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39th Year of Publication

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RM CALLS FOR INCREASED SYNERGY BETWEEN DRDO AND INDUSTRY TO ACHIEVE SELF-RELIANCE

DRDO organised DRDO-Industry Synergy Summit 2019 in Hyderabad on 22 November 2019. Hon'ble Raksha Mantri (RM) Shri Rajnath Singh, in a video message welcomed the synergy being created for boosting the indigenous development of defence systems and technologies. "DRDO is taking crucial steps for attaining self-sufficiency in the area of defence systems development" said Hon'ble RM. Under the Defence Production Policy, the Ministry of Defence has set the target of \$26 billion for aerospace, defence services and goods by 2025. In this, approximately \$10 billion is targeted for creating job opportunities for 20-30 lakh people, said RM.

Highlighting the various initiatives of Government to encourage innovation and self-sufficiency in the defence sector, Shri Rajnath Singh stressed on the need for excellence in the field of

defence innovation and their adoption. He said, Defence Public Sector Units, industry, research institutes and services need to work in tandem to achieve the target of incorporating at least 25 artificial intelligence-based products into defence in near future.

RM appreciated that DRDO has nurtured more than 1,800 industries which are actively working together to produce defence systems. He asked the DRDO and industry to explore new ways for enhancing synergy to achieve the goal of self-sufficiency.

In his address, Secretary, Department of Defence, Research & Development and Chairman DRDO Dr G Satheesh Reddy elaborated about among others the latest policies of DRDO like Zero Royalty for Development-cum-Production Partners and free usage of DRDO patents by domestic industry. Expressing confidence in defence industry, he said, healthy

scenario is to be fostered for closer interactions between Industry and DRDO to overcome the gaps. The DRDO Chairman also highlighted that of late industry base has greatly widened from mere manufacturing to development and designing of components and sub-systems. He said, the Indian industry has matured from 'Build from Print' to 'Build from Specifications'.

A panel discussion chaired by Chairman DRDO was also held. Many concerns were raised and suggestions were given by the industry participants. Industry representatives also spoke about the challenges faced by start-ups and MSMEs. It was communicated that constructive suggestions will be duly taken into account in the upcoming policies for improvement of the functioning of the system.

Senior officials of DRDO and around 300 industry representatives were present on the occasion.





CNS REVIEWS AIP PROGRAMME

Air Independent Propulsion (AIP) has a force multiplier effect on lethality of a diesel electric submarine as it enhances the submerged endurance of the boat, several folds. Fuel cell-based AIP has merits in performance compared to other technologies. DRDO programme to build a fuel cell-based AIP system for Indian Naval submarines has crossed several milestones in technology maturity.

Operation of the land-based AIP prototype engineered to form-and-fit on a submarine was witnessed by Chief of the Naval Staff Admiral Karambir Singh in the presence of Secretary, DDR&D and Chairman DRDO Dr G Satheesh Reddy at the Naval Materials Research Laboratory (NMRL), Ambarnath.

Admiral Karambir Singh appreciated the breakthroughs achieved in the programme and said that the AIP is of great value to the nation and Indian Navy in particular. He urged DRDO and Indian Navy to continue the partnership



to meet the timeline set for short and long-term goals.

Chairman DRDO assured to meet the performance standards and timeline

of the programme so that induction of DRDO AIP into operational submarines could be achieved as per the Indian Navy schedule.

LATOT

DIPAS SIGNS LATOT FOR ERGONOMICALLY DESIGNED BACKPACK 70 LT

Defence Institute of Physiology and Allied Sciences (DIPAS), Delhi, signed Licence Agreement for Transfer of Technology (LAToT) of Ergonomically Designed Backpack 70 lt to Indian industries. Dr Bhuvnesh Kumar, Director DIPAS, handed over the LAToT documents to representatives of the firms in the presence of inventors Dr Madhusudan Pal, Sc 'F', Dr Deepti Majumdar, Sc 'E' and Shri Tirthankar Chatterjee, Sc 'D'. The backpack can be used for multipurpose activities in various terrains specifically at



High Altitude. It can accommodate around 25-30 kg as compact mode (single unit) and has many additional

features like detachable haversack, integrated hydration pack, rifle carrying facility for better balance and stability

and integrated hydration pack for rehydrating the individuals.

DFRL SIGNS LATOT WITH 15 INDUSTRIES

Defence Food Research Laboratory (DFRL), Mysuru in coordination with Directorate of Industry Interface & Technology Management (DIITM), DRDO HQ and Vibrant Goa Foundation organised DRDO's Food Technologies Expo at Vibrant Goa Global Expo and Summit 2019 held during 17-19 October 2019 at Dr Shyama Prasad Mukherjee Indoor Stadium Goa University, Taleigao, Goa. DFRL showcased 142 technologies like MRE ration technology, survival ration, emergency flying ration, ready-to-eat foods, ready-to-eat bars and biscuits and detection kits under categories A and B to create awareness and commercialisation of food technologies and to generate employment opportunities in rural and urban India.

