ISSUE NO. 264

बी एआरसी न्यूज़लैटर

BARC NEWSLETTER

JANUARY 2006

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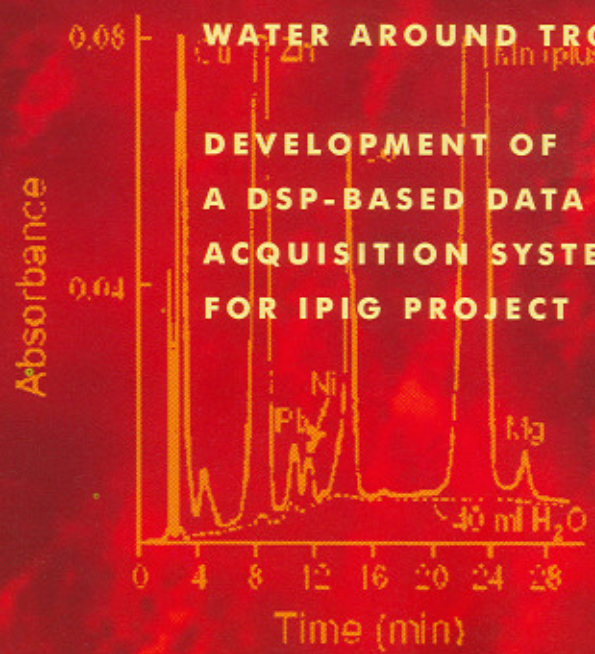

भाभा परमाणु अनुसंधान केंद्र
Bhabha Atomic Research Centre

पंडित जवाहरलाल नेहरू द्वारा परमाणु ऊर्जा संस्थान, ट्रॉम्बे (जिसका बाद में श्रीमती इंदिरा गांधी द्वारा दिनांक 12 जनवरी 1967 को भाभा परमाणु अनुसंधान केंद्र के रूप में पुनर्नामन किया गया) का दिनांक 20 जनवरी 1957 को औपचारिक उद्घाटन किया गया था.

Atomic Energy Establishment Trombay (later renamed as Bhabha Atomic Research Centre on 12 January 1967 by Smt. Indira Gandhi) was formally inaugurated by Pandit Jawaharlal Nehru on 20 January 1957.

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New Year Message from Director, BARC

Dear colleagues,

It gives me immense pleasure to extend my warm greetings and best wishes for a happy and prosperous New Year to all of you and your family members. The year 2006 is of special significance to all of us in BARC as our great institution will be celebrating this year as the Golden Jubilee year.

The last year has been yet another successful year in our developmental efforts in nuclear science and technology and its applications in power generation, agriculture, food preservation, health care, industry and national security. Among the various systems and technologies developed during the last year, I would mention only a few as illustrative examples.

As part of R&D support for 540 MWe PHWRs, various control and instrumentation systems for Unit 3 have been commissioned and the plant is on the course to criticality. The hot commissioning of the PHT system of TAPS-3 was completed in the shortest period so far in the history of Indian PHWRs.

The on-line non-intrusive turbine blade vibration monitoring system developed at BARC has been used to monitor the health of turbine blades of TAPS-4. The technology was also used successfully for the 500 MWe super thermal power plant of NTPC at Ramagundam. The Environmental Survey Laboratory at Tarapur has initiated the programme to extensively monitor the tritium content in the environment of Tarapur where two 540 MWe PHWRs will be operating. The sparger system designed at BARC for introduction of moderator into MAPS-1 calandria has been commissioned to enable full power operation of the unit.

In order to enable continued operation of Zircaloy-2 pressure tube beyond 9.75 effective fuel power years, estimation of the ratio of hydrogen to deuterium contents in selected pressure tubes of KAPS-1 has been carried out. A slit burst test facility for evaluation of fracture toughness and critical crack length of irradiated Zr-2.5% Nb pressure tubes for KAPS-2 has been developed at Post Irradiation Examination Division.

The Aerial Gamma Spectrometry System developed by BARC and other radiation monitoring instruments were installed in MI-17 helicopter and detailed Aerial Gamma Spectrometry Survey has been carried out for the Narora Emergency Planning Zone.

At the request of NPCIL, a methodology based on zone refining technique has been developed to prepare antimony rods of 7 mm diameter for use in the power reactors for generation of neutron sources.

I take this opportunity to congratulate our scientists engaged in the development of pressurized light water reactor system. In some recent experiments, they have achieved hot criticality in such a system and have collected valuable reactor physics data.

Several activities related to R&D for the AHWR development were continued. For the upcoming AHWR critical facility, the reference core consisting of metallic Uranium and Thorium oxide fuel pellets has been fabricated and fuel assemblies are undergoing final quality assurance checks. A test set up to study the performance of passive containment cooling system has been commissioned. Another new facility has recently been completed for studies of instabilities of coolant flow in parallel channels under high pressure, high temperature, 2 phase natural circulation conditions. As per the revised Level-1 Probabilistic Safety Analysis study of AHWR, the estimated core damage frequency has been evaluated.

Construction of Critical Facility building has been completed and equipment and components of AHWR critical facility are being progressively installed.

Preliminary studies were also conducted for developing a 5 MW_{th} Compact High Temperature Reactor to supply high temperature (1000°C) process heat for producing hydrogen. Both prismatic fuel block type and pebble bed type of reactor core are being evaluated for this application. A lattice analysis code to treat the spherical geometry has been developed to consider pebble bed type of reactor.

For carrying out thermal hydraulic studies on the coolant circuit of the Compact High Temperature Reactor, the fabrication and erection of a liquid metal engineering test loop, using lead-bismuth as the working fluid has been completed.

Our research reactors APSARA, CIRUS and DHRUVA were operational with impressive availability factors. The reactors were well utilized for R&D activities and for radioisotope production. Utilization of APSARA for

various R&D activities include Neutron Activation Analysis, Radiation Damage studies, Forensic research and Neutron Radiography of Zr-Nb pressure tubes for blister detection.

Performance of CIRUS was very good with an availability factor of 75.5%. The reactor was utilized for thorium irradiation in Graphite reflector region and production of radioisotopes. Irradiation of Argon and Krypton gases has commenced and the radioisotopes produced are used as radio tracers in process industries.

DHRUVA recorded the highest ever availability factor of 78.2% for the year 2005 since its commissioning. The performance of DHRUVA fuel has improved considerably after introduction of thicker aluminium clad. Regular production and supply of radioisotopes continued. Endurance testing of 2 MW In-Pile Loop Test Section was carried out and vibration signatures were monitored. In-Service Inspection campaign of equipment and piping of the primary coolant system has started.

In the context of evaluation and generation of nuclear data, our work on KAMINI has received international acclaim.

In the context of the fast reactor development program, manufacture of axial breeder blanket pellets required for PFBR core has been taken up and 10% of the requirement of the first core has been produced. First end plug welding of MOX fuel pins for PFBR has started at Advanced Fuel Fabrication Facility, Tarapur. Research programme has been initiated for characterization and evaluation of thermo-physical properties of binary and ternary metallic fuels which have a great promise in improving the breeding ratio.

Operation of Plutonium Plant at Trombay has been resumed after major modifications and repairs. At Waste Immobilisation Plant, Trombay, all the three furnaces were made operational and vitrification of high level waste has been restarted. Campaign for tank remediation by ion exchange (TRIX-II) treatment of low level waste at Trombay is progressing well and about 900 m^3 of waste has been treated so far using indigenously developed resin. A new scheme for chemical treatment of low level waste generated during TRIX-II campaign has been implemented on plant scale. Advanced vitrification system at Tarapur for vitrification of high level waste by joule heating is ready for conducting runs with depleted uranium.

The fluidized bed thermal de-nitration technology has been successfully established on synthetic ammonium nitrate solution and further studies are in progress to arrive at the suitable process parameters. Once established, the process can be employed for decomposition of ammonium nitrate solution generated both in the front and in the back end of the nuclear fuel cycle.

Significant progress has been made on the 10 MeV RF based electron linac being commissioned at Electron Beam Centre, Kharghar, Navi Mumbai. The development work on the electron linac cavity has been completed. A pulsed klystron based microwave power source for driving the linac cavity has been made in collaboration with SAMEER. Laser based liquid metal level sensor involving triangulation technique has been developed and integrated with the experimental mercury loop for measuring the free surface of mercury during experiments. The sensor has applications in measuring distances in radioactive environment.

For the K-500 superconducting cyclotron being built at Variable Energy Cyclotron Centre, the important mechanical components such as three pairs of DEE stems (resonators), 3 nos. of RF amplifier systems, support structures and drive mechanisms have been built in BARC and delivered to VECC.

For the EXAFS beamline of INDUS II synchrotron for Raja Ramanna Centre for Advanced Technology, Indore, several components and systems have been assembled and integrated together with appropriate computer control system.

The researchers working in the area of astrophysics in BARC were successful in detecting emission of TeV energy gamma from the BLAZER Mercurian-421 during the recent observation spell in Dec-05 to Jan-06. The TACTIC gamma ray telescope at Mt.Abu has detected flaring episode from this extra galactic object earlier also in 2001 and 2003. The recent observation spell of the present close object which is at 400 million light years away was also monitored in the optical band using 2 m Hanle telescope.

Structural analysis was performed for the 32 m diameter tracking, dish antenna to be used by ISTRAC for CHANDRAYANN-1 mission. The development of control servo system for the 32 m deep space network antenna is also progressing well in BARC.

A quadrupole Mass Analyser developed by BARC has attained the capability of providing a mass resolution of 1 amu, and a range of mass numbers upto 300 amu.

Photo-absorption experiments on some biogenic volatile organic molecules were carried out using beamline at INDUS-1.

Anti-reflection coated polarizing beam combiner for multiplexing two high power dye lasers (573-576 nm and 594-598 nm) has been successfully developed. The device comprises 37 layers of TiO_2 / SiO_2 thin films deposited in sequence under controlled conditions.

Air-spaced Fabry Perot etalon devices with ultra fine wave length resolution, which are not commercially available in the country, were developed for dye laser wavelength stabilization.

Research activities in chemistry resulted in several important developments. The sonochemical splitting of water to produce hydrogen from water methanol mixture has been well established. A large number of room temperature ferromagnetic semiconductor oxide materials have been prepared and investigated in detail to understand the reasons for the appearance of magnetic ordering at room temperature in these dilute magnetic semiconductors which are important spintronics.

Polypropylene membranes grafted with acrylic acids using radiation technology have been developed for use in alkaline batteries as separators. The grafted synthetic polymer in comparison to the conventional cellulose membranes is found to have superior lifetime. The process has been scaled up to graft 100 m long films for complete industrial trials.

Total reflection X-ray fluorescence technique has been successfully adopted to differentiate rare earth tagged ink samples from the untagged ink with high sensitivity. The technique has important applications in forensic investigation to detect genuineness of printed documents.

The Honourable Prime Minister of India, Dr. Manmohan Singh visited BARC, addressed the scientific community on November 15, 2005 and inaugurated the new Super Computing Facility. The Parallel Computing Facility ANUPAM-Ameya with 512 nodes cluster has now attained 1.7 Teraflopp High Performance Linpack (HPL) rating, which is expected to go upto 2 Teraflopp shortly.

To facilitate BARC researchers to have online access to the scientific and technical information, the online information gateway LAKSHYA and intranet SARASWATI have been successfully developed and implemented. The prototype E-Sangrah, a digital library of Ph.D theses and publications of BARC scientists and engineers is ready and will soon be made available to BARC community. To promote Hindi activities in the Centre, a dynamic font technology based Hindi version of BARC website has been designed and hosted.

In the past three months, BARC has signed 5 MoUs and 6 technologies were transferred to the Industry. The MoU with National Institute of Ocean Technology was successfully implemented by commissioning low temperature thermal desalination plant to produce 1 lakh litres of fresh water per day from sea water at Kavaratti, Lakshadweep. The second MoU for the development of Instrumented Pipe Inspection Gauge (IPIG) and Caliper IPIG for other sizes of oil pipelines has been signed with Indian Oil Corporation Limited (IOCL) in October last year.

The crop improvement program of Nuclear Agriculture and Bio-technology Division continued to make excellent progress. A new groundnut variety TG 38 B has been identified for release for Zone IV comprising Orissa, West Bengal, Bihar and North Eastern States by the Indian Council of Agricultural Research (ICAR). The protocol for tissue culture production of sugarcane plants has been established and plants are being field evaluated at Parbhani and Akola in Maharashtra. In blackgram, DNA based molecular marker linked to Mungbean mosaic virus resistance has been identified.

The technology was developed using radiation for making packed ready-to-eat pomegranate arils and French beans during this period. India's first transgenic cynobacteria expressing regulator of heterocyst development and green fluorescent protein genes were successfully constructed under a Department of Bio-Technology sponsored project. A novel protein recycling phenomenon was shown to be a major component of post irradiation of Dinococus radiodurans from exposure to 6-10 kGy of ^{60}Co gamma rays.

In conclusion, I would like to emphasise that we have plenty of challenges for the future. With the synergistic effort of all of us in BARC the scientists, engineers, technicians and administrators, I am sure, we will be able to rise to the occasion to meet the future challenges in a manner consistent with the tradition of BARC.

