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NUCLEAR CAPABLE AGNI-5 BALLISTIC MISSILE TESTED SUCCESSFULLY

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FROM THE DESK OF THE CHAIRMAN

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

Dear Friends,

My Best wishes to the DRDO family for a Happy and Prosperous New Year as well as DRDO Day. What a better way of ending the year with a success story! In fact, we served the services more than ever before in the year gone by.

I would like to thank and wish all my colleagues and the entire DRDO family, for their untiring efforts in making the year very successful. Having seen such a wonderful year, we must now look forward to the year, which is ahead of us. I am sure that we will succeed in achieving the targets we have set our sights on.

Our achievement is not a complete picture of what we have done. This is only a glimpse of few things that we could do. Let me summarise the landmarks our clusters achieved in the year 2017.

AERO CLUSTER

You all are aware that LCA has been inducted into the Indian Air Force (IAF) and we now have a production clearance for 83 LCA Mk 1A at a cost of Rs 53,000 crore. Weapon release trials of bombs and derby BVRAAM and PIDs for envelope expansion in operations cleaning configuration of the aircraft have been completed successfully.

Our indigenously developed Airborne Early Warming and Control (AEW&C) system, inducted into the IAF last year, participated in the Akraman exercise as well as several large fleet exercises. The aircraft has completed 250 mission sorties conducted for a total duration of 500 hr. Tejas and AEW&C system were also part of the fly-past in the Republic Day Parade 2017 and 2018. Induction of AEW&C system has made the country one of the four elite countries in the world with this technology.

Another area where Aero Cluster has done well is Unmanned Air Vehicles. Rustom-I was demonstrated to Central Reserve Police Force and a command range of 200 km was manifested. The Medium Altitude Long Endurance (MALE) UAV Rustom-II also successfully completed 10 design validations flights. It is almost in the process of reaching highest altitude range as well as endurance. Work is also in progress to enhance the capacity of its engine to enhance its payload capacity. Nine flight trials of weaponised remotely piloted air vehicle Lakshya, were carried out successfully with 20 m circular error probable.

All Aero developments require secluded place away from civilian

Aeronautical Test Range was dedicated to the nation by the then Hon'ble Raksha Mantri Shri Arun Jaitley (inset).

air zone. DRDO's own Aeronautical Testing Range (ATR) was inaugurated at Chitradurga by the then Hon'ble Raksha Mantri Shri Arun Jaitley. The ATR is intended for conducting trials of UAVs, air-to-ground weapons, parachutes and aerostats.

The other landmark weapon system, which the Aero Cluster successfully tested is Nirbhay Sub-Sonic Cruise Missile. One of its kind in the world, Nirbhay can travel up to 1000 km. With this India has entered in a small group of countries having indigenous cruise missile technology. Indian Air Force has shown interest in endorsing 40 Nirbhay. Hopefully, Army and Navy would also follow the suit.

MISSILE & STRATEGIC SYSTEM CLUSTER

The Missile and Strategic System cluster has several accomplishments to its credit. Agni series of strategic missiles, which have been inducted into the services, were periodically tested by the users.

Prithvi Defence Vehicle and Advanced Air Defence Vehicle were successfully tested for the lower altitude. With this we are moving closer towards induction of our own Ballistic Missile Defence System.

Advanced Air Defence Vehicle was tested successfully

Akash Weapon System, already in service with the IAF, was refurbished with the IR seeker to the satisfaction of the user. We are now in process of exporting the system to the friendly countries.

In another first, we flight tested BrahMos supersonic cruise missile, a joint venture of DRDO and NPOM Russia, from Su-30 Mk-1. The air launched BrahMos–a 2.5 ton supersonic air-to-surface missile with range of more than 400 km–is the heaviest weapon to be deployed on Su-30.

We also carried out successful operational flight of Army, Air Force and Naval versions of LRSAM, MRSAM and QRSAM. The missiles are being developed jointly with Israel. In addition, anti-tank missile Nag and its helicopter launched version HELINA, with indigenously developed IIR seeker, were also tested in the presence of senior officers of Armed Forces.

In another landmark, Smart Anti-

Airfield Weapon (SAAW) was tested with flying colour by IAF with high accuracy at targets more than 70 km away.

The cluster also tested Ku-band indigenous Astra seekers and transferred the technology of multi-mode hand grenade and bund blasting device.

ARMAMENTS & COMBAT ENGINEERING CLUSTER

Armaments cluster carried out technical trials of Advanced Towed Artillery Gun Systems (ATAGS), G1 and G2, developed with private industry Kalyani Group and Tata Power. Hon'ble Raksha Mantri Smt Nirmala Sitharaman also witnessed the trials. Orders for G3 and G4 has been placed and the guns will be offered for the User Assisted Technical Trials (UATT) and User Trials (UT) around June and September 2018, respectively.

Configuration and functionality of Guided Pinaka was proven for 65 km and 75 km range. PSQR-based user trials of family of new munition Vaibhav and Vishal were also conducted successfully.

Our Combat Sonar Dome was fitted onboard INS Kolkata and INS Chennai. First prototype of Arjun Armoured Repair and Recovery Vehicle (ARRV) rolled out in October 2017 and is undergoing UATT. User trials of Bar Mine Layer (SP) and floatation trials of Wheeled Armour Platform (WhAP) have been completed. Different versions of WhAP will be available with the army soon.

NAVAL SCIENCE & MATERIALS CLUSTER

Naval Science and Materials cluster has carried out the technical and UATT of Advanced Light Towed Array Sonar (ALTAS), factory acceptance tests (FATs) and endurance tests of USHUS-2 sonar, and standalone STW of onboard electronics of INS Sindhukesari at Russian dockyard. Acceptance test of 105 kW Brushless DC motor for Advanced Lightweight Torpedo was cleared.

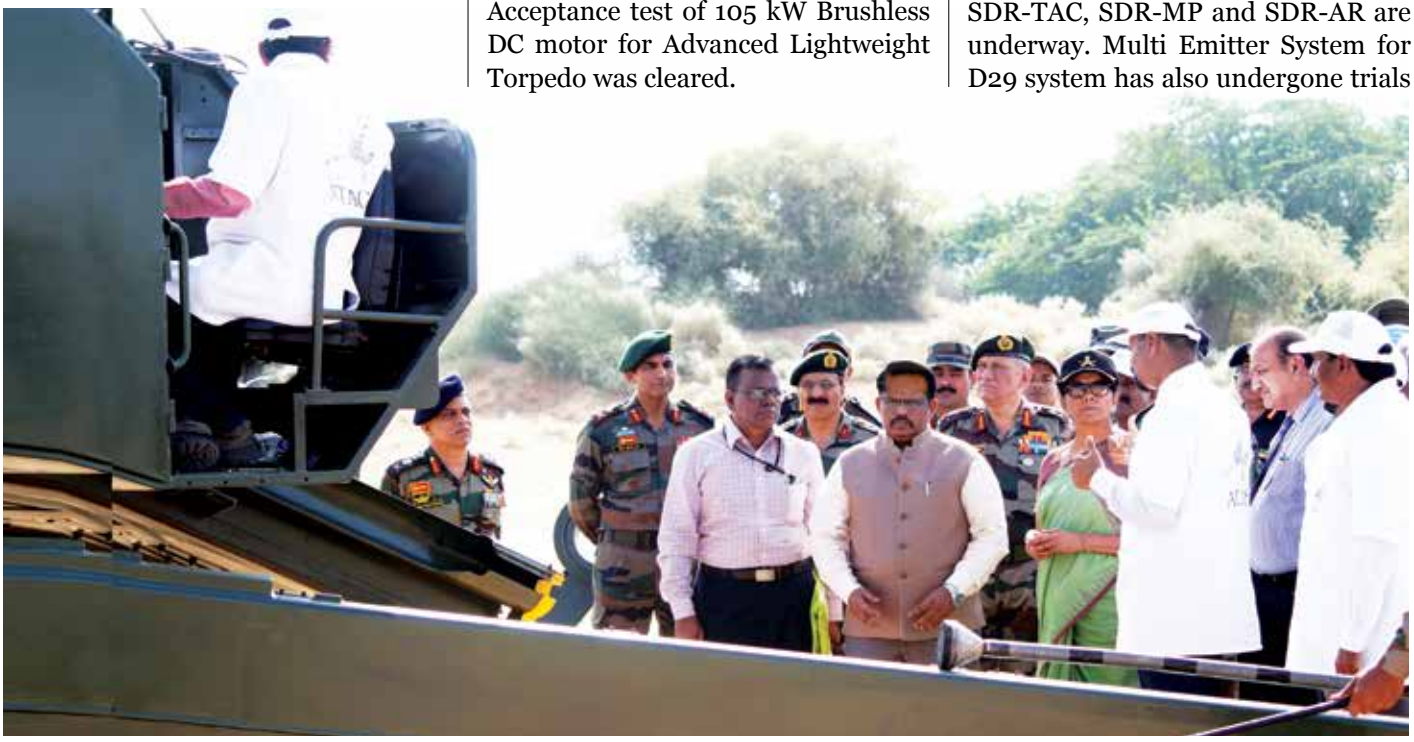
Air Independent Propulsion (AIP) for P-75 submarine has cleared definition phase and its land-based prototype has achieved 14-day endurance trials by the user.

