ISSUE NO. 295 | AUGUST 2008

बी एआरसी न्यूज़लैटर

BARC NEWSLETTER

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DEVELOPMENT OF A RADIOISOTOPE GUIDED SURGICAL GAMMA PROBE FOR EARLY DETECTION AND MANAGEMENT OF BREAST CANCER

In the next issue

Radiation technology enabled market access to Indian Mango

BARC has been conducting experiments on irradiation of tropical fruits, including Mango for several years now. The challenges faced during commercial irradiation; the requirements and subsequent approval of national and international agencies on the wholesomeness of the irradiated food, the development of the KRUSHAK project resulting in export of Mangoes have been discussed in this article.

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BARC NEWSLETTER

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DEVELOPMENT OF A RADIOISOTOPE GUIDED SURGICAL GAMMA PROBE FOR EARLY DETECTION AND MANAGEMENT OF BREAST CANCER

Parag B. Walinjkar, Umesh Kumar and Gursharan Singh
Isotope Applications Division

Breast cancer is a malignant (cancerous) tumour that starts from the cells of the breast. Worldwide, breast cancer is the second most common type of cancer after lung cancer and it is by far, the most common cancer amongst women. A woman's breast is made up of glands that produce milk (lobules), ducts (small tubes that carry milk from the lobules to the nipple), fatty and connective tissue, blood vessels and lymph vessels. Most breast cancers begin in the cells that line the ducts (ductal cancer), some begin in the lobules (lobular cancer) and the rest in other tissues. There are higher chances of breast cancer developing in women staying in Indian metros as compared to those in rural areas. Breast cancer if detected at an early stage, can be effectively treated and has a cure rate of more than 80 percent.

Axillary lymph node status for lymphatic staging in breast cancer, is the best prognostic indicator and guides systemic treatment. Sentinel Lymph Node (SLN) biopsy is a novel, minimally invasive technique, for lymphatic staging proven to improve quality of life. Currently, the use of SLN mapping is widespread in patients with early stage breast cancer. The accurate detection of the SLN is paramount for the success of the procedure.

In recent years, intra-operative localization of Sentinel Lymph Node (SLN) using radiotracer has been established, as a new technique to detect breast cancer in it's early stage. In this technique, the first node to receive cancer cells called the sentinel node is located, detached and tested for cancer.

Radioisotope guided gamma probe is a lightweight hand-held device, which is used in SLN biopsy to selectively detect the radioactive nodes, that result in early detection of breast cancer. It helps in the detection and management of cancer as it localizes areas of tumours along with tracer-avid radiopharmaceuticals with higher accuracy. It finds application not only in sentinel node localization, but also in radio guided occult lesion localization and radio-guided surgery.

The Isotope Applications Division of BARC has successfully developed a compact, micro-controller based, radioisotope guided SLN detection system, as an import substitute for the Indian medical community. *The prototype system has been carefully evaluated in the laboratory for it's minimal required performance. Clinical performance evaluation and trials have been conducted at the Rajiv Gandhi Cancer Institute and Research Centre, New Delhi.*

Design Considerations

Essentially, a radioisotope-guided probe for such clinical applications is a compact and programmable gamma counting system. Important performance indicators of such a system are it's detection sensitivity and collimation. Besides these, other features include high reliability and repeatability, compact size and ease of operation. The most important issue is that prior to a surgical procedure, the probe needs sterilization.

System Description

With these specific requirements on design modalities, a microprocessor-based "RIG" surgical gamma probe was developed. It consists of a measurement and control unit and a handheld probe. The probe consists of a collimation system and scintillation [NaI(Tl) ϕ10 X 20 mm] detector, housed in a ϕ19 x 160 mm stainless steel housing fabricated in-house. Two types of tips were fabricated - one with conical tip (2) and other with flat tip (2A) as shown in Fig.1. The detector probe converts the gamma rays to electrical signal using PhotoMultiplier Tube (PMT). This signal is fed to a measuring unit through a three meter long shielded cable.

The measuring unit consists of signal processing circuits and a microcontroller-based digital count rate meter, as shown in the block diagram of RIG system (Fig. 2). The signal from the detector is amplified and shaped by an amplifier. The amplified signal is converted into a rectangular pulse signal using a discriminator and a mono-stable oscillator stage. These pulses are counted by the micro-controller based counter. The number of Counts Per Second (CPS) is displayed as count rate on 2 x 16 alphanumerical LCD display module with backlit, for clear vision from a distance. The clear acoustic signal is produced in direct correlation to the count rate during surgical procedures, requiring minimum or no visual attention to the instrument panel, by the user. The maximum count rate is limited to 10000 cps. The unit incorporates online data transfer facility to a PC, through the inbuilt serial port. "RIG Pro" software was developed for the purpose of data acquisition. A photograph of the system is shown in Fig. 3.

