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BRAHMOS-AIR LAUNCHED CRUISE MISSILE GETS FLEET RELEASE CLEARANCE



INNOVATION >> p06

TECHNOLOGY TRANSFER >> p13

EVENTS >> p14

SOCIETAL ACTIVITY >> p16

DRDO SERIES >> p17

PERSONNEL NEWS >> p20

CONTENTS

JULY 2020
VOLUME 40 | ISSUE 07
ISSN: 0971-4391

COVER STORY 04

BrahMos ALCM gets Fleet Release Clearance



INNOVATION 06

DRDO Combats COVID-19

TECHNOLOGY TRANSFER 13

Tejas FOC Aircraft Handed Over to the IAF

EVENTS

14



PERSONNEL NEWS

20

40th Year of Publication

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BRAHMOS-AIR LAUNCHED CRUISE MISSILE GETS FLEET RELEASE CLEARANCE

With the FRC, the missiles can now be used in combat missions.

BrahMos, a joint venture between India's DRDO and Russian NPO Mashinostroyeniya reached another milestone when its Air Launched version was given 'Fleet Release Clearance (FRC)' by the Centre for Military Airworthiness & Certification (CEMILAC) on 10 June 2020 through video conferencing. The conference was attended by members from DRDO, BrahMos Aerospace, Aircraft and Systems Testing Establishment (ASTE), Software Development Institute (SDI), IAF HQ and CEMILAC. This also led to operationalization of the weapon on Su-30 MKI of Indian Air Force (IAF).

The fastest supersonic cruise missile created history on 22 November 2017 after it was tested for the first time from IAF's frontline aircraft Su-30 MKI against a sea-based target. It was tested on 22 May 2019 in users' configuration with launch point, target point, way point, launch altitude and range decided by the IAF.

The airborne BrahMos was again flight tested on 17 December 2019 against a sea-based target successfully hitting the target at bull's eye. The successful test firings have established BrahMos as the world's most powerful conventional airborne precision strike

weapon capable of annihilating high-value land and sea-based enemy targets from longer ranges and safer distances. On 20 January 2020, Indian Air Force formally inducted Squadron of Su-30 MKI equipped with BrahMos Supersonic Cruise Missile.

Designed as a modified variant of its original anti-ship configuration BrahMos Air Launched Combat Missile (ALCM)—featuring a lighter propulsion system, improved nose cone and enhanced aerodynamic structure—has become the heaviest and most powerful weapon onboard the frontline super-maneuvrable



BrahMos-A induction



BrahMos-A

Su-30 combat aircraft of the IAF. With a strike range of 290 km and a warhead of up to 300 kg, the 2.5 ton missile promises to deliver a deadly blow to strategic enemy positions across the land or sea.

The air-launched BrahMos project was fraught with innumerable challenges as it involved the integration of a very powerful, high-speed, manoeuvrable missile on-board a heavy long-range air superiority fighter platform. The Russian-origin Su-30 combat aircraft underwent structural modifications to carry the BrahMos ALCM whose weight was reduced by 500 kg in order to fit it onto the heavy strike fighter. The missile underwent design refinements for aerodynamic stability in the early stages of its flight from the supersonic air fighter platform.

The highly intricate and

challenging BrahMos-A programme became a marvellous engineering and technological feat for India wherein BrahMos Aerospace in close coordination with the IAF, HAL, DRDO, Russia's Sukhoi and all other major defence entities successfully modified, integrated and flight tested a weapon of such class and calibre from a fighter aircraft for the very first time in the world.

"The Su-30 MKI armed with formidable BrahMos is going to be India's ultimate trump card against any kind of enemy aggression" said Dr Sudhir K Mishra, Director General BrahMos, DRDO.

"BrahMos is a very heavy missile and such a class of weapon has never been deployed by a powerful frontline air combat platform of any country in the world. The missile has enormously widened our Air Force's stand-off

air attack capability and has given it a distinct strategic edge over its adversaries" added BrahMos Chief.

The incredible BrahMos Weapon System having excellent land attack and anti-ship capability has established its multi-platform, multi-trajectory and multi-target features for platforms based on land, sea, sub-sea and air. BrahMos missile has emerged as a major 'Force Multiplier' in the modern day battlefield with impeccable capabilities furthering the confidence amongst all the three wings of the Armed Forces and has given them the much needed capability to undertake deep surgical strikes.

In a rapidly evolving regional and global geostrategic order, a powerful weapon such as BrahMos has undoubtedly changed the security dynamics for India.

DRDO COMBATS COVID-19

Mobile BSL 3 Laboratory for COVID Sample Testing

Defence Food Research Laboratory (DFRL) Mysuru, has developed a quick response laboratory called Parakh to deal the situation arising due to contagious diseases including COVID-19 pandemic.

The laboratory, stationed on mobile platform, provides for unidirectional airflow and gradient negative room pressure with class III Biosafety Cabinet (BSC) for entry and safe processing of clinical samples. The viral inactivation and first two steps of viral analysis of RNA extraction are performed inside the BSC assuring staff protection.

