, environmental engineering and information technology. It provides significant technological intervention in many areas with regard to societal efforts which include environment, health, drinking water, food, housing, energy, leather, farm and non-farm sectors.

CSIR is the Nation's custodian for Measurement Standards of Mass, Distance, Time, Temperature, Current etc. CSIR has created and is the custodian of Traditional Knowledge Digital Library (TKDL) which is a powerful weapon against unethical commercial exploitation of Indian traditional knowledge. CSIR maintains Microbial Type Culture Collection(MTCC) and Gene Bank.

Pioneer of India's intellectual property movement, CSIR today is strengthening its patent portfolio to carve out global niches for the country in select technology domains.

CSIR has pursued cutting edge science and advanced knowledge frontiers. It has published around 5776 papers in SCI Journals during 2015 with average impact factor of 3.005.

CSIR through its various constituent laboratories is also placing major focus upon creating incubation facilities for spin off and startups. The CSIR would hand hold these companies so as to create a new segment of knowledge enterprises.

CSIR has been focusing in a significant manner for the development of S&T Human Resource in the country through various fellowships. It has been imparting skills in diverse S&T areas so as to empower youth for better career and employment opportunities. CSIR proposes forging linkage with Ministry of Skill Development and Entrepreneur ship to enhance and widen its contributions for Skill Development in the country.

CSIR today is a globally benchmarked organization. According to the Scimago Institutions Ranking World Report 2014, CSIR is ranked at 84th among 4851 institutions worldwide and is the only Indian organization among the top 100 global institutions. CSIR holds the 17th rank in Asia and leads the country at the first position. From research output perspective, CSIR is ranked 72 in a global context, according to the Nature Index 2014, published by Springer Nature in December 2015, CSIR is among the only two Indian organizations of the top 100 institutions across the world.

4.1.1 Significant Events

India is Surging Ahead in R&D on Alternative Fuels- Dr. Harsh Vardhan

Dr. Harsh Vardhan, Hon'ble Minister for Science and Technology, visited CSIR-Indian Institute of Petroleum (IIP), Dehradun and announced that the Indian Railways would soon set up plants to manufacture diesel for mechanical traction with technology patented CSIR-IIP and Gas Authority of India Limited (GAIL).

Dr. Harsh Vardhan Flags off Mobile Laboratory Van of CSIR-NEERI

Dr. Harsh Vardhan, Hon'ble Minister for Science & Technology and Earth Sciences on the occasion of "World Environment Day" visited CSIR-NEERI, where he inaugurated a Green Museum and flagged off a Mobile Emission Monitoring and Control Laboratory (MEMCL) developed by CSIR-NEERI.

Dr. Harsh Vardhan, Hon'ble Minister calls upon CSIR Laboratories to Catalyse India's Evolution into Samarth Bharat-Sashakt Bharat

At a two-day 'Chintan Shivir' held at CSIR-IIP, all CSIR labs agreed to make efforts to be self-financing in the next two years. The two-day brainstorming session of CSIR Directors also adopted the 'Dehradun Declaration' where Directors of CSIR labs resolved that technologies will be developed for national missions like Swachh Bharat, Swasth Bharat, Skill India, Smart Cities, Digital India, and Namami Ganga.

CSIR Celebrates its 73rd Foundation Day

CSIR celebrated its 73rd Foundation Day at a function was held in the Vigyan Bhawan in New Delhi. The Foundation Day lecture was delivered by Mr A.S. Kiran Kumar, Secretary, Department of Space and Chairman, ISRO.

The Union Minister of Science & Technology and Earth Sciences and Vice President, Council of Scientific and Industrial Research CSIR, Dr. Harsh Vardhan, called for mobilizing the entire potential of CSIR to be mobilized in a structured manner to solve various problems of the country. Speaking at the CSIR Foundation Day Celebrations, the Minister said that he was proud of the diverse research taking place in CSIR labs from aeroplanes to nanomaterials, from ayurgenomics to new drugs and petroleum.

Launching of "Ksheer Scanner", a technology platform to detect adulterated milk

Dr. Harsha Vardhan, Minister of Science & Technology and Earth Sciences , launched "Ksheer Scanner", a technology platform to detect adulterated milk. The technology has been developed by the CSIR-CEERI.

Ksheer Scanner offers automated scanning of raw milk samples at milk collection points. It is safe to use and ideal for installation at milk collection centres of milk societies at village and tehsil levels. The technology has been transferred to Rajasthan Electronics & Instruments Ltd. (REIL) and Alpine Technologies, Surat, Gujarat, for commercialization.

Constructed Wet Land in CRPF, Bhubaneswar Campus

CSIR-IMMT has constructed a pilot-scale constructed wetland in CRPF Bhubaneswar campus. DG CRPF inaugurated the constructed wetland facility and agreed to propagate the same in other CRPF campuses. This is the first successful attempt by CSIR-IMMT under the Swachh Bharat Programme.

4.1.2 Significant S&T Achievements

Micro Inverter for Decentralised Power Generation

A grid-connected micro-inverter, powered by photovoltaic panels has been developed at the CSIR-CEERI. High-efficiency operation with maximum power transfer from photovoltaic panels was the salient feature of the system.

The photovoltaic inverter was capable of delivering maximum 300 W power to the grid at close to unity power factor. The micro-inverter normally operates in grid-connected mode delivering maximum power available from photovoltaic panels. In case of grid failure, the inverter can be operated in a stand-alone mode supplying power to local loads. Batteries are not used for inverter operation, resulting in no running cost of the system.

Development of 3D Endoscopes for Dental examination

CSIR-CEERI has developed 2D as well as 3D dental endoscope. It includes the stereo assembly in frontal parallel arrangement, consisting of miniature cameras, assembled in a medical grade stainless steel housing. The miniatures cameras are encircled by the LEDs to provide strong source of light.

Mercury-free plasma UV (MFP-UV) Lamp for efficient water disinfection

CSIR-CEERI has developed a mercury free VUV/UV lamp with a novel structural design and an optimized gas mixture that produces strong spectral bands peaking at wavelengths 253 nm and 172 nm along with a weak band peaking at wavelength 265 nm, which are highly useful for water sterilization. This invention alleviates a large number of problems of mercury lamps by virtue of its unique design and the composition of active discharge elements. As a result it is able to produce the desired VUV/UV wavelengths for the deactivation of bacteria and viruses most efficiently - without the use of mercury.

Handheld embedded odour-vision sensing system (HEOVS)

A handheld embedded odour-vision sensing system (HEOVS) using artificial olfactory (e-nose) and image processing techniques (e-vision) has been developed by CSIR-CEERI. The system helps in estimating optimal harvest time for plucking of fruits. The HEOVS system was tested with 100 orange (local market) samples.

A Sensor for early detection of heart attack in humans

Heart disease is the leading cause for death in men and women. Early detection of heart attacks can save a human life. In a collaborative work with CSIR-CSIO, developed a sensor to detect the antigen cardiac-Troponin I (cTnI). The technique uses Graphene quantum dots conjugated to antibody anti-cardiac Troponin I and fluorescence resonance energy transfer (FRET). The sensor is highly specific and shows negligible response to non-specific antigens.

Non-invasive topical delivery of plasmid DNA to the skin using a peptide carrier

CSIR-IGIB has Reported an amphipathic peptide Mgpe9 that can penetrate the uncompromised skin, enter skin cells and deliver plasmid DNA efficiently as nanocomplexes *in vitro* and *in vivo* without any additional physical or chemical interventions prevalent currently. It is observed that efficient gene expression up to the highly proliferating basal layer of the skin without observable adverse reactions or toxic effects after delivery of reporter plasmids.

An Eco-friendly Technology to Treat Water

CSIR- IICT has developed a technology to manufacture hydrazine hydrate, which is used in agrochemicals, pharmaceuticals and water treatment. The technology's pilot project was demonstrated at Gujarat Alkalies & Chemicals Ltd, Vadodara (GACL), to overwhelming appreciation.

Technology to Manufacture Hydrofluorocarbons - solution to technology denial

Faced with the reluctance of multinational companies in the US, UK, France, Japan and China to transfer the technology to manufacture hydrofluorocarbons to India, the CSIR-IICT has developed a technology to manufacture hydrofluorocarbons. The technology is ready to be transferred to the industry.

Development of pilot scale facility for production of graphene from natural graphite

CSIR-IMMT in collaboration with Tata Steel developed a process for the production of graphene from natural graphite. A cost effective process has been developed for the production of graphene oxide in dry method using dual drive planetary ball mill.

Technology to make Buildings Blast-proof

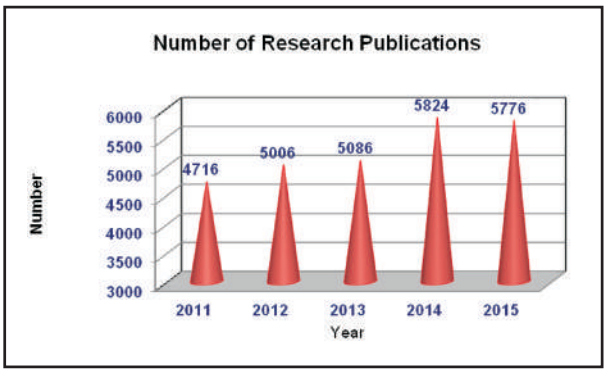
CSIR-SERC has developed a construction technology that promises to make buildings blast-proof. Called Laced Steel-Concrete Composite Technology (LSCC), the new technology incorporates prefabricated design, steel rods in a lace-like pattern filled with concrete providing enhanced strength and durability.

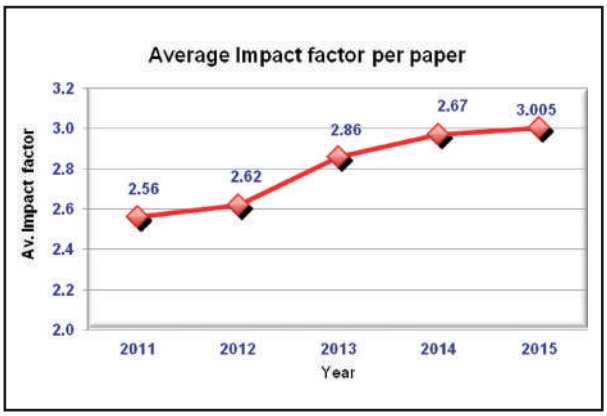
CSIR Successfully Foils Two MNC Patents

CSIR has successfully foiled attempts by two multinationals to patent medicinal compositions that have been used since long in the Indian systems of medicines like Ayurveda and Unani and which have been documented in the Traditional Knowledge Digital Library (TKDL), a unit of CSIR.

4.1.3 Scientific Excellence

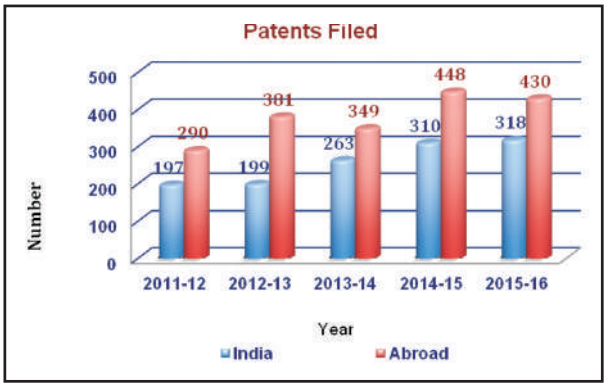
CSIR has published 5776 research papers during 2015 in SCI journals of repute. The new knowledge generated from CSIR laboratories is reflected in terms of high average Impact Factor (3.005). Following Graph shows the trend of research over the last five years:

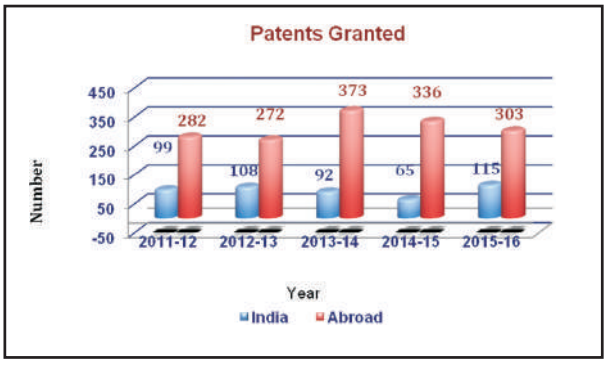




Value Generation through Creation of Intellectual Property

CSIR has filed 430 patents abroad and 318 patents in India during 2015-16, and it has been granted 303 patents abroad and 115 patents in India. Following graphs provide data on patents filed and patents granted over the last five years:





4.2 Consultancy Development Centre (CDC):

Consultancy Development Centre (CDC) is an Autonomous Institution of the Department of

Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Government of India set up for promotion, development and strengthening of consultancy skills and capabilities in the country including enhancement of export of consultancy and professional services.

In the changed policy and economic environment at national and international levels, "Knowledge" is being considered as "Power" and consultancy is a knowledge based profession. CDC aims at fostering and promoting intellectual cross - fertilization of knowledge and ideas at regional and sub- regional levels within the country and interaction at the international level as well.

During the financial year 2015-16, plan support of Rs. 140.00 lacs was received from DSIR for carrying out specific projects & activities. Besides plan support activities, CDC undertook various funded projects from various Ministries/Departments of the Government of India.

5. PUBLIC SECTOR ENTERPRISES

5.1 National Research Development Corporation (NRDC):

National Research Development Corporation (NRDC) is a Government of India enterprise, under the Administrative control of Department of Scientific & Industrial Research (DSIR), established in 1953 under section 25 now section 8, of the companies act. The main objective is to promote, develop and commercialize technologies/ know how/ inventions/ patents/ processes emanating from various national R&D institutions. The Corporation offers its services through-out the country in improving the Nation's manufacturing base with innovative technologies specially suitable for our entrepreneurs and conditions. It acts as an effective Interface for translating R&D results into marketable products. Over the last six decades of its existence, the Corporation has forged strong links with various R&D organizations both within the country and abroad and pursued bringing inventions and innovations to commercial fruition. The Corporation is recognized as a repository of a wide range of technologies and has licensed technologies to over 4800 entrepreneurs spread over almost all areas of industry and has provided assistance for filing of 1700 patents.

5.2 Central Electronics Limited (CEL):

Central Electronics Limited (CEL) is a Public Sector Enterprise under the Department of Scientific and Industrial Research (DSIR), Ministry of Science & Technology, Government of India. It was established in 1974 with an objective to commercially exploit indigenous technologies developed by National Laboratories and R&D Institutions in the country. CEL is one of the companies that utilized home grown technologies during all these years of its existence. The Company is primarily engaged in production of strategic components for defence applications of national importance, equipment for railway safety and solar photovoltaic modules and systems.

The Company has developed a number of products for the first time in the country through its own R & D efforts and in close association with the premier National & International Laboratories including Defense Laboratories. In recognition of all these efforts, CEL not only have the distinction of being a DSIR recognized R & D Company, but also has been honored a number of times with prestigious awards including "National Award for R & D by DSIR".

CEL has already established partnerships and linkages with various stake-holders and business associates in the areas of railways, telecom, police, power generation and distribution companies, service providers in the energy sector, public funded institutions and even rural communities through the state governments. The existing marketing channels are being consolidated and expanded harnessing the unique advantage CEL has experienced manpower in terms of its product base and PSE status.

During the year the Company recorded production of Rs. 215.32 Crore and sales of Rs. 211.18 Crore and net profit after tax is Rs.8.56 Crore .

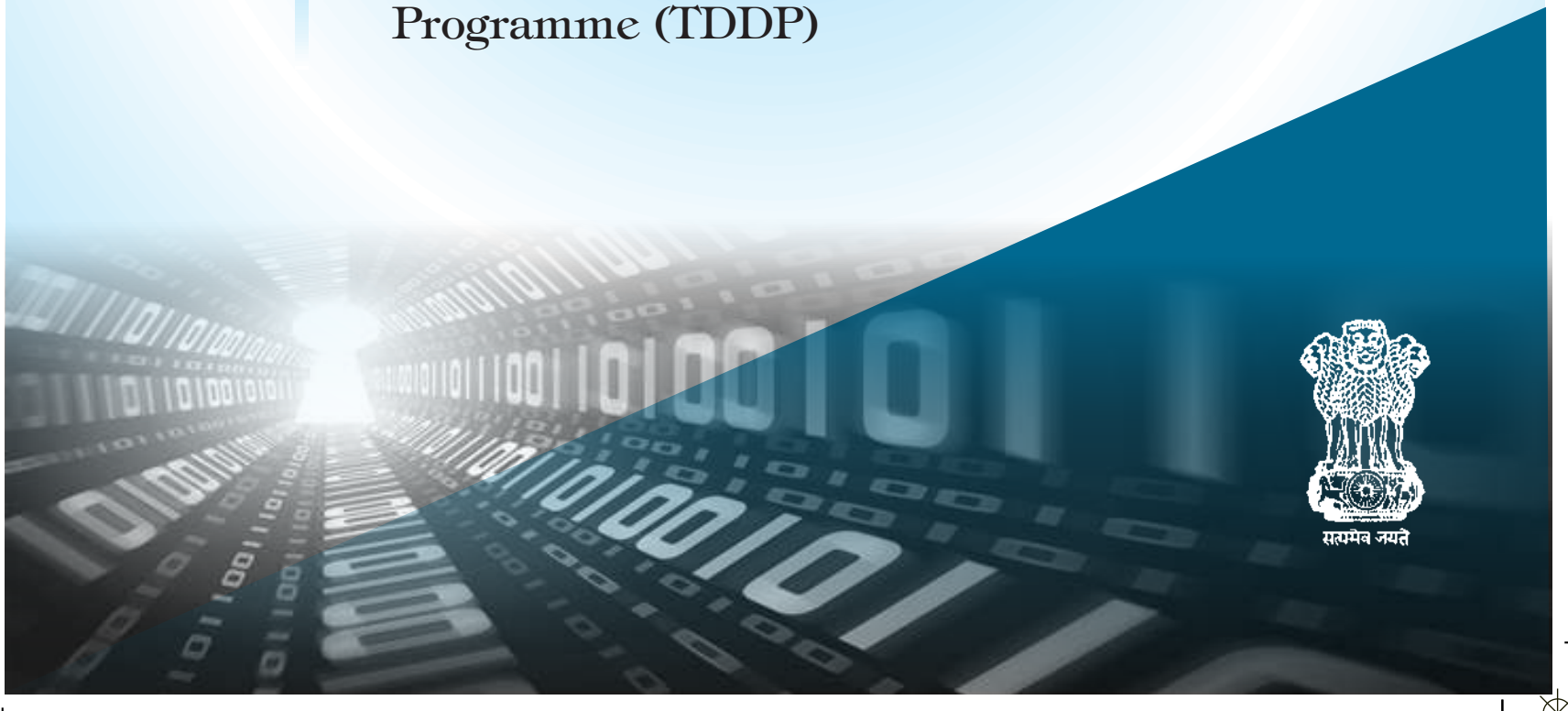
Access to Knowledge for Technology Development and Dissemination (A2K+)

1. A2K+ - Studies

2. A2K+ -Events

3. Technology Development and Utilization Programme for Women (TDUPW)

4. Technology Development and Demonstration Programme (TDDP)



ACCESS TO KNOWLEDGE FOR TECHNOLOGY DEVELOPMENT AND DISSEMINATION (A2K+)

Access to Knowledge for Technology Development and Dissemination (A2K+) is a scheme targeted towards developing mechanisms to disseminate science, technology and innovation related information to industries, research and academic institutions, In-house R&D units of industry, Scientific & Industrial Research Organizations (SIROs), consultants, industry associations, techno-entrepreneurs, government departments and others.

Programmes supported are the following:

1: Supporting industrial technology related studies (A2K+ Studies)

2: Supporting the organization of national and international conferences, exhibitions etc. (A2K+ Events)

3: Support for Technology Development and Utlization Programme for Women, including projects spilling over from the 11th five year plan.

4: Continuing support to Technology Development and Demonstration Programme projects, spilling over from the 11th five year plan (TDDP)

1: A2K+ Studies

A2K+ - Supporting Industrial Technology Related Studies

Studies on frontier areas of technology that impact the country are being undertaken. These include technology status studies in specific product and process areas, analytical reports of specific industry clusters, cases studies bringing out industry practices, research studies on industry related subjects, technology norms of industrial sectors, and other categories of reports.

Achievements:

The Technical Advisory Committee recommended 10 studies on various subject areas. Among 10 proposals, four studies were approved and first three studies are under going and fourth one is in process to start. Following are the details of ongoing projects:

1. Framework of Industry-University Linkage in Research study being conducted by PHD Chamber of Commerce and Industry, New Delhi

The study proposes to cover all the 29 States of the country and four other countries, viz., China, Japan,

Germany and USA, to study the international scenario and develop a road-map for India. The study would also analyze the growth and emerging sectors of the Indian industry in respect of capacity building, R&D activities and innovation

2. Technology diffusion in the Millet processing industry specific to Karnataka, Andhra Pradesh and Maharashtra states study being conducted by CSIR-Central Food Technological Research Institute (CFTRI)

The study covers the technology diffusion in the millet processing industry with emphasis to ragi processing technologies specific to Karnataka; barnyard millet & foxtail in Andhra Pradesh and Sorghum in Maharashtra. The study also aims on evolving an appropriate platform for technology transfer mechanism targeted to millet farming community

3. Effective Grain storage for better livelihoods of Indian Farmers for food and nutritional security in the new millennium study being conducted by Indian Institute of Crop Processing Technology, Thanjavur

The study mainly focus on the safe storage condition based on moisture, temperature and quality of pulses for tropical weather conditions, with special emphasis on the coastal regions of Tamil Nadu. It is involve in design and develop eco-friendly safe storage structures with provisions for physically eliminating insect pests to store pulses for small scale enterprises, retailers, rural livelihoods, pulse growers, millers and Farmer producer organizations.

4. Cold Chain Technologies for Safe and Hygienic preservation of fresh Horticulture & Food Products, from Farm to consumers study being conducted by Gujrat Industrial and Technical Consultancy Organisation, Ahemdabad

The study will cover storage parameters aspects for various Fresh and Horticulture produce/ food and health products, and giving comparative aspects for various regions and seasonality of storage parameters. The technology aspect on Quality, Safety and Hygiene to be adopted in cold chain operation and suggesting bench mark standards, as per regulation has been included as part of study. It also covers on the cold chain technologies and study will cover Conventional Ammonia/ other Refrigeration System base Pre-cooling systems/ cold Storage of all 3 types-Normal/ MA/ CA Technology type, Mobile Cold chain components such as reefer vehicles, container for rail/ Sea and Air Transport systems, etc

2: A2K+ Events

The "Access to Knowledge for Technology Development and Dissemination - Events" programme of DSIR provides a platform for exchange of views leading to useful insights on issues relating to industrial research and technological innovation. The programme supports the organization of workshops, interactions, training programmes, exhibitions and other events to facilitate industry, consultancy organizations, academic and research institutions in identifying and developing tools and techniques to remain competitive in today's business climate.

The main objective is to provide a platform for exchange of views and sharing of useful insights and learnings from industry, academia, consultancy and research organizations. These events aim at increasing awareness and capacity building of stakeholders in various facets of industrial research and innovation, leading to strengthening of technological capabilities and competitiveness.

Achievements:

During the financial year, 56 proposals were received from different agencies to organize workshops, stakeholder meetings, interaction meets, training programmes, exhibitions and other events on topics related to promotion of industrial

research and innovation and discussed in two Technical Advisory Committee Meetings held on 27 April 2016 and 30 September 2016 were received. Proposals recommended by TAC were processed for financial concurrence & approval and then sanctioned to the concerned agencies.

Some events that were supported by the department during the year are illustrated below:

- International Conference on Nanotechnology for Better Living
- Conference on Defence Manufacturing Technologies - Defence Indigenization: Window of Opportunities
- 4th National Conference on Waste to Wealth: Solid Waste, Industrial Waste, E-Waste
- 2nd National Symposium-cum-Awards on Nutraceuticals, Herbals & Functional Food
- Conference on Role of IPR in Startups, Technology Transfer and the journey to Make in India
- India International Innovation Fair 2016
- Conclave on Waste Management "The Role of technology in Safe & Efficient Bio Medical Waste Management"
- Conference on 3D Printing- The Game Changer
- National Conference on Technology & Innovations in Healthcare Delivery
- Seminar on 'Global Opportunities for technological collaborations with India' during IESS Chennai
- Industry Academia Engagement and Commercialization
- Workshop on Big Data Analytics

3: Technology Development and Utilization Programme for Women (TDUPW)

The program is aimed to meet specific needs of women and to enhance their contribution towards technology capability building. The objectives of the programme are:

- Promoting the adoption of new technologies by women.
- Awareness creation and training of women on technology related issues with regard to women.
- Promoting Technology up gradation (through technologies developed by scientific establishments) of micro, small and medium enterprises run by women Self Help Groups (SHGs)/ entrepreneurs .
- Showcasing of appropriate technologies developed by scientific establishments and organizing demonstration programmes for the benefit of women.
- Design and development of products, processes (by utilizing waste) beneficial to women.
- Diffusion of technologies developed by scientific establishments for reduction of drudgery and empowerment of women.

The following three projects were in progress as on 31st December, 2016 :

(i) Capacity Building of Economically Backward Rural Women Through Participatory Training on Integrated Fish Farming with Improved Backyard Poultry Breeds in Homestead Ponds

The main objectives of the proposal received from Bidhan Chandra Krishi Viswavidyalaya, Directorate of Research, P.O: Kalyani, Pin- 741 235, District Nadia, West Bengal are capacity building of rural women on integrated poultry-fish farming in their homestead ponds through participatory training

and demonstration programmes for their income generation and nutritional support as well and dissemination of the technology in the adjoining villages through organizing training and demonstration programmes in association with different panchayats of adjoining Block of the village.

The integrated poultry-fish farming offers great efficiency in resource utilization, as waste or by-products from one system is effectively recycled. It also enables effective utilization of available farming space for maximizing production. Fish culture in combination with agriculture or livestock is a unique and lucrative venture and provides a higher farm income, makes available a cheap source of protein for the rural population, increases productivity on small land-holdings and increases the supply of feeds for the farm livestock. Thus, it provides more employment, and improves socio-economic status of farmers and betterment of rural economy. The project will be implemented in Nadia district of West Bengal. The project has been recommended by the Technical Advisory Committee and was being processed for approval and support.

(ii) Enhancing the Livelihoods of Tribal Women through Technological Intervention of Trainings on Non-Wood Forest Products (Identification, collection, storage, processing and marketing of Non-Wood forest products)

The main objectives of the proposal received from Department of Agricultural Extension and Rural Sociology, Tamil Nadu Agricultural University, Coimbatore are to train the tribal women on collection, storage, processing, value addition and marketing of Non-wood Forest Products (NWFPs) and assess the impact of the trainings on the livelihood status of tribal women. The project deals with strengthening the Non-Wood Forest Products (NWFPs) sector by means of training the tribal people regularly on aspects related to proper collection methods, storage, processing, value addition techniques and marketing of NWFPs to improve socio-economic status of the beneficiaries of the project areas. The project has been recommended by the Technical Advisory Committee and was being processed for approval and support.

(iii) Empowerment of rural women by Promoting the adoption of appropriate Sericulture Technologies in Chittoor (Dist) of Andhra Pradesh

The main objectives of the proposal received from S.P.Mahila Visvavidyalayam, (Women's University), G.Savithri, Department of Sericulture, S.P.Mahila Visvavidyalayam, Tirupati, Andhra Pradhsh are to disseminate knowledge and technological skill improvement techniques for adoption of scientific sericultural practices for bringing improvement in production and quality of silk for self sustenance and empowerment of women through on-farm training cum demonstrations; to enhance the bio-organic based technological interventions towards improvement of environment, productivity and sustainability of sericulture; Promotion of sericultural entrepreneurship among women and to entice women farmers to adopt Sericulture as a source of livelihood and enhance their economic status. The proposed project is aimed at imparting Integrated Capsule Training in Sericulture Technology (ICTST) to women Sericulture farmers on various appropriate advanced sericulture technologies in Chittoor District of Andhra Pradesh. The target group for the proposed program is primarily women farmers who are practicing sericulture and women interested to take up sericulture as their livelihood.

The following five proposals, recommended by the Technical Advisory Committee were at various stages of approval.

(i) Socio-economic development of rural women of Uttar Pradesh by educating & training in the cultivation of medicinal plants, their processing for health care product development and marketing for gainful employment

The main objectives of the proposal received from Amity Institute of Herbal Research & Studies; Amity University Uttar Pradesh are to educate and train rural women of the SC/ST, backward and economically weaker section of the society in the identification, cultivation, and uses of medicinal plants and to train women of the target area/ population (Muzaffarnagar district, UP) in the cultivation of medicinal plants at home stead and on community land and processing for personal health care, product development and their marketing for gainful employment and income generation. Trainings will be arranged to educate and train the target group of women for the cultivation, processing, storage, pre and post-harvest methodology and techniques for the processing and cultivation of different selected medicinal plants. They will be encouraged to utilize the possibility of growing medicinal plants in home stead, kitchen garden or available under-utilized land and marketing for gainful employment. Some important medicinal plants having good market potential and utility in Indian system of medicines will be selected depending on the agro-climatic condition of the selected area. In the list we have included some additional medicinal plants as an alternative approach for the total success of the project.

(ii) Empowerment of women through bee keeping and value addition of honey products for income generation in rural areas

The main objectives of the proposal received from Tamil Nadu Agricultural University, Department of Agricultural Entomology Agricultural College and Research Institute Madurai are to create awareness among women on bee keeping, post harvest technology, honey based value added products through trainings, exposure field visit; to motivate women groups by training, demonstration on bee keeping and post harvest technology of honey products; to motivate of land less women entrepreneurs on paid bee pollination in increasing productivity of various crops and to empower women and entrepreneurship development through Hands-on-training on bee keeping and value addition. Bee keeping is one of the income generation ventures for farmers and other entrepreneurs. Through this project, bee keeping techniques will be transferred to communities through effective extension methods like training and demonstrations. Knowledge on beekeeping and its value addition will be imparted to women groups comprisin and land less women from Sedapatti ,Alankanallur and Madurai east blocks of Madurai District.

(iii) Training of women groups in processing of horticultural and wild fruit resources for marketable health product development and employment generation in Higher Himalayan region

The main objectives of the proposal received from Society for Environment & Employment Development (SEED), Uttarkashi are to organize village women of border area of Uttarakhand in groups for capacity building in utilization of wild tree based fruits for self employment development; training and technology transfer to village women groups for utilization of pulp and oil for marketable products development and to provide support for small entrepreneurship development for income and employment generation. Training will be imparted to women groups in processing of horticultural and wild fruit resources for marketable health product development with special focus on Chulu, Apple, Plums and Peaches.

(iv) Capacity building of rural women for enhancing household income and nutrition through mushroom cultivation

The main objectives of the proposal received from ICAR-Indian Institute of Horticultural Research, Bengaluru are to enhance awareness about mushrooms and their nutraceutical properties among women; impart skill development training

to rural women for oyster mushroom cultivation; impart training on methods to fortify daily diet with dry mushrooms to enhance nutrition and to impart training for production of mushroom value added products. Hands on training to women will help in development of knowledge as well as skill among the beneficiaries and the women will learn the twchnique of mushroom production at home as well as develop the necessary expertise in making value added products from fresh/ dry mushrooms.

(v) Nutrition on Reproduction of Ornamental Fishes and Transfer of Ornamental Fish Culture Technology for Employment Generation of Rural Women from SC/ST and Fishers Population of Thiruvananthapuram District, Kerala

The main objectives of the proposal received from Amity Institute of Marine Science & Technology, Amity University Uttar Pradesh (AUUP), Noida is to impart training on ornamental fish culture and breeding. Ccommon ornamental fishes such as gourami, goldfish, guppy, molly, sword tail, angel fish and platy will be used. Survey will be carried out on ornamental fish farms located in various areas/ regions all over Kerala. Training will be imparted on all aspects of ornamental fish culture, breeding, rearing the young ones, feed formulation and pelletisation, aquarium fish keeping and management, capacity building in ornamental fish culture and glass aquarium tank fabrication.

4: Technology Development and Demonstration Programme (TDDP)

The Department has been providing partial financial support to research, development, design and engineering (RDDE) projects proposed by industry in the following areas:

(a) Development of a new or improved product resulting in prototype development and ending with demonstration in commercial environment.

(b) Development of a new or improved process resulting in establishment of process know-how, development of process equipment and demonstration of yield, efficacy etc on a pilot plant.

(c) Absorption and up-gradation of imported technology.

(d) Priority technology development projects of PSEs in consultation with and co-financing from economic ministries. Under this, consortium projects for development of technologies of common interests for group of industries or associations to be undertaken by industrial units, national laboratories, user industries in important focused areas such as Electronics and Communications, Railways, Drugs, Chemicals and Fertilizers etc.

(e) Development and demonstration of technologies for common use by industry clusters.

(f) Development and demonstration of technologies for government's flagship and mission mode projects.

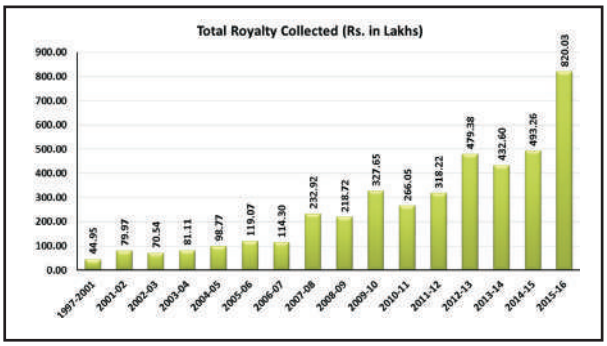
The partial financial support by DSIR in the above areas primarily covers prototype development and pilot plant work, testing and evaluation of products from such R&D, user trials, etc. Bulk of the cost of the project is met from the proposer industry's resources.

The Technology Development and Demonstration Programme (TDDP) is started in 1992, the department has supported 254 R&D projects of Industrial units with a total project cost of Rs. 750.60 crores in which DSIR support is Rs. 280.40 crores. The projects cover a number of industry sectors and the share of these industry sectors in the project supported is: 32% engineering; 27% electronics; 21% Chemical; 7% energy and waste utilization and 13% Health & Pharma. The projects supported have

been spread over 22 states of the country and the share of top five states in the number of project supported is: Andhra Pradesh 18%, Karnataka 15%, Maharashtra 13%, Delhi 10% and Tamil Nadu 10%.

88 technologies developed under the scheme have been commercialized (Annexure 1) and the department has received a cumulative royalty of around Rs. 41.98 Crore during 1997-2016.

During the current financial year, progress of on-going projects was monitored and 3 projects were successfully completed.



Year-wise royalty received from the commercialized products/processes developed under TDDP projects.

1.3 Status of TDDP Projects on-going from Eleventh Plan and monitored during the financial year 2015-16

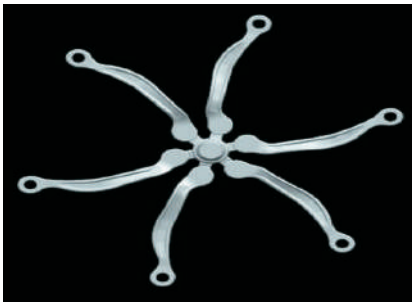
1. Process Up-scaling & Clinical Evaluation- PBL 1427 - A Novel Long Acting DPP IV Inhibitor for the Treatment of Type 2 Diabetes by M/s Panacea Biotec Ltd., New Delhi

The main objectives of the project were to scale-up the process for producing B-amino acid based DPP IV inhibitor using novel heterocyclic, structurally unrelated to any DPP-IV inhibitors known so far and to conduct clinical safety and efficacy trials of the drug molecule. It is a new DPP-IV inhibitor that has better half-life, advantageous potency, stability and selectivity, less toxicity and/or better pharmacodynamics properties. Preclinical Toxicology studies have been successfully completed on tablet formulations. The stability studies of 36 months duration and accelerated studies have been successfully completed. A modified controlled release formulation for once a week dosage form has been successfully developed and its long term stability studies are in progress. For this New Chemical Entity (NCE), the company has filed patents worldwide and has been granted in countries like China, France, Germany, Japan, Switzerland, United Kingdom and United States of America. The project is under progress.

2. Conversion of steel/iron forged/cast under chassis auto-components e.g. steering knuckles & suspension links to lighter weight aluminium equivalents by deploying advanced LPDC process by M/s. Synergies Castings Limited, Visakhapatnam

The aim of this project was conversion of steel forged / cast under chassis auto-components to lighter weight Aluminum equivalents by deploying advanced LPDC process. Components identified for conversion are 'Suspension Links', 'Steering Knuckles' from cast / forged steel / iron components

Steering knuckle



Suspension links

for production with LPDC Aluminum equivalents. The suspension links and steering knuckles have been developed successfully in the facilities developed under the project. Automation of the developed process and defect recognition and correction automatically has also been completed. The developed products will reduce the weight and improved the mileage of the vehicle which results lesser running cost and reduced emissions. The Project is successfully completed.

3. Fuel Cell Bus development Programme by M/s Tata Motors Ltd, Mumbai.

M/s Tata Motors Ltd, Mumbai has taken up project on development and demonstration of Fuel Cell Bus. Hydrogen is emerging as a leading contender for the energy carrier options of future. The project is aimed at design, development and demonstration of 10 Fuel Cell Buses which will be fueled by Hydrogen. A total of 10 prototype buses with successive design improvements are targeted to be demonstrated in the project. Hydrogen refuelling infrastructure with approval of Petroleum and Explosives Safety Organisation (PESO), Ministry of Road Transport and Highways (MORTH) / Central Institute of Road Transport (CIRT) for testing of fuel cell bus at TML Sanand Gujarat has been created and regular field trials on the prototype is under progress at TML facility at Sanand. The Project is under progress. Three prototype buses are ready. Road testing on two prototype buses are under progress within TML Sanand in isolated premises. 1st proto (proto 1) bus has covered more than 2000 km. Integration of Proto 4 is also nearing completion. After completion preliminary testing (1000km), few buses will be transported to IOCL, Delhi for demonstration. TML is in the process of seeking approval for taking bus on public road. Components for Fuel cell power system for buses 6-10 are procured and their integration is at various stages. Tata Motors has collaborated with IOCL and facilitated creation of Hydrogen refuelling infrastructure at IOCL, R&D Faridabad for demonstration of buses at Delhi.

Fuel Cell Bus

4. Bench and Pilot Scale Process Development for UV Reflective Security Inks & Pigments (UVRIP) by M/s Aron Universal Ltd., Bangalore

M/s Aron Universal Ltd., Bangalore has taken up the project to develop and commercialize novel UV-reflective security inks and pigments in five colours with improved performance characteristics in terms of glow intensity under UV exposure, solvent resistance, reduced particle size and acid/ alkali resistance. The process for four colours viz. Blue, Lemon Yellow, Golden Yellow & Red with desired properties been developed for both pigments & Inks. The project is successfully completed.

5. Development and Commercialization on Low Temperature Polymer Exchange Membrane Fuel Cell and Stack by M/s Elpro Energy Dimensions Pvt. Ltd., Bangalore

The project is aimed for Development of Polymer Exchange Membrane fuel cell stacks for stationary applications. The development of fuel cells is very critical in view of the energy and environmental considerations. The developement and fitting of all the required supporting equipment such as gas chamber, flow path, test bench, etc. has been completed. The project has achieved a maximum current density of 665 mA/cm^2 with O_2 and 347 mA/cm^2 with air for a single 300 cm^2 cell. The company has fabricated 3 cell stack successfully. The project

is now integrating multiple cells for developing 1kW and 3 kW fuel cell stack. The Project is under progress.

6. Development of Spiral Cobalt Radiotherapy Machine by M/s Panacea Medical Technology Pvt. Ltd., Bangalore

The aim of the project is development of Spiral Cobalt Radiotherapy Machine for treatment of cancer. The deliverable output of this project is fully functional prototypes for Rotational Gamma Beam machine to achieve conformal therapy. The proposed machine will be able to offer the 3D conformal therapy using cobalt 60. The overall cost of treatment delivery with such a configuration will be lowest, while offering the 3D conformal treatment. Isotope based tele-therapy machine work with maximum advantage when the distance from source to tumor is lower. This machine offers a very low distance of 60 cm. This is a major breakthrough in tele-therapy and it will be first of its kind in the world. This machine will be precise, accurate, rugged and reliable for conformal therapy at a fraction of the cost of competing technologies in developing countries. It is operated by a built-in battery with low power consumption, suitable for rural India. Final testing/ validation has been technically completed.

7. Development & commercialization of Rapid cast Technology for manufacturing of stainless/ steel castings of weight 5000 Kgs single piece by M/s PTC Industries Limited, Lucknow

The objective is to set up a pilot plant facilty of Rapidcast Technology for production of the cast upto 5000 Kg single piece and to reduce the cumbersome process of making dies and mold of the product which requires lot of time and investment. The technology "Rapidcast" have been used to cast a 5000 Kg stainless steel casting of single piece with better quality, consistency and surfaceness. This technology involves much faster speed of production. The existing processes like sand moulding, shell moulding, investment castings etc do not fulfill these features. The high point of the project is that the parts developed did not need any Tooling and are poured in partial vacuum. A state of Art Plant for Rapidcast Technology has been established for the project. Equipments have been Engineered for Project. The total project cost is Rs. 1800.00 lakhs and DSIR support is Rs 500.00 lakhs. The project has been technically completed.

5000 kg single piece stainless steel rapid cast technology

8. Development and Validation of a novel Computer Aided Drug Design (CADD) technology for drug discovery by M/s Rational Labs Pvt. Limited, Hyderabad

The project is dealt with the development of an integrated CADD technology for drug discovery, validation for relative salvation free energies of

M/s Rational Labs Pvt Limited, Hyderabad

small molecules and validation for a diverse set of small molecules for some Drug Targets viz. anticancer, anti diabetics and anti-bacterial. The company has already developed QM/MM based FEP method, which has the potential to automate calculations (both qualitative & quantitative) and thereby increases the use of free energy calculations in the drug design, expecting more accurate results leading to better drug candidate prioritization and ultimately to shorter discovery times. The project has been completed technically.

9. Manufacture of Corey's Lactone and Prostanoids: Iloprost, Lubiprostone and Travoprost by M/s Sai Life Sciences Limited (formerely Sai Advantium Pharma Limited), Hyderabad

The main objective of the project was to synthesize Corey's Lactone, a key intermediate required for the synthesis of several prostanoids at pilot plant level, and to synthesize Iloprost, Lubiprostone and Travoprost from synthesized Corey's Lactone. The prostanoids are lipids in animal tissues that co-ordinate a number of physiological and pathological processes, either within the cells in which they are formed or in closely adjacent cells in response to specific stimuli. Under normal physiological conditions, they have essential homeostatic functions in the cytoprotection of gastric mucosa, renal physiology, gestation and they are also implicated in a number of pathological conditions such as inflammation, cardiovascular disease and cancer. The project has been successfully completed.

10. Motor and control for hybrid car on transmission shaft by M/s. S K Dynamic Pvt. Ltd., Roorkee

The project is aimed to develop, fabricate, test and commercialize switched reluctance motor and control system for a hybrid car that can be mounted on the transmission shaft. The hybrid electric Vehicle (HEV) has been developed. Two times development test and three times emission tests has been conducted at ARAI, Pune. Improvement in fuel economy has been noted during developmental tests, while emissions has not been found at satisfactory level during emission tests. The Project is under progress.

List of projects completed during 2016-17

1. Conversion of Steel/Iron Forged/Cast Under Chassis auto components to lighter weight aluminium equivalent by deploying advanced LPDC process by M/s Synergies Castings Ltd., Visakhapatnam

2. Manufacture of Corey's Lactone and Prostanoids: Iloprost, Lubiprostone and Travoprost by M/s Sai Life Sciences Limited (formerely Sai Advantium Pharma Limited), Hyderabad

3. Bench and Pilot Scale Process Development for UV Reflective Security Inks & Pigments (UVRIP) by M/s Aron Universal Ltd., Bangalore

Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM)

1. Preamble

2. Other Activities

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Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM)

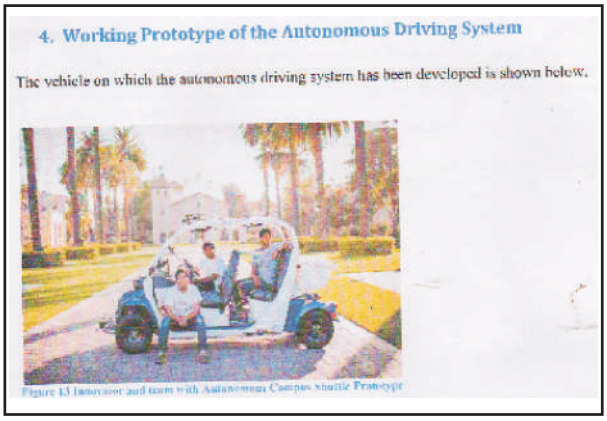
1. PREAMBLE

Department of Scientific and Industrial Research (DSIR) has launched a new programme viz. Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM) during 12th five year plan. The programme aims at to support individual innovators having original ideas to convert them into working models, prototypes etc. It also aims at supporting autonomous institutions or organizations or registered society for developing state-of-art new technology solutions aimed at helping MSME units in industrial clusters. The department has supported sixteen (16) new projects during 2016-17 (up to November 30, 2016). As a part of its commitment to complete on-going spill-over projects supported under erstwhile TePP, the department has successfully completed one TePP projects during the period. The department has also successfully completed fourteen (14) PRISM projects during the year. The details of the completed projects supported under erstwhile TePP as well as PRISM are given in **Annexure-2**. The highlights of some of the completed /on-going PRISM/TePP projects are given below for ready reference:

Development of Autonomous Driving System for Ground Vehicles

Shri Srinivas Reddy Aellala of Kharagpur has been scouted and mentored by TOCIC at IIT Kharagpur with financial support from DSIR under PRISM Scheme. The innovator has developed an autonomous driving system which is driven from one location to another without requiring any human assistance. The system comprises of hardware sensors, processing unit, embedded code for intelligent decision making and vehicle interface modules. Sensors are mounted around the vehicle to provide information of the surroundings to guide the vehicle on path.

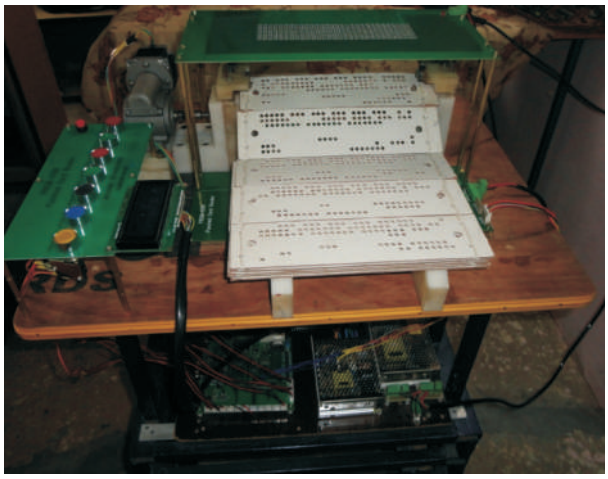
The innovation is standalone scalable system for automating any vehicle, with various degrees of automation available as per the application use ease. The innovation involves use of a number of low cost sensors instead of a single high cost complex sensor. The innovation has increased fault tolerance, increased field of view and distributed & efficient data processing. The same autonomous



driving system can be used in non-road vehicles such as cargo transport carts in warehouses, lawn mowers and autonomous mining trucks. The innovation has potential to solve societal problems like loss of human life in traffic accidents, time wastage in driving and commuting, increasing traffic congestion, depleting fuels and so on.

A novel jacquard punched card reader for digitizing the woven designs

Shri R. Kumaravelu of Kanchipuram has been scouted and mentored by TOCIC at ANU, Guntur with financial support from DSIR under PRISM Scheme. The innovator has developed a prototype of Novel Jacquard Punched Card Reader for digitizing the woven designs for the Handloom industry. The system involves design generation software, embedded system with user interface and line sensor with stepper motor interface to roll the punched cards. The designs can be saved in bmp, gif, jpeg formats.



The innovation would help handloom industry in transferring their traditional woven design information from the old and used punched cards to conventional design file format like bmp, gif, jpeg etc.

Improving the Existent Laser Tag to make it suitable for a varied spectrum of application

Shri Arpan Bose of Kharagpur (W.B.) has been scouted and mentored by TePP Outreach cum Cluster Innovation Centre (TOCIC) at IIT Kharagpur with financial support from DSIR under PRISM Scheme. Shri Bose has developed a Laser tag, which is an indoor physical game/ fighter model where players/ soldiers play/train in teams/groups. They are worn laser sensitive suits and given a laser gun. The basic objective is to tag players/ soldiers from

the opponent team/group by shooting at them and at the same time saving them from being tagged by someone else. The arena will be different from what other laser tag corners have. It will be of puzzle type with large number of corners to limit the line-of-sight for players/soldiers and providing lot of hiding space. The arena walls will be made of detachable panels so that the puzzle/targets can be changed to give the players/soldiers a sense of uncertainty and suspense. The innovator has made the instrument from scratch and programming them as well. The innovator successfully demonstrated Laser Tag. The project has been successfully completed.

Design Development and Performance Evaluation of EcoTrapIn-3

Waterless Urinal Technology

The innovation has been developed by the innovator Ms. Neha Bagoria from Mumbai with the support of PRISM/DSIR. EcoTrapIn3 (Patent applied for) is most cost effective, ergonomic and green product that has a retrofit design and technology, to convert conventional urinal into 'dry' hygienic waterless urinal.

Salient Features

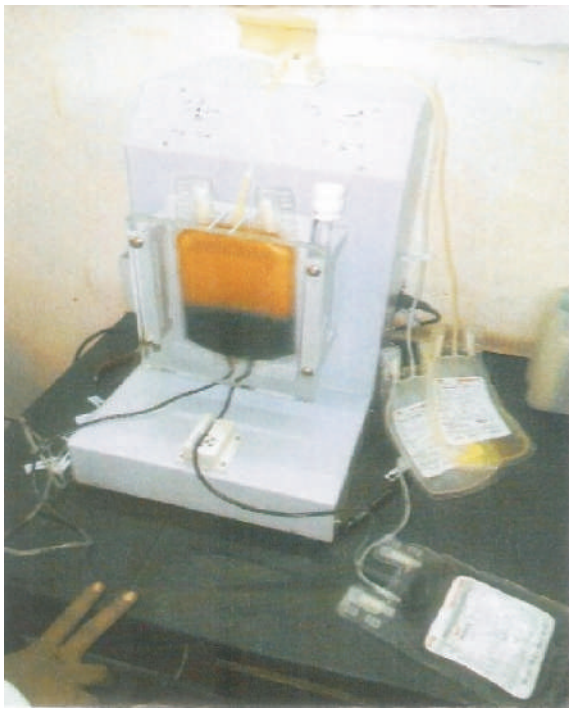
- EcoTrapIn-3 (Patent applied for) coverts conventional urinal into 'dry' hygienic waterless urinal
- Saves 1,67,900 liters of water per urinal per year a solution to foster water conservation
- Ergonomic retrofit design
- Moist free and odorless washroom experience
- Easy installation and maintenance
- Cut the environmental burden with significant cost savings by slashing water and utility bills by 99%
- Corporate Social Responsibility
- EcoTrapIn-3 is recyclable

Semi-automatic Plasma Expressor (on-going)

Shri Om Prakash Beniwal of Udaipur has been scouted and mentored by TOCIC at College of Technology and Agricultural Engineering (CTAE), Udaipur with financial support from DSIR under PRISM Scheme. The innovator has fabricated a semi-finished prototype of semi-automatic plasma expressor. The project is on-going.

Plasma expressor top and bottom is equipment used for separating plasma, buffy coat and Leuko reduced RBCs. It is a mechanical device, which exerts uniform pressure on the blood bags during the separation of blood components. Until now Leuko Reduced red blood cells could be separated only by automated expressor which is costly and requires maintenance The purpose of this machine is to generate Leuko Reduced Red Blood Cells at blood banks to reduce the adverse blood transfusion reactions.

Plasma expressor semi- automatic top and bottom will be a new machine in the field of affordable healthcare. At present in market two types of machines are available to separate blood components. One is fully automatic (imported), which is known as automated top and bottom and another is manually operated top and top machine.



- ***Impact of the product in terms of quality, or cost compared to other similar products***

The novelty of the machine is that it separates the blood components simultaneously which is not available in any of the presently available machine. The main advantage is that the buffy coat layer will not be disturbed in mother bag. In presently available machines the flow of RBC and Plasma is intermittent which disturbed the layer of Buffy coat fastly. It will be low cost machine as compared to impetrated German, UK and other Machines. The cost is under negotiation and yet to be finalized shortly.

- ***Social impact of the project***

The main aim of the product is to develop an indigenous machine for Blood Component Expressor. Presently only imported machines are available in the range of Rs. 15-25 lakhs only and assessed to the higher end hospitals only. HLL has taken the initiative and going to market it at District Level Hospitals. This will help rural people to get blood components at districts level hospitals.

- ***Further spin-offs in terms of R&D, industrial development from the project***

As per the present status the product will be manufactured by Pyrotech Engineering Limited (PEL), Udaipur and will be marketed by HLL, Trivandrum. Innovator will get the royalty from PEL, Udaipur on the basis of Invoice to HLL Trivandrum.

- ***Patents & Awards***

Patent application and PCT has been filed with application no. is PCT/IN2015/000259. The innovator has won International / National awards for the innovation.

2. OTHER ACTIVITIES

2.1 To expand the reach of PRISM among common masses, two new TePP Outreach cum Cluster Innovation Centre (TOCIC) has been set up by DSIR during the year at following location:

(i.) Indian Institute of Technology Guwahati

(ii.) CSIR-National Aerospace Laboratories (NAL), Bangalore.

2.2 A number of other activities organised/ participated by PRISM during the year to sensitize academia, disseminate information on PRISM to the larger mass of the populace network partners and impact generation among common masses:

- PRISM innovators participated in India International Innovation Fair 2016 at BIEC, Bangalore during September 9 - 11, 2016.

A Review meeting of TePP Outreach cum Cluster Innovation Centre (TOCICs) in association with SIDBI Innovation and Incubation Centre (SIIC), IIT Kanpur, was organized during November 21-22, 2016 at Kanpur (Uttar Pradesh). On the occasion, a product exhibition was also organized to create awareness among common public.

Building Industrial Research & Development And Common Research Facilities (BIRD-Crf)

1. Creation of Common Research and Technology Development Hubs (CRTDH)

2. Industrial R&D Promotion Programme

3. Asian Pacific Centre for Transfer of Technology (APCTT)

4. Information Technology and e-Governance (ITeG)

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Building Industrial Research & Development And Common Research Facilities (BIRD-Crf)

1. CREATION OF COMMON RESEARCH AND TECHNOLOGY DEVELOPMENT HUBS (CRTDHs)

1.1 Background

The Department of Scientific and Industrial Research (DSIR) has a program for providing support to Common Research and Technology Development Hubs (CRTD-Hubs) that aim to enhance translational research and fostering industry institution interaction leading to growth of innovative capabilities targeted towards innovative products developments. This helps research institutes and companies to translate scientific knowledge, ideas and inventions into marketable products and services. Three such hubs have been approved under the program at three CSIR institutions, viz. Centre for Cellular and Molecular Biology (CCMB), Hyderabad, Institute of Himalayan Bioresource Technology (IHBT), Palampur and National Institute for Interdisciplinary Science & Technology (NIIST), Thiruvananthapuram, the first two dedicated to development of products for affordable healthcare and the third dedicated towards environmental interventions.

1.2 Aims and objectives

The DSIR-CRTDH programme is aimed at creation of hubs to facilitate and encourage enterprises, startups and micro and small enterprises (MSEs) to access common research facilities having analytical equipment and pilot plant facilities.

1.3 Achievements

During the current year, the Department is in the process of inviting applications from enterprises to work in following three hubs set up under the scheme:-

i. Centre for Cellular and Molecular Biology (CCMB), Hyderabad

The focus of DSIR-CRTDHs at CCMB is support and nurture product development projects in the field of health care and modern biology covering inter alia Diagnostics, Bio-pharma and Medical devices. In particular, the products and technologies that are targeted relate to development of DNA based diagnostic kits for screening of eye infections, Acute Encephalitis, Septicaemia, antibiotic resistance, and others.

ii. Institute of Himalayan Bioresources Technology (IHBT), Palampur

The DSIR-CRTDH at IHBT is being setup to take advantage of the institute's expertise in development of value added products such as thermo-stable enzymes, zero-calorie sugar

substitutes etc. The hub aims to catalyse development of bio-pharmaceutical ingredients such as black carrot anthocyanin, beetroot betaine, mango peel carotenoids etc. by industries located in its vicinity.

iii. National Institute for Interdisciplinary Science and Technology (NIIST), Thiruvananthapuram

The objective of the DSIR-CRTDH at NIIST is towards development of products and technologies addressing environmental issues. The institute's experience in technologies related to odour control, anaerobic treatment, nitrification treatment, water quality analysis and others shall be used to provide interventional R&D solution for a particular sector of MSMEs and is expected to be used by them to improve their environmental performance.

The facilities available under the hubs for use by the MSEs/Innovators have been uploaded on the websites of the respective institutes and call for proposals from MSEs to work in the CRTDH have been made. The centres shall be operated on a cost plus non-commercial basis and are evolving a business model for self-sustainability.

In the current financial year, the Department has invited proposals from National laboratories, Public funded bodies and Institutions of National Importance in sectors of Low cost machining, New Materials/ Chemical Process and Electronics/ Renewable Energy. The proposals received are under processing for possible DSIR financial support for setting up of CRTDHs in these sectors.

2. INDUSTRIAL R&D PROMOTION PROGRAMME

2.1 OBJECTIVES

The broad objectives of the Industrial Research and Development Promotion Programme are to:

- Bring In-house R&D into sharper focus;
- Strengthen R&D infrastructure in Industry and Scientific and Industrial Research Organisations (SIROs);
- Promote R&D initiatives of the Industry and SIROs;
- Ensure that the contributions made by the In-house R&D centres and SIROs dovetail adequately in the overall context of technological and industrial development.

