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IAF TESTS BRAHMOS-A SUCCESSFULLY

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IAF TESTS BRAHMOS-A FROM SU-30MKI, HITS LAND TARGET WITH PERFECT PRECISION

Indian Air Force (IAF) successfully test fired the BrahMos air version (BrahMos-A) missile from its frontline Su 30 Mk-I fighter aircraft on 22 May 2019. The launch from the aircraft was smooth and the missile followed the desired trajectory before directly hitting the land target.

The trial was under users' configuration with launch point, target point, way point, launch altitude and range being decided by the user. The aircraft with BrahMos-A took off from Thanjavur Air Base. The missile was launched 30 km from Car Nicobar towards the target point at Trak Island at a distance of 229 km from the launch point. The maximum available path length of the missile was utilised by providing waypoints. Downrange Ship with Telemetry receiving station was positioned nearly 25 km away from target point beyond the weapon danger zone.

Peripheral Control Device carried out health check, PREP and issued all relevant commands pertaining to the preparation & launch precisely. All inputs and computed parameters by PCD including the LINS array were loaded into the missile during the preparation/and launch phase.

The missile, after being gravity dropped from the fighter's fuselage, reached the safe distance from the aircraft and flew for its full range towards the designated land target hitting it with "bull's eye precision".

BrahMos-A has been integrated on Su-30Mk-I aircraft to provide enhanced employability to our Armed Forces as an offensive weapon. The air version missile can be deployed against sea as well as land targets. The successful integration of BrahMos-A on Su 30 Mk-I aircraft has been demonstrated in number of drop trials and first launch against ship target in November 2017 proving the carriage and launch envelope of the missile.

BrahMos-A: Target hit (top) and target after hit

Raksha Mantri congratulated DRDO, BrahMos and Indian Air Force on this spectacular achievement. Dr G Satheesh Reddy, Secretary Department of Defence R&D, and Chairman DRDO, congratulated Dr Sudhir Mishra, DS and DG (BrahMos), DRDO, who spearheaded the launch activities and joint team of DRDO, BrahMos and IAF, for the successful launch. Indian Navy provided the critical support by ensuring availability of a large number of monitoring ships to ensure range safety clearance.

INDIAN NAVY CONDUCTS COOPERATIVE ENGAGEMENT FIRING OF MRSAM

The Indian Navy achieved a significant milestone in enhancing its Anti Air Warfare Capability with the maiden cooperative engagement firing of the Medium Range Surface-to-Air Missile (MRSAM).

The firing was undertaken on the Western Seaboard by Indian Naval Ships Kochi and Chennai wherein the missiles of both ships were controlled by one ship to intercept different aerial targets at extended ranges. The firing trial was carried out by the Indian Navy, DRDO and Israel Aerospace Industries.

The successful conduct of the test has been the result of sustained efforts by all stakeholders over the years. DRDL Hyderabad, a DRDO Lab, has jointly developed this missile in collaboration with Israel Aerospace Industries. The MRSAM has been manufactured by Bharat Dynamics Limited, India.

These surface-to-air missiles are fitted onboard the Kolkata Class Destroyers and would also be fitted on all future major warships of the Indian Navy.

With the successful proving of this cooperative mode of engagement, the Indian Navy has become a part of a select group of Navies that have this niche capability. This capability significantly enhances the combat effectiveness of the Indian Navy thereby providing an operational edge over potential adversaries.

DRDO LAUNCHES TECHNOLOGY DEMONSTRATOR VEHICLE

DRDO launched a Technology Demonstrator Vehicle to prove a number of critical technologies for futuristic missions from Dr Abdul Kalam Island off the coast of Odisha on 12 June 2019. The missile was successfully launched at 1127 hours. Various radars, telemetry stations and electro optical tracking sensors tracked the vehicle through its course. The data has been collected and will be analysed to validate the critical technologies.

DRDO CARRIES OUT FLIGHT-TEST OF GUIDED BOMB

DRDO flight tested a 500 kg class Inertial Guided Bomb from Su-30 Mk I Aircraft from the Pokhran test range in Rajasthan on 24 May 2019. The guided bomb achieved the desired range and hit the target with high precision.

The bomb is guided to its target through the inertial guidance system, which allows precision targeting from long distances even under adverse visibility conditions. All the mission objectives were met successfully. The weapon system is capable of carrying different warheads.

AKASH MK-1S TESTED SUCCESSFULLY

DRDO successfully test fired Akash Mk-1S missile from Integrated Test Range (ITR), Chandipur, Odhisa on 25th and 27th May 2019. Akash Mk-1S is an upgrade of existing Akash missile with indigenous seeker.

Akash Mk-1S is a surface-to -air missile, which can neutralize advanced aerial targets. The Akash weapon system has combination of both command guidance and active terminal seeker guidance. Seeker and guidance performance was consistently established in both the tests, which met all the mission objectives.

RM REVIEWS PROGRESS ON R&D IN AREA OF CRITICAL DEFENCE TECHNOLOGIES

Raksha Mantri Shri Rajnath Singh reviewed the progress of research and development activities in the area of defence technologies at DRDO HQ on 14 June 2019.

Chairman DRDO, Dr G Satheesh Reddy and other senior scientists gave detailed presentation to the RM. The presentation covered recent achievements, details of major ongoing projects and the roadmap of DRDO. Shri Singh was apprised about the DRDO developed cutting-edge, state-of-the-art technologies and systems accepted by the Armed Forces and those under development.

The RM appreciated the commitment and dedication of DRDO scientists and directed that they should focus their energies on flagship programmes of national importance. He also appreciated the DRDO initiatives to promote academia and industry. The Minister desired that such interaction should be enhanced further to create a greater scientific temper and production base, which would be a driving force for accelerated research and defence manufacturing.

