

ARMY CONDUCTS SUCCESSFUL SUMMER TRIALS OF NAG



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**DRDO NEWSLETTER WISHES
READERS A VERY HAPPY
INDEPENDENCE DAY**



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Editor-in-Chief: Dr Alka Suri
Associate Editor-in-Chief: B Nityanand
Managing Editor: Manoj Kumar

Editor: Dipti Arora
Editorial Assistance: Biak Tangpua
Multimedia: RK Bhatnagar

Printing: SK Gupta
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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

Ambarnath: 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 Bhuvanawari, 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 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 Letha MM, 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, 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)

ARMY CONDUCTS SUCCESSFUL SUMMER TRIALS OF NAG

Indian Army successfully carried out summer user trials of third Generation Anti-Tank Guided Missile Nag at Pokhran Field Firing Ranges. The trials of DRDO developed missile were conducted between 7-18 July 2019. Raksha Mantri Shri Rajnath Singh congratulated the user evaluation teams and DRDO for the successful completion of the user trials.

Nag, with day and night capabilities can engage highly fortified enemy tanks in all weather conditions at a minimum range of 500 metre and a maximum range of four kilometre. It is a fire and forget class missile and uses an indigenously developed imaging

infrared seeker in lock-on-before launch mode.

The missile is launched from the Nag missile carrier (NAMICA) capable of carrying up to six combat missiles. The robust imaging algorithm enables the missile hit the target at four kilometre even in severe summer desert conditions, which is unique in its class.

As part of the Nag summer user trials, six missions were conducted under the extreme temperature conditions of the Thar desert. All the missiles have met the mission objectives including minimum range, maximum range, in direct attack as well as top attack modes, and achieved a direct hit onto the target.

The trials were conducted by the user team from the Army as per the user defined trial directive. The missile system has already cleared the winter user trials in February 2019. Government has already issued the Acceptance of Necessity for induction of Nag after user trials. All the ten missiles, which were fired during winter and summer trials, successfully hit the targets. Completion of summer user trials will now pave the way for production and induction of the Nag into the Army.

The trials were witnessed by senior officials of the Army and DRDO.





OPCW CERTIFICATION TO DRDE'S SCHEDULE-1 CHEMICAL WEAPONS PRODUCTION FACILITY

Defence Research and Development Establishment (DRDE), Gwalior, has a Schedule-1 Chemical Weapons Production Facility in accordance to the Article VI of the Chemical Weapons Convention (CWC), administrated by the Organization for the Prohibition of Chemical Weapons (OPCW) with its HQ at The Hague. The activities of the Schedule-1 Facility are subjected to periodical verification by the OPCW inspectors as per the provisions of CWC.

The 11th systematic inspection of DRDE's Schedule-1 Facility was conducted during 26-30 May 2019. Three inspectors from OPCW escorted by a representative from National Authority Chemical

Weapons Convention (NACWC), New Delhi, visited DRDE to carry out the systematic inspection. The inspectors verified various records with respect to production, consumption and utilization of various CW agents from January 2016 (10th systematic inspection) till date. They also physically verified the quantity stored in the Facility and attested the quantities declared to the OPCW vis-à-vis the quantities of the CW agents produced and consumed during the last three years. Inspectors also verified the safety and security norms followed by DRDE in the Schedule-1 facility.

The preliminary finding report was prepared and handed over to DRDE and no pending issues related to Schedule-1 Facility were found. The

final inspection report will be issued by OPCW in due course.

It is worth mentioning that DRDE Gwalior is the only declared facility of the country to carry out R&D activities for protective purposes utilizing Schedule-1 Chemical Warfare Agents. It is further notable that ever since the inception of CWC from 1997, this facility is logged on to fulfil all the obligations of the country for compliance of CWC pertaining to Chemical Warfare Agents.

The OPCW has verified the activities of this facility through 1st to 10th systematic inspections and endorsed the compliance of CWC for R&D activities pertaining to protective purposes.



RESEARCH SHIP INS SAGARDHWANI EMBARKS ON SAGAR MAITRI MISSION-2

Oceanographic research vessel of the DRDO, INS Sagardhwani, embarked on a two-month long Sagar Maitri (SM) Mission-2 from South Jetty, Southern Naval Command (SNC) in Kochi on 18 July 2019. Secretary, Department of Defence R&D & Chairman, DRDO, Dr G Satheesh Reddy flagged-off the ship in the presence of Vice Admiral Anil K Chawla, FOC-in-C (South). Raksha Mantri Shri Rajnath Singh extended his warm wishes for the success of the Mission.

Sagar Maitri is a unique initiative of DRDO which aligns with the broad objective of Prime Minister Shri Narendra Modi's policy declaration "Safety and Growth for All in the Region (SAGAR)" to promote closer co-operation in socio-economic aspects as well as greater scientific interaction,

especially in ocean research, among the Indian Ocean Rim (IOR) countries.

INS Sagardhwani has been designed and developed by Naval Physical and Oceanographic Laboratory (NPOL), Kochi, a premier systems laboratory of DRDO. It conducts ocean research experiments in the Indian waters and spearheads NPOL's at-sea data collection activities.

Sagar Maitri Mission-2 commemorates the Golden Jubilee Celebrations of India's lone research ship INS Kistna's missions as part of the historic International Indian Ocean Expeditions (IIOE), which took place during 1962-65. As part of the mission, INS Sagardhwani will revisit the selected tracks of INS Kistna and provide NPOL scientists ample opportunities to collaborate and garner a close working relationship with the

oceanographic counterparts of the IOR countries.

The prime objectives of the Sagar Maitri Mission are data collection from the entire North Indian Ocean, focussing on the Andaman Sea and adjoining seas and establishing long-term collaboration with eight IOR countries in the field of ocean research and development. The programme also aims at establishing long term scientific collaboration with the IOR countries in the field of 'Ocean Research & Development' and data collection with a focus in the Andaman Sea.