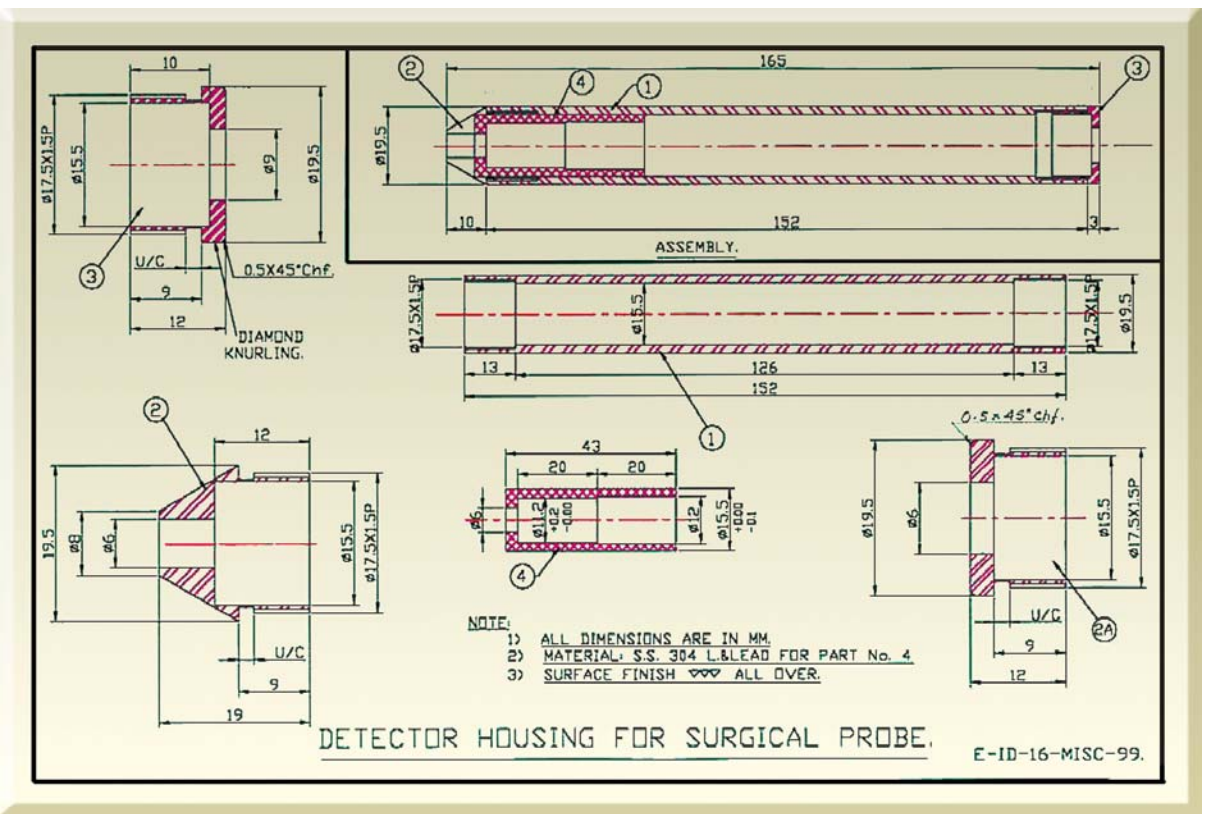

Fig. 1: Probe's housing

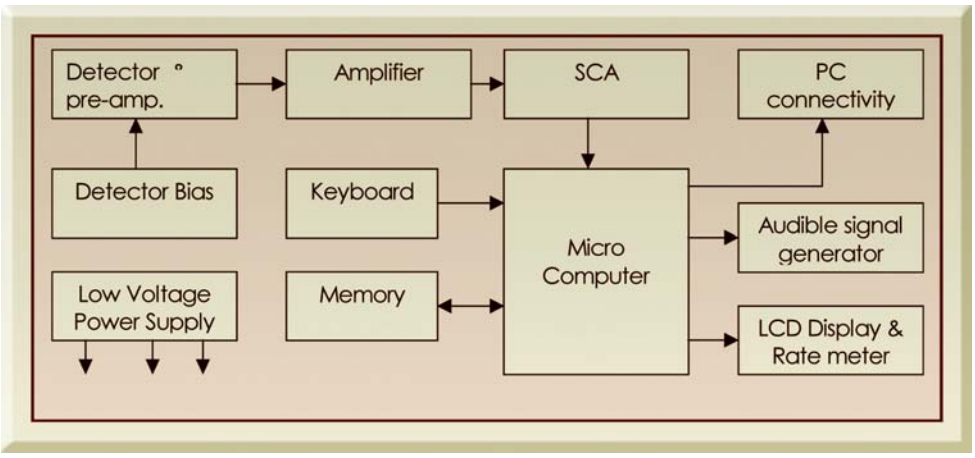

Fig. 2: Block diagram of measuring unit

Fig. 3: Photograph of "RIG" Probe

Performance Evaluation and Results

In case of early detection of breast cancer, the accuracy of diagnostic statement depends on the clear pre-and-intraoperative identification of the Sentinel Lymph Node (SLN). The success of the SLN surgery, depends on the quality and performance of surgical gamma probe system as well as on the expertise of the surgeon.

The main parameters of physical performance of gamma probe are sensitivity, spatial resolution, angular resolution and shielding from sidewall. The probe was tested in the laboratory for these requirements and it's physical performance.

Laboratory Evaluation

A prototype unit of the probe has been evaluated in the laboratory for it's performance. Various parameters such as angular resolution, spatial resolution, maximum sensitivity and quality of shielding have been tested. Evaluation was carried out using a point source of Co-57 (Ø 2 mm, 270 days half-life, 122 KeV, 25 mCi) rather than Tc-99m to overcome the inaccuracies due to short half-life of Tc-99 m. Measurements were carried out by taking a set of 20 readings at each location and then averaging out to get better measurement accuracy and minimize statistical variations. For most of the measurements, the probe was fixed and the source was moved except the one for the measurement of spatial resolution.

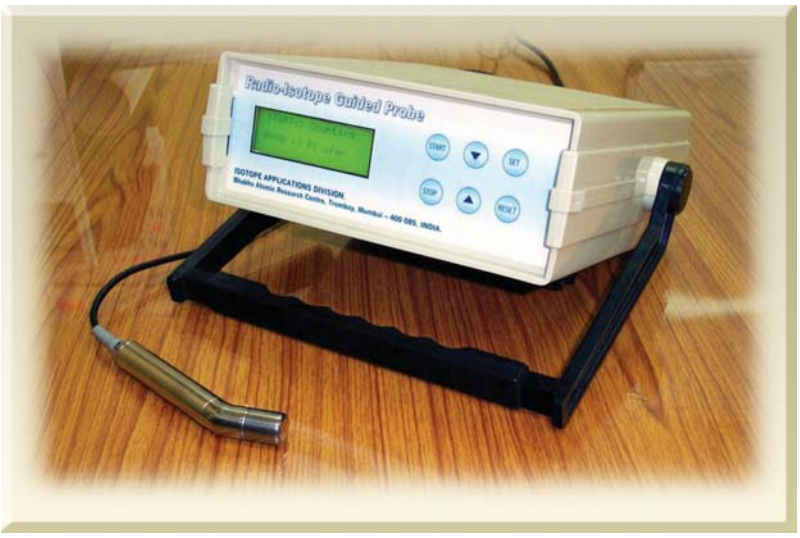

Fig. 4: CsI(Tl) based 'RIG' Surgical Probe System

The results obtained as part of our laboratory evaluation are shown in a Table 1 and Figs. 5 to 8. It was observed, that a Flat tip probe is more sensitive and is in good agreement with the minimal performance requirements. Therefore, RIG surgical gamma probe with flat tip was chosen for further clinical trials.

Clinical Evaluation

Clinical performance of the probe was evaluated at the Rajiv Gandhi Cancer Institute and Research Centre, New Delhi. Seven patients with early stages of breast cancer (T1-2 N0M0), underwent lymphoscintigraphy for the sentinel node detection with a peritumoral injection of 99 mTc nanocolloid (Nanocoll, Amersham). This was followed by excision of the sentinel node with the help of the "RIG" gamma probe. Routine axillary dissection was performed thereafter. The probe was evaluated based on it's spatial resolution, accuracy of locating the node on the skin surface, sensitivity to localize the radioactive node in the axillary cavity per-operatively and identification *in-vitro* i.e. after dissection.

Sentinel lymph node was visualized in 6 patients by lymphoscintigraphy. Locating the sentinel node preoperatively on the skin surface using surgical probe was possible in 4 of these patients. Scatter from the tumour injection site, did not permit sentinel node

Table 1: Results of 'RIG' gamma probe

PARAMETER	FLAT PROBE	CONICAL PROBE
Spatial Resolution 1cm	19mm	17.5mm
Radial sensitivity distribution 20cm	30^0	20^0
Radial sensitivity distribution 3cm	29^0	30^0
Max. Sensitivity [cps/MBq]	5000	2000
Leak-sensitivity [cps/MBq]	10	20
Shielding (Ratio of leak-sensitivity to max-sensitivity)	0.2%	1%
Response ratio to the radioactive source at depth	0.5 / 8mm	0.5 / 6mm
Diameter	19mm	19mm