Shri Rajnath Singh also released a publication titled 'Roadmap of DRDO', which encapsulated its target for the next ten years. He congratulated DRDO for its singular achievements in strengthening the national defence capabilities and enabling the nation to join a select club of countries having some of the most advanced defence technologies, such as Anti-Satellite Capability, 4.5th Generation Fighter Aircraft, Airborne Early Warning & Control System (AEW&CS), Ballistic Missile Defence Programme, etc.

Earlier, on his arrival at DRDO Bhawan, Shri Singh paid floral tribute at the statue of former President and DG DRDO Dr APJ Abdul Kalam.

Hon'ble Raksha Mantri paying homage to Dr APJ Abdul Kalam (top) and being briefed by Chairman DRDO Dr G Satheesh Reddy

DETECTION SYSTEM PREEMPTOR HANDED OVER TO PRINCIPAL SCIENTIFIC ADVISOR

Laser-based Stand-off Explosive Detection System, developed by Laser Science and Technology Centre (LASTEC), Delhi, was handed over to the Principal Scientific Advisor to Government of India (GOI) for various security agencies. The system, based on Raman Backscattering principle, would be used for securing area by security forces. The system was handed over by the Dr G Satheesh Reddy, Secretary DDR&D and Chairman DRDO to Prof. K Vijay Raghavan, Principle Scientific Advisor to GOI at LASTEC, in the presence of Ms J Manjula, DS and DG (ECS); Shri HB Srivastava, OS and Director, LASTEC; Shri Neeraj Sinha Advisor, Niti Ayog; Dr GP Srivastava, Hon'rary Scientific Consultant (Security Tech) to PSA and the project team.

EVENTS

NATIONAL TECHNOLOGY DAY

National Technology Day (NTD) is celebrated all over India with great enthusiasm on 11th May every year in order to commemorate successful nuclear tests conducted at Pokhran, Rajasthan on 11 May 1998. The following DRDO labs/estts also celebrated the day at their respective places by organising scientific orations/ lectures and exhibitions, quizzes, open day etc.

ACEM, Nasik

Advanced Centre for Energetic Materials (ACEM), celebrated NTD on 14 May 2019. Shri U Raja Babu, OS and PD AD, Research Centre Imarat (RCI), Hyderabad, was the Chief Guest on the occasion and delivered a talk on "BMD

Technologies" and other technologies developed for the ASAT missile. Shri Srinivasan Seshadri, Sc 'G' and GM, ACEM, addressed the gathering and highlighted the significance of the day.

The NTD Oration was presented by Shri G Sathesh Kumar, Sc 'D', on "Mixing of High Energy Composite Solid Propellant Compositions: Process Development in Blade less Mixer." He highlighted the process development carried out in Blade less Mixer for processing of energetic propellant formulations. He was given NTD Oration Medal and Commendation certificate by the Chief Guest. Shri Sunil Hadake, TO 'B' delivered a talk on "Development of Casting System for Large Size Rocket Motor Casting."

A number of events were conducted during the week to mark the celebration. Competitions like Technology Quiz and Crossword were conducted and the winners were awarded. Dr SC Bhattacharyya, Sc 'G' proposed the vote of thanks.

CAIR, Bengaluru

Shri Biswajit Paul, Sc 'E', delivered National Technology Day oration on "Multiple Faces of Internet and Its Challenges for Open Source Intelligence". In his talk, he explained about availability of huge data in public domain due to social media and smart phones. In his talk he stressed on the ever growing need to tap, churn and generate valuable Open Source Intelligence (OSINT) for addressing various informational needs.

DMRL, Hyderabad

Dr S Nagarjuna, Sc 'G' delivered the Technology Day oration on "Development of Technology for Cu-Ti Alloy Non-Sparking Tools and Indigenization of AB Grade Steels for Naval Applications." Dr Nagarjuna was presented the National Technology Day Medal and a certificate by Dr Vikas Kumar, DS & Director, DMRL.

TBRL, Chandigarh

Dr Sudhir Kamath, OS & DG, Micro Electronic Devices & Computational Systems (MED & CoS) was the Chief Guest of the function. Shri P Siva Prasad, Director, DRDO Young Scientist Lab working in the field of Asymmetric Technologies in Kolkata, was the Guest of Honour. Dr Manjit Singh, DS & Director TBRL, spoke about TBRL's contribution in India's nuclear weapon programme. He encouraged the young scientists to break the barriers of individual academic disciplines and carry out interdisciplinary research.

Dr Sudhir Kamath presented a brief overview of Futuristic Technologies for Defence specially in the field of AI, asymmetric technologies and quantum technologies. Shri P Siva Prasad discussed the application of Asymmetric Technologies for design of nano and micro drones, smart bullets and plasma deflector shields.

The Technology Award and medal was conferred on Shri Sandeep Malik, Sc 'F', in recognition of his contributions for Supersonic Captive Flight Testing of Aerospace Systems using RTRS.

ANTI TERRORISM DAY 2019

DRDO Integration Centre, Panagarh, celebrated anti terrorism day on 21 May 2019. On this occasion pledge was taken by the entire employees. General Manager Shri Sankar Kishore delivered an awareness speech emphasising terrorism as the biggest threat to humanity and asked employees to be vigilant against anti national activities.

RAISING DAY CELEBRATIONS

ADE, BENGALURU

Aeronautical Development Establishment (ADE) celebrated its Diamond Jubilee Foundation Day on 26 April 2019. Dr G Satheesh Reddy, Secretary, Department of Defence R&D and Chairman, DRDO, was the Chief Guest at the function. Dr (Ms) Tessy Thomas, DS & Director General (Aeronautical Systems) graced the occasion as the Guest of Honour. On this occasion, new entrance of ADE, Raman Gate was inaugurated by the Chief Guest.

