ISSUE NO. 276

बी एआरसी न्यूज़लैटर

BARC NEWSLETTER

JANUARY 2007

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NEW YEAR MESSAGE FROM DR SRIKUMAR BANERJEE, DIRECTOR, BARC

Dear colleagues,

I wish you and all your family members a very happy and prosperous new year. The year 2007 marks the culmination of the Golden Jubilee celebrations of BARC. On this occasion we reaffirm our commitment to progress and development in nuclear energy. Let me brief you about our achievements and activities during the last year.

The three Research Reactors at BARC, viz., APSARA, CIRUS and DHRUVA, were operational with good availability factors and utilized extensively for R&D activities. DHRUVA attained the highest ever availability factor of 81.72% in the year 2006. APSARA completed 50 years of successful operation. To refurbish its reactor core, the physics design and other engineering details are being worked out.

The conceptual design of a 30MW high flux Multipurpose Research Reactor, proposed to be set up at Vishakhapatnam is now ready for detailed deliberations amongst the designers and the user communities.

The reactor physics design of the AHWR core, with 225 mm lattice pitch, has been completed with respect to burn-up optimization and position of control and shut down devices. The validation of the design is also underway through the Integral Test Loop (ITL) Facility, which would simulate the passive cooling system of the AHWR and generate performance data. Pre-licensing safety design appraisal of AHWR has been completed and documents required for obtaining clearance to start construction are being prepared. A Critical Facility for validation of AHWR physics design is in advanced stage of construction and will attain first criticality very soon.

As part of high temperature reactor development programme, computer codes have been developed which are being used for the physics and thermal hydraulic design of 600 MW(th) High Temperature Reactor.

BARC continues to provide R&D support to the nuclear power programme in the country. Some of the latest developments include: the Flux Mapping System (FMS) using 102 Vanadium self-powered neutron detectors located at different positions for periodical monitoring neutron flux in the reactor core; the ion-exchange process for the removal of Gadolinium Nitrate in the presence of Boron from its moderator; the liquid zone control system, the

Sludge Lancing equipment (SLE) for removal of sludge, an ultrasonic technique for the measurement of axial creep of coolant channels, an online vibration diagnostic system for the steam turbine and several others. An integrated system to test and monitor the reactor protection and shutdown functions has been installed and commissioned at TAPS 3&4, for the first time in India.

A non-contact ultrasonic sensor-based system was developed for axial creep measurement of coolant channels in PHWRs. The system used in TAPS 3&4, KAPS 1, RAPS 2&3 and KGS-2 has demonstrated significant reduction in the measurement time and in the man-rem expenditure.

BARC also provided analytical and technical support for life management of coolant channels of operating nuclear power plants for obtaining regulatory clearance for extended operation.

For the 700 MW(e) PHWR, steam line break analysis was carried out and capability of passive decay heat removal system was evaluated by simulating station blackout scenario.

Under the Radiological safety programme, Portable Personnel Decontamination Kit (PPDK) has been designed and developed which can be used for decontamination of affected persons, at any site, within 20 minutes. A total of 18 DAE-Emergency Response Centres (ERC) have been established, to respond to any nuclear/radiological emergencies, anywhere in the country. One of the ERCs was inaugurated at AMD, Bangalore, by the Chairman, AEC, on the 13th of September, 2006.

As part of Front end fuel cycle activities, fifty MOX fuel bundles were fabricated and loaded in KAPS-1. BARC has recently supplied a consignment of mixed carbide and mixed oxide fuel for FBTR, for the realization of a hybrid core. The production of the axial blanket pellets for PFBR is in full swing and about 20% of the PFBR core requirement, has been manufactured. The second fabrication line for MOX fuel is currently undergoing cold commissioning trials, at AFFF, Tarapur. A peroxide precipitation process has been developed in a bench-scale set-up for purification of impurities such as Boron, Gadolinium [Gd] and Samarium [Sm] from uranium. A patent has been filed for this process and the feasibility of its deployment on industrial scale, is being examined, in collaboration with UCIL.

Reprocessing and Waste Management activities related to recovery of useful materials from spent fuel have registered all-round progress. Major activities include : revamping and modification of the Plutonium Plant at Trombay; commissioning of the Spent Fuel Storage Facilities (SFSFs) at Tarapur and Kalpakkam and the transfer of fuel from power reactors to the facility; development of a process based on indigenously developed Ammonium Phospho-Molybdate (AMP) resin for removal of ^{137}Cs, demonstration of the production of prototype ^{137}Cs pencils using simulated waste and vitrification of High-Level-Waste at Tarapur using the Joule-Heated Ceramic Melter. To address the need of future vitrification plants, an engineering scale demonstration facility

for cold crucible induction melting technology, has been built and successfully commissioned. The Advanced Vitrification System at Tarapur was operated for processing high-level liquid waste and about 2.4 tonnes vitrified waste was produced. A facility for processing of depleted Uranium pellets was successfully commissioned at Trombay.

An Extended Reach Master Slave Manipulator (ERM) of 9 kg capacity and a sealed type Three Piece Master Slave Manipulator (TPM) with modular construction have been successfully developed, as part of our Robotics and Automation programme.

An automated Gamma Scanning Unit for online inspection of industrial columns used in petrochemical plants, oil refineries, heavy water plants etc., has been developed.

The Extended X-ray Absorption Fine Structure (EXAFS) Beam Line of INDUS II Synchrotron has been designed, manufactured and installed and a Linear Distancing System for calibration of Gamma Ray detectors has also been designed and manufactured. The KALI-5000 pulsed power electron accelerator has been used at 350 keV, 20 kA, 100 n-sec., to generate short duration bursts of X-rays required for flash radiography. A 10 MeV, 2 kW, RF electron linac for X-ray radiography of large container scanning system is being developed for ECIL.

An experimental facility to record laser-induced fluorescence from a single molecule, has been set up. The facility will enable investigations of protein dynamics, using resonance energy transfer, protein-DNA interactions and radiation-induced degradation, in polymers and bio-molecules. Track etched membrane was produced using High Energy Heavy ion beams of about 100 MeV from the BARC-TIFR Pelletron accelerator. Nanostructured semiconductors (CuO, ZnO, In_2O_3 and Te) have been developed which can sense gases like Ammonia, H_2S, CO and NO efficiently at room temperature.

In the area of materials development, a standardization in experimental conditions was achieved, to synthesize B_4C powder, which is vacuum hot-pressed to specific shapes and which is needed as control rod and shielding material, for PFBR. A critical current density (Jc) of more than 800 amp. cm^{-2} has been achieved, on bulk high Tc Yttria-123 superconductor of hollow cylindrical geometry, prepared by top seeded melt growth technique, using single crystal seed. Crown ether (namely, Di-t-butyl benzo 21 crown 7) has been successfully synthesized, for the extraction of Cs137 from high-level-waste. BARC supplied the Ni-Ti-Fe shape memory alloy heat shrinkable sleeves for the Technology Demonstration Series of Light Combat Aircraft (Tejas). Zirconium-based bulk metallic glasses were also synthesized by solidifying bulk glass forming multi-component alloys in copper moulds. An autoclave with Slow Strain Rate Testing (SSRT) and Recirculation has been set up for online monitoring of dissolved oxygen and hydrogen, pressure, electrochemical current, potential and crack growth rate. Extensive studies have been carried out on the precipitation behaviour of resolutionized Alloy-625 in order to determine their useful cycle in cracker tubes in Heavy Water Plants.

