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INDIA NEUTRALISES LIVE SATELLITE IN LOW EARTH ORBIT ENGAGEMENT

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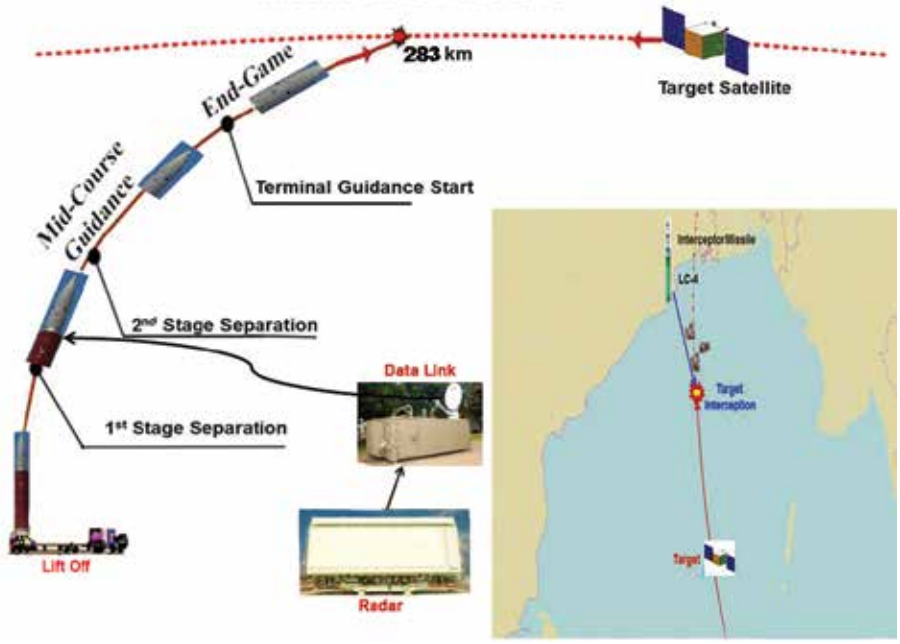
INDIA JOINS SELECT GROUP OF NATIONS, NEUTRALISES LIVE SATELLITE IN LOW EARTH ORBIT

DRDO successfully conducted an Anti-Satellite (A-SAT) missile test 'Mission Shakti' from Dr APJ Abdul Kalam Island in Odisha on 27 March 2019. A DRDO developed Ballistic Missile Defence (BMD) Interceptor Missile successfully engaged a live Indian satellite orbiting in Low Earth Orbit (LEO) in a 'Hit to Kill' mode. The interceptor missile was a three-stage missile with two solid rocket boosters. Tracking data from range sensors confirmed that the mission met all its objectives.

The test demonstrated India's capability to defend its assets in outer space. It is a vindication of the strength and robust nature of DRDO's programmes.

With this India joins a select group of nations with such a capability. The test has once again proven the potential of indigenous weapon systems.

With the successful 'Hit to Kill' test, India becomes the fourth country to do so.



ASAT Mission on 27 March 2019

MISSION SHAKTI IS A DETERRENCE CAPABILITY: DR G SATHEESH REDDY

The anti-satellite (ASAT) test, Mission Shakti, conducted on 27 March is a "deterrence interceptor" and the missile can cover all satellites in Low Earth Orbit (LEO), said Dr G Satheesh Reddy, Secretary, Department of Defence R&D (DDR&D) and Chairman DRDO in a press conference on ASAT test on 6 April 2019. We have developed guidance and control algorithm to do interception at 1,000 km above the earth and hitting multiple satellites is feasible, said Dr Reddy.

The space has gained importance in the military domain, and the best way of defence is to have deterrence said Dr Reddy on a question on militarisation of space.

Giving details of the test, Dr Reddy said that the first discussion on the test started in 2014. A detailed presentation was made in 2016 and it took us two years to develop the system. The major challenges in the mission were to achieve 'hit to kill' a live satellite with an accuracy less than 10 cm. All critical technologies for the test have been developed indigenously, he further added. Around 150 scientists worked hard in the past six months and about 2,000 components were sourced from 50 private industries.

Dr Reddy also allayed the fear of threat from debris created by the test to the International Space Station (ISS). "LEO was chosen after extensive simulations with primary objective being to minimise debris. It was intentionally done at 280 km altitude so that debris decay fast," said Dr Reddy. The interception was designed to hit at an angle so that minimal debris goes up and also have minimal velocity. "Some of the debris have already decayed. Our simulations show all debris will decay in 45 days," he added.

DRDO SUCCESSFULLY TEST FIRED INDIGENOUS MAN PORTABLE ANTI-TANK GUIDED MISSILE

In a major boost for Army, DRDO successfully test fired indigenously developed, lightweight, fire and forget Man Portable Anti-Tank Guided Missile (MPATGM) for the second time on 14 March 2019 in the Rajasthan desert. The missile was also tested on 13 March 2019. The tests achieved the mission objectives successfully.

The MPATGM comprises advanced features including state-of-the-art Imaging Infrared Radar (IIR) Seeker with integrated avionics. In both the missions, the missiles hit the designated targets precisely at different ranges.

SUCCESSFUL TRIAL OF NIRBHAY SUB-SONIC CRUISE MISSILE

DRDO successfully test fired indigenously designed and developed Long Range Sub-Sonic Cruise Missile Nirbhay on 15 April 2019 from the Integrated Test Range (ITR), Chandipur, Odisha. Nirbhay has been developed by DRDO's Bengaluru-based Aeronautical Development Establishment (ADE).

It was the sixth development flight trial of the missile to prove the repeatability of boost phase and cruise phase using way point navigation at very low altitudes. The missile took off vertically and turned horizontally in the desired direction. The booster separation, wing deployment, engine start, and cruise to the intended way points happened with the text-book precision. The missile demonstrated its sea-skimming capability to cruise at very low altitudes.

The entire flight was tracked by a chain of Electro Optical Tracking Systems, Radars and Ground Telemetry Systems deployed all along the sea coast. All the mission objectives were met.

LASTEC TRANSFER TECHNOLOGY FOR LASER FENCE SYSTEM

Laser Science and Technology Centre (LASTEC), Delhi, transferred technology of Laser Fence System (LFS) to PSU Central Electronics Limited (CEL), Sahibabad, on 11 March 2019. Shri Hari Babu Srivastava, OS and Director, LASTEC, handed over Licensing Agreement for Transfer of Technology (ToT) along with ToT Document to CMD, CEL, Dr Nalin Singhal. Dr Mayank Dwivedi, Director, Directorate of Industry Interface and Technology Management (DIITM), DRDO HQ, members LFS team and senior officials from LASTEC and CEL were present on the occasion.

