

SUCCESSFUL TECHNICAL TRIALS OF GUIDED PINAKA ROCKET SYSTEM





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SUCCESSFUL TECHNICAL TRIALS OF GUIDED PINAKA ROCKET SYSTEM



Guided Pinaka, an INS+GPS guided, canard controlled, precision strike guided artillery rocket system, has been designed and developed by ARDE, Pune, in association with Research Centre Imarat (RCI), Hyderabad; Defence Research & Development Laboratory (DRDL), Hyderabad; HEMRL, Pune and Proof and Experimental Establishment (PXE), Balasore. The rocket system has a capability of engaging targets in 20 km to 80 km range with accuracy of < 60 m at all ranges.

The technical trials of the system were conducted during 11-12 March

2019. Three guided Pinaka rockets were fired for engaging target located at 43 km range. Artillery team led by Brig AS Raghav, DDG Arty (Ops) participated in the trials. The mission objectives were to assess the accuracy and consistency of the rocket against ground target. The range instrumentation including Doppler radars and Telemetry, which monitored the flight performance of the rockets, confirmed that all the mission objectives were successfully achieved. All the three rockets impacted the designated target area with a high accuracy of 33 m, 23.3 m and 25.5 m.

The trials were conducted under the guidance of Dr KM Rajan, DS & Director, ARDE and Shri BHVS Narayana Murthy, DS & Director, RCI. DRDO teams from ARDE, RCI, DRDL, HEMRL and PXE participated in the trials. Smt Chandrika Kaushik, Director, DISB, DRDO HQ also witnessed the trials.

The trials were conducted with support of 1890 Rocket Regiment (Pinaka) commanded by Col Satpal Bishnoi.



USER DEMONSTRATION TRIALS OF CORNER SHOT WEAPON SYSTEM

Corner Shot Weapon System (CSWS), Trikaal, is a special purpose weapon being developed by Armament Research & Development Establishment (ARDE), Pune. It allows the firer to see and engage an armed target without exposing himself from any counter attack. Two different versions of CSWS are being developed—one to mount and fire 9 mm pistol and the other as a platform for 40 mm Under Barrel Grenade Launcher developed by ARDE.

A team of users led by Brig PS

Sangwan from the office of the Director General, Rashtriya Rifles (RR), New Delhi participated in User Demonstration Trials (day and night), during 12-13 March 2019 at the Pashan range at ARDE. Both versions of CSWS were tested and evaluated for verification of technical parameters, viz., weight, length, trigger pull, D/R/I, etc., by the users. The system complied with all the parameters as laid down in the PSQR. Users have recommended the conduct of UATT and finalisation of GSQR.



DRDO SUCCESSFULLY CONDUCTS FLIGHT TEST OF ABHYAS

DRDO conducted successful flight test of Abhyas—High-speed Expendable Aerial Target (HEAT) from ITR, Chandipur in Odisha on 13 May 2019. The flight test was tracked by radars and electrooptic systems and proved its performance in fully autonomous waypoint navigation mode.

The configuration of Abhyas is

designed on an in-line small gas turbine engine and uses indigenously developed MEMS-based navigation system for its navigation and guidance. The performance of the system was as per simulations carried out and demonstrated the capability of the system to meet the mission requirement for a cost-effective HEAT.



HEALTHCARE AT HIGH-SEA: TELEMEDICINE FOR NAVY

Indian Navy has initiated acquisition of Defence Bio-Engineering and Electro Medical Laboratory (DEBEL), Bangaluru, developed rugged portable tele-medicine system for healthcare management on its warships and submarines. This will be a morale booster for its personnel as they will now be connected to shore hospitals, thus enabling state-of-the-art tele-medicine support in emergency medical situations. Implementation and operationalisation of tele-medicine will be carried out by M/s Maestros Electronics & Telecommunications Systems Ltd (METSL), Mumbai (ToT

holder), on whom Indian Navy has recently placed production order. DEBEL developed system comprises indigenously developed vital parameter monitor known as BioDAS, which can acquire 12 leads of ECG, heart rate, respiratory rate, blood pressure, O2 saturation, and body temperature and transmit data in live streaming. This was successfully demonstrated in extensive trials carried out in ships and submarines in various operational scenarios. System is designed to operate in rigours of all naval environments.



LATOT FOR REDUCED SENSITIVITY RDX

Licence Agreement for Transfer of Technology (LAToT) for in-house developed Reduced Sensitivity RDX (RS-RDX) was signed with two production agencies namely Ordnance Factory (OF), Bhandara and Sri Kaleswari Fireworks Pvt Ltd (SKFPL), Sivkasi. Shri A Shanmugam, General Manager, OF Bhandara and Shri AP Selvarajan, Chaiman, SKFPL received the technology document from the Chief Guest Air Vice Marshal Sunil J. Nanodkar AVSM, VM, VSM (Retd) in presence of Shri KPS Murthy, OS & Director, HEMRL, Dr RK Pandey, OS, HEMRL and other dignitaries. RS-RDX is the key ingredient of high performance propellant and insensitive high explosive formulations for futuristic missiles.



TOT OF SPACE HEATING DEVICE HIM TAAPAK

Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi, transferred the technology of space heating device (Bukhari), Taapak, to five firms, i.e., M/s Vijay Aluminium Works, Kanpur; Ordnance Equipment Factory, Kanpur; Ajit Technoplast Pvt. Ltd, Kanpur; Krishna Allied Industries, Mumbai and Shakti Engineering Industries, Gwalior on 26 March 2019. The technology transfer documents were handed over to the firms by Dr Bhuvnesh Kumar, OS and Director, DIPAS. Dr Sanjeev Kumar Sharma and Shri Satish Chouhan the inventor scientists and Dr Rajiv Varshney, Head TMD were also present on the occasion.

Tapak has been designed for the maximum heat extraction, both convective and radiative, with no chances of blast or fire and below the detectable level carbon monoxide. A specially designed burner provides efficient heating because of proper burning of fuel; burner can also be used separately for cooking of food.



It's specially designed maintenance free exhaust vent system does not allow the back draft of air and saves about 60 per cent of kerosene oil as compared to existing bukharis.

Border Security Force has already procured 2400 sets and Army is procuring 20,000 sets from DIPAS ToT holders.



DRDO CELEBRATES NATIONAL TECHNOLOGY DAY

National Technology Day (NTD) is observed every year on May 11 across India to mark the anniversary of Pokhran Nuclear Tests (Operation Shakti) held in 1998. The day symbolises the importance of science in daily life and encourages youngsters to embrace it as a career option. DRDO celebrated NTD with great fervour by invited talks and NTD lectures. Defence Science Forum (DSF)—a common platform of DRDO where scientists of diverse disciplines interact for mutual development organised NTD oration by Shri KN Vyas, Secretary, Department of Atomic Energy and Chairman Atomic Energy Commission (AEC) at DRDO HQ. Dr G Satheesh Reddy, Secretary, DDR&D and Chairman DRDO, presided over the function. Shri AK Singh, DG (LS), DRDO, and Convenor DSF, welcomed the august gathering and briefed about the history and importance of the day among the scientific community.