2.2 AREAS OF COVERAGE

The specific areas covered under the component scheme are:

- In-house R&D in Industry,
- Scientific and Industrial Research Organisations (SIROs), and
- Fiscal Incentives for Scientific Research

Activities and achievements in each of above areas are presented below:

2.3 IN-HOUSE R&D IN INDUSTRY

2.3.1 Recognition of In-house R&D Units

A strong S&T infrastructure has been created in the country. This covers a chain of national laboratories, specialised R&D centres, various academic institutions and training centres, which continuously provide expertise, technically trained manpower and technological support to the industry. Various policy measures have been introduced from time to time, to meet the changing industrial and technological requirements of the industry. The Government has been giving special attention to promotion and support to industrial research in industry. Several tax incentives have also been provided which encourage and make it financially attractive for industrial units to establish their own In-house R&D units.

A scheme for granting recognition to In-house R&D units in industry is operated by the DSIR. A number of incentives and support measures are made available to In-house R&D units. Ministry of Finance has issued notification amending the basic notifications under Customs and central excise. As per the amendments, all DSIR recognized In-house R&D units other than hospitals can avail Customs and central excise Duty exemption on their procurements for research purposes.

The In-house R&D units qualifying for recognition are expected to be engaged in research and development activities related to the line of business of the firm, such as, development of new technologies, design and engineering, process/ product/design improvements, developing new methods of analysis and testing; research for increased efficiency in use of resources such as capital equipment, materials and energy; pollution control, effluent treatment and recycling of waste products.

The R&D activities are expected to be separate from routine activities of the firm, such as production and quality control. The In-house R&D units should have staff exclusively engaged in R&D and headed by a full-time R&D manager who would have direct access to the chief executive or to the board of directors depending upon the size of the unit. The In-house R&D units are also expected to maintain separate identifiable infrastructure and R&D accounts.

Number of In-house R&D units recognised by DSIR increased steadily from about 100 in 1973 to about 275 by 1975, to over 700 by 1980, around 925 by 1985, over 1100 in 1990, over 1200 in 1995 and thereafter hovering between 1200 to 1250; 1361 in March 2010**;** 1618 in December 2011, 1767 in December 2012, 1797 in December 2013, 1762 in December 2014, 1800 in December 2015 and 1880 in November 2016. Of these nearly 1700 are in the private sector and the remaining units are in public/ joint sector. The last updated 'Directory of Recognised In-house R&D Units' was brought out in December, 2015. This Directory lists 1880 recognised In-house R&D units, giving registration number, name and mailing address of the company, location of the In-house R&D unit(s) and validity of DSIR recognition.

Under the e-governance initiative of DSIR, the application system has been made completely online through the department website (http://www.dsir.gov.in) for recognition and registration of In-house R&D units (RDI), Scientific & Industrial Research Organisations (SIRO) and Public Funded Research Institutions (PFRI). With the objective of Minimum Government and Maximum Governance the new portal has reduced the time and increased the transparency of operation within the DSIR. Department upload the barcode generated certificates for recognition, registration and its renewal of In-house R&D units of industries, Scientific & Industrial Research Organizations and Public Funded Research Institutions.

To promote entrepreneurship in biotechnology sector, DSIR has implemented, relaxation in three years of existence of enterprise for granting short term fresh recognition to Biotech Start-ups established in incubation centre or technology park with effect from July 2015. DSIR refers applications received from biotech start up to Department of Biotechnology (DBT), being nodal department promoting biotechnology for their views and comments. Based on recommendation of DBT and keeping the DSIR guideline relaxation in view, the applications are re-considered for recognition. The efforts are being made to extend the provision of granting recognition to Bio-tech startups to all sectors.

Detailed guidelines about the schemes are available on department website.The applications received are scrutinised for their completeness in DSIR and are then circulated for comments to various other departments/agencies, concerned administrative ministries, MSME, CSIR, ICAR, ICMR, CCRAS, DBT,

DC & PC, DoT, DRDO, DIT, DoP and NRDC. The applicant industries seeking recognition are invited for presentation and discussion in DSIR and may be visited by a team of experts and DSIR representatives. The applications along with comments from outside agencies, visit reports, and the Department's own evaluation are considered by an inter-Departmental Screening Committee constituted by the Secretary, DSIR. The Committee meeting is scheduled every month to consider the applications and makes recommendations to the Secretary, DSIR.

R&D recognition by DSIR is considered as the basic requirement to avail fiscal incentives focused towards R&D and separation of R&D activities from commercial production/service activities of the company is considered important.

During the period under report, the Screening Committee met **10** times. Of the **302** applications received for recognition, the screening committee considered **285** applications**. 183** R&D units were granted fresh recognition based on their satisfactory R&D Infrastructure, Qualified Manpower and Programmes; **102** applications were rejected and **17** applications are under process at the end of **30th November, 2016**. A statement giving month-wise receipt, disposal and pendency of applications for recognition of In-house R&D units is given at **Annexure 3.**

During the period under report, more than **225** discussions/meetings were held with heads/ representatives of In-house R&D units. Also, expert teams visited a number of In-house R&D units.

2.3.2 Renewal of Recognition

Recognition to R&D units is granted for a period ranging from 2 to 5 years. The R&D units are advised to apply for renewal of recognition well in advance (3 months prior to the date of expiry of the recognition). The department calls for online submission of applications for renewal of recognition. The applications are examined in DSIR taking into account the inputs received from other agencies for taking suitable decision on their renewal. As of 1st **April 2016**, **611** In-house R&D units were due for renewal of recognition out of which **540** applications were received. Based on the evaluation of the performance of the R&D units, renewal of recognition was granted to **530** R&D units. Recognition granted to **71** companies could not be renewed because of the reason that either their application was not received or the R&D performance was not up to the mark. A statement showing month-wise receipt, disposal and pendency of the cases of renewal of recognition of the R&D units is given in **Annexure 4.**

2.3.3 R&D Expenditure

The expenditure incurred by In-house R&D units in industry has steadily increased. During 1980-81 it was of the order of Rs. 300 crores. In 1985-86, it was of the order of Rs. 500 crores. It is estimated that the present R&D expenditure of the 1880 recognised in house R&D units is of the order of about Rs.34,500 crores per annum. The share of public and joint sector is about 20 per cent and that of private sector about 80 per cent among the recognized In-house R&D units. Of these recognized In-house R&D units, 115 units spent over Rs. 5000 lakhs each on R&D while 509 spent between Rs. 500 lakhs to Rs. 5000 lakhs each per annum on R&D and 411 spent between Rs. 200 lakhs to Rs. 500 lakhs each per annum on R&D. The list of these R&D units is given in **Annexures 5, 6** and **7** respectively.

2.3.4 R&D Infrastructure

The In-house R&D centres have created excellent infrastructural facilities for R&D including sophisticated testing facilities, laboratory equipment and pilot plant facilities. Analytical facilities such as NMR spectrometers, Electron microscopes, Particle size analyzers, Portable particle counting systems; Vibration test equipment, Calorimeter, Ultra filtration equipment,

Sonicator, Spectro fluorimeter, Protein purification set up, Digital viscometer, High temperature test and evaluation facilities, HPLCs, HPTLC, FTIR, GCMS, Polymerase Chain Reaction(PCR) equipment, Hydrogenator, Stability Chamber, Aflotoxin analyzer, X-ray defractometer, Salt Spray test chamber, Vickers hardness tester, IR/UV-VIS spectrophotometers, CAD-CAM facilities, rapid prototype building machines, 7 Axis Fanuc Robot, CNC machines, Horizontal and vertical machining centres, PLC controlled filling machines, Microcontroller based control systems, FPGA based super computers, Greenhouse and tissue culture laboratory facilities are available with many In-house R&D units.

2.3.5 R&D Manpower

There has been a steady increase in R&D manpower employed by the In-house R&D units. By 1975-76, about 12,000 R&D personnel were employed by recognised in- house units and by 1981-82, the figure was over 30,000. The present estimated manpower for the **1880** In-house R&D units is over **1,60,000.**

2.3.6 Achievements of In-house R&D Units

Some of the R&D achievements reported by the recognised In-house R&D units are listed below:

Agricultural Sciences :

- Development of short duration maize hybrid SUN VAAMAN
- Development of tall Bajra hyrids with high yielding potential
- Development of hybrids of Cotton, Guar, Moong bean and Mustard crops variety suitable for different agro-climatic regions.
- Development of high yielding hybrids and varieties of French beans, yard longb e a n s , peas, beans colicus, drumstick, Cow, pea, paddy.
- Development of Hybrids and pure-line varieties of different mandate crops like Castor Hybrid – Hira & Kohinoor; Wheat - Durga, Ganga & Uday; Mustard – Basant Bahaar & Arshi and Okra Hybrid – Nirogi & Anjali.
- Development of a PROM (Phospho Rich Organic Manure) out of the spent biogas slurry from a 6000 Cum^3 semi solid waste biogas plant which is a DAP replacement, Superphosphate, organic, provides micronutrients; yield increased from 10-15% and is Eco friendly.

Biological / Biomedical Sciences/Pharmaceuticals:

- Development of fumarate analogs for Psoriasis
- Development of Omega-3 fatty acid supplements for human and veterinary Applications through novel biotechnological processes
- Development of Rabies vaccine, Monovalent Flu vaccine (H1N1), Quadrivalent Flu vaccine, Ebola Vaccine, MERS Vaccine and RSV vaccine
- Development of Captopril 25 mg Tablet, Simvastatin 10, 20 and 40 mg Tablet, Enalapril 5 mg Tablet, Metformin SR Tablet 500 mg. Nifedipine 30 mg ER tablet, Atrovastatin 20 mg tablet, Amlodipine 5 and 10 mg tablet.
- Development of Pharmaceutical Excipients and Specialities like Granular Magnesium Stearate, Low and High specific surface area Magnesium Stearate, Dicalcium phosphate Dihydrate , Sodium, Potassium and Calcium itrates, Sodium Benzoate etc.
- Development Ayurvedic formulation for the treatment of Mastitis in Cows

Chemical Sciences:

- Development of lubrication aids for non-ferrous reactive metals and related alloys
- Development of Ceramic Inks, UV Inks, Ecosolv Inks for Graphics Arts and Solvent Inks for Graphic Arts

- Development of tyre patch with enhance injury capability with reduced dimension
- Development of Performance enhancing products like Anticaking Agent & Anticaking Cum Coloring Agent for Water soluble fertilizer.
- Development of New Grades AISI 347 - Rolled & Forged AISI 321 – Rolled & Forged AISI 316 Ti - Rolled & Forged
- Development of agro chemicals like Profenofos 72% EC, Lambda cyhalothrin 25% CS, Carboxin-17.5%+thiram-17.5%FF, Carbendazim 46.27% SC, Dimethoate 40 % EC, Difenoconazole 25 % EC, Sulphur 40 % SC

Engineering / Information Technology Industries :

- Mooditt Digital Store that brings the entire ecosystem of content providers, application providers and distribution channels on a single platform and leverages multiple channels of content distribution
- Method and Device for Utilizing an Available Balance In Mobile Money Account While Roaming
- Rotary Paper Carton Opening and Closing Machine
- Camera based Vibrating Object Tracking & Analysis Machine
- Threat Evaluation and Weapon Assignment Module for Combat Management System
- Multi Party Voice Conferencing with Optimum Bandwidth Utilization
- Cold End Exhaust System
- New Gen Air Defence Fire Control Radar
- Smart Street Light Gateway
- Smart Secure Hub System (Smart India Plug)
- Digital Video Recorder for Security
- Tungsten Carbide Insert mining rotary

2.3.7 Imports Made by In-house R&D Units

The recognised In-house R&D units have imported a variety of equipment, raw materials and samples for their R&D activities. These include: HPTLC, FTIR, LCMS-8030, Nuclear Magnetic Resonance (NMR) Ultrashield 400MHz, Anchoeic chamber, Sanger Sequencer 3730 genetic analyzer, Gas Chromatography Mass Spectrometry (GCMS), UPLC System, UV Visible spectrophotometer, 6000M Metallurgical microscope, FANUC ROBOCUT ALPHA - C4001A etc.

2.3.8 Other Benefits Availed by the Recognised R&D Units

The Department provides assistance to recognised In-house R&D units in a number of ways, such as cases of industrial R&D units requiring allotment of special controlled materials for R&D, permission to export of specialised products reserved for small scale industries by medium scale industries for test marketing in other countries and disposal of imported R&D equipment/instruments and pilot plant produce are examined for making suitable recommendations to concerned agencies.

2.4 SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATIONS

2.4.1 Recognition of Scientific and Industrial Research Organisations (SIROs)

The DSIR had launched a scheme of granting recognition to SIROs in 1988. SIROs recognized & registered by DSIR are eligible for Customs Duty Exemption in terms of notification No. 51/96-Customs dated 23.07.1996 & its amendment in No. 24/2007-Customs dated 01.03.2007 and Excise Duty Waiver in terms of Govt. Notifications No. 10/97-Central Excise dated 01.03.1997 & its amendment in No. 16/2007-Central Excise dated 01.03.2007.

In order to simplify the processing of application and augment the transparency, DSIR has commissioned online filing of application for both fresh and renewal of recognition.

The DSIR has brought out Guidelines for Recognition of SIROs, which gives procedural details and application proforma for seeking recognition under the SIRO Scheme. Functional SIROs having broad based governing council, research advisory committee, research personnel, infrastructural facilities for research, well defined, time bound research programmes and clearly stated objectives of undertaking scientific research, are considered eligible for recognition by DSIR. The investments of surplus funds not needed for immediate research should be in accordance with the Income-tax Act, 1961.

Applications for seeking recognition under the SIRO scheme are considered in DSIR by an Inter-departmental Screening Committee with members from Council of Scientific and Industrial Research (CSIR), Indian Council of Medical Research (ICMR), Indian Council of Agricultural Research (ICAR), Indian Council of Social Sciences Research (ICSSR) and University Grants Commission (UGC). The recommendations of the Screening Committee are put up for approval of Secretary, DSIR. The recognition is effective from the date of the Screening Committee meeting. Retrospective approval is not granted.

During the period, January 2016 to November 2016 the Screening Committee met 09 times and recommended 48 cases for recognition as SIROs. These include cases in the Natural and Applied Sciences, Agricultural Sciences, Medical Sciences and Social Sciences. The sector-wise list of these SIROs is furnished at **Annexure - 8.**

Recognition granted to SIROs is for duration ranging from 1 to 3 years. The SIROs are advised to apply for renewal of recognition well in advance (3 months prior to the date of expiry of recognition). Such applications received for renewal of recognition are examined by Research Review Groups by involving representatives from ICAR, ICMR, CSIR and ICSSR depending on the areas of research. Based on the evaluation made by the Research Review Groups, renewal of recognition is granted to SIROs.

At present, there are 634 SIROs duly recognised by DSIR; of these, 267 are in the area of natural and applied sciences, 249 are in the area of medical sciences, 39 are in the area of agricultural sciences and 79 are in the area of social sciences.

The SIROs have employed qualified scientists and researchers and have also established good infrastructural facilities for research. They have developed new processes, procedures, techniques and technologies and also filed several patents. They have also organised seminars/ symposiums/ workshops and published research papers / reports / books.

2.5 FISCAL INCENTIVES FOR SCIENTIFIC RESEARCH

Government has evolved, from time to time, fiscal incentives and support measures to encourage R&D in industry and increased utilisation of locally available R&D options for industrial development. New incentives to encourage investments in R&D by industry are announced in the Union Budget. Fiscal incentives and support measures presently available include:

- Income-tax relief on R&D expenditure (capital & revenue);
- Weighted tax deduction U/s 35(2AA) of IT Act 1961 for sponsored research programs in approved national laboratories, universities and IITs;
- Weighted tax deduction u/s 35(2AB) of IT Act, 1961 on In-house R&D expenditure for any company engaged in the business of biotechnology or in any business of manufacture or production of any article or

thing not being an article or thing specified in the list of the eleventh schedule of IT Act, having R&D facility approved by Secretary, DSIR.

- Customs Duty exemption on capital equipment, spares, accessories and consumables imported for R&D by approved institutions/SIROs;
- Customs Duty exemption on specified goods (comprising of analytical and specialty equipment) for use in pharmaceutical and biotechnology sector;
- Central Excise Duty waiver on items purchased from the domestic market by approved institutions/ SIROs for R&D;
- Ten year tax holiday for commercial R&D companies approved upto 31.03.2007
- Central Excise Duty waiver for 3 years on goods produced based on indigenously developed technologies and duly patented in any two of the countries out of India, European Union (one country), USA and Japan;
- Accelerated depreciation allowance on plant and machinery set-up based on indigenous technology;
- Customs Duty exemption on imports for R&D projects supported by Government.

Information on some of these fiscal incentives implemented by DSIR is given in the following paragraph.

2.5.1 Depreciation Allowance on Plant and Machinery Setup Based on Indigenous Technology

Secretary, DSIR, Ministry of Science and Technology, is the Prescribed Authority to certify expenditures where higher rate of depreciation is to be allowed for the plant and machinery installed for the manufacturing of products using indigenous know-how as per provisions of rule 5(2) of IT Rules. Guidelines have been issued for making application for obtaining the aforesaid certificate. All such applications received are examined in the department, and discussions and visits by experts to verify the claim are made to the plants by expert teams. Based on a detailed examination, certificates in deserving cases are issued for eligible expenditure.

During the year, one certificate involving Rs. 7939.59 lakhs during 2014-15 on cost of plant and machinery was issued by DSIR. Details are given at **Annexure 9.**

2.5.2 Central Excise Duty Waiver for three years on patented products

Government of India, Department of Revenue, vide Notification No. 13/99-CE dated 28th February 1999 had exempted, all goods of the description specified in the Annexure appended to the notification falling under the Schedule of the Central Excise, Tariff Act, 1985 (5 of 1986), from the whole of the Duty of excise leviable thereon under the Central Excises (Goods of Special Importance) Act, 1957 (58 to 1957), subject to the following conditions:-

(i) the specified goods are designed and developed by an Indian owned company, national laboratory, public funded research institution, or university;

(ii) The specified goods which are so designed and developed are patented by such Indian owned company, national laboratory, public funded research institution, or university, in any two countries from amongst India, Unite States of America, Japan and any one country of the European Union;

(iii) the specified goods are manufactured by a wholly Indian owned company;

(iv) the manufacturer produces a certificate from the Department of Scientific and Industrial Research to the effect that the specified goods are designed and developed by a wholly Indian owned company, national laboratory, public funded research institution, or university and are patented in any two countries from amongst India, United States of America., Japan and any one country of the European Union;

(v) the procedure as prescribed by the jurisdictional Commissioner of Central Excise is followed;

(vi) the exemption contained in the notification shall not apply to the goods which are cleared on or after a period of three years from the date of issue of the certificate by the Department of Scientific and Industrial Research referred to in condition (iv) above.

The incentive aims to promote development and manufacturing of innovative indigenous products. In order to operationalise the scheme department has evolved guidelines and application form for screening and issuance of certificate. These guidelines and application form are available on DSIR website.

During the year, department had received 5 applications. These applications were evaluated by the technical expert committee. Five certificates were issued to two companies by DSIR. Details are given at **Annexure 10.**

2.5.3 Reference on expenditure on scientific research under Section 35 (3) of Income-Tax Act, 1961

Section 35(3) of Income-tax Act, 1961 provides that if a question arises as to whether and, if so, to what extent any activity constitutes or constituted or any asset is or was being used for scientific research, the Central Board of Direct Taxes would refer the question to the Prescribed Authority. Chief Commisioner Income-tax (Exemptions) in concurrence with Secretary, DSIR is the Prescribed Authority for deciding such cases.

During the period under report, department had received one reference from Department of Revenue (CBDT) for M/s Kansara Bearings Ltd., Jodhpur for assessment year 1997-98. The department has sent the reply to the reference.

2.5.4 Approval of Commercial R&D Companies

In order to promote research and development activities in the commercial research and development companies, the Finance Act, 2000 provided for a ten-year tax holiday from income-tax under section 80-IB(8A) of the Income-tax Act, 1961, to approved companies, whose main objective is undertaking scientific and industrial research, Secretary, DSIR is the Prescribed Authority vide Gazette notification no. S.O. 85(E) dated 31 January, 2001, issued by Department of Revenue, Ministry of Finance for granting approval under section 80-IB(8A) of the IT Act. The notification was valid upto 31st March, 2007 and this scheme was not extended further by the Government.

The approval to commercial R&D companies is given initially for a period of 3 years, which can be extended up to 10 years based on evaluation of its performance. The tax exemption is available to a company, which is accorded approval by the Prescribed Authority at any time after the 31st day of March 2000 but before the 1st day of April 2007.

Out of 45 companies approved till 31st March 2007, No companies is availing benefit under the section at present.

2.5.5 Customs Duty Exemption to Recognised SIROs

All SIROs recognized & registered by DSIR other than hospitals are eligible for Customs Duty Exemption on the import of scientific equipment, instruments, spares, accessories as well as consumables for research and development activities and programmes.

The department was issuing the essentiality certificates to SIROs for obtaining the Customs Duty exemptions. As per the notification No. 24 /2007 dated 1st March, 2007 the Director or Head of the institute/ organization is empowered to sign the essentiality certificate.

2.5.6 Central Excise Duty Exemption to Recognised SIROs

All SIROs recognized & registered by DSIR other than hospitals are eligible for Excise Duty Exemption on purchase of scientific and technical instruments, apparatus, equipment (including computers); accessories and spare parts thereof and consumables; computer software, Compact Disc - Read Only Memory (CD-ROM), recorded magnetic tapes, micro films, microfiches; and prototypes for research and development activities and programmes.

This provision was introduced by Ministry of Finance (Department of Revenue) vide notification No. 10/97-Central Excise dated 1st March, 1997. The department was issuing the essentiality certificates to SIROs for obtaining the central excise Duty exemptions. As per the notification No.10/ 2007 dated 1st March, 2007 the Director or Head of the institute/organization is empowered to sign the essentiality certificate.

2.5.7 Customs and central excise Duty exemption to Recognised In-house R&D units

Ministry of Finance has issued notification no. 24/ 2007 – Customs dated 01/03/2007 and 16/2007 – Central Excise dated 01/03/2007 amending the basic notifications under Customs and excise. As per the above amendments all DSIR recognized In-house R&D units other than hospitals can avail Customs and central excise Duty exemption on their procurements for research purposes. All the eligible In-house R&D units recognized by DSIR have been issued the certificates of registration.

2.5.8 Registration of Public Funded Research Institutions, Universities etc.

Public funded research institutions, universities, IITs, IISc., Bangalore; Regional Engineering Colleges (other than a hospital) are eligible for availing Customs Duty exemption on import of equipment, spares and accessories and consumables for research purposes through a simple registration with the DSIR. The heads of the public funded research institutions / organisations duly registered with DSIR can certify the goods for R&D Duty free import as per the notification No. 51/96-Customs dated 23 July 1996. As per the Government notification No. 10/97-Central Excise dated 1.3.1997, the above Public Funded Research Institutions registered with DSIR are also eligible for Central Excise Duty Waiver on purchase of indigenously manufactured items for scientific research purposes.

Coinciding with the presentation of Union Budget for the year 2004, Ministry of Finance amended the notification No. 51/96-Customs vide notification No. 28/2003-Customs dt.1.3.2003. As per the amendment, departments & laboratories of central government and state governments (other than a hospital) are not required to register with DSIR for availing the Customs Duty exemption. They can clear the consignments by producing a certificate from the Head of the institution certifying that the said goods are required for research purposes only. Another significant change in the notification is that Regional Cancer Centres have been included in the list of institutions eligible for DSIR registration for importing goods for research purposes at a concessional rate of Customs Duty.

Under the e-governance initiative of DSIR, department has started online application submission facility for greater accessibility and transparency of the department programmes/ schemes. For the purpose of registration / renewal of registration of Public Funded Research Institutions (PFRIs) and others, submission of online application facility started in the year 2012 through

the department website (www.dsir.gov.in). Details about the schemes are available on department website. So far about 250 institutions have applied online. The complete applications are considered by an Inter-departmental Screening Committee constituted by the department for considering the requests from various institutions. Presently the committee is chaired by a former Secretary of DSIR.

The Screening Committee met once during the period under report and considered 18 applications received from various public funded research institutions. During the period under report, 12 registration certificates were issued to such public funded research institutions for availing Customs Duty exemption on import of scientific equipment, spares and accessories, consumable items and Central Excise Duty exemption on indigenous purchases for Scientific Research Purposes. There are about 600 PFRIs registered by DSIR.

The registration to public funded research and other institutions mentioned in the notification is granted for maximum period of five years / ten years (for all institutions of national importance, CSIR, ICAR & ICMR labs, IITs, NITs, etc.). The registered institutions are advised to apply for renewal of registration well in advance of the date of expiry of the registration.

During the period under report, **230** institutions were due for renewal of registration. The department received **170** renewal applications. These were processed on individual files and approval of Competent Authority was obtained and **162** renewal certificates were issued.

2.5.9 Approval of In-house R&D Centres under Section 35(2AB) of I.T. Act 1961

In order to encourage R&D initiatives of industry, the finance bill 1997 introduced a sub section (2AB) in section 35 of the IT Act, 1961. The provision introduced initially was for select sectors of industry i.e. drugs, pharmaceuticals, electronic equipment, computers, telecommunication equipment, chemicals and provided weighted deduction of 125 per cent on expenditure on In-house research and development facility as approved by the prescribed authority i.e. Secretary, DSIR. Subsequently, a number of other sectors were added to the list of eligible sectors. From the year 2009 the benefits have been extended to all sectors of industry with a select list of non-priority items. Rate of weighted tax deduction was raised from 125 per cent to 150 per cent subsequent to the year ending March, 2000. The rate of weighted tax deduction was further enhanced to 200% from 1st April 2010. In the Union budget of 2016, from 1st April 2017 to 31st March 2020 the rate of weighted tax deduction has been reduced from 200% to 150%. Initially the provision was introduced up to 31st March, 2000. The provision was extended from time to time initially till 31st March, 2005 and then upto 31st March, 2007, further up to 31st March 2012. In the Union Budget 2012, the provision has been extended up to 31st March 2017. This provision was further etended in Union budget of 2016 upto 31st March 2020.

During the period under report, 127 new applications were received for approval under the provision. New approvals were accorded to 110 companies in Income Tax prescribed Form 3CM. Further, the detailed R&D expenditure of the approved companies were also examined and 485 reports valued at Rs.13774 corers forwarded to DGIT (E) in Form 3CL as prescribed in IT Act. A list of companies approved under Section 35(2AB) of IT Act, during the year 2016 is furnished in **Annexure-11.**

3. ASIAN PACIFIC CENTRE FOR TRANSFER OF TECHNOLOGY (APCTT)

3.1 Preamble

The Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology (MOST), Government of India has been the national

focal point of APCTT since its inception in 1977. Matters pertaining to the APCTT and UNESCAP are dealt with in cooperation with the Ministry of Commerce and Industry and the Ministry of External Affairs, Government of India. DSIR also plays an active role in APCTT's functioning, particularly relating to its programmes and policies. India being the host country has been providing institutional support to APCTT.

APCTT receives annual institutional support of US$ 200,000 in Indian Rupees (to meet local costs) from DSIR in addition to funding for building repairs, renovation work, and municipal taxes. DSIR has also extended programme support towards the APCTT project entitled, "Promotion of National Innovation Systems (NIS) in Countries of the Asia-Pacific Region – Phase II" which concluded in 2016.

The revised Statute of APCTT, adopted by the Commission at its Seventy second session in May 2016, through its resolution 72/3, stipulates among other things, that the Centre shall have a Governing Council consisting of a representative designated by the Government of India and no fewer than eight representatives nominated by other members and associate members of ESCAP elected by the Commission. The members and associate members elected by the Commission shall be elected for a period of three years but shall be eligible for re-election. The Council shall advise on the formulation and implementation of the programme of work of the Centre and review the administration and financial status of the Centre. The Executive Secretary shall submit an annual report, as adopted by the Council, to the Commission at its annual sessions. The Commission at its Seventieth session elected the following countries along with the host country, India, to be members of the Governing Council of the Centre for the period 2014 to 2017: Bangladesh, China, Fiji, Indonesia, Islamic Republic of Iran, Malaysia, Pakistan, Philippines, Republic of Korea, Samoa, Sri Lanka, Thailand and Viet Nam. The 11th Session of the Governing Council and Technical Committee of APCTT were held in New Delhi, India in December, 2015 in cooperation with DSIR.

3.2 Activities of APCTT in 2016

1. Science, Technology and Innovation (STI); Technology Transfer; and Technology Intelligence were identified as three focus programme areas in the five year Strategic Plan (2013-2017). Under these areas, the activities focused on: promotion and strengthening of national innovation systems; promotion of new and emerging technologies such as nanotechnology and renewable energy; promotion of sustainable agricultural technologies and improved market linkages; support technology transfer capacity building in member countries; and provision of technology intelligence through normative and analytical studies, regular periodicals, dissemination of technological information, networking and sharing of experiences and best practices relating to the management of technology.

2. In 2016, APCTT has undertaken several activities of immediate relevance to Member States of the region. During this period, the Centre delivered and/or actively contributed in capacity building programmes in 9 Member States (China, India, Indonesia, Malaysia, Myanmar, Pakistan, Philippines, Singapore and Thailand) in close collaboration and partnership with 21 partner institutions. These programmes include international and regional conferences, regional consultative forums and regional/sub-regional training workshops targeting senior policy makers and relevant STI stakeholders. These Capacity building activities involved , experts and resource persons from 20 countries (such as Afghanistan, Cambodia, China, France, Germany, India, Indonesia, Japan, Lao PDR, Maldives, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri

Lanka, Thailand, United Arab Emirates and Viet Nam) who shared their knowledge, experience and best practices for the benefit of participants.

3. APCTT assists Member States to strengthen their National Innovation Systems (NISs) through enhancing innovation capacity, promoting technology transfer and deployment, enhancing competitiveness of enterprises and promoting new technology entrepreneurship. Following are the key activities carried out during this reporting period:

   a. *Completion of NIS Phase II project:* APCTT started the programme of strengthening national innovation systems in Member States in 2005 with support from the Department of Scientific and Industrial Research (DSIR) of the Ministry of Science and Technology, India. The Centre continued this programme through implementing NIS phase II project, also supported by DSIR since 2010 and completed in 2016. Through this project, APCTT assisted the participating countries in strengthening their key NIS components through capacity-building activities for policymakers, industries, universities, R&D institutions and other relevant stakeholders in relevant areas such as: formulating and implementing strategic policies and programmes; managing technology business incubators; strengthening the enabling environment and strategies for sustainable energy options; promoting technology-based entrepreneurship; and working on new and emerging technologies.

   During the NIS phase II project period, APCTT strengthened specific NIS components of the 18 participated countries (such as Afghanistan, Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Islamic Republic of Iran, Laos People's Democratic Republic, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Republic of Korea, Sri Lanka, Thailand and Viet Nam) through implementing more than 30 project activities. This was achieved by enhanced capacity of 1,220 policy makers in the governments, and decision makers in the R&D institutions, academia and industries, the key actors of national innovation systems. About 190 national and international experts from 22 countries and five international institutions participated in the Asia-Pacific regional and national capacity building activities. Nearly 300 women experts and participants from the government ministries, R&D institutions, academia and industries participated in the project activities. A key feature of the second phase was the involvement of several countries with special needs, namely Afghanistan, Bangladesh, Bhutan, Cambodia, the Lao People's Democratic Republic, Myanmar and Nepal. In order to increase the impact of the outputs of project activities, including the reports and presentations made by national and international experts were disseminated through the on-line NIS Resource Centre (http://nis.apctt.org).

   b. *International Conference on Innovation Strategies for Sustainable Development, 19 December 2016, Islamabad, Pakistan:* As a part of the substantive segment of the twelfth session of the APCTT Governing Council in cooperation with the Ministry of Science and Technology, Government of Pakistan, the Centre will organize an International Conference on Innovation Strategies for Sustainable Development, on 19 December 2016, in Islamabad, Pakistan.

The conference objectives are to: discuss the role of public policies in facilitating innovation and effective partnerships for sustainable development; exchange best international practices and strategies in order to encourage innovation and innovative entrepreneurship; and exchange best international practices and strategies for technology transfers. The exchange of policy experience would also contribute to building capacity of attending high-level policymakers, Governing Council members of APCTT, representatives of United Nations specialized agencies and international organizations, and representatives of the business and academic communities as well as the civil society.

c. *1st Indonesia International Conference on Science Technology Park (IICSTP), 12-13 October 2016, Bogor, Indonesia:* The Head of APCTT was invited as key note speaker and she delivered a presentation on "Promoting Innovations – the role of Science and Technology Parks" which contained policy recommendations. The Conference further discussed on how to create an enabling environment to make STP successful, intellectual property management, business support, incentives, issues related to infrastructure and networking, among others. The Conference was attended by over hundred senior policymakers, researchers and representatives from the private sector.

d. *Second National Consultation on Sustainable Development Goals (SDGs) 8 and 9, 2-3 August 2016, New Delhi, India:* As part of this event, APCTT in cooperation with Research and Information System for Developing Countries (RIS), New Delhi, India, co-organised a panel discussion on "Innovation for Sustainable Industrialization and Development". In this session, the Head of APCTT delivered a presentation entitled "Role of the Government in Eco-innovation". This high level meeting was attended by senior policymakers from NITI Aayog (National Institution for Transforming India) of Government of India, various Government departments and States, think tanks, international agencies and experts.

e. *The 4th China-South Asia Expo and 2nd Forum on China-South Asia Technology Transfer and Collaborative Innovation, 12-14 June 2016, Kunming, P.R. of China:* In cooperation with Yunan Academy of Scientific and Technical Information (YASTI), China, APCTT serviced and participated in the 4th China-South Asia Expo and 2nd Forum on China-South Asia Technology Transfer and Collaborative Innovation, Kunming, P.R. of China, 12-14 June 2016.

- *4th China-South Asia Expo*: The Expo was sponsored by the Ministry of Commerce and the People's Government of Yunnan Province. Senior officials from China, the host country followed by officials from Afghanistan, Maldives, Nepal, Pakistan and Sri Lanka addressed more than 1,000 participants from the South Asian countries, China, Chinese entrepreneurs in ASEAN countries. Participants included SMEs, officials from the concerned ministries dealing with science and technology, trade, commerce and industry.

- *2nd Forum on China-South Asia Technology Transfer and Collaborative Innovation*: APCTT participation at the plenary session of the Forum increased awareness about the ongoing and

future activities of the Centre in the area of technology innovation and transfer of technology. In addition, strengthened networking with the key STI stakeholders in the Yunan Province of China and South Asian countries. In addition, senior experts and officials from China, Maldives, Nepal, Sri Lanka, Pakistan, Afghanistan and India also delivered their views on technology innovation and transfer of technology of their respective countries.

- *China-India Technology Transfer Workshop*: APCTT also attended the China-India Technology Transfer Workshop held in conjunction with the Forum and emphasized on the role and the need for development and transfer of technologies as well as narrated key issues and challenges. At this workshop, 58 Chinese technology innovators and SMEs participated and interacted with the Indian companies looking for technology opportunities. In addition, 10 Chinese entities, including, SMEs and R&D institutions presented specific technological opportunities for cooperation with India.

f. *NIS Training Manual:* Under the NIS Phase II project, APCTT developed a NIS training manual entitled "NIS Diagnosis and STI Strategy Development to Achieve National Sustainable Development Goals". The manual describes the process of adopting a NIS framework, and evolves strategies to strengthen the process of creating and diffusing new technologies and innovation within a nation's economy. The manual would be useful for policy makers working within the government ministries and institutions that support technological change, as well as to researchers in and students of the economics and policy regimes of technological change.

g. *Asia-Pacific National Innovation Systems Online Resource Centre (http://apctt.org/nis/):* This online knowledge platform, set up with the objective to give science, technology and innovation stakeholders the opportunity to share policy approaches and experiences of countries on issues pertaining to strengthening national innovation systems, was updated with outputs and outcomes of the activities as of 2015 under the STI/ national innovation system programme of work of the Centre. Users can view and download presentations made by the national and internal experts and reports of the regional and national workshops, meetings and national innovative systems forums.

4. Since 2011, APCTT has been implementing several activities aimed at strengthening nanotechnology R&D management capacity of relevant stakeholders (e.g. policy makers, R&D institutions, researchers and SMEs) in the member countries. Under this programme, relevant knowledge, experience and best practices were shared among stakeholders through South-South cooperation to enhance their R&D management capacity and market competitiveness in the area of nanotechnology-based value added product development and commercialization. During the reporting period, APCTT continued its efforts to engage with and assist the member States by updating and sharing project outputs and relevant information through the Centre's dedicated website of "Asia-Pacific Nanotechnology R&D Management Network" (http://apctt.org/nanotech/). The APCTT-developed "Manual on Critical Issues in Nanotechnology R&D Management: An Asia-Pacific Perspective" was disseminated

through the above website to help various stakeholders involved in the research and development (R&D) and innovation management activities in the area of nanotechnology.

5. In addition, the Centre liaised with the National Nanotechnology Directorate (NND) of Ministry of Science Technology and Innovation (MOSTI), Malaysia and Technology Application and Promotion Institute (TAPI) of Department of Science and Technology (DOST), Philippines to organize regional capacity building workshops entitled "Regional workshop on nanosafety and sustainable development" and "ASEAN Regional forum on fostering innovation ecosystems for SMEs in new and emerging technologies" proposed to be held in 2017 in Malaysia and Philippines respectively.

6. The Asian and Pacific Centre for Transfer of Technology has been engaged in strengthening the technology transfer capacity of relevant stakeholders in member countries through a wide range of activities including, but not limited to, organizing Training of Trainers (ToT) programmes on planning and managing technology transfer projects; provision of technology transfer support services for SMEs and entrepreneurs through online as well as offline mechanisms; organizing business-to-business meetings in specific sectors in partnership with key nodal agencies in member countries; technology information services through information portals and technology publications; establishment of specialized technology transfer networks in specific sectors for enhancing cross-border technology-based business and research cooperation among member countries.

7. To support the implementation of ESCAP Commission resolution 64/3 on promoting renewables for energy security and sustainable development in Asia and the Pacific, the Centre established the Renewable Energy Cooperation-Network for the Asia Pacific (RECAP) in 2010. The main focus of this mechanism is to strengthen the capacity of participating member countries in implementing projects related to renewable energy technologies through training, cooperation and the promotion of partnerships among R&D institutions, universities, industries and other stakeholders in the region. The current membership of RECAP includes 16 member States of ESCAP, namely Bangladesh, China, Fiji, India, Indonesia, the Islamic Republic of Iran, Malaysia, Mongolia, Nepal, Pakistan, the Philippines, the Republic of Korea, Sri Lanka, Thailand, Vanuatu and Viet Nam. The Centre has so far provided training to more than 550 renewable energy professionals from the region on various aspects of renewable energy technology transfer and adoption. A brief summary of the Centre's activities carried out under the RECAP framework during the reporting period is provided below:

a. *Regional Workshop on Overcoming Critical Bottlenecks to Accelerate Renewable Energy Deployment in ASEAN+6 Countries, Bangkok, Thailand, 14-15 June 2016*. APCTT, in partnership with the International Renewable Energy Agency (TISTR) and Thailand Institute for Scientific and Technological Research (TISTR) of the Ministry of Science and Technology (MOST) of Royal Thai Government organized a Regional workshop on Overcoming Critical Bottlenecks to Accelerate Renewable Energy Deployment in ASEAN+6 Countries in Bangkok, Thailand during 14-15 June 2016. Over 107 renewable energy experts from 13 countries from Asia and Europe namely Cambodia,

France, Germany, India, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Philippines, Thailand, United Arab Emirates and Viet Nam participated and contributed to the deliberations. The workshop focused on addressing various issues related to strengthening policy, regulatory and institutional frameworks as well as financing of renewable energy investments that are critical for accelerating renewable power deployment in countries in the Asia-Pacific region. This workshop also focused on knowledge sharing on technical aspects that are critical for accelerating biomass energy deployment in the region. The workshop facilitated brainstorming on how regional and international platforms such as the Asian and Pacific Energy Forum of ESCAP, Sustainable Energy for All (SE4All) of the United Nations and IRENA's Clean Energy Corridor initiative in the ASEAN region could be effectively used for promoting renewable power deployment in ASEAN + 6 countries.

b. *Accelerating Low-Carbon Technology Transfer: Helping Developing Countries Implement Nationally Determined Contributions, Asian Development Bank Roundtable and Singapore International Energy Week 2016, 27 October 2016.* This roundtable meeting focused on the challenges for accelerating transfer of low-carbon technologies to developing countries to help them achieve their Nationally Determined Contributions (NDCs). Senior government officials and experts from Singapore, China, India, ADB, Economic Research Institute for ASEAN and East Asia (ERIA) and the United Nations system actively participated and contributed to this roundtable meeting. The discussions during the roundtable meeting were aimed at identifying the support needed by developing countries to allow and foster accelerated transfer and diffusion of low carbon technologies, sharing practical experiences in promoting low carbon technology transfer and investment as well as to draw key energy-sector insights on the challenges and opportunities of moving forward to meet global climate goals. APCTT participated and actively contributed to this roundtable discussion on successful cases of energy technology transfer and investment promotion in the Asia-Pacific region. The outcomes of APCTT's Diagnostic Study on Assessment of Technology Innovation Ecosystem of Lao PDR and APCTT's recommendations on sustainable energy strategy for Lao PDR were presented during the brainstorming session.

c. *Regional Workshop on Enhancing Innovation and Competitiveness of MSMEs in Response to the ASEAN Integration for Agro-enterprise, Manila, Philippines, 28-29 September 2016*. APCTT organized this workshop in partnership with the Technology Application Promotion Institute (TAPI) of the Department of Science and Technology (DOST), Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) and DOST-Region XI during 28-29 September 2016 in Manila, Philippines. The overall objective of this regional workshop was to strengthen the knowledge base of key stakeholders, especially MSMEs involved in agriculture and agro-food processing in the Philippines by introducing best practices from other countries in the Asia-Pacific region towards enhancing their

innovation and competitiveness. This workshop also focused on how agro-enterprises in the Philippines could leverage the opportunities provided by the ASEAN framework to establish linkages with their counterparts in other ASEAN countries through cross-border technology transfer, business partnerships and knowledge networks. Apart from the representatives of MSMEs, government nodal agencies involved in agro-enterprise promotion in the Philippines, experts from Japan, Indonesia, India and APCTT actively participated and contributed to the deliberations. This workshop helped DOST to receive inputs and suggestions from participants on how to link various technology transfer initiatives of DOST to support agro-enterprise development. As an initial step towards this direction, DOST is planning to expand its mandate to include agro-enterprises in their portfolio. This is a major policy decision that was influenced through this workshop organized by APCTT.

8. The Centre is implementing a project entitled "An Integrated Rural Economic and Social Development Programme for Livelihoods Improvement in the Dry Zone of Myanmar" in partnership with the Centre for Alleviation of Poverty through Sustainable Agriculture (CAPSA) and the Centre for Sustainable Agricultural Mechanization (CSAM). The project, which is being funded through the Livelihoods and Food Security Trust Fund (LIFT), supports integrated socioeconomic development in the Myanmar dry zone in the context of inclusive and sustainable development with special emphasis on livelihoods improvement and food security. The Centre is working towards strengthening the capacities of key stakeholders in the transfer of improved and environmentally sound technologies for small and medium-sized enterprises to improve the livelihoods and food security aspects of the people in the dry zone. The project activities comprise a range of analytical and capacity-building interventions and development of case studies, policy papers and policy briefs. During the reporting period, the Centre organized and participated in the following activities pertaining to the project:

a. *Workshop on Best Practices in Mung bean (Green gram) Seed Production, Quality Control and Maintenance' in Magway, Myanmar from 29 February-01 March 2016.* APCTT in partnership with the Network Activities Group, Myanmar and the Department of Agricultural Research (DAR) of Myanmar organized a 'Workshop on Best Practices in Mung bean (Green gram) Seed Production, Quality Control and Maintenance' in Magway, Myanmar from 29 February-01 March 2016. Twenty eight participants (including 12 women) participated in the event representing lead farmers, farmer associations, NGOs and LIFT implementing partners involved in Mung bean seed production, key nodal agencies of the government including Department of Agricultural Research (DAR) and the private sector (entrepreneurs as well as representatives from seed farms) and the United Nations Office for Project Services (UNOPS). During the workshop, the constraints in Mung bean seed production in the dry zone of Myanmar were brainstormed with the participants through interactive discussions to identify key challenges and technical barriers related to Mung bean production. Based on the observations, a few best practices and solutions for fixing problems in Mung bean seed

production were shared with the participants. This workshop also covered aspects of different seed production systems at the level of: individual farmers, farmer groups, non-governmental organizations and the private sector. Through this workshop, APCTT highlighted the importance of focusing on capacity building of various stakeholders in the Mung bean seed production process through a wider multi-stakeholder engagement. The workshop also enabled the participants to appreciate the need for knowledge sharing among all stakeholders to achieve the desired outcomes which would be helpful not just for policy makers in planning and implementation of programmes but also in strengthening the capability and skill of relevant stakeholders associated in the Mung bean seed value chain in Myanmar.

b. *Workshop on Practices in Farmer-led Seed Enterprise Development for Improving Seed Quality and Enhancing Revenue Generation, Mandalay, Myanmar,8-9 November 2016*. APCTT organized this workshop in partnership with the Network Activities Group (NAG) and the Department of Rural Development (DRD) of the Ministry of Agriculture, Livestock and Irrigation (MOALI) of Myanmar in Mandalay, Myanmar during November 8 - 9, 2016. This workshop focused on enhancing the awareness of various stakeholders involved in agro-enterprise development in Myanmar with a specific focus on challenges and constraints in farmer-led seed enterprise development especially in the dry zone of Myanmar. Deliberations during the workshop were also aimed at identifying solutions for overcoming challenges as well as to learn best practices in establishing effective and efficient farmer-led seed enterprises in the dry zone of Myanmar. Over 20 participants representing a broad stakeholder group including lead farmers, farmer association representatives, NGOs and LIFT implementing partners involved in seed production, key nodal agencies of the government including Department of Agriculture and Department of Agricultural Research (DAR), and the private sector (entrepreneurs as well as representatives from seed farms) actively participated and contributed to the workshop. APCTT also presented successful business models for farmer-led seed enterprise development from other countries during this workshop. It is envisaged that this workshop will strengthen Myanmar government's efforts to support seed enterprise development in the country especially in the dry zone of Myanmar.

9. APCTT has been engaged in strengthening the technology transfer capacity of key stakeholders in member countries through a wide range of activities, such as organizing training of trainers programmes on planning and managing technology transfer projects, providing technology transfer support services for small and medium-sized enterprises and entrepreneurs, organizing business-to-business meetings in specific sectors in partnership with key central agencies in member countries and technology information services through information portals and technology publications, and the establishment of specialized technology transfer networks in specific sectors. During the reporting period, APCTT organized and/or actively contributed to the following activities:

a. Workshop on Developing and Strengthening Manufacturing Sector through Skill Development in Networking & Technology Transfer, 28th January 2016, New Delhi, in partnership with the Federation of Indian Export Organizations (FIEO), New Delhi, India.

b. 2nd Forum on China-South Asia Technology Transfer and Collaborative Innovation, 26 February 2016, Kunming, China in partnership with Yunnan Academy of Scientific and Technical Information (YASTI), Kunming, China

c. Training programme on New Models of Partnership & Technology Transfer, March 9-11, 2016, Ghaziabad, India in partnership with the Human Resource Development Centre of the Council of Scientific and Industrial Research (CSIR), Ministry of Science and Technology, Government of India

d. Food Security - Low Water Agriculture – The Next Solution? 13th April 2016, Kuala Lumpur, Malaysia in partnership with the Human Life Advancement Foundation, Malaysia

e. Regional Agricultural Innovation Summit, 25-26 May 2016, Bangkok, Thailand, United States Agency for International Development (USAID) – Regional Mission for Asia and Winrock International.

f. 1st Meeting of the Advisory Committee for Formulation of New Schemes beyond 31st March, 2017, Government of India–Autonomous Bodies, PSEs and International Organizations, 10th June 2016, New Delhi, India

g. Workshop on Enhancing Innovation and Competitiveness of MSMEs in Response to the ASEAN Integration for Agro-enterprise, 28-29 September 2016, Manila, Philippines in partnership with the Technology Application Promotion Institute (TAPI) of the Department of Science and Technology (DOST), the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) and DOST-Region XI of the Republic of Philippines

10. The Centre also began to integrate various stand-alone information technology-based technology databases and tools into its website in order to provide all available technology transfer support services under one platform. As part of this initiative, the technology databases from the Centre's key technology transfer portal, Technology4SME.net was migrated to APCTT website. The Renewable Energy Cooperation Network for Asia Pacific (RECAP) website was also migrated and integrated to the Centre's website to provide ease of access to users interested in renewable energy technologies and partnerships.The Centre designed a new section in the APCTT website known as "Global Technology Databases" to replace APTITUDE and the search functions that were offered to users through this search engine. The Global Technology Databases section currently provides direct access to various national and international technology databases to the users of APCTT's technology transfer services.

11. APCTT has been providing technology intelligence to assist member States and their key stakeholders (such as policymakers, institutions, academia, technology transfer intermediaries and SMEs) to address the challenges of today's dynamic business and technological setting. Towards this objective, APCTT continued publishing several online periodicals and carrying out a combination of normative and analytical studies of regional relevance to identify trends highlight good

policies and practices, and foster regional cooperation.

12. APCTT continued to publish and disseminate free-of-cost online periodicals (www.techmonitor.net), namely Asia-Pacific Tech Monitor (quarterly) and Value Added Technology Information Service (VATIS) Updates on biotechnology, food processing, new and renewable energy waste management (all quarterly), and ozone layer protection (bimonthly). The Tech Monitor features articles on technology trends and developments, technology policies, technology market, innovation management, technology transfer and new products and processes. The VATIS Updates feature a range of technological information on latest technological innovations, technology policies and market related developments, recent publications and events. The activities and outputs relating to the periodicals during this reporting period are presented below:

a. Asia-Pacific Tech Monitor:

- APCTT published 04 issues of Tech Monitor featuring articles on four special themes such as: Climate friendly technologies: perspectives on financing and investment (Oct-Dec 2015); Science, Technology and Innovation (STI) to achieve 2030 sustainable development agenda (Jan-Mar 2016) in support to the theme of the 72nd ESCAP Commission Session held in 2016; Technology Transfer through Foreign Direct Investment: Policy approaches in the Asia-Pacific region (Apr-Jun 2016); and Social innovation for inclusive and sustainable development: current practices and challenges (Jul-Sep 2016). The four special issues of Tech Monitor featured 18 articles contributed by 32 authors/experts from 10 countries such as Austria, China, Germany, India, Indonesia, Japan, Malaysia, Philippines, Republic of Korea and Thailand. The articles presented data and analysis with respect to critical issues under various special themes and included several case studies and best practices from the region and outside.

- The Tech Monitor disseminated information on about 60 latest technological innovations from around the world in several new and emerging areas such as: biotechnology, renewable energy technologies, technologies for rural application, and environmentally sound technologies. An almost equal number of technology policy and market related news items from the Asia-Pacific countries were also compiled and disseminated through the periodical. About 40 short articles providing useful how-to guides, best practices, and tips for SMEs were sourced, compiled and disseminated through the 'Business Coach' section of Tech Monitor. The articles were featured under various topics relevant for SMEs such as start-up venture creation, venture financing, managing innovation, technology transfer and green productivity. The Tech Monitor disseminated selected technology offers and technology requests from 11 countries such as Bangladesh, China, Hungary, India, Islamic Republic of Iran, Malaysia, Pakistan, Sri Lanka, Thailand, the United Kingdom and Viet Nam.

b. VATIS Updates:

- APCTT published 19 issues of VATIS Updates which disseminated information on more than 600 latest technological innovations with potential commercial applications and important technological events. The key features of the VATIS Update series are the packaging of information in a capsule form and the facilitation of direct access to information sources, wherever available. The Centre partnered with prominent institutions to jointly publish two of the VATIS Update periodicals. Ozone Layer Protection was published with

support from the Ozone Cell of the Ministry of Environment, Forests & Climate Change (MoEF&CC) of the Government of India. Biotechnology was co-published with the Biotech Consortium India Limited (BCIL), a government of India undertaking.

- APCTT supported India's ozone depleting substances (ODS) phase-out efforts under the Montreal Protocol through disseminating about 1100 printed copies of each issue of VATIS Update (Ozone Layer Protection) among the stakeholders including SMEs, policy makers, intermediary agencies and related stakeholders in India.

- APCTT's e-subscribers list for targeted dissemination of its web-based periodicals presently comprises of about 470 e-subscribers who have requested for specific periodicals to be sent to them by email as and when they are released on the website. The Centre disseminated e-periodicals through social media platforms such as Facebook and twitter.

13. During the reporting period, APCTT carried our several normative and analytical works and provided substantive analytical contributions to ESCAP theme study:

- *ESCAP theme study report of the seventy-second session of the Commission, "Harnessing Science, Technology and Innovation for Inclusive and Sustainable Development in Asia and the Pacific"*[1] (E/ESCAP/RES/72/12)**:** APCTT provided substantive inputs to various sections of the theme study in the areas of STI policy, National Innovation Systems (NIS), institutions and infrastructure for STI development, open and inclusive innovation. This publication highlights the breadth, diversity and dynamism of the STI agenda in the Asia-Pacific region and puts forward a conceptual framework for STI that is bound by the principles of openness, inclusivity, accountability and collaboration. It also calls on governments to put in place recommended action-oriented STI plans aligned to development strategies to meet the ambitions of the 2030 Agenda. .

- *NIS training manual - "NIS Diagnosis and STI Strategy Development to Achieve National Sustainable Development Goals":* The training manual describes the process of adopting a NIS framework, and strategies to strengthen the process of creating and diffusing new technologies and innovation within a nation's economy. The manual would be useful for policy makers working within the government ministries and institutions that support technological change, as well as to researchers and students of the economics and policy regimes of technological change.

- *Case Study on Policies, Institutions and Processes to Support Value Chains for Seed Development for Pulses, Legumes and Oil Crops in the Dry Zone of Myanmar:* APCTT prepared this case study to highlight the critical issues and barriers for seed industry development in Myanmar and to support policymakers in making informed decisions related to strengthening the value chain for seed industry. The Dry Zone in Myanmar, due to its geo-climatic conditions, faces many challenges that are often aggravated by adverse effects of climate change such as low rainfall, soil erosion, land degradation and decreased nutrient availability in the soil. Availability of good quality seeds that are adapted to different agro-ecological zones is critical for increasing the yield, as well as for improving the quality of grains from an export perspective. Through this case study, APCTT highlighted that the current systems for seed production and distribution and the associated extension services are not able to meet the requirements of farmers in the dry zone of Myanmar. The case study also emphasized that a shift in the policy approach from the current top-down

structure to a bottom-up approach with the active involvement of stakeholders from the grass-roots level is essential for strengthening the value chain for seed enterprise development in Myanmar.

- *Policy Brief on Supporting Value Chains for Seed Development of pulses, legumes and oil crops in Myanmar's Dry Zone:* APCTT developed this policy brief to highlight the barriers and constraints to seed enterprise development in Myanmar's dry zone. The formal seed distribution system lacks efficacy due to financial constraints as well as weaknesses in monitoring the process of seed distribution among contact farmers. The policymakers in Myanmar should consider developing a "National Seed Policy" to assist the implementation of the Seed Law enacted in 2011. Through this policy brief, APCTT also emphasized that the government should increase funding to support R&D, testing, and extension services and prioritize capacity building of government officials, staff of seed-related associations, and farmers to accelerate the seed enterprise development in the country.

14. Following least developed countries (LDCs) benefited from APCTT activities during the reporting period. They include Cambodia, Myanmar and Lao PDR.

- APCTT strengthened the capacities of the following LDCs namely, Cambodia, Lao PDR and Myanmar on overcoming critical bottlenecks to accelerate renewable energy deployment.

- APCTT is currently implementing a project in dry zone of Myanmar for improving livelihoods and enhancing food security entitled, *'An Integrated Rural Economic and Social Development Programme for Livelihoods Improvement in the Dry Zone of Myanmar'* funded through the Livelihood and Food Security Trust Fund (LIFT) and co-implemented by APCTT in partnership with the Centre for Alleviation of Poverty through Sustainable Agriculture (CAPSA-ESCAP), the Centre for Sustainable Agricultural Mechanization (CSAM) and the Network Activities Group (NAG). The Department of Rural Development of the Ministry of Agriculture, Livestock and Irrigation of Myanmar (DRD-MOALI) has been designated as the focal government agency to collaborate in the implementation of the Project. The project aims to support integrated socioeconomic development in Myanmar's Dry Zone in the context of inclusive and sustainable development with special emphasis on livelihoods improvement and food security (with a geographic focus on Magway and Mandalay regions). The project activities include a range of analytical and capacity building interventions including development of case studies, policy papers and policy briefs, as well as organization of training workshops and policy dialogues.

15. APCTT participated and made substantive contributions in key ESCAP programmes and activities during the reporting period:

    a. Science Technology and Innovation (STI) Advisory Board Meeting and the First Session of the Committee on Information and Communications Technology, Science Technology and Innovation organised by TIID and IDD Divisions in ESCAP from 3 to 7 October, 2016, Bangkok, Thailand

    b. Fifth meeting of the Task Force on Preparations for the Theme Study of the 72nd Commission session: "Science, Technology and Innovation for Sustainable Development" through VC on 18th January 2016.

16. APCTT works with other United Nations agencies in India through various channels.

During the past year, APCTT engaged with different UN agencies in India on a range of areas relevant to its work programme.

17. Under the United Nations in India on its United Nations Development Assistance Framework (UNDAF), APCTT is currently involved in the activities related to UNCT Results Group 5 – Energy, Environment and Resilience and United Nations Disaster Management Team (UNDMT).

- APCTT participated in the first meeting of the Results Group 5 on Energy, Environment and Resilience on 9th August 2016 and provided inputs to discussions held on the 2016 draft work plan of the Results Group 5.

- APCTT provided substantive inputs to the draft on strategic priorities of Results Group 5 for the preparation of India's UN Sustainable Development Framework (formerly UNDAF) 2018-2022.

- APCTT participated in the UNDMT meeting held on 19th April 2016 which deliberated on UNDMT support to India in several key areas such as: a study on urban governance and climate change resilience; capacity building for disaster preparedness of airports; national consultation on drought programming for children; and the first Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR) scheduled to be held in New Delhi, India on 2nd – 5th November 2016. APCTT suggested that UNDMT should include a drought related component as part of AMCDRR side events. APCTT also shared experience from a recent workshop on "Drought planning and low water agriculture" held in Malaysia, where various innovations with regard to alternative crops in the context of drought situation were showcased.