Besides, four phases of trials of Chaff Cartridges have been carried out in collaboration with IAF and Centre for Military Airworthiness and Certification (CEMILAC). Indigenous Fused Silica Radome for Astra missile has also been successfully flight tested.

ECS CLUSTER

In ECS cluster, Varuna Electronic Support Measure (ECM) has been inducted in the Navy. SATs and UET Phase-2 of Nayan COMINT system have been completed and first-off Production Model (FOPM) of Ground-based Mobile ELINT System Himraj is under ATP.

Defence Acquisition Council (DAC) has approved Software Defined Radio (SDR) NC after completion of UET. Developmental sea trials of SDR-TAC, SDR-MP and SDR-AR are underway. Multi Emitter System for D29 system has also undergone trials



Hon'ble Raksha Mantri Nirmala Sitharaman witnessed the Advanced Towed Artillery Gun Systems' technical trials.

at Gwalior with reasonably accepted results.

A number of Radar Systems developed by DRDO have already been inducted into the Services. User trials of Medium Power Radar (MPR) Arudhra and Low Level Transportable Radar (LLTR) Ashwini have been completed. Arudhra was displayed in the Republic Day Parade 2017. Active Electronic Scanned Array Radar (AESAR) Uttam has been integrated and subjected to extensive ground evaluation at LRDE and STIR, Bengaluru. System is ready for integration on LCA Tejas.

The Weapon Locating Radar Swathi has been handed over to the Indian Army.

MED, COS & CS CLUSTER

In Micro Electronic Devices, Computational Systems and Cyber Security (MED, COS and CS) cluster, Project ANUCOS has been completed and integrated with CMS. It is being used by Weapon and Electronic Systems Engineering Establishment (WESEE), Ministry of Defence. ATP of Microwave Power Module with indigenous tube is complete and first production model of Ku-band MPM has been manufactured.

Twenty crypto products has been graded and their crypto keys issued. Development work for Build 1 of IMSAS was completed and its field testing done at Western Naval Command and Eastern Naval Command.

LIFE SCIENCES CLUSTER

DRDO's Life Sciences cluster is striving to enhance health and efficiency of the soldiers operating under varied environment including high altitude, extreme cold and harsh desert. An oxygen enriched shelter for 50 men has been handed over to Army at Giagong, Sikkim. Army has placed order for 50,000 NBC Suit Mk-V developed by the cluster. The cluster has also handed over the NBC Drug Kit and HAPO Chamber Mk-II to the Army and the Telemedicine System to the Indian Navy. Demonstration of Bio-fencing and Strategic Camouflaging has been done at the user's site. Internal trials for Chemical Detector ACADA and CAM have also been concluded successfully.

SYSTEM ANALYSIS & MODELLING CLUSTER

System Analysis and Modelling (SAM) cluster has developed three novel organic molecules of which one is an import item synthesized and tested for use as a Halon alternative. Project ARNAV and SANGRAM-II are under user trials and under user exploitation, respectively. Cluster has also established a unique 1000 m^3 Test Facility for water mist validation. System Safety Policy,

Weapon Locating Radar Swathi was handed over to the Army

Systems Analysis Policy and Software Repository Management have also been established.

CORPORATE INITIATIVES

The organisation took a number of corporate initiatives during 2017. DRDO ranks top in Ministry of Defence for excellent grievance disposal of over 98 per cent concurrently for the past four years. ANUBHAV programme was promulgated among retiring employees, which resulted in uploading of over 250 biodatas of retired DRDO employees on the portal during 2017. DRDO also bagged nine awards out of 18 awards conferred by DOP&PW for the best write-up on ANUBHAV.

Implementation of online APAR; recruitment of first batch of scientists after transition from SET to GATE; dispension of interviews for recruitment of Group B and Group C posts as a measure for minimum government and maximum governance of GoI; customised short duration training programmes for scientists in niche area in association with IIM Kolkatta and Bengaluru; extension of AEBAS to 36 DRDO laboratories; videos magazines, e-books and flip books of DRDO magazines, Coffee Table Books on DRDO and on Dr APJ Abdul Kalam and host of other activities to celebrate DRDO's 60 years were taken successfully by HRD of DRDO.

The 13th Five Year Plan was formulated and released. Thirty-nine projects worth Rs 22,369 Crore have been sanctioned and around 50 projects were closed. Alignment of PM 2016 with provisions of GFR 2017; 139 Parliament Questions; 10 Parliamentary Committee visits; inauguration of Dr APJ Abdul Kalam memorial at Rameshwaram by Hon'ble Prime Minister and construction of highest Research Lab at 17,644 feet (Guinness World Record) are some other activities accomplished by R&M corporate.

DRDO released its IPR policy in April 2017 and conducted six awareness workshops. More than 155 patents were filed in 2017 out of which 78 patents were granted. Three hundred and nine projects costing Rs 246 Crore were taken up as ER initiatives. Three new Centres of Excellence, JB-CAT, COPT and JATC, were established. Technology Development Fund (TDF) scheme has been operationalised. More than 600 industries have registered on the web portal of TDF.

Production order worth Rs 13,700 Crore were received during 2017. DRDO also concluded contract for 3rd party Quality Assurance for production as well as development phases of products. MHA has issued guidelines for fast tracking of the procurement of 33 DRDO-MHA collaborations. The organisation also inked MoU with CII, PHDCC, NRDC and ASSOCHAM for technology assessment and commercialisation. One hundred and eight LAToT during the year accrued a fee of Rs 21.77 Cr.

DRDO also provided critical inputs and played a key role in India becoming member of MTCR and WASSENAAR agreement.

Seven Young Scientists Centre established by DRDO to encourage less than 35 years ignited minds to showcase their talents are performing excellently.

DRDO also showcased its technologies in important international and national exhibitions. As part of corporate social responsibility, the organisation actively contributed to the new initiatives of GoI. Cleanness drive, 'Go Green Save Green' initiative, e-procurement, e-ticketing, project reviews through Video Conferencing, 'Make in India', 'Digital India' and 'Skill India Programme', were taken up earnestly across all DRDO labs.

We all feel proud today. DRDO would be completing its 60 years in 2018. A number of initiatives have been launched to celebrate DRDO@60. DRDO Cyber Challenge; Young Scientist Lectures Series at DIAT; Public Lectures across India; DRDO Online Innovation Challenge; DRDO National Level Essay Competition, and the DRUSE–The DRDO Robotics Challenge to Unfold the Future – are some of the programmes being organised to give youngsters an opportunity to showcase skills and problem solving abilities in the domain of cyber space, present new ideas in their respective domain, to propagate the defence S&T research being carried out by DRDO, showcase new theoretical ideas and innovations in the field of defence and to harness potential ideas in the field of robotics and unmanned systems.

Our achievements give us confidence to move forward towards a brighter future with heads raised high with esteem and pride. Our success gives us encouragement to still perform better. I would like all of you to focus on the following in the year 2018:

- ☑ Our projects should complete without time overrun.
- ☑ IPR is our legacy to feel proud. Our IPR portfolio should increase to 150 per year. So do our technology transfer. Glory of DRDO should be saved for the future by enhancing ToT.
- ☑ We should also work towards enhancing our production portfolio from Rs 2.7 lakh Crore to at least Rs 3 lakh Crore.
- ☑ We must think of moving from internal to external and should not hesitate to export.

The year 2018 should be the year of 'Internal Consolidation and External Outreach'. I wish you and your family a very healthy, happy and fruitful new year once again.

Jai Hind.

NUCLEAR CAPABLE AGNI-5 BALLISTIC MISSILE TESTED SUCCESSFULLY

Long-range surface-to-surface ballistic missile, Agni-5, was successfully flight tested for its full range on 18 January 2018 from Dr Abdul Kalam Island, Odisha. This was the fifth test of the missile and the third consecutive one from a canister on a road-mobile launcher. All the five missions have been successful.

The flight performance of the most advanced missile in the Agni series was tracked and monitored by radars, range stations and tracking systems through out the flight. All objectives of the mission were met successfully. Successful test of Agni-5 reaffirms the country's indigenous missile capabilities and further strengthens our credible deterrence.

Shri G Ramaguru Project Director, Agni-5, and Shri MRM Babu, Programme Director, Agni, led the launch operations. Dr G Satheesh Reddy, Scientific Adviser to Raksha Mantri and Director General, Missiles and Strategic Systems (MSS), DRDO, witnessed the launch. Directors of Advanced Systems Laboratory (ASL), Defence Research and Development Laboratory (DRDL), Integrated Test Range (ITR), Research Centre Imarat (RCI) and Terminal Ballistics Research Laboratory (TBRL) reviewed the entire launch operations. Senior officials from the Armed Forces were present on the occasion.

Chairman DRDO and Secretary Department of Defence R&D Dr S Christopher congratulated the team Agni-5 and described the fifth consecutive successful flight test as a major boost to country's defence capabilities.

Smt Nirmala Sitharaman, Hon'ble Raksha Mantri, congratulated DRDO on this successful feat and also lauded the industries that contributed to the manufacture of indigenous technologies that went into the making of the missile.