Director General (Naval Systems and Materials), DRDO, Dr Samir V Kamath, Director, NPOL Shri S Vijayan Pillai and senior Naval and DRDO officials were present during the flagging-off ceremony.



Dr G Satheesh Reddy, Secretary DDR&D and Chairman, DRDO flagging off Sagardhwani

ARDE TRANSFER TECHNOLOGY OF ANTI-TANK MUNITIONS VIBHAV AND VISHAL

DRDO signed License Agreements for Transfer of Technology (LAToT) for Land-based Munition Hardware Technologies with M/s BFL, Pune on 30 April 2019 for manufacturing of anti-tank munitions Vibhav and Vishal. The munitions are an essential part of the armoury of Indian Army and can be used in all terrains and climatic conditions.

Vibhav and Vishal have been developed by Armament Research

and Development Establishment (ARDE), Pune, under the new family of Munitions Programme of DRDO. The munitions remain effective once laid underground, unless removed or deactivated through a preset mechanism for humanitarian concerns. The munitions can be laid manually as well as mechanically.

Major technologies for arming delay, safety mechanism, in-built anti-removal device and enhanced lethality have been incorporated, and were

designed and developed by ARDE jointly with M/s Bharat Forge Ltd., Pune.

Both munitions successfully completed user trials during October-November 2016 and were recommended for induction into Services. The handing over of ToT documents was done in the presence of Shri PK Mehta, DS and DG (ACE), Dr KM Rajan, DS & Director, ARDE, and Col RS Bhatia (Retd), CEO, M/s BEL, Pune.



DEAL TRANSFERS TECHNOLOGY OF HD-VLF SYSTEM

Defence Electronics Applications Laboratory (DEAL), Dehradun, signed LAToT for "HD-VLF Modulator and HD-VLF-HF Receiver" with BEL on 21 May 2019. Very Low Frequency (VLF) is the means of long-range reliable communication from

Indian mainland to distributed ships and submerged vessels. High Data Rate VLF (HD-VLF) communication system is designed for high data rates (secure mode) up to 800 bps in constrained bandwidth of VLF band.

HD-VLF communication system comprises of HD-VLF Modulator and HD-VLF-HF Receiver. HD-VLF Modulator has the capability to broadcast secure VLF data at 800 bps in interface with transmitter.

HD-VLF-HF Receiver is standalone complete system from 10 KHz to 30 MHz, capable of receiving VLF and HF broadcast data. It can receive secure VLF data up to 800 bps and HF audio and data in all standard HF waveforms. A combination of complex signal processing algorithms like spectrally efficient modulation scheme,

high code rate high performance FEC, higher order lossless data compression, impulsive noise mitigation scheme is being used to achieve the higher data rate in HD-VLF systems.

The equipment has an Ethernet interface enabling it to be interfaced with the Navy Enterprise Wide Network (NEWN). It has in-

built encryption and has external programming features. A power ON security token authentication helps in unauthorized access. It has legacy mode of operation for interoperability with the older VLF systems. It is a rack mountable system with 2U height. The system has undergone user assisted trials.



DIPAS SIGNS LATOT FOR ERGONOMICALLY DESIGNED COMBAT BOOTS

Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi, signed Licence Agreement for Transfer of Technology (LAToT) of ergonomically designed Combat Boots on 27 June 2019 to M/s Superhouse Ltd, Kanpur, M/s Prosafe International Pvt Ltd, Bhiwadi, M/s Humero Tanning Industries Pvt Ltd, Kanpur, and to M/s Model Exims, Ltd, Kanpur.

Dr Bhuvnesh Kumar, Director DIPAS, signed the LAToT with the representatives of the said firms in the presence of inventors Dr Madhusudan Pal, Sc 'F' and Dr Debojyoti Bhattacharyya, Sc 'D'.

The lightweight combat boots weighs around 1.5 kg a pair (size 8)



and crafted on ergonomic principles, which ensures better fit, comfort, safety and usability. The boots provide better energy expenditure and impact shock

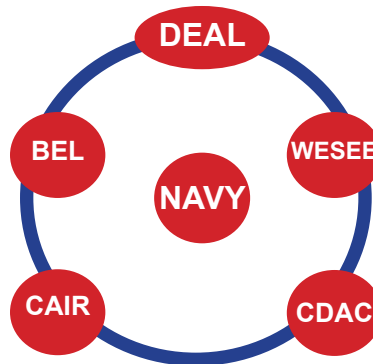
absorbance when compared to existing boots used by the Armed Forces. The boot minimize the risk of injury and augment combat efficiency.

MOD SIGNS CONTRACT FOR PRODUCTION OF SOFTWARE DEFINED RADIOS FOR IN

A major milestone in the indigenous series production of advanced technology, Software Defined Radios (SDRs), was achieved with signing of contract by Ministry of Defence on 18 June 2019 for manufacturing SDRs worth ₹ 488 crore for the Indian Navy (IN).

Defence Electronic Applications Laboratory (DEAL), Dehradun in association with Centre for Development of Advanced Computing (CDAC), Centre for Artificial Intelligence and Robotics (CAIR) and Weapon and Electronics System Engineering Establishment (WESEE) has developed the SDRs.

As part of the contract, present hardware-based legacy communication



sets will be replaced by software based multi-band, multi-functional and multi-role/mission radios to improve information sharing and situational awareness through secure communication means.



EVENTS

DRDO CELEBRATES INTERNATIONAL DAY OF YOGA



International Day of Yoga (IDY) is celebrated worldwide on 21 June every year. The proposal was first introduced by Prime Minister Shri Narendra Modi in his address during the 69th opening session of the General Assembly, in which he said: "Yoga is an invaluable gift from our ancient tradition. Yoga embodies unity of mind and body, thought and action... a holistic approach [that] is valuable to our health and our well-being. Yoga is not just about exercise; it is a way to discover the sense of oneness with yourself, the world and the nature."

