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DESIDOC Publications

Defence Research & Development Organisation

FROM THE DESK OF THE CHAIRMAN

Dr S Christopher
CHAIRMAN
Defence Research & Development Organisation
&
SECRETARY
Department of Defence Research & Development

DRDO ON THE PATH OF SELF-RELIANCE

Growing Indigenisation of Defence Technologies

Following its vision of empowering India with world-class cutting edge defence technologies, DRDO aims for self-reliance and equipping Indian Armed Forces with the state-of-the-art weapons systems. Over the years DRDO has demonstrated its capability to design, develop and realize highly complex multidisciplinary weapon systems and platforms, and, if recent inductions were any indication, then country has reposed a great deal of confidence in DRDO developed world-class contemporary products.

It gives me pleasure to write home about some of the recent achievements that DRDO has made. In series of events, Hon'ble RM handed over DRDO developed Products to Service Chiefs. Significant among these were, Airborne Early Warning and Control (AEW&C) System, LCA Tejas, Akash System, Pinaka, Abhay (Hull-Mounted Sonar), HUMSA UG, NACS (Near field Acoustic Characterization) System; AIDSS (Advanced Indigenous Distress Sonar System for submarines); Varunastra (Advanced heavy-weight anti-submarine torpedo); Maareech (advanced torpedo defence system); USHUS-II (Submarine Sonar); Directing Gear for Hull Mounted Sonar Array; RLG based INS for Ship Applications (INS-SA); Swathi (Weapon Locating Radar); NBC Reece Vehicle Mk-I, IP-based Secure Phone and, Gallium Nitride Technology

The inducted systems have gone through a series of extensive user trial and evaluation process of Armed Forces in extensively harsh and battle like conditions and met all stringent quality requirements. The value of DRDO developed products inducted into Services or in the process of induction stands at ₹ 2.56 lakh crores and expected to achieve ₹ 5 lakhs crores in next five years.

Besides, there are several systems—Agni series up to Agni-5, Prithvi BMD, Radars (MPR Arudhra, SAR for UAVs), EW Systems (DCMAWS, EW suite for fighter aircraft, GYPSY), WhAP, ATAG, Pinaka Mk-II, Thermobaric Ammunitions, NBC Protection and Soldier Support Systems—that have undergone successful trials. In the next five years, DRDO aims to foray into futuristic research and fighting system for the evolving battlegrounds.

I also share with you that the export potential of DRDO developed systems has increased manifolds. As many as 20 countries have shown interest in acquiring Akash, BrahMos, Sonar, Underwater Acoustic Communication System, Torpedoes, Thermobaric and FSAPDS Ammunition, Titanium Sponge, AEW&C System, and BFS Radar. The nation, which till recently weren't a export faring country, this count sounds very inspirational and exciting.

Needless to mention that DRDO is fully dedicated to attain self-reliance in defence systems and technologies. The organisation has made significant contribution in the country's defence preparedness and is aspiring to accelerate the pace of self-reliance by enhancing its capabilities and extending capacity building. Towards this, I thank all of you for your dedication, sincerity and hard work, which made DRDO the organization with more visibility, acceptability and credibility.

Jai Hind.

DRDO HANDS OVER INDIGENOUS PRODUCTS TO INDIAN ARMY

Hon'ble Raksha Mantri Shri Manohar Parrikar handed over Weapon Locating Radar (WLR), Swathi, NBC Recce vehicle and NBC Drugs developed indigenously by DRDO to General Bipin Rawat, Chief of the Army Staff for induction into the Indian Army in a function on 2 March 2017.

RM complimented DRDO scientists for handing over of the indigenous products to the Indian Army and congratulated DRDO for the successful trials of the interceptor missiles on 1 March 2017. DRDO, Defence Forces, PSU's and Private Sector industry's partnership can be a game changer in the near future, said Shri Parrikar.

General Bipin Rawat lauded DRDO for achieving another milestone in their continuing success stories and said, "I am optimistic that at this speed, modernisation of Indian Army would move at a much faster pace."

Speaking at the function Dr S Christopher, Chairman DRDO and Secretary Department of Defence R&D said, "After Navy and Air Force, time has now come to hand over our products to the Army and it is a proud moment for all scientists in DRDO. I am sure that the co-development approach of DRDO, users and the industry would speed up the ongoing projects."

DRDO has been developing a number of products for the Indian Army in support of their field operations and welfare of soldiers on ground. Many of these products have been inducted and are presently operational in field units. In 2016, the Weapon Locating Radar, NBC Recce Vehicle and a set of NBC Drugs had undergone successfully testing and extensive evaluation by competent evaluation teams/bodies.

Raksha Mantri also released a Coffee Table Book, Kalam...a Journey to Excellence, a pictorial tribute to Dr APJ Abdul Kalam traversing his simple life from a humble village in Tamilnadu to the highest office of the land. The book has been brought out by Defence Scientific Information and Documentation Centre (DESIDOC), Delhi.

ADVANCED AREA DEFENCE ENDO-ATMOSPHERIC INTERCEPTOR MISSILE TESTED SUCCESSFULLY

The endo-atmospheric missile capable of intercepting incoming targets at an altitude of 15 to 25 km has proved the Ballistic Missile Defence (BMD) prowess of the country.

DRDO conducted successful test firing of the interceptor missile Advanced Area Defence (AAD) on 1 March 2017 from Abdul Kalam Island, Odisha. The endo-atmospheric missile, capable of intercepting incoming targets at an altitude of 15 to 25 km successfully destroyed the incoming missile. All the mission objectives were successfully met.

The weapon system radars tracked the target and provided the initial guidance to the interceptor, which precisely homed on to the target and destroyed it in endo-atmospheric layer. The complete event including the engagement and destruction was tracked by a number of electro-optical tracking systems using infrared imagery.

AAD Endo-Atmospheric Interceptor Missile

Radars and telemetry stations tracked the target and the interceptor till the destruction of the target. The launch has proved the Ballistic Missile Defence (BMD) prowess of the country.

