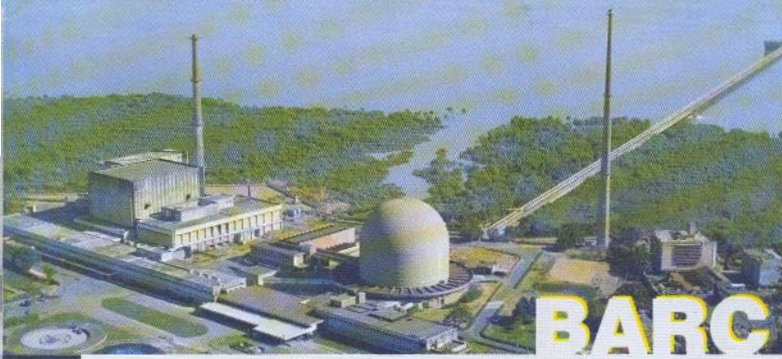


BARC
NEWSLETTER

No. 221
June
2002

INDIGENOUS DEVELOPMENT OF MINIATURE UNDERWATER RADIATION RESISTANT CCTV CAMERA FOR REMOTISED INSPECTION OF COOLANT CHANNELS OF PHWRs

R.K. Puri, A.K. Haruray, M. Padamanabhan, H.M. Bapat and Manjit Singh
Division of Remote Handling & Robotics

Introduction

Under IX-Plan project, "Development of Tools and Techniques" (Power-6), development of state-of-art technologies for in-service inspection of coolant channels of PHWRs was taken up at DRHR. Under this project, a Miniature Underwater Radiation Resistant CCTV Camera and Camera Control Unit for visual inspection of coolant channels has been developed. The camera has been designed to be compatible with BARCIS delivery system. The development has resulted in achieving self-reliance in high tech area and substantial savings in cost.

Fig. 1 shows the CCTV camera system. The system consists of Camera Head, Camera Control Unit and the Monitor. The Camera is specially designed with only minimum electronic components (Pick-up tube & pre-amplifier PCB) working in high radiation environment. All other electronic components needed for camera operation are built in the Camera Control Unit, which is located outside radiation environment. The optical and electronic components of the Camera have been specially developed and qualified for use in radiation field of 10^6 rads/hr for an integrated dose of 10^8 rads. Gamma Chamber 5000 has been used for irradiation testing of optical and electronics

Contents

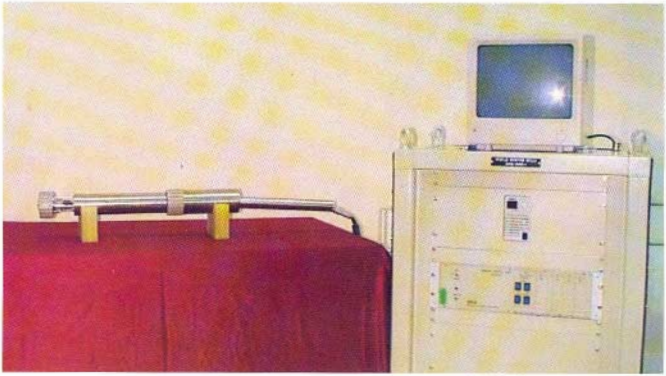


Fig. 1 Miniature Underwater Radiation Resistant CCTV Camera System

components. CG&CRI and ECIL have helped in the fabrication of optical and electronics components, respectively. The Camera System has been qualified on full-scale mock-up test facility at BARC and the system is ready for use on reactor channels.

Camera Head

Fig. 2 shows the Camera Head. The Camera Head consists of 2/3 inches Yoke Assembly, 2/3 inches Pick-up Tube, Tube Socket PCB, Pre-amplifier PCB and Macro Motor for focus, a Rotating Mirror for radial viewing, a motor for rotating the mirror, and Illumination Head at the front end of camera and water sealing arrangements and centring provisions. The Camera Head is designed to be inter-changeable with BARCIS Inspection Head. The assembly of Camera Head and BARCIS Sealing Plug is loaded into the coolant channel using the Fuelling Machine. Fig.3 shows the assembly of Camera Head and BARCIS Sealing Plug.

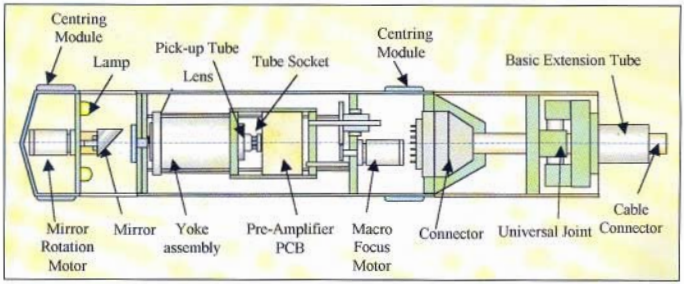


Fig.2 Camera head

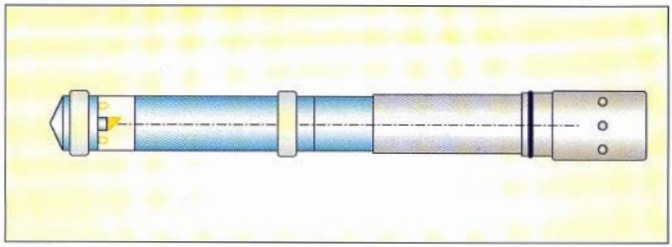


Fig.3 Camera Head with special sealing plug

Specification of Camera Head

Radiation tolerance	:	100 M rad @ 1 M rad per hour
Pickup element	:	2/3" non-browning vidicon tube
Resolution	:	Better than 600 lines at the centre
Sensitivity	:	10 lux on face plate
Illumination	:	3 Halogen bulbs rated at 6 V, 20 W
Inputs	:	10-200 nA from pick-up tube
Controls		Macro focus control
		Illumination control
		Mirror rotation control
Output	:	15 mV video signal
Environment (underwater)	:	Rated at 10 kg/sq cm; Working pressure 5 kg/sq cm
Cable	:	Radiation resistant cable length 100 metres

Parts of Camera Head

- **Yoke Assembly:** The yoke consists of the vertical and horizontal deflection coils for the scanning of the beam in the pick-up tube and a focus coil, which controls the beam current for sharp focus.
- **Pick-Up Tube:** The Pick-up Tube is the heart of the camera. This is a 2/3 inches radiation hardened pickup tube. It picks up the image signal and supplies it to the Pre-amplifier PCB.
- **Tube Socket PCB:** The Tube Socket PCB is on the rear side of the Pick-up tube. This PCB supplies the filtered voltages to the electrodes of the Pick-up tube.
- **Pre-amplifier PCB:** The Pre-amplifier PCB is situated next to the Tube Socket PCB. The signals picked up by the tube are fed to the Pre-amplifier before they are given the main video amplifier PCB. This Pre-amplifier PCB is housed in a shielded copper box to avoid stray

noise pick-ups. All the components in the PCB are radiation hardened. Fig.4 shows block diagram of Pre-amplifier.