On the Chemistry front, a method for the preparation of high purity electronic grade trimethyl gallium has been developed. A spectrometer, based on unique methodology of fluorescence up-conversion has also been developed for getting fluorescence information from a system, in sub pico-second to femto-second time scale. Feasibility of water-based dye laser system has been demonstrated, using supra-molecular host-guest chemistry. Using the molecular imprinting technique, a novel polymer that preferentially removes Cobalt in the presence of large concentrations of iron, has been successfully synthesized. A time-resolved, tunable, high resolution laser method was developed for the study of atmospherically important species such as hydroxyl radical at parts-per-trillion level. A tunable pyromethane laser dye has been indigenously developed. A plant-based anti-fungal skin formulation has been developed. The drug shows good results against recurring microbial skin infections, without any adverse effects.

On the nuclear instrumentation side, technology of a Multi Channel Analyser, designed for high resolution nuclear spectroscopy applications, has been developed and the CAMAC (Computer Automated Measurement And Control), FERA (Fast Encoding Readout ADC) with PCI (Peripheral Component Interconnect) card has been specially developed and evaluated, for the India Gamma Array Experiment at TIFR. The KALI-500 system at Engg. Hall-4 has been operated at 420 keV, 22 kA, 100 n-sec. Flash X-rays have been generated and recorded on film, shielded by 12mm thick stainless steel. BARC and ECIL have jointly developed a Training Simulator for the Indian Navy. As part of BARC instrumentation programme, an Instrumented Pipeline Inspection Gauge (IPIG) was developed for the inspection of oil pipelines of the Indian Oil Corporation.

BARC has developed 1.7 Teraflops Supercomputer, based on 512 nodes parallel system, which is the largest and the fastest computer in the country. A 20 Million Pixel (5120 x 4096) high-resolution wall-size Tiled Display system, using commercially available multiple LCD's (4 x 4), has enabled advanced data visualization. The first-of-its-kind system in the country is being used on regular basis, to display voluminous analytical data. This system will have large-scale defence and space applications. A DAE computing grid connecting three DAE sites: namely VECC, Kolkata, RRCAT, Indore and BARC, Mumbai has been developed allowing users at VECC, RRCAT and BARC to submit Fortran jobs, successfully, to the DAE Grid. Under the DAE-CERN collaboration programme, BARC has developed many Grid middleware tools, namely, SHIVA - a problem tracking system, Grid-View - a grid operations and monitoring system, fabric monitoring etc., which are deployed in LCG grid at CERN, Geneva.

Dosimeters using indigenously developed PIN Si diode have been developed for patient dosimetry in cancer hospitals. The Radiation Medicine Centre continues to promote its three-pronged function, viz. diagnosis and treatment of disease, performing R&D and teaching nuclear medicine. A new phosphonate molecule labelled with 177-Lu, was developed for cancer palliation therapy and human trials are currently underway. The President of India dedicated an advanced Telecobalt machine, Bhabhatron-II, to the nation on the 11th of December 2006. Seven more machines are being manufactured for use in cancer hospitals in the country.

In the field of nuclear agriculture, a new groundnut variety, TG 38 has been released, during 2006, for commercial cultivation in Orissa, West Bengal, Bihar and North-Eastern States, for Rabi/summer season, by the Ministry of Agriculture, Govt. of India. This brings the total number of Trombay crop varieties to 28. Six more new Trombay crop varieties will also be released shortly. During 2006, one each in mustard, sunflower, soybean, groundnut and two in mungbean have been released, by the State Varietal Release Committees in Maharashtra, Madhya Pradesh and Andhra Pradesh and awaiting gazette notification. Four Nisargruna biogas plants have become operational at Hiranandani Estate (Thane), INS Chilka (Orissa), Ankleshwar (Gujarat) and Chandrapur (Maharashtra). Upgradation of KRUSHAK facility has been initiated, for the treatment of Mangoes with gamma radiation, under the Framework Equivalency Work Plan agreement signed between India and USA, for export of mangoes. An MoU has been signed, between BARC and the National Centre for Electron Beam Food Research, The Texas A&M University, USA, for co-operation in the advancement of electron and X-ray irradiation technologies, for food preservation.

As part of DAE-Societal initiative, based on Non-Power Applications (NPAs), the AKRUTI (Advanced Knowledge and Rural Technology Implementation) programme was evolved at BARC, for the techno-economic growth of rural areas. One such AKRUTI is operational at the Srikakulam district, AP.

For the first time in the history of DAE, under the XI plan, a scheme of prospective research funding has been introduced. Scientists are invited to submit proposals for any new R&D ideas that they would like to develop. I hope our scientific community takes maximum advantage of this opportunity.

His Excellency Dr A. P. J. Abdul Kalam, President of India, visited our Centre on 17th of July, 2006. It was a memorable and inspiring occasion for our young scientists and trainee officers.

The celebrations of the Golden Jubilee year, on the 20th of January this year, saw some of our young colleagues, giving their vision of BARC, in the next 25 years. We must encourage our young deserving colleagues to follow in the footsteps of our seniors and work towards achieving the common goals of BARC.

We are now entering into XI Plan and our programmes for the next five years have been finalized and submitted to the Planning Commission for approval. All the scientific activities of BARC have been grouped into 32 programmes for effective implementation. These consist of XI Plan projects, X Plan continuing projects and on-going R&D, operation, maintenance and service activities pursued by various divisions. The list of 32 such programmes is given in the Annexure for reference. All the activities pursued by our scientific staff should form part of these listed programmes which have been identified through a series of discussions at various levels. We recognize that scientific programmes continuously evolve and the system should remain open for introduction of new programmes or reorientation of some of the existing programmes. Nevertheless it is important to review and monitor our programmes periodically on a continuous basis.

Efforts have been made for the last few months to develop a computer system intended to integrate these programmes, personnel and resources of BARC in a well structured manner. As a result of these efforts, a prototype working system (enhanced BTS) called PARINAY (Programme And Resources INtegrAtion sYstem) has been developed by the Computer Division and will be ready for use from April 2007. The PARINAY system is expected to serve as an add-on tool for better implementation of our programmes and I hope this system will synergize our activities by a more effective allocation of scientific personnel and better utilization of our resources. I am earnestly requesting all our colleagues to utilize the PARINAY system on a regular basis and continuously provide inputs for further refinement of the system.

Dear colleagues, on the occasion of our Golden Jubilee year, let us make a reaffirmation to excellence, perseverance, innovation and national development.

List of Programmes

Programme Serial No.	Programme Title
1.	R&D for Heavy Water Reactors
2.	Light Water Reactors
3.	Enrichment Programme
4.	Front End Fuel Cycle Programme
5.	Back End Fuel Cycle Programme
6.	Safety & Environment Related Programme
7.	Fuels for Fast Reactors
8.	Advanced Nuclear Reactor Development
9.	Thorium Technologies
10.	High Temperature Materials
11.	Hydrogen Energy Programme
12.	Research Reactor Programme
13.	Isotopes & Radiation Technologies
14.	Nuclear Agriculture, Food Preservation & Hygenization
15.	Healthcare Services
16.	Desalination & Water Purification Technologies
17.	Accelerator & ADS Technologies
18.	Special Programmes and Special Materials Development
19.	Nuclear Instrumentation & Radiation Detectors
20.	Beam Technology Programme
21.	Manufacturing Technologies
22.	Scientific & Medical Equipment Development
23.	Enhancement of Computing Power and Connectivity
24.	Nuclear Physics, Astrophysics & Neutron Beam Research
25.	Energy Conversion
26.	Advanced Research in Chemistry
27.	Radiation Effects in Biological Systems
28.	Advanced Spectroscopy & Utilization of Synchrotron Sources
29.	Advanced Functional Materials
30.	Scientific Information Resources, Technology Transfer & HRD
31.	Infrastructure
32.	Remote Handling & Robotics