Hon'ble Raksha Mantri Shri Manohar Parrikar congratulated DRDO on the successful launch of the interceptor missile.

Dr S Christopher, Chairman DRDO and Secretary Department of Defence R&D, also congratulated team AAD for the successful test firing.

Scientific Advisor to Raksha Mantri and Director General (Missiles and Strategic Systems), DRDO, Dr G Satheesh Reddy, monitored the launch operation along with other senior officials.

AAD Target Missile

BRAHMOS EXTENDED RANGE MISSILE TEST-FIRED SUCCESSFULLY

As part of capability enhancement endeavour, a major milestone was achieved on 11 March 2017 when an enhanced version of the BrahMos supersonic cruise missile with an Extended Range (ER) was successfully test-fired from the Integrated Test Range (ITR), Chandipur at sea in Balasore, off the coast of Odisha.

In a historical first, the formidable missile system once again proved its mettle to precisely hit enemy targets at much higher range than the current range of 290 km, with supersonic speed of 2.8 Mach.

During the launch the land-attack version of the supersonic cruise missile system met its mission parameters in a copybook manner. It was a text book launch achieving 100 per cent results, executed with high precision from the Mobile Autonomous Launcher (MAL) deployed in full configuration.

The unique BrahMos weapon system has empowered all three wings of the Indian Armed Forces with impeccable anti-ship and land attack capability.

The technology upgrade comes after India's full membership to the Missile Technology Control Regime, which removed caps on range of BrahMos.

"With the successful test firing of BrahMos ER missile, the Indian Armed Forces will be empowered to knock down enemy targets far beyond the 400 km. The missile has thus proved its prowess once again as the best supersonic cruise missile system in the world," said Dr Sudhir Kumar Mishra, CEO and MD of BrahMos Aerospace, from the launch site.

Dr S Christopher, Chairman DRDO and Secretary Department of Defence R&D, congratulated the BrahMos team, DRDO and NPO Mashinostroyenia (NPOM) scientists involved in the successful mission.

The launch was witnessed by Deputy Chief of Army Staff, Director General Artillery, Corps Commander and many other senior officers from Indian Army. BrahMos Project Director Shri VSN Murthy, and Programme Director Shri Dasharath Ram along with other senior officers from DRDO and BrahMos were present during the launch.

BrahMos is a joint venture between DRDO of India and NPOM of Russia.

DMRL TRANSFERS HIGH NITROGEN STEEL TECHNOLOGY TO JSHL

Defence Metallurgical Research Laboratory (DMRL), Hyderabad, a premier research laboratory of DRDO, and Jindal Stainless (Hisar) Limited (JSHL) signed Licensing Agreement for Transfer of Technology (ToT) of High Nitrogen Steel (HNS) for armour applications on 1 March 2017. Speaking on the occasion the Hon'ble RRM, Dr Subhash Bhamre, congratulated DMRL and DRDO for their outstanding achievement in developing a breakthrough technology for armour applications and complimented JSHL for partnering with DRDO. RRM said that HNS technology is a step forward towards Army's quest for lighter and high performance armouring material compared to the currently used materials and has the potential for a number of civilian applications and export as well. Dr Bhamre asserted that this is a major step towards achieving the Prime Minister Shri Narendra Modi's vision of 'Make in India' and wished the team a great success in future endeavours. RRM called upon both public as well as private industries and Ordnance Factories to use this material extensively in their products.

Dr S Christopher, Chairman DRDO and Secretary DDR&D complimented DMRL for the achievement and termed it as a giant leap forward towards DRDO's quest for stronger and high performance defence material. He further said that the ToT to industry is aligned with the 'Make in India' policy to foster conducive environment for industry's potential growth in the strategic sectors.

Shri Abhyuday Jindal, Vice Chairman, JSHL, appreciated the team efforts of DRDO to come out with innovative solution of HNS. He assured that JSHL would aim to be a major strategic defence partner in manufacturing of HNS.

Dr SC Sati, OS and DG (Naval Systems and Materials), DRDO, applauded DMRL for developing varieties of steel including HNS, which would be of great importance to the industry. Dr S Guruprasad, OS and CC R&D (PC&SI), described HNS a dream material that has wide applications for the industry.

DMRL has developed and established a number of frontline and pathbreaking technologies in the areas of metallurgy and material science. HNS is not only tough but also has good strength. In addition to being non magnetic as well as corrosion resistant, the HNS cost is about 40 per cent less compared to Rolled Homogenous Armour Steel (RHA). Very few countries in the world have developed this technology and the material has potential for a number of defence and civil applications.

DRDO CELEBRATES NATIONAL SCIENCE DAY

National Science Day (NSD) is celebrated all over India to commemorate the discovery of 'Raman Effect' by Dr CV Raman. Dr Raman was awarded the Nobel Prize in Physics in 1930 for the work on the scattering of light, which was named the Raman Effect. DRDO, like every year, celebrated the day with great enthusiasm. Scientific lectures/talks by invited guests and DRDO scientists were organized by all DRDO labs/estts. Defence Science Forum (DSF) in Delhi, organized DRDO National Science Day Oration on 'Wellness—A New Concept' by Dr BM Hegade, President World Academy of Authentic Healing Sciences at Dr Bhagvantham Auditorium, Metcalfe House. The function was presided over by Dr Shashi Bala Singh, DS, DG (LS), DRDO.

Dr AK Singh, OS and Director, Institute of Nuclear Medicine and Allied Science (INMAS) and President DSF welcomed the august gathering and bring out the significance of the day. Dr Shashi Bala Singh, in her Presidential Address called upon the scientific community of DRDO to celebrate the science daily and spread spin-off of defence science among the masses.

Dr BM Hegade, in his informative and engrossing talk elucidated the notion of science and wellness. "Human body is illusion of human mind. Human mind is beginning of all illness and end of all illness. Being healthy is very easy. Simply keep your mind clean" said Dr Hegade. To live happily only requires three things: eat in moderation what you like; drink enough water and do not eat when you are not hungry; and fill your mind with compassion, he further added.

