

DRDO CELEBRATES NATIONAL SCIENCE DAY

National Science Day Orations

Oration 1: Indian Navy – Indigenisation Imperatives

by

Vice Admiral G Ashok Kumar, AVSM, VSM

VCNS, Indian Navy

Oration 2: What next after the Higgs Boson?

by

Dr. Rohini Madhusudan Godbole

Theoretical Particle Physicist



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APRIL 2019
VOLUME 39 | ISSUE 4
ISSN: 0971-4391

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Cover: Release of DRDO Science Spectrum by Vice Adm Ashok Kumar, AVSM, VSM, DCNS, IN, Dr Chitra Rajgopal, DS and DG (SAM), DRDO, and Dr Rohini Madhusudan Godbole, Theoretical Particle Physicist, IISc, Bengaluru



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39th Year of Publication

Editor-in-Chief: Dr Alka Suri
 Managing Editor: B Nityanand
 Editor: Manoj Kumar
 Editorial Assistance: Biak Tangpua
 Multimedia: RK Bhatnagar
 Printing: SK Gupta, Hans Kumar
 Distribution: Tapes Sinha, RP Singh



Website: <https://www.drdo.gov.in/drdo/pub/newsletter/>

Please mail your feedback at:
director@desidoc.drdo.in

Contact: 011-23902403; 23902474
 Fax: 011-23819151

LOCAL CORRESPONDENTS

Ambernath: Dr Susan Titus, Naval Materials Research Laboratory (NMRL); **Chandipur:** Shri Santosh Munda, Integrated Test Range (ITR); **Bengaluru:** Shri Subbukutti S, Aeronautical Development Establishment (ADE); Smt MR Bhuvaneswari, Centre for Airborne Systems (CABS); Smt Faheema AGJ, Centre for Artificial Intelligence & Robotics (CAIR); Ms Tripty Rani Bose, Centre for Military Airworthiness & Certification (CEMILAC); Smt Josephine Nirmala M, Defence Avionics Research Establishment (DARE); Shri Kiran G, Gas Turbine Research Establishment (GTRE); Shri Venkatesh Prabhu, Electronics & Radar Development Establishment (LRDE); Dr Vishal Kesari, Microwave Tube Research & Development Centre (MTRDC); **Chandigarh:** Dr HS Gusain, Snow & Avalanche Study Establishment (SASE); Dr Prince Sharma, Terminal Ballistics Research Laboratory (TBRL); **Chennai:** Shri PD Jayaram, Combat Vehicles Research & Development Establishment (CVRDE); **Dehradun:** Shri Abhai Mishra, Defence Electronics Applications Laboratory (DEAL); Shri JP Singh, Instruments Research & Development Establishment (IRDE); **Delhi:** Shri Ashutosh Bhatnagar, Centre for Personnel Talent Management (CEPTAM); Dr Dipti Prasad, Defence Institute of Physiology & Allied Sciences (DIPAS); Dr Dolly Bansal, Defence Institute of Psychological Research (DIPR); Shri Navin Soni, Institute of Nuclear Medicine and Allied Sciences (INMAS); Shri Anurag Pathak, Institute for Systems Studies & Analyses (ISSA); Dr Indu Gupta, Laser Science & Technology Centre (LASTEC); Ms Noopur Shrotriya, Scientific Analysis Group (SAG); Dr Rupesh Kumar Chaubey, Solid State Physics Laboratory (SSPL); **Gwalior:** Shri RK Srivastava, Defence R&D Establishment (DRDE); **Haldwani:** Dr Atul Grover, Defence Institute of Bio-Energy Research (DIBER); **Hyderabad:** Shri Hemant Kumar, Advanced Systems Laboratory (ASL); Shri Pramod K Jha, Centre for Advanced Systems (CAS); Dr JK Rai, Advanced Numerical Research & Analysis Group (ANURAG); Ms Bidisha Lahiri, Centre for High Energy Systems & Sciences (CHESS); Shri ARC Murthy, Defence Electronics Research Laboratory (DLRL); Dr Manoj Kumar Jain, Defence Metallurgical Research Laboratory (DMRL); Dr K Nageswara Rao, Defence Research & Development Laboratory (DRDL); Shri Lalith Shankar, Research Centre Imarat (RCI); **Jagdalpur:** Dr Gaurav Agnihotri, SF Complex (SFC); **Jodhpur:** Shri Ravindra Kumar, Defence Laboratory (DL); **Kanpur:** Shri AK Singh, Defence Materials & Stores Research & Development Establishment (DMSRDE); **Kochi:** Smt MM Letha, Naval Physical & Oceanographic Laboratory (NPOL); **Leh:** Dr Dorjey Angchok, Defence Institute of High Altitude Research (DIHAR); **Mussoorie:** Dr Gopa B Choudhury, Institute of Technology Management (ITM); **Mysuru:** Dr M Palmurugan and Shri NV Nagraj, Defence Food Research Laboratory (DFRL); **Pune:** Dr (Mrs) JA Kanetkar, Armament Research and Development Establishment (ARDE); Dr Vijay Pattar, Defence Institute of Advanced Technology (DIAT); Shri AM Devale, High Energy Materials Research Laboratory (HEMRL); Shri SS Arole, Research & Development Establishment (Engrs) [R&DE (E)]; **Tezpur:** Dr Jayshree Das, Defence Research Laboratory (DRL); **Visakhapatnam:** Dr (Mrs) V Vijaya Sudha, Naval Science & Technological Laboratory (NSTL)

DRDO CELEBRATES NATIONAL SCIENCE DAY

National Science Day (NSD) is celebrated on 28 February to commemorate the discovery of the Raman Effect by the great Indian Physicist Bharat Ratna Sir Chandrashekhara Venkata Raman. He discovered the Non Elastic Scattering of Photons in Liquid Medium and announced it on 28 February 1928. He was the first Asian to be honoured with Nobel Prize in physics for this work in 1930. This effect is used to study the materials by chemists and physicists. DRDO and its various also celebrated NSD with enthusiasm by organising NSD oration in Dr Bhagvantham Auditorium, Metcalfe House, Delhi. Vice Adm Ashok Kumar, AVSM, VSM, DCNS, IN, was the Chief Guest of the function and delivered invited Science Day Oration on “Indian Navy—Indigenization Imperative.” Dr Rohini Madhusudan Godbole, Padma Shri, Theoretical Particle Physicist, Indian Institute of Science (IISc), Bengaluru delivered invited Academic Oration on “What Next after the Higgs Boson?”

Vice Adm Ashok Kumar gave an insight into what the Indian Navy does and the challenges it faces because of which certain imperatives for the indigenization are critical.

In her invited Science Day Oration, Dr Godbole discussed where the subject of particle physics heading six years after the discovery of Higgs Boson at the large Hadron Collider, new directions in which explorations of the fundamental laws of the nature will move forward, and how experimental and theoretical advances in the subject have historically added to new pathways in research for defence and how they will continue to do so!

Dignitaries released DRDO Science Spectrum—a compilation of Science Day Orations delivered by DRDO scientists in their respective labs/estts, brought out by Defence Science Information and



Vice Adm Ashok Kumar and Dr Rohini Godbole delivering Science Day Orations

Documentation Centre (DESIDOC), Delhi.

The following DRDO labs/estts also celebrated NSD by organising science lectures/orations/quizzes and open day at their respective places.