DFRL signed Licence Agreement on Technology Transfer (LAToT) with prominent food industries and start-up



enterprises for transfer of Meals Ready-to-Eat Ration (MRE) technology, Sea Dye Marker and instant food products.

Government's keenness to promote new business avenues in order to boost the economy on sustainable mode.

Hon'ble Chief Minister of Goa Shri Pramod Sawant expressed State

DRL SIGNS MOU WITH TEJPUR UNIVERSITY

In spirit of symbiotic enrichment of scientific research and mutual benefits, collaboration between Defence Research Laboratory (DRL) and Tezpur University (TU), a Memorandum of Understanding (MoU) was signed by Dr SK Dwivedi, Director, DRL and Prof. VK Jain, Vice Chancellor, (TU).

The MoU has a number of provisions for both the institutes including recognition of DRL Scientists as PhD supervisor, undertaking joint projects of mutual interest, sharing of scientific equipment, library facility and opportunities for DRL scholars for enrolling in PhD programme, etc.



DRDO ORGANISES WORKSHOP TO INCREASE SYNERGY WITH ACADEMIA IN DEFENCE R&D



DRDO organised a workshop on 'DRDO-Academia Interaction for Achieving Leadership in Future Technologies' on 13 November 2019. The workshop was aimed to leverage the academic expertise available in the country and increase the synergy with academia. Various ideas were discussed to explore new horizons of collaboration so that research directly contributes to defence products and applications. The avenues where the researchers and technology experts in the country can be engaged strategically for contribution to the design and development of advanced defence products were also discussed.

Defence Research and Development has huge potential to absorb innovation not only from R&D organisations but from any corner of the country. DRDO has established eight Centers of Technology in various universities to undertake targeted advanced research for conceiving and realizing futuristic defence applications. Eminent

academicians present in the workshop brought forward many ideas to forge the interactions between DRDO and academic institutions.

Speaking on the occasion, Secretary Department of Defence R&D and Chairman DRDO Dr G Satheesh Reddy called for directed research in specialised defence areas like Advanced Propulsion, Terahertz Technologies, Advanced Robotics, Cyber Technologies, Quantum Technologies, Smart Materials, etc., for future preparedness. He talked about various existing mechanisms for engagement between DRDO and Academia like CARS Projects, Extramural Research Projects, Technology Development Fund, Directed Research Project and Kalam Innovation Award, etc. DRDO is ready to bring out more models of engagement for enabling academia participation in mainstream Defence R&D added Dr Reddy and proposed that models of engagement need to be worked out with accountability from

both sides for increased technological output and its utilisation into defence products.

In his address, Secretary (Higher Education), Ministry of Human Resource & Development Shri R Subramanyam stressed the need for an ecosystem and effective synergy between all stakeholders for accelerated development of critical technologies. He proposed a joint task force to evolve a way ahead.

Additional Secretary at MHRD Shri Rajesh Sarwal; Directors of IIT Delhi, Jodhpur, Varanasi, Palakkad, Guwahati; Directors of NIT Jaipur, Bhopal, Calicut, Delhi and Kurukshetra; Vice-Chancellors of University of Hyderabad, Jadhavpur University, Mizoram University, Bharthiar University attended the function. DG (RM & SAM), DG (TM), DG (HR), DG (LS), DG (MED & CoS) from DRDO and representatives of heads of other eminent academic institutes were also present during the deliberations.

DRL CELEBRATES DR APJ ABDUL KALAM BIRTH ANNIVERSARY

Defence Research Laboratory (DRL), Tezpur, celebrated 88th Birth Anniversary of Dr APJ Abdul Kalam at Udmari Lower Primary School, Tezpur. Drawing and quiz competitions were organized where students participated enthusiastically. A medical camp for all villagers was also organized. Dr SK Dwivedi, Director, DRL inaugurated the programme by paying homage to Dr. Kalam. Dr Dwivedi recalled the hardships faced by Dr Kalam during his early days and motivated the students to follow the path of Dr Kalam and excel in their lives.



VIGILANCE AWARENESS WEEK-2019

The Central Vigilance Commission observes the Vigilance Awareness Week every year during the week in which birthday of Sardar Vallabhbhai Patel (31st October) falls. The objective of the week is to sensitize the citizens of the India about the ill-effects of corruption. Theme of the week this year was "Integrity—A Way of Life." The following DRDO labs/estts also observed Vigilance Awareness Week at their respective places:

DFRL, MYSURU

Vigilance Awareness Week-2019 was observed at Defence Food Research Laboratory (DFRL), Mysuru from 28 October to 2 November 2019 as per the guidance from Directorate of Vigilance & Security (DVS), DRDO HQ. Vigilance awareness pledge was taken on 29 October 2019. Dr AD Semwal, Director, DFRL and staff took the Integrity Pledge. Dr Dharanidevi Malagatti,



IPS, SP and Principal, Police Training School, Mysuru, was the Chief Guest of the function. Dr AD Semwal presided over the function. Dr T Anand Sc 'E' Vigilance Officer, DFRL welcomed the

dignitaries and explained the theme.

