



ANNUAL REPORT 2017-18



CSIR-NPL: Vision and Mandate



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Vision and Mission

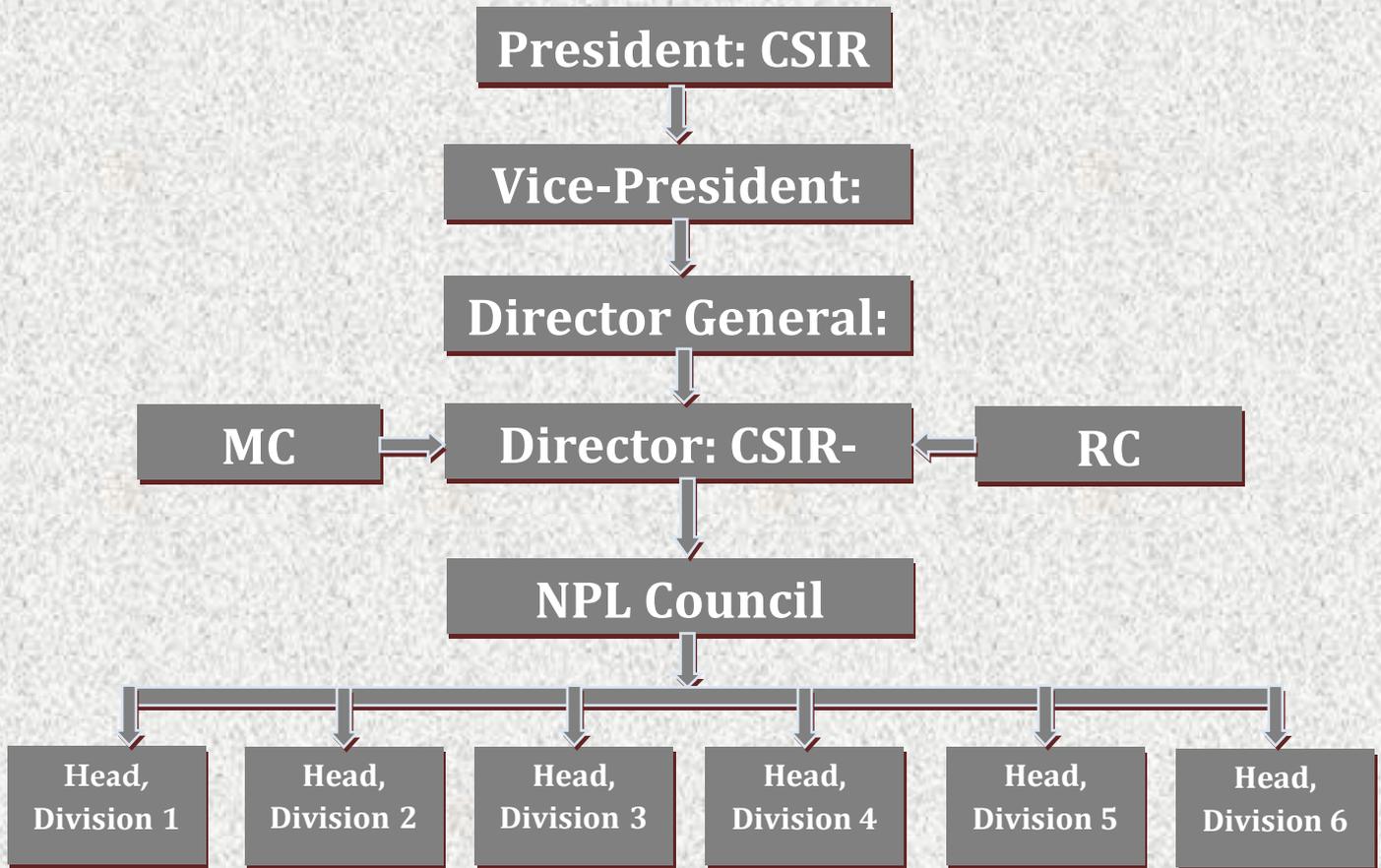
“Accurate and precise measurement are essential to drive the growth engines of Indian Science & Industry as it removes chaos and prompts innovations, which in turn, would save precious lives, resources and time....

- a) *Developing India's measurement standards that are internationally accepted and disseminating the measurement capabilities to industry, government, strategic and academia that underpin the India's prosperity and quality of life.*
- b) *Conducting multidisciplinary R&D with a mission to establish the futuristic quantum standards and upcoming technologies so that India remains on par with international measurement laboratories.*
- c) *Developing sophisticated analytical equipments (i.e. import substitutes) under “make in India” programme to cater the ever increasing demands of emerging India.*
- d) *Training of young scientists and industry personnel in the area of measurements under “Skill India” programme.*

Mandate

CSIR-National Physical Laboratory (NPL-India) is mandated to be India's “National Measurement Institute” (NMI) by the act of Parliament and is the custodian of “National Standards” with a responsibility of the dissemination of measurements to the needs of the Country.

CSIR-NPL: Assuring Quality Of Life



Division 1: Physico-Mechanical Metrology

Division 2: Time & Frequency and Electrical & Electronics Metrology

Division 3: Environmental Sciences and Biomedical Metrology

Division 4: Advanced Materials and Devices

Division 5: Bhartiya Nirदेशak Dravya (BND): Indian Reference Materials

Division 6: Directorate

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Preface

It gives me great pleasure to present the Annual Report of CSIR-National Physical Laboratory (CSIR-NPL) for the year 2017-18. The year, 2017-18, had been productive, eventful and transformational. CSIR-NPL, with mandate to realize, maintain National Standards of measurement and carrying out R&D in Metrology and related areas, has come a long way and continues to grow its horizons as National Metrology Institute of India.

Due to ever-changing pace of development in the international scientific arena and the altered dynamics of the scientific and technological scenario, caused by the accelerating pace of globalization, CSIR-NPL has to keep orienting itself from time to time to maintain its significant contribution to India's national competitiveness as well as global image. CSIR-NPL continued to fulfil its mandate as National Metrological Institute (NMI) of India and the custodian of the national standards of measurement, maintenance and up-gradation of National Standards of Measurements remained the statutory responsibility of CSIR-NPL. In addition, intensive R&D was carried out in frontier areas of physics was carried out under several externally funded and in-house projects

The world health organization (WHO) and Minamata convention has a mission to phase out mercury in the health care by year 2020, and India is signatory to these missions. To enable this mission NPL India has initiated work to setup calibration facility for mercury free IR clinical thermometers.

To cater the need of lighting industries and energy efficient LED and LED based lighting manufacturers in India, 'Creation of Testing and Calibration Facility for LED and LED based Lighting at CSIR-NPL India as per National/International Standards', has been initiated, funded by Bureau of Energy Efficiency (Ministry of Power) and CSIR.

CSIR-NPL has started providing the time and frequency traceability to times scale systems at Bengaluru and Lucknow of ISTRAC/ISRO. NavIC satellites are also synchronized to CSIR-NPL time. SAR and Phasor Measurement Unit Calibration Systems to cater DoT and Smart Grids, respectively, are being established. The traceability of AC High Voltage and High Current is also being disseminated to Power Sector.

CSIR-NPL is also undertaking initiative to develop single photon detection based quantum metrology standard, quantum current standard and epitaxial graphene based quantum Hall devices.

CSIR-NPL is also promoting the quality measurements in the domains of atmospheric pollution and biomedical metrology under its mission projects. In view of this, CSIR-NPL is working on a comprehensive testing, calibration and certification scheme to cater the national needs in this area.

During 2017-18, significant achievements have been made in the area of photovoltaic, new energy materials, sensors and carbon-based products: National Facility for primary solar cells calibration has been initiated under a MNRE funded project Perovskite/Organic Solar Panels and Novel HTL, ETL and Solar absorber materials, multifunctional, luminescent nanostructures etc., were developed for various strategic applications.

Technological solution for rural population of the nation provided this year include, a low cost refrigerator and technology for conversion of jute sticks to activated carbon

Understanding the national need for development of indigenous reference materials traceable to National Measurement Institute (NMI) of India, CSIR- NPL expanded its mission for metrological traceability and development of indigenous Certified Reference Materials/ Bharatiya Nirdeshak Dravyas™ and joined hands with various Reference Material Producers (RMP's) for cration of new BND's. During the year BND of Gold and Bituminous Coal were released

CSIR-NPL plays an important role in Human Resource Development in areas of metrology A one year course on precision measurement and quality control has been started under CSIR integrated skill development initiative The first batch of this course comprising of 13 students was completed successfully and placed well in jobs. Industrial trainings were also organized in the area of Metrology as well as other specialized topics. CSIR-NPL provided facilities to students from universities and other educational institutes including IITs / IISc-Bangalore, etc., for project work and training. Under the Academy of Scientific and Innovative Research (AcSIR), 207 students were registered this year and 23 were awarded Ph.D.

During the year, a total of 395 papers in SCI indexed Journals were published. Six patents were filed in India and three were filed abroad. Nine international patents and five Indian patents filed in previous years were granted during 2017-18. Eighteen new projects (sponsored and consultancy) were undertaken and 2615 calibration reports were issued, which contributed to generation of external cash flow (ECF). ECF from external funded projects and testing and calibration are ~Rs1525 lakhs and ~Rs752 lakhs, respectively.

I, earnestly, acknowledge the unflinching support and team spirit of all our CSIR-NPL staff members and young researchers during the year.

I also take this opportunity to acknowledge the valuable guidance, solidarity and encouragement received from CSIR Head Quarters, Research Council and Management Council from time to time which proved to be very helpful in achieving our aims. The interaction with external experts who visited CSIR-NPL on different occasions had been very rewarding.

(D K ASWAL)

Director, CSIR-NPL

CSIR- NPL –Enabling Quality Infrastructure

Selected list of organizations to whom support, advices and apex calibration services are being provided

Government/Semi-government organizations

Air Force; Air India; Bharat Electronics; BHEL; Bhilai Steel Plant; Bureau of Indian Standards; Central Pollution Control Board; Central Power Research Institute; Central Public Works Department; Railway Information System; Central Institute of Mining and Fuel Research; Defense Electronics Applications Laboratory; Delhi Jal Board; Directorate of Border Security Force; Hindustan Aeronautic Limited; Indian Oil; ISRO Inertial Systems Unit; Maharashtra State Electricity; Micro, Small and Medium Enterprise Testing Center; NTPC; Nuclear Fuel Complex (DAE); Ordnance Factory; Rail Coach Factory; etc.

Industries

ABB India; ACC; AIMIL Ltd.; Alstom India; Ambuja Cement; Binani Cement; Birla Tires; Blue Star; Bureau Veritas; Casio India; Crompton Greaves Limited; Diesel Locomotive Works; Essar Oil Ltd.; Godrej & Boyce Mfg. Co. Ltd; Havells India; Honda Cars; International Zinc Association; J.K. White Cement; JK Lakshmi Cement; Kirloskar Brothers; Larsen & Toubro; Maruti Suzuki; Mysore Paints & Varnish; Philips India; Piramal Healthcare; Ranbaxy; Rapid Metro Rail Gurgaon; Samsung India; etc.

SAARC Nations

Nepal Bureau of Standards & Metrology (MBSM), Nepal; Bangladesh Standards and Testing Institution (BSTI), Bangladesh; Measurement Units, Standards and Services Department (MUSSD), Sri Lanka; National Physical and Standards Laboratory (NPSL), Pakistan; Bhutan Standards Bureau (BSB), Bhutan; Afghanistan National Standards Authority (ANSA), Afghanistan; Maldives Standards and Metrology Unit (MSMU), Maldives.

Highlights of the year 2017-18

Significant contributions during 2017-18

CSIR Integrated Skill Initiative “One year Certification course in “Precision Measurement and Quality Control” (PMQC2017)

CSIR - National Physical Laboratory, India is mandated to be ‘National Measurement Institute (NMI)’ and custodian of ‘National Standards’ with a responsibility of the dissemination of measurements. Based on CSIR-NPL’s strength and expertise in accurate and precise measurements, CSIR-NPL, India has started a one year full time certification course on ‘Precision Measurements and Quality Control’ for the first time in the country for B.Sc. (Physics & Maths), B.Sc. Engineering or 3 years Diploma in (Mechanical/ Electrical/ Electronics/ Electronics & Communication/ Instrumentation engineering).



Inauguration of PMQC Course

The first batch of this course has got 13 students who were groomed to be metrology professionals through meticulously designed course modules with blend of classroom lectures, discussion, tutorials and practical related to measurements, testing and calibrations. They also got industrial oriented experimental learning with hands on experience in industrial internship of 3 months. The students got placed well after the course.