ARDE, Pune

The Science Day Oration on “Telemetry for Armament Stores” was presented by Shri Dinesh Tilante, Sc ‘D’. The Chief Guest, Prof. Dr Pranay Goel from Indian Institute for Science Education & Research, Pune, gave an invited talk on, “Oxidative Stress in Relation to Type-II Diabetes.” The Science Day Medal and Certificate were presented by Dr Goel to Shri Tilante.



ASL, Hyderabad

Dr MYS Prasad, Vice-Chancellor of Vignan’s Foundation of Science, Technology & Research, Guntur delivered a talk on “Lesson Learnt in Technical Management”. Shri Sanjaya Kumar Sahoo, Sc ‘E’, delivered NSD Oration on “High Energy Radiography –Theory and Practice.” He presented



the capability of detecting flaws with extreme sensitivity within the propellant or at the bonded interface between the casing-insulation, insulation-propellant and propellant-inhibition using high-energy radiography sources (up to 15MeV) for successful performance and safety of large size case bonded solid rocket motors. Dr MRM Babu, DS & Director, ASL presented NSD Medal and Certificate to the orator.



CABS, Bengaluru

Shri Sukhen Saha, Sc ‘D’, delivered a talk on “Airborne Doppler Weather Radars”. Shri MS Easwaran, DS and Director, presented the Medal to Shri Sukhen Saha.



Continued on Page 7...



TWIN SUCCESS FOR QUICK REACTION SURFACE-TO-AIR MISSILE

DRDO successfully test fired indigenously developed Quick Reaction Surface-to-Air missiles (QRSAM) from ITR Chandipur, off the Odisha Coast on 26 February 2019. The two missiles were tested for different altitude and conditions. The test flights successfully demonstrated the robust Control, Aerodynamics, Propulsion, Structural performance and high manoeuvring capabilities thus proving the design configuration.

Radars, Electro Optical Systems, Telemetry and other stations have tracked the Missiles and monitored through the entire flights. All the mission objectives have been met.

Raksha Mantri Smt Nirmala Sitharaman congratulated DRDO on the successful test flights and said the indigenously developed state-of-the-art QRSAM will significantly boost the defence capabilities of our armed forces.



GUIDED PINAKA TESTED SUCCESSFUL

Indigenously developed guided rocket system Pinaka developed by DRDO was successfully test fired on 12 March 2019 at Pokhran ranges after two successful trials on 11 March 2019. All the three trials met mission objectives. The weapon system is equipped with state-of-the-art guidance kit comprising of an advanced navigation and control system.

The weapon systems impacted the intended targets with high precision and achieved desired accuracies. Telemetry Systems tracked and monitored the vehicle all through the flight path. The consecutive successful testing of Guided Pinaka proves the efficacy, reliability



and high precision capabilities of the weapon system. Guided Pinaka would significantly boost the capability of the artillery to make precision hits.

SUCCESSFUL TRIALS OF SAHAYAK MKI

Indian Navy successfully carried out testing of Sahayak Air Droppable Containers, developed by Naval Science and Technological Laboratory (NSTL), Visakhapatnam in collaboration with Aerial Delivery Research and Development Establishment (ADRDE), Agra. The containers can be air-dropped to enhance Navy’s operational logistics capability at sea. With capacity of up to 50 kg, these containers can carry spares for ships up to 2000 km away from the coast. The trials were undertaken into the Arabian Sea on 8 January 2019 from an IL-38 aircraft off the coast of Goa. A test payload of 50 kg was dropped in the container, which descended to the sea with the help of a parachute.

Speaking after the trials, a naval spokesperson said: The containers would reduce the requirement of ships to be close to the coast for collecting spares and stores, thereby increasing the duration of their deployment. The Sahayak containers would enhance navy’s operational logistics capability.



“Sahayak is a lightweight air droppable container fitted with a parachute system designed to carry critical engineering stores up to 50 kg for distressed Indian naval ships at mid sea. It is dropped from a fixed wing aircraft near the vicinity of the ship in sea” he further added.

The GFRP containers are designed to withstand water entry shocks and are completely water tight. The parachute

system helps to control the rate of descent of the container. This system has P4M Pyro Cutter Mechanism, designed and developed by NSTL, for separation of pilot parachute from main parachute.

With the success of these trials, series production of Sahayak containers and parachutes would be undertaken. The product has high export potential.

TOT

DIPAS SIGNS LATOT FOR NOISE PROTECTION DEVICES

Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi, signed the License Agreement for Technology Transfer (LAToT) with competent firms for absorption of technology of the following products developed by DIPAS.

Stellar Ear Plug, a level dependent ear plug designed to provide protection against impulse noise encountered during firing of weapons/weapon systems was transferred to M/s Ajit Technoplast, Kanpur, M/s Netplast Kanpur and Bajaj Engineers, Bahadurgarh.





Active Ear Defender, an active noise reducing device that reduces low frequency as well as high frequency noise thus providing noise protection over a comprehensive audible range, was transferred to M/s Argus,

Hyderabad, M/s Ajit Technoplast, M/s Netplast, Kanpur, and Bajaj Engineers, Bahadurgarh.

Dr Bhuvnesh Kumar, Director DIPAS signed the agreements on 25 February 2019 with the proprietors/

authorised signatories of the firms in the presence of Dr AK Singh DG (LS), DRDO. Inventors, Dr Neeru Kapoor, Sc 'G', and Dr KV Mani, Sc 'E', were present on the occasion.

DRDO CELEBRATES NATIONAL SCIENCE DAY

Cover story continued from Page 7...

DESIDOC, Delhi

Ms Dipti Arora, Technical Officer 'B', presented NSD Oration on "Popularising Science using Electronic Media." In her oration Ms Arora brought out advances in Information and Communication Technology (ICT), how the changes in ICT technology has transformed the distribution of information, and how Defence Scientific Information and Documentation Centre (DESIDOC) has kept pace with the changes in dissemination of information to DRDO scientific community from print to digital and to multimedia. She also delineate the popularity of the video magazines of DRDO Newsletter and Technology Focus and elucidated the whole process of making these video magazines.



DIPAS, Delhi

National Science Day oration was delivered by Dr Krishna Kishore, Sc 'D', on 'Physiological responses to Microgravity'. Director DIPAS, Dr Bhuvnesh Kumar Presented Dr Krishna Kishore NSD Oration Medal and Certificate.



DFRL, Mysuru

Dr R Kumar, Sc 'F', delivered NSD oration on "Non Thermal Food Technologies." Dr Anil Dutt Semwal, Director, Defence Food Research Laboratory (DFRL) presented NSD Medal and Certificate to Dr R Kumar.



DMRL, Hyderabad

Defence Metallurgical Research Laboratory (DMRL) celebrated the occasion by organizing NSD oration delivered by Dr RV Krishna Rao, Sc 'G', on "Synthesis, Processing and



Fabrication of Ultra High Temperature Ceramics (UHTCs): ZrBr₂-SiC and Cf-SiC based composites.

DRL, Tezpur

Dr Uddhab Kumar Bharali, Padma Shri, Indian inventor, from North Lakhimpur district of Assam was the Chief Guest of the function. NSD oration on "Aeration: A Nature's approach for Water Treatment" was delivered by Dr Rama Dubey, Sc 'E'. A competition "HYPOTHESIA: Overcoming Challenges of Modern India with Science" was organised for students of local schools. The Chief Guest elucidated his simple yet useful innovations in various fields including agriculture engineering, food science and equipment for the divyangs.