Dr G Satheesh Reddy in his address, spoke about the recently conducted successful test of Anti-Satellite (A-SAT) Missile and exhorted young scientist to make concerted efforts for the development of state-of-the-art technologies for the development of the nation.

Shri Vyas, in his oration, put forth various aspects of Nuclear Science for Societal Applications, such as, the use of radioisotope in medical, agriculture, food preservation, chemical industry, etc. He also talked about the facilities available and the accomplishments of the Bhabha Atomic Research Centre (BARC). Shri Sanjay Pal, Sc 'G' and Secretary, DSF, highlighted the very purpose of the gathering on the day and the benefits it garnered among the scientific community and called upon everyone to synergies their talents and work for the betterment of the society.

The following DRDO labs/estts also celebrated NTD at their respective places by organising scientific lectures, quizzes and open day.



Shri KN Vyas, Secretary, DAE and Chairman AEC, delivering NTD oration at DRDO HQ

ADE, BENGALURU

Smt AP Revathy, Sc 'F' delivered the NTD oration on "Self-Reliant Technologies for UAVs." Dr Venugopal S, OS and Director, Aeronautical Development Establishment (ADE), in his address talked about the way forward to achieve ADE goals. He also presented the NTD Medal and Certificate to Smt Revathy.



ANURAG, HYDERABAD

The programme began with address by Dr JVR Sagar, OS and Director, Advanced Numerical Research and



Analysis Group (ANURAG). Shri Kiran Kumar S Garje, Sc 'E', delivered NTD oration on "Neuromorphic Integrated Circuits: Future of Artificial Intelligence." Dr Sagar presented NTD Medal and Certificate to Shri Kiran Kumar S Garje.

CABS, BENGALURU

Centre For Air Borne System (CABS) celebrated NTD on 14 May 2019. Shri SK Sahoo, Sc 'F', delivered a talk on "Simulation of Airborne Surveillance Systems."



DESIDOC, DELHI

Defence Scientific Information and Documentation Centre (DESIDOC) celebrated NTD on 16 May 2019. Shri Nishant Kumar, Sc 'E' delivered NTD oration on "Creation of Online Digital Library for DRDO." A quiz was organised on the occasion.



DIC, PANAGARH

Shri M Sankar Kishore, GM, DRDO Integration Centre (DIC), in his address, emphasized the need to develop state-of-the-art technologies to make the country self-reliant. Chief Guest Shri R Venugopal, Sc 'G', Associate Project Director, Agni-5, delivered a technical lecture on "Advances in Strategic System Technologies."



HEMRL, PUNE

Shri KPS Murthy, OS and Director, High Energy Materials Research Laboratory (HEMRL), stressed the need for the innovative ideas, which could be converted to technological level. Air Vice Marshal Sunil J Nanodkar (Retd), the Chief Guest, delivered the keynote address on “Importance of Interactions between Researcher, Technologist, User and Team Leader for Successful Technology Development” and how effective leadership brings the successes to the organisation. NTD oration was delivered by Shri Pankaj Verma, Sc ‘E’, on “Indigenous Development of Boron based High Energy Fuel Rich Propellant Technology for Variable Flow Solid Fuel Ducted Rocket Ramjet Application.” He was awarded NTD Medal and Certificate by the Chief Guest.



INMAS, DELHI

Shri Anant Narayan Bhatt, Sc ‘E’, delivered NTD oration on “Development of Cell Signalling and Inflammation



Modulators based Radiation Counter-measure Strategy for Armed Forces.” Dr Tarun Sekhri, Director, INMAS, presented NTD Medal and Certificate to Dr Bhatt.

ITR, CHANDIPUR

Dr BK Das, OS and Director, Integrated Test Range (ITR), highlighted the importance of technology and encouraged all scientists to be more creative and innovative in their approach. Shri Rajen Kumar Patra, Sc ‘D’, presented NTD oration on “A Comparison of Performance of LMS, NLMS, Leaky LMS and Normalised Leaky LMS Adaptive Beamforming Algorithms.” He was presented NTD Medal and Certificate.



NPOL, KOCHI

Shri VN Panchalai, Sc ‘E’ delivered the technology day oration on “Modern Techniques in Power Amplifier Design for Underwater Applications.” Shri S Vijayan Pillai, OS & Director, Naval Physical and Oceanographic Laboratory (NPOL) presented the NTD medal to Shri VN Panchalai. An invited talk on “Facets of Submarine Operations in Indian Navy” by Cdr R Sanjeev Kumar was also organized.



NSTL, VISAKHAPATNAM

Dr Nandagopan, Director, Naval Science and Technological Laboratory (NSTL) appealed to scientists to tune towards achieving futuristic goals with innovation and creativity. Chief Guest of the function Sri MV Gowtama,

Chairman and Managing Director, Bharat Electronics Limited, Bengaluru in his keynote address, highlighted how NSTL and BEL are moving towards strengthening the mutual collaboration in making indigenous manufacturing base for various underwater defence products. The NTD Medal and Certificate was presented to Sri A Sambasiva Rao, Sc ‘D’ for his NTD oration on “LMS-based Sparse Aware Adaptive Equalisation Techniques for Underwater Acoustic Communication Channel.”



MTRDC, BENGALURU

Dr Vishal Kesari, Sc ‘E’ deliver NTD oration on “Vacuum Electronic Device based Active Denial System.” He gave a brief introduction of non-Lethal Weapons in general and directed to the millimeter-wave based active denial system. He was presented NTD medal and certificate by Dr SUM Reddy, Director, MTRDC.



SASE, CHANDIGARH

Prof. Dheeraj Sanghi, Director PEC, Chandigarh, the Chief Guest, delivered an invited talk on ‘Uses of Technology for Betterment of Human Life’. Dr JC Joshi, Sc ‘E’, delivered NTD oration on “Development of Artificial Neural Network based Snow Cover Simulation Model for Snowpack Stability Assessment.” He was presented NTD Medal and Certificate by Director Snow and Avalanche Study Establishment (SASE), and the Chief Guest.

NATIONAL FIRE SERVICE WEEK

The Fire Service Week (FSW) is observed nation-wide under the guidance of the Fire Adviser, Ministry of Home Affairs, Govt of India during 14-20 April every year in remembrance of the lives lost in the devastating fire that erupted and the explosions that followed on 14 April 1944 at the Victoria Dock in the Bombay Port and also to prevent fire in all industries. The following DRDO labs/estts observed FSW at their respective places.

ARDE, PUNE

Armament Research & Development Establishment (ARDE), Pune, organised lecture on First aid, Fire Fighting and Precautionary Measures by expert from M/s Usha Fire Equipments Pvt. Ltd. A practice session for using all types of portable fire extinguishers was also organised. ARDE has nominated two Group 'A' officers as 'Group Fire Safety Officers' (GFSO) who would act as Nodal Officers for fire safety in the concerned Group.



