

DRDO DEVELOPS INDIGENOUS TRAWL

The indigenous development of trawls would result in achieving self-reliance in area of critical military equipment under 'Make in India' initiative



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Defence Research & Development Organisation

FROM THE DESK OF THE CHAIRMAN



Dr S Christopher

CHAIRMAN

Defence Research & Development Organisation

&

SECRETARY

Department of Defence Research & Development

Dear friends,

Excellence in life can only be achieved by burning midnight oil. There is no shortcut to hard work in reaching the pinnacle either in personal life or professional career. And to take your organization to unassailable heights, it requires sustainable efforts from each member, unstinting support from the family members and clear cut vision and directions from the leaders in the organization. DRDO has abundance of all these in writing the saga of our achievements in golden letters for the past 60 years. Today, we stand tall with pride celebrating DRDO@60.

The events planned for DRDO@60 have got overwhelming response. 'Submarine Exhibition' was inaugurated by Hon'ble Raksha Mantri, Smt Nirmala Sitharaman. The logo competition has received creative logo entries from many labs worth appreciating and having professional touch. The painting competition "DRDO in my Eyes" is also progressing well. I am happy to know that Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur has planted over 1000 tree saplings of more than eight varieties giving a green look to the campus. The young scientists have given invaluable input for DRDO@60 and have come forward voluntarily to conduct the events. This type of positive response from the team raises the threshold level of the team as well as boost up the confidence level of people heading such a dynamic team. My complements to one and all.

Let the tempo remain. Let the fire in the belly to achieve the impossible burn more vigorously. Let our predecessors, who worked tirelessly to enhance the image of our esteemed organization, feel that their contributions did not go waste and today the organization is in safe hands, who have the capability, willpower and confidence to contribute to nation building and New India - 2022. Let us aim for the New India where innovations in defence sector are synonym with DRDO. Together we can and we will show to the world that we are "Second to None".

Jai Hind.

INDIGENOUS DEVELOPMENT OF TRAWL SYSTEM BY DRDO

Research and Development Establishment (Engrs) [R&DE (E)], a premier system engineering laboratory under Armament and Combat Engineering (ACE) cluster of DRDO, has designed and developed Trawl System for cleaning the minefield area in the battle zone to meet the operational requirements of Indian Army. The indigenous System would be used for creating a vehicle safe lane for the advancing columns of mechanized forces in combat zone by breaching a variety of land mines including passive and active influence mines.

The indigenous development of trawls by DRDO is an important step towards achieving self-reliance in area of critical military equipment under 'Make in India' initiative and would result in saving of precious foreign exchange for the country.

The equipment consists of a trawl roller, a track width mine plough and an electro-magnetic device (EMD). The system crossed a major milestone recently with the successful completion of blast trials in collaboration with High Energy Materials Research Laboratory (HEMRL), Pune. The trials demonstrated the survivability of the equipment when subjected to successive series of blast directly underneath it.

The fieldable prototype of the Trawl System is in final stage of realization and would be ready shortly for the user's evaluation by the Army.





DEVELOPMENT TRIALS OF ASTRA BVRAAM CONDUCTED SUCCESSFULLY



The final development flight trials of Astra, Beyond Visual Range Air-to-Air Missile (BVRAAM) were successfully conducted over the Bay of Bengal, off the coast Chandipur, Odisha, during 11-14 September 2017. A total of seven trials were conducted against Pilotless Target Aircraft successfully.

The missions included engagement of target at very long range, engagement of high manoeuvring target at medium range and multiple launches of missiles in salvo to engage multiple targets. All the sub-systems including the indigenous RF Seeker performed accurately, meeting all the mission

parameters and objectives. Two missiles were also launched in the combat configuration with warhead and the targets were neutralized.

This effort for building a state-of-the-art BVRAAM by DRDO together with Indian Air Force (IAF) has completed the development phase of the weapon system successfully. Hindustan Aeronautics Limited (HAL) has played a role in modifying the aircraft for weapon integration. More than 50 public and private industries have contributed in building the Astra weapon system.

Dr S Venugopal, Programme Director led the launch operations and flight trials along with the teams from

multiple organisations.

SA to RM and Director General, Missiles and Strategic Systems (MSS), DRDO, Dr G Satheesh Reddy, said the technologies developed under the programme will be the building blocks for development of more variants of air-to-air and surface-to-air missiles.

Hon'ble Raksha Mantri Smt Nirmla Sitharaman congratulated DRDO, IAF, Defence Public Sector Undertaking and industries for the successful trials of Astra missile. Chairman, DRDO, and Secretary, Department of Defence R&D, Dr S Christopher also congratulated the 'Team Astra' for developing and flight testing of the formidable weapon system.

