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India successfully Flight Tests Long Range Surface-to-Air Missile

डीआरडीओ न्यूज़लैटर

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From the Desk of the Secretary

My dear friends,

I was thinking for a while to connect with DRDO S&T community since I believe that interaction with DRDO family is very important for making DRDO a world-class S&T organization; an organisation where each member of DRDO is dedicatedly contributing to achieve organizational goals. To this end, I thought there is no better medium than *DRDO Newsletter*.

My pillars of strength are the youngsters who join the organization with big dreams, self-assured and with new ideas. Important is to translate these ideas into reality, with hard work, determination and dedication. The feeling one gets on achieving the goal cannot be explained, the memory is everlasting. The sense of achievement would enhance your level of vision and ambition.

Learning and contribution are two things that would never exhaust and one should not stop learning. Everyday brings in something new for all of us to learn. I too had my share of failures and achievements; 'a hole-in-one' as in golf, does not come every day but one should not stop trying for it. It is said, 'failure is the stepping-stone of success' and friends you have to take all the failures in positive stride, in the end you will come out with flying colours. 'Where there is a will, there is a way'. I have a strong conviction that if we play our part well then the complete act would be perfect.

Let your name be etched in golden letters in the organization. Pen down your ideas, dreams, articles and technical papers and they would find a place on DRDO website or suitably in the in-house journals/magazines in print form. I welcome you to connect with me on DRONA e-mail: secy@hqr.hqrdom and rest assure to get a reply.

Jai Hind!

Dr S Christopher

India successfully Flight Tests Long-Range surface-to-air missile

India successfully flight tested the long-range surface-to-air missile (LRSAM) system for Indian Navy twice against Pilotless Target Aircraft (PTA) on 20 September 2016 at 10:10 and again on 21 September 2016 at 14:25 from Integrated Test Range (ITR), Balasore, Odisha. The LRSAM has been developed through a joint venture between India's premier defence research organization DRDO and Israel Aerospace Industries (IAI) of Israel.

The naval version of the SAM system, this time was tested from land, and the earlier was flight tested from Naval Ships, at ITR. Both missiles directly hit their respective targets at different ranges and altitudes. The trajectory of the flight of missiles was throughout tracked and monitored by the radars and electro-optical systems installed at ITR.

Many Indian defence PSUs and industries, viz., Bharat Dynamics Limited (BDL), Mishra Dhatu Nigam Limited, (MIDHANI), TATA, GODREJ, SEC, PEL, ADITYA and others have contributed towards the development of the missile system. Both Israel and Indian scientists and technicians were involved in the launch.

> **" The nation is proud of this achievement. I am sure that this success will further boost India's defence capabilities in technologically challenging areas. "**
>
> ***- Pranab Mukherjee***

The Israel team was led by Mr Boyes Levy, Vice President, IAI, whereas the Indian Team by Mr Patrick D'Silva, Project Director, Mr MSR Prasad, Director, Defence Research and Development Laboratory (DRDL), Hyderabad, and Dr BK Das, OS and Director ITR. Dr G Satheesh Reddy, DS and DG (Missiles and Strategic Systems), DRDO and SA to RM also witnessed the launches.

The President of India, Shri Pranab Mukherjee congratulated DRDO on the successful test firing of the missile. In a message to Dr S Christopher, Secretary, Department of Defence R&D and Chairman, DRDO, the President said, "I extend hearty congratulations to you and all those associated with the successful test-firing of the surface-to-air missile–'Barak-8' developed jointly with Israel. The nation is proud of this achievement. I am sure that this success will further boost India's defence capabilities in technologically challenging areas. Kindly convey my greetings and felicitations to all members of the team of scientists, engineers, and others involved in this Mission."

DFRL transfers Ready-to-Eat Bars & Performance Enhancement Drink Technology

Defence Food Research Laboratory (DFRL), Mysuru, transferred the state-of-the-art technologies of 'flax oat bar, ergogenic bar, omega-3 rich bar, composite cereal bar and high energy bar' to M/s Nature Essential Foods Pvt Ltd, Mumbai. Dr Gopal Kumar Sharma, Additional Director, DFRL, exchanged the ToT documents with Shri Rohit Bhardwaj, Executive Director, M/s Nature Essential Foods Pvt Ltd. The inventors, Dr AD Semwal, Sc G, Ms A Padmashree, TO, and Ms Neha Negi, STA, Dr Shiby Vargheese, Sc D, Shri KA Srihari, Sc C and Ms Aisha Tabassum, TO, and senior scientists from DFRL were present during the event.

DFRL has developed different types of nutritious energy bars, viz., compressed tasty bar, composite cereal bar (protein rich bars), sweet and sour tasty bar (provide variety in Armed forces), flax oat tasty bar (rich in soluble fibre), soy fortified oat bar, ergogenic bar (energy dense), barley bar (rich in soluble fibre β- glucan), omega-3-rich bar (rich in omega -3-fatty acids), fibre enriched bar, coco-cocoa delight bar (antioxidant and fibre rich) and chicken bars, etc., to cater to the requirement of Armed Forces stationed at desert and high altitude. Each bar is targeted with a specific functional ingredient with a calorific value ranging from 400 K Cal to 540 K Cal with shelf-life of 6-15 months with good organoleptic acceptance as compared to the bars available in the market with limited shelf-life of 4-6 months.

DFRL also transferred the state-of-the-art technology of Aloe Pineapple-based Performance Enhancing Drink to M/s Arboreal Agro Innovations Pvt Ltd, Jabalpur. Dr Rakesh Kumar Sharma, Director, DFRL, exchanged the transfer of technology documents with Miss Swathi Pandey, CEO and Shri Manish Chouhan, Business Partner of M/s Arboreal Agro Innovations Pvt Ltd.

The inventors Dr Farhath Khanum, Sc G, Dr T Ananad, Sc E, Shri D Singsit, TO and Dr AD Semwal, Sc G, Head Technology Transfer, were present during the event.

High Gain Telemetry System Facility inaugurated at ITR

Dr BK Das, OS and Director, Integrated Test Range (ITR), Chandipur, inaugurated the building of High Gain Telemetry System Facility on 12 August 2016. In his inaugural address, he elucidated the importance of High Gain Telemetry System for collection of various trials data.