Defence Institute of Physiology and Allied Sciences (DIPAS) conducted the IDY 2019 in Delhi with full zeal and



Mass Yoga session at Central Park, DRDO Residential Complex, Timarpur

enthusiasms. Mass yoga was conducted at Central Park, DRDO Residential Complex, Timarpur. Secretary DDR&D and Chairman, DRDO Dr G Satheesh Reddy inaugurated the programme graced by DG (SAM), and Delhi-based Directors. Around 600 DRDO employees and their family members joined in the event. Yoga demonstration was given by Shri Sanjay Kumar and Shri Virendra Singh as per common yoga protocol of Ministry of Ayush. In the afternoon session, yoga oration was delivered by Prof. Ramesh Bijlani (Retd), Head of the Department of Physiology, AIIMS, Delhi, on “Yoga for Wellbeing” at Kothari Auditorium, DRDO Bhawan.

IDY was also celebrated at extreme altitudes in Siachen and Bumla, Arunachal Pradesh. DIPAS and DRL in association with the Indian Army, organised the event at Bumla. Highlight of the programme was the participation of around 70 soldiers of Chinese People’s Liberation Army. At both the places around 200 soldiers practiced yoga with great zeal and enthusiasm despite bad weather conditions.

The following DRDO labs/estts too celebrated IDY at their respective places.

ADE, BENGALURU

A mass yoga demonstration and a lecture was conducted. Led by Dr Venugopal S, OS and Director, Aeronautical Development Establishment (ADE), around 75 employees performed yoga under expert Shri Prabhu Mallikarjun, SVYASA University. Yoga prayer, Surya namaskar, asanas of common yoga protocol were performed. Dr Marappa V and Swami



DRDO in association with Indian Army organised yoga at Siachen (top) and at Tawang in Arunachal Pradesh

Dayatmananda ji Maharaj from Ramakrishna Math, Ulsoor who delivered a lecture on Yoga, its Importance and Benefits. Dr Marappa V taught the technique and nuances of meditation. He also conducted guided meditation.

ANURAG, HYDERABAD

Dr JVR Sagar, OS & Director, Advanced Numerical Research & Analysis Group (ANURAG) in his address explained the benefits of practicing yoga daily and its effects on the physical, emotional, psychological and spiritual wellbeing of an individual.

Yoga trainer Shri Ramachandra Chary, demonstrated yoga to the ANURAG employees. A special session of meditation was also organised on this occasion by Shri SS Rao, former Sc ‘F’, DMRL for the benefit of the employees.





ASL, HYDERABAD

A lecture was organized on the Stress Management and Wellness through Yoga by Ms Chitra Ananth, a volunteer teacher of the Art of Living. She highlighted the importance of yoga, meditation, breathing techniques and healthy diet in day to day life to achieve wellness and manage the stress. Dr M Rama Manohara Babu, DS and Director, Advanced Systems Laboratory (ASL) addressed the gathering and spoke about significance and benefits of yoga. As an initiative to inculcate the habit of practicing yoga, yoga classes were initiated at ASL from 24 June 2019 for one month for the benefit of ASL employees.



CAS, HYDERABAD

Banners were exhibited at various locations in the Centre for Advanced Systems (CAS) to popularise yoga. The officers and staff of CAS, BDL and SSQAG participated in the programme organised to mark the IDY. Director, CAS in his address projected the means to achieve excellence in life, by combining mental/spiritual, professional and social excellence. Smt Manasa Venkatesh, yoga instructor conducted the yoga session and delivered a motivational talk.



CAIR, BENGALURU

Dr Upendra Kumar Singh, OS and Director, Centre for Artificial Intelligence and Robotics (CAIR) delivered an informative and inspirational talk titled "The World Within-Approach to Oceanic Mind". The talk was followed by yoga practice session which was coordinated by Shri Vinayak Nageli, Sc 'D'. Employees of CAIR enthusiastically participated in yoga practice session which consisted of surya namaskar, asanas (postures), pranayam and meditation.

DEAL, DEHRADUN

The event was inaugurated by Shri PK Sharma, Director, Defence Electronics Application Laboratory (DEAL). As per the common yoga protocol, prayer, asana, pranayam and dhyana was performed by the participants. Large number of employees from DEAL, IRDE, MES, EMU and DSC participated in the event.



DEBEL, BENGALURU

The programme began with a presentation by Smt Anuradha Srinivas, Sc 'E', wherein she deliberated on the benefits of Sookshma Vyayams. This was followed by a practical demonstration of simple exercise techniques for joints and facial muscles and how to adopt props to train in asanas for the benefit of the Defence Bio-engineering and Electromedical Laboratory (DEBEL) employees. She spoke on the benefits of meditation and asanas in relieving musculoskeletal strain and mental anxiety. Smt Manimozhi Theodore, Director spoke about the benefits of the yoga.



DESIDOC, DELHI

Dr Alka Suri, Director, Defence Scientific Information and Documentation Centre (DESIDOC) expounded the preponderance of yoga in keeping the life stress free. A yoga session was conducted under the guidance of yoga guru Shri Vinod Yadav.



DIBER, HALDWANI

The employees and the families of Defence Institute of Bio-Energy Research (DIBER) practiced yoga under the expert guidance of yoga instructor Shri Bhushan Tewari from the Art of Living.



DFRL, MYSURU

To raise awareness among Defence Food Research Laboratory (DFRL) employees about practicing yoga, events such as lectures and practical sessions of yoga were conducted during



10-20 June 2019. Lectures on yoga asanas and its various techniques, mindfulness and ways to practice mindfulness, ayurveda and yoga, tips to good health, yoga for good health and importance of pranayama were delivered by yoga gurus. Yoga classes were conducted for the benefit of employees and students by Mr Pasupathi, Yoga Trainer, Sri Raghavendra Yoga Kendra, Mysuru.