In his key note address, Dr Malagatti, enlightened the audience with the ways and means to eradicate corruption in society with the help of public



participation and also highlighted how integrity will bring laurel to organization.

In his presidential address, Dr Semwal, briefed about the integrity and preventive measures to eradicate corruption in public life.

HEMRL, PUNE

To observe Vigilance Awareness Week from 28 October to 2 November 2019 in a befitting manner, HEMRL carried out a series of activities. Badges were distributed to all the employees. During the campaign against corruption, handouts/pamphlets were distributed to all the employees to promote awareness about corruption.

As the theme of this year for observing the Vigilance Awareness Week was "Integrity—A way of life", number of banners were displayed at prime locations in the laboratory to spread awareness about anti-corruption campaign.

Integrity Pledge was administered to all the officers and staff in their respective divisions with emphasis to maintain integrity and transparency all the time in all the spheres of activities irrespective of the period during Vigilance Awareness Week. In addition, by publishing circular and through HEMRL's Intranet employees were asked to take e-pledge, Number of officers have taken e-pledge and shared the certificate of Commitment through social media for promotion of honesty and integrity in all spheres of life.

On 1 November 2019, besides an address by Director HEMRL on vigilance, an invited talk by Shri Anant Shinde, former Special IG of Police (CID), Pune, was also organized to help to promote the cause. Another invited talk was delivered by Shri RR Bansode, SP, Anti-corruption Bureau, Pune. A documentary on anti-corruption was presented by him.

All officers and staff of HEMRL participated in the Vigilance Awareness campaign.



ITR, CHANDIPUR

Vigilance Awareness Week-2019 was observed in Integrated Test Range (ITR), Chandipur from 28 October 2019 to 2 November 2019. Banners promoting vigilance awareness were displayed inside and outside of the office premises.

On the inaugural day Shri PC Routray, Outstanding Scientist and Officiating Director, ITR administered the pledge on vigilance awareness to all employees of ITR. During the week, several competitions like Essay Writing, Poster Presentation and Quiz competition were conducted and

suitable prizes were distributed among the participants.

Shri PC Routray encouraged all to upkeep honesty and integrity in every sphere of life and asked all to be vigilant enough to eradicate corruption in all activities. The programme was organised by Shri PN Panda, Sc 'F', and his team.

NPOL, KOCHI

Naval Physical and Oceanographic Laboratory (NPOL) observed Vigilance Awareness Week from 28 October to 1 November 2019 to participate in the prevention and fight against corruption and to raise public awareness.



Integrity Pledge on anti-corruption was taken by the employees of the laboratory under the leadership of Shri S Vijayan Pillai, OS and Director NPOL. As an outreach activity, the pledge was also taken by family members of NPOL employees.

Posters and banners on the significance of vigilance and corruption free practices were displayed prominently outside and inside the technical campus. Flash news was given through Intranet for encouraging the employees to take e-pledge. 'VIGILATHON-2019' a mini run by a team of NPOL employees, allied units like ACDA with the active participation of Works Committee was organised on 31 October 2019 to spread the awareness of the importance of vigilance among public. On the concluding day, an invited talk was organised on "Threats faced by Defence Establishments and the Significance of Departmental Security" by Shri D Sreeraj, Deputy Central Intelligence



Officer, Thiruvananthapuram. The talk focused on general aspects of security breaches in defence establishments like physical security, data and information

security, etc., and highlighted the topic with some case studies. Dr T Mukundan, Sc 'G', Group Director, Vigilance and Security coordinated the event.

WORLD FOOD DAY CELEBRATION

Association of Food Scientists and Technologist India [AFST (I)] in association with Defence Food Research Laboratory (DFRL) and Central Food Technological Research Institute (CFTRI) organized World Food Day Prof. JV Bhat Memorial Lecture and Curtain Raiser of 27th Indian Convention of Food Scientist and Technologist (ICFOST) at DFRL, Mysuru on 23 October 2019.