The fully autonomous containment laboratory is built on ISO 20 feet container and mounted on Ashok Leyland 1618-2C-4700 wb cabin Chassis. It adheres to Class ISO 7 and is operated with negative pressure to handle clinical, food and environmental samples during biological emergency without any risk to personal and environment. Complete Heating Ventilation Air Conditioning (HVAC) is used to maintain desired unidirectional airflow and room pressure gradients of negative pressure as compared to the ambience.

The ingress of the samples is done in a safe way through a specifically designed dynamic pass box for direct delivery inside the Class III biosafety cabinet for safe sample processing.

Parakh comprises a clean air work station, cold chain for storing the reagents and samples, and provision for treatment of liquid effluents, safe storage of solid biohazard wastes and decontamination by autoclaving.



Clockwise from top left: Entrance and first air lock room with sterile PPE, gloves and mask storage; Second airlock with PPE change, emergency shower and eye wash and used PPE disposal facility; Interior view of the lab showing Class III biosafety cabinet, real time PCR, PCR work station, pass box, -20 °C freezer, refrigerator and incubator

Further provision for storing and donning PPE, storage for autoclave and dynamic pass box facility have been provided for sample entry used aprons, emergency body shower and eye wash, etc., have been provided.

The lab set-up has necessary captive and raw power supply, space for sufficient fuel and water provisions and therefore can be easily transported by road and deployed at the site of emergency as per the



requirement. Air bellow suspension and air compressor have been used to reduce the vibration during transport and for inflating tyres, respectively

Parakh has Real-Time PCR detection platform specifically for COVID-19 testing. Medical professional can easily and safely handle and preserve samples from disease outbreaks or during surveillance. The laboratory has been handed over to Mysore Medical College and Research Institute for testing COVID-19.

Ultra Swachh for Disinfection of PPE and other Materials

Institute of Nuclear Medicine and Allied Sciences (INMAS), Delhi, has developed a disinfection unit named Ultra Swachh to disinfect a wide range of materials, including Personal Protective Equipment (PPE), electronics items, fabrics, etc., with industry partner M/s Gel Craft Healthcare Private Ltd, Ghaziabad. The system uses an advanced oxidative process comprising of multiple barrier disruption approach using Ozonated Space Technology for disinfection. Ultra Swachh is double layered with specialised Ozone sealant technology assuring trapping of ozone for the necessary disinfection cycle. It also has catalytic converter to ensure environment friendly exhaust, i.e., only oxygen and water.

The system is in compliance with International Standards of Industrial, Occupational, Personal and Environmental Safety. It comes in two variants, namely, ozonated space and Trinetra technology. Trinetra technology is the combination of ozonated space and radical dispenser. Treatment is optimised with automation for quick disinfection cycle.

The system operates on 15 A, 220 V, 50 Hz power supply. It has various safety features such as emergency shut down, door interlocks, dual door, delay cycle, and leak monitors, etc., to ensure safe operations for longer duration. Dimensions of the Industrial Cabinet 7’ x 4’ x 3.25’ ensures that a large quantity can be disinfected at a time. Cabinets of different sizes would be available for the industry.



Ultra Swachh

AI-Based Attendance Application

COVID-19 pandemic has presently made it unsafe to use contact-based biometric verification. An AI-based Attendance Application (AINA) has been developed, which allows contact less personnel verification using facial features of the person. Existing CCTV cameras can be utilized for capturing facial images. Thousand of facial features can be stored in the computer; facial features of each employee are encoded in a small (less than 25 KB) file. The system is scalable as the time for identification and verification for each person remains constant even if number of registered personnel increases. The system is secure as it works as a standalone system and does not requires Internet. Since only the

facial features are saved in encoded form, the actual face images need not be saved, thereby ensuring privacy and security. Server for storing facial feature database is placed within organisation premises.

AINA can be deployed with minimal upgradation to the legacy attendance infrastructure with RFID (Radio Frequency Identification) readers. It has a lightweight installation process and can be installed on a normal desktop computer with a GPU-based display adapter. AINA comes with a very intuitive and user-friendly GUI.

Drone Surveillance System

An unmanned aerial vehicle has been configured by Terminal Ballistics Research Laboratory (TBRL), Chandigarh in collaboration with industry partner for surveillance of COVID-19 hotspots and containment zones to ensure strict compliance of lockdown guidelines in densely populated areas, where streets are too narrow for motorised patrolling and police personnel are susceptible to infection in case of manual patrolling.

The 2.5 ft x 2.5 ft system weighs less than 3 kg and can be remotely operated through a hand-held tablet. It can fly up to a height of 60 m and has a range of 3 km with the capability of way point navigation. It is equipped with a public announcement system and an onboard video camera for recording and broadcasting real-time video feed to the control room. The controlling software of the drone has built-in artificial intelligence tools for decision-making. The UAV automatically returns to its home location in case of any communication failure.

The system has been demonstrated to the Chandigarh Police in a containment zone. It can act as a force multiplier for law enforcement



UAV-base surveillance system

agencies fighting battle against the global pandemic.

Medidoot - Medical Trolley

DRDO along with a start up JanYu Technologies, has developed a medical trolley named Medidoot for supply of essential items like food, clothes and medicines to a COVID patient in isolated wards for reducing exposure of doctors and other health staff at the infected area. The design of the trolley was reviewed by DRDO's Advanced Systems Laboratory (ASL) to improve and improvise the trolley to comply the requirements of the containment zone.