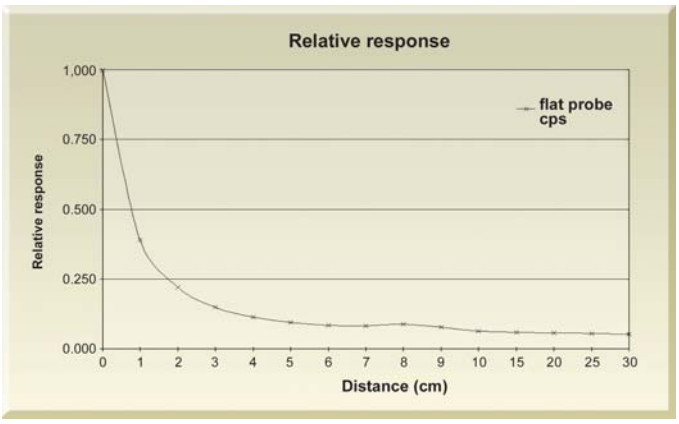

Fig. 5: Sensitivity of 'RIG' surgical probe

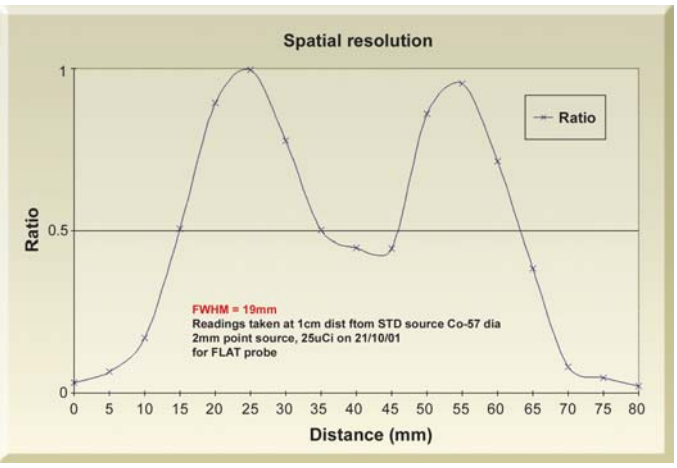

Fig. 6: Spatial resolution of 'RIG' surgical probe

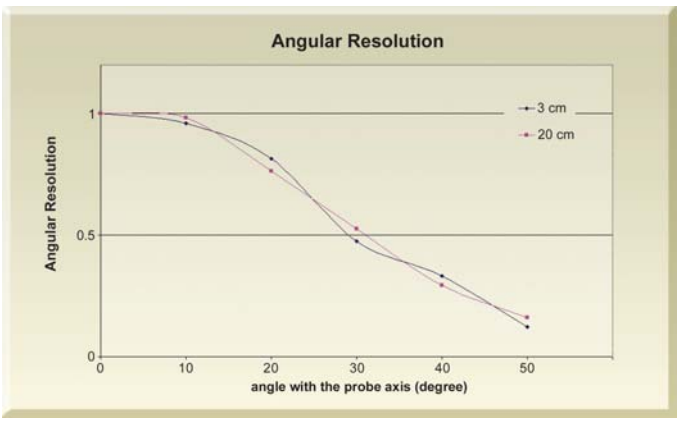

Fig. 7: Radial sensitivity distribution of 'RIG' surgical probe

localization in one patient. The counts per second (cps) detected by the probe in the node,were almost 10 times that of a room background of 10-20 cps. The detected count density was expected maximum *in vitro*. The count measurements were not affected by transmission, through shielding from the injection sites. Probe was able to localize 5 out of the 6 nodes seen on lymphoscintigraphy *in-vivo* and all 6 in *in-vitro*. All the sentinel lymph nodes thus identified, were negative on frozen section evaluation and final histopathology. Routine axillary dissection did not show axillary nodal involvement in any of the patients. This suggested correct identification of the sentinel node using 'RIG' surgical gamma probe.

Further Improvements

The instrument has been modified [Fig. 4] and incorporated with a CsI (Tl) detector, a tungsten collimator in kinked shape and built-in facilities for data storage. The modified unit was also evaluated for it's performance and has shown better results during it's laboratory evaluation as shown in Table 2. The results of clinical evaluation at the Tata Memorial Hospital, Parel are awaited.

Conclusions

The Isotope Applications Division of BARC has successfully developed a new radioisotope-guided intra-operative probe, that meets expected minimal requirements and suitability to clinical applications. Preliminary clinical

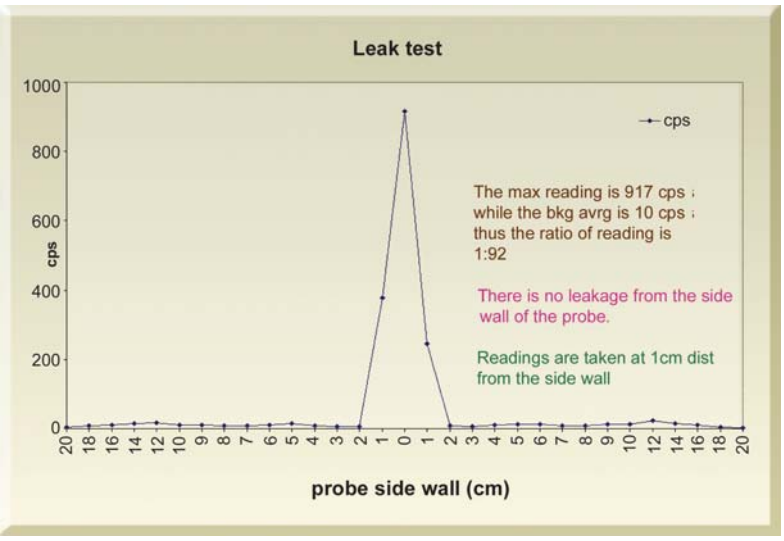

Fig. 8: Shielding curve of 'RIG' surgical probe

Acknowledgements

Special thanks are due to Dr. N. Ramamoorty, former Associate Director, Isotope group and Dr. P. S. Choudhary, Chief of Nuclear Medicine, Rajiv Gandhi Cancer Institute & Research Centre, New Delhi. Authors would also like to thank all those who contributed directly or indirectly in this developmental work.

Table 2: Comparative Performance Evaluation Report

Sr. No.	Parameter	NaI probe	CsI probe
1.	Spatial Resolution @ 1cm	19mm	15mm
2.	Radial sensitivity distribution @ 20cm	30^0	28^0
3.	Radial sensitivity distribution @ 3cm	29^0	28^0
4.	Max. Sensitivity [cps/MBq(27μCi)] @ probe Tip	5000	~15000
5.	Leak-sensitivity [cps/MBq(27μCi)] @ side walls	10	15
6.	Ratio of leak-sensitivity to max-sensitivity	0.2%	0.1%
7.	Response ratio to the radioactive source at depth	0.5 / 8mm	0.5 / 6mm
8.	Collimator Type (opening)	Lead (6mm)	Tungsten (6mm)
9.	Probe Size	19 x 180mm	16 x 110mm
10.	Biasing Voltage	1000V DC	100V DC
11.	Maximum Counts	10000	60000
12.	Probe Shape	Straight	Kinked
13.	Measurement time	Fixed (1sec)	Adjustable
14.	Cable length	2 meters	3 meters
15.	Data Storage	NO	YES

performance evaluation suggests, that this simple indigenous surgical gamma probe with basic features, is useful in the sentinel node detection and is able to produce clinically relevant data, with good sensitivity.

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Forthcoming Symposium

Symposium on Operational and Environmental Issues concerning use of Water as Coolant in Power Plants and Industries

(OPENWAC-2008)

The Water & Steam Chemistry Division, BARC and the DAE Advisory Committee on Steam and Water Chemistry (COSWAC) have organized the above symposium. It is being sponsored by BRNS and will be held at Kalpakkam on 15th & 16th Dec. 2008. OPENWAC-2008 addresses the issues of environmental effects, caused by the discharge of heated effluents, from power plants and the impact of these discharges on aquatuc biota, especially in tropical waters. Papers are invited on the following themes:

"Corrosion issues including FAC & it's control in water coolant systems; Chemistry of primary and moderator systems in nuclear power plants and research reactors; Chemistry of Steam and water at elevated temperature in nuclear power plants; Once-through steam generator chemistry; Industrial fire water systems; Water chemistry of coolant systems in power plants and other industries; Ion-exchange purification"etc.

