

DRDO SUCCESSFULLY TESTS STATE- OF-THE-ART QRSAM



CONTENTS

SEPTEMBER 2019
VOLUME 39 | ISSUE 09
ISSN: 0971-4391

COVER STORY 04

DRDO successfully flight-tested state-of-the-art Quick Reaction Surface-to-Air Missile



TOT 05

Design of Mobile Metallic Ramp Handed Over to Indian Army



RCI signs LATOT of Control Grade Fiber Optic Gyroscopes
DIPAS signs LATOT of Female Full Body Protector

EVENTS 07



HRD ACTIVITIES 9

PERSONNEL NEWS 16

INFRA DEVELOPMENT 16

DRDO SERIES 17

VISITS 19



39th Year of Publication

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
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; 23902472/74
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 Devala, 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 SUCCESSFULLY FLIGHT-TESTS STATE-OF-THE-ART QUICK REACTION SAM AGAINST LIVE AERIAL TARGETS

DRDO successfully flight-tested its state-of-the-art Quick Reaction Surface-to-Air Missiles (QRSAM) against live aerial targets from Integrated Test Range (ITR), Chandipur on 4 August 2019. The system is being developed for Indian Army with search and track on move capability with very short reaction time.

Two missiles were tested against two live targets and met all mission objectives of engaging the targets at different ranges and altitudes.

The systems have been tested in final configuration with Radar mounted on a vehicle and missiles on the launcher. The systems are equipped with indigenously developed Phased Array Radar,

Inertial Navigation System, Data Link and RF seeker. The entire mission was tracked by various Electro-optical Tracking Systems, Radar Systems and Telemetry Systems.

Raksha Mantri Shri Rajnath Singh congratulated DRDO and industries on achieving the significant milestone.



DESIGN OF MOBILE METALLIC RAMP HANDED OVER TO INDIAN ARMY

Defence Research and Development Organisation (DRDO) handed over the design of Mobile Metallic Ramp (MMR) to the Indian Army at a ceremony held at DRDO Bhawan on 20 August 2019. Secretary, Department of Defence R&D and Chairman, DRDO Dr G Satheesh Reddy handed over the design of MMR to Vice Chief of Army Staff, Lt Gen Devraj Anbu.

With load bearing capacity of 70 metric ton (MT), the MMR has been designed and developed by DRDO's

premier research laboratory, Centre for Fire, Explosive and Environment Safety (CFEES) on the requirements projected by Army for reducing the strategic mobility time of mobilizing Armoured Fighting Vehicles. The ramp will provide the strategic mobility for Armoured and Mechanized Units and formations of the Army. It is portable, modular in design, which can be easily assembled or disassembled.

Lt Gen Devraj Anbu appreciated the design of MMR and lauded the efforts of DRDO towards meeting the

requirement of the Army by drastically reducing the time required for operational mobilization.

Director General Operational Logistics and Strategic Movement, Lt Gen NK Khanduri, and senior officers of the DRDO were also present at the function.

Raksha Mantri Shri Rajnath Singh congratulated DRDO and the Army for the successful development of MMR.



RCI SIGNS LATOT OF CONTROL GRADE FIBER OPTIC GYROSCOPES

DRDO transferred the technology of Control Grade Fibre Optic Gyroscopes (FOG) to BEL, Pune on 20 July 2019. Research Centre Imarat (RCI), Hyderabad, a missile cluster laboratory of DRDO, has developed the technology for FOG and qualified it for application in missiles, tanks and stabilization systems of radar. Shri BHVS Narayana Murthy, Director, RCI and Shri Mahesh, Director (R&D), BEL signed and transferred the documents of LAToT (Licensing Agreement for Transfer of Technology). Dr G Satheesh Reddy, Secretary, Department of Defence R&D and Chairman DRDO, Shri MSR Prasad, DG (MSS), Dr Chitra Rajagopal, DG (SAM&R&M), Dr Mayank Dwivedi, Director DIITM, and Shri R Gopal Naik, Head FOSD/



RCI, were present during the occasion.

RCI has established the limited production facility for producing control sensor packages based on FOG to meet

the immediate requirements of users. So far more than 900 units of FOG sensor packages have been produced and delivered to multiple users.

DIPAS SIGNS LATOT OF FEMALE FULL BODY PROTECTOR

DRDO handed over female full body protector (FFPB) for police women engaged in riot control assignments in a function held at CRPF HQ on 19 July 2019. Dr AK Singh DG (LS), DRDO, presented the FPB to Shri Rajeev Rai Bhatnagar, DG CRPF. DRDO's Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi has developed the FFPB.

Police women working in CRPF were lacking gender specific full body protectors (FPBs) and were performing riot control duties with uncomfortable and ill fitting male FBPs. DIPAS has ergonomically designed FFPB after collecting and analysing the anthropometric data of female troops working in Rapid Action Force and CRPF. The protector has been trial evaluated in various security specifications norms and undergone



successful user trials.

Dr Bhuvnesh Kumar, Director, DIPAS, Ms Anupam Kulshreshtha, IG (Prov) CRPF, Shri Arun Kumar

IG (RAF), and senior officers from CRPF and DIPAS were present on the occasion. The technology of FFPB has been transferred to six firms.