HEMRL, Pune

Dr Ramesh Kurva, Sc 'F', welcomed the invitees and briefed about the activities conducted as a part of NSD 2019. Prof. Sangeeta Kale from Defence Institute of Advanced Technology (DIAT), Pune, was the Chief Guest and delivered a talk on "Nano Technology for Sensors." She also presented in brief about the "Soldier as a System."

Shri KPS Murthy, OS and Director HEMRL, in his address stressed upon the need and importance of science for the development of the country. Dr Siddhartha Gogoi, Sc 'E', delivered NSD Oration on "Role of Energetic Ingredients in the Performance of NG Free Gun Propellants." He was presented NSD Medal and Certificate by the Chief Guest.

To celebrate the occasion Presentations, Science Crossword, Science Quiz and Essay Writing were organised. The best performers in each activity were awarded with certificates and prizes by the Chief Guest.



INMAS, Delhi

Dr Rashmi Aggarwal, Sc 'E', delivered NSD oration on the topic "Developing a Deeper Insight into the Changing Etiologies and Varied Clinical Presentation of the Metabolic Master: The Thyroid Gland." Orator explained the fascinating journey of changing etiologies and varying clinical presentation of the small gland whose secretion controls metabolism of the whole body. Dr Tarun Sekhri, Director, INMAS, Delhi, presented NSD Medal and Certificate to Dr Rashmi Aggarwal.



Sansadhan Pratiyogita Award Distribution

An award ceremony took place on the sideline of NSD to reward the winners of the "Sansadhan Pratiyogita" organised by the Directorate of Finance & Material Management (DFMM), DRDO HQ. The competition was organised to inculcate awareness about finance and materials management among the DRDO personnel to improve efficiency and effectiveness and to promote financial prudence on 11 December 2018 at 17 different centers at 13 stations. Seven hundred and fourteen personnel participated in

the competition. Awardees were from the three cadres of the DRDO.

First Prize of ₹ 50,000/-, Second Prize of ₹ 30,000/-, Third Prize of ₹ 20,000/- and ₹ 10,000/, two consolation prizes along with mementos and certificates in each category were given by Dr Rohini M Godbole, Vice Admiral G Ashok Kumar, Dr Chitra Rajagopal, Dr Zakwan Ahmad, OS and DG (R&M), and Dr AK Bhateja, OS and Director (FMM).





ITR, Chandipur

Dr BK Das OS and Director, ITR, inaugurated the programme. Shri CR Ojha, Sc 'F', presented the welcome address. Shri PC Routray, OS, Associate Director, ITR, scientists, technologists, officers and staff were present on the occasion. In his inaugural address, Director, ITR highlighted the importance of science and technology in modern life and encouraged all scientists, technologists to be more creative and innovative in their approach in addition to their normal assignment. Shri BK Shaw, Sc 'D', presented NSD oration on "Modelling and Control of Dual Stage Grid Connected Solar Photovoltaic System with Local Voltage support by Utilizing Inverter Capacity." He was presented NSD Oration Medal and Certificate. Prizes were distributed to the winners of the competitions organized on the occasion.

MTRDC, Bengaluru

Shri U Shanmughanathan, Sc 'E', Microwave Tube Research and Development Centre (MTRDC), delivered a talk on "High Voltage Pulse Power Source for Defence Applications." He gave a brief introduction of high voltage pulse



power sources (PPSs) and explained the design and development of high voltage PPSs used for high power microwaves-based directed energy weapon systems, electromagnetic rail gun, electric armour and underwater electrical wire explosion. Firing trials and technology challenges were also discussed. Shri Shanmughanathan was presented NSD Medal and Certificate by Dr SUM Reddy, Director, MTRDC.

NPOL, Kochi

An invited talk on "Light-Absorbing Short-Lived Climate Forcer: Science and Policy" by Bhatnagar awardee Prof. Dr SK Satheesh, Chair, Divecha Centre, Indian Institute of Science, Bengaluru, was organized as part of the NSD celebrations. Prof. Satheesh discussed the science behind the paradox of global warming due to black carbon aerosols and investigation of its policy implications. Various climate change scenarios related to these issues were discussed.

Dr P Muralikrishna, Sc 'F', made NSD Oration on "100 Years of Noise: Origin and Ubiquity in the Realization of Signal Processing and Communication Systems." He was presented NSD Medal and certificate at a function organised by DSF at Dr Bhagwantham Auditorium, Metcalfe House, Delhi.



Patentees of NPOL in 2018 were felicitated on the occasion. Shri S Vijayan Pillai, OS and Officiating Director, launched Web OPAC of newly implemented open source Integrated Library Management Software KOHA by TIRC.

NSTL, Visakhapatnam

Dr RR Rao, former Scientist, NPOL, was the Chief Guest of the function and delivered NSD talk on "Effects of Climate Change and Global Warming and How to Reduce the Carbon Foot Prints." Speaking on the occasion, 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 the development of defence technologies. Twenty schools and 25 colleges in and around Vizag participated in the various competitions conducted for them.

Smt M Vijaya, Sc 'F', was awarded for her outstanding contributions. She presented her work on "Physics of a Ship's Wake" highlighting the physics of formation of wake and its identification based on the acoustic echo characteristics for wake homing for torpedoes.



NATIONAL SAFETY WEEK

The National Safety Week (NSW), organized by the National Safety Council, is celebrated every year during 4-10 March in India to enhance the safety awareness among people. The following DRDO labs/estts observed 48th National Safety Day/Week by organising lectures on safety awareness, demonstrating safety techniques, emergency management and use of safety equipment. Poster and painting competitions for children were organised to mark the week.

ARDE, Pune

Lecture and practical demonstration on Hazards of Electro-static Discharge and its Control Measures by Shri PV Vidyadhara Rao from ESD Control Systems, Hyderabad, was organised. Winners of Slogan, Safety essay and Safety drawing competitions were awarded.



DESIDOC, Delhi

The week-long commemorations at Defence Scientific Information and Documentation Centre (DESIDOC), focused on sensitizing the employees on safe practices at work place. Talks on safety precautions and procedures to avoid accidents and accident like situations were organised. Dr KG Wadhwa, Sc 'G', Centre for Fire, Explosives and Environment Safety (CFEES) gave a talk highlighting the relevance and significance of fire safety and practices for ensuring a healthy, safe and accident free environment. Col Neeraj SK, Chief Security Officer,



Metcalf House, briefed about security in the campus, cyber safety, and precautions to prevent misuse of data. Dr Alka Suri Director, DESIDOC, while summing up the talks emphasized on integrating safety with all hazardous activities in the lab. Dr Rajeev Vij, Sc 'G', Convenor of the Programme, thanked participants for their inquisitive attendance.

DIPAS, Delhi

Defence Institute of Physiology and Allied Sciences (DIPAS) organized lectures for enhancing safety awareness. Dr Bhuvnesh Kumar elucidated promotion of safety culture in DRDO work places to protect the personnel as well as environment. Dr Geetha Suryakumar, Sc 'E', delivered a lecture on "DRDO Safety Policy and Implementation Procedures." Dr Divya Singh, Sc 'E', explained about lab safety measures and biological safety the main

core work area of DIPAS. Dr Deepika Saraswat, Sc 'E' delivered a talk on "Fire Safety and Prevention" emphasizing fire prevention as well as protection.