SUCCESSFUL TEST OF 3RD GENERATION ANTI-TANK GUIDED MISSILE

The third-generation anti-tank guided missile (ATGM) Nag was successfully tested by the DRDO on two different targets on 8 September 2017.

As expected Nag attacked both the targets at different distances in very precise ways. After these two successful trials and along with the tests conducted in the hot summer in June last year,

testing of the Nag and that of Namica projection system has been completed.

RAISING DAY CELEBRATIONS

ARDE, Pune

Armament Research and Development Establishment (ARDE), Pune, celebrated its 59th Raising Day with great enthusiasm on 1 September 2017. Various events like release of festive balloons and sapling plantation were organised to mark the day. In his Raising Day address, Shri KJ Daniel, OS, Officiating Director, presented an overview of the achievements of the establishment during the past year and laid down the areas for future work. Cash awards and Armament awards were presented to the meritorious employees.



DESIDOC, Delhi

Defence Scientific Information and Documentation Centre (DESIDOC), Delhi, celebrated its 47th Raising Day on 10 August 2017. Dr Hina A Gokhale, OS and DG (HR) presided over the function. Dr M Hafizur Rahman, DS and former DG (HR&TM), DRDO, was the Chief Guest on the occasion.

In his welcome address Shri Gopal Bhushan, OS and Director, DESIDOC, counted Centre's attainments in knowledge generation and distribution through smart information tools and services, roadshows, and exhibitions and said, "DESIDOC has evolved in the past few years and has successfully combined knowledge and technology for the image building of the DRDO."

Dr M Hafizur Rahman lauded DESIDOC for providing latest domain information to the DRDO scientists. Dr Hina Gokhale, delineated the growth of DESIDOC from a simple Scientific Information Bureau into a Knowledge Hub. Commending the DRDO Newsletter's video news bulletin, brought out by the DESIDOC, she said, "From a simple newsletter to e-newsletter to a visual newsletter, it is

a remarkable journey by the Centre."

A book exhibition was organised on the occasion. Dr Rahman and Dr Gokhle also planted saplings. Laboratory-level DRDO Awards, Cash Awards and Sports Awards were distributed by Dr Rahman and Dr Gokhale.

A large number of retired employees attended the function. The function ended with a colourful cultural programme. Dr Rajeev Vij, Sc 'G', and Convener, DESIDOC Raising Day Committee, proposed the vote of thanks.





DMSRDE, Kanpur

The 41st Laboratory Raising Day as well as Ruby Jubilee Closing Ceremony of Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur, was celebrated on 29 July 2017. Dr N Eswara Prasad, OS and Director, DMSRDE, inaugurated the ceremony and presented the achievements of the Establishment in the fields of technology, project execution, product development, laboratory management and sports. The Chief Guest, Dr SC Sati, former DG (NS&M) and the Guest of Honour Shri Shailendra Nath, Senior GM, Field Gun Factory, Kanpur, addressed the DMSRDE fraternity. Laboratory-level DRDO Awards, Sports Awards and DMSRDE Special Awards



were distributed to the meritorious employees. Superannuating employees and employees who completed 25 years

of service were also felicitated. The function ended with a splendid cultural programme.

RCI, Hyderabad

Research Centre Imarat (RCI), Hyderabad, celebrated its 29th Annual Day on 27 August 2017. Dr S Christopher, Chairman, DRDO and Secretary, Department of Defence R&D was the Chief Guest and Dr G Satheesh Reddy, SA to RM and DG (MSS) was the Guest of Honour at the function.

Shri BHVS Narayana Murthy, OS and Director, RCI, presented an account of the activities and achievements

of the Centre in the past year and congratulated scientists and staff for the successful flight trials during the year.

Dr S Christopher released RCI Women's Magazine *Anmol* 2017 and presented laboratory-level DRDO Awards to the meritorious employees. Dr G Satheesh Reddy presented 25 Years Service Mementoes to RCI staff and stressed on better quality practices in all labs of missile cluster. He also

suggested RCI to be the Nodal Centre for interaction with industry and academic institutions in missile R&D.

Dr S Christopher in his address stressed on better collaboration between Project Management teams in areas of missile design, quality management and manufacturing to deliver cost-effective weapons as per user requirements.



LADAKHI KISAN-JAWAN-VIGYAN MELA

Defence Institute of High Altitude Research (DIHAR) organized its 24th Ladakhi Kisan-Jawan-Vigyan Mela at DIHAR HQ Leh during 12-13 August 2017 to create awareness and interest on various DIHAR developed agro-animal technologies and herbal

health supplements among local farmers and troops deployed in the region. The Mela was inaugurated by Lt Gen PJS Pannu, AVSM, VSM, GOC, HQ 14 Corps in the presence of Dr OP Chaurasia, Director, DIHAR. Various competitions were organized during the Mela for the civil

population as well as defence units and the winners were felicitated with mementoes and certificates.