Dr KSMS Raghava Rao, Director, CFTRI, delivered lecture. He briefed about the CFTRI and action needed for ensuring zero hunger through techno-innovative ways. Dr (Mrs) Neerja Hajela, Head, Science and Regulatory Affairs, Yakult Danone India Pvt Ltd, New Delhi, delivered Prof. JV Bhat Memorial lecture on "The Growing Burden of Antibiotic Resistance: Can Probiotics be One of



the Solution to Combat the Crisis?" Dr DD Wadikar, Hon'ble Secretary AFST(I) briefed about the 27th ICFOST, National Conference being held at Tezpur University, Assam during 18-20

December 2019 on the theme "Raising Agro Processing and Integrating Novel Technologies for Boosting Organic Wellness (RAINBOW-2019)."

Dr GK Sharma, Sc 'G', DFRL, spoke



about the Curtain Raiser for ICFOST and wished a grand success to the conference. He appreciated the AFST(I)

for reaching at North East to spread the knowledge on food technology. Dr Anil Dutt Semwal, Director, DFRL,

expressed delegates would benefit from the traditional knowledge showcased by the North-East research groups.

SWACHHTA ABHIYAN

On the fifth anniversary of the Swachh Bharat Mission, Swachhta Week was celebrated by Naval Materials Research Laboratory (NMRL), Ambernath from 26 September 2019 to 2 October 2019. As part of the celebration a massive cleanliness drive was undertaken at the laboratory. All employees enthusiastically participated in the cleaning programme. The employees volunteered to weed out and segregate unused material for proper disposal. To sustain the zeal of maintaining cleanliness in and around work area as well as surroundings, Director, NMRL, Dr M Patri, introduced "Swachh Trophy" to NMRL Departments who



maintain high standards of neatness and cleanliness and the same was awarded

to Marine Bio-technology Department for this year.

RAISING DAY CELEBRATIONS

ASL, HYDERABAD

Advanced Systems Laboratory (ASL), celebrated its 18th Annual Day on 13 October 2019. Dr G Satheesh Reddy, Secretary, DDR&D and Chairman, DRDO, honoured the event as the Chief Guest and Shri MSR Prasad, DG (MSS), DRDO as the Guest of Honour. Dr Avinash Chander, former Director, ASL was felicitated on this occasion.

Shri Giridhar Rao, Sc 'G', Chairman, Organizing Committee welcomed the august gathering. Shri AK Singh, Sc 'F', DOMS, presented the annual report of ASL. Dr MRM Babu, Director, ASL and Programme Director, Agni, in his address highlighted various achievements and future programmes of ASL. Shri MSR Prasad, appreciated the dedicated work done by all employees of ASL and mentioned about technologies need to be developed in coming years.



Dr G Satheesh Reddy lauded the excellent work done by the ASL and emphasized on the development of advanced new technologies.

Laboratory-level DRDO Awards and mementos were presented to employees

who completed 20, 25 & 30 years of service by the Chief Guest. Dr APJ Abdul Kalam Merit Awards and Dr APJ Abdul Kalam Welfare Awards were also given to children of ASL employees. A cultural programme was also organized.

ARDE, PUNE

It was a day full of pride and joy for Armament Research & Development Establishment (ARDE) as it celebrated its 62nd Raising Day in the eminent presence of Dr G Satheesh Reddy, Secretary DDR&D and Chairman DRDO. Shri PK Mehta, DG (ACE); Dr (Ms) Chandrika Kaushik, Director, DISB, DRDO HQ; Dr VV Parlikar, Director, R&DE(E); Shri KPS Murthy, Director, HEMRL and Maj Gen Ajay Gupta, General Manager, MSC, were also present on the occasion. The presence of Shri AM Datar, former DG (ACE) and former Director ARDE and Maj Gen D Kapil, former Director ARDE added happiness to the occasion.

Festive balloons were released by Dr G Satheesh Reddy to mark the beginning of the celebrations. In his address, Dr V Venkateswara Rao, Director, ARDE, presented a motivating overview of past achievements of ARDE and laid out the current priorities and future goals. Shri PK Mehta highlighted the important position that ARDE occupies in the DRDO pyramid. He brought out that Chairman, DRDO has a clear vision for ARDE, and is confident that the establishment would rise to the expectations in the changing defence scenario.

Dr G Satheesh Reddy energized the audience through his address. He highlighted the obligation ARDE has for design and development of small

arms, artillery and tank guns and mission critical ammunition in order to strengthen our armed forces and reduce India's reliance on defence imports.

Laboratory-level DRDO Awards and Armament Awards were given away to deserving officers and staff by the dignitaries. Commendation Certificates and mementos for completing 25 years of service were also distributed to employees. Shri VS Rokade, TO 'D' was felicitated as the longest serving employee of ARDE as well as DRDO, having put in more than 40 years of dedicated service.

Shri S Harikrishnan, Sc 'G', Chairman, Raising Day Organizing Committee presented the vote of thanks.