Important Dates

Abstract submission	: 1st Aug. 2008
Full paper submission	: 30th Sep. 2008
Registration	: 30th Oct. 2008
Accomodation request	: 30th Oct. 2008

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DEVELOPMENT OF AN ECHELLE SPECTROMETER FOR SIMULTANEOUS TRACE ELEMENTAL ANALYSIS

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Spectroscopy Division

Introduction

The Spectroscopy Division is involved with the development of instrument and standardization of process for the qualification of nuclear and other materials by Atomic Emission Spectroscopy (AES). The method involves excitation of the sample to very high temperatures (> 4000 K) and recording of the light emitted, which is characteristic of the sample constituents. An analysis of the emission spectra enables estimation of the sample constituents. The optical spectrometer used for recording of the emitted spectrum is usually a polychromator, which has multiple exit slits and detectors facilitating simultaneous recording of the emission characteristics of different elements. Conventionally, a standard spectrometer consists of photomultiplier tubes (PMT) as detectors, which are positioned on the focal plane of the polychromator as shown in Fig. 1. The PMT based polychromator is bulky and requires complex data acquisition system. The other limitations of such a system are the limited number of channels due to the physical consideration of accommodating more PMTs and the wavelengths available for measurement and analysis. The task of developing a novel system that overcomes these limitations was undertaken.

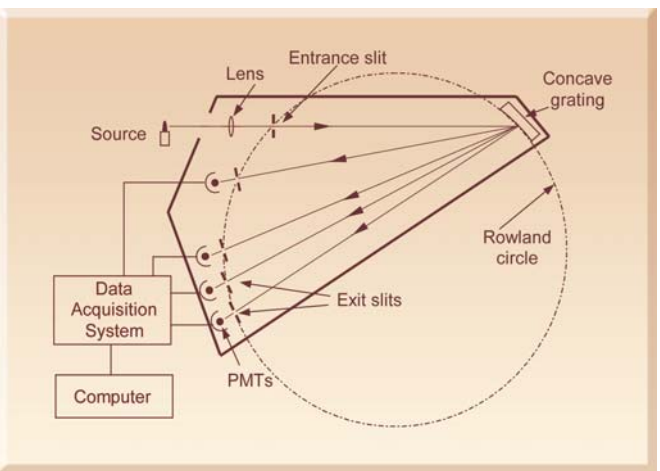

Fig. 1: Schematic of a polychromator using multiple PMTs for simultaneous spectro-chemical analysis.

Conceptual design of AES for simultaneous elemental analysis

A schematic of the system developed, is shown in Fig. 2. It employs an Inductively-Coupled Plasma (ICP) source, an echelle grating spectrometer as the dispersive optics to separate various emission lines and a detection system for recording the emission spectrum. The optical layout of the spectrometer is shown in Fig. 3. The emission from an ICP source is made to incident on a diffraction grating (echelle), with the help of a focusing lens, collimating mirror and prism. The dispersed light in turn is focused onto a Charged Coupled Detector (CCD) by a concave mirror. The spectrum dispersed by the grating is at a high order of interference. A problem associated with the higher orders is the overlap of many neighbouring orders, which make the spectra complex, particularly, when simultaneous analysis of a large number of elements is required. A second low dispersing element (order sorter) is employed, to separate out the

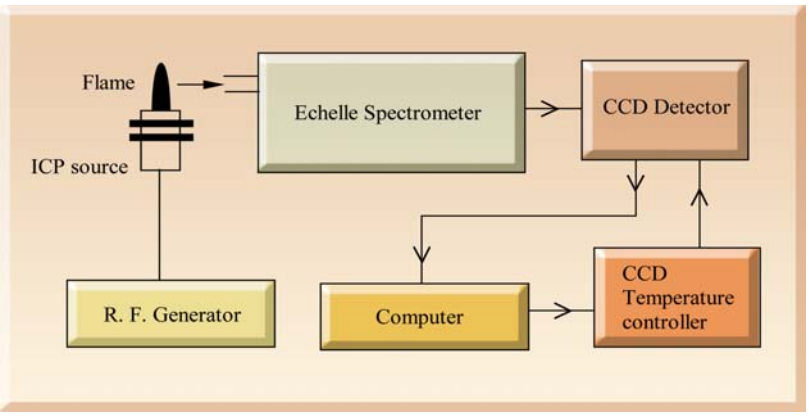

Fig. 2: A schematic of the atomic emission spectrometer system

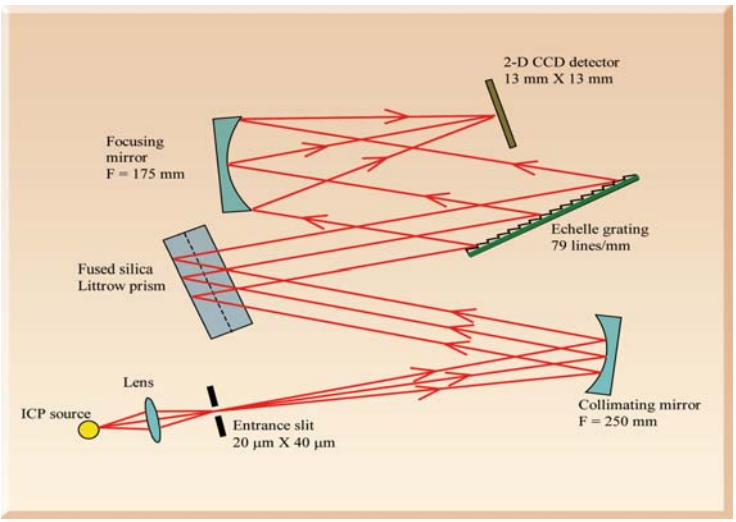

Fig. 3: Optical layout of the echelle grating spectrometer

overlapping orders of diffracted light, in a direction perpendicular to the grating dispersion. In the present instrument a fused silica prism has been used as an order sorter.

Optical design of echelle spectrometer

The optical design of the spectrometer is based on the calculations for the dispersions of wavelengths, such that, the entire wavelength band of 2100–4000 Å is covered in different orders, without any missing wavelength gaps and with a minimum overlap at the detector. This spectral range allows the analysis of up to 51 elements. An optical resolving power ($\lambda/\Delta\lambda$) of 15000 is needed, to resolve all the spectral lines of different elements, for spectro-chemical analysis. The corresponding wave-length resolution at 3000 Å is 0.2 Å. An echelle grating with 79 lines/mm ruling and blazed at 74 degrees of an arc has been used, to achieve this resolution. The maximum achievable resolving power of this grating is 10^5, which is well above the required resolving power. The range of orders needed to cover the intended wavelength range is 58 to 116. The prism disperses in the vertical direction, whereas the grating disperses in the horizontal direction. The apex angle of the fused silica prism needed for order separation is 22.5 degrees of an arc. This angle ensures at least a five pixel separation, among the neighbouring orders and that all the orders are still covered on the detector. The application of an f/10 system design, enables the spectrometer to overcome the effects of spherical aberration and coma. The focal length of the focusing mirror has been chosen, to achieve a minimum of five-pixel separation along the horizontal direction, to resolve closely-spaced spectral lines. The angle of incidence maintained on the echelle grating is 81 degrees of an arc. The choice of this angle ensures coverage of full spectral range by the focusing mirror, on a CCD of size 13.3 mm X 13.3 mm.

Various optical elements viz. focusing mirrors and the prism were fabricated in-house. The surface accuracy of the mirrors used is better than $\lambda/4$, the prism surface flatness is better than $\lambda/8$ with a maximum angle error of 30 arc-sec. Fig. 4 shows the photograph of the

complete analytical system, comprising the echelle spectrometer coupled to an ICP torch assembly, with an RF generator (27.2 MHz, 1.5 kW, developed by VPID, BARC). The initial angular setting of the echelle grating was carried out, for the calculated diffraction order for He-Ne laser beam. Prominent spectral lines emitted by a mercury discharge lamp were used, for precise positioning of the echelle grating, prism and the detector. Two closely spaced spectral lines of beryllium excited in a hollow cathode lamp with a separation of 0.17 Å (2494.73 Å and 2494.56 Å) were used, to determine instrument resolution.