Over the years, the Mela has grown in its size and scope and evolved as a platform for interaction among farmers, troops and scientists.



RUN FOR UNITY

SF Complex (SFC), Jagdalpur, organised a road running programme 'Run for Unity' to

celebrate spirit of Independence Day and to promote Hindi. Shri Jay Chand Choudhary, GM, SFC, flagged off the

Race. The whole SFC enthusiastically took part in the event.



EMU (R&D) BENGALURU BAGGED FIRST PRIZE IN HORTICULTURE AND FLOWER SHOW

Estate Management Unit [EMU (R&D)], DRDO, Bengaluru, won 1st Prize in 60 events it competed in the 204th Horticultural Show organized by the Mysore Horticulture Society, Government of Karnataka. DRDO was also awarded

a special “Outstanding Trophy and Rolling Shield” by the Society for overall performance, maintenance and upkeep of its arboriculture assets at Bengaluru. EMU (R&D), was awarded two “Special Silver Mementos” in recognition of their outstanding performance.

Dr S Christopher, Chairman, DRDO and Secretary, Department of Defence R&D, congratulated Shri MVL Narasimha Rao, Estate Manager, and his entire team for the excellent results.



KU LIMAYE MEMORIAL LECTURE

Microwave Tube Research and Development Centre (MTRDC), Bengaluru, organised 9th KU Limaye Memorial Lecture on 17 August 2017. Dr Sudhir Kamath, OS and Director, MTRDC, welcomed the august gathering and briefed about the contributions of KU Limaye, former CC R&D, DRDO. On this occasion Shri SS Nagaraj, OS and Director, Electronics and Radar Development Establishment (LRDE), Bengaluru, delivered a talk on ‘Evolution of Radars’. Dr Sum Reddy, Sc ‘G’, Associate Director, MTRDC, gave the vote of thanks.



TRAINING PROGRAMME ON MANAGEMENT OF CBRN EMERGENCIES

A Specialized Training Programme on Management of CBRN Emergencies for Medical Officers, Non-Health Responders and CISF was conducted by Institute of Nuclear Medicine and Allied Sciences (INMAS), Delhi, during 2-4 August 2017. The three-day course had 43 medical officers and specialists, 22

non-health responders and 20 CISF personnel as participants. They were introduced to CBRN topics like awareness, decontamination, decorporation, chemical and biological agents and nuclear and radiological incidents and their management. The participants were sensitized on the identification of CBRN casualties and

medical management. The course was specially customized for each group of participants. The course comprised lectures and demonstrations with hands-on training as well. Various products developed by DRDO for CBRN emergency mitigation and management were displayed to the participants.



HUMAN ACCLIMATIZATION STUDIES AT HIGH ALTITUDE

A team of scientists from Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi, carried out studies on human acclimatisation

at high altitude in Kyrgyz and Indian population at High Altitude Centre at Syok Pass (4111m) in Kyrgyzstan. Basal recording of physiological, bio-

chemical, molecular variables and sleep architecture was done at Kyrgyz-Indian Mountain Biomedical Research Centre (KIMBMRC), during 7-12 August 2017.





SEMINAR ON AERONAUTICAL MATERIALS & SYSTEM DEVELOPMENT

Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur, organised a one-day seminar on Aeronautical Materials and Systems Development and Prototype

Production on 28 July 2017. Dr N Eswara Prasad, OS and Director, DMSRDE, inaugurated the seminar and delivered a lecture on Aerospace Materials and Material Technologies: A Brief Overview. More than 90

participants comprising students from local engineering colleges, officers from HAL and AFS, Kanpur and scientists from RCMA, Kanpur and DMSRDE, attended the seminar. A Poster Session was also organised.



COURSE ON FUNDAMENTALS & HANDS-ON TRAINING ON MICROWAVE MEASUREMENTS

A CEP course on Fundamentals and Hands-on training on Microwave Measurements was conducted by Microwave Tube Research and Development Centre (MTRDC), Bengaluru, during 5-8 September 2017. The objective of the course was to provide an introductory training to refresh the RF and Microwave basic concepts and measurement fundamentals at high frequencies. Dr Sudhir Kamath, OS and Director, MTRDC, inaugurated the course.

Prof. S Balasubramanian, former Professor, BITS, Pilani, delivered lectures on fundamentals of microwave measurements, coaxial cables and connectors, passive components, etc. Experts from industries and MTRDC



also delivered lectures on topics relevant to the course. Hands-on training on

all the topics was also provided to the participants.