Calibration and testing facility for LED and LED based lighting

To cater the need of lighting industries and energy efficient LED and LED based lighting manufacturers in India, an initiative has been taken to set up a world class calibration and testing facility for LED and LED based Lighting under the project ‘Creation of Testing and Calibration Facility for LED and LED based Lighting at CSIR-NPL India as per National/International Standards’, jointly funded by Bureau of Energy Efficiency (Ministry of Power) and CSIR.

Establishment of calibration facility for mercury-free clinical thermometers

The measurement of body temperature is a basic parameter and vital sign of the human body health. Over the last few years there are several new clinical thermometers coming up in the market based on electrical and infra-red (IR) type sensors to avoid the mercury toxicity. The world health organization (WHO) and Minamata convention has a mission to phase out mercury in the health care by



Ear thermometer calibration set up

year 2020, and India is signatory to these missions. The non-contact type IR Ear and forehead thermometers For calibration of clinical electrical and IR thermometers, a standard blackbody source (BBS) traceable to ITS-90 is needed. A copper black body cavity has been designed and fabricated to get the emissivity of 0.99 and placed in a high stability water bath. The temperature of bath and hence IR cavity temperatures were measured by standard platinum resistance thermometer (SPRT) calibrated on ITS-90 fixed points. Various experimental parameters such as bath stability, emissivity variation and size-of-source effect are measured and optimized. The measurement performed with standard pyrometer and commercially available IR Ear thermometer and digital electrical thermometers in the range from 35 °C to 42 °C, are within ± 0.2 °C. The facility is now made open for the users.

Time and frequency metrology

CSIR-NPL contributed significantly in Digital India mission of GoI. CSIR-NPL realized the Primary Time Scale generating Indian Standard Time (IST) which is traceable to International Bureau of Weights and Measures (BIPM). Under the National Digital India Mission, CSIR-NPL is contributing by synchronizing



Primary Time Scale generating Indian Standard Time (IST).

all the device clocks in the country to within one second of Indian Standard Time (IST) generated by CSIR-NPL for the social, economic and strategic growth of the Nation.

LF, HF impedance and DC metrology

Knowledge development towards the realization of quantum current standard using both quantum phase (QPS) slip and single electron tunneling (SET). Observation of Quantum oscillations and Landau quantization in superconducting TiN thin films. Niobium Oxide based resistive switches are explored for quantum states stability. A

bilateral comparison on high frequency capacitance standards with NIM China: The bilateral comparison covered the capacitance standards from 1 pF to 1000 pF up to 10 MHz. It will enhance the 'Calibration and Measurement Capability (CMC)' of CSIR-NPL for capacitance standards up-to 30 MHz, which is highest in terms of frequency range among the National Metrology Institutes in the Asia-Pacific Metrology Program. The measurement has been performed in December, 2017.

LF, HF voltage, current and microwave metrology

Establishment of SAR measurement system as per IEEE Standard 1528-2013 with indigenous E field sensor, tissue equivalent liquids, and liquid dielectric measurements with software at different frequencies from 500 MHz to 6 GHz, was accomplished this year. This facility is established to cater department of telecommunication and mobile



SAR Measurement System

manufacturer in the country. The uncertainty evaluation for the abovementioned parameter is under progress. Calibration facility has a future scope associated with millimeter SAR evaluation for 5G communication.

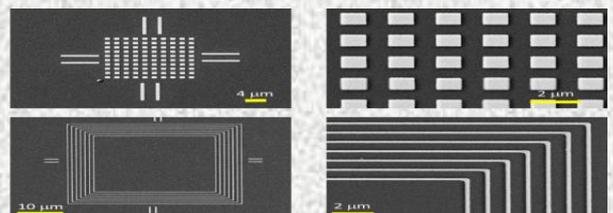
Establishment of Phasor Measurement Unit Calibration System (PMU-CAL)

PMU-CAL is an integrated system that completes number of automated tests and meets the entire compliance testing as per IEEE C37.118.1a-2014 standard. Calibration time is shortened to five to six hours instead of a week and handles all the steady-state, dynamic-state, and reporting latency tests for both M class and P class at all required frame rates. Today's smart grid relies on phasor measurement units (PMUs) to deliver real-time, mission critical data on the voltage, current, frequency and phase within the distribution grid. To ensure consistent, accurate and credible PMU data, it is essential that PMUs be properly calibrated.



PMU CAL System

Fabrication of dimensional artifacts is important for the calibration of instruments like TEM, SEM, AFM, Optical microscopes etc. At CSIR_NPL, FIB Lab is fabricating following artifacts and will be used for the above applications.



Dimensional Artefacts(FIB)

Quantum nanophotonics metrology

Ferroelectric Loop Tracer apparatus developed for polarization vs. electric field measurement at various frequencies in thin film samples comprising in-situ monitoring and on screen plotting of PE loop; real time calculation of saturation field (Esat), coercive field (Ec), saturation polarization (Ps) and remnant polarization (Pr); data acquisition and data saving in file for future analysis; facility for offset removal; compensation setup for lossy dielectric and parasitic capacitance.

Measurement Capabilities	System Specifications
PE or Hysteresis loop at different frequencies. Large signal CV, IV	Voltage range: $\pm 10V$
PUND/ pulse polarization measurement	No. of ADC bits: 18
Fatigue, Imprint measurement	Min Charge Resolution: 1.0fC
Read, write pulse measurement	Minimum Area Resolution: $0.10\mu m^2$
Retention measurement	Maximum charge resolution: 5.0mC
Compensation values measurement for lossy sample	Maximum Area Resolution (Q/P): 50.0 cm^2
Small signal capacitance	Maximum hysteresis frequency: 2.5kHz
Pulsed IV, leakage current measurement	Minimum hysteresis frequency: 1Hz
	Minimum Pulse Width (R/W): 1ms
	Maximum Pulse Width: 100ms
	Maximum Delay between Pulses: 1s

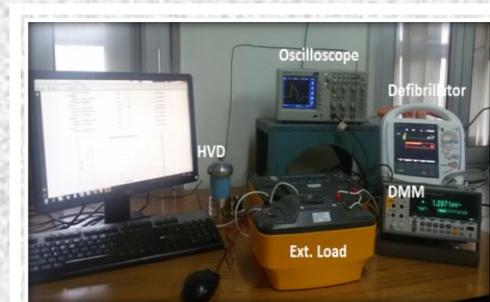
A PM_{2.5} high volume sampler technology developed

This technology involves a novel design and development of PM_{2.5} impactor sampler. This impactor can segregate particulate matter > 2.5-micron size and facilitate to collect ≤ 2.5 -micron size particles suspended in ambient air on filter size 8 inch \times 10 inch. The impactor is designed for sampling air with a high flow rate (1.13 m³/min, i.e. 40 cfm). For high-volume PM₁₀ (also for total suspended particles, TSP) sampler, CFR EPA USA has been recommended a flow rate of 40 cfm. The design of this impactor is made as a retrofit on the filter holder of conventional high-volume TSP reference sampler to make it high-volume PM_{2.5} sampler. The sampler is successfully tested under Indian conditions, and can provide very accurate PM_{2.5} data with a total measurement uncertainty $\leq \pm 5\%$. This technology has been transferred to an Indian manufacturer.



Calibration facility established for defibrillator machines

Facility has been established for teachable calibration of defibrillator machines to provide services to the



national healthcare sector e.g. hospitals, clinical and test laboratories and medical device manufacturers/industries. The facility is capable for the calibration of following parameters of the defibrillator analyzer, viz. Discharge energy in joule (J); Discharge time (sec), Defibrillator load resistance (Ω) and Pacer resistance (Ω).

Bhartiya Nirdeshak Dravya (BND)

Bituminous Coal CRM BND 5101A (Released on 5th July 2017) in collaboration with CSIR-CIMFR Dhanbad.

CSIR-NPL has released Gold standard of BND 4201 of four Nine Purity Certified Reference Material for MINT in collaboration with NCCCM, BARC, and Hyderabad.



APMP QM-P30: Pilot study

Calibration solution of Pb, As, Ni and Fe (1000 mg/kg range) for particulate matter. This pilot study is being jointly organized by NPLI (Coordinating lab) and KRISS (Co-ordinating lab). Draft A report was presented at APMP-TCQM-2017, New Delhi meeting.

Perovskite/Organic solar panels

A Perovskite/Organic Solar Panels and Novel HTL, ETL and Solar absorber materials have been developed.



PV metrology & primary solar cells calibration, apex level testing and calibration

An initiative has been taken for establishing 'National Facility for primary solar cells calibration' under a MNRE funded project. We are contributing in CSIR-skill initiative in solar energy. MNRE has approved 5 Research fellowships for next 3 years under national renewable programme.

Solid-state peltier-based low-cost refrigerator

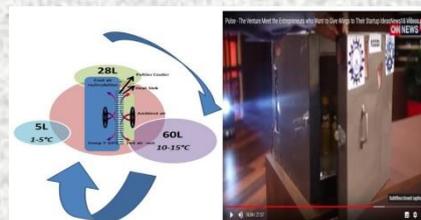
A Solid-state Peltier-based low-cost refrigerator has been developed, which is maintenance-free with a long life, robust, environmentally-friendly, requires less electrical power and hence can be operated on solar power. Specifications are

Cooling chamber ~ 30 cm x 30 cm x 30 cm,

Temp~5 to-10°C,

Power requirement: ~75-80W, compatible to operate with Solar panels.

DC and AC power operated. Weight: 8Kg (max)



Development of 0-D to 3-D multifunctional luminescent nanostructures for various strategic applications

0-D to 3-D multifunctional luminescent nanostructures have been developed for various strategic applications; invisible luminescent security ink, security codes, optoelectronic devices, biological fluorescence labeling, fluorescence quenching, luminescent paint, phosphor coated solar cell, field emission display and luminomagnetic nanophosphors for drug delivery and magnetic tracking applications.

Activated carbon from waste biomass Jute sticks

To address the issue and to improve income of the jute growing farmers in the north-eastern state, CSIR-National Physical Laboratory, New Delhi has provided the environmental -friendly, socio-economic and self-sustaining and innovative technological solution for value addition to waste biomass jute sticks instead of burning it. The jute stick powder is converted to activated carbon by chemical activation. The resultant activated carbon possesses high surface area,



micro porosity and small ash content. Activated carbon is a versatile material widely

used throughout a number of industries as a powerful adsorbent for gaseous and liquid streams.

A prototype CO sensor device

A prototype CO gas sensor device, based on Metal Oxide Semiconductor, has been designed and fabricated on Alumina substrate. For this purpose, Micro-heater has also been designed and fabricated



Calibration facility for breath alcohol analyser

Calibration facility for breath alcohol analyser has been created which will help to enforce driving under the influence of alcohol legislation and in the areas of forensic testing laboratories and traffic police for the successful prosecution. The development of alcohol BND for the calibration of breath alcohol analyzer significantly contributes to the reliability of measurements.

SI Traceable Aqueous Alcohol Standard & Calibration of Breath Alcohol Analyser



Glimpses of Events

The 33rd Asia Pacific Metrology Programme General Assembly and Related Meetings (APMP-2017), November 24, to December 1, 2017 at CSIR-NPL, New Delhi,

The 33rd Asia Pacific Metrology Program (APMP) General Assembly and Related Meetings held during November 24 – December 1, 2017 at CSIR-National Physical Laboratory, New Delhi. This prestigious event of APMP is held annually. The APMP is a group of national metrology institutes (NMIs) from the Asia-Pacific region with a mission to promote and support a measurement infrastructure in the Asia-Pacific region that facilitates international trade, improves industrial efficiency and competitiveness, ensures equity in the marketplace, and enhances the quality of life and the environment.

More than 400 delegates from 31 countries around the globe attended this event along with more than 100 participants from Indian laboratories, public organizations and industries. The different events like 12 Technical Committee (TC) Meetings (Mass & related quantities; Length; Time & Frequency; Acoustic Ultrasonic and Vibration; Electricity & Magnetism; Photometry & Radiometry; Temperature; Fluid Flow; Quality System; Quantity of Matter; Ionizing Radiation and Materials

Metrology), Developing Economies Committee (DEC) Meeting, Metrology Enabling Developing Economies in Asia (MEDEA) Meeting, APMP Symposium, APMP Directors' Meeting, General Assembly, TC Technical Tour, TC Workshop, 4 Focus Group Meetings (on climate changes, food safety, medical metrology and energy efficiency), TC Initiatives Meetings (on Stack Gas measurement) were conducted and the whole event was grand success. As a host NMI and a signatory of International Committee for Weights and Measure - Mutual Recognition Arrangement (CIPM-MRA), the scientist and work force of CSIR-NPL as a whole were greatly benefitted by this event in following its vision to be "Giant in measurements" to support the needs of the country.