The LFS developed indigenously by LASTEC is a field deployable laser fence system. The invisible, virtual laser wall, helps in detection of intrusion into restricted areas/vital installations/ high value assets and boundaries. It is rugged, reliable, has minimal power requirements, offers day/night operability and has been evaluated in the field areas.

TECHNOLOGY TRANSFER OF PDDS TO BEL

The Licensing Agreement for Transfer of Technology (LAToT) of Portable Diver Detection Sonar (PDDS) was signed between Naval Physical and Oceanographic Laboratory (NPOL) and Bharat Electronics Limited (BEL), Bangalore on 15 March 2019. Shri TD Nandakumar, AGM (Naval Systems-1), BEL handed over the first-stage ToT fee to Shri S Kedarnath Shenoy, OS and Director NPOL, at a function organised at NPOL.

Designed and developed by NPOL, PDDS is a portable sonar system capable of detecting potential underwater threats like, divers and diver delivery vehicles in shallow waters. The system alerts the operator with the type of threat so that effective countermeasures can be initiated in time. The system can be deployed either outboard from a ship or at any location in a harbour. As an auto-alert system, PDDS performs detection, tracking and classification of divers or diver-like targets automatically and alerts the operator accordingly.

TECHNOLOGY TRANSFER OF HNS

Defence Metallurgical Research Laboratory (DMRL), Hyderabad transferred the production technology of nickel free High Nitrogen Steel (HNS) for armour applications to Midhani, Hyderabad. The HNS has high strength coupled with excellent ductility and impact properties and has shown improved ballistic properties against small calibre ammunitions and equal performance against large calibre ammunitions compared to that of Rolled Homogeneous Armour (RHA) with almost half of the cost of RHA. The steel has many other potential applications also.

Dr Vikas Kumar, DS and Director, DMRL, handed over the ToT document to Dr DK Likhi, Chairman and Managing Director, Midhani, on 5 March 2019. Dr Samir V Kamat, DS & DG (NS&M), DRDO, and other senior officials of DMRL and Midhani were present on the occasion.

EVENTS

CEPTAM CELEBRATES 23RD RAISING DAY

Centre for Personnel Talent Management (CEPTAM), Delhi, celebrated its 23rd Raising Day on 12 March 2019 with great zeal and enthusiasm. Dr G Satheesh Reddy, Secretary, Department of Defence R&D and Chairman DRDO graced the occasion as the Chief Guest. Shri KS Varaprasad, OS & DG (HR), DRDO, was the Guest of Honour. The event was attended by former Chairpersons and Directors of CEPTAM, Directors of Delhi-based sister labs and CEPTAM employees.

Dr Vijaya Singh, OS and Director, CEPTAM, welcomed the august gathering and presented a glimpse of CEPTAM's achievements during 2018. Shri Sudhir Gupta, OS, Chairman CEPTAM and DG (TM) shared his vision about future thrust areas of CEPTAM and identified potential areas of improvement. Shri Varaprasad appreciated the efforts of CEPTAM in successfully implementing Computer Based Test (CBT) for recruitment of STA 'B'. He also stressed upon the need to link training with career progression. Dr Reddy in his address congratulated CEPTAM on completing 23 years of meaningful existence and acknowledged its contribution in the area of HRD for DRTC and Admin and Allied cadre. He advised CEPTAM to reduce time of future recruitment cycles and for creation of future training roadmap. Achievements of last five years were projected to Dr Reddy through poster presentation, display of CEPTAM publications/documents. Dignitaries also planted the saplings.

Chairman DRDO being briefed about achievements of CEPTAM

INTERNATIONAL WOMEN'S DAY CELEBRATIONS

Release of Workshop Proceedings on the International Women's Day celebration at ARDE, Pune

International Women's Day (March 8) is a call for gender parity and global celebration of economic political, and cultural achievements of women. The following DRDO labs/estts also celebrated International Women's Day to celebrate the achievements of their women scientists.

ARDE, Pune

Armament Research & Development Establishment (ARDE) celebrated International Women's Day (IWD) by organising a workshop "Stree as Manager, Innovator, Leader, Entrepreneur and Scientist (SMILES 2019)." The theme was chosen in recognition of the multi-faceted roles played by working women, and their multi-tasking skills. Smt Rekha Sharma, Chairperson, National Commission for Women, inaugurated the workshop.

Maj Gen (Dr) Madhuri Kanitkar, AVSM, VSM, Dean and Deputy Commandant of Armed Forces Medical College (AFMC) was the Guest of Honour on the occasion. Dr G Satheesh Reddy, Secretary, Department of Defence R&D and Chairman, DRDO, Shri PK Mehta, DS and Director General (ACE) and Dr KM Rajan, DS and Director, ARDE were present. Lab Directors, Corporate Directors, senior scientists and nearly 250 delegates from over 50 DRDO labs took part in the celebrations. Dr KM Rajan welcomed the august gathering.

In her inaugural address, Smt Sharma appreciated the innate abilities of women and the role they play as a dynamic manager, innovator, and a leader every day at home and at work. She emphasized that thrust should be given to changing the mindset of the society for the advancement of women. Maj Gen Kanitkar, in her motivating talk, implored women to take care of their health to give their best at work and at home. She also advised that women and men should 'grow together without growing apart'.

In his presidential address, Dr Satheesh Reddy praised the contributions made by women scientists of DRDO, crediting them with the success of many noteworthy products, and requested them to stay at the forefront for developing world class systems. He expressed confidence that the women work force in DRDO would go up from 15 per cent to 50 per cent in the next five years. Dr Reddy strongly recommended that Women's Cells of DRDO labs should identify and organize specific social works for the uplifting of the society. Shri PK Mehta appreciated the multiple roles played by women in the professional and personal lives. The Workshop Proceedings, comprising more than 40 papers contributed by DRDO women employees were released by the dignitaries. Dr KM Rajan, and Dr (Smt) SD Naik, Convener of IWD 2019 also handed over the Deepalakshmi to the representative of Naval Physical and Oceanographic Laboratory (NPOL), Kochi, which has been designated as the host of IWD 2020.

As a social initiative, a Mini Market was set up for the sale of hand made products created by Yerawada Jail inmates, Shri Sai Baba Home for Aged and Blind Women and Shramik Nari Sangh. Several other stalls selling Pune's special merchandise formed a part of the Mini Market. The cultural programme, "Smiles Sanskriti", showcasing the culture of Maharashtra through folk dances and Mallkhamb rope and pole gymnastics was appreciated by all.

CAIR, Bengaluru

The celebrations started with address by Smt Manimozhi Theodore, Director,

Centre for Artificial Intelligence and Robotics (CAIR), who elucidated contributions of women at work place and how mother has positive impact on the children and how it inspires the entire family to strive better in life. All women CAIR employees, development partners, contract employees, student trainees and casual workers actively participated in activities organised to celebrate the occasion. Winners were given attractive token prizes.