ARDE CONDUCTS PENETRATION TRIALS OF 125 mm FSAPDS Mk-II AMMUNITION

The Armament Research and Development Establishment (ARDE), Pune, conducted successful penetration trials of Fin Stabilized Armour Piercing Discarding Sabot (FSAPDS) ammunition, design and developed for T 72 and T 90 main battle tanks of Indian Army with 1 mil accuracy at 2 km range, at Proof and Experimental Establishment (PXE), Balasore, from 27 November 2017 to 7 December 2017. The trial results established the penetration capabilities of the indigenously designed FSAPDS ammunition at par with NATO and Russian tank ammunition.

With low cost, low wear and moderate chamber pressures, this ammunition is extremely safe and effective up to combat ranges. High Energy Materials Research Laboratory (HEMRL), Pune, provided high performance propulsion system required to launch projectile at hyper velocities. The successful trials would pave the way to overcome the shortage of tank ammunition for T 72 and T 90 MBTs of Indian Army.

USER TRIAL OF LAND-BASED PROTOTYPE FOR AIR INDEPENDENT PROPULSION (AIP) COMPLETED SUCCESSFULLY

Endurance mode user trial of Land-based Prototype (LBP) for Air Independent Propulsion (AIP) System for submarines for a period of 14 days was successfully completed at Naval Materials Research Laboratory (NMRL), Ambernath, on 2 December 2017.

Primary performance parameters as per trial directives were met satisfactorily. The endurance trial was carried out in presence of Indian Navy and part of the plant was operated by Navy's representatives. Easy operability and safe operation of the plant was appreciated by the user.

DFRL TRANSFERS TECHNOLOGY OF INSTANT UPMA MIX

Defence Food Research Laboratory (DFRL), Mysuru, signed Licence Agreement for Transfer of Technology (LAToT) of Instant Upma Mix with M/s Bhojanapriya Foods, Bengaluru. Dr Rakesh Kumar Sharma, Director, DFRL, and Smt Suganthi Sudhir, MD, M/s Bhojanapriya Foods, signed the agreements on 13 December 2017 at DFRL. The inventors, Dr GK Sharma, Sc 'G', and Shri Pandit Srihari, Technical Officer and Dr M Pal Murugan Sc 'D' from DFRL and Shri Sudhir G Rao, Managing Partner from M/s Bhojanapriya Foods, were present during the occasion.

The semolina savoury based dish Upma is very common breakfast food. To ease the difficulties in preparation of upma, the Instant Upma Mix was developed by DFRL.

The mix gets reconstituted by simmering in hot water. The product is stable chemically, micro-biologically and sensorily up to 12 months. Consumer gets all characteristic taste and flavour of home made upma.

TECHNOLOGY DEMONSTRATION

DRDO PROMOTES ENTREPRENEURSHIP IN FOOD PROCESSING IN NORTH EAST

A two-day programme on value addition to locally available fruits and vegetables of Arunachal Pradesh was conducted at Defence Research Laboratory (DRL) Detachment, under DRDO TD Programme Arunodaya during 9-10 December 2017 for the local farmers and self-help groups of Salari and Nafra regions of West Kameng District of Arunachal Pradesh. The programme featured demonstration of hurdle technology of pineapple, osmo-dehydrated oranges, crystallized ginger candy, tomato sauce and chutney, etc.

Scientists from Defence Food Research Laboratory (DFRL), Mysuru;

DRL, and Office of the DG Life Sciences, New Delhi, conducted the programme. The AGM, Agricultural and Processed Food Products Export Development Authority, Guwahati, also attended the programme and encouraged the local farmers to develop self-sustained food processing units and to provide them with the market linkage for exports.

ITM DISPLAYS DRDO PRODUCTS

Institute of Technology Management (ITM), Mussoorie, displayed products developed by various DRDO labs/estts during 16-17 December 2017 at Mussoorie. The event was inaugurated by Dr (Smt) Hina A Gokhale, OS and DG (HR), DRDO HQ.

The exhibition was primarily organized to create awareness amongst the Service Officers attending 25th Course of Advance Work Study (AWS) and to provide them an insight into the research and development work being carried out at various DRDO labs/estts.

The seven DRDO labs/estts, viz., Defence Laboratory (DL), Jodhpur; Defence Research and Development Establishment (DRDE), Gwalior; Defence Institute of Bio-Energy Research (DIBER), Haldwani; Defence Food Research Laboratory (DFRL), Mysoru; Instruments Research and Development Establishment (IRDE), Dehradun; Defence Institute of High Altitude Research (DIHAR), Leh; and Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur, displayed their products.

The faculty/trainees of ITBP Training Academy, Lal Bahadur Shastri National Academy of Administration, Mussoorie, Indian Military Academy, Dehradun, other units of Army and Air Force located in Dehradun and a large number of civilians visited the exhibition.

INTERNATIONAL WORKSHOP ON PHYSICS OF SEMICONDUCTOR DEVICES: IWPSD 2017

Solid State Physics Laboratory (SSPL), a premier semiconductor research laboratory of DRDO, and Indian Institute of Technology (IIT), Delhi, organised the 19th International Workshop on Physics of Semiconductor Devices (IWPSD 2017) in association with Society for Semiconductor Devices, Semiconductor Society (India), and Society for Information Display. Chairman ISRO and Secretary Department of Space Dr AS Kiran Kumar inaugurated the event on 12 December 2017 at IIT Delhi. Dr S Christopher, Chairman DRDO, and Secretary, Department of Defence R&D, presided over the inaugural function. Scientific Advisor to Raksha Mantri Dr G Satheesh Reddy and Prof. V Ramgopal Rao, Director IIT Delhi, were present on the occasion.

The biennial event is considered as a prominent international forum on Advanced Semiconductor Technologies. The event held in India provides an opportunity for Indian researchers to interact and discuss state-of-the-art in advanced semiconductor R&D with eminent scientists and academicians from international and national educational institutes, government laboratories and leading industries. The workshop received wide international participation and served as the principal forum for dissemination of semiconductor research in South Asian region.

Semiconductor devices are used in the technological aids related to defence and space applications in addition to day-to-day consumer electronics. The four-day workshop covered most of the emerging semiconductor R&D fields including VLSI technologies, Sensors, GaN (Gallium Nitrite) Materials and Devices, Optoelectronic, Crystal Growth and Epitaxy, Photovoltaic, Display Technologies, 2D materials and Organic Semiconductors and Semiconductors for Quantum Computing, etc. Special emphasis was given to the role of semiconductor technologies in space, defence and civilian applications.

Many renowned scientists and technologists from the USA, Europe, Asia Pacific and other countries participated in this event.

Over 130 internationally acclaimed speakers delivered talks in their field of expertise. Around 500 researchers from national institutions of repute participated in the workshop.

DRDO DIRECTORS' CONFERENCE

DRDO organised 40th DRDO Directors' Conference during 29-30 December 2017 at DRDO Bhavan, New Delhi. The theme of the conference was "Celebrating Success and Marching towards a New India." Conference took place in the background of coming up of 60 years of DRDO. Shri Amitabh Kant, IAS, CEO, Niti Aayog, was the Chief Guest at the inaugural function and delivered the invited talk.

Dr S Christopher, Chairman, DRDO, and Secretary, Department of Defence R&D, in his inaugural address, gave an overview of the achievements of the DRDO. He dwelt upon DRDO's significant impact on India's security and defence preparedness and how Hon'ble Prime Minister's 'Make in India' vision has accelerated the pace of self-reliance and indigenization in defence technologies and has empowered the Defence PSUs and private industries. He appreciated DGs, Directors, scientists and other DRDO family for the multifold growth of the organisation.

Dr Christopher called upon the organisation to share greater responsibility and encourage 'Start-up India' and 'Skill India' programme as an initiative to celebrate 60th year of the organisation.

In his invited lecture on the "Role of DRDO for a New India", Shri Amitabh Kant appreciated DRDO's contributions, which makes India not only proud but also leads the country to the Make in India path of self-reliance.

Speaking on the subject of his invited talk, Shri Kant asked DRDO to achieve and retain technological asymmetry over our potential rivals by mastering disruptive technologies.

Articulating ten pillars of Technological Advancement that form the foundation for Industry 4.0, he said, "To actively shape India's defence transformation DRDO must embrace big data and analytic; autonomous robots; simulation; horizontal and vertical system integration; the industrial internet of things; cyber security; the cloud additive manufacturing; augmented reality and artificial intelligence.

Asking to re-articulate DRDO mission so as to increasingly engage the DRDO resource base, Shri Amitabh Kant said, there are many pan-Indian challenges that require Indian solutions with applications across agriculture, mining, forests, fisheries, railways, highways and waterways, etc., and can transform the ease, cost and way of doing business. Many of these solutions can indeed come from DRDO laboratories and scientists.

Shri Kant elucidated synergy among NITI Aayog, Department of Industrial Policy and Promotion (DIPP) and DRDO for developing innovation, entrepreneurship and the defence and aerospace industry supply chain through start-ups and the SME route. Both institutions can consider to jointly engage youth at school and college levels, he added.

Concluding his talk, CEO Niti Aayog said, "DRDO has tremendous potential to transform India and I urge all of you to actively participate in the task of nation building and deliberate, brainstorm and ideate during the 40th Directors' Conference. I assure you that NITI Aayog will stand by any effort, by DRDO, to any end - to realise our collective vision and national aspiration of a New India at 2022."