RAISING DAY CELEBRATIONS

ACEM, NASIK

Advanced Centre for Energetic Materials (ACEM), Nasik, celebrated its Raising Day on 1 July 2019 with enthusiasm and fervour. Dr Avinash Chander, former Secretary DDR&D and SA to RM was the Chief Guest. Shri PK Mehta, DS and DG (ACE), Shri KPS Murthy, OS and Director, HEMRL and Shri GA Srinivas Murthy, OS and PD, SLCM, ASL, graced the occasion.

General Manager, ACEM welcomed the august gathering and briefed about the achievements and activities of the ACEM. Dr Avinash Chander, appreciated the progress of ACEM in last 10 years. He congratulated ACEM team on successfully scaling up solid rocket motors with a wide range of burn rates. He stated that process technology to realise large motors with a given propellant composition is a very involved process and challenging. Shri PK Mehta, in his address stressed the need to follow safe practices with utmost sincerity in all activities being carried out at ACEM. Shri KPS Murthy, in his address highlighted the necessity to have uniform testing standards for propellants and other ingredients across the laboratories. Shri GA Srinivas Murthy lauded ACEM for delivering zero rejection articles. Various events were conducted among ACEM employees and family members like essay competition, drawing competition, and sports activities. Winners and runners-up of the events were awarded prizes by Guest of Honours. Laboratory-level DRDO Awards and Cash Awards were conferred to meritorious employees.

DESIDOC, DELHI

Defence Scientific Information and Documentation Centre celebrated its 49th Raising Day on 29 July 2019 at Bhagwantham



Dr Avinash Chander being felicitated on ACEM Raising Day

Auditorium, Metcalfe House. Shri KS Varaprasad, DG (HR), DRDO, and Dr Shantanu Ganguly, fellow, Tata Energy and Resources Institute (TERI) were the Chief Guest and the Guest of Honour, respectively. The event was attended by directors from DRDO HQ and Delhi-based sister DRDO labs, and former directors and employees of the DESIDOC.

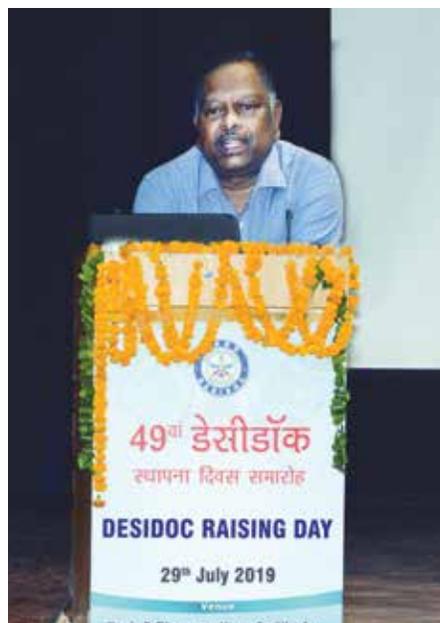
Dr Alka Suri, Director, DESIDOC welcomed the august gathering and spoke about the achievements of the

Centre in the year 2018. She conveyed her thanks and appreciated all employees of DESIDOC for the achievement of the set goals. She further highlighted some of the new services started by DESIDOC for the DRDO scientific fraternity.

Dr Shantanu Ganguly, in his address, appreciated DESIDOC for providing innovative and value added services far and wide. He also said that TERI is committed to strengthening the bonds with DESIDOC in order to augment various innovative information services for the research fraternity.

DG (HR) in his address expressed his appreciation for the informative services provided by the Centre to the DRDO scientists. He elaborated the challenges being posed by the fast changing information technologies and advised scientists to update themselves to come out with innovative methods to reach out to the users. DESIDOC should take lead and should work as centrally training centre to update DRDO's library workforce, he further added.

The Chief Guest and the Guest of Honour distributed various laboratory-level DRDO Awards to the meritorious employees. Cash, sports and other awards were also distributed by the Director and former Directors of the DESIDOC. The function concluded with a cultural programme.



DG (HR) delivering his address on DESIDOC Raising Day

NMRL CELEBRATES 73RD INDEPENDENCE DAY

Naval Materials Research Laboratory (NMRL), Ambarnath celebrated 73rd Independence Day on 15 August 2019 with great patriotic fervour. Dr M Patri, OS and Director, hoisted the National Flag and extended his greetings to the employees and their family members.

In a highly inspiring address Dr Patri deliberated upon the successes achieved by DRDO during 2018 and highlighted the achievements of NMRL. He encouraged young scientists of NMRL to think innovatively and undertake research in the frontier areas of science and technology to further strengthen the defence of the country.



DRDO CELEBRATES HINDI PAKHWADA

Directorate of Rajbhasa and O&M, DRDO HQ, celebrated Hindi Pakhwada and Kavi Sammelan on 16 August 2019. It was the first time in DRDO that the Kavi Sammelan was organized on the occasion of the Hindi Pakhwada with an aim to encourage the staff of DRDO to work in Hindi. In his inaugural address Shri Sunil Sharma, Sc. 'G' & Director, Rajbhasa and O&M said that Hindi should be used not only during the Pakhwada but also regularly to achieve the target of the Central Government. Eminent poets/poetess Smt Mamta Ladiwal, Smt Shobha Sachan, Dr Chetan Anand, Dr Indrajeet Sukumar, Dr Manoj Kamdev, Shri Jagdish Meena and Shri Sanjay Kumar Giri, spell bounded the audience with their poems. Shri Babu Lal, Jt Director (OL), presented the vote of thanks. Shri SK Mehta, Assistant Director (OL), conducted the programme.