DMRL, Hyderabad

Dr Vikas Kumar, DS and Director, DMRL, presided over the IWD function. Dr G Jagan Reddy, Sc 'G' and Chairman, DMRL Works Committee, welcomed the gathering. Shri K Srikanth Goud, President, DMRL Workers' National Union and Shri B Rambabu, Vice Chairman, Works Committee, also addressed the gathering. Prof. S Sameen Fatima, Principal, University College of Engineering, Osmania University, Hyderabad, the Chief Guest of the function delivered the keynote address on "IQ and EQ: Finding the Balance." Dr S Banumathy, Sc 'E' and Convenor, DMRL Women's Cell, presented a report on the activities carried out by the Cell during the past one year. She also elaborated the achievements made by women employees of DMRL.

NMRL, Ambernath

Naval Materials Research Laboratory (NMRL) celebrated IWD with great joy. The celebration commenced with an address by Dr M Patri, Director, NMRL, wherein he congratulated the entire female workforce of NMRL and encouraged them to bring more laurels to the laboratory as innovators and leaders. Dr (Smt) BK Sapra, SO 'H', BARC, was invited as the Chief Guest. A Guest Lecture by Dr Harvinder Palaha, SNEHA Foundation, was arranged on this occasion. First Lady of NMRL also graced the occasion and greeted all women. The Chief Guest and the Guest Speaker spoke about the essence of modern woman self-explained with this year's DRDO IWD's theme: SMILES.

NSTL, Visakhapatnam

Naval Science and Technological Laboratory (NSTL), celebrated IWD in a befitting manner on 8 March 2019 with the active participation of women employees as well as spouses of male employees. Smt M Kavita, Director, M/s HBL, Hyderabad, and Dr (Smt) B Sri Krishnaveni, Deputy Commissioner (Transport), Vizianagaram, were present as the Chief Guest and the Distinguished Guest of Honour, respectively. Dignitaries paid floral tributes to Smt Sarojini Naidu, the icon of IWD 2019.

Dr Nandagopan in his address spoke about how DRDO's is encouraging her women employees and providing them opportunities by placing them in decision-making positions.

Dr Krishnaveni gave an insightful talk on traditional lifestyle and how it helps in strengthening women. Various health awareness programmes were organised. Talks by eminent doctors, 10-day morning Yoga practice sessions and a free medical camp in association with KIMS IKON Hospital, Sheelanagar, were organised for the women employees of NSTL and spouses of male employees.

SASE, Chandigarh

Snow and Avalanche Study Establishment (SASE) celebrated IWD with great enthusiasm as a part of its Golden Jubilee celebration. Dr Seema Vinayak, Director SSPL, Delhi, was the Chief Guest and Ms Ravinder Sahi, Director, ETDC, Mohali was the Guest of Honour. Programme started with the inaugural address by Shri Naresh Kumar, Director SASE followed by the addresses of the Chief Guest and the Guest of Honour.

In her speech, Dr Seema Vinayak recounted her journey so far and praised the efforts made by the women in the field of science and technology. Highlighting the theme for this year's IWD, she emphasized that let's think equal, build smart and innovate for change to achieve good health and successful life of the women in our society. The Guest of Honour addressed the SASE fraternity and talked about challenges for women in modern society. She praised the courage of women in breaking the shackles of society. Women employees of SASE were felicitated on the occasion.

NATIONAL SAFETY WEEK CELEBRATIONS

The National Safety Week (NSW)/ Day, organized by the National Safety Council, is celebrated in India every year on 4 March to enhance the safety awareness among people. A number of safety awareness programmes about how to prevent industrial accidents are organised for the benefit of the people during the week. The following DRDO labs organised National Safety Day/Week at their respective labs.

CAIR, Bengaluru

The Safety Committee of Centre for Artificial Intelligence and Robotics (CAIR) conducted National Safety Week from 4 March 2019. Smt Desiraju Padma, Sc 'G', Chairperson, Safety Committee, gave a presentation on the safety issues at homes and apartments. An evacuation mock drill was conducted as part of the Safety Week. Demonstration of usage of different classes of fire extinguishers and the capabilities of the fire engine in extinguishing fires at high risk buildings and basements by fire fighting team from HAL. Shri Muthiah, Manager, Fire Services, HAL, gave a detailed presentation on the causes of fire and the various ways to extinguish them. A talk on the common road safety issues based on the real life incidents was given by Shri PD Sreenivasa, TO 'C', Gas Turbine Research Establishment (GTRE).

CFEES, Delhi

National Safety Week was celebrated from 4-11 March 2019. The programme commenced with Safety Oath by Centre for Fire, Explosives, and Environment Safety (CFEES). Various competitions and presentation by Safety Coordinators of various technical groups on safety initiatives in their work places were organised during the safety week.

Evacuation Mock Drill at CAIR

Safety Oath by CFEES employees

Shri RP Singh, DGM (GAIL), delivered a lecture on "Behaviour Base Safety." Scientists from CFEES also gave lecture on "Cultivate and Sustain Safety Culture" & "Safety Hazards in CFEES." The week long celebrations focused on sensitizing the employees on safe practices at work place at all working levels for accident prevention. This was in line with this year's safety theme "Cultivate and Sustain Safety Culture for building Nation."

NPOL, Kochi

Naval Physical and Oceanographic Laboratory (NPOL), celebrated NSW by conducting various competitions on different aspects of safety. The National Safety Day was celebrated on 5 March with a series of events. The programme started with flag hoisting by the senior most technician followed by safety day pledge by NPOL fraternity.

Live demo of fire fighting was conducted to enhance the awareness of fire safety in the organization. Shri Nissand G, Station Officer, enlightened the employees about the classes of fire and different type of fire extinguishers followed by talk on "Safety-Afloat" by Cdr Rajeev Maroli.

On the concluding day, Dr D Thomas, Sc 'G' and Chairman, Safety Committee, NPOL, stressed the significance of practicing safety measures in the organization. Shri Joseph John, Kochi Metro Rail Limited, delivered an enlightening talk on "Safety in Industries and Heavy Infrastructure Projects." Shri S Kedarnath Shenoy, OS and Director, NPOL, distributed the prizes to winners of Safety Week Competitions.

Fire fighting demo at NPOL

NATIONAL SCIENCE DAY CELEBRATIONS

National Science Day (NSD) is celebrated every year to commemorate the discovery of scattering of light, known as Raman Effect, by Sir CV Raman on 28 February 1928. To pay homage to the great son of India, the following DRDO labs/ estts celebrated NSD at their respective places:

ACEM, Nasik

Shri Srinivasan Seshadri, Sc 'G' and GM, Advanced Centre for Energetic Materials (ACEM), presided over the function. NSD Orations were presented by Shri Jayant Satav, Sc 'D', on "Resin Modified HTPB for Composite Solid Propellants" and Shri Samadhan Khairnar, Sc 'B', on "Introduction to Medical Diagnostic Tests." Commendation certificates were presented to them by the GM.