RAISING DAY CELEBRATIONS

CEPTAM, DELHI

Centre for Personnel Talent Management (CEPTAM), Delhi, celebrated its 22nd Raising Day on 14 December 2017 with zeal and enthusiasm. Dr Hina A Gokhale, OS and DG (HR), graced the occasion as the Chief Guest. Dr Vijaya Singh, OS and Director, CEPTAM, in his welcome address presented CEPTAM's achievements in the year 2017. Dr Lalit Kumar, Chairman, CEPTAM, shared his vision about future work areas and potential areas of improvement. Dr Ghokale, in her keynote address, congratulated CEPTAM on completing 22 years of significant contributions in the area of Human Resource Development in DRDO. She also distributed lab-level DRDO Awards and Cash Awards to the employees.

The occasion also corroborated endowment of the ISO Certificate to DG (HR), Chairman, CEPTAM, and Director, CEPTAM, by Shri AK Sharma, CEO, STQC Certification Services.

DRDE, GWALIOR

Defence Research and Development Establishment (DRDE), Gwalior, celebrated its Lab Raising Day on 28 December 2017. Dr DK Dubey, Director DRDE, Gwalior inaugurated the function and highlighted the significant achievements of the establishment in the year 2017 and urged scientists and staff to work with dedication so that all commitments of DRDE to the services can be fulfilled.

Director also gave away lab-level DRDO Awards to the meritorious scientists and staff for their contributions to the laboratory and also felicitated DRDE staff who completed 25 years of service in the organization.

Dr Beer Singh, Sc 'G', Associate Director, presented prizes to the winners of various sport events held to mark the Raising Day.

A colourful cultural programme was also organized. Smt Dubey, the first lady of DRDE, was the Chief Guest on this occasion and distributed prizes to children.

GTRE, BENGALURU

Gas Turbine Research Establishment (GTRE), Bengaluru, celebrated its Lab Raising Day on 24 November 2017.Occasion was graced by the Chief Guest Prof. Bari, SA, Vice Chancellor, Central University, Gujarat and Shri H Mahadevan, President GTREEU and working president AITUC. Chief Guest in his address emphasized the importance and responsibilities of the scientific community for the betterment of mankind. Shri MZ Siddique, OS and Director, GTRE, brought out the establishment's achievements in the year, future assignments and challenges ahead.

ITR, CHANDIPUR

Integrated Test Range (ITR), Chandipur, celebrated its 35th Raising Day on 10 December 2017. Shri SC Narang, former Director ITR, was the Chief Guest. Dr Gitanjali Batnambane, Director, AIIMS, Bhubaneswar, and Shri Manickvasagam, Sc 'G', Advanced Systems Laboratory (ASL), Hyderabad, were the Guests of Honour. Shri CR Ojha, Sc 'F' and Chairman, Raising Day Committee, welcomed the distinguished guests and delivered a brief note on the celebration. Dr BK Das, OS and Director, ITR, in his address highlighted various achievements of the range and its future objectives. He stressed on teamwork and an all-out efforts towards social activities along with ongoing official activities.

Shri Manickvasagam appreciated the efforts of ITR fraternity towards the success of missile programme of the nation. Dr Gitanjali Batnambane congratulated ITR for fulfilling the vision of Dr APJ Abdul Kalam. Shri SC Narang in his address emphasised on improvement of the range capabilities.

The first issue of in-house Hindi Magazine 'Arohi: Utkrushtata ki Or' was released during the occasion. Various lab-level DRDO Awards were distributed to meritorious employees. Merit and Welfare scholarships were given to children of ITR employees.

A colourful cultural programme was organised on the occasion. Prizes were also distributed for various sports and cultural events.

NPOL, KOCHI

Naval Physical and Oceanographic Laboratory (NPOL), Kochi, celebrated its 65th Annual Day on 8 December 2017. Dr VK Aatre, former SA to RM, Secretary Department of Defence R&D and DG, DRDO, was the Chief Guest on the occasion. Dr Aatre, in his address, lauded the achievements of the laboratory. He shared his nostalgic experiences as the Director NPOL and highlighted the symbiotic relationship between NPOL and Indian Navy for fostering R&D activities in the defence sector. He emphasized the need for synergistic collaboration with academia to enhance the research capabilities to enable India to become a super power.

Smt M Rema Devi, Sc 'G' and Chairperson Annual Day Organising Committee, welcomed the gathering and presented an overview of the function.

Shri S Kedarnath Shenoy, OS and Director, NPOL, presented a detailed account of the achievements of the laboratory in both technical and non-technical areas and spoke about the commitments for the future.

NPOL employees who made outstanding contributions were honoured with various lab-level DRDO Awards. Prizes were distributed to the winners of sports competitions held during Annual Day. The function concluded with a colourful cultural programme.

ADE CELEBRATES KARNATAKA RAJYOTSAVA

Aeronautical Development Establishment (ADE), Bengaluru, celebrated Karnataka Rajyotsava 2017 on 21 November 2017. A show highlighting folk arts of Karnataka, viz., "Goravara Kunitha" and "Huli Kunitha" by folk artists, sponsored by Kannada and Culture Department, was organised.

Shri MVKV Prasad, DS and Director, ADE, presided over the function. Dr HS Venkatesh Murthy, Kannada poet and playwriter witnessed the programme as Chief Guest. Shri Belur Rama Murthy, a notable humour writer was also present as an honorary Guest. Shri MVKV Prasad, stressed the need for such cultural events and lauded the organisers and participants. Prizes were distributed to the winners of various competitions.

Smt Cynthia Surya, Technical Officer 'D', and Secretary, ADE Cultural Society, was felicitated for her leadership and immense contribution in organising cultural events in ADE. Shri Hashim K, Technician 'B', Shri Mare Gowda, Technical Assistant 'B' and Shri Changappa, CA were felicitated for their contribution towards betterment of Cultural Society.

To mark the occasion, ADE employees performed various cultural programmes.

COURSE ON CHECKOUT SYSTEM FOR STRATEGIC MISSILE

Advanced Systems Laboratory (ASL), Hyderabad organized a course on "Checkout System for Strategic Missile" during 11-13 December 2017 under Continuing Education Programme (CEP) of DRDO. Dr Tessy Thomas, DS and Director, ASL, inaugurated the course and addressed the participants.

Thirty-eight participants from various DRDO labs, HQ Strategic Force Command (SFC) and Strategic Systems Quality Assurance Group (SSQAG) attended the course. Experienced faculty from DRDO, reputed universities and industries delivered 15 lectures during the course. Demonstration of checkout system operations, display of various sub-systems of the checkout system and visit to Exposition Hall, Research Centre Imarat, was arranged for the participants.

Smt R Sheena Rani, Sc 'G', Technology Director, SINT (Checkout), was the Course Director. Shri L Parida, Sc 'F', and Shri Kamlesh Kumar, Sc 'C', were the Course Coordinators.

WORKSHOP ON REINVENTING DRDO LIBRARIES, PUBLICATIONS & IT SERVICES FOR FUTURE

Defence Scientific Information and Documentation Centre (DESIDOC), Delhi, organised a two-day Workshop on "Reinventing DRDO Libraries, Publications and IT Services for the Future" during 28- 29 November 2017. Dr Rajeev Vij, Associate Director, DESIDOC, spoke about the purpose of the workshop and urged participants to discuss contentious issues assiduously.

Dr Alka Suri, Director, DESIDOC, in her welcome address emphasised how technology has changed the way in which the readers now look up for information from plethora of options like internet, e-books, audio books, video books, multimedia, etc. She urged library professionals to think new ways to reach out to users.

Dr Hina A Gokhale, OS and DG (HR), DRDO, presided over the function. In her address, Dr Gokhale elucidated on how the information needs and knowledge sustenance and information seeking behaviour have changed over the time and stressed that DESIDOC should take lead in developing in information tools and training needs for a modern library. She exhorted DRDO librarians to actively pursue latest research activities, to get some insight on how to refer information needs of DRDO scientists. "You insight either into the way library can be used or in the wake the systems making evolution how it can be adopted for DRDO and I think that also should be inculcated. Don't remain mere knowledge scientist become a knowledge generator in your own area", she added.

The keynote talk on "New Vistas

in Information Dissemination" was delivered by Prof. Uma Kanjilal, IGNOU, New Delhi. Her talk focussed on 24X7 information seeking behaviour of the users. She impressed that libraries and librarians have to realise their critical role in creating knowledge.

The workshop comprised six technical sessions. Sixty-seven delegates from various DRDO labs/estts attended the workshop. Dr SS Murthy, former Director, DESIDOC, Chaired the valedictory session and emphasised on being proactive. Dr Nabnita Radhakrishnan, Dr JP Singh, Dr Ramesh Gaur, Dr G Mahesh were among those who addressed the gathering and shared their experiences. The workshop proved to be very productive in establishing procedures for DRDO Library Manual. Dr Rajeev Vij proposed the vote of thanks.