Inauguration: by Dr. Harsh Vardhan, Hon'ble Union Minister of Science & Technology and Earth Sciences, in the presence of Dr. Girish Sahni, DG-CSIR, Dr. D. K. Aswal, Director, CSIR-NPL, Dr. Martin Milton, Director, BIPM and Dr Toshiyuki Takatsuji, Chair, APMP



Inaugural address by Dr. Harsh Vardhan, Hon'ble Union Minister of Science & Technology and Earth Sciences

17th International Conference on Thin Films (ICTF-17)

The 17th International Conference on Thin Films (ICTF-17) was organized by CSIR-National Physical Laboratory (NPL), New Delhi in collaboration with Indian Vacuum Society (IVS) during 13-17 November 2017 at NPL campus. It is one of the triennial conference series endorsed and co-organized by the Thin Film Division of the International Union for Vacuum Science, Technique and Applications (IUVSTA) (<http://www.iuvsta.org>), a union of national member societies whose role is to stimulate international collaboration in the fields of vacuum science, techniques and applications and related multi-disciplinary topics including solid-vacuum and other interfaces. This International conference was the 17th one of the series and was hosted by India at CSIR-NPL after 30 years (earlier it was held at IIT Delhi in 1987), attended by more than 600 participants.

Dr. Satheesh Reddy, Scientific Adviser to Raksha Mantri was the Chief Guest in the inaugural function of ICTF-17 on November 14, 2017, and in his inaugural address he emphasized on importance of thin film research in various area including coating for thermal imaging in defence. Prof. A.K. Grover, Chairman Research Council, CSIR-NPL and Vice Chancellor, Panjab University Chandigarh, has preside the inaugural function of the conference and he delivered the Presidential



Inaugural speech by Dr. Satheesh Reddy, Scientific Adviser to Raksha Mantri, the Chief Guest

Address. Prof. David Cahen, Scientific Director, ASERI, Weizmann Institute of Science, Israel has delivered the keynote talk on "Electron Transport across Proteins and Peptides @ Interfaces: *Mostly Riddles, Some Insights*". He discussed about proteins for use in future biomolecular electronic devices by bridging between the surfaces of solid-state electrodes. During the conference the "26th Prof. C. Balakrishnan Memorial Lecture" was also organized and same was delivered by Prof. K.L. Chopra on the evening of November 15, 2017. He talked about historical evolution of science and technology of thin films. There were about 75 nos. of talks delivered on various aspects of thin films by eminent speakers (as plenary and invited speakers from India and abroad). In addition there were about 400 oral and poster presentations were made by students and faculties. Total of 40 Nos. of awards were given for best presentation in both format of the presentations; sponsored by Springer and IVS (Indian Vacuum Society). There were participations from eighteen countries, such as Germany, USA, UK, France, Slovenia, Spain, Croatia, Slovakia, Singapore, Japan, Israel, Iran, Russia etc. Apart from presentation by eminent researchers, there were technical presentations by industries who also displayed their products in the exhibition stalls throughout the conference duration. In addition, there were two pre-conference workshops organized namely (i) Thin Films & Coating Technology: Science and Industry and (ii) Thin Film Solar cells on November 13, 2017. More than 150 students and faculties from various institutes and universities have participated in these workshops. In addition, there was a session on Springer author workshop for Ph.D students on November 17, 2017.



National conference on Environmental Challenges: solutions & Way Ahead' June 28-29, 2017



CSIR-NPL and IFR Information Dissemination Services Pvt. Ltd. sign MoU for Time and Frequency Traceability Services



Seminar on Standards for Quality & Life Service to the Nation', Oct 31, 2017



Brain Storming Session on Reference Materials and its Traceability , Feb 12, 2018



Release of BNDs; during a roadmap for the Production and Certification of Indian Certified Reference Materials meeting, March 16, 2018



CSIR-NPL and ISRO sign MoU for Time and Frequency traceability Services

Divisional Activities

Physico-Mechanical Metrology

Metrology is the enabling tool for the development of technology. It promotes global competence and confidence. The Physico-Mechanical metrology underpins the industrial development and quality infrastructure. This division has a mandate to establish, maintain and continuously upgrade the Physico-mechanical standards such as Mass, Length and Dimensions, Temperature and Humidity, Optical radiation, Force and Hardness, Pressure, Vacuum & Ultrasonic, Acoustic and Vibration, and Fluid Flow Metrology. Over the years the standards and services of the division have achieved the global status of compatible measurement standards and calibration facilities through its visibility in the BIPM international mutual recognition arrangement database. Our calibration measurement capabilities (CMCs) and results of international inter-comparison are available in the BIPM Key Comparison Database (KCDB).

During the year 2017-18 Capacity building through training was carried out for Legal Metrology Officers in area of mass, length, temperature and pressure metrology and various programmes for industries. Consultancy services were also extended to industries during this year. The division has published 49 research papers in journals and 27 conference presentations and filed 3 patents. Apex level calibration services were extended to R&D Labs, calibration labs, strategic sectors, leading automobile industries, illumination and lighting, display, opto-electronics, defence, space, health and safety, pollution monitoring, manufacturing industries, government sectors, research organizations and some SAARC NMIs. We have generated an ECF of about Rs. 4.93 crore from 1576 test and cal reports. A world class calibration and testing facility for LED and LED based Lighting is being setup under the project 'Creation of Testing and Calibration Facility for LED and LED based Lighting at CSIR-NPL India as per National/International Standards', funded by Bureau of Energy Efficiency (Ministry of Power) and CSIR. A course on precision metrology and quality control was started at CSIR NPL and this division played important role in training young minds admitted to this course.

This Year a mega event, namely the 33rd Asia Pacific Metrology Program (APMP) General Assembly and Related Meetings was organised during November 24 – December 1, 2017 at CSIR-National Physical Laboratory, New Delhi. Six technical committee meetings namely TCM (Mass & related quantities); TCL (Length); TCAUV (Acoustic Ultrasonic and Vibration); TCPR (Photometry & Radiometry); TCT (Temperature); TCFF (Fluid Flow) and related workshops were organised attended by this division. Technical presentations and reports were made by our scientist during the event.

Mass metrology

The section has been maintaining apex level standards of mass, volume, density and viscosity and disseminating traceability by calibration. This year, we re-established transfer standards and working standards of mass against National Prototype Kilogram (NPK-57). We also re-established reference grade hydrometers against solid density standards. We also disseminated national standard to the Indian industries, strategic sectors, accredited laboratories, manufacturers etc. through traceability.



Heavy weights calibrated for Satish Dhawan Space Centre,

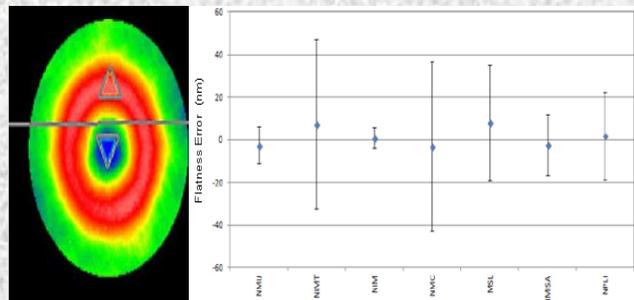
Length, Dimension and Nano metrology

The section has been realising SI unit 'metre' and maintaining apex level standards of length, dimension and nano metrology and disseminating it by calibration. During the year this section provided consultancies to the firms for measurement, an example is that we carried out verification of artificial defect standards for rails. This section participates continually in international intercomparison to maintain international equivalence of national measurement system.



Euramet LK-5 artefact being measured on CMM

This year we also participated in international key-comparison EURAMET.L-K5 for calibration of one dimensional CMM artefact. Figure shows the images of artefact being measured. Also as pilot lab and coordinator for APMP intercomparison of step height (8 nm to 10 μm) we prepared APMP.L-S7 draft report A and A.1 to get consensus of five participating countries. For optical flatness using Fizeau interferometer comparison APMP.L-S8 draft B report was received, this report shows a very satisfactory result with $E_n < 1$.



Optical flat Intercomparison APMP L-S8 result (Draft B)

Temperature and Humidity metrology

The section has been maintaining apex level standards of temperature and humidity from -200 $^{\circ}\text{C}$ to 3000 $^{\circ}\text{C}$ and disseminating it by calibration. During the year we have standardized the Blackbody Calibrator for IR Clinical Thermometers, as part of our efforts of setting up calibration facility for mercury-free non-contact clinical IR Ear thermometer in the range from 35 $^{\circ}\text{C}$ to 42 $^{\circ}\text{C}$. We extensively tested for the

standardization of commercially available IR ear thermometers, the measurements performed are within ± 0.2 °C. We have demonstrated the facility in APMP TCT Workshop on Thermometry in clinical and medical applications.

Optical Radiation metrology

This section provides measurement traceability of optical radiation related parameters in the wavelength range 200 nm to 25 μm , to a wide range of organizations and industries. The base unit candela is realised here. To cater to the need of lighting industries and energy efficient LED and LED based lighting manufacturers in India, a world class calibration and testing facility for LED and LED based Lighting is being setup under the project 'Creation of Testing and Calibration Facility for LED and LED based Lighting at CSIR-NPL India as per National/International Standards', jointly funded by Bureau of Energy Efficiency (Ministry of Power) and CSIR.

During the year R&D in the area of photonics, quantum optics and LED photometry was performed for their applications in information processing and illumination technology. Plasmon augmented two photon absorption in a strongly coupled nano-molecular hybrid system was demonstrated for applications in photonic information processing. An effort to establish relation between enhanced two-photon absorption coefficients and nanoscopic energy transfers was also made. Experimental study of geometrical misalignment induced wave front distortion in partially coherent monochromatic and polychromatic dark hollow beam, generated from axicon, for their applications in generation of short range non-diverging optical array and elliptically dark hollow beam was also conducted. The Section also focuses on bio-spectroscopic study of therapeutic agents and understanding the interaction mechanism of these agents with nucleic acid and proteins at molecular level. Infrared spectroscopy techniques for distinguishing malignant tissues from the normal ones and to estimate the stage of disease in the cancer diagnosis has also been part of our diagnostic studies. Testing /Calibration services for various photometric parameters namely luminous flux, illuminance, luminance, luminous intensity, detector responsivity, color temperature and radiometric parameters namely spectral irradiance and spectroscopic parameters namely, spectral reflectance, spectral transmittance, absorbance, and polystyrene film calibration by FTIR were provided.

Force and Hardness metrology

Force and Hardness Metrology group has been engaged in establishing, developing and maintaining the primary standards in force, torque and hardness measurements.. This group has provided the apex level calibration and traceability in measurement in these physical parameters to several user industries across the county. This group is constantly involved in research and developmental activity for augmenting and upgrading the standards at par with other leading National Metrology Institutes (NMIs)

to establish equivalence to the international system of measurements by participating in the international intercomparisons.

The result of the APMP M.F-k2 inter-comparison performed in the 50 kN and 100 kN force range using Force Primary Standard machine is released. In this comparison, KRISS, Korea; NML-SIRIM, Malaysia; NIS, Egypt; NPLI, India, A* Star, Singapore; SCL, Hong Kong; VMI, Vietnam; ITRI, Taipei; NIMT, Thailand; KIM-LIPI, Indonesia; KEBS, Kenya; NIM, China; and NMJJ, Japan participated. The result of this comparison was good which reaffirms the claimed uncertainty of $\pm 0.002\%$ in this force range. This also enables us to achieve a degree of equivalence with the other NMIs and also gives us the confidence in our measurements and the realization of the force scale.

We have provided calibration services to more than 250 customers including, government organizations, public and private sectors, NABL accredited calibration laboratories, industries, institutions, etc.

Pressure Vacuum and Ultrasonic metrology

The section is responsible for establishment, maintenance, up gradation and dissemination of pressure, vacuum and ultrasonic standards. The main achievements include re-establishment of some of the primary and secondary standards, simulation (Ansys / Solid works / Monte Carlo) studies on pressure sensors and standards, development of a variable frequency ultrasonic Interferometer, development of calibration facility for ultrasonic velocity at 50 kHz in concrete/Perspex reference blocks, Raman studies on different strategic materials at ambient and high temperature and development of low cost and high sensitivity polar-resistive humidity sensor.