CABS, Bengaluru

Shri Sukhen Saha, Sc 'D', Centre for Air Borne Systems (CABS), delivered NSD Oration on ''Airborne Doppler Weather Radars."

DARE, Bengaluru

Shri Saurabh Shukla, Sc 'D', Defence Avionics Research Establishment (DARE), delivered the NSD Oration on "Ultra Wideband Linear Vivaldi Phased Array for EW Application." He was presented NSD Oration Medal and Certificate by Dr K Maheswara Reddy, DS and Director, DARE.

DRDE Gwalior

Dr Vijay Tak, Sc 'E', delivered NSD oration on "Verification of Chemical Weapons and its Challenges." Dr DK Dubey, Director, DRDE, presented NSD Medal and Certificate to the orator.

DIHAR, Leh

Defence Institute of High Altitude Research (DIHAR) organised a talk on the important technologies developed by DIHAR for the development and prosperity of Ladakh by Shri Phuntsog Stanzin, EC (Agri), LAHDC, Leh, who was the Chief Guest of the function.

Dr OP Chaurasia, Director, DIHAR, highlighted R&D achievements of the institute. Dr Vijay K Bharti, Sc 'D', delivered NSD oration on "Studies on High-Altitude Poultry Egg Hatching." He was presented NSD Oration Medal and Certificate.

NMRL, Ambernath

Dr M Patri, Director, NMRL, greeted all the employees and urged them to pursue science and technology development for the progress of nation. NSD Oration Medal was bestowed upon Dr Akshaya Kumar Satapathy, Sc 'D', for his presentation on "Metal-Air Secondary Battery as a Futuristic Energy Storage Device for Defence Application." Various competitions such as oration, science quiz, and project display were organised for students of nearby schools. The winners were awarded medals.

SASE, Chandigarh

Shri Naresh Kumar, Director, Snow and Avalanche Study Establishment (SASE), welcomed the Chief Guest, Prof. Savita Gupta, Director, UIET, Chandigarh, who delivered a talk on "Reshaping the Future with Intelligent Technologies" and explained about the use of artificial intelligence, machine learning and deep learning algorithms in reshaping the future technologies. Shri Sudhir Dhamija, Sc 'D', presented NSD oration on "Dynamic Modelling for Web Map for Snow and Avalanches." He was presented NSD Oration Medal and Certificate.

FIRST INTERNATIONAL CONFERENCE ON RANGE TECHNOLOGY

Integrated Test Range (ITR), Chandipur, the premier Test Range of the country organised the first International Conference on Range Technology (ICORT-2019) during 15-17 February 2019.

Shri AS Kiran Kumar, former Secretary, Department of Space, Chairman, Space Commission and Chairman, Indian Space Research Organisation (ISRO) was the Chief Guest and Dr Avinash Chander former Secretary, Department of Defence R&D, Director General, DRDO and Scientific Adviser to Raksha Mantri, was the Guest of Honour of the inaugural function. Shri MSR Prasad, Director General (MSS), DRDO, Patron of the Conference, also graced the occasion. Dr BK Das, OS and Director, ITR, was present as the General Chair of ICORT-2019. Dr Das welcomed guests and delegates from 17 countries and briefed about the conference.

Shri Kiran Kumar highlighted the technological achievements of India in the field of Defence and Space and emphasized on harnessing the tremendous expertise and proficiency that India possesses in technological know-how.

Release of Conference Souvenir

Dr Avinash Chander appreciated ITR for adopting state-of-the-art technologies and meeting the global standards in test and evaluation of airborne systems. He hoped that the generation next would take advantage of this conference and interact with global experts to meet future technological challenges. Shri MSR Prasad lauded the contribution made by ITR in Indian defence research programmes by providing world-class testing and evaluation facilities.

A souvenir containing the proceeding of the conference was released on this occasion.

BRAINSTORMING ON SATELLITE REMOTE SENSING OF OCEAN SURFACE FEATURES

A brainstorming session on "Advances in Satellite Remote Sensing for Exploration of Ocean Surface Features generated by Underwater Bodies" was held at NPOL on 12 March 2019 to bring together scientists, academicians and Indian Navy under a common platform for sharing innovative ideas and familiarize with advances in satellite remote sensing including current trends, technology status and future missions required for exploration of ocean features generated by underwater targets. Three DRDO laboratories including NPOL, several Naval units, research organisations like Space Application

Centre, Ahmedabad, National Remote Sensing Centre, Hyderabad, National Institute of Oceanography, Kochi, CMLRE, Kochi, and many academic institutions attended the session. Over 100 academicians/scientists from 23 institutions participated in the programme. Dr PV Hareesh Kumar, Sc 'G', highlighted the importance of the programme.

The session was chaired by Shri AS Kiran Kumar, former Chairman, ISRO and Secretary, Department of Space. In his inaugural address, Shri Kiran Kumar elucidated the current satellite programmes undertaken by ISRO which can be explored for non-acoustic detection of underwater targets.

Shri S Kedarnath Shenoy, OS and Director, NPOL, in his presidential address explained the importance of detection of submerged features using satellite-based techniques.

Presentations on underwater detection using satellite imaging and role of airborne SAR for mapping of strategic areas were made by the eminent experts.

CEPTAM ANNUAL TRAINING CALENDAR RELEASED

Annual Training Calendar 2019-20 of Centre for Personal Training and Management (CEPTAM), Delhi, was released by Dr G Satheesh Reddy, Secretary DD R&D and Chairman DRDO on 12 March 2019. CEPTAM has planned 68 training courses at 21 institutes in more than 16 cities pan India for 2019-20. These training programmes include: Induction Programme for Fresh Recruits, Orientation Training for Newly Promoted Officers, Skill Upgradation & Technical Training for DRTC, Managerial & Soft Skill Programmes and Refresher Training for Admin & Allied personnel of DRDO.

57TH SENIOR FIRE SUPERVISOR'S COURSE

Centre for Fire, Explosives and Environment Safety (CFEES), Delhi, organised 57th Senior Fire Supervisor's Course from 14 January 2019 to 8 March 2019. The course, mandatory for promotion to Station Officer for Defence Fire Services personnel, was attended by 40 participants from various MoD Organizations. The objective of the course is to enhance the career of Fire Fighting Professionals as Shift-in-Charge/Station Officer of a Fire Station by imparting them knowledge of advance aspects of fire science. A total of 87 theory and 116 practical periods on subject such as fluid dynamics, design principles of fire pumps, fire engines and fixed fire fighting systems suits, etc., and testing and maintenance of all fire equipment were conducted.