COURSE ON ADVANCED CHARACTERIZATION TECHNIQUES FOR FUNCTIONAL MATERIALS

Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur, conducted a CEP course on "Advanced Characterization Techniques for Functional Materials" during 20-24 November 2017. Dr N Eswara Prasad, OS and Director, DMSRDE, inaugurated the course and delivered a talk on "Functional Materials: A Brief."

Thirty-one participants attended the course. Application experts from four Original Equipment Manufacturers (OEMs) also delivered talks on latest developments in the field of different analytical systems. In addition, participants were also imparted hands on training, in two sessions, on different characterization systems available in the DMSRDE.

Prof. Dipankar Banerjee, from Indian Institute of Science, Bengaluru, delivered the valedictory address.

COURSE ON TECHNIQUES OF SYSTEMS ANALYSIS MODELLING & SIMULATION

Institute for Systems Studies and Analyses (ISSA), Delhi, conducted a CEP course on "Techniques of Systems Analysis, Modelling and Simulation" during 11-15 December 2017. The scientists from various DRDO labs attended the course. The course covered the fundamental of Systems Analysis, Modelling, and Simulation approaches for solving defence related problems, exposure on new issues like Geospatial Decision making, Terrain Modelling, Cyber Warfare, Intangible Modelling, etc. Case Studies on crisis gaming, weapon effectiveness/AMTAB, MBT hit probability analysis, etc. and war gaming products developed at ISSA, were also discussed.

BASIC/FOUNDATION COURSE IN TECHNOLOGY MANAGEMENT

A Five days Basic/Foundation Course in Technology Management–2 was conducted by Institute of Technology Management (ITM), Mussoorie, during 18-22 December 2017. The objective of the course was to apprise participants about the scope of R&D Management. Special emphasis was given on product development process, critical factors for success of product development and commercialization.

Shri Sanjay Tandon, OS and Director, ITM, inaugurated the Course. In his keynote address, Director, ITM, emphasized on different aspect of R&D Management 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, Understanding User Requirement: Tools and Techniques, Case Study Project Akash, Concurrent Engineering for Acceleration of Product Development, Planning for Innovative Product Development through Creative Problem Solving, R&D Management: Case study of Bulletproof Jacket were deliberated upon during the course.

WORKSHOP ON POST HARVEST TECHNOLOGIES

Defence Food Research Laboratory (DFRL), Mysuru, in association with Krishi Vigyan Kendra and MYRADA organised a workshop on Post Harvest Technologies for farmers Under the Rural Development Programme on 30 November 2017 at Haradhanahally, Chamarajanagar, Karnataka. Various post harvest technologies were demonstrated during the workshop.

Farmers and rural entrepreneurs from Haradhanahally and nearby villages participated in the workshop and were given demonstration for the preparation and preservation of tomato products such as tomato puree, tomato sauce, sambhar paste, etc.

COURSE ON COMPOSITE STRUCTURES FOR UNDERSEA APPLICATIONS

Naval Physical and Oceanographic Laboratory (NPOL), Kochi, conducted a CEP on "Composite Structures for Undersea Applications" during 13-14 December 2017. The course was aimed to provide an overview of the subject and update the knowledge of the participants on the trends, technologies and applications. Shri S Kedarnath Shenoy, OS and Director, NPOL, inaugurated the course. A keynote address on "Types of Composites and Applications" was delivered by Shri A Rajarajan OS and Director (CMSE/PRSO), ISRO, Thiruvananthapuram. Twenty participants attended the course.

The topics covered during the course included Composites for Deep Water Applications, Manufacturing Methods, FE Analysis, Design and Analysis, Testing Characterization and Failure Modes of Composite Structures, Composites for Undersea Applications, Composites-Quality Assurance and Life Prediction.

Shri K Ajithkumar, Sc 'E' and Shri VM Dhiwakar, Sc 'D' were the Course Director and Deputy Course Director, respectively.

29 BRIG SK MAZUMDAR MEMORIAL ORATION

Brig SK Mazumdar Memorial Trust and Institute of Nuclear Medicine and Allied Sciences (INMAS), Delhi, organized 29 Brig SK Mazumdar Memorial Oration on 12 December 2017. Dr Shashi Bala Singh, DS and DG (LS), was the Chief Guest of the function. Dr Damodar Gupta, Sc 'E', Jt Secretary, Brig SK Mazumdar Memorial Trust delivered the welcome address. Dr AK Singh, OS and Director, INMAS and Chairman, Brig SK Mazumdar Memorial Trust gave opening remarks. He also remembered Brig SK Mazumdar and his role in bringing-up INMAS.

Lt Gen Bipin Puri, VSM, PHS, Director General, Armed Forces Medical Services (AFMS), delivered the oration on 'Clinical Research in India: Challenges and Solutions'. He discussed historical and current status of clinical research in India and elucidated various medical practices from Indian traditional medicines (Charak, Ayurveda, Siddha, Unani) to Allopathy. He also spoke about

the management of pathogenesis. Dr Shashi Bala Singh, in her address appreciated strength, association and involvement of DRDO scientists and medical fraternity from services for their efforts to serve the community.

Dr Shashi Bala Singh, Lt Gen Bipin Puri, Dr AK Singh, and trustees of Mazumdar Memorial Trust, presented Brig SK Mazumdar Memorial Young Scientist Award 2017 to Ms Suguna Sree, Sc 'D' from DEBEL, Bengaluru for her meritorious contribution towards 'Electronic Control Unit for Life Support System'. The Award comprised a running shield and a citation. The best DRM student 2016-17 was conferred to Dr Taruna Goel.

Dr Rashi Mathur, Sc 'E', proposed the vote of thanks. An Exhibition in the memory of late Brig Mazumdar was also organised.

DRDE SCIENCE EXHIBITION-2017

Defence Research and Development Establishment (DRDE), Gwalior, organized the 6th DRDE Science Exhibition for Senior School students of Gwalior on 25 November 2017. The theme of the exhibition was Innovation for Sustainable Development. The exhibition was inaugurated by Dr DK Dubey, Director, DRDE. Students from 26 schools participated in the exhibition and displayed models.

Various NBC products and technologies, diagnostic kits, bio-toilet (biodigesters), insect repellents, etc., developed by DRDE were also exhibited. Director, DRDE, apprised the students about the significance of the exhibition theme and efforts

made by DRDE in this direction. A large number of students from participating schools evinced keen interest in the exhibition and DRDE developed products. Lt Gen (Retd) VK Sharma, Vice Chancellor, Amity University, Gwalior, was Chief Guest for the prize distribution ceremony and distributed the trophies to the winners.

ADVANCED TORPEDO DEFENCE SYSTEM-MAAREECH

The column covers some of the pathbreaking and successful projects and programmes of the DRDO.

Advanced Torpedo Defence System (ATDS) 'Maareech' was designed and developed by Naval Physical and Oceanographic Laboratory (NPOL), Kochi, to protect surface ships of Indian Navy. The system comprises sonar and acoustic countermeasures to defeat a torpedo attack. The system has been subjected to about thirty performance evaluation trials under actual operational conditions. The system has performed successfully in all the sea evaluation trials. The two production grade systems were formally inducted for active service in Indian Navy on 14 November 2015. The total cost of the project including two production grade systems is Rs 58.89 crore.

Maareech—Conceptual Impression

OVERVIEW

Anti-submarine warfare or ASW as it is popularly known is perhaps the most challenging and also the most fascinating form of warfare. NPOL, a constituted establishment of DRDO, occupies a unique space in oceans and ASW technology and had already developed a full platter of systems and technologies for ASW. APSOH, HUMSA, HUMSA NG and UG versions of hull mounted sonar, developed by NPOL, have been delivered to the Indian Navy (IN). Indian submarines navigate using NPOL designed submarine sonar suite USHUS and our ASW aircraft use dunking sonar and airborne processing systems. Maareech towed array sonar-based Torpedo Defence System was designed and developed by NPOL to protect the ships of IN.

The survival capability of a ship is greater if the torpedo can be detected early and also at a range more than the escape range of the platform. Hence, present day maritime warfare necessitates the requirement of reliable early warning torpedo detection and countermeasure systems that can directly engage the attacking torpedo. Maareech provides total defence against a torpedo attack.

The main objective of the Maareech is to provide a reliable defence mechanism for all the surface ships of IN against torpedo attacks. Its core functions include automatic detection and alert of acoustic homing torpedoes (passive and active) and also acoustic decoying of the torpedo. Fully indigenous system comprises detection, classification and localization systems along with multiple types of countermeasure solutions. Naval Science and Technological Laboratory (NSTL), the other naval laboratory in the Naval Systems and Materials (NS&M) cluster of DRDO, has developed the expendable decoy countermeasure system, which is integrated with the Maareech system.

USER REQUIREMENTS STUDY & ANALYSIS

In this project, the User requirements were clearly understood through continuous interaction with officers of Indian Navy at Anti-Submarine Warfare School and other units. It was important to understand how Maareech is going to be used by the Navy and also hear from people who are going to operate the system.

User defined scenarios are an excellent input as far as the requirements study is concerned. The broad requirements with respect to the overall system were well understood

and an optimum concept design and configuration for the ATDS system was arrived at.