ITR OBSERVED DR KALAM MEMORIAL DAY

Integrated Test Range (ITR), Chandipur, observed Dr Kalam Memorial Day on the 4th death anniversary of the former President of India on 27 July 2019. Floral tributes were offered to Dr Kalam at a function held at Range Staff Mess & Institute, Balasore by the Director and the employees of the ITR.

Dr BK Das, Director, ITR recollected the contributions of the multi-faceted genius to the cause of the nation. He described the pioneering roles played by Dr Kalam during his stints as the first Director of ITR, SA to RM and DG DRDO, PSA to PM and as the President of India. Dr Kalam's virtues par excellence as a human being, as a scientist, as a technologist, as a manager, as a mentor, as a leader, as a motivator and as the People's President who goaded innumerable blooming



citizens to weave dreams into reality, were articulated by Dr Das in his speech. Several scientists, officers and staff of ITR and Dr (Maj) MC Sahoo of

AIIMS, BBSR expressed their profound admiration for Dr APJ Abdul Kalam's wisdom and enlightenment in their address to the gathering.

DESIDOC CELEBRATES LIBRARIAN'S DAY

Defence Scientific Information & Documentation Centre (DESIDOC), Delhi, celebrated National Librarian's Day on 19 August 2019 to mark the birth anniversary of Dr SR Ranganathan, father of Library Science in India. An invited talk on "Relevance of Ranganathan's Philosophy in Coherent Development of Library and Information Services" was delivered by Dr Raj Kumar Bhardwaj, Librarian, St. Stephens College, University of Delhi.

Dr Alka Suri, Director, DESIDOC in her welcome address briefed the importance of libraries in the R&D activities and remembered

Dr Ranganathan's contributions and his dedication towards libraries and its users.

Speaking on the occasion Shri SB Taneja, Director, ISSA, appreciated DESIDOC for the various services provided to the DRDO community over the years. Seventy participants from DESIDOC and Delhi-based DRDO labs attended the programme.



HRD ACTIVITIES

COURSE ON QUALITY CONTROL, ASSURANCE & RELIABILITY

Armament Research & Development Establishment (ARDE), Pune conducted a course on "Basics of Quality Control, Assurance & Reliability" for DRTC personnel during 22-26 July 2019 on behalf of Centre for Personnel Talent Management (CEPTAM), Delhi.

Nineteen participants from ARDE; Advanced Centre for Energetic Materials (ACEM), Nasik; CAS, Hyderabad; Combat Vehicles Research and Development Establishment (CVRDE), Chennai; Defence Avionics Research Establishment (DARE), Bangaluru; Defence Electronics Research Laboratory (DLRL), Hyderabad; Defence Research and Development Establishment (DRDE), Gwalior; Joint Cipher Bureau (JCB), Delhi; RCMA



(AA), Pune and Solid State Physics Laboratory (SSPL), Delhi attended the course. Interactive and informative

lectures were delivered during the course by experts from ARDE and other institutes.

COURSE ON ELECTRICAL INTEGRATION & TESTING OF LONG RANGE SYSTEM

Advanced Systems Laboratory (ASL), Hyderabad organized a course on “Electrical Integration and Testing of Long Range System” under the Continuing Education Programme (CEP) during 5-7 August 2019.

Dr M Rama Manohara Babu, DS and Director, ASL, inaugurated the course. In his address to the participants, he stressed upon importance and criticality

of electrical integration, requirement of miniaturization of electronic sub-systems, lightweight cables, universal test jigs, and maintaining database of test data using tools like big data for analysis. The course provided insight into electrical integration, checkout and testing of aerospace vehicles and launch vehicles. Lectures on Reliability & Quality Assurance, Flight Control systems, Sensors and

Signal Conditioning Systems, Battery Technologies, etc., were organized to familiarize the participants about different aspects of Electrical Integration involved in Long Range Systems.

Forty participants from various DRDO Labs, SSQAG, MSQAA, RCMA and BDL have attended the Course. Shri CH Reddy, Sc ‘F’, Technology Director, SINT (E), was the Course Director.



DRL-NEIST INTERACTIVE WORKSHOP

Defence Research Laboratory (DRL), and North East Institute of Science & Technology (NEIST) Tezpur conducted a one-day interactive workshop on 2 July 2019 to work upon on a large number of areas on a collaborative mode and joint proposals. A team of 12 scientists from DRL led by Dr SK Dwivedi, Director, DRL visited the prestigious R&D institute of CSIR and conducted scientific interaction with Dr G Narahari Sastry, Director, NEIST and his team of scientists.





