

BRAHMOS TESTED SUCCESSFULLY FOR LIFE EXTENSION AND CRITICAL INDIGENOUS COMPONENTS





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DRDO CONDUCTED VALIDATION TRIALS OF SERVICE LIFE EXTENSION & CRITICAL INDIGENOUS COMPONENTS OF BRAHMOS

BrahMos, supersonic cruise missile was successfully test fired from Integrated Test Range (ITR), Balasore, Odisha, as part of service life extension programme. The life extension test firing, witnessed by the scientists from DRDO and BrahMos, was conducted from a Static Inclined Launcher proving the efficacy and longevity of the system.

The precision strike missile flew in the designated trajectory and its key components functioned perfectly. BrahMos, a joint venture between DRDO and NPOM of Russia, is highly versatile and has emerged as the ultimate weapon of choice in modern warfare with its unmatched speed, precision and fire power.

Raksha Mantri Smt Nirmala Sitharaman congratulated team DRDO and BrahMos for the successful



test firing and said that it would result in huge saving of replacement cost of missiles held in the inventory of Indian Armed Forces.

BrahMos was tested again at 1145 hours on 22 May 2018 from ITR from a Mobile Autonomous Launcher (MAL) and successfully flew in the pre-set trajectory fulfilling

its mission objectives. The major sub-systems manufactured indigenously under “Make in India” campaign were tested during the launch. “Through this launch the critical indigenous components including fuel management system and other non-metallic airframe components have qualified to form part of the missile” said CEO and MD, BrahMos, Dr Sudhir Mishra after the launch. He congratulated the team BrahMos for the successful flight test and said this launch will benefit the Armed Forces to maintain its missile inventory economically for a longer duration.

Chairman, DRDO, and Secretary, Department of Defence R&D (DDR&D), Dr S Christopher, congratulated team DRDO and BrahMos for the successful test firing of the missile.





SUCCESSFUL FLIGHT TEST OF SOLID FUEL DUCTED RAMJET

The technology demonstrator flight test of 'Solid Fuel Ducted Ramjet (SFDR)' propulsion-based missile was carried

out successfully from the Launch Centre-III of ITR, Balasore, Odisha, on 30 May 2018. The flight test met all the mission objectives. The technology of

nozzle-less booster was successfully demonstrated during the test for the first time in the country.

BALLISTIC MISSILE AGNI 5 READY FOR INDUCTION

The long range ballistic missile Agni 5 was successfully flight tested at 0945 hrs on 3 June 2018 from Dr APJ Abdul Kalam Island (Wheeler Island), Odisha. Radars, Electro Optical Tracking Stations and Telemetry Stations tracked the vehicle all through the course of the trajectory. All the mission objectives were successfully achieved. Raksha Mantri Smt Nirmala Sitharaman congratulated DRDO scientists and staff, the Armed Forces and industries for the success of the mission.

Agni 5 is the most advanced missile in the Agni series with new technologies incorporated in it in terms of navigation and guidance, warhead and engine. The missile has a high speed on-board computer and fault tolerant software along with a robust and reliable bus. Its path is precisely directed by the advanced on-board computer and inertial navigation system.

The three-stage Agni 5 has higher reliability and enhanced mobility. This was the sixth trial of the state-of-the-art ballistic missile.



LCA TEJAS ACHIEVES YET ANOTHER MILESTONE TOWARDS FOC CERTIFICATION

Tejas has successfully completed a series of captive flight trials to clear Derby for the full operational capability in the entire FOC envelope.



Tejas, the Light Combat Aircraft (LCA) successfully fired Derby air-to-air Beyond Visual Range Missile (BVRM) to expand its firing envelope as well as to demonstrate safe operation of the aircraft during missile plume ingestion into the aircraft engine under worst case scenarios. The missile was launched from LCA Tejas piloted by Wg Cdr Siddharth Singh on 27 April 2018 from the firing range off the Goa coast after exhaustive study of the missile separation characteristics and plume envelope. Integration of Derby is one of the major objectives of Final Operational Clearance (FOC) of Tejas. Tejas has been designed and developed by DRDO's autonomous

society Aeronautical Development Agency (ADA).

The aircraft was tracked by two other Tejas aircraft in close formation to capture the firing event in the specially instrumented high speed cameras for detail analysis and comparison with the simulation model for validation. The entire planning, practice sorties and final firing was carried out by ADA and its National Flight Test Centre (NFTC) officials Cmde JA Maolankar and Gp Capt A Kabadwal; IAF; DG (AQA); HAL and INS HANSA.

Based on the successful integration and demonstration, Regional Centre for Military Airworthiness (RCMA), a unit of DRDO, cleared the series

production aircraft of Squadron 45 to be equipped with Derby operational capability. LCA Tejas has successfully completed a series of captive flight trials to clear Derby for the full operational capability in the entire FOC envelope. In the past, Tejas has qualified for the armaments and missile release related trials.

Raksha Mantri Smt Nirmala Sitharaman complimented DRDO and other agencies involved in making Tejas a world-class aircraft platform.

Chairman, DRDO, and Secretary, Department of Defence R&D, Dr S Christopher in his congratulatory message said that with this firing Tejas has achieved another major milestone towards FOC certification.

DMRL TRANSFERS COLD ISOSTATIC PRESSING & SINTERING TECHNOLOGY

Radar-Dome (Radome) is an important component of high speed target seeking missile as it protects the navigation system of missile from adverse environment without affecting the electromagnetic performance of the antenna. In view of the strategic nature and long-term application, Defence Materials Research Laboratory (DMRL), Hyderabad, has established an indigenous technology based on Cold Isostatic Pressing (CIP) and sintering route in a very short time in the country to manufacturing silica radomes of desired shape and isotropic properties required for high speed missiles.

The CIP technology for silica Radome uses indigenously available low-cost raw materials and offers a substantial saving in foreign exchange. The development stands as a major milestone towards self-reliance in missile defence systems. Productionisation of large number of radomes for different missiles



has been entrusted to Mishra Dhatu Nigam Limited, Hyderabad and Central Electronics Limited, Ghaziabad through License Agreement on Transfer

of Technology (LAToT). The LAToT documents were handed over to the industry partners by the Chairman, DRDO on 14 May 2018.

DFRL SIGNS LATOT FOR HURDLE TECHNOLOGY PRESERVED FRUITS

Defence Food Research Laboratory (DFRL), Mysuru, signs LAToT for Hurdle Technology Preserved Fruits with M/s Nature's Cane Foods, Hyderabad at DFRL Mysuru on the occasion of National Technology Day.