DRDO Science Spectrum, a compendium of collections of orations of the DRDO scientists published by Defence Scientific Information and Documentation Centre (DESIDOC), Delhi, was released on the occasion. The following DRDO labs/estts also celebrated NSD at their respective places:

ANURAG, Hyderabad

A guest lecture by Dr SK Chaudhuri, Former Director, RCI, on "System Engineering and Technology for Embedded Systems" was organized. Shri CVS Sastry, OS and Director ANURAG, stressed on the need of curiosity. Shri Amit Shrivastava, Sc F, presented NSD Oration on "Improved Intelligence for Unmanned Ground Vehicles using Graphics Processing Unit (GPU)".

ASL, Hyderabad

Shri Alex Daniel, Sc D, delivered National Science Day Oration on the topic "Advanced Ceramics for High Temperature Propulsion and Electro Magnetic Application." He explained about carbon silicon carbide-based low erosion propulsion materials and new generation propulsion materials that are under development and brought out the research efforts made by ASL on developing electromagnetically tailored ceramics. Dr Tessy Thomas, OS and Director, ASL gave away Silicon Medal and Commendation Certificate to the orator.

CABS, Bengaluru

Shri Dhipu TM, Sc C, delivered NSD oration on "Evolution of Air Surveillance System". He was awarded the medal and certificate by Smt Suma Varughese, Outstanding Scientist and Programme Director, AWACS(I).

DARE, Bengaluru

Defence Avionics Research Establishment (DARE), Bengaluru organised a talk on "Science behind Human Brain" by Smt Sunita Awasthi Singh, Sc F. She explained importance and complexity of the most complex organ of human body. She was awarded certificate and medal by Director.

DRDE, Gwalior

Dr AK Goel , Sc F, delivered National Science Day Oration on "CRISPR CAS: A Novel Tool for Genome Editing" on this occasion. Dr Lokendra Singh, OS and Director, DRDE, presented medal and certificate to Dr Goel.

DIBER, Haldwani

Defence Institute of Bio-Energy Research (DIBER), Haldwani, jointly with Kumaun University (KU), celebrated National Science Day (NSD) at DSB Campus, Nainital with great enthusiasm. Prof SPS Mehta, Director DSB Campus, inaugurated the event and highlighted the importance of science and technology. Dr SK Dwivedi, Officiating Director, DIBER, highlighted the R&D activities of DIBER and necessity of interaction between R&D Institutions and academia.

Shri Merwyn P Raj, Sc B, delivered NSD oration on "Molecular Techniques for Unambiguous Identification of Bacterial Wilt, a Devastating Plant Pathogen". NSD was also celebrated at DIBER Field Station Pithoragarh. Students from various schools visited the institute. Dr SK Joshi, Sc D, delivered a talk on National Science Day to the students.

DIPAS, Delhi

Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi following the national theme of Science and Technology for Specially Abled Persons, invited 41 specially abled students from Sahas Special School, Masoom Special School, Bal Chetna School, Prabhat Special School and Janta Adarsh Vidhyalaya. Ms Ira Singhal, the first physically challenged woman, who topped civil services examination in 2014 was the Chief Guest of the function. She motivated all the audience and about overcoming her disability, the importance of mental strength and determination that could make it possible to reach to the top. She closely interacted with all the school children and inspired them by her encouraging words.

HEMRL, Pune

Dr KM Paknikar, Director, Agharkar Research Institute, Pune, delivered an invaluable talk on 'Bio-inspired Innovation in Nano-Technology'. He also advocated the significance of fostering scientific knowledge in the present scenario. Various activities were organized in HEMRL. The theme for this year's science day celebration was "Science & Technology for Specially Abled Persons" and the same was topic for Essay writing competition.

Director HEMRL, Shri KPS Murthy addressed the HEMRL employees and stressed upon the need and importance of science for the development of our country. The Science Day Oration was delivered by Dr MN Manda, Sc D, on the topic 'Advanced Infrared and Radar Countermeasure Systems'.

INMAS, Delhi

Dr Raj Kumar, Sc E, delivered the NSD oration on "Development of Radiation Countermeasures using Radioresistant Bacteria to Protect Biological Systems against Nuclear Radiation" at INMAS, Delhi. He spoke about radioresistant bacteria and his work on development of radioprotective drug, which can protect the soldiers as well as civilian population from nuclear radiation during nuclear emergency. Dr Shashi Bala Singh, DS and DG (LS), DRDO, presented

NSD Medal and citation to Dr Raj Kumar.

ITM, Mussoorie

Col RS Sial delivered a talk on MBT Arjun and gave a brief on its evolution and development over the years. The speaker also presented salient features of MBT Arjun and compared it with other military tanks of the world. He also covered the various aspects of trials concluded on MBT Arjun to include AUCRT trials and comparative trials with tank T-90. A light was thrown on the various problems and concerned areas from the User perspective and modifications which have been included in Mark 2.

LRDE, Bengaluru

Dr Anil Kumar Singh, Offg. Director, Electronics and Radar Development Establishment (LRDE), Bengaluru, brought out the importance of the Day. Shri SD Suresh, Sc F, delivered the NSD Oration on 'Multi-Radar Surveillance to Multi-Sensor Surveillance'. He was presented NSD Medal and Citation by Shri Anil Kumar Singh.

MTRDC, Bengaluru

Smt Mita Jana, Sc D, delivered a lecture on 'Cyber Security and Cryptography'. Medallion and certificate were presented to Smt Mita by Dr Sudhir Kamath, OS and Director, MTRDC.