HEMRL, Pune

As a prelude to national safety week, safety badges were distributed to all employees. Slogan, poster, quiz on safety-related issues were organised for the employees. A presentation on 'First Aid' followed by a demo and a fire-fighting demo were conducted to create awareness about first aid and fire security.

Shri Sangam Sinha, OS, General Manager, Mobile system complex (MSC), Pune, and the Chief Guest on the concluding day, delivered a talk on 'Good Safety Practices'. Shri KPS Murthy, OS and Director, High Energy Materials Research Laboratory (HEMRL) addressed the gathering on





the importance of safety during handling of various high energy materials. Safety Health and Environment (S.H.E) bulletin containing various articles pertaining to safety, health and environment was released. The best three articles were awarded.

Based on safety performance audit, Testing and Evaluation Group (TEG) Division and Fire Division were awarded safety trophies. Prize and Certificates were distributed to the winners of the various programmes organised during the week by the Chief Guest and the Director HEMRL.

ITR, Chandipur

The National Safety Day was celebrated at ITR on 6 March 2019. Dr BK Das, OS and Director, ITR, inaugurated the programme and administered a pledge on safety and health to all employees of ITR. Shri PC Routray, OS, Associate Director, ITR, in his address highlighted the importance of safety in range and informed that 'Nil' accident was

reported so far as far as range safety is concerned. Data Processing Division (DPD) of ITR, Shri Kuldeep Behera, TO 'B', and Shri Dayasankar Achari, STA 'B', were adjudged as Best Safety Conscious Directorate and Best

Safety Monitors for the year 2018-19, respectively and awarded with Trophy, Certificate and prizes. The program was organized by Dr SK Sahu, Sc 'E', and Chairman Safety Committee and his team.



LASTEC ORGANISED CLEANLINESS AWARENESS WALK

A walk to create awareness on cleanliness was organized by LASTEC on 8 March 2019 with the participation of all the labs of Metcalfe House. Director, LASTEC, along with Director, DTRL, and Director, ISSA led the walk. The walk started from the Bhagwantham Auditorium, covered Chandrawal Staff Quarter Delhi Jal Board, DCP Office, Education Office behind Vidhan Sabha and concluded at the North Gate, Metcalfe House. Some school children also joined the walk. A talk on importance of cleanliness was delivered by Shri RC Singh of CEPTAM.



RAISING DAY CELEBRATIONS

ITM, Mussoorie

Institute of Technology Management (ITM), Mussoorie, celebrated its 58th Lab Raising Day on 2 March 2019. Dr G Satheesh Reddy, Secretary DDR&D and Chairman, DRDO, was the Chief Guest and Shri Benjamin Lionel, OS and Director, IRDE, was the Guest of Honour. Shri Sanjay Tandon, OS and Director ITM, welcomed the august gathering and briefed about the achievements and activities of the ITM. Secretary visited various facilities and interacted with Officers, Staff and Welfare Committee on various issues of concern.

Children of ITM School presented a cultural programme. The Chief Guest visited the art and craft exhibition put up by ITM school children and appreciated their efforts.

DRDO lab-level Awards and Cash Awards were presented to awardees by the Chief Guest who appreciated their hard work and dedication. He also urged the ITM fraternity to keep up the good work in order to strengthen the techno-managerial skills of DRDO's manpower. Ms Gopa Bhattacharyya Choudhury, Sc 'E', proposed vote of thanks.

HEMRL, Pune

High Energy Materials Research Laboratory (HEMRL), Pune celebrated its 111th Raising Day on 1 March 2019 with great enthusiasm and fervour. Shri PK Mehta, DS and Director General (ACE), Dr KM Rajan, DS and Director ARDE, Shri Sangam Sinha, GM, MSC, Begdewadi, Shri Srinivasan Seshadri, GM, ACEM, Nasik, and invitees from BEL, Pune, graced the occasion. Shri PK Mehta in his address greeted HEMRL employees. He touched upon the importance of the work carried out by HEMRL and stressed the need to follow utmost safety in all the activities being carried out in the lab.



His address highlighted the necessity to maintain required quality of products and technologies being delivered by the Lab. Shri KPS Murthy, OS and Director, HEMRL, in his address highlighted the important achievements of HEMRL during the past year and motivated the employees to work hard and take HEMRL to new heights.

An amphitheatre was inaugurated by Shri PK Mehta and a large number of trees were planted by the invitees and HEMRL employees to commemorate the day. Laboratory-level DRDO Awards

and Cash Awards were conferred on meritorious employees. Employees who completed 25 years of service were also felicitated. Prizes were distributed to the winners of various sports competitions held on the eve of Raising Day. Outgoing works committee members and JCM-IV members were felicitated for their good work carried out throughout the year.

As a part of Annual Day celebrations, Wall Painting, Walkathon and games such as Volley Ball, Slow Bicycling, Slow Motorcycling, Running, and fun games were organised.



INTERNATIONAL WOMEN'S DAY CELEBRATIONS

HEMRL, PUNE

High Energy Materials Research Laboratory (HEMRL), Pune, celebrated International Women's Day (IWD) on 8 March 2019 in a befitting manner. A one-day training programme covering activities like team building, which included sports events, group discussions, interactions, inspirational movies/documentaries, etc., for women of HEMRL were conducted.

Shri KPS Murthy, OS and Director, HEMRL, addressed the women employees and touched upon various aspects related to women empowerment and women's role in the society. He elaborated the theme of this year's IWD, "Think Equal, Build Smart, Innovate for change."

Dr Prachee Sathe, Director, Deptment of Critical Care Medicine, Ruby Hall Clinic, Pune, delivered a talk on "Current Concepts of Health: Myths and Realities." The talk was followed by an interactive session on various health problems and health care.

NPOL, KOCHI

Naval Physical and Oceanographic Laboratory (NPOL), Kochi, celebrated IWD by organizing a number of programmes. A workshop on "Empowering Women through Knowledge and Skill Management (CHETHANA)" was organized with well known trainer and motivator Dr Sumathi Narayanan as the resource person. She covered the areas related to enhancing skills for communications, leadership and personal effectiveness and ensured active participation of the attendees through well designed activities.

A talk on "Status & Rights of Women



—A Contemporary Discourse" was delivered by Dr Athira PS, Assistant Professor, National University of Advanced Legal Studies (NUALS) who, with examples and statistics, established that women face discrimination. Citing an event that happened during the Tsunami 2006, she talked about how women are heavily conditioned by

societal norms. Dr Athira exhaustively covered and interpreted the Indian laws, which protect the rights of women.

Shri S Kedarnath Shenoy, OS and Director, NPOL, offered felicitations on the occasion and highlighted relevance of IWD celebrations in present Indian context.



WORKSHOP ON ADMINISTRATIVE RULES & PROCEDURES

In continuation of DOP's endeavour to impart administrative, personnel and establishment related knowledge and propagate good governance across laboratories of DRDO a "Workshop on Administrative Rules and Procedures" was held in Armament Research and Development Establishment (ARDE), Pune, from 10th to 11th January 2019. Objective of the workshop was to refresh procedural and administrative knowledge of the personnel dealing with administrative issues at the labs/estts and establish a standard way of dealing the varied nature of administrative issues/cases for expedited disposals.