NPL-H1: Primary Pressure Standard for 1GPa



Variable Frequency Ultrasonic Interferometer

Acoustics and Vibration metrology

Acoustics and Vibration Metrology

section maintains and up-grades the primary standards of sound pressure and vibration amplitude and provides calibration & testing services in field of sound



impedance tube system for acoustics

and vibration to the industry & other institutions in India. Moreover, this Section is involved in R&D in applied acoustics, building acoustics and atmospheric acoustics. Highlights of work done during the year are: secondary vibration system up-graded up to 5 Hz to 10 kHz; revival of vibration meter calibration and DG set noise testing facility; and establishment of impedance tube system for building acoustics. We also upgraded our SODAR system (Sound Detection and Ranging) with newly preamplifier circuit and sensors for temperature, relative humidity and wind speed to collect weather data.

Fluid Flow metrology

This section provides traceability to fluid flow measurements in the country. We have water flow calibration facility, water meter testing facility and gas flow calibration facility. The water flow calibration facility (WFCF) is being upgraded using latest instrumentation and control to achieve uncertainty of 0.05% or better up to DN100 line and 0.07% or better up to DN200, at par, to the international level. Figure shows the photograph of new facility being upgraded.



Instrumentation Panel of WFCF being upgraded

Time, Frequency, Electrical and Electronics Metrology

During the year 2017-18 the division of “Time & Frequency and Electrical & Electronics Metrology” has continued its apex level calibration services to strategic labs, regional calibration labs, R&D labs and industries. This Division is participating in various intercomparisons to strengthen the existing CMCs and various parameters are being upgraded to cater to the needs of industry, STQC laboratories and other customers. Time and Frequency group will be setting up secondary timing labs in various places throughout the country aimed at putting in place the accurate timing system nationwide. New measurement facilities like SAR and PMUCAL system are being established to support the quality infrastructure of the country. Development of quantum standards like single photon detection, Graphene-based hall devices, current standard is being undertaken.

Time and Frequency metrology

CSIR-NPL realized the Primary Time Scale generating Indian Standard Time (IST) which is traceable to International Bureau of Weights and Measures (BIPM). CSIR-NPL maintains IST (UTC+05:30) within ± 7.2 ns with the help of atomic clocks in environment-controlled laboratories with uninterrupted power supply. Development of the secondary timing laboratories in different cities of the country has been undertaken by CSIR-NPL. Collaboration and MoUs with strategic sector, specifically, ISRO, IAF, DoT, DoCA, and NIC-NKN for nation-wide time synchronization have been setup. The training, consultancy and traceability services to strategic and non-strategic sector are being undertaken.

CSIR-NPL has developed the Primary time scale generating Indian Standard Time (IST) and created the time traceability link to Indian Space Research Organization (ISRO). ISRO is using the time traceability established via the Satellite link with ns accuracy for national deep space missions and for Indian Regional Navigation Satellite System (IRNSS). Time with ns accuracy is the most critical requirement for realization of Indian navigation system which is being provided by CSIR-NPL to two ISRO centres at Bangalore and Lucknow.

LF, HF Voltage, Current and Microwave metrology

Developing, upgrading and maintaining the LF & HF Voltage, Current and Microwave related Standards traceable to SI units as national capabilities. SAR measurement system as per IEEE Standard 1528-2013 with indigenous E field sensor, tissue equivalent liquids, liquid dielectric measurements with software from 500 MHz to 6 GHz has been

developed. Phasor Measurement Unit Calibration System (PMU-CAL) which meets the entire compliance testing as per IEEE C37.118.1a-2014 standard has been established.

AC High Voltage and Current metrology

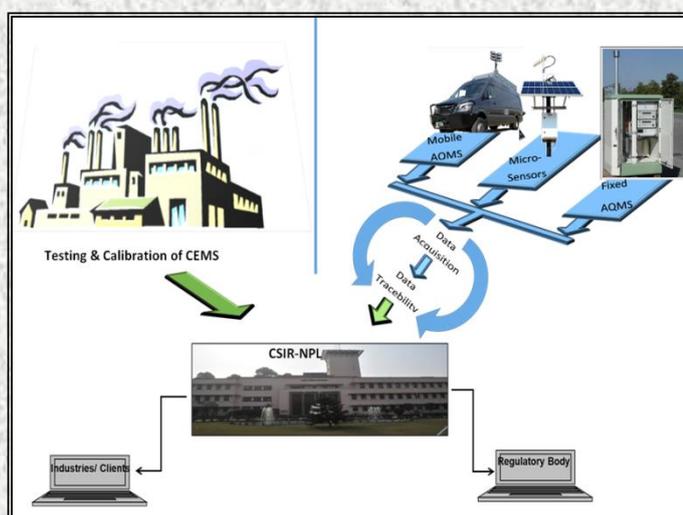
Maintaining the National Standards of AC High Voltage Ratio upto 100kV, AC High Current Ratio upto 5 kA and High Voltage Capacitance & Tan δ up to 200 kV. Disseminating the traceability of AC High Voltage and Current Metrology to Power Utilities, Electrical Equipment Manufacturers and Accredited Electrical Testing and Calibration Laboratories.

Environmental Sciences and Biomedical Metrology

The Environment Sciences & Biomedical Metrology Division (ESBMD) of CSIR-NPL is promoting the quality measurements in the domains of atmospheric pollution and biomedical metrology under its mission project through working with different stakeholders. The division has four specialized groups i.e. Atmospheric Sciences and Metrology, Gas Metrology, Biomedical Metrology and Theoretical Environment section. Each of the four groups is continuously working on the national issues related to the field of environment and biomedical. The glimpse of each group has been described below.

Atmospheric Sciences and Metrology:

In the field of environmental monitoring, the data quality is posing a major challenge as the reliability of such measurements needs to be ascertained. The role of instruments and the calibration are the major issues that need to be addressed. While most of the instruments used are usually imported from abroad which comes with certifications from agencies like USEPA, TUV, and MCERT etc. These certificates are issued based



on the environmental conditions of the certificate issuing country which are very different from the environmental conditions prevalent in India. This affects quality of measurements by the instrument operation in long run in Indian conditions which warrants the revisit of certification process at regular intervals. However, as of now, no certification system is available in India for environmental monitoring equipments. The traceability of measurement is also an integral part of generation of reliable data. In view of this, the group is actively working to establish a testing and calibration facility for various automated air Monitoring Systems (AMS) especially for Continuous Emission Monitoring Systems (CEMS) and Continuous Ambient air Monitoring Systems (CAMS), which will be a new national facility to help in developing Indian Certification System for catering to the national needs. In India, the lack of such facility is creating a major barrier in ensuring quality of environmental monitoring data from various sources.

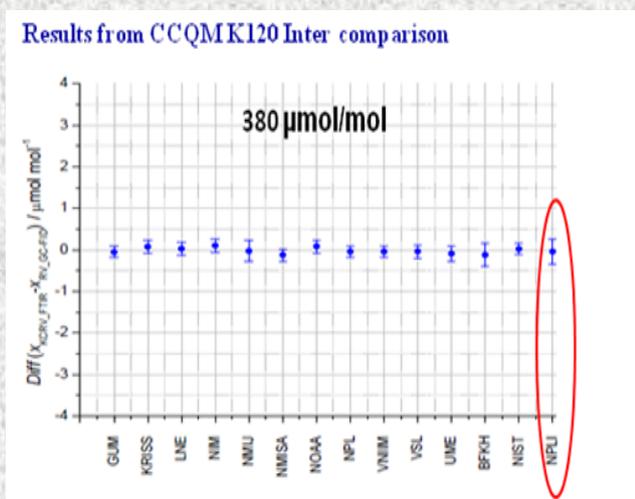
Gas metrology:

The main focus of this group is to realization of mole in gas measurements through gravimetric preparation of Primary Reference Gas Standards. To provide traceability for vehicle emission, greenhouse gases and air quality measurements as per NAAQS (12 parameters). This section is providing services for reliable measurement of air quality data which are directly related to environment, and have indirect impact on health and society. In line of this, the group involved in development of primary reference gas mixtures (PRGMs) Gravimetrically for Ambient Air quality monitoring parameters and the Vehicle emission monitoring parameters and green house gases (e.g. CO₂, CO, CH₄, NO, SO₂). Participation in International Inter-comparisons CCQM K120 a and b for CO₂, in Synthetic Air conducted by BIPM France. Dissemination of PRGMS in the country. The group is also actively involved in technology development in the field of environmental monitoring systems. Recently, the group successfully developed, patented and transferred a technology, "High-Volume PM_{2.5} Impactor Sampler" to an industry. This technology involves a novel design of PM_{2.5} impactor sampler, which segregates particulate matter (PM) > 2.5 μm size (aerodynamic diameter) and facilitate to collect ≤ 2.5 μm size particles suspended in ambient air on filter size 8 inch × 10 inch with a high-flow rate (1.13 m³/min, i.e. 40 cfm).



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Biomedical metrology

The group is actively engaged in the field of biomedical metrology. In line of this, a facility has been established for the traceable calibration of defibrillators. This group has also been engaged in the technical development of biosensors for application to clinical diagnostics using various experimental techniques such as FTIR, UV-visible, Zeta potential, Contact angle, AFM, differential scanning calorimetric (DSC), cyclic voltammetry and Electrochemical impedance spectroscopy.

Advanced Materials and Devices

Flexible Organic Energy Devices

Perovskite/Organic solar cells have enormous potential for low cost energy generation directly from sunlight. They can be processed on large area flexible substrates giving light weight rollable solar cells. The power conversion efficiency of PSCs has reached near to that of conventional Si solar cells which is high enough for their commercialization but the only problem they are facing at the moment is their degradation. The flexible organic devices group is actively involved in the development of Perovskite/Organic Solar Panels and Novel HTL, ETL and Solar absorber materials. The main focus includes improved stability of PSCs in actual operating conditions by device and molecular engineering. Group is also involved in the development of Polystyrene film for FT-IR calibration.

Inorganic Photovoltaic Devices

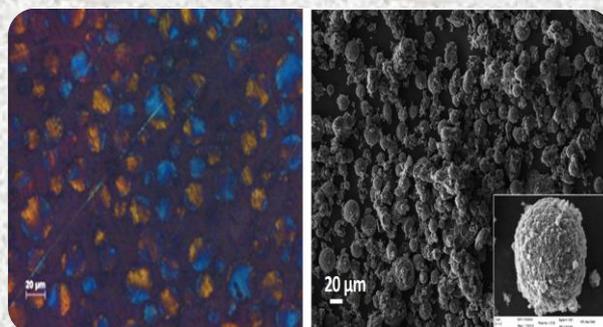
The inorganic photovoltaic devices group is actively involved in various R & D aspects of Photovoltaic mostly in PV metrology & primary solar cells calibration, apex level testing and calibration, process to improve efficiency by nano-texturization, surface passivation and cost effective anti-reflection. The group has started activity on establishing ‘National Facility for primary solar cells calibration’ under a MNRE funded project. We are contributing in CSIR-skill initiative in solar energy. MNRE has approved 5 Research fellowships for next 3 years under national renewable programme.

Alternative Energy Materials

Group is focuses on the fabrication of lab scale small-power generation unit for increasing the fuel efficiency of automobiles. Later these devices will be tested at ground level applications (Societal). Currently, our group actively engaged in developing of these devices indigenously to substitute the imported devices, which are too expensive and economically not viable in Indian market. Group is also involved in the development of new emerging 0-D to 3-D multifunctional luminescent nanostructures for various strategic applications; invisible luminescent security ink, security codes, optoelectronic devices, biological fluorescence labelling, fluorescence quenching, luminescent paint, phosphor coated solar cell, field emission display and luminomagnetic nanophosphors for drug delivery and magnetic tracking applications.

Advanced Carbon Products

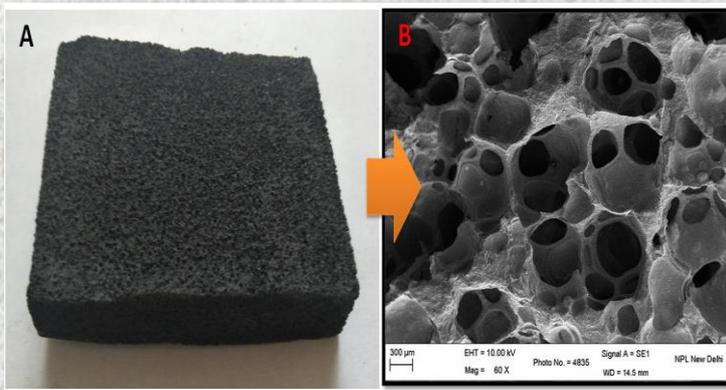
Group is actively involved in the development of mesocarbon microbeads and carbon foam from coal tar. Optical



Mesocarbon microbead (MCMB) of spherical size

MCMB after extraction and heat treatment at 1000 °C

micrograph shows the formation of mesocarbon microbead (MCMB) of spherical size of anisotropic characteristic in coal tar pitch developed by heat treating at 410°C. These mesocarbon microbeads of spherical size are separated by solvent extraction method from coal tar pitch and heat treated to get mesocarbon microbeads powder shown in SEM image. The MCMB can be used as anode material in Li ion Batteries.