COURSE ON CHEMICAL & LAB SAFETY MANAGEMENT

A course on "Chemical and Lab Safety Management" was conducted at CFEES during 13-15 March 2019. The course covered different aspects of chemical and lab safety, viz., Safety Policy and Elements of Safety Management, Chemical Waste Management and Disposal, Safety for Compressed Gases and Cryogenic Liquids, Occupational Safety and Safe Laboratory Practices (MSDS, SOPs, Do's and Don'ts), Accident Prevention, Accident Reporting and Analysis, Safety Monitoring and Evaluation, Fire Hazards in Chemical, Chemical Hazard Identification & Risk Assessment, Acts & Regulations for Manufacturing, Storage and Handling of Chemicals, Safe Education and Training Needs, Contingency Plan and Emergency Management and Electrical Safety in Laboratory, etc.

A fire drill was also conducted for the benefit of the participants. Thirty-one participants from various DRDO laboratories attended the course. The participants appreciated receptive and interactive faculty from the CFEES and suggested for the inclusion of more practical sessions.

WORKSHOP ON INFORMATION & LIBRARY TECHNOLOGIES FOR FUTURE

Defence Scientific Information and Documentation Centre (DESIDOC), Delhi, organised a two-day Workshop during 25-26 March 2019 on "Information and Library Technologies for the Future." The basic aim of the workshop was to increase awareness and train all categories of DESIDOC personnel about the technological advancements in the field. Dr Rajeev Vij, Sc 'G', Course Coordinator, briefed the participants about the objectives of the workshop. Dr Alka Suri, Director, DESIDOC, inaugurated the workshop and elucidated the importance of such need-based courses. She stressed on the need for increasing awareness about the learning tools and techniques for sustainable developments in the future.

HINDI WORKSHOPS

DESIDOC organized a Hindi Workshop on 27 March 2019. Dr Rajeev Vij, Associate Director, DESIDOC, inaugurated the workshop and spoke about the various initiatives taken by the Centre to encourage use of the Rajbhasha in day-to-day official working. Shri Deepak Bist, DHDI, and Shri Gaurav Misra SAO I, Laser Science and Technology Centre (LASTEC), Delhi, delivered lectures on "Pension Benefits" and "Conduct Rules", respectively. Ninety-six participants attended the workshop. Shri Ajay Kumar, Sc 'D', DESIDOC, proposed the vote of thanks.

Integrated Test Range (ITR), Chandipur, conducted a Hindi Workshop during 27-28 March 2019 for DRTC and Admin and Allied Cadre Officers and Staff. Dr BK Das, OS and Director, ITR, highlighted the importance of OL Hindi and emphasized on its use in official activities. Director, ITR, on this occasion, informed that the progress of OL Hindi is increasing well and we should be a part of it. The participants of the workshop were taught to eradicate and remove the difficulties, hesitations in use of OL Hindi. OL Policy of the Union was also explained to them. The lectures were delivered by Shri Navneet Acharya, Asst. Professor from Netaji Subhas Ashram Mahavidyalay, Purulia, WB. Eighty participants participated in the Hindi Workshop. Shri PN Panda, Sc 'F', Associate Group Director (HR&PL) and his team organized the program.

COURSE ON SPECIALTY STEELS FOR DEFENCE

Defence Metallurgical Research Laboratory (DMRL), Hyderabad, organized a course on "Specialty Steels for Defence Applications" under the Continuing Education Programme (CEP) of the DRDO during 11-15 March 2019. The inaugural function was presided over by Dr Vikas Kumar, DS and Director, DMRL. Dr R Balamuralikrishnan, Sc 'G' and the Course Director welcomed the delegates and participants. Dr Amit Bhattacharjee, Sc 'G' and Coordinator, HRD Cell, presented the summary of HRD activities of the DMRL.

Dr Vikas Kumar delivered the inaugural address. Prof. V Ramaswamy, PSG College of Technology, Coimbatore,

delivered the keynote lecture on "Recent Trends in Quality Control in the Development of Strong High Strength Steels." Dr G Madhusudhan Reddy, OS and Associate Director, DMRL, delivered the second keynote lecture on "Development and Applications of DMR 1700 Steels."

Twenty-nine participants from DMRL, RCMA (Mat), PGAD/RCI and NMRL attended the course. Lectures on a variety of topics like steels for naval, missile and armour applications were delivered and covered various aspects of steels.

COURSE ON CBRN DEFENCE

A five-day specialized course on "CBRN Defence for Medical Officers of AFMS" was conducted at DRDE, Gwalior, as part of DRDE's continued effort to impart knowledge on chemical and biological warfare mitigation strategies to the defence services. Thirteen AFMS officers from Army, Navy and Air Force participated in this specialized course. The course was inaugurated by Dr DK Dubey, Director, DRDE. The specialized course covered various topics both theory and practical aspects on Overviews on CBW Agents, Physical protection, Medical countermeasures, Decontamination and CBW Threat perception.

Dr DK Dubey, Director DRDE, Gwalior distributed the certificates in the valedictory function. Dr PK Dash, Sc 'F' was the Course Director.

TRAINING PROGRAMME ON FINANCE AND MATERIALS MANAGEMENT

A training Programme on Finance and Materials Management was organised during 25 February-1 March 2019 at ITR, Balasore. Forty seven participants from 20 labs/estts of DRDO and CGDA participated in the course. The Course was inaugurated by Dr BK Das, OS and Director ITR, Dr AK Bhateja, OS and Director, DF&MM, and Shri DK Joshi, Director, PXE. Topics relevant to DRDO such as PM-2016, GFR 2017, Contract Management, Foreign Procurement/ACA Contract, SMG, GST, RFP, GeM, Audit, Financial Delegation, BTS and RDR/Deposit works were covered during the course.

A panel discussion was conducted on the final day of the course under the Chairmanship of Shri AV Rao, PCDA (R&D), Hyderabad, wherein various issues pertaining to DRDO were discussed.

Shri Manish Kumar, Sc 'E' and Shri Saurav Negi, Deputy Director from DF&MM were Course Coordinator and Dy Course Coordinator, respectively.

NPOL EMBARKS ON MARINE & ALLIED INTERDISCIPLINARY TRAINING & RESEARCH INITIATIVE

Naval Physical and Oceanographic Laboratory, Kochi, conducted a unique S&T initiative named "Security and Growth for All in the Region—Marine & Allied Interdisciplinary Training and Research Initiative (SAGAR MAITRI)" under the broad objective of PM's policy of Safety and Growth of All in the Region (SAGAR) 2019-2020. The programme aims at conducting six scientific cruise in the North Indian Ocean and to visit and initiate collaborative research programmes with the relevant marine institutes in these Indian Ocean Rim (IOR) countries.