ITR, CHANDIPUR

Integrated Test Range (ITR), celebrated national FSW 2019 by organising a number of safety activities like demonstration of first-aid appliances, conducting mock drills at various places like New Range Centre, Control Centre, PSD, Wet Canteen, MT, Radar, EOTS, telemetry and security locations inside technical area of the range to create fire safety awareness



National Fire Service Week celebration at ITR

among the employees. Dr BK Das, OS and Director, ITR, witnessed the programme. Dr Das appreciated the efforts of firefighting team for zero fire incident in ITR. He further highlighted the need of strict implementation of fire safety measures and maintenance of such systems.

MSC, PUNE

As a part of the observance on 15 April 2019, Mobile System Complex (MSC), Pune, organised an event to

create awareness about fire fighting and allied safety practices. The event was attended by MSC personnel, CCE (R&D) West personnel, User Units, railway personnel and contractual staff. The fire fighting team lead by OIC (Fire), Shri Vikram V Mitkari, TO 'B', demonstrated the fire fighting drills, usage of fire fighting equipment and deliberated upon the precautions to be observed to prevent fire. Shri Sangam Sinha, GM, MSC witnessed the mock drills and appreciated the firefighting team.



Mock Fire Drill at MSC

128TH AMBEDKAR JAYANTHI CELEBRATION

DMRL, HYDERABAD

Defence Metallurgical Research Laboratory (DMRL) SC/ST Employees Welfare Association organized the celebrations of 128th birth anniversary of Bharat Ratna Dr BR Ambedkar and 111th birth anniversary of Babu Jagajivan Ram on 17 April 2019 at Tamhankar Auditorium. Dr Vikas Kumar, DS & Director, DMRL, was the Chief Guest while Shri Rajinder Kashyap, Joint Secretary, Department of Justice, Ministry of Law and Justice, Govt of India, Delhi, was the Guest of Honour. Shri M Satyanarayana, President, and Shri J Anil Kumar, General Secretary, of the Association welcomed the gathering. Dr G Appa Rao, Sc 'G' and Liaison Officer, DMRL, talked about the work done by Dr BR Ambedkar and Dr Babu Jagajivan Ram.

Dr Vikas Kumar, in his address highlighted the contributions of Dr Ambedkar and Babu Jagajivan Ram in the nation building.



NSTL, VISAKHAPATNAM

The SC-ST Association, JCM III, TCE Union, Works Committee, OBC Association, and Naval Science and Technological Laboratory (NSTL) Seva Samiti and NSTL Management celebrated 128th Ambedkar Jayanthi in an appropriate manner on 14 April 2019. Smt S Sudha Rani, Sc 'F' Chairperson, welcomed the participants and briefed about the various programme conducted for Ambedkar Jayanthi. She strongly felt that the education gives self confidence to children and appealed that every child should be well educated.

Dr OR Nandagopan, OS & Director,

NSTL, was the Chief Guest of the function Dr OR Nandagopan explained the life history of Dr Ambedkar and gave a motivated talk on how to improve the strengths of the children through education. Shri D Apparao, Scientist (Retd), the invited speaker gave a inspiring talk on Dr Ambedkar achievements and also briefed about how to make a value-based progressive society for future generations. On this occasion, a book on Dr BR Ambedkar life achievements was released. As part of celebrations, Essay writing, Drawing and Fancy dress competitions were conducted for NSTL employee's children.



CEPTAM CONDUCTS COMPUTER BASED TEST FOR THE RECRUITMENT OF STA B

Centre for Personnel and Talent Management (CEPTAM), Delhi, successfully conducted Tier II Computer-based Test for the recruitment of the Senior Technical Assistant 'B' in DRDO on 7 April 2019 at 21 centres in eight cities.

Around 1500 officials from various DRDO labs/estts, other institutes/government departments/offices monitored and supervised the examination to conduct it in a transparent manner.





MSC CELEBRATES NATIONAL SAFETY WEEK

In accordance with the directives of Govt of India, Ministry of Defence, O/o Director General (SAM), National Safety Week-2019 was observed at Mobile System Complex (MSC), Pune from 4 March 2019 to 11 March 2019. The National Safety Week-2019 is being observed to create awareness about safety in the organisation and day to day life and to promote the safety culture in organisation.

As a part of celebration, an event comprising special lectures on safety awareness were organised under the guidance of Shri Sangam Sinha, OS & General Manager, MSC. The event was attended by MSC personnel, CCE (R&D) personnel, User Units, railway personnel and contractual staff. Three sessions were conducted by two guest lecturers. Shri Nilesh Karmakar explained about the precautions to be observed during day to day life to avoid accidents and hazards and the safety measures



to be followed to tackle emergency situations. During the second lecture session Shri Ajay K Badalia, Officer Incharge Safety from Mazagon Docks Ship builders Ltd, Mumbai shared his experience and knowledge in the field

of industrial safety, safety measures to be observed during day to day activities in workshops and selection criteria for personal protective equipments. He has also provided important information about the Factories Act 1948.

DRDO ORATION

Defence Scientific Information and Documentation Centre (DESIDOC), Delhi, jointly with Metcalfe House-based DRDO labs/estts organised DRDO Oration by Mary Kom, Indian Olympic boxer, on 3 April 2019 at Dr Bhagavantham Auditorium, Metcalfe House, Delhi. Dr Chitra Rajgopal, DS & DG, SAM, DRDO, Dr Alka Suri, Director, DESIDOC, Dr Rajeev Vij, Sc 'G', convenor of the oration, were present on the occasion.

Olympic Bronze Medallist, Mary Kom enriched the audience with her vast experiences, ideas and thoughts. She talked about how she fought both at home and society to get trained in male dominated game of boxing.

Dr Chitra Rajgopal appreciated relentless service and sacrifices made



by Mary Kom to bring in laurels for the country. Over 600 personnel including Directors of DRDO HQ and DRDO labs/

estts of Delhi, officers and staff from various Delhi-based labs attended the oration.

AGRICULTURAL TRAINING WEEK IN 'L' SECTOR

Defence Institute of High Altitude Research (DIHAR), Leh conducted an intensive week long training programme for the farmers and troops of Leh sector during 8-10 April 2019. Fifty-four local farmers from 15 villages

were trained in vegetative propagation method in apple and apricot.

On 11th April, DIHAR in collaboration with HQ 14 Corps, imparted training to 60 soldiers from 24 Army and Paramilitary Units on unit gardening and

greenhouse management. Appropriate package of practices and technologies were briefed in detail which the trainee can adopt in their respective location premise.



DRDO E-LIBRARY WORKSHOP

A three day national workshop on "DRDO E-Library" was organised by DESIDOC, Delhi during 1-3 May 2019. The aim of the programme was to increase awareness and train all DESIDOC and DRDO librarians to use Koha software for developing DRDO E-Library. Dr Alka Suri, Director, DESIDOC, welcomed all participants and elucidated the importance of such need-based courses. She stressed on the need for increasing

awareness and learning tools for sustaining developments in future. Shri KS Varaprasad, OS & DG (HR), DRDO, stressed on the need for active participation of sister DRDO libraries for successful completion of this task.

