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Cover (R to L): Dr G Satheesh Reddy Secretary DDR&D and Chairman DRDO, Dr Shekhar C Mande, DG CSIR and Secretary DSIR and Dr AK Singh, DS and DG (LS), DRDO releasing DRDO Science Spectrum on the occasion of National Science Day.



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DRDO CELEBRATES NATIONAL SCIENCE DAY

National Science Day (NSD) is celebrated every year on 28th February to commemorate discovery of the 'Raman Effect', which led to Indian scientist Sir Chandrasekhara Venkata Raman winning the Noble Prize in Physics in 1930. On this day in 1928, Dr Raman discovered a phenomenon of scattering of photons, which was later known as 'Raman Effect' after his name. The objective of NSD is to promote active involvement of students and teachers in science related activity, encourage students to ask questions and to get doubts cleared in different areas of science and promote their effective participation and enable students to know about the latest developments in the fields of science and technology. The theme of NSD 2020 was "Women in Science."

Defence Science Forum, a common platform for DRDO Scientists of various disciplines, organised National Science Day Oration on "Defining S&T Priorities of a Nation" by Dr Shekhar C Mande, DG CSIR and Secretary DSIR at Dr Kothari Auditorium at DRDO HQ on 4 March 2020. Dr G Satheesh Reddy, Secretary DDR&D and Chairman DRDO presided over the function. Speaking on the occasion, Dr Reddy appreciated the contributions of women scientists of DRDO working in many critical projects. Adding further Dr Reddy said, Science Day gives us inspiration and chance to acknowledge the contributions of many eminent scientists of India particularly Dr CV Raman, and emphasised on the need of working on the basic sciences and core research for the betterment of the country. He also appreciated CSIR for providing support to many of DRDO projects in the field of Aeronautics, Missiles and in the area of space.

Appreciating DRDO's contribution to the nation Dr Mande said, "A lot of work being done by DRDO is classified



Dr Shekhar C Mande, DG CSIR and Secretary DSIR delivering NSD oration

and not many people know what work is going on in DRDO, but yet they make such a valuable contributions not only for the wartime but also for society at large." Citing the example of US, Dr Mande said, how S&T support from public in US grow in wartime and how S&T has helped US to grow in a most powerful nation in the world.

Driving example from China, Dr Mande explained how China received a setback during the cultural revolution in spite of inventing compass, printing press, paper, and gunpowder in ancient time and then how the theory of Chairman Deng Xiaoping of four modernisation of agriculture, industry, national defence and S&T helped Chinese Society to develop.

In context of Indian journey of development, Dr Mande said, India's journey has been very fascinating and has been driven by individual excellence, self-reliance and technology denial. He emphasised that future S&T roadmap in India should focus on circular economy and stressed that any technology which

we develop should have strong science behind that technology. He ended with stressing on proper S&T solutions for many of the problems being faced by the Indian society.

Dignitaries released DRDO Science Spectrum, a compilation of scientific papers presented by DRDO scientists at their respective laboratories to commemorate NSD. The publication was brought out by Defence Scientific Information and Documentation Centre (DESIDOC).

The following DRDO labs also celebrated NSD at their respective places.

ARDE, PUNE

Armament Research & Development Establishment (ARDE) celebrated NSD on 28 February 2020. Dr Vijay P Bhatkar, Founder Executive Director, CDAC, was the Chief Guest on the occasion. Shri PK Mehta, DS & DG (ACE) attended the event. Dr Bhatkar delivered an inspiring talk on, "India's National Initiative in Exascale Super Computing." The Science Day Oration



was presented by Shri Rahul Chopade, Sc 'E', on the topic, "Vortex Shedding and its effect on Engineering Design." The NSD Certificate and Medal was presented to Shri Chopade.



CAS, HYDERABAD

Lectures from eminent personalities from the field of science & technology were organised. Shri M Neelakantappa, former GM, BDL, gave the inaugural lecture on the topic "Stepping into new Areas of Advanced Technologies." Prof. Thiruvikraman from BITS, Hyderabad enlightened the audience, which comprised officers/staff of CAS, BDL & SSQAG, with his lecture on "Science: Past, Present & Future". Director, CAS thanked the orators for broadening the knowledge base about science and its importance and sparing their valuable time. Commendation certificate and NSD medal was presented to Shri Pramod Kumar Jha, Sc 'F' for his oration on "Vulnerability Assessment and Penetration Testing for Safeguarding IT Assets."



CVRDE, AVADI

Shri N Ponnusamy, Additional Director (Admin), spoke about

the significance of the NSD by acknowledging technical contribution of both Indian and international women scientists. To mark the occasion, two events were organised by CVRDE.

Shri G Palanivel, Head (R&QA) Division, delivered special oration on "System Engineering Model for Quality Objectives of Armoured Fighting Vehicles." He emphasised on the use of model-based system engineering and KANO model for fulfilling user requirements with utmost satisfaction. Shri V Balamurugan, Director, CVRDE, delivered keynote address and honoured the orator with NSD Certificate and Medal. Elaborating on the theme of the NSD 2020, he praised women scientists of DRDO and CVRDE for their outstanding scientific contributions.

Smt R Prabhavathy, Addl Director (Electrical), CVRDE, interacted with viewers and explained the role of women in the field of science and technology. She also highlighted ongoing research opportunities in science and engineering field for young budding aspirants.



DEBEL, BENGALURU

Shri MV Mallikarjuna Reddy, Sc 'D', delivered NSD Oration on "Artificial Intelligence in Telemedicine". Various methods of automated



diagnosis to augment healthcare using AI were presented. Shri Reddy discussed the potential application of AI in DEBEL developed Rugged Portable Telemedicine System, which is currently under implementation in the Indian Navy. Science Day medal and certificate were presented to the speaker by OS & Director, Mrs Manimozhi Theodore.

DESIDOC, DELHI

Dr Faizul Nisha delivered NSD oration on "Perspective to Smart Libraries based on Internet of Things (IoT)." She explained the genesis of IoT, the underlying building blocks of IoT, IoT-based libraries, and the role of IoT in ease of access to knowledge in an effective and intelligent manner. She emphasised on transition of progressive libraries to this new technology and preparing a roadmap, which is futuristic and sustainable over next decade for better implementation of IoT in libraries. She received NSD Medal and Certificate from Dr Alka Suri, Director, DESIDOC.



DFRL, MYSURU

Dr Om Prakash Chauhan, Sc 'F', Head, Fruits & Vegetables Technology Division, delivered NSD oration on "Food Technologies for Space Mission."



Dr Chauhan highlighted the major requirements of space-specific foods. He also provided an overview about the food products used in earlier space mission. Dr Anil Dutt Semwal, Director, DFRL, presented NSD Medal and Certificate to Dr Chauhan.

DRDE, GWALIOR

NSD oration was delivered by Dr Nandita Saxena, Sc 'E' at Lecture Hall, Defence Research & Development Establishment (DRDE), Gwalior. She was presented NSD Medal and Certificate by Director, DRDE.

DRL, TEZPUR

General Officer in Commanding (GOC) of 4 Corps Lt Gen Shantanu Dayal, AVSM, SM, VSM was the Chief Guest of NSD 2020. Dr SK Dwivedi, Director, DRL, gave a comprehensive overview of the on-going research programme of the laboratory under the Programme Arunodaya and the services offered to the Indian Armed Forces.

Dr PK Raul, Sc 'D', presented NSD oration, He was presented NSD medal and certificate by Gen Dayal. Several events like science quiz and science model competitions were organised amongst the students from local schools of Sonitpur district of Assam to inculcate the scientific temperament amongst the young ignited minds. Winners were awarded prizes and certificates.



HEMRL, PUNE

Smt C Sharada Prabhakar, Technology Director, Advanced

Composite Centre, ASL, Hyderabad was the Chief Guest of the function. Shri KPS Murthy, OS & Director HEMRL presided over the function. Dr Ramesh Kurva, Sc 'F', Coordinator NSD, welcomed all invitees and briefed about various activities, namely, Technical Paper Presentation, Science Crossword, Science Quiz and Essay Writing conducted to commemorate NSD 2020. General science quiz and science crossword competitions were conducted through LAN. One hundred forty-five employees participated in these events. The best performers in each activity were awarded certificates and prizes by the Chief Guest.