- **Macro Motor:** The Macro Motor is used to adjust the macro focus. This is done by coupling the movement of the yoke assembly on a fixed horizontal axis using the Macro Motor. The motor moves the yoke assembly near or away from the lens depending on the positive or negative voltage supplied to the Macro Motor.
- **24-Pin Connector:** The 24-Pin connector at the rear end of the Camera Head provides all the input voltages coming from the Camera Control Unit. It also brings out the signals from Pre-amplifier Board to the Camera Control Unit. It also provides the illumination to the bulbs provided at the front end of the Camera Head. The cable connector facilitates repair/servicing of the Camera Head.
- **Illumination Head:** The Illumination Head is designed to illuminate the dark inside surface of the pressure tube.
- **Rotating Mirror:** The Rotating Mirror is provided to obtain radial view of the internal surface of the pressure tube.

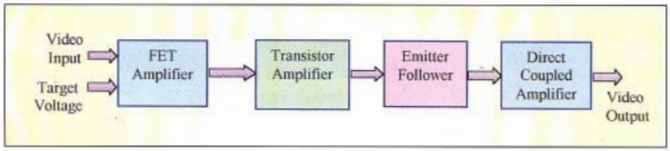


Fig. 4 Block diagram of Pre-amplifier PCB

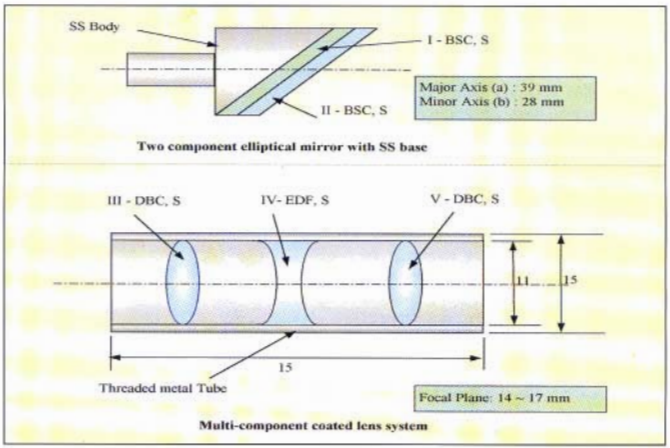


Fig. 5 Optical components of Camera

Sr. No.	Glass type	Lens dimensions in mm	%CeO_2 Doping
I	BSC, S *(Borosilicate)*	39 (a) x 28 (b) x 4	0.5
II	BSC, S *(Borosilicate)*	39 (a) x 28 (b) x 2	1.8
III	DBC, S *(Dense Barium Crown)*	ϕ 10 x 5	0.5
IV	EDF, S *(Extra Dense Flint)*	ϕ 10 x 6	0.5
V	DBC, S *(Dense Barium Crown)*	ϕ 10 x 5	0.5

- **Multicomponent Lens System:** The multi-component lens system is provided to obtain focussed image. Fig. 5 shows optical components. The Optical Components are radiation hardened.

Camera Control Unit

The Camera Control Unit consists of six PCBs, which control the various functions of the Camera Head. A separate power supply (SMPS) 0~60V, 7 amps supplies the required power for illumination. The PCBs in Camera Control Unit are listed as follows:

- Power Supply PCB
- Signal Generator PCB
- Horizontal Scanning PCB
- HV Converter PCB
- Video Amplifier PCB
- Macro Focus PCB

Specifications of Camera Control Unit :

Standards	CCIR-B
Bandwidth	> 5.5 MHz @ 3 db
Sensitivity	10 Lux
AGC	10/1
Signal to noise ratio	40 db
Power supply	230 V Ac 50 Hz
Power Consumption	50 VA
Video Output	1 V p-p with 75 Ω termination

Camera Control Unit PCBs

- **Power Supply Board:** The main function of this PCB is to convert 240V AC into stable ripple free output of ±15V DC. These voltages are supplied to all other circuit boards through the bus bars. Fig. 6 shows block diagram of Power Supply.
- **Signal Generator Board:** This board performs the functions of vertical scanning, magnetic focus current control and generation of various standard signals. Fig. 7 shows block diagram of Signal Generator.
- **Horizontal Scanning Board:** This circuit board generates the voltages that are necessary to drive the horizontal deflection coil in the Camera Head. Horizontal centring and horizontal amplitude/width adjustments are done using this circuit. Fig. 8 shows block diagram of Horizontal Scanning circuit.
- **HV Converter Board:** The main purpose of this board is to generate all the high voltages required for vidicon tube to generate tube heater voltage (-6.3V) and to generate the composite blanking signal. Protection in case of sweep failure is also provided in this circuit. Fig. 9 shows block diagram of HV Converter.
- **Video Amplifier Board:** The video signal coming from the pre-amplifier output is applied to an automatic gain control stage through