WORKSHOP ON SCIENTIFIC WRITING, RESEARCH PUBLICATION & IPR

Advanced Systems Laboratory (ASL), Hyderabad organized one-day workshop on “Scientific Writing, Research Publication & IPR” on 22 October 2019. Shri M Rajagopal Reddy, Sc ‘F’, Head HRDG, welcomed the participants. Dr M Rama Manohara Babu, Director, ASL inaugurated the workshop and addressed the gathering. He encouraged the scientists to write and publish research article. Shri PVG Brahmanandam, Associate Director, in his address, stressed upon importance of scientific writing and IPR.

Sixty-four participants from ASL, DRDL, and PG AD offices attended the course. Shri Sudhanshu Bhushan, Sc ‘E’, DESIDOC delivered a talk on “Scientific Writing and Research Publication.” He talked about importance of scholarly communication, facets of scientific writing, reference management tool, peer-review process, and plagiarism detection tools, etc.

Dr Avinash Kumar, Associate Director, ER&IPR, DRDO HQ, delivered



a talk on “Intellectual Property Rights.” He stressed upon protecting intellectual properties in DRDO, IPR Policy 2016, IPR activities in DRDO, capturing IPR, drafting and filing patents, etc. Shri N Venkatesh, Sc ‘G’ (Retd.), RCI, delivered

a talk on “Knowledge Management and R&D.” He focused on how to tackle the tacit and explicit knowledge for the development of an organization. Shri Hemant Kumar, Sc ‘D’, Head TIC, was the course coordinator.

WORKSHOP ON APPLICATION OF ERGONOMIC APPROACHES TO IMPROVE HEALTH & SAFETY

A one-day pre-conference workshop on “Application of Ergonomics: Approaches to Improve Health and Safety” under aegis of 8th Congress of Federation of Indian Physiological Societies (FIPS) was conducted on 26 September 2019 at Defence Institute of Physiology & Allied Sciences (DIPAS), Delhi. The workshop was attended by many senior faculties like Prof. VP Varshney, Director Prof. and HOD, Department of Physiology, MAMC, New Delhi; Prof. Mona Bedi, Director Prof., MAMC, Dr Madhulika



Monga and Dr Anita Pawar, Professors at Lady Harding Medical College, New Delhi; Dr Narendra Singh, HOD & Professor, Community Medicine, ESIC Medical College and Hospital, Faridabad; Dr Swapnatai A Meshram, HOD & Professor, ESIC Medical College & PGIMS, Chennai and others.

The proceedings of workshop commenced with a thought provoking talk by Dr Bhuvnesh Kumar, OS and

Director, DIPAS. In the interactive-cum-demonstration sessions, faculty, in their own domain of expertise, explained importance of ergonomic assessment and interventions along with human-machine compatibility in maintaining and enhancing the occupational health and safety of human operators, whether it is in industries, military or health care sectors. While demonstrating the state-of-the-art infrastructure

for extensive ergonomics research, DIPAS faculty explained why applying ergonomics approaches were important for identifying and ameliorating these causal factors, resulting in enhancement of occupational health, safety and productivity with reduction in absenteeism, accidents and musculoskeletal disorders.

COURSE ON DESIGN ASPECTS OF EMBEDDED SYSTEMS FOR MISSILE & SATELLITE APPLICATIONS

Research Centre Imarat (RCI), Hyderabad conducted a course on “Design Aspects of Embedded Systems for Missile and Satellite Applications” under the Continuing Education Programme (CEP) of DRDO. The course was inaugurated by Director RCI. The CD containing course material was also released. Mrs T Venkatamani, Course Director, briefed about the programme.

Eminent speakers from DRDO, ISRO, academia (IIIT and SRM University) and industry (Xilinx, Texas Instruments, Analog Devices, Coreel Technologies, Embedded Systems &



HiQ) delivered lectures and shared their experiences.

The course had an overwhelming response and a total of 105 participants

from various DRDO labs attended the course.

COURSE ON EMERGING TRENDS IN EXPLOSIVE, FIRE, ENVIRONMENTAL & HEALTH SAFETY

To promote the safety awareness and educate the employees about various safety measures, Terminal Ballistics Research Laboratory (TBRL), Chandigarh successfully organised a CEP on “Emerging Trends in Explosive, Fire, Environmental and Health Safety.”

The course focused on explosive and fire safety technology, safety

during blast and damage studies, and during the disposal of ammunitions, environmental safety, process safety and RHA for explosive facilities along with mechanical materials handling safety. A special lecture on accident prevention and electrical safety was given by the expert from the National Safety Council of India. Special lectures on safety audit systems in DRDO,

on 5S and housekeeping along with firefighting drill-cum-demonstration were given during the course.

The course provided employees a unique platform to interact with safety experts from various laboratories who shared their valuable experience on safety.