NMRL, Ambernath

National Science Day Oration was delivered by Dr Sarada Prasad Mishra, Sc D, on Luminescent Polymers—A Revolutionary Development in the field of Organic Electronics. A lecture on Listening to Black Holes Collisions with LIGO by Prof. A Gopakumar of Department of Astronomy and Astrophysics, TIFR, Mumbai and a movie on Science Innovation in India: Past, Present and Future was organized for the school children. Students participated in the science exhibition and quiz contest. Winners of the events were awarded certificate and trophy.

NPOL, Kochi

Shri P Annadurai, Sc F, delivered NSD oration on "Polymer Nanocomposites: Advanced Materials for Underwater Systems". He narrated history, features and applications of polymer nanaocomposites especially in defence arena. He also focused on the design and development of polymer nanaocomposites in DRDO with special emphasis on the initiatives of NPOL in this direction. Dr DD Ebenezer, Associate Director, NPOL presented Medal and Certificate to Shri Annadurai. As part of the celebration, an invited talk on "Engineering Artificial Microswimmers" by Prof. PB Sunil Kumar, Director, Indian Institute of Technology, Palakkad, was also organized.

NSTL, Visakhapatnam

As part of National Science Day Celebrations 2017, quiz, painting and essay competitions for students were organised. Dr VK Aatre, Chairman Advisory Committee, Society for Bio Medical Technologies and former Scientific Adviser to Raksha Mantri and DG, DRDO, was the Chief Guest at Science Day function. He delivered the

National Science Day talk, and took the NSTL fraternity on a Science Odyssey detailing the achievements of science across the globe.

Shri V Ramakrishna, Sc D, delivered NSD Oration on "Determination of Optimum Influential Parameters and Prediction of Propeller Noise using MINITAB and Fuzzy Logic."

RCI, Hyderabad

Dr YVN Krishna Murthy, DS, Director, NRSA, Hyderabad was the Chief Guest at the function. In his address he stressed on excellence in all areas of Space Technology. Shri Ankit Lat, Sc C, delivered Science Day Oration on Support Vector Machine: A Machine Learning Algorithm and its Applications. Shri BV Rao, OS and Associated Director, Research Centre Imarat (RCI), highlighted New Scientific Developments during last decade.

R&DE (E), Pune

Prof Sudarshan Ananth from Indian Institute of Science Education and Research (IISER), Pune, delivered a

talk on "Space Time and Quantum Mechanics." Shri Chandrajit Ganguly, Sc C, delivered the NSD Oration.

SASE, Chandigarh

Snow and Avalanche Study Establishment (SASE), Chandigarh, organized a motivational and inspirational talk by distinguished Prof. Sarit K Das, Director, IIT, Ropar. Prof Das enthralled the audience by giving a brief of the nation's achievements and further delved upon the 'History of Science and Technology in India and the Way Forward'. He discussed the scientific and technological challenges of the century and was confident that technological advancements will lead India to top three biggest economies in the world by 2030.

Shri Ashwagosha Ganju, OS and Director, SASE, in his address, stressed on the spin-off societal benefits out of niche research in line with the theme of NSD 2017, 'Science and Technology for Specially Abled Persons'. He further highlighted the achievements of the SASE and encouraged scientists to lead the nation in line with the long term perspective plan of the users.

Shri Jagdish Joshi, Sc D, presented his technical work on 'Avalanche Forecasting in Western Himalaya: Challenges and Issues'. He discussed various techniques for avalanche forecasting in complex mountainous terrain and pertinent issues of concern in operational avalanche forecasting. He was presented the Science Day Medal and Citation by the Chief Guest.

VRDE, Ahmednagar

Around 200 school students from 14 different schools participated in various competitions organized by Vehicle Research and Development Establishment (VRDE), Ahmednagar. They displayed innovative science projects depicting the importance of the alternate fuels in automotive sector, advanced farming techniques to enhance the productivity of the crop, energy conservation technique, etc.

Shri Sabhakant Tripathi, Sc D, delivered NSD Oration on Robust PID Control Optimizer for VTOL Platform for UGV-UAV Coordinated Operation. Dr PK Pal, Outstanding Scientist (Retd), BARC delivered a talk on 'Robot Sensing and Artificial Intelligence'.

SPORTS ROUND-UP

DRDO NORTH ZONE TABLE TENNIS TOURNAMENT

Defence Laboratory, Jodhpur (DLJ), organized DRDO North Zone Table Tennis Tournament from 23-25 January 2017 and DRDO National Table Tennis Tournament during 27-29 January 2017. Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur, won DRDO North Zone Team Championship.

Shri AK Pandey, Shri Vishal Das, and Dr Mahender Prassad represented DMSRDE. In Men's Doubles event Shri AK Pandey and Shri Vishal Das were the winners. In Veteren's Single event Shri AK Pandey was the winner. Shri Pandey was runner's up in Men's Single event also.

RAISING DAY CELEBRATIONS

DEAL, Dehradun

Defence Electronics Applications Laboratory (DEAL), Dehradun, celebrated its Annual Day on 23 February 2017 with great enthusiasm and fervour. Various sports events and games were organised to commemorate the occasion.

Dr RS Pundir, Director, DEAL, presented the accomplishments of the laboratory during 2016. Laboratory-level DRDO Awards, Cash Awards and Sports Awards were given to the meritorious employees and the winners of the various sports events.

A cultural programme was also organized by the employees.

HEMRL, Pune

High Energy Materials Research Laboratory (HEMRL), Pune, celebrated its 109th Lab Raising Day on 1 March 2017 in a befitting manner. On this occasion, Shri Anil M Datar, Dr BD Nagchoudhury DRDO Chair, and former DG (ACE), Dr SN Asthana, former Director HEMRL, Dr KM Rajan, DS and Director, Amament Research and Development Establishment (ARDE), Pune, Shri S Srinivasan, General Manager, ACEM Nasik, Shri MRK Raju, Sc G, RCMA (AA), Pune and Smt Y Sobha, IDAS, ACDA, graced the function.

As a part of Annual Day celebrations tricoloured balloons were released by Shri KPS Murthy, OS and Director, HEMRL, and the guests highlighting the theme of Make in India and Swachh Bharat Abhiyaan. Tree plantation programme was also carried out.