GTRE, BENGALURU

The Chief Guest Dr Shashikanth S Kumbar briefed about the concept of medical yoga and emphasized on the importance of relaxation at work place. Guests of Honour Dr Krishna Dahiya delivered a talk on combined benefits of yoga and ayurveda and Dr Anagha PS enlightened with a talk on yoga as a Darshana Shastra. Shri Debabrata Roy, Officiating Director, Gas Turbine Research Establishment (GTRE) reiterated the benefits of yoga and urged the employees to make yoga as an integral part of their daily life.



HEMRL, PUNE

High Energy Materials Research Laboratory (HEMRL) employees participated in the yoga programme conducted under the yoga expert Shri PM Deshmukh, Sc 'E'. He elaborated the importance and benefits of yoga in

day-to-day life. The session was as per common yoga protocol.



NMRL, AMBERNATH

Naval Materials Research Laboratory (NMRL) fraternity celebrated IDY with great ardour. The celebration included a yogic session by Ms Girija S Nambiar, a certified Yoga Teacher. Simple exercises helpful in relaxing and maintaining good health were demonstrated. Dr M Patri, Director, NMRL, motivated employees and their families to make yoga an indispensable part of their daily schedule. Banners were exhibited at various locations in the establishment to popularize the yoga.



NPOL, KOCHI

Naval Physical and Oceanographic Laboratory (NPOL), Kochi celebrated IDY with enlightening programmes focusing on the significance of yoga for healthy and happy life. Shri S Vijayan Pillai, OS and Director, NPOL emphasized the significance of yoga, in ensuring happiness and harmony. Shri Kithapram Vasudevan Namboothiri, eminent yoga guru and Chairman, Patanjali Yoga Training and Research Centre, Kochi, conducted a workshop on yoga practices. He described 'Ashtanga Yoga' in detail.



NSTL, VISAKHAPATNAM

Naval Science and Technological Laboratory (NSTL) celebrated IDY with mass yoga programme, brief meditation sessions, audio visual programmes and lectures. Swami Guneashanandaji from Ramakrishna Mission, Visakhapatnam, delivered lecture on philosophy of yoga. Dr OR Nanadgopan, Director, NSTL, elucidated the need to practice yoga. Mass yoga sessions were organized during 25-29 June 2019. More than 150 participants attended the sessions under the guidance of Shri A Visweswara Rao, a Level 2 Yoga Teacher.



RCI, HYDERABAD

Eminent Intervention Cardiologist Prof. (Dr) MS Ramachandra delivered lecture on "Healthy Heart: Problems, Precautions and Prescriptions." Yoga master Shri ESR Murthy conducted practical yoga session. Director, Research Centre Imarat (RCI), and employees attended the programme.



CVRDE CELEBRATES WORLD ENVIRONMENT DAY

Combat Vehicles Research and Development Establishment (CVRDE), Chennai, celebrated World Environment Day 2019 in a grand manner on 18 June 2019. A talk was delivered on “Beat Air Pollution” by environmentalist Shri SK Sathyanarayana, Plant Head Chief Manager, Balmer Lawrie, Chennai.

In his didactic and informative talk Shri Sathyanarayana, spoke about the national ambient air quality standards, sources of indoor air pollution, lead particulates in candle burning, tobacco toxins, etc. Estate Management Unit, CVRDE, also conducted various awareness programmes at CVRDE Residential Complex. Shri V Balamurugan, OS and Director, CVRDE, distributed prizes to winners of the various events organised to celebrate the World Environment Day.



Shri V Balamurugan (right) felicitating Shri SK Sathyanarayana

ASL CELEBRATES NTD

Advanced Systems Laboratory, Hyderabad, celebrated National Technology Day (NTD) on 7 June 2019. Dr V Venkateswara Rao, Associate Director (V), ASL, and Programme Director, Agni, presided over the event and addressed the gathering.

Smt S Prasuna, Sc ‘E’ delivered NTD Oration on the “Formal Methods for Software Verification: Practice and Experience.” In her oration Smt Prasuna explained how to tackle the extremely challenging task of establishing guarantees on the reliability of a software using formal methods, recommended certification standard for avionics as per DO178C. She was presented NTD Oration Medal and Certificate by the Chief Guest.



Smt S Prasuna receiving NTD oration medal from Dr V Venkateswara Rao

RAISING DAY CELEBRATIONS

CAS, HYDERABAD

Centre for Advanced Systems (CAS) celebrated its 4th Raising Day on 16 June 2019. The event was attended by prominent scientists of Missile Cluster Laboratories. Shri MSR Prasad, DG (MSS), DRDO, presided over the event as the Chief Guest. Dr VG Sekaran, former DG (MSS) graced the occasion as the Guest of Honour. Dr MRM Babu, DS and Director, ASL, Dr V Venkateswara Rao, OS, Programme Director (Agni) and scientists from sister DRDO labs, SSQAG and BDL were also present.

Shri G Ramaguru, OS and Director, CAS, briefed about the progress and achievements of CAS in crucial strategic fields and acknowledged the all associated with CAS for their cooperation and support.

To encourage and motivate the workforce, meritorious awards were distributed to CAS employees. A cultural programme portraying India's diverse culture was the highlight of the function. The event concluded by expression of vote of thanks by Shri Pramod Kumar Jha, Sc 'F', DOMS, CAS.

DEBEL, BENGALURU

Defence Bio-engineering and Electromedical Laboratory (DEBEL) celebrated its 38th Raising Day on the 17 June 2019. Air Marshal Rakesh Kumar Ranyal, VSM, Dy Chief Integrated Defence Staff (Medical), HQ Integrated Defence Staff (Med), New Delhi, was the Chief Guest of the function. Smt Manimozhi Theodore, Director, DEBEL, welcomed the Chief Guest and invited dignitaries and spoke about the activities and achievements of DEBEL in the year 2018.