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डॉ. श्रीकुमार बॅनर्जी, निदेशक, भापअ केंद्र, का नव वर्ष का संदेश

प्रिय साथियों,

मैं आपको और आपके परिवार के सभी सदस्यों को सुख एवं समृद्धिपूर्ण नव वर्ष हेतु हार्दिक शुभकामनायें देता हूँ । वर्ष 2007 भापअ केंद्र के "स्वर्ण जयंती समारोह" का वर्ष है। इस अवसर पर हम नाभिकीय ऊर्जा की प्रगति एवं विकास के प्रति अपनी प्रतिबद्धता की पुन: पुष्टि सुनिश्चित करते हैं। मैं, पिछले वर्ष के दौरान अर्जित उपलब्धियों एवं गतिविधियों के बारे में आपको संक्षेप में बताना चाहता हूँ।

भापअ केंद्र के तीन अनुसंधान रिएक्टर यथा अप्सरा, सायरस एवं ध्रुवा अच्छी उपलब्धता गुणांक सहित प्रचालनरत रहे और अनुसंधान एवं विकास गतिविधियों के लिए विस्तृत रूप से इनका उपयोग किया गया। ध्रुवा द्वारा वर्ष 2006 में 81.72% का अब तक का उच्चतम उपलब्धता गुणांक प्राप्त किया गया। अप्सरा का "50 वर्ष का सफलतापूर्वक प्रचालन" संपन्न हुआ। उसके रिएक्टर क्रोड को पुन: सज्जित करने हेतु भौतिकी डिज़ाइन एवं अन्य इंजीनियरी ब्यौरों पर कार्य किया जा रहा है ।

विशाखापट्टनम में स्थापन हेतु प्रस्तावित 30 मेगावाट वाले उच्च फ्लक्स बहुप्रयोज्य अनुसंधान रिएक्टर की संकल्पनात्मक डिजाइन अब डिजाइनरों एवं प्रयोगकर्ता समूहों के बीच विस्तृत विचार-विमर्श के लिए तैयार है।

225 मिमी लैटिस पिच युक्त एएचडब्ल्यूआर क्रोड की रिएक्टर भौतिकी डिज़ाइन को बर्न-अप इष्टतमीकरण एवं नियंत्रण तथा शट-डाऊन तंत्रों की स्थिति सहित पूरा किया गया। डिज़ाइन के मान्यकरण का कार्य भी इन्टीग्रल टेस्ट लूप (आईटीएल) सुविधा के माध्यम से किया जा रहा है जो एएचडब्ल्यूआर की निष्क्रिय शीतलन प्रणाली को अनुकारित करेगा एवं निष्पादन डाटा तैयार करेगा। एएचडब्ल्यूआर का अनुज्ञप्ति- पूर्व डिज़ाइन मूल्यांकन का कार्य पूरा किया गया है एवं निर्माण कार्य शुरू करने हेतु अनुमति प्राप्त करने के लिए आवश्यक दस्तावेज तैयार किये जा रहे हैं। एएचडब्ल्यूआर की भौतिक डिजाइन के मान्यकरण हेतु क्रांतिकता सुविधा का निर्माण कार्य प्रगत स्तर पर है एवं शीघ्र ही प्रथम क्रांतिकता प्राप्त की जायेगी। उच्च ताप रिएक्टर विकास कार्यक्रम के अंतर्गत कंप्यूटर कोडों का विकास किया गया है जिन्हें 600 मेगावाट वाले उच्च ताप रिएक्टर की भौतिकी एवं ताप द्रवचालित डिज़ाइन के लिए प्रयोग किया जा रहा है।

भापअ केंद्र द्वारा देश के नाभिकीय विद्युत कार्यक्रम के लिए अनुसंधान एवं विकास सहायता प्रदान करने का कार्य जारी रहा। कुछ अद्यतन विकास कार्य हैं : रिएक्टर क्रोड में न्यूट्रान फ्लक्स के आवधिक मॉनीटरन हेतु विभिन्न स्थानों में स्थित 102 वैनेडियम स्व-ऊर्जित न्यूट्रान संसूचकों का प्रयोग करते हुये फ्लक्स मैपिंग सिस्टम (एफएमएस); मंदक में से बोरान की उपस्थिति में गैडोलिनियम नाइट्रेट को निकालने हेतु आयन विनियम प्रक्रिया; द्रव क्षेत्र नियंत्रण प्रणाली, आपंक को निकालने के लिए आपंक लैन्सिंग उपस्कर (एलएसई), शीतलक वाहकों के अक्षीय विसर्पण के मापन हेतु एक पराध्वनिक तकनीक, भाप टरबाइन हेतु एक ऑन लाइन कंपन नैदानिक प्रणाली एवं कई अन्य भारत में पहली बार टीएपीएस 3 एवं 4 में रिएक्टर संरक्षण एवं शट-डाउन कार्य की जांच एवं मॉनीटरन के लिए एक समेकित प्रणाली का स्थापन एवं कमीशनन किया गया।

पीएचडब्ल्यूआर में शीतलक चैनलों के अक्षीय विसर्पण मापन हेतु एक असंपर्क पराध्वनिक सेंसर आधारित प्रणाली विकसित की गयी। टीएपीएस 3 एवं 4, केएपीएस-1, आरएपीएस 2 एवं 3, केजीएस -2 में प्रयुक्त प्रणाली द्वारा मापन काल एवं मैन-रैम व्यय में महत्वपूर्ण कटौती का निदर्शन किया गया ।

भापअ केंद्र द्वारा प्रचालन में विस्तार हेतु नियामक अनुमति प्राप्त करने हेतु प्रचालनरत नाभिकीय विद्युत संयंत्र के शीतलक चैनलों के आयु प्रबंधन हेतु विश्लेषणात्मक एवं तकनीकी सहायता प्रदान की गयी।

700 मेगावाट वाले पीएचडब्लयूआर हेतु स्टीम लाइन ब्रेक विश्लेषण किया गया एवं स्टेशन ब्लैक आउट परिदृष्य के अनुकारण द्वारा निष्क्रिय ऊष्मा क्षय निकासी प्रणाली की क्षमता का मूल्यांकन किया गया।

वैकिरणकी संरक्षा कार्यक्रम के अंतर्गत सुवाह्य कार्मिक विसंदूषण किट (पीपीडीके) का अभिकल्पन एवं विकास किया गया जिसका प्रयोग प्रभावित व्यक्तियों के विसंदूषण के लिए किसी भी स्थल पर 20 मिनट के अंदर किया जा सकता है। देश में कहीं भी किसी भी नाभिकीय/ वैकिरणकी आपातकाल से निपटने के लिए कुल 18 पऊवि - आपातकालीन अनुक्रिया केंद्र (ईआरसी) स्थापित किये गये हैं। एक ईआरसी का एएमडी, बैंगलोर में दिनांक 13 सितंबर 2006 को अध्यक्ष परमाणु ऊर्जा आयोग द्वारा उद्घाटन किया गया।

ईंधन चक्र के अग्रभाग की गतिविधियों के अंतर्गत पचास मॉक्स ईंधन गुच्छों का संविरचन कर केएपीएस -1 में लोड किया गया। भापअ केंद्र द्वारा हाल ही में हायब्रिड क्रोड के कार्यान्वयन हेतु मिश्रित कार्बाइड एवं मिश्रित ऑक्साइड ईंधन के एक परेषण की आपूर्ति की गई । पीएफबीआर हेतु अक्षीय ब्लैंकेट गुटिकाओं का उत्पादन तीव्र गतिसे चालू है एवं पीएफबीआर क्रोड आवश्यकता का लगभग 20% विनिर्माण कार्य किया जा चुका है । मॉक्स ईंधन हेतु द्वितीय संविरचन कार्य वर्तमान में एएफएफएफ, तारापुर में शीत कमीशनन परीक्षण के अंतर्गत है । यूरेनियम से बोरॉन, गैडोलिनियम (Gd) एवं समेरियम (Sm) जैसी अशुद्धियों के शुद्धिकरण हेतु बेंच-स्केल सेट-अप में एक परॉक्साइड अवक्षेपण प्रक्रिया का विकास किया गया । इस प्रक्रिया के लिए एक पैटेन्ट फाइल की गयी है एवं यूसीआईएल के सहयोग से इसके औद्योगिक स्तर पर प्रयोग की व्यवहार्यता की जांच की जा रही है ।