COURSE ON ORGANISATIONAL BEHAVIOUR

Institute of Technology Management (ITM), Mussorie conducted an off-campus course on “Organisational Behaviour” for Mid-Level Scientists during 22-24 July 2019 at Aeronautical Development Establishment (ADE), Bangalore. Shri Sanjay Tandon, OS & Director, ITM gave an account of the activities carried out by ITM.

Dr Venugopal S, Director, ADE stressed the importance of learning management skills to improve organisational effectiveness.

Keynote address was delivered by the Chief Guest Shri Gurkirandeep Singh, who shared his own challenges and experiences faced in his professional life. The faculty consisted of established

professionals in the field drawn from industries. Thirty-five participants from ADE and Defence Bio-Engineering and Electromedical Laboratory (DEBEL) actively participated in the course. Shri M Sudhakara, Sc ‘F’, TSO and Head (HRD), ADE and Ms Gopa B Choudhury, Sc ‘F’, Course Programme Director, ITM organised the programme.

COURSE ON TARGETS FOR TEST & EVALUATION

A course on “Targets for Test and Evaluation” was organised under the Continuing Education Programme (CEP) of DRDO at Integrated Test Range (ITR), Chandipur, during 9-11 July 2019. Dr BK Das, OS & Director, ITR, inaugurated the course. During his inaugural address, Dr Das emphasised on the importance of various types of targets during test and evaluation process in ITR.

Dr M Manickvasagam, OS and

Project Director (A1P) delivered the inaugural lecture on “Weapon Systems Test and Evaluations.” The course was organised with an aim to highlight all types of targets being used presently at ITR as well as required for future applications. Topics related to various types of targets, different signature enhancement techniques, flight profile planning, safety and in-flight emergency handling, targets for present and future range application, RCS Measurement,

Missile endgame and WH lethality analysis, etc., were covered in the course. A practical demonstration of quad copter with 2 kg payloads was also carried out. Distinguished faculties and experts from ITR, DRDL, ASL, RCI, ADE, QintiQ, UK and Sagar Defence Mumbai delivered the lectures and the practical demonstrations. Twenty-four participants from DRDL and ITR attended the course.



COURSE ON TIMING TECHNOLOGY & APPLICATION IN TEST RANGE SCENARIO

A CEP course on “Timing Technology and Application in Test Range Scenario” was

organized at ITR during 15-19 July 2019. Dr BK Das, OS & Director, ITR inaugurated the course. Dr Ashish

Agarwal, Principal Scientist, NPL, New Delhi, delivered the inaugural speech. The course was aimed at imparting



knowledge and practical exposure on Timing Technology and Application in Test Range Scenario. Various topics, viz., Timing Standards, Generation and Dissemination, Time Acquisition from

IRNSS System, Time Generation and Dissemination in SHAR Test Range (CDT&ATD), etc. were covered during the course. Faculties and experts from NPL, New Delhi, URSC & SHAR,

ISRO, ASL Hyderabad, IIT KGP, Osmania University, Hyderabad and ITR, Chandipur delivered the lectures. Twenty-four participants from ITR and other DRDO labs attended the course.



PROGRAMME ON MILITARY OPERATIONAL, TACTICAL AND STRATEGIC TRAINING

Institute for Systems Studies and Analyses (ISSA), Delhi in collaboration with United Service Institution of India (USI), Delhi

organized a three-day training programme on Military Operational, Tactical and Strategic Training for Systems' Analysis, Modelling and

Simulation during 17-19 July 2019 at USI, New Delhi. Fifty-three participants from ISSA and DRDO sister labs attended the training programme.

ISSA DIAMOND JUBILEE LECTURE SERIES

ISSA organized its 2nd Diamond Jubilee Lecture on "Changing Human Resource Landscape in India" by Shri Mussarat Hussain, Vice-President (HR), Maruti Suzuki India Limited, and "Innovation, Disruption and Cyber Security" by Dr Gulshan Rai, former National Cyber Security Coordinator, on 22 July 2019.

Dr Chitra Rajagopal, DS & DG(SAM) graced the occasion as the Chief Guest. Directors and scientists from Delhi-based sister DRDO labs/estts attended the lectures.





INDO-US WORKSHOP ON PHOTONICS – MATERIALS, DEVICES & SYSTEMS

Electronics & Radar Development Establishment (LRDE), Bengaluru organized Indo-US Workshop on “Photonics—Materials, Devices and Systems” during 24-26 July 2019 at JRD Tata Auditorium, NIAS, IISc. Campus, Bengaluru. The workshop was organised with an intention to increase the mutual understanding of research in the field of Photonics leading

to identification of potential research opportunities for collaboration. During the workshop both US team and LRDE team discussed their topics of interest in an interactive session.

Ms J Manjula, DS, DG (ECS), DRDO, Dr S Guruprasad, DS, DG (PC&SI), Shri SS Nagaraj, OS and Director, LRDE, Shri P Radhakrishna, OS, LRDE, Dr Shashi P Karna, ST-Senior Research

Scientist, Army Research Laboratory, US Army Combat Capabilities Development Command, Dr Nibir K Dhar, Chief Scientist, Night Vision & Electronic Sensor Directorate, US Army Combat Capabilities Development Command, Dr Shekhar Guha, Senior Scientist, Materials and Manufacturing Directorate, Air Force Research Laboratory also attended the workshop.