Director, HEMRL, in his addressed to the HEMRL employees stressed upon the role of women in science and its importance in the development of the country. Dr Saroj Kumar Sahoo, Sc 'E' delivered NSD Oration on the topic "Preparation and Laser Ignition of Al-MoO₃ Super Thermite." He was presented NSD Medal and Certificate. The Chief Guest delivered an encouraging and invaluable talk on Women in Science.



INMAS, DELHI

Dr Anant Narayan Bhatt, Sc 'E', delivered NSD Oration on the topic "Metabolic Modification and Cell Signalling Approaches for Obviating Radioprotection" at INMAS Delhi. Dr Tarun Sekhri, Director, INMAS, Delhi, presented NSD Medal and Certificate to Dr Anant Narayan Bhatt.



ITR, CHANDIPUR

Dr BK Das, OS and Director ITR in his inaugural address highlighted the importance of science and technology in modern life and encouraged all to be more creative and innovative in their approach in addition to their normal assignment. Guest of Honour on the occasion Prof. S Lakshmiarahan, University of Oklahoma, highlighted the scientific developments in India and continuous progress in this area.

Md. Sujauddin Ahmed, Sc 'C', presented NSD oration on "Design of an Ultra-Low Noise, High Gain MMIC Low Noise Amplifier for C-Band Radar Receiver" for which he was presented NSD Certificate and Medal. Prizes were also distributed among winners of the competitions organized to commemorate NSD.

LRDE, BENGALURU

Shri SS Nagaraj, DS & Director, Electronics & Radar Development Establishment (LRDE) inaugurated the celebrations and brought out the importance of the day. Shri Vishnu OC, Sc 'E' delivered the NSD Oration on "Passive Coherent Location Radar using Opportunistic FM Transmission." Director, LRDE, presented Shri Vishnu NSD Oration Medal and Certificate.





MTRDC, BENGALURU

Dr SUM Reddy, Director, Microwave Tube Research & Development Centre (MTRDC) expressed his best wishes on the occasion. Shri Jayateertha Devanahalli, Sc 'E', delivered a talk on "Deep learning: Application in Microwave Tubes". He gave a brief introduction of artificial intelligence and its applications, machine learning, artificial neural networks and deep learning. He also elaborated on prospective applications of deep learning and artificial intelligence in the field of microwave tubes.



NPOL, KOCHI

As part of the celebration, an invited talk by Dr GC Anupama, Senior Professor (Dean), Indian Institute of Astrophysics, was organized on the topic "India's Venture into 30 m Telescope Project." She explained why high altitude is the ideal location for telescopes, adaptive optics and history and scientific advancements

of astronomical instruments. She also elaborated overall picture of TMT project and India's contribution to the project.

Dr Rahna K Shamsudeen, Sc 'E', presented NSD oration on "Piezopolymers: Emergence as Sensor Materials for Sonar." She presented the chemistry and structure of PVDF-based polymers. The history and evolution of piezoelectric properties was explained and correlated with structure. Shri S Vijayan Pillai, Sc 'H' & Director presented the NSD Medal and Certificate to the orator and the Commendation Certificate to ATPV awardee Shri K Ajithkumar, Sc 'E' during the event.



NSTL, VISAKHAPATNAM

Former Vice-Chancellor of Andhra University Dr Beela Satyanarayana, was the Chief Guest of NSD function at Naval Science & Technological Laboratory (NSTL). He delivered the National Science Day talk, Sharing my Experience on Science and Technology Development.

Dr OR Nandagopan, OS and Director, NSTL, recalled the exemplary

research of Sir CV Raman, and stressed upon the need for focused approach to realize the benefits of scientific research for development of the Organisation.

Shri M Padmanabham, Sc 'E' was awarded NSD Silicon Medal for his outstanding work. ATPV Commendation Certificate was presented to Shri Deepak Chandra Tiwary, STA 'B'.



R&DE(E), PUNE

Shri Akash Verma, Sc 'D' delivered NSD oration on "Micro-mechanical Modelling of Composites: An Approach towards Virtual Testing." Shri VV Parlikar, OS & Director, Research and Development Establishment (Engineers) [R&DE(E)] presented NSD Oration certificate and medal to Shri Verma.



TOT

TOT OF HIGH POWER LI-ION BATTERY TECHNOLOGY

High power Li-ion battery technology developed by Naval Science & Technological Laboratory (NSTL), Visakhapatnam was handed over to M/s Hyderabad Batteries Limited, Hyderabad by Dr

G Satheesh Reddy, Secretary DDR&D and Chairman, DRDO in the presence of Hon'ble Shri Rajnath Singh, Defence Minister, Govt of India and Shri Yogi Adithyanath, Hon'ble Chief Minister of Uttar Pradesh in the ToT function

conducted on 7 February 2020 in the DefExpo-2020 at Lucknow. This function was attended by Dr OR Nandagopan, Director, NSTL, Dr A Srinivas Kumar, TD (B&E) and Dr TVSL Satyavani, PD (Li-ion Project).

DMRL TRANSFERS RARE EARTH PERMANENT MAGNETS TECHNOLOGY

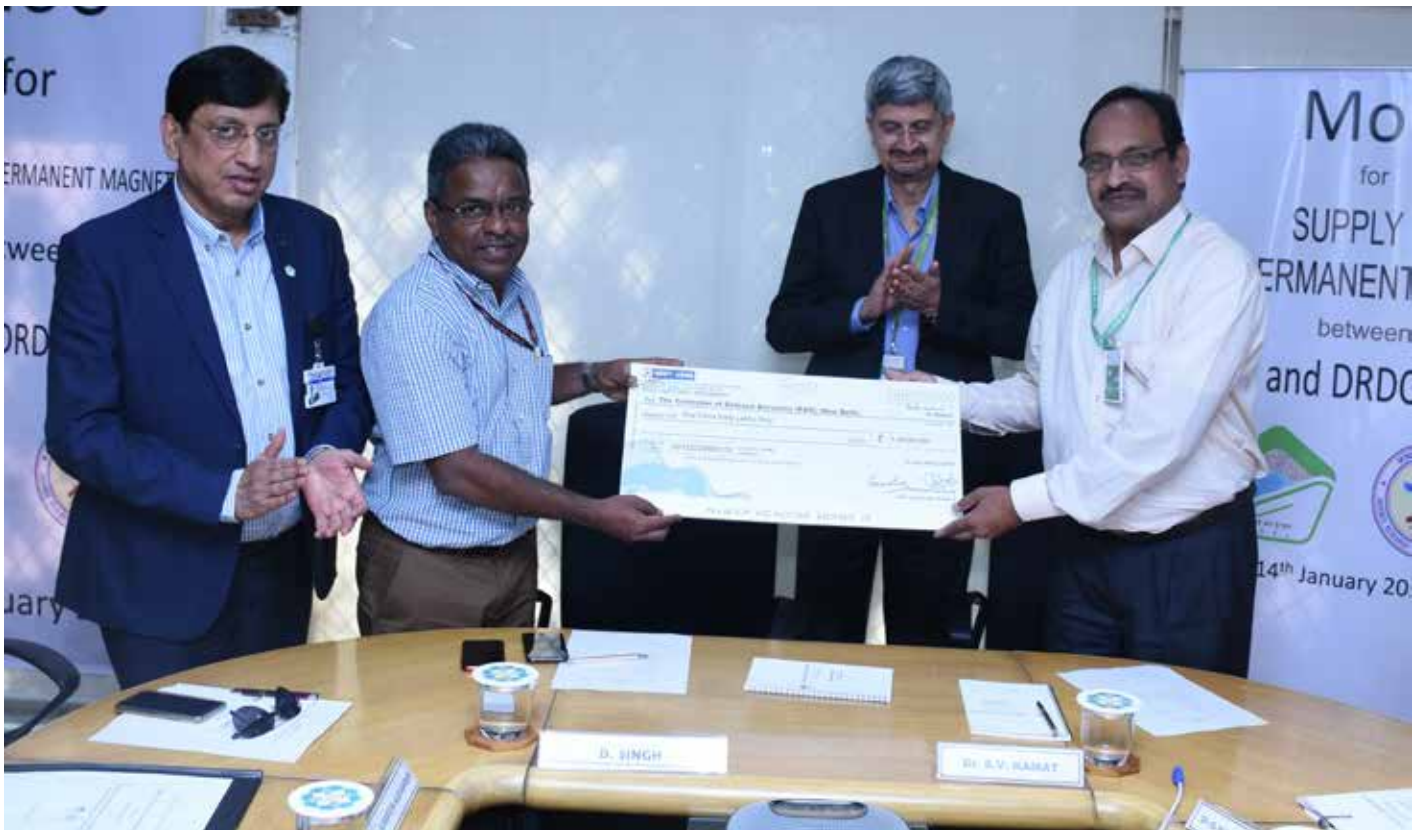
Defence Metallurgical Research Laboratory (DMRL), Hyderabad has long pursued an intensive R&D on Rare Earth Permanent Magnets (REPM), which culminated into establishing process technologies for making different classes of rare earth magnets. In an effort to 'Make in India' and thereby totally indigenize the production from mineral to magnet, the Indian Rare Earth Limited (IREL) plans to reduce the rare earth salts it sources from the beach sand mineral by acquiring the technology established by Bhaba Atomic Research Centre (BARC) and use this indigenous raw material to produce magnets in large scale by adopting the technologies developed by