Shri V Ashok Rangan, OS and Associate Director, ADE welcomed the august gathering. Shri MVKV Prasad, DS and Director, ADE, in his address, presented the achievements of ADE. The Chief Guest, in his address, set the future roadmap of ADE. The Guest of Honour, in her address, gave a brief about her vision of ADE.

Dr Reddy released the in-house magazine 'Nabtarang' and along with DG (MSS) presented awards to meritorious employees of ADE. Creative Partnership memento was presented to M/s Uma Enterprises, Bengaluru and M/s KPIT, Pune. The programme ended with vote of thanks by Shri Shashikanth CC, Sc 'G' and Chairman, ADE Foundation Day Committee.

Chairman DRDO also inaugurated indoor test facility at Autonomous Cooperative Systems Laboratory (ACSL) and Raman Gate, the new entry gate of ADE.

Chairman DRDO addressing the august gathering on the occasion of ADE Raising Day

ANURAG, HYDERABAD

Advanced Numerical Research & Analysis Group (ANURAG) celebrated its 28th raising day on 18 May 2019. Dr Sudhir Kamath, OS & DG (MED, CoS & CS), was the Chief Guest on the occasion. Shri AV Rao, IDAS, PCDA and Dr A Ljnga Murthy, Associate Director, RCI, were the Guests of Honour. Dr JVR Sagar highlighted the major technical activities and achievements of ANURAG for the year 2018-19 and targets for the year 2019-20.

Cultural programme was organized by the employees and their children. Lab-level DRDO Awards and Cash Awards were distributed for the commendable performances for the year 2018. Awards for best innovative ideas were also distributed on this occasion. Mementos were distributed to employees who completed 20 and 25 years of service.

Raising Day celebration at ANURAG

DRDO CONFERS YOUNG SCIENTIST AND BEST PERFORMANCE AWARDS

In recognition of the outstanding contributions made to the organisation, DRDO conferred Young Scientist, Best Performance and DRTC Award for Excellence in Technical Performance and Support for the year 2018 to the meritorious employees in the recently concluded DRDO Directors' Conclave in Dehradun. The following were awarded by the Secretary, DD R&D and Chairman, DRDO, Dr G Satheesh Reddy:

Award	Awardees
Young Scientist Award	**Vignesh Kannan M**, Sc 'D', GTRE **Karania Sameer Bhagwanjibhai**, Sc 'D', ADA **A Karthik**, Sc 'D', RCI **R Gopikrishna**, Sc 'D', DRDL **Mohammed Kareem Khan**, Sc 'D', NSTL **Amit**, Sc 'D', SSPL **Ramita Sardana**, Sc 'D', ISSA **Awadhesh Kumar Baranwal**, Sc 'D', MTRDC **Swaraj Varshney**, Sc 'D', LRDE **SV Raja Goutham**, Sc 'D', ASL **Sounak Samanta**, Sc 'D', DLRL **P Mathiyazhagan**, Sc 'D', CVRDE **Mahesh Sopan Katore**, Sc 'D', HEMRL **Pramod Kumar**, Sc 'D', DARE **Yogeshwar Nath**, Sc 'D', TBRL **Himanshu Karnatak**, Sc 'D', DEAL
Best Performance Award	**Vinod Kumar Singh**, Sr Admin Assistant O/o DG (R&M), DRDO HQ, & **Pranab Jyoti Gogoi**, TO 'C', DRL **Arun Kumar Mishra**, TO 'C', DMSRDE & **P Sanjeeva Kiran**, Accounts Officer, RCI **M Chandra Sekhara Rao**, TO 'B', NSTL & **Roshan Lal**, AO, DMS, DRDO HQ **Dr B Naga Mohan Rao**, TO 'B', RCI & **Ganesh Chandra Roul**, SAO-II, ITR **Uttam Gopal Suryawanshi**, TO 'C', NMRL & **MG Babu**, Asstt Dir, DOP, DRDO HQ **Mankad Kuldeep Ileshkumar**, TO 'A', MSC & **Daler Singh**, Store Officer, LASTEC **Renge BE**, Steno Grade-I, ARDE & **J Kiran**, TO 'A', DMRL **Manjula G**, PS, CEMILAC & **Sashilekha**, TO 'B', CAIR **Suresh Sithta**, TO 'B', TBRL & **S Lalita Devi**, Ex PPS, O/o Chairman, DRDO HQ **Srinivas Rao Illa**, TO 'A', DRDL & **Kuldeep Singh**, DEO 'D', IRDE **K Viswanathan**, TO 'C', CVRDE & **Monika Grover**, PS, CFEES **Pratibha Rajan Bhagwat**, Sr. Adm Asstt, VRDE & **Dr PC Jatav**, TO 'D', DRDE **JH Lakshmana**, TO 'B', DFRL & **Horee M**, Security Asstt 'C', GTRE **Venkatesh Joshi B**, TO 'C', DARE & **N Sivathanu**, TO 'A', CABS **KB Subba Lakshmi**, TO 'D', DLRL & **Vivek Hanmantrao Made**, TO 'C', R&DE(E) **Ajay Kumar Sharma**, TO 'B', IRDE & **Dibyendu Debnath**, TO 'B', HEMRL
DRTC Award for Excellence in Technical Performance	**Vikas A Katkar**, TO 'B', NMRL & **Ashok Puna Mahajan**, TO 'A', ACEM **SK Verma,** TO 'C', ARDE & **MP Padmakumar**, TO 'C', NPOL **Tsewang Tamchos**, TO 'A', DIHAR & **Inderjeet Singh**, TO 'A', DIPAS **Shruti Khanna**, TO 'A', DOP, DRDO HQ & **Tharanath JN**, TO 'A', LRDE
DRTC Award for Excellence in Technical Support	**Meherajul Middya**, STA 'B', SASE & Rajbir Singh, STA 'B', DISB, DRDO HQ **Dhananjay Kumar**, STA 'B', JCB & Sayyed Imran Sarfaraj Ail, Tech 'C', VRDE w**Gunjan Bakshi**, STA 'B', DESIDOC & Vibin M V, Tech 'B', CCE(R&D) West **Bhado Oraon**, STA 'B', ADRDE & Ashish Suresh Nale, Tech 'C', R&DE(E)

COURSE ON COST ESTIMATION

A two-day course on Cost Estimation in Sync with Chapter 8 of Procurement Manual 2016 was held at Combat Vehicles Research Development Establishment (CVRDE), Chennai, from 29 April 2019 to 30 April 2019. The course was conducted by ITM faculty on the specific request of CVRDE.