WORKSHOP ON SIMULATION TOOLS & MODEL BASED SYSTEM ENGINEERING

Microwave Tube Research and Development Centre (MTRDC), Bengaluru, conducted a one-day workshop on “Simulation Tools and Model Based System Engineering” on 3 August 2019. Dr Vishal Kesari, Sc ‘E’, and Workshop Coordinator, briefed about the programme. Dr SK Datta, Sc ‘G’, Officiating Director, inaugurated the workshop. In his opening remark, Dr Datta highlighted the shortcomings of CST Microwave Studio and put forward the suggestion to be implemented in CST Microwave Studio for error less simulation. The executives from Dassault Systems, industry leader, brand technical leader, solution consultant, and senior business consultant



were the invited speakers. Besides regular lectures a session on multi-scale and multi-physics simulations for real world applications like structural, ther-

mal, fluid dynamics and multi-disciplinary optimization were also included in the workshop. Twenty-five participants from MTRDC attended the workshop.

SASE ORGANISED SAMS-2019

Snow and Avalanche Study Establishment (SASE) organised an International Symposium on Snow Avalanches and Mitigation Strategies (SAMS-2019) during 7-9 July 2019 at RDC SASE, Chandigarh, as part of its Golden Jubilee Celebration Lecture. The event was inaugurated by the Chief Guest Dr Avinash Chander, Former Secretary, Department of Defence R&D, Guests of Honour Dr Satish Kumar, Director NIT-Kurukshetra and Shri PK

Mehta, Director General (Armament and Combat Engineering), DRDO.

Delegates from Canada, Norway, Austria and India presented their research work on avalanche forecasting, avalanche accidents, mountain weather, avalanche control structures, avalanche dynamics, avalanche safety and rescue, snow cover monitoring using remote sensing, snow cover properties, sensors and integrated mountain development in the changing climate of the Himalayas,

Alps and other snow bound regions of the globe. More than 90 research papers were presented in the three-day conference. A panel discussion was held in the concluding session. Shri Naresh Kumar, OS and Director SASE apprised that a report has been prepared based on the panel discussion and presentations during symposium for the future strategies to be adopted in mitigation of snow avalanche hazard in mountainous regions.



NATIONAL WORKSHOP ON PRACTICE FIRING RANGES: ISSUES & CHALLENGES

A National Workshop on "Practice Firing Ranges: Issues & Challenges" was organised at Terminal Ballistics Research Laboratory (TBRL), Chandigarh on 11 July 2019. Around 100 officers from armed forces, paramilitary forces, special forces, state police forces, officers' training academies and construction agencies participated in the workshop.

In his opening address, Dr Manjit Singh, DS & Director, TBRL remarked that baffle ranges designed by TBRL have resulted in the reduction of land

requirements from 500 to 20 acres with enhanced safety and marksmanship. He informed that more than 80 Baffle Ranges are operational in the country with different users and more than 130 ranges are under planning/maturing stage. He observed that this workshop would provide a platform for designers, security forces and construction agencies to deliberate on various issues and challenges involved in the design of practice firing ranges and evolve effective solutions for the same.

In her inaugural address, Chief

Guest Mrs Surina Rajan, IAS, Director General, Bureau of Indian Standards, appreciated the role of DRDO scientists in designing practice firing ranges for security forces. She proposed to develop an Indian Standard on design of practice firing ranges to cater for wide spectrum of demographic and operational requirements of security forces deployed in urban, rural and remote strategic locations.

During the technical sessions, TBRL scientists presented the technical features of baffle ranges with special



emphasis on safety and maintenance parameters .

The issues faced by security forces regarding practice firing ranges were

recorded and will be addressed in the revised manual on practice firing ranges. It was decided that a technical committee including all stakeholders

will be constituted to develop an Indian Standard for Design of Practice Firing Ranges.



SOCIETAL ACTIVITY

ITR ORGANISED BLOOD DONATION CAMP

Integrated Test Range (ITR), Chandipur organised a mega Blood Donation Camp on 26 June 2019. Dr BK Das, OS and Director, ITR inaugurated the camp. Dr Das, CDMO District HQ Hospital, Balasore and Dr S Pradhan, Blood Bank Officer, Balasore, Shri Niladri Roy, Sc ‘F’, GD

(DOMS) ITR were present during the occasion.

Dr Das in his inaugural speech said that the blood you donate gives someone another chance of life. There is no substitution for blood. Everybody should be encouraged to donate blood voluntarily for the noble

cause. A record number of 523 units of blood were collected during the camp. Many scientists, officers, staff and ITR fraternity, DSC personnel participated for the noble cause. All the participants were awarded with a certificate. Director ITR congratulated all for making the event a grand success.





APPOINTMENT

**DIRECTOR VRDE
AHMEDNAGAR**



Shri Sangam Sinha, OS, has been appointed Director, Vehicles Research and Development Establishment (VRDE), Ahmednagar, w.e.f.

3 July 2019. Shri Sinha did his BE (Mechanical Engineering) in 1985 from Birla Institute of Technology, Mesra, Ranchi and acquired MTech (Machine Dynamics) from IIT Kharagpur in 1990.