Trolley is remotely operated by a trained person for delivering essential supplies to the designated patient in an isolated ward. It has closed enclosures to prevent cross contamination of the supplies and can only be opened remotely by the operator. There is a provision of two-way audio visual interaction between the patient and the medical team through the screen and microphone either on WiFi or standalone cellular network.

Trolley has the capability to sense obstacles and stop automatically in order to take care of operational errors and has provision to alert the patient by way of an alarm once it reaches in his/her vicinity. It has an in-built short circuit protection mechanism for the

safety of the patient. A pilot light has been provided to alert the people that the device is in operation. It also has a battery charge level indicator in the interface console.

The trolley can be easily sanitized (dry/wet) post operation without removal of any of the components. Hot swapping of the battery is possible for continuous operation of the trolley.



Medidoot

Acoustic Throat Infection Analyzer

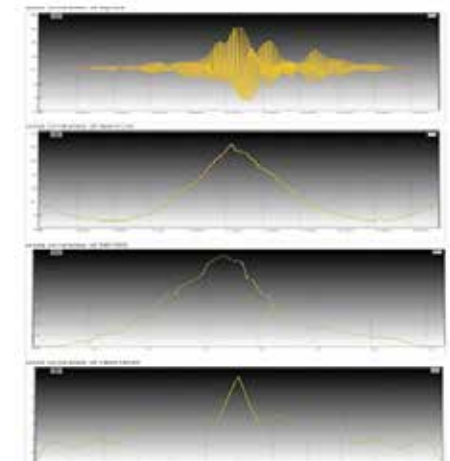
Naval Physical and Oceanographic Laboratory (NPOL) has developed an Acoustic Throat Infection Analyser (ATIA) using acoustic data processing techniques used in defence applications. The ATIA aims to detect upper respiratory tract infections by non-invasive means of acoustic scanning of word(s) spoken by a person.

COVID-19 infection develops initially in upper respiratory tract. Detection of infection may give early information even before symptoms develops and would be helpful in non-contact screening of a person entering any office/establishment.

Voice samples of a healthy person are first recorded as per SOP using a microphone connected to computer/mobile, etc., and added in a data base.

Later the same recorded data is subjected to acoustic analysis. For carrying out the analysis, signal processing techniques such as Spectrum Analysis, Tonal Analysis, Modulation and Phase Analysis, Mel Frequency Cepstral Coefficients (MFCC) Analysis are carried out to generate results for a person.

At any point of time, live voice samples of a person can be compared with data base and distortion in voice due to throat infection can be easily noticed. The technique has potential for overall management of the pandemic.



Acoustic Throat Infection Analyser

Crowd Temperature Monitoring System

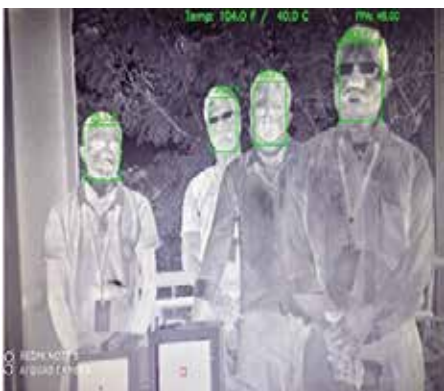
A crowd temperature monitoring system has been developed using



expertise in infrared imaging for missile applications. DRDO in collaboration with industry partner has innovated and developed algorithms for thermography in outdoor conditions. Advanced face detection techniques have been used over thermal images.

The system consists of a thermal camera and a desktop/laptop computer. Artificial Neural Network, trained with a very large in-house thermal database, allows face recognition directly on the running video from the IR thermal camera. A large number of people can be thermally profiled outdoors without disturbing their movements. Persons showing more than pre-set thermal threshold can be earmarked, recorded and real time inputs can be given to authorities.

The system developed by DRDO using its hardware and software



Crowd Temperature Monitoring System

resources has already been deployed at Hyderabad-based laboratories. Test results show that the system can be used in indoor environments as well as in areas where a large number of people gather/move regularly. The two camera and lens options have been worked out as: (i) 320 x 240, 17 μ, 7 mm (2-3 m) 25 mm (10-12 m typical standoff) and (ii) 640 x 480, 17 μ, 50 mm (25-30 m typical standoff).

Estimated unit cost of the system would be about 2 to 2.5 lakhs for the basic configuration (camera, computer) with about 0.5 lakh for accessories (tripod, reference).

Automated System For Decontamination of N95 Face Masks

An Automated System for Decontamination of face masks has been developed based on ultraviolet (UV-C) germicidal irradiation for killing the bacteria and virus. The system comprises two sub-systems; the Air Sterilization Unit (ASU) and the Automated Feeder for supplying face masks configured as per time required for sterilization of every mask. Very high intensity radiation is achieved inside the ASU to the tune of 69.07 J/s/cm² that ensures the high Sterility Assurance Level (SAL). Further studies are being carried out in Bio Safety Cabinet (BSC) class II-b in a contained environment.



Automated Mask Decontamination System

The prototype has been realized and US-FDA requirement of “viricidal activity of atleast 3 log reduction” has been met. The face masks treated in this system can be reused for many cycles.