The Chief Guest delivered a talk on 'Cyber Attacks and Armed Forces



Inaugural function of CAS Raising Day



Air Marshal Rakesh Kumar Ranyal delivering his talk on DEBEL Raising Day

Medical Services' wherein he spoke on relevance of cyber security in Tri-Services, AFMS Network, Hospital Information System and Cyber

Warfare. Chief Guest and Director, DEBEL, also presented Laboratory-level DRDO Awards to the employees for their meritorious contributions.



NPOL-VARUNA MERIT EVENING 2019



Naval Physical & Oceanographic Laboratory (NPOL), Kochi organised NPOL-Varuna Merit Evening-2019 on 2 July 2019 to felicitate and reward the meritorious students of Bhavan's Varuna Vidyalaya (BVV), a joint venture of NPOL-DRDO and Bharatiya Vidya Bhavan (BVB) for their commendable performance in class XII CBSE examinations. Shri S Vijayan Pillai, OS and Director, NPOL lauded the remarkable achievements

of the students and highlighted the role of the school and teachers in nurturing the talent. He also appreciated the efforts of BVV in supporting all renovation works in school without disturbing the academic activities.

The Chief Guest, Prof. (Dr) KN Madhusoodanan, VC, Cochin University of Science and Technology presented trophies and merit certificates to the school topper, stream toppers and to the students

who secured A1 in all subjects in the CBSE Class XII Board Examinations. In his address he emphasised the role of schools in inculcating scientific temperament in students. All stream toppers were awarded cash prize of Rs 1200; the award has been constituted by the family of Late Shri A Balakrishnan, former Scientist of NPOL. Smt Usha K, former Principal, BVV, who retired in May 2019 was also felicitated by Director, NPOL.

CHAIRMAN DRDO REVIEWS LRDE PROJECTS

Dr G Sathesh Reddy, Secretary DDR&D and Chairman DRDO reviewed projects of Electronics and Radar Development Establishment (LRDE), Bengaluru on 17 April 2019. DS and DG (ECS) Ms J Manjula; DS and DG (PC&SI) Dr S Guruprasad; OS and Director, DP&C Ms Nabanita R Krishnan; Director, DISB Ms Chandrika Kaushik; Director, LRDE Shri SS Nagaraj were present during the review. The project activities and future plans of LRDE were discussed at length based on presentations of Project Directors and senior officers of LRDE.





COURSE ON RESERVATION AND RECRUITMENT RULES

Centre for Airborne Systems (CABS), Bengaluru, conducted a three-day course on “Reservation and Recruitment Rules” during 12-14 June 2019 under the Continuing Education Programme (CEP) of DRDO. The objective of the course was to create awareness among Administrative Cadre about reservation and recruitment rules. The CEP was attended by 31 participants from various DRDO labs/estts.



COURSE ON APPLICATION OF COMPUTERS, LAN AND DRONA IN OFFICE

Defence Scientific Information and Documentation Centre (DESIDOC), Delhi conducted a three-day course on Application of Computers, LAN and DRONA for Admin and Store Assistants during 11-13 June 2019 under CEP of DRDO. Dr Rajeev Vij, Sc ‘G’, Course Coordinator, in his welcome address, briefed the

participants about the objectives of the programme.

Dr Alka Suri, Director, DESIDOC, inaugurated the course and stressed on the need for application of computers and DRONA in office for improving the quality and speed of work. Twenty-four participants from five DRDO labs/estts attended the course. The topics covered

during the course included: Basics of computer and hardware, conduct and leave rules, store accounting procedures, store management guidelines, etc. Three most active participants were awarded by the Director, DESIDOC.





WORKSHOP ON DRDO WATER TESTING KIT

Defence Research Laboratory (DRL), Tezpur organized a workshop on “Demonstration of DRDO Water Testing Kit-II Parameters” under programme Arunodaya at AF Station Tezpur, 102 Engineering Regiment, Solmara and 155 Base Hospital (BH) Tezpur from 17

to 19 June 2019. Officers and ORs from AF Station Tezpur, 4 Corps and 155 BH attended the programme.

Dr Rama Dubey, Sc ‘E’ presented the ongoing water related activities of DRL, emphasized the role of DRL in water quality survey, analysis and the usefulness of water testing kit during

field testing of water. Water samples, provided by the participants were tested during practical demonstration by Dhiraj Dutta, Sc ‘D’. Issues like water testing related challenges and their probable remedies were discussed in details.



PROGRAMME ON MUSHROOM CULTIVATION

DRL in association with Agronomy Department, Govt of Arunachal Pradesh conducted a skill development training programme on Mushroom Cultivation under HA conditions at Changbu village, Tawang on 28 June 2019 under the Programme Arunodaya. Forty-two farmers of Khinmey and Changbu villages, participated in the programme. Shri Lobsang Tsering, Deputy Director (Agronomy) and team from DRL trained the farmers and the participants prepared around 100 mushroom bags. Farmers, especially ladies showed keen interest in the mushroom cultivation.



WORKSHOP ON CBRN FORENSICS

Institute of nuclear medicine and Allied Sciences (INMAS), Delhi, jointly with AIIMS, Delhi, conducted one-day workshop on Chemical, Biological, Radiological and Nuclear (CBRN) Forensics on 22 May 2019. CBRN is one of the major concern area today because of its potential to be used as weapon of mass destruction. Though progress is being made in India on various response aspects such as protection, detection, evacuation and decontamination, medical management has only recently been added as an essential component of formal and structured response. Within the medical response category, CBRN forensics is almost a totally neglected area in India.

The workshop was probably the first attempt at national level to get all principle stakeholders on one platform in an attempt to form guidelines and SoPs, with respect to CBRN forensics for further consideration



of the authorities. The workshop was conducted with a viewpoint that virtually all stakeholders will be involved in making and sustaining a response network. Role of NIA was prospectively visualized as a navigator of this activity, being the central agency responsible for investigating terror activities, including CBRN events.