Dr HK Kaul Director, DELNET, the Chief Guest of the event, welcomed the initiative taken by DESIDOC in networking DRDO libraries. Dr Ramesh C Gaur, Director (L&I) & Head, IGNCA, Shri Yogendra Singh,

Ex-Librarian, IIT Roorkee, and Dr Narender Kumar, Deputy Librarian, Delhi University, delivered invited talks. A panel discussion on Resource Sharing among DRDO TIRCs was also held. Panellists included Dr Ramesh C Gaur, Shri Ashok Kumar, Director HRD, DRDO HQ, and Dr AK Tyagi, Sc 'G', IRDE. DRDO E-Library demonstration and Koha hands on sessions were also conducted. Dr Rajeev Vij, proposed the vote of thanks.



TRAINING PROGRAMME ON SPARROW

DESIDOC, jointly with Directorate of HRD, DRDO HQ, organised a three-day Training Workshop on Smart Performance Appraisal Report Recording Online Window (SPARROW) Training Programme on 26 April, 1 May and 6 May 2019 for two nodal officers

each from DRDO labs/estts located in Central and North India and DRDO HQ.

The electronic Annual Performance Appraisal Report is an online system based on the comprehensive performance appraisal dossier that is maintained for each member of service

by the State Government/Central Government. The aim of the system is to facilitate the electronic filling of PAR by officers in a way that is not only user friendly but also allows to fill from anywhere anytime as per their convenience.



NAVOTKARSH-19@DESIDOC

Navotkarsh-19@DESIDOC: Training Programme on Presentation and Interview Facing Skills was organised by DESIDOC during 1-3 May 2019. The basic aim of the programme was to train the DRTC personnel to present themselves in an effective and confident manner before the board. This training programme does not guarantee any

promotion at any stage, but it assures that it enables assesses to face the assessment board in an effective way.

Dr Rajeev Vij, Sc 'G', Course Coordinator, in his welcome address, briefed the participants about the objectives and purpose of the training programme. Dr Alka Suri, Director, DESIDOC, inaugurated the programme.

She stressed on the need of learning presentation and communication skills for improving the day-to day quality of work. Shri SC Narang, Ex-Chairman, CEPTAM, inaugurated the training course. Forty participants from 15 DRDO labs/estts, who will be appearing Assessment Board this year actively participated in the training programme.

WORKSHOP ON CHALLENGES AND ISSUES IN COMMERCIALIZATION OF PRODUCTS

Defence Research Laboratory (DRL), Tezpur, organized a workshop on “Challenges and Issues in Commercialisation of Products: Services-Industry-Scientist Meet on 4 April 2019. Dr AK Singh, OS & DG (LS), DRDO, was the Chief Guest and Prof. Vinod K Jain, Vice Chancellor, Tezpur University was the Guest of Honour. Dr SK Dwivedi, Director, DRL welcomed the august gathering and briefed on the workshop theme, requirement in DRDO and possible benefits.

The Chief Guest highlighted various issues related to the commercialisation as well as the importance of commercialization of

products developed by DRDO. Dr Singh also emphasised on the collaboration of DRDO with academia for the basic research. Prof. Jain elaborated areas where universities can contribute as a research partner with DRDO.

Shri Devkanta P Singh, Director, PM&SQR (LS), DRDO, delivered a talk on DRDO Life Sciences Cluster: Integrating Science, Soldiers, and Society. Dr Mayank Dwivedi Director, DIITM, DRDO HQ, delivered a talk on DRDO: Enhancing the Capabilities of Defence Manufacturing Sector wherein he discussed various aspects related to the transfer of technology of DRDO developed products.

Brig. AK Jindal, YSM, HQ 4 Corps, delivered a lead talk on Medical Challenges and Issues in High Altitude and Importance of Life Supporting Products in Armed Forces. In the interactive session a total of 60 participants from DRDO, Bureau of Indian Standards, National Innovation Foundation, Tezpur University, industry partners and service personnels from HQ 4 Corps, SSB, Assam Rifles and ITBP, etc. participated.

DRL's annual Hindi magazine 'Purvaiya' was released by the dignitaries during the inaugural session.





COURSE ON REGULATORY CHALLENGES

DRL organised a CEP course on “Regulatory Challenges and Certification of Product Development” during 1-3 April 2019. Dr SK Dwivedi, Director, DRL, delivered the welcome address and Dr P Chattapadhyay, Course Director, briefed about the relevance of the course. The course was inaugurated by the Chief Guest Prof. Usha Sarma, Medical Superintendent, TMCH, Tezpur, and the Guest of Honour Brig. SK Kaushik, Commandant 155 Base Hospital, 4 Corps. Thirty participants from various DRDO labs, AMC, ITBP and SSB attended the course.



SKILL DEVELOPMENT PROGRAMME FOR OYSTER MUSHROOM CULTIVATION

A two-day Multi-Level Extension (MLE) Programme on Oyster Mushroom Cultivation under DRDO Programme Arunodaya was conducted at Namet Village, Tawang, from 2 to 3 April 2019 DRL by Shri Ashok Naglot, Sc 'D', Shri Vijay Pal, STA 'B' and Shri Arpan Sarkar, STA 'B'. DRL has adopted Namet as Mushroom Village on positive response from farmers involved in mushroom cultivation in the year 2018. A total of 25 tribal farmers of the Namet segregated into five clusters were imparted exhaustive technical and practical demonstration sessions.



WORKSHOP ON CHALLENGES OF HEALTH AND HYGIENE IN RURAL SOCIETY

DRL conducted an awareness workshop on Challenges and Issues Related to Health And Hygiene

in Rural Society at Udmari Village, Assam on 8 March 2019. The topics covered the importance of proper hand

washing, control and prevention of lice infestation, importance of vaccination in pregnant women and children, care

during menstruation and the use of clean drinking water.

Dr SK Dwivedi, Director, Dr P Chattopadhyay, Deputy Director, a team of scientists and staff from DRL and Smt Neera Sarma, a philanthropist known as the Bamboo Lady for her significant work in helping the rural communities to generate income and earn a livelihood through sustainable use of bamboo in making various articles like jewellery, addressed the rural community.



COURSE ON BASIC CBRN EMERGENCY MANAGEMENT

Institute of Nuclear Medicine and Allied Sciences (INMAS), Delhi, organised a five-day basic training courses on “CBRN Emergency Management for Seaport Emergency Handlers” under a joint initiative with National Disaster Management Authority (NDMA) and Seaport Authority of India (AAI) at Mangalore and at Kochi seaport, respectively.

Eighty-six participants from different sections of seaport department besides from Central Industrial Security Force, state police and State Disaster Management units attended these courses. Faculties for the training course were comprised of scientist from Division of CBRN defence of INMAS, consultant and senior consultants of NDMA, faculty from emergency response centre and other sister DRDO laboratories viz., Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi and Defence Research and Development Establishment (DRDE), Gwalior.