- APCTT participated in the "Workshop to Develop Action Plan for implementation of Sendai Framework at state level", 02 June 2016, New Delhi, India. Organized by UNDP and UNICEF, the one day consultation workshop brainstormed on a proposal to provide technical support to the Indian states in establishing state platforms for Disaster Risk Reduction (DRR) and facilitate formulation of state action plans for implementation of the Sendai Framework.

- The Centre participated in the UNDMT-India meeting on 20th January 2016 to discuss on UNDMT draft Work Plan 2016, as well as a UNDMT brainstorming session with Mr. Kamal Kishore, Member, National Disaster Management Authority (NDMA), the Government of India on how the UNDMT could better align its work to India's priorities in disaster risk reduction and humanitarian action.

18. APCTT, as a member of the UN Communication Group (UNCG), India participated in the advocacy and inter-agency communication meetings organized by UNCG time to time and also contributed inputs to the issues of UN Development Supplement (UN News) published by United Nations Information Centre for India and Bhutan.

19. The Centre is placing a renewed focus on the use of ICT tools to assist in increasing the impact and outreach of its program outputs and outcomes. The Centre initiated the development of a Digital Strategy in 2013. The completed initiatives during 2016 under its Digital Outreach include:

- Redesigning of the APCTT website with a purpose to integrate various satellite websites developed by APCTT over a period of time under one consolidated main institutional website

(www.apctt.org). The website is designed based on the UN Minimum Security Requirements for public websites and adopted ESCAP website coding standard using Drupal 7, JavaScript and MySQL; Developed, tested, and put in production Drupal modules using standard software engineering methodologies for CSS, DIV, PHP and HTML5 coding to provide responsive and dynamic features and having the search engine facility. The newly redesigned website has a user-friendly interface and is adaptive to various devices.

- Digital communications channels for APCTT i.e., Twitter (twitter.com/UNAPCTT), Facebook (facebook.com/UNAPCTT) and linkedin (RE Mapping in Asia and the Pacific) are being continuously used for enabling direct and real-time interactivity with audiences.

20. APCTT partnered with the following agencies to delivering its programme of work during the reporting period.

- Centre for Alleviation of Poverty and Sustainable Agriculture (CAPSA) of ESCAP, Indonesia
- Centre for Sustainable Agricultural Machinery (CSAM) of ESCAP, China
- Department of Science and Technology (DOST), Philippines
- Department of Scientific and Industrial Research (DSIR), Government of India
- International Renewable Energy Agency (IRENA), United Arab Emirates
- Technology Application and Promotion Institute (TAPI), Department of Science and Technology (DOST), Philippines
- Thailand Institute of Scientific, Technological Research (TISTR)
- Economic Research Institute for ASEAN and East Asia (ERIA)
- Asian Development Bank (ADB)
- US Agency for International Development (USAID)
- Council of Scientific and Industrial Research (CSIR), Government of India
- Federation of Indian Export Organizations (FIEO)
- Human Life Advancement Foundation (HLAF), Malaysia
- Yunnan Academy of Scientific and Technical Information (YASTI), Kunming, China
- Network Activities Group (NAG), Myanmar
- Department of Rural Development (DRD) of the Ministry of Agriculture, Livestock and Irrigation (MOALI) of Myanmar
- Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD)
- Indonesian Institute of Sciences (LIPI), Indonesia
- Ministry of Science and Technology (MOST), Pakistan
- Ministry of Science and Technology, Thailand
- United Nations Office on Project Services (UNOPS)
- Ozone Cell, Ministry of Environment Forest and Climate Change (MoEF&CC), Government of India
- Biotech Consortium of India Limited (BCIL), Department of Biotechnology, Ministry of Science and Technology, Government of India

- National Institute of Science Technology and Development and Development Studies (NISTADS), Council of Scientific and Industrial Research (CSIR), Ministry of Science and Technology, Government of India
- National Nanotechnology Directorate (NND), Ministry of Science Technology and Innovation (MOSTI), Malaysia

21. Since January 2010, the Centre is being backstopped by the Trade Investment and Innovation Division (TIID) of ESCAP. The objective of TIID is to strengthen regional cooperation and integration in trade, investment, finance and technology transfer in the ESCAP region in support of inclusive and sustainable development. The Centre works closely with the Private Sector and Development Section of TIID due to the emphasis placed by this section on the development of small and medium enterprises. APCTT worked closely with TIID in developing the 2016-2017 strategic framework and is currently working to develop the 2018-2019 strategic framework of the sub-programme of the Division to ensure greater synergy and more effective backstopping support. The Centre receives guidance and advice on programme management and budget utilisation from the Strategic Partnerships Management Division of ESCAP.

22. APCTT is committed to provide the best quality of services to member countries in terms of its programme delivery. To this end, continued efforts are undertaken to strengthen its personnel infrastructure to adequately staff the Centre to match its focus areas. There is a great need for more staff at the professional and managerial levels in order to strengthen its programme of work. However, there is no financial provision under the current institutional funding for the medium-term employment of professional staff. Hence, APCTT seeks the support of member countries in placing non-reimbursable loan experts. When opportunities arise, APCTT channels requests through ESCAP to the United Nations in New York for the placement of associate experts at the Centre. Correspondence regarding the placement of non-reimbursable loan experts is sent to interested member countries and their cooperation is solicited. This has been reiterated at all subsequent sessions of the Governing Council. APCTT seeks the active cooperation and support of member countries to take this forward.

23. The Centre has one P-level staff member and nine General Service staff, out of which. four of the General Service staff is shared with ESCAP'S Sub-Regional Office co-located with APCTT. In July 2016, Ms. Michiko Enomoto has joined the position of the Head, APCTT. One General Service programme staff position is currently vacant following retirement of a staff and another General Service Professional Assistant post remains vacant and has not been filled due to lack of financial resources. The total full time equivalent (FTE) staffs supporting the activities of APCTT is 4. Increased financial resources are essential to staff the Centre optimally.

24. APCTT continues to avail itself of the services of consultants to meet specific project needs during 2016. The Centre hired the services of experts to support implementation of the NIS phase II and LIFT projects during the reporting period.

25. Over the years, APCTT has been actively been involved in the ESCAP Internship Programme. The objective of this programme is to promote better understanding on international problems and an insight into the workings of the United Nations and provide departments with the able assistance of the participants in the programme.

During the reporting period interns from Australia, India, Ireland and United Kingdom undertook internship at the Centre. The interns have assisted with the projects that the Centre is implementing, as well as with the normative and analytical work of the Centre.

26. In bulletin ST/SGB/1998/6 on building the future, the Secretary-General stressed that the greatest strength and the key to the success of the organization is the quality of the people employed. The United Nations is, therefore, committed to building human resources capacity for the future. Being an out-posted, XB organization, emphasis is placed on self-learning through the UN wide Human Resources/skill development portal called UN Inspira. From time to time specific in-person classroom trainings are organised in response to emerging/changing requirements. APCTT participated in the following are the training programmes and/ or staff development activities during this reporting period:

- Global Diversity Webinar, 20 - 21 September 2016
- Mandatory online training - "I Know Gender: An Introduction to Gender Equality for UN Staff"
- Umoja trainings
- Library training on "UN documentation: Searching ODS and other research tools", 17 November, 2016
- Training Workshop on Giving and Receiving Feedback, organized by the Regional UN Ombudsman for Asia Pacific on 15 November 2016.

27. In this reporting period, APCTT has continued to deliver capacity building programmes to meet specific needs of Member States and facilitate regional cooperation for promoting science, technology and innovation in the Asia-Pacific. Focussing on the three programme areas of – Science Technology and Innovation, Technology Transfer and Technology Intelligence – APCTT partnered with international and national institutional partners to increase the STI and technology transfer capacity of stakeholders in the Members States. Despite its limited financial and human resources, APCTT has managed to deliver a range of capacity building activities and carried out normative and analytical work relevant to the member countries.

4. INFORMATION TECHNOLOGY AND e-GOVERNANCE

4.1 Introduction

Information Technology and e-Governance (IT-eG) group was formed during mid of the 10th Plan period in order to create an IT enabled work environment in the Department through accelerated usage of various Information Technology opportunities. Primarily aims to convert the existing procedures and processes into *citizen centered,* IT-eG division implements e-Governance in the Department progressively that needs be in conformance to the National eGovernance Action Plan. For the implementation of an IT Action Plan IT-eG Division operates on a separate IT Budget Head that came into effect in DSIR since FY 2004-05.

4.2 IT Action Plan

For IT and e-Governance activities a comprehensive IT-Action Plan in the department as formulated in line with the Government directions issued during Tenth Plan remains

- *Infrastructure Development:* Provide and maintain Personal Computers (PCs) and other essential IT- equipment and software to all the functionaries.

- *Networking:* Up gradation, extension and maintenance of the Local Area Network (LAN).

- *Office Automation:* Implement various applications software that not only maintain records of receipt, issue of letters and movement of files but also offer enhancement in accountability, responsiveness and transparency in governance.

- *IT Training:* Provide relevant training courses to the officers/ staff that enable them to work on computers by using application software developed.

- *e-Reports*: Convert the Acts, Rules, Circulars and other published materials of interest or relevance to the public, in the electronic form.

- *Website*: Enrich the contents of the DSIR website by including downloadable forms and guidelines relevant to various citizen services that Department provides.

- *IntraDSIR*: Enrich the contents of the IntraDSIR by including downloadable forms and circulars relevant to employees of the Department.

4.3 Automation of DSIR Operations

DSIR essentially focuses on enabling Indian industry to reach state-of-the-art innovation excellence and competitiveness through research & technological interventions.

Information Technology and e-Governance (IT-eG) group within DSIR has got it developed and implemented an IT enabled work environment and Enterprise Resource Planning (ERP) application to automate all the operations of DSIR and link it to providing online services to the Industries and relevant stakeholders. Incidental benefits include reduction of costs / efforts in seeking and obtaining information and services and minimization of administrative overheads.

4.3.1 Enterprise Integration, Program Implementation and e-Service Delivery

A user friendly online application form submission for recognition and renewal to In-house R&D Units, Scientific and Industrial Research Organizations (SIRO), Public Funded Research Institutions (PFRI) and Fiscal Incentives to Industry for Submission of Application in FORM 3CK, generation of 3CM certificate & submission of yearly returns in the Form 3CL has been developed. User friendly and time efficient backend application approval process has been developed. The workflow for each scheme has been configured as per the hierarchy in the department.

System for on-line submission of application in web-enabled form as per the prescribed application format under Patent Acquisition and Collaborative Research and Technology Development (PACE) Program has been developed for technology providers and seekers along with submission of proposals under Technology Development and Demonstraion. Time efficient backend application approval process has also been developed.

System for on-line submission of application in web-enabled form as per the prescribed application format under Promoting Innovations in Individuals, Start-ups and MSMEs (PRISM) Program has been developed along with backend application approval and workflow for grant release.

System for on-line submission of application in web-enabled form as per the prescribed application format under Grant-in-Aid Support to Autonoumous Bodies, Public Sector Enterprises, and Asian and Pacific Centre for Transfer of Technology (APCTT) has been developed along with backend application approval and workflow for grant release.

The application has provision of entering legacy data into the system.

A platform is designed for continuous tracking of issues across users. The usage of the system can be monitored through logs, system reports and electronic traces across transactions.

4.3.2 Office Automation Solution, Workflow Management, Record Management, and Data Warehousing

Various modules such as Office Automation Solution, Workflow Management, Record Management, Data Warehousing and additional modules such as HR Management and processes, Store and Purchase, Planning, Budget and Audit, e-Office, revamping of existing website in bilingual, m-governance compliance, RFID implementation in record room are developed and in use. For achieving these objectives, value added through Document Management and Business Process management solution designed, developed and tested to suit and adequately addresses the requirements within any Government environment.

The progress made under ERP project is being reviewed and monitored through regular meetings. Training to the Users along with Hand-hold sessions has been regularly conducted.

4.3.3 DSIR Website

The DSIR Website has been made compliant to the Guildelines for Indian Government of Websites (GIGW). The website has been regularly updated.

The users when they log in to the ERP Portal, are presented with a customized adaptive landing page

and electronic desktop with links related to tasks to be performed by them. The Graphical User Interface (GUI) of this re-designed website is user-friendly and rich in appearance since uses superior graphics, self-explanatory, promptly guiding the user to different sections, offer appropriate navigation assistance to user in the form of tooltips, messages, images etc. wherever required / applicable.

4.3.4 IntraDSIR (An electronic Workdesk)

IntraDSIR (An electronic Workdesk) has been created, wherein all the employees of DSIR can accss through a username and password to communicate with each other as well as the electronic workdesk of all the employees of DSIR. An employee can perform activities assigned to him/her. An employee has the facility of switching the roles (if s/he has multiple roles) and performs the tasks which appear in the in-tray and all the completed tasks are shown in his the out-tray. The employee has online access to the Employee Self services such as LTC, Leave, Reimbursement of Medical Claims, Telephone, Newspaper, Children Education etc.

Patent Acquisition and Collaborative Research and Technology Development (PACE)

1. Preamble

2. Objectives

3. Projects/Activities

Patent Acquisition and Collaborative Research and Technology Development (PACE)

1 Preamble

The scheme Patent Acquisition and Collaborative Research and Technology Development (PACE) aims at facilitating acquisition of early stage technologies from academic and research institutions, including industry and other sources in India and abroad by Indian industries on an exclusive or a non-exclusive basis with a view to manufacture "Made in India" products. The scheme also aims at supporting up-scaling of a lab-scale technology for development and demonstration of innovative products and processes that can be commercialized. Support is provided for proposals which give clear evidence of existence of proof-of-concept and aim at developing an innovative content for fulfilling an unmet need. Development and demonstration of technologies can be undertaken by industries alone (including In-house R&D centres of the industry recognized by DSIR) or in collaboration with Universities, Public Funded Research Institutions or academic institutions in India or abroad. The technology development projects supported under the scheme aim at development of a new product or a process with attractive market potential which will result in significant benefits to the industry concerned in terms of raising its technological level, turnover, energy and material savings/recovery, export sales etc. Focus sectors include (i) Energy & Environment, (ii) Affordable healthcare including Drugs & Pharmaceuticals and Medical Equipment & Devices (iii) Agriculture, food & nutrition, (iv) Engineering (auto-components, machine tools & foundry), (v) Specialty Chemicals etc.

2 Objectives

The objectives of the scheme are:

- To facilitate Indian industries to acquire patented technology at an early stage from within the country or overseas on an exclusive as well as non-exclusive basis, add value to the acquired technology for exploitation in Indian/foreign markets and develop "Made in India" innovative and socially relevant products for public consumption in India and abroad;
- To encourage and accelerate development and demonstration of indigenous product / process technologies by In-house R&D centres of the industry for commercialization;
- To create enabling environment for collaborative research between Indian Industry and R&D organizations/ academic institutions/ universities in India or abroad and formulate collaborative projects for development and demonstration of lab scale technologies aimed at commercialization of new products and processes;

- To develop a dynamic database on existing expertise and IPs available in the R&D organizations/ academic institutions/ universities in India or abroad to facilitate PPP and tie-ups with Indian industry for collaborative projects.

3 Projects/ Activities during 2016-17

Details of important projects/activities that were completed or were in progress during the year under report are given below:

3.1 Facilitating Technology Acquisition

It emerged from the eight workshops on technology acquisition conducted during the earlier years that most of the SMEs are unaware of the specific technologies/patents needed for innovative product/process development. Therefore, efforts were made to deploy intermediary agencies/ consultants who need to engage with SMEs in a cluster for a reasonable period of time to assess their precise technological requirements/needs and then, map the SME needs with appropriate technologies/patents from technology suppliers with a view to facilitate technology acquisition by SMEs.

This process requires specific skills in Technology Assessment and Forecasting, Patent or Technology landscaping, IP Valuation etc. besides experience of working with SME clusters. Discussions were continuing to engage agencies like CSIR Tech, Frost & Sullivan etc. for doing the necessary due diligence and assisting DSIR in facilitating technology acquisition to SMEs.

3.2 Technology Development and Demonstration

3.2.1 The following proposals were monitored during the year.

(i) Technology up gradation of pelletization facility for herbal veterinary feed supplements: Demonstration in terms of value addition to produce quality supplements at low cost - Natural Remedies Pvt. Ltd., Bangalore

M/s Natural Remedies Pvt. Ltd., Bangalore have undertaken to demonstrate a steam sterilization based pelletization facility using semi-automated equipment and improved pelletization machine for herbs & herbal powders to produce improved quality veterinary feed supplements with reduced microbial load and minimal wastage of biomass. The company plans to produce the three existing products viz. Zigbir (hepatoprotective – it helps in optimizing growth, weight gain, feed conservation ratio (FCR) and livability in poultry), Natchol (Choline replacer – it is a natural choline supplement that helps in mobilization of liver fat) and Phytocee (Vitamin C and electrolytes supplier – it is a natural Vitamin C source which helps in reducing free radical formation induced lipid peroxidation) with the new pelletization facility. The project will lead to production of microbe free herbal feed supplements for the benefit of livestock, such as

Blender and Shifter system

Palletization plant at NRPL site

Poultry, aqua ruminants, small ruminants, etc. which will not only protect the animal but also protect human's health who are end consumers of animal products viz. meat, egg and milk. The project has been supported by DSIR through a soft loan of Rs. 200.0 lakhs out of a total project cost of Rs. 599.30 lakhs in November 2014. Three Project Review Committee meetings have been held to assess the project progress.

Erection of new upgraded pelletization plant is nearing completion at the project site of M/s Natural Remedies Pvt. Ltd. Trial productions on each equipment have been conducted at vendor's site where assessment of microbial burden, in-vivo & in-vitro efficacy studies and stability studies have been carried out for trial batches. Trial Batch production in the integrated and upgraded pelletization plant to establish the process efficiency is expected in early F.Y. 2017-18.

(ii) Development of Genetically Engineered Cellulose-free Alkaline Xylanase through submerged fermentation process (SMF) - Kaypeeyes Biotech Pvt. Ltd., Mysore

M/s. Kaypeeyes Biotech Pvt. Ltd., Mysore is a company engaged in the manufacture of industrial enzymes like Pectinase, Amylase, Xylanase, Cellulase, Phytase, Amyloglucosidases, Beta-Glucosidases, Acidic & Alkaline proteases and Neutraceuticals, Probiotics for food, feed, therapeutics and other industrial applications. The company had purchased *Bacillus pumilus* culture from RRL, Trivandrum for producing Cellulase free Xylanase at laboratory level. They characterized the kinetics of production of xylanase and developed two products viz. Chlorzyme – AX (Xylanase for bio-bleaching of paper pulp) and Recyclase – X1 (for use in Bio-refinery). These two products were evaluated by CPPRI, Saharanpur and found suitable for paper industry use. The company however found that yields of the products were inconsistent because of deployment of Solid State fermentation (SSF) method. Also bulk production of products in SSF in wheat bran media had reduced storage stability. Therefore the company took recombinant route of expressing the gene viz. *Bacillus pumilus* in *Pichia pastoris. Pichia pastoris* is a well-studied host used in the production of recombinant enzymes world over and being methyl tropic in nature can produce large quantity of enzyme. The company plans to develop, validate and produce recombinant Cellulase - free alkaline Xylanase for application in paper and pulp industries.

The company has successfully transformed *Pichia pastoris culture* which can produce Xylanase in large quantities and is now conducting trial production in 14 Lts fermentor. They have installed and commissioned all the pilot plant equipment & machinery including 14 Lts. & 100 Lts. Fermentors. They have also equipped their Laboratory with analytical equipment required for molecular biology experiments. Transformation and screening of recombinant xylanase produced by *Pichia pastoris* including biochemical studies have been completed. Lab-Scale studies of recombinant xylanase produced by *Pitchia pastoris* with aims of maximum cell density production during fermentation have been completed successfully in shake-flask and pilot level studies are in progress. The company has applied for approval from RCGM-DBT to scale-up at 100 Lts. Fermentor at Pilot level at the company's facility. Also downstream processing of Xylanase is in progress.

The project has been supported by DSIR with a soft loan support of Rs. 206.00 lakhs out of a total project cost of Rs. 468.00 lakhs in November, 2014. The I & II Installment of Loan Amounting to Rs. 165.00 lakhs has been released. Two meetings of the Project Review Committee have been held to assess the progress of the project.

(iii) Design, Manufacturing, Proving, Supply of Three Roller Flow Forming Machine - Paras Flowform Engineering Ltd., Mumbai

M/s. Paras Flowform Engineering Ltd., Mumbai are mainly in the business of manufacturing of Flow-

forming chambers for missiles & rockets; CNC Machining for aerospace & defense industries; turn key projects for non-ferrous mining & metallurgical industries, heavy machining & fabrication of the same; special purpose machines; rolling mill equipment & turnkey electronic systems for communication, radar, sonar, fire control, etc for Indian Army & Navy. They have taken up design and manufacture of a new 3 Roller CNC Flow-forming machines with advance controls after successful In-house refurbishment of 3 roller Flow-forming machine (procured as scrap) from overseas in the year 2010. The refurbished machine is presently producing Pinaka Motor Tubes etc.

The company has tied up with IIT, Mumbai and ARDE, Pune for up-scaling in the areas like Design, Electronics before commercialization. The innovation lies in carrying out the mechanical fabrication maintaining the roundness, concentricity & straightness of the tubes with high precision.

The company has finalized the Machine design & specifications, completed manufacturing drawings & documentations, initiated manufacturing of machine parts & the sub-assemblies including items like Machine Bed, Saddles, Beams, Gear Box, Covers and Roller Shafts etc. They have also procured critical purchase parts of the machine like LM Guides, Ball Screws, Servo Motors etc. and these parts are installed on the machine. The company has procured Hydraulic Systems, Electronics, Bearings & Software are installed on the machine. Also Machine building/ Assembly integration & trials has been initiated and is in progress.

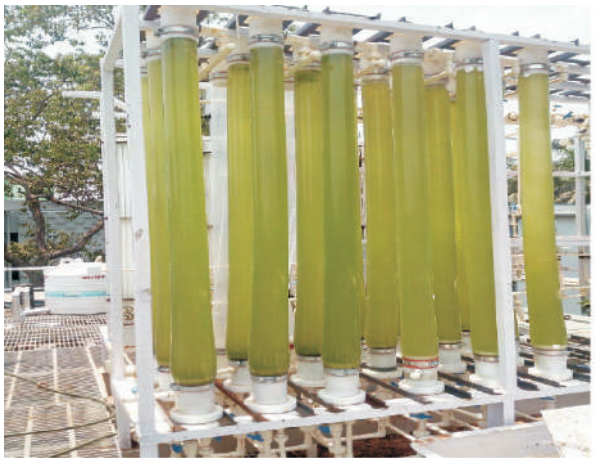
The project has been supported by DSIR with a soft loan of Rs. 500.00 lakhs out of a total project cost of Rs. 1900.00 lakhs in November, 2014. The I & II Installment of Loan Amounting to Rs. 400.00 lakhs has been released. Two meetings of the Project Review Committee have been held to assess the progress of the project.

(iv) Macroalgal Biorefinery for CO_2 Sequestration and Production of Biofuel and Value-Added Compounds - AquAgri Processing Pvt. Ltd., New Delhi & DBT-ICT Centre for Energy Biosciences & CSIR-CSMSRI, Bhavnagar

M/s AquAgri Processing Pvt. Ltd., New Delhi in collaboration with DBT-ICT Centre for Energy Biosciences, Institute of Chemical Technology (ICT), Mumbai and CSIR- Central Salt & Marine Chemicals Research Institute, Bhavnagar (CSIR-CSMCRI) have undertaken to demonstrate the concept of sequestration of CO_2 through large scale controlled growth of macroalgal species (Ulva) in closed photo-bioreactors using CO_2 generated by power plants or other industries, and making the technology sustainable through conversion of the grown macroalgal biomass to bioenergy and other value-added products. Globally the dry sea plants are used to manufacture hydrocolloids and these have a wide application in food, cosmetics and toiletry industry. Aqua Sap derived from the fresh living algal plants is a plant nutrient, which contains substantial amounts of micro and macronutrients, naturally occurring Plant Growth Regulators (PGRs) and amino acids. The PGRs such as Auxins, Cytokinins and Gibberellins, accelerate the metabolic function of the plant there by boosting yield and productivity. The concept of a multi-product macroalgal refinery using modular photo-bioreactors for CO_2 capture and growth of ulva in vertical glass reactors to demonstrate efficient CO_2 sequestration coupled with downstream processing technologies for biomass deconstruction and separation of value-added products for economic sustainability is an innovative concept.

This project has been supported by DSIR through a soft loan of Rs. 225.00 lakhs to M/s AquAgri Processing Pvt. Ltd., New Delhi and grants of Rs. 85.00 lakhs to ICT and Rs. 45.00 lakhs to CSIR-CSMCRI out of a total project cost of Rs. 580.00 lakhs in November 2014. Four Project Review Committee meetings have been held to assess the project progress.

ICT and CSIR-CSMCRI demonstrated ulva cultivation in a 3000 L flat panel photo-bioreactor at ICT. The flat panel bioreactors gave a DGR upwards of 30%. The capital cost of the panel was coming to about Rs. 150/ L. To reduce the capital cost as well as the operating energy cost, tubular PBRs were designed using both, flexible HDPE and polycarbonate. The tubular PBRs cost about Rs. 50/L including the supporting, piping, pumping and cooling assemblies. However, the pumping related operating cost is higher than desirable and efforts were made to reduce this to acceptable levels using air-lift liquid circulation principle coupled with automatic nutrient and temperature management. The polycarbonate PBRs are installed and further studies are being carried out for optimization for field level scale-up. Up-scaling of downstream processing of ulva biomass sourced from outside has been suggested in a 10KL extraction unit commissioned at M/s Aquagri project site.



Tubular Photo bioreactor (PBRs)

Tubular Concentric Air-Lift PBRs

(v) Chitosan Based Drug Delivery system for Dental and Oral Diseases - ICPA Health Products Ltd., Ankleshwar & Govt. College of Pharmacy, Aurangabad

M/s. ICPA Health Products Ltd., Ankleshwar, leader in Oral Health Care and has proposed to scale-up production of chitosan films from lab scale (400 units/ batch/day) to pilot scale (20,000 units/ batch/ day). They intend to complete successfully pilot batches and target at 200,000 patches/ batch/day to cater to the market demand. The company has signed MOU with Govt. College of Pharmacy, Aurangabad on various chitosan based technologies. Govt. College of Pharmacy, Aurangabad has developed chitosan based thin film at lab-scale wherein film patches are casted manually. They have been producing 75 pieces of chitosan films in 4 hours costing at Rs. 6.50 lakhs a piece manually.

The Govt. College of Pharmacy, Aurangabad have synthesized 3 derivatives Caboxylated Methyl Chitosan, Chitosan Lactate & Chitosan Ascorbate. The Collaborator have prepared/ manufactured 200 chitosan patches or films/ day using the High-Speed Mixing machine (VMC-2 model) manually in their lab and are now planning to produce the same by automating the same machine in the lab. The company has procured, installed & commissioned pilot plant equipment and also chitosan & raw materials. Also first Machine prototype developed and fabrication of the same in progress. Standardization of Acetate, Lactate & Caboxylated Methyl Chitosan derivatives for their use completed. The Formulation development has been initiated

The project has been supported by DSIR with a soft loan of Rs. 72.00 lakhs to M/s. ICPA Health Products Ltd and a grant of Rs. 72.00 lakh to Govt. College of Pharmacy, Aurangabad out of a total project cost of Rs. 260.00 lakhs in December, 2014. The Project Review Committee met in July to assess the progress of the project.

3.2.2 Agreements for the following proposals were signed during the year

(i) Development of Controller Release [CR] Formulation of Natural Highly-Purified Human Chorionic Gonadotropin [hCG] – M/s Sanzyme Ltd. Hyderabad & ICT Mumbai

M/s Sanzyme Ltd., Hyderabad in collaboration with Department of Pharmaceutical Sciences & Tech., Institute of Chemical Technology, Mumbai had submitted a project proposal on "Development of Controlled Release [CR] Formulation of Natural Highly - Purified Human Chorionic Gonadotropin[hCG] for possible support under PACE-TDD scheme. 99% pure hCG is used as a surrogate for LH [Lutenising Hormone] for triggering ovulation and maintenance of pregnancy. However recent developments, have shown that the role of hCG is not restricted to infertility treatment alone but has wider applications in the field of metabolic disorders such as Diabetes and other clinical conditions where hCG is being used for a process known as angiognessis in the fields of vascular surgery and CNS surgery. Currently two forms or variants of hCG are available either as highly purified form or the recombinant version of hCG. Despite recombinant being available, only a single dosage form is available for clinical use. The project aims to improve compliance and reduce the frequency of injections and make the treatment more affordable and available to masses rather than class alone. The CR- release formulation using nano technology with release rates of either 15 or 30 days will reduce the frequency of injections required in infertility problems, maintenance of pregnancy and controlling metabolic disorders such as Diabetes.

The project has been supported by DSIR with a soft loan of Rs. 52.50 lakhs to M/s. Sanzyme Ltd. Hyderabad and a grant of Rs. 52.24 lakhs to ICT, Mumbai out of a total project cost of Rs. 159.55 lakhs in December, 2016.

(ii) Cold plasma based technology development for green ammonia/urea production – M/s Nagarjuna Fertilizers and Chemicals Limited, Hyderabad

M/s Nagarjuna Fertilizers and Chemicals Limited, Hyderabad had submitted a project proposal "Cold Plasma based Technology Development for Green Ammonia / Urea Production" for possible support under PACE-TDD scheme. The project aims at developing a technology platform for production of Green Ammonia / Urea by non-conventional production route using cold plasma based technology and process simulation & engineering design and upscaling the process to multi ton stage. The project shall develop a non-conventional source for ammonia/urea production where the requirement of pressure is not limiting. The process once optimized can be operated in integrated manner with existing urea/ ammonia industries and it will also be possible to decentralize production. Therefore, to validate the technology it is essential to study the developed technology at higher scale. Additionally, strategies for production of ammonia/ urea will also be studied in packed bed reactor which may be cold plasma based or packed bed reactor connected to cold plasma with metal oxide catalyst to maximize the production capabilities.

The project has been supported by DSIR with a soft loan of Rs. 500.00 lakhs to M/s Nagarjuna Fertilizers and Chemicals Limited, Hyderabad out of a total project cost of Rs. 1125.50 lakhs in December, 2016.

3.2.3 The following proposal, recommended by the TAC was under approval as on 31st December, 2016

(i) Cost-effective 3G/4G based Multimedia Video Conferencing Service – Intellisys Technologies & Research Ltd., Kolkata

M/s Intellisys Technologies & Research Ltd., Kolkata is a high end global R&D company in the area of videoconferencing technology and communication space. One of its previous products "Enlitor"- a learning management system developed in joint collaboration with NSE.IT Ltd., (a 100% subsidiary of National Stock Exchange of India) was implemented across the country. The company has developed a product "Vennfer"- unique H.264 high definition software based multiparty multipoint video conferencing solutions on multicast network transmission protocol. The company plans to build a suite of products & services on the "Vennefer Mobility Cloud" which will produce unified collaboration across a range of standard audio visual rooms, business desktop solutions, smart-phones & tablets. The proposal envisages offering video telephony (point-to-point) and conferencing (multipoint-to-multipoint) as a service, for building this application, the company will need technologies for SoftMCU, WebRTC to SIP gateway & SIP to H.323 interoperability module, which they plan to acquire from Synergy Research, USA and Doubango Telecom, France or could even develop them In-house. The company will be scaling up relay & media server bandwidth up to 32 kbps using cluster methodologies for 4 lakhs subscribers and host the application with M/s. TATAs as the ISP/ TELCO. During the commercialization phase, the company will host the application to data centers of ISPs or TELCOs and would generate revenue on pay per use basis. The company expects to have around 50 lakh licenses in 5 years of commercialization and expects revenue of Rs. 10 crore / month @ Rs. 20 per user per month. The project has been recommended by the Technical Advisory Committee and is being processed for approval and support.

3.2.4 Technology development project on 'Pilot Plant to manufacture Magnesium Hydroxide from Dolomite mineral, having specifications same as commercially available pharmaceutical grade from sea water source but with a lower cost and Calcium Nitrate as a byproduct' by M/s Rudraksha Allied Chemical Pvt. Ltd., Nagpur was completed during the year. However, industry did not demand any funds from DSIR for completing the project. Another project on 'Light weight, high energy density desktop model, portable power supply using fast charging capable lithium ion secondary battery, AC/ DC charging including Solar Input' by M/s d-ESPAT Pvt. Ltd, Chennai was withdrawn by the company.

3.3 IMPacting Research INnovation and Technology (IMPRINT)

IMPacting Research INnovation and Technology (IMPRINT), a flagship programme launched by the Hon'ble PM on 5th November, 2015 is being implemented by Ministry of Human Resource Development (MHRD). A MoU among 25 Ministries/Departments of GOI was signed on 31st March 2016 for implementation of IMPRINT programme. DSIR is one of the signatories. 10 Technology domains have been identified under IMPRINT in which technology development proposals from IITs, IISc, NITs etc. shall be supported. 50% of the funding for proposals shall be by MHRD and remaining 50% by the participating department. DSIR has been identified as the participating department in the Manufacturing Technology and Water Resources Domains and the coordinating institutes for the two domains are IIT-Madras and IIT-Kanpur respectively. DSIR agreed to support five projects of IITs and IISc. in the two technology domains of Manufacturing and Water Resources.

Implementation of RTI Act 2005

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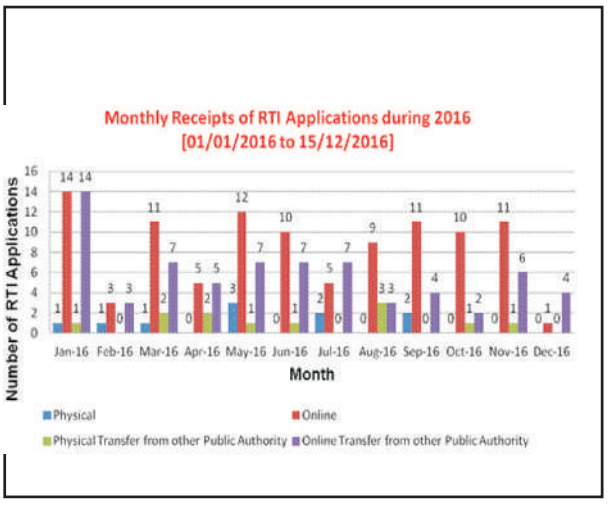
IMPLEMENTATION OF RTI ACT 2005

The Right to Information Act 2005, enacted on 15th June 2005, has been implemented successfully in the department. As per the provisions of the RTI Act 2005, following officers are designated:

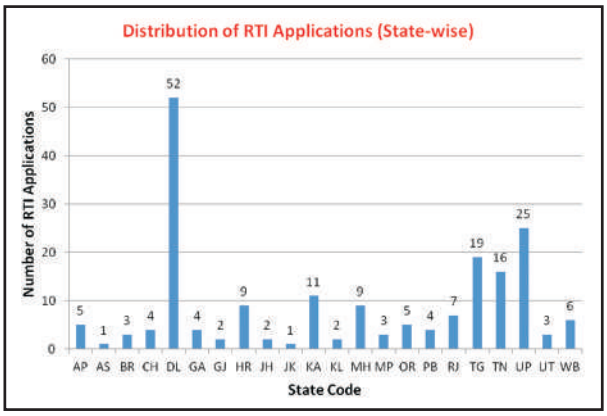
Appellate Authority	Dr S K Deshpande Scientist 'G'Department of Scientific and Industrial Research19-C, Administrative Block Technology Bhawan, New Mehrauli RoadNew Delhi-110016	Tel: 26518019, 26590387 TeleFax: 26960629 skdpande[at]nic[dot]in
Appellate Authority	Shri Ashwani Gupta, Scientist 'G'Department of Scientific and Industrial Research19-C, Administrative Block Technology Bhawan, New Mehrauli RoadNew Delhi-110016	Tel: 26866123, 26590257 TeleFax: 26960629 skdpande[at]nic[dot]in
Transparency Officer	Dr Prabhat Kumar Dutta, Scientist 'F'Department of Scientific and Industrial ResearchRoom No. 43, TIFAC BuildingTechnology Bhawan, New Mehrauli RoadNew Delhi-110016	Tel: 26534823, 26590394Fax: 26960629 pkdutta[at]nic[dot]in
Nodal Officer and Central Public Information Officer	Shri Vimal Kumar Varun, Scientist 'F'Department of Scientific and Industrial Research14-B, Administrative BlockTechnology Bhawan, New Mehrauli RoadNew Delhi-110016	Tel: 26590416 TeleFax: 26516078vkv[at]nic[dot]in
Central Assistant Public Information Officer	Dr (Ms) Sujata Chaklanobis, Scientist 'F'Department of Scientific and Industrial ResearchRoom No.15, Hall - BTechnology Bhawan, New Mehrauli RoadNew Delhi-110016	Tel: 26520887, 26590277Fax: 26960629 priya[at]nic[dot]in
Central Assistant Public Information Officer	Dr Prabhat Kumar Dutta, Scientist 'F'Department of Scientific and Industrial ResearchRoom No. 43, TIFAC BuildingTechnology Bhawan, New Mehrauli RoadNew Delhi-110016	Tel: 26534823, 26590394Fax: 26960629 pkdutta[at]nic[dot]in

The proactive disclosures under Section 4 (1) (b) of the RTI Act 2005 enacted on June 15, 2005 are regularly updated and available on the DSIR Website at *http://www.dsir.gov.in*. DSIR has complied with the directives received from Central Information Commission. RTI Requests and First Appeals received and their responses are available on DSIR Website.

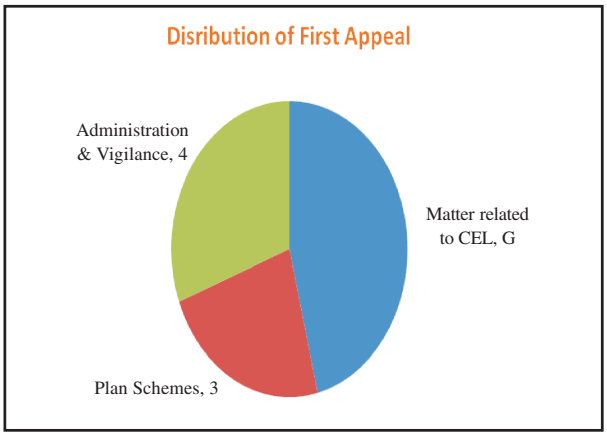
DSIR has received **193** Applications during 2016 [01/01/2016 to 15/12/2016] and all the Applications were registered and disposed off on RTI Request & Appeal Management Information System, *https://rtionline.gov.in/RTIMIS*. The monthly receipt of the RTI Applications is given below:

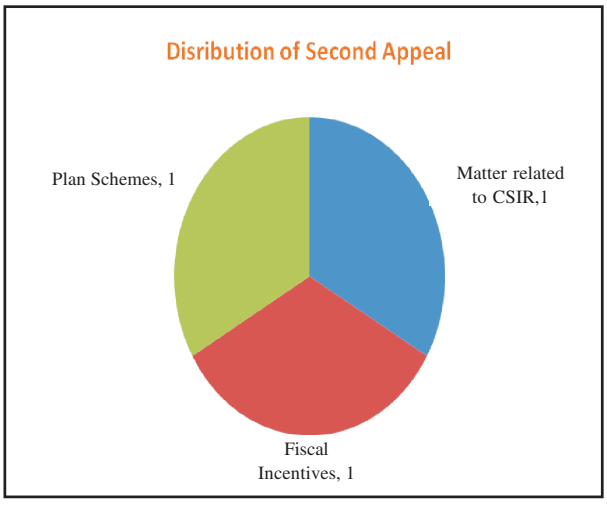


The State-wise distribution of **193** RTI Applications received during 2016 [01/01/2016 to 15/12/2016] is given below:

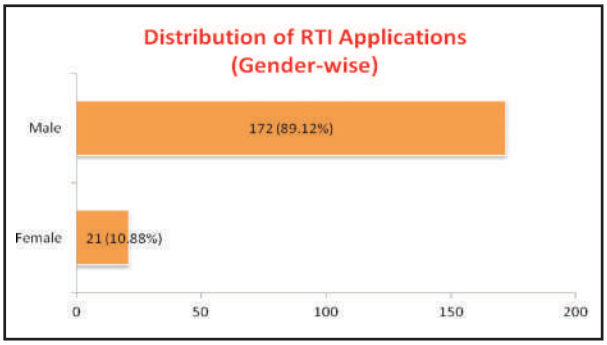


During 2016 [01/01/2016 to 15/12/2016], **13** applications were registered as first appeal and **03** application was registered as second appeal. The distribution of First Appeals and Second Appeals is shown below:

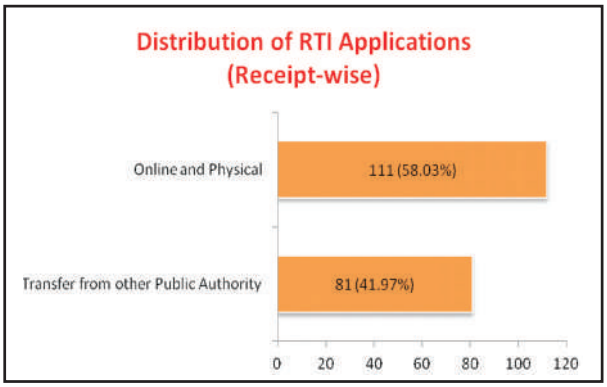




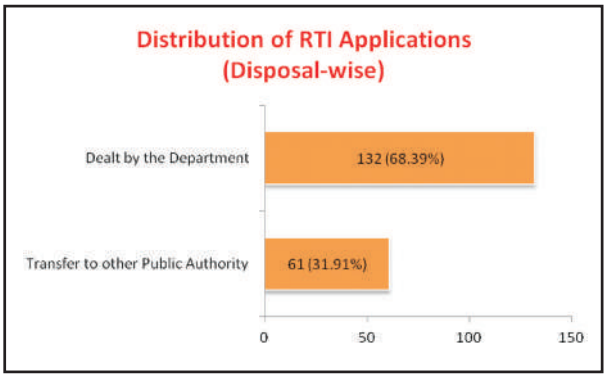
The number of female applicant was 21 (10.88%) and male applicant was 172 (89.12%). The Gender-wise distribution of 193 RTI Applications received during 2016 [01/01/2016 to 15/12/2016] is given below:



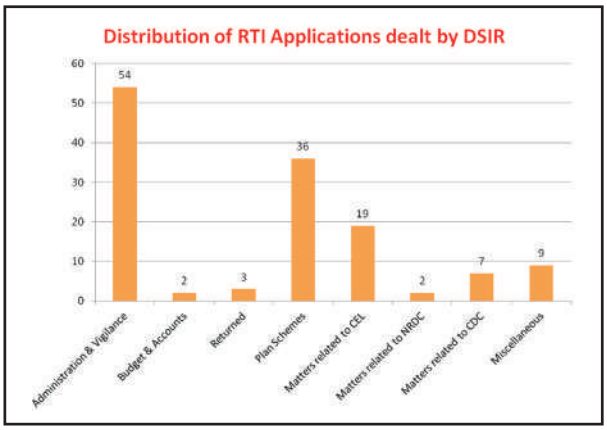
Out of 193 RTI applications received during 2016 [01/01/2016 to 15/12/2016], 81 were received as transfer from other Public Authority and 111 were received as physical and online as depicted below:



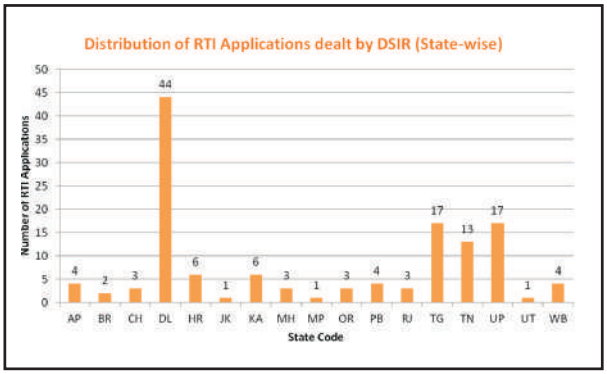
Out of 193 RTI applications received during 2016 [01/01/2016 to 15/12/2016], 61 were transferred to other Public Authorities and 132 were dealt by the department as depicted below:



The distribution of 132 RTI Applications dealt by DSIR during 2016 [01/01/2016 to 15/12/2016] is shown below:



The State-wise distribution of 193 RTI Applications dealt by the DSIR during 2016 [01/01/2016 to 15/12/2016] is given below:



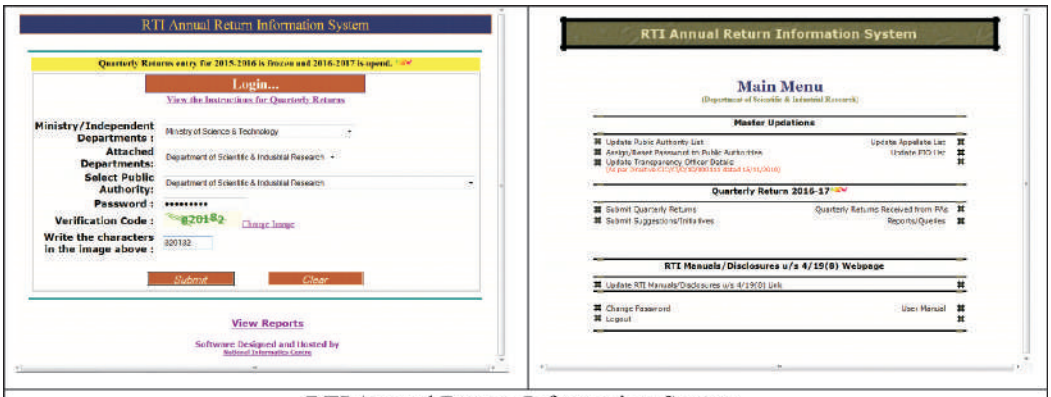
The Division provided technical support by way of lectures on 'RTI Online Portal, RTI Request & Appeal Management Information System, RTI Annual Return Information System, Proactive Disclosures under Section 4 (1) (b) of the RTI Act' during:

- Training Programme on **'Good Governance and Transparency'** organized by Council of Scientific and Industrial Research at CSIR-Human Resource Development Centre, Ghaziabad on 18/02/2016.

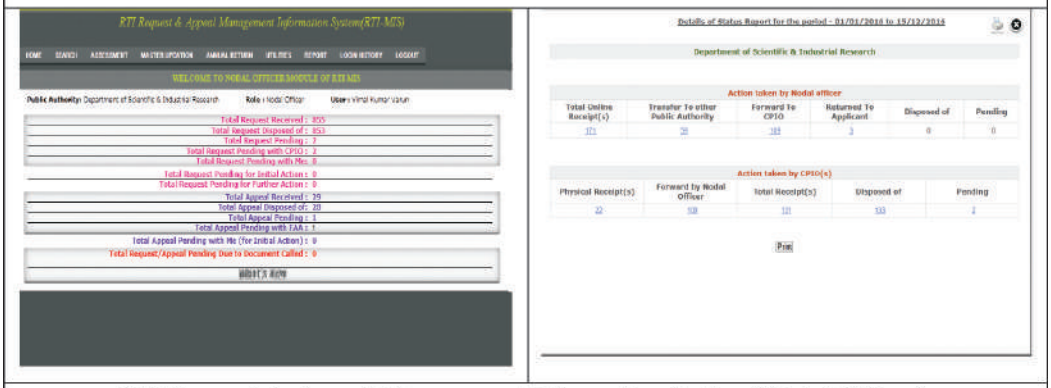
- Training Workshop on **'RTI Online Portal for Nodal Officers'** in alignment with the DoPT D.O. No. 01/Misc. Matters/2016-IR dated 5th

October, 2016 regarding aligning the Public Authorities (PAs) under the DSIR with the RTI online portal of DoPT organized by Council of Scientific and Industrial Research at CSIR-Human Resource Development Centre, Ghaziabad on 10/11/2016.

DSIR has been effectively using various IT applications like RTI Request & Appeal Management Information System at *http://rtionline.gov.in/RTIMIS,* RTI Annual Return Information System at *http://rtiar.nic.in* wherein quarterly returns were uploaded regularly.



RTI Annual Return Information System



RTI Request & Appeal Management Information System (Nodal Officer)

RTI Request & Appeal Management Information System (CPIO)

Autonomous Bodies

A. Council of Scientific & Industrial Research (CSIR)

1. Biological Sciences
2. Chemical Sciences
3. Engineering Sciences
4. Information Sciences
5. Physical Sciences

B. Consultancy Development Centre (CDC)

1. Introduction
2. Activities
3. Funded projects
4. Financial performance

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AUTONOMOUS BODIES

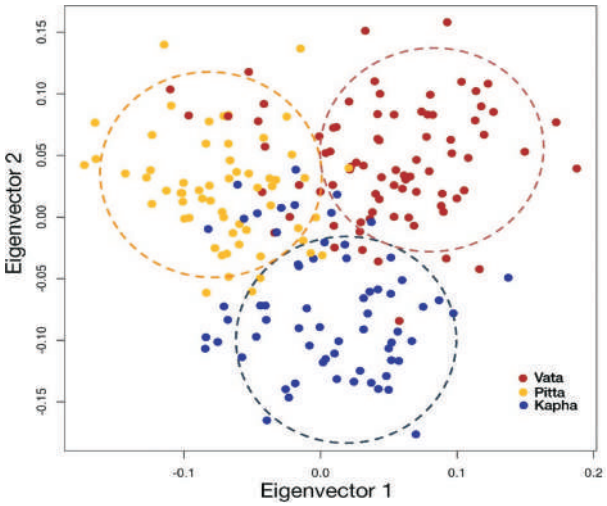
A. COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

1 BIOLOGICAL SCIENCES

1.1 Contribution to Science

Genome-wide analysis correlates Ayurveda Prakriti

Ayurveda is an ancient Medical System, its documented history dates back of 1500 BC. Ayurvedic practitioners believe that each individuals has different levels of three doshas, which lead to diversity. CSIR-CCMB researchers were addressed that such prototypic classification has molecular basis. For this, about 3400 people were assigned Prakritis by both well-trained Ayurvedic physicians, as well as by the use of a software programme called AyuSoft developed by C-DAC, Bangalore. The blood samples were collected and genome analysis was carried out from the isolated DNA. The data analysis revealed that it fell into three groups providing evidence for modular basis of this ancient classification. This is the first genome-wide study to establish such correlation between Ayurvedic prakriti classifications with genomic diversity. Analysis of the SNPs revealed that about 52 genes might be responsible for specifying an individual's doshas or prakritis.

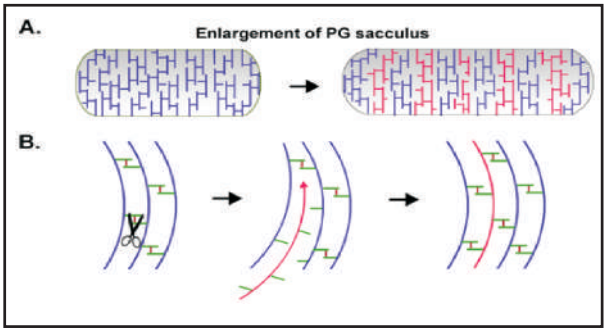


Principal component analysis (PCA) with 52 SNPs that showed p-value of <1 X 10^{-5} (A) PCA of Prakriti individuals showing three clusters (Vata, Pitta, Kapha), despite their linguistic, ethnic and geographical diversity.

Bacterial cell wall synthesis: Identification of a potential drug target

Drug-resistance in bacteria is increasing worldwide despite advances in antibacterial therapies. Meanwhile, the research and development of new antibiotics has declined over the years. A study published by CSIR-CCMB in the ***Proceedings of the National Academy of Sciences, USA***, describes a novel potential drug target for development of new

antibiotics. All biological cells have a membrane that envelops the cell contents. Bacteria have a rather tough cell wall made up of a biochemical entity known as peptidoglycan (PG). When a bacterium grows and increases in size, the cell wall also to increases in size which requires the PG to be remodelled. Using the model bacterium *Escherichia coli*, researchers at CSIR-CCMB have identified novel mechanism by which this remodeling is regulated. They show that the activity of the PG hydrolase MepS is controlled by a proteolytic system comprising NlpI, an outer membrane lipoprotein of unknown function, and a periplasmic protease. Blocking this process could potentially inhibit bacterial growth and provides a new avenue for eliminating bacterial infections.



Cross-link cleavage *Nascent glyean stand insertion* *Cross-link formation*

Development of non-viral nanoparticles

The use of non-viral transfecting agents for cancer therapy has been proposed for a long time but their clinical success has been poor due to their low transfection efficiency, difficulty of integration and unstable expression. An In-house collaborative effort at CSIR-CCMB has led to the development of non-viral nanoparticles for the targeted delivery of nucleic acids to cancer tissues. The efficient transfection of c-Myc shRNA bound with nanoparticles was demonstrated both *in vitro* as well as in established murine cancer models. The delivery of shRNA directly into mouse tumours enabled the effective knockdown of c-Myc, leading to the suppression of tumor growth and increasing survival times.

Palladium-Catalyzed Regio- and Stereoselective Cross-Addition of Terminal Alkynes to Ynol Ethers and Synthesis of 1,4-Enyn-3-one

Conjugated enynes, enol ethers, and enynones are versatile building blocks that can be elaborated by a wide variety of synthetic transformations. The selective synthesis of such units is a prerequisite for their effective utilization. The synthesis of conjugated 2-phenoxyenynes through a palladium-catalyzed cross-addition of terminal alkynes to phenylethynyl ethers (hydroalkynylation) has been developed by CSIR-CDRI. The reaction is highly regio-, stereo-, and chemoselective, and shows excellent tolerance toward functional groups. The addition further features very mild reaction conditions (room temperature) and an inexpensive catalytic system (without a ligand and with a cheaply available Pd catalyst). The thus synthesized enynyl ethers with allylic hydroxy tethers, which survived the reaction, were shown to be ready precursors for valuable 1-en-4-yn-3-ones.

Synthesis of 3,4,5-Trisubstituted Isoxazoles from Morita-Baylis-Hillman Acetates by an NaNO2 /I2 -Mediated Domino Reaction

An efficient NaNO2 /I2 -mediated one-pot transformation of Morita-Baylis-Hillman (MBH) acetates into alkyl 3-nitro-5-(aryl/alkyl) isoxazole-4-carboxylates has been developed by CSIR-CDRI. In a cascade event, initial Michael addition of NaNO2 to the MBH acetate furnishes the allylnitro intermediate which undergoes I2 -catalyzed oxidative á-C-H nitration of the nitromethyl subunit followed by [3+2] cycloaddition to afford the title compounds. Structural elaborations of these highly substituted isoxazoles by SN Ar reactions and hydrogenolysis allows access to useful products.

Ocimum basilicum* (L.) and *Premna integrifolia* (L.) modulate stress response and lifespan in *Caenorhabditis elegans

The progression in age is correlated with elevation in oxidative stress. The increment in oxidative stress ultimately affects human health, which led to

search for new stress alleviating compounds, but very few bioactive molecules are available presently. The present study by CSIR-CIMAP delineates effect of OPW (Ocimum basilicum extract), PSW (Premna integrifolia extract) and OCW (mixture of both herbs) on lifespan using survival and stress assays. The maximal lifespan extension was observed in OPW (50 ìg/ml) 32% ($P < 0.0001$) followed by 27.9% ($P < 0.0001$) in PSW (50 ìg/ml) and 18.39% ($P < 0.0001$) in OCW (50 ìg/ml). Furthermore, all the three extracts were able to modulate both the oxidative as well as thermal stress. Altogether, OPW mediates maximal lifespan extension in the worm which can be attributed to modulation of stress level to a greater extent. These results may provide insights for designing evidence-based herbal therapy in future.

Anti-phytopathogenic activity of *Syzygium cumini* essential oil, hydrocarbon fractions and its novel constituents

This study by CSIR-CIMAP aimed to explore natural anti-phytopathogenic compounds for plant disease management. The essential oil of *Syzygium cumini* and its compounds were screened for their anti-fungal assay against two phytopathogenic fungi, *Rhizoctonia solani* AG 4HG-III and *Choanephora cucurbitarum*. The findings suggest that 7-hydroxycalamenene, 7-acetoxycalamenene, 1-epi-cubenol,-terpineol, and (*Z*)-b- & (*E*)-b-ocimene have potential as antifungal agents for the medicinal plants. A novel compound 7-acetoxycalamenene has been reported from a natural source for first time.

Early Mint Technology- A novel agro-system developed for minimizing cost of production of menthol mint oil

Early mint technology is an improved method for the production of planting material (suckers / roots) by raising seedlings from suckers in winter season in poly houses/ polytunnels/ polycovers using modified method of transplanting/planting on ridges, withdrawing irrigation for about 10-15 days before harvest and using improved method of distillation. This technology developed by CSIR-CIMAP has been successfully adopted by the farmers. The technology is responsible for bringing earliness of about 20-30 days and minimizes expenditure on land, labour, water and fuel by about 30% with about 30% increase in productivity.

Elevated Hepatic miR-22-3p Expression Impairs Gluconeogenesis by Silencing the Wnt-Responsive Transcription Factor Tcf7

Levels of miR-22-3p, a highly abundant hepatic microRNA, are abnormally increased in mouse models of insulin resistance and type 2 diabetes, yet its contribution to deregulated hepatic metabolism under diseased is not well understood. CSIR-IGIB has unraveled a novel link between elevated hepatic miR-22-3p expression and impaired gluconeogenesis in diabetic db/db mice via the regulation of Tcf7 (transcription factor 7). miR-22-3p antagonism improved glucose tolerance and insulin sensitivity. Importantly, the hepatic Tcf7 levels were restored along with reduced hepatic glucose output, which was also reflected by the decreased expression of gluconeogenic genes. CSIR-IGIB results support a critical role for miR-22-3p and its target, Tcf7, in the pathogenesis of diabetes by upregulating gluconeogenesis. Moreover, targeting the miR-22/Tcf7/Wnt axis might hold therapeutic potential for the treatment of altered hepatic physiology during insulin resistance and type 2 diabetes.