Protecton™ Bio-Suit & Mask

Protecton™ is a protection technology developed initially as protective clothing for medical responders who deal with patients contaminated with radiological agents during CBRN scenario. The technology was transferred to M/s Frontier Protective Wear (P) Limited and since then it has made headway in many applications, based on state-of-the-art technologies, by integration and optimization processes.

Spread of Corona Virus necessitated the need of PPE for the frontline warriors against Corona. Protecton™ was further modified, tested and validated as Bio-Suit for prevention of risk of infectious agents like Corona Virus. The technology complies with ASTM 1671 Tested using Phi X 174 Bacteriophage), which prevents entry of biological organisms four times smaller than the size of Corona Virus, and NFPA 1999:2018 standard that allows it to use multiple times (25 cycles certified) after every work cycle in open field and isolated wards, making it useful for both health and non-health care workers.

Salient Features

- * Re-usable (as per NFPA 1999: 2018 compliance) PPEs that can be reprocessed for complete month
- * Laundry Washable (as per EN ISO 6330: 2012 6N Procedure)-25 Certified tested for Water Absorption Resistance Test [NFPA

1999-2018 modified test (section 8.13) as per standard of AATCC 42].

- * Complied with ISO 4920:1981 (liquid integrity); ASTM D 5034-09 (2013)/ D3787-07 (2011): (high tensile & burst strength); ASTM D 2582/5587 (extremely resistant to tears); ASTM E 96-00 method BW /F 1868 (part C)/para 8.42 of NFPA 1999 (comfortable for long term wear & breathable) & ASTM D 1230-10 (2016) e1 (fire resistant for open field operations)
- * Fits into the category of compliance of protective clothing for emergency medical operations as per NFPS 1999: 2018 certification

Protecton™ India 365 Mask

Protecton™ India 365 Mask, has been designed and developed for long term protection. Re-washable (100 times) mask would replace the existing three-ply disposable mask at a cost less than a rupee per day.

Benefits

- * Per day utility cost is less than 240 INR with enhanced protection level; saving utilization month cycle for 1000 Health Care Workers (w.r.t. Rs 1500 INR per PPE kit of export quality; single day use) = > 80 % (approximately minimum saving of Rs 3 crore 50 lakhs per 1000 HCWs requirement)
- * Biological waste reduction by 30 times (as well associated cost and labor)
- * Export potential with economic earning of DRDO (@ 2% royalty) = > 50 crore per supply of 50 lakh suits (containerized supply to



Protecton™ Biosuit and Mask

other countries especially SAARC, BRICS association)

At present, multiple manufacturers are developing/trying multiple fabrics with varying level of design issues not complying with breathable standards faulty seam tapes. Quality control is major challenge as only “Synthetic Blood Penetration Test” is considered as primary criterion. The supply of such high quality DRDO PPE to healthcare workers—uniform protection for all (no discrepancies between various workers at reception or isolated wards)—will boost their

confidence and reduce probability of occurrence of infection.

Protection™ Disinfection/ Decontamination (pair of Suits with India 365 Mask) for Sanitation Workers and Protecton™ Disaster Management (for urban flooding to Dirty Bomb attacks/Covid-19) are also available. Protecton™ CBRN Combat+ (lightweight strategic force suits for surgical strikes, NSG and ATFs of various states) are being in process of integration and optimization.



COMBAT AGAINST COVID-19: TESTING FACILITY ESTABLISHED AT DRDO LABS

Molecular Investigation Facility Established at DIPAS

A new facility for detection of severe acute respiratory Syndrome Corona Virus 2 (SARS-CoV-2), commonly known as COVID-19 has been established at Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi. This facility was inaugurated by Dr G Satheesh Reddy, Secretary DDR&D and Chairman, DRDO on 29 May 2020 in the presence of Dr AK Singh, DS, Director General (Life Sciences) and Dr Bhuvnesh Kumar, OS, Director, DIPAS. This is an enhanced Biosafety Level (BSL)-2 containment facility for detection and research with viral vectors, arboviruses, and other emerging infectious diseases. The facility contains separate sample collection area, personal protective equipment donning room, virus inactivation room maintained at negative pressure containing biosafety cabinet (Type B2) and virus burnout unit, RNA isolation room, Pre-PCR room, PCR and reporting room, doffing area and bio-waste management area as per ICMR guidelines. The facility is equipped with QuantStudio 5 Real-Time PCR System (ThermoFisher, USA) and CFX96 real-time PCR detection system (Bio-Rad Laboratories) and compatible with all the available approved COVID-19 RT-PCR detection kits.

Dr Himanta Biswa Sarma Inaugurates DRL Centre for COVID Testing

Dr Himanta Biswa Sarma, Hon'ble Minister, Health and Family Welfare, Govt of Assam, inaugurated a well-



Inauguration of Molecular Investigation Facility at DIPAS

equipped DRL Centre for COVID Testing (DCCT) with Biosafety Level 2 (BSL-2) and other essential infrastructure, as per ICMR and WHO guidelines on 29 May 2020. Shri Pijush Hazarika, Minister of State, Health & Family Welfare, Govt of Assam, Shri Pallab Lochan Das, Member of Parliament, Lok Sabha, MLAs from local constituencies, and senior

officials from local administration and Health Department were also present on the occasion. Dr Sanjai K Dwivedi, Director, DRL, Dr Vanlalhmua, Sc 'E' and Dr SN Datta, Sc 'D' briefed the dignitaries about the facility.