COURSE ON ADVANCES IN RANGE TECHNOLOGY

A CEP course on 'Advances in Range Technology: Present and Future' was organized at Integrated Test Range (ITR), Chandipur, during 31 July-4 August 2017. Dr BK Das, OS and Director, ITR, inaugurated the course. Bi-annual Newsletter of ITR, 'Sagar: The Saga of the Range', was released on this occasion. The inaugural lecture was delivered by Dr M Manickavasagam, Sc 'G', Advanced Systems Laboratory, Hyderabad.

The course aimed to update the knowledge of the participants on the latest developments of range technologies, its implications and future

advances. Sixty-eight participants from ITR, other labs of DRDO and BrahMos Aerospace Pvt Ltd, attended the course.

Shri CR Ojha, Sc 'F', was the Course Director and Shri Santosh Munda, Sc 'D', was the Course Coordinator.



BASIC/FOUNDATION COURSE IN R&D MANAGEMENT

A 'Basic/Foundation Course in TM-2 (R&D Management)' was conducted at Institute of Technology Management (ITM), Mussoorie, from 28 August to 1 September 2017. Eighteen Officers from different DRDO labs/estts attended the course. The aim of the

course was to focus on the importance of different aspects of managing R&D projects in DRDO.

The course was inaugurated by Shri Sanjay Tandon, OS and Director, ITM. He deliberated upon management issues related to R&D projects and tools and techniques required to accomplish

the projects effectively. Lecture on various topics, viz., Criticality and Challenges in DRDO Projects, An overview of R&D Process and DRDO Practices, Developing Detail Feasibility Report: Discussing Provision of PPFM, etc., were discussed during the course.



DR CHRISTOPHER, INAUGURATES MEGH & BADRA FACILITIES AT DLJ

The facilities, established under mission mode project, would help development of indigenous technologies for passive microwave countermeasures for airborne platforms.

Dr S Christopher, Chairman DRDO, and Secretary, Department of Defence R&D, inaugurated Microwave Electronic Countermeasure Generation Hub (MEGH) established under project Indigenization of Microwave Chaff for Defence Applications, and Blooming and Dynamic Radar Cross-Section (RCS) Analysis (BADRA) facilities at Defence Laboratory, Jodhpur (DLJ), on 15 August 2017.

MEGH facility consists of pilot plant for limited scale production of

Chaff Fibre, Simulation and Modelling and laboratory facilities for RCS measurements. The pilot plant has a capacity to produce about 1.5 lakh metres of chaff fibre per day.

BADRA consists of microwave chaff blooming facility and mobile dynamic RCS measurement facility. The mobile dynamic RCS facility is first of its kind in the country wherein the time dependent RCS measurement and analysis of chaff cloud generated by the firing of chaff cartridge is performed at a time scale of milliseconds.

These facilities have been established under a mission mode project and would help development of indigenous technologies for passive microwave countermeasures for airborne platforms. Chairman DRDO acquainted with the details of the facilities and their applications.

Dr Christopher also inaugurated a new Transit Facility Godawan Palace. It consists of 30 rooms and other amenities including Multi-purpose Hall, Conference Hall, Gymnasium and a very spacious Dining Hall.



A meeting on NBC Technologies, was also attended by Chairman DRDO, Dr Shashi Bala Singh, DS and DG (LS), Dr SV Kamat, OS and DG (NS&M), Dr AK Singh, OS and Director, Institute of Nuclear Medicine and Allied Sciences (INMAS), Dr N Eswara Prasad, OS and Director, Defence Materials and Stores Research and Development Establishment (DMSRDE), Dr DK Dubey, Director, Defence Research and Development Establishment (DRDE), Dr Rajeev Varshney, Director, TSM, DRDO HQ, Dr Devkanta Pahad Singh, Director, PM&SQR, DRDO HQ, and Shri Manish Bhardwaj, Director, DPI, DRDO HQ were present in the meeting.



RADIO FREQUENCY ANECHOIC CHAMBER FACILITY ESTABLISHED AT DIPAS

A highly sophisticated Fully-Shielded Radio Frequency (RF) Anechoic Chamber has been established at Defence Institute of Physiology and Allied Sciences (DIPAS), to study the bio-effects of broad range

of RF radiation exposure (900 MHz-100 GHz) on experimental animal models. The facility aids to evaluate the thermal and non-thermal implications of RF radiation on physiological responses, and alterations at biochemical and

molecular levels. This facility would be helpful for dose-response studies using varied RF physical parameters, real-time behavioural monitoring and risk assessment to generate safety guidelines.