Objective of the course was to acquaint/impart knowledge on various aspects related to one of the most important aspects in procurement i.e. Cost Estimation. The course contents covered: Types of costs and ways to control the costs, important clauses that effects costing of any proposal, techniques used for decision making while costing a proposal, bench marking, methods of bench marking, INCOTERMS and detailed concepts of costing as laid down in Chapter 8 of PM 2016.

Course was inaugurated by Shri Sanjay Tandon, OS & Director, ITM who highlighted the importance of costing proposals related to Public Procurement and the various existing techniques that could be gainfully applied in carrying out this important activity. Shri V Balamurugan, OS & Director, CVRDE while addressing the participants emphasized that they should keep themselves abreast with the latest changes in the procurement procedures and gainfully utilize the knowledge imparted in the course.

COURSE ON ADVANCE SUPPLY CHAIN MANAGEMENT & FOOD TECHNOLOGY

Defence Food Research Laboratory (DFRL), Mysuru, organised a three-day course on Advance Supply Chain Management and Food Technology (ASMAFT-10) during 20-22 May 2019. Twenty-two senior ASC officers along with Chief Instructor from ASC Centre and College, Bengaluru, attended the course.

Dr S Nadana Sabapathi, Sc 'G' and Officiating Director, DFRL, inaugurated the course. Lectures were delivered on principles of food processing and preservation, quality control, food standards and food supply chain management, ration technology and management, food packaging in supply chain management, storage of cereals, modern warehousing, food safety, etc.

Hands-on trainings was provided to render comprehensive knowledge to the senior Army officers in food processing, frozen and chilled meat/chicken, quality control and management. A visit to Karnataka Milk Federation dairy was also arranged as a part of the course to understand the different technological aspects of milk processing.

Dr R Kumar, Sc 'F', the Course Director, delivered the vote of thanks.

TRAINING OF ARMY PERSONNEL IN SIACHEN SECTOR

Defence Institute of High Altitude Research (DIHAR), Leh organised a three-day training capsule during 1-3 May 2019 on vegetable cultivation under open and protected area for the defence personnel posted at Siachen sector of Nubra Valley. Forty-five participants attended the training capsule, which comprehensively covered various aspects of vegetable cultivation suitable for the Sector. On-ground demonstration of the technologies was also organised for the participants. Participants were handed over various types of saplings and seeds for propagation at their Unit locations.

TRAINING ON CUCURBIT CULTIVATION AMONG FARMERS OF SALARI VILLAGE IN ARUNACHAL PRADESH

Salari village in West Kameng district of Arunachal Pradesh is popular for growing oranges and tomato. Most of the farmers cultivate tomato for two seasons, mostly under contract cultivation. They grow other crops for self consumption only. With an aim to popularize cucurbit cultivation among the local farmers, Defence Research Laboratory (DRL), Tezpur, conducted training programme on raising seven varieties of cucurbit like Cucumber, Bitter Gourd, Bottle Gourd, Sponge Gourd, Ridge Gourd, Ash Gourd and Pumpkin. DRL also distributed cucurbit seedlings to 110 farmers. Farmers were also trained on method of cultivation of these crops. Periodic visit to farmer's field is made to record on-field performance of the crops.

SKILL DEVELOPMENT-CUM-TRAINING PROGRAMME ON MUSHROOM CULTIVATION, VEMICOMPOSTING AND SOIL HEALTH

A training course was conducted at Military Station, Hattigor, Assam, jointly by DRL, Tezpur, and 21 Arty Bde, Hattigor during 14-15 May 2019 under DRDO Programme Arunodaya. Lectures on mushroom cultivation, vermicomposting and soil health were delivered by faculty of DRL. Demonstrations on soil health and hands-on training on mushroom cultivation and vermicomposting were given to the participants. One JCO, 51 ORs from different units of lower Assam including ex-servicemen attended the course. Technical bulletin and calendars on the topics were distributed among the participants.

WORKSHOP ON WATER: ISSUES, CHALLENGES & FUTURE TECHNOLOGIES FOR NE INDIA

A workshop on Water: Issues, Challenges and Future Technologies for North East India was organized by DRL, Tezpur, on 21 May 2019 under the programme Arunodaya. Senior Army Officers and ORs from the services attended the workshop. Dr SK Dwivedi, Director, DRL, emphasized on the importance of water research. Dr Vanlalhmuaka, Sc 'E' briefed about the workshop. Dr GN Sastry Director, CSIR-NEIST, Jorhat, the Chief Guest, in his inaugural speech briefed about the importance of water and its purification and gave a glimpse of R&D activities of CSIR-NEIST. Brig AK Jindal, YSM, Med 4 Corps talked about different contaminant, standard limits, prescribed by regulatory bodies like WHO, BIS and the importance of clean water for human health. Dr Rama Dubey, Sc 'E' presented a talk on water related activities at DRL. Seventy participants from Army, Air Force, ITBP, SSB, MES, NERIWALM, Tezpur University, NIT Nagaland and industry attended the workshop.