The High Gain Telemetry System is based on 11-m Cassegrain antenna with Single-Channel Monopulse tracking scheme operating in S Band with diversity reception for circular polarization. It has rated acceleration of $15^{o}/s^{2}$ with full motion and unlimited rotations and thus distinguishing itself as the first and one of its kind in the country. It can be commanded in manual, auto (monopulse), remote and program modes to follow a flight trajectory.

The facility is equipped with an extensive software utility for testing and monitoring along with third-generation digital receivers with data rate of 20 mbps with demodulation for ARTM schemes like PCM/FM, SOQPSK and MHCPM.

The system is a joint development between ITR and Electronics Corporation of India Limited (ECIL), Hyderabad. It is calibrated and tested through Sun Tracking and LEO-satellite tracking. The system has been successfully deployed for various trials and has collected data as per expectation.

Structural Load Test Facility at ARDE

A Structural Load Test facility was inaugurated at Armament Research and Development Establishment (ARDE), Pune, by Dr KM Rajan, OS and Director, ARDE, on 23 August 2016. Structural load testing is required to validate the structural design and analysis of the store for carriage loads encountered during carriage of bombs on fighter aircraft.

The load test set-up uses hydraulic jacks to apply loads at various locations on the bomb being tested. Pressured oil is fed to the hydraulic jacks through a manual hydraulic pump. The bomb can be simultaneously loaded at four different points in lateral directions and along axial direction. Two fins of the tail units can also be loaded using two vertical hydraulic jacks, simultaneously. Loading capacity of any individual point is 2 ton and loads are measured through load cells. Strains and displacements are measured through

strain gauges and LVDTs, respectively. Load cells, strain gauges and LVDTs are connected to a 80-Channel Data Acquisition System (DAQ). Parameters are monitored and recorded using the DAQ. The maximum size of the bomb which can be load tested is 600 mm x 4000 mm.

XXIII Tamhankar Memorial Lecture

Indian Institute of Metals (IIM), Hyderabad Chapter, and Defence Metallurgical Research Laboratory

(DMRL), Hyderabad organized the XXIII Tamhankar Memorial Lecture on 27 July 2016. Shri Shashi Shekhar Mohanty, President, IIM and former Director (Technical), Steel Authority of India, delivered the lecture on “Steels for Future Defence and Strategic Applications”. Dr Amol A Gokhale, Distinguished Professor, IIT Bombay and Chairman, IIM Hyderabad Chapter, started off the proceedings by presenting a brief introduction of Dr RV Tamhankar and his contributions on the foundation of Magnetic Society of India (MSI) and Powder Metallurgy Association of India (PMAI).

Shri Mohanty presented a broad overview of major players in iron and steel industries around the world and compared the Indian position with respect to world’s steel

production scenario. He also presented the application of steel in different fields such as railways, aerospace, defence and energy sectors. He shared his vision about the future of iron and steel industries (specifically SAIL) in India and spoke about the application of steel developed by DMRL in defence as well as in civilian sector. He also highlighted the importance of Steel Research Technology Mission in India (SRTMI) in shaping the future of iron and steel industries in India. Shri Rajnish Goyal, Sc E, DMRL, presented the vote of thanks.

National Librarian's Day Celebrations

Armament Research & Development Establishment

The 125th birth anniversary of Dr SR Ranganathan, father of library science in India, is celebrated as National Librarian's Day every year on 12 August in India. To pay tribute to Dr Ranganathan, Armament Research and Development Establishment (ARDE), Pune, celebrated Library Week during 11-18 August 2016. The aim was to proliferate library and reading culture and to fruitfully utilize the technical information for research and development in armaments.

To add regalement to the Library Week, three competitions, Treasure Hunt, Library Quiz and Suggestions for improvement of Information Centre for Armament Technology (ICAT), were organised. These proved to be a knowledgeable experience for both the participants and ICAT professionals. An Artillery Gun Information Exhibition showcasing rich collection of ARDE's books, journal articles and reports, was also organized.

Awareness Lectures about ICAT were also organised. Smt SS Avachat, Sc G, Head, ICAT, outlined the special services of ICAT and urged all officers and staff to utilize these services and facilities. Dr KM Rajan, OS and Director, ARDE, described his experience as a library user and stressed the importance of library and reading, encouraging everyone to take maximum advantage of the facility. Dr (Smt) JA Kanetkar, TO C, traced the history and growth of ICAT through her presentation 'A Photo Journey: From TIC/TL to ICAT'. In the presentation 'Behind the Scenes', ICAT officers made users aware of library services, viz. the varied library collections, collection development and technical processing activities, content analysis and analytical indexing, and the Intranet and Internet websites. Shri AK Pandey, Sc D, highlighted the special facilities and infrastructure at ICAT.

In a special guest lecture on Science Communication and Technical Writing, Dr AL Moorthy, Consultant, BrahMos Aerospace, Hyderabad, and former Director, DESIDOC, explained various aspects of science communication and technical writing.

An Exhibition-cum-Sale of books was also organised in which more than 1000 books on varied subjects were on display. The exhibition got an excellent response and many books were recommended for purchase.

Integrated Test Range

Integrated Test Range (ITR), Chandipur, organised a Book Exhibition at its Knowledge Centre during 8-12 August 2016 to celebrate the National Librarian's Day. Dr BK Das, OS and Director, ITR, inaugurated

the exhibition. Shri Santosh Munda, Sc D, highlighted the importance of the day and appraised about the exhibition. Director, ITR in his inaugural speech said that books are the source of knowledge and helps in developing our memory, wisdom and intelligence. He advised all the scientists and staff to develop reading habit. Director, ITR, also emphasised the importance of Dr SR Ranganathan's contributions towards library and information services in India.

Shri CR Ojha, Sc F, Chairman, Library Committee, highlighted the contributions of Dr Ranganathan made to the library science and how his five laws of library science are still being followed in this modern era.

More than 1500 books on different subjects, viz., radar, optoelectronics, telemetry, communication, fire safety and management were put on display to update scientific community of ITR on the latest editions of books available.

Raising Day Celebrations

Defence Institute of Psychological Research

Defence Institute of Psychological Research (DIPR), Delhi, celebrated its 68th Raising Day with fun and fervor on 29 August 2016. Dr Manas Kumar Mandal, DS and DG (LS), DRDO, was the Chief Guest of the occasion. Directors from DRDO HQ, sister labs and former Directors, scientists, and staff of DIPR also graced the occasion.