Carbon Foam

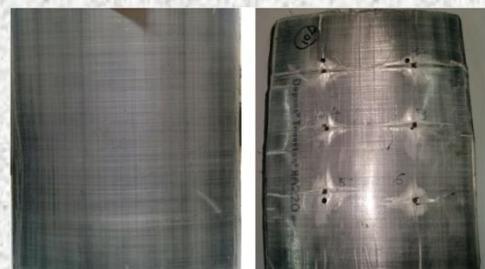
Carbon foam was developed by a novel method instead of modified coal tar pitch synthesis by using semi-coke (SC). The advantage of SC as compared to modified coal tar pitch is that oxidative stabilization process not required before the carbonization steps. The carbon foam prepared from SC with some content of binder resin that gives uniform pores, better mechanical strength and free from any type of cracking. Figure shows (A) digital photograph of carbon foam prepared by using semi-coke in acetone with 10wt% phenolic resin shows highly porous structure with open pores. SEM image (B) for the same carbon foam reveals the porous structure with clear open pores. Carbon foam exhibited bulk density of ~0.60g/cm³ and porosity of around 74%. Carbon foam developed by using SC is cost effective technique.

Group is developing high density isotropic graphite of size diameter 75 mm and length 150 mm for BARC using suitable coal tar pitch which is easily available in the country. The high density isotropic graphite should possess bulk density >1.80g/cm³, Bending strength >35 MPa, Compressive strength >65 MPa, Thermal conductivity >90 W/mK, coefficient of thermal expansion < 5.5 x 10⁻⁶/°C, grain size <20 µm, tensile strength >22 MPa etc. Figure shows the high-density graphite developed from coal tar pitch based semicoke after heat treatment at 2350°C.



High density graphite after heat treatment at 2350°C

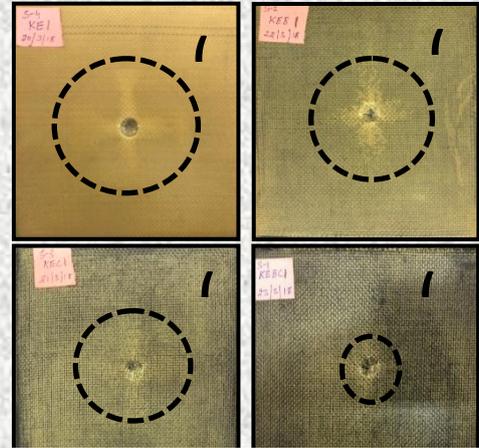
For the development of light weight bullet proof vest and shield best material will have a high level of elastic storage energy that will cause bullet to bounce back and to be deflected group has taken an initiative on the development of light weight body armour materials. CNT based papers have been



UHMWPE-MWCNT paper composite vest plate before and after ballis

sandwiched between the ultra-high molecular weight polyethylene sheets for making light weight body armour plates. These vest plates have also been tested for ballistic performance and passed successfully.

Further, the major causes of failure of Kevlar reinforced composites are inter-yarn slippage and poor adhesion with polymer. Herein, in-house synthesized long length multiwalled carbon nanotubes based bucky papers have been sandwiched between the Kevlar fabrics. These results into the improvement of tensile strength, flexural strength and energy absorbed by drop test from 237.2 ± 29.7 MPa to 367.2 ± 10.3 MPa, 139.0 ± 19.9 to 227.5 ± 2.1 MPa, and 10.5 ± 1.69 to 13.8 ± 0.26 J respectively. Figure shows the impact of drop test on different Kevlar- CNTs composites. This significant improvement in the mechanical properties of these composites showed their great potential for application in the development of light weight high performance ballistic resistant helmets.



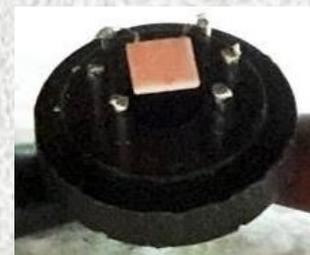
(a) Kevlar epoxy composite, (b) Kevlar-CNT Epoxy composite, (c) Kevlar-bucky paper- Epoxy composite and (d) Kevlar-bucky paper/ CNT-Epoxy composite after drop test.

Carbon paper with improved properties as compared to the commercially available SGL carbon paper had been developed by optimizing the fiber/ matrix ratio. The polarization curve for the unit PEMFC shows enhanced power density of 1050 mW/cm^2 for the sample with fiber/matrix ratio of 70:30, which is also substantially elevated in comparison to the output power densities values of carbon paper reported till date as well as commercially available SGL paper (948 mW/cm^2).

Group is also involved in the development of 'Graphitized Petroleum Coke' BND that provides certified values of Ash, sulphur, and Heat of Combustion and reference values for fixed carbon, moisture, and Volatile Matter. It is a reference against which any lot of carbon additive could be precisely ascertained for its quality and the measuring instruments for the above parameters could be calibrated.

Thin Film Devices

With the increasing pollution in India, there is a huge demand for inexpensive, portable, accurate and reliable gas sensors in large numbers which can detect the gas concentration below threshold limit value. At present, these sensors are being imported to measure and monitor our atmospheric pollutants gases. Hence, indigenous development of these sensors will help meeting this demand and will also save enormous foreign currency. The group is actively engaged in the



Fabricated Micro-heater on alumina

development of gas sensor. For MO based gas sensor application, the Micro-Heater (on Alumina substrate) has been designed and fabricated. Sensing behaviour of fabricated MO based CO gas sensor (on alumina substrate), for 915ppm CO gas, at 250 °C has been measured.

Moderate sensitivity for CO gas has been achieved in the initial stage. Further improvements are in progress.

Indian Reference Materials BND

BHARATIYA NIRDESHAK DRAVYAS (BND™): Indian Reference Materials

Precise, accurate and reliable measurement data is a mandatory requirement of national and international level of quality systems for global acceptance of products. A certified Reference material (CRMs) ensures high quality in measurements and provides traceability to the analytical measurements through SI units. Use of these CRMs in the calibration of analytical equipment and validation of test methods, assures the quality control in the country and also improve the quality of life. Most of the CRM users in the country are facing great difficulties in procurement of SI traceable CRMs of various matrices and completely depending on international CRM producers.

A reasonable cost of CRMs with a measurement traceability certificate and prompt supply, CSIR-National Physical Laboratory, India (NPLI) being the National Metrology Institute (NMI) started its mission since more than three decades towards the development, certification and dissemination of SI traceable CRMs in the country and abroad. To meet the demand of CRMs various national and international inter laboratory programmes on development and dissemination of certified reference materials are being coordinated by CSIR-NPL time to time.

Certified Reference Materials prepared under this programme are christened as Bharatiya Nir deshak Dravyas or Indian Reference Materials or BND™ in short. The traceability of BNDs has been established linking to all the SI primary standards established in CSIR-NPL. The BND™ are being validated by various established methods such as gravimetric, titrimetric, coulometry and the sophisticated analytical instruments. CSIR-NPL has developed indigenous CRMs which are gravimetrically traceable to SI mass (BIPM Copy No. 57 at NPLI). Since then CSIR-NPL has developed 64 BNDs traceable to SI units in various matrices.

Now, Bharatiya Nir deshak Dravyas has been trade mark as BND™. To establish measurement traceability and dissemination of Bharatiya Nir deshak Dravyas (BND™s) in the country, CSIR-NPL has rejuvenated the mission for the development of indigenous BND™ through join hands with Reference Material Producers (RMPs). The RMPs in the respective field of expertise develops Reference Materials and validates the measurement result and certification through CSIR-NPL to ensure quality assurance in our country.

This division comprises of Planning, monitoring evaluation and outreach; Industrial liaison group; Centre for calibration & testing; Workshop; International science & technology affairs group; Human resource development group; Administration- Quality management system; Rajbhasha unit; Knowledge resource centre; Finance & Accounts Store & Purchase section; Works & services.

Planning, Monitoring Evaluation and Outreach

Project Management and Outreach are the key activities of the Planning Monitoring and Evaluation (PME) department. This inter-alia covers Planning, Monitoring & Evaluation of FTT, mission mode and other externally funded projects. Apart from this, PME also attends to technical queries, Parliament Questions and technical audit as well as assist Director in liaisoning with CSIR-HQ, Management Council (MC) and Research Council (RC) on project related matters. The outreach program is aimed to provide services of sophisticated instruments at NPL to users from academic institutes across India. PME & Outreach also undertakes in-house software development activities in the area of knowledge development and management. Major activities the Division carried out are as follows:

- The Institute undertakes projects sponsored by various external agencies such as Ministry of Science & Technology, MNRE, DST, etc. The details of External Cash Flow i.e., money received from these agencies to carry out specified project is regularly recorded and monitored by PME against the target established by the Institute.
- A project database is developed by PME, which is regularly updated incorporating addition of new projects, modifications during their implementation stage and finally during their completion. The database includes project title, classification and technical and financial details, which help in tracking the technical and financial progress of the projects. PME also maintains the cash inflow of all the projects.
- Registration of all projects and allotment of specific identity in terms of a Project No. is made at PME, soon after the money for the project is received along with In-Principle approval. Projects are registered in different modes viz FTT, mission mode, sponsored Research, Grant-in-Aid, Collaborative and CNP. The total number of projects registered in different modes is 60. The total cash-in-flow generated is Rs 40 crores.
- Major projects (> 50 Lakhs) running during the year are listed in Annexure – I.
- PME designed, maintained and modified the proforma pertaining to various project related activities as per the need from time to time.

- PME is a gateway for various important activities like new project proposals, budget sanctions and monitoring, issue of various OMs, utilization and project completion reports etc. PME deals with lot of files containing important documents of projects, audit paras, budget sanctions, indents, minutes etc. On an average we receive around 500 files in a month from various departments and for different activities. In current system we were doing the file tracking manually by maintaining in and out entries for each file. However it is tedious to trace exact location of files using these register and offers less transparency and hassleful scheme of things. In such a backdrop, PME felt the need for an Information & Communication Technology (ICT) based application that could re-orient the whole system and developed barcode enabled Online File Tracking System (FTS). FTS has enabled tracking of file movement using web based software. FTS adopted a unique bar-coded sticker system to track the location of the file at a single click. The package have features for diarizing of files, updating its status, opening of new files, tracking the movement of files, dispatch of letters/files and record management.

FTS Outgoing Entry Form

- Outreach program was formally launched on 20th May, 2016 and is responsible for its operation, management and implementation. PME acts as an interface between NPL Scientists and outreach customers to provide required services. Thousands of requests are received under this program and hundreds of researchers have been benefitted.
 - A customer database has been designed to manage outreach customer interactions and data throughout customer lifecycle from enquiry management to billing.
 - Initially held regular one to one meetings with the respective CSEs to motivate them and resolve their queries if any.
 - Process re-engineered to assign a unique request number to all the requests received depending upon the study. The same enquiry

number has been quoted to CSEs, SMEs and Outreach customers in the 'Subject' of email during correspondence.

- Implemented a mechanism to update the modalities of payment received in the Outreach Program, to bill and F&A department.



Indian Map marked with red dots for outreach requests received from different regions of India.

- PME prepares Annual Plan containing information related to research work plan to be carried out and financial requirements. NPL budget requirements are prepared by PME including the financial requirements in Plan and Non-Plan basis. PME is coordinating with CSIR-HQ as well as other funding agencies for FTT, mission mode and other R&D projects. A series of brain storming have been done at Institute level as well as different R & D group levels. Also review of available man power for development and co-ordination for the projects has been taken up.
- Parliamentary questions, project queries and RTIs are handled by PME. The queries related to CSIR guidelines, technical progress of projects, etc are also handled by PME. The replies are prepared after collecting, compiling and collating information from within/ or outside NPL and CSIR-HQ.
- Successfully conducted 82 NPL Council Meetings, 04 Research Council & Management Council meetings and 60 institutional review meetings.
- Provided information to the management to monitor the flow of financial inputs in relation to physical outputs.
- Realistically projected the future requirements of projects in the budgetary process.

- Research Utilisation Data (RUD) reporting on the performance and the status of various projects is carried out by PME. RUD contains information related to various projects handled by the Institute.