The testing centre has started full-fledged testing of COVID from 8 June 2020.



Dr SK Dwivedi, Director, DRL (left), briefing Dr Himanta Biswa Sarma about the facility

DIBER DEMONSTRATES COMBINED HEAT & POWER PRODUCTION FROM WASTE PINE NEEDLES

Pine needles are a problematic biomass in Uttarakhand Hills. As per the Uttarakhand Renewable Energy Developmental Agency (UREDA), nearly 20.58 lakh ton of dry pine needles are produced in Uttarakhand forests. Dried pine needles on the forest bed eventually become a reason of forest fires with 1000-3000 incidences every year. As per Forest Department of Uttarakhand, the state has lost 44,519 hectare of forests due to fire since 2000.

As a part of the R&D project “BEST”, Defence Institute of Bio-Energy Research (DIBER), Haldwani has developed gasification technology for converting waste biomass to energy using dried pine needles as the feedstock. Pine needles have high Calorific Value (CV: 19.6 MJ/kg), and are excellent source of energy. Gasification of pine needles pose enormous challenge because of their low volumetric energy density (<100 kg/m³) and high Lignin content (up to 40 per cent), as compared to wood chips (CV of 16 MJ/kg, volumetric energy density 250 kg/m³ and Lignin content 25 per cent), which are easily amenable to gasification. DIBER has developed a process and designed a gasifier for gasification of pine needles for co-generation of heat and power (combine heat and power, CHP), as a first initiative in Uttarakhand state. CHP refers to the concurrent production of electricity and/or mechanical power and useful thermal energy (heating and/or cooling) from a single source of energy. Typically,



DG Life Sciences, DRDO Dr AK Singh being demonstrated generation of electricity (above) and heat from dry pine needles

CHPs are utilized in distributed modes of power generation. The present technology is quickly deployable, cost-effective and can be used in isolated and remote areas.

A prototype of pine needles-based CHP with biomass consumption

capacity of 10 kg/hr has been installed at DIBER Haldwani. There are vast possibilities of its potential applications in army units in Uttarakhand, besides being useful for small household or cottage industry in the state.



TEJAS FOC AIRCRAFT HANDED OVER TO THE IAF



Air Chief Marshal RKS Bhadauria handing over ceremonial key of FOC Mk-1 to Group Captain Manish Tolani, CO, 18 Squadron

The Indian Air Force (IAF) inducted Tejas Mk-1 FOC aircraft on 27 May 2020 into the recently resurrected No 18 Sqn, the “Flying Bullets” at Air Force Station Sulur, marking yet another important step towards enhancing the operational capability of the Air Force. The Squadron is the first in the IAF to induct this platform. This is also an important milestone in the country’s indigenous fighter aircraft programme and a significant boost to the ‘Make In India’ initiative. Tejas Mk-1 FOC is a single engine, lightweight, highly agile, all weather multi-role fighter aircraft capable of air-to-air refueling thus making it a truly versatile platform.

The Squadron was operationalised by Chief of the Air Staff (CAS) Air Chief Marshal RKS Bhadauria, PVSM AVSM VM ADC who also flew a sortie in the Tejas Mk-I. Air Officer Commanding in Chief of the

Southern Air Command, Air Marshal Amit Tiwari, and the Commodore Commandant of 18 Sqn, Air Marshal TD Joseph, Mr R Madhavan, CMD, HAL, Dr Girish S Deodhare, PGD (CA) and Director, Aeronautical Development Agency were also present during the ceremony. While addressing the personnel at AF Station Sulur, the CAS congratulated them and lauded the efforts put in by Southern Air Command and AF Station Sulur towards the induction of the new airborne platform. He complimented Chairman HAL, ADA, DRDO labs, DPSUs, MSMEs and all agencies involved in the production of LCA for achievement of this historic milestone.

The occasion was marked by the presentation of aircraft documents of the Tejas FOC version by the HAL, CMD, to the CAS. The CAS further handed these over to the Commanding Officer of 18 Squadron

Group Captain Manish Tolani, along with the ceremonial keys to the unit. The event commenced with a fly past comprising of a helicopter formation of the Mi 17 V5 and the ALH, An-32 transport aircraft and Tejas Mk-1 fighters.

No 18 Sqn was raised at Ambala on 15 April 1965 with the Folland Gnat Aircraft. Flying Officer Nirmal Jit Singh Sekhon, the only Param Vir Chakra recipient of the Indian Air Force was a part of the Squadron during the 1971 Indo-Pak War. The Squadron also has the unique distinction of having operated two HAL made aircraft, the Tejas and the Ajeet which it also operated from the same station. The Squadron was number plated in April 2016. The Squadron falls under the operational control of Southern Air Command which is responsible for integrating the Squadron into the IAF Concept of Operations.