Dr K Ramachandran, Director, DIPR, welcomed the august gathering and highlighted the achievements of the establishment and exhorted employees to rededicate themselves to fulfill the charter of duties of the establishment.

In his address, Dr Mandal appreciated the efforts being made by DIPR. He distributed the laboratory-level DRDO Awards, Cash Awards and Swachh Bharat Awards to meritorious employees. A colorful cultural programme was organized to mark the occasion.

Research Centre Imarat

Research Centre Imarat (RCI), Hyderabad, Celebrated its 28th Annual Day on 27 August 2016. Dr G Satheesh Reddy, SA to RM and DG (MSS), DRDO, was the Chief Guest of the Raising Day.

Shri T Narasimha Rao, Sc G, DOMS, gave the welcome address. Shri G Krishna Rao, Sc G, Chairman Welfare Committee, presented detailed account of RCI welfare activities. Dr G Satheesh Reddy released 'Anmol 2016', RCI Women's Magazine and also presented DRDO laboratory-level and other awards. He congratulated scientists and staff for successful flight trials during the year. Dr SB Gadgil, Shri BHVSN Murthy and Shri BV Rao, Associated Directors of RCI presented Mementos and Merit and Welfare Scholarships. Dr Tessy Thomas, OS and Director, RCI, presided over the function. Shri D Venu Gopal, Sc G, proposed the vote of thanks.

Manpower Development Activities

Course on Scientific Computing using High Performance Computing

Advanced Numerical Research and Analysis Group (ANURAG), Hyderabad, conducted a week-long course on "Scientific Computing using HPC" under DRDO's Continuing Education Programme (CEP) from 29 August 2016 to 2 September 2016. The CEP focused on application areas, which require high-performance computing (HPC). Dr Narendra Karmarkar, Emeritus Professor, the Chief Guest, delivered the Keynote Address on "Creating HPC Controlled Smart Networks—Linear Graph Analytics and Algorithms for Big Data".

Due focus was given to fundamental concepts used in the domain of scientific computing and practical sessions were also included. Few emerging areas such as Quantum Computing and Cognitive Computing were also touched upon. Lectures included topics on Linear Algebra, Numerical Methods, Simulation and Modeling, Deep learning and Big Data, Evolutionary Multi-objective Optimization, Parallel Sparse Matrix Computations and Approximation Methods. The topics were presented by eminent professors and talks given by scientists from DRDO labs, viz. SAG, and DTRL, Delhi; CAIR and ADA, Bengaluru; R&DE(E), Pune; DRDL, Hyderabad, and ANURAG. Representatives from industry also gave talks on latest technologies and tools of HPC domain.

The course received response from 38 participants from various DRDO labs/estts, including SAG, DESIDOC, DIPR and ISSA from Delhi; LRDE, CABS and ADA from Bengaluru.

Recent Advances in Aerospace Composites

Advanced Systems Laboratory (ASL), Hyderabad, organized a CEP course on "Recent Advances in Aerospace Composites" during 25-29 July 2016. Dr Tessy Thomas, OS and Director, ASL, inaugurated the course and addressed the participants. Dr MRM Babu, Programmme Director, Agni, Dr RK Gupta, Associate Director, ASL, and Shri S Bhaskar, Technology Director, Advanced Composites Centre (ACC) also graced the occasion and addressed the participants. Forty participants from various DRDO labs/estts including ASL attended the course. Experienced guest faculty from DRDO, CSIR, ARCI and BITS-Pilani, Hyderabad delivered lectures along with internal faculty. Shri J Dhanasekaran, Sc G, was the Course Director and Smt C Sharada Prabhakar, Sc G, was the Course Coordinator.

Corporate Reviews

Corporate Review of **Defence Scientific Information and Documentation Centre (DESIDOC)**,

Delhi, was held on 24 August 2016. Shri GS Malik, DS and CC R&D (R&M and Imp), chaired the meeting. Dr Hina A Gokhale, Director of Personnel, Ms Nabanita R Krishnan, Director DP&C, Shri Ashok Kumar, Director HRD, representatives of DBFA, DMM and DCW&E, Divisional Heads of DESIDOC also attended the meeting. Shri Gopal Bhushan, Director DESIDOC, apprised the committee about the activities and new initiatives taken by the Centre during the past year. Various corporate issues were discussed during the meeting. The Committee also hold discussions with employees of DRDS, DRTC, and Admin and Allied Cadres.

Corporate Review of **Institute for Systems Studies and Analyses (ISSA)**, Delhi, was held on 24 August 2016 under the Chairmanship of Shri MH Rahman, OS and CC R&D (HR). Other Committee members included Dr Hina A Gokhale, Director of Personnel, Ms Nabanita R Krishnan, Director DP&C, Shri Ashok Kumar, Director HRD, representatives of DBFA, DMM and DCW&E. Technology and Group Heads of ISSA also attended the meeting. The Committee also interacted with the young scientists, representatives of DRTC and Admin and Allied Cadres. Issues and concerns of the corporate office, lab and various cadres were discussed and way ahead were decided.

Course on Military Operations & Tactics for Systems Analyses

ISSA, Delhi, organized a special course on "Military Operations and Tactics for Systems Analyses" at Institute of Technology Management (ITM), Mussoorie, during 25-29 July 2016. The course was designed to give insights of operations and tactics of Services followed by the systems analyses, modeling and simulation and wargaming aspects handled at ISSA to the participants from various clusters. The invited faculties delivered the talk on Introduction to Organization, Role, Operations and Tactics of respective services. Twenty-four participants attended the course.

Course on Finite Element Analysis—Principles and Practices

Combat Vehicles Research and Development Establishment (CVRDE), Chennai, conducted a CEP course on "Finite Element Analysis—Principles and Practices" during 8-12 August. The course was intended to impart thorough understanding of the rudimentary theoretical knowledge on the finite element methods essential for the engineers functioning in this field. Shri S Ramesh, Additional Director (CEAD), CVRDE and Course Director, inaugurated the course and delivered the inaugural address. Shri R Murugesan, Sc F, acquainted the participants on the details of the course. Dr V Balamurugan, Additional Director (AP), CVRDE and Dr J Roopchand, Additional Director (PLM), CVRDE, released the proceedings and course kit, respectively.

The important topics covered during the course included finite element methods in product design, mathematical formulation of 1D, 2D and 3D finite elements, isoparametric element formulation, finite element modeling and analysis of nano-composites.