Quarterly Performance Report (QPR) contains information about the performance of the Institute on various parameters on quarterly basis. These reports are sent to CSIR for their perusal on quarterly basis. These reports also help the Institute in reviewing its own performance as a monitoring tool. PME Division also calls for progress report of all the on-going projects in the Institute for processing. This exercise is meant to monitor & ascertain the status of each of the projects with respect to adherence to time schedule and other milestones. Any deviation is intimated to the respective project leaders and remedial measures are taken to put the project on course. Completed projects, as reported by the respective Project Leaders are processed for closure.

Industrial Liaison Group

The Industrial Liaison Group (ILG) serves as an interface between the Industry and the scientific community of the CSIR-NPL with an objective to help the Industries solve their technical problems by transferring the technologies developed by CSIR-NPL. Transfer of technologies, is one of the main activities of the group. ILG also facilitates to provide consultancy and technical services to the clients (Govt/Public/R&D or Private Sector) in the form of time bound projects. ILG activities also involve review of project proposals, preparation of the Office Memorandums for the fund allocation of the projects as per the sanction, handling of payments, GST Remittance, distribution of royalty/premium and honorarium to the inventors etc. The group maintains and manages the database of all these projects and prepares and disseminates various reports to CSIR and other departments from time to time. ILG web site is being maintained by the group and serves as a strong medium to show-case the CSIR-NPL Technologies and Know-How of processes ready for transfer to the industries and other organisations. Besides this, the group also takes care of the management of S&T outputs, MoUs, MoAs and NDAs with the interested industries and research organizations in India and abroad.

➤ Consultancy Projects (2017-2018)

1. "Feasibilities study on Development of Activated Charcoal/ Carbon Products from Jute Sticks and preparation of DPR", National Jute Board, Kolkata, West Bengal, May 17, 2017 to Oct. 16, 2017, Rs 24,59,640 including tax.

2. "Verification of dimensional features in artificial standard defects in test rails", M/s Physimech Instrumentation, Hyderabad, May 19, 2017 to May 18, 2018, Rs 2,51,000 including Service Tax.
3. "Feasibilities study on Development of value added carbon product using coal tar", M/s Tata Steel Limited, Jamshedpur, May 23, 2017 to Aug. 22, 2018, Rs 26,22,648 including tax.
4. "Evaluation of acoustical characteristics of acoustical doors", M/s Sound works, Wilson Gardon, Bengaluru, Aug. 08, 2017 to Aug. 07, 2018, Rs 5, 90,000 including tax.
5. "Metrological Evulation of Analouge and mercury free LCD sphygmanometers", M/s Rennex, Medical , New Delhi, Aug. 09, 2017 to Feb. 08, 2018, Rs 3,54,000 including tax.
6. "Metrological Performance Characterization of Digital Sphygmomanometers", M/s Medsource Ozone Biomedicals Pvt. Ltd, Delhi, Nov. 16, 2017 to May 15, 2018, Rs 1,45,140 including tax.
7. Evaluation of acoustical characteristics of acoustical products/sound barriers, M/s Armacell India Pvt Ltd, Nagar Road, Pune, Maharashtra, Jan. 24, 2018 to Jan. 23, 2019, Rs 5,90,000 including tax.
8. "Specification testing of filter material used for ambient particulate matter sampling", M/s Micro Separations, Indirapuram, Ghaziabad, UP, Jan. 17, 2018 to Jul 16, 2018, Rs 3,45,334 including tax.
9. "Acoustics characteristics of multiple interior products", M/s. New Era Interior Collection Pvt. Ltd., Bangalore, Karnataka, Feb. 01, 2018 to Jan. 31, 2019, Rs 5,90,000 including tax.

➤ **Technology Transferred (2017-2018)**

1. Low cost Peltier based refrigerator : Licensed to M/s Joy Trading company, New Delhi on May 31, 2017.
2. Recycling of plastic waste for tiles : Licensed to M/s Shayna Ecounified, Ghaziabad, Uttar Pradesh on Jun. 23, 2017.
3. High-Volume PM2.5 Impactor Sampler: Licensed to M/s Environmental Solutions, Noida, Uttar Pradesh on Sept. 25, 2017.
4. Ferroelectric Loop Tracer : Licensed to M/s ATOS Instruments Marketing Services, Bangalore on Feb. 28, 2018.
5. Recycling of plastic waste : Licensed to M/s Addin Infra Pvt Ltd, Ahmedabad, Gujarat on Feb. 28, 2018.

➤ **MoUs, MoA and NDA (2017-2018)**

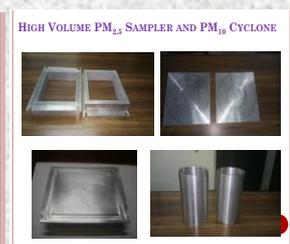
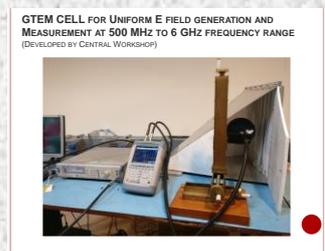
1. National Jute Board, Ministry of Textiles, Govt. of India, Kolkata “Feasibility study on Development of Activated Charcoal/carbon from Jute sticks and preparation of DPR”, Apr. 11, 2017.
2. M/s Security Printing and Minting Corporation of India (SPMCIL) , New Delhi, “To meet the technology and security raw materials requirements of SPMCIL”, Apr. 20, 2017.
3. M/s Joy Trading Company, New Delhi for technology transfer of “Low cost Peltier based refrigerator”, May 31, 2017.
4. MoU with PTB Germany concerning “cooperation in the field of Metrology”, Jun. 05, 2017.
5. M/s Shayna Ecounified India Pvt. Ltd., Delhi for technology transfer of “Recycling of waste plastic bags into tiles for structure designing”, Jun. 29, 2017.
6. ISRO Telemetry Tracking and Command Network (ISTRAC), Indian Space Research Organisation (ISRO), Govt. of India, Bengaluru for providing “Time and Frequency Traceability”, Aug. 03, 2017.
7. M/s Cell Propulsion Pvt Ltd., Karnataka for “Development of carbon foam as heat sink for high energy Lithium ions batteries for electrical vehicles”, Sept. 20, 2017.
8. M/s Environmental Solutions, Noida, U.P. for technology transfer of “High-Volume PM2.5 Impactor Sampler”, Sept. 25, 2017.
9. Lease Agreement of CSIR-NPL with National Institute of Information and Communication Technology (NICT)-Japan for “GNSS equipment for time-link calibration”, Dec. 06, 2017.
10. Agreement for Joint Research with M/s Tata Steel Ltd. (Public Limited Company), Jamshedpur, India for “Feasibility study on Development of Value Added Carbon Products from coal tar”, Dec. 27, 2017.
11. MoU between CSIR-NPL and M/s Addin Infra Private Limited, Rajkot, Gujarat for know-how transfer of “Recycling of Waste Plastic Bags into tiles for structure designing (Patented in India and SAARC countries)”, Feb. 28, 2018.
12. MoU between CSIR-NPL and M/s ATOS Instruments Marketing Services, Bangalore, Karnataka for know-how transfer of “Ferroelectric Loop Tracer”, Feb. 28, 2018.
13. MoU between CSIR-NPL and IFR Information Dissemination Pvt. Ltd (IFR), Hyderabad, Telangana for “providing Indian Standard Time and Frequency Traceability by CSIR-NPL to IFR”, Mar. 28, 2018.

Centre for Calibration and Testing

Centre for calibration and testing has been setup to promote calibration and testing services of NPL. It acts as an interface between customers and all calibration and testing groups. CFCT is responsible for accepting the applications, generating casefiles and sending calibration certificates and testing reports to the customer. It maintains a customer data base of more than 2000 customers. During the year the revenue generated from calibration and testing is 7.52 crore out of 2390 reports

Workshop

Workshop of the CSIR-National Physical Laboratory has started in the year 1950. To become a premier research organization in the area of physical sciences and also known as the National Metrology institute of India, The mechanical workshop of the laboratory is playing a vital role in the designing and development of highly precision and sophisticated instruments, components and devices using in the nano science and other research labs of the CSIR-NPL. A large number of devices and high precision components are fabricated in the workshop such as Improved version of High Volume PM_{2.5} sampler and PM₁₀ Cyclone, E-Field Sensor Calibrator, SAR Measurement Device, High Precision Copper Bus Bar for I-V measurement of Photovoltaic Solar Cells, Devices for the calibration of IR and Digital Thermometer, Ultrasonic Liquid Cell for the measurement of Ultrasonic Velocity, Devices for Energy Material Groups, Micro Precision shadow Masks etc. Beside this the workshop helps in the maintenance of Apex level standards and establishing the new facility in the laboratory in several manners. The workshop facility also involves in the fabrication/manufacturing of the precision instruments and sophisticated accessories for sister CSIR laboratories and other external organizations. The notional earning for the year 2017-18 was approximately 0.7 Crore. Some of the devices are shown herewith:-



To facilitate this, the workshop equipped with a state-of-the-art facility that comprises -



CNC Deckel Milling Machine



Micro Milling Machine



Precision Lathe Machine



Precision Surface Grinder



Tool and Cutter Grinder



Welding Shop

International Science and Technology Affairs Group

International Scientific Collaborations are assisting the scientists to share their ideas & papers for developing new technologies & bridging the gap between them for the service of man kind. ISTAG group facilitates the overseas visits of scientific and technical personnel of the laboratory to get acquaintance & learn new techniques . It advises the scientists to participate in International Conferences, seminars and summer schools. It helps the scientists to get prestigious international fellowships. This group also advises the scientists to avail bilateral exchange programme. The total numbers of visited conducted by NPL scientists/technologists were 28. It also organizes the visit of foreign delegations at NPL. International experts are invited to give talks and lectures at NPL. The total numbers of foreign visitors visited NPL were 11. The scientific staff is motivated to avail sabbatical leave/study leave. Arranging training programmes for international candidates is also the job of this group. International collaborative projects, bilateral exchange programme and MOU are also handled by this group.

Human Resource Development Group

The HRD group represents a central group of the laboratory and is involved in a wide range of HRD related activities in various areas of core competence of the lab and also related to research scholars/students.

The basic objective behind these activities is to make the scientific, technical & administrative human resource better informed, knowledgeable and highly skilled & trained so that it can prove to be more competitive, productive and useful to the society and the country. Activities of HRD group are: Organization of Industrial Training Programmes, Placement, Ph.D. Registration & Other Support to Research Fellows, AcSIR – Ph.D. related activity, One year certification course in precision measurement and control, 'Organization of Students' Training at NPL, Deputation of NPL Staff Members to attend Conferences / Similar events, Dissemination of HRD-Related Information to NPL Staff Members/Students, Orientation of Newly-Recruited Scientists and Organization of National Science Day and NPL Open Day. During the year 13 students passed the first batch of PMQC course, 207 were registered for Ph.D and 23 were awarded Ph.D.

➤ Training organized

Training Programme Name	Duration	No. of Persons Trained
Short/Long Term Student Training (B.Tech/M.Tech/M.Sc. Etc.)	6 weeks to 6 months & more	139
Hands on Training on Electron Microscopy	June 15 to July 15, 2017	4
Certification Course on Precision Measurements and Quality Control (PMQC 2017)	One year	14
Training Programme on Fluid Flow & Pressure Metrology	July 26-28, 2017	13
Training Programme on Mass, Volume, Density & Viscosity Metrology	August 7-9, 2017	10
Training Programme on Force and Hardness Metrology	August 2-4, 2017	01
Training Programme on Technical requirement as per ISO/IEC 17025:2005 & Uncertainty of Measurement in Length and Dimension	August 28, 2017	24
Training Programme on Organic Photovoltaics and Electronics Technology	September 18-22, 2017	21
Training Programme on Temperature and Humidity Metrology	September 19-22, 2017	12
One Day Brain Storming Session on electrical and Electronic Measurement	September 20, 2017	30
Training cum Awareness Programme IP Awards CSIR Children Innovation Awards 2017	September 25, 2017	8
Training Programme on Optical Radiation Metrology	October 25-27, 2017	5
Training Programme on Dimension	November 2-3, 2017	4

Training Programme Name	Duration	No. of Persons Trained
Metrology using CMM and LMM		
Training Programme on Time & Frequency Metrology for DoT Officers	November 6-10, 2017	8
Training Programme for Legal Metrology Officers in Mass, Length, Temperature and Pressure	December 11-15, 2017	41
Training Programme on Nano Technology for students of Central University, Jammu	December 23, 2017 to January 1, 2017	9
Training Programme on Time and Frequency Metrology	February 5-9, 2018 & February 19-23, 2018	26
Training Programme on Pressure & Vacuum Metrology	February 7-9, 2018	7
Training Programme on Fluid Flow and Pressure Metrology	March 19-21, 2018	8

➤ **Ph. D. Awarded:**

No. of Ph. D. Students registered	No. of Ph.D. Awarded During 2017-18
207	23

Quality Management System

Quality Management System (QMS) of NPL is implementing and fulfilling the requirements of ISO/IEC 17025:2005 for the various sub-divisions covered under QMS. Many amendments were issued with respect to the QMS.