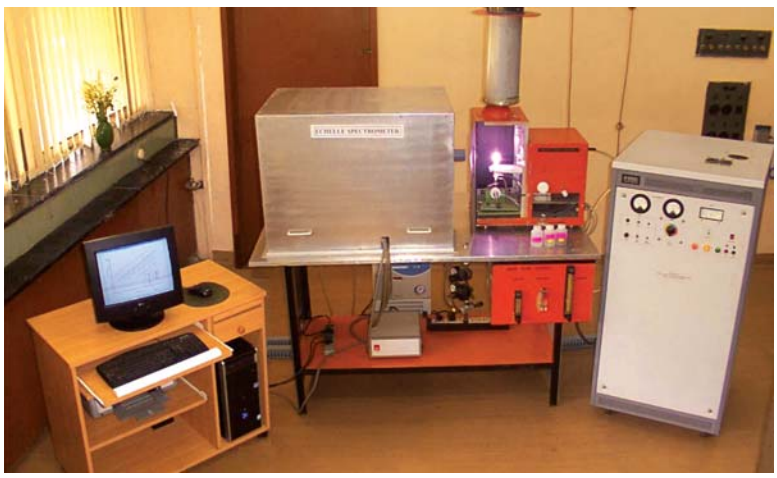

Fig. 4: Photograph of the analytical system

Wavelength calibration

The wavelength calibration of the present configuration is complicated, due to superposition of two different dispersions, with multiple orders. Consequently, it requires the application of a number of known wavelengths in each diffraction order. The emissions from Fe, Mg, Mn, Be, Co, Cu single-element hollow-cathode lamps were used, for precise correlation between the wavelength and the pixel positions on the detector.

Instrument calibration and analysis

The spectrometer is optically aligned to an ICP source. The optical alignment of the analytical zone of the plasma flame to the entrance slit of the echelle spectrometer was achieved, by recording the signal-to-background ratio of the boron line, (2497.73 Å) in a 10 µg/ml boron sample. The optical alignment was verified by recording the spectra of several elements for which standard solutions having a high concentration of 1 mg / ml were prepared. Fig. 5 shows the emission spectra recorded by introducing a 500 µg/ml tungsten aqueous solution, into the ICP flame. The pixel values corresponding to at least four analytical wavelengths (on an average)

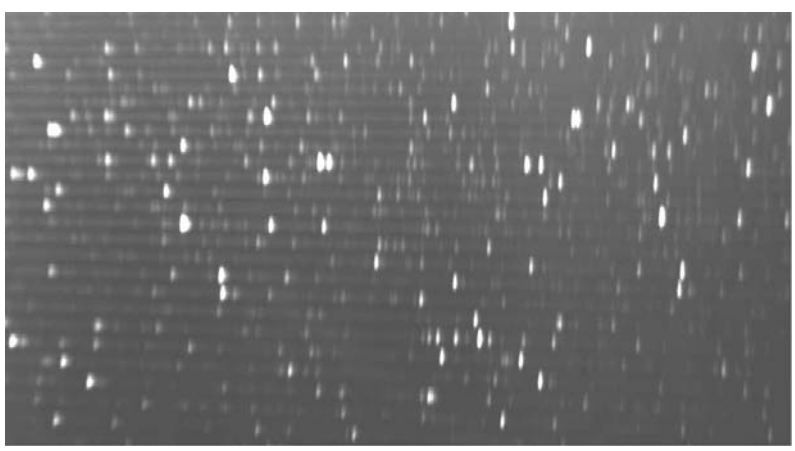

Fig. 5: CCD image of tungsten spectra over the region 2100 – 3000 Å, recorded by introducing a 500 mg/ml tungsten aqueous solution into the ICP flame. The bright spots correspond to the characteristic emission lines of tungsten.

for each of the 51 elements were assigned, by exciting their spectra in 100 µg/ml aqueous solutions.

A LabVIEW based Virtual Instrument (VI) programme has been developed, for data acquisition and analysis, in both local and remote modes. The programme offers various menus to a user for performing the analysis. The *'Modify menu'* allows the user to set parameters common to all the impurities like the integration time, the number of standards and the type of standard. The programme also enables a user, to set the CCD detector temperature in the range of 40°C to 20°C. The *'Table menu'* allows creation of a new table for analytical conditions to be set up either by copying data from an old table or modifying an existing one. The *'Analysis menu'* provides the options to perform blank subtraction, background correction and impurity element estimation. The programme runs the blank and standards according to the pre-set sequence in the table of analytical conditions, acquire data from the CCD detector and store the data into a file. The data is then processed to calculate the net counts as per the set modes of analysis. The program generates a linear fit of the concentration vs counts data, for calibration purposes.

Table 1: Lower detection limits measured for some of the elements

Element	Lower concentration limit µg/ml
Eu, Y, Yb	0.01
B, Cd, Dy, Er, Gd	0.02
Ce, Co, Mn, Mg, Fe, Sm	0.1
Al, Ni	0.2
Cr	1.0

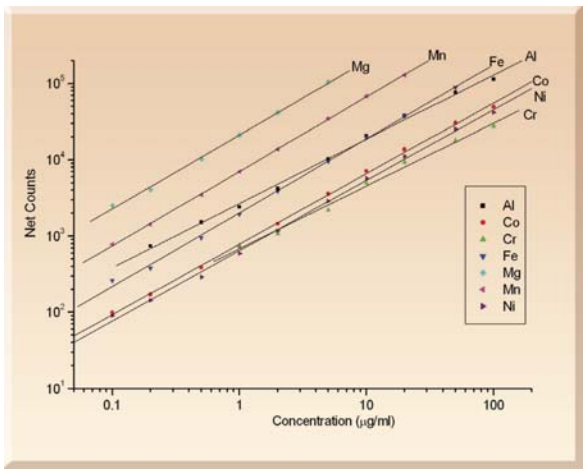

Fig. 6: Calibration plots of the simultaneous analysis of 7 elements. The concentration range is 0.1–100 mg/ml.

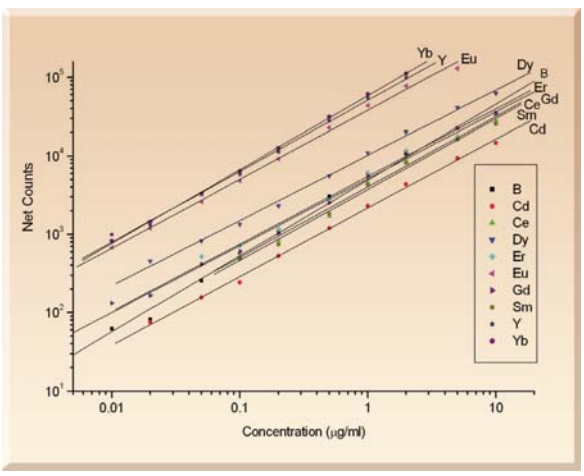

Fig. 7: Calibration plots of the simultaneous analysis of 10 elements. The concentration range is 0.01–10 µg/ml.

The detection limits obtained with the spectrometer for a set of 17 impurities viz. Al, B, Cd, Co, Cr, Fe, Mg, Mn, Ni, Ce, Dy, Er, Eu, Gd, Sm, Y and Yb, usually analyzed in uranium samples, are given in Table 1. The corresponding calibration plots recorded are shown in Figs. 6 and 7.