A large number of participants participated in the workshop, which



encompassed discussions, case-studies and 11 interactive sessions on topics varying from Conduct Rules to Disciplinary Proceedings, Reservation Roster, Compassionate Appointment, Grievance Redressal, etc.

Workshop ended with a Panel Discussion where panellists raised various aspects of good governance, personnel and establishment related matters.

AKHIL BHARATIYA RAJBHASHA SANGOHSTI

Defence Scientific Information and Documentation Centre (DESIDOC), Delhi, jointly with Metcalfe House-based DRDO

labs/estts organised a joint Rajbhasha Sanghosti on 14 March 2019 at Dr Bhagavantham Auditorium, Metcalfe House, Delhi. Eminent Hasya

Kavi Shri Surender Sharma, was the Chief Guest of the inaugural function. Dr Sudhir Kamath, OS and Director General, Micro Electronic Devices &





Computational Systems (MED&CoS), Dr KG Narayanan, former Advisor, DRDO; Shri RK Jain, OS and Director, JCB; Dr Alka Suri, Director, DESIDOC, Directors of the Delhi-based DRDO labs/estts and Dr Rajiv Vij, Sc 'G', DESIDOC, were present on the occasion. Dr Alka Suri, Director, DESIDOC, welcomed the guests and gave a brief introduction of the Chief Guest.

The Chief Guest, famous for his humours four lines, in his inimitable style addressed the jam-packed auditorium and gave away many social messages for a happy and content life thorough his witty poems.

Shri RK Jain emphasised the need of staying happy and appreciated Shri Surendra Sharma for serving the

masses by increasing their happiness index from his humours poems. A CD of the abstracts of the papers received for the Sanghosti was released by the dignitaries. Dr Rajeev Vij, proposed the vote of thanks.

Defence Research Laboratory (DRL), Tezpur, organised an Akhil Bharatiya Rajbhasha Sangosthi entitled 'Simavarti Kshetra kay Vikas kay Liyay Vigyan ka Yogdan on 28 January 2019. Dr SK Dwivedi, Director, DRL, in his welcome address spoke about the role of science in boosting agriculture, health and hygiene in the border areas.

The Chief Guest, Prof. S Kushwaha, VC, Rajiv Gandhi University, Arunachal



Pradesh released the 'Sangosthi Patrika'. Prof. Kushwaha in his inaugural speech, stressed upon on popularization and progress of Rajbhasha.

Fifty-Seven participants from institutes like ITBP, SSB, Tezpur University, LGBRIMH, Tezpur, and DRDO laboratories presented their papers.

SKILL DEVELOPMENT-CUM-TRAINING PROGRAMME

A two-day training course under DRDO Programme Arunodaya was conducted at Defence Research Laboratory (DRL), Tezpur, during 21-22 February 2019. Lectures on mushroom cultivation, greenhouse technologies and vermicomposting were delivered. Eighteen participants

including eight farmers from Tezpur and adjoining areas and tea estates, six army personnel from various units, viz., 9 Kumaon Bomdila, 1812 Pioneer Coy, Solmara and DRDO Missa Camp, four personnel from Central Police Organization attended the course. Lectures and demonstration

on mushroom cultivation, vermicomposting, were given to the participants. The participants actively participated in the hands-on training modules and were provided with "starter kit" for mushroom cultivation.

WORKSHOP ON STATISTICAL AND RELIABILITY PRACTISES IN LIFE MANAGEMENT

DMRL, Hyderabad, organised a one day workshop on Statistical and Reliability Practises in Life Management on 5 February 2019. Several eminent speakers including Prof. VV Haragopal from Birla Institute of Technology and Science



(BITS), Pilani (Hyderabad Campus), Prof. B Shobha, Associate Professor from University of Hyderabad and Dr Hina Gokhale, former OS and DG (HR), DRDO, delivered talks covering applications of statistical methods in engineering.



WORKSHOP ON AI APPLICATIONS IN MATERIALS TECHNOLOGIES

Defence Metallurgical Research Laboratory (DMRL), Hyderabad, organized a one day workshop on “Artificial Intelligence Applications in Materials Technologies” to deliberate on the applications of Artificial Intelligence (AI)/Machine Learning (ML) to usher in a paradigm shift for the accelerated development of highly optimized materials and related technologies, in collaboration with academia, R&D agencies and industry. Prof. Surya R Kalidindi, Georgia Institute of Technology, USA, delivered the keynote address followed by invited technical talks by senior faculty from IITs and IISc.

The whole gamut of issues ranging from AI/ML potential, success stories, and possibilities for future was discussed threadbare; all focused on the faster and economic development



of highly optimized materials, from concept to implementation. A panel discussion was held facilitating a detailed discussion on all relevant aspects and identification of the way forward for the fruitful exploitation of AI/ML technologies. Over two hundred

scientists/researchers/faculty from various DRDO laboratories, industries, and academia actively participated in the workshop and benefited from the insights provided into the state-of-the-art technologies.

COURSE ON METAL FORMING PRACTICES AND ENGINEERED PRODUCTS

A course on “Metal Forming Practices and Engineered Products” under the Continuing Education Programme (CEP) of DRDO was conducted by DMRL during 28 January 2019 to 1 February 2019. Dr N Srinivasan, Sc ‘G’, the Course Director, welcomed the participants. Dr Amit Bhattacharjee, Sc ‘G’, HRD Coordinator, gave a brief on CEP. The course was inaugurated by Dr Vikas Kumar, DS & Director, DMRL. Prof. S Venugopal, Director, National Institute of Technology (NIT), Dimapur, Nagaland delivered the Plenary Lecture. Lectures on topics pertaining to the course were delivered by eminent speakers from academia, R&D laboratories and industry.





TRAINING PROGRAMME ON FINANCE & MATERIALS MANAGEMENT

Directorate of Finance and Material Management (DF&MM), DRDO HQ, successfully conducted a training programme during 4-8 February 2019 at Centre for Artificial Intelligence and Robotics (CAIR), Bengaluru for DRDO and DAD officials. Forty-five

participants from more than 17 labs/estts and the Office of IFA R&D, CDA R&D participated in the course.

Talks were delivered by the faculty from DF&MM and CGDA. The course was concluded with a panel discussion in which outstanding issues were addressed.

The panel discussion was chaired by Dr Tessy Thomas, DS and DG (Aero), Smt Manimozhi Theodore, Director CAIR, Smt K Inderjeet Kumar, CDA (R&D), Bengaluru and Dr AK Bhateja Director, DFMM. Shri Jagdeep, Sc 'F', DFMM, was the Programme Coordinator.

DIPAS CONDUCTS YOGA CERTIFICATE COURSE FOR ARMED FORCES

A one-month yoga certificate course was conducted at Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi, in collaboration with Central Council for Research in Yoga and Naturopathy (CCRYN), Ministry of Ayush, from 15 January to 15 February 2019. Fifteen participants from 59 Infv Div participated in the course.