Dr Rakesh Kumar Sharma, Director, DFRL, exchanged the LAToT documents with Shri Premchand, Director, M/s Nature's Cane Foods, Hyderabad.

Inventors Dr OP Chauhan, Sc 'E', and Mrs Roopa, TO 'B', were also present on the occasion



NATIONAL TECHNOLOGY DAY

To commemorate successful nuclear tests conducted at Pokhran, Rajasthan, on 11 May 1998, the country celebrates National Technology Day (NTD) every year on 11th May as a symbol of quest for scientific inquiry and technological creativity, and their translation into the integration of science, society, and industry. The following DRDO labs/ estts also celebrated NTD at their respective places:

ACEM, Nasik

Prof. S Alwan, former GM, Rocket Propulsion Plant, Vikram Sarabhai Space Centre, Thiruvananthapuram, delivered a talk on “HTPB—Synthesis, Manufacture and Propellant Processing.” Shri Srinivasan Seshadri, GM, ACEM, highlighted the significance of the day. NTD orations were presented by Shri Subir Kumar Mandal, Sc ‘D’ and Shri Ehtasimul Hoque, Sc ‘B’ on “Study of Mixing Sequence for Propellant with Multimodal AP on Large Scale” and “Friction and Impact Sensitivity Determination of Energetic Materials”, respectively.



ADE, Bengaluru

As a part of NTD celebration, an oration was given by Shri Akhilesh



Kumar Jha, Sc ‘F’, on “System Engineering with Digital Product Definition and Simulation: Present and Future for MALE UAV (Rustom-II)”. GD (AWS) presided over the function and presented the orator with NTD Certificate and a Medal.

CABS, Bengaluru

Shri AS Kumaran, Sc ‘F’, presented NTD Oration on “Flight Test and Evaluation: Max Range Performance of Airborne Early Warning Radar.” He was presented NTD Medal and Certificate by Smt Sushma Varughese, OS and Officiating Director.



CAIR, Bengaluru

Shri Mallapur Veerayya, Sc ‘E’, delivered NTD oration on “Towards Architecting High Assurance Security Systems”. In his talk he explained security vulnerabilities in the area of communication, information and cyber systems. The presentation covered detailed security system design principles and the requirement for a generic architecture for high assurance platforms which enable quick composition of a security solution.



DESIDOC, DELHI

Dr Alka Suri, Director, DESIDOC, in her inaugural address, described the role of DRDO in the Pokhran nuclear tests and how indigenous S&T benefited DRDO after technology control regime was enforced by the developed countries. Smt Sumati Sharma, Sc ‘F’, delivered NTD Oration on “Institutionalisation of Knowledge Goldmines of R&D Organisations.” She explained significance and impact of tacit and explicit knowledge generated by an organization. A science quiz was organised by Dr Rajeev Vij, Sc ‘G’, to mark the occasion. Top five participants were awarded.



DMRL, Hyderabad

Shri R Pradyumna, Sc ‘G’, delivered the NTD Oration on “Investment Casting Technology for Turbine Blade/Vane Components and its Applications a Tolling Perspective.” He outlined the various activities and processes developed by the Die Design Group in establishing the technology for investment casting of turbine hollow blades/vane castings for aero engine applications. Dr Vikas Kumar, OS and Director, DMRL, presented the NTD Medal and Certificate to Shri Pradyumna.





DFRL, Mysuru

Dr MM Parida, Sc 'G', delivered the NTD Oration on "Omic Technologies for Food Defence." Dr Rakesh Kumar Sharma, Sc 'G', Director, DFRL, presented NTD Oration Medal and Certificate to Dr Parida.



DG (Aero), Bengaluru

Shri P Jayapal, CE, CEMILAC, in his presentation on "Airworthiness and Certification for Airborne Systems" touched upon the challenges involved in understanding, assuring and certifying safety critical aerospace products for military applications. Dr PN Tengli, Director, Admin and SQR, in his presentation on "Solid Rocket Motor Processing and Automation Areas" gave an overview of various process involved in manufacturing of rocket motors.



DRDE, Gwalior

Dr DT Selvam, Sc 'F', delivered NTD Oration on "Biothreat Mitigation Technologies." Dr DK Dubey, Director, DRDE, presented NTD medal and certificate to Dr DT Selvam.



HEMRL, Pune

Dr BB Kale, Director, CMET, Pune graced the occasion as the Chief Guest and delivered the keynote address. Shri KPS Murthy, OS and Director, HEMRL, also exhorted scientists to culture innovative mindset. Shri SR Gore, Sc 'E', delivered NTD oration on "Design & Development of Composite Propellant for PTA Lakshya Booster." He was presented NTD Oration Medal and Citation by the Chief Guest. An exhibition of R&D activities of HEMRL was also organised on the occasion.



IRDE, Dehradun

Instruments Research and Development Establishment (IRDE) exhibited its products on the occasion. Maj Gen JS Yadav, SM, GOC Uttarakhand Sub Area, the Chief Guest, inaugurated the exhibition. Dr NS Vasan, Sc 'G', delivered an informative oration on "Laser Target Designators: Evolution and Progress of Technology."



LRDE, Bengaluru

Shri SS Nagaraj, OS and Director, LRDE, elucidated the importance of



the day, highlighting technological advancements achieved by the LRDE. Shri Vasudev R, Sc 'E', delivered the NTD Oration on "Long Range Multifunction Radars for Ballistic Missile Defence (BMD)" and was presented NTD Medal and Certificate by Shri Nagaraj.

NMRL, Ambarnath

Dr M Patri, Director, NMRL, stressed on the need of innovation for cutting-edge Defence technologies. He asked scientists to come forward and take active role in shaping new technologies for the laboratory. Dr Swati Rao, Sc 'E', delivered a talk on "Membrane Technology for HTPEM Fuel Cell" and was presented NTD Certificate and Oration Medal by Dr Patri.



SASE, Chandigarh

Dr Satish Kumar, former DG (MSS), DRDO, was the Chief Guest of the function and delivered an invited talk on "R&D and Technology in India: Opportunities and Challenges." Shri Naresh Kumar, Director, SASE, described the importance of the day and role of DRDO in the Pokhran nuclear tests. Dr HS Gusain, Sc 'E', delivered NTD Oration on "Application of Remote Sensing and GIS Technology for Snow Cover Parameters Estimation and Generation of Avalanche Information System in the Himalayas." He was presented NTD Medal and Certificate by Director SASE and the Chief Guest.