DRDO-KISAN-JAWAN-VIGYAN MELA

Defence Research Laboratory (DRL), Tezpur organized 2nd DRDO-Kisan-Jawan-Vigyan Mela at its R&D Centre, Salari, Arunachal Pradesh. Tsering Dorjee Rokpu, Gaon Burah, Salari, was the Chief Guest of the inaugural function and inaugurated the Mela. Various events like Kisan Sabha, competition of farm produce, exhibition, health camp, science quiz and model competition for students were organized. Around 200 participants, including farmers, state officials, armed personnel and paramilitary forces visited the mela.



ENGINEERS DAY CELEBRATION

The 52nd Engineers Day was celebrated with great enthusiasm by The Institution of Engineers (India), Ahmednagar Local Centre at Ashok Bhau Firodiya Auditorium, Ahmednagar. “Engineering for Change” was the theme of the function.

Shri Sangam Sinha, OS & Director VRDE, Ahmednagar was the Chief Guest of the function. He shared his experiences in DRDO with the engineer fraternity. Dr RS Shinde, OS & Head, Magnet Technology Division, DAE, Raja Ramanna Centre for advanced Technology, Indore was the keynote speaker. Technical paper writing competition was held and the best paper was awarded.



MONOGRAPH PUBLISHED

A monograph titled “Outlier Detection: Techniques and Applications – A Data Mining Perspective” authored by Dr NNR Ranga Suri, Sc ‘F’, Centre for Artificial Intelligence and Robotics (CAIR), Bengaluru has been published by



Springer-Nature, Switzerland. The monograph has been co-authored by Narasimha Murthy M and G Athithan. The contents of the

monograph are based on the research done by Dr Ranga Suri during his PhD degree at Indian Institute of Science (IISc), Bangalore. The reference details of the monograph are: 1868-4394 (ISSN), and 978-3-030-05125-9 (ISBN).

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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2. How would you rate the *DRDO Newsletter* as a medium to adequately present DRDO developments?

Excellent Very Good Good Fair Satisfactory

3. How would you rate the technical contents of the *Newsletter*?

Excellent Very Good Good Fair Satisfactory

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DRDO HARNESSING SCIENCE FOR PEACE & SECURITY

CHAPTER 4: MARCHING FORWARD

The article is 45th 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).

FOOD & AGRICULTURE

Defence Food Research Laboratory

The activities on ready-to-eat convenience foods and dehydrated foods were aimed at the possibility of including these in the Pack Rations for different types of requirements of the Services. Such foods would be lightweight and would have a shelf-life of one year. They would be either in a ready-to-eat form or could be quickly reconditioned in a few minutes with the addition of water and without losing the original taste. In addition, these foods would lead to reduction in bulk, economy in transportation, in storage space and in packaging material. These were also resistant to microbial attack. The ready-to-eat foods were prepared by the High Temperature Short Time Retort Drying process which was developed by the Laboratory. It was a single-step process in which cooking, forming and drying was achieved by high speed mixing, shearing and extruding under pressure to impart any shape. The resulting product would be crisp, crunchy, lightweight and ready-to-eat. DFRL developed a variety of compressed ready-to-eat food formulations, such as the vegetarian and the non-vegetarian savoury bars, cardamom-flavoured sweet bars, porridge bars, cereal bars based on banana, mango, tomato and curd-rice bars. In these formulations, cereals (rice or wheat), pulses, vegetables, fruits, skim milk, curd and processed or dehydrated meat could be added. The ready-to-eat foods were in the form of tablets of 100 g each and were suitably packed for ensuring a shelf life of more than 12 months under ambient and field

conditions. Based on the results of field trials, compressed ready-to-eat bars were recommended for introduction into service by the Armed Forces. DFRL also developed compact dehydrated foods with high caloric content in the form of conventional items of a normal meal suiting the Indian palate. For example, an instant omelette mix consisting of egg powder, dehydrated onion, green chillies, salt and oil hydro was developed. It could be reconstituted by mixing with double its weight in water, allowing five minutes for soaking and shallow frying on a greased hot plate in the normal manner. It could be conveniently packed either in flexible foil laminate or in cans (Fig 4.26). The product had a shelf-life of more than 6 months. A second example of the dehydrated food developed by the Laboratory was the fruit- flavoured milk and lassi powders. The method of preparation consisted of spray drying clarified fruit juices in admixture with milk or lassi in a spray drier. In the case of pulpy fruits such as banana, mango and guava, clarification could be obtained by using pectic enzymes and the milk was concentrated under vacuum prior to use. Alternatively, clarified fruit juices could be freeze-dried and their powders mixed with spray dried milk or lassi powder. The beverages reconstituted readily in cold water with natural aroma with a minimum shelf life of six months under ambient conditions when packed under nitrogen. Their inclusion in Service rations, therefore, greatly improved nutritional quality besides providing variety.

It goes without stating that the processes developed by the Laboratory were transferred to the industry for supply of rations to the Armed Forces.