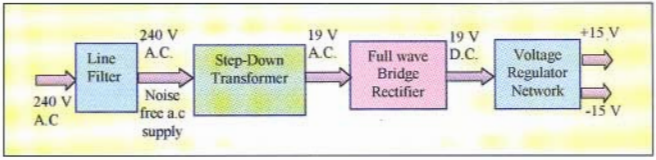


Fig. 6 Block diagram of Power Supply PCB

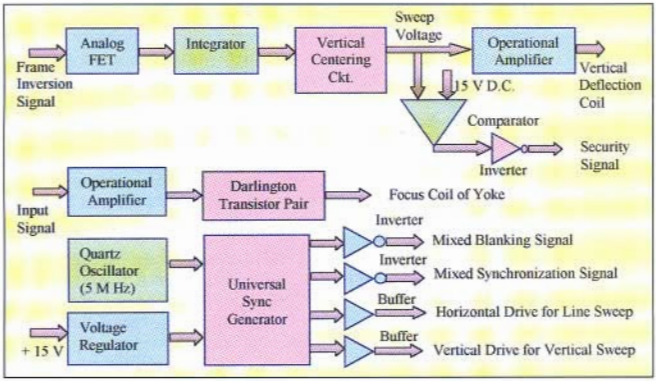


Fig.7 Block diagram of Signal Generator PCB

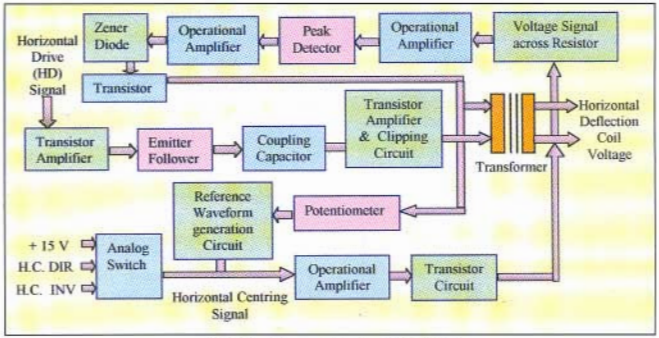


Fig. 8 Block diagram of Horizontal Scanning PCB

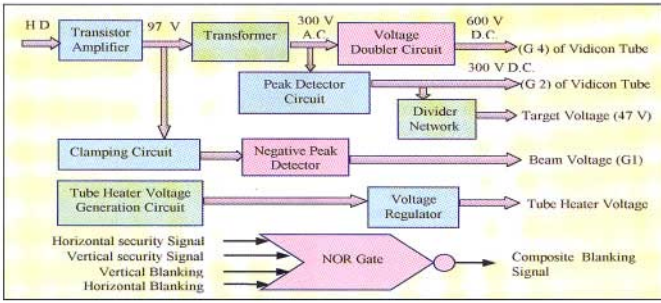


Fig.9 Block diagram of HV Converter PCB

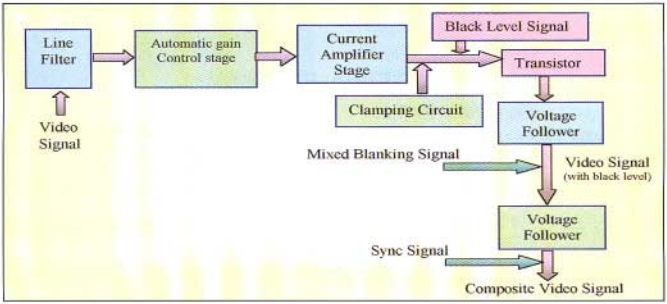


Fig. 10 Block diagram of Video Amplifier PCB

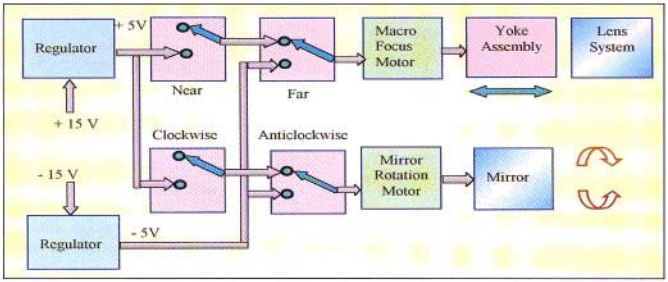


Fig. 11 Block diagram of Focus and Mirror Adjustment PCB

coupling capacitor. The automatic gain control stage is followed by a transistor based current amplifier. Fig. 10 shows block diagram of Video Amplifier.

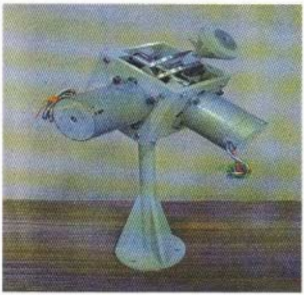
- **Focus Adjustment Board:** This PCB controls the focus motor to move back and forth the yoke assembly and also rotation of the motion of the reflecting mirror for the radial viewing of the inside surface of the pressure tube. Fig. 11 shows block diagram of Focus and Mirror Adjustment circuit.

Conclusion

The indigenous development of Miniature Underwater Radiation Resistant CCTV Camera for Remotised Inspection of Coolant Channels of PHWRs has been completed. The camera has been designed to be compatible with BARCIS delivery system. The camera can be used for radial viewing of inside surface of pressure tubes of 220 MWe/500 MWe PHWRs during in-service inspection. The camera can also be used for in-situ inspection of inside surface of calandria tubes prior to installation of pressure tubes. This development has resulted in self-reliance in high tech area and substantial savings in cost. With the experience gained during the development, it will be possible to develop radiation resistant CCTV camera with pan, tilt and zoom for use in hot cells & water pools.

ACTIVE STABILIZED ANTENNA PEDESTAL

Active Stabilized Antenna Pedestal is a device to maintain satellite link by actively compensating for a vessel's navigation and motion: pitch, roll, and yaw. It is a part of the stabilized platform equipped with gyro-sensors and control electronics for use in ships. As the vessel moves, the antenna instantaneously takes the corrective move so that it stays pointed at the appropriate statellite to which it is anchored. This orientation device has got two rotational axes which are driven by stepper motor through two stage gear train of reduction ratio of 64. These are fine pitch gears of precision class AGMA10 and made of hardened stainless steel. In order to minimize weight, the mechanism housing and pedestal are made of high strength aluminium alloy. Control Instrumentation Division (CnID), BARC, is integrating this unit for the requirements of DRDO. On the concepts of CnID, the engineering and manufacturing has been done at Centre for Design and Manufacture (erstwhile CWS).



Rotational DOF of Antenna Axis	: 2
Range of the end effector (each axis)	: +45° to 45°
Angular positional error	: <10 arc min
Overall height of the Antenna Pedestal	: 445mm
Overall size of the gear housing	: 102x102x96mm
Approximate weight	: 2 kg

BARC SIGNS MoU WITH UNIVERSAL CABLES LTD.

A Memorandum of Understanding was signed by BARC with Universal Cables Ltd. (UCL), Satna, on November 29, 2001 for developing thin walled electron beam crosslinked elastomeric cables. UCL is a leading manufacturer of cables of all kinds and has facility for production, quality control and testing.

Mr A.M. Patankar, Head, TT&CD, BARC, and Mr S.L. Kakkar, President (Works), Universal Cables Ltd., exchanging the signed Agreement in the presence of Dr S. Sabhrawal, Head, RTDS, BARC

Electron Beam cross-linking of cables results in improved properties, like improved form stability at higher temperatures, improvement in deformation resistance, reduced swelling behaviour and increased abrasion resistance. The thin walled, high temperature and high performance EB cross-linked cables are used by Indian Railways for electric traction and rolling stock. This development will provide an import substitution and achieve self-reliance.

BARC will provide technical consultancy and jointly develop the under-beam cable handling system and carry out initial trial irradiation runs of cables for process optimization. This work will be carried out by Radiation Technology Development Section of C&I Group at ILU-6 accelerator facility, Board of Radiation and Isotope Technology (BRIT) complex, Vashi, Navi Mumbai.

'SENSOR STOP AND PUSHER' ASSEMBLIES

A function was organised by Centre for Design and Manufacture (CDM), BARC, on March 27, 2002 for handing over of the last set of spare 'Sensor Stop and Pusher' assemblies for 220 MWe FM Head to NPCIL. The last set of assemblies were formally handed over by Mr B. Bhattacharjee, Director, BARC, to Mr V.K. Chaturvedi, Chairman and Managing Director, NPCIL. Dr Anil Kakodkar, Chairman, AEC, presided over the meeting. Mr G. Govindarajan, Director, A&M Group, BARC, was also present on the occasion. The previous heads of CDM were also invited along with other dignitaries of BARC/NPCIL. This completes the manufacturing cycle of FM Head assemblies and reactor channel components for 220 MWe power projects. So far, CDM has successfully manufactured and delivered 22 numbers of FM Heads, 4600 numbers of End Fitting Bodies and 5250 numbers of Liner Tubes for various 220 MWe Power Projects. CDM has now undertaken the manufacture of End Fitting Bodies and Liner Tubes for 500 MWe Project, TAPS-3, and FM Head components for 500 MWe Project, after successfully manufacturing and delivering the End Fitting Bodies and Liner Tubes for TAPS-4.