Eminent faculty from premier academic institutions, expert from industries and scientists from DRDO delivered the lectures. The participants were also exposed to various case studies and hands on sessions.

Dr P Sivakumar, DS and Director, CVRDE, interacted with the participants about their experience of the course. Shri S Ramesh presided over the valedictory function and distributed the participation certificates and prizes to the winners of the test.

CEP on Qualification Techniques of Wireless Communication Equipment

A CEP course on "Qualification Techniques of Wireless Communication Equipment" was conducted by **Defence Electronics Applications Laboratory (DEAL)**, Dehradun, on 8 August 2016. Dr RS Pundir, Director, DEAL, inaugurated the course.

The lectures on EMI/EMC Control Methodologies, EMP Hardening, Introduction to EMI/EMC Instrumentation, Reliability Engineering and Modeling, Design for Reliability, Failure Modes and Effects Analysis (FMEA), Environmental Engineering, Total Quality Management System, Software Qualification Aspects and Spectrum Management were delivered during the course. Twenty-five participants from ASL Hyderabad, DL Jodhpur, TBRL Chandigarh, IRDE and DEAL Dehradun attended the course. The faculty was drawn from various DRDO laboratories, WPC New Delhi, M/s R&S Bengaluru and M/s Juken India Ltd Bengaluru. Shri RB Singh, Sc F, was the Course Director.

Training Programme for Local Farmers

Defence Institute of High Altitude Research (DIHAR), Leh, conducted a training programme on “Agro Technologies for Cold Arid Ladakh Region” for the members of the Farmers' Cooperative Society Leh and Kargil. The farmers were given a presentation on the various DIHAR developed agro-animal technologies appropriate for Ladakh conditions followed by field visit to DIHAR’s experimental field.

GATET Workshop on Gas Turbine Blade Flutter

Gas Turbine Research Establishment (GTRE), Bengaluru, under the aegis of Gas Turbine Enabling Technologies (GATET) initiative, organised a Special Interest Group Workshop on "Aero-elastic Issues in Gas Turbine Engine Blades", during 19-22 July 2016. Ninety professionals from academia and research institutes participated in the workshop. Shri MZ Siddique, OS and Director, GTRE, presided over the inaugural function.

In his inaugural address, the Chief Guest, Dr AR Upadhya, former Director, NAL, enumerated the differences between aero-elasticity effects in aircraft and gas turbine engine blades. The Guest of Honour, Dr A Rama Rao, Associate Director, BARC, Mumbai, highlighted the blade vibration issues and their mitigation methods. He encouraged the participants to understand the nuances of this crucial technology, which is essential

for the country. Shri MZ Siddique, highlighted the issues faced by GTRE in this domain and efforts made to address these. He emphasized the need to develop robust design approaches for mitigating this complex problem.

Prof. Damian Vogt, Director, Institute of Thermal Turbomachinery and Machinery Laboratory, University of Stuttgart, Germany and Dr Mehdi Vahdati, Head, Aero-elasticity Group, Rolls-Royce Vibration University Technology Centre, Imperial College, London, were the key speakers of this workshop.

The seminal topics covered in the workshop included aero-elastic and aero-acoustics issues in gas turbine engines, rotating stall and non-synchronous vibration at low Reynolds numbers, understanding flutter prediction methods and challenges in developing a flutter-free aero gas turbine blades.

Course on Satellite Communication Systems and Networking

Integrated Test Range (ITR), Chandipur, organized a CEP course on "Satellite Communication Systems and Networking" during 25-29 July 2016. Dr BK Das, OS and Director, ITR and Dr SK Shivakumar, former Director, ISRO Satellite Centre (ISAC), Bengaluru, the Chief Guest, inaugurated the course. Dr Shivakumar presented the inaugural lecture on “Evolution of Communication Satellites in India.”

The course aimed to update the knowledge of the participants on the latest trends and techniques on satellite communication systems. Various topics related to satellite communication systems and networking were covered in the course. Distinguished faculties and experts from ISRO, Bengaluru and Ahmedabad, Research Centre Imarat, Hyderabad, Defence Electronics Application Laboratory (DEAL), Dehradun, NIT Rourkela, IIT Kharagpur, AIR and Doordarshan, Bhubaneshwar delivered the lectures. Twenty-nine participants from ITR and other labs of DRDO attended the course. The course was organised by Shri HK Ratha, Sc G, Course Director, Shri Pradip Saha, Sc F, Deputy Course Director and Shri AK Das, Sc E, Course Coordinator.

CEP on Office Procedure and Automation

ITR, Chandipur, organized a CEP course on Office Procedure and Automation during 1-5 August 2016. Dr BK Das, OS and Director, ITR inaugurated the course. The course aimed to update the knowledge of the participants on the latest rules and regulations on Office Procedures and Automation. Various topics related to office procedures were covered in the course. Thirty-six participants from ITR and other labs of DRDO participated in the course. The course was organised by Shri CR Ojha, Sc F, Course Director, Shri Santosh Munda, Sc D and Shri Subhasis Kar, TO A.

Personnel News

Appointments

Director, Research & Development Establishment (Engrs)

Shri VV Parlikar, OS, has taken over as Director, Research and Development Establishment (Engineers) [R&DE(E)], a premier systems engineering laboratory of DRDO in Pune.

Born in 1961, Shri VV Parlikar joined DRDO at R&DE (E) in 1984 after completing his BTech in Mechanical Engineering from JNTU, Hyderabad in 1983. He completed his PGDCA in 1988 from BTE, Maharashtra. He also completed his MTech from IIT Bombay in 1992 with specialization in Systems and Controls. His area of specialization is design and development of Missile Launchers, Military Engineering Equipment, Advanced Robotics and Mobile Unmanned Systems for military applications.

As Project Leader and System Manager for Akash Ground Systems, he has been a key member of Akash team and has played a major role in the design, development and production of Akash Launchers and mission-critical Ground Systems. His efforts have been resulted in the release of production orders to the tune of 1000 crores for the Akash Launchers and Ground Systems.