The inaugural functions of the courses was attended by Shri P Bali



from Ministry of Shipping, Dr Kunal Sharma, consultant from NDMA and Dr Himanshu Ojha, Se ‘D’, from INMAS. All the three nodal officers emphasised the necessity of these courses and how to build capacity of different section of seaport to manage CBRN emergencies.

The first three days of the courses focussed on classroom lectures to build

basic foundation and the last two days for table-top and hands on exercises to provide firsthand experience.

A mock drill was organised by the National Disaster Relief Force (NDRF) where a chemical spillage scenario was created to demonstrate the protocols need to follow during the management of such emergencies.



COURSE ON ALTERNATIVES TO ANIMAL RESEARCH

A three-day course titled Alternatives to Animal Research was organised by INMAS, Delhi, during 13-15 March 2019 under the Continuing Education Programme (CEP) of DRDO. The course was attended by 24 scientists and technical staff of DRDO's Life Sciences cluster laboratories.

Dr Tarun Sekhri, Director, INMAS, inaugurated the course. He emphasised on rationalizing the need to include alternatives in Animals Research wherever possible on the basis of 3 'R's of animal experimentation. The Course was organised to educate and disseminate current information and approved practices to the participants on alternatives and their use in research without compromising the scientific intent.

Course was proportionately structured on lectures and hands



on training exercise. Lectures were delivered from invited guest lecturers in an interactive way. Faculties from INMAS and DIPAS talked about the basic and advanced methods of In-Vitro tests and current trends worldwide on use of non-animal technologies. Rules,

regulations, guidelines and frameworks for animal experimentation applicable to national and international level were also talked about. Hands on training to the basic techniques employed in animal experimentation were also given to the participants during practical session.

SEMINAR ON COGNITIVE COLLABORATION: HUMAN AND MACHINE

INMAS organised a one-day seminar on "Cognitive Collaboration: Human and Machine" on 1 March 2019. Dr AK Singh, OS and DG (LS), DRDO, inaugurated the seminar. Dr Tarun Sekhri, Director, INMAS, in his welcome address emphasised on the importance of human-machine teaming. Dr Sushil Chandra, Sc 'G' and Coordinator of the seminar addressed about effective integration of humans and machines into war fighting systems that out-performs our opponents.

The objective of the seminar was to discuss effective integration of humans with complex machines and integration of human factors





and software engineering aspects of artificial intelligence technique along with cognitive-perceptual training to provide intelligent information and interaction capabilities. Around forty participants from various DRDO

labs, Defence and Paramilitary Forces attended the seminar. Participants understood the need of cognition in system engineering and evaluated the methods to reduce gap between human cognition and machine intelligence in

modern warfare. An active panel of three groups were formed to discuss research problems of concerned fields and subsequently research goals for human-machine teaming to be laid on, for future interactions.

WORKSHOP ON SAFETY MANAGEMENT

A two-day workshop on “Safety Management for Directors and Senior Scientists” was organised by Centre for Fire, Explosives and Environment Safety (CFEES), Delhi, at Institute of Technology Management (ITM), Mussoorie, during 29-30 March 2019. Twenty-nine senior DRDS officers from different DRDO labs/estts attended the workshop. The objective of the workshop was to provide a structural management approach to control safety

risks in operations, processes related to safety of operations and to ensure maximum safety in DRDO labs.

The workshop was inaugurated by Shri Sanjay Tandon, OS and Director, ITM and Shri Rajiv Narang, OS and Director, CFEES. In his Inaugural address, Director, ITM emphasized on the importance to provide a structured management approach to control safety risks in operations. Director, CFEES welcomed the course participants

and deliberated upon the scope of the workshop.

Lectures on various topics, viz., safety management in DRDO, explosive safety, occupational health and safety management, process safety, fire safety, electrical safety, environment safety, lab safety, disaster Management, system safety and DSSB and safety compliance and monitoring were delivered during the workshop.



Patent Granted

A Patent (No. 291570) for “Method of Coating Emission Enhancement Film on Dispenser Cathodes by Chemical Route” has been granted by Patent Office, Govt of India to Shri Ashutosh Panchal, Sc ‘D’, *et. al.*, of Defence Metallurgical Research Laboratory (DMRL), Hyderabad who invented the method.



ORIENTATION MODULE FOR DIRECTORS OF YOUNG SCIENTISTS LABS OF DRDO

A two-day Orientation module for Directors of Young Scientists Labs of DRDO was conducted by ITM during 26-27 March 2019 at Development Enclave, New Delhi. The course was a contrivance of the Secretary DDR&D and Chairman DRDO Dr G Sathesh Reddy. Newly appointed five young Directors attended the module. The objective of the course was to enhance leadership capabilities to tackle new technological challenges in futuristic technologies and to lead the organisation towards realisation of its vision.

The keynote address was delivered by Shri KS Varaprasad, OS & DG (HR) on the “Role and Expectations of Young Scientist Laboratories in DRDO.” Sessions on various topics, viz., Threat



Perception, Security and Vigilance issues, Interpersonal Effectiveness, Administrative Responsibilities of Directors including handling of Legal Matters & Grievances, Succession Planning with Competency Mapping of Young Talent Capabilities, Conflict Resolution, Orientation to Budget,

Audit and GFRs, Do's and Don'ts for Laboratory Directors, Leveraging International Collaborations for Competency Building, Project and Risk Management in DRDO perspective, etc., were delivered by Corporate and Laboratory Directors and ITM Faculty.

WORKSHOP ON WORK-LIFE BALANCE

A three-day workshop on “Work-Life Balance” was conducted by Institute of Technology Management (ITM), Mussoorie, from 6 to 8 March 2019. A total of 31 officers from different DRDO labs/estts attended the workshop. The objective of the workshop was to enlighten the participants about how to achieve a healthy work life balance and how this can enable them to feel more in control of their working life.

Dr Manas Kumar Mandal, Distinguished Visiting Professor, IIT, Kharagpur and Former DG (LS), DRDO, and Shri Sanjay Tandon, OS and Director, ITM, inaugurated the workshop. Shri Tandon welcomed the participants and deliberated upon the importance of the course. Dr Mandal, in his keynote address, emphasised on the importance of work-life balance for achieving excellence. Lectures on various topics, viz., Fostering Happiness



in Life and Career, Anger Management, Stress Management, Time Management, Mindfulness & Heartfulness, Managing

issues at home, work place and social set up and Human Excellence were delivered during the workshop.



COURSE ON ORGANISATIONAL BEHAVIOUR FOR MID LEVEL SCIENTISTS

A three-day course on “Organisational Behaviour for Mid Level Scientists” was successfully conducted by ITM, at Advanced System Laboratory (ASL), Hyderabad. Participants from ASL; Defence Research & Development Laboratory (DRDL), Hyderabad; and Research Centre Imarat (RCI), Hyderabad, attended the course. Thirty-six officers participated in the course. The course objective was to acquaint mid level scientists in understanding, predicting and managing human behaviour to enhance effectiveness in an organisation.