RAISING DAY CELEBRATIONS

DL, JODHPUR

Defence Laboratory, Jodhpur (DLJ) celebrated its 59th Raising Day on 16 May 2018. A slide show on “Defence Laboratory Jodhpur – A Golden Journey Down the Memory Lane” was shown on this occasion wherein the growth profile along with the glimpses of the success stories of the laboratory were highlighted during the journey of 59 years.

Dr SR Vadera, Director, DLJ, paid his tribute to the founder of the lab Dr DS Kothari, and expressed his gratitude to all former Directors, Scientists and Staff for their outstanding contributions. He elaborated upon various achievements in the fields of scientific and technological development, administration, management and sports during the last one year. He also spoke about future technological challenges that laboratory need to work upon.

Director DLJ also gave away various laboratory-level awards for the outstanding contributions made by DRDS, DRTC, Admin and Allied category of DLJ employees. A cultural programme and Bada Khana (Dinner) were also organized for employees and their family members. A large number of retired officers and staff joined the event.

LASTEC, DELHI

The 59th Raising Day of Laser Science and Technology Centre (LASTEC), Delhi, was celebrated on 23 May 2018. Air Marshal JK Singh AVSM, VSM, Director General (Systems), graced the occasion as the Chief Guest of the function. R Adm Sanjay Misra, Director General, Naval Armament Inspection, was the Guest of Honour.

A live demonstration of recently developed products was given to both the esteemed guests. An exhibition of



LASTEC products was also organised to mark the occasion. Various Lab-Level awards were presented to the employees for their meritorious work and dedication towards their responsibilities.

LASTEC's Newsletter and a compendium of technical papers, reports and patents published during

last one year were released. Centre's Hindi magazine “Arunodya” and a technical book in Hindi titled “Concepts and Applications of Fibre Laser” were also released by the Chief Guest and the Guest of Honour, respectively.

A cultural programme was organized where in LASTEC employees showcased their talents.





DR CHRISTOPHER INAUGURATES YOUNG SCIENTISTS FORUM BENGALURU REGION

Young Scientists Forum, Bengaluru Region was inaugurated by Dr S Christopher, Chairman DRDO and Secretary DDR&D on 28 April 2018 at Electronics and Radar Development Establishment (LRDE), Bengaluru. On this occasion, DG

(NS&M) and Directors of all Bengaluru-based DRDO labs as well as Director, INMAS (Rep. Delhi region) were present. The event was attended by about 200 young scientists from DRDO Labs of Bengaluru region. The forum offers young DRDO scientists under

the age of 35 an opportunity to share and exchange scientific experience, and unleash their creative and innovative potential. Dr Christopher interacted with young scientists for about one hour.



DMRL CELEBRATES DR AMBEDKAR JAYANTI

DMRL celebrated 127th Birth Anniversary of Babasaheb Dr BR Ambedkar and 110th Birth Anniversary of Babu Jagjivan Ram on 3 May 2018. Prof. (Dr) Faizan Mustafa, Vice Chancellor, NALSAR University of Law, Hyderabad, was the Chief Guest at the function.

Shri M Sathyanarayana, President and Shri J Anil Kumar, General Secretary of DMRL SC/ST Employees Welfare Association welcomed the gathering. Dr G Appa Rao, Sc 'G', Liaison Officer, DMRL, highlighted the tireless efforts of Dr Ambedkar and Babu Jagjivan Ram to alleviate disparities in the society and to accomplish national integrity and prosperity. Dr TK Nandy, Outstanding Scientist, DMRL, in his address brought out the aspects covering education, political career and patriotism of

Dr BR Ambedkar and Babu Jagjivan Ram. In the keynote address, the Chief Guest elucidated the ideologies of

Dr Ambedkar and Babu Jagjivan Ram towards betterment of the social and economical stature of people of India.



WORLD ENVIRONMENT DAY CELEBRATIONS

CFEES, DELHI

World Environment Day (WED) was observed at Centre for Fire, Explosives and Environment (CFEES), Delhi, on 5 June 2018. Dr PK Rai, Head Environment Safety Group, highlighted the importance of the day and brought out the theme for the year 2018 "Beat Plastic Pollution." Shri Rajiv Narang, Director CFEES, and employees planted sapling in the campus. An invited talk on "Air Pollution Management in India: Status, Challenges and Strategies" was delivered by Dr SK Tyagi, former Additional Director, Central Pollution Control Board.

DRL, TEZPUR

Lt. Gen. GS Sangha, SM, VSM, GoC, 4 Corps was the Chief Guest at the celebration programme of the WED at Defence Research Laboratory (DRL), Tezpur. Dr SK Dwivedi, Director, presented a comprehensive overview of the ongoing research activities at DRL including the Programme Arunodaya. GOC took keen interest on the efforts being undertaken by DRL and emphasized the need of more interaction for the well-being of the troops. Gen. Sangha released Wall Magazine of DRL, Tatva Darshan. He also planted a sapling in DRL premise to mark the day. A lecture on "Handling Waste Disposal and General Perspective of Humans towards Protecting Environment", animated video, and quiz competitions were organized. Eminent artist, Runal Rajbongshi, gave a talk on artwork and a live demonstration of his painting.

ITR, CHANDIPUR

Integrated Test Range (ITR), Chandipur, observed the WED in an exemplary manner. The day started with a cleanliness drive conducted at Balasore by ITR employees and their family members, the members of Ladies Wing of ITR Cultural and Environmental Club, personnel from AIIMS, Bhubaneswar, State Pollution Control Board, the NGO Jivan Jyoti and Balasore Chemist and Druggist



Dr SK Tyagi, delivering invited talk on the occasion World Environment Day



Lt. Gen. GS Sangha being briefed about DRL technologies



Cleanliness and environment protection drive at ITR on World Environment Day

Association. A silent road march to spread awareness about the importance of protecting environment with special emphasis to "Beat Plastic Pollution",



cleaning of Balasore District Hospital and Bus Stand were covered under the drive. A street play 'Samayara Dakara' was enacted by the ITR employees to depict the importance of a cleanliness. A workshop was also organised to generate awareness regarding environmental protection. Dr BK Das, OS and Director, ITR, inaugurated the workshop and emphasised on the importance of continuing the cleanliness drive and rejecting plastic products. Shri NR Sahoo, Senior Environmental Engineer, State Pollution Control Board, Odisha was the Guest of Honour on this occasion. Dr MC Sahoo, Deputy Medical Superintendent, AIIMS, Bhubaneswar delivered a lecture on 'Harmful Effects of Plastic.' Shri Uday Kumar Sahu, JRF, ITR, delivered a lecture on Use of Renewable Energy Sources. A massive plantation programme was also conducted and more than 150 saplings

of different types of trees were planted.