Around 30 experts and personnel from 22 agencies of national stature attended and contributed in the workshop. Prof. Adarsh Kumar from AIIMS Delhi and Dr Dhruv Kumar Nishad, Sc 'D' from INMAS were the coordinators of the workshop.

PERSONNEL NEWS

APPOINTMENT

Director, ARDE, Pune



Dr V Venkateswara Rao, OS, took charge as Director, Armament Research & Development Establishment (ARDE) from 1 July 2019.

Dr Rao holds B.Tech (Mechanical Engg) from AUCE, Visakhapatnam, M.Tech (ICE & GT) from REC, Warangal and PhD (Mechanical Engg) from Jawaharlal Nehru Technological University College of Engineering, Hyderabad. He has holds MBA (Finance and HR) from IGNOU.

Dr Rao earlier served as the Programme Director, Agni, at

Advanced Systems Laboratory (ASL), Hyderabad, where he guided the building up of a dynamic setup for design, development, production, delivery, flight testing and lifecycle management of Agni missile variants. Earlier, as Director, Centre for Advanced Systems (CAS), he established new integration and test facilities for missiles. He played a crucial role in configuration design and establishment of integration and storage facilities, and delivered the Agni variants to different regiments as per requirements. Design, planning and operationalisation of bases for Agni variants are his other significant contributions. Adoption of automation in integration and testing of missiles production has been another important contribution. He provided critical training to the regiment teams and

the Missile Management Organization groups. During his tenure of more than two decades at ASL and DRDL, Hyderabad, Dr Rao earned a rich experience in all stages of development of Agni systems. Design and realisation of solid rocket motors for Agni and Upper Stage Static Test Facility are to his credit. He immensely contributed towards the integration and testing of solid rocket motors for Agni as well as other missile systems such as ANSP, PJ10, Helina, Astra, LRSAM, etc. As Project Director, Agni 3 and Sites, he played a major role in coordinating with ISRO and SFC, Jagdalpur for processing, integration and static testing of Agni-3 stage I and II solid rocket motors, and with the regiment for the delivery of Agni 3 missiles.

Dr Rao has to his credit, several technical papers published in



national and international journals and conference proceedings. He is a Fellow of the Institution of Engineers (India) and the Aeronautical Society of India. He is serving as a Life Member and Secretary of Indian Institute of Welding and High Energy Materials Society of India, as well as Life Member of Indian Society of Non-Destructive Testing, Indian Welding Society and Astronautical Society of India.

He is the recipient of DRDO award for Pathbreaking Research/ Outstanding Technology Development for successful completion of Agni-3 developmental trials in 2007 and Best Performance Team Award from Chairman, ISRO for successful assembly and static testing of solid rocket motors of PSLV in 1996. He was awarded the Best PhD Thesis Award by Indian Welding Society in 2010.

AWARDS

Fakhruddin Ali Ahmed Award for Outstanding Research in Tribal Farming Systems 2018

Indian Council of Agricultural Research (ICAR) conferred 'Fakhruddin Ali Ahmed Award for Outstanding Research in Tribal Farming Systems 2018' to Dr Tsering Stobdan, Dr Anand Katiyar, Shri Tsewang Tamchos and Shri Desyong Namgail of Defence Institute of High Altitude Research (DIHAR), Leh, for their outstanding research and extension work in tribal Ladakh region.

The award was given in recognition to contributions in demonstrating doubling vegetable productivity under low input system; growing melons as new cash crops; identifying native apricots (Raktsey Karpo) as unique and sweetest apricots; development of passive solar greenhouses for growing warm season crop in sub-zero temperature; and development and commercialisation of seabuckthorn-based products. Based on their report 'Value Chain Analysis of Seabuckthorn in Leh Ladakh', Seabuckthorn is included as a horticulture activity



Dr Tsering Stobdan (centre) receiving the Fakhruddin Ali Ahmed Award for Outstanding Research in Tribal Farming Systems 2018

under MIDH of Ministry of Agriculture and Farmers Welfare, GoI in five Himalayan states. Working closely with the state agriculture and horticulture departments, and local NGOs resulted in effective and sustained dissemination of the technologies. The research and extension activities resulted in direct benefit to the tribal farmers in Ladakh region.

Dr Tsering Stobdan, team leader, received the award from Dr T Mahapatra, Director General, ICAR, and Dr Panjab Singh, President, National Academy of Agricultural Sciences (NAAS) on ICAR Foundation Day on 16 July 2019 at the National Agricultural Science Centre, New Delhi.

TOLIC Rajbhasha Implementation Award

Institute of Nuclear Medicine and Allied Sciences (INMAS), Delhi, was awarded Town Official Language Implementation Committee (TOLIC), North Delhi Outstanding Rajbhasha Implementation Award at INMAS during 2018-2019 on 26 June 2019 in large institution category. Dr KV Prabhu, Chairman Agriculture Scientists Recruitment Board, gave away the award. INMAS got First Award for Best home magazine 'Prastuti' and Second Award for Outstanding Rajbhasha Implementation.



Dr AK Mishra (right) and Dr AN Bhatt (left) from INMAS receiving TOLIC Award



Readers' Views

(Your feedback is important to us as it gives scope for improvement and serve the Organisation in a better way)

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DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 4: MARCHING FORWARD

The article is 41st 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).

ELECTRONICS

Defence Electronics Research Laboratory

Defence Electronics Research Laboratory (DLRL) which was set up in 1962, found that the growing application of electronics in defence gave ample scope for its scientists to gain experience and build expertise in electronic warfare which was in its infancy, on-line ciphers for teleprinter traffic, HF/VHF/UHF communication antennas and radars. Since LRDE's focus was on speech secrecy, DLRL found a niche in secrecy systems for teleprinter traffic, which was being increasingly used by the military. In the first five year period, namely 1962-67, DLRL like LRDE, had to build its human resource, organise the Laboratory for undertaking R&D work, and go through learning by doing of import substitution/indigenisation and improvements to existing equipment.