Srikumar Banerjee

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प्रिय साथियों,

आप और आपके परिवार के सदस्यों को नव वर्ष की हार्दिक शुभकामनाएं देते हुए मुझे अपार हर्ष हो रहा है । वर्ष 2006 भाभा परमाणु अनुसंधान केंद्र में हमारे लिए विशेष महत्वपूर्ण है क्योंकि इस वर्ष हमारा संस्थान अपना स्वर्ण जयंती वर्ष मना रहा है ।

पिछला वर्ष, विद्युत उत्पादन, कृषि, खाद्य परिरक्षण, स्वास्थ्य देखभाल, उद्योग एवं राष्ट्रीय सुरक्षा के क्षेत्र में नाभिकीय विज्ञान एवं प्रौद्योगिकी में किए गए हमारे विकासात्मक प्रयासों और उनके अनुप्रयोगों के परिप्रेक्ष्य में एक और सफल वर्ष रहा है । मैं, पिछले वर्ष के दौरान विकसित विभिन्न प्रणालियों/प्रौद्योगिकियों में से उदाहरण के लिए कुछ के बारे में बताना चाहता हूँ ।

540 मेगावाट पीएचडब्ल्यूआर हेतु सहयोगी अनुसंधान एवं विकास कार्य के अंतर्गत यूनिट -3 के लिए विभिन्न नियंत्रण तथा उपकरण प्रणालियाँ स्थापित की गई हैं और संयंत्र क्रांतिक होने की प्रक्रिया में है। टीएपीएस-3 की पीएचटी प्रणाली का हॉट कमीशनन बहुत कम अवधि में पूरा हुआ जो अब तक भारत के पीएचडब्ल्यूआर के इतिहास में सबसे कम अवधि है ।

भापअ केंद्र में ऑन-लाइन नान-इंस्ट्रूसिव टरबाइन ब्लेड वाइब्रेशन मानीटरन प्रणाली विकसित की गई है जिसका प्रयोग टीएपीएस-4 के टरबाइन ब्लेडों के स्वास्थ्य के मानीटरन हेतु किया गया है । इस प्रौद्योगिकी का रामगुंडम स्थित एनटीपीसी के 500 मेगावाट सुपर कोयला बिजलीघर के लिए सफलतापूर्वक इस्तेमाल भी किया गया है । तारापुर स्थित पर्यावरण सर्वेक्षण प्रयोगशाला ने तारापुर के पर्यावरण में ट्रिशियम की मात्रा के व्यापक मानीटरन के कार्यक्रम को प्रारंभ किया जहाँ दो 540 मेगावाट के पीएचडब्ल्यूआर प्रचालित होंगे । एमएपीएस-1 के केलेड्रिया में मंदक के रूप में पुनःस्थापन हेतु भापअ केंद्र में अभिकल्पित स्पार्जर प्रणाली का कमीशनन किया गया है ताकि यूनिट को बिजली की पूरी क्षमता से प्रचालित किया जा सके ।

जिर्कोलॉय-2 दाबित ट्यूब के प्रचालन को 9.75 प्रभावी ईंधन शक्ति वर्षों के बाद भी जारी रखने के उद्देश्य से केएपीएस-1 के चयनित दाबित ट्यूबों में हॉइड्रोजन से ड्यूटीरियम के प्रतिशत के प्राक्कलन का कार्य किया गया है । केएपीएस-2 हेतु विकिरणित Zr-2.5% Nb दाबित ट्यूबों की विभंजन कठोरता और क्रांतिक दरार की लम्बाई के मूल्यांकन हेतु एक स्लिट बर्स्ट टेस्ट सुविधा का पश्च विकिरणन जाँच प्रभाग में विकास किया गया है ।

भापअ केंद्र द्वारा विकसित एरियल गामा स्पेक्ट्रोमिट्री प्रणाली और अन्य विकिरण मानीटरन उपकरण, एमआई-17 हेलीकॉप्टर में स्थापित किए गए और नरोरा आपातकाल योजना क्षेत्र हेतु एरियल गामा स्पेक्ट्रोमिट्री सर्वेक्षण किया गया है ।

एनपीसीआईएल के अनुरोध पर, बिजली रिएक्टरों में न्यूट्रान स्रोत के उत्पादन हेतु 7 मिली मीटर व्यास की एन्टिमनी छड़ें तैयार करने के लिए एक कार्यप्रणाली आधारित जोन परिष्करण प्रौद्योगिकी विकसित की गई ।

इस अवसर पर मैं दाबित हल्के पानी रिएक्टर तंत्र से जुड़े हमारे वैज्ञानिकों का अभिनंदन करता हूँ । हाल ही में कुछ प्रयोगों में उन्होंने एक ऐसी प्रणाली में तप्त क्रांतिकता प्राप्त की है और मूल्यवान रिएक्टर भौतिकी के आंकड़े भी प्राप्त किए हैं ।

एएचडब्ल्यूआर विकास हेतु संबंधित विभिन्न अनुसंधान एवं विकास गतिविधियाँ जारी रहेंगी । एएचडब्ल्यूआर क्रांतिक सुविधा के परिणाम हेतु संदर्भित कोर धातुकी यूरेनियम और थोरियम ऑक्साइड ईंधन गुटिकाओं की संरचना की गई और ईंधन समुच्चयों की अंतिम गुणवत्ता जाँच की जा रही है । निष्क्रिय संरोधन शीतलन प्रणाली के कार्यनिष्पादन के अध्ययन हेतु एक टेस्ट सेट-अप का कमीशनन किया गया । समानांतर चैनलों में उच्च दाब, उच्च तापमान, 2 कला प्राकृतिक संचरण परिस्थितियों के अंतर्गत शीतलक के प्रवाह में अस्थिरता के अध्ययन हेतु हाल ही में एक नई सुविधा का स्थापन किया गया। एएचडब्ल्यूआर के परिशोधित लेवल-1 प्रायिकतात्मक संरक्षा विश्लेषण के अनुसार क्रोड क्षति आवृत्ति परिकलन का मूल्यांकन किया गया । क्रांतिक सुविधा भवन का निर्माण हो चुका है एवं एएचडब्ल्यूआर, क्रांतिक सुविधा के उपस्कर एवं घटकों का स्थापन कार्य प्रगति पर है ।

हाइड्रोजन के उत्पादन हेतु उच्च तापमान (1000° से.) प्रक्रम ऊष्मा आपूर्ति हेतु एक 5 MW_{th} संहत उच्च तापमान रिएक्टर के विकास के लिए प्रारंभिक अध्ययन भी किए गए हैं । इस अनुप्रयोग हेतु प्रिज्मेटिक फ्यूयल ब्लाक टाइप एवं पेबल बेड टाइप के रिएक्टर क्रोड का मूल्यांकन किया जा रहा है । पेबल बेड टाइप के रिएक्टर के विचारार्थ गोलीय ज्यामिति के उपचार हेतु एक लैटिस विश्लेषण क्रोड विकसित किया गया है ।

संहत उच्च तापमान रिएक्टर के शीतक परिपथ में तापीय जलगतिक अध्ययन करने हेतु वर्किंग फ्लूइड के रूप में लैड- बिस्मथ के प्रयोग द्वारा द्रव धातु इंजीनियरी जाँच लूप का संविरचन एवं स्थापन किया गया है ।

हमारे अनुसंधान रिएक्टर अप्सरा, सायरस एवं ध्रुवा प्रभावपूर्ण उपलब्धता गुणांक सहित प्रचालनरत रहे । रिएक्टरों का अनुसंधान एवं विकास गतिविधियों तथा रेडियो आइसोटोप उत्पादन हेतु पूर्ण रूप से प्रयोग किया गया । अप्सरा के विभिन्न अनुसंधान एवं विकास गतिविधियों हेतु प्रयोग में न्यूट्रान सक्रिय विश्लेषण, विकिरण क्षति अध्ययन, फोरेंसिक अनुसंधान तथा डिटेक्शन हेतु Zr-Nb दाबनलियों की न्यूट्रान रेडियोग्राफी शामिल हैं ।

75.5% उपलब्धता गुणांक के साथ सायरस का कार्य-निष्पादन बहुत अच्छा रहा । रिएक्टर का प्रयोग, ग्रेफाइट प्रतिबिंबक में थोरियम किरणन एवं रेडियो आइसोटोपों के उत्पाद हेतु किया गया । आर्गन एवं क्रिप्टोन गैसों का किरणन आरंभ हो चुका है एवं उत्पन्न रेडियो आइसोटोपों का संसाधन उद्योगों में रेडियोट्रेसर के रूप से उपयोग किया जा रहा है ।

ध्रुवा का वर्ष 2005 में उसके कमीशनन से लेकर अब तक का उच्चतम उपलब्धता गुणांक 78.2% रहा । थिकर एल्यूमिनियम क्लैड के प्रयोग के बाद ध्रुवा ईंधन के निष्पादन में काफ़ी प्रगति हुई है। रेडियो आइसोटोपों का नियमित उत्पादन तथा उसकी आपूर्ति जारी रही । 2 MW इन-पाइल लूप टेस्ट सेक्शन की सहनशक्ति की जाँच की गई एवं कंपन सिग्नेचरों का मानीटरन किया गया । प्राथमिक शीतक प्रणाली के उपस्कर एवं पाइपिंग का सेवाकालीन निरीक्षण प्रारंभ किया गया ।

नाभिकीय आँकड़ों के मूल्यांकन एवं तैयार करने के संदर्भ में कामिनी पर हमारे कार्य को अंतर्राष्ट्रीय ख्याति मिली है ।

तीव्र रिएक्टर विकास कार्यक्रम के संदर्भ में पीएफबीआर क्रोड हेतु आवश्यक अक्षीय अभिजनक आवरण गुटिकाओं का विनिर्माण प्रारंभ किया गया एवं प्रथम क्रोड की 10% आवश्यकता का उत्पादन किया गया । प्रगत ईंधन संविरचन सुविधा, तारापुर में पीएफबीआर हेतु मॉक्स ईंधन पिनों का फर्स्ट एण्ड प्लग वेल्डिंग का कार्य प्रारंभ हो चुका है । द्विभाजी एवं त्रिभाजी धातु ईंधनों के ताप-भौतिक गुणधर्मों के अभिलक्षणन एवं मूल्यांकन पर अनुसंधान कार्य किया गया है जो ब्रीडिंग अनुपात बढ़ाने के लिए बहुत महत्वपूर्ण है ।

बड़े परिष्करण एवं मरम्मत कार्य के पश्चात ट्रॉम्बे में प्लूटोनियम संयंत्र का प्रचालन पुनः आरंभ हो गया है । अपशिष्ट निश्चलीकरण संयंत्र, ट्रॉम्बे में तीनों भट्टियाँ प्रचालनरत हो गई हैं तथा उच्चस्तरीय अपशिष्ट का काँचीकरण का कार्य पुनः आरंभ हो गया है । निम्नस्तरीय अपशिष्ट के आयन एक्सचेंज (TRIX-II) उपचार द्वारा टैंक उपचारीकरण हेतु कार्य अच्छी प्रगति पर है तथा स्वदेश में विकसित रेज़िन द्वारा अब तक लगभग 900 घनमीटर अपशिष्ट का उपचार किया गया है । TRIX-II के दौरान निर्मित निम्नस्तरीय अपशिष्ट के रासायनिक उपचार हेतु एक नवीन योजना संयंत्र स्तर पर लागू की गयी है। तारापुर में जूल-ऊष्मन द्वारा उच्चस्तरीय अपशिष्ट के कॉचीकरण हेतु प्रगत काँचीकरण प्रणाली निःशेष यूरेनियम के साथ प्रचालन हेतु तैयार है ।

सिन्थेटिक अमोनियम नाईट्रेट विलयन पर तरल-तल ताप डिनाइट्रीकरण प्रौद्योगिकी सफलतापूर्वक स्थापित कर ली गई है तथा उपयुक्त प्रक्रिया पैरामीटर प्राप्त करने हेतु आगे के अध्ययन कार्य जारी हैं। एक बार स्थापित होने पर प्रक्रिया का उपयोग नाभिकीय ईंधन चक्र के अग्र एवं पश्च भाग दोनों में निर्मित अमोनियम नाइट्रेट विलयन के अपघटन हेतु किया जा सकता है ।

इलेक्ट्रॉन किरणपुंज केन्द्र, खारघर, नवी मुंबई में स्थापित 10 MeV RF पर आधारित इलेक्ट्रॉन लाइनेक के कार्य में उल्लेखनीय प्रगति हुई है ।

इलेक्ट्रॉन लाइनेक कैविटी पर विकासात्मक कार्य पूर्ण कर लिये गये हैं । समीर के सहयोग से लाइनेक कैविटी के प्रचालन के लिए एक स्पन्द क्लाइस्ट्रॉन आधारित माइक्रोवेव पॉवर स्रोत बना लिया गया हैं ।

लेसर आधारित, त्रिभुज तकनीक वाले तरल धातु लेबल सेंसर का विकास कर लिया गया है और प्रयोगों के दौरान पारे की मुक्त सतह के मापन के लिए प्रयोगात्मक पारा लूप के साथ इसे जोड़ा गया है । विकिरण सक्रिय वातावरण में दूरी मापन के लिए इस सेंसर का अनुप्रयोग किया जाता है ।

परिवर्ती ऊर्जा साइक्लोट्रॉन केन्द्र पर बनाए जा रहे K-500 अतिचालक साइक्लोट्रॉन के लिए महत्वपूर्ण यांत्रिक घटकों जैसे - DEE स्टेम्स (रेज़ोनेटर्स) के तीन जोड़े, तीन RF एम्पलीफायर प्रणालियाँ, सहायक संरचनाएं और ड्राइव मेकेनिज्म का भापअ केंद्र में निर्माण किया गया है और उन्हें वीईसीसी को भेजा गया है ।

राजा रामण्णा प्रगत प्रौद्योगिकी केन्द्र, इन्दौर हेतु इन्डस II सिंक्रोट्रोन की EXAFS बीमलाइन हेतु अनेक घटकों एवं प्रणालियों का समुच्चयन किया गया और उन्हें उचित कंप्यूटर नियंत्रण प्रणाली के साथ जोड़ा गया है ।

भापअ केन्द्र में खगोल भौतिकी क्षेत्र में कार्यरत् अनुसंधानकर्ताओं ने हाल ही में दिसम्बर 05 से जनवरी 06 के बीच प्रेषण अवधि के दौरान BLAZER मरक्यूरिन-421 से TeV ऊर्जा गामा के उत्सर्जन की सफलतापूर्वक पहचान की । इससे पूर्व 2001 एवं 2003 में भी माउंट-आबू में TACTIC गामा किरण टेलिस्कोप द्वारा इस अतिरिक्त मंदाकिनीय पदार्थ से फ्लेयरिंग एपीसोड की पहचान की गई थी । हाल ही में 400 मिलियन प्रकाश वर्ष दूर स्थित वर्तमान संवृत्त पिंड 2 m हानले टेलिस्कोप का प्रयोग करते हुए ऑप्टीकल बैन्ड में मॉनीटरन किया गया ।

32 मीटर ब्यास के ट्रैकिंग, चंद्रयान-1 मिशन हेतु ISTRAC द्वारा प्रयुक्त किए जाने वाले डिश एन्टीना का संरचनात्मक विश्लेषण किया गया । भापअ केंद्र में 32 मीटर गहरे स्पेस नेटवर्क एंटीना हेतु नियंत्रण सर्वो प्रणाली का विकास भी प्रगति पर है ।

भापअ केंद्र द्वारा विकसित क्वाड्रापोल मास एनालाइज़र 1 amu का द्रव्यमान रेजोल्यूशन तथा 300 amu तक द्रव्यमान संख्या की रेंज उपलब्ध करवाने की क्षमता रखता है ।

इन्डस-1 में बीमलाइन का प्रयोग करते हुए कुछ बायोजैनिक वाष्पशील कार्बनिक अणुओं पर फोटो-अवशोषण प्रयोग किये गये ।