NATIONAL SCIENCE DAY CELEBRATIONS AT BARC : A REPORT

The Bhabha Atomic Research Centre and the Mumbai Chapter of the Indian National Science Academy, jointly organized the National Science Day on February 28, 2008, at BARC. As part of the celebrations, about 200 XI Std. Science students were invited to BARC, from various colleges including the Atomic Energy Jr. College, Anushakti Nagar; SIES College, Sion; Swami Vivekanand College, Chembur and St. Xaviers' College, Fort. The students were first briefed about the various facilities available at BARC and thereafter taken around to visit the DHRUVA Reactor, APSARA Reactor, Food Irradiation Processing Laboratory and the Waste Management Division of BARC.

In the afternoon, three popular Science lectures were delivered by the Mumbai-based newly elected fellows of the Indian Academy of Sciences, Bangalore. Dr. Srikumar Banerjee, Director, BARC, presided over the function held at the Central Complex Auditorium, BARC. He briefed the students about the various R&D activities of BARC and elaborated the efforts being made, to attract young minds to the field of R&D. Dr. S. M. Sharma, Head, High Pressure Physics Division spoke on Physics with Synchrotron Radiation. Dr. S. K. Apte, Associate Director, Bio-Medical Group delivered a talk entitled "Living Dangerously : the Deinococcus way", wherein he described the extreme

Dr. Srikumar Banerjee, Director, BARC, presiding over the National Science Day function

Students visiting various BARC facilities

Students visiting various BARC facilities

radioresistance of this superbug and elucidated the biotechnological applications there of. Prof. Dulal Panda, from the School of Biotechnology, IIT, Mumbai discussed the importance of cell architecture in his talk entitled "Cytoskeleton and Human Diseases". Mr. R. K. Sharma, Head, Media Relations & Public Awareness Section, SIRD, BARC proposed a vote of thanks.

The programme was attended by students and faculty members of several Mumbai colleges and a large gathering of scientists, engineers and other staff members of the BARC family.

BARC TRANSFERS KNOW-HOW OF "BACK-WASHABLE SPIRAL ULTRAFILTRATION TECHNOLOGY FOR DOMESTIC AND INDUSTRIAL WATER PURIFICATION"

The technology of "Back-washable Spiral Ultrafiltration Technology for Domestic and Industrial Water Purification" developed by the Desalination Division, was transferred to M/s Concord Enviro Systems Pvt. Ltd., Mumbai on the 19th of March, 2008.

Photograph after signing of the agreement with M/s. Concord Enviro Systems Pvt. Ltd., Mumbai (Maharashtra). Inside the frame seen from left to right Dr. P. K. Tewari, Head, DD, Mr. Prayas Goel, Vice President, M/s. Concord Enviro Systems Pvt. Ltd., Mumbai, Mr. B. P. Sharma, Director, Chemical Engineering Group, Mr. Kamlesh Goel, Managing Director, M/s. Concord Enviro Systems Pvt. Ltd., Mumbai, and Mr. A. M. Patankar, Head, TT&CD.

To the right of Dr. P. K. Tewari, Head, DD, seen from right to left are: Dr. S. Prabhakar, Head, STS, DD, Ms. S. Mule, Mr. T. H. Salunke and Mr. V. K. Upadhyay, all from TT&CD.

To the left of Mr. A. M. Patankar, Head, TT&CD, seen from left to right are: Mr. D. Goswami, Dr. R. C. Bindal, Mr. Sushil Tiwari, Ms. Payel Sarkar and Mr. V. S. Somarajan, all from DD.

The technology consists of preparation of ultrafiltration membrane, it's assembly in spiral configuration and the final making of backwashable spiral ultrafiltration membrane device, for water purification. The backwashable spiral ultrafiltration device has got a membrane of average pore size < 10 nm and can be used at community level water purification, for removal of microorganisms like bacteria, viruses etc. and colloidal species. In view of it's relevance in providing safe drinking water, particularly for waters contaminated with microbiological organisms and turbidity, the technology is useful for societal applications. They can also be used for industrial effluent treatment and in Reverse Osmosis plants for pretreatment. The key features of this technology are: i) Preparation of polysulfone UF membrane in sheet form having a width of up to 1000 mm, ii) Assembly and housing of these UF membranes in a compact spiral configuration which allows the operation of module in large capacities and iii) Backwashing procedure for it's repeated use without the loss of productivity, by restoring stabilized pure water flux.

The Technology Transfer and Collaboration Division coordinated all activities related to the transfer of this technology, such as preparation of technical brochure, technology transfer document, advertisement of the technology, evaluation of the party, technology transfer agreement preparation and the signing of the agreement.

Forthcoming Symposium

DAE Solid State Physics Symposium

DAE - SSPS 2008

The DAE Solid State Physics Symposium, the 53rd in the series, will be held at BARC Mumbai, from Dec. 16-20, 2008. The scientific programme of the symposium includes invited talks, seminars, PhD thesis presentations and contibuted papers. Manuscripts are invited on the following topics and are to be submitted at pap_ssps@barc.gov.in.

a. Phase Transitions
b. Soft Condensed Matter including Biological Systems & Liquid Crystals
c. Nano-materials
d. Experimental Techniques & Devices
e. Liquids, Glasses & Amorphous Systems
f. Surfaces, Interfaces & Thin Films
g. Electronic Structure & Phonons
h. Superconductivity
i. Transport Properties
j. Semiconductor Physics
k. Magnetism including Spintronics
l. Novel Materials

Important Dates

Paper submission	:	August 25, 2008
Registration	:	Nov. 3, 2008
Accomodation	:	Nov. 3, 2008

For accomodation, one may contact the Local Convener & for registration, the Secretary at the following addresses:

Mr. M.R. Singh
Local Convener,
DAE-SSPS 2008, TPPED, BARC,
Mumbai-400 085. INDIA
E-mail : loc_ssps@barc.gov.in
Home page : www.barc.gov.in/symposium/ssps2008

Secretary
DAE-SSPS 2008
SSPD, BARC, Mumbai-400 085 INDIA
E-mail : daessps08@gmail.com

IAEA NATIONAL COORDINATORS' MEETING ON SUPPORTING WEB-BASED NUCLEAR EDUCATION AND TRAINING THROUGH REGIONAL NETWORKING

The first National Coordinators' meeting for IAEA Technical Cooperation Project, Supporting Web-Based Nuclear Education and Training for Regional Networking, was held from 19 to 23 November 2007, in Goa. The meeting was attended by 24 participants from 18 countries and two international organizations; Bangladesh, China, India, Indonesia, Israel, Lebanon, Malaysia, Mongolia, Myanmar, Palestinian A., Philippines, Qatar, Korea (Rep. of), Sri Lanka, Syrian Arab Rep., Thailand, Vietnam, Yemen, European Nuclear Education Network (ENEN) Association and IAEA.

Mr. Y. Yanev, Unit Head of Nuclear Knowledge Management (NKM) delivered the opening remarks, on the first day at the opening session, on behalf of IAEA. He stressed upon the increasing importance of nuclear education and training and articulated his expectations from this meeting. In his response, Dr. Vijai Kumar, Associate Director, Knowledge Management Group, BARC, warmly welcomed all participants and expressed his satisfaction that an important event was successfully launched. On behalf of the local organizing committee, Dr. R. R. Puri, Head, HRDD, BARC gave remarks on all the preliminary groundwork that was carried out for holding the meeting at Goa. As the current Chairperson of the Asian Network for Education in Nuclear Technology (ANENT), Mr. Kyong-Won Han of Korea, Atomic Energy Research Institute (KAERI), Korea, gave a brief review of the past year's activities. Ms. K. Hanamitsu of IAEA, in her capacity as the Scientific Secretary, briefly remarked on the activities of ANENT and extended her appreciation to the host, for holding the meeting at Goa.