DMRL. In a recently organised function at IREL Corporate Office, Mumbai, DMRL handed over the Technology Document for Samarium-Cobalt class of Rare Earth Permanent Magnets to IREL.

The function was attended by Dr Samir V Kamat, DG (NS&M), DRDO, Shri D Singh, CMD, IREL and Shri Mervin Alexander, Joint Secretary, Department of Atomic Energy. Shri D Singh, handed over demand draft of Rs 1.6 Crores as upfront technology fee to Dr G Madhusudan Reddy, Director, DMRL. IREL is establishing a plant for manufacturing of these magnets at Visakhapatnam, which is going to be

first of its kind in the country as these magnets were being imported so far for the strategic needs of defence, atomic energy and space sectors of the country.

Speaking at the function, Shri Singh emphasized the culmination of ongoing research activities into a production facility using indigenous raw material and indigenous technology as an important event. Dr Kamat brought out the importance of the rare earth magnets specially Samarium-Cobalt class of magnets in niche market of global strategic sector and advised IREL to look beyond India and tap the global market in general.



Shri D Singh (left), CMD, IREL, handing over demand draft as upfront technology fee to Dr G Madhusudan Reddy, Director, DMRL

WIND BLAST TEST ON LIGHTWEIGHT INTEGRATED AIRCREW HELMET AND PRESSURE BREATHING OXYGEN MASK FOR PILOTS

The integrated helmet-mask assembly has been designed to primarily incorporate Helmet Mounted Display and Sight (HMDS) as per user requirement and was subjected to open jet wind blast test at 600 KEAS at DGA, CEAT, France as per MiL 29591/1(AS). The integrated helmet with internally retractable dual polycarbonate visor system (with EMI/EMC complied pre-amplifier meeting RS-03 test) and pressure breathing oxygen mask has been developed by Defence Bio-Engineering & Electro Medical Laboratory (DEBEL), Bengaluru, against specific QRs issued by Indian Air Force.

The helmet-mask assembly was subjected to eight different profiles and has successfully withstood all the tests thereby proving the integrity of Helmet-Mask assembly during ejection. The team led by Dr R Indushekar, Sc 'F', DEBEL with representatives of Air HQ (Flying Clothing Cell), Regional Centre



Lightweight Integrated Aircrew Helmet for Su-30, BISON, MiG 29 and Mirage aircraft with EMI/EMC complied pre-amplifier



Pressure Breathing Oxygen Mask for pilots operating Su-30, BISON, MiG 29, BISON and Mirage aircraft

for Military Airworthiness (A/C), Director General Air Quality Assurance (DGAQA), Institute of Aerospace Medicine (IAM), Aircraft and Systems Testing Establishment (ASTE) and development partners from industries M/s Shakti Enterprises and M/s Vega Aviation participated in the successfully

tests. The data obtained from 3-axes head accelerometer, eye pressure sensors, mouth sensor and bending moment and tensile force transducers in the neck (C1 & C7), was analysed by IAM as per the AGARD technique met the neck injury criteria.

STATIC TESTING OF 3RD STAGE ROCKET MOTOR OF AGNI-V

Advanced Centre for Energetic Materials (ACEM), Nasik, successfully conducted sea level static testing of the third stage rocket motor of Agni-V on 4 March 2020. This test was conducted to qualify the propellant and evaluate the ballistic performance parameters. Various parameters, viz., thrust, chamber pressure, igniter pressure, temperature, strain, displacement, vibration and acoustic pressure, were validated and real-time data was recorded. The pressure-time and thrust-time plots of the rocket motor matched exactly with the prediction. The ballistic performance parameters closely matched with the predicted values.



MOU

DRDO SIGNS MOU WITH GOVERNMENT OF GUJARAT

A Memorandum of Understanding (MoU) was signed at DRDO Bhawan between Institute of Defence Scientists and Technologists (IDST), a registered society approved by DRDO, and Government of Gujarat on 3 March 2020 in the presence of Secretary DDR&D, Chairman DRDO and Patron IDST, Dr G Satheesh Reddy.



Signing of MoU between IDST DRDO and Govt of Gujarat at DRDO HQ

The officials from IDST, DRDO and Govt of Gujarat were present.

The MoU was signed by Dr KC Arora, President IDST and Smt Anju Sharma, IAS, Principal Secretary Higher and Technical Education, Govt of Gujarat. The MoU would facilitate exchange of knowledge between DRDO and Educational Institutions for enhancement of the education and civil society ecosystem for contribution to

the Aerospace and Defence, homeland security and allied fields.

Government of Gujarat would facilitate the School of Advanced Defence Studies (SADS), with the nodal partner Gujarat University, Ahmedabad, and a School of Defence Technologies (SDT), with the nodal partner Institute of Infrastructure Technology Research and Management (IITRAM), Gandhinagar, with the

knowledge support of IDST.

A Steering Committee under the chairmanship of Secretary DDR&D and Principal Secretary Education Govt of Gujarat as Co-Chair would monitor and guide the implementation of MoU.

IDST, DRDO team would discuss the course and schedule with Gujarat University and IITRAM mutually agreed to them.

EVENTS

INTERNATIONAL WOMEN'S DAY CELEBRATION

International Women's Day (March 8) is a global day celebrating the social, economic, cultural and political achievements of women. The day also marks a call to action for accelerating women's equality. DRDO also celebrated IWD with enthusiasm by organising women-specific programmes at its various laboratories.

ARDE, PUNE

A workshop on 'Work-Life Balance & Mindfulness' by KBK Raksha was organized by Armament Research & Development Establishment (ARDE) Women's Cell on 4 March 2020. As per tradition, a donation campaign was conducted. Nearly 500 pairs of old footwear were collected from employees and donated to Green Sole, an NGO, through Shantikumar Foundation, Ahmadnagar. Green Sole makes new footwear by recycling the old footwear and provides them to the needy,



especially children. Team building games, rangoli and flower arrangement competitions and funfair were also organised.

DEBEL, BENGALURU

Defence Bio-Engineering & Electro Medical Laboratory (DEBEL), conducted a one-day workshop for all its women employees to celebrate IWD. The workshop addressed issues like work-life balance, stress in everyday life, mindfulness, etc. All these topics were taken up through fun and group activities where participants got opportunity to interact with each other and learn through the experiences of others. Team activities helped the participants to introspection on their inner strengths and gain confidence from them.



DTRL, DELHI

International Women's Day 2020 was celebrated by Defence

Terrain Research Laboratory (DTRL) Women Cell on 5 March 2020. The celebration included some indoor games along with TED talk videos on 'Women Leadership'. All the members participated enthusiastically and made it a successful event.