दो उच्च शक्ति वाले डाय लेसरों (573-576 और 594-598 nm) के मल्टीप्लेक्सिंग हेतु एन्टी-रिफ्लेक्शन लेपित पोलराइजिंग बीम कम्बाइनर का सफलतापूर्वक विकास किया गया है । इस उपकरण में नियन्त्रित परिस्थितियों के अंतर्गत श्रंखलाबद्ध TiO_2/SiO_2 तनु फिल्मों की 37 परतों का समावेश है ।

डाय लेजर तरंगदैर्ध्य स्थिरीकरण हेतु , देश में व्यवसायिक रूप से अनुपलब्ध अल्ट्रा फाइन तरंगदैर्ध्य विभेदक सहित एअर-स्पेस्ड फ़ेबरी पेरोट इटेलोन उपकरणों का विकास किया गया ।

रासायनिकी में होने वाली विभिन्न अनुसंधान गतिविधियों के महत्वपूर्ण परिणाम सामने आये हैं । जल मेथेनोल मिश्रण से हाइड्रोजन बनाने हेतु जल के सोनोरसायन विपाटन का कार्य अच्छी तरह से स्थापित किया गया है । बड़ी संख्या में कक्ष तापमान पर लौहचुम्बकीय अर्धचालक ऑक्साइड पदार्थ तैयार करके जाँचे गये ताकि तनु चुम्बकीय अर्धचालकों में जो कि महत्वपूर्ण स्पिन्ट्रॉनिक्स है, कक्ष तापमान पर चुम्बकीय क्रम विन्यास की उपस्थिति का कारण विस्तृत रूप से समझा जा सके ।

सेपरेटर्स जैसी क्षारीय बैटरीज़ में प्रयोग हेतु विकिरण प्रौद्योगिकी का प्रयोग करते हुए एक्रिलिक अम्ल से रोपित पॉलीप्रोपाइलिन झिल्लियों का विकास किया गया है। रोपित सिन्थेटिक पॉलीमर का परम्परागत सेल्यूलोज़ झिल्लियों की तुलना में जीवन काल अधिक अच्छा पाया गया । पूर्ण औद्योगिक

परीक्षणों हेतु 100 मीटर लम्बी फिल्मों को रोपित करने हेतु प्रक्रिया का उन्नयन किया गया है ।

उच्च संवेदनशीलता वाली अनटैग्ड इंक से विरल मृदा टैग्ड इंक नमूनों को अलग करने हेतु टोटल रिफ्लेक्शन एक्स-रे संदीप्ति तकनीक को सफलतापूर्वक अपनाया गया है । इस तकनीक का महत्वपूर्ण अनुप्रयोग छपे हुए दस्तावेजों की सत्यता पहचानने हेतु फारेंसिक न्यायिक जाँचों में किया जाता है ।

भारत के माननीय प्रधानमंत्री डॉ. मनमोहन सिंह का दिनांक 15 नवंबर 2005 को भापअकेंद्र में आगमन हुआ तथा उन्होंने वैज्ञानिक समुदाय को संबोधित किया । उन्होंने एक नयी सुपर कंप्यूटिंग सुविधा का उद्घाटन किया । 512 नॉड्स क्लस्टर वाली समान्तर कंप्यूटिंग सुविधा अनुपम-अमेया ने अब 1.7 टेराफ्लॉप हाई परफोरमेन्स लिंकपेक (HPL) रेटिंग प्राप्त कर ली है जो शीघ्र ही बढ़ कर 2 टेराफ्लॉप होने वाली है ।

भापअ केंद्र के अनुसंधानकर्ताओं को सुविधा उपलब्ध करवाने हेतु वैज्ञानिक एवं तकनीकी सूचनाओं के लिए ऑन लाइन अभिगम उपलब्ध करवाये गये हैं । ऑन लाइन सूचना गेटवे लक्ष्य तथा इन्ट्रानेट सरस्वती सफलतापूर्वक विकसित करके कार्यान्वित किये गये हैं । भापअ केन्द्र वैज्ञानिकों एवं इंजीनियरों के पीएचडी शोधग्रन्थों एवं प्रकाशनों का एक डिज़िटल पुस्तकालय प्रोटोटाइप ई-संग्रह तैयार है तथा शीघ्र ही भापअ केंद्र में कार्मिकों को उपलब्ध कराया जायेगा । केन्द्र में हिन्दी गतिविधियों को बढ़ावा देने के लिए भापअ केंद्र में डाइनामिक फॉंट प्रौद्योगिकी पर आधारित हिन्दी वेबसाइट की रचना की गई है तथा उसे आरंभ कर दिया गया है ।

पिछले तीन महीनों में भापअ केंद्र ने 5 समझौता ज्ञापन हस्ताक्षरित किये हैं तथा 6 प्रौद्योगिकियों का उद्योगों को हस्तान्तरण किया है । नेशनल इंस्टीट्यूट ऑफ ओशन टेक्नोलॉजी के साथ समझौता ज्ञापन सफलतापूर्वक क्रियान्वित किया गया है जिसके द्वारा कावारट्टी, लक्षदीप में समुद्र के पानी से प्रतिदिन एक लाख लीटर ताज़े जल का उत्पादन करने हेतु निम्न तापमान पर तापीय निर्लवणीकरण संयंत्र का कमीशनन किया गया है । दूसरा समझौता ज्ञापन इंस्ट्रूमेंटेड पाइपलाइन इन्सपेक्शन गेज़ (IPIG) एवं अन्य आकारों की तेल पाइपलाइनों हेतु कैलीपर IPIG के विकास के लिए इंडियन ऑइल कारपोरेशन लिमिटेड (IOCL) के साथ पिछले वर्ष अक्टूबर में हस्ताक्षरित किया गया ।

नाभिकीय कृषि एवं जैव प्रौद्योगिकी प्रभाग के फ़सल सुधार कार्यक्रम में बहुत अच्छी प्रगति हुई है । मूंगफली की एक नई किस्म TG 38B की पहचान की गई है तथा इंडियन काउंसिल ऑफ एग्रीकल्चर रिसर्च (ICAR) द्वारा उसे ज़ोन IV, जिसमें उड़ीसा, पश्चिमी बंगाल, बिहार एवं उत्तर पूर्वी राज्य आते हैं, के लिए जारी किया गया है । गन्ने के पौधों के टिश्यू कल्चर प्रोडेक्शन हेतु प्रोटोकॉल विकसित किया गया है और पौधों का महाराष्ट्र के परभणी एवं अकोला में खेती करके मूल्यांकन किया जा रहा है । काले चने में वायरस रोधी मूंगबीन मोज़ेक से संबंधित DNA आधारित मॉलेकुलर मार्कर की पहचान की गई है ।

इस अवधि के दौरान पैक किये हुए खाने के लिए तैयार अनार एवं फ्रेंच बीन्स हेतु विकिरण का प्रयोग करते हुए प्रौद्योगिकी का विकास किया गया । जैव प्रौद्योगिकी विभाग द्वारा प्रायोजीत परियोजना के तहत हिटरोसिस्ट विकास तथा हरित फ्लूरीसेंट प्रोटीन जीन्स के नियामक दर्शक भारत के प्रथम ट्रांसेनिक सायनोबैक्टिरिया का सफल निर्माण किया गया। एक नई प्रोटीन पुनश्चक्रण प्रक्रिया, ^{60}Co अल्फा किरणों के 6-10 KGy तक उदभासन से संबंधित डायनोकोकस रेडियोड्यूरन्स के पश्च किरणन की एक प्रमुख घटना रही ।

अन्त में, मैं यह रेखांकित करना चाहूँगा कि भविष्य में हमारे समक्ष अनेक चुनौतियाँ हैं । मुझे विश्वास है कि हम भापअ केंद्र के वैज्ञानिकों, इंजीनियरों एवं प्रशासकों के सम्मिलित प्रयासों के द्वारा, इस केंद्र की परम्परा के अनुसार, भविष्य में इन सब चुनौतियों का सफलतापूर्वक सामना कर सकेंगे ।

श्रीकुमार बॅनर्जी

बी एआरसी न्यूज़लैटर
BARC NEWSLETTER

50 YEARS OF PIONEERING R&D IN NUCLEAR SCIENCE

Reminiscences of Early Days

To mark the beginning of the Golden Jubilee Year celebrations of BARC, a function was organised on Friday afternoon, January 20, 2006 in the Central Complex Auditorium, BARC, which was devoted to the "Reminiscences of Early Days". Twenty eight scientists from within and outside Mumbai, who were instrumental in shaping India's nuclear programme during its formative years, were specially invited, to attend the function. Dr H.N. Sethna, Dr P.K. Iyengar, Mr S.D. Soman, Dr V.K. Iya, Prof. B.M. Udgaonkar, Mr S.M. Sundaram, Dr G. Venkataraman, Mr R.K. Garg, Dr N. Kondal Rao, Prof. R.Y. Deshpande, Mr S. Sen, Mr T.K.S. Murthy, Mr N. Veeraraghavan and Dr K.S. Venkateswarlu reminisced about the institution's early days and recalled the challenges and the excitement of working in the pioneering field of atomic and nuclear physics, under the guidance of Dr Homi Bhabha.

Dr Srikumar Banerjee, Director, BARC honoured the distinguished invitees, by presenting them with a shawl and a set of the commemorative volumes of 50 years of DAE, a photo album titled "BARC Today" and also a framed photograph of Pandit Nehru in conversation with Dr Bhabha (with the Apsara reactor in the background). The function was also attended by a large number of senior scientists from other DAE units in Anushaktinagar. Dr Banerjee welcomed the large gathering at the Central Complex auditorium and expressed his gratitude to all the distinguished invitees for having readily accepted his invitation to reminisce about the early days of AEET. He also briefly mentioned about the activities envisaged as part of the golden jubilee year celebrations of the centre. He took the opportunity to talk about the milestones in the Indian Atomic Energy Programme achieved during the last fifty years and said that all this would not have been possible without our founding fathers, some of whom were present in the function. Dr Anil Kakodkar, Chairman, Atomic Energy Commission and Secretary to the Government of India, could not attend the function due to unavoidable reason and consequently his message for the occasion was read by Dr Banerjee.

BARC History

In the year 1954, it was decided to build the Atomic Energy Establishment at Trombay, screened from the city of Mumbai by Trombay hill on the west and bordered by the waters of the upper reaches of the Bombay harbor on the east. The Atomic Energy Establishment, Trombay (AEET) and India's first swimming-pool-type reactor were formally inaugurated on January 20, 1957 by the then Prime Minister Pandit Jawaharlal Nehru. The swimming pool reactor was named Apsara. Later, the establishment was renamed in the memory of it's founder as Bhabha Atomic Research Centre (BARC) on January 12, 1967 by former Prime Minister Smt. Indira Gandhi. Consequently, the year 2006-2007 happens to be the Golden Jubilee year of the centre, which is being celebrated in a variety of ways, with a focus on our past achievements and future goals.

Dr S. Banerjee, Director, BARC, addressing the dignitaries during the Golden Jubilee celebrations at the Central Complex auditorium, BARC

After the welcome address of Director, BARC, the distinguished guests were invited for their reminiscences of the early days. Dr Sethna, a former Chairman of AEC, and who happened to be one of the few who had initiated this programme about 50 years ago, gave outlines of the Indian Atomic Energy programme which were formulated when there was hardly any technological or engineering expertise available in the country. The objective was to make use of our natural resources to the fullest extent possible and draw a road map to accomplish the same. He was extremely pleased to assess the success of the Indian atomic energy programme and attributed it to the whole-hearted support extended by Pandit Nehru and to the vision of Dr Bhabha. He also made a special mention of the Member Finance, Mr I.G. Patel who had initiated an excellent administrative system, which enabled rapid growth. He said that their top priority then, was to ensure that the establishment would not turn into a bureaucracy-ridden government institution. Speaking of the peaceful experiment of May 18, 1974, Dr Sethna described it to be a definite moment in our history. Dr G. Venkataraman, a distinguished physicist was also of the same opinion and said that Indians in the USA prided themselves on their Indian nationality after the 1974 Pokhran experiment. Adding to Dr Sethna's views on the administrative system, Dr P.K. Iyengar, former Chairman, AEC said that Dr Bhabha had his own ideas on administration that encouraged every bureaucrat to give his best thus ensuring a succession of good administrators. Citing an example, he said that AEET was the first institute in India where a gazetted officer had no need to sign a paper to claim his salary, which was automatically credited to the individual's bank account. No other government department had ventured to do so. He also mentioned the high importance accorded to manpower training and said that the department owed it to Dr Ramanna and to the support of Dr Bhabha. In 1942, Bhabha was asked as to how he was going to organise the Indian Nuclear Power Programme with only a handful of nuclear scientists available. He replied "Indians have been sitting at the bottom and thinking and philosophising, making new religions; I will turn them to Science and Technology". Indeed, the creation of the BARC Training School cultivated interactions between researchers and students and resulted in generating able scientific manpower for India's nuclear programme. In this regard, Dr Iyengar mentioned about the contributions of late Dr P.R. Roy and Mr S.N. Seshadri who were graduates of BARC Training School. Both Dr Sethna and Dr P.K. Iyengar assessed the indigenous development of Indian Nuclear

Dr H.N. Sethna, former Chairman, Atomic Energy Commission being honoured with a shawl by Dr S. Banerjee, Director, BARC during the Golden Jubilee celebrations

Energy Programme which is second to none in the world and wished that we maintain our competitive edge by pursuing the development of different types of power reactors. According to Dr Iyengar, Bhabha had the vision of Rutherford (Father of nuclear physics) in creating new avenues of research and thus leap-frog into new technology.

Mr S.D. Soman, a former Director of Health & Safety Group while going down the memory lane, recalled an instance of uranium contamination at TIFR, due to which the upper forehead of Dr Mazumdar, a Medical Officer at TIFR, had become red; radon contamination at Tata Memorial Hospital and studies pertaining to the mapping of high background areas in Kerala in the early days. The remedial measures which were consequently taken in the handling of fuel elements and neutron source for the commissioning of Apsara indeed marked the beginning of the Radiation Protection Programme of the Department. He complimented the scientists for their contribution in continuing to maintain an excellent safety record. A mention of an important operational procedure in Isotope laboratory was also made by Dr V.K. Iya, a former Group Director. The procedure required a proper documentation of all the activities and a prior mandatory health physics clearance. He dwelled on the development of isotope technology at the Centre which had its beginning at the old warehouse of the Bombay Dyeing Mill at Prabhadevi and which led to the setting up of a laboratory at South Site for work on the production processes of isotopes and also a small hot cell for producing Cobalt-60. The isotope production activity got an impetus with the commissioning of 40 MW(thermal) CIRUS Reactor and later with the setting up of HIRUP. Speaking about Bhabha, he said, "while full support was given to scientists, at the same time appropriate results were also expected".