Mr B. Bhattacharjee, Director, BARC, greeting Mr V.K. Chaturvedi, Chairman & Managing Director, NPCIL, during the handing over function of the assemblies.

While appreciating the efforts of CDM in manufacturing high quality precision components,

Mr Bhattacharjee, Director, BARC, during his speech, opined that such functions needed to be encouraged so that the nature of the jobs undertaken by CDM were made known to others. He further added that he looked forward for the continued support from CDM for future priority jobs. Dr Anil Kakodkar, Chairman, AEC, appreciated the various jobs manufactured by CDM and also recalled the contribution of ex-heads of CDM in the nuclear power programs of the Department.

Mr B. Bhattacharjee, Director, BARC, formally handing over the 'Sensor Stop and Pusher' assemblies, to Mr V.K. Chaturvedi, Chairman & Managing Director, NPCIL

He supported and appreciated the total service provider concept being implemented by CDM. Further, he suggested that this concept could be extended with the help of BARC network to evolve concurrent engineering. While appreciating the support of CDM for manufacturing various precision components required for the power projects, Mr Chaturvedi, CMD, NPCIL, expressed the hope of getting full support of CDM in the future also for various development works in particular, whenever only one vendor is available for their work. He also opined that such functions be conducted in appreciation of the CDM staff for their quality output. Mr G. Govindarajan, Director, A&M Group, BARC, also spoke on the genesis of this get-together and encouraged the CDM staff to perform even better. Mr A. Manjunatha, Head, CDM, welcomed the dignitaries and invitees. Mr R.L. Suthar, Head, D&DS, CDM, explained the history of manufacturing technology of FM heads and reactor channel components in Hindi. Mr L.D. Chavan, one of the CDM technical staff associated with FM head assembly during the last 30 years, proposed the vote of thanks.

ONE YEAR STIPENDIARY TRAINING COURSE ON HEALTH PHYSICS

The valedictory function of the 8th batch of the One Year Stipendiary Course on Health Physics conducted for the Divisions of Health, Safety & Environment Group (HS & E Group), BARC, and Health Physics Units of NPCIL, IGCAR and AERB was held on February 27, 2002 at the auditorium of Radiation Protection Training & Information Centre (RPTIC), CT & CRS Building, Anushaktinagar. 52 trainees of the current batch graduated on this occasion.

Mr S. Krishnan, Senior Executive Director (CP), NPCIL, delivering the Valedictory address. Others present on the dais (from L to R) are Mr G.S. Jauhri, Head, HPD, BARC, Dr V. Venkat Raj, Director, HS & E Group, BARC, Dr K.S. Parthasarathy, Secretary, AERB, and Mr R.M. Sharma, HPD, BARC.

This function was presided over by Dr V. Venkat Raj, Director, HS & E Group, BARC. Mr S. Krishnan, Senior Executive Director (CP), NPCIL delivered the valedictory address. Dr K.S. Parthasarathy, Secretary, AERB, presented the AERB awards to the first two rank holders.

Mr Ajay Pratap Singh receiving the certificate from Dr V. Venkat Raj, Director, HS & E Group, BARC.

Mr G.S. Jauhri, Head, Health Physics Division, BARC, welcomed the dignitaries and the distinguished invitees.

The Presidential address was delivered by Dr V. Venkat Raj, Director, HS & E Group, BARC. He conveyed the good wishes of Director, BARC, to all the trainees for successfully completing the course. He advised the trainees to apply the knowledge gained by them during the training to the field jobs which they will undertake. He said that the job of health physicists is a delicate one in which they have to ensure the efficient functioning of the plant without making any compromise on the safety aspects.

Mr Sunil Kumar Sahoo receiving the AERB award for the first rank from Dr K.S. Parthasarathy, Secretary, AERB

The valedictory address was delivered by Mr S. Krishnan, Senior Executive Director (CP), NPCIL. In his valedictory address, Mr Krishnan said that it was difficult to start such a course and much more difficult to sustain it for a long period. He congratulated the Organisers for sustaining the momentum and running this programme successfully for more than a decade. He recalled that DAE, since its very inception, had given top priority to safety and there was no compromise on safety aspects. He reiterated that the job of a Health Physicist was to ensure that a plant functions and all the safety aspects are being taken care of.

Mr R. Sreenivas Prabhu receiving the certificate from Mr S. Krishnan, Senior Executive Director (CP), NPCIL.

The first two rank holders, Mr Sunil Kumar Sahoo and Mr Ajay Pratap Singh were awarded Certificates and cash prizes instituted by AERB. These certificates were given by Dr K.S. Partha-sarathy, Secretary, AERB. Dr. Parthasarathy explained the rationale behind the institution of these awards. Dr Parthasarathy remarked that the operational health physicists function as the "eyes and ears" of the regulatory authority .

The trainees were awarded the Course Certificates by Mr S. Krishnan and Dr V. Venkat Raj.

The function concluded with a vote of thanks by Mr R.M. Sharma, Head, Power Projects Safety Section, Health Physics Division, BARC.

TRAINING COURSE IN 'BASIC RADIATION PROTECTION'

Radiation Safety Systems Division (RSSD), BARC, conducted a three-day training course (March 20-22, 2002) in basic radiation protection for the benefit of the staff members working in the irradiator and accelerator facilities of BARC, Board of Radiation and Isotope Technology (BRIT), Centre for Advanced Technology (CAT), and Variable Energy Cyclotron Centre (VECC) located at Mumbai, Navi Mumbai, Indore and Kolkata, respectively.

Dr K.L. Narasimharao, one of the organisers of the training course, speaking at the inaugural function

In the inaugural session, Mr M.L. Joshi, Head, Radiation Hazard Control (RHC) Section, RSSD, welcomed the participants and said that the awareness about safety in handling radiation would go a long way in increasing the safety of our plants. Dr M.C. Abani, Head, RSSD, in his opening remarks, said that this was the third such training course after the ones conducted for the benefit of staff members at Radiological Laboratories and at Nuclear Recycle Group, and there were requests from several Divisions to conduct such courses. He also said that this course had been specially designed to benefit staff members working in the accelerator and irradiator facilities of the Department of Atomic Energy. Dr (Ms) A.M. Samuel, Director, Bio-medical Group, BARC, in her inaugural address, said that since the human body cannot recognise the presence of radiation, detection of radiation was very important, and that a lot of progress has been made in this field. She also told that there was a fear psychosis about nuclear radiation as a result of nuclear bombs, which should be removed. She also said that fear comes from the unknown, and therefore we need to understand and respect the radiation, follow the rules, and remove the fear.