HEMRL, PUNE

High Energy Materials Research Laboratory (HEMRL) celebrated IWD on 9 March 2020 in a befitting manner. Shri KPS Murthy, OS & Director, HEMRL, in his address touched upon various aspects related to women empowerment and women's role in the society. He elaborated the theme of this year's IWD. Mrs Sandeep Kaur, Sc 'F', Vice Chairperson, HEMRL Women's Council, elaborated activities of HEMRL Women Council during 2018-2020. In-house magazine 'URJA' was released by the Chief Guest of the function Gp. Capt. (Dr) Pauline Babu, HOD, Plastic and Reconstructive

Surgery, Command Hospital, Air Force, Bengaluru.

Training programme on ‘Effective Work-Life Balance’ was conducted. About 150 HEMRL women employees participated in the programme. Various games were organized for the women employees of HEMRL.

The highlight of the day’s function was a talk by Gp Capt. (Dr) Pauline Babu. The topic of her talk was “Spirit of Womanhood and Wellness of Women.” The talk was followed by an interactive session, which was very useful for the employees of HEMRL.



Release of HEMRL in-house magazine ‘URJA’

ITR, CHANDIPUR

Mrs B Sucharita, Sc ‘G’, Chairperson Integrated Test Range (ITR) Women Cell welcomed the distinguished guests and delivered a brief note about the occasion. Mrs Gitanjali Batmanabane, Director, AIIMS, Bhubaneswar, graced the occasion as the distinguished guest. In her address, she highlighted about women’s rights, gender inequality and harassment in our society. Dr BK Das, OS & Director, ITR, in his address emphasised the empowerment of women in our society and realizing women’s right through gender equality.



IWD celebration at ITR

NATIONAL SAFETY WEEK CELEBRATIONS

National Safety Week (NSW) is observed every year in India on 4th March to highlight the importance of safety in all spheres of life so as to prevent mishaps and accidents resulting out of neglect or lack of awareness. Various DRDO labs celebrated NSW at their respective labs to create safety awareness among the employees.

ARDE, PUNE

Armament Research & Development Establishment (ARDE) celebrated National Safety Week from 4 to 10 March 2020. Shri G Ananda Murugan,



Sc ‘E’, Safety Engineering Division, gave a talk on ‘Safety in Armaments’ on 5 March 2020. Winners of various

competitions were given cash awards by Dr V Venkateswara Rao, OS & Director, ARDE



HEMRL, PUNE

The national safety week was observed at High Energy Materials Research Laboratory (HEMRL), from 4 to 10 March 2020. Various programmes were organised during the week. As a prelude to national safety week, safety badges were distributed to the employees. During the safety week the following programmes were organized: Safety slogan competition in English, Hindi and Marathi; Safety Quiz for two categories of employees; Safety poster competition; PPE's colouring competition for children and Fire Fighting Demo.

Safety Health & Environment (S.H.E) bulletin containing various articles pertaining to safety, health and environment was released and best three articles from the bulletin were awarded. A lecture on "Disaster Management" by Shri MK Jain, Associate Director, CFEES, Delhi was organized.

Based on safety performance during the year 2020, two divisions of the laboratory, High Explosive (HE-I) Division and Mechanical Engineering Division, were awarded safety trophies.

Dr Manoj Gupta, OS, HEMRL addressed the gathering on the importance of safety during handling of various high energy materials. Certificates and Safety trophies were distributed by Dr Gupta.

ITR, CHANDIPUR

The "National Safety Day/Week" was celebrated at Integrated Test Range (ITR) on 4 March 2020. Shri P C Routray, OS & Officiating Director ITR inaugurated the programme and administered a pledge on safety and health to all the employees. In his inaugural address, Shri Routray highlighted the importance of safety and appreciated all Range employees for 'Nil' accident during various missions. Er. Umesh Chandra Sutar, Deputy Director, Directorate of Factories & Broilers, Govt of Odisha and Chief Guest of the occasion delivered the



National Safety Week Prize distribution ceremony at HEMRL



National Safety Week celebration at ITR

keynote address on the theme "Enhance Safety & Health Performance by use of Advanced Technologies."

Directorate of Communication of ITR and Shri SK Mishra, Sr. Admin. Asst., Finance Group and Shri SK Sethi, STA 'B' were adjudged as Best Safety Conscious Directorate and Best Safety Monitors, respectively for the year 2019-20 and awarded with Trophy, Certificate and prizes.

The programme was organized by Dr SK Sahu, Sc 'E', and Chairman Safety Committee and his team.

NPOL, KOCHI

Naval Physical & Oceanographic Laboratory (NPOL) organized National

Safety Week 2020 to promote the awareness of safety in the organization. Several competitions like Essay, Slogan, Short-Story and Cartoon focusing on different aspects of safety were conducted for employees. On 2 March a written quiz competition on safety was conducted, which attracted larger participation. On the same day a talk was organised on 'Stress Management and Work-Life Balance' by Fulbright Fellow Dr Geetanjali Natarajan, Associate Professor/HOD, Department of Clinical Psychology, Amrita Institute of Medical Sciences, Kochi, to impart knowledge on causes of occupational stress and relieving techniques. Stress, as a major factor, promotes the occurrence

of accidents, was highlighted by the speaker. NPOL community also enjoyed the stress relieving demonstration by the psychologist.

On 3 March, Dr Parameswari, Medical Officer, Hindalco Industry, during her talk on Health and Safety highlighted the link between behaviour and safety. She stressed on safety management systems in the form of safety committees for responsible, accountable and should also coordinate Safety training, audit and review.

The National Safety Day was celebrated on 4 March with a series of events. The programme started with flag hoisting by the senior technician and safety day pledge by the NPOL fraternity. This was followed by a live demo on fire fighting to enhance the awareness of fire safety in the organization by Fire Department of NPOL.

On the concluding day of the celebration, Shri GS Radhakrishnan



NPOL fraternity taking Safety Pledge

Nair, Sc 'F', Chairman Safety Committee NPOL welcomed the gathering and briefed about the status of safety with respect to facilities and infrastructure of NPOL and briefed on the safety audit and safety training activities. safety day speech was delivered by Dr Dipak Sahoo,

Professor (Fire & safety), School of Engineering, CUSAT. He highlighted on accident theories and rules governing compensation with respect to accidental injury/death. Shri S Vijayan Pillai, OS & Director, NPOL, distributed the prizes to winners of safety week competitions.

PLATINUM JUBILEE YEAR SEMINAR

As part of its platinum jubilee celebration Defence Institute of Psychological Research (DIPR), Delhi, organised a Seminar on Interview Technique on 17 February 2020 to discuss various issues and challenges being faced by the assessors especially Interviewing Officers of Selections Boards of Armed Forces. The seminar was inaugurated by Lt Gen PP Malhotra VSM, DG Recruiting, Army HQ. During

his inaugural address, DG Recruiting appreciated the efforts put in by DIPR in improving the overall effectiveness of selection system in Armed Forces. The seminar was attended by Commandants of all Service Selection Centres, Presidents and Interviewing Officers of Army, Naval, Air Force, and Coast Guard Selection Boards along with representatives of three Service HQ.

The seminar provided a platform to have a meaningful discussion among participants and scientists and instructors of DIPR. The topics deliberated during Seminar included improvement in present training system, questioning techniques, emerging challenges in Officer Selection in armed forces especially due to societal changes, coaching effects, social media impacts and legal & ethical issues.



RAISING DAY CELEBRATIONS

DEAL DEHRADUN

Defence Electronics Applications Laboratory (DEAL) celebrated its annual day on 23 February 2020 with immense zeal and enthusiasm. To commemorate the occasion various sport events and games including cricket, football, volleyball, badminton, table-tennis, field events, etc., were organized. Large number of DEAL employees participated in the events.

Shri PK Sharma, Director, DEAL outlined the accomplishments of DEAL during 2019 and plan for the coming years. He presented the Lab-level DRDO awards, cash awards and sports awards to the meritorious employees and the winners of the various sports events. A cultural programme “Kalakriti-2020” with inclusive flavour showcasing the diverse culture India was presented by the employees.