APPOINTMENT

Director, DMRL



Dr Vikas Kumar, OS, has taken over as Director, Defence Metallurgical Research Laboratory (DMRL), Hyderabad. He obtained his Bachelor's degree in

Metallurgical Engineering from IIT, Roorkee (earlier University of Roorkee), in 1980, MTech from IIT, Kanpur, in 1982 and PhD from IIT, Madras, in 1995. He has been visiting scientist

for two years at Centre Des Materiaux, ENSMP, Paris, France and worked under the framework of an Indo-French collaborative research programme on development of advanced materials for aeroengines. He has developed expertise in the area of Fatigue and Fracture Mechanics in DMRL for more than three decades, developing several application software codes for testing and analysis.

His fundamental and applied research work has led to several Indian and International Patents, and awards such as SAIL Gold Medal, National Research and Development Corporation's Award, United Nation's WIPO Gold Medal for meritorious invention, DRDO's Technology Group

Award and Agni Award for Excellence in Self-Reliance. He has published more than 100 papers in peer reviewed National and International journals, and conference proceedings. Indian National Academy of Engineering (INAE) has also selected him as Distinguished Visiting Professor at Indian Institute of Science, Bangalore. He is also Chairman of a Committee of Bureau of Indian Standards (BIS) on 'Mechanical Testing of Materials'.

He is the life member of several professional bodies such as The Institute of Engineers (India), Indian Institute of Metals (IIM), Aeronautical Society of India (AeSI), Indian Society for Non-Destructive Testing (ISNT).

HIGHER QUALIFICATIONS ACQUIRED

SFC, Jagdalpur



Shri MVL Ramesh, Sc 'G', SF Complex (SFC), has been awarded PhD in Metallurgical Engineering by the JNT University, Hyderabad for the thesis entitled

'Effect of Post-weld Heat Treatment on the Mechanical and Metallurgical Properties of the Weld Joints made by Laser Beam Welding'.

SASE, Chandigarh



Shri Prem Datt, Sc 'E', Snow and Avalanche Study Establishment (SASE), has been awarded PhD by NIT Kurukshetra, for the thesis entitled

'Acoustic Emission Analysis for Damage Response of Snow and Characterization of Acoustical Properties'.

MTRDC, Bengaluru



Shri V Nallasamy, Sc 'F', Microwave Tube Research and Development Centre (MTRDC), has been awarded PhD by IIT (BHU), Varanasi, for the thesis titled

'Design Optimization and Experimental Evaluation of S-band MILO for Performance Improvement'.

DARE GETS AS9100C & ISO 9001:2008

Defence Avionics Research Establishment (DARE), Bengaluru, has been accorded AS9100C and ISO 9001:2008 Certification in accordance with the requirements of AS9104/2012, TUV SUD America Inc. The scope of the quality management systems includes: "Research, Development, Testing and Integration of Radar Warning Systems, Electronic Support Measures, EW Suites and Avionics Systems."



VISITORS TO DRDO LABS/ESTTS

HEMRL, Pune

Ms Pamela Satpathy, IAS, Assistant Secretary, Department of Defence Production, Ministry of Defence, New Delhi, visited High Energy Materials Research Laboratory (HEMRL) on 3 August 2017. Ms Satpathy, was appraised about the research and development activities at HEMRL. She visited the Chemical Engineering and Pilot Plant, High Explosive and Solid Rocket Propellant Processing Facilities.



DIHAR, Leh

Col (R) Rajyavardhan Rathore, Minister of State for Information and Broadcasting, Government of India and Shri Mansukh Mandauya, Minister of State for Road, Transport, Shipping, Chemical and Fertilizer, Government of India, visited Defence Institute of High Altitude Research (DIHAR), on 15 August 2017. They were given a presentation about DIHAR activities and how it is helping to transform the life of local population as well as defence forces deployed in the region. The ministers applauded DIHAR for its pathbreaking and innovative research.



NPOL, Kochi

Mr Brendon Anderson, Counsellor, Defence Science and Technology Group (DSTG), Department of Defence, Australia, visited Naval Physical and Oceanographic Laboratory (NPOL), Kochi, on 8 August 2017. Discussions on various technological areas pertaining to maritime security were held among the visitors and Shri S Kedarnath Shenoy, OS and Director and other senior scientists of NPOL. Mr Anderson briefed about the S&T capabilities of DSTG, strategic industry alliances, partnerships with universities and international engagements. He also visited state-of-the-art underwater surveillance facilities at NPOL.