The course consisted of both theory and practical sessions of Yoga modules developed by DIPAS and, also a visit to Naturopathy Centre for practical demonstration on different modalities of naturopathy and physiotherapy treatment. Expert faculty from CCRYN and DIPAS delivered lectures, and practical sessions were conducted by proficient yoga therapists



RAC COMMENCE NEW SELECTION NORMS FOR THE RECRUITMENT OF SCIENTIST 'B' IN DRDO

In an effort to improve the selection procedure for tapping the best talent from within the country, RAC would recruit Scientist 'B' through a descriptive examination, in addition to the initial short listing based on the GATE scores. The Descriptive Examination for Recruitment of Scientists (DERS) has been introduced to address the concern of poor turnout in interviews, experienced by RAC in the past recruitment cycles. Short listing of candidates based on performance in the DERS, which tests the subject knowledge, is expected to result in better selections with improved attendance of candidates during interviews.



AWARDS

Aerospace & Defence Award-2019

Naval Physical and Oceanographic Laboratory (NPOL), Kochi, bagged the award for “Outstanding Contribution in Naval Systems” on 19 February 2019 at Bengaluru during the ‘Aerospace & Defence Awards-2019’ held on the side-lines of Aero India 2019. Shri. S Kedarnath Shenoy, OS and Director, NPOL, received the award from Air Chief Marshal Arup Raha (Retd). NPOL is winning this award for the second time in four years.

NPOL was chosen for the award from amongst several nominated players in the industry by a jury headed by scientist Dr Kota Harinarayana. NPOL has been doing cutting edge research for the Indian Navy for more than six decades. In the recent years, 10 major products/ systems related to underwater surveillance have been handed over to the Indian Navy.



National Design Award-2018

Dr KM Rajan, DS and Director, Armament Research & Development Establishment (ARDE), Pune, was conferred with the National Design Award-2018 for outstanding contribution in the field of Engineering Design at the 33rd Indian Engineering



Congress held by the Institution of Engineers (India) at Udaipur.

Manager of the Year-2017 Award

Dr N Kishore Nath, Sc ‘G’ and Project Director Agni-4, ASL, has been conferred ‘Manager of the Year 2017’ award by Hyderabad Management Association (HMA) for his excellent contribution towards Development and Production of Agni-4 System. The award was presented by Chief Justice Shri Challa Kodandaram, Judicature of Hyderabad for the State of Telangana at a function held at KLN Auditorium, FAPCCI, Redhills, Hyderabad, on 3 January 2019.



Vice Chief of Naval Staff Commendation

Shri Suresh Chand Meena, TO ‘A’, Office of the SA to CNS has been conferred Commendation Note for utmost dedication, commitment and

professional competence of a very high order.

HIGHER QUALIFICATION ACQUIRED



Smt Dhanalakshmi Sathishkumar, Sc ‘F’, Combat Vehicles Research and Development Establishment (CVRDE), Avadi, has been awarded PhD under the Faculty of Mechanical of Engineering by Anna University, Chennai for the thesis titled “Investigations on the Structure and Properties of Hot Extruded Aluminium-SiCp Composites.”



Shri Satheesh Kumar S, Sc ‘E’, Naval Physical and Oceanographic Laboratory (NPOL), Kochi, has been awarded PhD from Cochin University of Science and Technology, Kochi in March 2019 for the thesis titled “Discrete Spectrum of Non-selfadjoint Schrödinger Operators and an Application to Ocean Acoustics.”

ARDE gets ISO 9001:2015 Certificate

ARDE, Pune, has been re-certified upgraded ISO standard ISO 9001:2015. A series of training programmes were conducted for ARDE’s ISO team and internal auditors to familiarize them with the upgraded standard. Consistent efforts were taken to upgrade all the processes of the lab as per the new standards and Internal and External Audits were conducted, leading to the award of the certificate. The certification was done by M/s TUV SUD South Asia Pvt. Ltd.



SMALL TURBO FAN ENGINE

This column covers the pathbreaking and successful projects and programmes of the DRDO.

Subsonic cruise vehicle demand is growing at rapid pace as projected by Armed Forces mainly due to its capabilities like cruise and combat, reconnaissance and surveillance, target acquisition and battle damage assessment. Gas Turbine Research Establishment (GTRE), Bengaluru, is developing a 400 kg thrust class Small Turbofan Engine (STFE) for propulsion needs of unmanned air vehicles (UAVs) targeted for subsonic applications.

Development of Small turbofan engine has many first in India facilitated through indigenous efforts. Ultra high speed operation of engine high pressure spool demands many tribological challenges. Technologies like rotor blisk and investment cast hot end parts with nickel-based super alloys enabled the size and weight targets. Friction welding of dissimilar materials and in-built alternator with oil-cooled environment made a compact power source. Pyro-based cranking and ignition provided the much needed autonomous start capability of the engine.

Status

GTRE has realised six prototype engines with 95 per centage indigenous content and tested the engine for max power setting at Bengaluru for 90 minutes continuous operation. During peak winter, the engine was tested at LEH at -15 °C and operational challenges.

Further efforts are on to flight test the engine and to manufacture the same through Indian industries.



Salient Features

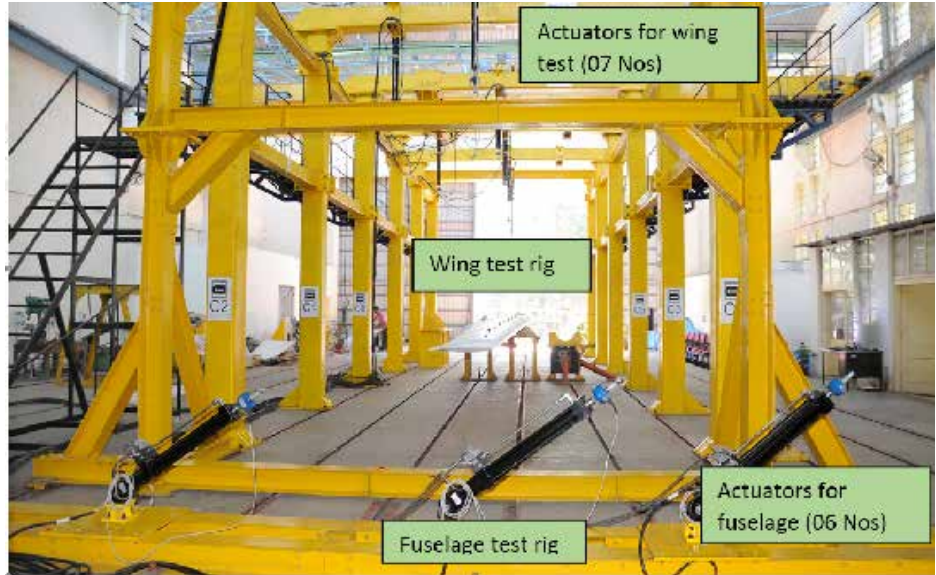
| Cycle Parameters/Units | Value | Engine Specs | Value |
|---------------------------|-------------|--------------------|--------|
| Thrust – kN | ~ 4 | Length | 0.95 m |
| Cycle Pressure Ratio | < 8 | Diameter | 0.35 m |
| Air Mass Flow Rate (kg/s) | 11 ± 0.4 | Weight | 100 kg |
| By-Pass Ratio | 1.0 ± 0.05 | Engine Accessories | 20 kg |
| Turbine Entry Temp (°K) | < 1360 | | |
| SFC (kg/kgf/hr) | 0.95 ± 0.05 | | |
| Power Off Take (kW) | 3 | | |

STATIC LOAD TEST FACILITY ESTABLISHED AT ADE

A new Static Load Test Facility was inaugurated at Aeronautical Development Establishment (ADE), Bengaluru, on 14 February 2019 by Shri MVKV Prasad, DS, Director, ADE. The rig would meet the lab's need for full-fledged evaluation of structural integrity, design validation and certification of ADE's projects.