The main objective of developing processed foods was to provide the Armed Forces with a nutritionally balanced, lightweight, ready-to-eat food with adequate calories and catering to a variety of tastes. The first step in this direction was taken by DFRL with a study on rationalisation of Army Ration Scales for Peace and Field Areas with special reference to calorie and nutritional requirements of troops at high altitude where soldiers faced extreme climatic conditions. Similarly, DFRL took up the dietary requirements of submariners in the Navy who were subjected to high stress environment. The scientists developed Pack rations based on fresh and processed foods, which were approved for introduction into the Service. In addition, DFRL came up with new scales of rations based on the processed food for use by naval personnel during operations and these have been introduced by the Navy.

Chapathi, the staple diet of a large percentage of our country men did not escape the attention of the DFRL scientists. Since the consumer put a premium on the freshness of the preparation, DFRL began the development of an automatic chapathi making machine which could produce these at a fairly rapid rate. The original design went through a few transformations before a prototype could be fabricated in collaboration with industry with capability for producing 20 ± 5 fully baked chapathis per minute. The prototype machine consisting of two units, one for dough making and kneading and the other for rolling, baking and puffing was under testing and evaluation.

DFRL also undertook troubleshooting for the Armed Forces. When the serious

problem of de-emulsification of tinned butter was posed by the Army, DFRL provided the solution of adding milk solids. It was proved by laboratory scale that the tinned butter remained good/fresh in all climates and the taste of the butter did not change. It also launched efforts to study the feasibility of incorporating milk powder by the industry during the processing stage. Similarly, the Laboratory scientists found a solution to extend the short shelf-life as well as to retain the bland taste of the refined groundnut oil by adding 25 per cent polyunsaturated fatty acid.

AGRICULTURAL RESEARCH LABORATORIES

The three agricultural laboratories comprising of the Field Research Laboratory (FRL) at Leh, the Defence Agricultural Research Laboratory (DARL) at Almora (later shifted to Haldwani) and the Defence Research Laboratory (DRL) at Tezpur were set up to solve a major problem faced by the armed forces personnel stationed in inhospitable terrains, such as high altitudes where fresh, varied, tasty as well as nutritious food was unavailable. FRL and DARL focussed on assessing and enhancing the agricultural potential of high altitude Himalayan areas as well as the development of suitable agricultural practices for increasing production. DRL, Tezpur focussed on the north-eastern region. In animal husbandry, the stress was on improvement of animal breeds and to find ways and means to increase the milk/meat yields and acclimatisation to high altitude conditions. A major mission common to all the three laboratories was to liaise with civil agricultural authorities as well as with the Army units to establish model farms for demonstration, training, consultancy and to render help to local problems of environmental interest. The activities carried out by the FRL, Leh are typical of the work carried out by them.

Leh, where the Field Research Laboratory is located is one of the districts of Ladakh which is a high altitude area with altitudes varying between 2900 m to 5900 m and with temperatures

as low as -50°C . The majority of the inhabitants of Leh depended on agriculture for their livelihood but the arable irrigated land was limited and farming was possible for only 3-5 months in a year. Agriculture was primitive and traditional and was based on sustainable organic farming. The scientists of FRL made attempts to grow suitable varieties of vegetables at these high altitude areas. FRL introduced trench cultivation for raising nursery of vegetables in the early years to overcome the major handicap of a small farming season. Seedlings were raised in polythene covered trenches during April and were transplanted as soon as cropping season started. Green vegetables like coriander, mint, lettuce, celery, parsley, fenugreek and palak were grown by following polyhouse and trench cultivation. FRL introduced polyhouse type of crop cultivation in which crops were grown inside a closed enclosure made of wood with the roof covered with an ultraviolet stabilised white polythene film. The crop inside was covered overnight with a black film. This technique helped in winter cultivation of vegetables and flowers, when minimum ambient temperature sometimes went down to -33°C . FRL assisted the local farmers in adopting these techniques by liaising with local agricultural authorities, setting up model farms for demonstration, arranging training programmes, providing consultancy and rendering help in solving local problems of environmental condition. FRL succeeded in production of seeds of several vegetables to help the local farmers to get reliable seeds of specific variety suitable for the region. The FRL was also responsible for providing the much needed varieties and nutrition to the restricted local diet of barley and tea. Thanks to FRL, the economy of the region was transformed and Ladakh, instead of buying vegetables for its needs not only met its needs and that of the Army, but was also able to sell its surplus crop. It not only reduced the strain on air transport for supply of fresh vegetables, but also resulted in a saving of substantial amount annually by way of reduction of transport charges. Giant-size vegetables like 1 kg potato, 8 kg radish, 14 kg cabbage and 25 kg pumpkin