Shri Parlikar, as a Team Leader and Lead Designer, has played a major and pioneering role in the successful design, development and delivery of a number of military engineering systems and equipment including missile launchers for Programme AD, MRSAM, Nirbhay Subsonic Cruise Missile System, Prahar, QRSAM, XRSAM, Hyperbaric Chamber and Mobile Power Supply and High Pressure Pneumatic Systems. He has also pioneered the development and implementation of Electro-mechanical Servo Drive Technology for high performance defence applications. Beside these, he has also successfully developed advanced products such as autonomous unmanned ground vehicles, and intelligent robotic equipment for military application.

Shri Parlikar has launched a series of new technological initiatives in the emerging technology areas like High Performance High Power Servo Drive Technology, Platform Stabilization Technology, AFPM-based Alternator Technology, VSCF-based Power Source Technology, Electric Propulsion Technology, Missile Canister Technology, Autonomous Navigation Technology for small UGVs, Intelligent Robotic Manipulators for hazardous military applications and Linear Electric Motor Technology.

He has provided effective leadership, management, technical guidance and direction to the scientists and technologists and has a futuristic vision to make the country self-reliant in the critical areas of advanced missile launchers and specialized military engineering systems. He has plans to develop dual use, multi-purpose products and technologies with enhanced civilian application of DRDO products and technologies.

Shri VV Parlikar is the recipient of the DRDO Technology Spin-off Award in 2006, the DRDO Agni Award for Excellence in Self-Reliance in 2007 and in 2015, the DRDO Award for Pathbreaking Research/ Outstanding Technology Development in 2008 and the DRDO Scientist of the Year Award in 2012. He is also the recipient of the Swatantraveer Savarkar Memorial Award for Scientific Achievements for the year 2015.

He is a fellow of the Institution of Engineers (India), Life Member of Indian National Society for Aerospace and Related Mechanisms (INSARM), Member of Fluid Power Society of India (FPSI), Robotics Society of India, and Life Member of Institute of Smart Structures and Systems (ISSS).

Director, Research Centre Imarat

Shri BHVS Narayana Murthy, OS, has taken over as Director, Research Centre Imarat (RCI), Hyderabad, on 12 September 2016. He is an Electronic Engineering Graduate from NIT, Warangal and MTech in Computer Science from Jawharlal Nehru

Technological University (JNTU), Hyderabad. He joined DRDO in 1986 as Fellow of 2nd Electronic Fellowship Course in IAT Pune.

An outstanding scientist with more than two and half decades of experience, Shri Murthy has made vital contributions towards design, development and productionization of onboard computers (OBCs), missile interface units (MIUs) and navigation computers for various missile projects. He has developed onboard mission software implementing guidance and control functions integrated with tolerant schemes—real-time recovery mechanism from transient faults or power failures and dual redundant configuration with hot standby. He has also developed System-on-Chip (SoC) for embedded systems. His areas of interest include development of advance onboard computer architectures, mission software development using reusable components, SoC and integrated missile electronics on a chip to realize avionics on chip and multi-modal biometrics. He has worked as Associate Director, RCI and Technology Director, Directorate of Navigation and Embedded Computers, responsible for design and development of OBCs and navigation systems and mission software for missile and aircraft systems from 2013 onwards.

Shri Murthy is the recipient of Rocket and Related Technologies Award for the year 2013 from Astronautical Society of India; Agni Award for Excellence in Self Reliance for the year 2012 as a team leader for the development of System-on-Chip (SoC) for Onboard Computers; Scientist of the Year Award for the year 2009; DRDO Award for Pathbreaking Research/Outstanding Technology Development for the year 2008 as a team member in recognition of contribution for Akash missile system to meet the operational requirements of Indian Army and Air Force; DRDO Award for Performance Excellence for the year 2007 as a team member in recognition of contribution for development of a special missile for Indian Navy; DRDO Award for Pathbreaking Research/Outstanding Technology Development for the year 2007 as a team member for successful flight testing and realization of long-range Agni 3 missile system; DRDO Award for Performance Excellence for the year 2004 as a team member for successfully developing BrahMos Weapon Complex; Agni Award for Excellence in Self-Reliance for the year 2001 as a team member for making highly significant and innovative contribution to development of Distributed Bus Architecture and On Board Avionics.

Shri Murthy is a Fellow of IETE, Senior Member IEEE and Life Member of Aeronautical Society of India and Computer Society of India.

Awards

IEI-IEEE (USA) Award for Engineering Excellence

In recognition of his significant national contributions towards Missiles and Aerospace technologies, eminent scientist Dr G Satheesh Reddy, Scientific Advisor to Raksha Mantri and Director General, Missiles and Strategic Systems, DRDO, received the prestigious IEI-IEEE Award for Engineering Excellence-2015 during the award ceremony as part of the glittering Golden Jubilee Celebrations of the IEEE Asia-Pacific Region held at Hotel Lalit Ashok, Bengaluru on 24 August 2016. His pioneering work in Navigation and Avionics technologies has been integral in the success of several defence projects making India self-reliant in many vital areas.

Dr Reddy received the award from Shri AS Kiran Kumar, Chairman ISRO, in the presence of Dr Barry I Shoop, President, IEEE, USA, and many other eminent luminaries from India and abroad.

Fellow of INAE

Dr Ashim Kumar Mukhopadhyay, OS and Associate Director, Defence Metallurgical Research Laboratory

(DMRL), Hyderabad, has been elected Fellow of the Indian National Academy of Engineering (INAE) in recognition of his distinguished contributions to the field of Engineering.

Higher Qualification Acquired

Shri Gurujit Singh Walia, Sc E, Scientific Analysis Group (SAG), Delhi, has been conferred PhD in Electronics and Communication from Delhi Technological

University (formerly Delhi College of Engineering), Delhi, for the thesis titled 'Study of Associations among Various Video Sequences.'

Shri Chaman Chandel, Sc E, Snow and Avalanche Study Establishment (SASE), Chandigarh, has been conferred PhD by IIT Delhi for the thesis titled 'Micromechanical Analysis of Deformation and Failure of Snow'.

DG (ECS) gets new Office Accommodation

The newly constructed Office Building of Director General [Electronics and Communication Systems (ECS)], DRDO, in the lush green environment of Electronics and Radar Development Establishment (LRDE), Bengaluru campus was inaugurated on 15 August 2016 by Dr S Christopher, Secretary, Department of Defence R&D. DG (ECS), DG (Aero), Chief Executive, DCWE, Directors of all Bengaluru-based DRDO labs, IFA, EMO and Heads of other DRDO units were present on the occasion. The office accommodation, built in an area of 3280 Sqm, houses the Chamber of DG (ECS), officers and staff of DG (ECS) with all other amenities. The accommodation has been constructed using latest techniques. Dr S Christopher appreciated the excellent and timely work carried out by the Chief Executive and his team.