The main radar activity at DLRL in the 1960's was the de novo development of the Secondary Surveillance Radar under the ADGES Plan of the IAF. This was the ground-based radar that interrogates through coded transmission of pulses from all airborne transponders within its coverage volume. The new generation IFF Mk 10 which was under development in developed countries had new features, such as sidelobe suppression through interrogation and control patterns of the antenna, active and passive decoding, degarbling, defruiting, interlacing of interrogation pulses, and so on. The system when completed would be modern and comparable in features and performance to any system available in the world. Thus, in the field of radars, by the second half of the 1960's, DLRL was offering innovative and competitive system solutions.

The major activity in the field of communications at DLRL in the 1960's was the development of On-line Cipher machines which replaced the World War II Typex machines for clearing large volume of classified traffic on teleprinter channels. An innovative design approach based on digital techniques for complex key generation, real time encrypting and decrypting algorithms, and synchronisation provided a machine which was competitive on a global basis. Two versions of on-line cipher machines were successfully developed and introduced in the Services. These were produced in numbers at the pilot plant established by DLRL in 1965.

Unlike radar and communication systems, electronic warfare systems are characterised by large bandwidths for which octave bandwidth microwave components are crucial. Right from the beginning, since the Laboratory found that procurement of such components from abroad was not easy, DLRL had no choice but to build competence and expertise in the design, development and fabrication of these vital components. The Radar Augmentation Plan of 1965 provided financial resources and additional manpower so that an additional 18,000 square feet of area was available for housing microwave circuit, microwave antenna, and radar EW laboratories, which would be equipped with test and measuring equipment and staffed with young, qualified engineers/scientists. Scientists were also deputed for training abroad and on their return, they were gainfully employed in design and development of waveguide, coaxial and strip line passive components and active modules. Besides these hardware activities, DLRL undertook propagation studies in the VHF/UHF range of frequencies including the effect of vegetation and based on this data,

graphical representations were drawn for ease of utilisation by the Services.

In the first quarter of the 1970's, the development of the secondary surveillance radar was completed. It was evaluated, accepted and the technology was successfully transferred to Bharat Electronics Ltd, Ghaziabad, which produced these in numbers. Collaboration between DLRL and BEL ensured that the system was contemporary in technology and competitive in cost. Based on the technology of DLRL, indigenous secondary surveillance radars were not only supplied to all the three Services but were also exported to other countries.

DLRL undertook two more projects namely, Indigenization of the SA-75 System – code named Project DEVIL, and Analog Moving Target Indicator for the Radar used in SA-75 system, and the Infantry Battlefield Surveillance Radar. The DLRL effort on the SA-75 radar was part of the overall import substitution exercise undertaken by DRDL. The indigenous design had to conform operationally to the specifications, but in view of the fact that technology had shifted from vacuum tube to integrated circuits, the detailed circuit designs of the missile radar were totally Indian. The main technical challenges for DLRL scientists were in the design of the high power transmitter and electromechanical scanning antenna. The laboratory collaborated with SAMEER in Bombay which had the required competence for high power transmitter development. As the information on the antenna was very sketchy, considerable effort was devoted towards the analysis of the intricate design by which the scanning was achieved. A simplified design from the point of view of fabrication and a more efficient electromechanical scanning was attempted. The development of the Analogue Moving Target Indicator



for SA-75 was taken up to improve the performance of the original imported system against ground clutter and chaff. By the end of the decade, DLRL had designed and developed most subsystems of the missile radar and that of the analogue MTI. However, the closure of the main project on the indigenous development of the imported missile system required DLRL also to discontinue the development work on the missile radar. Both the projects were stage closed but the experience and insight gained through these projects was of great help in the development of radars for the Integrated Guided Missile Development Programme and for development of high power jammers.

The Battlefield Surveillance Radar was the other project undertaken for development in mid 1970's by DLRL in response to the qualitative requirements of the Army for a battery-operated man-portable system for the infantry. The challenges in using the pulse Doppler approach were, detection of very low Doppler targets, such as crawling men, ease of operation, the need for the system to be man-portable, and ensuring low primary power consumption by the radar station. The requirement of man-portability set an upper limit of 15 kg for weight for the radar station and the other limit was at least 4 hr of operation with a given battery pack. To satisfy both the limits, innovation in circuit design and operation was necessary. A novel way of correcting frequency drift of the transmitter over time and a search procedure which would enable the operator to detect anywhere in the search zone the moving target in a very short period of time, were evolved. Special efforts had to be made for getting the rechargeable battery pack designed and developed so that 4 hr of continuous operation was met. The systems were field evaluated by the Infantry at their School in Mhow. Subsequently, the systems went through evaluation by the Infantry in jungle, mountainous ranges, desert, high altitude terrains successfully and by the end of 1981, introduction into the Services was decided and orders were placed on M/s HAL, Hyderabad. The technology was successfully transferred from DLRL to HAL, Hyderabad and the radars were supplied to the Army.

The focus of DLRL in non-radar areas was on microwave circuits, cipher

machines, and electronic warfare equipment/ systems. In the area of microwave components, passive microwave components in waveguide configuration, ferrite devices, low noise tunnel diode parametric and transistor amplifiers, and YIG filters and oscillators were designed, fabricated and used in DLRL's own equipment designs as well as supplied to the Services on request. In addition, as strip line and microstrip line structures replaced waveguide and coaxial structures, DLRL kept pace with these technology advancements by setting up a Microwave Integrated Circuits (MIC) laboratory so that thick film hybrid circuits would be fabricated in-house and used in their own equipment. The success of the first two cipher machines, ECL Mk-I and Mk-II brought in more orders for better machines, such as ECL Mk-III for on-line and off-line operations.

Further, as component technology advanced and as small scale and medium scale integrated circuits became available, DLRL scientists developed ECL Mk-IV incorporating digital techniques, complex key stream generators and real-time powerful encryption algorithms. The customers list went beyond the Services to include law and order agencies of the Ministry of Home Affairs. Instead of the pilot plant, Bharat Electronics Ltd, Ghaziabad, to whom the technology was successfully transferred, manufactured the equipment.