WORKSHOP ON NAVAL REQUIREMENTS IN MATERIALS RELATED TECHNOLOGIES

Naval Physical and Oceanographic Laboratory (NPOL), Kochi, organized a one-day interactive workshop on Naval Requirements in Materials Related Technologies on 7 June 2019 for naval officers. Shri S Vijayan Pillai, OS and Director, NPOL, inaugurated the workshop and delivered the keynote address wherein he emphasized the need to cater the user requirements for interactions with Navy. Dr Reji John, Sc 'G' presented a brief outline of the envisaged project "Materials Technology for SONAR". Dr K Ajith Kumar, Sc 'G' and Dr T Mukundan, Sc 'G' highlighted the importance of interactions with Navy before launching any project. Cdr. Dini Prakash, OIC, Machine Trial Unit, Southern Naval Command, Kochi, Cdr. A. Sanjayan, Directorate of Marine Engineering (Naval HQ, Delhi), Cdr. (Dr) Swaroop Das, Directorate of Indigenization (Naval HQ, Delhi) and Lt. Cdr. NK Jha, Naval Trial and Acceptance Authority, Mumbai, represented the Indian Navy team. The team made a presentation on immediate and futuristic requirements of technologies related to materials and products for enhancing sonar performance.

An exhibition of recently developed materials, technologies and products by NPOL was also organised for the benefit of the participants.

USER INTERACTION WORKSHOP

Snow and Avalanche Study Establishment (SASE), organized User Interaction Workshop during 12-13 June 2019 at RDC SASE Chandigarh. Shri PK Mehta, DS & DG (ACE), DRDO, was the Chief Guest of the function and Dr Chandrika Kaushik, Director, Directorate of Interaction with Services for Business, DRDO HQ, was the Guest of Honour. User interaction workshop was drived from the feedback of the users to mitigate avalanche hazard in the Indian Himalayan region and suggestions for further improvement. Participants from various Army formations and organizations, i.e, DGMO 4, Northern Command, 14 Corps, 15 Corps, 16 Corps, High Altitude Warfare School, Gulmarg, ITBP, BRO, BSF, National Disaster Management Authority, attended the workshop. Many action points like faster dissemination of avalanche warnings to the end users, avalanche mapping of avalanche prone areas in Uttarakhand Himalaya, avalanche prediction for north-east Himalaya, interaction with state Disaster Management Authorities and National Disaster Response Force, etc. were discussed during the workshop.

SEMINAR ON ADVANCED MATERIALS AND MATERIALS TECHNOLOGIES

To commemorate the Decennial Celebrations of TR Anantharaman Education and Research Foundation (TRAERF), Hyderabad, TRAERF and Defence Materials and Stores R&D Establishment (DMSRDE), Kanpur, jointly organized a four-day National Seminar on Advanced Materials and Materials Technologies for Prototypes and Systems (AMMTPS-2019) in association with JATC IIT-Delhi and SFA Kanpur Chapter, with active participation of 160 engineers from OFs, HAL, PSUs, MSMEs, UP Corridor industries, scientists from DRDO and other organisations, and faculty members from IIT-BHU, IIT-Kanpur, IIT-Delhi, NIT Nagpur, NIT Jamshedpur, AU, Visakhapatnam, PSG College, Coimbatore, and UPTTI, Kanpur. Besides, 75 meritorious students and research scholars of various laboratories and engineering colleges of Kanpur also attend the national seminar. A technical exhibition on Advanced Defence Products was organized in which 12 large industries showcased their products and software capabilities directed towards defence production. As many as 2000 students and learned citizens of Kanpur visited this technical exhibition.

The principal aim of the AMMTPS-2019 were two-fold: to evolve roadmaps for the development and deployment of advanced materials, and to develop materials technologies and materials systems for the futuristic requirements of systems in general and for Indian Defence in the areas of Missile, Aero and Naval applications in particular. A keynote lecture on Materials for Future Defence Systems, by Dr SV Kamat, DS & DG (NSM), DRDO, 12 invited lectures by leading systems/programme Laboratory Directors of DRDO, 5 detailed technical interaction sessions and a special brainstorming session on Re-establishing Innovative Research in DRDO, Chaired by Professor Shrikant Lele, Former Director, IIT-BHU & Chairman, LRC, DMSRDE were the key components of the seminar.

Prof. P Rama Rao, President, TRAERF; Dr G Malakondiah, Treasurer, TRAERF; Dr K BhanuSankara Rao, Trustee, TRAERF; Prof. D Banerjee, LM Manocha, V Ramaswamy, Vakil Singh, RK Mandal, NK Mukhopadhyay, P Venkitnarayanan, Anish Upadhyay, Dr V Bhujanga Rao, KU Bhasker Rao, MZ Siddique, Vikas Kumar, N Eswara Prasad, AK Ghosh, Manoranjan Patri, Air Cdre. DB Murali, VSM, chaired the various technical sessions.

A special report prepared on the proceedings of AMMTPS-2019 will be submitted to NITI Aayog and DRDO with recommended roadmaps and the salient pointers for future initiatives for advanced materials and materials technologies for Indian Defence.

ISSA DIAMOND JUBILEE LECTURE

Institute for Systems Studies and Analyses (ISSA), Delhi, organised its Ist Diamond Jubilee Lecture on Values which Spur Creativity and Innovation by Shri TD Chandrashekhar, BCCL and Anti-Satellite Weapons and Space Warfare by Gp. Capt. Ajey Lele (Retd), IDSA on 30 May 2019.

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

APPOINTMENT

DIRECTOR, CAIR

Dr Upendra Kumar Singh has assumed the charge of Director, Centre for Artificial Intelligence and Robotics (CAIR) Bengaluru, with effect from 1 June 2019. Prior to this, he was Director, Defence Bioengineering and Electromedical Laboratory (DEBEL), Bangaluru from 1 January 2015 to 31 May 2019. He has worked as Project Director (Weapon Systems) for Ballistic Missile Programme, Research Centre Imarat (RCI), Hyderabad from July 2012 to December 2014.