The course was inaugurated by Dr MRM Babu, DS and Director, ASL. Sessions on various topics, viz., human behaviour in organisation, motivation: theory and techniques, creative problem solving, essential



soft skills, managing organisational change, building effective interpersonal relations, conflict management, EQ vs IQ and stress management were delivered. Apart from ITM faculty, Dr Radha Raghuramapatruni, Asst

Prof. GITAM School of International Business (GISB), Visakhapatnam and Dr Akila Jai Kumar, Management Consultant, were the invited speakers who delivered their lectures during the course.

AWARENESS TRAINING ON ISO 27001:2013

A two days awareness training programme on “ISO 27001:2013 based on Information Security Management System” was conducted during 25-26 April 2019 at Integrated Test Range (ITR), Chandipur. Dr BK Das, OS and Director, ITR inaugurated

to educate the participants about threats, vulnerabilities and the risk involved in the security. Shri CR Das and Shri T Bandopadhyay from STQC Services, ERTL (Kolkata), conducted series of lectures during the two days training. The faculties also handed over

a list of action plan for ITR to implement ISO 27001. Seventeen participants from ITR attended the training.

Shri PK Mohanty, Sc ‘G’ was the Course Director and Shri R Marndi, Sc ‘F’ was the Course Co-coordinator.





COURSE ON APPLICATION OF OPEN SOURCE SOFTWARE IN TIRC/KC OF DRDO

A course on “Application of Open Source Software in TIRC/KC of DRDO” was organised at Integrated Test Range (ITR), Chandipur, during 25-29 March 2019. Dr BK Das, OS & Director, ITR, inaugurated the course. The course was aimed at implementation of open source software for TIRC/KC of DRDO.

Faculties and experts from Sambalpur University, IIT KGP, TATA Steel, Jamshedpur, Khalikote University, NIT Rourkela, DESIDOC, Delhi and ITR delivered the lectures. Seventeen participants from ITR and other DRDO labs attended the course.

The course was organised by Shri C R Ojha, Sc ‘F’ and Course Director and his team.



COURSE ON FINANCE AND MATERIAL MANAGEMENT

A five-day training programme on “Finance and Material Management” was conducted jointly by Laser Science and Technology Centre (LASTEC), Delhi, and Directorate of Finance and Material Management (DFMM) at LASTEC, Metcalfe House, during 8-12 April 2019. The programme was inaugurated in the presence of Dr AK Bhateja, OS & Director, DFMM and Dr Hari Babu Srivastava, OS & Director, LASTEC.

The programme covered various topics related to finance and material management. Officers from DRDO, Defence Accounts Department and PCDA discussed and resolved multiple important issues in panel discussion and also generated new ideas for further improvement in system and better synergy between all the stakeholders.



Dr Zakwan Ahmed DG (RM & Imp), DRDO, graced the panel discussion of the programme as the Chief Guest, Shri Sandeep SN Singh (PCDA) and

Dr Bhateja, were also present. Fifty participants, both from DRDO and PCDA and DCDA, attended the programme.



PERSONNEL NEWS

APPOINTMENT

DIRECTOR, ADE



Dr S Venugopal, Sc 'H', has assumed the charge of Director, Aeronautical Development Establishment (ADE), Bengaluru, with effect from 1 May 2019. He obtained his BE in Mechanical Engineering from PSG College of Technology, Coimbatore, Madras University; ME Mechanical (Guided Missiles) from Institute of Armament Technology, Poona University; and PhD in Rocket Propulsion from JNTU, Hyderabad.

He joined DRDO on 26 December 1986 and worked in the field of Aerodynamics and Aero-structures of missile systems for a period of 10 years. During this period, he was deputed to National Aerospace Laboratories, Bangalore for more than four years.

He worked for the BrahMos Missile System from 1997 for a period of 12 years. He was the Deputy Project Director (Airframe) and Head (Mechanical Integration) for this programme up to 2006. He was deputed to BrahMos Aerospace Private Limited in 2007 on appointment as Project Director (BrahMos-Air) which he served for 3 years. In addition to his appointment, he was given the full time responsibility to head the company BrahMos Aerospace Thiruvananthapuram Ltd. as its Executive Director for two years (2008 & 2009).

He was given the assignment of Project Director (Astra) in 2011 and Programme Director in 2016. He was the Group Director (Air Launch Weapons and Variants) at DRDL before his appointment as Director, ADE.

AWARDS

FELLOW OF ACADEMY OF SCIENCES

Dr P Saravanan, Sc 'F' of Defence Metallurgical Research Laboratory



(DMRL), Hyderabad, has been elected Fellow of the Academy of Sciences, Chennai, during the General Body Meeting held at Deptt of Nuclear Physics, University of Madras.

BEST POSTER AWARD

A paper entitled Specific Heat and Magnetocaloric Effect in Hodoped DyMnO₃ Multiferroic System authored by Dr N Pavan Kumar, Young Scientist Fellow (DST-SERB), Dr A Srinivas and Dr M Manivel Raja was awarded Best Poster Award at International Conference on Advanced Functional Materials and Devices 2019 organised by Department of Physics, National Institute of Technology, Warangal.

NARI SHAKTI AWARD

Ms Ipsita Biswas, Sc 'G', Terminal Ballistics Research Laboratory (TBRL), Chandigarh has been conferred with Nari Shakti Award, the highest civilian honour for women in India. The award was presented by Hon'ble President of India at a special ceremony in Rashtrapati Bhavan on the occasion of International Women's Day. Nari Shakti Award is conferred on eminent women achievers, who rise above barriers and become role models and inspiration for generations to follow, for rendering distinguished service to the cause of women empowerment in India.



HIGHER QUALIFICATION ACQUIRED



Shri Veer Singh Gangwar, Sc 'E', Electronics and Radar Development Establishment (LRDE), Bengaluru, has been awarded PhD by Indian Institute of Technology, Banaras Hindu University, Varanasi for the thesis entitled "Studies on Sparse Array Antennas for Radar Applications."



Shri P Anil Kumar, SC 'F', Research Centre Imarat (RCI), Hyderabad, has been Awarded PhD from NIT, Warangal for the thesis entitled "Design and Development of Metallic Vibration Isolators for Air Borne Vehicles."



Shri Jagdish Joshi, Sc 'E', Snow and Avalanche Study Establishment (SASE), Chandigarh, has been awarded PhD by Punjab University, Chandigarh, for the thesis entitled "Development of Hidden Markov Model (HMM) based Avalanche Forecasting System for North-West Himalayas."

NABL ACCREDITATION TO CAMEC LRDE

Calibration and Measurement Centre (CAMEC) of Electronics & Radar Development Establishment (LRDE), Bengaluru, has been accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) in accordance with the standard ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories in the field of calibration.