Twenty-two participants from BARC, BRIT, CAT, and VECC attended the course. The course consisted of 12 lectures covering various subjects, namely, dose calculation, radiation biology, health physics instruments, dose and contamination control, industrial hygiene & safety, environmental monitoring, radiation emergency handling, internal dosimetry, plant-specific Health Physics procedures, unusual incidents in irradiators and accelerators, etc. The faculty for the course was drawn from the Health, Safety & Environment Group, BARC, and included Mr S. Kannan, Dr P.C. Gupta, Mr N. Kalyanasundaram, Mr A. Raju, Dr A.R. Nayak, Dr M.V. Dingankar, Mr D.P. Pimputkar, Dr R.K. Gopalakrishnan and Dr K.S. Pradeepkumar of RSSD; Dr B.S. Rao of Radiological Protection and Advisory Division; Dr R.K. Singhal of Health Physics Division; and Ms Pramilla Sawant of Internal Dosimetry Division. Dr S. Kailas, Head, Nuclear Physics Division, Dr B.N. Karkera, Head, Mechanical Design and Prototype Development Section, and Mr R.D. Iyengar, Senior Manager, Spice Irradiator, BRIT, gave invited lectures on accelerators in science and technology, radiation vault design for accelerators, and safety in irradiators, respectively. Dr N. Ramamoorthy, Chief Executive, BRIT and Associate Director, Isotope Group, BARC, in his concluding remarks, said that the non-power applications of the Atomic Energy Programme involve the public at large. He highlighted that the safety standards are becoming more and more stringent, but they have been successfully incorporated during the design and development of the various irradiators. He emphasized the need for good rapport between the

operating and radiation protection staff, with objectivity, professional identity, and interactive behaviour. He appreciated the good response for the course from the various user departments and urged the participants to translate the knowledge gained into useful work. The course was organised by Mr M.L. Joshi, Dr K.L. Narasimharao and Mr Ranjit Sharma of RSSD.

TRAINING PROGRAMME ON 'APPLICATION OF NAA IN FORENSIC ANALYSIS'

A week-long Training Programme on 'Application of Neutron Activation Analysis (NAA) in Forensic Analysis' was organised jointly by the NAA Unit of CFSL, Hyderabad (BPR&D) and Analytical Chemistry Division, BARC, at BARC, Mumbai, during February 4-8, 2002.

The objective of the Training Course was to expose mainly the forensic scientists to recent advances in the use of Neutron Activation Analysis for elemental analysis of evidentiary materials, which has proved to be of immense value in forensic investigations.

The programme consisted of a series of lectures, hands-on practicals as well as demonstrations in Radiochemical and Instrumental Neutron Activation Analysis with associated gamma-ray spectrometry. The role of analytical techniques like Atomic Absorption Spectrophotometry, Electroanalytical Techniques, XRF, DCP & ICP-AES. Thermal Analysis, Liquid Chromatography, etc. were also covered in lectures. In addition, lectures on possible applications of Photochemistry, Raman Spectroscopy, Isotope applications in forensic science and a lecture on the role of forensic scientists in proper/successful conviction were also arranged. The experiments emphasised the applications of NAA to real life case samples of forensic interest, i.e. in the field of ballistics, toxicology, source correspondence to decide commonness of origin or otherwise, narcotics, white collar crimes, suspected electrocution cases, documents, etc.

Thirteen participants from different State and Central Forensic Science Laboratories attended the programme. Three scientists from ACD, BARC, also participated and attended the technical lectures and practicals.

Inauguration of the Training Programme on 'Application of NAA in Forensic Analysis'. Seated from left to right are : Dr (Ms) R. Krishnamurthy, Director (officiating), Forensic Science Laboratory, Mumbai, Maharashtra, Dr N. Chattopadhyay, Deputy Director, NAA Unit of CFSL, Hyderabad at ACD (Course Director), Dr M. Sudersanan, Head, Analytical Chemistry Division, BARC, Dr A.B.R. Tripathi of NAA Unit (Course Co-ordinator), Mr C.A. Bhadkambekar of NAA Unit (Course Co-ordinator)

Dr M. Sudersanan, Head, Analytical Chemistry Division, BARC, inaugurated the training programme. Delivering the inaugural address, Dr Sudersanan gave a brief account of salient features of the NAA Unit since its inception. He also gave an overview on the "Role of Nuclear Analytical Chemistry" in its application for the benefit of the public.

Dr N. Chattopadhyay, Deputy Director, NAA Unit of CFSL, Hyderabad and the Course Director of this programme, on behalf of the Director, CFSL, Hyderabad, welcomed the participants who had come all the way from different parts of the country to attend the programme. He also gave an introductory address pointing out the importance and relevance of this Course for the forensic

scientists, stressing the objective and utility of the Course.

Dr A.B. R. Tripathi and Mr C.A Bhadkambekar of the NAA Unit who were Course Co-ordinators and other personnel in the NAA Unit of CFSL, Hyderabad, were also closely associated with the Course Director at all stages which enabled the preparation and organisation of the meet very successfully.

Objective type feed-back excercise in the form of 4 possible options to arrive at the most appropriate answers were conducted for the participants followed by discussions on February 7, 2002.

On the final day, i.e. February 8, 2002, after group discussions and feed--back from the participants, Dr M. Sudersanan, Head, ACD, BARC, presented the certificates to the participants highlighting the overall importance of analysis in forensic studies. He also stressed about the necessity of awareness percolation among end users, with special reference to sampling for NAA following steps as given in the laid out guidelines.

Dr C.N. Bhattacharyya, Director, CFSL, Hyderabad, BPR&D, MHA, Govt. of India, rendered his full administrative and financial support which enabled successful organisation of the meet. Overall, the programme was thought-provoking and the interactive lively discussions were highly appreciated by the participants.

NATIONAL SAFETY DAY CELEBRATION AT BARC

The National Safety Day was celebrated on March 4, 2002 at BARC with a day-long programme. An exhibition was arranged at the Central Complex Auditorium. Display of safety posters on different themes as well as safety information charts, a safety slogan contest and screening of safety films were the highlights of the programme. The annual programme is a part of the educational and

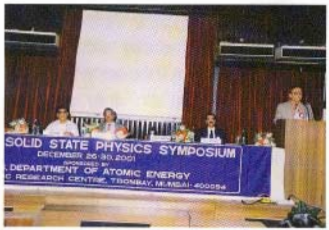
Mr Antony De Sa, Controller, BARC (facing the camera) at the Safety Exhibition organized on National Safety Day at the Central Complex Auditorium

motivational activities under the Accident Prevention Programme and is being regularly organised in BARC by the Industrial Hygiene and Safety Section, Radiation Safety Systems Division. About 500 employees of the Centre took part in the celebration. Director, BARC and the Controller visited the exhibition and showed their appreciation. Director, BARC gave valuable suggestions. The Fuel Reprocessing Division at Trombay, PREFRE and AFFF, Tarapur, and the BARC facilities at Kalpakkam conducted similar programmes on this occasion.