Prof. B.M. Udgaonkar, a former dean at TIFR who was responsible for starting reactor physics research activity at AEET said that Dr Bhabha wanted his scientists to be broad-based in their approach. During his deputation to Saclay to study the beryllium reactor, he was also allowed to attend a summer school in high energy physics. Prof. Udgaonkar also mentioned the role played by TIFR in developing the control system for Apsara. This development was possible because requisite experience in building electronic instruments was gained by the scientists who were actually pursuing basic research. The activity on electronics initiated at TIFR, led to the setting up of a production unit at Trombay and eventually to the formation of the Electronics Corporation of India Ltd. (ECIL). Prof. R.Y. Deshpande, a former Head of Technical Physics Division talked of the instrumentation and technology development activity that had its beginning at TIFR and which blossomed at BARC. Technology has to be developed and besides its usefulness to science, there are profitable spin-offs in the form of industrial products and which are important for national development. This activity was initiated by Prof. D.Y. Phadke and it paid rich dividends in subsequent years. The development and production of 200 large volume plastic scintillators, marked the beginning of detector development technology. He said, "Those days we enjoyed full freedom and whatever we proposed, we were allowed to do so, but with a sense of

Dr P.K. Iyengar, former Chairman, Atomic Energy Commission being honoured with a shawl by Dr S. Banerjee, Director, BARC during the Golden Jubilee celebrations

responsibility and commitment". Dr G. Venkatraman recalled "when I started working in AEET there was no infrastructure and work began in the naval barracks at Colaba. The Centre did not have a vehicle of its own and work on the first reactor Apsara had just commenced. I remember visiting Trombay when there was only a solitary tractor to clear the jungle. The sparkling BARC Campus now is one of the best planned academic facilities." He said "Those of you serving here presently, do not know how lucky you are".

Mr T.K.S. Murthy, a former Director of the Chemical Engineering Group while recalling the challenges of work said, "The subjects that we were working on in the department in those days, were new to academics, that indeed made our job more challenging". Mr R.K. Garg, also a former Director of the Chemical Engineering Group expressed a similar view and said, "I joined AEET because of an exciting job offer and that excitement continued throughout my career". He made a special mention of his first experiments on the reaction between uranium and calcium metal which led to the development of new ideas for future implementation and which eventually led to the setting up of the production facility, the Nuclear Fuel Complex at Hyderabad. It also marked the development of unique chemical processes for separation of various isotopes. He said the congregation of experts from all disciplines under one umbrella, makes BARC a unique institution in the country. Mr S. Sen, another former Director of Chemical Engineering Group mentioned about Pandit Nehru's remarks on the day of the inauguration of AEET, "Combination of a nuclear reactor represented by Apsara on one side and the artistic value and culture of Elephanta on the other side might strike the right balance in life". Mr Sen said that Dr Bhabha's vision and Nehru's conviction about the role of science and technology has made India one of the few countries which possesses comprehensive technology, for using nuclear energy, for peaceful purposes. Mr Sen talked about the pace of work in the early days and said, "The Chairman of the Canadian Atomic Energy Commission (during a meeting in Vienna), told Dr Bhabha that if India wanted a reactor they would have to bear half the cost and a decision to this effect would have to be made within 24 hours. Knowing that not much could happen within 24 hours, Dr Bhabha sent a telegram to Pandit Nehru and forgot about it. Dr Bhabha was woken up at midnight and given the Prime Minister's green signal to go ahead".

Eminent dignitaries seen at the gathering of the Golden Jubilee Celebrations at the Central Complex auditorium, BARC

Mr Sen said that when Dr Bhabha made a commitment to the Canadians that half of the fuel cost for the CIRUS reactor would be borne by India, actually no facility existed at that time. The development of the entire process and the setting up of the uranium metal plant within 24 months, speaks volumes about the department's commitment in those days. Continuing his reminiscences he said, "Pandit Nehru taught us how to visualize and plan and that was how the planning commission came into existence. Dr Bhabha taught us how to choose the right person and develop appropriate infrastructure. Later, Dr Sarabhai brought in the concept of finance in R&D; that is, research should innovate and transform this innovation, into marketable technology. Quoting Francis Baker, Sen said, "Science and technology should go hand in hand. Knowledge is not to be sought for pleasure of mind or for contention or for superiority to others or for profit or for fame or power, but for the benefit and use of life". Mr Sen wished that BARC would continue to work for the benefit of mankind.

Dr Kondal Rao, a former Head of Atomic Fuels Division talked about the difficulties faced during the fabrication of reactor fuels in the initial period. Lack of advice in the field and measuring up to the quality assurance criteria of the Canadians were the most important concerns in those days. He said, "Today I am glad to hear that FBTR production fuel has already crossed the envisaged operational mark of hundred thousand MW(thermal)". Mr N. Veeraraghavan, a former Director of Reactor Operations Group reminisced about the commissioning problems faced with CIRUS. He said that when power could not be raised at all, Dr Bhabha decided to let the Canadians go back and to undertake the commissioning work by ourselves. Indian scientists and engineers eventually did bring the reactor to full power and according to Mr Veeraraghavan, this was one of the greatest achievements of that time. Dr K.S. Venkateswarlu, former Head, Water Chemistry Division talked about the role of chemistry and how 20 kgs. of uranium nitrate was extracted from a drum of yellow cake.

The function concluded with a vote of thanks by the Director, BARC. He said, "We heard several anecdotes, we also got a feeling of the scientists who were responsible for founding this great institution. If I have to make a summary in one line, it is the self determination of our scientists which made things happen in the formative years. He assured everybody that this message would be carried forward by the younger generation into the next generation". Finally, he concluded the proceedings by thanking the invitees, for having accepted the invitation, to attend the inaugural session, of the Golden Jubilee Year celebrations.

A group photograph of the dignitaries at the Golden Jubilee celebrations at Central Complex auditorium, BARC

बी एआरसी न्यूज़लैटर
BARC NEWSLETTER

THE ROLE OF AQUATIC HUMIC SUBSTANCES ON SPECIATION OF DIFFERENT ELEMENTS IN SURFACE AND SUBSURFACE WATER AROUND TROMBAY

R. K. Singhal , A.G.Hegde and M.L.Joshi
Health Physics Division

Introduction

Speciation studies of different physico-chemical species of an element, in different environmental matrices, is necessary for understanding their behavior in the ambient environment. Various radioactive and non-radioactive elements exist in a variety of physico-chemical forms such as

- free metal ions,
- metal ions incorporated into colloids or adsorbed onto suspended particles,
- small inorganic complexes and
- complexes with Natural Organic Matter (NOM) each complex with its own unique properties.

The toxicity, bio-availability, bio-accumulation, bio-degradability, persistence, mobility, solubility, extractability and many other critical properties depend on the form and nature of the chemical species. Speciation analysis or simply speciation is in fact, the determination of these distinct species.

Speciation has gradually gained wide recognition as a vital component of environmental chemistry, since knowledge about the total concentration of an element in specific environmental compartment, is often inadequate to explain all its properties. The term speciation encompasses usually two slightly different connotations of speciation namely

1. Functional and
2. Operational

There may be an overlap between the two, but they are not identical.

Functional speciation

Functionally, one can identify and distinguish between species that are, for example

- Available to plants or eco-toxic
- Species of an element that are more easily exchangeable in mineral surfaces than others, etc.

The International Union of Pure and Applied Chemistry (IUPAC) has tried to dissociate speciation from functionality by defining speciation as " the process yielding evidence of the atomic or molecular form of an analyte, even if this might be the objective of all environmental studies."

Operational speciation

Operationally, speciation is determined by the physicochemical properties of the real natural entities which are the so called species and analytical techniques and means are available to the researchers, to determine them.

Therefore, speciation, basically involves the determination of the concentration of various fractions, which are clusters of species having different physicochemical properties such as extractable or detectable under specific conditions and specific means.

According to various speciation models like CHESS [Chemical Equilibrium Speciation Studies], one can assume that these fractions correspond to specific atomic or molecular forms and specific biochemical or geo-chemical characteristics are attributed to them. In inorganic analytical chemistry, speciation has always been a vital component of its development, if not its starting point. The determination of various nitrogenous species (NO_3^-, NO_2^-, NH_4^+) offers a valuable example of early achievements where functional and operational definitions of speciation were found to coincide. However, in the field of environmental and marine chemistry dealing with metals, the developments were more recent and perhaps, less impressive due to inherent difficulties in the exercise. Various inorganic and organic ligands in the environment are given in Table 1.

Analytical techniques for speciation of radioactive and trace metals in the natural environment

The techniques being used in ESS, HPD, to investigate metal speciation in aqueous environmental samples (e.g., freshwater, rain water, marine aquatic environment) and solid samples (e.g., fluvial sediments, soils and plants) are:

1. Size fractionation by ultra-filtration
2. Physicochemical characterization by Anodic Stripping Voltammetry with a Rotating Disk Electrode, Adsorptive Cathodic Stripping Voltammetry
3. Competing Ligand Exchange Methods using cation exchange resins
4. Atomic Absorption Spectrometry with Graphite Furnace (AAS-GF) to investigate the dissociation kinetics of the metal-complexes.
5. Capillary Electrophoresis with Diode Array Detector.
6. Zetasizer Nano ZS for the measurement of dissolved species in the range of size 0.45 μm to 0.6nm and zeta potential in the range

Inorganic	Organic
	MxLy where L_y^{-1} organic ligand
$M(aq)^{+n}$ where M- metal ion	Carbohydrate e.g. glycol cellulose
$MCl_x^{+(n-x)}$ x =1 - 4	Fatty acid e.g. $CH_3(CH_2)_{16}COOH$
$M(OH)_x^{+(n-x)}$ x=1 - 4	Humic Acids
$M(SO_4)^{+(n-2x)}$ x =1 - 2	Fulvic acid
$M(CO_3)^0$, $M(HCO_3)^+$	Alcohol e.g. CH_3OH
	Porphyrins e.g. Chlorophyll
	Sulphur compound e.g. CH_3SCH_3, RSH

Table 1 : Various inorganic and organic ligands in the environment

of size 5 nm to 10 μm and the measurement of size ranging from 1000 to 2 x 10^7 Daltons of molecular weight.

Physical speciation of Uranium in ground water

The behavior of uranium in ground water system is getting considerable attention, due to its toxicity. The health effects of uranium can be divided into carcinogenic and non-carcinogenic effects and these classification systems are based on the radiological risk of uranium isotopes and its chemical toxicity as a heavy metal. At present, US Environmental Protection Agency (EPA) has classified uranium as a confirmed human carcinogen and fixed a regulation level as maximum contaminant level (MCL) of 30 μgl^{-1} (ppb). The World Health Organization (WHO) strictly recommends a reference level as 2 μgl^{-1}. Aqauatic Humic Substances in ground water system is an important speciation-controlling parameter for uranium.

Uranium occurs in all rocks and soils, except for continental igneous rocks. Silica-rich rocks such as granite, contain high uranium concentrations (average 4 ppm). The parent isotope of the decay series, ^{238}U may enter the aqueous phase by direct dissolution or leaching of the rock matrix or by selective dissolution or leaching of a mineral phase within which uranium is concentrated.

All natural waters contain organic matter, the major fraction of organic material is in the form of humic and fulvic acids i.e approximately 50-55% and termed as Aquatic Humic Substances (AHS). AHS, high molecular weight, refractory, yellow-black, amorphous, macromolecular acids show appreciable solubility in water and have following distribution.

Fulvic acids - AHS which range from 500 - 2,000 Atomic Mass Unit (amu); form 80-90% of the AHS fraction; yellow in color. Soluble in water at pH <2.
Humic acids - AHS which range from 2,000 - 100,000 amu; commonly associated with clay minerals and Fe/Mn oxy-hydroxides; form 10% of AHS fraction; precipitate from water at pH <2.

Once uranium enters the aquatic system it interacts with natural organic matter (NOM) through sorption or ion exchange processes. These processes change the size and charge characteristics of the dissolved uranium. The quantification of NOM in aquatic medium is carried out by the measurement of Dissolved Organic Carbon (DOC).

The ground water samples were collected from five different locations, spread over a distance of 1.6 km at Trombay. From each location, three samples were collected at one month intervals. Each time a two litre sample was collected in a clean polypropylene can. The samples were immediately filtered through 0.45μm millipore membrane, using suction filtration and spiked with UO_2^{2+} ion, using a standard solution of Uranyl acetate [$U(CH,COO)UO_2 2H_2O$] so that the final concentration of the solution was 30 ppb. The samples were kept at equilibration, with intermittent stirring.

The physicochemical characteristics of the samples like pH and conductivity were measured. The major cations and anions in the samples were analysed, using an ion chromatograph (Dionex 500). Calibration was carried out, by using Dionex mixed standard, for cations and anions. Figure 1 gives the concentration of DOC and non volatile DOC in samples collected from different locations. The concentration of DOC varied from 10.4 to 17.8 ppm whereas the non volatile DOC varied between 0.8 to 2 ppm. The observed range of DOC is higher compared to the reported range of 1 to 8 ppm, in ground water system, in the USA (Choppin R. Gregory, 1988) . The higher DOC is attributed to dense vegetation around the sampling locations.

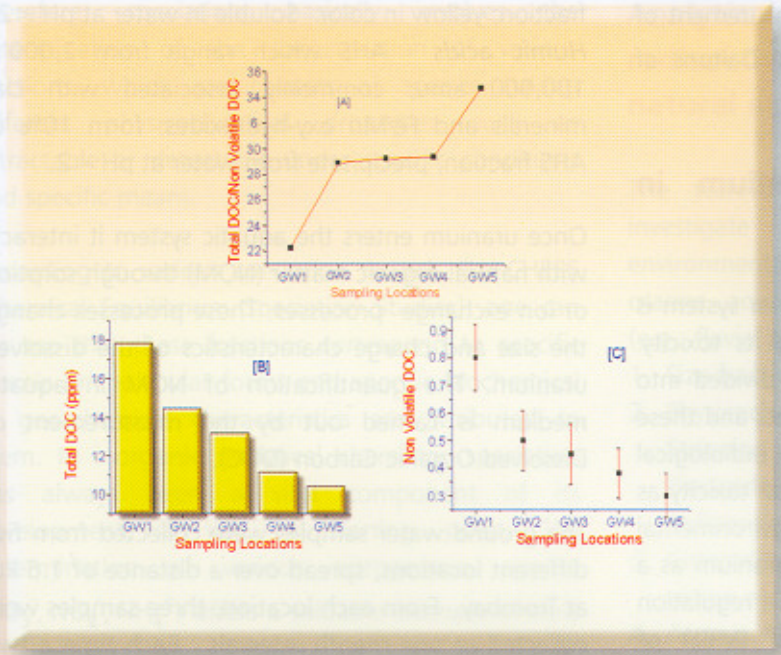


Fig. 1 : [A] Ratio of total DOC/Non Volatile DOC; [B] Total DOC; and [C] Non volatile DOC at various sampling locations

The samples were subjected to sequential ultra-filtration, after filtering them through 0.45µm filter (Figure 2). According to international convention, particles which pass through a filter paper with a pore size of 0.45µm, are termed as dissolved species and called colloids. These dissolved species (colloids) act as major contaminant carriers.