He worked at R&DE (E), Pune from 1986 to March 2017 as Scientist in different grade. During this period, he was Project Director for Platform System of Submarine Launcher System and Project Director for Ground System of Agni launchers. From 2012 to 2017, he was also looking after MSC, Begdewadi as General Manager in addition to his assignment at R&DE (E).

He was responsible for design, development and commissioning of unique world-class 12 ton shock testing facility and 25 ton Kinematic and Dynamic test facilities for simulating sea, road and air motion at R&DE (E).

Number of flight trials of underwater missile and different version of Agni

missile has been carried out on launcher designed under his guidance including first Agni-V Launch.

Shri Sangam Sinha is recipient of Laboratory Scientist of the Year Award, DRDO Performance Excellence team award and DRDO Scientist of the Year Award.

He is Life Member of Fluid Power Society of India, Institute of Smart Structure, Indian Nation Society of Aerospace and Related Mechanism, and Robotics Society of India. He has to his credit around 15 national and 2 international papers, and two patents.

**HIGHER
QUALIFICATION
ACQUIRED**



Shri Nomesh Kumar, Sc 'E', Advanced Systems Laboratory (ASL), Hyderabad, is conferred PhD from IIT Delhi, for the thesis entitled "Hyperviscoelastic Modelling and Crack Behaviour of Solid

Constitutive Propagation of propellant."



Smt Shiny Nair, Sc 'E', Naval Physical and Oceanographic Laboratory (NPOL), Kochi, has been awarded PhD from Cochin University of Science and

Technology, in the area of Materials Science, for the thesis entitled "Development of Patternable Conducting Polymers based Organic Thin Film Transistors for Acoustic Sensor."

INFRA DEVELOPMENT

ITR GETS NEW RANGE DATA PROCESSING CENTRE

Dr B K Das, OS and Director, ITR inaugurated the "Range Data Processing Centre" at ITR, Chandipur on 18 July 2019. The centre is designed ergonomically, aesthetically and incorporates human factoring engineering with state-of-the-art facilities. This centre houses independent Real Time Data Processing Unit, Real Time Software Development Unit, Real Time Software Testing Unit, Post Mission Analysis and a Mini Conference Hall. All the units are equipped with Green Guard certified modular consoles incorporating the features of all ergonomic elements to improve operator's efficiency by reducing ergonomics risk factors. The consoles are aesthetically pleasant with articulating arm based HD display monitors complying VESA standards for ease of height and angle adjustment as per operator's comfort.





DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 4: MARCHING FORWARD

The article is 42nd 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

The requirement of a high performance search and monitoring system for operations in the VHF/UHF bands for the Army was taken up by DLRL for development in 1977. The receiver was required to analyse the interference, categorise it as AM, FM, CW and pulse type of signals and display all the relevant information in panoramic/sector and manual modes, with each mode displaying information specific to that mode. Digital techniques were employed in the design to tune and control the functions of the receiver. The salient features of the equipment were high frequency stability, high spurious rejection, switchable IF bandwidth, IF analysis, signal-level indication, remote operation and digital read-out. After evaluation, the equipment was accepted and the technology was successfully transferred to M/s ECIL for manufacture.

The Electronic Support Measure (ESM) system to be 'fitted' on fast patrol boats of the Navy, and which was required to intercept, analyse, locate, and estimate relevant signal parameters, was taken up for design and development by DLRL in 1979. A frequency coverage of more than three octaves, starting from the low microwave frequency region was stipulated.

The system was to provide simultaneous warning capability for multiple threats, display about half of the unidentified ones and also provide audio alarm for the first-time interception of the warned threat. In addition, it was required to be fitted on to the boat in such a way that the three main subsystems namely, the antenna unit, the ESM cabinet, and the display with associated circuitry would be

physically separated with antenna unit on top of the mast for maximum line of sight and the display in the operator's cabin. DLRL developed a digital system with a wide-open crystal video receiver with eight LPA's for DF purposes and an omni antenna for band warning. The specific technical challenges were in the placement of antennas for minimising interference from own radar; design, fabrication and testing of the antennas with radome, and of the DF receiver for optimum accuracy through amplitude comparison; algorithm for DOA estimation based on antenna pattern, for signal de-interleaving and for minimisation of multi-path effects. For determination of the position for co-location of the antennas of the ESM receiver system, the expertise of the faculty of IIT, Madras was sought for prediction by analysis of the electromagnetic field at different locations on the ship. These were verified by experiments. Since it was a de novo development, reworking/iterations could not be avoided. Until 1982, fabrication of the laboratory model was under way. The Navy also wanted a heliborne ESM system covering 1 GHz to 18 GHz frequency band, with capability to provide 100 per cent probability of intercept, direction of arrival, parameters of radar emitters and an automatic warning. In view of the non-availability of gain-tracked multiplexers, omni antenna for base band identification was preferred to distributed antennas with multiple receivers. On acceptance of this approach by the User, in 1982 studies were initiated for choice of antenna location and also for determining the effect on the aerodynamics of the helicopter.