Shri Murthy, in his Annual Day address, briefed about various contributions and achievements of the laboratoy during the year 2016. He highlighted the contributions made for the development of Torroidal Combo Gas Generator (TCGG) propellant and novel igniter design.

Employees who completed 25 years of service in HEMRL were felicited by the Director. Laboratory-level DRDO Awards were conferred on meritorious employees. Besides, Cash Awards and awards to the winners of various sports events organised to mark the occasion, were also distributed. Games like Tug of War, Basket the Ball and Musical Chair, etc., were organised.

COURSE ON TECHNOLOGY MANAGEMENT

A course on "Technology Management" was organised by Institute of Technology Management (ITM) at Mussoorie during 5-8 February 2017. The Course was inaugurated by the Chief Guest Dr S Christopher, Chairman DRDO and Secretary DDR&D. Shri MH Rahaman, DS and CC R&D (HR&TM), Ms J Manjula, DS and DG (ECS), Dr RS Pundir, OS and Director DEAL, Shri Benjamin Lionel, OS and Director, IRDE and Shri Sanjay Tandon, Director, ITM were present during the inaugural ceremony. The course was attended by 24 scientists from different DRDO labs. Institute's Hindi patrika 'Srijan' was also released by the Chief Guest.

Director, ITM, in his welcome address emphasized on the importance of Technology Management in DRDO Projects and deliberated upon the various facets of technology management.

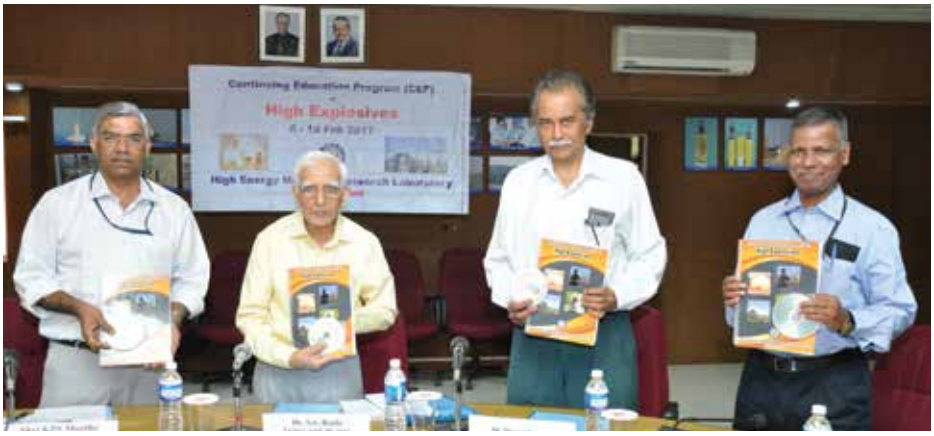
In his inaugural address Shri MH Rahaman, gave a detailed presentation on Technology Planning and Technology Models and discussed the various mechanisms through which the technology intensive projects of DRDO may be undertaken.

Dr S Christopher in his highly motivating keynote address brought out the importance of innovation in technology development and also emphasized on how to drive the scientific and technical manpower towards accomplishing the organizational goal in achieving self-reliance.

COURSE ON HIGH EXPLOSIVES

A CEP course on "High Explosives" was conducted during 6-10 February 2017 at High Energy Materials Research Laboratory (HEMRL), Pune. The course was inaugurated by Dr SS Rathi, former DG Quality Assurance, who delivered the keynote lecture on High Explosives.

Thirty participants attended the course. Proceedings comprising 22 lectures presented during the course was also released.



COURSE ON NBC DEFENCE

Defence Research and Development Establishment (DRDE), Gwalior, organised one-day course on Nuclear Biological and Chemical (NBC) Defence for Indian Navy and Coast Guard on 16 February 2017. Course was attended by 35 participants.

Lectures on nuclear chemical and biological warfare agents and medical countermeasures against these agents were delivered by DRDE scientists. Participants were also demonstrated various NBC products developed by DRDE.

YOGA TRAINING FOR SSB JAWANS IN NE REGION

A two-month Yoga Training programme was conducted at Seema Suraksha Bal (SSB) Unit, Salonibari, Assam by Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi, during December 2016 to February 2017.

Physiological parameters of the SSB Jawans were recorded before and after the training programme and the data was analysed. Various health-related problems of unit-based family members were also attended and yoga therapy was imparted.

ALL INDIA SCIENTIFIC RAJBHASHA SEMINAR

A two-day all India Scientific Rajbhasha Seminar on "Contribution of Defence Science and Technology in Progress of Country and Contribution of Hindi in Bringing Unity in Country" was organized at Defence Food Research Laboratory (DFRL), Mysuru, during 2-3 March 2017.

Dr GK Sharma, Sc G and Hindi Liaison Officer, welcomed the august gathering and participants from different laboratories/establishment of DRDO. The Chief Guest Smt SA Pathan, Dy IFA, IDAS, R&D Bengaluru, inaugurated the seminar and delivered the inaugural address. She stressed on the importance of Rajabhasha Hindi for unification of the nation.

Dr RK Sharma, Director, DFRL, released the seminar souvenir. Twenty-nine scientific papers and nine paper were presented in Hindi during the seminar.

Various awards were presented for the outstanding contribution in promoting Hindi in day-to-day office activities by Smt SA Pathan and Director DFRL.

HINDI WORKSHOP

Research Centre Imarat (RCI), Hyderabad, organised 4th Hindi Workshop for 2016-17 on 2 March 2017. Shri T Narasimha Rao, Sc G, Vice Chairman, OLIC, inaugurated the workshop. Thirty-five participants from various divisions of the RCI attended the workshop.

Shri Ram Singh Shekhwat, Senior Lecturer, Hindi Teaching Scheme, Ministry of Home Affairs delivered a lecture on Technical Terminology in Hindi Implementation and Shri Kazim Ahmed, Senior Translator, RCI, delivered a lecture on Hindi grammar.