Dr Singh did his MSc and MTech in Computer Science from DAVV, Indore and obtained his doctorate from University of Hyderabad on Soft Computing. Starting his career in ATV Project in Ship building Centre (SBC), Visakhapatnam in October 1989, he moved to Naval Science and Technological Laboratory (NSTL), Visakhapatnam, in 1992 where he worked for system simulation and embedded software development of On-Board Computer of lightweight and heavy-weight torpedoes.

In his 30 years of service so far, Dr Upendra Kumar Singh has closely worked with Indian industries, academia and foreign firms for the realization of advanced weapon systems for the services. As Director, DEBEL, he was engaged in meeting critical requirements of the Indian Armed Forces and steered many Life-Support Systems such as Protective Equipment and Integrated Life Saving System for LCA Tejas, Underwater Submarine Escape System, Individual Underwater Breathing Apparatus, NBC Protective Equipment and many biomedical devices and equipment such as Telemedicine System for Navy and Army, Wearable Soldier Physiological Monitoring System, Military-grade Portable Physiological Parameter Monitor and high altitude life saving devices.

A propagator of self-reliance, he has successfully spearheaded Transfer of Technology (ToTs) to many industries and encouraged private and public institutes participation in development and product activities.

He is also the CEO of the Society for Biomedical Technology (SBMT) started by Dr APJ Abdul Kalam to help the common man with development of affordable biomedical devices. A staunch supporter of indigenous and affordable health care development, he spearheaded many products such as Cochlear Implant, MEMS Intracranial Pressure Monitor and Electrocorticogrpahy Sensors, External Counter Pulsator, Virtual Laparoscopic Simulator, and Above Knee Prosthesis to get into the clinical trials and ToT to Industries.

He has published/presented many papers in national/international conferences. He is a recipient of DRDO Award for Path Breaking Research/ Outstanding Technology Development and Laboratory Scientist of the Year Award. He is a Life member of the Institution of Electronics and Telecommunications Engineers (IETE), Computer Society of India (CSI) and Aeronautical Society of India (AeSI).

AWARDS

COMMENDATION CERTIFICATE OF FLAG OFFICER C-IN-C EASTERN NAVAL COMMAND

Shri Arvind Kumar Mahla, Sc 'F', Institute for Systems Studies and Analyses (ISSA), Delhi, has been awarded Flag Officer Commanding-in-Chief, Eastern Naval Command Commendation for successful implementation network gaming trials of ARNAV Wargaming Software.

WILEY REVIEWER CERTIFICATE

Dr Vishal Kesari, Sc 'E' of Microwave Tube Research and Development Centre (MTRDC), Bengaluru received the Reviewer Certificate of Wiley for

his contribution towards the review of the manuscripts for the International Journal of Numerical Modelling: Electronic Networks, Devices and Fields, Wiley (USA) for the year 2018.

BLOOD DONATION CAMPS

Combat Vehicles Research and Development Establishment (CVRDE), Chennai Poor Children Educational Trust organised 31st Blood Donation Camp on 1 May 2019 at CVRDE Residential Premises, Avadi. Shri V Balamurugan, OS and Director, CVRDE, issued certificates to the donors. The trust further conducted 32nd Blood Donation Camp on 3 May 2019 in association with M/s Borg Warner, Kakkalur, near Thiruvallur at their premises. Director, M/s Borg Warner and Shri Ponnusamy, AD (Admin), CVRDE issued certificates to the donors. One hundred and three units of blood were collected with support from Kilpauk Medical College.

HEALTH CAMP AT SALARI DETACHMENT IN ARUNACHAL PRADESH AND DRL, TEZPUR

Defence Research Laboratory (DRL), Tezpur, in association with Institute of Nuclear Medicine & Allied Sciences (INMAS), New Delhi, organized a Health Camp during 29-30 April 2019 at DRL Detachment, Salari, Arunachal Pradesh. A team of specialists from Department of Medicine, Gynaecology, Paediatrics, ENT, Ophthalmology and Dental from INMAS and Tezpur Medical College examined the patients and provided their expert suggestions.

Around 260 patients from Salari and adjacent villages benefited from the camp. Free medicines were distributed during the camp. A similar health camp was also organized at DRL Tezpur on 1 May 2019 for the employees of the laboratory, contract workers and their family members.

WEST ZONE CARROM TOURNAMENT

High Energy Materials Research Laboratory (HEMRL), Pune, successfully organised DRDO West Zone (Intra-Zonal) Carrom Tournament. The tournament was inaugurated by Dr SM Pande, Sc 'G', Chairman, Works Committee, HEMRL. Teams from West Zone, i.e., ARDE and R&DE(E), Pune, MSC, Begdewadi, Pune, VRDE, Ahmednagar, NMRL, Mumbai and ACEM, Nasik, besides HEMRL participated in the tournament. Players from these teams competed under various categories enthusiastically. The carrom tournament was conducted for the different events, viz., Team Championship, Men's Single, Men's Double, Women's Single, Women's Double and Veteran's Single, to make the tournament more competitive and interesting. Shri Dattatray Salagare, from Pune District Carrom Association was the Chief Referee for the tournament. ARDE, Pune team was winner of the Team Championship and HEMRL, Pune team was the Runners-Up.

Shri DK Kankane, Associate Director, HEMRL, gave away the trophies and the medals to the winners and the runners-up.