This programme also commemorates the Golden Jubilee Celebrations of India's research ship INS Kistna's historic International Indian Ocean Expeditions (IIOE) took place during 1962-65. INS Sagardhwani would revisit the selected tracks of INS Kistna. Besides, interactions under MAITRI with the IOR countries, viz., Oman, Maldives, Sri Lanka, Thailand, Malaysia, Singapore, Indonesia and Myanmar would be chalked out by the NPOL scientists for the collaborative research activities with the oceanographic counterparts of these countries to promote scientific cooperation in ocean research among these nations for mutual benefit.

EMERGING CHALLENGES OF ADDITIVE MANUFACTURING IN MULTILATERAL EXPORT CONTROL REGIMES

Dr Meetul Kumar & Atul D Rane

Admission of India as the 42nd member of Wassenaar Arrangement (WA) in December 2017 and 35th member of Missile Technology Control Regime (MTCR) in June 2016 is expected to enhance its credentials in the field of non-proliferation. Multilateral regimes play significant role in promoting transparency and ensure responsibility in transfer of conventional arms and dual use items and technologies. MTCR and WA participating states are required to ensure that transfer of dual use items and technology do not enhance nor contribute towards the development of programmes for weapon of mass destruction and their delivery. Multilateral regimes define dual use technologies as the information required for the development, production and use of a controlled item; the intangible technology transfer in form of technical data sets, software or technical assistance.

Automation in new emerging technologies plays important role in manufacturing. Therefore the technological advances in these emerging fields must be monitored to understand the potential of intangible transfer of these technologies to non-state players. Three-dimensional printing (3D printing) and Additive Manufacturing (AM) is one of the emerging technologies that present challenges to export control regimes due to their increasing automation compressing the knowledge barrier and application of post processing tools.

In the last joint meeting of MTCR and WA regime; 25 participating states had addressed the challenges for control of emerging technologies like AM and ways to de-conflict technical approaches between the MTCR and WA regimes with AM advances and control of technology. The meeting shared ideas and insights related to Additive Manufacturing control discussions in multilateral regimes, including the advances made in AM and procedures to mitigate the risks of overlaps, loopholes and diverging or conflicting criteria on AM amongst the participating states.

One of the participating state expert was of the view that application of controls to lasers and electron beam for metal processing of components typically accomplished by traditional machine tools can be an approach to control the items under the regimes. WA control was proposed to be applied to materials, software, designs, STL files and CAD models required for development of dual use items. Development of munition list item, Rapid Additively Manufactured Ballistics Ordnance (RAMBO), and 3D printed Grenade Launcher were of concern for the participating states. It was informed that hypersonic engine combustors, aircraft engine components, under water autonomous vehicle components have been demonstrated using AM technology. Some experts were of view that AM process can be effectively controlled through control on machine tools and/or metal powders.

Senvol database is the first and most comprehensive database for industrial AM machines and materials. Senvol lists all commercially available material for AM; database includes 809 metal powders, unspecified Ni-based alloys, 88 Aluminium alloys but only 10 are advertised to meet the minimal tensile strength requirements for control, six different Mg-based powders and 144 powders of Ti-based alloys.

Participating experts advocated the WA control on machine tools particularly the industrial 5 axis milling machines with defined control parameter of unidirectional repeatability in 1 μm range. Control and software control through 2.B and 2.D.2 sections of MTCR can adequately address the new hybrid AM machines, which incorporate 5 axis CNC grinding, milling or turning machines inside fabrication chambers. Other participating state presented the assessment of control parameters where monitoring of AM technology was performed through usable parts, performance and process chain. Expert also opined that WA control AM production equipment through 9.B.1 equipment, tooling or fixtures, specially designed for manufacture of gas turbine blades, vans or “tip shrouds”. The national policy of one of the participating state for AM included (i) Monitoring of the developmental trends as well as End User Certificate of AM, besides interactions with academia and institutions, (ii) monitoring licensing applications for listed and not listed powders, (iii) monitoring licensing applications for listed spare parts, in particular lasers and (iv) use of “catch all” mechanism for metal AM systems.

One of the expert mentioned that AM was not suitable for parts with higher quantity and outlined the requirements for outreach programme with industries on emerging technology, in particular the AM. Participating states mentioned the need to close the loophole created by AM and other powder related processes by expanding the section 6.C.8 of MTCR Annex to control the maraging steel powders with at least 90 per cent of particle size of 200 μm or less.

The joint MTCR-WA meeting provided an overview of the advances made in the AM Technology and its applications, especially in complex aero-engine components. Besides technology, use of AM to develop new tools with potential dual use applications was a concern among the participating states. While there are no clear cut controls for the AM, in both MTCR and WA regimes most states have applied their national policies of export controls. In addition, there is extensive monitoring of the AM systems being developed worldwide.

Control of powders through regimes provides insights on the AM system being developed. However powders and its alloys are controlled to some extent in MTCR and WA. Consensus on control of AM among the participant states will require extensive deliberations in both regimes. Use of AM to simulate product designs raises the level of innovation, eliminating the manual processes and most importantly bringing a paradigm shift in designing and executing ideas. For India, AM is still in early years; the AM pace has garnered momentum in last 4-5 years and India must make advantage of the progress in AM through its industries, academia, research agencies keeping the proliferation risks under control.

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PERSONNEL NEWS

APPOINTMENT

Shri S Vijayan Pillai, OS, has assumed the charge as Director, NPOL, Kochi, with effect from 1 April 2019. An MTech in Integrated Circuits and System Engineering from IIT Kharagpur, Shri Pillai started his career in Indian Air Force (IAF). He later joined DRDO in 1989 as Sc 'B'.

His short stint in IAF provided him a first-hand experience in airborne and ground equipment, which has held him in a good stead throughout his career in defence R&D. As DRDO scientist, user perspective, and end-use environment has always been the strongest drives in his system design approach. He had worked in various capacities starting from System User, Maintainer, Circuit Designer, System Designer, Project Coordinator, Project Manager, Associate Project Director, and Project Director for mission mode sonar projects. Before taking over as Director, he served as Associate Director for USHUS sonar systems. Four USHUS systems have been installed in EKM class of submarines under his stewardship at Russian dockyards.

AWARD

Ms Dipti Arora, Technical Officer 'B', DESIDOC, Delhi, has been awarded the Best Paper Citation Prize for her paper "E Research Support Services: Intensifying Landscape of S&T Libraries" presented at three-day International Conference on "Intellectual Property Rights: Digital Transformation" held at Sanskruti Bhavan, Panaji, during 27-29 March 2019. The paper was co-authored by Dr Alka Suri, Director, DESIDOC and Ms Alka Bansal, Sc 'F', DESIDOC.