SOLID STATE PHYSICS SYMPOSIUM

The 44th DAE Solid State Physics Symposium was organised under the auspices of the Board of Research in Nuclear Sciences, Department of Atomic Energy, and held at BARC during December 26-30, 2001. This was yet another very successful conference in a series of symposia held every year without break since 1957 in different parts of the country in various universities and research institutions. This annual symposium continues to represent the largest gathering of solid state physicists in the country, with 316 research papers presented this year and a total of 365

registered participants from all parts of India and a few from abroad. Compared to topical conferences, this symposium indeed allows a somewhat unique opportunity of interdisciplinary interactions among solid state physicists.



Mr B. Bhattacharjee, Director, BARC, delivering the presidential address during the inaugural function of the DAE Solid State Physics Symposium

The symposium was inaugurated by Dr Anil Kakodkar, Chairman, AEC, and Secretary, Government of India, DAE. Mr B. Bhattacharjee, Director, BARC, presided over the inaugural function, and Dr S. K. Sikka, Director, Atomic and Condensed Matter Physics Group, BARC, welcomed the delegates. Dr S.L. Chaplot, Convener of the symposium, proposed a vote of thanks. Dr R. Mukhopadhyay, Local Convener, coordinated the local arrangements.

The deliberations at the symposium covered a wide range of topics of current interest in solid state physics which included phonon physics, phase transitions, superconductivity, magnetism, electronic structures, semiconductor physics, transport properties, surface science, soft-condensed matter, novel materials and instrumentation, etc. The symposium this year included invited seminar sessions on recent research and development activities at the INDUS-1 synchrotron at Indore, photo-electron spectroscopy and emerging superconductors. The invited speakers were selected by a national organising committee from a large number of suggestions received from all over the country, with a view to cover the topics of current interest. The detailed scientific programme was worked out by the scientific secretaries, Dr T. Sakuntala and Mr P.S.R. Krishna.

A highlight of the symposium was an invited talk by Dr S. K. Sikka on condensed matter physics of nuclear materials, which was truly informative and inspiring. In all, 28 invited presentations, 27 oral contributed papers, 256 poster contributed papers and 5 doctoral theses were presented at the symposium. The exceptionally good quality of several contributed papers demonstrated the fundamental inherent strength of the science in the country. In the concluding session, Dr B. K. Godwal summarised the proceedings. A best thesis award, sponsored by the Indian Physics Association, was also presented at this symposium.

भाभा परमाणु अनुसंधान केंद्र के वैज्ञानिकों को सम्मान

• डॉ. के.पी मिश्रा, अध्यक्ष, कोशिकीय एवं मुक्त मूलक विकिरण जीव विज्ञान अनुभाग, विकिरण जीव विज्ञान प्रभाग, भापअ केंद्र को वर्ष 2001 में भारत के राष्ट्रीय विज्ञान अकादमी के फेलो के रूप में चुना गया हैं। डॉ मिश्रा को यह सम्मान विकिरण जीव विज्ञान, मुक्त मूलक जीव विज्ञान एवं जैव भौतिकी के क्षेत्रों में उनके महत्वपूर्ण योगदान के लिए दिया गया है।

• सुश्री वाहबीज जमादार, खाद्य प्रौद्योगिकी प्रभाग एवं विकिरण रसायनिकी तथा रसायन गतिकी प्रभाग, भापअ केंद्र और मुंबई विश्वविद्यालय के संयुक्त परियोजना के अंतर्गत पीएचडी की छात्रा को Influence of

Radiation and hotolysis on Intracellular Proteases नामक लेख के लिये मुंबई में 6 से 11 जनवरी 2002 के दौरान आयोजित तृतीय एशिआई प्रकाश रसायनिकी सम्मेलन में सर्वोत्तम पोस्टर पुरस्कार से सम्मानित किया गया। इस पुरस्कार में 500 रू नकद एवं प्रशस्ति पत्र दिया जाता है।

• सुश्री दीक्षा एन.दानी, आण्विक जीव विज्ञान एवं कृषि प्रभाग, भापअ केंद्र को 20 से 22 फरवरी, 2002 के दौरान भारतीय प्रौद्योगिकी संस्थान (IIT), मुंबई में आयोजित Electron Microscopy and Allied Fields पर भारतीय इलैक्ट्रान सूक्ष्मदर्शी संस्थान के रजत जयंती समारोह के दौरान सर्वोत्तम पोस्टर प्रस्तुतीकरण पुरस्कार से सम्मानित किया गया। पोस्टर का शीर्षक था Transmission Electron Microscopy of Semi-Thin Sections of Cyanobacterium *Anacystis nidulans* at 160 kV और इसके रचनाकार दीक्षा दानी, जे.के. सैनिस (एम बी एवं एडी) और जी.के.डे (एम एस डी) भापअ केंद्र थे। जैविक नमूनों के लिये पारंपरिक प्रसारण इलैक्ट्रान सूक्ष्मदर्शिकी 70-100 nm के अतितनु सेक्शन का प्रयोग करते हुये 80-100 kV पर प्रचालित TEM से किया जाता है। इससे अधिक मोटाई वाले सेक्शनों को ऐसे पारंपारिक TEM द्वारा देख पाना संभव नही हैं। अक्सर उपयोग में लाये जाने के बावजूद ऐसे यादृछिक रूप से काटे गये अतितनु सेक्शनों द्वारा अतिसंरचनात्मक लक्षणों की विशिष्टता पर पूर्ण सूचना नहीं मिलती। पोस्टर में दर्शाये कार्य में प्रसारण इलैक्ट्रान सूक्ष्मदर्शिकी के उच्च वोल्टता (160 kV) पर 200-500 nm के मोटाई वाले सेक्शनों को दर्शाने में उपयुक्तता का मूल्यांकन किया गया। Cyanobacteria *Anacystis nidulans 500* nm तक के अर्धतनु सेक्शनों का 160 kV पर TEM द्वारा प्रेक्षण किया जा सका।

500 nm thick section, 160 kV
x60K — 100 nm

कुंदन कुमार

• रिमोटली ऑपरेटेड नॉन डिस्ट्रक्टिव सरफेस सैंप्लिंग टेक्निक्स फॉर एसेसमेन्ट ऑफ रेसिड्यूअल सर्विस लाईफ नाम का लेख कुंदन कुमार और बी.बी. रूपानी द्वारा रेसिड्यूअल लाईफ एसेसमेन्ट एंड

बी.बी. रूपानी

प्लांट लाईफ एक्स्टेन्शन में NDE - 2001 की भूमिका पर राष्ट्रीय सम्मेलन एवं प्रदर्शनी में प्रस्तुत किया गया जिसे सर्वोत्तम लेख घोषित किया गया। सम्मेलन का आयोजन इंडियन सोसायटी फॉर नॉन डिस्ट्रक्टिव टेस्टिंग, मुंबई क्षेत्र द्वारा 7 से 9 दिसंबर 2001 के दौरान किया गया। लेखकों को मानद चिन्ह, प्रमाण पत्र एवं 2000 रू. नकद पुरस्कार से सम्मानित किया गया।