DRDO CELEBRATES INTERNATIONAL DAY OF YOGA

The International Day of Yoga is celebrated annually on 21 June following its inception in the United Nations General Assembly in 2014. Yoga is a physical, mental and spiritual practice, which originated in India. The idea of an International Day of Yoga was first proposed by the Prime Minister Narendra Modi, during his speech at the United Nations General Assembly (UNGA), on 27 September 2014. Following the adoption of the UN resolution, the first International Day of Yoga was observed around the world on 21 June 2015. DRDO also celebrated International Day of Yoga by organising a Web Sanghosti “COVID-19 Prabhandan may Yoga ki Bhumika.” Acharya Balkrishna of Patanjali Ayurved was the Guest Speaker on the occasion. Dr G Satheesh Reddy, Secretary Department of Defence R&D and Chairman DRDO presided over the Sanghosti. Dr AK Singh, DG Life Sciences, DRDO, Dr Bhuvanesh Kumar, Director, Defence Institute of Physiology and Allied Sciences (DIPAS) and Dr Alka Suri, Director, Defence Scientific Information and Documentation Centre (DESIDOC) were also present on the occasion.

In his welcome address, Dr AK Singh briefed about the significance of the IDY. Speaking about the theme of the Sanghosti, Dr Singh said that there is no medicine to cure COVID-19 but as prevention is better than cure, yoga can play an important role in fighting the viral.

In his address, Dr Satheesh Reddy said, around 5000 years ago our great rishis identified the techniques to hone the mind and the body. Yoga is a big gift India has given to humankind. DIPAS, one of the life



Dr G Satheesh Reddy sharing his thoughts in Web Sanghosti on the occasion of IDY

sciences laboratory of DRDO, has also formulated special yoga packages to optimise our soldiers’ performance under different climatic extremes. Adding further Dr Reddy said, in last few months we have seen pandemic effecting a large number of people psychologically and physiologically and I think yoga can help a lot in increasing the resistance of the people in fight against the pandemic.

Speaking on the occasion Acharya Balkrishna congratulated everybody on International Yoga Day and said that our sages had suggested prevention as the first and foremost cure from any disease. And the practise of yoga and ayurveda can act as deterrent against any disease. In context of COVID-19, Acharya Balkrishna said persons with better immunity have been able to cope the pandemic better, and practicing yoga daily would be beneficial in increasing the immunity.

The Sanghosti was organised jointly by DIPAS and DESIDOC.

NPOL, KOCHI

Naval Physical and Oceanographic

Laboratory (NPOL), organised the event according to the United Nations theme for this year’s IDY “Yoga for Health-Yoga at Home” to maintain social distancing. The lab displayed posters prominently for encouraging employees to practice yoga at their home along with the entire family. Yoga classes were restarted by NPOL Women’s Welfare Association with all precautionary measures against corona.



BHARAT RATNA DR BR AMBEDKAR'S JAYANTI

Defence Metallurgical Research Laboratory (DMRL), Hyderabad organized 129th Birth Anniversary of Bharat Ratna Dr BR Ambedkar on 29 April 2020. Dr G Madhusudhan Reddy, Director, DMRL was the the Chief Guest on the occasion. Dr G Appa Rao, Sc 'G' highlighted the contributions of Dr Ambedkar with special emphasis on constitutional provisions made by Dr Ambedkar to bring social justice and economic/political empowerment to the Indian society.

Dr G Madhusudhan Reddy, in his address brought out various aspects of Dr Ambedkar's life including his academic achievements despite several hardships. He also elaborated the eminent leadership qualities and political career of Dr Ambedkar. He brought out his contributions in



drafting Indian Constitution referred time and again to lead the nation and maintain the equal rights of every citizen. Dr G Jagan Reddy, Sc 'G' and Chairman Works Committee,

Shri K Srikanth Goud, President, DEFMETLAB Employees Union & JCM-III Member, Shri Vishnu Kumar, Shri Raju also spoke about Dr Ambedkar and his contributions.

INTERNATIONAL WOMEN'S DAY

The International Women's Day-2020 was celebrated by DMRL on 13 March 2020 at Tamhankar Auditorium with great enthusiasm. Ms Anjali Kumari, Sc 'C' and Convenor, DMRL Women's Cell, presented annual report on the activities of Women's Cell during 2019. She elaborated the achievements of women employees of DMRL.

Dr G Madhusudhan Reddy, Director, DMRL appreciated all the women employees for their efforts made in the field of material science and encouraged them for their future endeavours. Chief Guest for the programme Prof. K Laxmi, Ex Principal, University College of Arts & Social Sciences, Osmania University,



gave an informative speech on "Innovate for Change: Empowering Women in Different Dimensions." She emphasized on the importance of

women safety at work place in building vibrant and successful women who can take the country forward.

NATIONAL TECHNOLOGY DAY

National Technology Day (NTD) is celebrated on 11 May every year to commemorate India's successful nuclear tests at Pokhran in 1998. Centre for Artificial Intelligence and Robotics (CAIR), Bengaluru, celebrated the day by organising scientific events. Shri Siddhartha Banerjee, Sc 'F', delivered NTD oration on "Enterprise Artificial Intelligence System Development for Defence." He was presented NTD Medal and Certificate by Dr Upendra Kumar Singh, Director, CAIR.