LASTEC, DELHI

To raise awareness about environmental issues as well as to

encourage everyone to participate in protection of environment, LASTEC organised tree plantation in Metcalfe House. The saplings were planted by the employees about to retire shortly.



ITR CELEBRATES NATIONAL FIRE SERVICE WEEK

The National Fire Service Week 2018 was celebrated at Integrated Test Range (ITR), Chandipur, during 14-20 April 2018. Dr BK Das, OS and Director, ITR, inaugurated the week and appreciated the efforts of Fire Fighting Team for zero incident in ITR. He further encouraged all the ITR employees to take pre-emptive steps to avoid untoward incident. Pledge on fire service was administered by the Director on the occasion.



SWACHH BHARAT CAMPAIGN

As a part of Swachh Bharat Programme, a clean-up drive was organised in the Defence Metallurgical Research Laboratory (DMRL), Hyderabad on 15 May 2018. A pile of used and old metallic items, and other dead materials were removed and dumped in the designated area.

DMRL employees enthusiastically participated in the event. The campaign was led by Dr TK Nandy, OS, DMRL.





DR CHRISTOPHER LAYS FOUNDATION STONE FOR LCA FULL MISSION SIMULATOR

Foundation stone for the LCA Full Mission Simulator (LCA-FMS) at Air Force Station, Sullur, was laid by Dr S Christopher, Chairman, DRDO and Secretary, DD R&D on 19 May 2018 in the presence of Dr CP Ramanarayanan, DG (Aero) and Air Vice Marshal BR Krishna, AVSM, SC, Assistant Chief of Air Staff (Plans). Director ADE, PGD (CA) & Director ADA, Air Officer Commanding AFS Sullur, other senior scientists and IAF officers were present on the occasion.

The brief of the project was presented by Shri BP Shashidhara, Project Director (LCA-FMS), ADE. Dr Anil Khurana, Chief Construction Engineer R&D (East), explained the salient features of the building to the dignitaries.

Chairman, DRDO addressed the august gathering highlighting the scientific milestones achieved by DRDO. He complimented Director, ADE and LCA-FMS team for the design and



development of the simulator, which is critically required by the Indian Air Force to train its pilots. He highlighted the role of Indian Air Force in their

constant support, regular feedback and confidence bestowed in DRDO which enabled production of the state-of-the-art indigenous equipment.

CHAIRMAN DRDO LAYS FOUNDATION FOR ISSA NEW BUILDING

Chairman DRDO and Secretary DDR&D Dr S Christopher laid the foundation stone of new building of Institute for Systems Studies & Analyses (ISSA) at Development Enclave, Delhi Cantonment, on 16 May 2018. Dr G Satheesh Reddy, SA to RM & DG (MSS); Dr Chitra Rajagopal, DG (SAM); Dr Zakwan Ahmed, DG (R&M and Imp); Dr Samir V Kamat, DG (NS&M); Shri Sudhir Gupta, DG (TM), DRDO HQ; Director, SPIC; Director, DESIDOC; Director, CEPTAM; Director, DMS; Director, DHRD; CE (DCW&E); Chief Construction Engineer (R&D), North; representative from Directorate of DRDO HQ, and Shri SB Taneja, Director, ISSA were present on the occasion.





TAPAS BH-201 (RUSTOM II)

This column covers the pathbreaking and successful projects and programmes of the DRDO.



Aeronautical Development Establishment (ADE) located at Bengaluru, is entrusted with design and development of Unmanned Aerial Vehicle (UAV) of various configurations. In this endeavour, a programme was sanctioned to ADE to design and develop a Medium Altitude Long Endurance (MALE) UAV Tapas BH-201 along with establishing an Aeronautical Test Range (ATR), at Chitradurga, Karnataka. The UAV is being developed to meet requirements of Tri-Services for Intelligence, Surveillance and Reconnaissance (ISR) missions. In addition, the UAV can also be used for civil applications as in rescue and relief operations during natural disasters, etc.

Development of Tapas is a multi-disciplinary activity, involving various DRDO labs, small/medium scale

vendors with ADE as the nodal agency. A dedicated Project Management Team (PMT) is positioned at ADE by IAF and IA, for continuously providing valuable inputs in fine tuning the design of systems/sub-systems. The EP&IP of IAF are actively participating in all flight trials and provided vital inputs for refinement of systems and Ground Control System (GCS).

To meet the provisional Joint Staff Qualitative Requirements (JSQR) of the three Services, Tapas has been designed to take-off and land from a runway with the assistance of an external pilot or automatically through an ATOL system.

So far, six airframes have been realised and 25 flight trials have been carried out using AF 3 to AF 5 at ATR, Chitradurga. Tapas is the first UAV in the country to get certified by Centre for Military Airworthiness (CEMILAC). Tapas has achieved maximum endurance of 85 minutes, an altitude

of 14200 ft and range of 40 km during the trials. An imported Electronic Intelligence (ELINT) payload, indigenously developed medium range electro-optic payload developed by ADE and IRDE, Dehradun, have been successfully flight tested.

Tapas: Performance Capabilities

- * Service Ceiling: 32,000 ft, Operating Altitude: up to 30,000 ft
- * Control and carry out mission through Internal Pilot (IP) from Ground Control Station (GCS)
- * Endurance (take-off to landing) of 24 hours with Long Range Electro-Optic (LREO) and Synthetic Aperture Radar (SAR) payloads at an altitude of 20,000 feet (about 7 km)
- * Capable of carrying multiple

payloads like Electro-optic, Signal Intelligence, Image Intelligence along with Situational Awareness Payloads like Traffic Collision Avoidance System (TCAS), Identification of Friend or Foe (IFF), Automatic Identification System (AIS)

- ✧ Launch capability from an altitude of 11,000 ft

Salient Features

- ✧ Multi-mission capabilities with variety of payloads.
- ✧ State-of-the-art real-time simulator to train external pilot.
- ✧ World class GCS & datalinks.
- ✧ Advanced Ground Support Systems (RAIR & HILS).
- ✧ Flight Control (GTH & GHH) Logics.
- ✧ Airworthiness Certification by CEMILAC (DO178B-Level A); first time in the country for UAV.
- ✧ Easy up-gradation and customisation based on user requirements.
- ✧ Easy maintenance and cost-effective product lifecycle support.
- ✧ Technologies being developed, legacy for future UAV/UCAV.