Carrier colloids containing organic compounds and uranium may be formed in two different ways (i) ion exchange or sorption of radionuclides on organic compounds (ii) sorption of organic complexes of the radionuclides on inorganic colloids

Uranium (VI) complexation with NOM has been discussed in detail [Choppin R. Gregory, 1988; Shanbhag and Choppin, 1981]. Complexation of UO_2^{+2} with humic substances occurs mainly in acidic waters, up to pH 6.7, while carbonate complexes predominate at higher pH values. Shanbhag and Choppin in their investigations of the binding of uranyl ion to humic acid at pH 8, found that in the absence of carbonate, the uranyl ion forms 1:1 and 1:2 complexes with humates and binds to the carboxyl group. When uranyl ions encounter a reducing agent such as organic matter (NOM), the uranyl ions reduce to U(IV) and get adsorbed on NOM of various Nominal Molecular Weight Cut-off Limits (NMWL). Figure 3 gives the concentration of uranium in dissolved fraction at various stages of sequential filtration. From this figure it is observed that most of the pseudo colloidal population of uranium occurred in the size

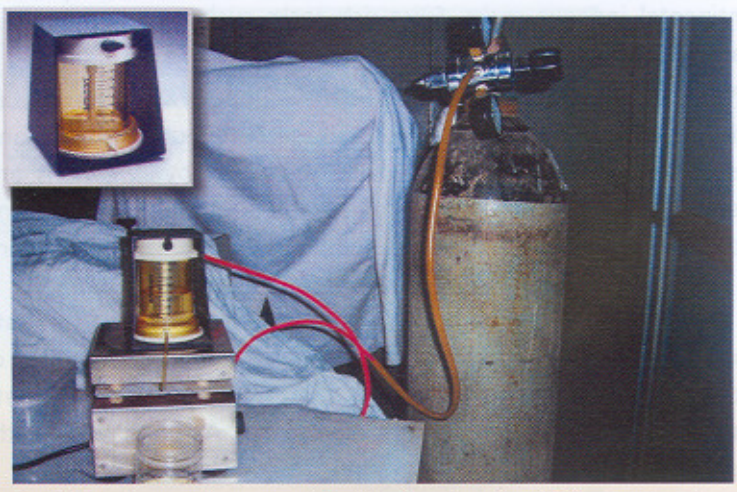


Fig. 2: Experimental set-up used for size fractionation of dissolved species. Ultra-filtration cell is used in concentration operation mode. Nitrogen gas is applied with pressure (2-3kg/Cm^2) directly to the cell. In this mode, solutes above the membrane molecular weight cut-off, are retained in the cell, while water and solute below the cut-off, pass into the filtrate and out of the cell

range of 2.2 nm (30,000 NMWL) and 1.6 nm (10,000 NMWL). The DOC that passed through a 10,000 NMWL filter (1.6 nm approx.) consisted mainly of fulvic acid. Whereas the fraction >1.6 nm was composed of both humic and fulvic acids. Studies conducted by Moulin et al, 1992, also reported that natural uranium in the ground water system is bound to humic colloids of nominal size, larger than 1 nm diameter.

Mean uranium concentration in various water samples filtered through 0.45μm was 30.93 3.10 ppb. From this figure it is clear, that uranium in 30k NMWL got concentrated about 5 times. Figure 4 gives the correlation between NOM concentration (concentrated with 30 k NMWL) and uranium. A strong positive correlation (r=0.99) was observed between the two.

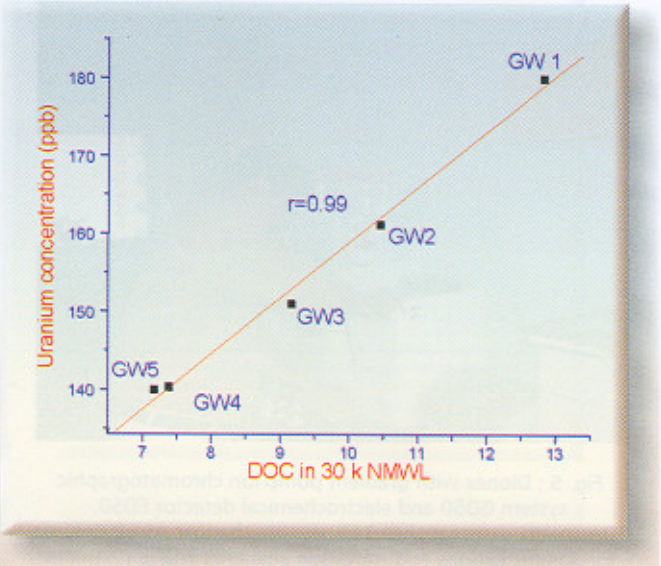


Fig. 4 : Concentration of uranium in 30k NMWL at various locations.

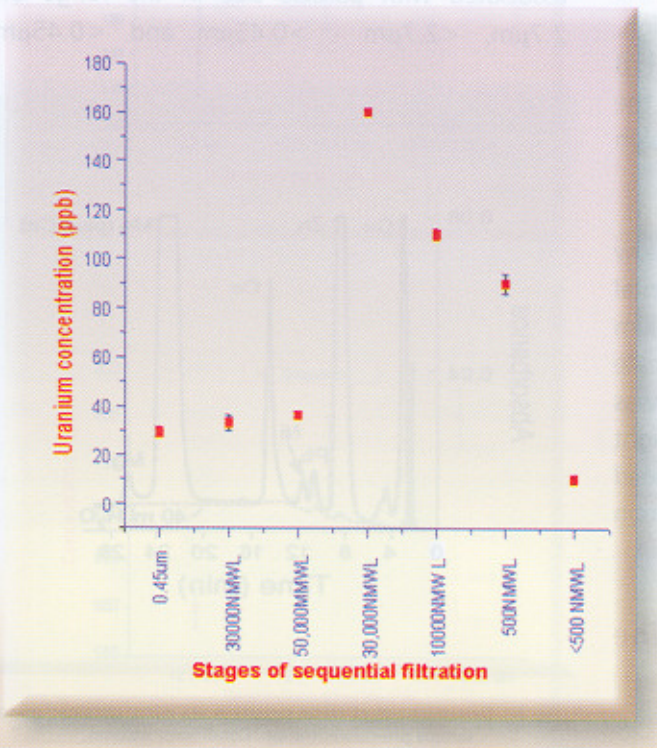


Fig. 3 : Uranium concentration in various stages of sequential filtration

Experimentally observed pseudo-colloidal behavior of uranium in ground water can be understood on the basis of work carried by Stumm and Morgan, 1981. They suggested that sorption of radionuclides is frequently governed by electrostatic forces between nuclide species in aqueous solution and surface charges of the sorbent. Many suspended and colloidal solids in natural waters have surface charge, originating from ionizable functional groups (e.g. OH, COOH etc.), from lattice imperfections at the solid surface or isomorphous replacement within the lattice or from adsorption of surfactant ions (e.g. adsorption of an organic coating onto an inorganic surface). These surface charges attract the opposite charge species of uranium [Stumm and Morgan, 1981; Singhal et al 2005 {1}].

Uranium present in soluble form in water, passed through even the smallest pore size (0.5 k NMWL). The concentration of uranium

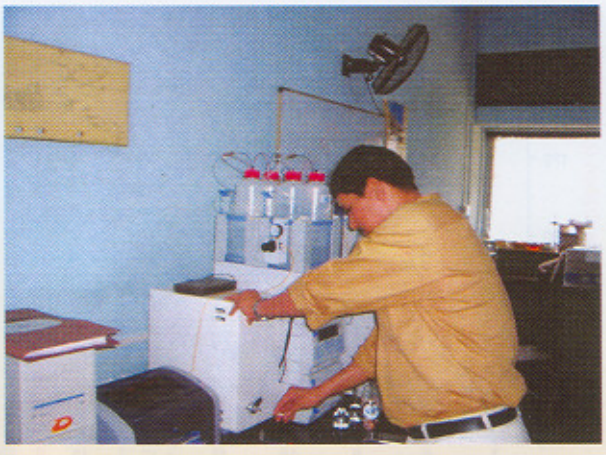


Fig. 5 : Dionex with gradient pump ion chromatographic system GD50 and electrochemical detector ED50, PDA UV-VIS detector UVD 340, sample changer AS 50 Column for anions, cations and transition elements and lanthanides and chromeolean ion chromatography software

in this fraction is mainly due to its complexation, with carbonate. This complexation kept the uranium in soluble form, even where the concentrations of humic substances were high. According to Shanbhag and Choppin, at pH 8 uranyl ion binding to carbonate displaces the binding of uranyl ion to humic acid, at high carbonate concentration.

Fulvic acid is characterized on the basis of low molecular weight i.e. < 10K NMWL. Experimental results show that higher concentration of uranium with 30 k NMWL and 10 k NMWL clearly indicate that the binding of U(IV) and U(VI) by NOM was found to be stronger for low molecular weight NOM. The concentration in fraction concentrated with <0.5K NMWL probably give the concentration of uranium as UO_2CO_3 [Singhal et al 2004].

Trace Metal Speciation in marine environment

Ultra filtration is used in speciation studies of trace elements in coastal sea waters. Seawater samples were collected from about 1km off-shore in Mumbai Harbour Bay. The sampling was carried out six times, over a period of four months and all the samples were collected during high tide. The samples were collected in 5 litre polypropylene plastic cans. The plastic cans were thoroughly washed with soap solution, followed by tap and deionised water prior to sampling. The sample storage procedure generally acceptable for total metal analyses are not appropriate for this work, since acidification and freezing may induce irreversible change in the speciation of an element. The samples were subjected to sequential filtration from 2.7µm to 1.1 nm. The samples were analysed by Ion Chromatography (Dionex-500, see Figure-5). A typical chromatogram obtained during the analysis is shown in Figure 6.

Figure 7 shows the concentration of trace metal associated with particle size in the range of > 2.7µm, <2.7µm - >0.45µm and <0.45µm -

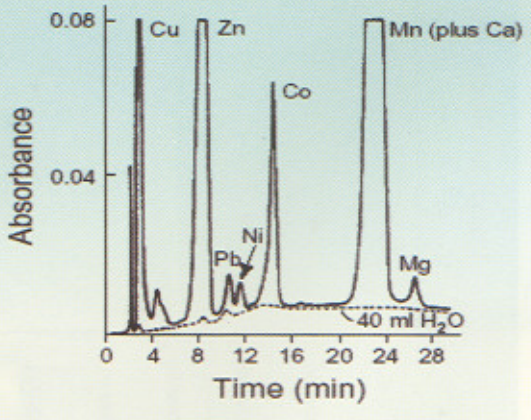
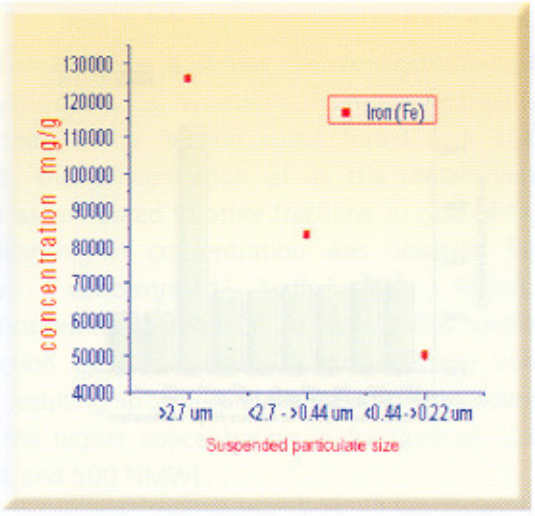
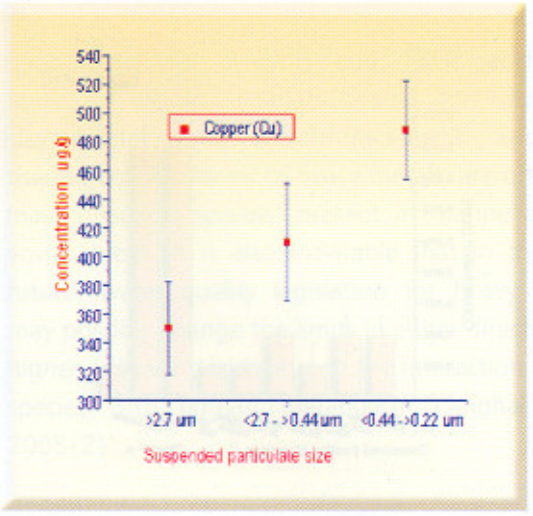
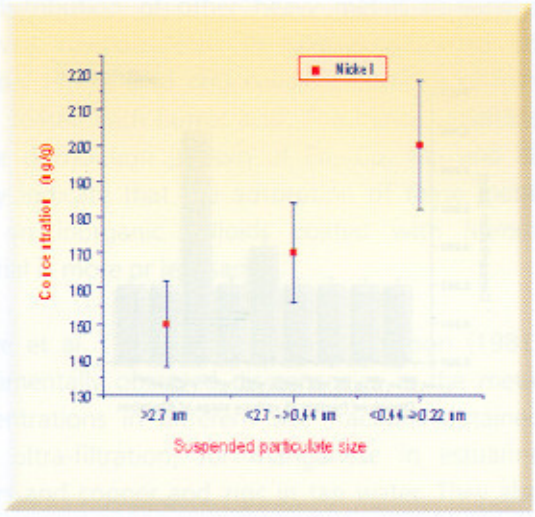
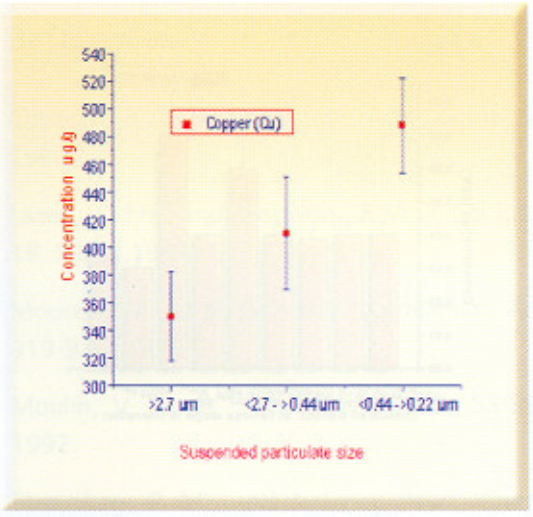