TRAINING ON ISO 9001

Centre for Personnel Talent Management (CEPTAM) currently certified ISO 9001:2008, conducted Internal Auditor and Awareness Training during 6-8 March 2017 and on 9 March 2017, respectively with the aim of switching over to the ISO 9001:2015. Faculty from Indian Institute of Quality Management (IIQM), Jaipur, delivered the lectures.

AWARDS

MICROWAVE PIONEER AWARD 2016

Dr Surendra Pal, Hon'ble Vice Chancellor, Defence Institute of Advanced Technology (DIAT), Pune, was conferred Microwave Pioneer Award- 2016 by the International Symposium on Microwaves (ISM) in recognition of his pioneering contributions to the RF Communication, Space Communication, Microwaves, Electromagnetics, Antennas, Radars, Digital Communication, and Global Navigation Satellite System (GNSS) over a period of more than four decades.

Shri AS Kiran Kumar, Chairman, ISRO and Secretary Department of Space, gave the award to Dr Surendra Pal, on the occasion of the International Symposium on Microwaves-2016 held at the National Institute of Mental Health and Neuro-Sciences (NIMHANS) Convention Centre, Bengaluru.

RAJBHASHA PRIZE

Snow and Avalanche Study Establishment (SASE), Chandigarh, was awarded first prize for the implementation of 'Rajbhasha Hindi' for the year 2015-16 by Town Official Language Implementation Committee (Nagar Rajbhasha Karyanwayan Samiti), Chandigarh. Shri Kailash Chandra Jain, Principal Chief Commissioner of Income Tax and Chairman TOLIC, presented the prize to Dr HS Negi, Sc E and Karyakari Adhyaksh, Hindi Samiti, and Smt Usha Rani, Admin Officer.

Besides, Dhawal 2014, the Hindi annual magazine of SASE, got second prize in inter-departmental Hindi Magazine Competition and Shri Ashwani Kumar, TO A got 'Protsahan Puruskar' in the scientific poster competition.

HIGHER QUALIFICATIONS ACQUIRED

DIPAS, Delhi

Smt Yamini Singh, Sc D, Defence Institute of Physiology and Allied Sciences (DIPAS), has been awarded PhD by Jiwaji University, Gwalior for the thesis entitled 'Purification, Characterization, Toxicity Evaluation of Curcin toxin and Detoxification of J. Curcas cake.'

DRDE, Gwalior

Ms Ruchi Yadav, TO A, Defence Research and Development Establishment (DRDE), Gwalior, has been awarded PhD by Jiwaji University for the thesis entitled 'Isolation, Characterization and Bioefficacy of some Bioactive Compounds from Certain Plants against Aedes Albopictus Mosquito, A Vector of Dengue and Chikungunya.'

❑ Shri Vikas Thakare, Sc F, DRDE, has been awarded PhD by Jiwaji University for the thesis entitled 'Nurturing Innovation and Technological Capabilities: A Case of Government R&D Laboratory.'

VISITORS TO DRDO LABS/ESTTS

HEMRL, Pune

Shri Nand Kishore, Dy Comptroller and Auditor General of India, Govt. of India visited High Energy Materials Research Laboratory (HEMRL), Pune on 1 February 2017. Dr Manoj Gupta, OS and Officiating Director, HEMRL, presented an overview of the laboratory to the visitor. Technical presentations were made on development of Bi-modular Charge System & Pinaka Mk-I Rocket.

❑ Shri Subir Mallik, Addl. FA (SM) & JS, visited HEMRL on 3 March 2017. Shri KPS Murthy, Outstanding Scientist & Director HEMRL, presented an overview on the activities of HEMRL. Shri Mallik visited the Universal Pilot Plant and Rocket Propellant Processing Facility. He also witnessed Static Firings of Rocket Propellant, Explosive Reactive Armour and Dynamic Firing of Infra Red Flares.

LASTEC, Delhi

Long Gunnery Staff Course (Officers) Serial-AD 1510 comprising one Instructor-in-Gunnery (Officer-in-Charge), two Assistant Instructors (Junior Commissioned Officers) and 32 student officers visited Laser Science and Technology Centre (LASTEC) on 9 February 2017. Demonstration of LASTEC products was given to them.

❑ Freshly appointed CSIR officers visited LASTEC on 14 February 2017 during their induction program. LASTEC was chosen by CSIR as a model lab to give them awareness about DRDO. An overview of DRDO along with demonstration of LASTEC products was given to them.

MTRDC, Bengaluru

Dr S Guruprasad, OS and CC R&D (PC&SI), DRDO HQ, visited Microwave Tubes Research and Development Centre (MTRDC), Bengaluru, on 13 February 2017. Dr Sudhir Kamath, OS and Director, MTRDC, briefed him about the various facilities at the lab and Microwave devices developed at MTRDC.

DRDO HARNESSING SCIENCE FOR PEACE AND SECURITY- XIV

CHAPTER 2: TRANSFORMATION-DEFENCE RESEARCH & DEVELOPMENT ORGANISATION (1958-1969)

The article is fourteenth 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).

Expansion of the DRDO

Shri Krishna Menon foresaw very clearly that attaining self sufficiency in defence requires continuous and dedicated research and development effort in many scientific and technology areas which may not always be forthcoming from other departments and ministries unless there is a corresponding civilian requirement. Therefore, he decided to expand the scope of the DRDO to cover almost all important are as of interest to the three Services in a phased manner and used all means at his command to overcome opposition to his plans for expanding the scope of activities of the DRDO. For example, the need to set up a separate metallurgical laboratory in DRDO was first questioned as CSIR had already established National Metallurgical Laboratory (NML) in Jamshedpur. Major General Kapur the CCR&D included Director NML as a member of the Committee to examine the need for setting up DMRL and convinced the latter of creating the new laboratory since the orientation of the defence laboratory would be towards research and development of materials crucial to defence.