Aerodynamics

Tapas has been designed with large endurance parameter, minimum drag and lower fuel consuming turbocharged IC engine to achieve higher endurance and higher ceiling. A new high lift air foil ADE-LS-E2 has been designed with high endurance parameter with high aspect ratio and optimum taper ratio to reduce the induced drag.

The present aerodynamic configuration was arrived with multidisciplinary optimization approach with considerations of aerodynamics,



Tapas-CFD Analysis

TAPAS—WORKCENTRES	
Labs	Sub-systems
DEAL, Dehradun	Data link
MTRDC, Bengaluru	Microwave Power Module
CAIR, Bengaluru	Data link security
R&DE (Engineers), Pune	Ground Handling Systems/ Wing development through RFI technology
RCI, Hyderabad	INS/ GPS
DLRL, Hyderabad	ELINT and COMINT payloads
CVRDE, Chennai	Retractable Landing Gear (RLG)
IRDE, Dehradun	Medium & Long Range Electro-optic Payloads (MREO & LREO)
VRDE, Ahmednagar	High power engine
LRDE, Bangalore	Synthetic Aperture Radar (SAR) payload

structures, flight mechanics, payloads, etc. Configuration design in the initial stage used the Panel Code and RANS solver extensively for CFD analysis. The aerodynamic characteristics and performance was verified in wind tunnel tests prior to the successful flight testing of UAV.

strength and stiffness. In addition, provision for fitments of variety of payloads and adequate tank space for fuel are catered in the design.

The development of airframe is a very challenging task involving structural design and analysis, including dynamic and aero elastic estimates and



Tapas-Wind Tunnel Test

Airframe

Ab initio airframe developed for the Tapas uses predominantly high performance composite materials. Airframe is designed with adequate

translation of the design into fabrication of the wing. Airframe development effectively utilized the advanced tools for analysis, modelling and digital mock-up, which resulted in the realization of



the airframe in a very short time period. It also provides flexibility for design and process optimization. Airframe was developed, tested, structurally qualified and certified for airworthiness.

Landing Gear

An indigenously conceptualised Landing Gear developed by M/s Timetooth and cleared by CEMILAC and the Directorate General of Aeronautical Quality Assurance (DGAQA) is being used for flight trials. The development of a retractable landing gear for Tapas has been taken up by Combat Vehicles Research and Development Establishment (CVRDE), Avadi.



Tapas-Landing Gear

Ground Control Station

The Ground Control Station (GCS) is being used for:

- * Displaying the location of UAV and health status of its on-board systems.
- * Displaying the search footprint of the payload on the moving map.



Tapas-Ground Control Station

- * Providing dynamic mission and Payload sensor re-tasking during operational mission execution.
- * Receiving, processing, formatting, storing and retrieving flight and payload data and for performing exploitation of payload data.
- * Providing the operator a caution/warning when a malfunction of UAV system is detected/identified.
- * Providing Imagery exploitation capabilities to meet the mission objectives.
- * Providing an online SIGINT/ELINT analysis capability with geo-location facility.
- * Recording full SIGINT/ELINT data for offline analysis.
- * Supporting simultaneous control of more than one UAV.
- * Programmable data rates.
- * Data-link security & Anti-jamming.
- * Wide bandwidth—simultaneous downlinking of payload data (ELINT, COMINT, SAR, MPAR).
- * Simultaneous viewing, overlaying and cueing of all payload data.
- * Simultaneous FLIR, CCD downlink.
- * HD Video downlink.
- * More than 40 km RVT range.
- * Display of all payload data on RVT.

Real-time Simulation

Real-time Simulator is a pilot training facility to train external and internal pilots. Emergency test cases can also be simulated to train the pilot.

Higher Power Engine (HPE)

The indigenous development of higher power engine is in advanced stage with one engine handed over to ADE for ground testing after completion of 50 hours of endurance testing. VRDE, Ahmednagar, is coordinating the indigenous development of power plant by M/s Jayem Automotive, Coimbatore.

Flight Control System

Flight Control System (FCS) consists of flight control sensors, flight control computer, control law and actuators.

Data-Links

- * Range: 250km.
- * Simultaneous operation of short range LOS, long range LOS.
- * Datalink redundancy.



Tapas Simulator

Flight control sensors are INS, Air Data sensor, heading sensor, Vertical gyro, GPS receiver (SBAS), Rate gyro, etc. The sensor suite is selected so as to provide the redundancy as a duplex system for navigation and control law computation. TAPAS UAV is a Fail Safe system.

Flight Control Computer has been designed by ADE and developed by L&T. DO-178B Level A certified On-board Flight Program (OFP) has also been developed by ADE to meet the flight requirements.

Control Law Design (CLAW) has been evolved through various versions after incorporating the requirements for flight configurations.

The Linear Actuators for Control Surface and Flap was designed by ADE and now being further developed by ECIL, Hyderabad. The Software developed in ADE follows Mil- 2167A standard.

Research Centre Imarat (RCI), Hyderabad, is entrusted with the design and development of G3INS and Rotary Actuator for this programme. Hardware-in-Loop Simulation (HILS) integration test facility has been set-up for the test and clearance of FCS and FCS-related systems.

Payload Indigenization

The indigenous development of payloads is in mature stage. The development of SAR payload is in advanced stage with one prototype undergoing flight trials and evaluation in Dornier manned aircraft.

The development of ELINT is completed and is undergoing flight trials with aircraft EMBRAER. The COMINT payload is also in advanced stage.

Instrument Research and Development Establishment (IRDE), Dehradun is entrusted with

responsibility of development of EO payloads. The MREO development is in advanced stage with prototype fitted in Tapas (AF 5) and flight tested. Software upgradation is currently in progress.

To meet the immediate requirement of programme, three sets of payloads have been imported.

Production

A consortium of HAL and BEL is involved in the development of Tapas from the design stage. The teams are actively participating and concurrent ToT is taking place. The consortium will be the lead integrators for the production, after getting the sub-systems.

The programme is expanding the envelope of the flight trials and increasing the range, altitude and endurance in the second half of this year in which all the payloads, imported as well indigenous, will be flight tested.