READERS' VIEWS

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

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2. **How would you rate the *DRDO Newsletter* as a medium to adequately present DRDO developments?**

   Excellent ◻ Very Good ◻ Good ◻ Fair ◻ Satisfactory ◻

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DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 4: MARCHING FORWARD

The article is 40th 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

The activities of the Laboratory were directed toward passive phased arrays instead of mechanically scanning reflector type antennas, high range resolution waveforms, high angular resolution beams, digital signal processors, multi-microprocessor-based radar data processing, improved algorithm for the tracker performance, and man-machine interface, multi-moding in radars and multi-target tracking capability. In the field of communications as the 1970's opened for LRDE, two projects in this area, namely the Sound Ranging System and the Automatic Electronic Exchange {(40+12) lines}, were ongoing activities. The Sound Ranging System development was completed, the System was evaluated by the Army and on approval for introduction into Service, technology was transferred to M/s ECIL, Hyderabad for manufacture and supply.

The Automatic Electronic Exchange {(40+12) lines}, was the first of the developments to be undertaken by LRDE for Plan AREN. In this decade as well as in the next decade, a major part of the development activities of LRDE would be directed toward the design and development of Plan AREN equipment. LRDE was in the unique position of being the developing agency for three distinct families of switching systems, namely, manual switchboards, automatic electronic switches for local calls, and integrated switches for trunks. In each category, the developmental activities were aimed at integrating progressively and at the earliest, relevant technological advancements as they were taking place.

In the manual switch boards, the emphasis was on increased reliability with reduction in weight, size, and power consumption. A solid state 15-line manual exchange with push button control, CMOS devices for low power consumption, solid state cross-points for reliability and compactness, was developed, user evaluated, and technology was transferred to BEL, Bangalore for re-engineering and production.

In the automatic electronic switching systems, the designs progressed from wired, program-controlled space division multiplexed analogue switching matrix to time division multiplexed digital switching matrix, using advanced control concepts and component technologies. The first of the development projects in this area was the Automatic Electronic Exchange [(40+12) lines] which was taken up for development in 1968. In this pre-microprocessor era, wired program control was implemented using discrete devices. A three-stage solid state switching matrix was employed with reed relay cross-points in the early version as speech path switching elements. As technology advanced, reed relays were replaced by silicon-controlled rectifiers, and still later, by CMOS cross-points with very low power consumption. For the first time in the country, an Exchange provided the subscribers with sophisticated facilities such as multi-level priority, conference, and call-transfer. The design of the exchange was modular in that by adding an identical switching matrix the capacity was doubled, i.e., [(80+24) lines]. In 1972, the Army evaluated the laboratory model of SWITEL, preferred LRDE's equipment to that of our indigenous competitor and cleared it for industrial prototype and manufacture by M/s ITI, Bangalore.

The modularity of the SWITEL was not extended to the Corps level electronic exchange with [(160+48)] lines because by the time SWITEL was productionised, component technology had advanced to a point where time division switching of digitised speech signals could be considered. The development of the time division switch TIDEX, was sanctioned in 1978 with basic modularity of (40+12) lines and expandable up to [(160+48) lines]. TIDEX was modular with a processor and switch (PAS) unit, a subscriber unit, an ac/dc power supply unit and a derived power supply module. For expandability, only the subscriber unit was added up to a maximum of four. PAS, the core of the equipment, contained a digital switch and dual microprocessors operating in a load-sharing mode. The digital switch was a single-stage time switch with four input and four output TDM highways, each having a gross bit rate of 2 megabits and 64 time slots. The subscriber unit

contained the trunk and line interface for 40 lines and 12 trunks. TIDEX offered all the call processing facilities of SWITEL. Facilities were provided for the operator through his console to carry out diagnostics, isolate faulty circuit modules, and reconfigure the Exchange. Call processing, diagnostic, as well as man-machine interaction software were also developed for the Exchange. The changeover to digital switching resulted in smaller size, lesser weight, greater flexibility and higher reliability for the Exchange. The laboratory model was evaluated by the Army in 1982 and cleared it for industrial prototype and manufacture at M/s Bharat Electronics Ltd, Bangalore.

For the trunk switch, LRDE had persuaded the Army in 1968 to opt for the futuristic digital time division multiplexing instead of space division, as the former would provide an integrated facility for voice, data and teleprinter and also would reduce the complexity of the switching network. The Automatic Electronic Switch (AES) as it was called, was designed as a real-time stored, programme-controlled, time division multiplexed (TDM) trunk exchange catering for 192 voice circuits/32 data channels/256 teleprinter channels. It was a full availability communication system centred around a time-space digital switch with capability to handle 16 TDM highways of 12 channels. AES system comprised synchroniser, front-end processor, digital switch, main processor, local switchboard and system monitor. Two new design concepts were implemented in the digital switch. To ensure process integrity and operational reliability, dual processors were employed in hot stand-by mode with module-level synchronisation between the processors. The other novel concept was the use of hard wired, front-end processor for extracting signalling information from the TDM highways and passing the reduced signalling data to the main processor. The software was modular in nature with watch dog timer for programme sanity checks and included real-time hardware/software diagnostics. The AES had the following additional features namely, adaptive routing, priority pre-emption, fail-soft networking, and operator's command memories. Thus, the design of AES by LRDE incorporated functional modularity, processing integrity, operational reliability, and ease of operation and maintenance. The laboratory model of AES was given the "go ahead" signal for industrial prototype to be fabricated by BEL, after its operation with other Plan AREN equipment was demonstrated in 1979. The industrial prototypes based on LRDE design along with that of our indigenous competitor were extensively tried out over a period of six months of User and troop trials before the LRDE design was recommended for production by BEL, Bangalore in November 1982.

Two more Plan AREN projects namely, the development of Radio Trunk Extension (RTS) and Radio Local Extension (RLS) systems, were undertaken for development in this period. RTS was expected to provide to mobile subscribers (Gypsy) access into the Plan AREN grid network. It was a duplex, digitised voice radio telephone system. It was also capable of operating in the stand-alone mode. The RLS was also meant to connect a mobile subscriber to the Plan AREN local exchange. The system was designed to operate in the VHF band using demand-assigned pooled channel approach to a maximum of 10 subscribers in clear as well as in secure voice modes of working. The hardware was under development in the first quarter of the 1980s.