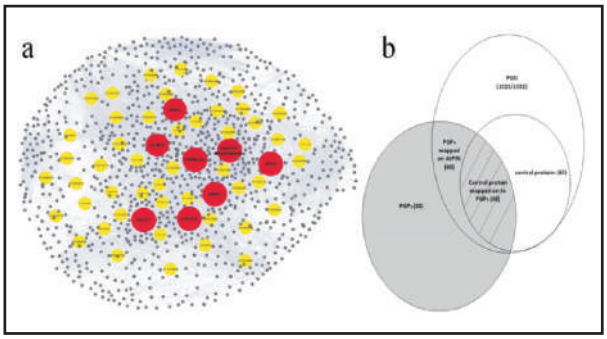
Non-invasive topical delivery of plasmid DNA to the skin using a peptide carrier

Topical delivery to skin is an essential step in non-invasive application of nucleic acid therapeutics for cutaneous disorders. The barrier posed by different layers of the skin – stratum corneum on top followed by the viable epidermis below – makes it extremely challenging for large hydrophilic molecules like nucleic acids to efficiently enter the

uncompromised skin. CSIR-IGIB has Reported an amphipathic peptide Mgpe9 (CRRLRHLRHHYRRRWHRFRC) that can penetrate the uncompromised skin, enter skin cells and deliver plasmid DNA efficiently as nanocomplexes in vitro and in vivo without any additional physical or chemical interventions prevalent currently. It is observed that efficient gene expression up to the highly proliferating basal layer of the skin without observable adverse reactions or toxic effects after delivery of reporter plasmids. The entry mechanism of nanocomplexes possibly involves reversible modulation of junction proteins accompanied by transient changes in skin structure. This peptide holds potential to be used as an efficient transporter of therapeutic nucleic acids to the skin.

Protein data of the germination pathway in *Podophyllum hexandrum*- a high altitude plant

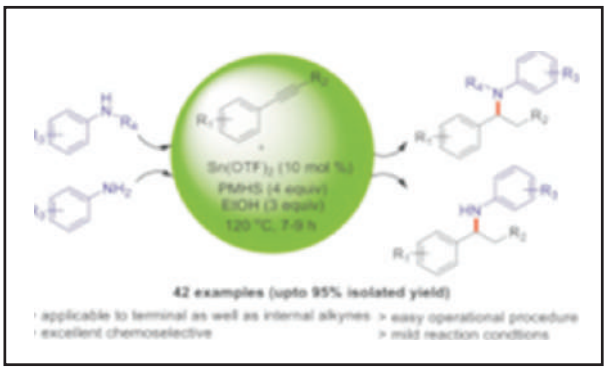
Podophyllum hexandrum Royle is an important high-altitude plant of Himalayas with immense medicinal value. Earlier, it was reported that the embryo of the seed is surrounded by thick walled, multi layered endosperm tissue and thick testa and these protective layers create a physical barrier to the water uptake and provide a constraint against radicle emergence during seed germination. CSIR-IHBT constructed *Podophyllum* germination protein interactome network (PGN) was constructed by using the differentially accumulated protein data set of *Podophyllum* during the radicle protrusion step of seed germination with reference to *Arabidopsis* protein–protein interactome network (*At*PIN). The developed PGN is comprised of a giant cluster with 1028 proteins having 10519 interactions and a few small clusters with relevant gene ontological signatures. In this analysis, a germination pathway related cluster which is also central to the topology and information dynamics of PGN was obtained with a set of 60 key proteins. Among these, 8 proteins which are known to be involved in signalling, metabolism, protein modification, cell wall modification and cell cycle regulation processes were found commonly highlighted in both the proteomic and interactome analysis. The systems-level analysis of PGN identified the key proteins involved in radicle protrusion step of seed germination in *Podophyllum*.



Podophyllum Germination Network (PGN) representing molecular mechanisms underlying Podophyllum seed germination. The giant component comprising of 10466 interactions among 1028 proteins was used for the network analysis. Key proteins

Development of Lewis acid catalyzed C-N bond formation reactions for synthesis of substituted amines and *N*-heterocycles Synthesis of substituted amines from alkynes

CSIR-IHBT Amines are ubiquitous structure in various natural products, pharmaceutical and agrochemical industry. Under this study, the unique preference of Lewis acidic Sn(II) for aniline activation is disclosed. Herein, Sn(II) triflate was reported as an efficient catalyst for highly selective reductive hydroamination of internal as well as



Lewis acidic Sn(II)

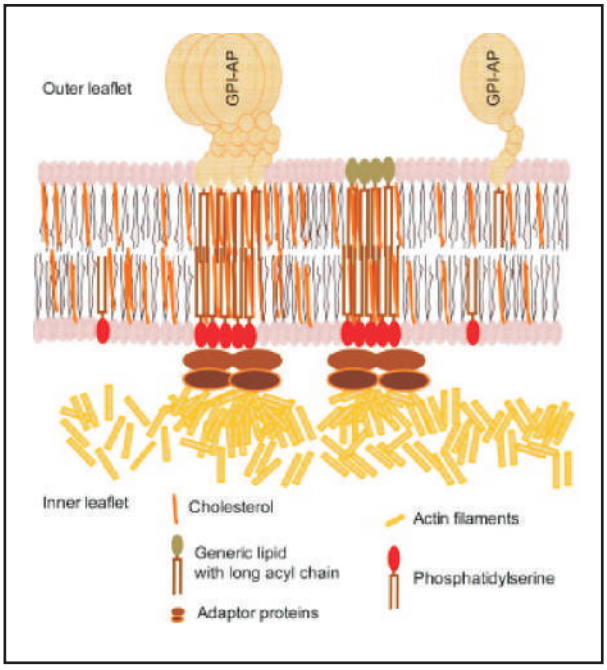
terminal alkynes to form a range of secondary and tertiary amines in good to excellent yield. The mechanistic study revealed the involvement of two steps in one pot wherein alkyne reduces to corresponding alkene in presence of PMHS as reducing agent followed by hydroamination of alkene.

Functional promiscuity of two divergent paralogs of Type III plant polyketide synthases

Plants effectively defend themselves against biotic and abiotic stresses by synthesizing diverse secondary metabolites, including health-protective flavonoids. These display incredible chemical diversity, ubiquitous occurrence and confer impeccable biological and agricultural applications. Chalcone synthase (CHS), a Type III plant polyketide synthase is critical for flavonoid biosynthesis. It catalyzes acyl CoA thioesters to synthesize naringenin chalcone through a polyketidic intermediate. The functional divergence among the evolutionarily generated members of a gene family is pivotal in driving the chemical diversity. Against this backdrop, CSIR-IIIM functionally characterized two full length cDNAs (1179 bp each), *Re*CHS1 and *Re*CHS2 encoding unique paralogs from *Rehum emodi*. Heterologous expression and purification in *E. coli*, bottom-up proteomic characterization, HPLC-ESI-MS/MS analysis and enzyme kinetic studies using five different substrates confirmed their catalytic potential. Comprehensive analysis revealed the existence of higher rate of synonymous substitutions in the intron-less divergents of *Re*CHS. The investigations establish that *Re*CHS1 paralog displays prime involvement in flavonoid biosynthesis, while as *Re*CHS2 seems more flexible towards substrate selectivity and may be in the biosynthesis of polyketidic anthraquinones. The homodimeric Type III PKSs seem to display substantial substrate promiscuity and metabolic diversity. These divergent paralogs are suitable for production of novel polyketide scaffolds with promising biological activities employing protein engineering.

Transbilayer Lipid Interactions Mediate Nanoclustering of Lipid-Anchored Proteins

Understanding how functional lipid domains in live cell membranes are generated has posed a challenge. Here, CSIR-IIIM showed that transbilayer interactions are necessary for the generation of cholesterol-dependent nanoclusters of GPI-anchored proteins mediated by membrane-adjacent dynamic actin filaments. CSIR-IIIM found that long saturated acyl-chains are required for forming GPI-anchor nanoclusters. Simultaneously, at the inner leaflet, long acyl-chain-containing phosphatidylserine (PS) is necessary for transbilayer coupling. All-atom molecular dynamics simulations of asymmetric multicomponent-membrane bilayers in a mixed phase provide evidence that immobilization of long saturated acyl-chain lipids at either leaflet stabilizes cholesterol-dependent transbilayer interactions forming local domains with characteristics similar to a liquid-ordered (lo) phase. This is verified by experiments wherein immobilization of long acyl-chain lipids at one leaflet effects transbilayer interactions of corresponding lipids at the opposite leaflet. This



Transbilayer Interactions

suggests a general mechanism for the generation and stabilization of nanoscale cholesterol-dependent and actin-mediated lipid clusters in live cell membranes.

Thiol reductive stress induces cellulose-anchored biofilm formation in *Mycobacterium tuberculosis*

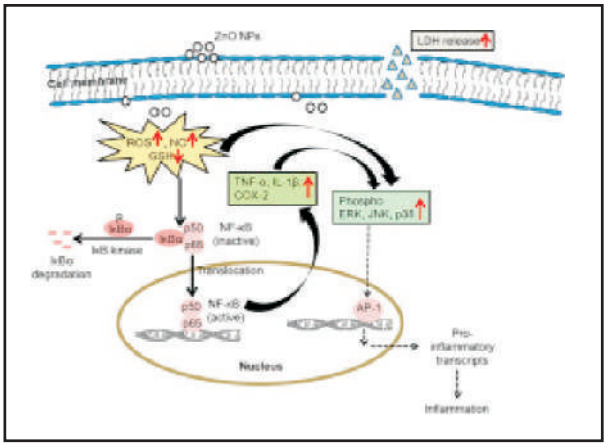
Mycobacterium tuberculosis (Mtb) forms biofilms harbouring antibiotic-tolerant bacilli *in vitro*, but the factors that induce biofilm formation and the nature of the extracellular material that holds the cells together are poorly understood. CSIR-IMTECH has shown that intracellular thiol reductive stress (TRS) induces formation of Mtb biofilms *in vitro*, which harbour drug-tolerant but metabolically active bacteria with unchanged levels of ATP/ADP, NAD^+/NADH and $NADP^+$/NADPH. The development of these biofilms requires DNA, RNA and protein synthesis. Transcriptional analysis suggests that Mtb modulates only <"7% of its genes for survival in biofilms. In addition to proteins, lipids and DNA, the extracellular material in these biofilms is primarily composed of polysaccharides, with cellulose being a key component. The results contribute to a better understanding of the mechanisms underlying Mtb biofilm formation, although the clinical relevance of Mtb biofilms in human tuberculosis remains unclear.

NR1D1 ameliorates *Mycobacterium tuberculosis* clearance through regulation of autophagy

NR1D1 (nuclear receptor subfamily 1, group D, member 1), an adopted orphan nuclear receptor, is widely known to orchestrate the expression of genes involved in various biological processes such as adipogenesis, skeletal muscle differentiation, and lipid and glucose metabolism. Emerging evidence suggests that various members of the nuclear receptor superfamily perform a decisive role in the modulation of autophagy. Recently, NR1D1 has been implicated in augmenting the antimycobacterial properties of macrophages and providing protection against *Mycobacterium tuberculosis* infection by downregulating the expression of the IL10 gene in human macrophages. This anti-infective property of NR1D1 suggests the need for an improved understanding of its role in other host-associated antimycobacterial pathways. CSIR-IMTECH demonstrated that in human macrophages either ectopic expression of NR1D1 or treatment with its agonist, GSK4112, enhanced the number of acidic vacuoles as well as the level of MAP1LC3-II, a signature molecule for determination of autophagy progression, in a concentration- and time-dependent manner. Its role in the modulation of autophagy and lysosome biogenesis together with its ability to repress IL10 gene expression supports the theory that NR1D1 has a pivotal antimycobacterial function in human macrophages.

ZnO nanoparticles induced inflammatory response and genotoxicity in human blood cells: A mechanistic approach

Wide application of zinc oxide nanoparticles (ZnO NPs) in cosmetics, paints, biosensors, drug delivery, food packaging and as anticancerous agents has increased the risk of human exposure to these NPs. Earlier *in vitro* and *in vivo* studies have demonstrated a cytotoxic and genotoxic potential

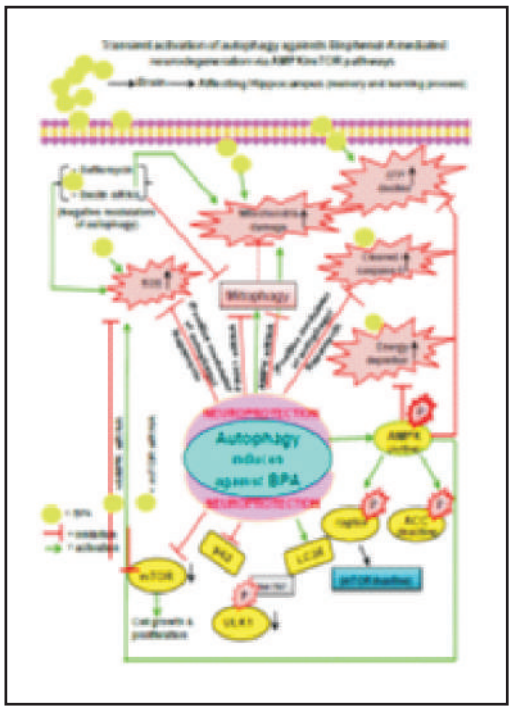


A schematic showing possible mechanism of ZnO NPs induced inflammatory response in human monocytic cells. The dotted lines represent the pathway of other inflammatory mediators activated during inflammation. Activator protein 1 (AP-1).

of ZnO NPs. However, there is paucity of data regarding their immunomodulatory effects. Therefore, the present study by CSIR-IITR was aimed to investigate the immunotoxic potential of ZnO NPs using human monocytic cell line (THP-1) as model to understand the underlying molecular mechanism. At the concentration tested, NPs induced DNA damage as assessed by the Comet and micronucleus assays. The study demonstrated that ZnO NPs induce oxidative and nitrosative stress in human monocytes, leading to increased inflammatory response via activation of redox sensitive NF-êB and MAPK signaling pathways.

Activation of Autophagic Flux against Xenoestrogen Bisphenol-A-induced Hippocampal Neurodegeneration via AMP kinase (AMPK) / Mammalian Target of Rapamycin (mTOR) Pathways

The human health hazards related to persistance use of bisphenol-A (BPA) are well documented. BPA-induced neurotoxicity occurs with the generation of oxidative stress, neurodegeneration, and cognitive dysfunctions. However, the cellular and molecular mechanism(s) of the effects of BPA on autophagy and association with oxidative stress and apoptosis are still elusive. CSIR-IITR observed that BPA exposure during the early postnatal period enhanced the expression and the levels of autophagy genes/proteins. BPA treatment in the presence of bafilomycin A1 increased the levels of LC3-II and SQSTM1 and also potentiated GFP-LC3 puncta index in GFP-LC3-transfected hippocampal neural stem cell-derived neurons. BPA-induced generation of reactive oxygen species and apoptosis were mitigated by a pharmacological activator of autophagy (rapamycin). Conversely, BPA exposure down-regulated the mammalian target of rapamycin (mTOR) pathway. Moreover, silencing of mTOR enhanced autophagy, which further alleviated BPA-induced reactive oxygen species generation and apoptosis. BPA-mediated neurotoxicity also resulted in mitochondrial loss, bioenergetic deficits, and increased PARKIN



Proposed schematic model for the role of autophagy against BPA induced neurotoxicity in the hippocampus region through modulation of the AMPK and mTOR pathways

mitochondrial translocation, suggesting enhanced mitophagy. These results suggest implication of autophagy against BPA-mediated neurode generation through involvement of AMPK and mTOR pathways. Hence, autophagy, which arbitrates cell survival and demise during stress conditions, requires further assessment to be established as a biomarker of xenoestrogen exposure.

Development of whitefly resistant GM cotton

Whitefly is an invasive insect pest of several crops including cotton. High temperature, humidity, dense cropping and cultivation in polyhouses promote the outbreak of whitefly. The insect damages the crops by sucking sap from the host plant, causing fungal infection and spreading plant viruses. The most severely affected crops are cotton, eggplant, tomato, cassava, causing a huge financial loss. GM technology for the control of

whitefly is not yet available.

CSIR-NBRI has identified a novel anti-whitefly protein in an edible fern. This protein interferes in the reproductive system of whitefly and thus restricts its population. The gene encoding this protein was cloned and introduced in cotton. The transgenic cotton shows remarkable control of whitefly population through several generations. The transgenic cotton also shows protection against whitely vectored viral diseases. CSIR-NBRI has filed patents on this gene in 8 countries, based on potential market prospects for the technology.

Development of whitefly resistant GM cotton

CSIR-NBRI has made some of the critical biosafety studies and established that the anti-whitefly protein designated as Tma12, is safe to mammals. It is digested easily in the stomach and do not harm the test animals. It does not contain any allergenic property. It is also non-toxic to beneficial insects.

Problem of whitefly on cotton and tremendous loss in crop yield was speculated in 2006 and the GM-cotton producing its own bio-pesticide for defense against whitefly is offered as the solution for the problem.

The experimental evidences that show health and vigour of the GM cotton expressing anti-whitefly gene relative to the non-GM cotton plants, clearly demonstrate the benefits of the GM cotton. It does not require chemical pesticides. Health of the GM-cotton plants as well as yield and quality of cotton developed on it are markedly superior to that in the non-GM cotton.

De novo assembly and characterization of root transcriptome in two distinct morphotypes of vetiver, _Chrysopogon zizaniodes_ (L) Roberty

Vetiver, a perennial C4 grass, has long been known for its multifarious uses in perfumery, medicine and environmental protection. Two distinct vetiver morphotypes have been identified in India by CSIR-NBRI i.e., “A”, North Indian type characterized by thick and smooth fast growing roots that produce superior quality of laevorotatory oil; and “B”, South Indian type with more number of thin and hairy roots that produce inferior quality of dextrorotatory oil. The two morphotypes were targeted for transcriptome analysis to understand the contribution of genetic background on oil quality and root morphology. Sample “A” showed enhanced activity of flavonoid and terpenoid

Morphology of whole plants, root architecture and anatomy of two vetiver morphotypes, South Indian Type (A) and North Indian Type (B)

biosynthesis related genes, i.e. ERF, MYB, bHLH, bZIP and WRKY. The study demonstrated that several transcripts involved in root development and hormonal regulation being up regulated in Sample "A". The study provided an important start point for further discovery of genes related to root oil quality in different ecotypes of vetiver.

Evaluation and improvement of turmeric accessions for north India

Thirty four accessions of turmeric (*Curcuma longa)*, collected from various bio-geographical regions are conserved at Banthra Research Station by CSIR-NBRI. Biochemical analysis (total curcuminoids, total phenolic contents, Antioxidant activity) and DNA profiling of 29 accessions has been done. Among all the accessions three accessions (NBH-10, NBH-12 and NBH-18) were found to be best yield and are cultivated for commercial purpose at Aurawan centre. Of these, "Kesari", a promising variety for shade conditions in northern plains was released on February 07, 2016.

1.2 Contribution to Economy/Society

New Herbal Medication for Bone Health Standardized Extract of *Dalbergia sissoo* (Brand name: Dalzbone) for accelerated fracture healing and management of post-menopausal osteoporosis:

Standardized Extract

CSIR-CDRI Isolated 16 compounds from the Standardized extract, out of these four compounds were active. One novel compound was identified that was present in abundance. It exhibited osteogenic activity and was used as an osteogenic marker.

***In vivo* Activities**

Novel and abundantly present marker CAFG increases chondrogenic differentiation; Adult female osteopenic rat model: Treatment at 50.0 and 100 mg/kg body weight dose led to increased mineral apposition and bone formation rate thus increased bone mineral density; DS ethanolic extract was evaluated by CSIR-CDRI in rat rapid fracture healing model: 250, 500 &1000 mg/kg body weight. Treatment stimulates callus and fracture healing at dose as low as 250.0 mg/kg body weight; CAFG was evaluated in mice in post-menopausal model for osteoporosis & rapid fracture healing model (1 & 5 mg/kg body weight); Stimulates fracture healing by activating Wnt/â catenin signaling pathway; and CAFG devoid of uterine estrogenicity.

Licensed to Pharmanza Herbal Pvt. Ltd. Gujarat in April, 2015. Dalzbone clinical trial were registered on June 03, 2015 (registration number CTRI/2015/06/005850). Clinical trial on accelerated fracture healing started from July 2015 at Karandikar Hospital and Research Center, Nasik, Maharastra. Clinical trial on preventing post-menopausal osteoporosis started from September 2015 at Nanavati Hospital, Mumbai and Tanvir Hospital, Hyderabad, Andhra Pradesh. Product launched for marketing on 17 Feb 2016.

Candidate Drugs under Fast Track Development Mode

a) Candidate Drug Comp 99/373 (Anti-osteoporosis)

CSIR-CDRI Compound 99/373 is a promising alternative option in the prevention and treatment of osteoporosis. It 99/373 is an orally active and achiral compounds, which has excellent antiresorptive activity, backed by elegant bone biology studies. It has favourable animal PK profile. Found safe in preclinical regulatory pharmacology and toxicity studies. CSIR-CDRI has obtained DCGI permission to carry out Phase-I clinical trial. National and international patents granted which are active. Product has advantage over existing clinically used drugs like raloxifene and bisphoaphonates in terms of its efficacy as well as

toxicity. Cost effective due to "one pot synthesis". Phase I Clinical trials are to be initated shortly.

b) Candidate Drug Comp 97/78 (Anti-malarial)

Artemisinin derivatives are drugs of choice for the treatment of malaria and artemisisin combination therapy (ACT) is being used across malarious regions for treatment of disease. **CDRI 97/78 is a novel, fully synthetic 1,2,4-trioxane** [empirical formula: $C_{28}H_{36}O_8$] with impressive activity against multidrug resistant forms of *Plasmodium.* It is a schizonticidal compound with powerful anti-malarial activity against chloroquine resistant *P. falciparum in vitro*, multidrug resistant *P. yoelii* in mice and *P. cynomolgi* in Rhesus monkeys. It has been developed as a synthetic substitute for artemisinin and its derivatives (arteether, artemether, artesunic acid). CDRI97/78 is effective by oral, intramuscular and intravenous routes and can thus be used by any route. Oral formulation for the compound has been developed. Phase I Clinical trial (single dose) completed. Phase I Clinical trial (multiple dose) were to be initated shortly.

c) Lead Compound S-007-867 (Antithrombotic)

CSIR-CDRI has a novel small molecule anti-platelet compound which may be useful in treating intravascular arterial thrombosis. This novel compound (chiral) is patented and has unique scaffold. The compound was picked after extensive SAR studies, which are active and selectively inhibit collagen mediated platelet activation. The compound is relatively simple to synthesize (MW < 500) and can easily be chemically modified to obtain the desired ratio of anti-platelet activity. The anti-platelet molecule has shown definite activity in animal models of arterial thrombosis. Preclinical studies show the compound to have lower incidences of bleeding as compared to currently used agents such as aspirin and clopidogrel. Acute toxicity studies in rats and mice studies demonstrate a favourable safety profile of this compound. Toxicity studies in Monkey Model were to be initiated shortly.

d) Lead Compound S-007-1500 (Anti-osteoporotic)

S-07-1500 has potential osteogenic property and shows accelerated fracture repairing studies by CSIR-CDRI. New bone formation at the fracture site is increased by ~40% in rats increases callus formation at only 1 mg/kg dose and restores trabecular microarchitecture at fractured site in normal female and osteopenic rats. It leads to accelerated fracture repair by BMP-2/Smad signalling pathway. Compound found safe in single dose toxicity studies in rodents and in 10 days DRF studies. Essential Safety Pharmacology study as per schedule Y was completed and no mortality/ adverse effect was observed.

Development and Release of Genetically Improved High Yielding Varieties

Nine new varieties of different medicinal and aromatic plants were developed and released by CSIR-CIMAP for the benefit of the growers and entrepreneurs of medicinal and aromatic plants. The brief description of these varieties is given as under:

CIM-Sanjeevni: It is a late flowering artemisinin rich (1.2%) variety that gives 10-125/ha higher yield than the existing variety CIM-Arogya. This new variety would fetch an extra income of Rs. 10-15 thousand per hectare to the farmers.

CIM-Sanjeevni of Artemisia annua developed by CSIR-CIMAP

CIM-Sunahari: CIM-Sunahari is a high yielding variety of Peeli Satavar that gives 9.75t/ha dry root yield with 11.03% saponin content. This variety has a potential to enhance the income of the farmers by about one and a half times.

Var. CIM-Sunahari of Peeli Satavar developed by CSIR-CIMAP

CIM-Shikhar: This new variety of Lemongrass gives increased oil yield of >200kg/ha with an oil content of 1.63% and 86% citral in the oil. It would create an extra income of Rs. 25000-30000/ha to the cultivators.

Var. CIM-Shikhar of Lemongrass developed by CSIR-CIMAP

NIMITLI-101: It is a high yielding variety of Ashwagandha with improved immuno-modulatory activity. The plants of this new variety has a potential to yield 23Q roots/ha with a total withanolide content of 0.28%.

CIM-Sharda: It is a methyl chavicol rich (80-85%) variety of Tulsi. It is an improved variety over the existing one with an oil content of 0.70% and oil yield of about 206kg/ha

CIM-Nirom: It is a hairless pod variety of kewanch with dark green stem and curled blue flower petals. The ripened pods and seeds are dark black in color. The seed yield potential is 33.30 q/ha with L-dopa content of 4.50%.

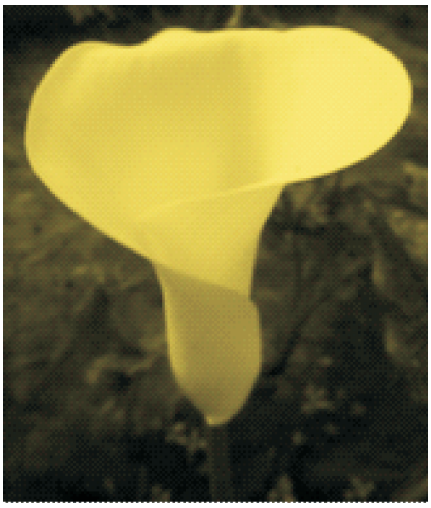
Khus-Khusnalika: This variety is capable producing >1% (w/w) essential oil containing 45% Khusinol (v/v) and oil yield of 16-18kg/ha from fresh roots harvested from 06 month old plantations.

CIM-Harit: CIM harit is an improved early maturing variety of clarysage over CIM-chandini with an oil content of 0.12-13%, oil yield 20-22 kg/ha with 45-50% linalyl acetate in the oil.

CIM-Medha: *CIM-Medha* is an high yielding cold tolerant variety of *Centella asiatica*. This new variety has dry herb yield potential of 11.29ql/ha with 5.36% asiaticoside content in leaves. Besides it also has high survival rate during winter season due to cold tolerance.

Novel Variety of Calalily

Through conventional breeding two novel varieties of calality were developed by CSIR-IHBT. The genotype is labelled at CSIR-IHBT-Cl-Y-I. The parental genotypes of *Zantedeschia elliottiana* CSIR-IHBTCL-ZE-1 (light yellow coloured) and CSIR-IHBT-CL-ZE-2 (Red purple coloured) were crossed and variable colours of calla lilies were obtained in the progenies which were morphologically characterized for floral traits. The genotype CSIR-IHBT-CL-Y-1 has been selected for its unique



CSIR-IHBT CL-Y-1 Cylinderical trupet flower

cylindrical trumpet flower shape and attractive bright yellow colour. The genotype along with parents were evaluated for two years with respect to flower production potential and other agronomic attributes *viz*., flower stalk length, stalk diameter, leaf size and numbers, plant height, number of flowers per plant and number of shoots under field and protected conditions.

Novel Gerbera Variety

Superior gerbera were developed through conventional breeding techniques. CSIR-IHBT- Gr-13-1 was superior to parental lines with respect to leaf length (cm) and stalk length (cm), while CSIR-IHBT-Gr-11-6 and CSIR-IHBT-Gr-24-6 were superior to parents for leaf width (cm). CSIR-IHBT-Gr-24-6 was superior to one of the parents for number of flowers per plant in a year but had significantly reduced stalk length (cm) in comparison to the parents. CSIR-IHBT-Gr-29-1 and CSIR-IHBT-Gr-Y-1 were superior to the parents for stalk length.

Gerbera Variety

A bud sport (natural mutant); growth habit drooping; leaves variegated, medium-ovate; leaf size 6.0-7.5 × 4.5-6.0 cm; thorns slightly curved; 0.6-1.0 m long; density 17 nos. of thorns in 30 cm length of shoot; floral bract size 2.5-3.0 × 1.8-2.3 cm; bract colour - young red (Red group53-D, Fan-1); mature red-purple (Red purple 63-B, Fan-2); bract shape medium ovate; slightly twisted; star creamy colour (Green-yellow 1-C, Fan-1); 0.5-0.7 cm in diameter; flowering habit all along the branches.

This is winter blooming variety with variegated leaves having combination of three types of colour (green, lemon yellow and ashy-yellow). The bracts are large and twisted.

Bougainvillea 'NBRI-A.P.J. Abdul Kalam'

A Sensor for Early Detection of Heart Attack in Humans

Heart disease is the leading cause for death in men and women. Early detection of heart attacks can save a human life. In a collaborative work with CSIR-

CSIO, developed a sensor to detect the antigen cardiac-Troponin I (cTnI). The technique uses Graphene quantum dots conjugated to antibody anti-cardiac Troponin I and fluorescence resonance energy transfer (FRET). The sensor is highly specific and shows negligible response to non-specific antigens. The sensor displayed a linear response to cTnI from 0.001 to 1000 ng/mL with a limit of detection of 0.192 pg/mL.

Ethnic Food of Himachal Region

CSIR-IHBT has developed know-how for commercial production of ready-to-eat food based on ethnic recipes of H.P. especially Kangri Dham. The patent has also been filed. The canned recipes remain fresh under room condition for more than six months. It has positive health attributes. The

Kangri Dham developed by CSIR-IHBT, Palampur

technology has been licensed to M/s Sai Foods company having its registered office at Ustehar, Teshil Baijnath Distt Kangra (H.P.). It has unique taste and palate because of its regional cooking style and ingredients.

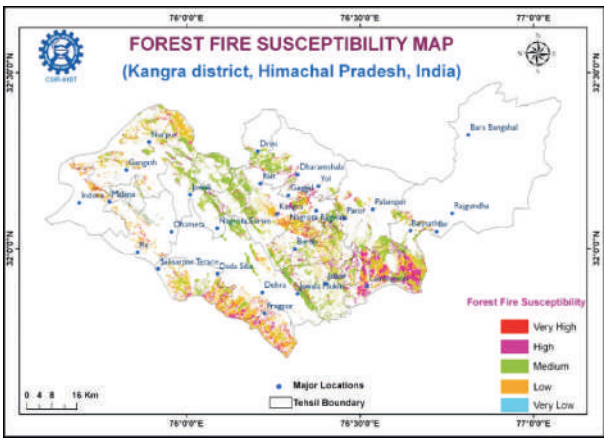
Functional Foods

Buckwheat is a traditional crop of the high altitude Himalayan region having potential health benefits. Analysis of its nutritional properties revealed that puffed buckwheat is rich in protein, fat and carbohydrate as well as rutin content. There is a great potential for value addition of buckwheat into other products. CSIR-IHBT has developed simple technology for production of range of products from buckwheat like nutrition bar, noodles pasta etc.

Food processing facility for buckwheat has been established at CSR-IHBT centre CeHAB, Keylong (Lahaul and Spiti) and demonstration to the local authority, progressive entrepreneurs, NGOs and SHGs for promoting entrepreneurship development in the region.

Identifying Triggers for Forest Fire and Assessing Fire Susceptibility of Forests

A study to identify fire prone sites was carried out by CSIR-IHBT in Kangra (HP). For this, geographical coordinates of the recorded fire locations were overlaid on various thematic layers such as elevation, slope, aspect, mean annual temperature and fuel map of the region. The 10.7 % of the forest cover in the study area was categorized as 'very high' and 'high' forest fireprone area. The 14.02 %



Prioritized forest fire-prone regions in Kangra district, Himachal Pradesh

villages of the region were identified as 'high' forest fire prone. The *Pinus roxburghii*, mixed forest species, Khair forest (*Acacia* spp.) and oak forest (*Quercus* spp.) were identified as fire-sensitive forest types of the region.

Rejuvenation Treatment of the Ancient 'Parijaat' Tree at Barauliya, Barabanki

In Barauliya, Barabanki district of Uttar Pradesh, there is a sacred tree, known as "Parijat". This tree is believed to belong to Mahabharat period. A stamp of the tree has also been issued by the Indian Postal Department in 1997. The Parijat tree (*Adansonia digitata*) is considered to be a divine tree which is unique in more than one aspect.

The tree is degenerating with age, and also because of human and other biotic disturbances. The Forest Department of Uttar Pradesh approached CSIR-NBRI Lucknow to examine the degenerating Parijaat and suggest measures for its rejuvenation. CSIR-NBRI made sincere efforts to help the tree regenerate itself. After survey, sampling and analysis, a detailed report has been prepared, giving recommendations to the Forest department for rejuvenating the religious historical tree. CSIR-NBRI microbial biopesticide (*Bacillus* based inoculants) has been found very effective for controlling the infections.

Parijaat Tree : Before Treatment

After Treatment

CSIR-NBRI has submitted the report and *Bacillus* packets to the Forest Department Officials, Uttar Pradesh.

'BGR-34' for Diabetes Management

Diabetes mellitus is a complex metabolic disorder resulting from either insulin insufficiency or insulin dysfunction. Type II diabetes is the more common form of diabetes constituting 90% of the diabetic population. Therefore, considering the prevalence and emergence of herbal drugs based on traditional knowledge, CSIR-NBRI and CSIR- CIMAP jointly developed a novel, safe, poly-herbal formulation for management of diabetes. M/s Aimil Pharamaceuticals Pvt Ltd, New Delhi has taken up commercial manufacturing and marketing of the product.

Launch of the Herbal Formulation 'BGR 34' for commercial marketing

1.3 S&T Services & Facilities

Nanotechnology Laboratory for Biomedical Applications

Nanotechnology is one of the best enabling technologies, now influencing literally every sphere of human activity. With the help of DST and an industrial partner, USV Ltd., Mumbai, CCMB has been able to establish a state-of-the-art *Nanotechnology Laboratory for Biomedical Applications*. This laboratory is open for collaborative efforts from entrepreneurs.

Common Research and Technology Development Hub (CRTDH)

In order to facilitate innovation and technology-driven product development by start-ups and entrepreneurs, CCMB has set up a "***Common Research and Technology Development Hub*** (CRTDH)" with the support of DSIR. The major objective of the CRTDH is to facilitate productivity and competitiveness of start-ups, small and medium scale industries by providing scientific and technological support, problem solving and capacity building. CRTDH will focus its efforts on diagnostics, biopharma and medical devices particularly, based on microfluidics and affordable health care diagnostics. The facility has flexible business models to cater to different needs of startups.

Sophisticated Analytical Instrument Facility (SAIF)

Sophisticated Analytical Instrument facility at CSIR-CDRIis more than 40 years old and is one of the first four such facilities set up by the Department of Science & Technology (DST), Government of India in mid-seventies. SAIF-CDRI provides primarily chemistry centric analytical facilities for researchers throughout India and industries to enable them to carry out measurements for R&D work. This facility also organizes short term courses/workshops on the use and application of various instruments and analytical techniques. During 2015-16, the centre carried out analyses of more than 3422 external and 111986 internal samples.

National Laboratory Animal Centre (NLAC)

National Laboratory Animal Centre at CSIR-CDRI possesses complete facilities for breeding and maintenance of laboratory animals under standard husbandry conditions. The centre houses animal strains of different species of rodents, including inbred strains of mice, rat, hamster, logomorphs and nude mice. The centre also possesses specific pathogen free (SPF) and complete germfree (gnotobiotic) rodent breeding nuclei and a facility for primate behaviour studies and primate breeding. This centre is self-contained with its own Radiology, Genetics, Microbiology, Pathology, Nutrition, Parasitology, Services etc. for disease monitoring and management of laboratory animals. The environment provided to animals housed in the centre - including cages, feed, water etc. - matches with specifications laid down by Bureau of Indian Standards. This centre takes care of humane handling of animals and follows Indian National Science Academy guidelines for this purpose. NLAC is registered with the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) for breeding and experiments. During 2015-16, a total of 33628 animals were supplied for research studies, out of which 3054 animals were supplied to CPCSEA registered outside research and academic institutions including pharmaceutical companies.

Biological Screening of Services

CSIR-CDRI has excellent facilities for carrying out *in vitro* and *in vivo* biological screenings against various disease models and the facility is being provided to R&D Institutions, Universities, Academic Organizations and Industrial houses within the country on payment basis. During the reporting period, more than 112 external samples were screened against various models and report sent to the respective researchers.

S&T Knowledge Resource Centre (KRC)

The KRC has been established by CSIR-CDRI with an objective to provide biomedical information services for the scientists in the era of information boom. The centre also caters to the need of the pharmaceutical industry, entrepreneurs and researchers. This centre is computerized and conforms to the norms of e-governance. KRC continued to provide information services to its users and a total of about 1255 outside users (Students of M. Pharm, Biotechnology, Biomedical Sciences) utilized these services during 2015-16. Its present collection comprises of 22494 books and 73969 bound volumes of journals. Centre also provides access to various e journals, open source resources and bibliographic databases viz-Scifinder, Web of Science, R&D Insight etc.

New Facilities

Orbitrap mass spectrometer equipped with an electrospray ionization source (ESI) Mass range: upto 4000 Da for singly charged molecules Resolution: upto 100,000 at 400 Da and Intra-vital Imaging Facility Olympus BX61- FV1200-MPE were established by CSIR-CDRI.

Orbitrap mass spectrometer

Intra-vital Imaging Facility
Olympus BX61- FV1200-MPE

Smoke Facility

Chronic obstructive pulmonary disease (COPD) is the fourth leading cause of death globally and is predicted to become the third leading cause of death by the end of next decade. Chronic exposure to tobacco smoke and/or other environmental insults such as smoke from biomass fuel, organic and inorganic dust, diesel exhaust result in the progressive decline in lung function and are associated with the occurrence of chronic obstructive pulmonary disease (COPD). Of these factors, cigarette smoking and exposure to smoke from biomass fuel are considered to be the major risk factors associated with the pathophysiology of COPD in low-to-middle income countries including India. Therefore, understanding the molecular mechanisms underlying the smoke induced lung function decline would provide us with novel therapeutic targets that could rescue the lung function in COPD subjects. Smoke exposed mice lungs at least in part mimic the pathological changes associated with human COPD and are therefore of great help to understand the disease pathophysiology.

Smoke Facility

The smoke facility at CSIR-IGIB with its state-of-the-art design is best suited for both acute and chronic exposure of multiple mice to cigarette smoke. Apart from this, to mimic the exposure to biomass fuel in the rural setting of our country, we have also custom designed an indigenous biomass fuel exposure cabinet for mice. Together, these facilities would help us unravel the pathological mechanisms associated with COPD.

Advanced Imaging Facility Transmission Electron Microscope (TEM)

The Tecnai™ G2 Spirit (FEI, The Netherlands) Transmission electron microscope (TEM) provides high-contrast, high-resolution imaging and analysis in life science applications was established by CSIR-IITR. Its unique BioTWIN lens is designed for optimal contrast and allows the observation of unstained material. Nanomaterial samples can be

Transmission Electron Microscope

characterized for their particles shape, size, distribution of particles, phase identification etc. The TEM is operable at 20 kV to 120 kV for high contrast and high resolution.

Ultra Microtome Facility

The Ultra microtome (Leica EM UC7, Leica Microsystems GmbH, Germany), is a fully automated system which provides easy preparation of semi- and ultrathin sections as well as perfect, smooth surfaces of biological and industrial samples for TEM and SEM examination was installed CSIR-IITR. Combining ergonomic design and innovative technology the Ultramicrotome Leica EM UC7 sets new standards in Ultramicrotomy. It offers a range of outstanding features and benefits of use for the ultramicrotomist, whether highly skilled or absolute beginners.

Bioinformatics Centre

A national facility supported by the Department of Biotechnology (DBT), the Bioinformatics Centre (BIC) at the Institute of Microbial Technology (IMTECH) is playing multiple roles that include, i) serving as a national facility under the Biotechnology Information Systems Network (BTISnet) programme of DBT, ii) conducting Research and Development (R&D) activities in the field of bioinformatics and computational biology, iii) housing Computational Resources for Drug Discovery (CRDD), iv) maintaining infrastructure for protein modelling/engineering, and iv) providing Information Technology (IT)-related services to IMTECH.

1.4 Service to Industry or Collaboration with Industry

Diagnostics: Molecular Genetic Testing for Monogenic Disorders & Chromosome Diagnostics Services

- Referral cases close to 20,000 cases for 35 genetic disorders
- Advisor to various NGOs working on disease like Thalassemia, Muscular
- Dystrophy and Hemophilia
- CSIR-CCMB is a Member of Genetic Testing Registry, NCBI.
- ~ 45 Publications
- Revenue Generated ~ 50 lakhs

Transfer of Technology on Metal Gluconate

- CSIR-IIIM signed agreement signed with M/S Hindustan Phosphates Ltd. for transfer of technology on metal gluconate salts (CNP-1307) 2015
- Agreement signed with M/S Sarvotham Care Ltd. for optimization of two probiotic based formulations (CNP-1308) 2016.
- Organise interactive meet between farmers (producer of essential oils) and Industrial houses to meet out the industrial requirement of essential oils and aroma constituents.
- Supply of high value essential oils to develop value added products in collaboration between CSIR-IIIM, Jammu and concerned industrial house.

Services in the Field of Environment and Chemical Testing to the Industries

CSIR-IITR is providing its services in the field of environment and chemical testing to the industries. The services include air and stack emission monitoring and analysis of water, waste water, industrial effluents, sludge, soil, coal, flyash etc. Water quality analysis with respect to bacterial contamination of drinking water is also provided by the institute. The quality assurance of the data generated is ensured by NABL accreditation of the institute in chemical and biological field. Through its GLP certified pre-clinical toxicity studies, the institute is providing service to industry for the certification of its chemicals/products for its safety.

Collaborative development of drugs signed the following agreements with Industries in the area of drug development & Healthcare

Nature of Service or collaboration	Industry	Date of signing
Consultancy Agreements Signed		
Consultancy services to GSKCH on bone biology including osteoporosis covering the pathology, animal model, clinical and preclinical end points and treatments	GSKCH, Gurgaon	18-02-2016
Consultancy services in the area of TEM /DLS analysis of liposomes/ vesicles	Galaxy Surfactants Ltd., Navi Mumbai	15-03-2016
Consultancy on bone disorders and osteoporosis	Glemmark Pharmaceuticals Limited, Mumbai	04-12-2015
Sponsored Projects Agreements Signed		
In vitro studies of 10 leads of NIF for anti-malarial evaluation	National Innovation Foundation-India (NIF), Ahmedabad.	04-06-2015
In vivo studies of 6 leads of NIF for anti-malarial evaluation	National Innovation Foundation-India (NIF), Ahmedabad.	04-06-2015
Validation of two herbal leads from NIF for three doses each in SHR using Telemetric system	National Innovation Foundation-India (NIF), Ahmedabad,	02-09-2015
Secrecy Agreements Signed		
Engaging CSIR-CDRI for scientific advice on a project related to bone health disorders including osteoporosis, covering the pathology, animal models, clinical and preclinical end points, translational aspects and treatments	Glenmark Pharmaceuticals Limited, Mumbai	02-07-2015

99/373 as anti-osteoporotic (antiresorptive) compound, Centchroman (INN: Ormeloxifene,) for Breast cancer, Kaempferol for enhancing osteogenic action.	Akums Drugs & Pharmaceuticals Limited, New Delhi	06-08-2015
Evaluation of data for the DRL samples	Dr. Reddy's Laboratories Ltd., Hyderabad	27-08-2015
CSIR-CDRI Synthetic compound 80/574 as antidyslipidemic especially in dyslipidemia of diabetes.	USV Limited, Mumbai	15-10-2015
Evaluation of hit/lead/candidate drugs/molecules and utilizing the R&D facilities	Dr. Reddy's Institute of Life Sciences, Hyderabad	10-12-2015
Evaluation of data on CDRI candidates drugs S007-867,S002-333, S007-1235	Sun Pharma Advanced Research Company Ltd, Mumbai	15-12-2015
Ligand and structure-based virtual screening of designed and synthesized chemical library against DNMT1	TCG Life Sciences, West Bengal	18-01-2016
Synthesis of CDRI compound under cGMP conditions	TCG Life Sciences, West Bengal	13-04-2016

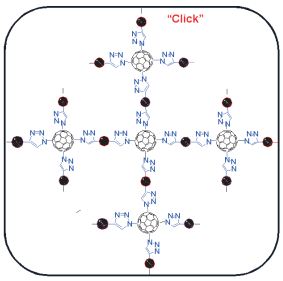
Four technologies Developed by CSIR-CIMAP namely pain relieving oil relaxomap, knowhow of isolation of artemesinin from *Artemisia annua*, low cost sanitary napkin and Khus Digger has been transferred to M/s U Toll Corporation Limited, Delhi, M/s T.A. Herbals, Mohali,Punjab M/s Pirincs Pharma, New Delhi, M/s BGP Healthcare Pvt. Ltd,Mehsana, Gujarat and M/s Govind Industries, Barabanki, respectively.

2 CHEMICAL SCIENCES

2.1 Contribution to Science

Fullerene Copolymer for Solar Cell Device Fabrication

CSIR-CLRI and CSIR-NCL have prepared fullerene-based copolymer by using "click" polymerization method. The material was successfully used as a component of bulk heterojunction solar cell device which showed modest power conversion efficiency.



Fullerene based copolymer

Origin of Voltage Decay in High-capacity Layered Oxide Electrodes

Lithium-ion battery technology, having the highest gravimetric and volumetric energy densities of commercialized batteries, has conquered the portable electronics market. Moreover, it is the battery of choice for powering electric vehicles while having great potential for grid energy storage. Success in the fields depends on the ability to further increase their energy density to ensure longer cruising autonomy for electric vehicle and lower cost (per kilowatt-hour) to compete with pumped hydroelectric storage for grid applications. To achieve such targets, CSIR-CECRI has been synthesizing of new Fe-based polyanionic compounds which improving the existing layered oxides. To understand of substituent's chemical–physical characteristics on the voltage which fade on cycling, the work was extended to the study of $Li_2Ru_{1-y}Ti_yO_3$. The $Ti^{4+}(d^0)$ substitution was selected owing to its zero crystal field splitting, similar to d^{10} Sn^{4+} , its smaller size (0.60 Å) and its presumed

ability to show accelerated cation migration for direct visualization of migration paths.

Bifunctional Electrocatalytic Activity of Boron-Doped Graphene Derived from Boron Carbide

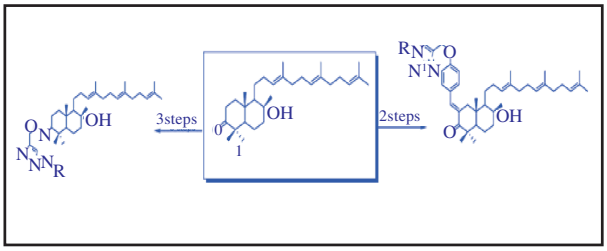
Research in the field of graphene science has advanced tremendously over the last decade. However, commercial preparation of graphene and related materials for electrocatalytic applications is delayed for dearth of feasible production techniques suitable for industrial upscaling. The bulk preparation of graphene doped with heteroatoms, such as boron (B), nitrogen (N), etc., still remains a challenge. In-plane doping (sp2) of graphene with B or N or both, has received remendous scientific attention owing to the possibilities of engineering the band gap and reactivity without altering the morphology or structure of pristine graphene. The bulk synthesis of BG and its separation from bulk B4C using a simple technique is developed by CSIR-CECRI. The BG thus obtained is microscopically and spectroscopically analyzed. A detailed electrochemical study, including rotating disc electrode measurements, was conducted to demonstrate the efficiency of the BG electrode. In addition, the laboratory has compared the BG electrode performance with benchmark catalysts such as Pt/C and bulk B4C. The study concludes by establishing the bifunctional catalytic nature of BG.

Patent Granted to CSIR-CSMCRI's Iodising Agent

CSIR- CSMCRI won a long-drawn patent battle that saw its novel iodising agent finding use in iodised salt finally being granted a patent. The patent application related to a novel process for the preparation of stable iodising agent, which can be effectively used in the formulation of iodised salt, wherein it offers stability to iodine. The CSIR had filed the patent application in June 2004. However, the patent was opposed by the Hindustan Lever Limited on the grounds that the process put forward by CSIR was not new so the patent should be cancelled. In 2013, the Indian Patents Office rejected CSIR's patent application. However, CSMCRI's inventors decided to pursue the matter further and approached the Intellectual Property Appellate Board (IPAB) in Chennai which has now upheld that the technology was "novel, inventive and non-obvious" so the patent can be granted. Iodine deficiency is a recognised disorder that can be corrected by salt iodisation. It has been part of health programmes of various international organisations focusing on health. CSMCRI's novel invention reduces the cost of purification of salt besides maintaining the iodising agent in the stable form.

Novel triazole Hybrids of Myrrhanone C, a Natural Polypodane Triterpene: Synthesis, cytotoxic activity and cell based studies

Myrrhanone , a natural bicyclic triterpene, has chemically modified and synthesized by CSIR-IICT. 27 novel triazole hybrids belonging to two different series were synthesized and evaluated for their cytotoxic potential against five human cancer cell lines. The synthesized compounds showed promising anticancer activity. The oxime based triazole with unsubstituted aryl ring found to be the most potent one exhibiting highest activity against almost all the cell lines used. It showed approximately two fold enhanced activity against lung cancer cell line (A-549) and ~2.5 fold enhanced activity against cervical cancer cell line (Hela). Flow cytometric analysis revealed that this compound arrested the cell cycle at G2/M phase and induced apoptosis.



Synthesis of triazole hybrids from myrrhanone

Identification of New Molecular Entities (NMEs) as Potential Leads against Tuberculosis from Open Source Compound Repository

Chemically diverse set of compounds are important for the drug discovery programmes in any disease. CSIR-IICT carried out phenotypic screening of the open-source compound library against *Mycobacterium smegmatis* and *Mycobacterium bovis* (BXG) with hit validation against M. *tuberculosis* (*H37Rv*) and have identified novel potent hit compounds. To determine their druglikeness, a systematic analysis of physicochemical properties of the hit compounds was performed using cheminformatics tools. The hit molecules were analysed by clustering based on their chemical finger prints and structural similarity determining their chemical diversity. The hit compound library was also filtered for druglikeness based on the physicochemical descriptors following Lipinski filters. The robust filtration of hits followed by secondary screening against BCG, *H37Rv* and cytotoxicity evaluation has identified 12 compounds with potential against *H37Rv* (MIC range 0.4 to 1â.5 ìM). Furthermore in cytotoxicity assays, 1â compounds displayed low cytotoxicity against liver and lung cells providing high therapeutic index > 50. The hits reported here are potential starting points for generation of new leads which eventually adds to drug discovery pipeline against tuberculosis.

An Eco-friendly Technology to Treat Water

CSIR- IICT has developed a technology to manufacture hydrazine hydrate, which is used in agrochemicals, pharmaceuticals and water treatment.. The process developed by CSIR-IICT is based on hydrogen peroxide, it reduces the adverse impact of pollutants on environment and living conditions.

Hydrazine hydrate is used in several industrial operations such as in certain organic pigments for dyes, as reagent for photography, anticorrosion additive in the water circuits of thermal and nuclear plants, oxygen scavenger in the water of industrial boilers and high pressure steam generators, refining of precious metals, recovery of metals from pickling and surface treatment solutions, and treatment of liquid and gas wastes.

CSIR-IIICT has even signed an agreement with GACL for development of hydrazine hydrate technology. GACL will shortly establish a commercial plant initially of 8,000 TPA of 80 per cent hydrazine hydrate based on IICT technology and detailed designs.

Technology Developed to Manufacture Hydrofluorocarbons

Faced with the reluctance of multinational companies in the US, UK, France, Japan and China to transfer the technology to manufacture hydrofluorocarbons to India, CSIR-IICT has now come up with a new technology to manufacture hydrofluorocarbons. The technology is ready to be transferred to the industry.

Chlorofluorocarbons earlier used in refrigeration systems as coolant were banned in 2005 because they were hugely contributing to the depletion of the ozone layer. In fact, the chemical was blamed as one of the causes for the depletion of the ozone layer up to 29 million square kilometers over the Antarctica – the ozone hole. As per the Montreal Protocol, of which India is a signatory, it was decided not to use Chlorofluorocarbons anymore. Hydrofluorocarbon emerged as a viable and effective alternative. However, western nations refused to part with the technology.

The technology has been transferred to two industries with one industry having already set up a manufacturing plant to producing 50 per cent of the country's requirement of refrigeration coolant.

India is Surging Ahead in R&D on Alternative Fuels, says Dr. Harsh Vardhan

Dr. Harsh Vardhan, Union Minister for Science and Technology, visited CSIR-IIP announced that the

Indian Railways would soon set up plants to manufacture diesel for mechanical traction with technology patented by CSIR-IIP and Gas Authority of India Limited (GAIL). In a unique scientific innovation, CSIR-IIP and GAIL have come with a technology that can convert 1 tonne of broken buckets, mugs, toothpaste tubes, bottle caps and other Polyolefin products into 850 litres of the cleanest grade of diesel. The development makes possible manufacture of diesel conforming to Euro-5 specifications in sulphur content.

The Minister elaborated: "We are the first to have this capability and henceforth plastic waste will be viewed more as a resource than a nuisance."

On his visit to the CSIR-IIP campus, Dr. Harsh Vardhan also inaugurated the Advanced Triblogy Research Centre.

Dr. Harsh Vardhan in another significant announcement said that another feather in CSIR-IIP's cap is the successful project to produce low-carbon jet fuel from the inedible, drought-resistant Jatropha plant. He said, "We have gone several steps ahead in developing alternative sources of jet fuel. Jatropha apart, CSIR-IIP has the knowledge to make jet fuel out of any non-edible oil – even the waste cooking oil from our kitchens is soon to become prized material in the market."

The Minister further said, "We must make a social movement out of alternative fuel use. Our cultural heritage has been one of the most environment friendly. Our villagers have used cowdung cakes as a fuel source for thousands of years. In recent decades we had been following the mad path of over-consumption. Now, thanks to our scientists we can revert to our original mindset of preservation."

While moving fast with alternative fuels, CSIR-IIP has continued with its founding mission of developing cleaner forms of fossil fuels. This has led to the development of a world class sweetening catalyst which helps to remove excessive foul

Dr. Harsh Vardhan visiting the CSIR-Indian Institute of Petroleum (IIP) campus in Dehradun

smelling mercaptans from LPG. "After capturing the Indian market, recently 600 kg of this new material hit the international market," Dr. Harsh Vardhan announced.

CSIR-IIP Develops Micro-Channel Reactors for Hydro-processing of Vegetable Oils

CSIR-IIP has developed micro-channel reactors to convert non-edible oil and biomass-derived oil (pyrolysis-oil), biomass-derived gases (syn-gas) and coal derived gasses (Coal gasification to syn-gas) into second and third generation biofuel. These reactors greatly increase the product yield and conversion in hydro-processing of vegetable oils.

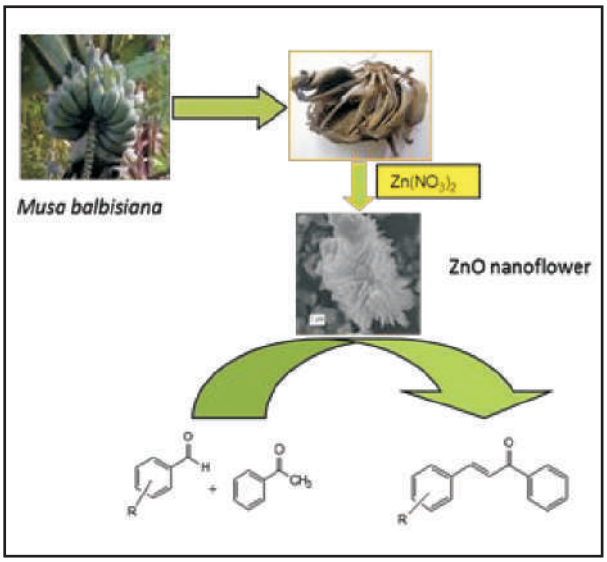
The micro-channel reactors find immediate applications as a tool to intensify the process at places where there is inadequate supply of raw material (biomass); where transportation of (feedstock) fossil fuels is a problem. All this is possible mainly due to excellent mixing, controlled reaction environment, and energy efficiency enabled by these micro-channel reactors.

The micro-channel reactors are better than the conventional (fixed bed tubular reactors) reactors in terms of: hydrodynamics and heat and mass transfer. Due to better hydrodynamics, the wall effect channeling etc. in micro-channel reactors is zero. Moreover, the high surface-to-volume ratio provides better heat control, which in turn ensures

proper product distribution. The catalyst used in a micro-channel reactor is either coated on the wall or packed inside the channel. The amount of material required for micro-channel reactor, the catalyst cost and the operating cost are far less than that in case of conventional reactors.

Bio-derived ZnO Nanoflower: a Highly Efficient catalyst for the synthesis of chalcone derivatives

Over the past several years, plants and other natural sources have come up as low cost, energy efficient, eco-friendly and non-toxic resources for the synthesis of nanomaterials. *Musa balbisiana* is a medicinal and economic plant from North East India. The peel of the fruit is a food additive and helps with normalizing digestive disorders of the stomach. It is widely used to produce soaps and detergents for washing clothes and shampooing hair.



Green, eco-friendly synthesis of ZnO nanoparticles using peel of Musa balbisiana and its utility as nanocatalyst in the synthesis of chalcone derivatives

CSIR-NEIST has succeeded in synthesizing ZnO nanoparticles with a green eco-friendly method using the peel of *Musa balbisiana*. ZnO nanoparticles were then characterized by XRD, XPS, FTIR, SEM, BET and TEM techniques. The SEM images indicate the formation of flower like morphology of ZnO. The flower-like morphology consists of petal-like small nanosheets. The formation of flower-like structure of nanoparticles may be due to synergic effect of ions like K^+, CO_3^{2-}, Na^+, Cl^- etc which are available in the biomaterial during synthesis of nanoparticles. So, it is a very simple eco-friendly method for synthesis of ZnO nanoflower using natural resources. This biomaterial can be used further for synthesis of other metal oxides without Green, eco-friendly synthesis of ZnO nanoparticles using peel of Musa balbisiana and its utility as using any hazardous chemicals. So, it is one of best source of natural alkali.