were setting records in vegetable production. FRL also developed the technology for the exploitation of high market value crops like hop and saffron. A horticultural garden of temperate fruits was established, at a height of 11,500 feet for pilot-scale studies in Ladakh. The cultivation of Choti-lerma wheat variety which was about 2-3 times more productive than that of the local Fort variety, was introduced. Work on breeding short-duration, cold-resistant varieties of vegetables, suitable for high altitude border areas, was initiated and the response to these varieties was very encouraging. Several local germplasm were collected and improved with hybridization techniques. The seedlings were cultivated by the farmers which revolutionised the cultivation of vegetables like cabbage, cauliflower, turnips, carrots, potato, onion, tomato, peas, beans and radish in the area where hitherto nothing was grown. Similarly, cultivation practices and varieties of cereal crops which were standardised, were adopted by the local farmers for general cultivation at these high altitudes.

Improved breeds of poultry birds were reared under subzero temperature conditions without use of external heat. Studies of incubation under low oxygen content at high altitudes was also undertaken to evolve a suitable technique for large-scale hatching of eggs to meet the growing needs for poultry birds in Ladakh. For higher egg production, it was found that underground system of housing was the most ideal method. Initially, three exotic breeds of broilers were inducted in the Ladakh areas. Hybrid broiler strains of chicken were cultivated and methods popularised the use of non-conventional energy sources, such as wind-powered pumps, solar photovoltaic systems for lighting and biomass gas plants among the local population. Training was imparted to a number of Service personnel in poultry farming and broiler chicks were distributed to the army units so that the units even in remote locations could have their own poultry farms. Follow up to study the performance of these broilers at different altitudes was taken.

To be continued...



DR REDDY ELECTED HONORARY FELLOW OF ROYAL AERONAUTICAL SOCIETY

Dr G Satheesh Reddy, Secretary Department of Defence Research and Development and Chairman DRDO has another feather in his cap when he was elected Honorary Fellow of Royal Aeronautical Society (RAeS). The Fellowship is one of the world’s highest distinctions in the field of aerospace and is awarded for the most exceptional contributions to the field. Founded in 1866, the Society incorporates the Institution of Aeronautical Engineers, the Helicopter Association of Great Britain and the Society of Licensed Aircraft Engineers and Technologists.



HIGHER QUALIFICATION ACQUIRED

Shri Subhash Chander, Sc ‘F’, Terminal Ballistics Research Laboratory (TBRL), Chandigarh, has



been awarded PhD by Punjab Engineering College (Deemed to be University), Chandigarh, for the

thesis entitled “Performance Analysis of Pulse detonation Engine Powered Surface to Air Missile.”

VISITS

DIHAR, LEH

Two hundred Higher Secondary students selected by Innovation in Science Pursuit for Inspired Research (INSPIRE), an innovative programme sponsored and managed by the Department of Science & Technology for attraction of talent to science, from all over Ladakh region visited Defence Institute of High Altitude Research (DIHAR) on 1 October 2019.

The students were briefed about the relevance of DIHAR in Ladakh region and the various agro-animal R&D activities being carried out by the laboratory.



MTRDC, BENGALURU

Dr G Satheesh Reddy, Secretary DDR&D and Chairman DRDO, visited Microwave Tube Research & Development Centre (MTRDC) on 1 October 2019. Dr SUM Reddy, Director, MTRDC, welcomed the Chairman and apprised him about the current status of ongoing projects at the Centre. Chairman critically reviewed the projects and stressed the need of their timely completion. Dr Reddy also visited product exhibition area where he showed keen interest in the products developed by MTRDC. He also witnessed live test demonstrations of High Power Microwaves and Microwave Power modules.



Dr Satheesh Reddy being apprised about MTRDC products

SFC, JAGDALPUR

Air Marshal NJS Dhillon, PVSM, Commander-in-Chief of the Strategic Forces Command (SFC), visited SF Complex, Jagdalpur. Shri JC Choudhary, GM SFC, briefed the distinguished visitor about the activities and achievements of the SFC. During his site visit to the processing facilities and static test facilities he interacted with the scientists and applauded the targets achieved by them. Dr MRM Babu, Director, Advanced Systems Laboratory, Hyderabad; Dr Shri Manniykayvasnam, Programme Director A1-P; Dr MVL Ramesh, DGM SFC and other scientists were present during the visit.



Air Marshal NJS Dhillon being briefed about SFC activities

TBRL, CHANDIGARH

Shri VP Singh Badnore, Hon'ble Governor of Punjab and Administrator of Chandigarh, visited Terminal Ballistics Research Laboratory (TBRL). Dr Manjit Singh, Director TBRL apprised the Governor of the initiatives taken by TBRL for the design and development of conventional warheads and electronic fuzes. Many other products and ammunition for low intensity conflicts and asymmetric warfare were also displayed.



Hon'ble Governor of Punjab being briefed about RTRS