READERS' VIEWS

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

- Name of the Establishment:**_____
- How would you rate the DRDO Newsletter as a medium to adequately present DRDO developments?**
 Excellent Very Good Good Fair Satisfactory
- How would you rate the technical contents of the Newsletter?**
 Excellent Very Good Good Fair Satisfactory
- How would you rate the quality of photographs in the Newsletter?**
 Excellent Very Good Good Fair Satisfactory
- Ideal number of pages you would like for the Newsletter?**
 8 Pages 12 Pages 16 Pages 20 Pages
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- When are you receiving the Newsletter:**
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 In the next month of publishing
- Suggestions, if any, to further improve the technical content of the Newsletter?**

Name:
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Please mail your suggestions to:

The Editor, DRDO Newsletter, DESIDOC, DRDO, Metcalfe House, Delhi - 110 054

DRDO HARNESSING SCIENCE FOR PEACE AND SECURITY- XXI

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

The article is twenty-first 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).

CONSOLIDATION

Project Selection & Planning

Even as the Five Year Plans were being finalised, the Scientific Adviser at the 8th Annual R&D Conference in 1965 at Bangalore announced the decision to strengthen and expand activities in the areas of electronics, missiles and rockets, aeronautics and naval research and development. His vision and foresight in giving strategic direction to DRDO's work and in providing resources to expand R&D activities in these four technological areas paid dividends by paving the way for the Secondary Surveillance and the INDRA radars for the ADGES Plan, the mobile digital switching systems, TIDEX (Time Division Electronic Exchange) and AES (Automatic Electronic Switch) for the Plan AREN (Army Radio Engineering Network), several generations of cipher and speech secrecy systems, the APSOH (Advanced Panoramic Sonar Hull-mounted) for the Indian Navy IGMDP (Integrated Missile Development Programme), and LCA (Light Combat Aircraft) development among others, nearly twenty years later.

It is interesting to note that at the 12th Annual R&D Conference in 1969, the topic of laser was discussed from the point of view of initiating R&D activities. During the discussions it emerged that if work in this area has to be launched then it would have to be on a wide front starting from the devices such as laser diodes, photo diodes, components such as couplers, power dividers/combiners, sub-systems such as laser sources, photo-detector amplifiers and

equipment design and development for a wide range of possible applications. The Conference came to the conclusion that such an effort would cut severely into the resources of the DRDO without payoff in the near future. Dr Bhagavantam therefore ruled that prior to launching any effort in this area, DRDO should prioritise the activities from the point of view of immediacy of application to the military, clarify our own ideas in such applications, and interact with the Services. This is a clear instance of participative decision making through dialogue-discussion which contributed to greater cohesion and understanding among Directors.

Integrated Procedure for Development & Production

Three different customers, several technology and science fields, different outputs (reports, product, process), several categories of industries (departmental undertakings, public sector and private sector) with different requirements and conditions for technology transfer, stringent performance requirements and first generation designers was the picture of DRDO and its activities when Dr Bhagavantam took over as full time Scientific Adviser in 1962. In such a situation any problem faced would be specific to a laboratory and to a specific technology/science field. This would prevent effective communication and exchange of information among the laboratories to improve the R&D response. Design and development for a customer who is outside one's own department and transfer of technology for bulk production to

an outside manufacturer was being attempted for the first time in the country and therefore it was a new territory for all the parties involved in the process. The knowledge about the activities and the processes involved in the development and production of defence equipment in the UK due to the earlier close association of the Indian Armed Forces was useful in getting started but significant departures were necessary in many cases. For example, in the case of electronics equipment, the industry having no R&D of their own did not involve itself actively till the equipment was designed, developed and accepted by the User, whereas in the UK, the hardware was developed by the industry right from the beginning. Such departures and the inexperience of all the parties involved in the process led to many difficulties regarding rights and responsibilities, relaxations for deviations from the written document and so on. These were resolved by a dialogue-discussion process so that our own methodology for design, development and production of military equipment could be hacked out of the thickets of differing concepts, opinions and prejudices, and some measure of understanding between the Services, the DRDO, the bureaucrat at the Ministry and the public sector production agencies/ordnance factories was reached. For each industry sector such as armaments, electronics, automobile engineering, mechanical engineering and so on, there was commonality in the overall procedure for design, development, production and inspection of hardware for Defence but they differed in the details due to the industry structure, the technological expertise of the firms in the industry



and the rate of technological advance in that particular sector.

One of the first technology sectors within the defence ministry to attempt codification of the procedure in the form of a guideline document was electronics. The first version of such a document was prepared in the very first year of the DRDO namely 1958. Based on the experience that was gained in the next four years a modified version came into existence in 1962. A third version was made available in 1964 and subsequently a comprehensive document named DDPIL-69 was issued by the Ministry of Defence. Shri MM Sen, Secretary Defence Production prefaced the document in the following manner. "...The design, development, production and supply of increasingly complex electronic equipment systems will require optimum coordination of the efforts of the numerous agencies involved in such programmes. Such coordination cannot be arranged through the medium of a formal procedure, however exhaustive it is made. If all the agencies involved realized that the tax payer on the one hand and the Service on the other, are looking up to them to design, develop, produce and supply military equipment systems expeditiously and economically, the guidance provided by this procedure would be adequate..."