The prepared ZnO-nanocatalyst was then utilized for the synthesis of chalcone derivatives. The single step condensation of substituted aryl carbonyls is an attractive feature to obtain substituted chalcones by Claisen–Schmidt condensation reaction in 88–98% yields in less than 2 min under microwave irradiation in solvent free conditions. The significant yields and very short period of time are the novelty of our study on ZnO-nanocatalyst. The reusability of the ZnO catalyst in the condensation reaction has been tested. Very significant yield was obtained after use 5th cycle of the catalyst.

Shri Y.S. Chowdary, Hon'ble Minister of State, Ministry of Science & Technology and Earth Sciences, Visits CSIR-NEIST

Shri Y.S. Chowdary, Honorable Minister of State in the Ministry of Science & Technology and Earth Sciences, Government of India, visited CSIR-NEIST

The Hon'ble Minister accompanied by Shri Kamakhya Prasad Tasa, Hon'ble Member of Parliament, Jorhat visited the exhibition stalls and interacted with the beneficiaries and entrepreneurs of CSIR-NEIST technologies. He showed keen interest and satisfaction in the dissemination of small-scale technologies like Mushroom cultivation

& Banana fibre extraction and also medium-scale technologies like TP-16 Biofertilizer. The Hon'ble Minister also showed keenness on the impact of the Common Facility Centre in Mariani (Assam) for the local weavers to boost their skills and products with appropriate S&T intervention.

Addressing the staff, Shri Y.S. Chowdary, emphasized on a lab-to-land approach while mentioning the importance of commercialization and marketing aspects of technologies and products developed by the Institute. He urged all the scientists and everyone in general to contribute in addressing the problems of the country and work towards its growth & development. He appreciated the work carried out by the Institute during the last more than five decades and encouraged the staff to identify the gaps still present and take immediate remedial steps.

Shri Kamakhya P. Tasa, Hon'ble Member of Parliament, in his address spoke about the potentiality of the region in terms of its rich biodiversity and natural resources and urged the scientists and stakeholders to further explore and reach out to more people.

Later, during the open interaction, the Hon'ble Minister addressed the queries and issues raised by the beneficiaries and entrepreneurs such as fund for more cluster-wise projects for societal development, facilities for solar power systems for rural entrepreneurs, etc. He extended an open invitation to them to come to New Delhi and propose such projects for funding by the Government under suitable schemes/programmes.

Later, the Hon'ble Minister inaugurated an Essential Oil Distillation Plant (300 L/Day) and then had a look around the Experimental Farm area. To mark the visit, Hon'ble Minister and Hon'ble Member of Parliament also planted saplings of *Mesua ferrea* L. (Family: Clusiaceae, Common name: Iron wood tree) in the Experimental Farm.

Hon'ble Minister, Shri Y.S. Chowdary, addressing the gathering in the interactive program with beneficiaries & entrepreneurs

Hon'ble Minister, Shri Y.S. Chowdary, visiting the exhibition stalls along with Shri Kamakhya P. Tasa, Hon'ble Member of Parliament, Jorhat, Dr. D. Ramaiah, Director, CSIR-NEIST and other guests & officials.

2.2 Contribution to Economy/Society

Compost from Animal Hair

CSIR-CLRI has identified and isolated microorganisms for effective hair degradation. The keratinase produced by the micro-organism has also been characterized. Initial pot studies revealed that the compost brought about enhanced plant growth. Scale up studies on degradation of hair is carried out for production of compost at larger scale. An MoU has been signed with M/s National Agro Foundation for evaluating the compost at field level.

National Agro Foundation
TOWARDS RURAL PROSPERITY

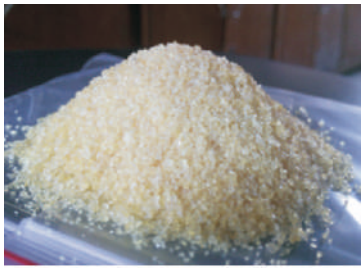
Compost from hair to enhance plant growth

Pharmaceutical Grade Gelatin from Waste

Scientist from CSIR-CLRI have developed a process for preparation of pharmaceutical grade gelatin from the raw trimmings and standardized at laboratory scale. Commercialization process has been initiated.


Scientists make gelatine from tannery waste

VALUE FROM WASTE



High Grade Gelatin on Reactor

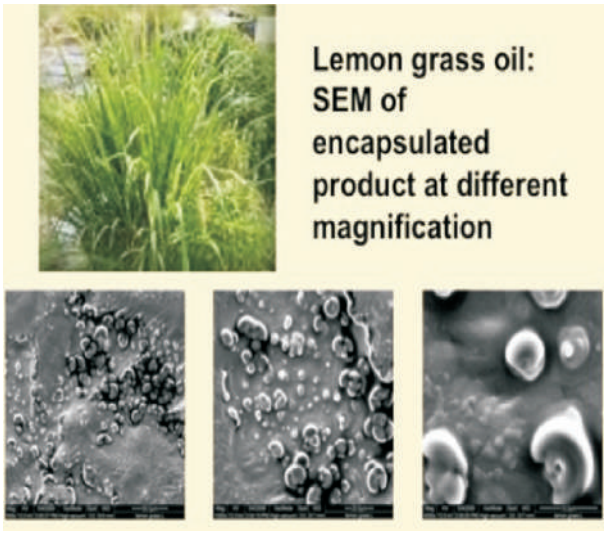
Super critical fluids for leather manufacture

CSIR-CLRI has developed super critical carbon dioxide based preservation technique for improving the storability of raw leather. Conventionally common salt is used for the preservation of hide and skin. The use of salt for preservation is a major contribution for the salinity in tannery wastewaters. Laboratory scale trials using Supercritical carbon dioxide ($SCCO_2$) had been carried out for preservation of skins as an alternative greener option wherein skins could be stored for upto 90 days.

Wet salted *$SCCO_2$+ acetone* *$SCCO_2$*
Curing of skin using $SCCO_2$

Scented Leather

CSIR-CLRI has developed scented leather through nanospheres of encapsulated scent oils. The laboratory has succeeded in encapsulating lemongrass oil in chitosan and acrylic acid producing smaller spheres with the diameter of 117 nm. In addition to that, the antimicrobial activity of the nanospheres was tested against bacteria and fungi.These nanospheres act as good delivery vehicles for the manufacture of fragranced leather and are expected to add economic value to the leather. These have significant potential for application in leather and textiles.



Lemon grass oil; SEM encapsulated product at different magnification

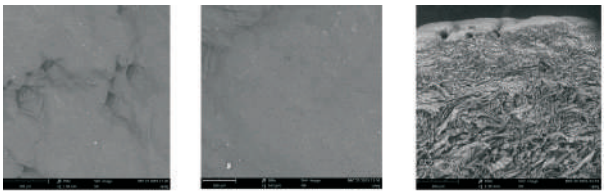
Dye from Green Fluorescent Protein (GFP)

CSIR-CLRI has developed a novel dye for leather using a green fluorescent protein (GFP) by genetic engineering approach. Specifically, two different charged variants GFP and GFPR were evaluated for the leather dyeing process. The GFP variants were

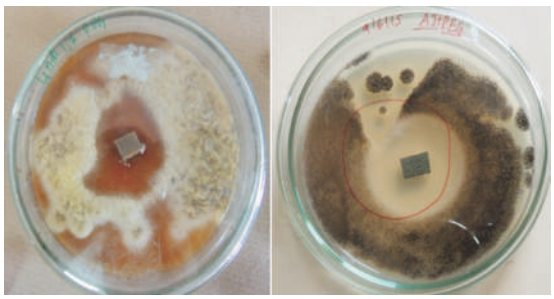
cloned using gene specific primers with restriction enzymes. These were successfully over expressed in *Escherichia coli* and purified. Results strongly suggest that GFP could serve as an environment friendly dye for leather thereby help in reducing reducing pollution load generated by the leather industry.

Development of Antifungal Fatliquors from unexplored oils

Fatliquors were developed by CSIR-CLRI from unexplored oils by adopting different chemical modification like sulphation, sulphonation and transesterification. The unusual antifungal activity present in the oil was retained even after the modification. The prepared fatliquor exhibited excellent antifungal activity. This can be used as retanning cum fatliquoring to overcome the problem associated with commercial fungicidal which are being added in most of the steps during leather processing.



Shows the Scanning Electron Microscopy image of leather treated with Fat liquor made from 10% trans esterified unexplored oil based emulsion. a) 300 µm b) 100 µm and c) cross section



Antifungal activity of fatliquor against two fungal species

Clarification of Emu Medical Oil

As part of societal welfare for farmer's community, Telangana & A.P., CSIR-IICT has developed appropriate methodology for clarification of Emu oil. Indigenous microporous hydrophobic ceramic tubular membrane has been employed to process crude Emu oil. The membrane exhibited improved performance in terms of reduction in color, turbidity, viscosity, chemical composition and free fatty acid (FFA) content and the final obtained permeate is as per American Emu Oil standards. A maximum flux of 14.81 L/m^2h is obtained when operating at feed pressure of 2 kg/cm^2. The ceramic membrane could be regenerated with methanol wash followed by heating at 80^oC in an oven for half an hour to restore flux and separation properties.

Glycerol-based SO_3H-Carbon Catalysts for Green Processes

CSIR-IICT has developed a sustainable method for the preparation of heterogeneous carbon-based soild acid catalyst with esterification activity from crude glycerol (by-product of biodiesel process)/ technical grade glycerol/ glycerol pitch (waste from fat splitting industry). The catalyst was employed for the production of biodiesel from high FFA containing non-edible oils & fats by replacing traditionally used homogeneous sulfuric acid, thus making the biodiesel process green and economically more profitable.

Stem Cells and Regenerative Medicine

To improve the transplantation efficiency of the stem cells in harsh wound microenvironment, CSIR-IICT has developed castor oil based polyethyleneglycol-polyurethane networks that are biocompatible with wide variety of cells as well as pH-sensitive and enzymatically biodegradable. Cellular penetrations of these porous polymer networks were evident by Akt/Erk-dependent increased expression and activation of selective MMPs. Oxidative stress-mediated cellular apoptosis

and decreased proliferation was abrogated by the presence of these polymer networks. Protection from oxidative stress and inflammation, enhanced engraftment of BMSCs at wound site with increased neo-vascularization accelerated wound repair process (~50% faster) as early as post-surgery day 7. Thus the study suggests that these polymers can serve as suitable cell delivery vehicle or scaffolds for tissue engineering in stem cell transplantation therapies

Antifouling, Anti corrosive Coating Composition for Ships/other Surfaces in Natural Sea Water

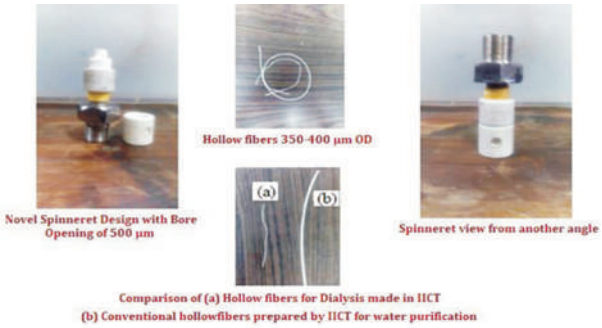
CSIR-CECRI has developed copper tannate based antifouling, anti corrosive coating composition for ships/other surfaces in natural sea water The copper tannate based marine antifouling coatings comprising, one primer coat, two under coats and one top coat resulting in three different four coat formulations with varying amount of biocides. The antifouling coatings can be used on ship hulls and other surfaces such as oil rig supports, sea installations, offshore structures and power station cooling inlets to prevent the settlement and growth of aquatic and marine organisms such as barnacles, oysters, mollusks and algae, generally by release of biocide from the coating matrix.

Process for Tissue Adhesive

Cyanoacrylates are a family of instant adhesives used for various house hold, stationary and industrial applications. Few homologues of this family are also used in medicine as tissue adhesives and sealants. Due to their rapid cure, ease of application and minimal toxicity, CSIR-IICT has pioneered in development of processes for these tissue adhesives in India and had transferred technologies for two cyanoacrylate homologues to industries like M/S. Nector Labs, Hyderabad, M/S. Endotech, Mumbai and M/S. Concord Drugs Ltd, Hyderabad. They are presently marketed with trade names like 'Endocryl' and 'Amcrylate' in India.

Low cost novel spinneret for Development of Ultrathin Hollow Fibers

More than 1 lakh people suffer with kidney failure problem each year. The primary causes of kidney failure are due to Diabetes, High blood pressure, Glomerulonephritis, cystic diseases and urologic diseases. Dialysis is one of the most commonly adopted processes for purifying blood of a person whose kidneys are not working normally. Conventional methods for producing dialysis grade hollow fibers using patented/custom made spinneret requires high capital cost. The Membrane Group has designed a low cost novel spinneret with outer bore opening of 500 ìm for developing hollow fibers for dialysis/haemodialysis.



Novel Technological Innovation to reduce the dimensions of hollow fibers to 1/5 the conventional size for application in Hemodialysis

The spinneret with detachable needle arrangement has been designed by CSIR-IICT for producing high quality hollow fibers for dialysis application is very cost effective. The uniqueness of this invention is that it is very easy to remove the material stuck inside the holes. A detachable needle arrangement is provided to vary the pore diameter of fiber.

Development of a Process for Vinylidene Fluoride (VDF)

VDF is an important monomer for preparation of valuable fluoropolymers such as PVDF and also several copolymers and ter polymers, which have

important applications in space, defence and aviation applications. Fluoroorganic division of CSIR-IICT has developed an efficient three step process for VDF at bench scale starting from readily available acetylene. This process is ready for transfer to Indian industries and the major beneficiaries are defence, space and aviation sectors.

Pheromone Application Technology (PAT) for Pest Management

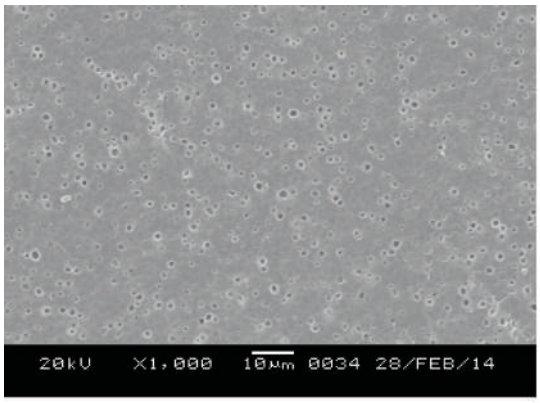
Utility of indigenously synthesized insect pheromones in pest management as an alternative to hazardous chemicals is a new perception in Indian farming community which will create avenues to the production of clean & green pesticide residue free agro produce with improved yields.

CSIR-IICT has successfully implemented PAT for the control of Yellow Stem borer in Rice; Brinjal Shoot & fruit Borer; and Leaf Miner in Groundnut

Implementation of environmentally safe PAT benefited nearly 200 small farm holders of rice, Brinjal & groundnut crops from ten villages of three districts of Telangana state.

Brushable / sprayable Thermal Barrier Silicone Paint

Brushable/Sprayable thermal barrier silicone paint system have received tremendous attention because of its unique advantages over other conventional technologies CSIR-CECRI developed Brushable/Sprayable Thermal Barrier Silicone Paint and its process thereof for systems operating upto 400°C. In the present invention, low thermal conductive silicone resin and thermally non-conductive or less conductive pigments are used to formulate thermal barrier paint which can withstand corrosion resistance upto 400oC with good thermal barrier properties.



SEM image of enantiomeric membrane developed

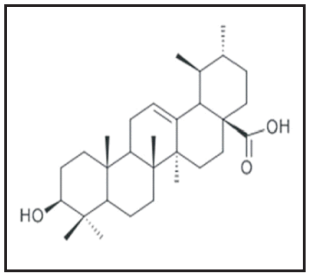
Membrane for Racemic Resolution of Drugs

CSIR-NEIST developed a membrane device from special proprietary chiral polymeric (CP) material for racemic resolution of drugs. The membrane achieved high enantioselectivity with some selected drugs and amino acids. This is a less energy intensive, eco-friendly, cost-effective, re-usable and stable polymeric membrane

***Calamus leptospadix* Griff: A high Saponin yielding plant with antimicrobial property**

CSIR-NEIST has identified *Calamus leptospadix* Griff an ethno-medically important plant yielding 9.5% of saponin, It can be a novel source for saponin production. The saponin is identified as ursolic acid (3-beta-3-hydroxy-urs-12-ene-28-oic-acid) type triterpenoid saponin, which possesses antibacterial and antifungal activity.

Calamus leptospadix



Structure of triterpenoid

Dispersible Deodorant and Freshener

CSIR-NEIST has developed Dispersible deodorant useful for cleaning the floor, tiles & also can be used as deodorant, freshener & mosquito repellent. The

Solid dispersible deodorant and freshener

manufacturing process of the deodorant is simple and eco friendly.

Infrared Reflecting Blue Pigment for Indoor Heat Reduction and Energy saving Applications

A Blue pigment is designed and synthesized by CSIR-NIIST for cool-paints and cool-roofs. The process is patented in India and abroad. This product is an alternative to toxic cobalt blue. It reflects 77% IR energy in the sunlight thereby reducing the heat within the range of 5-7^{0}C. This property facilitates lesser dependency on air conditioners thereby reducing the energy costs considerably. The pigment is compatible for paint coatings, polymer and metal roofs.

An Improved Anaerobic Digester for Household Organic Wastes

The compact digester developed by CSIR-NIIST, which is capable of stabilizing household biomass wastes on the site and without any further pollution. In the compact anaerobic system, biomass wastes are converted to compost slurry having higher content of stable solids while producing methane rich biogas. The stabilized compost slurry from this biogas plant is an excellent ready to use soil manure with for agriculture applications. The plant is easy to operate with no requirement for skilled labour.

2.3 S&T Services & Facilities

Facilitating new Venture

FLAIRMEN™ is the brand which is selling its exclusive range of leather products for men through leading e-portals such as Amazon, Flipkart etc. Mr. Harshal D. Pawar, the owner of the company approached CSIR-CLRI for training on different aspects of leather goods making. CSIR-CLRI provided "e-learning course on design and making of leather goods".

Fermentation Upscaling Facility

The fermentation upscaling facility at 500 L scale at CSIR-CLRI was commissioned in 2008. The objective of the facility was to upscale the enzyme products that had been earlier developed. The supply, installation and maintenance of the plant and machinery were executed by the local fermenter manufacturer M/s. Scigenics India ltd., Chennai. Fermenters include 5, 10, 50 and 500 L capacity. Downstream processing systems include continuous centrifuge, filter-press, micro / ultrafiltration, mini spray dryer, precipitation tank, mixing vessels, etc. A small laboratory for pre-fermentation and analytical tasks, help monitor performance of the various unit operations. The plant is supported by its own boiler, chilled water, oil-free compressed air and back-up power systems

Fermentation Upscaling Facility

The facility is used by many Indian Companies including Goderj Agro Foods, ABL Biotechnologies, EID Parry etc.

Centre for Biofuels-Bioethanol Pilot Plant

The Centre for Biofuels (CBF) is actively involved in research on developing alternative renewable transportation fuels, and more precisely second generation bioethanol. A 100 kg biomass /day capacity pilot plant for ethanol production from lignocellulosic biomass including agro-residues and forestry by has been set up in the CSIR-NIIST campus. The plant started full operations in 2013 and is currently used routinely for various studies on various aspects on biomass conversion to energy, and predominantly biomass pretreatment and hydrolysis. Apart from that research is being carried out in the areas of enzyme technologies, organism development and overall process integration to achieve better process economics. In addition CSIR-NIIST has set up primary databases on biomass availability in India and has initiated work on compositional characterization and variability of potent Indian feedstock. The CBF Pilot Plant is a national facility where R & D related to Biomass Conversion can be performed.

3 ENGINEERING SCIENCES

3.1 Contribution to Science

Thermo Responsive & Magnetic Shape Memory Materials and Devices for Engineering Applications

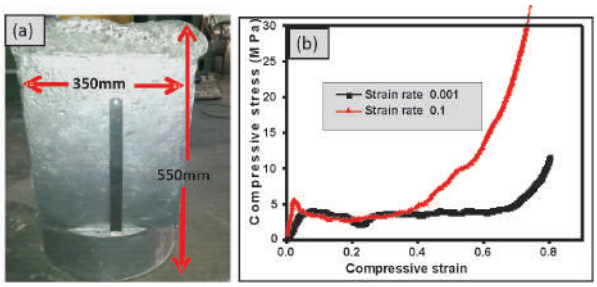
CSIR-AMPRI has developed demonstrative Cu and NiTi based alloy shape memory materials in the form of wire, coil, plate and slab. Pioneering work is being done in areas like SMA foam, Ni-Ti SMAs through SHS and SMPolymer composites which is being carried out for the first time even on a worldwide level. The following have been achieved:

- Optimized alloys composition and heat treatment cycles to maximize the Shape Memory Effect and thermal stability with high transition temperatures of Cu-based Shape Memory Alloys through liquid and powder metallurgy routes
- Nanostructured NiTi based Shape memory alloy by P/M route
- Data bank on information pertaining to newer versions of shape memory materials
- Demonstrative foams with shape memory effect
- Improved recovery stress, higher conductivity and switching efficiency of Shape Memory Polymers by reinforcing them uniformly with Carbon Nano Tube (CNT)/nano particles
- Prototype development of actuators for automobile like door and dickey locks, using commercially available shape memory wires. This is to be extended by using shape memory materials made at the Institute from the above research.

Rolled specimens compared with unrolled specimen through LM route

Novel Energy Effective Metallic Materials for Engineering Applications including Cellular Materials

CSIR-AMPRI has developed aluminium Metallic Foam in bulk quantity (35 kg/heat) through liquid

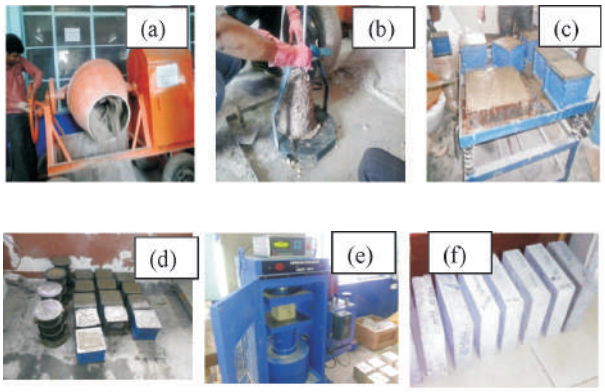


(a) Big foam casting and (b) Compressive stress strain diagram

metal processing route by using SiC as thickening agent and TiH_2 or CaH_2 as foaming agents. The foam has been made with almost uniform cell size and morphology. The density of the foam is within the range of 0.4 to 0.5 g/ cm^3 and the observed plateau stress is around 5-7 MPa.

Development of Advanced Non-Toxic Radiation Shielding Materials

CSIR-AMPRI, Bhopal has been working in the development of advanced non-toxic radiation shielding materials over a decade for different kind of radiations and has successfully developed shielding materials for X-ray, gamma ray and neutron radiation which are competitive on international level. The radiation shielding material developed by CSIR-AMPRI, Bhopal are accredited by AERB and included as list of materials for making diagnostic X-ray rooms. Board of Research in Nuclear Sciences (BRNS), Department of Atomic Energy (DAE) has actively supported the development of advanced non-toxic radiation shielding materials at CSIR-AMPRI, Bhopal by sponsoring successive research projects. Based on encouraging results on development and demonstration of advanced non-toxic radiation shielding materials developed at CSIR-AMPRI, Bhopal, a "Centre for Advanced Radiation Shielding Materials" has been sanctioned by DST and supported by CSIR for up-scaling of the technology. Dr. Girish Sahni, DG-CSIR has laid the foundation stone for the centre in the presence of Dr. S. Das, Director, CSIR-AMPRI and Dr. Debanik Roy, Chief Program Officer, BRNS at CSIR-AMPRI campus.



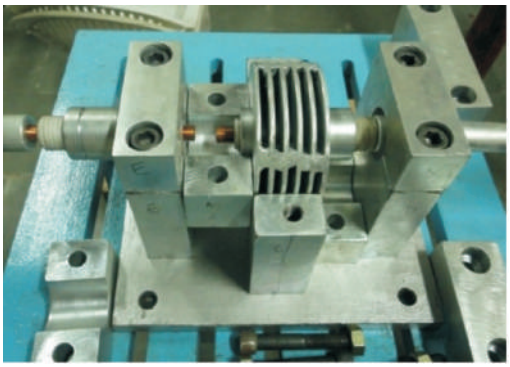
Development of the design mix of synthetic shielding aggregate based irradiation shielding concrete, (a)concrete mixer (b) slump cone test (c) vibration table (d) concrete cubes (e)compression test (f) radiation shielding samples

Advanced Hybrid Green Composites

CSIR- AMPRI, has developed process know-how in making hybrid composites and optimised the parameters for large scale recycling and value addition of different industrial wastes such as fly ash, bauxite residues, marble wastes, jarosite wastes, GRP wastes and other mineral wastes. The composites exhibits a tensile strength and tensile modulus 30.45 ± 3.52 MPa and 4.7 ± 0.0476GPa respectively with lower tensile elongation 0.7 ± 0.0912% using about 50% coal ash with epoxy resin. The developed composites are (i) Stronger than wood and plastic, (ii) Durable, (iii) Fire self-extinguishing nature, (iv) More cost effective and maintenance free. This composite can be used for doors, ceilings, flooring, roofing, partitions, and furniture as an alternative to wood, plastic and GRP products in building construction, and transport systems.

Advanced Processing techniques for Designing and Fabricating of Engineering Components

CSIR-AMPRI under took a study on formability of an Al alloy and its various aspects in Electrohydraulic forming (EHF). Basic formability and parametric study of the high strain rate forming using Electrohydraulic forming (with 5 KJ machine) has



Die tooling for metallic bellow

been carried and compared with conventional forming. The results indicate huge potential of the technology for various industrial products including tubular products like metallic bellow. A new 40 KJ facility is being commissioned to design and develop various types of industrial products using EMF and EHF technique.

Glass Façade Cleaning Robot

a. Uniform Dirt distribution and dirt detection test for sensor development

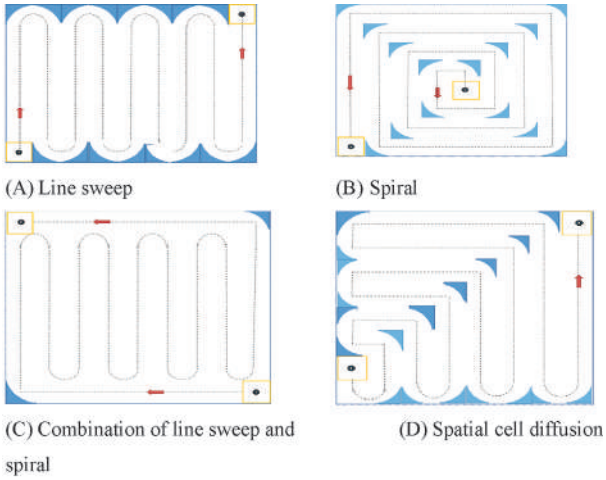
Experiments have been carried out by CSIR-CBRI to devise a methodology for detecting dirt using IR Photo diode (PD) and LED, to be incorporated within the cleaning mechanism of glass façade cleaning robot.

Experimental set-up using trapezoidal chamber with four small exhaust type fans powered by DC supply for dust circulation has been developed for the uniform dirt distribution over the glass samples.

b. Testing of path planning of robot for cleaning within a specified area

A four wheeled mobile robot with three degrees of freedom (DOF) was designed and fabricated by CSIR-CBRI for path planning purpose. The locomotion control of the robot using differential drive mechanism has been implemented. The robot can perform various motions such as forward, backward, spin and turn using these control strategies. The robot has length 337 mm and width 360 mm with a ground clearance of 20 mm. The wheels have a diameter of 105 mm and width 25 mm. Two front wheels are connected with individual DC geared motor, and the two rear wheels are ideal for free rotation provided by pillow block bearing support system with the robot frame. The robot traces its path on the floor using a sketch pen arrangement on the four corners, allowing verification of the coverage area experimentally.

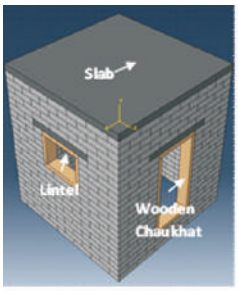
Coverage efficiency was calculated theoretically for various planned paths such as spiral pattern, line-sweep, their combination and spatial cell diffusion using the relation (Covered area- Repeated area)/ Total area. In this calculation repetition/overlap is not considered. It was observed that maximum coverage was achieved in the case of combination path, however, at an expense of repeated coverage.



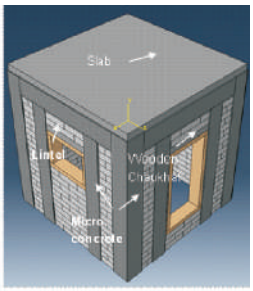
Covered and uncovered areas by wheeled mobile robot for various planned path

Innovative external binding strengthening technique for elastic behavior of stone masonry structure

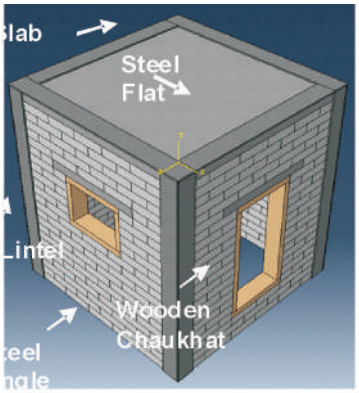
The CSIR-CBRI study presents analyses of eight finite element models using ABAQUS out of which NS represents masonry house with No Strengthening,



Un-strengthened model NS



Existing external binding



Innovative external binding scheme model DNS-EB

ES-EB represents masonry house strengthened using existing external binding technique, DNS-EB (O1-O6) represent masonry house strengthened using innovative external binding out of which the most promising DNS-EB (O6) is shown and hereinafter referred as **DNS-EB**.

Natural Marine Sponge Skeleton as a Bone Mimicking Biomaterial: A Trans-disciplinary R&D

CSIR-CGCRI has identified and characterized natural sponges from sea as potential bioscaffolds stand alone in combination with Insulin Like Growth Factor-1 (IGF-1) and Bone Morphogenetic Protein-2 (BMP-2) on the *in vivo* bone healing performance in rabbit model. These natural marine sponges harvested from a beach in Goa were found to be promising materials for bone repair and augmentations both individually and in combination with growth factors. The IGF-1 impregnated converted sponge scaffold promoted excellent osseous tissue formation followed by the one with the BMP-2 loaded and the stand alone.

This multi-institutional research has been carried out in collaboration with CSIR-NIO, Goa, IIT-Guwahati and West Bengal University of Animal and Fishery Sciences, Kolkata

Constructed Wet Land developed by CSIR-IMMT Inaugurated in CRPF, Bhubaneswar

Constructed wetlands are a sustainable wastewater treatment process for mildly polluted wastewater like sewage. It is one of the technologies that can be highly appropriate for the Indian situation and has the potential of replacing costly conventional treatment plants. Based on wastewater flow regime, subsurface flow constructed wetlands have emerged as efficient and suitable choice for sewage treatment.

An experienced research group at the CSIR-IMMT is active in this field and running a subsurface flow constructed wetlands for treating combined municipal and canteen wastewater for their premises in Bhubaneswar. The above said constructed wetlands are perfect examples of passive treatment which does not require any mechanical and electrical machineries and chemical dosing for treatment of wastewater. This

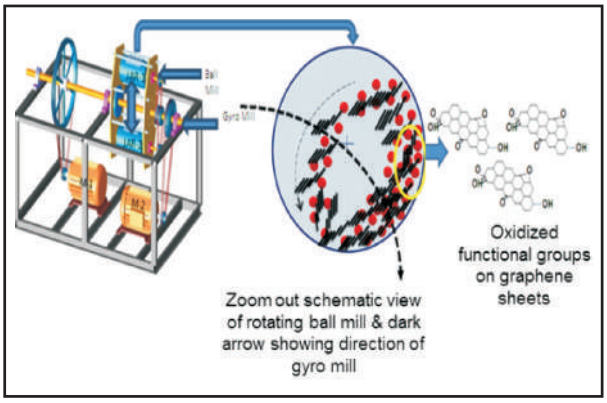
DG CRPF, inaugurated the constructed wetland designed by IMMT inside CRPF campus Bhubaneswar

characteristic of constructed wetlands makes it very appropriate for wastewater treatment in the Indian context.

CSIR-IMMT has constructed a pilot-scale constructed wetland in CRPF Bhubaneswar campus. It took more than a month to construct it. On 18th June 2015, DG CRPF inaugurated the constructed wetland facility and agreed to propagate the same in other CRPF campuses. This is the first successful attempt by CSIR-IMMT under the Swachh Bharat Programme.

Development of pilot scale facility for production of graphene from natural graphite

CSIR-IMMT in collaboration with Tata Steel developed a process for the production of graphene from natural graphite. A cost effective process has been developed for the production of graphene oxide in dry method using dual drive planetary ball mill. Current scale up project has been taken up to validate the process in large scale and also to study the commercial viability of the process further. Oxygen and hydrogen gas injection has been introduced in ball mill during operation for direct oxidation and reduction.



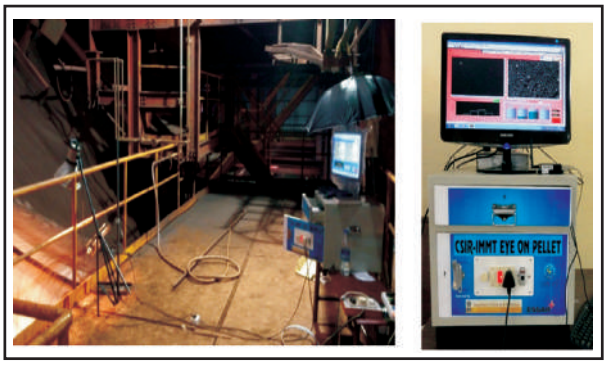
Schematic diagram for preparation of graphene oxide in a laboratory designed ball mill

Processing of natural gemstones

CSIR-IMMT has carried out detailed characterization of garnet and emerald gemstone samples collected from Bolangir and Mayurbhanj districts of Odisha indicated that garnets are present in the high grade metamorphic rocks such as basic granulites and amphibolites. Predominance of almandine end member indicated that the garnets must have been formed in amphibolite facies metamorphism of argillaceous rocks and the temperature of metamorphism may be around 700°C. Inclusions of rutile and ilmenite indicated presence of appreciable amount of Ti and Fe in the parent rocks.

Online pellet size monitoring system

While there is increasing demand of steel day-by-day, the scarcity of high grade and lumpy iron ores made pelletization an important root for steel making. In addition to Indian market, there is a high demand of good quality pellets in international markets. Pelletization process enhances the value of low grade iron ores and fines and makes them usable.



Industrial setup of Eye-on-Pellet

CSIR-IMMT has developed a system named as "EYE-ON-PELLET" which is an online image processing system where the use of one or multiple cameras are fitted to a processing system to view and process the real-time images of pellets for each disc pelletizer and generate the size distribution trend on a display panel. This size distribution trend is very useful for the operator to control the process parameters to maintain the desired size range and reduce recycling load. The system has been successfully field trialed at a number of industries in India and a patent related to this is filed in India.

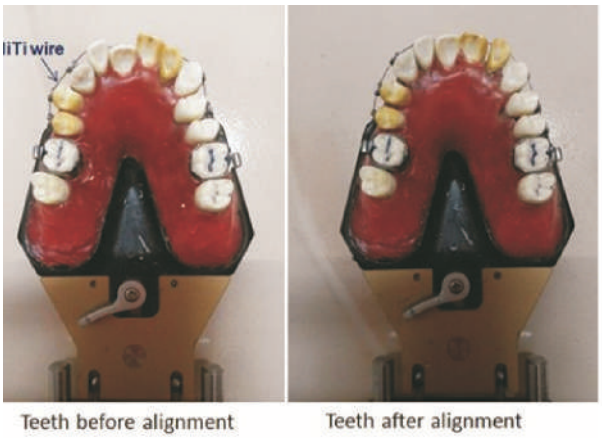
Metals from poly metallic nodule

CSIR-IMMT is a long time significant contributor to this multinational programme coordinated in India by Ministry of Earth Sciences. Currently, IMMT is working on reductive sulphuric acid leaching route for processing of polymetallic nodules, alternative processing of polymetallic nodules for recovery of Cu, Ni, Co and Mn, development of process flow sheets for the treatment of solid wastes and liquid effluents and setting up of extractive metallurgy laboratory for the treatment of sea bed minerals and human resource development.

Organic reducing agents such as sucrose and glycerol have been used as the promising reducing agents in semi bench scale acid leaching studies for testing all the unit operations. As an alternative process, gaseous reduction followed by smelting route is being pursued to recover Cu, Ni and Co as alloy. Recovery of Mn and Fe from the slag is also attempted as marketable Fe-Si-Mn alloy. The process has been optimized for small scale production of alloy containing Cu, Ni, Co and Fe. The slag contained most of the manganese and silica values which will be further smelted for the production of FE-Mn or Fe-Mn-Si alloy. Solid and liquid wastes generated during processing of manganese nodules were being processed for the recovery of valuable metals and abating the environmental pollution.

Nickel-Titanium (NiTi) Shape Memory Alloys (SMAs)

CSIR-NAL has completed successfully development the technology development for production of NiTi shape memory alloys in 20-40 kg melt capacity in collaboration with HAL and MIDHANI. Continuing with the success, pseudo-elastic NiTi shape memory alloy (SMA) wires in the diameter range 0.2-0.5 mm with properties suitable for biomedical applications have been developed and fabricated. The functional response of the NiTi wires for orthodontic application has been demonstrated successfully

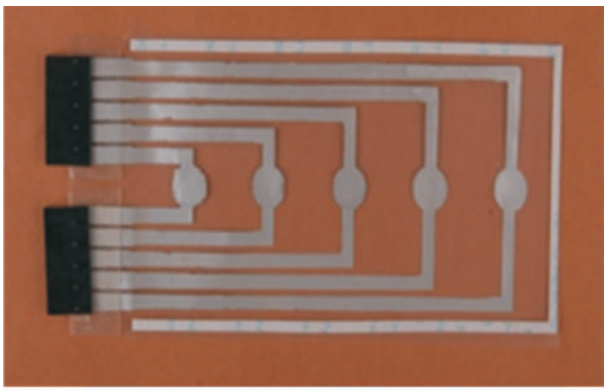


Mouth simulator test result showing the performance of the pseudo-elastic NiTi wires developed and fabricated at CSIR-NAL

using a mouth simulator. The result showed that the NiTi wires developed at CSIR-NAL has the required thermo-physical and functional properties for aligning the irregular teeth profile.

Development and characterization of PVDF film for surface pressure sensing

The piezoelectric properties of polyvinyliden efluoride PVDF are used to advantage to manufacture tactile sensor arrays, inexpensive strain gauges and lightweight audio transducers. At CSIR-NAL polyvinylidenefluoride (PVDF) sensors were designed, fabricated and tested for operational pressure range 0–5 bars. The



A PVDF array sensor used for measuring pressures simultaneously at multiple points on the airfoil

performance was compared with a commercially available pressure sensor and the results were found to be in good agreement. Further, PVDF sensors were tested on NACA 4415 airfoil in wind tunnel and variation in output peak voltage was measured for wind speed in the range 0-20 m/s. Figure shows a single PVDF strip with an array of sensors of active area of 10 mm diameter for mounting on the air foil. This morphology of the array was adopted for measuring pressures at multiple points on the surface of the airfoil simultaneously. This new low-cost PVDF film sensor finds application as surface pressure sensing element.

Weather Radomes – Installation of Radomes at Gopalpur, Odisha and Kochi, Kerala

As a part of a multi-organizational weather monitoring programme involving Indian Metrological Department, Department of Space, Bharat Electronics Ltd., CSIR-NAL has successfully completed the installation of DWR Mark II Radome

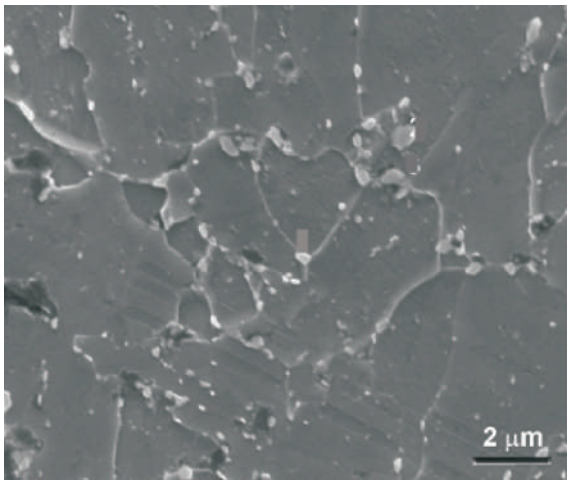
DWR Radome at Gopalpur, Odisha

DWR Radome at Kochi, Kerala

at Gopalpur seashore, near Chandipur, Odhisa in May 2015 and at Kochi, Kerala in December 2015. With the successful completion of these two installations, the DWR Mark II Radome indigenization program, that has a significant role in weather monitoring activities of IMD, has successfully met the objectives and culminated with dissemination of the technology to industry.

Damage Assessment through Non-destructive Evaluation

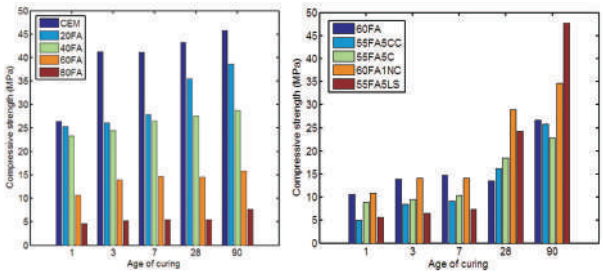
CSIR-NML has undertaken investigation of sensitization behaviour of austenitic stainless steel using magnetic techniques. To find the effect of sensitization on the magnetic properties of stainless steel. (SS304LN and SS304L with carbon content of 0.025%) and to explore the feasibility of using magnetic methods as NDE tool for sensitization study of stainless steel. Creep Damage Assessment of High Temperature Headers and Pipelines Using Multi Parameter Non-Destructive Examinations.



SEM–SE microstructure of creep exposed specimens of P91 at 650°C/ 100MPa for 504h and creep strain of 3.34

Development of nano-engineered concrete with high volume fly ash

In the recent times, utilization of industrial by-products with pozzolanic or hydraulic properties in cement/construction industries has increased considerably. An attempt by CSIR-SERC made to develop high volume fly ash (HVFA) concrete using locally available fly ash. With the high volume replacement of cement by fly ash, the reduction in hydraulic property has taken place and it can be compensated through suitable engineering. From the study carried out, it was found that by appropriate engineering of materials, it is possible to achieve the compressive strength (at 28 days) of



As-received *Engineered*

Compressive strength of fly ash incorporated and suitably engineered cement mortar at various ages

about 45 and 30 MPa even with the fly ash replacement of 40% and 60% in cement, respectively. As the target strength of 30 MPa is suitable for most of the structural engineering applications, concrete made with 60% replacement (which is many fold higher than the present perception) of fly ash can be used as a structural concrete in civil engineering applications. Similar strategies are also being formulated for high volume replacement of cement using other industrial by-products (with pozzolanic or hydraulic properties) by re-establishing the hydration process through required chemical interventions. The present study shows the promising results for further studies and scale-up.

Technology to Make Buildings Blast-proof

CSIR-SERC has developed a construction technology that promises to make buildings blast-proof. Called Laced Steel-Concrete Composite Technology (LSCC), the new technology incorporates prefabricated design, steel rods in a lace-like pattern filled with concrete providing enhanced strength and durability.

The new technology has been subjected to rigorous field trials, exposing it to high-intensity explosions. Apart from being cost-effective, the technology meets all security parameters. The technology is ideal for storage of explosives and chemicals in defence installations as well as buildings and installations considered vulnerable or of high importance.

Cheap, Durable Alternative to Wood & Bricks

CSIR-SERC has come up with an alternative to wood and bricks that is not only cheap but durable as well.The alternative is a steel mesh plastered with cement mortar. CSIR-SERC developed cupboards, roof rafters, water tanks and even toilets and bathrooms with the new technology replacing conventional bricks. While replacing bricks can cut costs by 30%, in the case of wood replacement the expenses can be brought down by 50%. The technology, however, requires skilled labour.

The technology can be used to make thin and lightweight panels and sections, which can be used in boats, window frames, and storage structures. The reinforcement or steel mesh can also be moulded into the desired shape allowing for offbeat architectural designs.

3.2 Contribution to Economy/Society

Development of Spatial Decision Support Systems (SDSS) and Hydrological Modelling for Assessment and Management of Nutrient and Pesticide Pollution Load as NPS pollution in Agricultural Watersheds

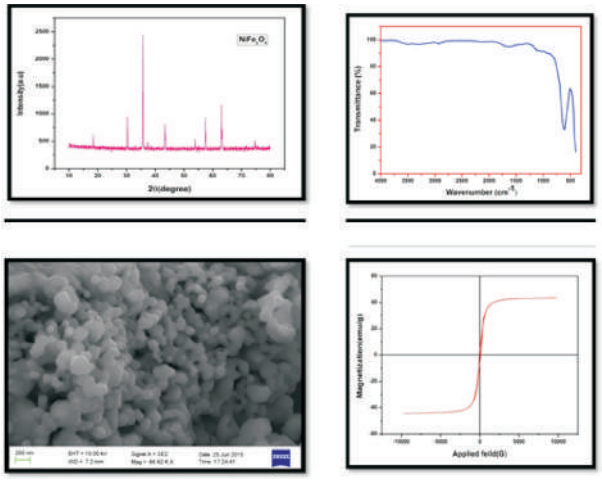
CSIR-AMPRI has undertaken various activities to develop SDSS model. The crops cultivated in the study area have been identified and acreage has been estimated through satellite data and quantity of fertilizers used for individual crops is assessed. Use of Pesticides, insecticides, fungicides, and weedicides has also been assessed. Water quality analysis has been done for TDS, PH, EC, Phosphate, Fluoride, Iron, Manganese, Chlorine, Sulfide, Chloride, Sulphate and Nitrate. Base map, contour map, Drainage map, Soil map, and land use/ land cover map have been prepared using satellite data and Geographical Information System.

Modeling of soil behaviour change due to ground water level variation for rural water resource management

Landsat-8 satellite Band 10 data was analysed by CSIR-AMPRI for temperature analysis and Land surface temperature maps have been prepared using ERDAS and Arc GIS software. Analysis of temperature has provided temperature of surface for every month which was correlated with atmospheric temperature and it was found that there is remarkable difference between atmospheric temperature and temperatures of different components of earth surface like agriculture land, settlement, forest etc.. Further, pre & post monsoon water level data, rainfall and temperature and required satellite imagery have been collected and analysed. Maps like land use/ land cover, NDVI, and lithology maps have been prepared from satellite imagery with the help of Arc GIS software.

Synthesis of nickel ferrite from waste materials

Iron ore tailings and spent catalysts are considered as waste materials and they are disposed off in large quantities by mineral processing and petroleum industries. CSIR-IMMT made an effort to synthesize valuable materials from these wastes. Iron is extracted out as iron chloride from its tailing and nickel is extracted as nickel sulfate solution from its spent catalyst. By adopting suitable chemical methods, nickel ferrite is obtained. XRD powder pattern shows presence of single phase nickel ferrite ($NiFe_2O_4$). FTIR spectrum indicates the existence of metal oxygen bond vibration. FE-SEM picture shows synthesized nickel ferrite has particles size of below 100 nm. The vibrating sample magnetometry study shows that it has high saturation magnetization of 40 emu/g with low coercivity.



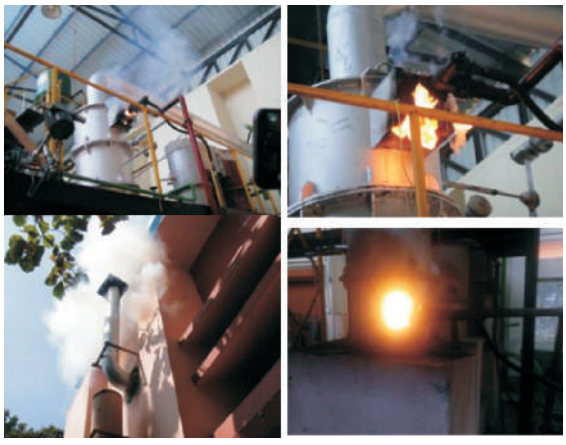
XRD pattern (top left), FTIR spectrum (top right), FE-SEM image (bottom left) and VSM curve (bottom right) of nickel ferrite from waste materials

Sustainable technologies for the utilization of rare earths

CSIR-IMMT has developed a process spent batteries such as Ni-MH for Rare earth element recovery. Under the optimized conditions about 100% Ni extraction with more than 95% REE extractions was been achieved. Rare earth precipitation with oxalic acid was carried out to separate rare earth elements in the leach liquor. In another study a hydrometallurgical process of selective recovery of samarium, and cobalt from scrap magnets involving sulfuric acid leaching in presence of ammonium oxalate was carried out. Recovery of samarium and cobalt as oxalate material with highly crystallinity was possible by applying selective acid mixture.

Energy recovery from wastes through advanced gasification system

CSIR-IMMT has completed Installation and commissioning of a 30 KWe entrained flow



Advanced gasification system

gasification system. Experimental campaign with the system was carried out using blended coal & dolochar (Size: < 150 µm) wastes in different weight ratio as feedstock material for gasification process. Initial phase of the experimental campaign with the prototype was conducted.

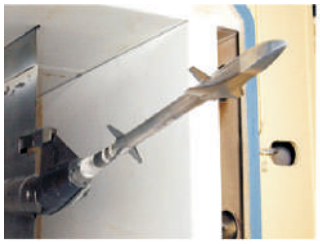
Successful Testing ISRO's RLV-TD Launch Vechile

CSIR- NAL was proud to associate with the successful launch of ISRO's Reusable Launch Vehicle – Technology Demonstrator (RLV-TD). CSIR-NAL has contributed significantly to the success of the programme. Acoustic tests on the RLV-TD were carried out at the Acoustic test Facility (ATF) of CSIR-NAL during April 2016. These tests were primarily to assess the integrity of the vehicle under acoustic loads during the lift-off phase and during the flight through the denser portions of the atmosphere. The ATF conducted a series of acoustic tests at different overall sound pressure levels in steps to determine the vehicle performance. The RLV-TD was "live" with all it's critical payloads active and operational during the acoustic tests. The vehicle health was continuously monitored with a vehicle checkout system, similar to that established at the launch pad. For the first time, vehicle telemetry systems were also "live" and telemetry data was transmitted in real time during the tests to the ISRO Master Control Facility (MCF) at Hassan, through a chain of RF links from the reverberation chamber at ATF , using one of the INSAT series of satellites. Almost 100 personnel, belonging to a number of units of ISRO participated in the test along with staff of ATF. The tests were completed successfully and analysis of all the data acquired during the acoustic tests indicated satisfactory performance of the vehicle.

CSIR-NAL led National Claw Team based on their vast experience in developing control laws for the TEJAS Aircraft programme assisted the design and development of RLV-TD Control Laws (especially for the descent phase when the flight re-enters the atmosphere) through detailed technical reviews.

RLV model used for unsteady pressure measurements at NAL's Wind Tunnel

RLV-TD positioned in the reverberation chamber for acoustic test



Ascent configuration of RLV

The team also assisted the VSSC designers in the design and review of the Flush Airdata System (FADS) algorithms, defining the flight test instrumentation for validating the Control Laws and Aero data base, and reviewing the Ironbird which was set up for testing RLV-TD control laws on ground prior to actual flight.

Textile Reinforced Concrete Median Barrier as Cost-Effective Life Saving Technology

Towards the design and development of textile reinforced concrete (TRC) median barrier, experimental investigations were carried out by CSIR-SERC for a high performance cementitious binder. Two types of alkali resistant glass textiles and one type of basalt textiles were investigated to find their suitability as reinforcement in TRC median barrier. It was noticed that the maximum impact force is almost doubled, when number of layers increased from 4 to 9.

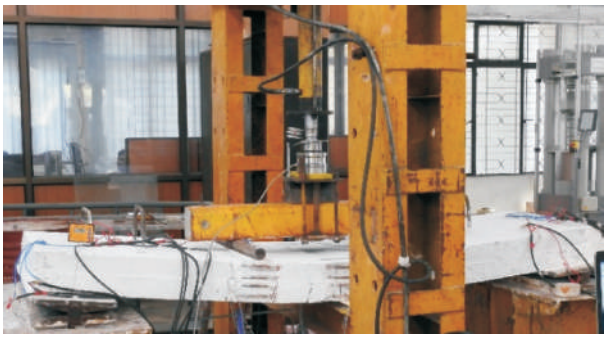
The product can be used by National Highway Authorities and State Highways. The pre-fabricated

Test set-up for flexural impact on TRC

textile reinforced concrete median barrier will have desirable mechanical properties namely, high impact resistance and deformability. Owing to these properties, it helps in preventing damage to the vehicle, and provides safety to the occupants from being injured. In consideration to the impact energy absorption, another advantage of the proposed median barriers is that, it is lighter in weight than conventional concrete. Therefore, their conveyance and handling become easier during the installation.

Segmental Composite Slabs for Bridge Decks

The testing of full slab of size 2.4mx3.4mx0.150m and half slab of size 0.8mx3.4mx0.075m each with shear connectors and also with provision for transverse connectivity to cover area of 2.4mx3.4m was carried out by CSIR-SERC under two point loading. It could be observed from the experiments that the full composite action of the segmental slab was achieved. Further, complete transverse connectivity could also be established. The shear connectors with 30, 45, 60, 90 degree and N-shaped, lattice and dual truss were used for



Testing one way composite slab under two point bending

connecting segmental slabs. Totally 9 specimens were tested. The efficiencies of the shear connectors were evaluated in terms of load carrying capacity of slab for area of shear connector crossing the shear plane.

In order to evaluate the shear capacity of the interface, Push-off tests were carried out on the slab specimens of size 0.8x1.0m with different types and spacing of shear connectors. Totally 12 specimens were tested and shear capacity of the specimens were evaluated. The precast technique and segmentalisation would be helpful to minimize total

Push-off testing of composite slab specimen

construction time, to reduce traffic diversion and to achieve sustainable environment.

Sustainable Construction Technologies for Societal Development: (CSIR 800 Program)

Sustainable construction technologies has been initiated as a CSIR-800 program which aims to

improve the quality of life with the help of developments in science and technology. Towards reviving a CSIR-SERC technology, shallow precast funicular shell for construction of floors and roofs has been taken up.

A novel ***semi pre-fabricated flooring system*** has been developed in this project. This system consists of I shaped precast concrete thin beams, shallow precast concrete funicular shells and screed. This technology reduces the cost of form work, plastering, onsite labour and construction time and make the flooring system affordable.

Shallow precast funicular shell technology for construction of floors and roofs has been revived and improved. Funicular shells of various thickness were cast and experimental studies on these shells have been conducted to assess its capacity. Shallow precast funicular shells square in plan and inner dimension of 1 m x 1 m were developed. Number of precast shallow funicular shells were cast for construction of a semi pre-fabricated flooring system.

I shaped thin precast concrete beam for supporting the shells has been designed. A specimen of I shaped thin beam has been cast and tested under two point loading for flexure to find out its structural adequacy.

Precast footing: For affordable housing precast foundation blocks designed for a typical three storey building have been developed for soil of nominal safe bearing capacity of 100 kN/m^2, in such a way that the width of the wall support can be varied from 230 mm to 375 mm.

Wall panel with skin-connector: A novel product called ***wall panel with skin-connector*** has been developed to produce lightweight sandwich wall panels. Prefabricated lightweight sandwich panels made up of infill materials sandwiched between two skin surfaces are used in buildings as infill wall panels. The connectors have been developed to resist the separation of the layers and provide structural stability. A patent has been filed. This can reduce the high cost of factory manufactured EPS panels.

Cement stabilized soil blocks have been developed with industrial waste materials such as fly ash, copper slag and GGBS as replacement material to cement. A simple technology has been developed to produce these blocks. The technology is suitable for application to the rural society as there is no burning of bricks, no steam curing or compacting machinery in this technology.

Monolithic Construction of building structure: With the availability of self-compacting concrete, a monolithic building structure is cast in a single pour. Ferrocement using self-compacting mortar is used for the shell roof and walls while self-compacting concrete is used for beams, columns and arch ribs. A scaled model of the system has been produced. The strength of the structure was achieved primarily due to its shape. Analysis and design of the structure has been carried out to arrive at a suitable section. Quality assessment of this monolithically constructed structure with thin structural elements has been carried out.

Technology for geopolymer concrete has also been studied. Effect of molarity of alkaline activators solution in geopolymer concrete was studied. Influence of addition of Ground Granulated Blast furnace Slag (GGBS) on strength of geopolymer concrete was investigated. Geopolymer mix formulations with compressive strength ranging from 10 to 60 MPa have been developed.

CalCar Brick: In this invention the brick was produced using industrial wastes such as calcium carbide waste, fly ash and lime stone waste or quarry dust using stabilization technique. The product has been tested for its suitability for construction purpose by conducting compression test and the results show adequate structural strength.

Development of appropriate technologies: Towards developing appropriate technology, bamboo fibers and fibers made out of waste plastic covers are added to concrete and the properties of concrete have been studied for suitable application. Development and testing of novel bamboo block with ferrocement skin has been carried out. Novel ferrocement wall panels with bracing rib as stiffeners have also been developed. Development of a ferrocement multipurpose channel with total replacement of fine and coarse aggregate with quarry waste has been carried out for rural application.

Evaluation of masonry buildings: Assessment of Un-Reinforced Brick Masonry (URBM) dwellings for seismic performance has been carried out. Simplified stress-strain model on mechanical characterization of brick masonry has been identified for soft and weak bricks.

Retrofitting strategies for masonry buildings: This technology was to provide grooves on the masonry interfacial surface and the confining concrete. This ensures proper load transfer and integral action for lateral loads. The confined masonry wall panel has increased the ultimate in-plane lateral load capacity and performed well compared to that of unreinforced masonry panel. Confined masonry structures are commonly adopted nowadays for residential buildings and this technique can be recommended as a useful construction practice.