Fig. 6 : Determination of metal cations in sea water obtained using sample pre-concentration. Conditions: column, Nucleosil C18; eluent, 2mM octanesulfonate/0.350.5M tartrate gradient; detection, UV/VIS at 510nm postcolumn reaction with 4-(2-pyridylazo)-resorcinol (PAR)









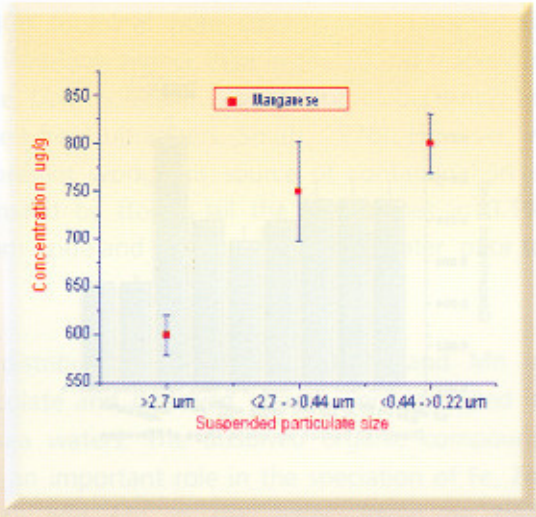
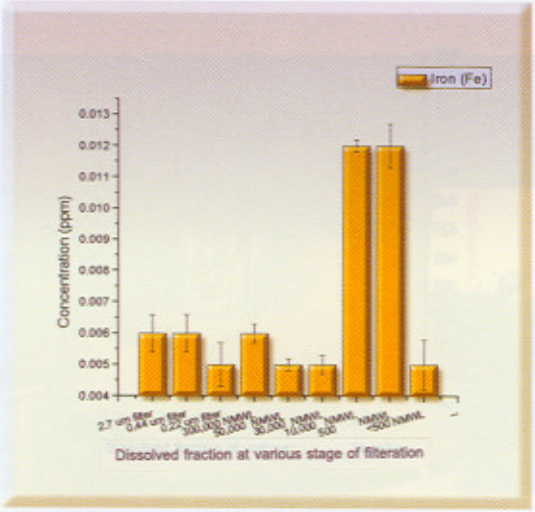
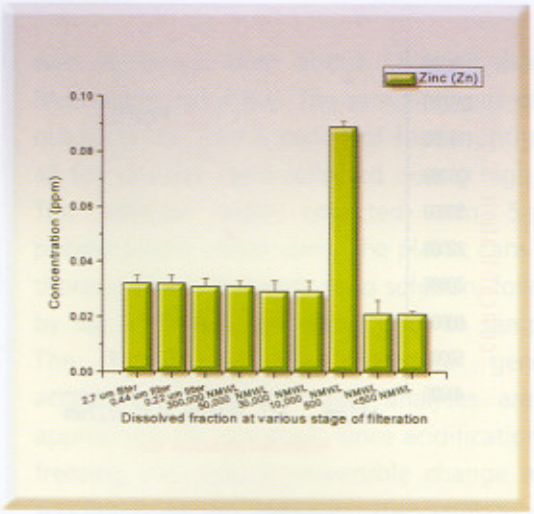
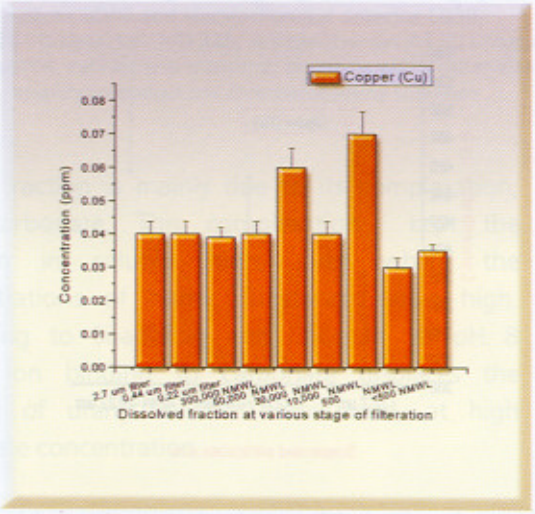
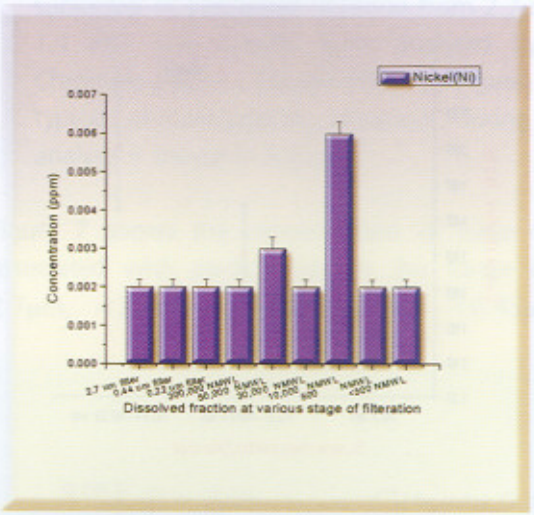


Fig.7 : Concentration of Fe, Zn, Cu, Ni and Mn in various fractions of silts









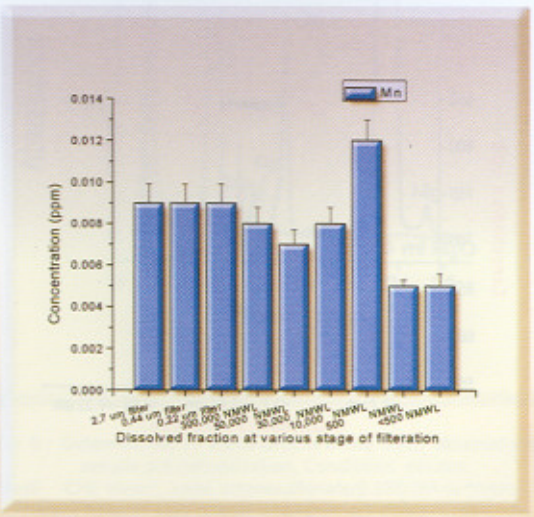


Fig. 8 : Concentration of Fe, Zn, Cu, Ni and Mn in different fractions of sea water at various stages of sequential filtration.

>0.22µm Figure 8 shows the concentration of dissolved Fe, Zn, Cu, Ni and Mn. From this figure it is clear that in the fraction concentrated with 10K NMWL, the concentration of all the metals was higher as compared to other fractions. In case of Fe, a similar higher concentration was observed for fraction concentrated with 500 NMWL. This distribution patterns of Fe may be due to the interaction of humic material with colloidal iron oxide resulting in a very stable colloid, as evident from the higher concentration in fractions of 10K NMWL and 500 NMWL.

The distribution of other heavy metals in various dissolved fractions exist as species adsorbed on colloidal humic acid and colloidal particles of iron oxide coated with humic acid. The minor variations in the distribution pattern of Zn, Cu, Mn and Ni clearly indicate that the adsorption of these metal ions on inorganic colloids coated with humus material is more or less same.

Moore et al. (1979) and Laxen & Harrison (1981) experimentally observed discrepancies in the metal concentrations in different size fractions obtained from ultra-filtration; for manganese in estuarine waters and copper and zinc in tap water. They also noted that the concentrations of these metals in the XM-300 (nominal pore size 14 nm) ultra-filtrate were invariably higher than in the 15 nm Nuclepore filtrate. Low molecular weight hydrocarbons may be leached from ultrafilters (Smith, 1976). However, in the present work, this source of contamination is eliminated by storing all the membranes in 0.1% sodium azide and flushing with Elix-3 water prior to use.

The distributions of Fe, Zn, Cu, Ni and Mn in particulate and dissolved phases were identified in the sea waters. The dissolved organic compound plays an important role in the speciation of Fe, Zn, Cu, Ni and Mn in sea water. Based on their molecular weight, they are categorized as Humic (high molecular weight) and fulvic acid (low molecular weight). Humate coated iron oxide and clay particles strongly adsorb trace metals, and these pseudo-colloids forms of heavy metals, are often the main dissolved species, present in marine aquatic environment. It is also inevitable that in the near future, water quality legislation for heavy metals may possibly change the limits in either direction i.e. higher or lower depending on the interaction of that species with human metabolism (Singhal et al 2005{2}).

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बीएआरसी न्यूज़लैटर
BARC NEWSLETTER

DEVELOPMENT OF A DSP-BASED DATA ACQUISITION SYSTEM FOR IPIG PROJECT

S. K. Bahuguna, S. Mukhopadhyay and S. Bhattacharya
Control Instrumentation Division
and
M. B. Patil, Shantanu Das and B.B. Biswas
Reactor Control Division

Introduction

Control Instrumentation Division, BARC, has been involved in the indigenous development of the Instrumented Pipeline Inspection Gauge (IPIG), under a memorandum of understanding signed between BARC & the Indian Oil Corporation Ltd. (IOCL). This inline inspection tool is used, to detect and characterize metal loss defects in a buried pipeline carrying petroleum product. The defects are characterized according to their severity, to enable the pipeline operators to take necessary preventive action, prior to any disastrous failure. IPIG works on the principle of saturating a section of the carbon steel pipe, with high magnetic flux and monitoring the leakage flux, on the inner surface of the pipeline. In the presence of any defect, there is a change in the leakage flux, which is sensed by two arrays of hall sensors (primary and secondary). IPIG consists of four modules i.e. Magnetic module, Data acquisition system (DAS) module, Battery module and PIG locator module.

A DSP based data acquisition system has been developed for the IPIG project. IPIG is self powered with lithium batteries. The electronics and power supply are housed in sealed pressure vessels, within a very limited space, thus restricting the size of the battery. This DSP based data acquisition system has been designed and developed for low power consumption and is capable of performing on line signal compression, enabling it to scan longer pipe lengths.

Key features and specifications of DSP-based data acquisition system

- Fixed point DSP processor based
- Low power consumption
- High computational real time signal processing
- Analog channels : 160
  Resolution : 12 bit
  Range : 0-5 Volts/0-10 Volts Selectable
  Maximum sampling rate : 600 kilo samples/second
- Triggering method: Hardware selectable Software trigger, On board pacer trigger, External trigger
- Digital input & digital output: 8 bit
- Asynchronous serial port (RS-232) for personal computer (PC) interfacing
- Real Time Clock (RTC)
- Watch dog timer (Programmable selectable).
- Ethernet for Data downloading

Basic block diagram of the DSP based DAS

The data acquisition system (DAS) is an ADSP2101 DSP Processor based dedicated system. Two cards have been developed to meet the requirement of the system; a DSP based data acquisition module card (DDAM) and a DSP based IDE controller module card (DIDEM).

The DSP-based data acquisition system comprises of two data acquisition module cards (DDAM) and one IDE controller module card as shown in the figure 1. One DDAM card acquires and compresses 80 analog primary hall sensor data and the other one acquires and compresses 80 analog secondary hall sensor data. IDE controller card receives data from both the DDAM cards through its high-speed serial port and stores the data in the flash disk. This new DSP based data acquisition system consumes less power, enabling it to scan longer pipe lengths and capable of doing on line signal processing activity like data compression.

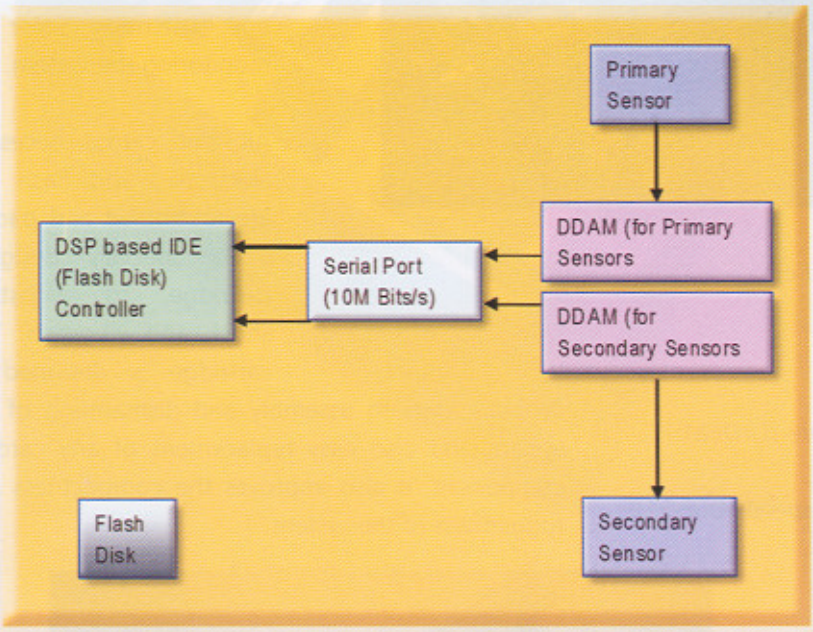


Fig.1: Conceptual block diagram of the data acquisition system

The system comprises three DSP processors working parallel to each other thus effectively enhancing the overall speed. DDAM card is designed in such a way that there is no involvement of DSP processor for acquiring the data. The processor is used only at the time of initialization of the data acquisition hardware. So the processor is free for compression of the previous data and transferring the compressed data to IDE controller card on request. The IDE controller card works as master and the two DDAM cards respond to the request. The communication protocol is developed in such a way even if one acquisition card fails, the master would still receive data from the other card. Data loss (to a certain extent) is also taken care of, by the task scheduler, running data storage and acquisition tasks in parallel. The system is configured to multiple levels of recovery, to override temporary malfunction, triggered by short time disturbances in the environment.