NATIONAL SCIENCE DAY

National Science Day (NSD) was celebrated at Advanced Numerical Research & Analysis Group (ANURAG), Hyderabad on 28 February 2020. The program began with Science Day address by Dr Manuj Sharma, Officiating Director, ANURAG. Smt J Nalini Vidyulatha, Sc 'E' presented NSD Oration on "Microwave Photonics Using Silicon Photonic Technology." Smt Nalini was presented the National Science Day Medal and Certificate.



SOCIETAL ACTIVITY

DRDO Mahila Kalyan Manch (MKM) proffered help to the needy persons in the wake of COVID-19 pandemic. Smt A Padmavathi, President MKM, distributed food packets daily to the indigent for more than a month.

Naval Science and Technological Laboratory (NSTL), Visakhapatnam also distributed food to the poor and needy people at various places in Visakhapatnam.

Smt A Padmavathi, President MKM, helping the needy persons.





DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 4: MARCHING FORWARD

The article is 52nd 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).

NAVAL SYSTEMS LABORATORIES

Three laboratories in the DRDO namely, Naval Materials Research Laboratory (NMRL) at Ambarnath (earlier at Mumbai), the Naval Physical and Oceanographic Laboratory (NPOL) at Kochi, and the Naval Science and Technological Laboratory (NSTL) at Vishakapatnam, work exclusively on science and technology solutions for the problems encountered by the Indian Navy. The Indian Navy is amongst one of the most conscious users of the sea who fully recognise and understand the difficulties and problems associated with this environment and has therefore been working very closely with the three laboratories. NMRL (as Naval Chemical & Laboratory) antedate DRDO whereas NSTL came into existence in 1969.

Naval Materials Research Laboratory

The main objectives of NMRL are providing protective measures against marine corrosion and bio-fouling growth, conducting investigations related to pollution of both marine and atmospheric environments, developing marine materials with reference to piezoelectric transducer (PZT) materials, acoustic polymers and welding technology of exotic metals like titanium and rendering

scientific support and consultancy to the Naval fleet.

Right from the early 1950s, it was recognised that the twin problems, namely, marine corrosion and marine bio-fouling were very severe in Indian tropical waters and that the protective coatings which were imported from abroad were not fully meeting Navy's requirements. The development of anti-corrosive, anti-fouling coatings, therefore, received top priority, and by mid 1960s, the laboratory had successfully developed paints based on oleo resins. These were immediately introduced in service by the Navy in 1966. These coatings offered, corrosion-and fouling-free life of 9 months, which was better than the performance of those imported from abroad. The know-how was transferred to the industry and the maintenance of seagoing vessels was considerably eased.

Antifouling paints based on organic toxins instead of conventional cuprous oxide and anti-corrosion paints containing magnesium were also developed. These contributions led to the Navy designating the NMRL as the agency for formulating national specifications for paints to be used by the Navy. It greatly helped the industry in meeting the requirements of the Navy. Another significant contribution was the development of a cathodic protection system based on aluminium alloy anodes for protecting

the hulls of naval ships from corrosion. In the field of services to the Navy, the Laboratory carried out assessment on the serviceability of paints, quality assurance of paint samples and supply of marine paints developed by it, till the formal production base was established.

Marine Corrosion and Bio-fouling – In the early 1970s, with the expansion of the fleet and with the limitations of the dry-docking and shore facilities which remained almost unchanged, the Laboratory recognised the need for developing coatings that would offer longer protective life. The second generation effort in this direction led to the development of coatings based on synthetic (vinyl) resins. These coatings helped to enhance the inter-docking period from 9 months to 18 months to the great advantage of the users. NMRL also successfully developed the next generation marine anti-fouling ship-hull paint based on tributyl tin methacrylate copolymers which made it possible to extend the fouling-free life to three years and thus reduce frequent dry-dockings. These paints were self-polishing, have low toxicity and are compatible with other paints. The Laboratory transferred the know-how to industry so that commercial production and supply to Navy would be possible.

To provide better and longer protection against corrosion and fouling, the Laboratory carried out



investigations and developed paints based on chlorinated rubber resin and coal tar. These were found to have good adhesion over chipped and wire-brushed surfaces and after evaluation, were accepted by the Navy for introduction into service.

NMRL also developed a solventless epoxy two-pack trowelling compound for application to wet steel substrates against corrosion. For example, the steel sheet pilings, which extend from below the mudline of harbour to above the intertidal zone, exhibited greatest corrosion in the splash zone and maintenance by means of in-situ application of protective coatings was not satisfactory due to intermittent splash and wetting by the tidal movements. NMRL's coating has been found to withstand most rigorous conditions of splash at the pilings, where the assessed corrosion was as high as 25 mils per year. The most important characteristic of the NMRL coating was its firm adhesion on wet surfaces due to the curing agent developed at the Laboratory. Other characteristics included, fast drying (4 hr drying time), higher dry film thickness per single coat (about 10 to 12 mils per average), corrosion resistance to alkaline and acidic solutions, resistance to diesel, fuel oil and common organic solvents, resistance to sea water splash, good flexibility, impact resistance and scratch resistance.

During the two decades, NCML developed a variety of coatings based on indigenous raw materials. Some of the paints were ship primers, anti-condensation paints, anti-skid paints, mica-based fire-retardant paints and chemical-milling primers used in aviation industry. All these coatings

were widely used, not only by the Indian Navy but also by the shipping and aviation industries in the public sector.