भुक्तशेष ईंधन से उपयोगी पदार्थों की पुन:प्राप्ति से संबंधित पुन:संसाधन एवं अपशिष्ट प्रबंधन गतिविधियों में सर्वांगीण प्रगति हुयी है। प्रमुख गतिविधियों में ट्रांबे स्थित प्लूटोनियम संयंत्र का नवीकरण एवं परिष्करण; तारापुर एवं कलपाक्कम स्थित भुक्तशेष ईंधन भंडारण सुविधाओं (एसएफएसएफ) का कमीशनन; ^{137}Cs के निष्क्रमण हेतु स्वदेश में विकसित अमोनियम फास्फो-मालिब्डेट (AMP) आधारित प्रक्रिया का विकास, अनुकारित अपशिष्ट का प्रयोग करते हुये प्रोटोटाइप ^{137}Cs पेन्सिलों के उत्पादन का निदर्शन एवं जूल तप्त सिरेमिक गलनित्र का प्रयोग करते हुये तारापुर स्थित उच्च-स्तरीय-अपशिष्ट का कांचीकरण शामिल हैं । भविष्य में कांचीकरण संयंत्रों की आवश्यकताओं को पूरा करने हेतु शीत क्रूसिबल प्रेरण गलन प्रौद्योगिकी के लिए एक अभियांत्रिक स्तरीय निदर्शन सुविधा को निर्मित कर उसका सफलतापूर्वक कमीशनन किया गया। उच्च-स्तरीय द्रव अपशिष्ट के संसाधन हेतु तारापुर स्थित प्रगत कांचीकरण प्रणाली को प्रचालित किया गया एवं लगभग 2.4 टन कांचीकृत अपशिष्ट का उत्पादन किया गया । ट्रांबे में रिक्त यूरेनियम गुटिकाओं के संसाधन हेतु एक सुविधा का सफलतापूर्वक कमीशनन किया गया।

हमारे रोबोटिक्स एवं स्वचालन कार्यक्रम के एक भाग के रूप में एक 9 कि.ग्रा. क्षमता वाला एक्सटेन्डेड रीच मास्टर स्लेव मेनीपुलेटर (ERM) तथा मॉडुलर संरचना वाला सील्ड टाइप थ्री पीस मास्टर स्लेव मेनीपुलेटर (TPM) का सफलतापूर्वक विकास कर लिया गया है।

पेट्रोकेमिकल संयंत्रों, ऑइल रिफ़ाइनरियों, भारी पानी संयंत्रों इत्यादि में प्रयुक्त होने वाले औद्योगिक कॉलमों के ऑन-लाइन निरीक्षण हेतु एक स्वचालित गामा स्कैनिंग यूनिट का विकास किया गया है।

इन्डस II सिंक्रोट्रॉन की एक्सटेन्डेड एक्स-रे एबजार्पशन फाइन स्ट्रक्चर (EXAFS) बीम लाइन का अभिकल्पन, विनिर्माण एवं स्थापन कर लिया गया है । गामा-रे-संसूचकों के अंशांकन हेतु लीनियर डिस्टेन्टिंग सिस्टम का भी अभिकल्पन एवं विनिर्माण कर लिया गया है । फ़्लैश रेडियोग्राफ़ी हेतु आवश्यक एक्स-रे के लघु अवधि प्रस्फ़ोटों के निर्माण के लिए काली-5000 स्पन्द शक्ति इलेक्ट्रॉन त्वरक का 350 KeV, 20 KA, 100 n- Sec पर प्रयोग किया गया है। ईसीआईएल के लिए लार्ज कन्टेनर स्कैनिंग सिस्टम की एक्स-रे रेडियोग्राफ़ी हेतु एक 10 MeV, 2kW, RF इलेक्ट्रॉन लिनेक का विकास किया जा रहा है ।

एकल अणु से लेसर-प्रेरित संदीप्ति रिकॉर्ड करने हेतु एक प्रयोगात्मक सुविधा का विकास किया गया है। बहुलुकों एवं जैव-अणुओं में अनुनादी ऊर्जा स्थानांतरण, प्रोटीन-DNA इन्टरेक्शन एवं विकिरण-प्रेरित डिग्रेडेशन के प्रयोग द्वारा प्रोटीन डायनामिक्स की जाँच में यह सुविधा सक्षम होगी । बीएआरसी-टीआईएफआर पेलेट्रॉन त्वरक से करीब 100Mev की उच्च ऊर्जा वाली भारी आयन बीमों का प्रयोग करते हुए ट्रैक निक्षारित झिल्ली का उत्पादन किया गया । नैनोसंरचित अर्धचालकों (CuO, ZnO, $ln_2 O_3$ एवं Te) का विकास कर लिया गया है जिससे कक्ष तापमान पर अमोनिया, H_2S, CO एवं NO जैसी तीक्ष्ण गैसों की क्षमता का बोध किया जा सकता है।

पदार्थ विकास के क्षेत्र में, PFBR हेतु B_4C चूर्ण के संश्लेषण के लिये प्रयोगात्मक परिस्थितियों का मानकीकरण कर लिया गया है। यह चूर्ण विशिष्ट आकारों हेतु वैक्यूम तप्त दाबित होता है तथा इसके लिए नियंत्रण छड़ एवं परिरक्षित पदार्थों की आवश्यकता होती है। एकल क्रिस्टल सीड का प्रयोग करते हुए टॉप सीडेड मेल्ट ग्रोथ तकनीकी द्वारा निर्मित हॉलो सिलेन्ड्रीकल ज्योमेट्री के बल्क हाई Tc इट्रिया-123 अतिचालक पर 800 amp Cm^{-2} से अधिक क्रांतिक करैन्ट सघनता प्राप्त की जा चुकी है। क्राउन ईथर नामत: Di-t-butyl benZo 21 crown 7) का सफ़लतापूर्वक संश्लेषण किया गया है ताकि उच्च-स्तर-अपशिष्ट से Cs^{137} का कर्षण किया जा सके । भाभा परमाणु अनुसंधान केंद्र द्वारा हल्के लड़ाकू विमान (तेजस) की प्रौद्योगिकी निदर्शन श्रंखला हेतु Ni-Ti-Re शेप मेमोरी मिश्र धातु ताप स्लीव्ज की आपूर्ति की गई है । कॉपर मोल्डस् में ग्लास फर्मिंग बहु-घटकीय मिश्रधातु के ठोसीकरण द्वारा जिर्कोनियम आधारित धात्विक ग्लासों की बड़ी मात्रा का भी संश्लेषण किया गया । मन्द तनाव दर परीक्षण (SSRT) एवं परिसंचरण युक्त एक आटोक्लेव का स्थापन किया गया है जिससे विलयित ऑक्सीज़न एवं हाईड्रोजन, प्रेशर, इलेक्ट्रोकेमीकल करेन्ट विभव तथा क्रेक ग्रोथ रेट का ऑनलाइन मानीटरन किया जा सकेगा। भारी पानी संयंत्रों में क्रेकर ट्यूबों में उनकी सायकल की उपयोगिता निर्धारित करने हेतु खण्डित मिश्रधातु 625 के अवक्षेपण व्यवहार पर विस्तृत अध्ययन किए गये हैं।