Similarly, at the time of setting up for Defence Food Research Laboratory in Mysore, as the CFTRI under the CSIR was already in existence, it was suggested that a separate laboratory in food sciences need not be set up for defence. The Defence Minister countered the argument by stating that the food and nutritional requirements of the Services cannot be determined in isolation to the total environment in which the military personnel operate in peace and war times. He cited the examples of sailors in submarines and soldiers in high altitude and cold regions to highlight the need for continual and integrated approach which cannot be devoted by organisations outside of defence. The reason for situating DFRL in Mysore was that it could draw upon the infrastructure and expertise of CFTRI when ever necessary so that duplication would be minimized.

By the end of 1961, the DRDO had 21 major institutions/laboratories of which the eleven new ones were

- Aeronautical Development Establishment, Bangalore
- Defence Food Research Laboratory, Mysore
- Defence Laboratory, Jodhpur
- Defence Research and Development Laboratory, Hyderabad
- Field Research Station (later converted to Laboratory), Leh
- Gas Turbine Research Establishment, Bangalore
- Institute of Nuclear Medicine and Allied Sciences, Delhi
- Institute of System Studies & Analysis, Delhi
- Naval Chemical and Metallurgical Laboratory (now called the Naval Materials Research Laboratory), Mumbai
- Solid State Physics Laboratory, Delhi
- Terminal Ballistic Research Laboratory, Chandigarh

The two laboratories namely, the Aeronautical Development Establishment (ADE) and the Gas Turbine Research Establishment (GTRE) were set up to meet the needs of the Indian Air Force. ADE was newly created with the nucleus of a few scientists/technologists drawn from DTD&P (Air) and was entrusted with the task to support ongoing acquisition of equipment for the Indian Air Force; to undertake research and development for improvement of safety, performance and reliability of aircraft; to give type approval of aeronautical stores offered by the industry; and to provide assistance in evolving aeronautical standards and specifications, their application and implementation.

GTRE was nucleated from the Gas Turbine Research Centre setup at Kanpur with funding from CSIR with the aim of designing and manufacture of small turbojet engines. It was shifted to Bangalore to be closer to HAL and after being absorbed into DRDO as GTRE, it was oriented towards design and development of aero engines for military applications and for establishment of test and research facilities in this area.

Defence Food Research Laboratory (DFRL) was a new laboratory created around the core of scientists of DSL who had worked in the areas of food and nutrition with nearly ten years of experience in carrying out research and development in nonoperational and operational feeding of the Armed Forces, i.e., supply, and storage including preservation to prevent chemical and biological degradation under all kinds of environments prevailing in the country.

The Defence Laboratory, Jodhpur was a new institution that was setup as a consequence, of both the Minister and the Scientific Adviser being certain that since the arid regions of Rajasthan, a border state, would play major part in any future conflict with our neighbour, a focus on the likely problems that the Indian Army would face in operating in this region need to be addressed. The Laboratory was housed in the Ratanada Palace which was not in use.

The Defence Research & Development Laboratory at Hyderabad was formed around the core group at DSL, which was constituted as a study team on guided weapons in 1958-1959. The purpose for which the laboratory was set up was to design and develop missiles for the Armed Forces.

The Field Research Laboratory at Leh was taken over by DRDO from the Indian Agricultural Research Institute, which inturn had set it up under Professor Boshi Sen, a well known botanist, at the instance of the Prime Minister. The main purpose of this laboratory was to study agriculture and animal husbandry in high altitudes so as to make available to the military personnel serving in inhospitable regions, fresh, varied, tasty and nutritious food.

The Institute of Nuclear Medicine and Allied Sciences (INMAS) was the brain child of Dr DS Kothari, the Scientific Adviser who had formed in the Defence Science Laboratory, a Radiation Cell in 1956 to focus on developing techniques of radiation medicine for better health care for the Service personnel and also for civilians. The Defence Minister as well as the Prime Minister welcomed the establishment of INMAS with great enthusiasm and this was perhaps the first institution of its kind in the world exclusively devoted to promotion and development of techniques of nuclear medicine for medical research, diagnostics and therapy.

The Institute of Systems Studies and Analysis (ISSA) at Delhi was created to focus on reliability and performance evaluation to assist the Services in the selection of weapon systems, plus war gaming and simulation of weapons and equipment. The study team setup earlier in 1958-1959, for Weapons Evaluation formed the core for the new laboratory.

The Naval Chemical and Metallurgical Laboratory (NCML) was transferred from the Navy to DRDO. It was already functional with the Navy for rendering scientific assistance to the naval dockyard and the fleet in their day-to-day maintenance problems and to keep the fleet operative. In addition to routine testing of samples, the NCML was also taking up investigations on problems of corrosion, barnacles materials used in by the Navy marine environment specific to the Navy.

The Solid State Physics Laboratory (SSPL) was a new laboratory created for the purposes of carrying out research and development in solid state matters of interest and use in electronic devices and circuits. The emergence of transistors had fired the imagination of physicists in the study of different types of compounds designated as semiconductors which could possibly be useful inelectronic circuits as oscillators, rectifiers, switches and amplifying devices. The nucleus of scientists for this laboratory cameout of the DSL whereas mall band of scientists were carrying out studies on semiconductor materials of interest to electronics.

The Terminal Ballistics Research Laboratory (TBRL) was newly setup for the specific purposes of providing facilities for basic and applied research in detonics, high energy materials, blast/damage effects, immunity/lethality of ammunition, and defeat of armour. In addition, it was required to assist in the design, development and performance evaluation of armament stores. The coregroup of scientists for this laboratory came from the Weapons Evaluation study team that had been formed earlier in 1958-1959 at DSL.