INMAS, DELHI

Institute of Nuclear Medicine and Allied Sciences (INMAS) celebrated its 59th Annual Day on 13 February 2020. Lt Gen VG Khandare, PVSM, AVSM, SM (Retd.) Military Advisor, National Security Council Secretariat, New Delhi was the Chief Guest and Dr AK Singh, DS and Director General, Life Sciences was the Guest of Honour on the occasion. Directors from DRDO HQ and various labs, former employees and family members of INMAS were present on the occasion. The function saw the culmination of many interesting scientific, societal, sporting, fun and cultural activities which were held at the institute over fortnight.

Dr Tarun Sekhri, OS & Director, INMAS, welcomed the guests and shared with them the recent achievements and future vision of INMAS. He focussed



Cultural artists at DEAL Raising Day

on the paradigm shifts in the research areas of INMAS based on its expertise in the frontier areas of radiation biology, molecular imaging, traumatic brain injury, CBRN research and combat casualty management cognitive sciences.

The Chief Guest applauded the contribution of INMAS in peaceful use of nuclear medicine. He appreciated the efforts of INMAS in the direction of training Armed Force as well as other agencies of CBRNE Defence.

Dr AK Singh, in his address appreciated the efforts of INMAS in the

area of Radiation Biology and training to military and paramilitary forces in the field of CBRN Defence. He urged INMAS for using its skill and expertise to do high-end research and focus on deliverables/products in areas of focus. The Chief Guest presented DRDO Lab-level awards and cash awards to meritorious employees of INMAS for their outstanding contributions. The dignitaries released in-house INMAS publication for the year 2019. A colourful cultural programme was presented by INMAS employees and students.



Release of in-house Publication of INMAS

R&DE(E), PUNE

Research and Development Establishment (Engineers) [R&DE (E)] celebrated its 58th Annual Day on 14 February 2020. As a part of Annual Day celebrations, Aga Memorial Lecture was organised in honour of Brig. Aga, the founder Director of R&DE (E). Shri PK Mehta, DS and DG (ACE), DRDO was the Chief Guest. The lecture was delivered on “Amazing Antarctica” by Guest of Honour, Dr Madhubala Chinchalkar, known as “Polar Woman”. She appreciated DRDO’s contribution to the Antarctic expeditions and setting up of Maitri Station at Antarctica.

Former employees who had contributed significantly to the establishment were felicitated by Shri VV Parlikar, Director R&DE (E), and Shri PM Kurulkar, DoMS.

A one-day workshop on “Control Systems” was also organised on the occasion. Mementos were distributed to employees who completed 25 years of service. Lab-level DRDO Awards and Cash Awards were given to the meritorious employees. A rolling trophy under Swacha Baharat Abhiyan, was awarded to the group in the establishment who contributed significantly to the cleanliness.

Earlier in the week Annual sports were also organised and prizes were distributed to the winners of the various sport competitions. Highlight of the Annual Day Celebration was a colourful cultural programme performed by the employees.

SSPL, DELHI

Solid State Physics laboratory (SSPL) celebrated its 58th Raising Day on 12 February 2020. Dr G Satheesh Reddy, Secretary DDR&D and Chairman DRDO, graced the occasion as the Chief Guest. Dr Sudhir Kamath, OS and DG (MCC) was the Guest of Honour.

Dr Seema Vinayak, OS and Director SSPL, presented the progress made in different projects during last year and highlighted the milestones achieved.



R&DE (E) employees performing dance at lab Raising Day

A short movie on SSPL, highlighting the state-of-the-art facilities and achievements of year 2019 was also screened.

Dr Reddy in his address appreciated the progress made by SSPL in the year 2019. He asked the scientists to set specified targets and focus more on delivery of products to armed forces/users within specified time frame. Dr Kamath also lauded the achievements of SSPL in various projects.

Various Lab-level DRDO Awards, Director’s Appreciation Awards, Best Paper Awards and Cash Awards were presented to scientists and staff.

Educational Awards to the wards of SSPL employees were also given.

Sports activities were also organised on the occasion for employees and their children. The function ended with a colourful cultural programme presented by the employees and their families.

Sir JC Bose Memorial Oration was organised as part of the SSPL Raising Day celebrations. On this occasion, Dr Aninda Sinha, Associate Professor, IISc, Bengaluru and recipient of Shanti Swarup Bhatnagar Award 2019, delivered a talk titled “What can String Theory teach us about Water.”



Chairman DRDO Dr Satheesh Reddy inaugurating SSPL Raising Day



TALK ON HEALTHY LIVING WITH SIRIDHANYA

As part of a HR initiative, a talk on “Healthy Living with Siridhanya (Millets)” by Krushi Ratna Dr Khadar Vali, Millet Man of India, was organised at Aeronautical Development Establishment (ADE) on 24 February 2020. The event was presided by Dr S Venugopal, OS & Director, ADE.

Shri M Sudhakara, Sc‘F’, Head (HR) welcomed the gathering and gave a brief on the relevance of the talk. Dr Khadar Vali delivered the talk on the benefits of Siridhanya (Millets), in general, for maintaining good health and specific usage of five varieties of millets in treatment of present day diseases, in

particular. He crisply explained the nuances of good eating habits leading to better health. He prescribed his message of achieving a healthier world by adopting a simple lifestyle coupled with the right kind of food and correct agricultural practices.

WORKSHOP ON SOLID PROPULSION TECHNOLOGIES

Advanced Systems Laboratory (ASL), Hyderabad conducted a two-day workshop on “Solid Propulsion Technologies” during 20-21 February 2020. Shri BV Papa Rao, OS, Group Director, Propulsion & Technology Director, CLSMC, welcomed the participants and invitees. Dr M Rama Manohara Babu, DS & Director, ASL, inaugurated the workshop and addressed the participants. Scientists of the Missile Complex, who are working in Solid Propulsion Area as well as various Projects, which requires Solid Propulsion Systems attended the workshop.

The workshop mainly covered advanced topics in Solid Propulsion like Combustion Instability, Internal

Aerodynamics of Rocket Motor, High Energy Propellants and Low Burn Rate Solid Propulsion Systems etc. Speakers from IIT (M), VSSC, HEMRL, ASL and

DRDL delivered the lectures. Scientists and officers from ASL, DRDL, MSQAA and SSQAG attended and appreciated the workshop.



NBCD ‘I’ COURSE FOR INDIAN NAVY & COAST GUARD

Defence Research & Development Establishment (DRDE), Gwalior conducted “NBCD ‘I’ Course (O61.0920) for Indian Navy and Coast Guard Sailors” on 6 February 2020 as part of DRDE’s continued effort to impart knowledge on chemical and biological warfare mitigation strategies to the defence services. A total of 37 Navy and Coast Guard sailors participated in the course. The course was inaugurated by Dr K Ganesan, Officiating Director, DRDE.



The course covered various topics including overview of chemical and biological warfare (CBW) agents,

Effect of CBW agents on human health and Medical countermeasures. The course was highly appreciated by the

participants. Dr PK Dash, Sc 'F' was the Course Director and Shri GP Bidua, Sc 'E' was the Liaison Officer.

TRAINING ON MUSHROOM CULTIVATION

A one-day training programme on mushroom cultivation under DRDO Programme Arunodaya was conducted at Amoni, Nagaon (Assam) by Defence Research Laboratory (DRL) on 14 February 2020. Twenty women from the area attended the training programme. In the technical session, the participants were informed about the nutritional values of mushroom, scientific aspects of mushroom cultivation, economics involved in cultivation and wealth generation from lignocellulosic waste. In the practical session, the participants were given hands-on demonstration about the preparation of mushroom bags for cultivation. Forty mushroom bags were prepared by the participants. Each participant was provided a 'mushroom cultivation' leaflet for ready reference and a 'mushroom spawn bag' (250 gm)



for starting cultivation in groups. All participants were very well satisfied with the comprehensive interaction

with the DRL team regarding different facets of oyster mushroom cultivation.