DRDO: Harnessing Science for Peace and Security-VIII

Chapter 1: The Beginning — Defence Science

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

The First Scientific Advisor

The Defence Science Organisation

The role, activities, and the structure of the defence science organisation proposed to be set up in the Ministry of Defence was finalised by Dr DS Kothari and was adopted at a meeting of the Defence Science Policy Board held on 10 September 1948, which was at about the same time as the report of Professor Blackett was submitted to the Defence Minister. In preparing this report, he had to bear in mind the deliberations of the Defence Science Policy Board. The Board had stressed that after taking into account the low level of progress of scientific research in the country and the very limited availability of experienced research workers, the role of the Organisation in the general set up of Defence Services be an advisory one in the initial stages. He was also influenced by Professor Blackett with whom he held discussions and had exchange of views about the proposed organisation. This is very clear from the very first sentence of his note in which he first placed on record his deep appreciation for the help and advice he had received from Professor Blackett and described the visit of the latter to India as of inestimable value. A brief account of Professor DS Kothari's note to the Defence Science Policy Board is provided in the following paragraphs.

Dr Kothari found the Technical Development Establishments functioning under the Army, inadequate for "systematic study of the now very extensive and highly developed defence science and to deal with the basic defence research and investigations concerned with scientific rather than the purely technical or engineering aspect of defence science". He pointed out that the most important function of the Defence Science Organisation (DSO) proposed by him would be that of rendering "effective help in the integration of scientific and military thought." Dr Kothari considered that DSO constituted an essential and integral part of defence, because in the absence of a properly functioning DSO, defence services in the country cannot "for long maintain its efficiency, make use of its weapons and equipment, modify and improve them to suit local conditions or keep in contact with the progress in weapons and techniques of warfare generally." He also pointed out that in a technologically backward country like ours, the demand for sophisticated weapons such as the atomic bomb, guided missiles, bacteriological warfare, is likely to be "more than ordinarily loud and insistent..... because of the lack of scientific background and understanding necessary for appreciation of the gigantic effort required for development and use of sophisticated appliances." He countered the oft expressed sentiment that technological backwardness of the country should not bar the Armed Forces from acquiring sophisticated weapons by the argument that, "it would appear strange and rather impractical in the present times for a country to base its defences on imported key–men and weapons". He was firm in his opinion that "the standard and efficiency of weapons and equipment of the Armed Forces must, in ultimate analysis be directly related to the technologies and industrial potential of the country." Therefore, he stated that the pattern of Defence Science Organisations of UK and USA "would not for the time being, suit our requirements." He stressed that, "a beginning on sound lines would be made and then the organisation be allowed to grow rather than discuss at this stage what the organisation should ultimately be". Thus, he announced that "for a few years to come the primary aim of the Defence Science Organisation would be to learn their trade. The role of the organisation, will be purely advisory. The question of assigning, if at all, any executive responsibility to the Defence Science Organisation can only be considered after a few years when the defence scientists have been adequately trained in their work." He proposed a compact organisation to work on topics of defence interest ranging from aircraft performance and instrumentation, applied psychology, ballistics, biological control, chemistry, defence science education, electrical communication including radar, explosives, heavy and light arms, naval research, operational research, optical instruments, physics including meteorology, prime movers, shipbuilding, and transportation. His expectations were that the personnel after a year or two of work at the TDEs would have the basic knowledge of defence science with reference to Indian conditions and with

special emphasis on performance rather than on constructional or on technical details of weapons and appliances of warfare. Thereafter, he envisaged the main function of the DSO would be one of rendering advice to the Ministry of Defence on matters of scientific interest to the Services. He also indicated that immediate thrust areas for the DSO would be on biological control of pests, harnessing of solar energy, thermodynamics of interchange of heat between human body and environment, electromagnetic wave propagation in hilly and dusty terrains, and working in collaboration with universities and with the CSIR so that the findings provide stimulus to the organisation and also lend some prestige.

Four years later at Kirkee in a speech on Science and Defence, Dr Kothari expounded his line of reasoning by stating, "How is a scientific establishment to be organised so that the men there will devote themselves completely, entirely and fruitfully to the pursuit of scientific research? This is a problem, difficult as well as delicate. It is beset with difficulties even in scientifically advanced countries. Firstly, the establishment should be manned by able and devoted men. Secondly, the conditions should be such as will allow them to grow in their full scientific stature and not dampen and dry up their enthusiasm and abilities. Thirdly, the problems to be worked at the establishment should be selected with the utmost care. This is extremely important. Do not have too many problems, but concentrate on a small number of problems selected judicially. In selecting problems, take account of the usefulness of the problems, the resources available for investigation and the speed with which these can be solved". Careful selection of talented and qualified personnel, concentration of effort, balancing usefulness of the problems with the aspirations of the scientists, appeared to have been uppermost in his thinking.

Dr Kothari's note proposed a small and compact organisation with a flatter hierarchy of three layers. Forty senior scientists and 100 junior scientists was the proposed strength, for which sanction was obtained from the Government of India in June 1949. The appointments of 25 scientific assistants was added later after the organisation decided to set up laboratory facilities. The Government letter clearly specified the role for the Defence Science Organisation by stating that it should undertake a systematic study, investigation and research into the various branches of defence science for purposes of tendering advice and assistance to the Services with regard to their technical and scientific problems.

The First Step

Dr Kothari along with Dr SS Bhatnagar, who founded the CSIR organisation, and Dr HJ Bhabha, the father of nuclear science in India, were the triumvirate who influenced the structure and the organisation of science and technology, research and development in independent India. All the three believed very strongly in the linear model of innovation also known as the science push model, which was universally endorsed by the scientific community world over, after the war. The linear model of innovation, assumed that scientists made discoveries, technologists after a time lag took them up and applied them, and still later, designers/ engineers turned them into new products and processes. The success of the Manhattan Project and the microwave radar during the World War II had led to the vision of Big Science in the postwar period in which it was opined that by providing scientists and technologists with well-equipped laboratories and giving them freedom to carry out research, discoveries, inventions and new products and processes will follow for the benefit of the society. Both Dr Bhatnagar and Dr Bhabha were committed to their visions and planned big, right from the beginning, one for industrialisation of India through science research, and the other for using nuclear energy for peaceful purposes for the benefit of the citizens. Hence, Dr Bhatnagar built the CSIR and Dr Bhabha, the Atomic Energy Organisation accordingly, by recruitment of the best scientific talent and building of well-equipped laboratories, which were called modern temples by Pandit Jawaharlal Nehru.