रसायनिकी के मोचों पर उच्च शुद्धता वाले इलेक्ट्रॉनिक ग्रेड के ट्राईमीथीइल गौलियम के निर्माण हेतु एक विधि का विकास किया गया है। प्रणाली से उप पीको-सेकंड से फेमटो -सेकंड टाइम-स्केल में एक संदीप्ति सूचना प्राप्त करने हेतु संदीप्ति ऊर्ध्व-रूपांतरण के विशिष्ट विधि पर आधारित एक स्पेक्ट्रोमीटर का विकास किया गया है। अति-अणु होस्ट गैस्ट रसायनिकी का प्रयोग करते हुए जल आधारित डाय लेसर प्रणाली की व्यवहार्यता का निदर्शन किया गया है। अणु अधिमुद्रण तकनीक का प्रयोग करते हुए एक अभिनव बहुलक का सफ़लतापूर्वक संश्लेषण किया गया जो कि लोहे के विशाल सान्द्रण की उपस्थिति में कोबॉल्ट को हटाता है। वायुमंडलीय महत्वपूर्ण स्पेशीज जैसे प्रति ट्रिलिऑन लेवेल पर हाइड्रॉक्सिल रेडिकल के अध्ययन हेतु एक समय भेदित ट्यूनेबल, उच्च वियोजन क्षमता वाली लेजर विधि का विकास किया गया है। एक ट्यूनेबल पाइरोमीथेन लेसर डाई का स्वदेश में विकास किया गया है। एक पादप -आधारित एन्टी-फ़ंगल स्किन फॉरमूलेशन का विकास किया गया है। बार-बार होने वाले माइक्रोबॉइल त्वचा संक्रमण पर इस दवा के बिना किसी प्रतिकूल प्रभाव के अच्छे परिणाम सामने आये हैं।

नाभिकीय यंत्रीकरण के क्षेत्र में उच्च विघटन नाभिकीय स्पेक्ट्रोस्कोपी अनुप्रयोगों के लिए बहु चैनल विश्लेषक की प्रौद्योगिकी के अभिकल्पन का विकास कर लिया गया है और टीआईएफआर में इंडिया गामा व्यूह प्रयोगों के लिए CAMAC (कंप्यूटर स्वचालित मापन एवं नियंत्रण), FERA (फास्ट एनकोडिंगरीड आउट एडीसी) तथा PCI (पेरिफ़ेरल कॉम्पोनेन्ट इन्टरकनेक्ट) कार्ड सहित FERA

(फ़ास्ट एनकोडिंग रीडआउट ADC) का विशेष रूप से विकास तथा मूल्यांकन किया गया है। इंजीनियरी हॉल-4 में काली-500 प्रणाली को 420 keV, 22 kA, 100 n-sec पर चलाया गया है। 12 मिमी मोटी स्टेनलैस स्टील द्वारा परिरक्षित है फ्लेश एक्स-रेज़ का निर्माण करके उन्हें फिल्म पर रिकॉर्ड किया गया है । बीएआरसी एवं ईसीआईएल ने संयुक्त रूप से इंडियन-नेवी के लिए प्रशिक्षण अनुकारक का विकास किया है। भापअ केंद्र के यंत्रीकरण कार्यक्रम के एक भाग के रूप में इंडियन ऑयल कारपोरेशन की तेल पाइपलाइनों के निरीक्षण हेतु एक यंत्रीकृत पाइपलाइन निरीक्षण गेज़ (IPIG) का विकास किया गया है ।

भापअ केंद्र द्वारा 512 नोड्स समान्तर प्रणाली पर आधारित 1.7 टेराफ़्लोप्स सुपर कंप्यूटर का विकास किया गया है जो कि देश का सबसे बड़ा व तीव्र कंप्यूटर है। वाणिज्यिक रूप से उपलब्ध मल्टीपल LCDs (4x4) का प्रयोग करने वाले एक 20 मिलियन पिक्सेल (5120 x 4096) उच्च विघटन वॉल साइज़ टाइल्ड डिस्प्ले सिस्टम द्वारा प्रगत डाटा विज़्यूलाइजेशन उपलब्ध कराया गया है । देश में अपने प्रकार के इस प्रथम सिस्टम का प्रयोग नियमित आधार पर बड़े विश्लेषण डाटा के डिस्प्ले के लिए किया जाता है । इस सिस्टम का रक्षा एवं अंतरिक्ष कार्यों में बड़े-स्तर अनुप्रयोग है। तीन डीएई साइटों नामत: वीइं सीसी, कोलकाता, आरआरकैट, इंदौर एवं बीएआरसी, मुंबई को जोड़ने वाले एक डीएई कम्प्यूटिंग ग्रिड का विकास किया गया है। इसके द्वारा वीईसीसी, आरआरकैट एवं बीएआरसी के प्रयोक्ता डीएई ग्रिड को सफलतापूर्वक फोरट्रेन कार्य प्रस्तुत कर सकते हैं। डीएई -सीईआरएन सहयोग कार्यक्रम के तहत बीएआरसी द्वारा अनेक ग्रिड मिडिलवेयर टूल्स का विकास किया गया है जैसे प्रोब्लम ट्रेकिंग सिस्टम, "शिवा" ग्रिड प्रचालन एवं मॉनीटरन सिस्टम, फेब्रिक मॉनीटरन इत्यादि, के लिए "ग्रिड व्यू" जिन्हें सीईआरएन, जिनेवा में एलसीजी ग्रिड में लगाया गया है ।

कैंसर अस्पतालों में पेशेन्ट डोसीमिट्री के लिए जो डोसीमीटर प्रयुक्त किये जा रहे हैं उन में प्रयोग किये जाने वाले PIN Si डियोड स्वदेश में ही विकसित किये गये हैं। विकिरण औषध केंद्र ने तीन बड़े कार्यों को प्रोत्साहित करना जारी रखा है जैसे बीमारियों का निदान व उपचार, अनुसंधान एवं विकास कार्य तथा नाभिकीय औषधियों का शिक्षण। कैंसर शमन चिकित्सा एवं मानवीय परीक्षणों हेतु 177-Lu के साथ एक लेबेल्ड नवीन फ़ॉस्फ़ोनेट अणु का विकास किया गया। दिनांक 11 दिसंबर 2006 को भारत के राष्ट्रपति ने एक प्रगत टेलीकोबाल्ट मशीन, भाभाट्रॉन-II देश को समर्पित की। देश में कैंसर अस्पतालों में प्रयोग के लिए सात अन्य मशीनों का निर्माण किया जा रहा है।