USERS' WORKSHOP FOR SSB

DRL conducted "DRDO Users' Workshop" on 17 February 2020 at 23rd Battalion of Sashastra Seema Bal (SSB), Lalpool, Udalguri (Assam) under the ongoing DRDO TD Programme Arunodaya. Chief Guest Dr SK Dwivedi, Director, DRL in his address mentioned that DRDO is not only giving services to the Armed Forces but also to Central Armed Police Forces like SSB, ITBP, Assam Rifles in North East India so that the technical problems faced by the soldiers in day-to-day functioning in the inhospitable terrain of the region can be addressed scientifically by DRDO. Guest of Honour Shri C Keishing, DIG, SSB, Sector HQ Bezpara, Mangoldoi appreciated the good initiatives taken by DRL for providing solutions to the problems faced by the soldiers in the Tawang sector. DRL products and

technologies were showcased. Live demonstration of DRDO Water Testing Kit and CAPSIGRENADETM was given to the participant. A total of 50 numbers of SSB Officers and personnel

from different units participated in the workshop. Shri Rohitashwa, Commandant of 23rd Bn SSB offered the vote of thanks.





COURSE ON SENSOR SYSTEM ANALYSIS & MODELLING

Institute for Systems Studies & Analyses (ISSA), Delhi organized a three-day course on “Sensor Systems Analysis and Modelling” under Continuing Education Programme (CEP) of DRDO during 5-7 February 2020. A total of 17 participants from sister DRDO labs attended the course.



TALK ON HUMAN EXCELLENCE

Integrated Test Range (ITR), Chandipur organised a talk on “Human Excellence” by Dr Chinmay Pandya, Pro Vice Chancellor of Dev Sanskriti Viswavidyalaya (DSVV), Haridwar on 10 February 2020. The programme was inaugurated by Officiating Director ITR Shri PC Routray, OS. In his inaugural address, Shri Routray said that the talk is being organised with an aim to harness the innate potential of youth, scientific, technical and all cadre of DRDO community and channelize the path of national development through self-refinement.



Dr Pandya highlighted how to develop faith in oneself and impart noble values of life for giving strength to the moral, ethical, eternal values of

personality development. Around 200 personnel of ITR, PXE, EMU, PMU, Chandipur and their family members

attended the talk. The programme was organised by Shri PN Panda, Sc ‘F’, AGD (HR) and his team.

TRAINING PROGRAMME ON ROAD SAFETY

ITR organised a one-day Training Programme on Road Safety on 7 March 2020. Shri PC Routray inaugurated the programme. The programme was aimed at sensitizing Vehicle Operators on defensive driving skills, road safety, latest traffic acts and rules, etc. Forty-six participants from ITR attended the course.



The programme was organised by Shri PN Panda, Sc ‘F’, AGD (HR) and his team.

2ND NATIONAL WORKSHOP ON EXPLOSIVE DETECTION (NWED)– 2020

High Energy Materials Research Laboratory (HEMRL), Pune organized the 2nd National Workshop on Explosive Detection during 1-2 March 2020 at Dr APJ Abdul Kalam Golden Jubilee Auditorium, Pashan, Pune. The theme of the workshop was “Stand-off Detection of Concealed and Open Explosives.” The main objective of the workshop was to bring the community working in the field of explosive detection together and enable them to explore the novel explosive detection technologies and discuss development of new materials and sensors technologies to meet the challenges for efficient detection of wide ranges of explosives.

Dr G Satheesh Reddy, Secretary DDR&D and Chairman, DRDO was the Chief Guest and Shri Jayant Naiknavare, DIG, ATS, Mumbai and Prof. Siva Umapathy, Director IISER, Bhopal were the Guests of Honour of the inaugural function. An Explosive Detection Device “Raider-X” jointly developed by HEMRL and IISc, Bengaluru was released by Dr Satheesh Reddy in the presence of Shri PK Mehta, DS & DG (ACE) and Shri KPS Murthy, OS & Director HEMRL. The ‘Rider-X’ can detect explosives from a stand-off distance even in concealed condition.

Shri KPS Murthy in his welcome address said that terrorism has become an international concern

and there is a need to develop rapid, sensitive and reliable methods for explosive detection. He brought out that the commercially available explosive detection devices works within specific limitations in terms of domain of explosives and pointed out that most of these works at a close proximity with the explosives. He stressed that it is utmost necessary to interact with the security agencies and end users to understand their specific requirements and develop reliable detection devices specific to particular applications. He also stressed about the need of test protocols and certifying agency for evaluating various explosive detection devices keeping in view the requirements of



Release of NWED Souvenir



Release of Explosive Detection Device "Raider-X"

various security agencies. Shri PK Mehta highlighted how the needs of different agencies differ in terms of requirement of the explosive detection device. He emphasised the importance of trace and bulk detection in different application scenarios such as detection of explosive vapour in a shopping mall and bulk explosive detection in concealed condition for the Airport security. He asked HEMRL to lead and play a vital role not only to devise a solution but also to evaluate or mark the devices, which can be used under particular scenarios or circumstances.

Shri Jayant Naiknavare, referred to the data regarding various terrorist attacks happened in the country. He accentuated the need of pre- and post-blast identification of explosives and appealed to the scientific community to bring out robust and reliable explosive detection devices for the use by the security agencies.

In his address, Prof. Siva Umamathy, highlighted that the increasing use of plastic components to make the IEDs will make the metal detectors

currently being used non-relevant and therefore imaging and also the material detection technologies will hold the key in future for detection of IEDs and explosives. He underscored that it is really impossible to bring out any universal solution to the explosive detection, but the concerted effort among the researchers in the country will definitely be able to bring out devices to meet specific requirement of the users.

Chief Guest Dr G Sathesh Reddy during his address emphasized the need of such a workshop and highlighted the requirement of development of explosive detection devices which can fulfil the different requirements of various security agencies and Armed Forces. He brought out that in absence of universal solution for detecting explosives in all scenarios, focus shall be given on developing different explosive detectors and amalgamation of few techniques to fulfil the requirements of end-users. He also accentuated the need of forming a consortium of all the developing agencies or work

centres in India and form the national steering committee to foresee the development of explosive detection devices, review the progress and interact with end-users to focus the research in the designated areas at different work centres in the country. He stressed upon the formulation of a comprehensive policy framework document comprising the need, development, testing and certification of explosive detection devices. He has also suggested bringing out a periodical newsletter to update all the users, developers and researchers regarding the progress in this field.

The workshop was attended by 250 participants from CRPF, CISF, MHA, NIA, Maharashtra Police, SSB, BSF, BDDS, ITBP, Forensic Science Laboratories, NSG, Armed Forces, DRDO labs, Academic institutions and industries. Three explosive detectors were demonstrated by the private agencies namely M/s Hitec21, Max Infocom and M/s Nanosniff. DRDO developed devices, viz., EDK Kit, OPX-Revilator, Preemptor and e-Nasika were also demonstrated.

AWARDS

Honorary Fellowship

Dr Madhu Bala, Director, Defence Institute of Bio-Energy Research (DIBER), Haldwani was bestowed with 'AZRA Honorary Fellowship Award' by Applied Zoologists Research Association (AZRA), Bhubaneswar, Odisha for her outstanding contributions towards developing medical interventions from Seabuckthorn, during XVII AZRA International Conference on "Frontier Research in Applied Zoology held during 12-14 February 2020 at University of Agricultural Sciences (UAS), Raichur, Karnataka. Dr Bala, who is also the serving President of Indian Society of Radiation Biology (ISRB), India, delivered a lead Lecture on "Himalayan Plant Bioresource-Medical Solution to Complex Pathologies" at the inauguration session of the conference attended by nearly 500 delegates from India and abroad.



Dr Madhu Bala receiving AZRA Honorary Fellowship

S.Z. Qasim Medal

Dr Madhu Bala, Sc 'G' and Director, DIBER, was also honoured with S.Z. Qasim Medal during 22nd Agricultural Scientists and Farmer Congress on Post Harvest Technology and Management for Empowering the Rural Society and Employment Generation. The Medal was conferred in recognition of outstanding contributions of Dr Madhu Bala for employment generation and empowerment of locals in border villages in Districts Pithoragarh, Chamoli and Uttarkashi.