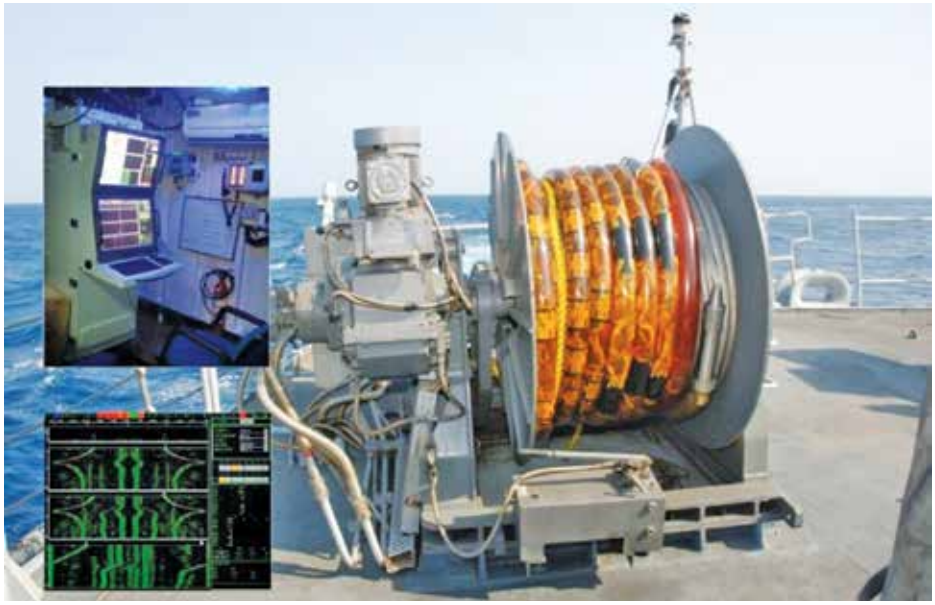
SYSTEM OVERVIEW

The detection system developed by NPOL comprises two sonar, namely, the Hull mounted sonar and towed array sonar for passive detection. Between them they provide panoramic detection and tracking of torpedoes. Apart from that there is an intercept sensor to characterize the active homing signature of the torpedo. Acoustic decoying is effected using two types of decoys namely the towed and expendable decoy. The decoys work in multiple modes depending on the situation. The complete wet end sensors including the towed array sonar is launched and retrieved using a hydraulically operated winch system.

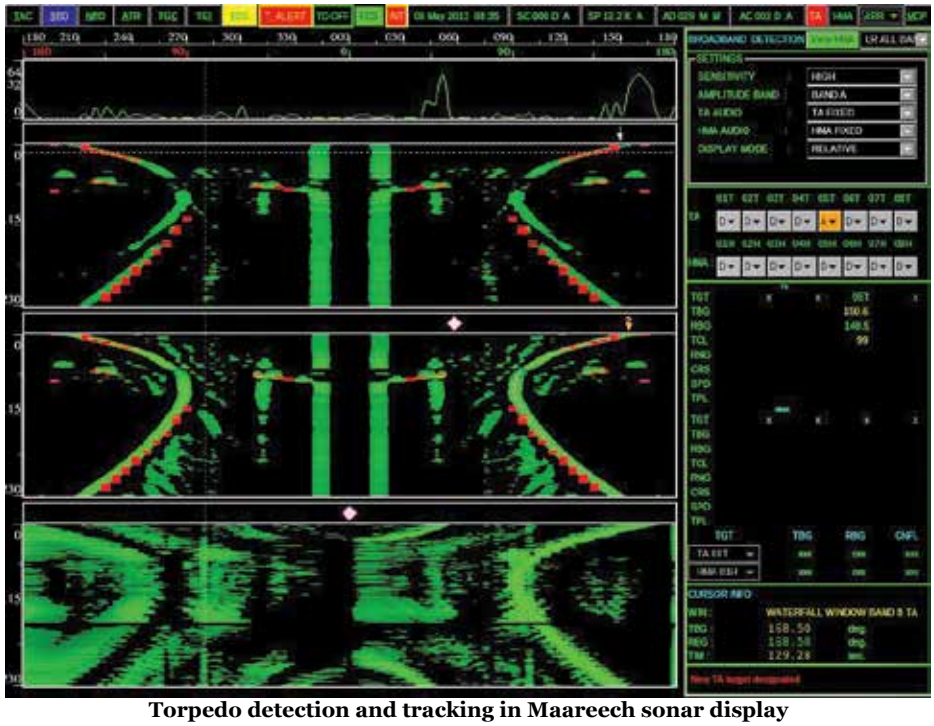
The onboard electronics processing system and HMI are combined in one single cabinet system which houses the front end electronics, signal processors and Display and control hardware. Industry standard Power PC's and Multi SHARC FPP boards are used. The Maareech system incorporates advanced adaptive beam forming techniques for detection and tracking targets. The unique auto torpedo recognition algorithms clearly demarcate a torpedo target from non-torpedo target. Also intelligent soft kill decoy systems with multi-mode operational capability is built into towed and expendable decoy systems which helps to deter and decoy a possible attack on the mother ship.

The expendable countermeasure system developed by NSTL consists of Fire Control System (FCS), Decoy Launcher (DL) and Expendable Decoy(ED). The sonar data after initial classification as a torpedo is being continuously fed to the FCS system. The target localization using Contact Motion analysis is being carried out by the FCS.

Also important information regarding the target like torpedo speed, torpedo course etc. are also computed. FCS system also generates the escape recommendations including when to launch the expendable decoy, direction of launch, own platform course and speed etc. Fire Control System (FCS) interfaced with Maareech towed and hull mounted sonar, identifies high risk adversary and generates recommendations for the Commanding officer of the ship regarding the safest escape route. Also FCS computes the time instants and number of decoys to be deployed / fired. The decoys would be deployed with the command from ASW Officer through Decoy Launcher having multiple built -in safeties. Both towed and expendable decoys can work in multiple modes namely, broad band jammer, echo repeater and transponder modes.



Maareech onboard IN Ship



Torpedo detection and tracking in Maareech sonar display

PROJECT INNOVATIONS AND ITS IMPACT

Some key features, introduced in the operational as well as configuration of

Maareech sonar processing system and winch with towed array onboard IN platform

the system is worth mentioning here. Hydraulic winch systems are used for launch and recovery of towed array sonar systems. The winch can handle multiple spooling of cable and array, has redundant modes of operation, built in safety features etc.

Prior to Maareech, the hardware and software architecture were custom designed to NPOL. We had been following configurations with customized hardware and software. There were frequent problems in this arrangement. We were using the communication links like SDLC and RS 232 interfaces for communicating sonar data. From the experience of projects like APSOH, HUMSA, Nagan etc., there was a paradigm change and improvement on both hardware and software used in project Maareech. For the first time in the history of NPOL we used standardized hardware and back panel communication. VME 64 was adopted as the standard for back panel. Network communication using standard protocols like Ethernet was introduced in Maareech. In addition, for the first time we have used Adaptive beam forming algorithms (MVDR) for detection, track and classification functions. Using MVDR, it became possible to have a fine bearing estimation for a fast moving target like torpedo. The results of sonar operations have to be interpreted by an operator. The link between operator and equipment is through Man-Machine Interface (MMI), and in Maareech we have the most modern and intuitive MMI which resembles a normal desktop computer interface. The raw data from the sensors are recorded during the trials and this data is available for offline analysis in the laboratory. Replaying this data is like going once again to sea to evaluate a new modification/ addition made on the algorithms/software. The innovation was valuable and well accepted and from then on all sonar projects followed this methodology.

The terms sonar and ASW are synonyms. So are naval scientists and ASW Officers. If Indigenous Torpedo defence has become a feasible proposition through Maareech, half of the credit goes to the officers and sailors of Indian Navy. The men in uniform were always there to advise us during the development phase and had no hesitation in demanding critical performance from the system. The officers and sailors of INS Dunagiri, INS Ganga and INS Gomati had a great role in realising Maareech system in its present form.

Sonar Winch System

L-R: Maareech Fire Control System; Decoy Launcher and Expandable Decoy.

PROJECT EVOLUTION

Project on 'Maareech' was sanctioned to NPOL in June 2003. System installation onboard INS Dunagiri was completed in October 2006 after which it underwent a series of User associated trials, which culminated in June 2010. As per IN's directive, installation of the two Production Grade Maareech systems on INS Gomati and INS Ganga was achieved in 2011 and 2012 respectively. Post installation, the system underwent 15 User Evaluation Trials (UET) as per the 'Trial methodology and Acceptance criteria' promulgated by PDSR/IHQ MoD (N) for proving the functionalities of the system. 'Maareech' ATDS was accepted for induction in March 2015 and the system was formally handed over to the Indian Navy by then Hon'ble Raksha Mantri on 14 November 2015.

Maareech is capable of detecting, tracking, seducing, confusing and decoying incoming modern and vintage torpedoes. It has a maximum towing speed of 32 knots and 10-24 knots tactical operating speed. Product-ionization of two production grade Maareech fire control system and 40 of expendable decoys have been completed by the production agency, BEL.

The features of Maareech ATDS are at par with the global torpedo defence systems. In fact, Maareech system possesses detection and decoying capabilities superior to that of global systems. Also, being totally indigenous, continuous support of DRDO and Indian industry is available for up gradation of capabilities based on new requirements arising out of tactical missions. The availability of this technology, critical know-how and support within the country empowers IN and enhances self confidence in their missions.