The facility comprises a wing test rig and a fuselage test rig. The 18 m (l) x 5 m (w) x 6 m (h) wing test rig comprises six frames. A total load of 30 ton can be applied using seven hydraulic actuators (five 5 ton capacity actuators with stroke length of ± 250 mm and two 2.5 ton capacity actuators with stroke length of ± 500 mm). Tensile load will be applied on the test component from top. The rig will be able to accommodate test component up to size of 20 meters in length and 4 meters in width.

The fuselage test rig will be able to accommodate test component measuring 15 meters in length and 4 meters in width. A total load of 16 tons can be applied using six hydraulic actuators (two 5 ton actuators with stroke length of ± 250 mm; two 2.5 ton



actuators with stroke length of ± 500 mm; and two half ton capacity actuators with stroke length of ± 250 mm). Tensile load will be applied on the test component from bottom.

For applying horizontal load on the test component, actuators are mounted on fixtures. The load will be applied in tension on the test component from side. Actuators of 2.5 ton with stroke

length of ± 500 mm and 1.5 ton with stroke length of ± 250 mm (2 no) are available for horizontal loading.

Work is going on for design and development of Pit Drop Test Facility, which will be part of the Wing Test Rig. The Pit Drop Test Facility will be used for characterising external store up to a maximum weight of 1000 kg.

ADVANCED LASER RESEARCH LABORATORY INAUGURATED AT LASTEC

Advanced Laser Research Laboratory (BHASKAR) at Laser Science and Technology Centre (LASTEC), Delhi, was inaugurated by Dr G Satheesh Reddy, Secretary Department of Defence R&D and Chairman, DRDO, on 14 February 2019. The building will house laboratories for research in various laser sources and laser applications.





DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 4: MARCHING FORWARD

The article is 37th 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).

ARMAMENTS

Armament Research and Development Establishment

From its inception till the mid 1970's, ARDE was responding reactively to the requirements of the Services. This was necessary because the implicit or tacit component of knowledge, which is essential for independent design and development as against derivative development, could only be acquired patiently over the years by a process of learning by doing through import substitution of materials, components and complete ordnance of the items in Service. In addition to developing the competence in this field, it also brought the scientist of ARDE into close interaction with the Services as well as with the manufacturers. Every successful effort shored up the confidence level of the Services and of the manufacturer in the competence of ARDE scientists, and every other attempt which was not accepted for introduction by the Services added to the tacit component of knowledge. At this juncture ARDE had a large number of small projects, about 150 of them, with sanctioned funds of less than 10 lakh for each, to accommodate requests from the Services for indigenous development and supply of one or other type of ammunition imported by them along with the weapon system.

Instead, the Laboratory decided to have a pro-active approach and take a

smaller number of projects of higher magnitude and include research and development to build newer competence to meet the challenges of the 1980's and beyond. The influence of electronics, the emergence of missiles and rockets and the new types of projectiles developed as part of the armour and anti-armour race would be the area for ARDE to focus on. In addition to taking up proactive type of R&D projects, induction of additional manpower and building up of infrastructure was also planned.

The first among R&D activities was that of building up the competence for taking up design and development activities of the main armament system for the Main Battle Tank. This is explained further in Section 4.12.2 of this chapter as part of the effort of DRDO for the development of the tank.

In the area of ammunition, the development of the Fin Stabilised Armour Piercing Discarded Sabot (FSAPDS) ammunition in the early 1980's deserves special mention. For the designer of the ammunition, defeat of armour is the crowning achievement and in the see sawing battle of armour and anti-armour ammunition, victory was always transitory and alternating between the two. During the World War II, the development of Armour Piercing Discarded Sabot (APDS) appeared to have given an edge to anti-armour ammunition since it combined the best of both worlds, namely, the advantage of a large diameter (full calibre) from the internal ballistics point of view and very high muzzle velocity up to 1800 m/s. On the other hand the very

dense reduced diameter projectile that emerged after the sabot was discarded, led to a sizeable drop in air resistance which permitted the projectile velocity to remain very high at long ranges. The reduced diameter ammunition consisted of tungsten carbide for APDS and for soft core FSAPDS a tungsten alloy of high specific gravity of over 18 with aluminium alloy sabots, nylon driving band, rubber seals, etc. The ammunition was fired from a gun at about 600 MPa (Mega Pascal) pressure, 3000 °C temperature and at about 1400 to 1800 m/s muzzle velocity. The development of the ammunition called for mastery over high precision engineering coupled with sophistication in design and fabrication. ARDE produced FSAPDS ammunition for the 105 mm gun with the assistance of DMRL, which developed the super-heavy alloy material and produced the penetrator based on powder metallurgy techniques. FSAPDS ammunition development in other calibres would follow in the mid of 1980's and ultimately it led to the setting up of a fully automated Heavy Alloy Penetrator Project (HAPP) plant based on totally indigenous technology (from ARDE, HEMRL and DMRL) and with full cooperation from ordnance factories.

High Energy Materials Research Laboratory

The importance of High Energy Materials Research Laboratory (HEMRL) arises due to the fact that all



weapons use high energy materials for their terminal lethal objective. It is a matter of fact that in every project that ARDE undertook, HEMRL had a role in providing the necessary propellants and explosives. In view of the strategic use of high energy materials and from safety considerations, import of such materials is highly involved and complicated. Therefore in 1960, TDE Explosives, Pune was bifurcated and personnel with a research mind-set were segregated to form Explosive Research and Development Laboratory (ERDL). However, due to constraints of space, the physical separation between the R&D and the Inspection functions did not take place until ERDL moved to the Pashan campus in 1963. In those early days, the motivation for development was import substitution of explosives as the country at the time of Independence had manufacturing facilities for conventional gun propellants, high explosives, as well as for primary and secondary explosives.

The initial efforts of the laboratory were to work on the processes for realising double-base that is, nitroglycerine and nitrocellulose (NG+NC) and triple-base (NG+NC+picrite) propellants to UK specifications. Later, the Laboratory successfully developed the processes for different gun and rocket ammunition and for mortars. These propellants were used in ammunition designed by ARDE for small arms, for the mountain gun, for the antitank operation of the 105 mm IFG, for heavy and light mortars. A pilot plant was established for producing plasticised white phosphorous for smoke ammunition. Safe initiatory compositions were established and electro-explosive devices required for various applications were also formulated.

HEMRL also initiated work on Extruded Double-base technology for solid rocket propellants. HEMRL demonstrated that it had the competence to start from quantities as

small as a few milligrams, and build up to one-to-one scale propellants in pilot plants for use in rockets, missiles and other applications.

In the decade of the 1970s, HEMRL successfully established the techniques for casting double base propellants and produced on semi-pilot plant scale, different types of grain required for trials. A new initiatory composition having most desirable properties of storage stability and compatibility with metals and a new gelling agent were developed. A new double salt of diazomide tetrazolic acid and styphnic acid was used as it combined the most desirable properties of storage stability and compatibility with copper. Since the superior properties and performance of this new initiator had enormous prospects for its application to civil and military application, the process was released for commercial exploitation through NRDC.