Dr Madhu Bala receiving S.Z. Qasim Medal

Distinguished Horticultural Scientist Award

Dr Narendra Singh, Sc 'F', Defence Institute of High Altitude Research (DIHAR), Leh has been awarded the 'Distinguished Horticultural Scientist Award' by the Society for Horticultural Research and Development for his contribution towards food and nutritional security of farmers of

Ladakh as well as soldiers posted in the region. The award was presented to Dr Singh by the society during first Indian Horticultural Summit-2020 held on 14-16 February 2020 at Chitrakoot, Madhya Pradesh.

Dr Narendra Singh receiving Distinguished Horticultural Scientist Award





National Innovation Award

Dr Reji John, Sc ‘G’, Naval Physical Oceanographic Laboratory (NPOL), Kochi and team comprising Shiv Kumar, Sc ‘E’ and RS Arun Sundar, TO ‘B’, won 9th National Technology Innovation Award from Ministry of Chemicals and Fertilizers, Govt of India. The award comprises a citation and cash prize of Rs 3 lakh. Shri Sadananda Gowda, Minister for Chemicals and Fertilizers, Govt. of India gave away the award.

The award is for their following two innovations: A smart fluid, called Magnetorheological Fluid formulated from Petrochemicals and for a Semi-active Low Frequency Vibration Isolator employing the above smart fluid (closed loop feedback controlled MR fluid semi-active vibration isolator).

For developing closed loop feedback controlled semi-active vibration isolator, the team has developed a magnetorheological fluid using petrochemicals stable in marine environment for the first time. The unique characteristics of this smart fluid

is that it can effectively interface with mechanical system and electronics/electrical devices, which makes the devices smart and work in real time. In addition to military applications, the

fluid can be easily spin-off for civilian applications also. Efforts are being taken by the team for technology spin-off for smart automobile shock absorber applications.



Dr Reji John receiving National Innovation Award from Hon'ble Union Minister Shri Sadananda Gowda, Minister for Chemicals and Fertilizer

HIGHER QUALIFICATIONS ACQUIRED



Dr K Kadirvelu, Sc ‘F’, Defence Bio-Engineering & Electro Medical Laboratory has been awarded Doctor of Science in Environmental Sciences by Bharathiar University, Coimbatore for his scientific contribution in the area of ‘Activated Carbon for Environmental Protection.’



Shri BS Hemanth Kumar, Sc ‘D’, Defence Bio-Engineering & Electro Medical Laboratory has been awarded PhD by Bharathiar University Coimbatore for the thesis titled “Biophysical Approach to Assess Morphological, Metabolic and Functional Changes in CMS Model of Depression using Multimodal MR Imaging.”



Shri Kirtan Sahoo, Sc ‘E’, Naval Science & Technological Laboratory, Visakhapatnam has been conferred with degree of Doctor of Philosophy by IIT, Kharagpur for the thesis “Spinel Oxide Based Electrode Material for High Energy and High Power Density Rechargeable Lithium Ion Cell.”

READERS’ VIEW

Your feedback is important for us as it gives scope for further improvement in the quality of the publication and serve the organisation in a better way. Please send your suggestions to:

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DESIDOC, DRDO, Ministry of Defence
Metcalf House, Delhi-110054*

DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 4: MARCHING FORWARD

The article is 49th in the Series of extracts of the monograph, "Defence Research & Development Organisation: 1958-1982", by Shri RP Shenoy, former Director of Electronics and Radar Development Establishment (LRDE).

MATERIALS

Defence Metallurgical Research Laboratory

With the setting up of MIDHANI, the activities of the DMRL in the future were shifted towards R&D on critical and advanced materials for defence applications. Over the years, DMRL's activities would cover friction materials, heavy alloys for armaments, steel projectiles and armour, ultra-high strength low alloy steel, titanium and titanium-based alloys, superalloys, investment casting of superalloys for aircraft applications, magnetic materials, electro-steel castings for guns and so on. The work of DMRL in the next seven years comprised mainly of R&D programmes, commissioning of facilities for production of quantities more than laboratory scale and fabricating specific hardware in its support role for laboratories such as ARDE, CVRDE, GTRE, DLRL, DRDL and so on.

A number of facilities for building up competence and taking up tasks of a challenging nature were set up. These included, successful installation and commissioning for the first time in the country of a Hot Isostatic Press (HIP) for production of aero-engine components out of superalloy atomised powders. In addition, facilities for conducting studies on Hot Isostatic Pressing for fabrication of components to near-net shapes, die shop for making different types of dies and punches and facilities for taking up major projects in the field of reinforced composites and silicones, were also installed. Further, facilities to produce titanium metal and for

development of gas turbine components made out of high temperature alloys were in the process of being set up.

One of the first R&D efforts was directed towards the indigenous design and development of brake pads for aircraft. Since aircraft could not take off or land without brake pads and as their attrition rate on Russian aircraft were higher than earlier estimates, a crisis situation appeared to be looming when the matter was referred to DMRL. The Laboratory rose to the expectations of the nation, experimented with steel and copper and then developed ceramic disc pads through powder metallurgical techniques for the particular aircraft, with service-life higher than the original component, initially fabricated and supplied these and successfully transferred the technology to M/s HAL so that our dependence on imports was eliminated. In addition, various types of friction materials, viz., cupped brake pad for AVRO 748, bimetallic stator pads for aircraft brakes and clutch discs for different aeronautical applications were developed. Subsequently, transfer of know-how to HAL for fabrication of bimetallic stator pads for aircraft was also carried out. Regular production of these at the Bangalore, Koraput and Hyderabad units of HAL continues. An extension of this activity was the development and subsequent production of iron-based friction clutch pads for the synchronised turbines of the SNF-class ships of the Indian Navy.

Another activity pertains to the development of armour and armour piercing projectiles in antitank warfare, which progressively used advances in science and technology to surge ahead.

With ARDE, DMRL collaborated to develop the second-generation armour piercing ammunition which had a core or long-rod penetrator of tungsten alloy of specific gravity 17 to 18. For CVRDE, it was developing the armour for the main battle tank under development. This long-rod penetrator was formed by DMRL using powder metallurgy techniques. The fin stabilised armour piercing discarded sabot ammunition developed by ARDE was a success. DMRL also developed an alloy of steel with significantly improved properties as compared to the imported variety for the penetrator. In addition, DMRL later developed process for two other parts of the FSAPDS round namely, sabot and tail unit. The sabot was developed using closed-die forging and the tail unit through star shaped extrusion technique, resulting in material savings as high as 45 per cent for the sabot and 85 per cent for the tail.

For the tank, initially the armour was required for providing protection against kinetic energy ammunition and by 1978, DMRL had developed 5 per cent nickel-steel armour which gave 10 per cent more ballistic immunity than the armour used on the Vijayanta tank against kinetic energy ammunition. Another approach pursued by DMRL was based on electro-slag refining (ESR) technology which would improve ballistic immunity of monolithic armour in the direction of attack by reduction of inclusions. In both cases, DMRL had the public sector and private sector steel companies taking up the work of fabrication of proof plates for conducting trials to evaluate their ballistic immunity. However, in 1979,



Army reassessed the threat and wanted that the armour should withstand not only the kinetic energy but also chemical energy ammunition. DMRL agreed to develop composite armour similar in performance to the Chobham armour of UK which was considered a breakthrough in armour technology. In view of the scanty information available about the sandwich-type construction of the composite armour, DMRL scientists had to work out on their own about the composition, the spacing and the thicknesses that would provide the desired performance.

By the middle of 1980, the DRDO could announce a breakthrough in armour with the initial encouraging results obtained during laboratory-scale firing of the composite armour, named Kanchan developed by DMRL. Subsequent trials against kinetic energy and chemical energy ammunition proved the ballistic immunity of Kanchan against the type of threats envisaged by the Indian Army and also its superiority in performance to the earlier versions developed elsewhere.

While the current requirements of defence in armour and armaments were being met, basic studies on chemistry-structure-property relationship for improvement in materials of interest to defence were pursued. The investigations focussed on modifying the chemistry of iron and steel alloys through small alloying additions and their effect on fracture resistance of steel. This would lead to the development of a new steel alloy at laboratory scale, with very low percentage of alloying elements but with toughness and strength equivalent to maraging steel.