IN has currently projected requirement of ATDS systems for both ASW and non ASW class of ships. ATDS developed by NPOL would be required for non ASW class of ships. IN has projected requirement of 13 ATDS including training systems. The case for AON for the production systems is in the final stages of approval. This shall result in total order value of about Rs 450 crore. Revenue to DRDO shall be about 20 per cent of the project cost as ToT fee apart from royalty fees on the number of systems delivered.

PARTNERS IN DEVELOPMENT

Maareech system is developed through a consortium approach with participation of both private and public sector industries. M/s Bharat Electronics, Bengaluru, is the lead system integrator and production agency. Major sub-systems like winch system and towed array sonar are being developed by M/s Larsen & Toubro, Mumbai and M/s Keltron Controls, Aroor, Kerala. There are also a number of private industries like M/s Apar Industries, M/s Sham Udyog, M/s Cornet Technologies, M/s Data Patterns. etc., contributing to development and supply of critical sub-systems. Torpedo defence is incomplete without countermeasure systems. NSTL is providing excellent support in developing and fine tuning sonar systems to realise a good decoy Fire Control System and Towed and Expendable Countermeasure Systems. NSTL has also helped in realising sonar sensors that work well with FCS system and generate the required target information and escape tactics.

During the early design stages, academic interactions with Indian Institute of Technology (IIT) Chennai, Indian Institute of Science (IISc) Bangalore, and Ramaiyah College of Engineering, Bengaluru helped in arriving at the optimum design and configuration. Also, with respect to reliability studies, institutes like Centre for Reliability and STQC, Chennai, carried out the reliability analysis for this project. Besides NSTL, other DRDO laboratory, NMRL has played key role in the development of corrosion protection for all outboard equipment.

Team Maareech onboard trial platform

AWARDS

LIFETIME ACHIEVEMENT AWARD

Dr P Sivakumar, DS and Director, Combat Vehicles Research and Development Establishment (CVRDE), Chennai, was awarded "Lifetime Achievement Award" by the President, SAE International and Chairman, SAE India Southern Section on 7 December, 2017 at Chennai.

Shri M Khader Basha, Sc 'G', was awarded "Last Mile Connectivity Appreciation Award" for leadership of Chennai Division of SAE India–Southern Section by the President, SAE International and Chairman, SAE India Southern Section, in the same function.

Dr P Sivakumar receiving SAE Lifetime Achievement Award

INNOVATION AWARD

Combat Vehicles Research Establishment (CVRDE), Chennai, was awarded 'SKOTCH Platinum Innovation Award' and 'SKOTCH Order of Merit Award' for design and development of Landing Gear System for Unmanned Air Vehicle (UAV) Rustom II. Shri B Arul Jothi, Sc 'G', received the platinum Innovation Award from Shri Sameer Kochhar, Chairman SKOTCH Group and Secretary General, CAII. The later award was received jointly by Shri B Arul Jothi and Shri NS Sekar, Sc 'E' from Shri Rohan Kochhar of SKOTCH Development Foundation.

SKOTCH Order of Merit Award being received by Shri B Arul Jothi and Shri NS Sekar

ASSOCIATE FELLOWSHIP OF AIAA

Dr Prakash Chand Jain, Sc 'G', Defence Research and Development Laboratory (DRDL), Hyderabad, has been inducted to the grade of Associate Fellow-Class of 2018, in the American Institute of Aeronautics and Astronautics (AIAA) for furthering the advancement of Aerospace Science and Technology. Dr Jain is also a Fellow of Aeronautical Society of India, Fellow of Telangana Akademy of Sciences and Fellow of Institution of Engineers India.

WORLD ACADEMIC CHAMPIONSHIP

International Agency for Standards and Ratings (IASR) honoured Dr Jubilee Purkayastha, Sc 'D', Institute

of Nuclear Medicine and Allied Sciences (INMAS), Delhi, with World Academic Championship-2018 in advancement of scientific knowledge in Molecular Biology and Biotechnology. IASR recognized Dr Jubilee Purkayastha among World's 500 most influential experts in Molecular Biology and Biotechnology for the year 2018.

DRDO SOUTH ZONE FOOTBALL TOURNAMENT

DRDO South Zone Football Tournament was organized by Electronics and Radar Development Establishment (LRDE), Bengaluru, during 28-29 November 2017.

Shri SS Nagaraj, Director, LRDE, inaugurated the tournament. The final match was played between Aeronautical Development Establishment (ADE), Bengaluru, and LRDE. LRDE won the tournament. Shri Nagaraj presented the trophy to the winner and runner-up teams.

DRDO CENTRAL ZONE CAROM TOURNAMENT

Research Centre Imarat (RCI), Hyderabad, organised DRDO Central Zone Carom Tournament from 2 January 2018 to 5 January 2018.

Shri BHVS Narayana Murthy, OS and Director, RCI, inaugurated the tournament. Eight teams, viz., DRDL, ASL, DLRL, DMRL, RCI, ITR, PXE and NSTL participated in the tournament. RCI won the Championship. DMRL was the runner-up.

VISITORS TO DRDO LABS/ESTTS

NPOL, KOCHI

Dr S Christopher, Chairman, DRDO, and Secretary, Department of Defence R&D and Dr Samir V Kamat, DG (NS &M), DRDO, visited Naval Physical and Oceanographic Laboratory (NPOL), Kochi, on 7 January 2018. Shri S Kedarnath Shenoy, OS and Director NPOL, and senior scientists of NPOL briefed the Chairman about the on-going project activities.

Dr Christopher visited important facilities at the laboratory. He also discussed export opportunities of NPOL products.

ISSA, DELHI

Lt Gen Manoj Mukund Naravane, AVSM, SM, VSM, GOC-in-C, Army Training Command (ARTRAC), along with Brig Laove Verma, SM, BGS (WG and SML), Brig Satish Dahiya, Dy MS, Brig Sanjeev Dogra, Commandant WARDEC, and a team of officers visited Institute of System Studies and Analyses (ISSA), Delhi, on 18 December 2017. Shri SB Taneja, Director, ISSA, gave a brief overview on the activities of the ISSA to the visitors. Distinguished guests were also given a detailed presentation and demonstration of SAMAR, Division Level Wargame with multiple thrust level, and Army Air Defence Deployment Simulator System (A2D2S2), a software product deployed at Army Air Defence Collage, Gopalpur.

NMRL, AMBERNATH

Vice Adm D Prabhakar (Retd) DG, ATVP, visited Naval Materials Research Laboratory, Ambernath on 28 November 2017. Dr M Patri, Director, NMRL, presented him the progress made in ATVP projects and the Air Independent Propulsion (AIP) programme.

DRDO HARNESSING SCIENCE FOR PEACE & SECURITY- XXIV

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

The article is 24th 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

Performance Balance Sheet

Medical Research

Some of the important investigations that were carried out are, effect of prolonged stay at high altitudes on physiological parameters, acclimatization to cold and altitude, tolerance and rationalization of military food rations under different operational environments, establishment of sound procedures in radiation safety and radiation hygiene. Further, a one year post graduate diploma course in collaboration with Delhi University was started. It had the distinction of being the first such course anywhere in the world.

Missiles

The development activities included missiles and its components. The components taken up for design and development were gyroscopes and accelerometers. In addition, the design and development of rockets up to a diameter of 125 mm was attempted. 'A wire-guided antitank missile' was developed and nearly 400 guided flights were carried including 100 flight tests as part of User trials.

Naval R&D

The main thrust has been towards design and development of items and processes for the Navy. In the area of devices and systems, sonar range finder, monitor panels for fire control systems and a sonobuoy were successfully designed and developed. The requirement of the Navy for the sonobuoy was met by pilot plant production. On the material side, the successful development of anti-corrosion and anti-fouling heavy duty underwater paints and transfer of technology to the industry considerably eased the maintenance of seagoing vessels. The paints based on oleo resins offered corrosion-and fouling-free life of around 9 months and were immediately introduced in the Services by the Navy in 1966. Anti-fouling paints based on organic toxins instead of conventional cuprous oxide and anti-corrosion paints containing magnesium were also developed. Another significant contribution was the development of a cathodic protection system based on aluminium metal alloy anodes for protecting the hulls of naval ships from corrosion. These contributions led to the Navy designating the NMRL as the agency for formulating national specifications for paints to be used by the Navy.

Psychological Research

Important investigations carried out relating to psychological tests were, development of psychometric tests for assessing leadership potentiality in Service Officers, psycho-dynamics of courage in operational contexts, selection of technical trades in the Army, effects of high altitude and low temperatures on mental performance, scales for assessment of flying failures in Air Force pilot training, new schemes for administration of PAB tests at the Air Force Selection Boards, and aptitude tests for categorization of cadet trainees into technical and non-technical groups. Experiments were conducted to determine the optimum duration of watch for radar plotters and ASDIC operators, and to devise an improved procedure of branch formation of artificer apprentices in the Indian Navy.