LRDE was equally active in the development of transmission and secrecy equipment in keeping with the technological advancements. LRDE was the first to propose time division multiplexer with speech/data based on Adaptive Delta Modulation (ADM) coding. This would particularly suit military networks because of its tolerance to high transmission error rates. The technology was progressively updated in this period so that by the end of the 1970s, the design was based on CMOS technology and active filters and provided expansion capability in 6 channel steps. LRDE also developed a family of speech secrecy equipment using both analogue and digital encryption. Time domain analogue scramblers based on rolling codes, digital encryption employing crack resistant codes were developed for single-channel, multichannel, frequency division and ADM multiplexers. A number of these were evaluated by the users, accepted for introduction into the Services, and were under production in the required numbers at the LRDE pilot plant. Some of the other project activities of LRDE were, the development of the commutated Aerial Direction Finder for the Indian Air Force, Radio Frequency Suppression Kits for vehicles, avalanche-victim detector, and emergency firing unit for Vijayanta tanks. All of these were taken up at the instance of the Services. These were evaluated by the Users, accepted for introduction into the Services and technology was successfully transferred to production.

LRDE and DRDO had the satisfaction of having contributed greatly to the indigenisation of the Army's tactical communication network. It would not be out of place to mention that but for the vision and courage of technology of that period would not have materialised from indigenous efforts. Contrast these developments for the military with the corresponding developments in switching systems on the civil side. The technology of the civilian telephone exchanges in the 1970s and 1980s was either Strowger or crossbar in our country.

To be continued...

VISITORS TO DRDO LABS/ESTTS

ANURAG, HYDERABAD

Lt Gen PJS Pannu, PVSM, AVSM, VSM, Deputy Chief of Integrated Defence Staff (DOT), along with members of training establishments and other members of DOT Branch of HQ IDS visited Advanced Numerical Research and Analysis Group (ANURAG), on 28 May 2019. Dr JVR Sagar, OS and Director, ANURAG, briefed the guests about the technical activities of ANURAG. The guests were given brief demo of various products being developed by ANURAG.

CAIR, BENGALURU

❄ Vice Admiral MA Hampihole, AVSN, NM, DGNO, visited Centre for Artificial Intelligence & Robotics (CAIR) on 20 May 2019. The guest was briefed by Director, CAIR, followed by discussion and demonstration of technologies developed by the Centre in the area of Secure Systems, Intelligent Systems and Robotics and Command and Control systems.

❄ Lt Gen Rajesh Pant (Retd), National Cyber Security Coordinator, visited CAIR on 21 May 2019. There was a briefing by Director CAIR, followed by discussion and demonstration of technologies developed by CAIR in the area of Secure, Intelligent, Robotics and Command and Control systems.

DEAL, DEHRADUN

❄ Vice Admiral SV Bhokare, AVSM, YSM, NM, visited Defence Electronics Application Laboratory (DEAL) on 15 May 2019. He was briefed about the various ongoing projects and activities by Shri LC Mangal, Sc 'H'. He visited various groups in the laboratory and was acquainted about the major projects including Software Defined Radio (SDR), Advanced Data Links System, Integrated Coastal Surveillance System, VLF Communication, etc. He lauded DEAL for developing state-of-the-art systems for the services.

❄ Rear Admiral Mukul Asthana, NM, ACNS (Air), visited DEAL on 24 May 2019. He was given first hand information about the different ongoing projects and activities of the laboratory by Shri PK Sharma, Director, DEAL. The guest was apprised of various projects, i.e., Rustom-2, Software Defined Radio, GSAT-6, Integrated Coastal Surveillance System (ICSS), Troposcatter Communication, VLF Communication, Satellite Imagery Software Exploitation, etc. He took keen interest in these projects and appreciated the progress made by DEAL in the development of these high end communication and surveillance systems.

DMRL, HYDERABAD

Lt Gen PJS Pannu, PVSM, AVSM, VSM, Deputy Chief of Integrated Defence Staff (IDS) of the Tri-Services visited Defence Metallurgical Research Laboratory (DMRL), on 28 May 2019

along with the members from Doctrine, Organisation & Training (DOT) Branch of IDS HQ. Dr Vikas Kumar, DS and Director, DMRL, briefed the visitors about the activities of the laboratory aided by a video show on DMRL.

HEMRL, PUNE

Air Vice Marshal Vivek Rajhans, VSM, Commandant, Military Institute of Technology, Pune, visited High Energy Materials Research Laboratory (HEMRL) on 30 May 2019. Dr Manoj Gupta, OS and Officiating Director, HEMRL, briefed the visitor about the activities of HEMRL. Presentation on the projects related to Solid Rocket Propellants, Tank Protection Systems, Flares for Aircraft Protection, Gun Propellants and High Explosives were given by the senior scientists of HEMRL.

AVM Vivek Rajhans being presented a memento by Dr Manoj Gupta, OS, HEMRL

INMAS, DELHI

Air Marshal RK Ranyal, VSM Dy Chief Integrated Defence Staff (Medical), visited Institute of Nuclear Medicine and Allied Sciences (INMAS), Delhi on 7 May 2019. Dr Tarun Sekhri, Director, Institute of Nuclear Medicine and Allied Sciences (INMAS), briefed him about the R&D activities of the institute. He visited Nuclear Magnetic Resonance (NMR) Division, Natural Radiation Response Mechanism Lab and Radiation Biodosimetry Lab of the institute. The ongoing projects and selective objectives were demonstrated through experiments designed by the senior scientists. Air Marshal took keen interest in the activities and lauded the R&D endeavours of INMAS. He also delineated his desire for long term R&D association with INMAS.

Air Marshal RK Ranyal being briefed about the lab activity at INMAS