• अभिजीत घोष, ए.के.गुलनार, आर.के. फोतेदार, जी.के.डे, डी.डी. उपाध्याय, राम प्रसाद और ए.के.सूरी द्वारा लिखे *TEM स्टडीज ऑन माइक्रोस्ट्रक्चरल इवल्यूशन इन हॉट प्रेस्ड सिलिकॉन कार्बाइड सिरॅमिक्स* नाम के तकनीकी लेख को सिरेमिक प्रौद्योगिकी अनुभाग के श्री अभिजीत घोष द्वारा प्रस्तुत किया गया। इसे आईआईटी, मुंबई द्वारा फरवरी 2002 में आयोजित भारतीय इलैक्ट्रान सूक्ष्मदर्शी संस्थान (EMSI-2000) के वार्षिक सम्मेलन में सर्वोत्तम प्रस्तुतीकरण पुरस्कार से सम्मानित किया गया। श्री अभिजीत घोष संरचनात्मक सिरॅमिक पदार्थ एवं उनके अभिलक्षणन के विकास कार्य से जुड़े हुये हैं।

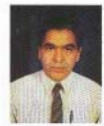
• नाभिकीय पुनःचक्रण वर्ग, भापअ केंद्र के श्री टी.एल.प्रसाद को उनके लेख अँडवान्सड ऑक्सिडेशन प्रोसेसेस फॉर ट्रीटमेन्ट ऑफ स्पेंट आर्गेनिक रेजिन्स इन न्यूक्लियर इंडस्ट्री को केंद्रीय चर्म अनुसंधान संस्थान, चेन्नई में भारतीय रसायन इंजीनियरी संस्थान द्वारा आयोजित राष्ट्रीय सम्मेलन (19-22 दिसंबर 2001) के CHEMCON- 2001 के मुख्य पोस्टर सत्र में द्वितीय सर्वोत्तम लेख पुरस्कार से सम्मानित किया गया ।

• डॉ (सुश्री) अरुणा कोरडे, विकिरण भेषज प्रभाग , भापअ केंद्र को उनकी पी.एच.डी. थेसिस डेवलेपमेंट ऑफ रेडियो आइसोटोपिकली लेबल्ड सब्स्टेंन्सस फॉर फार्मासूटिकल अप्लिकेशन के लिये वर्ष 2001 IANCAS प्रोफेसर एच.जे. अर्नीकर, सर्वोत्तम थेसिस मेडल से सम्मानित किया गया । यह सम्मान डॉ बी. भट्टाचार्जी, निदेशक, भापअ केंद्र ने डॉ. (सुश्री) कोरडे को भारतीय नाभिकीय रसायनज्ञ एवं सम्बद्ध वैज्ञानिकों (IANCAS) द्वारा 22 फरवरी 2002 को होमी भाभा विज्ञान शिक्षण संस्था, मुंबई में आयोजित समारोह में प्रदान किया । इस पुरस्कार में एक मेडल, एक प्रशस्ति पत्र और 5000 रू. का नकद पुरस्कार दिया जाता है। डॉ. (सुश्री) कोरडे ने अपना शोध पत्र डॉ.एम.आर.ए.पिल्लई, अध्यक्ष, विकिरण भेषज प्रभाग, भापअ केंद्र के मार्गदर्शन में पूरा किया ।

डॉ. (सुश्री) कोरडे ने PET / सायक्लोट्रान केंद्र YALE विश्वविद्यालय, यू.एस.ए. से पोस्ट डॉक्टरल रिसर्च एसोसिएटशिप भी पूरा किया हैं ।

• जे.कृष्णन, डी.जे.डेरोस और एन.कनगसबै, अभिकल्पन एवं विनिर्माण केंद्र, भापअ केंद्र के डिफ्यूशन बाँडिंग एस ए प्रोडक्शन प्रोसेस विषय पर तकनीकी लेख को विनिर्माण अनुभाग के डॉ जे.कृष्णन द्वारा प्रस्तुत किया गया । इसे ठाणे में मार्च 2002 के दौरान आयोजित वैल्डिंग फॉर प्रोडक्शन एंड प्रोडक्टिविटी (WPP - 2002) पर आयोजित राष्ट्रीय संगोष्ठी में सर्वोत्तम लेख/प्रभावपूर्ण प्रस्तुतीकरण पुरस्कार मिला । अभिकल्पन एवं विनिर्माण केंद्र द्वारा विसरण बंधक प्रक्रम द्वारा अनेक घटकों का विकास किया गया है ।

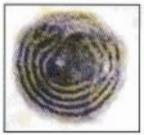
BARC SCIENTISTS HONOURED



• Dr K.P. Mishra, Head, Cellular and Free Radical Radiation Biology Section, Radiation Biology Division, BARC, has been elected a Fellow of the National Academy of Sciences, India, in the year 2001. Dr Mishra has been conferred this honor in recognition of his significant contributions in the area of Radiation Biology, Free Radical Biology and Biophysics.

• Ms Vahbiz Jamadar, a Ph.D. student under the collaboration project between Food Technology Division and Radiation Chemistry & Chemical Dynamics Division, BARC, and Mumbai University has been awarded the best poster award for the paper entitled, "Influence of Radiation and hotolysis on Intracellular Proteases", at the Third Asian Photochemistry Conference held at Mumbai during January 6-11, 2002. The award carries a prize money of Rs. 500/- and a citation.

• Ms Diksha N. Dani of Molecular Biology & Agriculture Division, BARC, received the best poster presentation award at the Silver Jubilee Conference of the Electron Microscope Society of India on 'Electron



500 nm thick section, 160 kV x60K — 100 nm

Microscopy and Allied Fields', held at IIT-Bombay during February 20-22, 2002. The poster was entitled, "Transmission Electron Microscopy of Semi-Thin Sections of Cyanobacterium *Anacystis nidulans* at 160 kV" and was authored by Diksha Dani, J. K. Sainis (MB&AD) and G. K. Dey (MSD), BARC. Conventionally Transmission Electron Microscopy for biological samples is done with TEM operating at 80-100 kV, using ultra-thin sections of 70-100 nm. It is not possible to view sections thicker than these with such conventional TEM. Though used quite often, such randomly cut ultra-thin sections yield rather incomplete information regarding specific ultra-structural features. In the work presented in the poster, the usefulness of Transmission Electron Microscopy at higher voltage (160kV) for viewing sections ranging from 200-500nm in thickness was evaluated. Semi-thin sections of cyanobacteria *Anacystis nidulans* upto 500 nm could be observed with TEM at 160 kV. The overall thylakoid arrangement and interconnections between the thylakoid membranes were clearly visible in these semi-thin sections as seen in Figure.