HIGHER QUALIFICATION ACQUIRED

Shri P Rama Subba Reddy, Sc 'E', DMRL, has been awarded PhD for the thesis entitled "Nano Composites" by the Jawaharlal Nehru Technological University (JNTU), Hyderabad.

Shri Sabyasachi Saha, Sc 'D', DMRL, Hyderabad has been awarded PhD for the thesis "TEM Characterization of Micro-structural Evolution of GaN Grown by MOCVD on e-Sapphire" by Indian Institute of Science (IISc), Bangalore.

Shri Suresh D Meshram, Sc 'E', DMRL, Hyderabad, has been awarded PhD for the thesis "Friction Stir Welding of Maraging Steel" by Indian Institute of Technology (IIT), Delhi.

NPOL GETS A NEW RO-RO BARGE

A new Ro-Ro Barge, 'MV Kurathi', was inaugurated by Shri S Kedarnath Shenoy, OS and Director, NPOL, Kochi, on 27 March 2019 for commencing trial operations at Underwater Acoustic Research Facility (UARF). UARF is a field trial facility of NPOL, located at Kulamavu on the banks of Idukki hydroelectric reservoir. The 100 ton Ro-Ro Barge has an overall length of 25 m, breadth of 7 m, depth of 2.3 m and draught of 1 m. The barge has a cruising speed of 9 knots. The vessel is powered by dual 270 HP Marine Diesel Engines and has a Ro-Ro Ramp to enable a 10 ton truck with testing equipment to move in and out of the vessel. The vessel is manufactured with IRS classification and will be registered with Kerala Inland Navigation authority.

The major equipment onboard the vessel to facilitate field trials of SONAR Systems/Transducer Arrays include: marine Jib Cranes of 5, 3 and 1 ton capacity; DG sets of 100 kVA, 30 kVA and 3 kVA; GPS; Depth Sounder; Range Finder; Capstan; etc. The barge has a measurement well with transducer mounting structure and measurement room with instrumentation and will enhance trial capabilities at UARF with faster deployment of heavy transducer arrays and equipment, and towed trials of transducer arrays and standalone generators for full power testing of transducer arrays.

DG (LS) INAUGURATES VE-CARE LAB AT INMAS

Dr AK Singh, OS and DG (LS), DRDO HQ, inaugurated a new Virtual Environment and Cognitive Assessment, Rehabilitation and Enhancement (VE-CARE) lab at Institute of Nuclear Medicine and Allied Sciences (INMAS), Delhi, on 1 March 2019. The lab comprises state-of-the-art systems for virtual and augmented reality for cognitive profiling. The work caters to maintaining standards throughout the world.

VE-CARE lab with facilities comprising eye tracking device, head mounted displays, Microsoft Hololens, 256 channels wireless EEG system, motion capture suits and high power workstations for virtual environment creation and physiological data analysis. This will be helpful in cognitive training of defence personnel under different scenarios.

DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 4: MARCHING FORWARD

The article is 38th in the Series of extracts of the monograph, "Defence Research & Development Organisation: 1958-1982", by Shri RP Shenoy, former Director of Electronics and Radar Development Establishment (LRDE).

ARMAMENTS

High Energy Materials Research Laboratory

The Laboratory also developed a new family of weapons called Fuel Air Explosive (FAE) system with a damage potential superior to conventional explosive weapons. When fuels like ethylene oxide, propylene oxide, heptane and methane were dispersed in air these formed detonable aerosols which produced very high impulse blast waves on detonation due to higher heats of combustion. These aerosols would be FAEs and owing to their gaseous state before detonation, they covered large areas irrespective of the land contour or protective buildings. FAEs were found very effective against soft targets like antipersonnel mines, ships, aircraft, bridges, missiles, troops and jungle clearance. HEMRL went further to explore the feasibility of developing a rocket-delivered FAE warhead for utilisation by multi-barrel rocket launching system.

Several pilot plants were set up in this decade for producing in bulk, propellants for a large variety of artillery and tank ammunition. The Laboratory was also in the process, setting up additional pilot plants for the manufacture of explosive composition for the Navy, various propellant cartridges and power cartridges. Setting up of more pilot plants were also under consideration for low-temperature plastic explosive, tear smoke ammunition, propellant for 100 mm, HE ammunition and anti-submarine rocket. The Laboratory was in the process of establishing a pilot plant for Air Regenerating Composition (ARC) for sailors working in submarines or soldiers operating at high altitudes, where the atmosphere would be of rarified oxygen. ARC, when in contact with moisture, would generate oxygen and absorb the exhaled carbon dioxide, thus providing relief. The ARC provides a self-contained breathing apparatus.

To back the extensive development activities, HEMRL established a strong research base in areas of high explosives, propellants, high energy materials, detonics of explosives, combination mechanism and ballistic modification of propellants. In 1970s HEMRL built capability to scale up from pilot plant level to full-scale production on a turn key basis.

Currently, HEMRL is the only laboratory of its kind in the country dealing with the entire range of high energy materials for use by military, starting from small rounds, mortars, high energy solid propellants for guns, rockets and missiles, to tailor-made high explosives, pyrotechnics and so on. The knowledge and expertise it has built resulted in the country being totally self-reliant in the field of explosives, propellants and pyro devices.

ELECTRONICS

There were are four laboratories in the field of electronics, namely, Electronics and Radar Development Establishment (LRDE) at Bangalore, Defence Electronics Research Laboratory (DLRL) at Hyderabad, Solid State Physics Laboratory (SSPL) at Delhi and Defence Electronics Applications Laboratory (DEAL) at Dehradun. However, in the 1980's two more laboratories in electronics were set up. These were, Microwave Tubes Research and Development Centre (MTRDC) and Centre for Artificial Intelligence and Robotics (CAIR), both at Bangalore. During 1958-1982, the major activities of LRDE were development of generating sets, radars and terrestrial communications for the Services. At DLRL, the focus was on electronic warfare, cipher systems for telegraph, and radars. SSPL was dedicated to research and development of solid state materials for electronic applications and devices, and DEAL was engaged in radio propagation, troposcatter/meteoric burst communications, and millimetre wave systems.