The DDPIL-69 document consists of three parts, Part I dealing with the separate procedures for design and development by the DRDO, design and development by a public sector under a development contract and design and development on a proprietary basis. Part II lays down the guidelines for production in public sector and in departmental undertakings while Part III concerns procedures for inspection. It also lays down the responsibilities of the different agencies involved and the type of documents and drawings to be prepared and the mechanism for monitoring the progress. Even though the DDPIL-69 had shortcomings, its main contributions were in the systematization of the steps, elimination of arbitrariness and lessening of confusion in the development process and in the technology transfer for production, that was prevailing in the civilian sector between R&D and the manufacturer.

Early in the 1960s, a few instances came to light where a hardware had been successfully designed and the Services had expressed their needs and were prepared to place orders but no recognised production agency could be found willing to manufacture. Mostly, the reason was that the Services order was not economical for the recognized manufacturer to launch production within the price targets. The only alternative in some of these cases was to import even if the DRDO effort had been successful. The first case that was discussed in this context was that of military store Charge Line Mine Clearing successfully developed by the ERDL (now HEMRL) which would have to be imported unless a way was found to get it manufactured within the country. In this case no production agency within the country had the necessary facilities and they would have to make investments as well as need additional time for completion.

A policy decision was taken that DRDO would have to extend its activities to small scale production to fulfil the needs of the Services in such instances lest the development effort go waste. It was also decided that costing should include DRDO overheads in addition to cost of materials, additional test equipment/ facilities and direct labour. Overhead was charged as production was an exceptional activity of DRDO. Over the years many laboratories set up pilot plant facilities and were successful in producing and completing the small orders on the equipment developed by it for the Services within the price limits. These activities did not occupy the centre stage in the laboratories except that the Director and some of the senior scientists had to spend part of their time in management and review. An idea of magnitude of the effort involved can be gauged from the pilot plant activities of LRDE which in a period of 18 years (1967-1984) had orders worth Rs. 9.6 crores for 32 hardware items and 17 types of Nickel Cadmium battery packs.

For the technique/science oriented laboratories, the scientist initiated a project based on a new idea, new material, new component, new process, new technique or new technology and after interaction with the Service on a less formal basis if necessary. The outcome could be a report, a process, a

component or a subsystem. In the case of a process or a hardware, the commitment of the Services to use or even to try it would be tentative or it might not exist at the initial stage. The interaction was at the Services echelons lower than the Services Headquarters and it would continue till the performance of the product or process has demonstrated its promise or the expectations did not materialise. In either case, the scientist or the laboratory director would take the decision and the input from the Services was one among others which helped in decision making. In the case where the expectations were not matched by performance, the chances of continuing it would reduce drastically and most likely the activity would taper off. The effort would not be considered as having failed but as a necessary step in the learning process of R&D. In case the results are judged to have matched the expectations, DRDO would formulate a Provisional Technical Specifications and raise the level of interaction to Services Headquarters.

Depending on the quantum of investment to be made, the urgency of the need, and the degree of satisfaction of the User about the performance, the formal procedure of issuing a Qualitative Requirement might be followed or the informal approach would be continued with the Services Headquarters being fully in the picture and work continued to its logical end. Over these years, the sharp conceptual divide between the equipment oriented laboratories and the technique/science oriented laboratories in their approach to R&D began to blur as the mutual interaction between these two groups as well as their experience of dealing with the Services increased. Though no single procedure was possible for technology oriented tasks as well as equipment oriented tasks across all technology fields for design, development and production, there was a lot of commonality in the processes. Also there was better understanding within the organization about the processes involved and adapted for the different Services and across technology fields.

To be continued...



DEFENCE AVIATION POST
Your Connect To The World Of Defence And Aviation

Wed, 06 Sep, 2017
(Online)

India's Very Own ATAGS Sets a world record at Pokhran

Setting a worldwide record, India's very own indigenous gun—the first high capacity, long range 155-mm 52 calibre Advanced Towed Artillery Gun System (ATAGS) on Monday successfully test-fired a round at about 48 kms of range at Pokhran, official sources in the know told DefenceAviationPost.com.

In comparison, 155-millimetre, 52-calibre guns in service worldwide fires this ammunition to maximum ranges of 40-45 kilometres.

"On Monday, the Advanced Towed Artillery Gun System successfully test fired a round at 48 Kms of range at Pokhran... which is perhaps the first time in the history / world," a senior official confirmed.

Senior officers of the Indian Army and Defence Research & Development Organisation and from Pune-based Armament Research & Development Establishment (DRDO's ARDE) were present during the trial.