Dr Kothari, on the other hand, did not respond in the same way when he became the Scientific Adviser to the Ministry of Defence in 1948 and undertook the responsibility of organising scientific research effort in defence. There was no grand inauguration function or foundation laying ceremony with speeches from the Prime Minister or the President of India extolling the benefits that will accrue to the nation, followed by the Scientific Adviser giving his vision of the tasks to be undertaken, to mark the occasion. Since the means of communications were primitive at that time, there was little publicity and limited public awareness about the new science and technology organisation that had been created. In spite of this, and mainly due to the reputation of the Scientific Adviser among his peers that the response from qualified and talented scientists and engineers to join the organisation was heartening. Dr Kothari hand-picked the scientists who would constitute the Defence Science Organisation. These were from the various universities in India

and were proficient in aeronautics, electronics, chemistry, mathematics, nutrition, physics, psychology so that research work in ballistics, electronics, chemistry related to explosives, paints and corrosion, food preservation and nutrition, psychological fitness profile for selection of Service personnel, battlefield stress and physical fatigue, could be initiated. Though the interviews were conducted by the Federal Service Commission (later the Union Public Service Commission) those selected had to pass the exacting standards set by Dr Kothari in aptitude, interest and competence in the desired scientific areas. The organisation was initially housed in the temporary hutments near the North and South Blocks of the Central Secretariat which had been built during the war to accommodate the swelling numbers of Government employees, most of whom had been demobilised after the war. Work was begun in the very first year in areas of ballistics, communications, explosives, food, operations research, and training methods.

To be continued...

DMRL Celebrates Haritha Haram

Haritha Haram, the flagship programme of the Telangana Government to increase the present 24 per cent tree cover in the state to 33 per cent of the total geographical area of the state, was organised by Defence Metallurgical Research Laboratory (DMRL), Hyderabad on 22 July 2016 by planting saplings around DMRL Sport Ground.

Dr Samir V Kamat, OS and Director, DMRL and Shri B Raja Gopal Rao, Deputy Chief of Inspector of Factories, led the DMRL fraternity in this green drive.

Visitors to DRDO Labs Estts

Armament Research & Development Establishment

Shri Subir Mallick, Addl FA (SM) and Joint Secretary, visited Armament Research and Development Establishment (ARDE), Pune, on 8 August 2016. He was briefed about ARDE Projects and technologies and products under development. He visited the static display and various work centers such as Rocket Technology Centre, Hardware-in-Loop Simulation lab, Modeling and Simulation lab of ATAGS, and the ICAT. Shri Mallick showed keen interest in the various ongoing projects of the lab and appreciated the research and development work pursued at ARDE.

Defence Food Research Laboratory

General Dalbir Singh Suhag, PVSM, UYSM, AVSM, VSM, ADC, Chief of the Army Staff, along with Lt Gen Bipin Rawat, UYSM, AVSM, YSM, SM, VSM, General Officer Commending in Chief Southern Command and senior Army officers visited Defence Food Research Laboratory (DFRL) Exhibition at INFOSYS Campus, Mysuru on 5 August 2016.

Dr Rakesh Kumar Sharma, Director, DFRL, briefed various R&D activities carried out by DFRL to meet the requirement of Armed Forces. Various packed rations, ready-to-eat, instant and convenience food products, adulteration detection kits, thermo pack, nutraceutical food products and food processing equipment developed by DFRL were showcased to the COAS. COAS appreciated R&D activities of DFRL.

Defence Metallurgical Research Laboratory

Air Vice Marshal Kuldeep Sharma, AVSM, VSM, Assistant Chief of Air Staff (Engg) along with Shri P Jayapal, Chief Executive, CEMILAC and Shri Debashis Deb, Executive Director, HAL (Koraput) visited Defence Metallurgical Research Laboratory(DMRL), Hyderabad, on 20 July 2016 to review the project 'Life Prediction Technologies for the Aero-engine Components'. The dignitaries also visited important facilities at DMRL.

Institute for Systems Studies & Analyses

A US Delegation comprising nine members, accompanied by Smt Pooja Taneja, Associate Director, DIC, DRDO HQ, visited Institute for Systems Studies and Analyses (ISSA) on 27 July 2016. Shri SB Taneja, Director, ISSA, and senior scientists were present during the interactions. The delegation was apprised about the activities and products developed by ISSA, Spectrum of Systems Analysis in Defense, Land Wargaming, Weapon Systems Analysis, Life Cycle Costing (LCC), Crisis Game Flow, etc

Director ISSA exchanged ideas on the possible areas of mutual interest like Strategic Planning, Multi-Resolution Modelling, Behavioural/Cognitive Modelling, Automated Forces, Information and Cyber Warfare and Modelling of Low Intensity Conflicts.

Naval Physical & Oceanographic Laboratory

Shri Subir Mallick, Joint Secretary and Additional Financial Adviser (R&D), Ministry of Defence (Finance), visited Naval Physical and Oceanographic Laboratory (NPOL), Kochi, on 27 August 2016.

DRDO in Press

THE TIMES OF INDIA

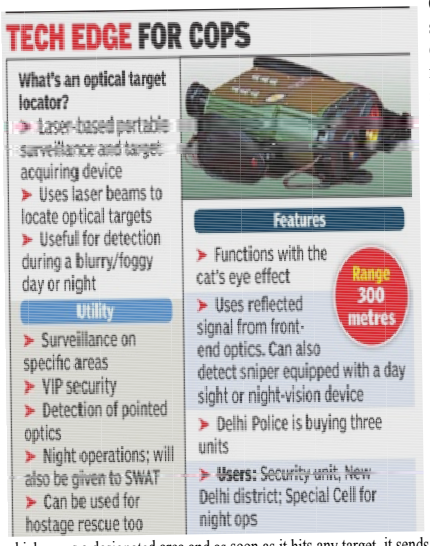
Tue, 13 Sep, 2016

Target locators to hunt out shooters & snipers

Delhi Police is buying gadgets that would help it locate snipers and sharpshooters hidden from view.