3.3 S&T Services & Facilities

Fire Retardant &Water Repellent Canvas for the Protection of Make-Shift Structure

Most of the functions, public meetings are generally held inside the shamiyanas, pandals, temporary shelters and tents made of canvas. Canvas is a thick cotton fabric, which is generally used to fabricate the temporary shelter. The canvas cloth is generally used for erecting of tents and temporary shelters. Temporary shelter are erected in the open and directly exposed to the formidable weathering conditions. Canvas is chemically made of cellulose fibers that are flammable and ignite very rapidly and water can percolate through it very easily. Therefore, fire and water are the main problems of the temporary shelter made of canvas. Many fire incidents occur in temporary shelters made of cotton canvas every year all over the world which resulted into large number of casualties and loss of properties. CSIR-CBRI, Roorkee has developed a technology to render cotton canvas fire retardant and water repellent through surface coating. Coating was prepared by reacting fire retardant additives and plasticizers with co-polymers and organic hydrocarbon compounds.

The National Trisonic Aerodynamic Facility (NTAF)

CSIR-NAL using the 1.2m Trisonic wind tunnel. NTAF completed a total of 1650 blowdowns in the 1.2m and 0.6m wind tunnels. Major user of the facility was ISRO, the tests were mainly related to aerodynamic characterization of launch vehicle variants. For ADA, wind tunnel tests on an aircraft configuration were carried out to update the aero database at higher Mach numbers. It is gratifying that the difference in corrected drag data from the 1.2m wind tunnel matched within 2 counts of data in the transonic Mach number range from a bigger wind tunnel in USA. A novel technique for enhancing mass flow rates through aircraft air-intake models at subsonic Mach numbers was established in the 1.2m wind tunnel. One of the defective balances was successfully refurbished. Several challenging design tasks have been completed.

Failure Analysis and Accident Investigations

CSIR-NAL has carried out forty-nine investigations related to failures of aircraft structures and aero-engine components/systems involving incidents and accidents were carried out for various defence organizations like Indian Air Force, India Navy, HAL, ADA, DGCA etc of the country. The laboratory

contributed significantly in identifying the causes of failures and suggesting recommendations for prevention of similar failures in future. The recommendations suggested encompassed design modification, selection of appropriate material and fabrication methodology, maintenance and inspection schedule as applicable depending on the nature of failure.

New Facility on C-Scan Commissioned

The state of the art C scan system was successfully commissioned at CSIR-NAL. The system has the capability of using the conventional ultrasonic inspection for the regular inspection requirements and it has the advantage of using the most advanced ultrasonic phased array technique using immersion inspection for composite components. This advanced NDE technique has many advantages and also the inspection can be completed in 1/10 of the

Ultrasonic Computer controlled C-scan III system (10 axes).

time when compared with the conventional inspection technique. This is an upcoming inspection technology which is being introduced in many leading aerospace industries (Boeing, Airbus etc).

Seismic Performance tests on Steel Frame with Energy Absorbing Device

CSIR-SERC developed Buckling Restrained Braces (BRB) is a simple, economical, and efficient energy dissipation device for improved seismic

Performance evaluation of BRB

performance of steel structures. BRBs are a special type of bracing element with a unique feature that they do not buckle when loaded in compression. Therefore, BRBs are able to achieve ductile yielding in both tension and compression and thus are able to dissipate significant amount of energy. The BRBs essentially act as the "fuse" elements of the structure. Cyclic performance evaluation of two types of BRBs are performed. One is circular core and other is rectangular strip core BRB. Cyclic performance evaluation of circular core BRB is completed and BRB exhibited symmetrical hysteretic behaviour under both tensile and compressive forces. The study assured the sponsoring agency confidence on the satisfactory behaviour of BRB in the steel framed structures to be used for better seismic energy absorption.

New facility in (Tower Testing & Research Station) TTRS

State of the art, **40 channel Real-Time Digital Controller System (RTDCS-40)** installed in Tower Testing & Research Station (TTRS), Trisulam Campus, CSIR-SERC. Evaluation of structural strength and stability of ultra-high voltage multi

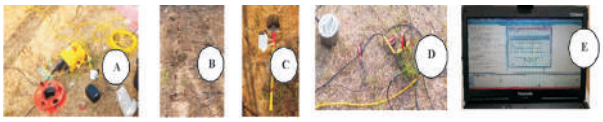
Channel Real-Time Digital Controller System in TTRS, CSIR-SERC

circuit transmission line towers made possible through implementation of RTDCS-40 for simultaneous load application in three mutual perpendicular directions, (horizontal, vertical and longitudinal directions) at 40 individual locations on the tower.

Some of the salient features of the RTDCS - 40 control system are: smooth application of loads through hydraulic actuators controlled through digital controller based on master/slave architecture, redundant master, monitors real time faults and triggers alarm, client and web display of applied loads, centralized hardware emergency stop to halt the application of load at any point of time during testing and online video streaming. Recently, TTRS has tested 230 kV Four Circuit Transmission Tower for Power Grid Company of Bangladesh with simultaneous application of 40 load points on the tower

48 Channel Seismograph

State of the art, 48 channel seismograph with accessories (4.5 Hz & 28 Hz vertical geophones and 2 Hz three component geophone) and software for data acquisition and processing (multiple geode operating data acquisition software, SeisImager/2D-standard refraction data processing software, SeisImager/SW-2D multi-channel surface wave data processing software and Seisimager-Passive microtremor and H/V analysis software) is installed in CSIR- SERC.



Geode (seismograph) with accessories, B- Geophones connected to spread cable in the field, C- 7.6 kg hammer with aluminum plate, D- 3D geophone connected to spread cable, E- Data acquisition software in laptop

One and two dimensional primary wave and shear wave velocity characteristics of any given site can be determined by the 48 channel seismograph having spread cable length of 240 m. The passive and active MASW surveys can aid quantification of average shear wave velocity of top 30 m (V_{s30}), which will be useful for site classification and development of design response spectra using International Building Code procedure. With the use of seismograph, site frequencies and amplification of the sites can be estimated, and also development of microzonation maps of cities based on V_{s30} amplification and site frequencies is possible. With the use of existing probabilistic seismic hazard maps, seismic hazard microzonation maps of cities can be developed

4 INFORMATION SCIENCES

4.1 Contribution to Science

Indian S&T and Innovation Policy (ISTIP)

CSIR-NISTADS studied under Indian S&T and Innovation Policy (ISTIP) project provided evidence based analysis of the nature and extent of research and innovation need and capability of the country. It examines in-depth the demand and supply driven policies for S&T and its impact on industry and rural development. The studies drew attention to suitable S&T interventions in policy making for India to reach the forefront of technology frontier and translational models that can exploit knowledge capacities. The informed policy advocacy was based on creating and collating long term data on various facets of science and technology capacity and capability in the country. S&T manpower of the

country is mapped to show the gaps at different levels that have to be addressed including skills that need to be imparted. Science and technology matrices highlight scientific performance and impact of the development and deployment of new and emerging technologies. Creating opportunities for rural India through augmenting S&T skills and employment potential in an important component of this project. Other key issues addressed are on creating capacities for MSME and green technologies.

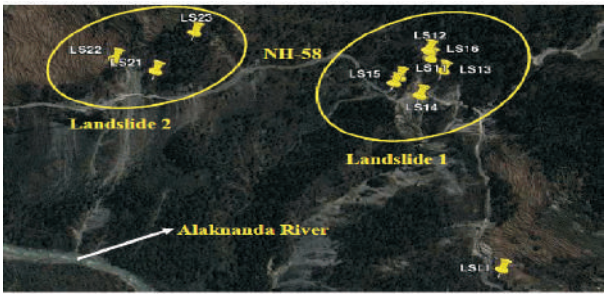
Flask measurements of greenhouse gases at Hanle, Pondicherry and Port Blair

Five years of flask measurements have been completed by CSIR-4PI conforming to WMO-standards, of carbon dioxide, methane, carbon monoxide, nitrous oxide, sulphur hexafluoride, and hydrogen from clean background sites, Hanle (32.78 °N, 78.96 °E, 4517 m a.s.l., HLE), Pondicherry (12.01 °N, 79.86 °E, 20 m a.s.l, PON) and Port Blair (11.65 °N, 92.76 °E, 20 m a.s.l., PBL).

The annual mean CO_2 gradient between PON and HLE reflects altitudinal difference of the two stations, and larger influence of CO_2 emissions at PON, mostly from South India. Seasonal cycles at PON and PBL reflecting the effect of monsoon circulation was clearly seen. At HLE, annual mean CH_4 increased from 1814.8±2.9 to 1849.5±5.2 ppb between 2007 and 2011. The multi year mean CH_4 value at HLE was lower than at KZM and WLG by on average 25.7±3.1 and 19.6±7.8 ppb.The seasonal cycle in methane is more pronounced in Pondicherry and Port Blair due to agriculture and biomass burning than at Hanle which is in a cold desert.

Landslide Studies Using Global Positioning System

For the first time in India, landslide deformation was monitored using in-situ GPS measurements by CSIR-4PI. Two active landslides in seismically active Gharwal Himalayas of Uttarakhand region, located in Pipalkoti on national highway from Chamoli to Badrinath along the river Alaknanda were selected for this study. Results indicate active deformation of 2 to 5 cm across different sections of the two landslides. It can be concluded that monitoring landslides with very high accuracy can be achieved using GPS.



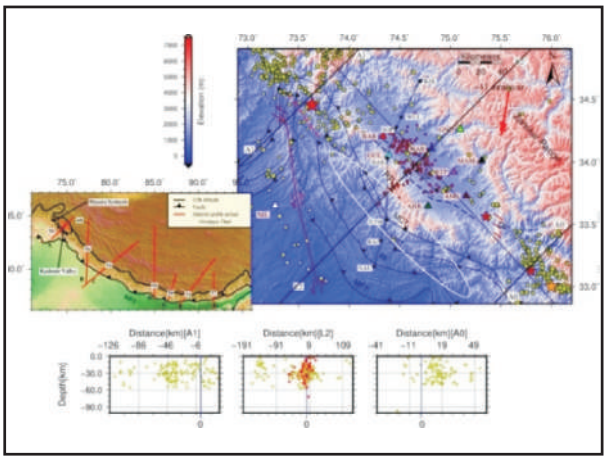
Landslides with GPS control points and reference base station (LSLI)

This study for the first time used GPS measurements for monitoring an active landslide and the results gave precise Inter and Intra landslide motion. Integration of GPS derived displacements and strain rates with other geo-technical and geological data collected from the landslide would provide significant insights into the dynamics of landslides and also can be used to develop realistic landslide deformation models.

Crustal structure beneath the Kashmir Basin adjoining the Western Himalayan Syntaxis

The first crustal shear velocity model of the intermontane Kashmir Valley longitudinally carved within the northwestern Great Himalaya barely 70 km to the southeast of the Hazara syntaxis is presented. Its existence in the complex stress field of the orogen fashioned by simultaneous compression both along and across it signals differences in the mode of deformation near the syntaxial bend compared with those in the central parts of the Himalaya with possible proxies in the crustal structure of the region. This is the first time

CSIR 4PI established the broadband seismic network in Kashmir Himalayas. The motivation for the present work arose from the desirability of imaging the crustal structure of the great Himalaya closest to its western syntaxis and comparing it with that of the region to its east and the more central parts of the Himalaya as new insight into understanding of crustal structure beneath Kashmir Himalayas. Also, the potentially higher resolution mapping of the regional seismicity, which the local network will make possible, was expected to delineate the high strain zones in the region and constrain the limits of the locked zone whose width together with the rate of convergence yields a measure of its hazard potential



The lower left inset shows the location of the Kashmir Valley longitudinally formed in the Pir Panjal range of the great Himalaya adjoining the Hazara syntaxial bend . Red lines across the range, mark the various

4.2 Contribution to Economy/Society

Database Management and support facility Development for INSPIRE Programme

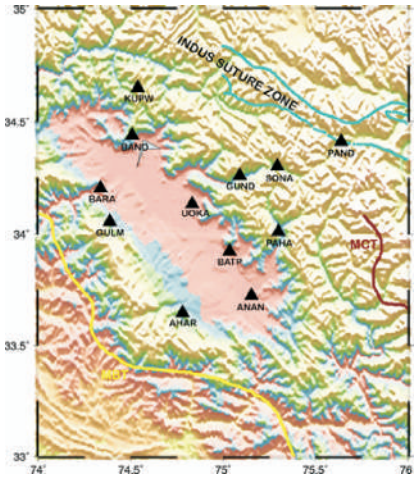
Innovation in Science Pursuit for Inspired Research (INSPIRE), of the Department of Science & Technology (DST) - comprises three major components viz., Scheme for Early Attraction of Talent for Science(SEATS), Scholarship for Higher Education (SHE), and Assured Opportunities for Research Carriers (AORC). INSPIRE, right from its inception has been undertaken by CSIR-NISTADS since the session 2007–2008. In CSIR-NISTADS the INSPIRE team screens and evaluates the applications of students from about 30 education boards all over India. Till date more than 25000 high grade students have been selected.

4.3 S&T Services & Facilities

The fourth GHG (greenhouse gas) station is being installed by CSIR-4PI near Bangalore in the IIA campus in Hosakote for continuous measurement of CO_2, CH_4, N_2O and CO. This station is also equipped with the primary standards of gases for calibration of the instruments as prescribed by WMO for precise measurements of GHGs. This can be treated as a reference station for all the GHG stations making precise measurements of GHGs presently in India. GNSS Kashmir Observation

Himalaya

Greenhouse gas station



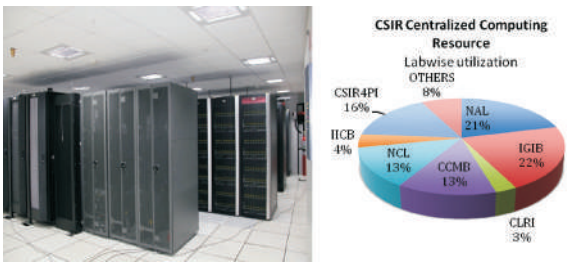
GNSS observation network in Kashmir

Network consisting of 12 continuous stations which run 24 X 7, 365 days has been setup. This network is aimed to give the arc-normal deformation rates across the Kashmir Valley which is seismically active. This network will yield stress and strain accumulation rates in this region which is a crucial input to seismic vulnerability assessment of this region.

High Performance Computing @ CSIR4PI

The centralized High Performance Computing facility located at CSIR 4PI is the main lifeline of the 200 and odd computational scientists across CSIR. The supercomputer is having a peak computing power of 360TF and a sustained computing capability of 334 TF on a High Performance LINPACK (HPL). The have clocked about 86% of average utilization during 2015-16 and an uptime of more than 99%.

Each node in the system is a HP Blade server, with two Intel Xeon E-5 2670 (8 cores, Sandy bridge) processors. There are 1088 such computing nodes distributed over 17 numbers of 42U 600mm width racks, resulting in 2176 physical processors and 17408 processing cores. Memory per core is one of the important aspects of the system. The nodes are designed with 4GB memory per core, which results in of about 68TB of distributed memory in the over all system. However, the 48GB memory can be used for shared memory parallel applications inside a single node. Figure shows the utilization of the computing system in percentage by the CSIR laboratories for the period 1st April 2015 to 31st March 2016. Small percentages of utilizations have been clubbed together into the "others" category



(a) CSIR centralized 360TF High Performance Computing Facility. (b) Laboratory wise utilization of the system in % for the year 2015-16

5 PHYSICAL SCIENCES

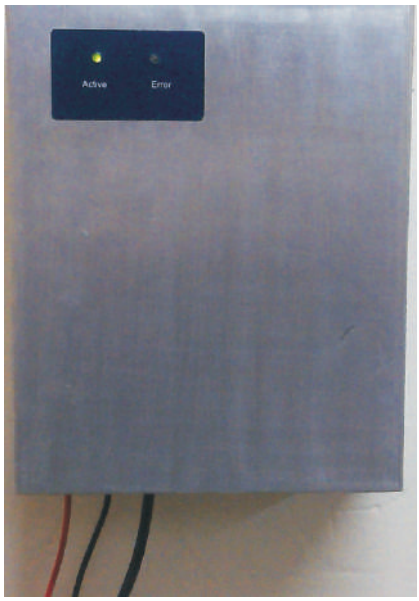
5.1 Contribution to Science

Micro Inverter for Decentralised Power Generation

A grid-connected micro-inverter, powered by photovoltaic panels has been developed at the CSIR-CEERI. High-efficiency operation with maximum power transfer from photovoltaic panels was the salient feature of the system.

The photovoltaic inverter was capable of delivering maximum 300 W power to the grid at close to unity power factor. The micro-inverter normally operates in grid-connected mode delivering maximum power available from photovoltaic panels. In case of grid failure, the inverter can be operated in a stand-alone mode supplying power to local loads. Batteries are not used for inverter operation, resulting in no running cost of the system. Detailed specifications of the system are given in Table-1.

Shows hardware prototype of the system



Prototype of PV-grid connected micro-inverter

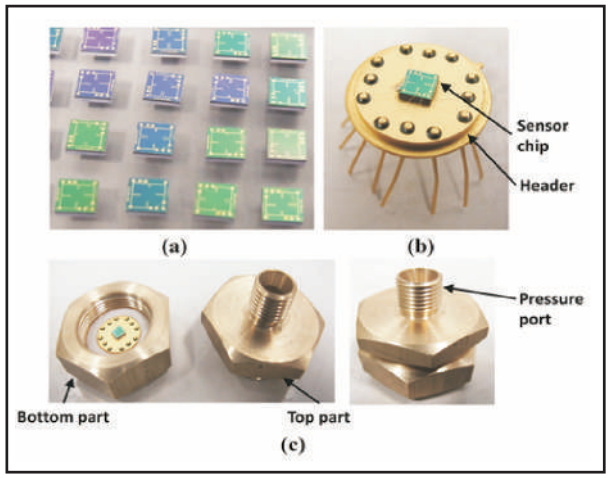
Table 1—Electrical specifications of 300 W grid connected micro-inverter

Parameter		Min	Typ.	Max	Units	Comments
PV input voltage		27	35	55	V	Designed for standard low voltage PV panels .
PV input power		70	250	300	W	
Grid Voltage		175	220	265	V	220 +/- 20 % rms.
Grid frequency		47.5	50	52.5	Hz	50 +/- 5 %.
Grid current (Ioutput)		0.31	1.13	1.36	A	
Pout		70	250	300	W	
Anti islanding method		—	< 12	—	ms	Active detection method
Output current THD		—	< 5	—	%	At nominal load
PF		—	> 0.98	—		From 100W up-to 300W.
Efficiency	MPPT	—	~ 99	—	%	PV voltage ripple < 0.5V Vpp at sinusoidal loading 230W
	DC-DC Conv.	94.6	96	96.8	%	60W-350W
	Inverter	96.9	97	97.2	%	60W-300W

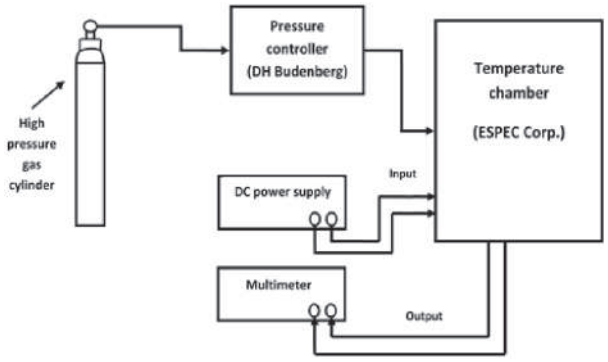
Polysilicon Piezoresistive Pressure Sensor Developed

Pressure sensors encompass a wide application spectrum and are used in various applications such as biomedical, ocean depth measurement, and aerospace. Silicon-based pressure sensors suffer from junction leakage at higher temperature. Polysilicon-based piezoresistive pressure sensors are useful for high-temperature applications as the piezoresistors are isolated from each other by an oxide layer.

Pressure sensors with different diaphragm sizes were fabricated at the CSIR-CEERI for pressure range of 0-30 bar and the piezoresistors were placed at optimised high stress regions. This methodology allowed choosing the most suitable design with desired sensitivity and linearity after experimental evaluation. A custom made jig was fabricated and the pressure sensor die (mounted on the header) was placed inside the jig for providing the package for sensor static characterisation. This sensor arrangement for packaging is illustrated below. All the sensors were characterised at three different temperatures (-5 °C, 25 °C and 55 °C). The block schematic of the characterisation setup is shown



Packaging of the pressure sensor (a) Fabricated pressure sensors (b) Pressure sensor chip wire bonded on header (c) Packaged sensor inside jig with ¼ inch pressure port

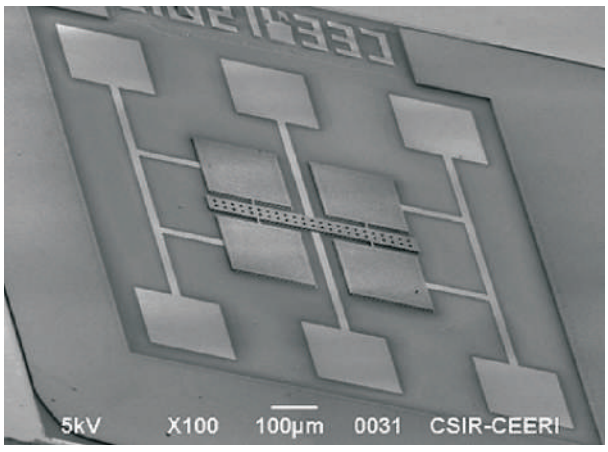


Block diagram of pressure sensor testing setup

MEMS Magnetometer

MEMS Magnetometer is a device that can measure the magnetic field amplitude and direction. In the current technological context, MEMS technology can be used to develop sensors that are small in size, consume low power and are easy to fabricate at low cost. The ability to detect change or variation in magnetic field opens a wide application spectrum ranging from consumer electronics to the strategic sector.

In line with the requirements of the strategic sector for navigation, CSIR-CEERI has designed and developed MEMS-based magnetometer using wafer bonding technology. The structure was a resonant beam fixed at its four supporting arms. SEM image of the fabricated structure is shown. The resonant frequency of the device was characterised using Laser Doppler Vibrometer (Polytec MSA-500) by electrically exciting it.

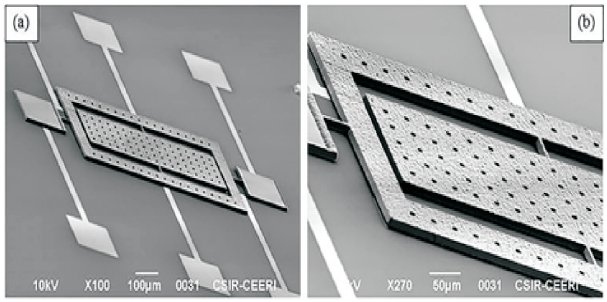


SEM image of the released structure

Gyroscope for MAV

Under the CSIR network project, a task to develop gyroscopes for Micro Air Vehicle (MAV) was taken up by CSIR-CEERI in collaboration with CSIR-NAL. The biggest challenge of the project was to reduce the operating voltage of the device to less than 3.3 V.

At the end of an extensive R&D activity, a two-gimbal torsional gyroscope structure was designed to overcome the limitation of current surface micromachining process, allowing it to be excited with desired voltage levels and increasing its sensitivity to angular rate. The device was fabricated by SU-8 based UV-LIGA process having 8 µm thick Ni-Fe as the key structural layer.



(a) Complete SEM image of the fabricated device
(b) Closer SEM image

The SEM images of one of the fabricated devices is shown. The prototype was also characterised for amplitude and phase spectral responses using Laser Doppler Vibrometer (Polytec MSA-500).

Moisture Sensor for On-line Measurement of Moisture in Coconut Chips

CSIR-CEERI was approached by M/s Marico Limited, Puducherry for on-line assessment of moisture content of copra at its Puducherry plant. High moisture content makes the copra vulnerable to fungal and pestilential attack. The Centre entered into an MoU with M/s. Marico for the trials.

Copra moisture remote display at Marico

An NIRS filter-type moisture sensor system was configured and enhanced with wireless transmitter/ receivers, and suitable repeaters to communicate the measured data to a remote PC at the control room. The system was installed and commissioned at M/s Marico Ltd. and its functioning has been found satisfactory. Based on the feedback, the system will be suitably modified and improved for on-line measurement and control.

Copra moisture sensor installation at Marico

Advanced Spraying Technology for Societal Applications: Air-Assisted Electrostatic Sprayer (AAESS)

Electrostatic force field has been exploited in the design and development of an air-assisted electrostatic nozzle for agricultural applications to increase the mass transfer efficiency, pesticide bio-efficacy, uniform deposition, maximum canopy coverage and liquid pest to reach the hidden areas and underside of the target by reducing the drift of active ingredients of pesticides from the target microorganism. Electrostatic spraying technology offers a very favorable approach to increase pesticide droplet deposition onto biological surfaces of crops and orchards with two-fold of mass-transfer efficiency of active ingredients of pesticides. There is a pressing need for new chemical application sprayer in Indian agricultural pesticides spraying. A new air-assisted electrostatic nozzle has been designed and developed by CSIR-CSIO for small scale farms with a specific focus on Indian agricultural and rural developing economies. This nozzle is light weight, highly efficient, reduces pesticide use and human health risks, and eco-friendly. An air-assisted electrostatic nozzle is a combination of an air assisted nozzle and induction based electrostatic charging system.

Giant enhancement in thermoelectric performance of copper selenide Cu_2Se by incorporation of different nanoscale dimensional defect features

CSIR-NPL has developed nanostructured n-type Cu_2Se, with very high thermoelectric performance in terms of its figure-of-merit, employing a novel experimental strategy (Patented). This is a simple binary alloy, wherein a thermoelectric figure-of-merit ~ 2.1 (third-party evaluation), has been realized which is one of the highest reported thus far for polycrystalline thermoelectric materials.

Demonstration of working of watt balance to measure Planck constant

CSIR–NPL has demonstrated the principle of working of watt balance to measure the value of Planck constant (*h*), which has been used to provide a linkage between macroscopic mass and microscopic mass. Watt balance will be used to

redefine kg instead of conventional measurement through artifact at apex level. CSIR – NPL has been working towards the development of 1 kg watt balance. In this regard, attempts are underway to design permanent magnet and coil. This will be helpful in further development of mechanical system of the watt balance.

Design and Development of a Fiber Optic Based Probe

A fiber optic based probe was designed and developed by CSIR-NPL for electrical transport measurements in presence of quasi-monochromatic (360 – 800 nm) light, varying temperature (T = 1.8 – 300 K) and magnetic field (B = 0 – 7 T). The probe is tested for the resistivity and Hall measurements performed on a LaAlO3-SrTiO3 hetrointerface system with a conducting two dimensional electron gas (2DEG).

Programmable Josephson Voltage Standard

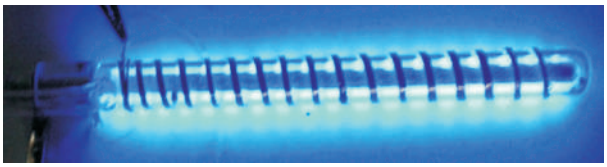
CSIR-NPL has Commissioned of the new 10V PJVS (programmable Josephson Voltage Standard) chip to get non fluctuating pin-to-pin measurements of the resistances between all the 24 pins of the chip.

Optimization and maintenance of Programmable Josephson Voltage Standard System (PJVS) for the dissemination of unit 'Volt' through calibration of Zener based National DC standards at 1.018V and 10V at par to international levels. This dissemination is used for providing calibration services to other organizations at par to international level.

5.2 Contribution to Economy/Society

Mercury-free plasma UV (MFP-UV) Lamp for efficient water disinfection

CSIR-CEERI has developed a mercury free VUV/UV lamp with a novel structural design and an optimized gas mixture that produces strong spectral bands peaking at wavelengths 253 nm and 172 nm along with a weak band peaking at wavelength 265 nm, which are highly useful for water sterilization. This invention alleviates a large number of problems of mercury lamps by virtue of its unique design and the composition of active discharge elements. As a result it is able to produce the desired VUV/UV wavelengths for the deactivation of bacteria and viruses most efficiently - without the use of mercury.



Developed MFP UV-Lamp

The working performance of the developed MFP-UV-lamp was demonstrated to about 35 industries across the country. For this, one-day technology awareness workshops were organized on 26th June 2015 at CSIR-CEERI, Pilani and on 29th January, 2016 at BISR, Jaipur. Also, this technology has been presented in the 2nd Indian Industrial Fair organized at Jodhpur during 3-5 October 2015 and Pride of India Expo Exhibition, 2016, Mysore during 3-7 January, 2016. A non-disclosure agreement has been signed with M/s Sahajanand Laser Technology Ltd., Gandhinagar, M/s INFUSIL India Pvt. Ltd., Bangalore, M/s Kubde Corporation Pvt. Ltd, Amravati, M/s METRO Electronic Lab, New Delhi, M/s The YOUWE (UV) Purifiers, Jaipur and M/s ARKIN Technologies Pvt. Ltd. Pune. Ultimately on 29th March 2016, this technology has been transferred to two industries on 29th March, 2016, namely, M/s The YOUWE (UV) Purifiers, Jaipur and M/s ARKIN Technologies Pvt. Ltd. Pune.

Development of 3D Endoscopes for Dental examination

High definition 3D endoscope relates to a system useful for dental examining of the patient and assessing the damage in dental cavity. 2D endoscopes are available but 3D dental endoscope are not available in the market. Moreover, even 2D

3D and 2D Dental Endoscope.

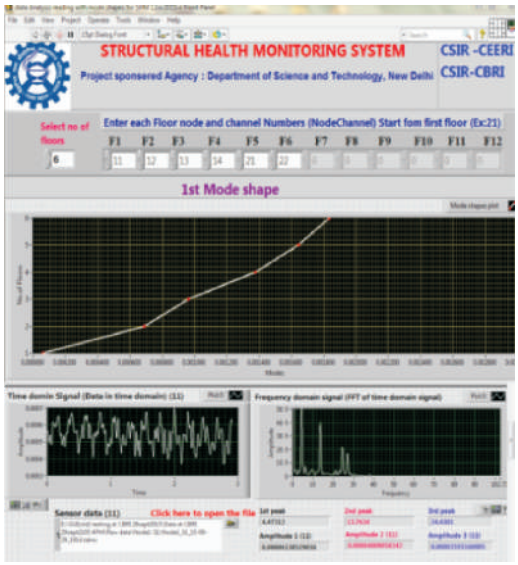
dental endoscope are imported whereas 3D endoscope is being developed in India. CSIR-CEERI has developed 2D as well as 3D dental endoscope. It includes the stereo assembly in frontal parallel arrangement, consisting of miniature cameras, assembled in a medical grade stainless steel housing. The miniatures cameras are encircled by the LEDs to provide strong source of light.

The novelty in the present product is that it enables the doctor to examine the dental on 3D screen and can also assess the damaged teeth easily. Further he can store the medical data such as patient visit history, 3D snapshot storage, 3D video storage, and previous visits history. He can also select a Region of Interest (RoI) from the live video and visualize it in greater details by zooming it 2X times.

Structural Health Monitoring using Wireless Sensor Networks

CSIR-CEERI has developed a process for Structural Health Monitoring using wireless sensor networks. Objective was to monitor the Structural Health of Civil infrastructure mainly Buildings and Towers. This project can be further extended to cover Heritage structures. The objectives have been achieved and demonstrated at CSIR-CBRI on a 6-storeyed Reinforced Concrete Structure.

A Lab View based Graphical User Interface (GUI) has been developed to pictorially demonstrate the monitoring on a display. This project has been successfully completed and report has been submitted to DST. The wireless experimental data has been compared against the wired system at CSIR-CBRI and the results are at par with that



SHM GUI for buildings

system. The first mode of building's natural frequency is observed to be 4.47312 Hz.

Marine Aquarium

A marine aquarium simulating a coral reef has been set up in CSIR-NIO. This aquarium hosts a variety of corals and associated organisms such as fishes, starfish, and snails. The aquarium serves as a live

Marine Aquarium

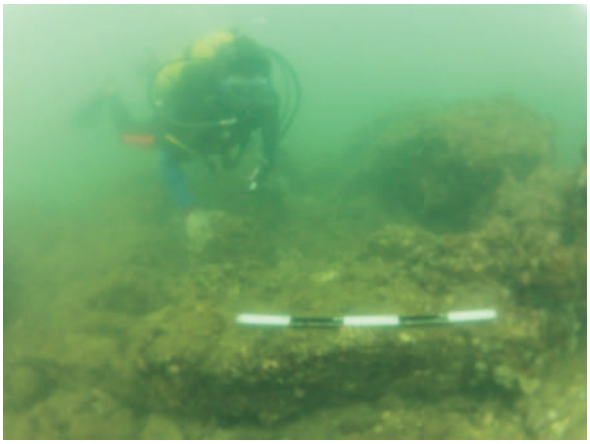
coral stock cum display tank and will facilitate research on coral biology, ocean acidification, and coral bleaching.

5.3 S&T Services & Facilities

High cadmium levels in Zuari oysters found

A recent study conducted by CSIR-NIO on oysters collected from the Zuari Estuary revealed that the oysters contained high concentration of cadmium

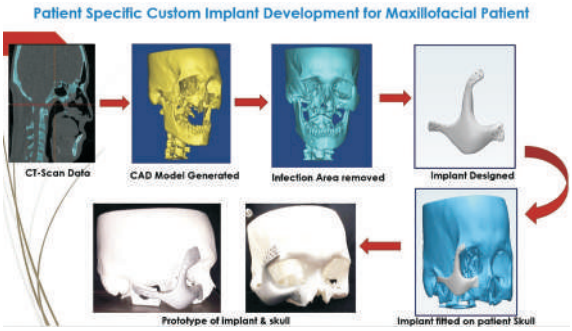
(Cd), a very toxic heavy metal. The Cd content varied from 3.2to 12.2 mg/kg which is much higher than the levels considered safe for human consumption.



Collection of oysters

Patient Specific Custom Implant development for Maxillofacial Patient

A patient specific implants was designed by CSIR-CSIO for patient of PGIMER, Chandigarh suffering from fungal infection of zygomatic region. The workflow starts with generation of 3D CAD model from the CT scan data of the patient, removal of infected area in 3D model, anatomy reconstruction



Patient Specific Implant designed Methodology

as design output. The implant was manufactured in Ti6Al4V alloy using metal 3D printing and was successfully implanted in patient. Figure below shows the methodology adapted for design of implant, designed implant and surgical images.

Optical Radiation Metrology Section has 14 nos. of calibration and measurement capabilities (CMCs) for different photometric and radiometric parameters which are published on BIPM website. The calibration certificates provided by CSIR-NPL for these parameters are valid in all countries following CIPM-MRA.

Number of calibration and testing services provided by CSIR-NPL result in saving of foreign exchange and lot of time in export and import.

B. CONSULTANCY DEVELOPMENT CENTRE

1. INTRODUCTION

Consultancy Development Centre (CDC) is an Autonomous Institution of the Department of Scientific and Industrial Research (DSIR), Ministry of Science and Technology, Government of India set up for promotion, development and strengthening of consultancy skills and capabilities in the country including enhancement of export of consultancy and professional services.

In the changed policy and economic environment at national and international levels, "Knowledge" is being considered as "Power" and consultancy is a knowledge based profession. CDC aims at fostering and promoting intellectual cross - fertilization of knowledge and ideas at regional and sub- regional levels within the country and interaction at the international level as well.

During the financial year 2015-16, plan support of Rs. 140.00 lacs was received from DSIR for carrying out specific projects & activities. Besides plan support activities, CDC undertook various funded projects from various Ministries/Departments of the Government of India.

CDC regularly brings out biannual Journal – Consulting Ahead. Consulting Ahead is devoted to the publication of articles advancing knowledge through research and cases in all sectors and disciplines of consulting. The objective of Consulting Ahead is to become a source of innovative thoughts, knowledge and information of concern for consultants, clients, policy makers, academicians and professionals from various disciplines. It also aims at sharing of professional achievements, professional concerns and providing a global perspective to consulting profession.

2. ACTIVITIES

Activities undertaken during the year including on going activities are as follows:

1. Programme: Building Capacities for Consultancy Development & Knowledge Management with Partner Institution (KMPI)

2. Consulting Ahead Journal - CDC has brought out two issues during the year i.e. July, 2015 and January, 2016 respectively. In July, 2015 issue the special focus was on Corporate Social Responsibility. In January, 2016 issue the special focus was on "Big Data". It included articles such as "Big Data & Business Analytics- the need, applications, challenges, new trends and a consulting perspective", Management Challenges of Analytics Rollout, etc.

3. Certificate Programmes in Consulting - A total of 29 participants were enroled in Management Consulting in FY 2015-16.

4. Franchise Delivery of Certificate Programmes in Consulting

5. Study on "Status and Consulting opportunities in India for the upcoming sectors: Renewable Energy, Bio-technology & Nano-technology"

6. Study on "Assessment of Skills required for Consultants and R&D Experts in India"

7. Entrepreneurship building in Food processing and Marketable Skill development through appropriate technology interventions in 3 LWE districts of U.P. and 11 LWE districts of Bihar

8. Accreditation Scheme for Consultants & Consulting Firms

3. FUNDED PROJECTS

1. Study on "Status of Languishing Handicrafts in clusters of Agra and Barabanki in the state of Uttar Pradesh and Strategy for their revival" for DC (Handicrafts), Ministry of Textile

2. Development of strategic Roadmap of *Translational Research and innovative Science Through Ayurgenomics (TRISUTRA)* and Output mapping of CSIR-IGIB by CSIR-IGIB

3. Preparation of Detailed Project Report (DPR/ Programme and Strategy Document for Data Science, Technology, Research & Applications (dASTRA) for DST, Ministry of Science & Technology

4. Operationalisation of the Certificate Programme in Management Consulting for Least Developed Countries (LDCs) for Ministry of Commerce & Industry

4. FINANCIAL PERFORMANCE

During the financial year 2015-16, Centre was provided Plan funds of Rs. 140.00 lakhs for carrying out various activities relating to consultancy development and promotion. Expenditure of Rs. 411.75 lakhs was incurred and the total revenue generation from various programmes & activities during the year was Rs. 276.19 lakhs.

Public Sector Enterprises

A. National Research Development Corporation (NRDC)

B. Central Electronics Limited (CEL)

सत्यमेव जयते

PUBLIC SECTOR ENTERPRISES

NATIONAL RESEARCH DEVELOPMENT CORPORATION (NRDC)

1. INTRODUCTION

National **R**esearch **D**evelopment **C**orporation (NRDC) is a Government of India enterprise, under the Administrative control of Department of Scientific & Industrial Research (DSIR), established in 1953 under section 25 now section 8, of the companies act. The main objective is to promote, develop and commercialize technologies/ know how/ inventions/ patents/ processes emanating from various national R&D institutions. The Corporation offers its services through-out the country in improving the Nation's manufacturing base with innovative technologies specially suitable for our entrepreneurs and conditions. It acts as an effective Interface for translating R&D results into marketable products. Over the last six decades of its existence, the Corporation has forged strong links with various R&D organizations both within the country and abroad and pursued bringing inventions and innovations to commercial fruition. The Corporation is recognized as a repository of a wide range of technologies and has licensed technologies to over 4800 entrepreneurs spread over almost all areas of industry and has provided assistance for filing of 1700 patents.

2. PROFIT

The highlights of the performance and the financial result for the financial year ended 31st March 2016 are given below:

Performance Parameters	2015 – 16	2014-15
	(Rs. in lakhs)	
Gross Income	1968.77	953.45 *
License Fee/Premia from Technology Licensing & Royalty	1364.20	810.59
Consultancy	383.82	91.99
Profit after tax	5.21	250.66 **
Paid up Share Capital	441.81	441.81
Reserves & Surplus	383.25	378.04
Net Worth	825.06	819.85

* *Excluding exceptional income of Rs.4.45 crores*

** *Including exceptional income*

3. Processes assigned and licence agreements concluded

The Corporation continued to lay emphasis on broadening and strengthening the technology resource base by nurturing long-term relationships with R&D institutions as well as universities, technical organizations, industries and also individual inventors. This endeavour is reflected in the Corporation signing Memorandums of Understanding/Agreements with 13 new

Execution of MoU between IICB, Kolkata and NRDC in presence of Hon'ble Minister for Science & Technology and Earth Sciences, Dr. Harsh Vardan and Minister for Science and Technology, Govt. of West Bengal, Dr. Rabiranjan Chattopadhyay.

organizations for assignment of technologies developed by them. Some of hese organizations are indicated below:

- Indian Institute of Technology, Chennai
- CSIR-Indian Institute of Chemical Technology, Hyderabad
- Indian Association for the Cultivation of Science (IACS), Kolkata (W.B.)
- RDCIS-Steel Authority of India Ltd., Doranda, Ranchi – 834 002
- CSIR-Indian Institute of Chemical Biology, Kolkata.
- Andhra University College of Engineering, Vishakhapatnam. (AP)
- Sathyabama University, Rajiv Gandhi Salai, Chennai – 600 119 (T.N.)
- Suresh Gyan Vihar University, Jaipur. (Rajasthan)
- Hindustan College of Science & Technology, Mathura (U.P.)

Process Assigned

During the year 47 new processes were assigned to the Corporation as compared to 47 processes in the previous year also. Some of the commercially important processes assigned to the Corporation from various research institutes, universities were:

Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru

- Nanoparticle composition of Antibacterial compounds and other uses thereof

University of Agricultural Sciences, Gandhi krishi Vignana Kendra, Bengaluru

- UASB drum composter
- Eco-friendly drought tolerant Aerobic rice variety-ARB-6
- Eco-friendly drought tolerant Aerobic rice variety-ARB-8

Suresh Gyan Vihar University, Mahal, Jagatpura, Jaipur

- Ocular patches of Gatifloxacin for Acute Ocular Infections
- Ocular Gel of Atenolol for Glaucoma treatment
- Penetrometer for characterization of viscous fluids
- Once in a day capsule for Anti inflammatory - Analgesic Therapy in Arthritis
- Nisome based once in day noninvasive anti diabetic insulin preparation.

Indian Association for Cultivation of Science, Jadavpur, Kolkata

- A4 Wire 3-Phase power distribution network sensor for monitoring minute load unbalance and harmonic noise and voltage spikes in power line

Central Council for Research in Ayurvedic Sciences, New Delhi

- AYUSH-82 An Ayurvedic Anti-diabetic formulation

University of Agricultural Sciences, Bengaluru

- Karnataka Rice Hybrid-4 (KRH-4)

Major Technologies Licensed

The Corporation managed to sign 21 license agreements during the year compared to 40 license agreements signed in the previous year. The data on Mou's signed, Technologies assigned and available for licensing, technologies commercialized, etc. are regularly updated on the website. Some of the major processes/technologies licensed by the Corporation in the financial year were:

Indian Institute of Horticultural Research (IIHR), Bengaluru

- A cost effective, eco-friendly para-pheromone trap for effective monitoring of Fruit Flies belonging to Bactrocera SPP for use in horticulture

SIGNING OF MOU FOR LICENSING AYUSH 64 AND AYUSH 82 TECHNOLOGIES AND PRODUCT LAUNCHING IN PRESENCE OF HON'ABLE UNION MINISTER OF AYUSH

Central Council for Research in Ayurvedic Sciences (CCRAS, New Delhi)

- AYUSH-82 (Anti-diabetic Formulation)

Vector Control Research Centre (VCRC), Pondicherry

- Mosquito Larvicidal formulation of Bacillus Thuringiensis Var. Israelensis

Defence Research Development Establishment (DRDE), Gwalior

- Test Kit for Microbiological Quality of Drinking Water

Nursery Raising

4. Lumpsum Premia and Royalty

Your Corporation's consolidated Lumpsum Premia & Royalty income is Rs.1384.20 lakhs as compared to Rs.810.59 lakhs in the previous year. The growth in Lumpsum Premia & Royalty Collection is 70.76 % over the last year. The Royalty received was from both the NRDC licensees and PATSER projects.

5. Consultancy/Export of Projects and Services

The Corporation has been offering consultancy services in the following fields:

- Technological upgradation for the SMEs – identify technological gaps, scouting for appropriate technology and partnering with R&D institute for developing the solution

- IP Consultancy services – Patent Datamining, Search and Analysis, Patent drafting, filing and prosecution, Patent landscaping, FTO analysis, IPR policy, Audit, Training.

- Project consultancy – undertaking and executing projects in India and abroad particularly in developing countries,

Pilot Research Project for Tomato Production in Ghana

The Corporation is implementing a consultancy project for setting up a "Pilot Research Project for Tomato Production in Ghana" in collaboration with CSIR, Ghana, Ministry of Science, Technology and Environment, Govt. of Ghana with a financial support from MEA, Govt. of India.

The objective of the project is to conduct the problem oriented applied research in agro-climatic regions of Ghana with a view to evolve effective cultivation techniques and measures to achieve higher yield of good quality tomato under Ghana conditions. The project is being carried out at three locations in Ghana. The necessary infrastructure, Fan Pad Greenhouse (for nursery) and Naturally Ventilated Polyhouse Structures, Micro Irrigation System has been set up at all the three sites i.e. Kumasi, Ada and Navrongo. The Corporation has exported major technologies to Ghana and supplied all the Agriculture implements and machinery.

6. PROMOTIONAL ACTIVITIES

During the 12th five year Plan the Corporation has taken up two new schemes viz.

A. Programme for Inspiring Inventors and Innovators (PIII)

B. Programme for Development of Technologies for Commercialisation (PDTC)

A. Programme for inspiring inventors and innovators (piii)

Prize Award for Meritorious Inventions

Recognition and award programs always have a major impact on the performance of the awardee in their area of expertise. Considering the benefits and the positive impact of awards, the Corporation under PIII DSIR Grants-in-Aid Programme continued to provide tax free Awards in three Categories, i.e., Innovation, Societal & Budding Innovators Award to Indian Nationals for their meritorious inventions with an objective to encourage inventive talent in the Country. These awards are decided by NRDC's Prize Award Committee approved by Secretary DSIR.

A total of ten awards have been announced by the Prize Award Committee, chaired by Prof. Baldev Raj, Director, NIAS, Bengaluru, for NRDC Meritorious Invention Awards of the Year 2014, two under Innovation award category, three under Societal Innovation award category and five under the Budding Innovators Award category. The cash awards amounting to ' 24 Lakh will be distributed along with shields and certificates to the 26 Awardees of NRDC Meritorious Invention Awards of the Year 2014 in the field of agriculture, environment, health and engineering science during Innovate India Programme.

Intellectual Property and Technology Facilitation Centres

NRDC – University Innovation Facilitation Centres (NRDC-UIFC)

NRDC has set up four NRDC – Innovation Facilitation Centres (NRDC-IFC) in various R&D Institutions to promote innovation related activities in the Universities, National Institutes of Technology (NIT's), IIT's, Autonomous Institutions & Academic Institutions across the country on behalf of DSIR under its Programme for Inspiring Inventors and Innovators (PIII).

During the financial year 2015-16, these centres have organized Seminars and Workshops on

Innovation, Intellectual Property Rights and Technology Transfer in these Institutions to stimulate the entrepreneurial activities within these Institutions and to sensitize the students, research scientists and faculty members about the effective management of Intellectual Property and management, technology transfer and commercialisation related issues.

The corporation obtained assignment of one technology, entitled, "Indigenous gold standard kit for MDR and XDR TB", from one of the NRDC-IFCs established in the premises of AIIMS, New Delhi which is presently undergoing third party evaluation in ICMR Laboratories.

MoMSME-NRDC Intellecutal Property Facilitation Centre (IPFC), Bengaluru

During FY 2015-16, the MoMSME-NRDC IPFC, Bengaluru has entered into collaboration with two new R&D institutions and renewed tie-up with one R&D institution by way of signing Memorandum of Agreements for providing intellectual property protection and technology commercialization services.

The MoMSME-NRDC IPFC was able to acquire 16 new technical know-hows for commercialization from various R&D institutions and concluded 9 license agreements with lumpsum premium earnings of Rs.8.00 lakhs. Some notable technologies licensed are Soil Moisture Indicator, Nata-de-Coco Production, Nemahari (A plant based formulation for management of mulberry root rot disease) and Ready to Eat Honey Paan Beeda. The IP Facilitation Centre has processed 13 patent applications out of which five patent applications were processed on consultancy basis earning total revenue of Rs.9.78 lakhs.

The IP Facilitation Centre has participated in many other technology promotional activities and IPR Awareness Programs organized in South India. Guest lectures were delivered in many of these programs on technologies ready for commercialization and also on intellectual property rights for creating awareness on the various tools available for protection. The Centre has also facilitated and guided over 15 innovators from industry, academia, R&D, etc. for patent searching, patent analysing, filing protection, etc. of their intellectual properties during the FY 2015-16.

Intellectual Property Facilitation and Management and IPR Consultancy:

One of the most prominent factors in the economic growth, socio-economic development is the creation of high value Intellectual Property. In a knowledge based economy, creation, acquisition, accumulation and application of Intellectual Property Rights (IPR) are effective ways for industry to enhance growth and competitiveness. It has become necessary to protect our intellectual property in this competitive world.

IPR seminar on Intellectual Property and Innovation Management in Knowledge Era

The Corporation continued to provide financial and technical support to various Universities, R&D Institutes and individual inventors etc. for filing patent applications in India and abroad during the year 2015-16. The various services provided and programmes undertaken are:

(i) **IP Protection:** During the year 2015-16, the Corporation in its pursuit of protection of inventions and technologies developed by

scientists, researchers and individual inventors has provided financial and technical assistance for filing of 25 patent applications received from various Universities, R&D Institutes individual inventors, etc.

(ii) Patent Search Facility

The Corporation has been catering to the requests received from various Universities, R&D Institutes and individual inventors etc for conducting the state of the art searches, the results of which are utilized for submitting research projects at university level so that the invention related to the R&D project should be novel and not a mere repetition of the R&D work already done. During the year 2015-16, 25 Prior Art Searches have been conducted by the Corporation.

(iii) IPR Seminar/ Workshop/Training

The Corporation has reached out to various Universities and R&D Institutions for creating awareness amongst scientific fraternity about the importance of protection of IP assets in the knowledge era by organizing 16 awareness programmes on "Intellectual Property Rights " across India in collaboration with the Indian Patent Office. It has sensitized more than 1700 participants. These programmes have been widely appreciated by all the segments of participants hailing from different sections of the society.

Technology Knowledge Management Programme

Knowledge Management Programme (KMP) is a self-propelled mechanism for systematic identification and evaluation of the technologies, by a team of experts for value addition to the extent possible for making a complete technology package for commercialization of technologies, so that the chances of success become high. Three Expert Panels in the areas of Biotechnology, Agriculture, Ayurveda & Herbal were formed. During 2015-16, four technologies related to Biotechnology, in one meeting of expert panel discussed. The Committee suggested various value additions required for the technology(ies) including market survey, etc. Market Survey was carried out for "Temple Socks for diabetic neuropathy" as suggested by committee.

B. Programme for development of technologies for commercialisation (PDTC)

The programme aims to add value to the lab-scale technologies developed by the universities/ research institutes/organizations, dissemination of the information and promotion of entrepreneurship development and appropriate innovative technologies in rural and north-east regions. Under this scheme the Corporation carried out various activities like Development of Innovation Portal, Value addition through preparation of Basic Engineering Design Package (BEDP), Market Surveys, and dissemination of information through exhibitions/seminars/workshops etc., promotion of indigenous technologies abroad through showcasing of indigenous technologies. The various programmes undertaken in this scheme are:

TECHNOLOGY VALUE ADDITION

- **Basic Engineering Design Package (BEDP)**

The preparation of Basic Engineering Design Package carried out by the Corporation is a very important value addition activity for laboratory scale technologies. The package provides information on the plant and equipment, raw material and the product, etc. which helps the entrepreneurs in decision making as well as implementation of the project. It requires a detailed study for working out the final process scheme, which can be obtained through series of simulation of the laboratory scale process and then incorporating required engineering input so that the process is workable. Once the BEDP is prepared based o the data the feasibility study and Detailed Project Report (DPR) can be prepared. With these

reports it becomes easy for the entrepreneur to carry out detailed engineering for setting up the commercial plant. The reports also help the Corporation in planning for marketing of its technologies.

During the year, BEDP on the following technologies were conducted through professional empanelled consultants:

- **Fenofibrate**
- **Ocular gel of Atenolol for glcuoma treatment**
- **Once in a day capsule for anti-inflammatory, analgesic arthritis.**
- **Ready to eat Honey Paan Beeda**
- **Nata-de-coco production from Microbial fermentation of coconut water**

Market Surveys

Market surveys are of considerable significance to the process of technology transfer. It makes the technology package more attractive to entrepreneurs. During the year, market survey reports on the following technologies were conducted through professional market survey agencies:

1. **Food Waste Management**
2. **Curcumin Encapsulated Chitosan Alginate**
3. **Temple socks- anti diabetic socks**
4. **Once in a day capsule for anti-inflammatory, analgesic arthritis.**
5. **Manually Operated Reverse Osmosis System**
6. **Improved Rice Husk Particle Board**
7. **Ready to Eat Honey Pann Beeda**
8. **Nata-de-coco Production from Microbial Fermentation of Coconut Water**
9. **Herbi-Chew: Tobacco and Chemical-free Mixture**
10. **Herbal Formulation for Diabetes Management (NBRMAP-DB)**

Promotion of Innovation in Rural and North-Eastern States

The Corporation with an objective to create employment opportunities and capacity building of development agencies for skill up-gradation through the application of innovative technologies in rural and backward areas carried out the following activities during 2015-16.

i. EDP on "Production of Fish Amino for increasing agricultural productivity" implemented in association with Vivekanand Kendra, Kanyakumari. EDP was conducted at Kanyakumari, Tamilnadu and about 447 candidates were benefited during this programme. The one day programme was conducted in 13 batches from 4th February, 2016 to 11th March, 2016.

ii. EDP on "Making of Solar Emergency lights and energy efficient light" implemented in association with Society for Pollution & Environmental Conservation Scientists (SPECS), Dehradun – 248001. EDP was conducted at Village Kandoli, Dehradun for women of Salt Block, Almora and about 34 participants were benefited during this programme. The Five days programmes was conducted from 1st March, 2016 to 5th March, 2016.

EDP on "Making of Solar Emergency lights and energy efficient light" held at Dehradun.

iii. EDP on "Alternate source of fodder Azolla" implemented in association with Himalayan Institute for Rural Awakening (HIRA), Rishikesh, Dist: Dehradun, Uttarakhand. EDP was conducted at Village Jaigaon (Paukhal) Block Dugadda, Dist: Pauri Garhwal, Uttarakhand and about 31 candidates were benefited during this programme. The EDP programme was completed in 9 days starting from 14th March, 2016 to 22nd March, 2016.

iv. EDP on "Electrical wiring & goods repairing & servicing" implemented in association with North Eastern Industrial & Technical Consultancy Organisation Ltd. (NEITCO) Guwahati-781005. EDP was conducted at Itanagar, Arunachal Pradesh and about 20 candidates were benefited during this programme. The EDP programmes was designed for 8 weeks and was completed during the period i.e. from 1st March, 2016 to 25th April, 2016.

v. EDP on "Skill up-gradation of traditional weaving through design and innovative technological" implemented in association with Himalayan Tribal Welfare Society (HTWS), Naharlagun, Dist, Papumpare, Arunachal Pradesh-791110. EDP was conducted at Deed, Lower Subansiri District, Arunachal Pradesh and about 30 candidates were benefited during this programme. The EDP programmes was designed for two months and completed it starting from 20 February, 2016 to 20th April, 2016.

vi. EDP on "Technological up-gradation of traditional handicraft artisans in Rural areas of Awadh region of UP" implemented in association with Social Economic and Versatile Welfare Association (SEVWA), Lucknow-226031 EDP was conducted at Awadh region in three villages of Dist: Faizabad UP and about 62 candidates were benefited during this programme. The EDP programme was designed for 10 days and completed during period from 5th March, 2016 to 31st March, 2016.

vii. EDP on "Value addition of Apricot oil and by-products in remote Uttarakhand Hills (Gairsain, Dist: Chamoli, UK)" in association with Science Technology and Development Initiative (STAD), New Delhi. EDP was conducted at Gairsain, Dist: Chamoli, Uttarakhand which is remote place in UK and about 25 candidates were benefited during this programme. The two weeks EDP programme was started on 20th June, 2016 and completed on 29th June, 2016.

7. EXHIBITIONS AND PUBLICITY

Participation in exhibitions, seminars, workshops and Industry interaction meet are of vital importance for the creation of awareness about the activities of the Corporation and the role of the Corporation in technology transfer and technologies available with the Corporation for transfer. With this objective in view, the Corporation participated in 19 exhibitions.

8. PUBLICATIONS

NRDC continued to publish its Hindi science monthly magazine Awishkar. The main objectives of the magazine are to disseminate information and create awareness about new technologies, inventions, innovations, IPR issues, etc. amongst the masses and foster the spirit of inventiveness/ innovativeness and entrepreneurship amongst the students, scientists, technicians, budding entrepreneurs, etc.

During the year some of the important topics covered in Awishkar are: Bionic Pancreas; Open Source Drug Discovery; Heavy Metals and Human Health; Swine Flu; Soft Robots; Exploring Sources of Energy in Space; Nanotechnology–Industrial Revolution of 21st Century; Special report on Innovate India-15, highlighting Conference on Make

in India: Opportunities through Innovation; NRDC Meritorious Invention Awards-2013; Creating an 'Ideas Economy' to Innovate the Future; New States of Matter; NRDC-NCL Partnership for Successful Technology Transfer and Commercialization of Potassium Humate; New Horizons; A Tribute to Dr. A.P.J. Abdul Kalam; Global Innovation–Increasing role of Indians; Royal Society; ASTROSAT; Membrane Technology; Extrasolar Planets; Science Nobel Prizes-2015; Metallic Pollution and Bioremediation; Science Round-up-2015; Cancer Vaccines; Zika Virus; Paris convention–Climate Change Agreement; and Towards Climate Justice.

Focused issues were also brought out on Health, Environment, and Space etc.

Awishkar aur Navachar (Invention & Innovation), NRDC kee Prodiykee apkey liyae (NRDC Technologies for You) and Baudhik Sampda kee batain (Talks of Intellectual Property) were published as regular columns in the magazine.