In the case of guns, propellant was developed for 106 mm RCL HEAT ammunition, 100 mm HE full charge, reduced charge and sub-charge ammunition for use over service range of temperature, i.e., -20°C to +57 °C. The Laboratory had also developed propellant for the 105 mm IFG for firing at high ambient temperature. When the use of metallic cartridge cases for high calibre ammunition was being questioned due to disadvantages of high gun wear, higher volume and weight and the presence of toxic gases in the confined space inside the tank, the development of semi-combustible and combustible cartridge cases became a necessity. HEMRL kept pace with this trend and undertook in the late 1970s to develop the technology. It was successful in establishing the manufacture of semi-combustible cartridge cases for 75/24 Pack Howitzer, 105 mm APDS and HESH. Further, the Laboratory was successful in developing additive liners which are wear-reducing agents for guns

so that their life could be extended with reduced wear per round of ammunition. The user evaluation of the additive liners appeared to be positive as a result of which production on a pilot plant scale was under consideration.

In the area of high explosives, a powerful plastic explosive based on RDX and for use at subzero temperatures, was developed by HEMRL and found acceptance for introduction into the Service. Later, HEMRL developed a continuous process for the manufacture of HMX, an explosive more powerful than RDX. A pilot plant with a capacity of 5 kg/h was set up and the design of a bigger plant to meet the requirement of Army was underway.

Work on various pyrotechnic compositions, such as candle for target indicating bomb with different delays, and replacement of various metal components with plastics in ammunition continued at a vigorous pace.

HEMRL successfully established the complete process for making nitrocellulose plastisol propellants which met the requirements of high energy and performance for use in rocketry and missiles. The propellant was made by the slurry process, a versatile, simple and inexpensive technique with lower plant investment. The process offered the advantage of not imposing any limitations on the size of the rocket grains and also permitted incorporation of metallic powders for high impulse rocket propellants. Initially the Laboratory made propellant grains of different sizes and compositions and evaluated these for their ballistic characteristics. Later, the Laboratory scientists produced grains of different sizes and compositions, both in composite and double-base systems in pilot plant scale.

To be continued...



DRDO WEST ZONE CRICKET TOURNAMENT

High Energy Materials Research Laboratory (HEMRL), Pune, conducted DRDO West Zone (Intra Zonal) Cricket Tournament from 7 January to 11 January 2019 at Ammunition Factory, Cricket Ground, Kirkee, Pune. Tournament was inaugurated by Dr RK Pandey, Sc. 'H', OS & Associate Director, HEMRL on 07th January 2019. Seven DRDO West Zone labs/estts, viz. HEMRL, ARDE, R&DE(E), MSC, Dehu Road, VRDE, Ahmednagar, NMRL, Ambarnath and ACEM, Nasik participated in the tournament.

Team VRDE, Ahmednagar won the tournament and Team HEMRL, was the Runner's-up. Various trophies to individuals for Man of the Match, Man of the Series, Best All Rounder, Best Batsman, Best Bowler, Best Wicket keeper, etc., were also distributed.



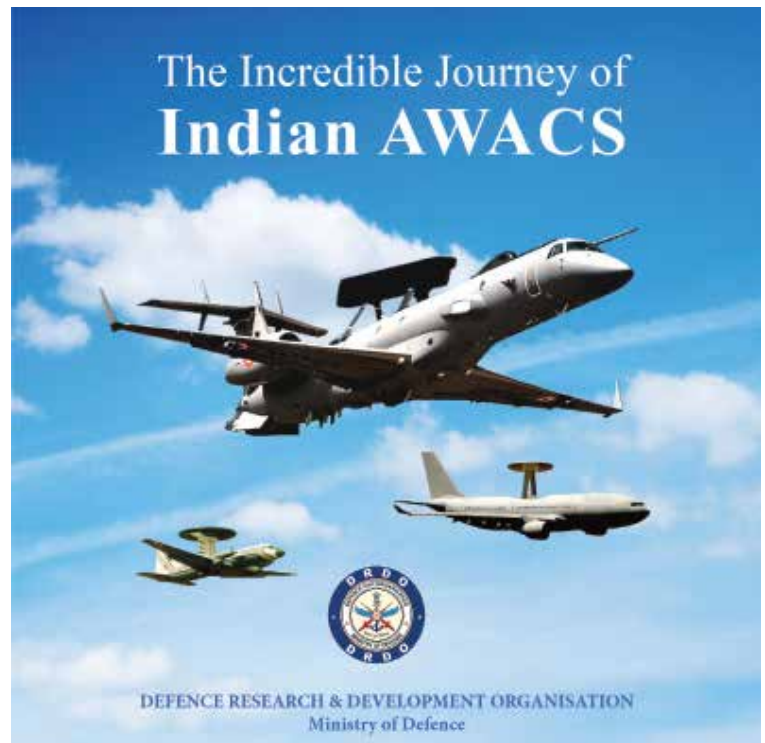
BOOK RELEASE

Defence Scientific Information and Documentation Centre (DESIDOC), Delhi, brought out a monograph titled "The Incredible Journey of Indian AWACS" authored by K Ramchand, S Krishnasamy and BR Srikant. The monograph chronicles the enthusiasm and excitement of the relentless pursuit of development of an Airborne Early Warning and Control (AEW&C) System and is an inspiring narrative of scientists, engineers and men in uniform who battled against all odds to design and operate an Indian AEW&C System. Every Chapter of the monograph mirrors the innumerable hurdles, which were conquered with key personalities recounting their experience in employing unique skills to achieve the desired results ultimately resulting in India's entry into the exclusive league of nations with a capability to design, develop, and fly an indigenous AEW&C System.

For more information and order please contact:

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DRDO, Metcalfe House
Delhi-110054

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UK£ 24



VISITORS TO THE DRDO LABS/ESTTS

DMRL, Hyderabad

A delegation from the Agency for Defence Development (ADD), Daejeon, South Korea, comprising Dr Seong Lee and Mr Sung Suk Hong visited Defence Metallurgical Research Laboratory (DMRL) and ATC. The delegation was a part of Indo-South Korea collaboration programme working on “Development of Bainitic Steel for Armour Applications.” Technical presentations were made by the delegate as well as DMRL scientists on the progress of various activities under the programme.



HEMRL, Pune

* Brig. SS Kahlon, VSM, Officiating Director General, Combat Engineers, New Delhi, along with Col. Vishal Pathania, Col. Combat Engineers-6, visited High Energy Materials Research Laboratory (HEMRL) on 15 February 2019. Dr Manoj Gupta, OS and Officiating Director, HEMRL, briefed them about the activities of the laboratory. Presentation on the projects related to High Explosives was given by the senior scientists.



* Dr G Satheesh Reddy, Secretary, Department of Defence R&D, and Chairman, DRDO, visited HEMRL on 9 March 2019. Dr Reddy inaugurated latest state-of the art High Performance Gun Propellant (HPGP) Processing Facility. Shri KPS Murthy, OS and Director, HEMRL, and senior scientists of HEMRL briefed Dr Reddy about the facility.

Dr Reddy evinced keen interest in the facility and exhibits of tank gun ammunition.