Quality Manager and Deputy Quality Manager attended and made presentation in the APMP TCQS workshop on “Revision of ISO/IEC 17025: 2005 standard” held at NPL in Nov. 2017. QMS group of NPLI contributed in the proceedings of the APMP TCQS meeting held at NPL in Nov. 2017 and Quality Manager also presented the country report of NPL – India (NPLI).

QMS coordinated the internal audits (schedule-I) of various sub-divisions and follow up of corrective actions and closure of NCs. The next cycle of internal audit is in planning.

QMS group coordinated with NABL and conducted “NABL Assessor’s Training Course” for NPL staff (22 candidates) from May 15-19, 2017 at NPL.

A half day “Workshop on Quality Management” for NPL staff was conducted at NPL on June 27, 2017.

QMS group in coordination with faculty members from other divisions of NPL, also conducted “Orientation Course on Quality Management System” for NPL staff from Aug 21-25, 2017. About 60 candidates of NPL attended this course.

Mr. Anil Kumar – Quality Manager of NPL delivered invited talks on Quality Management System in “Workshop on Evaluation of Measurement Uncertainty and ISO - 17025” held on July 25, 2017 at HRDC Ghaziabad and in “One day Workshop on Photovoltaic Metrology – Testing & Calibration of Solar Cell and Modules” held on Sep. 06, 2017 at NPL.

Knowledge Resource Centre

In CSIR-NPL, the umbrella term ‘Knowledge Resource Centre (KRC)’ comprised of Library and IT related activities under its domain.

As far as library and information support is concerned, KRC over the years has developed a rich collection of scholarly books and journals, especially in the field of physics and related sciences. During the current year, KRC subscribed numerous scholarly journals and added variety of books both in English and Hindi languages to enrich its textual collection. Regarding the services offered, KRC serves the CSIR-NPL community with services like Electronic Document Delivery service, Inter Library Loan service, Reference service, Literature Search service etc.

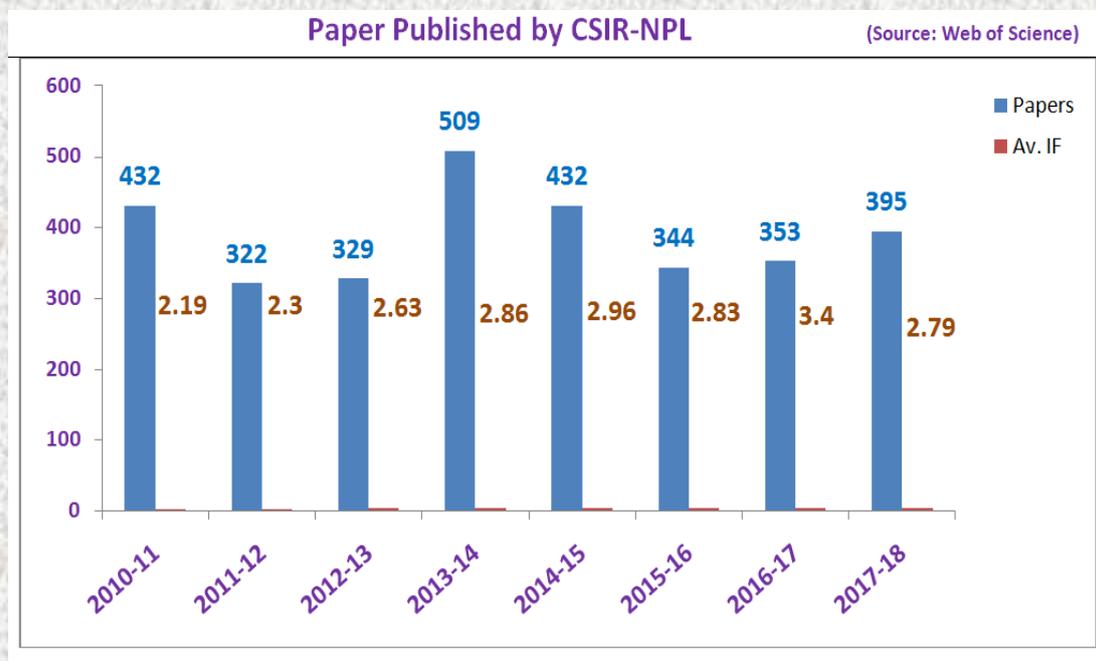
In addition to the printed content, the centre also offers online access to more than 6000⁺ full text journals under the e-consortium project of NKRC (CSIR+DST). The project facilitates access to the electronic content from various publishers such as, ACS (American Chemical Society), AGU (American Geophysical Union), AIP (American Institute of Physics), APS (American Physical Society), IOP (Institute of Physics), OSA (Optical Society of America), Oxford University Press, RSC (Royal Society of Chemistry), Springer, Wiley etc. KRC also provides access to the Indian Standards.

The shift in technology achieved with the automation of KRC activities and installation of improved routers helped in attracting the R & D personnel in large number to optimize the use of the available resources. Further, to promote free worldwide access to the intellectual outputs of CSIR-NPL in form of journals articles, research papers, conference papers, technical reports, preprints, and other scholarly communication, NPL-KRC has established the Institutional Repository (IR@NPL) <http://npl.csircentral.net/> and till date, around 2000 records has been added. Further, to enhance the use of licensed scientific software(s) available in CSIR-NPL, a central facility for such applications has been created in NPL-KRC.

Apart from the library related activities, NPL-KRC also contributes towards maintaining the CSIR-NPL website (<http://www.nplindia.in>) on Internet. This is to inform others about the

activities of the institute such as its role towards the society, thrust area of research, facilities, services and achievements.

➤ Paper Published by CSIR-NPL



राजभाषा यूनिट

राजभाषा यूनिटदिन-प्रति-दिन के सरकारी कार्यों में राजभाषा हिन्दी के प्रगामी प्रयोग को बढ़ाने का कार्य करती है । राजभाषा यूनिट का मुख्य उत्तरदायित्व संघ सरकार की राजभाषा नीति, राजभाषा अधिनियम के उपबंधों तथा आदेशों से प्रयोगशाला के वैज्ञानिकों/अधिकारियों/कर्मचारियों को अवगत कराना, अनुपालन कराना एवं अनुपालन हेतु सहायता प्रदान करना है ।

राजभाषा यूनिट के उत्तरदायित्व :

1. कार्यान्वयन :

- संघ सरकार की राजभाषा नीति, राजभाषा अधिनियम के उपबंधों तथा आदेशों से प्रयोगशाला के वैज्ञानिकों/अधिकारियों/कर्मचारियों को अवगत कराना, अनुपालन कराना एवं अनुपालन हेतु सहायता प्रदान करना ।
- प्रत्येक तिमाही में निदेशक, एन पी एल की अध्यक्षता में राजभाषा कार्यान्वयन समिति की बैठक का आयोजन, कार्यसूची एवं कार्यवृत्त तैयार करना । बैठक में लिए गए निर्णयों पर अनुवर्ती कार्रवाई करना ।
- हिन्दीदिवस/ हिन्दीमास तथा प्रत्येक तिमाही में हिन्दी कार्यशालाओं/व्याख्यानों का आयोजन करना ।
- राजभाषा विभाग, गृहमंत्रालय, भारत सरकार से प्राप्त वार्षिक कार्यक्रम में निर्धारित लक्ष्यों को प्राप्त करने हेतु उचित कार्रवाई करना ।

- संसदीय राजभाषा समिति के निरीक्षण सम्बन्धी कार्य तथा समिति को दिए गए आश्वासनों को पूरा करने हेतु कार्रवाई करना ।
- प्रत्येक वर्ष विज्ञान विषयों पर हिन्दी में दो दिवसीय राष्ट्रीय संगोष्ठी का आयोजन ।

2. प्रशिक्षण एवं प्रकाशन :

- हिन्दी प्रशिक्षण (प्रबोध, प्रवीण एवं प्राज्ञ पाठ्यक्रम)।
- हिन्दीटंकण/आशुलिपि एवं कम्प्यूटर पर हिन्दी में कार्य करने का प्रशिक्षण दिलाना।
- प्रत्येक छः माही में हिन्दी समीक्षा पत्रिका का प्रकाशन।
- प्रयोगशाला की वार्षिक रिपोर्ट तथा अन्य महत्वपूर्ण प्रकाशनों में हिन्दी अंश का संपादन।

3. अनुवाद :

- प्रयोगशाला में प्रयुक्त सभी प्रपत्रों (फार्मों), मानक मसौदों का द्विभाषीकरण ।
- हिन्दी अनुवाद कार्य ।
- राष्ट्रीय भौतिक प्रयोगशाला के वार्षिक प्रतिवेदन के महत्वपूर्ण अंशों का हिन्दी अनुवाद ।
- प्रयोगशाला की वेबसाइट का हिन्दी अनुवाद ।

कार्मिक :

1.	मंजु	हिन्दी अधिकारी	2.	जय नारायण उपाध्याय	हिन्दी अधिकारी
3.	विजय सिंह	वरिष्ठ आशुलिपिक (हिन्दी)	4.	रजनी कौशिक	हिन्दी अनुवादक

प्रयोगशाला द्वारा राजभाषा की प्रगति के लिए उठाए गए कदम एवं प्रयास

- प्रत्येक तिमाही में निदेशक, एन पी एल की अध्यक्षता में राजभाषा कार्यान्वयन समिति की बैठक में वार्षिक कार्यक्रम में निर्धारित लक्ष्यों को प्राप्त करने हेतु चर्चा एवं उन की समीक्षा की जाती है तथा बैठक में लिए गए निर्णयों पर अनुवर्ती कार्रवाई की जाती है ।
- संघ सरकार की राजभाषा नीति, राजभाषा अधिनियम के उपबन्धों तथा आदेशों से प्रयोगशाला के वैज्ञानिकों/अधिकारियों/कर्मचारियों को अवगत कराया जाता है, अनुपालन कराया जाता है एवं अनुपालन हेतु सहायता प्रदान की जाती है ।
- हिन्दी दिवस/हिन्दी सप्ताह/हिन्दी पखवाड़ा/हिन्दी मास मनाया जाता है । इस दौरान विभिन्न प्रतियोगिताओं का आयोजन किया जाता है, जिसमें प्रयोगशाला के सभी अधिकारी/कर्मचारी भाग लेते हैं और उन्हें नकद पुरस्कार द्वारा प्रोत्साहित किया जाता है ।
- प्रत्येक तिमाही में प्रयोगशाला के अधिकारियों/ कर्मचारियों हेतु हिन्दी कार्यशालाओं/ व्याख्यानो का आयोजन किया जाता है । इन कार्यशालाओं के माध्यम से स्टाफ सदस्यों को हिन्दी में अधिक से अधिक कार्य करने हेतु प्रेरित एवं प्रोत्साहित किया जाता है । टेबल-वर्कशाप के माध्यम से व्यक्तिगत रूप से चर्चा की जाती है एवं कठिनाइयों का समाधान किया जाता है ।

- प्रत्येक वर्ष विज्ञान विषयों पर हिन्दी में दो दिवसीय राष्ट्रीय संगोष्ठी का आयोजन किया जाता है। वैज्ञानिकों द्वारा शोध पत्र हिन्दी में प्रस्तुत किए जाते हैं। राष्ट्रीय संगोष्ठी की सारांश पुस्तिका हिन्दी में प्रकाशित की जाती है, जिस से विज्ञान शोध सम्बन्धित जानकारी हिन्दी में आम जन तक पहुंचती है।
- प्रयोगशाला के अधिकारियों/कर्मचारियों को केन्द्रीय हिन्दी प्रशिक्षण संस्थान से हिन्दी प्रशिक्षण (प्रबोध, प्रवीण एवं प्राज्ञ पाठ्यक्रम) दिलाया जाता है। कम्प्यूटर पर हिन्दी में कार्य करने का प्रशिक्षण दिलाने हेतु कार्यक्रम आयोजित किए जाते हैं।