Two projects were initiated at the instance of the Indian Air Force; one for providing frequency agility for an imported missile guidance radar and

the other for adding ECCM capability to an imported surveillance radar. For the missile radar, the proposal of DLRL to develop a frequency agile transmitter was accepted by the Indian Air Force. The Laboratory initiated the development of the hardware and by 1982, it was in the process of being assembled. The second proposal for adding ECCM capability to an imported surveillance radar was taken up in 1974. The DLRL proposed to develop and configure ECCM receivers to counter a variety of jammers, an interface unit which accepted 30 MHz IF signal from the radar, local/remote control unit, and an IF simulator capable of generating jamming scenarios for testing the effectiveness of the ECCM receiver configurations. The ECCM receivers comprising of a linear IF amplifier with CFAR and IAGC, a logarithmic IF amplifier, a Dicke-Fix IF amplifier, a pulse length discriminator and a video integrator with the control network providing preprogrammed selectable receiver configurations, were designed and developed. The system was subjected to extensive field trials against different types of emitters such as CW, noise, slow sweep and fast sweep jammers and the ability of the operator to track a moving target in the presence of these jammers with and without the ECCM receivers was evaluated for arriving at the efficacy of the system. The system was accepted for introduction by the Services and the number of ECCM systems required were fabricated and installed successfully.

The use of infrared and optical spectrum for weapon aiming and guidance prompted DLRL to undertake studies in characterising military lasers and active infrared emitters for design and development of effective countermeasures. Further, methods of detection and estimation of the direction of arrival of these emissions were also investigated. In addition,



investigations were also undertaken to explore various countermeasure techniques against passive IR guided missiles.

Solid State Physics Laboratory

Solid state Physics Laboratory (SSPL) is dedicated to the development of solid state materials and devices for applications in the electronic equipment and systems designed by LRDE, DLRL or any other laboratory in the DRDO. In the 1960s, the laboratory initiated work in silicon and gallium arsenide, two most important materials out of which integrated circuits, solar cells and microwave devices were being created and manufactured. At the very outset, facilities were created at the Laboratory for the growth of silicon crystals, slicing them in wafers and characterising them. It is a matter of record that SSPL was the first Laboratory in the country to initiate work on crystal growth of semiconductors and the extensive work carried out by the scientists of the laboratory led to indigenous development of techniques for growing dislocation-free single crystals and also of those with controlled doping. Once the infrastructure was in place, the Laboratory focussed on developing unit processes such as diffusion, lithography, contact and packaging, and testing of devices. As far as gallium arsenide was concerned, work was initiated in the late 1960s on epitaxial growth by vapour phase epitaxy. Besides these two materials, SSPL initiated work on microwave ferrites, out of which isolators, duplexers and circulators would be fabricated for use in radar systems. Recognising the strategic importance, feasibility experiments on synthesis of the material was started, useful data was collected and analysed so that future requirements could be met.

The work carried out by SSPL in the 1960s on devices and components can be gauged from the following six projects, which are representative of the activities of the laboratory. The first one was sanctioned in 1965 and was concerned with the development of special-purpose devices, such as varactor diodes, silicon point contact diodes, tunnel diodes, and so on. SSPL developed the silicon point contact diodes in standard microwave cartridge and the know-how was transferred to

two private sector firms through NRDC for manufacture. Varicap was the other device which was developed in chip form for encapsulation and use by BEL, Bangalore in a specific radio equipment under production. The project on the development of microwave ferrite isolator was sanctioned in 1965 and was aimed at building the competence in microwave ferrites and then developing specific high power ferrite components. The laboratory achieved success in the preparation for magnesium ferrites of various grades, nickel-copper and nickel-zinc ferrites. A major user of magnesium ferrites, was M/s ITI, Bangalore to whom large quantities in the form of slabs were supplied for manufacturing microwave ferrite components used in their communication systems. In addition, SSPL developed a high power X-band isolator which was evaluated for use in X-band radars under production at BEL, Bangalore. About 50 numbers of these high power isolators were fabricated and supplied to the Company. The project on development of solar cells taken up in 1965 was aimed at the standardisation of the phosphorous diffusion process in p-type silicon and design/test typical solar cell-nickel cadmium cell power system for application in communication sets. The project was successful, an array of 180 solar cells was tested for high altitude performance at Leh with a wireless set in use with the Army. Solar cells were also supplied to Space Science and Technology Centre for their use as photosensors. Two other projects, one on the development of laser sources and the other on microminiaturisation techniques, were aimed to build competence in these two important areas of interest to defence. The sixth project was on setting up a pilot plant facility for growing semiconductor-grade silicon.