नाभिकीय कृषि के क्षेत्र में कृषि मंत्रालय, भारत सरकार द्वारा रबी/गर्मी के मौसम के लिए 2006 के दौरान वाणिज्यिक कृषि हेतु उड़िसा, पश्चिम बंगाल, बिहार तथा उत्तर-पूर्वी राज्यों में मूंगफली की एक नयी किस्म टीजी 38 जारी की गयी है। इसको मिलाकर ट्राम्बे फसल किस्मों की कुल संख्या 28 हो गई है । ट्राम्बे फ़सल किस्मों की और छ: नई किस्में कुछ ही समय में जारी की जानेवाली हैं । वर्ष 2006 के दौरान, महाराष्ट्र, मध्य प्रदेश और आन्ध्र प्रदेश में स्टेट वेराइटल रिलीज कमेटियों द्वारा सरसों, सूरजमुखी, सोयाबीन, मूंगफली की एक-एक और मूंगबीन की दो किस्में जारी की गई जिन्हें राजपत्र में अधिसूचित किया जाना प्रतीक्षित है। हीरानंदानी इस्टेट (ठाणे), आईएनएस चिलका (उड़िसा), अंकलेश्वर (गुजरात) और चन्द्रपुर (महाराष्ट्र) में चार निसर्गऋण संयंत्र प्रचालनरत हो गए हैं। भारत और अमेरिका के बीच आमों के निर्यात हेतु हस्ताक्षरित फ्रेमवर्क इक्विवैलेंसी कार्य योजना के अन्तर्गत आमों के गामा विकिरण उपचार हेतु कृषक सुविधा का उन्नयन कार्य प्रारंभ किया गया है । भापअ केन्द्र, राष्ट्रीय इलेक्ट्रॉन किरणपुंज खाद्य अनुसंधान केन्द्र और दि टेक्सास ए एण्ड एम यूनिवर्सिटी, यूएसए के बीच एक्स-रे किरणन प्रौद्योगिकियों और प्रगत इलेक्ट्रान के सहयोग हेतु खाद्य परिरक्षण हेतु एक समझौता ज्ञापन हस्ताक्षरित किया गया ।

ग्रामीण क्षेत्रों में प्रौद्योगिक - मितव्ययी विकास हेतु गैर-बिजली अनुप्रयोगों (एनपीए) के आधार पर डीएई - सोसाइटल पहल के भाग के रूप में भापअ केन्द्र में **आकृति** (प्रगत ज्ञान तथा ग्रामीण प्रौद्योगिकी क्रियान्वयन) कार्यक्रम विकसित किया गया था । ऐसा ही एक **"आकृति"** आन्ध्र प्रदेश में श्रीकाकुलम जिले में प्रचालनरत है ।

डीएई के इतिहास में पहली बार XI प्लान के अन्तर्गत भावी अनुसंधान निधि की एक योजना प्रारंभ की गई है। वैज्ञानिकों को आमंत्रित किया गया है कि वे किसी नये अनुसंधान एवं विकास संबंधी विषय पर प्रस्ताव प्रस्तुत करें जिसका वे विकास करना चाहते हैं । मुझे विश्वास है कि हमारा वैज्ञानिक समुदाय इस मौके का अधिकतम लाभ उठाएगा ।

भारत के राष्ट्रपति महामहिम डॉ.ए.पी.जे. अब्दुल कलाम ने दिनांक 17 जुलाई 2006 को इस केन्द्र का दौरा किया था। युवा वैज्ञानिकों और प्रशिक्षु अधिकारियों के लिए वह एक अविस्मरणीय तथा प्रेरणात्मक अवसर था ।

इस वर्ष 20 जनवरी को, स्वर्ण जयंती वर्ष के समारोहों में कुछ युवा वैज्ञानिकों द्वारा आगामी 25 वर्षों में भापअकेंद्र के भावी परिदृश्य पर विचार प्रस्तुत किए गए । हमें अपने योग्य सहकर्मियों को अपने वरिष्ठों के पदचिह्नों का अनुसरण करने और भापअकेंद्र के समान लक्ष्यों की प्राप्ति हेतु कार्य करने के लिए प्रेरित करना चाहिए ।

अब हम XI प्लान में प्रवेश कर रहे हैं और आगामी 5 वर्षों के लिए हमारे कार्यक्रम तय हो गये हैं जिसे योजना आयोग का अनुमोदन प्राप्त करने हेतु प्रस्तुत किया गया है । प्रभावी क्रियान्वयन हेतु भापअकें की सभी वैज्ञानिक गतिविधियों को 32 कार्यक्रमों में वर्गीकृत किया गया है । इनमें XI प्लान की परियोजनाए, X प्लान की चालू परियोजनाएं एवं चालू आर एण्ड डी गतिविधियां, विभिन्न प्रभागों द्वारा संचालित प्रचालन, अनुरक्षण तथा सेवा गतिविधियों का समावेश है । इन 32 कार्यक्रमों की सूची संदर्भ हेतु संलग्न अनुलग्नक में दी गई है । हमारे वैज्ञानिक स्टाफ द्वारा संचालित सभी गतिविधियां इन सूची बद्ध कार्यक्रमों का हिस्सा होनी चाहिए जिनका निर्धारण विभिन्न स्तरों पर हमारे वैज्ञानिक कर्मियों द्वारा श्रृंखलाबद्ध चर्चाओं द्वारा किया गया है । हम मानते हैं कि वैज्ञानिक कार्यक्रम सतत रूप से बनते रहने चाहिए तथा हमारे सिस्टम को हमेशा नए कार्यक्रमों या कुछ विद्यमान कार्यक्रमों के पुन: अभिमुखीकरण के समावेशन के लिए रखा जाना चाहिए । तथापि, हमारे कार्यक्रमों की समीक्षा और मानीटरन लगातार तथा आवधिक आधार पर किया जाना आवश्यक है ।

इन कार्यक्रमों तथा भापअकेंद्र के संसाधनों एवं कर्मियों के सुव्यवस्थित ढंग से समेकन के लिए इन पिछले कुछ महीनों में एक कंप्यूटर प्रणाली विकसित करने का प्रयास किया गया है । इन प्रयासों के परिणामस्वरूप एक प्रोटोटाइप कार्य प्रणाली (विकसित बीटीएस) PARINAY (कार्यक्रम और स्रातों की समाकलन प्रणाली) का विकास कंप्यूटर प्रभाग द्वारा किया गया है और यह प्रणाली अप्रैल 2007 से प्रयोग हेतु तैयार होगी । हमारे कार्यक्रमों के अच्छे कार्यान्वयन के लिए आशा की जाती है कि यह PARINAY प्रणाली अतिरिक्त उपस्कर (एड-ऑन टूल) के रूप में कार्य करेगी और मैं आशा करता हूँ कि यह प्रणाली वैज्ञानिक कर्मियों के अधिक प्रभावी वर्गीकरण तथा हमारे संसाधनों के अधिक बेहतर प्रयोग द्वारा हमारी गतिविधियों में तेजी लाएगी । मैं अपने साथियों से तत्परता से अनुरोध करता हूँ कि PARINAY प्रणाली का नियमित आधार पर प्रयोग करें और प्रणाली में और सुधार हेतु लगातार निवेश (इनपुट) उपलब्ध कराएं ।

प्रिय साथियों, हमारे स्वर्ण जयंती वर्ष के अवसर पर आइए हम उत्कृष्टता, दृढ़ता, नूतनता एवं राष्ट्रीय विकास के प्रति समर्पित होने की प्रतिज्ञा करें ।

संलग्नक

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बी एआरसी न्यूज़लेटर
BARC NEWSLETTER

COLD CRUCIBLE INDUCTION MELTER: TECHNOLOGY DEVELOPMENT FOR HLW VITRIFICATION

G. Sugilal, P. B. S. Sengar and S. D. Misra
Nuclear Recycle Group

Introduction

Immobilization in suitable glass matrix is presently being practised in India, for the conditioning of High level radioactive Liquid Waste (HLW) originating from fuel reprocessing plants. In order to meet the challenging task of vitrification of HLW, research and development work was started in our country in the late sixties, encompassing various areas of HLW conditioning, including formulation of matrices for immobilization of HLW and their characterization. This was followed by research and development of process, equipment and assemblies, to condition HLW into an inert and stable waste form of acceptable quality. These efforts have finally culminated in the indigenous development of the induction heated metallic melter.