Called optical target locators, these devices would help sleuths of the security wing and two districts in securing VIPs, and the Special Cell in anti-terror operations, say sources. On Monday, police invited bids from vendors to buy three such devices.

Delhi Police protects the most number VVIPs in the country and could be the first police force to acquire this device that's usually handled by the armed forces.



Officers said it would help identify snipers equipped with any optical electro-optical surveillance device like night vision equipment, binoculars, surveillance cameras or laser range finders. "In a layman's language, you can say that the device will alert us if a shooter with a long-range weapon is hiding on a building or on a tree or even inside a vehicle which is close to the VIP route," an officer said.

The police are apparently looking at OTL-300, a shortrange device made by DRDO. It can spot threats within 300 metres. "It can detect passive or active optical threats like telescopes, binoculars," a source said. The devices will come with a display screen and around 4GB memory for recording.

An officer quoted from a document: "It is a laser based portable surveillance device that functions on cat's eye effect. It releases a laser beam which scans a designated area and as soon as it hits any target, it sends back the scattered energy and the target is detected. This retroreflected energy helps in locating optical targets against a static background. Any surveillance device with front-end optics and a sensor at the focal plane can be detected by this approach.

THE HINDU

Make in India gaining steam, says DG DRDO

By R. Aravind

The Make in India initiative of the Government of India is gaining steam and there is an increased indigenous content in the defence equipment being manufactured in the country, Secretary Defence (DRDO) and Director General Defence Research and Development Organisation S Christopher said.

Delivering the convocation address at the Seventh Convocation of the GITAM University Hyderabad and Bengaluru campuses at the Hyderabad campus here on Saturday he said "the new category of indigenously Designed, Developed and Manufactured (IDDM) equipment increases the local mix from 30 per cent to 70 per cent." Rapid strides are being made in the defence sector with a focus on indigenisation, he added.

"We have to give equal importance to each and every segment of technology for the security and well being of our mighty nation. The technologies developed for armed forces are also benefiting civil society. The bio- digesters developed for armed forces have been adopted for passenger coaches in Indian Railways," he said adding that a number of products developed by DRDO have high export potential and contributing to the Make in India.

An honorary doctorate was conferred on Dr S Christopher on the occasion by GITAM University Vice Chancellor M. S. Prasada Rao.

Stressing the need of quality education, Dr Christopher said "Out of the 14 million people that enter into workforce every year, barely two million are properly trained. A huge upgrade of the infrastructure for imparting skills is an obvious requirement. We have to invest more on improving engineering skills so that we can create good work force," he said and suggested to the students to acquire an aptitude for entrepreneurship from the beginning.

University Vice-Chancellor M.S. Prasada Rao presided over the programme. Later, graduation certificates were presented to the students. President GITAM University M.V.S.S. Murthy, and officials were present.

the pioneer

Wed, 21 Sep, 2016

India successfully test fires long range surface-to-air missile

Balasore (Odisha): In a bid to galvanise its air defence capabilities, India on Tuesday successfully test fired a new long range surface-to-air missile jointly developed with Israel from a Defence base off Odisha coast.

The long range missile, a product of a joint venture between India and Israel, was test launched from a mobile launcher at the Integrated Test Range (ITR) in Chandipur near here at around 10.13 hours, a DRDO official said.

The trial was successful and some more rounds of test are expected to be conducted shortly, the DRDO scientist said, "Apart from the missile, the system includes a Multi Functional Surveillance and Threat Alert Radar (MF STAR) for detection, tracking and guidance of the missile," the official said, adding the missile along with MF-STAR would provide the users the capability to neutralise any aerial threats.

Earlier, between June 30 and July 1, 2016 three consecutive test firing of the medium range surface to air missile, jointly developed by India and Israel were conducted from the Defence Research & Development Organisation (DRDO) base at Chandipur. The missile guided by armoured seeker had successfully hit the last minute manoeuvring target Indian Navy had also successfully test fired the long range surface to air missile (LR SAM).The test was undertaken on the Western Seaboard by INS Kolkata on December 30, 2015. These missiles would be inducted in all the three services after trials were completed.

Many Indian industries like BEL, L&T, BDL, and TATA group of companies besides other private industries have contributed to the development of a number of subsystems which have been put into use in this flight test, the official said.

As a safety measure, Balasore district administration in consultation with the defence officials had temporarily shifted 3,652 persons residing within 2.5 km radius of the launch pad No. 3 of the ITR at Chandipur to nearby temporary shelter centres this morning to ensure a safe launch of the missile, a district revenue official said. **PTI**

Live हिन्दुस्तान .com

Wed, 07 Sep, 2016
(online)

भारत से ब्रह्मोस मिसाइलें खरीदेगा रूस!

रूस की सेना भारत से ब्रह्मोस क्रूज मिसाइलें खरीदने की इच्छुक है, ताकि वह इससे अपने सुखोई एसयू-30, एसएम लड़ाकू विमानों को लैस कर सके। भारत ने इन मिसाइलों का निर्माण रूस के सहयोग से किया है।

मीडिया रिपोर्ट के अनुसार रूस की सेना अपने एसयू-30, एसएम लड़ाकू विमानों में भारतीय मिसाइलों का परीक्षण 2017 तक करेगी और इसके बाद ही वह इन्हें भारत से खरीदने के बारे में समझौता वार्ता शुरू कर सकती है।

भारत अपनी वायुसेना में नई मिसाइल प्रणाली तथा मिसाइल सहित लड़ाकू विमान का आयोजन पहले स्वयं शुरू करेगा और इसके बाद रूस इसका उपयोग पाकर करेगा। भारत ने मिसाइल युक्त लड़ाकू विमान का परीक्षण इस वर्ष गर्मियों में किया था।

Odisha News Insight

Wed, 21 Sep, 2016

Surface to Air Ballistic Missile 'Barak-8' test-fired from Odisha Coast

India on Tuesday morning successfully test-fired its Medium Range Surface-to-Air Missile (MR-SAM) Barak-8 from Odisha coast. The 4.5-meter long ballistic missile weighs around 270 kg and can carry a payload of 60 kg. Barak-8 can hit the target within a range of 70 km and it can deploy in sensitive Air Force stations.

The test-firing of the missile was jointly carried out by Indian Defence Research, DRDO and Israel Aerospace Industries (IAI), sources said.

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