The major activities and contributions of SSPL in the 12 years beginning from 1970 were the development of VT-fuze and silicon solar cells for space applications; investigations on IR devices and semiconductor epitaxial growth; infrastructure building for characterisation of silicon and gallium arsenide materials and devices; continuation of work on ferrite material, initiation of development work on complex integrated circuits, and discrete semiconductor devices for Missile Applications. The successful

development of VT-fuses by SSPL for the Russian 130 mm gun and the Navy's 4.5 inch gun has already been brought out under Armaments. Suffice it to state that the technology was successfully transferred to M/s HAL, Hyderabad for supply to the Armed Forces. The development of space quality solar cells as per the specifications provided by Indian Space Applications Centre (ISAC), required setting up of facilities for diffusion, evaporation metal-semiconductor contact, and evaluation. The project was successful, more than 300 solar cells were delivered to ISRO, which flew a panel of 10 of these solar cells in the satellite BHASKARA. The performance of SSPL panel was compared to that of the imported panel also flown on the satellite, and the SSPL cells delivered to ISRO were declared as space qualified. The other major activities were the development of Gunn diodes of about 200 mW CW power at X-band; specific integrated circuits such as diode matrix, clock, voltage-controlled oscillator, analogue switch, high frequency high gain block; microwave field effect transistors. In all these projects, the broad objectives set at the beginning of the activities were met. In some cases, efforts to productionise some of the developed items did not succeed because of lack of orders for commercially viable quantities. However the activities pertaining to the development of poly crystalline garnets and microwave substrates need further elaboration. They covered development of the process to synthesize poly crystalline YIG and aluminium substituted YIG process for fabrication of MIC substrates of substituted magnesium-manganese ferrites and lithium ferrites; and process for substituted lithium ferrites of saturation magnetisation between 1000-3000 gauss with square loop characteristics and of torroidal shape. The substituted lithium ferrites were a critical material for developing an important subsystem namely, the Phase Control Module (PCM) for a passive phased array radar that was under development at LRDE. It would be later transferred to M/s CEL, Ghaziabad for production of the PCMs.

To be continued...

VISITORS TO DRDO LABS/ESTTS

ARDE, PUNE

* Maj General SK Upadhyya, AVSM, VSM, SM, Master General Ordnance visited Armament Research and Development Establishment (ARDE) on 11 July 2019.

* Ms Harsha Rani, Under Secretary (R&D), Ministry of Defence, GOI visited ARDE on 19 July 2019.

* Lt Gen Sanjay Chauhan, DG QA, visited ARDE, on 1 August 2019.

* Rear Admiral Sanjay Misra, VSM, DG, Naval Armaments Inspectorate visited ARDE on 8 August 2019.



Lt Gen Sanjay Chauhan being briefed about ATAGS

CAIR, BENGALURU

Lt Gen P C Thimmaya, PVSM, VSM, Army Commander Army Trg Comd (ARTRAC) and team visited Centre for Artificial Intelligence & Robotics (CAIR) during 11-18 June 2019. There was a briefing by Dr Upendra Kumar Singh, OS & Director, CAIR, followed by discussion and demonstration of technologies developed by CAIR.

CVRDE, CHENNAI

Dr G Satheesh Reddy, Secretary DDR&D and Chairman DRDO, visited Combat Vehicles Research & Development Establishment (CVRDE) on 29 July 2019. He reviewed the ongoing projects/activities of CVRDE.



Dr Satheesh Reddy being felicitated at CVRDE

DIHAR, LEH

* Lt Gen Ranbir Singh, AVSM, YSM, SM, GOC-in-C, Northern Command along with Lt Gen YK Joshi, AVSM, VrC, SM, GOC, 14 Corps visited Defence Institute of High Altitude Research (DIHAR) on 23 July 2019. Dr OP Chaurasia, Director, DIHAR briefed the visitors about various on-going high altitude agro-animal activities and efforts made by the laboratory to meet fresh food requirements of army with the help of the local farmers.



Lt Gen Ranbir Singh and Lt Gen YK Joshi being briefed about DIHAR activities

* Shri Arjun Munda, Hon'ble Union Minister of Tribal Affairs, visited DIHAR on 17 August 2019. He had a detailed interaction with DIHAR scientist and took keen interest in the agro-animal technologies and tropical vegetables being grown in Ladakh. The Herbal garden of DIHAR was a show stopper during his visit wherein he was especially interested to know about the importance and cultivation practice of srolo (Rodiola) herb.

NMRL AMBERNATH

CWP&A, Chairman EPC, V Admiral AK Saxena, PVSM, AVSM, VSM visited Naval Materials Research Laboratory (NMRL) on 11 July 2019 for review of Air Independent Propulsion (AIP) Programme for submarine. Director, NMRL welcomed him and gave a brief presentation on the history and various activities of the laboratory. The Programme Director, AIP presented about the genesis and present status of the programme. Chairman appreciated the efforts of NMRL scientists for significant achievement made in AIP technology and visited the project site along with the dignitaries. Later he also visited the Product Exhibition Bay of NMRL and commended on the various products and technologies developed by NMRL.



Shri Arjun Munda, Hon'ble Union Minister of Tribal Affairs at DIHAR



Vice Admiral AK Saxena being briefed about NMRL technology

NPOL, KOCHI

Secretary, Department of Defence R&D and Chairman DRDO, Dr G Satheesh Reddy visited Naval Physical and Oceanographic Laboratory (NPOL) on 18 July 2019. Shri S Vijayan Pillai, OS and Director, NPOL briefed the guests about the technical activities of the laboratory followed by demonstration of various technologies, products and systems developed by NPOL. Chairman reviewed all ongoing projects and the Flagship Program being proposed by the lab. An exhibition was also arranged to showcase the products developed by the lab. Chairman appreciated the progress made by NPOL in the development of underwater surveillance systems.



Dr Satheesh Reddy being briefed about NPOL product