In the vitrification process employing the induction heated metallic melter, the progressive steps of evaporation, drying, calcination and melting of waste and glass additive slurry, are achieved in a metallic process pot heated by a multi-zone induction furnace. The molten product after homogenising is drained out from the inconel process pot through a freeze valve located at the bottom of process pot, to a stainless steel canister. This canister is seal-welded and subsequently overpacked, allowing reuse of the process pot. Though the induction heated pot melter is a compact and simple system, it has limited throughput on account of the size constraint and short melter life due to high temperature glass corrosion. In order to circumvent these limitations, Joule heated ceramic melter has been developed and demonstrated. The advanced vitrification system at SSSF, Tarapur employs the Joule heated ceramic melter for vitrification of HLW.

In the Joule heated ceramic melter, thermal energy required for vitrification, is generated using multiple pairs of metallic electrodes immersed in a pool of electrically conducting glass. Though glass is a non-conductor of electricity at room temperature, it starts conducting substantially well above the glass transition temperature. This initial heating is achieved by auxiliary resistance heaters located around the furnace plenum. Subsequently an alternating current is passed through the heated glass across the electrodes, to sustain heating up of the glass by Joule effect. Availability of unrestrained heat transfer area and amenability to continuous mode of operation, facilitate larger processing capacity and the presence of glass corrosion resistant refractory wall, enhances the life of the ceramic melter. Natural convection currents prevailing in the electrically conducting molten glass pool improve the product quality. By virtue of the large thermal inertia of the glass pool, the Joule melter can accommodate variations in the feed streams, to a better extent. However, the major operating constraint for the ceramic melter is that, its electrodes are not to be exposed to temperatures higher than 1100°C in order to ensure their long life. Moreover, decommissioning of the ceramic melter at the end of its service is quite involved.

Globally emerging vitrification technology based on cold crucible induction melting, offers several advantages such as long melter life, high temperature availability, high waste loading, high specific capacity, compatibility with new matrices etc. Developmental work ranging from laboratory scale experiments to engineering scale demonstration have been carried out, for the indigenous development of the crucible induction melting technology.

Cold crucible induction melting

In cold crucible induction melting, cooling of the induction heated melter produces a solidified glass layer, which acts as protection against glass corrosion along the inner wall of the melter. The main advantages of the cold crucible induction melting are:

- longevity and compactness of the melter,
- availability of high temperature to treat hard-to-process wastes and
- susceptibility for various wasteforms and thereby better waste loading.

The cold crucible between the inductor and the process material cannot be a simple water jacket, which would constitute a Faraday cage, thereby preventing the electromagnetic field from penetrating into the material. The electromagnetic field inside the crucible would then be zero and direct induction heating of the contents would become impossible under such a condition. The cold crucible is therefore sectorised, i.e. manufactured from contiguous segments forming a cylindrical volume, but separated by a thin layer of electrically insulating material. A schematic representation of the segmented cold crucible is shown in Fig. 1.

The flexibility of the Cold Crucible Induction Melter (CCIM) technology is mainly due to the fact, that very high temperatures can be reached in the melt, because of the high thermal power release that can be produced by direct induction in the melt. By virtue of the high temperature availability and protective layer formation, CCIM can process melts that are either too corrosive or too viscous for the standard Joule-heated ceramic type melters, which are usually limited to a maximum temperature of about

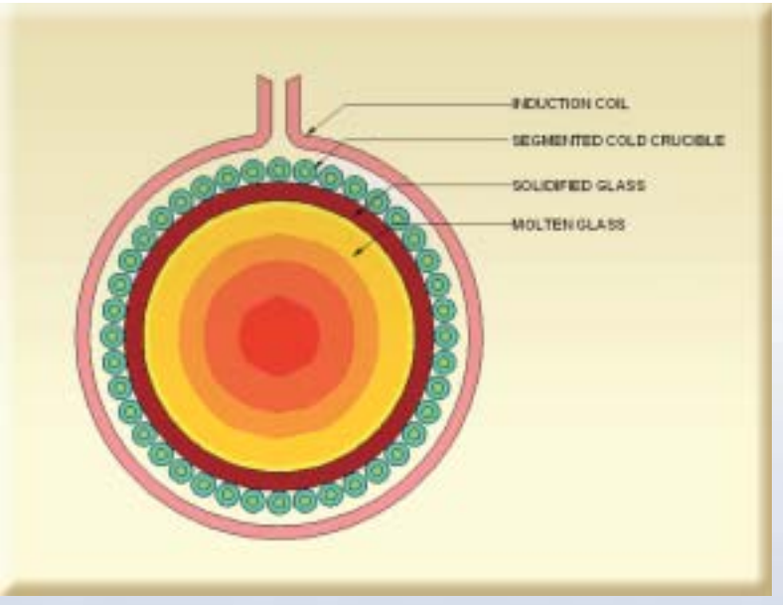


Fig. 1: Schematic representation of the segmented cold crucible

1100°C. This is especially relevant when the waste contains significant amount of difficult-to-melt compounds or corrosive elements (such as zirconia, alumina, flourine, molybdenum and sulphur). In the case of CCIM, the limits for glass formulation can be extended to glass-ceramic matrix, which can accommodate more than 40 wt % waste loading.

The CCIM is also more tolerant to the presence of noble metals than the traditional Joule heated ceramic melters, because of the heat release in the melt by direct induction. In traditional Joule-heated ceramic melters, the accumulation of noble metals can limit the power transferred to the melt and ultimately leads to the deterioration of the electrodes or short-circuit problems. The advantages of CCIM however, do come at a price: higher power consumption than for a conventional melter, since a carefully insulated melter has been replaced by a water-cooled crucible.

Laboratory scale experimental studies

The segmented cold crucible is manufactured from contiguous segments forming a cylindrical volume, but separated by a thin layer of electrically insulating material. The number and the shape of the segments and the insulating gap between them must be optimized to minimize the power dissipation by the induced currents in the crucible while ensuring sufficient cooling of the crucible. Detailed study has been carried out, to decide the geometry and configuration of the segmented crucible. A laboratory scale experimental facility as shown in Fig. 2 was set up, to test the chosen configuration and to measure its overall efficiency.