In the area of electronic warfare, DLRL's activities covered the three Services and ranged from receiver systems for electronics intelligence, communication intelligence, electronic support mission to jammers and electronic counter-countermeasures for enhancing the immunity of operational radar systems. The Laboratory also initiated work on electrooptical warfare systems. The first QR-based project for the Army was the development of a panoramic adapter in HF band for displaying radio frequency emissions with channel identification parameters in any selected sub-band. The adapter was to be fitted to an existing receiver of the Army to improve the speed of response. The next project was the development of a VHF jammer of high power covering net radio band. Since the jammer was required to carry out automatic search by monitoring the channels sequentially and then jam the required channels, the

EW system had a receiver for search and monitor purposes, a high power transmitter, a control unit to carry out the sequence of operations, a display unit for the human operator to monitor and initiate action, and an antenna unit for covering the band of operation. Both these systems were evaluated by the Army, accepted for introduction into the Services and manufactured at the pilot plant of DLRL. When the requirement for a vehicle-mounted electronic and communication intelligence (ELINT and COMINT) systems was reflected to the DRDO in 1974, DLRL took up the development of ELINT/ COMINT systems operating in the band, 0.5 GHz to 18 GHz and having the capability to search, intercept, acquire, analyse, determine direction of arrival, and record the important parameters of emissions. It required on the part of the Laboratory to develop nine major subsystems, assemble these in two vehicles and integrate these to achieve the desired receiver performance. This was the first electronic warfare system in which a microprocessor-based controller was employed to command the various subsystems to operate in a programmed manner. It was also the first step taken by the Laboratory toward modular multi-port computer controlled system. The receivers were superheterodyne broad band, which necessitated the laboratory to design and develop frequency synthesizers. For the radar band direct frequency synthesis was employed while for the communication band a hybrid between indirect frequency synthesizer and Direct Digital Frequency Synthesizer was developed. In the radar band rotary Direction Finding (DF) technique was implemented with Log Periodic Antennas (LPAs) as feed. For the communication band eight LPAs giving 360 degree coverage were electronically switched for amplitude comparison and estimation of Direction of Arrival (DOA). The broadband microwave components and the antenna were designed and fabricated in-house. Even though the system performance was demonstrated, the effort did not result in production. But it laid the foundation for greater interaction between the Users and DLRL.

To be continued...



15 MEV HIGH ENERGY LINAC FACILITY FOUNDATION STONE LAID AT ACEM

Foundation stone for 15 MeV high linear accelerator facility was laid by Dr G Sathesh Reddy, Secretary Department of Defence R&D and Chairman, DRDO on 19 April 2019 at Advanced Centre for Energetic Materials (ACEM), Nasik in presence of DG (ACE), Shri P K Mehta; Director, HEMRL, Shri KPS Murthy; General Manager, ACEM, Shri Srinivasan Seshadri and CCE (R&D), Shri Alope.

The facility would be used for NDT inspection of solid rocket motors and motors cast with HD 1.1 class propellant. High energy radiation protection as per BARC norms and Storage and Transport of Explosive Committee requirement of handling of HD 1.1 explosives would be combined together to optimise the shielding thickness and traverse requirement of the building. This facility will be a new



addition to the existing fleet of x-ray machines of the state-of-the-art NDT facility ACEM, Nasik.

VISITS

ARDE, PUNE

Rear Admiral Ranjit Singh, Director DQR&S visited Armament Research and Development Establishment (ARDE) on 4 July 2019 for witnessing trials of NIPUN anti-tank munition

CAS, HYDERABAD

Shri Sanjiv Mittal, IDAS, CGDA from Delhi visited Centre for Advanced Systems (CAS) on 19 June 2019. He went around the strategic facilities in CAS and was very glad with the progress and development of the lab. He appreciated the facilities and dedication with which the scientists have been working for developing capabilities in missile technology.



Rear Admiral Ranjit Singh at ARDE

DEAL, DEHRADHUN

Lt Gen PJS Pannu, PVSM, AVSM, VSM, DCIDS (Ops) visited Defence Electronics Applications Laboratory (DEAL) on 17 June 2019. He was briefed about the different ongoing projects and activities by Shri PK Sharma, Director, DEAL. He was apprised of various projects like Rustom-2, Software Defined Radio (SDR), GSAT-6 Integrated Coastal Surveillance System (ICSS), Tropo-scatter Communication, VLF communication, Satellite Imagery Software Exploitation development, etc. He interacted with the senior scientists regarding various projects and appreciated the progress made by DEAL in the development of high end communication and surveillance systems.



Lt Gen PJS Pannu being briefed about DEAL activities

DIHAR, LEH

Maj Gen Arvind Kapoor, Chief of Staff, 14 Corps visited Defence Institute of High Altitude Research (DIHAR) on 5 July 2019. He was briefed about the various R&D activities and services being extended by DIHAR to the troops of 14 Corps. He also visited the experimental fields of DIHAR. Maj Gen Kapoor appreciated DIHAR for its work being undertaken in Ladakh sector and pointed out various potential areas of collaboration in the sector.



Maj Gen Arvind Kapoor at DIHAR

HEMRL, PUNE

Maj Gen K Ravi Prasad, VSM, Additional Director General (B), Artillery, New Delhi along with Brig Rajesh Srivastava, SM and Col Chirayu Motial, Artillery, visited High Energy Materials Research Laboratory (HEMRL) on 20 June 2019. During the visit, Shri KPS Murthy, Director, HEMRL briefed them about the activities of HEMRL. Presentation on the projects related to Tank Gun Ammunition, Solid Rocket Propellants and High Explosives was given by the senior scientists. The visitors took keen interest in the exhibits and activities of the lab.



Maj Gen K Ravi Prasad showing keen interest in HEMRL product