9. HUMAN RESOURCE DEVELOPMENT

The Human Resource initiatives of the Corporation during the year were aligned to the overall business strategy of the organization as well as the career aspirations of staff members. Learning and development of the workforce was a priority during the year and the focus was around leadership development for achieving better productivity and building a sales-driven environment having involvement of the staff members in the execution of the organizational strategy. During the year 15 Training Programmes/Workshops were attended by 13 Officials of the Corporation to update their knowledge in respective fields.

The real asset of any company is its human resource. The total manpower of the Corporation as on 31st March 2016 is 82, viz., (Group A-31, Group B-21, Group C-19, Group D-05, and Group D (contractual engagements)-06. The employee-management relationship was cordial throughout the year.

10. RIGHT TO INFORMATION (RTI)

Under the provisions of section 4 of the Right to Information Act, 2005, every public authority is required to display necessary information to citizens to secure access to information under the control of public authority in order to promote transparency and accountability in its working and functioning.

NRDC, being a responsible public sector undertaking, has displayed essential information on its website under the head RTI. The management has notified PIO, Transparency Officer and the First Appellate Authority (FAA) in compliance with the requirements of the RTI Act. Between April 01, 2015 and March 31, 2016, a total of 23 applications were received by the Company and all of them were disposed of by providing requisite information as per rules. Apart from RTI applications, the Company also received 04 appeals against the information provided, which too were duly attended to and appropriately disposed off by the First Appellate Authority. It is pertinent to note that Central Information Commission has not passed any adverse order against the PIO/FAA.

11. TECHNOLOGY ABSORPTION, ADAPTATION AND INNOVATION

Being a Section 8 company under Companies Act 2013, while a major objective of the Corporation is the promotion, development and commercialization of indigenous technologies, the Corporation itself does not carry out any R&D. However, it promotes and finances R&D on a selective basis in both laboratories and industry.

As the Company's operations do not involve any manufacturing or processing activities, the particulars required under Section 134(3)(m) of the Companies Act, 2013 read with Rule 8(3) of the Companies (Accounts) Rules, 2014 regarding conservation of energy and technology and absorption are not applicable.

12. IMPLEMENTATION OF OFFICIAL LANGUAGE

The Corporation continued to make efforts to fulfil the targets prescribed by Govt. of India in the Official Language Act and Rules framed there in with regard to increase the use of Hindi Rajbhasha in office during the year 2015-16. Employees were motivated to use their working knowledge of Hindi in day to day official work.. All the Standard Forms, Files etc. are bilingual. Significant progress has been made in the field of correspondence, noting and drafting in Hindi. All Hindi letters are being replied in Hindi only. The Annual Report of the Corporation is being published in diglot form in both Hindi & English since 1986-87. The Corporation also publishes a popular Science & Technology monthly magazine in Hindi, entitled 'Awishkar'. To popularize the use of Hindi, the Corporation organized a "Rajbhasha Pakhwara" (14-30 September 2015). During the Pakhwara Hindi Noting & Drafting, Letter writing and Hindi Poetry competition was organized & cash awards were given to the winners on the occasion of the Foundation Day of NRDC (31st December 2015). Cash Awards were also given to employees under "Rajbhasha Incentive Scheme". One Work Shop on Hindi Unicode was organized for making the Hindi work more comfortable in computers. To enrich Hindi vocabulary of the employees of the Corporation as well as visitors, an English word with its Hindi meaning is written daily on a writing board as 'Today's word' at the reception of the Corporation.

CENTRAL ELECTRONICS LIMITED (CEL)

1. INTRODUCTION

Central Electronics Limited (CEL) is a Public Sector Enterprise under the Department of Scientific and Industrial Research (DSIR), Ministry of Science & Technology, Government of India. It was established in 1974 with an objective to commercially exploit indigenous technologies developed by National Laboratories and R & D Institutions in the country. CEL is one of the companies that utilized home grown technologies during all these years of its existence. The Company is primarily engaged in production of strategic components for defence applications of national importance, equipment for railway safety and solar photovoltaic modules and systems.

The Company has developed a number of products for the first time in the country through its own R & D efforts and in close association with the premier National & International Laboratories including Defense Laboratories. In recognition of all these efforts, CEL not only have the distinction of being a DSIR recognized R & D Company, but also has been honored a number of times with prestigious awards including **"National Award for R & D by DSIR"**.

CEL has already established partnerships and linkages with various stake-holders and business associates in the areas of railways, telecom, police, power generation and distribution companies, service providers in the energy sector, public funded institutions and even rural communities through the state governments. The existing marketing channels are being consolidated and expanded harnessing the unique advantage CEL has experienced manpower in terms of its product base and PSU status.

The renewed mandate of CEL includes development and harnessing technology for **(i)** Solar Energy Systems and Solutions **(ii)** Strategic Electronic Components and systems required for Defense, Space, Atomic Energy. **(iii)** Signaling and Safety in Public Transport Systems **(iv)** Infrastructure, Eco-systems management and energy conservation and **(v)** Security and Surveillance in strategic establishments. CEL has been the pioneer in the country in the different areas of manufacturing & proprietary manufacturer of the many strategic electronic components for use by defense organizations in the country.

2. OPERATING RESULTS

During the year the Company recorded production of Rs. 215.32 Crore and sales of Rs. 211.18 Crore against the previous year's production of Rs. 167.56 Crore and sales of Rs. 168.29 Crore.

(Rs. in Crore)

Year	2015-16	2014-15
Production	215.32	167.52
Sales	211.18	168.29
Gross Margin	21.87	13.88
Gross Profit	17.88	10.28
Profit Before tax (PBT)	11.21	4.96
Net Profit after tax (PAT)	8.56	4.06

During the year under review the net profit after tax is Rs.8.56 Crore as against Rs. 4.06 Crore in the previous year.

3 EXPORTS

During the year 2015-16, exports have been Rs 0.95 Crores.

3.1 Major Achievements

- During the year under review, your Company has supplied 36041 Nos. of Phase Control Modules (PCMs) to Bharat Electronics Limited (BEL), Ghaziabad. The Company has recently received order worth Rs.162 Crore for supply of PCMs to BEL, Ghaziabad.
- The Company has also enhanced manufacturing capacity of PCMs for AKASH Missiles.
- Company has already implemented ERP for cost effective management.
- The Company's new State- of –the- Art Automated Module Manufacturing line was dedicated to the nation by Dr Harsh Vardhan, Hon'ble Minister of Science & Technology & Earth Sciences on 03.06.2015 and this new DSIR funded facility has contributed immensely to the performance of the Company.
- The Company has developed and manufactured flexible crystalline Solar Panels for the first time in the country and installed the same on the Science Express.
- The Company has also received an order for setting up of 700 KWp On-grid solar Power plant at Guwahati Railway station.
- The Company achieved a turnover of Rs. 54.95 Crore from sale of Axle Counters (including Single Section Digital Axle Counter,) High Availability Single Section Digital Axle Counter (HASSDAC) and Multi Section Digital Axle Counter (MSDAC)) to Indian Railways despite tough competition from private and multinational companies.
- The Company has successfully executed a project for rural electrification in the districts of Bhadohi and Ghazipur , Uttar Pradesh where the Company has installed more than 1000 nos. of solar operated street lighting system
- The Company has exported various Solar PV Systems worth Rs. 2.87 Crores during the year under review.
- Company also satisfactorily executed order for Piezo assemblies for HEAT Fuse 551 and other Piezo Components worth Rs. 2.47 Crore from *Ordnance Factory Khamaria, Jabalpur.*
- Company has initiated R&D projects in key areas such as:
- Development of a range of solar applications including smart trees, flexible solar panels, BIPV solutions, portable power plants etc.

- Development of high efficiency solar cells.
- Upgradation of existing products of Railway Signaling systems and development of new products.
- Development of a range of components & sub-systems for defense requirements.

4. SWACHH BHARAT ABHIYAN

Company has implemented Swachh Bharat Abhiyan whole heartedly. Regular cleaning drives are taken up with participation of all employees for cleanness of both inside and outside of the factory premises. During the year under review, the Company has taken up project with Sulabh International for education and advocacy on cleanliness in the neighboring village.

5. FUTURE STRATEGY:

FUTURE OUT LOOK & VISION 2020

All the four areas that the Company operates in (viz. Solar Photovoltaic, Railway Signaling systems, Integrated Security & Surveillance Systems and Defence Electronics) are Per-Se high growth, core sector areas. The future potential for the Company is immense.

SOLAR PHOTOVOLTAICS (SPV)

The Government of India has increased the target for implementation of renewable energy under National Solar Mission to 175 GW by the year 2022. The Company proposes to enhance solar PV business of Off-Grid/Grid Interactive Power Plants Defence sector, educational institutions etc. under National Solar Mission directly as well as through channel partners. The announcement of "Swach Bharat Abhiyan" has big requirement of solar powered water pumping system in the remote areas of the country. Government of India is also focusing on implementation Solar Water Pumping all over India.

Some other emerging prospects in Solar Photovoltaics business are implementation of green energy programme by Ordinance Factory Board, solar power plants for Indian Railways and rural electrification programme in the international market etc.

CEL aims to play an important role in these efforts by focusing on the potential segment like water pumps, street lighting remote area/rural electrification through solar etc. In this regard, the Company has already installed a new state of the art of Module Production facility. This will bring down the cost of CEL modules and make it competitive in the domestic & international markets. The Company is also taking active step for development of high efficiency solar cells with the funding from Administrative Ministry, DSIR.

RAILWAY ELECTRONICS

CEL had been engaged in design and manufacture of Railways signaling equipment such as Analog and Digital Axle Counters & Block Signaling Equipment for last 30 years.

Indian Railways is planning major investment in the area of safety as well as capacity enhancement / new lines. This is expected to result in a huge demand for signaling and control equipments. CEL is working towards further developing its own R&D as well as production facilities in these areas with support from the DSIR.

The Company is upgrading its support network for Indian Railways to enhance customer satisfaction.

STRATEGIC ELECTRONICS

CEL is involved in the development of strategic electronic components such as Phase Control Modules (PCMs) for the Radar systems, Piezo Generators for High Explosive Anti Tank (HEAT) Fuse 551 & 651 for Carl Gustaf Gun, Concrete Vibration Sensor(CVS) Cristoballite for space applications etc. The Company is making all efforts to further expand

the product portfolio using state-of-the art technology for supply of strategic components.

INTEGRATED SECURITY SYSTEMS

The current security scenario in the country has made security systems (Including Baggage Scanners, DFMDs surveillance equipment, intelligent systems, Bomb detection and disposal equipment etc.) a very high growth area. There is a need for a reputed and reliable Public Sector entity in these areas. The Company is focusing on these areas as an important business segment for future growth. To achieve the business objective, the Company has tied up with a number of reputed original equipment manufacturers and is developing In-house integration expertise for establishing a core strength in this business.

TRAINING PROGRAMME IN SOLAR PHOTOVOLTAICS

To help meet the manpower needs for achieving the country's targets under National Solar Mission, the Company has taken up the task of capacity building in the area of Solar Photovoltaics installation, commissioning, & Maintenance with support from MNRE. The same is continuing and will be further expanded in the coming years.

6. FOREIGN EXCHANGE RECEIPTS AND OUTGO

During the year under review, your Company has spent Rs 27.60 Crore in foreign exchange as against Rs. 24.35 Crore in the previous year towards purchase of raw material, components and spares, capital goods, travel and agency commission etc. Your Company earned foreign exchange of Rs. 0.75 Crore as against Rs. 1.08 Crore in the previous year from export of its products.

7. ENERGY CONSERVATION

The Company continues its efforts to reduce energy consumption with the Objective of optimal use of energy resources and cost reduction to the Company. The Company has recently initiated a green campus project. Under this project, the Company has achieved its first milestone by converting its administrative complex into net zero energy complex by installation of roof top solar power plant with high efficiency solar modules complemented by a number of steps for reduction of power consumption. In addition keeping as the philosophy that **"ENERGY SAVED IS ENERGY PRODUCED",** the Company has taken following actions for conservation of energy:

a) By Installation of capacitor banks etc for improvement of the power factor. The Company is continuously getting the power factor over 0.985. This is a remarkable achievement even by the most stringent standards.

b) By changing all the boundary wall Sodium lights by LED lights

c) By installing ON/OFF base temperature control system at cooling tower fans to reduce the cooling tower fan consumption & also by replacing all aluminum blades with FRP blades.

d) The augmentation of solar power & optimization of load shifting reduced the DG consumption by 2% in respect of FY 2015-16

e) By minimizing idle running of machines during start-up through strict planning and close coordination among different activities of the plant.

f) Replacement of flourcent tube lights with CFL's/ LED lights etc.

g) Gradual switchover to star rated ACs.

h) Regular Maintenance of electrical equipment, switch gear & motor pump sets for optimal performance.

i) Encouraging employees to save electricity by switching off fans/lights/working equipment, when not needed.

j) Taking steps to make full use of energy from In-house solar capacities. Using Solar Generated Power through 480 KWp Solar Power Plant in CEL campus and further planning to expand the Capacity of on campus Solar Power plant to over one MW during 2016-17 .

8 PARTICULARS OF EMPLOYEES

In compliance with Section 217(2A) of the Companies Act, 1956 read with Companies (Particulars of Employees) Rules, 1975 as amended, none of the employees of the Company either employed throughout the year or employed for a part of the year was in receipt of remuneration more than that minimum prescribed in the Rules.

9. IMPLEMENTATION OF HINDI, INDUSTRIAL RELATIONS

The Company continued to implement the Official Language policies of the Government through motivation and incentivization. Employees were imparted training in usage of Hindi in computer applications. A Hindi month has also been organized from 14.09.2015 to 13.10.2015. During the Hindi months, competitions in Hindi, in the areas of General Knowledge, Poetry & Hindi Speech were organized for workers and Officers belonging to Hindi and non-Hindi areas. In-house Hindi Magazine named "Hamara CEL" was also published . The Annual Report of your Company is also regularly published in diglot form in compliance of DPE guidelines and employees are encouraged to use Hindi in official correspondence.

Industrial relations continued to be harmonious during the year. The Company has imparted training to the workmen and executives in their related fields, which has been helpful in development and growth of employees. A system of regular shop level and plant level meeting has been put in place for improving workers participation in Management. KRAs have also been implemented for all levels of executives.

Process of regular recruitments at various levels in keeping with the Company's growth & technology needs, has been put in place and annual system of inducting fresh Graduate Engineers, based on GATE exam performance has been put in place to induct young blood into the Company.

The Company is taking up training of employees at various levels through In-house programms as well as participating in external programms in relevant areas.

10. WELFARE OF RESERVED CATEGORIES

All Government Directives relating to the reserved categories such as SC, ST, Physically Handicapped, Ex-servicemen etc. continue to be implemented during the year.

Administration & Finance

1. Administration

2. Finance

3. Audit Observations by CAG

ADMINISTRATION AND FINANCE

1. ADMINISTRATION

The Department of Scientific & Industrial Research (DSIR) was created in January 1985. The Administrative Division of the Department, comprising Establishment Section, General Section and Vigilance Unit, looks after activities related to personnel, implementation of the Flexible Complementary Scheme (FCS) promotion mechanism meant for the Scientists (Group 'A'), foreign deputations of officers, vigilance matters, administrative reforms mechanism, work relating to CGHS facilities, staff welfare, coordination etc. Since both DST & DSIR are situated in same premises, all the celebrations such as S & T Foundation Day, Technology Day, Retirement Meetings, Hindi Pakhwada, Vigilance Week, etc. are celebrated as a common event with active cooperation of both Departments.

1.1 Staff Strength

The staff in position in different groups in the Department other than that of autonomous bodies viz. Council of Scientific and Industrial Research (CSIR) and Public Sector Undertakings viz. National Research Development Corporation (NRDC)/ Central Electronics Limited (CEL) as on 1st December, 2016 is given below and in **Annexure 12**:

	General	SC	ST	OBC	Total
Group 'A' (Gazetted)	28*	04	02	02	36
Group 'B' (Gazetted)	04	02	01	01	08
Group 'B' (Non-Gazetted)	13	04	01	02	20
Group 'C'	03	07	01	03	14
Total	**48**	**17**	**05**	**08**	**78**

* *Excluding one post of JS (Admn.) which is on notional basis.*

1.2 ISO 9001:2008 Certification for DSIR.

Department of Scientific & Industrial Research (DSIR) started implementation process of ISO 9001:2008 since the year 2011, in compliance with guidelines issued by the Performance Management Division, Cabinet Secretariat. After satisfactory audits of the functions and services of the Department, the Competent Certification Body has certified DSIR as "ISO 9001:2008 Department" on the 14th August 2015.

1.3 Promotion of Rajbhasha

Instructions issued by the Department of Official Language for implementation of the Official Language Policies in the Department, the Autonomous Bodies and Public Sector Undertakings under its administrative purview are implemented in right earnest.

The Department has taken the following steps for progressive use of Rajbhasha in the Department :

- In pursuance of Section3(3) of Official Language Act, Department's Annual Report, Budget Materials, Parliament Questions, Cabinet notes, Advertisements, General orders and Notifications etc were issued in Hindi and English.
- Three (03) Quarterly meetings of Official Language Implementation Committee held in regular interval and timely follow up action taken.
- The Quarterly Progress Report and Annual Assessment Reports regarding use of Rajbhasha in the Department forwarded to the Department of Official Language.
- Rajbhasha inspections carried out in the Attached Offices and PSUs of the Department, i.e Two Laboratores of CSIR (Central Drug Research Institute (CDRI), Lucknow & Central Institute of Medicinal and Aromatic Plants, Lucknow) Consultancy Development Centre (CDC) **&** National Research Development Corporation (NRDC) during the year.
- Unicode has been installed in all computers to enable officers/staff to use Rajbhasha Hindi in the electronic mode.
- During the year, 2 workshops were organized in the Department in which training of filling of quarterly progress report has been given to all officers of DSIR & other workshop was organized on usage of Ayurveda in daily life.
- The process of purchasing of books for Hindi Library in the Department on various subjects is being carried out every year.
- Hindi Pakhwada observed from 14-28 September, 2016 in collaboration with Department of Science and Technology. On this occasion, various competitions, viz Hindi Poetry, Essay writing, Hindi typing and shorthand, noting and drafting, translation, quiz and Hindi dictation (for MTS employees only) were conducted.

2. FINANCE

The financial summary giving the AE 2015-16, BE 2016-17, RE 2016-17, AE 2016-17 (up to September 2016) and BE 2017-18 of various Plan and Non Plan schemes of DSIR is given in Table -1.

3. EXTRACTS FROM CAG'S REPORT

The extracts from CAG's report are given at **Annexure** 13.

Financial Summary

Table -1

FINANCIAL SUMMARY (₹ in crores)

AE-2015-16, BE-2016-17, RE-2016-17, AE-2016-17, BE-2017-18(PROPOSED) [Rupees in crore]

Scheme	Actual Expenditure 2015-16			Budget Estimates 2016-17			Revised Estimates (Tentative) 2016-17			Actual Expenditure 2016-17 (upto September 2016)			BE 2017-18 (Tentative)
1. DSIR	**Plan**	**Non-Plan**	**Total**	**Plan**	**Non-Plan**	**Total**	**Plan**	**Non-Plan**	**Total**	**Plan**	**Non-Plan**	**Total**	**Total**
Secretariat Economic Services – DSIR	0.00	9.69	9.69	-	12.60	12.60	0.00	12.56	12.56	0.00	6.29	6.29	13.69
PRISM	1.67	0.00	1.67	4.00	0.00	4.00	2.25	0.00	2.25	0.64	0.00	0.64	5.00
PACE	3.29	0.00	3.29	6.00	0.00	6.00	7.00	0.00	7.00	0.21	0.00	0.21	6.50
BIRD	5.64	0.00	5.64	7.50	0.00	7.50	6.75	0.00	6.75	1.56	0.00	1.56	9.65
A2K+	6.90	0.00	6.90	9.00	0.00	9.00	7.00	0.00	7.00	0.43	0.00	0.43	5.00
CEL	8.20	0.00	8.20	6.50	0.00	6.50	8.00	0.00	8.00	5.75	0.00	5.75	9.75
NRDC	3.64	0.00	3.64	5.50	0.00	5.50	5.68	0.00	5.68	0.00	0.00	0.00	6.00
CDC	1.40	0.00	1.40	1.00	0.00	1.00	0.50	0.00	0.50	0.00	0.00	0.00	2.00
DSIR Bldg. & infrastructure	0.00	0.00	0.00	0.50	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50
National Laboratories-CSIR	1929.50	1755.64	3685.14	2010.00	1700.20	3710.20	2010.00	1703.06	3713.06	1029.17	991.78	2020.95	4062.91
Research Schemes, Scholarships & Fellowships-CSIR	225.00	78.00	303.00	250.00	50.00	300.00	250.00	50.00	300.00	125.00	25.00	150.00	325.00
Grand Total	**2185.24**	**1843.33**	**4028.57**	**2300.00**	**1762.80**	**4062.80**	**2297.18**	**1765.62**	**4062.80**	**1162.76**	**1023.07**	**2185.83**	**4446.00**

Note:AE 2015-16 includes Recoveries of Rs. 7.62 crore

AE 2015-16 and 2016-17 Source: E-lekha.nic.in

Annexures

सत्यमेव जयते

ANNEXURE –1

LIST OF TDDP/ PATSER PROJECTS COMMERCIALIZED

S. No.	Company	Project title
1	ACE Designers Pvt. Ltd., Bengaluru	PC Based CNC System
2	Aesthetic Technologies Pvt. Ltd., Kolkata	Dev. of an Interactive Multimedia Package for Intellectual Property Rights Training
3	Aishwaraya Telecom Pvt. Ltd., Hyderabad	Design & Development of Optical Power Meter (Type A & B) and Optical Talk Set
4	Aishwaraya Telecom Pvt. Ltd., Hyderabad	Hand Held Optical Test Equipments (Optical Power Meter, Optical Light Source 1310/1550NM, and Fiber Identifier)
5	Andrew Yule & Co. Ltd., Kolkata	Dev. of Rough Top Conveyor Belting
6	Anu's Lab Ltd., Hyderabad	Development of process for manufacture of 1-Bromo-3-chloropropane (B.C.P.) and 1-3-dibromo Propane (D.B.P.) in pilot plant
7	Arch Pharmalabs Ltd., Mumbai	Scale up Studies for Polymorphic Form-I of Clopidogrel Bisulphate Process
8	Ardee Technologies Pvt. Ltd. (Formerly Ardee Business Services Pvt. Ltd.), Vishakhapattanam	Dev. of a Mobile, Four Channel Modular, RAMDARS Sys tem for Dry Beneficiation of Coal.
9	Ardee Technologies Pvt. Ltd. (Formerly Ardee Business Services Pvt. Ltd.), Vishakhapattanam	Development of Higher Dimension Aluminum Granules Coded Wire along with Complete High speed Wire Feeder
10	Ardee Technologies Pvt. Ltd. (Formerly Ardee Business Services Pvt. Ltd.), Vishakhapattanam	Manufacture of Magnesium & Calcium Metal Power
11	ATCOM Technologies Ltd., Mumbai	Dev. of Microbalance of 200 gm. Capacity with 1 mg. Accuracy
12	Bel Optronic Devices Ltd., Pune	Development of High Sensitivity Photo Cathode for 18mm SUPERGEN Image Intensifier Tubes.
13	Bharat Earth Movers Ltd. (BEML), Bengaluru	Dev. of Crankshaft for Engines by Casting and machining process
14	Bharat Earth Movers Ltd. (BEML), Bengaluru	Upgradation of 50 T Dumper 200 HP Front end loader
15	Biocon Ltd., Bengaluru	Glargine Process Improvement
16	Celestial Labs Ltd., Hyderabad	Development of Toxicity Prediction Module and Integration with CELSUITE - A Computer Aided Drug Design Tool

S. No.	Company	Project title
17	Central Electronics Ltd., Sahibabad	Digital Axle Counter for Railway Signaling
18	Delta Agro Chemicals Ltd., Krishna	Dev.of process for manufacture of Furfural Alcohol by Hydrogenation of Furfural
19	Dolphin Industrial Co-operative Society Ltd., Vizianajaram	Glazing of terra-cotta Clay Products
20	Eddy Current Controls Ltd., Kerala	Development of 90KW Brushless Eddy Current Clutch Gear Unit for Radiator Cooling fans in diesel electric locomotives of the Indian Railways.
21	Elkay Chemicals Limited, Pune	Development of Next Generation Amino Silicone based on Hydrosilation Technology
22	Encon Thermal Engineers (P) Ltd., Faridabad	Dev. of Technology for Design and Manufacture of Improved Industrial Natural Gas Burners
23	Enercon Systems Pvt. Ltd., Bengaluru	Development of Centralised Electrical Energy Management System
24	Engineers India Ltd. (EIL) , New Delhi	Development of Membrane Technology for Natural Gas Separation
25	Genus Power Infrastructure Ltd., Jaipur	Smart Closed Loop Energy Management Solution
26	Gland Pharma Ltd., Hyderabad	Hyaluronic Acid and Formulation
27	Gujarat Mineral and Dev. Corporation	Dev. of Column Flotation Technology
28	Gujarat Narmada Valley Fertilizers Co.Ltd., Bharuch	Dev.and Demo. of Liquid Phase Oxidation Process for Hydrogen Sulfide Removal
29	Haryana Leather Chemicals Ltd., Haryana	Technology Development and Demonstration for application of Cross Linkables Aqueous Aliphatic Polyurethane Dispersions for Leather and Shoe Finishing
30	HERO Cycles Ltd., Ludhiana	Design,Development,Installation and Commissioning of 6-Hi Cold Rolling Mill
31	Hindustan Zinc Ltd., Udaipur	Extraction of Cobalt to Extract Copper Sulphate
32	Hi-Tech Robotic Systemz Ltd.,	Smarter Maaterial Handling Automated Guided Vehicles (AGVs)
33	IBP Co. Ltd., Gurgaon	Detonationg Cord for Shaped Charges
34	Innovation Communications Systems Ltd., Hyderabad	Development of Interactive Voice Response System With Multilingual Capability
35	Insecticides (India) Limited, Bhiwadi	A new approach to sythesis of an import substitute 3-methyl-N-nitroimino perhydro-1,3,5-oxadiazine (MNIO), an intermediate for the manufacture of Thiamethozam.
36	JSL Industries Ltd., Anand	Dev. of Air Circuit Breaker

S. No.	Company	Project title
37	Klas Technology Ventures Ltd., Bengaluru	Research & Development of Aluminium Cylinders for Liquified Gases for Domestic, Automotive Applications
38	Lifecare Innovations Pvt. Ltd., New Delhi	Liposomal Amphotericin-B
39	Litex Electricals Ltd., Pune	Laser Pumping Lamps
40	The Maharashtra State Seeds Corporation Ltd., Mumbai	Design, Development and Fabrication of Mini Dry Gas Cotton Seed Delinting Plant (0.5 TPH Capacity)
41	Maini Materials Movement Pvt. Ltd., Bengaluru	Development of In-plant Material Handling Equipments
42	MECPRO Heavy Engineering Ltd., New Delhi	Demonstration of on Efficient Solvent Extraction Plant & Technology with the Vent Air Cracking system
43	MECPRO Heavy Engineering Ltd., New Delhi	Development and Demonstration of Eco-friendly and Efficient Edible Oil Refining technology of Twin Bleaching system and Deacidification-cum-Deodorization System
44	MIC Electronics Ltd., Hyderabad	Development of Fraud Management and Control Centre (FMCC)
45	Minda Industries Ltd., Delhi	Development of Auto Electrical Switches using Rapid Prototyping Facility of I.I.Sc.
46	Minda Industries Ltd., Delhi	Innovative electronic control system for PNG (Pipeline Natural Gas) Fueled Stationary Engine.
47	Mishra Dhatu Nigam Ltd., Hyderabad	Development of Technology for Welding Molybdenum Coils to make coils in single coil weight of 20 kgs.
48	Mishra Dhatu Nigam Ltd., Hyderabad	Development of Technology for producing Wires With Superior Surface Finish employing Wet Drawing Technique
49	NALCO, Bhuvneshwar	Dev. of Technology at Pilot Scale Production of Special Grade Alumina
50	Natco Pharma Ltd., Hyderabad	Dev. of Anaerobic Reactor System for Pharmaceutical waste at pilot plant level
51	NED Energy Ltd., Bangaluru	Development of High Energy Density Valve Regulated Lead Acid Batteries
52	Neuland Laboratories Ltd., Hyderabad	Innovative process development for the manufacture of peptide APIs
53	Nirmal Seeds Pvt. Ltd., Jalgaon	Development of novel Biopesticides from antagonistic microbes Bacillus subtilis and Trichoderma viride using Dextrose as a Carrier
54	Ogene system India P. Ltd., Hyderabad	Nano Labelled DNA/RNA compounds
55	Organic Coatings Ltd., Mumbai	Development of (I) Water-based flexo inks used for alsorgent stock (craft paper) and Coated Stock (aat paper) (ii) U.V. radiation cuving inks used for coated stock and non-alsarlent sufistrates such as PVC Polyster etc.

S. No.	Company	Project title
56	Pan India Electromech Pvt. Ltd., Gurgaon	Development and Demonstration of Complete Automated Solution for Hydrography
57	Pennwalt Ltd., Mumbai	Dev. of Tech. for coating of Chemical process equmt. with fluoropolymers and other high performance polymeric products.
58	Poona Health Services Ltd., Pune	Development of Implants for Knee Joints
59	Priya Klay Pvt. Ltd., New Delhi	Development of Technology, Equipment and related "Product(s)" for Production of Stone Ware/ Vitrified Clay Pipes and other Pipes of other materials, made/produced as a result of this Project having large Diameters of 600 mm to 1000 mm and above and lenght
60	Pricol Limited, Pune	Design and Development of Capacitance Type Fuel Level Sensor for Flexi Fuels
61	Priya Klay Pvt. Ltd., New Delhi	Development of Technology, Equipment and related "Product(s)" for Production of Stone Ware/Vitrified Clay Pipes and other Pipes of other materials, made/produced as a result of this Project having large Diameters of 600 mm to 1000 mm and above and lenght
62	Pure Tech India, Trichy	Liquid Coolant Recovery Systems
63	Radiant Cables Pvt. Ltd., Hyderabad	Development of (a) Low loss RF cables for higher frequency above 10GHZ,(b) Data Bus cable with fire survival, low capacitance dielectric properties and © Laser marked loom assemblies.
64	Rajasthan Electronics & Instruments Limited	Development of small PV-Wind Hybrid power plant for rural application
65	Rishabh Instruments Pvt. Ltd., Mumbai	Design, development & manufacture of (i.) 5 3/4 digit multimeter & (ii) 6 3/4 digit multimeters
66	Rishang Keishing Foundation for Management of Tribal Areas, New Delhi	Ginger Oil
67	Sai Life Sciences Limited (formerely Sai Advantium Pharma Limited), Hyderabad	Manufacture of Corey's Lactone and Prostanoids: Iloprost, Lubiprostone and Travoprost
68	Sami Labs Limited, Bengaluru	Development and Pilot Plant Trials Towards Commercilisation of two Products, namely (I) A pentapeptide with a Natural Triterpenoid Conjugate (ii) Extraction of Pterostilbebe from Pterocarpus Marsupium & Conversion to Resveratrol
69	Select Packaging Machines Ltd., Thane	Special Blister Packaging Machines/Form Fill-seal Machine
70	Sequent Scientific Ltd., Thane	Development of Nitroscanate
71	Sequent Scientific Ltd., Thane	Development of Dorzolamide HCI
72	SM Telesys Ltd (SMTL), Noida	Dev. of Two Line Indian Language Multilingual Pager (ILP)

S. No.	Company	Project title
73	Solaris Chemtech Ltd. (formerly BILT Chemicals), Mumbai	Dev.and demo. of Technology for the manu. of Tetra Bromo Bisphenol-A (TBBA) on a pilot plant level
74	Sonodyne Technologies Pvt. Ltd., Kolkata	DSP Based High-end professional Audio Speakers
75	Steel Strips Wheel Ltd., Chandigarh	Technology Development and Demonstration of Improved Manufacturing Process for Automotive Wheel Discs
76	Sundram Clayton Limited, Chennan	Development of Magnesium alloy pressure die castings for automotive applications
77	T. Stanes & Company Ltd., Coimbatore	Establishing and Producing bio Control Agents on Pilot Plant Scale
78	T. Stanes and Company Limited, Coimbatore	Development of Biofertilizers (Emulsifiable concentrate) for Nutrient Management of Agricultural Crops
79	T. Stanes and Company Ltd., Coimbatore	Dev. of technology for manufacture of Digested Organic Supplement (DOrS)
80	Transasia Bio-Medicals Ltd., Mumbai	Fully automated high speed blood chemistry analyser for through put of around 1000 tests/hour
81	Tropilite Foods Pvt.Ltd., Gwalior	Upscaling and commercial production of Lactic Acid Bacteria Starter culture for Yogurt/Curd production
82	Uday Computer Aided Manufacturing (P) Ltd., Bangaluru	"Develop and demonstrate the Large Size CNC Rotary Table 2500 x 2500 with
83	Uniproducts (India) Ltd. Rewari	Development of UNI-Density Insulator for Vehicles
84	United Telecom Ltd., Bengaluru	Asymetric Digital Subscriber Line (ADSL) System
85	United Telecom Ltd., Bengaluru	Development of AAM (ATM Access Multiplexer)
86	Zen Technologies Ltd., Hyderabad	Design and Development of 6 DoF Electrical Motion Platform
87	Zen Technologies Ltd., Hyderabad	Interactive Small Arms Training Simulator (ISAT)
88	Zim Laboratories Ltd.	Development and demonstration of technology to manufacture a new dosage form namely — Oral thin Film

ANNEXURE – 2

DETAILS OF COMPLETED PROJECTS SUPPORTED UNDER PROMOTING INNOVATIONS IN INDIVIDUALS, START-UPS and MSMEs (PRISM)/ ERSTWHILE TECHNOPRENEUR PROMOTION PROGRAMME (TePP)

Completed Projects during the year 2016-2017

Sl. No.	Name of the Project
TePP Phase I /Phase II	
i.	Cost-effective bio-material for wound care
PRISM Phase I /Phase II	
i.	Mechanical Hoe
ii.	Pesticide mixer cum sprayer agricultural pump pesticide mixer cum sprayer agricultural pump
iii.	Geyser Daan
iv.	Motorized car jack
v.	Wireless Informer
vi.	Development of low cost sequence embroidery machine for productivity enhancement in Zari and Zardozi work
vii.	DTMF (Dual Tone Multi Frequency) control logic for Automobile Wind Shield Wipers
viii.	A novel jacquard punched card reader for digitizing the woven designs
ix.	Improving the Existent Laser Tag to make it suitable for a varied spectrum of application
x.	Design, development and performance evaluation of Eco-Trapin -3 : Waterless Urinal Technology
xi.	Development of autonomous driving system for ground vehicles
xii.	Design, development & testing of novel hollow clay brick manufacturing machine & accessories
xiii.	Development and commercial production of bio-product from bio-mass
xiv.	Partial replacement of Sand by Foundry Waste to make M30 grade concrete

ANNEXURE – 3

STATEMENT ON RECOGNITION OF IN-HOUSE R&D UNITS

Month	Year	Receipts	Cumulative Receipts	Disposal	Cumulative Disposal
January*	2016	30	52	19	19
February	2016	19	71	40	59
March	2016	27	98	32	91
April	2016	27	125	19	110
May**	2016	34	159		
June	2016	22	181	60	170
July	2016	26	207	18	188
August	2016	24	231	26	214
September	2016	24	255	21	235
October	2016	29	284	20	255
November	2016	18	302	30	285

* **A pendency of 22 applications was carried forward from year 2015**

** **No Screening Committee Meeting was held in May 2015**

ANNEXURE – 4

STATEMENT ON RENEWAL OF RECOGNITION OF IN-HOUSE R&D UNITS WHO'S RECOGNITION WAS VALID UPTO 31.03.2016

Month	Year	Receipts	Cumulative Receipts	Disposal	Cumulative Disposal
January	2016	250	250	-	-
February	2016	120	370	89	89
March	2016	86	456	88	177
April	2016	29	485	141	318
May	2016	21	506	-	318
June	2016	-	506	114	432
July	2016	-	506	47	479
August	2016	04	510	16	495
September	2016	03	513	20	515
October	2016	02	515	10	525
November	2016	05	520	05	530
December	2016				

ANNEXURE – 5

LIST OF IN-HOUSE R&D UNITS IN INDUSTRY REPORTING ANNUAL R&D EXPENDITURE MORE THAN RS. 5000 LAKHS

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
1.	Ajanta Pharma Ltd.	11500
2.	Alembic Pharmaceuiticals Ltd.	12162
3.	Apollo Tyres Ltd.	10427
4.	Ashok Leyland Ltd.	29286
5.	Asian Paints Ltd.	7164
6.	Astra Microwave Products Ltd.	8196
7.	Aurigene Discovery Technologies Ltd.	11100
8.	Aurobindo Pharma Ltd.	34163
9.	Avesthagen Ltd.	12500
10.	AVL Technical Centre Pvt. Ltd.	6463
11.	Bajaj Auto Ltd.	24500
12.	Bayer Bioscience Pvt. Ltd.	5930
13.	BEML Ltd.	8292
14.	Bharat Dynamics Ltd.	14993
15.	Bharat Electronics Ltd.	85351
16.	Bharat Heavy Electrical Ltd.	111379
17.	Biocon Ltd.	7097
18.	Biocon Research Ltd.	5287
19.	Biological E Ltd.	12282
20.	Bioseed Research India (A Division Of DCM Shriram Consolidated Ltd.)	6334
21.	Bosch Ltd.	15957
22.	Cadila Health Care Ltd.	53800
23.	Cadila Pharmaceuticals Ltd.	8769
24.	Cipla Ltd.	37805

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
25.	Comviva Technologies Ltd.	5100
26.	Crompton Greaves Ltd.	6100
27.	Daimler India Commercial Vehicles Pvt. Ltd.	24242
28.	Defence Land Systems India Ltd.	5218
29.	Delphi Automotive Systems Pvt. Ltd.	12892
30.	Dr. Reddy's Laboratories Ltd.	78761
31.	Edgeverve Systems Ltd.	62100
32.	E-I DuPont India Pvt. Ltd.	20893
33.	Eisai Pharmaceuticals India Pvt. Ltd	7352
34.	Emcure Pharmaceuticals Ltd.	20900
35.	Escorts Ltd.	10950
36.	Force Motors Ltd.	10183
37.	Fresenius Kabi Oncology Ltd.	21211
38.	Gland Pharma Ltd.	6100
39.	Glenmark Pharmaceuticals Ltd.	16200
40.	Grasim Industries Ltd.	5977
41.	Greaves Cotton Ltd.	5258
42.	Hero Moto Corp Ltd.	12696
43.	Hindustan Aeronautics Ltd.	12063
44.	Hospira Healthcare India Pvt. Ltd.	22506
45.	Indian Oil Corporation Ltd.	22656
46.	Ind-Swift Laboratories Ltd.	9825
47.	Intas Pharmaceuticals Ltd.	21186
48.	IPCA Laboratories Ltd.	14042
49.	ITC Ltd.	15337
50.	John Deere India Pvt. Ltd	13300
51.	Johnson & Johnson Ltd.	9586
52.	JSW Steel Ltd.	7378
53.	Jubilant Biosys Ltd.	12789
54.	Jubilant Generics Ltd.	13526
55.	Landis+Gyr Ltd.	6700

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
56.	Larsen & Toubro Ltd.	25319
57.	LG Electronics India Pvt. Ltd.	6360
58.	Lupin Ltd.	90521
59.	Macleods Pharmaceuticals Ltd.	13062
60.	Maharashtra Hybrid Seeds Co. Pvt. Ltd.	8409
61.	Mahindra & Mahindra Ltd.	101582
62.	Mann And Hummel Filter Pvt. Ltd.	5165
63.	Maruti Suzuki India Ltd.	89028
64.	Medha Servo Drives Pvt. Ltd.	15027
65.	Micro Labs Ltd.	7971
66.	Monsanto Holdings Pvt. Ltd.	6614
67.	MSD Wellcome Trust Hilleman Laboratories Pvt. Ltd.	5092
68.	Mylan Laboratories Ltd	50540
69.	Mylan Pharmaceuticals Pvt. Ltd.	9263
70.	Natco Pharma Ltd.	7765
71.	Nektar Therapeutics (India) Pvt. Ltd.	5715
72.	New Holland Fiat (India) Pvt. Ltd.	7052
73.	Novartis Healthcare Pvt. Ltd.	9165
74.	Oil and Natural Gas Corporation Ltd.	55093
75.	Oil India Ltd.	8258
76.	Oracle Financial Services Software Ltd.	31172
77.	Panacea Biotech Ltd.	6650
78.	PI Industries Ltd.	6536
79.	Piramal Enterprises Ltd.	16331
80.	Praj Industries Ltd.	5646
81.	Reliance Industries Ltd.	121805
82.	Reverse Logistics Company Pvt. Ltd.	5160
83.	Rolta India Ltd.	22500
84.	Serum Institute of India Ltd.	5240
85.	Shahi Exports Pvt. Ltd.	5546
86.	Shantha Biotechnics Ltd.	14763

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
87.	SRF Ltd.	5050
88.	Steel Authority Of India Ltd.	26420
89.	Stelis Biopharma Pvt. Ltd.	7495
90.	Strides Shasun Ltd.	15388
91.	Sun Pharmaceutical Industries Ltd.	95293
92.	Suven Life Sciences Ltd.	13050
93.	Syngene International Ltd.	76832
94.	Syngenta India Ltd.	9266
95.	Tata Chemicals Ltd.	5550
96.	Tata Consultancy Services (TCS) Ltd.	22507
97.	Tata Hitachi Construction Machinery Company Pvt. Ltd.	11130
98.	Tata Motors Ltd.	247331
99.	Tata Steel Ltd.	6230
100.	Tejas Networks Ltd.	7654
101.	The Himalaya Drug Company	5100
102.	The Tata Power Co. Ltd.	29900
103.	Torrent Pharmaceuticals Ltd.	23668
104.	TVS Motor Co. Ltd.	20500
105.	Unichem Laboratories Ltd.	6750
106.	UPL Ltd.	10621
107.	USV Private Limited	19360
108.	VE Commercial Vehicles Ltd.	22209
109.	Veeda Clinical Research Pvt. Ltd.	7067
110.	Vihan Networks Ltd.	7487
111.	Virchow Laboratories Ltd.	7955
112.	Watson Pharma Pvt. Ltd.	15768
113.	Wipro GE Healthcare Pvt. Ltd.	66080
114.	Wockhardt Ltd.	11500
115.	Zoetis Pharmaceutical Research Pvt. Ltd.	10557

* R&D Expenditures Reported are as claimed by the firms in their available Annual reports in DSIR/renewal applications.

ANNEXURE – 6

LIST OF IN-HOUSE R&D UNITS IN INDUSTRY REPORTING ANNUAL EXPENDITURE IN THE RANGE OF

RS. 500 Lakhs To RS. 5000 Lakhs

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
1.	Aarti Drugs Ltd.	870
2.	Aarti Industries Ltd.	1358
3.	Accord Software & Systems Pvt. Ltd.	875
4.	Ace Designers Ltd.	780
5.	Action Construction Equipment Ltd.	680
6.	Adama India Pvt. Ltd.	1585
7.	Advanced Enzyme Technologies Ltd	1150
8.	Advanta India Ltd.	2521
9.	Advik Hi-Tech Pvt. Ltd.	715
10.	Agada Medical Technologies Pvt Ltd.	672
11.	Aizant Drug Research Solutions Pvt. Ltd.	2100
12.	Ajeet Seeds Pvt. Ltd.	1894
13.	Akums Drugs And Pharmaceuticals Ltd.	750
14.	Alicon Castalloy Ltd.	555
15.	Alkyl Amines Chemicals Ltd.	535
16.	Alpha Design Technologies Pvt. Ltd.	1100
17.	Alphamed Formulations Pvt. Ltd.	557
18.	Alstom Hydro R&D India Ltd.	1459
19.	Amara Raja Batteries Ltd.	1470
20.	Amoli Organics Pvt. Ltd.	780
21.	AMW Motors Ltd.	4750

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
22.	Anand NVH Products Pvt. Ltd.	581
23.	Angiometrix Medequips India Pvt. Ltd.	857
24.	Ankur Seeds Pvt. Ltd.	2250
25.	Anthem Biosciences Pvt. Ltd.	1050
26.	Apex Laboratories Pvt. Ltd	2700
27.	Aptuit Laurus Pvt. Ltd.	3140
28.	Arvind Ltd.	3197
29.	Arvind Remedies Ltd.	1200
30.	Ashapura Minechem Ltd.	660
31.	Ashoka Biogreen Pvt Ltd.	690
32.	Atul Ltd.	980
33.	Aura Semiconductor Pvt. Ltd.	1950
34.	Aurangabad Electricals Ltd.	2147
35.	Auto Ignition Ltd.	725
36.	Autoliv India Pvt. Ltd.	780
37.	Autometers Alliance Ltd.	1225
38.	Avantel Ltd.	510
39.	Avasarala Technologies Ltd.	650
40.	Bajaj Electricals Ltd.	1800
41.	Balaji Amines Ltd.	1000
42.	Balkrishna Industries Ltd.	3625
43.	Balmer Lawrie & Company Ltd.	1404
44.	Banco Products (India) Ltd.	664
45.	BASF Chemicals India Pvt. Ltd.	3760
46.	BASF India Ltd.	630
47.	Bata India Ltd.	699
48.	Bayer Crop Science Ltd.	1816
49.	Bayer Vapi Pvt. Ltd.	641

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
50.	BDR Lifesciences Pvt. Ltd.	592
51.	Bejo Sheetal Seeds Pvt. Ltd.	750
52.	Berger Paints India Ltd.	2540
53.	Bg Li-In Electricals Ltd.	547
54.	Bharat Forge Ltd.	4313
55.	Bharat Petroleum Corporation Ltd.	4553
56.	Bharat Seats Ltd.	930
57.	Bharat Serums And Vaccines Ltd.	2715
58.	Bilcare Ltd.	1027
59.	Biogenex Life Sciences Pvt. Ltd.	612
60.	Biogenomics Ltd.	2026
61.	Bisco Bio-Sciences (P) Ltd.	1900
62.	Bliss Gvs Pharma Ltd.	595
63.	Blue Star Ltd.	4879
64.	Botil Oil Tools India Pvt. Ltd.	2030
65.	Brakes India Ltd.	4750
66.	Britannia Industries Ltd.	1421
67.	Buhler (India) Pvt. Ltd.	660
68.	C&S Electric Ltd.	625
69.	C.R.I. Pumps Pvt. Ltd.	900
70.	Camson Bio Technologies Ltd.	2110
71.	Caplin Point Laboratories Ltd.	1181
72.	Cavinkare Pvt. Ltd.	1561
73.	Ceat Ltd.	1700
74.	Celon Laboratories Ltd.	740
75.	Centaur Pharmaceuticals Pvt. Ltd.	2002
76.	Central Electronics Ltd.	800
77.	Central Mine Planning & Design Inst. Ltd.	4062
78.	Charoen Pokphand Seeds (India) Pvt. Ltd.	650

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
79.	Cheminova India Ltd.	1750
80.	Chennai Petroleum Corpn. Ltd.	870
81.	Claas India Pvt. Ltd.	3702
82.	Clause (India) Pvt. Ltd.	785
83.	Clearsynth Labs Ltd.	990
84.	Colourtex Industries Pvt. Ltd.	550
85.	Comstar Automotive Technologies Pvt. Ltd.	1591
86.	Concord Biotech Ltd.	650
87.	Cooper Corporation Pvt. Ltd.	1741
88.	Coreel Technologies (India) Pvt. Ltd.	2711
89.	Coromandel International Ltd.	650
90.	Cosmo Films Ltd.	770
91.	Cummins India Ltd.	2809
92.	Curadev Pharma Pvt . Ltd.	1350
93.	Dabur India Ltd.	1050
94.	DCM Engineering Ltd.	887
95.	Deepak Nitrite Ltd.	725
96.	Delphi -TVS Diesal System Ltd.	3474
97.	Dishman Pharmaceuticals & Chemicals Ltd.	1183
98.	Divi's Laboratories Ltd.	1966
99.	DTL Ancillaries Ltd.	1915
100.	Duroshox Pvt. Ltd.	521
101.	East West Seeds India Pvt. Ltd.	2929
102.	Eastman Exports Global Clothing (P) Ltd.	4015
103.	Ecocat India Pvt. Ltd.	582
104.	Economic Explosives Ltd.	550
105.	Efftronics Systems Pvt. Ltd.	648
106.	Eicher Motors Ltd.	4830
107.	Eimco Elecon (India) Ltd.	520

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
108.	Elantas Beck India Ltd.	634
109.	Elcom Innovations Pvt. Ltd.	572
110.	Electronics Corporation of India Ltd.	4328
111.	Elgi Equipments Ltd.	3570
112.	Embio Ltd.	800
113.	Emco Ltd.	864
114.	Emerson Climate Technologies (India) Pvt. Ltd.	775
115.	Emerson Network Power (India) Pvt. Ltd.	669
116.	Enaltec Labs Pvt. Ltd.	920
117.	Encube Ethicals Pvt. Ltd.	515
118.	Endurance Technologies Ltd.	4522
119.	Engineers India Ltd.	1593
120.	Enzene Biosciences Pvt. Ltd.	2727
121.	EPR Centre For Cancer Research &Amp; Bioinformatics Pvt. Ltd.	957
122.	Essar Steel Ltd.	3350
123.	Essel Propack Ltd.	1318
124.	Eternis Fine Chemicals Ltd.	1140
125.	Eugia Pharma Specialities Ltd.	2810
126.	Everest Industries Ltd.	600
127.	Evolva Biotech Pvt. Ltd.	1100
128.	Excel Crop Care Ltd.	800
129.	Excel Industries Ltd.	525
130.	Exicom Tele-Systems Ltd.	1100
131.	Exide Industries Ltd.	1550
132.	FDC Ltd.	1977
133.	Fermenta Biotech Ltd.	658
134.	Fibcom India Ltd.	2400
135.	Fiem Industries Ltd.	1266
136.	Finoso Pharma Pvt Ltd.	802

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
137.	Flash Electronics (India) Pvt. Ltd.	655
138.	Fleetguard Filters Pvt. Ltd.	3518
139.	Flowmore Ltd.	1545
140.	Forbes Marshal Pvt. Ltd.	800
141.	FTF Pharma Pvt. Ltd.	1420
142.	G.Surgiwear Ltd.	895
143.	Gabriel India Ltd.	1200
144.	Galaxy Surfactants Ltd.	680
145.	Ganga Kaveri Seeds Pvt. Ltd.	925
146.	Garware Wall Ropes Ltd.	546
147.	General Industrial Controls Pvt. Ltd.	540
148.	Gennova Biopharmaceuticals Ltd.	1687
149.	Genus Power Infrastructures Ltd.	1200
150.	Getz Pharma Research Pvt. Ltd.	2578
151.	Gharda Chemicals Ltd.	3514
152.	Goa Shipyard Ltd.	525
153.	Godavari Biorefineries Ltd.	747
154.	Godfrey Phillips India Ltd.	1949
155.	Godrej Agrovet Ltd.	945
156.	Godrej Consumer Products Ltd.	1150
157.	Granules India Ltd.	1469
158.	Grauer & Weil (India) Ltd.	1248
159.	GRP Ltd.	1055
160.	GTZ (India) Pvt. Ltd.	506
161.	Gujarat Alkalies & Chemicals Ltd.	840
162.	Gujarat State Fertilizers & Chemicals Ltd.	960
163.	Gupta H.C. Overseas (I) Pvt. Ltd.	590
164.	Hamilton Housewares Pvt. Ltd.	696
165.	Harita Seating Systems Ltd.	530

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
166.	Havells India Ltd.	3074
167.	Hawa Valves (India) Pvt. Ltd.	1155
168.	HCL Infotech Ltd.	1500
169.	HCL Services(Subsidiary of HCL infosystems)	823
170.	Hema Engineering Industries Ltd.	559
171.	Hero Cycles Ltd.	594
172.	Hetero Drugs Ltd.	4437
173.	Hetero Healthcare Ltd.	543
174.	Hetero Labs Ltd.	2615
175.	Hikal Ltd.	3500
176.	HIL Ltd.	550
177.	Hind Rectifiers Ltd.	585
178.	Hindalco Industries Ltd.	3821
179.	Hindustan Copper Ltd.	1150
180.	Hindustan Gum & Chemicals Ltd.	510
181.	Hindustan Petroleum Corporation Ltd.	1060
182.	Hindustan Zinc Ltd.	655
183.	Hitachi Hi-Rel Electronics Pvt. Ltd.	590
184.	Hitachi Home & Life Solutions (India) Ltd.	1405
185.	HLL Lifecare Ltd.	640
186.	HPL Electric &Amp; Power Ltd.	811
187.	Huntsman International (India) Pvt. Ltd.	2846
188.	Hytech Seed India Pvt. Ltd.	1081
189.	ICOMM Tele Ltd.	1060
190.	IFB Automotive Pvt. Ltd.	680
191.	IFB Industries Ltd.	2450
192.	Incozen Therapeutics Pvt. Ltd.	1639
193.	India Glycols Ltd.	686
194.	Indian Immunologicals Ltd.	2650

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
195.	Indo Phyto Chemicals Pvt. Ltd.	695
196.	Indo-American Hybrid Seeds (India) Pvt. Ltd.	885
197.	Indoco Remedies Ltd.	1520
198.	Indofil Industries Ltd.	3150
199.	Ind-Swift Ltd.	1167
200.	Innova Rubbers Pvt. Ltd.	650
201.	Innovassynth Technologies (India) Ltd.	510
202.	International Tractors Ltd.	2850
203.	Inventia Healthcare Pvt. Ltd.	2160
204.	Invictus Oncology Pvt. Ltd.	750
205.	Ion Exchange (India) Ltd.	750
206.	Ittiam Systems Pvt. Ltd.	1141
207.	J B Chemicals & Pharmaceuticals Ltd.	3850
208.	J Mitra & Co. Pvt. Ltd.	970
209.	J. K. Fenner (India) Ltd.	1240
210.	Jain Irrigation Systems Ltd.	2602
211.	Jay Ushin Ltd.	750
212.	Jayem Automotives Ltd.,	2250
213.	JBM Auto Ltd.	1250
214.	Jindal Steel & Power Ltd.	1808
215.	JK Agri Genetics Ltd.	1578
216.	Jk Lakshmi Cement Ltd.	985
217.	JK Tyre & Industries Ltd.	3650
218.	JNS Instruments Ltd.	1334
219.	JSW Steel Ltd.	4060
220.	Jubilant Life Sciences Ltd.	1205
221.	Jyoti Cnc Automation Ltd.	1050
222.	Kabra Extrusiontechnik Ltd.	850
223.	Kajaria Ceramics Ltd.	840

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
224.	Kalpataru Power Transmission Ltd.	972
225.	Kancor Ingredients Ltd.	815
226.	Kansai Nerolac Paints Ltd.	1450
227.	Kaveri Seed Company (P) Ltd.	1183
228.	Kaynes Technology India Pvt. Ltd.	1075
229.	KEC International Ltd.	1750
230.	Kemin Industries South Asia Pvt. Ltd.	694
231.	Kemwell Biopharma Pvt. Ltd.	650
232.	Kennametal India Ltd.	1000
233.	Kimplas Piping Systems Ltd.	1140
234.	Kinetic Engineering Ltd.	660
235.	Kirloskar Brothers Ltd.	1450
236.	Kirloskar Oil Engines Ltd.	3232
237.	Kirloskar Pneumatic Co. Ltd.	690
238.	Kluber Lubrication India Pvt. Ltd.	850
239.	Kokuyo Camlin Ltd.	605
240.	KPIT Techonologies Ltd.	2227
241.	Krish Biotech Research Pvt. Ltd.	550
242.	Krishidhan Seeds Pvt. Ltd.	1132
243.	Krishna Maruti Ltd.	950
244.	KSS Abhishek Safety Systems Pvt. Ltd.	3024
245.	Kuantum Papers Ltd	1572
246.	Kusam Healthcare Pvt. Ltd	586
247.	L&T Hydrocarbon Engineering Ltd.	1233
248.	L&T Valves Ltd.	1320
249.	Lakshmi Machine Works Ltd.	1376
250.	Lakshmi Precision Screws Ltd.	792
251.	LG Balakrishnan & Brothers Ltd.	520
252.	Lincoln Pharmaceuticals Ltd.	714

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
253.	Linkwell Telesystems (P) Ltd.	795
254.	Lohia Crop Ltd.	850
255.	Lucas-Tvs Ltd.	3278
256.	Luk India Pvt. Ltd.	2374
257.	Lumax Industries Ltd.	2700
258.	Luminous Power Technologies (P) Ltd.	1900
259.	Madras Engineering Industries Pvt. Ltd.	1150
260.	Mahashakti Energy Ltd.	1090
261.	Mahindra Reva Electric Vehicles Pvt. Ltd.	3185
262.	Mahindra Agri Solutions Ltd.	837
263.	Mahindra Reva Electric Vehicles Ltd.	3185
264.	Mahindra Sona Ltd.	700
265.	Mahle Behr India Pvt. Ltd.	1376
266.	Mahle Filter Systems (India) Ltd.	910
267.	Malladi Drugs & Pharmaceuticals Ltd.	686
268.	Manatec Electronics Pvt. Ltd.	610
269.	Mando Automotive India Pvt. Ltd.	2230
270.	Manjushree Technopack Ltd.	1103
271.	Mankind Pharma Ltd.	1866
272.	Marico Ltd.	850
273.	Mark Exhaust Systems Ltd.	741
274.	Marksans Pharma Ltd.	1920
275.	Matrix Comsec Pvt. Ltd	1104
276.	Mayur Uniquoters Ltd.	820
277.	Medley Pharmaceuticals Ltd.	539
278.	Medreich Ltd.	2125
279.	Megafine Pharma Pvt. Ltd.	1025
280.	Meritor HVS (India) Ltd.	969
281.	Metahelix Life Sciences Ltd	1776