YOUNG SCIENTISTS' LABORATORY

To encourage innovation and incubation through empowerment of young leadership of DRDO, Hon'ble President of India has sanctioned creation of five self-accounting DRDO Young Scientists' Laboratories (DYSL) in the five advanced technical areas, viz., Artificial Intelligence, Asymmetric Technologies, Cognitive Sensors, Quantum Technologies and Smart Materials in Bengaluru, Kolkata, Chennai, Mumbai and Hyderabad, respectively. All the laboratories are proposed to have scientists not more than 35 years at the time of selection for posting to the labs.

DYSL Smart Materials Laboratory presently situated in Aeronautical Materials Testing Laboratory Campus close to Defence Metallurgical Research Laboratory (DMRL), Hyderabad, officially started functioning from 2 April 2019. Six scientists from various DRDO labs have been selected and posted in the centre through interaction



with a screening committee. Senior scientists from DMRL, senior officers from MIDHANI, CCE (R&D) South and Estates and staff from AMTL were present on the occasion. DYSL-SM centre will be working in areas related

to development of new smart materials and in development of smart materials based technologies that will meet the requirements of strategic defence systems.

RENOVATED DRDO SPONSORED SCHOOL INAUGURATED

Bhavan's Varuna Vidyalaya, a joint venture of Naval Physical Oceanographic Laboratory (NPOL), Kochi and Bharatiya Vidya Bhavan has been functioning in NPOL residential campus since 1993. The newly renovated Bhavan's Varuna Vidyalaya complex was formally inaugurated by Shri S Kedarnath Shenoy, OS & Director, NPOL on 15 March 2019. The school was given a facelift after 25 years of its inception. The special repairs work of the school, taken up by NPOL through MES, was worth around ₹ 2 crore. The execution of work was well-planned and was completed in four phases within projected time, without hindering the regular classes.





SAG GETS NEW PT LAB

Integrated IT Product Test Lab (PT Lab) is a test facility created under Project ‘Aakalan’ for security testing of IT Product(s). This newly established test facility was inaugurated by Dr Sudhir Kamath, OS & DG (MED, CoS & CS) at SAG Main Building on 15 April 2019 in the presence of Ms Anu Khosla, Director, Scientific Analysis Group (SAG), Delhi. The major objectives of the work carried out under the Project Aakalan is towards creating a facility for IT product security testing and evolving an assurance framework for providing seven levels of trust assurance for IT product(s). Aligned with the objectives of Project Aakalan, PT Lab is the test facility to perform security testing of IT Product(s) at Integrated product level. The facility is also very useful towards Research & Development in the area of Cyber & Information Security and is currently being used by Cyber & Information Security Group (CISG), SAG, for Cyber Security R&D – Security Testing and Assurance activities. The team has earlier developed few Cyber/



InfoSec Solutions such as Secure File/Folder Deletion tool (SWIPE), Windows Password Cracker (PCrack), USB-Authorization Controller Engine (USB-ACE) & Automated File Integrity Testing Tool (AFITT) which are being used by various User agencies and DRDO Labs.

INAUGURATION OF DRINKING WATER POND

To overcome the perennial shortage of drinking water in the Naval Physical Oceanographic Laboratory (NPOL) campuses, a pond has been constructed by EMU for augmenting the water supply in the Varuna Residential Campus of NPOL. Water in Varuna Pond has been certified potable by Regional Analytical laboratory. A water treatment plant for iron-content removal and pumping facility has also been installed. This is expected to compensate to a significant extent the shortfall of water supply from Kerala Water Authority.

Shri S Kedarnath Shenoy, OS & Director, NPOL, inaugurated the pond on 15 March 2019.





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DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 4: MARCHING FORWARD

The article is 39th 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

Electronics & Radar Development Establishment

In the second half of the 1960's, the R&D work on radar systems to detect targets flying at low altitudes against the background of heavy clutter, was taken up primarily to meet the requirements of the Indian Air Force.

LRDE's approach was based on the use of continuous wave system for moving target detection and sine wave modulation for ranging the detected target. The other two major development efforts of the radar group of LRDE was the development of the Radar Distance Measuring Unit and the development/fitting of a moving target indicator (MTI) to an existing fire control radar held by the Army for improving its tracking performance against low-flying targets which tried to take advantage of ground clutter.

In the area of communications, LRDE had been involved in and contributed to Plan AREN for the Army at the time of its formulation. Plan AREN was revolutionary because it marked a changeover from linear communications to grid communications, at the same time as it was being introduced in defence forces in developed countries. The Laboratory provided technical input to the Army by way of analysis of their requirements, the likely impact of new technologies on communication networks, the concept of modularity that would lend itself readily for capacity expansion, the concept of adaptive routing within the network, and newer modulation techniques that were ideally suited for military network. In addition, LRDE configured a skeleton network to clarify the concepts and clear technical issues.

Further, LRDE took up the development of the basic module of the automatic electronic exchange with (40+12) lines. It was a space division exchange using the concept of wired programme digital processor to control the speech network for establishing speech path between the subscribers. Reed relay cross-points were employed as speech path switching elements. The architecture was modular with control processing unit, switching matrix, line and trunk interface unit, operator console, and the power supply as the major sub-systems.

Besides the activities related to Plan AREN, the other major activities of communication group were the development of the wireless set HM30, the speech secrecy unit Coding And Decoding of Digital Speech (CADDIS), transistorised metallic mine detector, and sound ranging system for location of enemy guns. These were taken up after extensive discussions with the Services and on their issuance of qualitative requirements. The development of the manpack wireless set HM30 was taken up in 1965 in response to an urgent need expressed by the Army for regimental communication sets up to a range of 30 km. Since it was to be productionised with minimum delay, the development was centred around available mechanical sub-assemblies and parts and used indigenously available electronic components to a large extent. Needless to state, the development was completed, evaluated, and production was launched in record time so that the urgent need of the Army was met. CADDIS, the speech secrecy unit was developed to provide secure voice communication over an existing simplex radio link with manpack sets as terminal units. The development was successful and the required numbers were fabricated for the Army at the

LRDE pilot plant. Another activity was the development of the transistorised metallic mine detector. The operation of the equipment was based on the principle of regenerative amplification and the completed equipment was lightweight. The metallic mine detector was user evaluated and approved for introduction into Service by the Army. The necessary numbers were supplied to the Army by the private sector on whom the orders were placed and to whom LRDE successfully transferred the technology. The Sound Ranging System for location of guns, employed a number of sound ranging microphones spread over a distance to pick up the acoustic signals from the enemy guns that were firing. These signals were transmitted by cable or by radio for further processing to determine the location of the gun (sound emitter). The system was required to be highly mobile and speedy in deployment and in dismantling. In this case, the sensitive grids for the microphone were developed by the Defence Science Laboratory, Delhi.