WORKSHOP ON MATERIALS & MATERIAL TECHNOLOGIES FOR DEFENCE SYSTEMS

A one-day workshop on “Materials and Material Technologies for Defence Systems-2018” was organized by the Women Cell of Defence Materials and Stores Research and Development Establishment (DMSRDE), Kanpur on 25 May 2018. The objective of the workshop was to educate female members of DRDO about woman empowerment and significant contributions of the DRDO’s women scientists in the field of science and technology. Fifty participants, from various DRDO labs like NMRL, SSPL, RCMA, etc., and Engineering Colleges like, UPTTI and HBTU Kanpur attended the workshop. The workshop comprised three sessions, two keynotes and technical presentations. A total 10 high quality lectures on different topics were delivered by distinguished speakers.

The Programme was inaugurated by Dr Anindita Chakraborty, Associate Professor, IIT Kanpur, who delivered the 1st keynote address, entitled ‘Women’s Day and Women’s Empowerment in India: Some Sociological Thoughts’. In the second keynote address, Ms Chandrika Kaushik, Director, DISB, DRDO HQR highlighted the contributions of various DRDO lab clusters and also elucidated the methodologies of inducting the indigenized products. Dr N Eswara Prasad, OS and Director DMSRDE, in his special address highlighted woman empowerment and noteworthy contributions made by women scientists of DRDO.

In the 1st technical session, an informative talk on “Water Quality” was presented by Dr Amita Bajpai, Jal

Kal Vibhag, Kanpur. Dr VD Kaushik of HBTU Kanpur covered the Biometrics and their Applications. Dr Reena Singhal of HBTU delivered a talk on “Hydrogels and its Agricultural Applications”. Technical session 2 comprised a talk by Mrs Aarti Kole, Sc ‘G’, on Process Development and Production of Strategic Materials for Defence Applications.

Dr (Mrs) Tandra Nandi, Sc ‘F’, shared her views on “Pursuing a Career in the Scientific World: Lessons Learnt in the Journey”. Talks on “Polymers and PMC’S for Aerospace Applications”, “Nano-Materials and their Applications” and “Women Empowerment” were delivered by Dr Vineeta Nigam, Sc ‘E’, Mrs Punam Awasthi, TO ‘B’, and Smt Savita Verma, Senior Admin Assistant, respectively.





WORKSHOP ON DRDO E-JOURNALS SERVICES

Defence Scientific Information and Documentation Centre (DESIDOC), Delhi, organised a three-day 'Workshop on DRDO E-Journals Services' during 2-4 May 2018.

Dr Rajeev Vij, Sc 'G', Course Coordinator, in his welcome address, explained the objective of the workshop and asked the participants to be interactive with the faculty.

Dr Alka Suri, Director, DESIDOC, inaugurated the workshop and elucidated the importance of such need-based courses.

Topics covered during the workshop included: DRDO e-journal services, standard related to e-resources discovery and management, licensing policy and issue with publishers, managing e-resources (types, life cycle, DeLCON Consortium, economics

of e-resources, etc. The workshop comprised lectures, demonstrations and hands-on training.

Highlight of the workshop was live tutorials by IEEE, ACM, Elsevier, SCOPUS, IHS Jane's, Remote Access Service, Springer-Nature and Web of Science vendors/publishers and also a visit to DELNET and NISCAIR. Thirty-six participants from different DRDO labs/estts attended the course.



COURSE ON APPLICATION OF COMPUTERS, LAN & DRONA

DESIDOC conducted a three-day course on Application of Computers, LAN and DRONA in Office for Admin and Store Assistants under the Continuing Education Programme (CEP) of DRDO during 20-22 June 2018. Dr Rajeev Vij, Sc 'G', Course Coordinator, in his welcome address, briefed the participants about the objectives and purpose of the training programme. Dr Alka Suri, Director, DESIDOC, inaugurated the CEP and stressed on the need for application of computers and DRONA in office for improving the quality and speed of work. Thirty-six participants from fourteen DRDO labs/estts attended the Course.

The topics covered in the course were basics of computer and hardware,



computer networking, Application of Computers, LAN and DRONA in Office, Computer Networks: Internet and Intranet, DRONA transactional system

for material management, basics of material management in DRDO, introduction to DRONA transactional system, digital signature, etc.



ADE RECEIVES AEROSPACE STANDARD AS9100D CERTIFICATE

Aeronautical Development Establishment (ADE), Bengaluru, has been awarded the AS9100D Certification for best practices of Quality Management System (QMS) adhering to the Aerospace Quality Standard. TUV-SUD America Inc., an authorised Certifying Body for Aerospace Standard AS9100, handed over the Aerospace Quality Management System-AS9100D certificate to Director, ADE, on 24 April 2018.

Aerospace Standard AS9100D is the superset of Quality Management System Standard-ISO 9001:2015. The QMS documentation of ADE was improved to cater for new requirements introduced in ISO 9001:2015—in context of the organisation and organisational knowledge and also new requirements of AS9100D—product safety and counterfeit parts.



With the certification to Aerospace standard-AS9100D, ADE is listed in the Online Aerospace Supplier Information System (OASIS), on the website of International Aerospace Quality

Group (IAQG) with Registration No: 951 17 7264 making it digitally visible worldwide.

NPOL UPGRADES CERTIFICATION TO ISO 9001:2015

Naval Physical and Oceanographic Laboratory (NPOL), Kochi, an ISO 9001:2008 laboratory has been upgraded to ISO 9001:2015 certification by Intertek India Private Limited, a United Kingdom Accreditation Service (UKAS) certification body, with effect from 25 April 2018. The quality management system is applicable to Design and Development of Prototypes of Underwater Sensors and Surveillance Systems and Transfer of Technology for Naval Applications.

The ISO 9001:2015 certificate of registration was handed over to



Shri S Kedarnath Shenoy, OS and Director, NPOL, by Shri M Suresh, Sc 'G', Management Representative

(ISO Implementation) on the occasion of the technology day celebrations 2018 on 11 May 2018 at NPOL.

VISITORS TO DRDO LABS/ESTTS

CVRDE, Chennai

Parliamentary Standing Committee on Defence undertook an on-the-spot study visit to Combat Vehicles Research and Development Establishment (CVRDE), Avadi on 16 April 2018. The committee under the Chairmanship of Shri Kalraj Mishra, MP, and seven other Members of Parliament: Col. Sonaram Choudhary (Retd.), Shri Thupstan Chhewang, Shri Dharmbir Singh, Smt Pratyusha Rajeshwari Singh, Shri KR Arjunan, Shri Harivansh, and Shri Shrirang Appa Barne, visited CVRDE and assessed R&D initiatives, including private sector participation leading to innovation and import substitution during the last 10 years. Officials from Lok Sabha Secretariat, Ministry of Defence, Dr P Sivakumar, DS and Director, CVRDE, Dr Zakwan Ahmed, OS and DG (R&M), Shri RK Sharma, Director, DPA, and senior officers from DRDO HQ and CVRDE were present.