The 155-millimetre, 52-calibre gun-howitzer fired three shells out to a distance of 48 kilometres from the gun position. This was achieved using special, long-range ammunition called "high explosive – base bleed" (HE – BB).

THE ECONOMIC TIMES

Sat, 09 Sep, 2017
(Online)

DRDO carries out successful tests of Nag missile

New Delhi: India's indigenously developed third generation anti-tank guided missile (ATGM) Nag has been successfully flight tested by premier defence research organisation DRDO in deserts of Rajasthan, marking completion of development trials.

The defence ministry said Nag has been successfully flight tested twice by the DRDO against two different targets yesterday in Rajasthan. The missile can hit a target up to seven km.

The ATGM Nag missile has successfully hit both the targets under different ranges and conditions with very high accuracy as desired by the armed forces," the ministry said.

India has been trying to ramp up its military capability in sync changing security dynamics in the region. The defence ministry said yesterday's flight tests and the trials in June marked the successful completion of development trials of Nag missile.

"With these two successful flight trials, and the flight test conducted earlier in June in the peak of summer, the complete functionality of Nag ATGM along with launcher system NAMICA has been established and marked the successful completion of development trials of Nag missile," it said.

SHEPARD

Tue, 05 Sep, 2017
(Online)

Indian Navy receives LRSAM

India's Defence Research and Development Organisation (DRDO) and Israel Aerospace Industries (IAI) have delivered the first Long-Range Surface-to-Air Missile (LRSAM) manufactured in India to the Indian Ministry of Defence, IAI announced on 31 August.

The missiles are to be installed on the Indian Navy's operational missile ships.

LRSAM is an advanced air and missile defence system designed to protect against a variety of aerial, naval and airborne threats. The system includes a multifunction surveillance, track and guidance radar, command and control system, launchers and missiles with advanced RF seekers.

LRSAM has been jointly developed by IAI and DRDO in collaboration with IAI subsidiary ELTA, RAFAEL and Indian industry. It is currently operational with the Indian Air Force, Indian Navy and Israel Defense Forces and is expected to enter operation with the Indian Army shortly.

THE FINANCIAL EXPRESS

Fri, 01 Sep, 2017
(Online)

India will need \$150 bn worth military equipment in 10 yrs: DRDO's Dr Sudhir Mishra

Distinguished scientist and Director General of BrahMos missile system division of the DRDO, Dr Sudhir Mishra, today said the country would require various military equipment worth USD 150 billion in the next 10 years.

Inviting private players to grab the opportunity by entering the defence equipment manufacturing, Mishra said the Defence Research and Development Organization (DRDO) is ready to share its technology with the manufacturers. Mishra, who is also the CEO and Managing Director of 'BrahMos Aerospace', an India-Russia joint venture of the Ministry of Defence, was speaking at an interactive session on defence manufacturing organised by the Gujarat chapter of CII here. "In the next 10 years, there is a requirement of around USD 150 billion of military equipment. This is a realistic and quite a moderate figure. This is a big opportunity for the entrepreneurs," he said.

The Tribune

Thu, 07 Sep, 2017

India, Japan to work on robotics

In a joint statement by India and Japan announced last night in Tokyo, both countries have decided to coordinate on robotics and unmanned round vehicles.

Japanese Acquisition, Technology and Logistic Agency (ATLA) and India's Defence Research and Development Organisation (DRDO) will soon commence technical discussions for research collaboration on unmanned ground vehicles and robotics.

Japan had, in 2011, famously sent in a robot to tackle the leak at its Fukushima nuclear plant which was hit by a Tsunami triggered by a massive earthquake.

The first-ever meeting on defence industry cooperation was conducted between ATLA and the Department of Defence Production (DDP) of the Ministry of Defence. Government entities and companies of both countries participated in this.



Fri, 08 Sep, 2017
(Online)

India Successfully Tests 500 kg Locally Developed Precision Guided HSLD Bomb

The development is significant as India continues to heavily rely on imports for air armaments. The Israel-manufactured SPICE bomb is the biggest conventional bomb that can be delivered by the Indian Air Force.

New Delhi (Sputnik) – India has successfully tested a precision guided high speed low drag (HSLD) bomb weighing 500 kg, which is the largest bomb locally developed by the country so far. During the flight trial in the western state of Rajasthan, the 500 kg general purpose bomb was released from Indian Air Force's (IAF) Su 30 MK1 aircraft. The bomb has been developed by the Armament Research and Development Establishment (ARDE) of the state-owned Defence Research and Development Organization (DRDO).

The trial covered ground adaptation, carriage and handling, limited separation and release of the bomb. Sukhoi-30MK1 released PGHSLD-500 fitted on station 05/06 from an altitude of 5 km at 900 km to verify separation performance and to estimate stability.