Kundan Kumar

B.B. Rupani

• A paper titled, "Remotely Operated Non-destructive Surface Sampling Techniques for Assessment of Residual Service Life" by Kundan Kumar and B.B. Rupani was presented in National Seminar and Exhibition on Role of NDE in 'Residual Life Assessment & Plant Life Extension, NDE-2001' and was adjudged the best paper in the conference. The seminar was organised by Indian Society for Non-destructive Testing, Mumbai Chapter, during December 7-9, 2001, with the aim of creating awareness regarding the role of Non-destructive examination for residual life assessment and plant life extension. The authors have been awarded with citation, certificates and cash prize of Rs. 2000/- for the paper.

Mr B.B. Rupani and Mr Kundan Kumar are actively working on residual life assessment through design and development of remotely operable surface sampling techniques, viz. Sliver Sample Scraping Technique (SSST) and Boat Sampling Technique (BST). SSST has been successfully used at RAPS and MAPS for obtaining large number of sliver samples from the bore of the coolant channels of these reactors, for life estimation of the channels. The BST is being planned to be deployed at Tarapur Atomic Power Station for assessing the integrity of Core Shroud.

• A technical paper titled, "TEM Studies on Microstructural Evolution in Hot pressed Silicon Carbide Ceramics" by Abhijit Ghosh, A.K. Gulnar, R.K. Fotedar, G.K. Dey, D.D. Upadhyaya, Ram Prasad and A.K. Suri, and presented by Mr Abhijit Ghosh of Ceramics Technology Section, won the Best Presentation Award at Annual Conference of Electron Microscopy Society of India (EMSI-2002) held at IIT-Bombay in February 2002. Mr Abhijit Ghosh is engaged in development work in structural ceramic materials and their characterization.

• Mr T.L. Prasad of Nuclear Recycle Group, BARC, was awarded the second Best Paper award for his paper titled, "Advanced Oxidation Processes for Treatment of Spent Organic Resins in Nuclear Industry", presented during the poster main session of CHEMCON-2001 national symposium (December 19-22, 2001), organised by Indian Institute of Chemical Engineers, and held at Central Leather Research Institute, Chennai.

• Dr (Ms) Aruna Korde of the Radiopharmaceuticals Division, BARC, was awarded the 'IANCAS Prof. H.J. Arnikar Best Thesis Medal' for the year 2001 for her Ph.D. thesis entitled, "Development of Radio-isotopically Labelled Substances for Pharmaceutical Application". Dr. B. Bhattacharjee, Director, BARC, conferred the award on Dr (Ms) Korde at a function organised by the Indian Association of Nuclear Chemists and Allied Scientists (IANCAS) on February 22, 2002 at Homi Bhabha Centre for Science Education, Mumbai. The award carries a medal, a citation and a cash prize of Rs.5000/- Dr (Ms) Korde completed her thesis work under the guidance of Dr. M.R.A. Pillai, Head, Radiopharmaceuticals Division, BARC.

The work reported in the thesis includes: (i) Development of radioimmunoassay of aflatoxin B_1 in agricultural commodities for measurement of its contamination in food (ii) Radioiodination of alpha methyl tyrosine, and (iii) Radioiodination of a pyrimidine nucleoside, 5-iodo-deoxyuridine (IUdR). Radioiodinated alpha methyl tyrosine and IUdR are useful radiopharmaceuticals.

Dr (Ms) Korde has also completed a Post-doctorial Research Associateship at the PET/Cyclotron Centre of the prestigious YALE University, USA.

• A technical paper, "Diffusion Bonding as a Production Process" by J. Krishnan, D.J. Derose and N. Kanagasabai of Centre for Design and Manufacture, BARC, and presented by Dr J. Krishnan of Manufacturing Section, won the Best Paper/Effective Presentation Award at the National Seminar on 'Welding for Production & Productivity (WPP-2002)', held at Thane during March, 2002. CDM has developed a large number of components by the diffusion bonding process.

WORLD NUCLEAR POWER STATUS

Today, the world produces as much electricity from nuclear energy as it did from all sources combined in 1960. Civil nuclear power can now boast over 10,000 reactor years of experience and supplies 16% of global needs. Many countries also built research reactors to provide a source of neutron beams for scientific research and the production of medical and industrial isotopes.

Today, 56 countries operate civil research reactors, and 31 have 440 commercial nuclear power reactors with a total installed capacity of 3,54,000 MWe (see table). This is over three times the total generating capacity of France or Germany from all sources. A further 32 power reactors are under construction, equivalent to 7.5% of existing capacity, while 32 more, on order or planned, are equivalent to 9.8%.

Fifteen countries depend on nuclear power for at least a quarter of their electricity. France and Lithuania get around three quarters of their power from nuclear energy, while Belgium, Bulgaria, Hungary, Japan, Slovakia, South Korea, Sweden, Switzerland, Slovenia and Ukraine get 35% or more.

In addition to commercial nuclear power plants, there are more than 280 research reactors operating in 56 countries, with more under construction. These have many uses including scientific research and the production of medical and industrial isotopes, as well as for training.

WORLD NUCLEAR POWER STATUS

Country	Reactors in operation		Reactors under construction		Nuclear electricity supplied in 2000	
	No of Units	Capacity MW(e)	No of Units	Capacity MW(e)	TWh(e)	Nuclear Share (%)
Argentina	2	935			5.73	7.3
Armenia	1	376			1.8	33
Belgium	7	5728			45	57
Brazil	2	1855			5.6	1.5
Bulgaria	6	3538			18	45
Canada	14	9998	6	3598	69	12
China	5	3702	6	4835	16	1.2
Czech Republic	5	2560	1	912	14	19
Finland	4	2656			21	32
France	59	63203			395	76
Germany	19	21141			160	31
Hungary	4	1755			15	42
India	14	2548	6	3526	14	3.1
Iran			1	950		
Japan	54	44301	3	3696	305	34
Korea, Republic of	17	13920	3	2850	104	41
Lithuania	2	2370			8.4	74
Mexico	2	1310			7.9	3.9
Netherlands	1	452			3.7	4.0
Pakistan	2	425			1.1	1.7
Romania	1	655			5.1	11
Russia	30	20793	3	2625	120	15
South Africa	2	1842			13	6.7
Slovak Republic	6	2472	2	840	16	53
Slovenia	1	679			4.5	3.7
Spain	9	7345			59	28
Sweden	11	9460			55	39
Switzerland	5	3170			24	36
Taiwan	6	4884	2	2600	37	24
UK	31	12282			78	22
Ukraine	13	11195			72	47
USA	104	98406			754	20
Total	439	355956	33	26432	2447	

Source : ANSTO, based on informations upto June 2002

Edited and published by Dr Vijai Kumar, Head, Library & Information Services Division, Bhabha Atomic Research Centre, Trombay, Mumbai 400 085.
Editorial Management : T.C. Balan; Computer graphics & layout : P.A.S. Warrier

BARC Newsletter is also available at URL:http://www.barc.ernet.in (for private circulation only)