Director, CVRDE, enlightened the Committee about major programmes such as Arjun MBT Mk-II, Arjun ARRV, Catapult, ICV Command, UGV/ Teleoperated Dozer, Next Generation Main Battle Tank, Aircraft products and Naval filters for P-75 scorpene submarines and about infrastructure established at CVRDE. CVRDE's roadmap for next two five year plans, considering the user perspective, was also explained. Hon'ray members posed their queries in writing and were provided replies. The Chairman appreciated the work being done by the establishment and welcomed the report and clarifications provided by the CVRDE. The Committee also saw Arjun MBT Mk-II, Arjun ARRV, Arjun AED Tank, MUNTRA, Aircraft products, IAVS, SAU, etc., exhibited by CVRDE.

CFEES, Delhi

Lt Gen Giri Raj Singh, SM, DGOS, visited Centre for Fire, Explosives and



Environment Safety (CFEES) on 30 May 2018. Shri Rajiv Narang, Director, CFEES, briefed the DGOS on the latest technologies developed by the centre in the field of Fire and Explosive Safety with particular reference to new generation ammunition storage facilities like Underground Ammunition

Storage, LRC Igloos, Unit Risk Principle based ESH, High Performance Magazines and Water Mist based Fire Suppression Systems. The DGOS appreciated contributions of CFEES in finding ammunition storage solution for the Army and commended the centre for the progress made in formulation





of Master Ammunition Storage (MASP) for the Ammunition Depot of the Army and the project on Eco-friendly Disposal of Unserviceable Ammunition.

HEMRL, PUNE

Air Vice Marshal S Saxena, VSM, ACAS (WPNS), visited High Energy Materials Research Laboratory (HEMRL), Pune, on 14 May 2018. Shri KPS Murthy, OS and Director, HEMRL, appraised the visitor about HEMRL activities. Presentations on the projects related to Flares, Canopy Severance System and Solid Rocket Propellant were given by the senior scientists to the visitor. AVM Saxena also visited FS&D, SRP Divisions and Exhibition Hall of the HEMRL and appreciated the research and development work being carried out by the laboratory.



PERSONNEL NEWS

APPOINTMENT

DG (AERO), DRDO



Dr Tessa Thomas, Distinguished Scientist, Director, Advanced Systems Laboratory (ASL), Hyderabad, has been appointed Director General (Aero), DRDO, with effect from 1 June 2018. A B.Tech in Electrical Engineering from Calicut University, ME in Guided Missiles from Institute of Armament Technology (now Defence Institute of Advanced Technology), Pune and PhD in Missile Guidance from Jawaharlal Nehru Technological University (JNTU), Hyderabad, Dr Thomas is an eminent missile scientist. She shot to fame in 2011 as *Agni Putri* with the successful launch of Agni IV, which she led as Programme Director.

HIGHER QUALIFICATION ACQUIRED



Shri Kurra Mallaiah, Sc 'E', Advanced Numerical Research and Analysis Group (ANURAG), Hyderabad has been awarded PhD in Computer Science and Engineering by Osmania University, Hyderabad, for the thesis entitled "Supporting Operations and Key Management for proxy based encrypted databases."



Shri Anil Kumar, Sc 'C', Instruments Research and Development Establishment (IRDE), Dehradun, has been awarded PhD in Physics from Guru

Jambheshwar University of Science and Technology, Hisar for the thesis entitled "Study of Nonlinear Optical Switching Properties of Dye-doped Organic/Inorganic Materials."

AWARD

Indian Academy of Biomedical Sciences Award

Dr Yasmin Ahmad, Sc 'D', Defence Institute of Physiology and Allied Sciences (DIPAS), has been awarded "Smt Kusum Sharma Award-2017" for outstanding contribution in the field of Biomedical Sciences by India Academy of Biomedical Sciences at Sher-e-Kashmir International Conference Centre (SKICC).



DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 3: OVER TO SYSTEMS DEVELOPMENT (1970–1982)

The article is 29th 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).

HEADQUARTERS REORGANISATION

PROFESSOR MGK MENON BECOMES THE SCIENTIFIC ADVISER

The departure of Dr Nag Chaudhuri to the Jawaharlal Nehru University as Vice Chancellor was a surprise to most heads of the laboratories in the DRDO. Most of them hoped that the post would be filled up shortly as it had been vested with the powers of the Secretary to the Government of India. While a small minority within the DRDO wanted that scientists from within the organisation to be considered, the general consensus was that an eminent scientist from outside the Organisation would most likely be the next the Scientific Adviser. The formal announcement that Professor M Govind Kumar Menon, an internationally known physicist and who was Chairman, Electronics Commission and Director, Tata Institute of Fundamental Research (TIFR), Bombay, would be the next Scientific Adviser made most of the scientists happy. Professor MGK Menon assumed the Office on 17 August, 1974.

Professor Menon had his early education at Jodhpur after which he was awarded MSc (Physics) of Bombay University while working at the Royal Institute of Science, Mumbai. He was enrolled at the Bristol University, England for advanced studies in physics and was awarded the PhD degree by the University of Bristol in 1953. At Bristol, he worked with Nobel laureate Professor CF Powell. During the period 1953-55, he held the highly coveted

senior award of the Royal Commission for the Exhibition of 1851, for two years. In 1955, he decided to return to India and joined the Tata Institute of Fundamental Research (TIFR) as Reader. For his outstanding work on cosmic rays, he was awarded the Shanti Swarup Bhatnagar Memorial Award for physics in 1960. He was also made Professor and Dean of the Physics faculty at the TIFR in the same year. In 1961 his contributions to physics were recognised by the President of India with the award of Padma Shri. In 1964 he rose to the position of Senior Professor and Deputy Director, and took over the mantle of the Director of TIFR two years later.