For the protection of submerged surfaces of seagoing vessels coated with anti-corrosive paints, the Laboratory developed the cathodic protection system using galvanic systems and the impressed current systems. The structure to be protected would act as a cathode and the material used for protecting the surface would undergo dissolution by galvanic action. Generally, commercial magnesium, zinc, or aluminium in alloy form would constitute the anode. The cathodic protection of NMRL was based on aluminium alloy anodes from indigenously available high purity aluminium. The advantage of aluminium over other metals arose out of its high energy capability, long life, lightweight and low cost. The cathodic method using aluminium anodes provided protection to the underwater hull and sea water systems of patrol boats and other vessels from marine attack and increased their active life by preventing corrosion. In general, a galvanic anode would be economical when used in conjunction with paints, since a painted surface by itself would not afford complete protection. The impressed current cathodic protection (ICCP) system was a sophisticated technique and as developed by NMRL consisted of inert anodes, reference electrodes, dielectric shield, and automatic control system. It would provide optimal protection against corrosion even under deteriorated paint conditions. Underwater hulls, inlet systems and sea water systems of missile boats, submarine and the supply ship would be protected better

by the ICCP systems. The ICCP system found wide use in the vessels of the Indian Navy, including the Leander frigates constructed at Mazagaon Docks, Bombay. Efforts were launched to get the industry to fabricate the ICCP system and to install it on the vessels. Interest was also shown by a foreign Navy in getting the ICCP fitted to its fleet.

The variety of paints and ICCP system for protection of ships' hulls and other underwater structures successfully developed by the laboratory resulted in operational benefits to the Navy. The spin off from these technologies were also utilised by Oil and Natural Gas Commission, Shipping Corporation of India and the Coast Guard.

Use of Chlorine as an Anti-foulant – In some marine applications such as coolant water intakes of thermal or nuclear power stations, where the use of marine coatings to prevent the growth of marine fouling organisms was not possible, the Laboratory found the use of chlorine as more appropriate. Whereas, chlorine is effective as an anti-foulant, it may, when released in large quantities in the marine environment, could adversely affect the life of economic value in the marine biota. The introduction of chlorine in the sea, therefore, needed to be executed very judiciously. Based on experiments, NMRL generated a good deal of information on the chlorination in the marine environment, particularly with relevance to the life of economic value.

To be continued...

DRDO NEWSLETTER



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PERSONNEL NEWS

APPOINTMENT



Shri P Radhakrishna, Scientist 'H' has assumed the charge of Director, Electronics & Radar Development Establishment (LRDE),

Bengaluru, w.e.f. 1 April 2020.

He received his B.E in Electronics & Communications Engineering from Andhra University and obtained his M.Tech in E&ECE (Computer Engineering) from IIT, Kharagpur. He joined LRDE in 1988 as Sc 'B'. He started his career in the field of Radar Signal Processing and over a period of time graduated himself into Radar Systems.

He played a major role and made significant contributions in the design and development of Signal Processor

for Rajendra Radar. As Team Leader, he has been the driving force in establishing a family of 3-D Medium Range Surveillance Radars with DSP-based Parallel and Programmable Signal Processor and Digital Receiver Technologies.

He functioned as Group Head of Radar Signal Processing Group providing signal processing solutions for various radar systems. He played a nodal role in the Radar Signal Processing, Processor Technologies and Radar Systems Engineering activities in the organization.

He contributed for various Radar Development Projects including Rajendra Multifunction Phased Array Radar of Akash Weapon System, Weapon Locating Radar, a family of 3-D Surveillance Radars namely 3-D Central Acquisition Radar for Akash Weapon System, Rohini for

Indian Air Force, Revathi for Indian Navy, 3-D Tactical Control Radar for Indian Army, all of them have been productionised and deployed.

He headed the Airborne Radars Division responsible for development of Primary Radar for AEW&C, Synthetic Aperture Radar (SAR) for UAV and Active Electronically Scanned Array (AESA) Radar for LCA.

He has been Associate Director (Systems) with additional charge as Associate Director (HR) prior to assuming charge as Director, LRDE. He is recipient of various awards including IETE-IRSI Award and DRDO Scientist of the Year Award. His areas of interest include Radar Signal Processing & Processor Architectures, Radar Systems Engineering, Active Phased Array Technologies, Multistatic Radar Technologies and Very Long Range Radar Technologies.

AWARDS

National Award for Women Development through Application of S&T

Dr Shweta Rawat, Sc 'E', Defence Institute of Physiology and Allied Sciences (DIPAS), was

awarded "National Award for Women Development through Application of S&T-2019" for Individual Category for young woman showing excellence through application of technology on National Science Day celebrated at Vigyan Bhawan. Hon'ble President Ram Nath Kovind presented the

award. Dr Harsh Vardhan, Minister of Science & Technology, Health and Family Welfare and Earth Sciences also graced the occasion.

Best Oral Presentation Award



Dr U Ravi Kiran, Sc 'E', DMRL has been awarded the "Best Oral Presentation Award" for his paper titled 'Investigation

on the Microstructure and Mechanical Properties of W-Cu Composite prepared by Sintering and Infiltration' presented at the International Conference on Multifunctional Materials (ICCM) held at Hyderabad.