Features of DAS and IDE controller card

DSP Based Data Acquisition Module (DDAM): DDAM is a low power, high speed, high performance multifunction DSP-2101 based data acquisition card. It offers 80 analog channels, with overall sampling speed of 600 Ksps. This data is buffered in 8Kbyte of FIFO, which can be read later by the DSP processor when an interrupt is generated. DDAM has one asynchronous serial port also for interfacing with the PC, one synchronous serial port for communication with DSP-based IDE controller card & one 8 digital inputs port. This DDAM has one watchdog timer too, for monitoring the system. Flash disk/Hard disk controller card will take the data from DDAM module through high-speed synchronous port (SPORT) and store in the hard/Flash disk.

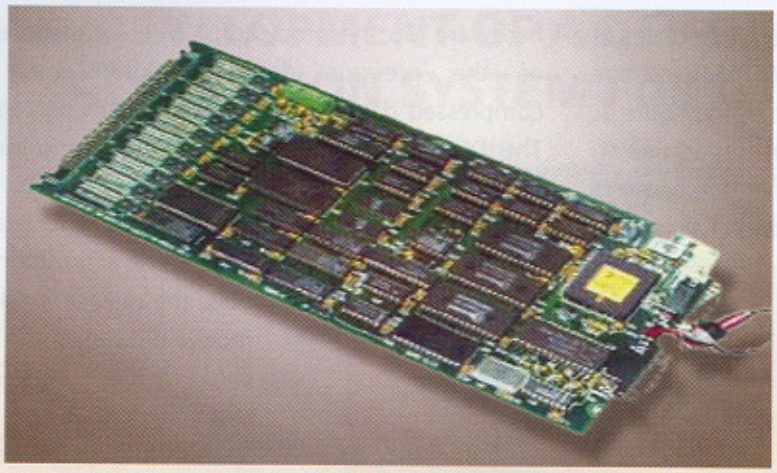


Fig. 2 : DSP based data acquisition module

acquired data offline from flash disk to other PC for the purpose of analysis. IDE controller card has one Real Time Clock (RTC) also for storing time information for different events and one watchdog timer for monitoring the system.

All the cards, necessary electronics and flash disk are assembled and packed in a specially designed cartridge, to withstand shock and vibration. This cartridge is designed to facilitate smooth assembly and dismantling of the system and also easy replacement of any card or component. It also improves the compactness and ruggedness of the system.

DSP Based IDE Controller Module (DIDEM)

DIDEM is a low power, high speed DSP-2101 processor based IDE Controller card. IDE controller card follows ATA2 protocol and supports IDE devices up to PIO mode-4. It is used for receiving on-line data from DDAM cards and storing it in Flash/Hard disk. IDE controller card will take the data from DDAM module through high-speed synchronous port (SPORT) and store it in the Flash/Hard disk. This DIDEM has one high-speed asynchronous serial port also for interfacing with PC, two synchronous serial ports for communication with two DSP-based data acquisition cards (DDAM) and one 8-bit digital output port. IDE controller card has Ethernet downloading facility for downloading the

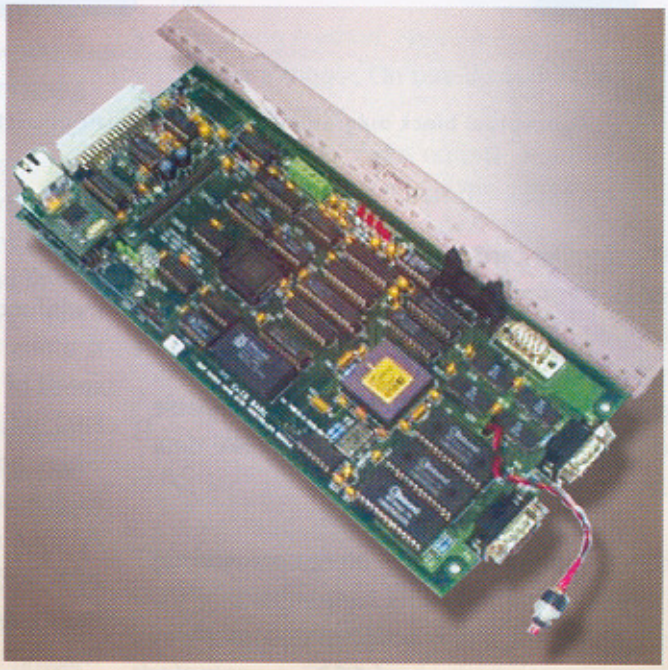
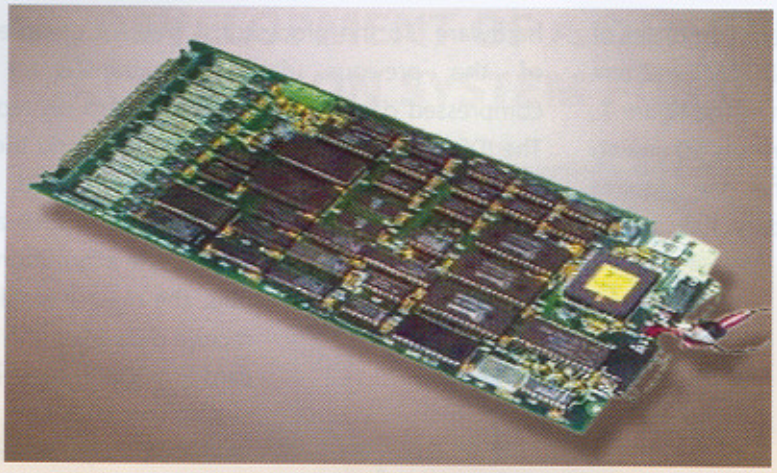


Fig. 3: DSP based IDE controller module



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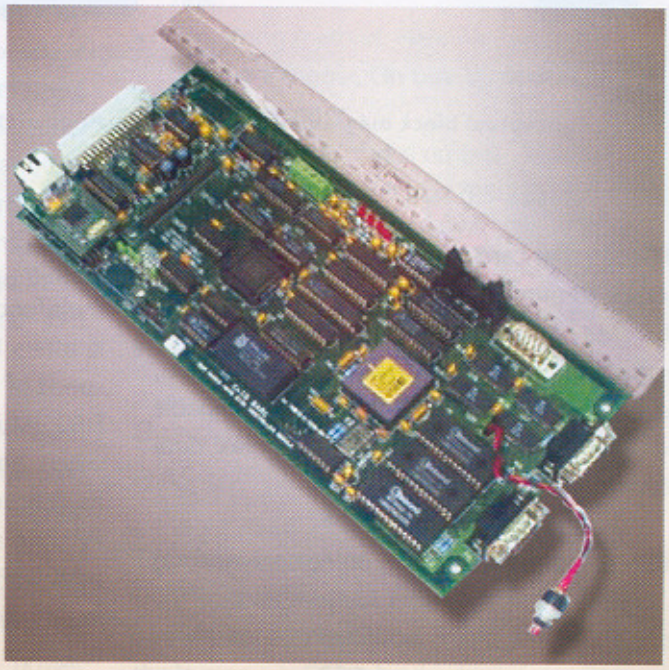

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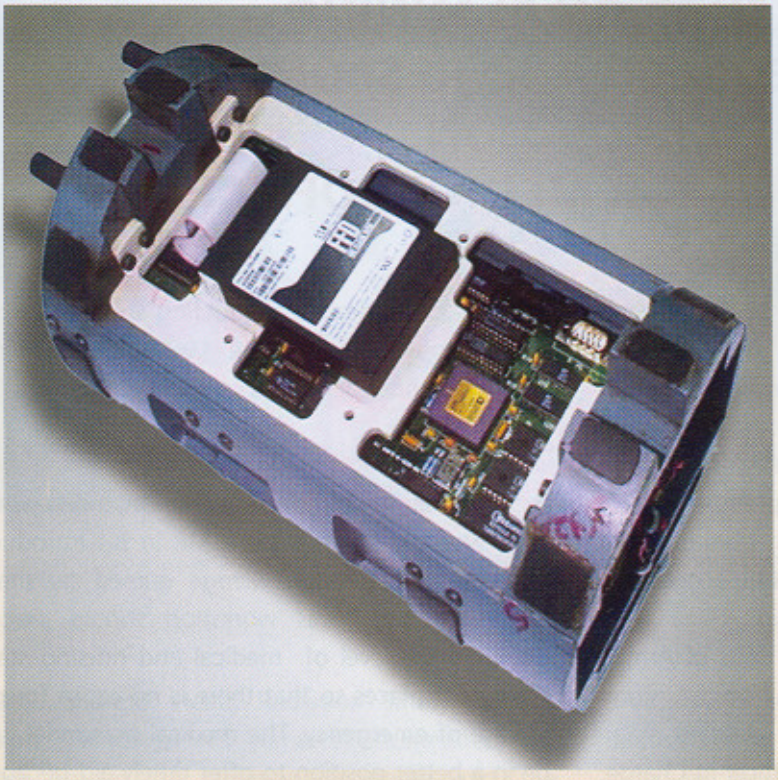


Fig. 4 : Electronic cartridge for DAS electronics

Tests performed on DSP-based DAS

The DAS, housed inside a pressure tight sealed vessel was tested continuously, for the entire range of functionalities, for three days under ambient temperature. This time was compared with the actual time taken by IPIG, to travel non stop for a pipelength of 162 Kms from Mughalsarai to Allahabad. The electronics equipment was subjected to prescribed levels of shock and vibration on a shock table at Hall-7, BARC and its performance under those conditions was monitored. Full configuration of IPIG with DSP- based data acquisition system was tested in Linear Pull Through Rig (LPTR) at CnID, BARC, before transporting the system to the Wet evaluation facility, IOCL R&D center, Faridabad. The IOCL R&D center has an above ground Wet test loop, which is made up of 120-meter long and 12-inch diameter pipe and simulates the environment close to the actual pipe conditions. We have evaluated the performance of the DSP-based IPIG in wet test loop. The system was tested in single and continuous run mode in wet test loop for evaluating repeatability of data and ruggedness of the system. After off line data analysis at BARC, all the features and faults of the loop were detected. In the last week of June 2005, a field trial of IPIG with DSP-based system in the actual pipeline of 162 Kms (in the Mughalsarai-Allahabad section) was undertaken. The performance of the tool was found to be satisfactory in all respects.

Other advanced applications

This DSP-based electronic tool can be used in similar embedded applications, where low power consumption and high computational real time signal processing is required in a compact and rugged environment. For nuclear reactors, the parallel processing embedded DSP architecture is well suited for on-line reactor transfer function estimation in real time. In nuclear power plant one can use this system for Turbo Generator (TG) vibration pattern monitoring and other diagnostic aids, for predictive maintenance of expensive plant equipment.

बी एआरसी न्यूज़लैटर
BARC NEWSLETTER

WORKSHOP ON PLANNING, PREPAREDNESS AND RESPONSE TO RADIATION EMERGENCIES FOR MEDICAL OFFICERS

The 15th Training Workshop on Planning, Preparedness and Response to Radiation Emergencies for Medical Officers was conducted by the local working committee for Radiation Emergency Medical Response (REMR) of BARC at AERB Auditorium, Mumbai from September 20-23, 2005. It was attended by 37 doctors from different units of DAE (NPCIL, NFC, IRE & BARC), teaching medical college hospitals (KEM, Sion, Nair & JJ Hospitals) and doctors from various units of Armed Forces Medical Services.

Dr. P.R. Bongirwar, Medical Officer-in-Charge, Trombay, BARC and Vashi Industrial Dispensary while welcoming the Chief Guest, invitees and delegates said, that the idea of conducting such a workshop was conceived in the late 1980's soon after the Chemobyl nuclear power plant accident on 26th April 1986.

Dr P.T.V. Nair, Head, Medical Division & Chairman of local working committee, REMR in his introductory address said, that knowledge gained by medical officers through this workshop should percolate down to the level of medical and nursing staff at their work places so that there is no cause for panic in case of emergency. The medical personnel would be in a better position to offer timely aid because of the preparedness.

At the inaugural function seated from left to right are :
Dr P.R. Bongirwar, Medical Officer-In-Charge, Trombay Dispensary, BARC,
Dr P.T.V. Nair, Head, Medical Division, BARC, Chief Guest, Mr S.K. Sharma, Chairman, AERB
and Dr D.N. Sharma, Head, Radiation Safety Systems Division, BARC

Group photograph of delegates, invitees and Chief Guest Mr K. Muralidhar, Secretary, AEC taken at the end of valedictory function

Dr D.N. Sharma, Head, Radiation Safety Systems Division, BARC, in his remarks enumerated the various causes of radiation accidents and the consequences thereof. He said that radiation risks were negligible if handled with care. He also spoke about the 17 Emergency Response Centres (ERCs) being developed all over the country with the nodal centre at BARC. He further added that the RSSD had developed several gadgets and systems for radiation detection.

Mr S.K. Sharma, Chairman, Atomic Energy Regulatory Board (AERB), in his inaugural address congratulated the organisers on conducting such workshops. He described AERB's mandate and its work through various committees, to achieve its goal. He also referred to the International Nuclear Event Scale (INES) and said that in India there were incidents of levels (INES 1-3) and never incidents of levels (INES 4- 7). He stressed and emphasized the need for training and emergency preparedness at all times.

Faculty for the training course was drawn from BARC, AERB and DAE. Apart from lectures and discussions on various aspects of management of radiation emergencies, the training course also included visit of delegates to RMC, TMH and BARC. Dr S.S. Galinde proposed a vote of thanks during the inaugural function.

Dr. H.M. Haldavnekar welcomed the invitees for the valedictory function held on September 23, 2005. Dr P.R. Bongirwar, course coordinator summarized the deliberations of the workshop including feedback and the comments given by the participants.

Mr. K. Muralidhar, Secretary, AEC & Head, MSG, DAE, presided over the valedictory function and distributed certificates of participation to delegates. He also distributed CDs containing detailed information about medical preparedness for management of radiation emergencies to the attending delegates.

Dr. Ravi S. Jammihal proposed a vote of thanks at the valedictory function.

बी एआरसी न्यूज़लैटर
BARC NEWSLETTER

BARC TRANSFERS TECHNOLOGY OF ON-LINE DOMESTIC WATER PURIFIER BASED ON ULTRAFILTRATION POLYSULFONE MEMBRANE

The technology of "On-line domestic water purifier based on ultrafiltration polysulfone membrane" has been developed by Desalination Division, BARC. This device is based on polysulfone type of ultrafiltration membrane, which is coated on a unique cylindrical configuration using phase inversion technique. The ultrafiltration membrane filters water containing micro-organisms and suspended solids. The average pore size of the membrane is 0.01micron and the coating thickness is around 200 micron. It removes E-Coli bacteria to the extent of > 99.99% (4 log scale) and also removes complete turbidity and produces crystal clear water. This device does not need electricity or addition of any chemical. It is almost maintenance free except for occasional cleaning of the membrane, on which suspended solids get deposited and which takes just a few minutes.