A group photograph of the participants and faculty

Inaugural session of IAEA National Coordinators' Meeting. On the dais from left to right Ms. K. Hanamitsu of IAEA, Scientific Secretary of the meeting, Mr. K.W. Han of Korea Atomic Energy Research Institute, Chairperson, ANENT, Mr. Y. Yanev, Head, Nuclear Knowledge Management, IAEA, Dr. Vijai Kumar, Associate Director, Knowledge Management Group, BARC and Dr. R.R. Puri, Head, Human Resource Development Division, BARC.

The technical sessions commenced soon after the brief inaugural session.

Session 1 on the first day involved presentations made by the seven speakers to review and report on the activities related to the project. It was chaired by Dr. R. R Puri of BARC.

In Session 2 on the second day, chaired by Mr. P. De Regge of the European Nuclear Education Network (ENEN) Association, participants from each of the member countries presented the current status of human resources development, nuclear education and training and IT development, in their country and organization.

Session 3 on the third day, chaired by Mr. Karsono of Indonesian National Nuclear Energy Agency (BATAN), was on Development of the ANENT Web-Portal and Cyber Platform. Mr. K. W. Han of KAERI demonstrated and explained the ANENT Web-Portal and the ANENT Cyber Platform. Discussions and further clarifications on the features of the ANENT Web-Portal and Cyber Platform followed.

During Session 4 on the fourth day, current issues and new proposals were clarified and discussed among the participants. The session was moderated by Mr. K.W. Han of KAERI, Korea. Discussions were on collection of training materials to be uploaded to the ANENT, courses to be offered on the cyber platform, and mechanisms / aspects of the RAS 0047 TC Project operation.

Session 5 was devoted to discussions on development of an Action Plan for Project Development which are summarized below:

- Activity 1 – Development of Cyber educational platform (exchange of information & materials and Cyber Learning) by Korea
- Activity 2 – Facilitation of HR Mobility (e.g., roster of lecturers)
- Activity 3 – Promotion of Knowledge Management Practices in Education (e.g., knowledge assist visits to universities)
- Activity 4 – Development of reference curricula (e.g., providing information for future credit transfer and mutual recognition of degrees; information document can be prepared on the situation in different countries)
- Activity 5 – Liaison and communication (all participating countries and IAEA Secretariat).

Dr. R. R. Puri, Head, HRDD, was nominated to be the next ANENT Chairperson for the term 2007-2008. It was agreed that China would be organizing the next ANENT National Coordinators' Meeting in October 2008, with Mr. Muzi Ran, China Institute of Atomic Energy (CIAE) as the next Chairperson for the term 2008-2009.

The closing session was chaired by Dr. R. R. Puri, the new chairperson of the ANENT. He thanked the ANENT members for nominating him as chairperson and expressed confidence that the activity will grow in strength in the coming years. Mr. Y. Yanev of IAEA made his closing remarks to conclude the meeting and expressed his gratitude to the host organization, BARC for their excellent organization and warm hospitality. In his response, Dr. Vijai Kumar, Associate Director, KMG, BARC gave a general overview of the meeting, thanked everyone involved in the activity for organizing and participating in the meeting and wished the activity all success in future endeavours.

भा.प.अ. केंद्र के वैज्ञानिकों को सम्मान

BARC SCIENTISTS HONOURED

ए.बोरगोहैं, एन.के. महेश्वरी, पी.के. विजयन, डी. साहा एवं आर.के. सिन्हा को 25-28 फरवरी 2008 के दौरान इन्डियन सोसाइटी फॉर इलेक्ट्रो-ऍनालिटिकल केमिस्ट्री (आइएसईएसी) द्वारा मुन्नार, केरल में द्वारा आयोजित "डिस्कशन मीट ऑन इलेक्ट्रो-ऍनालिटिकल टेक्नीक्स एन्ड दियर एप्लिकेशंज़" की गोष्ठी में "डेवलोपमेंट ऑफ हाई टेम्परेचर ऑक्सीजन सेंसर फॉर लेड-बिसमथ यूटेक्टिक" नामक शोध-पत्र पर सर्वश्रेष्ठ पुरस्कार प्रदान किया गया। यह शोध-पत्र ए. बोरगोहैं द्वारा प्रस्तुत किया गया।

A paper entitled "Development of High Temperature Oxygen Sensor for Lead Bismuth Eutectic" by A. Borgohain, N. K. Maheshwari, P. K. Vijayan, D. Saha and R. K. Sinha was given the best poster paper award at the "Discussion meet on Electro Analytical Techniques & their applications", organized by the Indian Society for Electro-Analytical Chemistry (ISEAC) at Munnar, Kerala, during Feb 25-28, 2008. The paper was presented by Mr. A. Borgohain.


Mr. A. Borgohain

ए. बोरगोहैं ने वर्ष 1998 में भाभा परमाणु अनुसंधांन केंद्र के रियक्टर इंजीनियरिंग प्रभाग की सदस्यता ली। इनकी अनुसंधान रुचि के क्षेत्र में लेड-बिसमथ एवं मोलटन साल्ट कूलंट टेक्नॉलोजी डेवलोपमेंट फॉर हाई टेंम्परेचर रियक्टरस शामिल हैं। आप द्रव्य धातु उपयोग हेतु आक्सीजन संवेदक एवं नाभिकीय रियक्टरों की सुरक्षा - संबन्धी अध्ययन हेतु ईंधन रॉड अनुकर्ता के विकास में सक्रिय रुप से व्यस्त हैं तथा उष्मीय- द्रवचालित विज्ञान के प्रयोगात्मक एवं सैद्धांतिक अध्ययन में भी कार्यरत हैं।

Mr. A. Borgohain joined the Reactor Engineering Division, BARC in 1998. His research interest is lead-bismuth and molten salt coolant technology development for High Temperature Reactors. He is actively involved in the development of oxygen sensors for liquid metal applications and development of fuel rod simulator for safety related studies of nuclear reactors. He is also involved in experimental as well as theoretical studies on thermal-hydraulics of advanced nuclear reactor systems.


Dr. N.K. Maheshwari

डॉ. एन.के. महेश्वरी ने वर्ष 1987 में भाभा परमाणु अनुसंधान केंद्र के रियक्टर इंजीनियरिंग प्रभाग की सदस्यता ली। निष्क्रिय सुरक्षा प्रणाली अध्ययन एवं उन्नत नाभिकीय रियक्टरों की प्रगत नाभिकीय रियक्टर प्रणाली का विकास इनकी अनुसंधान रुचि के क्षेत्र में हैं। आप गौण रुप से तपाई ईंधन रॉड अनुकर्ता एवं बहाव मानसदर्शन तकनीकों के विकास में व्यस्त हैं। ये उष्मीय- द्रवचालन विज्ञान के प्रयोगात्मक एवं सैद्धांतिक अध्ययन में भी कार्यरत हैं। आप होमी भाभा नैशनल इन्सटिट्यूट, एक मान्यता प्राप्त विश्वविद्यालय के सहायक प्रोफेसर हैं।

Dr. N. K. Maheshwari joined the Reactor Engineering Division, BARC in 1987. His research interest is passive safety system studies and development of advanced nuclear reactor systems. He is involved in the development of indirectly heated fuel rod simulator and flow visualization techniques. He is also actively involved in experimental and theoretical thermal hydraulic studies related to nuclear reactor systems. He is also an Associate Professor at the Homi Bhabha National Institute, a deemed university.