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
282.	Metrochem Api Pvt. Ltd.	670
283.	Mhindra Two Wheelers Ltd.	2224
284.	Micro Therapeutic Research Labs Pvt. Ltd.	725
285.	Minda Corporation Ltd	946
286.	Minda Industries Ltd.	2050
287.	Minda Stoneridge Instruments Ltd.	1477
288.	Mindarika Pvt. Ltd.	960
289.	Mirc Electronics Ltd.	837
290.	Mishra Dhatu Nigam Ltd.	1600
291.	MMTC-Pamp India Pvt. Ltd.	1450
292.	Modern Insulators Ltd.	670
293.	Monsanto India Ltd.	1403
294.	Moser Baer India Ltd.	1568
295.	Mother Diary Fruit & Vegetabls Pvt. Ltd.	590
296.	Motherson Sumi System Ltd.	2250
297.	MRF Ltd.	4332
298.	MRO Tek Ltd.	650
299.	MSN Laboratories Pvt. Ltd.	3229
300.	Muez Hest India Pvt. Ltd.	925
301.	Mybox Technologies Pvt. Ltd.	540
302.	Nagarjuna Agrichem Ltd.	725
303.	Nagarjuna Fertilizers & Chemicals Ltd.	1307
304.	Nath Biogene (I) Ltd.	1250
305.	National Aluminium Company Ltd.	4227
306.	National Engineering Industries Ltd.	1770
307.	Navin Fluorine International Ltd.	1905
308.	Nelcast Ltd.	1150
309.	Neo Crop International Ltd.	950
310.	Neuland Laboratories Ltd.	1065

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
311.	Neyveli Lignite Corporation Ltd.	1650
312.	Nirmal Seeds Pvt. Ltd.	981
313.	Nissan Ashok Leyland Technologies Pvt. Ltd.	4636
314.	NMDC Ltd.	2050
315.	Nova Integrated Systems Ltd.	872
316.	NRB Bearings Ltd.	850
317.	NTL Electronics India Ltd.	609
318.	Nucleus Software Exports Ltd.	4497
319.	Nunhems India Pvt. Ltd.	2628
320.	Nunhems Vegetable Seeds Pvt. Ltd.	990
321.	Nuziveedu Seeds Pvt. Ltd.	3055
322.	O/E/N India Ltd.	519
323.	Olive Lifesciences Pvt. Ltd.	650
324.	Omniactive Health Technologies Pvt. Ltd.	1196
325.	Optra Systems Pvt. Ltd.	550
326.	Orbicular Pharmaceutical Technologies Pvt. Ltd.	1415
327.	Orchid Chemicals And Pharmaceuticals Ltd.	2763
328.	Padmini VNA Mechatronics Pvt. Ltd.	960
329.	Paramount Conductors Ltd.	2650
330.	Parle Global Technologies Pvt. Ltd.	1080
331.	Perfint Healthcare Pvt. Ltd.	1196
332.	Perrigo Laboratories India Pvt. Ltd.	2927
333.	Pest Control (India)Pvt. Ltd.	573
334.	PHA India Pvt. Ltd.	550
335.	Pharmazz India Pvt. Ltd.	1476
336.	PHI Seeds Ltd.	952
337.	Philips Lighting India Ltd.	2590
338.	Phillips Carbon Black Ltd.	921
339.	Piaggio Vehicles Pvt. Ltd.	2065

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
340.	Pidilite Industries Ltd.	2289
341.	Pinnacle Industries Ltd.	525
342.	Pochiraju Industries Ltd.	800
343.	Poddar Pigments Ltd.	520
344.	Poly Medicure Ltd.	850
345.	Polycab Wires Pvt. Ltd.	560
346.	PPG Asian Paints Pvt. Ltd.	1912
347.	Pranav Vikas (I) Ltd.	870
348.	Prathista Industries Ltd.	820
349.	Precision Automation and Robotics India Ltd.	800
350.	Prescient Color Ltd.	545
351.	Pricol Ltd.	3610
352.	Privi Organics Ltd.	750
353.	Promed Exports Ltd.	1804
354.	R R Kabel Ltd.	610
355.	RA Chem Pharma Ltd.	904
356.	Radiant Corporation Pvt. Ltd.	525
357.	Raj Petro Specialities Pvt. Ltd.	589
358.	Rallis India Ltd.	2875
359.	Ramco Systems Ltd.	3829
360.	Ramtech Software Solution Pvt. Ltd.	555
361.	Ramyam Intelligence Lab Pvt. Ltd.	780
362.	Rane (Madras) Ltd.	1150
363.	Rane Brake Lining Ltd.	1700
364.	Rane Trw Steering Systems Pvt. Ltd.	772
365.	Raptakos, Brett & Co. Ltd.	610
366.	Rasayani Biologics Pvt Ltd.	1450
367.	Rashtriya Ispat Nigam Ltd.	3309
368.	Rasi Hyveg Pvt. Ltd.	1247

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
369.	Rasi Seeds (P) Ltd.	2451
370.	Raychem RRPG (P) Ltd.	1750
371.	ReGen Powertech Pvt Ltd.	550
372.	Reliance Life Sciences Pvt. Ltd.	3425
373.	Reverse Logistics Company Pvt. Ltd.	4410
374.	Rico Auto Industries Ltd.	775
375.	Rishabh Instruments Pvt. Ltd.	683
376.	RPG Life Sciences Ltd.	1498
377.	RRB Energy Ltd.	1400
378.	Rubicon Research Pvt. Ltd.	609
379.	Sahajanand Laser Technology Ltd.	595
380.	Sai Life Sciences Ltd.	975
381.	Salzer Electronics Ltd.	805
382.	Sami Labs Ltd.	883
383.	Sanden Vikas (India) Ltd.	684
384.	Sandhar Technologies Ltd.	521
385.	Sanofi-Synthelabo (India) Ltd.	3501
386.	Sanzyme Ltd.,	1015
387.	SAVA Healthcare Ltd.	509
388.	Savannah Seeds Pvt. Ltd.	934
389.	SEE Linkages Pvt. Ltd.	505
390.	Seedworks International Pvt. Ltd.	1291
391.	Selec Controls Pvt. Ltd.	650
392.	Semler Research Centre Pvt Ltd.	622
393.	Sequent Scientific Ltd.	1138
394.	Setco Automotive Ltd.	750
395.	SFO Technologies Pvt. Ltd.	896
396.	Sh Kelkar & Company Pvt. Ltd.	1362
397.	Sharda Motor Industries Ltd.	735

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
398.	Shilpa Medicare Ltd.	3044
399.	Shipla Biotech Pvt. Ltd.	1296.
400.	Shree Cement Ltd.	1750
401.	Shreem Electric Ltd.	1249
402.	Shriram Pistons & Rings Ltd.	1452
403.	Simpson & Co. Ltd.	1500
404.	Skanray Technologies Pvt. Ltd.	1107
405.	Ski Carbon Black (India) Pvt. Ltd.	1228
406.	Smilax Laboratories Ltd.	840
407.	SML Isuzu Ltd.	1775
408.	SMR Automotive Systems India Ltd.	725
409.	SMS Pharmaceuticals Ltd.	540
410.	Solar Industries India Ltd.	750
411.	Sphaera Pharma Pvt. Ltd.	1280
412.	Spicer India Pvt. Ltd.	987
413.	Srin Kaliswari Fireworks Pvt Ltd.	520
414.	Sripathi Paper And Boards Pvt. Ltd.	1893
415.	Steel Strips Wheels Ltd.	774
416.	Stelis Biopharma Pvt. Ltd.	4850
417.	Stellence Pharmscience Ltd.	608
418.	Stempeutics Research Pvt. Ltd.	2128
419.	Sterlite Technologies Ltd.	2500
420.	Strand Life Sciences Pvt. Ltd.	1968
421.	Structwel Designers & Consultants Pvt. Ltd.	1055
422.	Subros Ltd.	2950
423.	Sud Chemie India Ltd.	1275
424.	Sudarshan Chemical Industries Ltd.	989
425.	Suguna Foods Pvt. Ltd.	1216
426.	Su-Kam Power Systems Ltd.	2200

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
427.	Sun Edison Research Pvt. Ltd.	3673
428.	Sundaram Brake Linings Ltd.	850
429.	Sundaram Clayton Ltd.	1100
430.	Sundaram Fastners Ltd.	1725
431.	Super Agri Seeds Pvt. Ltd.	700
432.	Symed Labs Ltd.	1444
433.	Symmetrix Biotech Pvt. Ltd.	2958
434.	Syngenta Biosciences Pvt. Ltd.	1106
435.	Tafe Motors And Tractors Ltd.	4909
436.	Tally Solutions Pvt. Ltd.	1985
437.	Tamil Nadu Newsprint and Papers Ltd.	650
438.	Tata Advanced Systems Ltd.	623
439.	TATA Autocomp Hendrickson Suspensions Pvt. Ltd.	836
440.	Tata Autocomp Systems Ltd.	1478
441.	Tata Cummins Pvt. Ltd.	2940
442.	Tata Elxsi Ltd.	1631
443.	Tata Toyo Radiator Ltd.	818
444.	TD Power Systems Ltd.	840
445.	TEVA Api India Ltd.	3500
446.	Tevapharm India Pvt. Ltd.	4451
447.	The Century Textiles & Industries Ltd.	546
448.	The kerala Mineral &Metals Ltd.	1200
449.	Therdose Pharma Pvt. Ltd.	2488
450.	Thermax Ltd.	2799
451.	THINQ Pharma-Cro Ltd.	568
452.	Thyssenkrupp Industries India Pvt. Ltd.	855
453.	Titan Company Ltd.	4070
454.	Titan Laboratories Pvt. Ltd.	550
455.	TML Drivelines Ltd.	1050

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
456.	Toshiba Machine (Chennai) Pvt. Ltd.	560
457.	Tractors & Farm Equipment Ltd.	3943
458.	Transasia Bio-Medicals Ltd.	1579
459.	Transgene Biotek Ltd.	1200
460.	TRF Ltd.	935
461.	Trimurti Plant Sciences Pvt. Ltd.	610
462.	Triveni Turbine Ltd.	1250
463.	TRL Krosaki Refractories Ltd.	800
464.	Tube Investments Of India Ltd.	2120
465.	Turbo Energy Ltd.	2600
466.	Tuscano Equipments Pvt. Ltd.	845
467.	TVS Srichakra Ltd.	2359
468.	Ucal Fuel Systems Ltd.	850
469.	Uflex Ltd.	575
470.	Ultratech Cement Ltd.	2731
471.	Umedica Laboratories Pvt. Ltd.	2223
472.	Unijules Life Science Ltd.	1200
473.	Unison Pharmaceuticals Pvt. Ltd.	775
474.	United Genetics India Pvt. Ltd.	615
475.	United Spirits Ltd.	835
476.	United States Pharmacopeia India Pvt. Ltd.	4108
477.	USHA International Ltd.	539
478.	Uurmi Systems Pvt Ltd.	550
479.	Varroc Engineering Pvt. Ltd.	3287
480.	Vector Bioscience Pvt. Ltd.	623
481.	Veera Vahana Udyog Pvt. Ltd.	683
482.	VEM Technologies Pvt. Ltd.	661
483.	Venco Research & Breeding Farm Ltd.	4197

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. in lakhs) *
484.	Venkateshwara Hatcheries Pvt. Ltd.	1525
485.	Venkateshwara Research & Breeding Farm (P) Ltd.	2255
486.	Venus Remedies Ltd.	2100
487.	Vergo Pharma Research Laboratories .	1886
488.	V-Guard Industries Ltd.	910
489.	Videocon Industries Ltd.	840
490.	Virchow Biotech Pvt. Ltd.	1050
491.	Visteon Automotive Systems India Pvt. Ltd.	1317
492.	Vivimed Labs Ltd.	1670
493.	Voltas Ltd.	578
494.	Vrinda Technologies Pvt. Ltd.	802
495.	VVDN Technologies Pvt. Ltd.	1258
496.	Vyome Biosciences Pvt. Ltd.	1545
497.	WABCO-TVS (India) Ltd.	1215
498.	Wanbury Ltd.	1400
499.	Welspun India Ltd.	1758
500.	Welspun Syntex Ltd.	775
501.	Wendt India Ltd.	800
502.	Wheels India Ltd.	1653
503.	Whirlpool of India Ltd.	3525
504.	WILO Mather And Platt Pumps Pvt. Ltd.	618
505.	Windlas Healthcare (P) Ltd.	1800
506.	Yazaki India Pvt. Ltd.	1120
507.	Zen Technologies Ltd.	832
508.	ZIM Laboratories Ltd.	605
509.	Zuventus Healthcare Ltd.	575

ANNEXURE – 7

LIST OF IN-HOUSE R&D UNITS IN INDUSTRY REPORTING ANNUAL EXPENDITURE IN THE RANGE OF RS. 200 Lakhs To RS. 500 Lakhs

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
1.	20 Microns Nano Minerals Ltd.	220
2.	A2Z Filtration Specialities Pvt. Ltd.	355
3.	Aban Infrastructure Pvt. Ltd.	470
4.	Ace Manufacturing Systems Ltd.	483
5.	Achira Labs Pvt Ltd.	418
6.	Acme Formulation Pvt. Ltd.	406
7.	Aditya Auto Products & Engineering (India) Pvt. Ltd.	310
8.	Ador Powertron Ltd.	218
9.	Ador Welding Ltd.	410
10.	Advanced Microdevices Pvt. Ltd.	210
11.	Advanced Neuro-Science Allies Pvt. Ltd.	350
12.	Aeon Formulations Pvt. Ltd.	307
13.	Agappe Diagnostics Ltd.	225
14.	Agro Tech Foods Ltd.	394
15.	Albert David Ltd.	480
16.	Alchem International Pvt. Ltd.	270
17.	Allied Nippon Ltd.	265
18.	ALP Nishikawa Company Pvt. Ltd.	475
19.	Ama Herbal Laboratories Pvt. Ltd.	341
20.	American Megatrends India Pvt. Ltd.	428
21.	Ami Life Sciences Pvt. Ltd.	441

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
22.	Ami Organics Pvt. Ltd.	320
23.	Amol Pharmaceuticals Pvt. Ltd.	360
24.	Amtech Electronics (India) Ltd.	240
25.	Anabond Ltd.	260
26.	Analinear Design Technologies Pvt. Ltd.	245
27.	Anand Teknow Aids Engineering India Ltd.	255
28.	Anandnvh Products Pvt. Ltd.	412
29.	Anuh Pharma Ltd.	250
30.	Apar Industries Ltd.	310
31.	Appasamy Ocular Devices (P) Ltd.	210
32.	Applied Electro Magnetics Pvt. Ltd.	249
33.	Aquapharm Chemicals Pvt. Ltd.	205
34.	Aquatech Systems (Asia) Pvt. Ltd.	355
35.	Arjuna Natural Extracts Ltd.	460
36.	Arkray Healthcare Pvt. Ltd.	250
37.	Aron Universal Ltd.	216
38.	Arya Vaidya Pharmacy (Coimbatore) Ltd.	250
39.	Ashida Electronics Pvt. Ltd.	290
40.	Associated Soapstone Distributing Company Pvt. Ltd.	260
41.	Astec Lifesciences Ltd.	325
42.	Atlas Dyechem (India) Pvt. Ltd.	250
43.	Ats Elgi Ltd.	350
44.	Ava Cholayil Healthcare Pvt. Ltd.	206
45.	Avra Laboratories Pvt. Ltd.	330
46.	AVT Natural Products Ltd.	435
47.	Axxonet System Technologies Pvt. Ltd.	262
48.	Bajaj Healthcare Ltd.	232
49.	Bangalore Biotech Labs Pvt. Ltd.	220

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
50.	Barrix Agro Sciences Pvt. Ltd.	429
51.	BDR Pharmaceutical International Pvt. Ltd.	473
52.	Beloorbayir Biotech Ltd.	220
53.	Bench Bio Pvt. Ltd.	375
54.	Bharat Aluminium Company Ltd.	378
55.	Bharat Bio-Tech International Ltd.	466
56.	Bharat Fritz Werner Ltd.	220
57.	Bhat Bio-Tech India (P) Ltd.	250
58.	Bimetal Bearings Ltd.	250
59.	Biostadt India Ltd.	225
60.	Bioviz Technologies Pvt. Ltd.	261
61.	BMC Electroplast Pvt. Ltd.	340
62.	Bosch Chassis Systems India Pvt. Ltd.	391
63.	Bry-Air (Asia) Pvt. Ltd.	225
64.	Camlin Fine Sciences Ltd.	280
65.	Canara Hydraulics Pvt. Ltd.	462
66.	Carborundum Universal Ltd.	450
67.	Centum Electronics Ltd.	397
68.	Centum Rakon India Pvt. Ltd.	360
69.	Charak Pharma Pvt. Ltd.	350
70.	Chembond Chemicals Ltd.	245
71.	Chheda Electricals And Electronics Pvt. Ltd.	351
72.	Cholayil Pvt. Ltd.	358
73.	Cikautxo India Pvt. Ltd.	220
74.	Clonz Biotech Pvt. Ltd.	220
75.	Concept Pharmaceuticals Ltd.	335
76.	Connectwell Industries Pvt. Ltd.	320
77.	Construction Catalysers Pvt. Ltd.	263

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
78.	Continental Carbon India Ltd.	245
79.	Coral Drugs Pvt. Ltd.	450
80.	Crest Biotech Pvt. Ltd.	325
81.	Croda India Company Pvt. Ltd.	466
82.	Crystal Crop Protection Pvt. Ltd.	421
83.	Ctr Mfg Industries Ltd.	432
84.	CTX Lifesciences Pvt. Ltd.	225
85.	Cyient Ltd.	228
86.	Datt Mediproducts Pvt. Ltd.	218
87.	Deepak Fertilisers And Petrochemicals Corporation Ltd.	250
88.	Deepti Electronics &Amp; Electro-Optics Pvt. Ltd.	350
89.	Deki Electronics Ltd.	244
90.	Desiccant Rotors International Pvt. Ltd.	230
91.	Dhanuka Agritech Ltd.	275
92.	Dhoot Transmission Pvt. Ltd.	325
93.	DIC India Ltd.	300
94.	Doehler India Pvt. Ltd.	229
95.	Dorf Ketal Chemicals India Pvt. Ltd.	450
96.	Durovalves India Pvt. Ltd.	350
97.	Econ Metallic (India) Pvt. Ltd.	280
98.	E-Con Systems India Pvt. Ltd.	453
99.	Eesavyasa Technologies Pvt. Ltd.	325
100.	EICL Ltd.	368
101.	EID Parry (India) Ltd.	379
102.	Eldorado Agritech Pvt. Ltd.	295
103.	Elecon Engineering Company Ltd.	355
104.	Elecon Measurements Pvt. Ltd.	320
105.	Electrolab India Pvt. Ltd.	275

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
106.	Electropneumatics & Hydraulics (India) Pvt. Ltd.	325
107.	Elico Ltd.	250
108.	Elin Electronics Ltd.	450
109.	Elofic Industries Ltd.	220
110.	Elpro Energy Dimension Pvt. Ltd.	290
111.	Emmbi Industries Ltd.	425
112.	Encardio-Rite Electronics Pvt. Ltd.	250
113.	Envision Scientific Pvt. Ltd.	383
114.	Erkadi Medical Systems Pvt. Ltd.	220
115.	Essae- Teraoka Ltd.	370
116.	Eveready Industries India Ltd.	490
117.	Everest Organics Ltd.	264
118.	Evolute Systems Pvt. Ltd.	450
119.	Ewac Alloys Ltd.	250
120.	Fabtech Technologies International Ltd.	350
121.	Filtra Catalysts & Chemicals Ltd.	285
122.	Fizzy Foodlabs Pvt. Ltd.	250
123.	Flamingo Pharmaceuticals Ltd.	325
124.	Formulated Polymers Ltd.	255
125.	Forus Health Pvt. Ltd.	322
126.	Fowler Westrup (India) Pvt. Ltd.	230
127.	Frog Cellsat Ltd.	450
128.	Gammon India Ltd.	250
129.	Gandhar Oil Refinery India Ltd.	368
130.	GCC Biotech India Pvt. Ltd.	250
131.	G-Cube Web wide Software Pvt. Ltd	351
132.	Genome Life Science Pvt. Ltd.	307
133.	Gland Chemicals Pvt. Ltd.	450

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
134.	Glaxo Smithkline Pharmaceuiticals Ltd.	304
135.	Global Calcium Pvt Ltd.	375
136.	Globion India Pvt. Ltd.	320
137.	Godrej Industries Ltd.	350
138.	Greensignal Bio Pharma Ltd.	275
139.	GSP Crop Science Pvt. Ltd.	260
140.	Gujarat Metal Cast Industries Ltd.	291
141.	Gujarat Narmada Valley Fertlizers & Chemicals Ltd.	243
142.	Gulbrandsen Chemicals Pvt. Ltd.	415
143.	Gulf Oil Lubricants India Ltd.	364
144.	Gumpro Drilling Fluids Pvt. Ltd.	288
145.	H&R Johnson (India)(A Division Of Prism Cement Ltd.)	289
146.	Hanon Climate System India Pvt. Ltd.	450
147.	HCL Learning (Subsidiary of HCL Infosystems)	490
148.	Heinz India Pvt. Ltd.	489
149.	Hester Biosciences Ltd.	450
150.	Heubach Colour Pvt. Ltd.	321
151.	Hi Tech Bio- Science India Ltd.	201
152.	Himadri Chemicals and Industries Ltd.	430
153.	Hi-Media Laboratories Pvt. Ltd.	253
154.	Hindustan Shipyard Ltd.	480
155.	Hi-Tech Gears Ltd.	453
156.	Hitesh Plast Ltd.	485
157.	HMT Ltd.(Tractor Division)	310
158.	Hogannas India Pvt. Ltd.	460
159.	HPL Additives Ltd.	450
160.	Huber+Suhner Electronics Pvt. Ltd.	402
161.	Hy-Gro Chemicals Pharmtek Pvt. Ltd.	440

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
162.	ICPAHealth Products Ltd.	430
163.	Ideal Cures Pvt. Ltd.	363
164.	Imperial Auto Industries Ltd.	390
165.	Indbro Research And Breeding Farms Pvt. Ltd.	226
166.	Indfrag Ltd.	220
167.	India Japan Lighting (P) Ltd.	425
168.	India Nippon Electricals Ltd.	358
169.	India Pistons Ltd.	325
170.	Indo Colchem Pvt. Ltd.	295
171.	Indo Us Bio Tech Pvt. Ltd.	257
172.	Indovax Pvt. Ltd.	220
173.	Ingersoll Rand India Pvt. Ltd.	210
174.	Inspiron Engineering Pvt. Ltd.	208
175.	Intellect Design Arena Ltd.	287
176.	Intelux Electronics Pvt. Ltd.	312
177.	International Panaacea Ltd.	258
178.	Intervet India Pvt. Ltd.	490
179.	Inventys Research Company Pvt. Ltd.	231
180.	IOL Chemicals and Pharmaceuticals Ltd.	350
181.	ISMT Ltd.	350
182.	ISSAR Pharmaceuticals Pvt. Ltd.	340
183.	Jaipur Rugs Company Pvt. Ltd.	275
184.	Janatics India Pvt. Ltd.	450
185.	Jay Chemical Industries Ltd.	240
186.	Jaya Hind Industries Ltd.	257
187.	Jayant Agro-Organics Ltd.	223
188.	Jayashree Polymers Pvt. Ltd.	462
189.	JCBL Ltd.	247

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
190.	Jesons Industries Ltd.	329
191.	JKPaper Ltd.	439
192.	JSL Lifestyle Ltd.	250
193.	JSW Steel Coated Products Ltd.	410
194.	Jyoti Ltd.	470
195.	Kalash Seeds Pvt. Ltd	205
196.	Kalyani Carpenter Special Steels Pvt. Ltd.	250
197.	Kalyani Maxion Wheels Ltd.	327
198.	Kandui Industries Pvt. Ltd.	302
199.	Kaypeeyes Biotech Pvt. Ltd.	278
200.	Kerala Ayurveda Ltd.	325
201.	Kesoram Industries Ltd.	450
202.	Kimia Biosciences Pvt. Ltd.	244
203.	Kiran Global Chems Ltd.	423
204.	Kirtiman Agro Genetics Ltd.	438
205.	Kritikal Securescan Pvt. Ltd.	250
206.	Kumar Organic Products Ltd.	220
207.	L& T Construction Equipment Ltd.	446
208.	LA Renon Health Care Pvt. Ltd.	237
209.	Labindia Analytical Instruments Pvt. Ltd.	280
210.	Laila Pharmaceuticals Pvt. Ltd.	243
211.	Lamco Industries Pvt. Ltd.	380
212.	Laxmi Hydraulics Pvt. Ltd.	320
213.	Laxmi Organic Industries Ltd.	253
214.	Leadinvent Technologies Pvt. Ltd.	250
215.	Lee Pharma Ltd.	225
216.	Lifecell International Pvt. Ltd.	231
217.	Loba Chemie Pvt. Ltd	304

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
218.	Lumax Mannoh Allied Technologies Ltd.	365
219.	Lyka Labs Ltd.	232
220.	Mahabal Metals Pvt. Ltd.	226
221.	Mangalam Alloys Ltd.	394
222.	Mangalam Cement Ltd.	400
223.	Manugraph India Ltd.	317
224.	Max Speciality Films Ltd.	275
225.	Maxwatt Turbines Pvt. Ltd.	340
226.	Mecon Ltd.	263
227.	Mediatronix Pvt. Ltd.	325
228.	Meghmani Industries Ltd.	250
229.	Meghmani Organics Ltd.	358
230.	Mehru Electrical And Mechanical Engineers Pvt. Ltd.	355
231.	Merck Ltd.	449
232.	Metallizing Equipment Co. Pvt. Ltd.	320
233.	Metalman Auto Pvt. Ltd.	493
234.	Mic Electronics Ltd.	375
235.	Micromatic Grinding Technologies Ltd.	225
236.	Minda Vast Access Systems Pvt. Ltd.	493
237.	Mitra Biotech Pvt. Ltd.	496
238.	MKU Pvt. Ltd.	277
239.	Modi Mundipharma Pvt. Ltd.	283
240.	Motwane Manufacturing Co. Pvt. Ltd.	210
241.	Mukand Ltd.	250
242.	Murugappa Morgan Thermal Ceramics Ltd.	255
243.	Napino Auto And Electronics Ltd.	466
244.	Naprod Life Sciences Pvt. Ltd.	410
245.	Natesan Synchrocones Pvt Ltd	350

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
246.	Natsol Laboratories Pvt. Ltd.	250
247.	Natural Remedies Pvt. Ltd.	440
248.	Navya Biologicals Pvt. Ltd.	460
249.	Nicco Corporation Ltd.	275
250.	Nitta Gelatin India Ltd.	470
251.	Noble Seeds Pvt. Ltd.	310
252.	NOCIL Ltd.	405
253.	Nongwoo Seed India Pvt. Ltd.	240
254.	Nosch Labs Pvt. Ltd.	384
255.	Novalead Pharma Pvt. Ltd.	272
256.	NRB Industrial Bearings Ltd.	255
257.	Nulife Global Medical Devices Pvt. Ltd.	232
258.	Ocl India Ltd.	330
259.	Omax Autos Ltd.	271
260.	Omkar Speciality Chemicals Ltd.	325
261.	Optimus Drugs Pvt. Ltd.	260
262.	Optrix Laboratories Pvt. Ltd.	425
263.	Orange Sorting Machines (India) Pvt. Ltd.	235
264.	Oswal Industries Ltd.	230
265.	Oxygen Healthcare Research Pvt. Ltd.	375
266.	Paharpur Cooling Towers Ltd.	210
267.	Panacea Medical Technologies Pvt. Ltd.	412
268.	Paracoat Products Ltd.	370
269.	Paranjape Autocast Pvt. Ltd.	265
270.	Parason Machinery (I) Pvt. Ltd.	310
271.	Parthys Reverse Informatics Analytic Solutions Pvt. Ltd.	455
272.	Pathpartner Technology Pvt. Ltd.	324
273.	Persistent Systems Ltd.	450

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
274.	Pitambari Products Pvt. Ltd.	279
275.	Plant Lipids (P) Ltd.	225
276.	Plastiblends India Ltd.	275
277.	Plazma Technologies Pvt. Ltd.	245
278.	Pointred Telecom Ltd.	335
279.	Polyplastics Industries (India) Pvt. Ltd.	350
280.	Polyplex Corporation Ltd.	325
281.	Porus Laboratories Pvt. Ltd.	280
282.	Prakruti Products Pvt. Ltd.	275
283.	Pratishthan Alloys Pvt. Ltd.	220
284.	Precision Electronics Ltd.	330
285.	Premas Biotech Pvt. Ltd.	250
286.	Premier Seals (India) Pvt. Ltd.	275
287.	Premium Transmission Ltd.	285
288.	Prima Telecom Ltd.	215
289.	Promptec Renewable Energy Solutions Pvt. Ltd.	275
290.	Psychotropics India Ltd.	496
291.	Pulse Pharmaceuticals Pvt. Ltd.	307
292.	Quad Lifesciences Pvt. Ltd.	350
293.	R. N. Gupta and Company Ltd.	270
294.	Radix Electrosystems Pvt. Ltd.	407
295.	Rajasthan Antibiotics Ltd.	434
296.	Rajasthan Electronics & Instruments Ltd.	270
297.	Rashtriya Chemicals & Fertilizers Ltd.	430
298.	Ravindranath G.E. Medical Associates Pvt. Ltd.	401
299.	Regenerative Medical Services Pvt. Ltd.	276
300.	Relisys Medical Devices Ltd.	350
301.	Renu Electronics Pvt. Ltd.	455

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
302.	Resil Chemicals Pvt. Ltd.	402
303.	Rex-Tone Industries Ltd.	450
304.	River Engineering Pvt. Ltd.	350
305.	RJ Biotech Pvt. Ltd.	250
306.	Rockman Industries Ltd.	221
307.	Romsons Scientific and Surgical Industries Pvt. Ltd.	230
308.	Rossari Biotech Ltd.	235
309.	Ruchi Soya Industries Ltd.	345
310.	S. Kant Healthcare Ltd.	250
311.	S.V.A. Rikkon Lubes Pvt. Ltd.	338
312.	Sahajanand Medical Technologies Pvt. Ltd.	279
313.	Sahajanand Technologies Pvt. Ltd.	423
314.	Sakata Seed India (P) Ltd.	370
315.	San Engg & Locomotive Co. Ltd.	330
316.	Sandvik Asia Ltd.	300
317.	Sapala Organics Pvt. Ltd.	385
318.	Sasken Communication Technologies Ltd.	330
319.	Saurav Chemicals Ltd.	210
320.	Saveer Biotech Ltd.	280
321.	Savita Oil Technologies Ltd.	490
322.	Sea6 Energy Pvt. Ltd.	340
323.	Servall Engineering Works (P) Ltd.	315
324.	Shaily Engineering Plastics Ltd.	225
325.	Shalimar Paints Ltd.	227
326.	Sheel Biotech Ltd.	350
327.	Shivashakti Biotechnologies Ltd.	235
328.	Siechem Technologies Pvt. Ltd.	265
329.	Sieger Spintech Equipments Pvt. Ltd.	250

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
330.	Sigma Electric Manufacturing Corporation Pvt. Ltd.	450
331.	SLN Technologies Pvt. Ltd.	216
332.	Snam Alloys Pvt. Ltd.	300
333.	Solus Security Systems Pvt. Ltd.	210
334.	Sona Koyo Steering Systems Ltd.	450
335.	Sowbhagya Biotech Pvt. Ltd.	260
336.	Span Diagnostics Ltd.	244
337.	Spray Engineering Devices Ltd.	402
338.	Sri Biotech Laboratories India Ltd.	220
339.	Sri Research For Tissue Engineering Pvt. Ltd.	260
340.	Sri Sathya Agri Biotech Pvt. Ltd.	275
341.	SSP Pvt. Ltd.	330
342.	Stabicon Life Sciences Pvt. Ltd.	426
343.	Stanadyne Amalgamations Pvt. Ltd.	340
344.	Star Engineering (I) Pvt. Ltd.	250
345.	Steer Engineering Pvt. Ltd.	470
346.	Stone India Ltd.	260
347.	Stumpp, Schuele and Somappa Springs Pvt. Ltd.	450
348.	Sundaram Industries Pvt. Ltd.	230
349.	Sungro Seeds Ltd.	470
350.	Suraj Cropsciences Ltd.	246
351.	Survival Technologies Pvt. Ltd.	317
352.	Surya Roshni Ltd.	435
353.	Swagene Pvt. Ltd.	276
354.	Symbiotec Pharmalab Ltd.	450
355.	Symega Savoury Technology Ltd.	325
356.	Symphony Ltd.	440
357.	Synthite Industries Ltd.	330

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
358.	T Stanes & Company Ltd.	320
359.	Tagros Chemicals India Ltd.	500
360.	Talbros Automotive Components Ltd.	301
361.	Tasty Bite Eatables Ltd.	268
362.	Tata Ficosa Automotive Systems Pvt. Ltd.	230
363.	Tata International Ltd.	350
364.	Tecmuseh Products India Pvt. Ltd.	450
365.	The Andhra Sugars Ltd.	350
366.	The Hi-Tech Robotic System Ltd.	205
367.	The India Cement Ltd.	225
368.	The Indian Hume Pipe Company Ltd.	348
369.	Thirumalai Chemicals Ltd.	270
370.	Tide Water Oil Co. (India) Ltd.	425
371.	Tierra Seed Science Pvt. Ltd.	346
372.	Tirth Agro Technology Pvt Ltd.	300
373.	Transpek - Silox Industry Pvt. Ltd.	365
374.	Triesta Sciences (Unit Of HCG) Triesta Sciences (India) Pvt. Ltd.	380
375.	Trimex Sands Pvt. Ltd.	272
376.	Triton Valves Ltd.	250
377.	Trivitron Healthcare Pvt. Ltd.	350
378.	Troikaa Pharmaceuticals Ltd.	485
379.	TTK Prestige Ltd.	354
380.	TTP Technologies Pvt. Ltd.	484
381.	Ucam Pvt. Ltd.	209
382.	Ukb Electronics Pvt. Ltd.	450
383.	Ultra International Ltd.	225
384.	Uni-Tech Automation Pvt. Ltd.	263
385.	Unitech Machines Ltd.	312

Sl. No.	Name of the firm	R&D Expenditure Reported (Rs. In lakhs) *
386.	United Biotech (P) Ltd.	280
387.	United Telecoms Ltd.	406
388.	Universal Construction Machinery & Equipment Ltd.	320
389.	V Clinbio Labs Pvt. Ltd.	250
390.	V.B. Medicare Pvt. Ltd.	349
391.	Vaishnavi Biotech Ltd.	450
392.	Vanaz Engineers Ltd.	207
393.	Varuna Biocell Pvt. Ltd.	256
394.	Vasudha Pharma Chem Ltd.	384
395.	Vidya Herbs Pvt. Ltd.	226
396.	Vimta Labs Ltd.	230
397.	Viney Corporation Ltd.	400
398.	Vins Bioproducts Ltd.	310
399.	Vinvish Technologies Pvt. Ltd.	250
400.	VIP Industries Ltd.	235
401.	Virdis Biopharma Pvt Ltd.	410
402.	Viswaat Chemicals Ltd.	396
403.	Vivo Bio Tech Ltd.	337
404.	VST Tillers Tractors Ltd.	225
405.	Vulcan Industrial Engineering Company Ltd.	343
406.	Warade Packtech Pvt. Ltd.	415
407.	Windlas Biotech Ltd.	300
408.	Wires And Fabriks (SA) Ltd.	450
409.	Xcelris Labs Ltd.	325
410.	Yashraj Biotechnology Ltd.	250
411.	ZCL Chemicals Ltd.	420

* **R&D expenditures reported are as claimed by the firms in their available Annual reports in DSIR/ renewal applications.**

ANNEXURE – 8

LIST OF SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATIONS (SIROS) RECOGNIZED BY DSIR DURING THE PERIOD

January 2016 to December 2016

Sl. No.	Name of the Institute	Recognition granted up to
NATURAL AND APPLIED SCIENCES		
1.	Dr. B.V. Raju Foundation, Hyderabad	31.03.2018
2.	CMR Technical Education Society, Hyderabad, Telangana	31.03.2018
3.	Kishore Memorial Charitable Trust, Khordha, Odisha	31.03.2018
4.	St. Vincent Educational Society, Hyderabad	31.03.2017
5.	Aladipatti Vaithyalinga Nadar Pathrakaliammal Educational and Charitable Trust, Tirunelveli, Tamil Nadu	31.03.2018
6.	Er. Perumal Manimekalai Telugu Minority Educational and Charitable Trust, Hosur, Tamil Nadu	31.03.2018
7.	Sumandeep Vidyapeeth, District Vadodara, Gujarat	31.03.2018
8.	Sree Sastha Insitute of Engineering and Technology of A.M.Kanniappa Mudaliar and A.M.K Jambulinga Mudaliar Educational Trust, Chennai, Tamil Nadu	31.03.2018
9.	Maruthi Educatinal Society, Hyderabad	31.03.2018
10.	Marri Educational Society, Secundrabad	31.03.2018
11.	Sanjivani Rural Educational Society, District Ahmednagar, Maharashtra	31.03.2018
12.	Maratha Mandal Trust, Belgaum, Karnataka	31.03.2018
13.	Sagi Ramakrishnam Raju Engineering College Association, West Godavari District, Andhra Pradesh	31.03.2019
14.	Sethu Educational Trust, Madurai, Tamil Nadu	31.03.2019
15.	Valliammai Society, Chennai, Tamil Nadu	31.03.2019
16.	Gujarat Environment Management Institute, Gandhinagar, Gujarat	31.03.2019
17.	Aditya Institute of Technology and Management of Aditya Educational Society, Tekkali, Andhra Pradesh	31.03.2019
18.	MSME-Technology Development Centre, Process cum Product Development Centre (PPDC), Meerut, Uttar Pradesh	31.03.2019

Sl. No.	Name of the Institute	Recognition granted up to
19.	St. Martin's Children's Educational Society, Secunderabad, Telangana	31.03.2019
20.	SHARDAYA College of Engineering and Technology of Irinjalakuda Diocesan Educational Trust, Thrissur, Kerala	31.03.2019
21.	Gujarat Industrial Research Development Agency (GIRDA), Vadodara, Gujarat	31.03.2019
22.	JK Lakshmipat University, Jaipur, Rajasthan	31.03.2019
23.	Ayurvet Research Foundation, Delhi	31.03.2019
24.	Chockalingam Trust, Salem, Tamil Nadu	31.03.2019
25.	Tamil Nadu Food grains Marketing Yard (TFMY), Madurai	31.03.2019
AGRICULTURAL SCIENCES		
26.	Akhil Bhartiya Grameen Vikas Sanstha, New Delhi	31.03.2019
SOCIAL SCIENCES		
27.	Deepak Foundation, Vadodara, Gujarat	31.03.2019
28.	Institute of Applied Statistics & Development Studies, Lucknow, Uttar Pradesh	31.03.2019
29.	Tata Institute of Social Sciences (TISS), Deonar, Mumbai	31.03.2019
30.	Haryali Centre for Rural Development, New Delhi	31.03.2019
MEDICAL SCIENCES		
31.	Samatvam Science and Research for Human Welfare Trust, Bangalore, Karnataka	31.03.2018
32.	Indian Burns Research Society, Navi Mumbai, Maharashtra	31.03.2018
33.	Indian Pharmacopoeia Commission, Ghaziabad, Uttar Pradesh	31.03.2018
34.	St. Martha's Hospital, Bangalore, Karnataka	31.03.2019
35.	Maa Research Foundation, Hyderabad, Telangana	31.03.2019
36.	Institute of Bioinformatics and Computational Biology (IBCB), Visakhapatnam	31.03.2018
37.	Institute for Communicative & Cognitive Neurosciences, Palakkad, Kerala	31.03.2019
38.	Jeevan Blood Bank and Research Centre, Chennai, Tamil Nadu	31.03.2019
39.	Jan Swasthya Sahyog, New Delhi	31.03.2019
40.	Dabur Research Foundation, New Delhi	31.03.2019
41.	CVS Krishna Murthy Theja Charities, Tirupati, Andhra Pradesh	31.03.2019
42.	Centre for Brain Research, Bangalore, Karnataka	31.03.2019
43.	Shri Dharamsthala Manjunatheshwara Educational Society (Regd.), Ujire, Karnataka	31.03.2019
44.	Integral University, Lucknow, Uttar Pradesh	31.03.2019
45.	KMCH Research Foundation, Coimbatore, Tamil Nadu	31.03.2018
46.	Shafa Educational Society, Nandyal, Andhra Pradesh	31.03.2019
47.	Genome Foundation, Hyderabad	31.03.2019
48.	Dystrophy Annihilation Research Trust, Bangalore	31.03.2019

ANNEXURE – 9

CERTIFICATES FOR CLAIMING ACCELERATED DEPRECIATION ALLOWANCE ISSUED BY DSIR UNDER RULE 5(2) OF I.T. RULES VIDE NOTIFICATION NO. 133/342/86-TPL DATED 1.4.1987

Sl. No.	Name of the Company	Source of Know-how/ Technology	Item of Manufacture	Investments Certified (Rs. In lakhs)
1.	Bharat Electronics Ltd,	Defence Research & Development Laboratories and In-house R&D centre	Electronic equipment & systems for Defence	F.Y. 2014-15 Rs. 7939.59 lakhs
		Total		Rs. 7939.59 lakhs

ANNEXURE – 10

CERTIFICATE FOR CLAIMING CENTRAL EXCISE DUTY EXEMPTION FOR THREE YEARS AS PER NOTIFICATION NO. 13/99-CE DATED 28TH FEBRUARY, 1999

S.No.	Name of the Company	Product for exemption	Patented Technology
1.	M/s Troikaa Pharmaceuticals Ltd., Ahmedabad	Diclofenac Injection	Novel injectable formulation of Diclofenac salt manufactured by its patented & unique Aquatech process providing the route & site of injection advantage and achieving higher concentration of salt.
2.	M/s Venus Remedies Limited, Panchkula	Ceftriaxone/disodium edentate/sulbactam - ELORES	A combination of ceftriaxone (a beta-lactam) + sulbactum (a beta lactamase inhibitor) along with disodium Edetate as non-antibiotic adjuvant.
3	M/s Venus Remedies Limited, Panchkula	Cefepime & Amikacin - POTENTOX	An antibiotic product containing cefepime (a beta lactam antibiotic), Amikacin (an aminoglycoside antibiotic) with L-arginine as stabilizing agent for treatment of drug resistant gram negative bacteria causing severe infections.
4.	M/s Venus Remedies Limited, Panchkula	Ceftriaxone & vancomycin - Vancoplus	A novel antibiotic combination comprising of glycopeptides, cephalosporin and an excipient that works in MRSA and hGISA type of resistance of gram positive bacteria.
5.	M/s Venus Remedies Limited, Panchkula	Aceclofenac- Achnil	A controlled release parenteral formulation for treatment of pain and inflammation is provided

ANNEXURE – 11

LIST OF COMPANIES APPROVED U/S 35(2AB) OF INCOME TAX ACT, 1961 DURING THE YEAR 2016

1. Acme Formulation Pvt. Ltd.
2. Curadev Pharma Pvt. Ltd.
3. Century Textiles and Industries Ltd.
4. Barrix Agro Sciences Pvt. Ltd.
5. San Engineering & Locomotive Co. Ltd.
6. Kalyani Carpenter Special Steels Pvt. Ltd.
7. HCL Services Ltd.
8. HCL Learning Ltd.
9. Anand NVH Products Pvt. Ltd.
10. A2Z Filteration Specialities Pvt. Ltd.
11. Premiere Seals(India) Pvt. Ltd.
12. Kraft Powercon India Pvt. Ltd.
13. Kalapataru Power Transmission Ltd.
14. Mother Dairy Fruit & Vegetables Pvt. Ltd.
15. Ceat Ltd.
16. EWAC Alloys Ltd.
17. Saurav Chemicals Ltd.
18. Symega Savoury Technology Ltd.
19. Shree Magents Pvt. Ltd.
20. Loba Chemie Pvt. Ltd.
21. AMA Herbal Laboratories Pvt. Ltd.
22. Jayashree Polymers Pvt. Ltd.
23. Rathi Dye Chem Pvt. Ltd.
24. Ordain Health Care Global Pvt. Ltd.
25. Mafatlal Industries Ltd.
26. Jubilant Generics Ltd.
27. CoreEL Technologies(India) Pvt. Ltd.
28. Sapala Organics Pvt. Ltd.
29. Causeway Healthcare Pvt. Ltd.
30. Shivashakti Bio Technologies Ltd.
31. Rusan Pharmaceuticals Ltd.
32. Fleetguard Filters Pvt. Ltd.
33. A Raymond Fastners(India) Pvt. Ltd.
34. Aumgene Biosciences Pvt. Ltd.
35. Texmaco Rail & Engineering Ltd.
36. The Hi-Tech Robotic Systems Ltd.
37. Essel Propack Ltd.
38. Lake Chemicals Pvt. Ltd.
39. Coral Drugs Pvt. Ltd.
40. Hindustan Gum & Chemicals Ltd.
41. Comstar Automative Technologies Pvt. Ltd.
42. Orange Sorting Machines(India) Pvt. Ltd.
43. MMTC-PAMP INDIA PVT. LTD.
44. Welspun Syntex Ltd.
45. Wanburry Ltd.
46. TATA Autocomp Systems Ltd.

47. Symed Labs Ltd.
48. Sungro Seeds Ltd.
49. Aishwarya Seeds(India) Pvt. Ltd.
50. Philips Lightning(India) Ltd.
51. HCL Infotech Ltd.
52. Blue Circle Organics Pvt. Ltd.
53. Oracle Financial Services Software Ltd.
54. S.V.A. Rikkon Lubes Pvt. Ltd.
55. Nucon Aerospace Pvt. Ltd.
56. Orkash Services Pvt. Ltd.
57. Span Pumps Pvt. Ltd.
58. Ants Ceramics Pvt. Ltd.
59. T & I Projects Ltd.
60. Doehler India Ltd.
61. GR Intra Chem Ltd.
62. Raychem RPG(P) Ltd.
63. Thermolab Scientific Equipments Pvt. Ltd.
64. Beri Udhyog Pvt. Ltd.
65. J J Plastalloy Pvt. Ltd.
66. Deepti Electronics & Electro-Optics Pvt. Ltd.
67. Arihant Industrial Corporation Ltd.
68. Ravenbhel Healthcare Pvt. Ltd.
69. TTP Technologies Pvt. Ltd.
70. Kluber Lubrication Pvt. Ltd.
71. Elkay Chemicals Pvt. Ltd.
72. Pell Tech Health care Pvt. Ltd.
73. RAS Lifesciences Pvt. Ltd.
74. Viney Corporation Ltd.
75. JBM Auto Ltd.
76. Shri Ram Solvent Extractions Pvt. Ltd.
77. Jayem Automotive Ltd.
78. Kaynes Technology(India) Pvt. Ltd.
79. Harsoria Healthcare Pvt. Ltd.
80. Anand Teknow Aids Engineering(India) Ltd.
81. Shiva Pharmachem Ltd.
82. Making Auto Industries Pvt. Ltd.
83. Kumar Organic Products Ltd.
84. Tata Ficosa Automotive Systems Pvt. Ltd.
85. Polyplastics Industries(India) Pvt. Ltd.
86. Integrated Fire Protection Pvt. Ltd.
87. AMI Organics Pvt. Ltd.
88. Aeon Formulation Pvt. Ltd.
89. Jay Research and Biotech (India) Pvt. Ltd.
90. Sertel Electronics Pvt. Ltd.
91. Rhydburg Pharmaceuticals Ltd.
92. Royal Castor Products Ltd.
93. Nulife Global Medical Devices Pvt. Ltd.
94. Precise Chemipharma Pvt. Ltd.
95. Tadimety Aromatics Pvt. Ltd.
96. Hetero Labs Ltd.
97. Bharat Rasayan Ltd.
98. P P Rolling Milla Mfg Pvt. Ltd.
99. The Kerala Minerals and Metals Ltd.
100. Blue Cross Laboratories Pvt. Ltd.
101. Indo Phyto Chemicals Pvt. Ltd.
102. Unison Pharmaceuticals Pvt. Ltd.
103. Kan Biosys Pvt. Ltd.
104. Botil Oil Tools (India) Pvt. Ltd.
105. TTK Healthcare Ltd.
106. Mehru Electrical & Mechamical Engineers Pvt. Ltd.
107. Techno Auto Components (I) Pvt. Ltd.
108. Marsons Ltd.
109. Maharashtra Fastners Pvt.Ltd.
110. Edgeverve Systems Ltd.

ANNEXURE – 12

REPRESENTATIONS OF SCs, STs, AND OBCs

Group	Number of Employees					Number of appointments made during the Calendar Year										
	(As on 01.12-2016)					By Direct Recruitment				By Promotion			By other Methods			
	Gen.	SCs	STs	OBCs	Total	SCs	STs	OBCs	Total	SCs	STs	Total	SCs	STs	OBCs	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Group A	28*	4	2	2	36*	-	-	-	-	-	-	-	-	-	-	-
Group B	17	6	2	3	28*	-	-	-	-	-	-	-	-	-	-	-
Group C	03	7	1	3	14*	-	-	-	-	-	-	-	-	-	-	-
Total	48*	17	5	8	78	-	-	-	-	-	-	-	-	-	-	-

Note: 1. DSIR recruits only Scientific and Technical Post.

2. * Excluding one post of JS (Admn.) which is on notional basis.

REPRESENTATIONS OF THE PERSONS WITH DISABILITIES AS ON 1ST DECEMBER 2016

Group	Number of Employees				Direct Recruitment							Promotion						
					No. of Vacancies reserved				No. of Appointments Made			No. of Vacancies reserved			No. of Appointments Made			
	Total	VH	HH	OH	VH	HH	OH	Total	VH	HH	OH	VH	HH	OH	Total	VH	HH	OH
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Group A	36*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Group B	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Group C	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	78*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-

* Excluding one post of JS (Admn.) which is on notional basis.

ANNEXURE – 13

Audit Observations on Autonomous Bodies under DSIR - Council of Scientific & Industrial Research (CSIR)

(I) Report No. 12 of 2016 - Compliance Audit on Union Government, Scientific and Environmental Ministries/Departments

4.1 Unfruitful expenditure on procurement of BSL-3 facility

Centre for Cellular and Molecular Biology, Hyderabad procured a Bio-Safety Level-3 facility by making 100 per cent advance payment without ensuring proper installation of the same. There were problems in the facility that could not be rectified, which resulted in unfruitful expenditure of ‘1.90 crore incurred in its procurement.

Audit Observations on Public Sector Enterprises (PSEs) under DSIR

(II) Report No. 15 of 2016 Vol.II - Compliance Audit on Observations of Union Government, Commercial

3.1 Unproductive expenditure on upscaling of operations

Central Electronics Limited upscaled operations of its solar photovoltaic plant from two Mega Watt peak to 10 Mega Watt peak (MWp) per annum. However, production of solar photovoltaic cells remained even below the original capacity of two MWp per annum during 2007-08 to 2014-15 which rendered the expenditure of ‘ 22.43 crore on upscaling of operations unproductive.

CSIR Establishments

BIOLOGICAL SCIENCES

CSIR-CCMB	Centre for Cellular and Molecular Biology, Hyderabad
CSIR-CDRI	Central Drug Research Institute, Lucknow
CSIR-CFTRI	Central Food Technological Research Institute, Mysore
CSIR-CIMAP	Central Institute of Medicinal & Aromatic Plants, Lucknow
CSIR-IGIB	Institute of Genomics & Integrative Biology, Delhi
CSIR-IHBT	Institute of Himalayan Bioresource Technology, Palampur
CSIR-IICB	Indian Institute of Chemical Biology, Kolkata
CSIR-IIIM	Indian Institute of Integrative Medicine, Jammu
CSIR-IMTECH	Institute of Microbial Technology, Chandigarh
CSIR-IITR	Indian Institute of Toxicology Research, Lucknow
CSIR-NBRI	National Botanical Research Institute, Lucknow

CHEMICAL SCIENCES

CSIR-CLRI	Central Leather Research Institute, Chennai
CSIR-CECRI	Central Electrochemical Research Institute, Karaikudi
CSIR-CSMCRI	Central Salt & Marine Chemicals Research Institute, Bhavnagar
CSIR-CIMFR	Central Institute of Mining & Fuel Research, Dhanbad
CSIR-IICT	Indian Institute of Chemical Technology, Hyderabad
CSIR-IIP	Indian Institute of Petroleum, Dehradun
CSIR-NCL	National Chemical Laboratory, Pune
CSIR-NEIST	North-East Institute of Science and Technology, Jorhat
CSIR-NIIST	National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram

ENGINEERING SCIENCES

CSIR-AMPRI	Advanced Materials and Processes Research Institute, Bhopal
CSIR-CBRI	Central Building Research Institute, Roorkee

CSIR-CGCRI	Central Glass and Ceramic Research Institute, Kolkata
CSIR-CMERI	Central Mechanical Engineering Research Institute, Durgapur
CSIR-CRRI	Central Road Research Institute, New Delhi
CSIR-IMMT	Institute of Minerals and Materials Technology, Bhubaneswar
CSIR-NAL	National Aerospace Laboratories, Bengaluru
CSIR-NEERI	National Environmental Engineering Research Institute, Nagpur
CSIR-NML	National Metallurgical Laboratory, Jamshedpur
CSIR-SERC	Structural Engineering Research Centre, Chennai

INFORMATION SCIENCES

CSIR-NISCAIR	National Institute of Science Communication and Information Re sources , New Delhi
CSIR-NISTADS	National Institute of Science Technology and Development Studies, New Delhi
CSIR-4-PI	Fourth Paradigm Institute, Bengaluru

PHYSICAL SCIENCES

CSIR-CEERI	Central Electronics Engineering Research Institute, Pilani
CSIR-CSIO	Central Scientific Instruments Organisation, Chandigarh
CSIR-NGRI	National Geophysical Research Institute, Hyderabad
CSIR-NIO	National Institute of Oceanography, Goa
CSIR-NPL	National Physical Laboratory, New Delhi

Units

CSIR-HRDC	Human Resource Development Centre, Ghaziabad
CSIR-TKDL	Traditional Knowledge Digital Library, Ghaziabad
CSIR-URDIP	Unit for Research and Development of Information Products, Pune
CSIR-OSDD	Open Source Drug Delivery, New Delhi
CSIR-TRISUTRA	Translational Research and Innovative Science through Ayurgenomics, New Delhi

ABBREVIATIONS / ACRONYMS

AMPRI	Advanced Material and Processes Research Institute
APCTT	Asian and Pacific Centre for Transfer of Technology
CBDT	Central Board of Direct Taxes
CBRI	Central Building Research Institute
CCMB	Centre for Cellular and Molecular Biology
CDC	Consultancy Development Centre
CDRI	Central Drug Research Institute
CDS/ISIS	Computerized Data Services/Integrated Set of Information Systems
CECRI	Central Electrochemical Research Institute
CEERI	Central Electronics Engineering Research Institute
CFTRI	Central Food Technological Research Institute
CGCRI	Central Glass and Ceramic Research Institute
CII	Confederation of Indian Industry
CIMAP	Central Institute of Medicinal & Aromatic Plants
CIMFR	Central Institute of Mining and Fuel Research
CITT	Centre for International Trade in Technology
CLRI	Central Leather Research Institute
CMERI	Central Mechanical Engineering Research Institute
CRRI	Central Road Research Institute
CSIO	Central Scientific Instruments Organisation
CSIR	Council of Scientific & Industrial Research
CSMCRI	Central Salt & Marine Chemicals Research Institute
DBT	Department of Bio-Technology
DCPC	Department of Chemicals & Petrochemicals
DCSSI	Development Commissioner, Small Scale Industries
DRDO	Defence Research and Development Organization

DSIR	Department of Scientific & Industrial Research
ESCAP	Economic and Social Commission for Asia and the Pacific
EXIM	Export-Import
FC	Foreign Collaborations
FICCI	Federation of Indian Chambers of Commerce and Industry
ICAR	Indian Council of Agricultural Research
ICAS	Indian Council of Ayurveda & Siddha
ICMR	Indian Council of Medical Research
ICSSR	Indian Council of Social Sciences Research
ICSTI	International Centre for Science & Technology Information
IDAMS	Internationally Developed Data Management System
IGIB	Institute of Genomics & Integrative Biology
IGNOU	Indira Gandhi National Open University
IHBT	Institute of Himalayan Bioresource Technology
IICB	Indian Institute of Chemical Biology
IICT	Indian Institute of Chemical Technology
IIFT	Indian Institute of Foreign Trade
IIIM	Indian Institute of Integrative Medicine
IIP	Indian Institute of Petroleum
IISc	Indian Institute of Science
IIT	Indian Institute of Technology
IITR	Indian Institute of Toxicology Research
IMMT	Institute of Minerals and Materials Technology
IMT	Institute of Microbial Technology
INFLIBNET	Information Library Network
INSA	Indian National Science Academy
IPR	Intellectual Property Rights
ISRO	Indian Space Research Organization
ITPO	India Trade Promotion Organization
LAN	Local Area Network
LCA	Light Combat Aircraft

MDR	Multi Drug Resistance
MIT	Ministry of Information Technology
MoU	Memorandum of Understanding
NACIDS	National Access Centres to International Database Services
NAFEN	National Foundation of Indian Engineers
NAL	National Aerospace Laboratories
NBRI	National Botanical Research Institute
NCAER	National Council of Applied Economic Research
NCL	National Chemical Laboratory
NCSI	National Centre for Science Information
NEERI	National Environmental Engineering Research Institute
NEIST	North-East Institute of Science & Technology
NGRI	National Geophysical Research Institute
NICMAR	National Institute of Construction Management and Research
NID	National Institute of Design
NIDC	National Industrial Development Corporation
NIFT	National Institute of Fashion Technology
NIIST	National Institute for Inter-disciplinary Science and Technology
NIO	National Institute of Oceanography
NISCAIR	National Institute of Science Communication and Information Resources
NISTADS	National Institute of Science Technology and Development Studies
NMCC	National Manufacturing Competitiveness Council
NML	National Metallurgical Laboratory
NPL	National Physical Laboratory
NRDC	National Research Development Corporation
NRFC	National Register of Foreign Collaborations
NSTMIS	National Science and Technology Management Information System
PSE	Public Sector Enterprise
SERC	Structural Engineering Research Centre
SIRO	Scientific and Industrial Research Organization
SME	Small and Medium Enterprise.

TCO	Technical Consultancy Organization
TDB	Technology Development Board
TEDO	Technology Export Development Organization
TePP	Technopreneur Promotion Programme
TIFAC	Technology Information Forecasting and Assessment Council
TM	Technology Management
TQM	Total Quality Management
UGC	University Grants Commission
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
WIPO	World Intellectual Property Organization