हिन्दी माह आयोजन

राजभाषा विभाग, गृहमंत्रालय भारत सरकार के हिन्दी पखवाड़ा/हिन्दी माह आयोजन संबंधी निर्देशों के अनुपालन को सुनिश्चित करते हुए प्रयोगशाला में दिनांक 10 अगस्त, 2017 से 11 सितम्बर, 2017 तक हिन्दी माह मनाया गया था। प्रयोगशाला के सभी स्टाफ सदस्यों को अपना अधिक से अधिक कार्य हिन्दी में करने के लिए प्रेरित एवं प्रोत्साहित करने के उद्देश्य से निम्नलिखित प्रतियोगिताएं आयोजित की गयीं।

क्र.सं.	प्रतियोगिता का नाम	दिनांक
1.	निबन्ध प्रतियोगिता	10 अगस्त, 2017
2.	शब्दावली एवं अनुवाद प्रतियोगिता	17 अगस्त, 2017
3.	सामान्य-ज्ञान विज्ञान प्रतियोगिता	22 अगस्त, 2017
4.	वाद-विवाद प्रतियोगिता	30 अगस्त, 2017
5.	वर्ष के दौरान हिन्दी में किया गया अधिकतम कार्य (नोटिंग-ड्राफ्टिंग) एवं हिन्दी डिक्टेसन	01 सितम्बर 2017
6.	गीत एवं काव्य पाठ प्रतियोगिता	06 सितम्बर, 2017

प्रयोगशाला के वैज्ञानिकों/अधिकारियों/कर्मचारियों/शोध छात्रों ने उक्त प्रतियोगिताओं में उत्त्वाहपूर्वक भाग लिया। सभी प्रतियोगिताओं से संबंधित समितियों द्वारा निर्धारित मानदंडों के अनुसार विजेता प्रतिभागियों का चयन किया गया। निदेशक महोदय व समिति सदस्यों ने हर्ष व्यक्त किया व हिन्दी दिवस के लिए शुभकामनाएं दीं।

Annexure I

Major R & D Projects during 2017-18

The major projects of value >50 Lakhs are listed below,

Sr. No.	Project Title	Funding Agency	Contract Value (in lakhs)	Amount Received during 2017-18
1	A system to generate a common synchronized clocks using CVGNSS with an uncertainty of few ns at geographically disturbed sensor nodes	Defence Electronics Research Laboratory (DERL) Ministry of Defence	95.00	--
2.	Chemical Composition and source apportionment of Aerosols using Receptor Models at urban sites of the Himalayan Region of India	Department of Science & Technology	71.72	53.55
3.	Buried contacts high efficiency crystalline radial p-n junction Si Nanocord Solar Cell	Department of Science & Technology	89.00	17.80
4.	Megacity Delhi atmospheric emission quantification assessment and impacts (Delhi Flux)	Ministry of Earth Sciences (MoES)	198.28	58.11
5.	Growth and study of highly conducting delafossite single crystal: Device application in metrology	Department of Science & Technology	89.00	17.80
6.	Development of new Interfacial layers for efficient and stable excitonic solar cells	Department of Science & Technology	92.80	69.50
7.	National Primary Standard facility for cell calibration	Ministry of New and Renewable Energy (MNRE)	1788.50	900.00
8.	Carbonaceous Aerosols Emissions, Source Apportionment and climate effects	Ministry of Environment & Forest	274.672	85.00
Amount Received from above projects (above 50 Lakhs)				1201.83
Total Fund Received during 2017-2018				1525.25

Annexure II

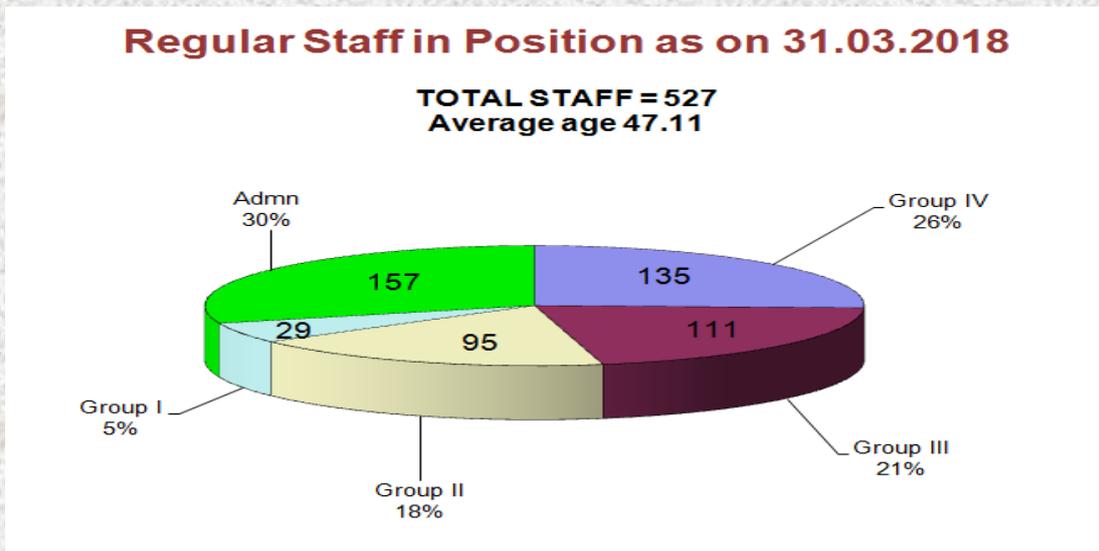
Awards & Achievements

1. **Dr. Vinay Gupta** conferred **Shanti Swarup Bhatnagar award** for 2017-2018 for physical science
2. **Dr. Bipin Kumar Gupta** has been awarded the prestigious “**MRSI Medal Award-2018**” by Materials Research Society of India for his significant contributions to the field of Materials Science and Engineering organized by MRSI Trichy Chapter and Centre for High Pressure Research, Bharathidasan University, Trichy, India on February 14th -16th, 2018.
3. **Dr. Govind** has been awarded the prestigious “**MRSI Medal Award-2018**” by Materials Research Society of India for his significant contributions to the field of Materials Science and Engineering organized by MRSI Trichy Chapter and Centre for High Pressure Research, Bharathidasan University, Trichy, India on February 14th -16th, 2018.
4. **Dr. S. K. Dubey** conferred “**URSI Young Scientist award 2018**”.
5. **Dr. Bipin Kumar Gupta** has been awarded the prestigious **Academician Fellow of Asia- Pacific Academy of Materials (APAM)** (It is a recognition as outstanding specialists in material science and technology who have made significant contributions to cooperation in Asia-Pacific Region) elected at meeting held on April 12, 2017, Sendai, Japan.
6. **Dr. Ashish Agarwal** Conferred **Academic Brilliance Award 2018** by EET CRS.
7. **Dr. Bhanu Pratap Singh**, received **IEI Young Engineer Award 2017** from The Institution of Engineers
8. Team of **Time and Frequency Metrology** Conferred **Technology Award 2017** by **CSIR-NPL** for contribution in establishing techniques for time synchronisation to IST by CSIR-NPL
9. **D.D. Shivagan** awarded with **CSIR-Raman Research Fellowship** to work at NPL, UK from February 15, 2017 to July 15, 2017 on “Measurement of thermodynamic temperatures by Acoustic Gas Thermometry”.
10. **Dr. Naveen Garg** has been awarded “**APMP Iizuka Young Metrologist Prize for Developing Economies, DEN**” on November 29, 2017

Annexure III

Staff, Patents, Reports and Financial Outflow

Regular Staff in position



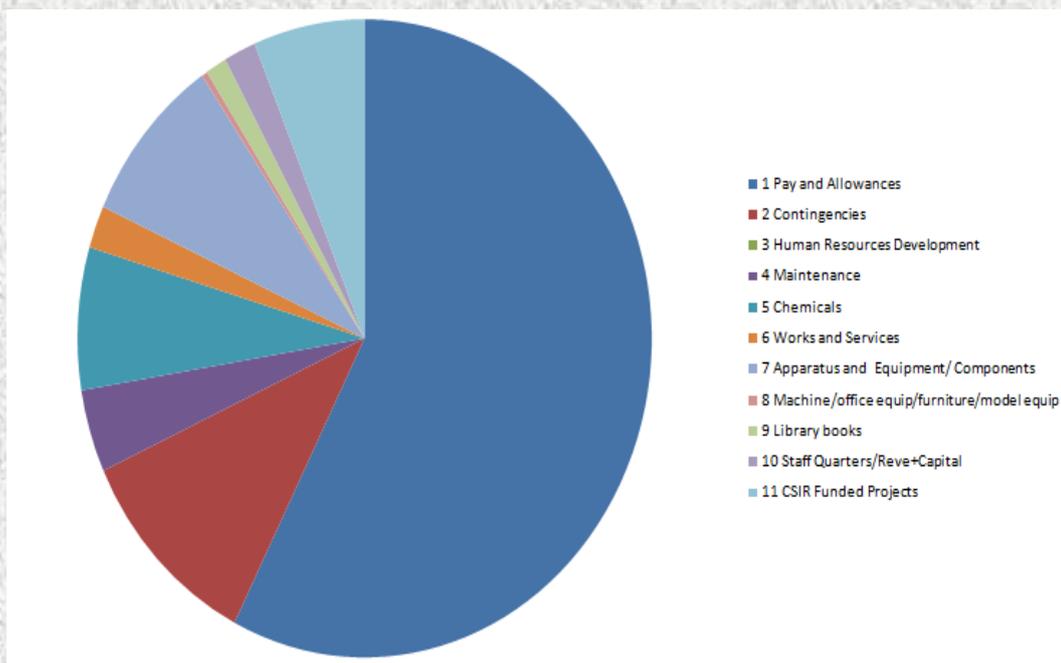
New Recruitments (2017-2018):

Sr. No.	Name	Post	Date of Joining
1	Dr. Shibu Saha	Scientist	Feb. 09, 2018
2	Dr. Kriti Tyagi	Scientist	Feb. 12, 2018
3	Mr. Afaqul Zafer	Scientist	Feb. 09, 2018
4	Dr. Komal Bapna	Scientist	Feb. 16, 2018
5	Mr. Anuj Krishna	Scientist	Feb. 21, 2018
6	Mr. Vattikonda Bharth	Scientist	Feb. 26, 2018
7	Ms. Indu Elizabth	Scientist	Feb. 26, 2018
8	Dr. Pallavi Kushwaha	Sr. Scientist	Apr. 24, 2018
9	Sudhir Pal	Assistant (G) Gr. III	Mar. 28, 2018
10	Pooja Singh	Assistant (G) Gr. III	Apr. 13, 2018
11	Pinki	Assistant (F&A) Gr. III	Jun. 01, 2018
12	Durga Singh	Assistant (G) Gr. III	Jun. 07, 2018
13	Sonia Kumari	Assistant (S&P) Gr. III	Jun. 08, 2018

Patents and Reports

- i) Patents file in India: 06
- ii) Patents granted in India: 05
- iii) Patents filed abroad: 03
- iv) Patents granted abroad: 09
- v) Test and Calibration Reports generated : 2390

Budget flow



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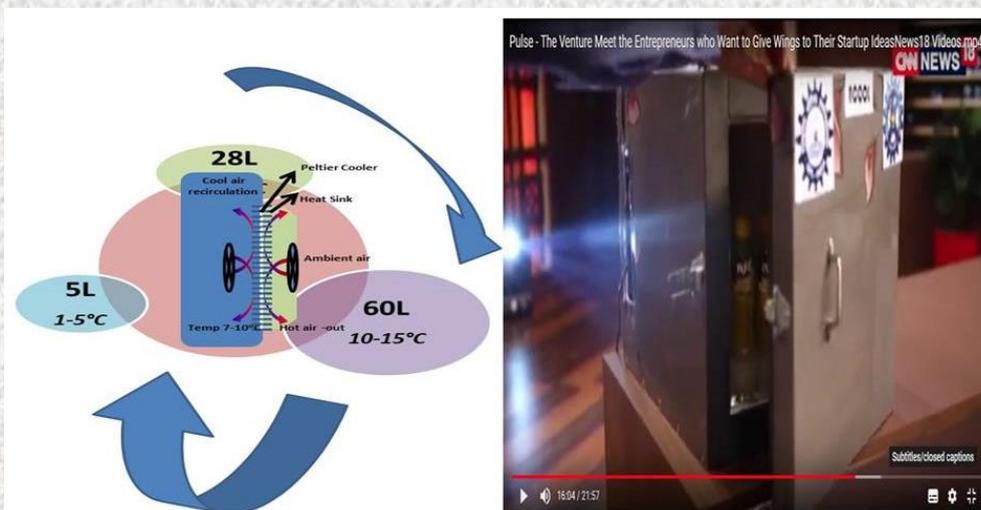
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Dr. Mahesh Kumar, Sr. Scientist

Dr. Naveen Garg, Sr. Scientist

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