डॉ. पी.के. विजयन, ने वर्ष 1977 में भाभा परमाणु अनुसंधान केंद्र के रियक्टर इंजीनियरिंग प्रभाग (आरईडी) की सदस्यता ली। ये इस समय आरईडी के उष्मीय-द्रवचालन विज्ञान अनुभाग के अध्यक्ष हैं। आप रियक्टर उष्मीय- द्रवचालन क्षेत्र, विशेषकर असाधारण


Dr. P.K. Vijayan

प्राकृतिक परिचालन के जाने माने विशेषज्ञ हैं। आप कई व्यावसायिक समुहों के सदस्य हैं तथा वर्ष 1998 में डीएई टेक्निकल श्रेष्ठता पुरस्कार के प्राप्तकर्त्ता भी हैं। आप होमी भाभा नैशनल इन्सटिट्यूट, एक मान्यता प्राप्त विश्वविद्यालय के प्रोफेसर भी हैं।

Dr P.K. Vijayan joined the Reactor Engineering Division (RED) in 1977. Currently he is the head of thermal hydraulics section of RED. He is a well known expert in the field of reactor thermo hydraulics especially in natural circulation phenomenon. He is a member of several professional bodies. He is a recipient of the DAE Technical Excellence award for the year 1998. He is also a Professor at the Homi Bhabha National Institute, a deemed university.


Mr. Dilip Saha

श्री दिलीप साहा ने वर्ष 1972 में भाभा परमाणु अनुसंधान केंद्र के रियक्टर इंजीनियरिंग प्रभाग (आरईडी) की सदस्यता ली। आरईडी में सदस्यता लेने के पश्चात ये नाभिकीय रियक्टर प्रणाली के उष्मीय-द्रवचालन विज्ञान एवं सुरक्षा क्षेत्र के अनुसंधान तथा विकास कार्य में व्यस्त हैं। प्रारंभ से ही श्री साहा भारी पानी रियक्टर के विकास एवं रूपरेखा में व्यस्त रहें हैं। इस समय ये भाभा परमाणु अनुसंधान केंद्र के रियक्टर इंजीनियरिंग प्रभाग के अध्यक्ष हैं।

Mr. Dilip Saha joined the Reactor Engineering Division in 1972. Ever since he joined RED, he has been involved in research and development work in the area of thermal hydraulics and safety of nuclear reactor systems. Right from it's inception, Mr. Saha has been

involved in the design and development of the Advanced Heavy Water Reactor. Currently, he is Head of Reactor Engineering Division, BARC.


Mr. Ratan Kumar Sinha

श्री रतन कुमार सिन्हा ने वर्ष 1973 में भाभा परमाणु अनुसंधांन केंद्र के रियक्टर इंजीनियरिंग प्रभाग (आरईडी) की सदस्यता ली। ये एक प्रतिष्ठित वैज्ञानिक हैं तथा भाभा परमाणु अनुसंधांन केंद्र के रियक्टर डिज़ाइन एन्ड डेवलोप्मेंट ग्रुप के निदेशक तथा डिज़ाइन मेनिफेक्चरिंग एन्ड ऑटोमेशन ग्रुप के निदेशक पद पर नियुक्त हैं। श्री सिन्हा ने भारतीय अनुसंधान पॉवर रियक्टरों से संबन्धित कई महत्वपूर्ण नियत कार्य संभाले हैं। इस समय ये डिज़ाइन एन्ड डेवलोपमेंट ऑफ इन्नोवेटिव एडवांसड हेव्यी वाटर रियक्टर एन्ड कॅम्पेक्ट हाई टेम्परेचर रियक्टर का मार्गदर्शन कर रहे हैं। श्री सिन्हा ने कई पुरस्कार तथा सम्मान प्राप्त किए हैं। ये नाभिकीय रियक्टर प्रौद्योगिकी क्षेत्र में राष्ट्रीय एवं अंतर्राष्ट्रीय स्तर पर मान्यता प्राप्त विशेषज्ञ तथा विभिन्न समितियों के सदस्य भी हैं।

Mr. Ratan Kumar Sinha joined the Reactor Engineering Division of BARC in the year 1973. He is a Distinguished Scientist and has been designated as Director, Reactor Design & Development Group and Director, Design, Manufacturing and Automation Group of BARC. Mr. Sinha has handled several major assignments related to Indian research and power reactors. He is currently guiding the design and development of the innovative Advanced Heavy Water Reactor and the Compact High Temperature Reactor. Mr. Sinha has received several awards and honours. Mr. Sinha is a nationally and internationally recognized expert in the area of nuclear reactor technology and a member of several national and international committees.


Dr. S.K. Apte

डॉ. श्रीकुमार आपटे, सह निदेशक, जैव चिकित्सा वर्ग एवं अध्यक्ष आणविक जैव प्रभाग, भाभा परमाणु अनुसंधान केंद्र को इन्डियन नैशनल साइन्स अकादमी (आइएनएसए) का प्रतिष्ठापूर्ण प्रोफेसर कृष्णा सहाय बिलग्रामी मेमोरियल मेडल-2007 पुरस्कार प्राप्त हुआ। यह पुरस्कार इन्हें (1) स्ट्रेस एन्ड एडाप्टिव रेसपोन्सिज़ ऑफ एग्रिकल्चरली इम्पोरटेंट बेक्टीरिया, एसपेशली सायानो बेक्टीरिया, टु एनविरोनमेंटल स्ट्रेसिज़, सच एज़ न्यूट्रियन्ट डेफिशन्सी, सोइल सेलिनिटी, डेसिकेशन, हीट-शॉक एन्ड पेसटिसाइड्स, तथा (2) नोवल मोलिक्यूलर मेकानिज़म्ज़ अंडरलाइंग दि एक्सट्रीम रेडियो रेज़िसटंस ऑफ डेइनोकोकस रेडियोडूरंस एन्ड बयोटेकनोलाजिकल एप्लिकेशन्स दियर ऑफ क्षेत्रों में उत्कृष्ट शोध को मान्यता देने हेतु दिया गया। नकद राशि, पदक एवं एक प्रशस्ति-पत्र का यह पुरस्कार इन्हें अक्टूबर 28, 2007 को डिपार्टमेंट ऑफ बयोकेमिस्टरी, इन्डियन इन्सटिट्यूट ऑफ साइन्स, बेंगलोर में आयोजित एक समारोह में प्रोफेसर एम.विजयन ने प्रदान किया।

Dr. Shree Kumar Apte, Associate Director-Biomedical Group (B) and Head-Molecular Biology Division, BARC, received the prestigious Prof. Krishna Sahai Bilgrami Memorial Medal-2007 of the Indian National Science Academy (INSA). The award was conferred in recognition of his outstanding contributions to the elucidation of (a) stress and adaptive responses of agriculturally important bacteria, especially cyanobacteria, to environmental stresses, such as nutrient deficiency, soil salinity, desiccation, heat-shock and pesticides and (ii) novel molecular mechanisms underlying the extreme radioresistance of *Deinococcus radiodurans* and biotechnological applications thereof. The award, which carries a cash prize, a medal and a citation, was presented by Prof. M. Vijayan (President, INSA) at a ceremony held in the Department of Biochemistry, Indian Institute of Science, Bangalore on October 28, 2008.

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Editorial Management : Ms. S.C. Deokattey,

Computer Graphics & Layout : B. S. Chavan, SIRD, BARC

BARC Newsletter is also available at

URL: http://www.barc.gov.in (for private circulation only)