Summing Up

In the twelve years after its formation, DRDO was transformed into a cohesive organization of professionals dedicated to the application of science and technology to defence. This was no mean task because being a department of the government it had to operate within the frame work of government rules which did not suit research and development activities. In addition, the large span of the technical and scientific disciplines, the geographical separation of the laboratories and the primitive communication infrastructure impeded free flow of information necessary for a new organization to cohere. In spite of these factors, Dr S Bhagavantam with Major General JR Samson as Chief Controller R&D and Dr V Ranganathan as Deputy Chief Scientist, steered the DRDO skilfully in the firm direction of applied research and development for meeting defence needs. By the end of the first decade of DRDO, the laboratories in the organisation were at different state of preparedness to move away from routine tasks towards more innovative and challenging assignments. The status of readiness depended on the rate of change in each technology, quality and capacity of industrial infrastructure of the country and the quality of manpower that was transferred from TDE and of those that were subsequently recruited. However, some of the DRDO laboratories specifically in electronics, made the switch from import substitution of equipment to development and delivering of contemporary solutions for the Services. Innovation was in evidence in many of those solutions because they differed in form, fit and function and were not replicas of what was available abroad. The next twelve years will be more eventful because the impact of rapid changes taking place in the landscape of technologies and of the step up in activities to contemporary systems development. This would be a challenge and an opportunity for the DRDO.

To be continued...

READERS' VIEWS

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DNA

Sat, 13 Jan, 2

DRDO's ayurvedic drug for leucoderma attracts global buyers

In the recently held International Arogya Festival 2017 in Delhi, conducted by the Mini of Ayush, many international pharmaceutical companies showed a keen interest in the drug cre by a DRDO scientist that helps cure leucoderma. Owing to this, and encouraged by local dem for herbal medicines, the government is also putting out all stops to tab the global market too.

Lack of awareness, myths, and the stigma attached to leucoderma are perhaps the m pressing challenges that take a toll on the social and psychological health of patients.

Dermatologists explain that Vitiligo is caused by the lack of melanin, the pigment gives skin its colour: the body's immune system attacks the pigment cells, mistaking them foreign invaders.

5 DARIYA NEWS

Fri, 12 Jan, 2018

DRDO Workshop & Exhibition on CBRN Defence Technologies

Chief of Army Staff General Bipin Rawat inaugurated a workshop and an Exhibition on CBRN Defence Technologies to showcase the Products and Technologies developed towards CBRN (Chemical, Biological, Radiological and Nuclear) threats at DRDO Bhawan, New Delhi.

Speaking on the occasion General Rawat complimented DRDO and said CBRN threat is becoming a reality, particularly from the "non-state actors" and he is sure that DRDO's long term perspective plan in conjunction and integrated perspective plan of the services must encompass development of mitigation of technologies against

THE TIMES OF INDIA

Mon, 15 Jan, 2018

High-altitude trials of indigenous gun

By Sandip Dighe

PUNE: The Defence Research and Development Organisation (DRDO) is all set to carry out high altitude (HA) trial of 155 mm 52-calibre advanced towed artillery gun system (ATAGS) in Sikkim next week. ATAGS has been jointly developed by DRDO and the private sector. In September last year, it successfully cleared the desert trials.

A senior DRDO official told TOI on Wednesday, "We will carry out HA trial next week in Sikkim. A team of scientists from Armament Research and Development Establishment (ARDE) and the army team will carry out the trial together. The duration of trial is not yet fixed but it generally goes on for a few weeks."

DRDO had carried out deserts trials in Rajasthan in September last year and its scientists claimed that the trials achieved the desired results. In fact, ATAGS set a record during desert trials, firing shells to a range of 48km, against the army's requirement of 40 km, the DRDO sources

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Connecting knowledge & people

Tue, 09 Jan, 2018

India: DRDO Unit and Uttarakhand Government Amalgamate For IPR Protection

By Sanjeeta Das and Kunal Setiya

Pursuant to the Memorandum of Understanding executed between the Defence Institute of Bio- Energy Research (DIBER), a unit of the DRDO and Uttarakhand Research Circle (URC), a division of the state forest department, in June 2017, followed by several dialogues and extensive research, both the aforesaid organizations have collaborated and agreed upon to apply for IPR protection for *Kasani* considered to be a rich source of carbohydrate and proteins, besides having anti-diabetic and anti-oxidant properties.

Kasani (*Cichorium Intybus*) commonly called Kasni, and more popularly known as "*syrup of wild cherries*" (Chicory) in European Countries is a widely grown herb throughout India. It ...ifying properties and is also a liver stimulant and is helpful in treatment of ...od pressure, liver and kidney diseases.

THE HINDU

Wed, 10 Jan, 2018

Army satisfied with Akash missile

Looks for performance enhancement of indigenously developed system

By Dinakar Peri

The Army is fully satisfied with the performance of the indigenously developed Akash short-range surface-to-air missile (SR SAM) system and is looking for further performance enhancements in future, Lt. Gen. Parminder Singh S Jaggi, Director-General, and Army Air Defence (AAD), said here on Tuesday.

Last month, the Army carried out the first user trial of the missile system. "We are happy with the Akash system. It is a watershed as far as indigenous systems are concerned. The biggest advantage is it is a home grown system," Lt. Gen. Jaggi said.

The Army's AAD celebrated its 25th year of raising on tuesday. The Army currently has two Akash regiments which it began inducting in 2015. Last year, the Defence Ministry cancelled a global tender for additional SR SAMs and approved procurement of two more regiments. Each regiment consists of six launchers with each launcher having three missiles. Officials say Akash has an indigenous content of 96%.

THE NEW INDIAN EXPRESS

Wed, 03 Jan, 2018

DRDO lines up crucial trials of Agni-V and K-4 missiles

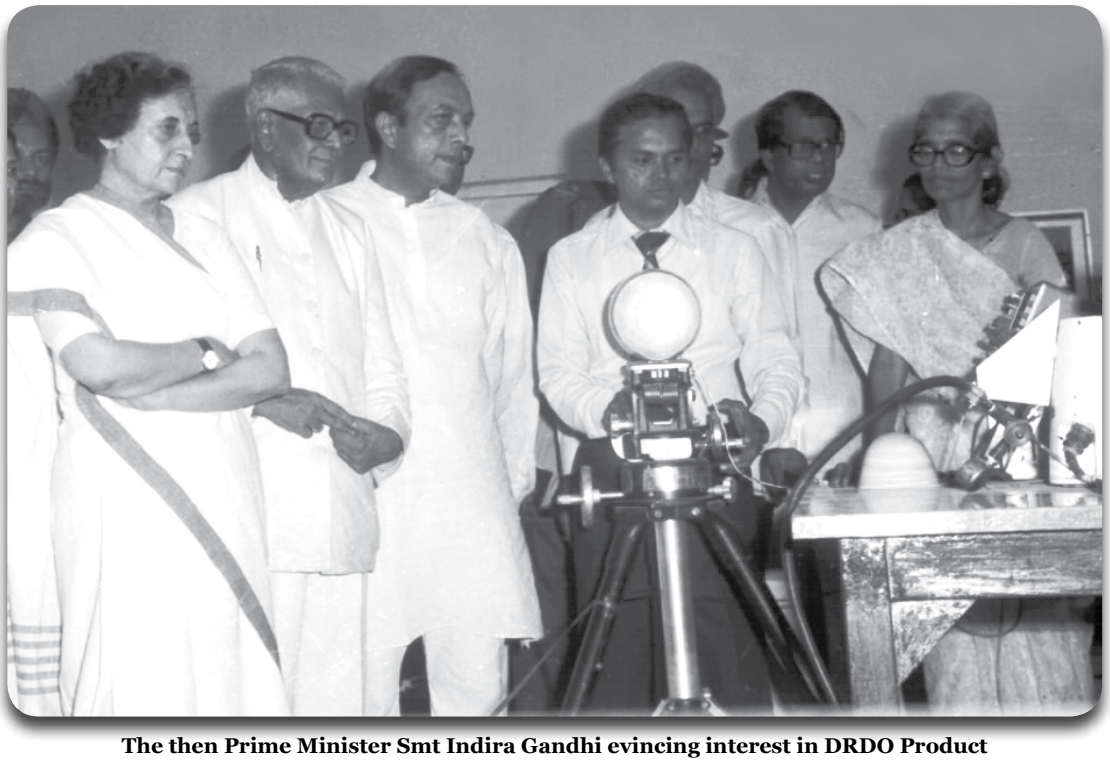
By Hemant Kumar Rout

Bhubaneswar: The Defence Research and Development Organisation (DRDO) are contemplating crucial tests of India's longest range and most potent Agni-V and Submarine Launched Ballistic Missile (SLBM) K-4 this month.

The two nuclear capable homegrown strategic missiles scheduled to be tested in the first month of the mission calendar are expected to add more teeth to the armed forces once they are inducted.

Defence sources said while this will be first user associate trial of 5,000-km range Agni-V before going into series of production, a successful trial of 3,500-km underwater missile K-4 will pave the way for development of its long range sibling K-5, which will have a strike range of over 5,000 km.

DOWN THE MEMORY LANE



The then Prime Minister Smt Indira Gandhi evincing interest in DRDO Product

Smt Indira Gandhi and the then Raksha Mantri R Venkataraman being briefed by Dr Raja Ramanna the then SA to RM

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