Photograph after signing of the agreement with M/s. SONADKA, Mumbai (Maharashtra), seen from left to right Mr V. K. Upadhyay, TT&CD, BARC, Dr R. C. Bindal, Desalination Division, BARC, Mr A. M. Patankar, Head, TT&CD, BARC, Dr S. P. Garg, Associate Director, KMG, BARC, Ms Soniya Lalla, Proprietor, M/s. SONADKA, Mumbai, Mr Pradip Lalla, CEO, M/s. SONADKA, Mumbai, Mr Aditya Lalla, Technician, M/s. SONADKA, Mumbai, Dr V. Ramachandran, Desalination Division, BARC and Mr B. K. Pathak, Head, TTS, TT&CD, BARC

Photograph after signing of the agreement with M/s. Sarita Aquatek Industries, Indore (M. P.) Seen from left to right Mr V. K. Upadhyay, TT&CD, BARC, Mr B. K. Pathak, Head, TTS, TT&CD, BARC, Mr Rajesh Yadav, CEO, M/s. Sarita Aquatek Industries, Indore, Dr. R. B. Grover, Director, KMG, BARC, Dr S. Prabhakar, Head, STS, Desalination Division,BARC, Mr A. M. Patankar, Head, TT&CD, BARC, and Dr R. C. Bindal, Desalination Division.

It produces about 40 litres of pure water per day at about 5 psig head and works from 5 psig to 35 psig. The device filters out bacteria. There are no dead bacteria in the final filtered water. (All the raw materials required are produced within the country and are available locally).

Since 2002, this technology has been transferred to twelve parties across the country and most recently to M/s. SONADKA, Mumbai (Maharashtra) on August 10th, 2005 and to M/s. Sarita Aquatek Industries, Indore (M.P.) on August 23rd, 2005.

The following three parties have proposed to launch the water purifier under the brand names:

1. **"PURITA"** - M/s. Aakar Technocrats, Nasik (Maharashtra)
2. **"AQUA SURE ULTRA"** - M/s. Aquamall Water Solutions, Hyderabad (A.P.)
3. **"NEW WATER SYSTEM"**- M/s. Uptodate Industries, Jalgaon (Maharashtra)

The Technology Transfer and Collaboration Division, BARC, coordinated all the activities related to the transfer of this technology; the follow-up with the licencees and technology absorption / commercialisation.

भा.प.अ. केंद्र के वैज्ञानिकों को सम्मान
BARC SCIENTISTS HONOURED

डॉ. पी. के. तिवारी, अध्यक्ष, निर्लवणीकरण प्रभाग, को अंतर्राष्ट्रीय निर्लवणीकरण समुदाय द्वारा निदेशक मंडल की 2005-2006 अवधि के लिए नामांकित किया गया है। इन्हें अंतर्राष्ट्रीय परमाणु ऊर्जा अभिकरण के द्वारा अंतर्राष्ट्रीय नाभिकीय निर्लवणीकरण सलाहकार वर्ग के सत्र (2005-2008) के सभापति के रूप में भी नामांकित किया गया है। इसके अलावा ये नाभिकीय निर्लवणीकरण की अंतर्राष्ट्रिय पत्रिका के संपादकीय एवं वैज्ञानिक मंडल के सह-सभापति हैं।

Dr P.K. Tewari, Head, Desalination Division has been nominated by the International Desalination Association in the Board of Directors for the term 2005-2007. He was nominated by International Atomic Energy Agency as Chairman of the International Nuclear Desalination Advisory Group for the term (2005-2008). He is also the Co-Chairman of the Editorial & Scientific Committee of International Journal of Nuclear Desalination.

डॉ. सुरेंद्र एम्. शर्मा, अध्यक्ष, सिंक्रोट्रोन रेडीयेशन अनुभाग, को दि नैशनल अकादमी ऑफ साइन्सिज, इन्डिया का अधिसदस्य निर्वाचित किया गया है। डॉ.शर्मा के पिछले तीन दशकों के शोध कार्य में डाइमंड एनविल सैल बेस्ड हाई प्रेशर फिजिक्स स्टडीज के लिए विभिन्न तकनीकों का विकास, मेटीरियल्स अंडर हाइ प्रेशर जैसी कई समस्याओं का समाधान, एक्स-रे डिफ्रेक्शन (एनर्जी एवं एंगल डिसपर्सिव), रमण स्केटरिंग एवं लॉइट एबजोरप्शन शामिल हैं। प्रशर इन्ड्यूस्ड एमोर्फाइजेशन ऑफ मटीरियल्जस, शॉक रेसपोन्स ऑफ रूबी एन्ड कारबन नेनोट्यूब्स पर इनका काम विख्यात है। इनकी वर्तमान शोध रुचि में बीम लाइन्स फॉर दि अपकमिंग 2.5 जीइवी इन्डस-2 सिंक्रोट्रोन रेडीयेशन सोर्स शामिल है।

Dr Surinder M. Sharma, Head, Synchrotron Radiation Section has been elected Fellow of The National Academy of Sciences, India. Last three decades of research work of Dr. Sharma include development of several techniques for diamond anvil cell based high pressure physics studies, working on a number of problems of materials under high pressures, X-ray diffraction (energy as well as angle dispersive), Raman scattering and light absorption. His work on pressure induced amorphization of materials, shock response of ruby and carbon nanotubes is well known. His current research interests includes the development of beamlines for the upcoming 2.5 GeV Indus-2 synchrotron radiation source.

डॉ. सुधीर कपूर को रसायनिकी विज्ञान के क्षेत्र में योगदान देने के लिए महाराष्ट्र अकादमी ऑफ साइन्सिज की सदस्यता प्रदान की गई। डॉ. सुधीर कपूर इन दिनों धातुकी के सूक्ष्म कणों की रचना

क्रिया प्रणाली के स्पष्टीकरण के कार्य में व्यस्त हैं। इलेक्ट्रान पल्स रेडियोलिसिज, फ्लोरेसेंस, अल्ट्रा फास्ट लेसर पल्सिस एवं सरफेस एन्हान्सड रमण स्पेक्ट्रोस्कोपी तकनीकों को उपरोक्त क्रिया में उपयोग में लाया जाता है।

Dr Sudhir Kapoor has been conferred with the Fellowship of the Maharashtra Academy of Sciences in recognition of his contribution in the area of chemical sciences. Dr Sudhir Kapoor is currently working on the elucidation of mechanism for the formation of metal nanoparticles which have usage as a support for the adsorption of biologically important compounds. Electron pulse radiolysis, fluorescence, ultra fast laser pulses and surface enhanced Raman spectroscopy are being employed to carry out these activities.

ट्रांजक्शन ऑफ इन्डियन इन्स्टिट्यूट ऑफ मेटल के जून एवं अक्टूबर 2004 के अंक में प्रकाशित दि क्रिस्टेलोग्राफी ऑफ दि बीससी टु एचसीपी (ओरथोहेक्सागनल मारटेन्सिटिक ट्रांसफोरमेशन इन डायल्यूट Zr-Nb एलोयज पार्ट I & II) नामक शोध - पत्र को वर्ष का सर्वश्रेष्ठ शोध नामांकित किया गया। इसके मुख्य लेखक डॉ.दिनेश श्रीवास्तव, पदार्थ विज्ञान प्रभाग को बिनानी गोल्ड मेडल पुरस्कार से सम्मानित किया गया। इन्हें यह पुरस्कार नवंबर, 14, 2005 को आइ आइ टी मद्रास, चैन्नई मे 59 वीं वार्षिक तकनीकी सभा तथा 43 वीं राष्ट्रीय धातुकी दिवस उद्घाटन समारोह में प्रदान किया गया।

The paper entitled The crystallography of the BCC to HCP "Orthohexagonal Martensitic Transformation in Dilute Zr-Nb Alloys : Part - I & II" published in the June and October 2004 issues of Transaction of Indian Institute of Metal was selected as the best paper of the year. As a principal author Dr Dinesh Srivastava, Materials Science Division was awarded "Binani Gold Medal". He was presented medal at the inaugural function of the 59th Annual Technical Meeting and the 43rd National Metallurgist Day celebrations on November 14, 2005 at IIT Madras, Chennai.

डॉ. एम. टी. जानवे एवं डॉ. ऐ. शर्मा, खाद्य प्रौद्योगिकी प्रभाग को नवंबर 23, 2005 को नैशनल सेमिनार ऑफ दि इन्डियन सोसाइटी ऑफ प्लाँट फिजिआलोजी के उद्घाटन समारोह के दौरान नवसारी गुजरात की नवसारी एग्रिकल्चरल युनिवर्सिटी में इन्डियन सोसाइटी फॉर प्लाँट फिजिआलोजी, नई दिल्ली के द्वारा आयोजित इन्डियन जे प्लाँट फिजियोल वोल्यूम. 9(2), 112-117, में प्रकाशित "इनहीबिशन ऑफ क्लोरोफिल डिग्रेडेशन इन स्टे-ग्रीन लंगरा मेन्गो (मेंगीफेरा इन्डिका एल.) फ्रूट्स" नामक शोधपत्र के लिए सर्वश्रेष्ठ प्रपत्र पुरस्कार (जी. एस. सिरोही अवार्ड -2005) से सन्मानित किया गया।

Dr M.T. Janave and Dr A. Sharma of Food Technology Division were awarded with the Best Paper Award (G.S. Sirohi Award 2005) for their paper entitled "Inhibition of Chlorophyll Degradation in Stay-green Langra Mango (Mangifera indica L.) Fruits" published in Indian J. Plant Physiol. Vol. 9(2), 112-117, by Indian Society for Plant Physiology, New Delhi on the November 23, 2005, during the inaugural function of the National Seminar of the Indian Society of Plant Physiology, organised at Navasari Agricultural University, Navasari, Gujarat.

भाभा परमाणु अनुसंधान केंद्र, मुंबई में दिसंबर 12-16 2005 के दौरान आयोजित, डीएई-बी आर एन एस की पचासवीं नाभिकीय परिचर्चा में पी.सिंह, एस.वी.एल.एस.राव, रजनी पांडे, टी.बसक, श्वेता रॉय, एम.असलम, पी.जैन, पी.के.नेमा, एस.कृष्णगोपाल, एस.कैलास एवं वी.सी.साहनी द्वारा लिखित डेवलाप्मेंट ऑफ दि 20 एमइवी हाई इन्टेन्सिटी लिनेक को सर्वश्रेष्ठ-शोध पत्र (पोस्टर) पुरस्कार से सम्मानित किया गया है।

A paper entitled "Development of the 20 MeV High Intensity LINAC", authored by P. Singh, S.V.L.S. Rao, Rajni Pande, T. Basak, Shweta Roy, M. Aslam, P. Jain, P.K. Nema, S. Krishnagopal, S. Kailas and V.C. Sahni was awarded Best Paper (poster) award during the DAE-BRNS 50th Symposium on Nuclear Physics held at the Bhabha Atomic Research Centre, Mumbai during December 12-16, 2005.

P. SINGH

S. V. L. S. RAO

MS. R. PANDE

MS. T. BASAK

MS. S. ROY

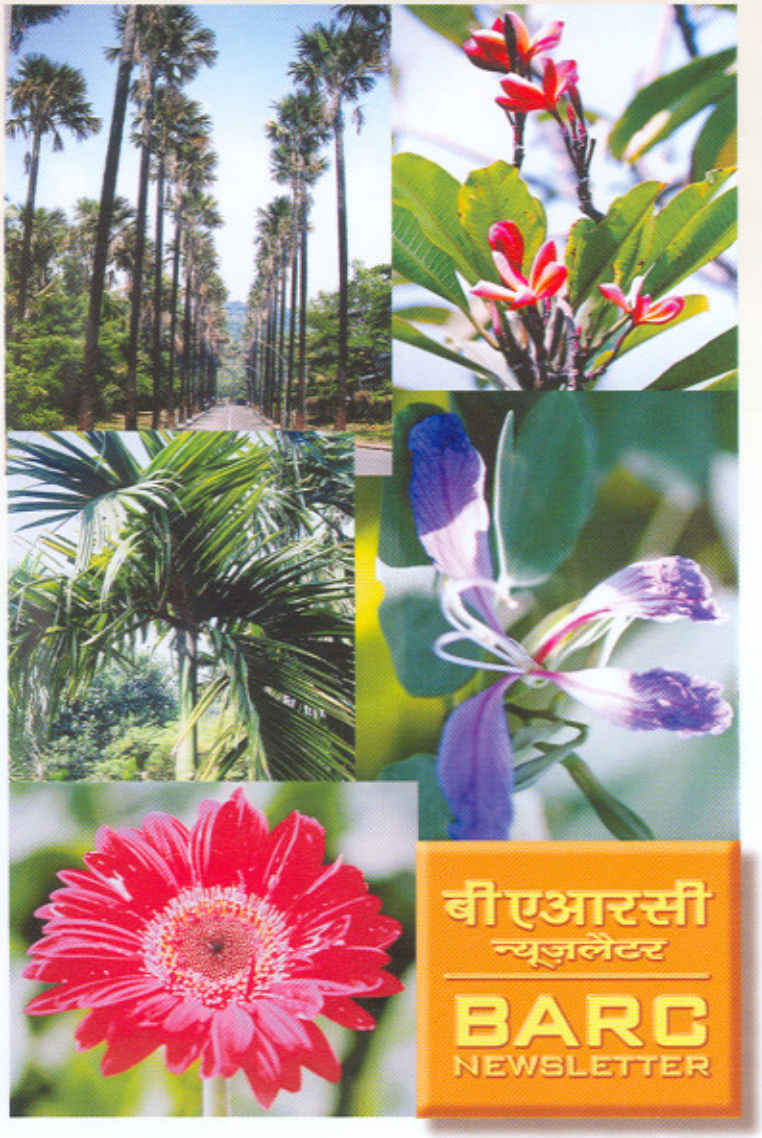
M. ASLAM

P. JAIN

P. K. NEMA

S. KAILAS

V. C. SAHNI



बी एआरसी न्यूज़लैटर

BARC NEWSLETTER

Edited & Published by: Dr. Vijai Kumar, Head, Scientific Information Resource Division,

Bhabha Atomic Research Centre, Trombay, Mumbai 400 085, India.

Editorial Management : Ms. S.C. Deokattey, Computer Graphics & Layout : P.A.S. Warrier, SIRD, BARC

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