Besides iron and steel, R&D activities on other metals like magnesium, nickel and titanium were pursued. Work on magnesium alloys, with applications to rockets and missiles in mind, on atomised nickel powder for application in fuel filters for missile and aeronautics, and titanium alloy development for airframes and

aero engines to utilise the vast titanium resources of the country, were also initiated. Magnesium alloy vibration fixtures were developed and supplied to Indian Space Research Organisation in this period. Further, special electronic ceramics components, like steatite rings, piezo shell components and chip resistors made out of alumina ceramics etc., were developed and supplied to other laboratories.

Defence Materials, Stores Research & Development Establishment (DMSR&DE)

DMSR&DE came into existence in 1976 after two other DRDO laboratories, Textiles and Stores Research & Development Establishment (TSRDE) and Defence Institute of Stores Preservation & Packaging (DISPP) were merged with Defence Research Laboratory (Materials) Kanpur, which was originally formed in 1962 after the bifurcation of Defence Research Laboratory (Stores) into two separate entities. The establishment undertakes R&D in non-metallic materials, textiles, light engineering and general stores.

The main focus in the 1960s was in the area of materials developments relating to corrosion inhibitors, parachutes, synthetics, solar heaters, helmets. The Laboratory was quite successful in developing these materials out of indigenous raw materials. Vapour phase corrosion inhibitors for protection of small arms, gauges and hand tools, corrosion inhibition treatment for jute and hessian used in packing metallic items, corrosion inhibitor for water-cooled engines, and cathodic protection of underground fuel storage tanks, were some of the items and processes that were developed successfully. In the area of textiles, flame proofing for olive green cellular shirting, glass-reinforced polyester for use in lightweight bullet-proof helmets, various types of parachutes, container and slings for paratropping supplies, were the major contributions. A solar

room heater based on the principle of thermal-siphoning was developed for use at high altitude and in extreme cold environments, so that a room of moderate size could be maintained at 20 °C. Based on this, a series of meteorological stations were set up along the border, including at Ladakh. The technique won international recognition.

In polymer science, the thrust was on synthesis, characterisation, compounding, moulding and modification of high polymers for specific defence requirements. In the 1970s, synthesizing polyurethane foam from indigenous raw materials was carried out successfully and the technical know-how was released for commercial exploitation. Further, research on the synthesis of novel high temperature-resistant resins was carried out for applications to aircraft radome, aircraft engine components, rockets and missiles. Efforts were also directed towards the development of rain erosion-resistant coating materials for protection of radome surfaces on aircraft.

Fibre-reinforced composite materials based on polymer matrices, generally known as fibre-reinforced plastic (FRP) was another area of research activity for the Laboratory. Initially, the activity was limited to glass fibre reinforcement and conventional polyester and epoxy resins, but the effort was steered towards building up competence in high temperature and protective armour applications. It paid off when the Laboratory developed a honeycomb core sandwich of glass fibre phenolic composite for use in Kanchan armour that was under development at DMRL for the main battle tank. Some of the other products developed by the laboratory in the area of composite materials were, transparent laminates for winds shields and windows for bulletproof automobiles, fibre glass combat helmets and FRP ceramic composites for ballistic applications.

To be continued...

EYE CHECK-UP CAMP

Gas Turbine Research Establishment (GTRE), Bengaluru in association with Micro Labs and Netradhama Eye Speciality Hospital, Bengaluru organised a four-day eye check-up and awareness camp from 11 to 14 February 2020. Screening was done for eye diseases like Cataract, Myopia, Hypermetropia, Pterygium, Computer Vision Syndrome and Diabetic Retinopathy. Fundoscopy was done for diabetics. Over Six hundred individuals were screened including contract labourers and contract employees. Many cases of Cataract, Pterygium and Retina Lattices were identified and referred for further treatment.



SPORTS ACTIVITY

DRDO South Zone Cricket Tournament

Centre for Artificial Intelligence & Robotics (CAIR), won the DRDO South Zone Cricket Tournament conducted at Naval Physical Oceanographic Laboratory (NPOL), Kochi during 10-14 February 2020. Shri S Vijayan Pillai, OS & Director, NPOL, Kochi, handed over the winning trophy to the team CAIR. Aeronautical Development Establishment (ADE), Bengaluru was the runner-up.

DRDO National Cricket Tournament

DRDO National Cricket Tournament 2019-20 was organized by Naval Science & Technological Laboratory (NSTL) during 25-27 February 2020. Four Teams (South Zone, West Zone, North Zone & Central Zone) participated in the tournament. The National tournament was conducted successfully with the guidance,

support and encouragement given by Director, Dr OR Nandagopan with the slogan “Stay Fit, Healthy and Contribute More to the NSTL.”

Central Zone Team won the tournament. South Zone Team was the Runner-up.

Sri PVS Ganesh Kumar, OS, presented the trophies to the winners and runner-up. He congratulated the Organising and Technical Committees for conducting the tournament meticulously & making it a grand success.



Team Central Zone with Tournament Trophy

VISITORS TO DRDO LABS/ESTTS

DEAL, DEHRADUN

Lt. Gen. Taranjit Singh, AVSM, VSM**, DCIDS (Ops) visited Defence Electronics Application Laboratory (DEAL) on 10 February 2020. He was briefed about the various ongoing project and activities of the laboratory by Shri PK Sharma, Director, DEAL. He was taken to visit the different divisions and was apprised of projects including Software Defined Radios (SDR), Rustom-2, GSAT-6 Integrated Coastal Surveillance System, Troposcatter Communication, VLF Communication, DESSI earth-station, Software for Satellite Imagery Exploitation, etc. Gen. Singh took keen interest in these projects and appreciated the progress made by DEAL in the development of these high end communication and surveillance systems.



Lt. General Taranjit Singh, being briefed about DEAL Products

HEMRL, PUNE

Lt. Gen. Jagdeep Kumar Sharma (Retd.), DRDO Distinguished Fellow, visited High Energy Materials Research Laboratory (HEMRL), on 26 February 2020. Dr Manoj Gupta, OS, briefed him about the activities of HEMRL. Discussions were held on different activities being carried out at the laboratory and ongoing projects with Shri KPS Murthy, OS & Director, HEMRL, and senior scientists. Lt. Gen. Sharma showed keen interest in the activities of HEMRL.



Shri KPS Murthy (left), Director, HEMRL presenting memento to Lt. Gen. Jagdeep Kumar

VRDE, AHMEDNAGAR

Dr S Guruprasad, DS & DG (PC&SI), visited Vehicle Research & Development Establishment (VRDE) on 14 February 2020 and witnessed the demonstration of 65 HP Rotary & 180 HP Diesel Engine developed for Unmanned Aerial Vehicles (UAVs). Dr Guruprasad appreciated the efforts put forth by VRDE for the development of niche vehicles technologies.



DG (PC&SI) being briefed about 65 HP Rotary Engine to

NMRL, AMBERNATH

Dr S Guruprasad, DS & DG (PC & SI) visited Naval Materials Research Laboratory (NMRL) on 11 February 2020 for gaining an insight on Air Independent Propulsion (AIP) system

developed at NMRL. Director, NMRL gave a presentation on overall NMRL achievements including ongoing project activities of the laboratory.

DG was also briefed about the current status of the AIP programme by Programme Director, AIP.

Dr Guruprasad appreciated the efforts put in by NMRL scientists for developing various products and significant achievement made in AIP technology. He also visited AIP Project site.



DS & DG (PC & SI) with Director, NMRL & senior Scientists

PATENTS GRANTED

A Patent No. 314906 for “Solid Acoustic Sensor Array Module” has been granted by Patent Office, Govt. of India to Dr Rahna K Shamsudeen, Dr VG Jayakumari, Shri Subash Subramoniam, SP and Dr T Mukundan, Naval Physical & Oceanographic Laboratory (NPOL), Kochi.

A Patent No. 315843 for “Method and Apparatus for the Simultaneous Generation and Detection of Optical Diffraction Interference Pattern on a Detector” has been granted by Patent Office, Govt. of India to Dr T Santhanakrishnan and Dr Tatavarti VSN Rao, former Scientist, NPOL, Kochi.