The expansion was not only in terms of the fields of research and development but also in terms of a network of R&D institutions throughout the country. The subjects covered ranged from aircraft, aero engines, chemistry, electronics, food and nutrition, materials, metallurgy, nuclear medicine, operations research, physics, psychology, textiles and so on. The laboratories spread the message of the importance of science and technology to defence. The concern at that time was not to situate the laboratories at places which were within near reach of the potential aggressor. In each of these cases, in accordance with the condition imposed by Dr DS Kothari, the Scientific Adviser, the institutions were housed in existing buildings which were either armed forces barracks/temporary hutments earlier used by the Services or palaces of the princes which were not in use after the merger of the princely states with the Union of India.

The DR&D Organisation adhered to the earlier practice set by the Defence Science Organisation in not investing in civil works at the time of setting up the laboratory or the training institute.

To be continued...

DRDO IN PRESS

THE HINDU

THURSDAY, 2 MARCH 2017

Interceptor missile test successful

The Defence Research & Development Organisation (DRDO) on Wednesday successfully carried out test of an interceptor missile, further validating the reliability of the under-development, two-layered Ballistic Missile Defence (BMD) in shooting down enermy missiles. Defence sources said the endo-atmospheric missile, which can intercept missile at the ranges of 15-30 km, was launched at 10.30 am from the Abdul Kalam Island off the Odhisa coast in response to an incoming missle which was launched from the Integrated Test Range (ITR) in Chandipur.

DECCAN Chronicle

Thu, 2 March, 2017

The missle man

DRDO fellow D.S. Reddy has been conferred with a LifeTime Achievement Award

India made history when the country's first Ballistic Missile, Prithvi, was successfully tested in 1988. It meant that India had finally taken the first step towards becoming self-sufficient in producing wide-range ballistic missiles. On March 25, a scientist who played a vital role in development and flight evaluation for the project and a Defence Research and Development Organisation Fellow, D. Sreenivasulu Reddy of Hyderabad, was conferred with a Lifetime Achievement Award for four decades of his contribution to the organisation by the Defence Minister, Arun Jaitley. He was also instrumental in the successful flight test of the ship-launched Dhanush missile.

THE ASIAN AGE

Thu, 2 March, 2017

DRDO radar that can spot Pak's weapons is ready

The Defence Research and development Organisation will hand over indigenous weapon-location radar to the Army Thursday. Bharat Electronics Ltd. will then produce the DRDO-developed WLR under a technology transfer pact. In the 1999 Kargil War, the Indian Army lacked such weapon-locating radar, which the Pakistani Army had. "The WLR detects and locates the weapon within seconds before the round land, enabling quick, accurate counter-artillery return fire," a person familiar with the matter told this newspaper.

the pioneer

Thu, 02 Mar, 2017

India Test-Fires Indigenous Supersonic Interceptor Missile to reality

India on Wednesday successfully test-fired an indigenously developed supersonic interceptor missile capable of destroying any incoming enemy missile at low altitude, a feat which reflects the country's Ballistic Missile Defence prowess.

The Defence Ministry said all the mission objectives were successfully met during the test-firing of the endo- atmospheric missile [illegible] Abdul Kalam Island in Odisha.

moneycontrol

Wed, 01 March, 2017 (online)

Jindal Stainless (Hisar) spikes 4% on new agreement with DRDO

The stainless steel maker signed a licence agreement with Defence Research and Development Organisation (DRDO) to help manufacture high nitrogen steel Shares of Jindal Stainless (Hisar) rose over 4 percent intraday on Wednesday as investors cheered the company's new agreement with the country's defence body. The stainless steel maker entered into a licence agreement with the Defence Research and Development Organisation (DRDO), which entails transfer of technology to manufacture high nitrogen steel (HNS) for Armour applications, according to a notification filed to the exchanges by the firm.

The company claims that the use of HNS will replace Armour steel, an existing material which is mostly imported. This, it says, will result into 50 percent cost efficiency in material acquisition. "This development reaffirms our endeavour to achieve higher benchmarks. We look forward to collaborate with Ministry of Defence to achieve greater efficacy of Indian armed forces and then take forward our capabilities," said Abyuday Jindal, vice-chairman, Jindal Stainless (Hisar).

[illegible] on the deal and sees de- an inter- dal Stain- 5 percent cent. Ad- e at 12-15 p Rs 1.40, Rs 119.50.

The Tribune

Tue, 28 March, 2017

IAF's 2nd base for radar planes ready for take-off in Bathinda

By Vijay Mohan

DRDO has built support base for the facility developed at Bhisiana station

The Indian Air Force's second airbase for operating airborne early warn[illegible] control systems (AEW&CS) aircraft that has come up at the Bhisiana A[illegible] Station near Bathinda in Punjab is ready for operations. The infrastructu[illegible] support facilities built up at the airbase by the Defence Research and [illegible] opment Organisation (DRDO) for the AEW&CS are complete and [illegible] complex within the airbase is expected to be handed over to the Air For[illegible] month, IAF sources said.

The base will house indigenous AEW&CS developed by the DRDO [illegible] is christened Netra and was showcased at the Republic Day Parade as [illegible] the Aero India show earlier this year. A fighter, unmanned aerial vehi[illegible] a missile squadron are also based at Bhisiana. The other IAF base to [illegible] AEW&CS is Agra, home to the A-50 AWACS, which are Israeli Phalco[illegible] tems integrated with a modified Russian IL-76 heavy-lift aircraft.

THE HINDU

Sat, 25 March, 2017

Imarat, DRDO delivers INS-SA to Indian Navy

Defence Minister Arun Jaitley handed over the Inertial Navigation System for Ship Application developed by Research Centre Imarat, DRDO, to the Navy Chief. G. Satheesh Reddy, Scientific Adviser to Defence Minister, said the successful development of INS-SA demonstrated the synergy between DRDO, Indian Navy, Public and Private Industries and would provide the necessary thrust to the defence capabilities of the Indian Navy.

Research Centre Imarat, DRDO, here developed a state-of-the-art high accuracy Inertial Navigation System based on indigenous Ring Laser Gyroscopes and Accelerometers, the technology which was available with only a handful of nations.

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