LRDE demonstrated its capability to go beyond import substitution/indigenization to design contemporary equipment to meet the needs of the Services. In the 1970's, the scorching pace at which technological advances in electronics were taking place, required originality in thinking as the vacuum tubes were replaced by transistors, which in turn were being replaced by integrated circuits. Even in integrated circuits the transition from SSI, MSI, and LSI which denote the integration density of circuits in ascending order was rapid. Consequently, obsolescence of electronics components was a factor that had to be taken into account in all system designs. The advancements in digital techniques were equally rapid



as a result of which the scope and range of signal processing applications in the military equipment appeared almost unlimited. Thus, the response of the DRDO scientists in the area of electronics was in keeping with changes in circuit miniaturisation and advances in digital techniques that were taking place, so that the equipment offered to Users was contemporary.

As 1970 dawned, at LRDE there were two projects which were continuation of development from the earlier years. The first was the development of the Distance Measuring Equipment. The system operated in the X-band and was based on the active radar transponder principle. It provided an accuracy of 10 cm in the measurement of distance between any two geographical positions separated not more than 50 km. The DME was tested and evaluated by the Artillery at Devlali in 1973. It was accepted for production and technology was successfully transferred to ECIL, Hyderabad for supply to the Artillery, and in addition to the Survey of India.

The second was the development of the moving target indicator for fitment to the fire control radar of the Army. The development was successfully completed and after testing and evaluation, an order was placed on the pilot plant of LRDE for fabrication of the required number of units.

Six additional projects on radar systems were initiated during this period by LRDE. The first two were aimed at providing the Air Force and the Army with state-of-the-art short range mobile surveillance radars for detection of moving targets in the presence of heavy ground clutter. The Indian Air Force had floated this requirement in 1967 and had searched worldwide for a system but had drawn a blank, as no radar existing or under development at that time had the capability to meet the target visibility conditions. The Artillery too had a requirement for a radar with the same stringent condition for target visibility but with reduced range. Both radars were required to be vehicle mounted. For the Air Force, LRDE proposed to base the radar on the concept of moving target detector, which was a combination of a ground clutter map, moving target indicator, and a bank of Doppler filters all in digital

mode, but was greeted with scepticism because many well known radar manufacturers did not have it on their drawing boards. LRDE had to prove the performance capability and physical realisation feasibility by analysis and simulation of the signal processor. The physical realisation of the anti-clutter filter for the Air Force radar was by way of FFT. Because of the reduced range, the solution for the Army radar was a simpler signal processor based on digital filtering. The radar system proposed by LRDE had a number of other features that were not available in any single surveillance radar system offered at that time by other countries to India¹⁶. A state-of-the-art coherent transmitter, digital signal processing, moving target detector, software based radar data processor for providing track-while-scan capability and multicolour displays with synthetic video sum up the effective transformation brought out by LRDE in the field of surveillance radars to raise our capabilities to be at par with the developed countries.

The third project was in response to a new qualitative requirement put forward by the Army for a lightweight field artillery radar which would have the capability to locate launch points of multiple projectiles such as the mortars in the shortest possible time. Since electron scanning radars at that time were not lightweight and also very expensive, the state-of-the-art systems employed electromechanical scanning, manual detection and located one weapon at a time. LRDE proposed a unique solution based on automatic detection, operator-aided extraction of trajectory and an algorithmic innovation of trajectory association from intercepts through snapshots of multiple projectiles taken at two distinct time intervals by the radar. This would then provide the launch and impact points in real time of the projectiles for which association could be established. The activities involved the development of the scanner antenna, a compact magnetron-based high power transmitter, automatic detection with constant false alarm rate provision, on-line computing, synthetic display and real time software for digital display, operator interaction, training and estimation of launch and impact points.

In addition to the design, fabrication, assembly, and integration of the hardware and software, user-assisted data collection at the ranges in Devlali for verification and modification of algorithm for multiple weapon location was carried out more than once. User evaluation and trials were planned for the first quarter of the 1980's.

The next three radar projects were aimed at acquiring competence in techniques and technologies that would find place in next generation systems. One was an airborne radar and the other two were for shipborne operations. The Indian Air Force had projected an Air Staff Requirement (ASR) for fitment of indigenously developed radar systems to the imported fighter aircraft. After an extended dialogue between DRDO, Air Force and HAL, it was decided that LRDE's effort would be aimed at developing a roof top (technology demonstrator) model of a passive airborne phased array radar while HAL would develop its system based on mechanically scanning antenna. Phased array technology was the most advanced radar technology of the time and it was necessary for DRDO to initiate activities with a specific goal in mind for advancing the state-of-art in the country. The LRDE technology demonstrator would be a coherent airborne phased array system with advanced features. The design of the phased array antenna was initiated based on the data and dimensions of a phase control module that was selected for import¹⁸. The emergence of sea skimmer missiles as a viable threat against ships required a search radar which would detect a high speed target with very low radar cross-section skimming over the sea surface and a tracking radar with high angular resolution to track the missile before it could be destroyed. LRDE undertook to carry out investigation of techniques for detection and tracking of targets of very small cross-section in sea clutter¹⁹. Hardware for a C-Band search radar and a tracking radar operating in the dual-frequency bands (X and Ku) for Naval applications was initiated. In the early years of the 1980's, design of the major sub-systems was under way.

To be continued...

VISITORS TO DRDO LABS/ESTTS

ARDE, PUNE

* Dr G Satheesh Reddy, Secretary, DDR&D and Chairman, DRDO visited Armament Research and Development Establishment, Pune, on 18 April 2019. The Chairman reviewed the status and development of Small Arms and Ammunition at ARDE. A firing demonstration of 5.56x30 Cal. Joint Venture Protective Carbine (JVPC), 5.56x45 Cal. CQB Carbine, 7.62x51 Cal. LMG and Corner Shot Weapon System was arranged.

* Lt Gen Anil Kapoor, VSM, Director General (Information System), visited ARDE on 2 May 2019 to review the progress of ATAGS project.

* Lt Gen SS Hasabnis, PVSM, VSM, ADC, DCOAS (P&S) visited ARDE, Pune on 9 May 2019 along with Colonel Manoj Oomen, Col Perspective Planning (DRDO), to take stock of ongoing Indian Army projects. Senior scientists of ARDE apprised him the status of project activities.



Secretary, DDR&D Dr G Satheesh Reddy showing keen interest in JVPC

DESIDOC, DELHI

Dr VS Arunachalam visited DESIDOC, Delhi on 16 April 2019. Dr Arunachalam addressed Officers and Staff of DESIDOC and appreciated the services provided by the Centre. He recalled his interaction and information services sought from DESIDOC during his tenure as SA to RM in Delhi.



Dr VS Arunachalam visited at DESIDOC

DMRL, HYDERABAD

Major General Rajesh Puri, Commander, Base Workshop Group, Corps of EME, visited Defence Metallurgical Research Laboratory (DMRL) on 29 April 2019. Dr Vikas Kumar, DS and Director, DMRL briefed him about the laboratory activities aided by a video show on DMRL. Maj Gen Puri discussed issues related to the overhauling and life extension of the battle tanks of Indian Army.



Major General Rajesh Puri being briefed about DMRL technologies