Under his inspiring stewardship, TIFR grew into a pioneer research centre that was internationally recognised. He made significant contributions in developing the technology of fabricating and flying very large balloons under tropical conditions, through very low temperatures of the equatorial tropopause, thus enabling cosmic ray work to be carried out at high altitudes, close to the geo-magnetic equator. His work in the field of elementary particle physics, particularly relating to strange particles, demonstrated the existence of muons of varying energies, of mono-energetic high energy pions, and of electrons of varying energies, as secondary in the decay of heavy mesons. He demonstrated the scattering phenomena involving K-mesons and contributed to the development in the nuclear emulsion technique, particularly the use of large stacks of stripped emulsions, which led to significant results relating to the decay modes and interactions of

the heavy mesons and hyperons. He pioneered deep underground studies in India relating to muons, neutrinos, weak interaction and nucleon decay; this included establishing the feasibility of experiments on neutrino-induced interactions and related new phenomena at great depths underground; first observations and analysis of natural neutrino interactions and observations of Kolar events; and from the late 1970s the first major dedicated experiment in the world to look for nucleon decay with life times up to 1030 years, with important observations on nucleon events, limits on magnetic monopoles, etc. The nation recognised his significant contributions to physics by the Presidential award Padma Bhushan in 1968. In 1970, the Fellowship of Royal Society (FRS), UK, was conferred on him. At the time of his appointment as the Scientific Adviser to Raksha Mantri, he was also Chairman of the Electronics Commission and Secretary to the Department of Electronics of the Government of India. In addition, he was the Chairman, Cosmic Ray Commission of International Union of Pure and Applied Physics, Indian National Committee for Physics, and was on UN Secretary General's Advisory Committee on Application of Science and Technology to Development. After Dr Vikram Sarabhai passed away in December 1971, he was for some time, Chairman, Indian Space Research Organisation.

As one of the world's top physicists and as one who had contributed to the growth of application of electronics in India to meet scientific and societal needs, the Professor brought to his new post his rich experience which



would be an invaluable asset to DRDO. It was the hope of every scientist in the Organisation that he would give a significant fillip to their activities and lead them further along the path of self-reliance.

Professor Menon was known to most of the senior scientists of DRDO as they would have come into contact with him at one or more of the science and technology activities he was involved in. On his part, DRDO was no stranger to him. Many of us who had the benefit of listening to him, admired him for his grasp, for the wide range of his knowledge, for the way he could effortlessly analyse the most difficult situations, for his clarity of thought and the power of expression in the military and scientific circles, and as the Scientific Adviser to Raksha Mantri, he would have a significant role to play in large military purchases from abroad. In addition, as Chairman Electronics Commission he had a decisive role in the promotion of indigenous R&D as well as manufacture of electronic component/equipment/systems. The scientists and technologists of DRDO were happy that with his appointment as the Scientific Adviser, DRDO would continue to have its voice heard at the highest level of decision-making, and that there would be a better understanding and appreciation of their efforts towards self-reliance in defence.

On his assuming the office of the Scientific Adviser, he reviewed the activities with the Chief Controllers and senior scientists to chalk out a plan and set the priorities. He recognised that DRDO in its role as an Organisation, solely dedicated to meet the needs of the Services, would have two types of project activities. The first one would be those that are relatively small and not spectacular, but nevertheless, necessary because of the need expressed by the Services. In these types of projects, it was essential to ensure success and a faster turnover so that the overall contributions of DRDO were high. He found that there were far too many small projects, each costing less than Rs. 20,000, neither linked to any major development programme, nor to any expressed need by the Services. He

closed these and brought the number of projects down from 600 to 350.

The second type of projects were big and high visibility projects dealing with weapon system hardware. These would get his attention, guidance, and direction to minimise the chances of failure. Therefore, it would appear that he set his priorities as the development of the MBT-80 tank at CVRDE, the building up of the capabilities of GTRE for aircraft engine development, and that of DRDL for missile development, the activities at DMRL for the development of special metals and alloys with particular application to Kanchan armour and aircraft brake pads and those of the three electronic laboratories involved in the development of sensors, communications and electronic warfare equipment; DLRL was specially designated as EW Laboratory. He was clear that the personnel policies of DRDO need to be changed as these were inferior to those prevailing at the Departments of Atomic Energy and Department of Space. The succeeding paragraphs bring out some of the important developments that took place during his tenure as the Scientific Adviser.

MBT-80 TANK PROJECT

He was briefed on the MBT-80 tank project by the Director and the scientists of the CVRDE and also by the brass of the Army so that he could make an assessment of the magnitude of the task undertaken by the Organisation, the capability of CVRDE and other laboratories involved in the project, and the developments taking place in this area and their likely impact. By 1974, CVRDE had a strength of 400 and was in the process of completing the design and development of modified guns, armoured personnel carrier, and the improvement of Vijayanta tank. It was clear to the Scientific Adviser that it was the vision and drive of Mr DP Mukherjee that was responsible for the scientists of the CVRDE to undertake the development of the MBT-80s. His presence at CVRDE would be essential for some more years for guiding the development effort. Since, Mr Mukherjee had reached the age of

superannuation, he re-employed him as Consultant so that he could concentrate fully on the project. The MBT-80 development envisaged the use of 110 mm to 115 mm bore gun, an integrated fire control system, night vision device, hydro-pneumatic suspension, nickel-chrome armour steel for hull and turret, and a 1500 HP engine. With the exception of the engine, all other features and subsystems were within the competence of DRDO for design and of the Indian production agencies for fabrication. Therefore, CVRDE's determination to develop an air-cooled 1500 HP diesel engine to be fitted within the specified space in the tank, was a bold venture, especially as Indian automobile industry was totally dependent on imports for their vehicle models and also for the automobile engines. The Scientific Adviser approved the development plan and the proposed methodology. Keeping it in mind, he appointed Brigadier KN Tandon as the Director of the Laboratory so that he could provide the necessary support to Mr Mukherjee by his management capabilities which were needed to form the team of engine, transmission and suspension specialists within the Laboratory to work on the indigenous engine. While the existing industrial infrastructure would be used to the maximum possible extent, there was a lack of adequate machining and test facilities. This was remedied by deciding to expand the Mechanical Systems Laboratory and also to establish test facilities for engine, transmission, fuel injection pump, etc., at CVRDE so that testing of engines up to 1100 kW capacity would be possible. In this way, the Scientific Adviser gave a concrete shape to the project and to the organisation of the effort by combining the system expertise of Mr Mukherjee, which enabled him to spot the technology trends in each of the major sub-systems of the tank ahead of others, with the management capabilities of Brigadier Tandon, who would ensure that the changes are smoothly incorporated into the design.

To be continued...



READERS' VIEWS



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

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DOWN THE MEMORY LANE



The then Defence Ministers Shri SB Chavan (top) and Shri Paranab Mukerjee showing keen interest in DRDO products.