Electronics & Radar Development Establishment

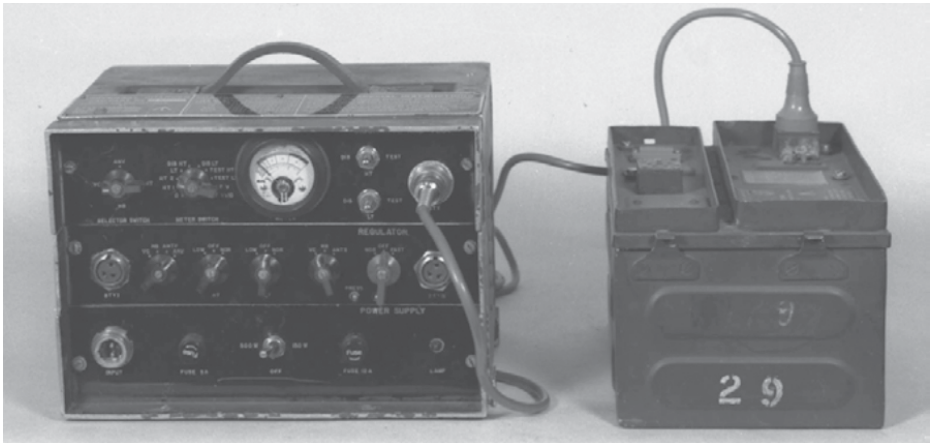
At the time of formation of LRDE in 1958, there were only a handful of qualified personnel whose experience was mostly in defect investigations and/or carrying out import substitution for the existing electronic equipment to keep these in operation. In some rare cases, minor modifications were also being carried out mainly because exact equivalents of obsolete components were not available. Thus, the first five years were devoted to recruitment of qualified scientists and engineers, organisation of the Laboratory for development and to initiate activities, which were a mix of import substitution

and improvements to equipment held by the Services. This was a period of learning by doing during which greater insight was gained into the complexities of design and development of equipment for meeting the stringent performance specifications laid down by the Armed Forces.

The quantum change in electronics components technology that had taken place, from power guzzling vacuum devices to transistors operating with low voltages and power levels, virtually eliminated replication of older generation equipment. Instead, DRDO seized this opportunity to design and develop transistorised equipment meeting the functional characteristics of the older equipment. Several types were successfully developed by LRDE and then manufactured. Some of the more important ones were, portable transistorised communication switchboard (manual exchange), light weight VHF ground-to-air wireless communication set, a forward area HF communication equipment, two types of speech secrecy units, channel doubling unit for speech and carrier communication equipment. In addition, portable/mobile generators for prime power, and lightweight portable nickel cadmium batteries were successfully developed. As the electrical industry had the technological capability, it was decided that developments in portable/mobile generators would be carried out by the industry with the technical direction from LRDE and after evaluation and approval by the Armed Forces, these would be manufactured by the firms which had developed these. In the case of nickel cadmium batteries which were needed for operations at subzero temperature and high altitude regions, industry did not take up the development as they did not foresee its commercial viability in the immediate future. LRDE took up the work as a challenge and developed the indigenous active plates and materials, non-spillable power packs with long storage and service life. In addition, a pilot plant was established at LRDE for the manufacture of nickel cadmium batteries and chargers. Pilot plants were also set up for production of other communication equipment which were required in small numbers .

In the aftermath of the 1962 Chinese invasion of the country, there was a realisation that modernisation of our Armed Forces was overdue and also that electronics technology would have an important role in contributing to our capability to deter such aggression. The Plan ADGES (Air Defence Ground Environment System) for the Indian Air Force and Plan AREN (Army Radio Engineered Network) were sanctioned so that the country would have radars along our borders to provide us early warning of any attack and the Army would have a tactical communication network that would link the forward units with each other and with the rear echelons. DRDO participated in the formulation as well as in the design and development for both the Plans. In both cases at the insistence of the Services, indigenous development activity was assigned to two R&D institutions of which one would be a DRDO laboratory. LRDE would be fully involved in the development of transmission, switching and speech secrecy equipment for Plan AREN for more than a decade. The Laboratory would undertake development of radars for the Indian Army as well as the Air Force.

In the 1960s, the radar projects of immediate concern for LRDE were the development of two mobile radar systems for the Artillery; one for surveillance and the other for location of mortars and other projectile launching weapons. As there was no readily available mobile surveillance radar meeting the Artillery's performance requirements, LRDE was vested with the responsibility of developing the system. Ab initio development and configuring it for mobile application did not fit the time frame for development, and thus major subsystems were imported from radar manufacturers abroad and the system was configured in a designated vehicle. The radar was evaluated by the Artillery and was accepted for production at Bharat Electronics Ltd. Since Bharat Electronics Ltd, the Public Sector Unit was in the process of producing a fire control radar with foreign collaboration, LRDE decided to develop the field artillery radar with the subsystems of the fire control radar. The analogue computer used for fire control purposes had to be redesigned for field artillery purposes. The field artillery radar was developed by LRDE, evaluated by Artillery for the role and was accepted for production at Bharat Electronics Ltd.



Nickel Cadmium Batteries

To be continued...

VISITORS TO DRDO LABS/ESTTS

CAIR, Bengaluru

❄ Shri Rajinder Khanna, Deputy National Security Advisor, visited Centre for Artificial Intelligence and Robotics (CAIR) on 18 March 2019. Smt Manimozhi Theodore, Director, CAIR, briefed the Deputy NSA about the technologies developed by the Centre. Demonstration of technologies developed by CAIR in the area of Secure Systems, Intelligent Systems and Robotics, Command and Control (Land Forces), Command and Control (Naval Forces), and GIS technologies, was made to the distinguished visitor.

❄ Maj Gen Mahesh Moolri, ADG (T), DG Signals, 1 HQ of MOD (Army) and team visited CAIR on 22 March 2019. There was a briefing by Smt Manimozhi Theodore, Director, CAIR, followed by discussion and demonstration of technologies developed by CAIR.

HEMRL, Pune

Dr G Satheesh Reddy, Secretary, Department of Defence R&D, Chairman DRDO and Director General, ADA visited High Energy Materials Research Laboratory (HEMRL) on 18 April 2019. He visited Universal Pilot Plant, Multiple Motor Processing Facility, Gravitational Mixer, Portable Propellant Discharge System, Granulation Machine and Dual Asymmetric Centrifugal Mixer in HEMRL and has shown keen interest in these facilities. Senior Scientists of HEMRL gave presentations on ongoing HEMRL projects and apprised him on other R&D activities of HEMRL. Dr Reddy also showed keen interest in the activities of HEMRL.

NMRL, Ambernath

Vice Adm KO Thakare (Retd), DG (ATVP), AVSM, NM, visited Naval Materials Research Laboratory (NMRL) on 28 February 2019. Director, NMRL welcomed him and briefed him about the progress made. DG (ATVP) appreciated the efforts of NMRL scientists for significant achievements made in various ATVP projects as well as for all the cooperation and scientific support received from NMRL. He laid stress on resolving all minor pending issues at the earliest.

Dr Reddy being briefed about Universal Pilot Plant at HEMRL

Vice Adm KO Thakare being briefed about NMRL activities

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