Fig.2 : Laboratory scale experimental facility

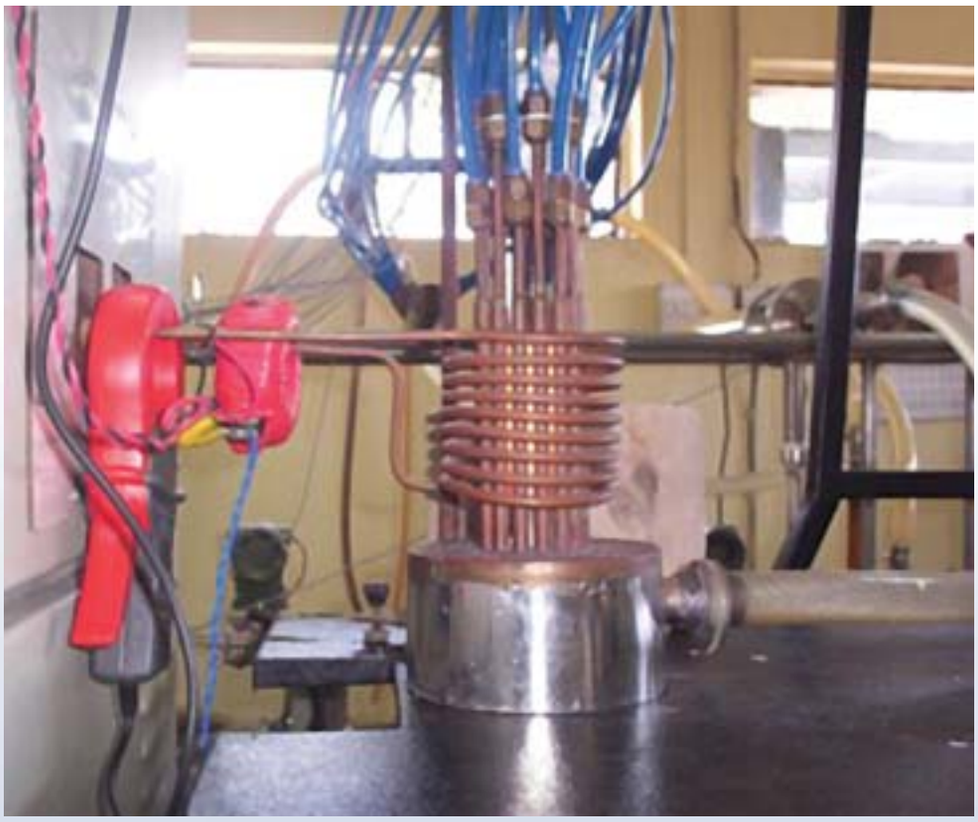


Fig. 3 : Laboratory scale segmented cold crucible

A segmented copper crucible with an inside diameter of 50 mm and comprising of 14 segments of 9 mm outside diameter each, was employed for the laboratory scale experiments. An IGBT-based induction heating power supply with a rated maximum power of 10 kW, 20 kHz was used to energise a 9-turn copper inductor with a coil (inside diameter 90 mm and height of 90 mm). A centrally located inconel 690 pipe was employed as the electrical load, to avoid the high frequency requirement. A photograph of the segmented cold crucible along with the inductor used for the laboratory scale study is shown in Fig. 3. A three-phase power analyser, Pt100 RTDs and turbine flow meters were used for data acquisition for power balance calculations. Based on the experimental results, the overall efficiency of the cold crucible induction heating was observed to be 17.2%.

Bench scale experimental studies

Subsequent to the successful demonstration of the laboratory scale unit, a bench scale cold crucible induction melter of 200 mm inside diameter was designed and tested, to demonstrate formation of solidified glass protective layer and to establish glass pouring from the melter bottom. A copper-segmented crucible and a perforated inconel succeptor containing glass powder were used, to demonstrate glass melting. The molten glass inside the inconel succeptor flew through the perforations and filled the annular space between the succeptor and the crucible. The contiguous segments of the bench scale crucible were spaced with a clearance of 10 mm.

Fig. 4 shows the formation of solidified protective layer near the water-cooled crucible. This layer prevented the molten glass from seeping through the gap between the contiguous segments.

Fig. 4 : Protective layer formation in the bench scale experiment

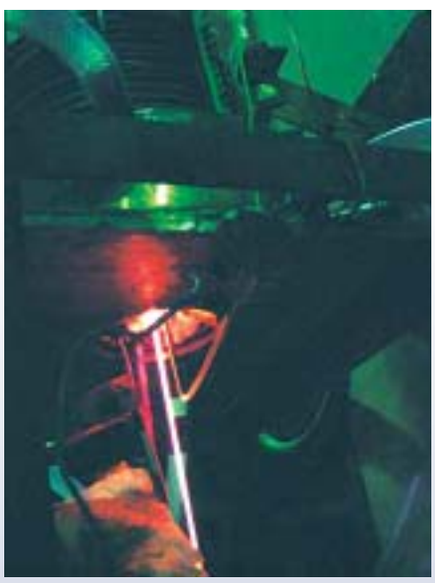


Fig. 5 : Glass pouring during the bench scale experiment

Bottom pouring of the molten glass was accomplished, by energizing the freeze valve to reach a temperature of 1000 °C. A conventional freeze valve made of Inconel-690 was employed for this purpose.

Bottom glass pouring from the bench scale melter is shown in Fig. 5.

Engineering scale demonstration facility

Based on the laboratory and bench scale experiments, an engineering scale facility was built to demonstrate the cold crucible induction melting of glass. The engineering scale demonstration facility comprises of a 350 kW, 200 kHz induction heating power supply, an industrial scale cold crucible, primary and secondary cooling water loops and a dedicated data acquisition and control system for the safe operation of the facility. The primary cooling circuit consists of a stainless steel plate-type heat exchanger, stainless steel circulation pumps and DM water reservoir, while the secondary cooling circuit consists of a cooling tower and circulation pumps. Total stand-by is provided in each of the cooling circuits to ensure the cooling of the crucible during normal operation. Emergency cooling water from the overhead tank is provided to ensure crucible cooling under abnormal conditions. Appropriate pressure relief valves were provided in the cooling circuit, to vent out the steam generated during loss-of-cooling simulation studies, as a part of the safety-related analysis. In addition to this, various safety-related alarms, trips and interlocks were incorporated, to ensure the safe operation of the melter. Adequate instrumentation such as flow rate and temperature measurements have been provided to generate sufficient engineering data for design verification and scale-up calculations. Fig. 6 shows the engineering scale demonstration facility

Fig. 6 : Engineering scale demonstration facility for cold crucible induction melting

set up in the CDCFT/PRTRF complex near WIP Trombay.

Engineering scale segmented cold crucible

The engineering scale cold crucible comprises of 56 stainless steel segments with a tube-in-tube configuration. These stainless steel cooling tubes are arranged in a circular array to hold a molten glass pool of 500 mm diameter. The bottom of the crucible is equipped with a water-cooled mechanical plug valve for draining the molten glass. The floor and the segmented crucible are electrically isolated with a 3 mm thick Teflon gasket in order to avoid electrical short-circuit of the segments at the bottom of the crucible. A pair of ring headers is employed for primary cooling water supply to and discharge from the melter. Various components of the engineering scale cold crucible are shown in Fig. 7. RTDs (Pt 100) and turbine flow meters are provided at different locations, to the coolant temperatures and flow rates respectively.

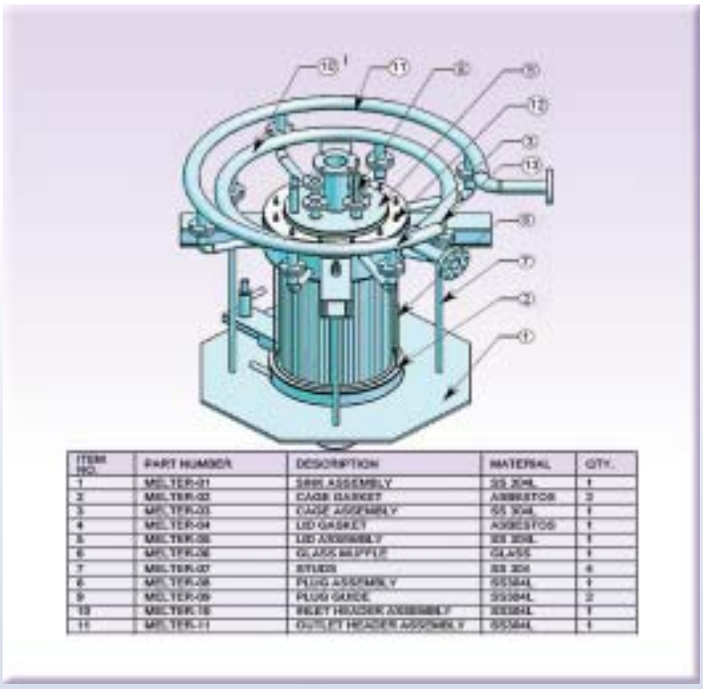


Fig. 7 : Engineering scale cold crucible

Induction heating power supply system

An induction heating power supply with a total power rating of 350 kW @ 200 kHz was employed for the engineering scale demonstration of cold crucible induction melting technology. A single turn, water-cooled, copper coil inductor was used to induce eddy current in the cold crucible melter. The power supply subsystem envisages a three-phase, air-cooled, step down transformer, a 12-pulse controlled rectifier, MOSFET-based high frequency inverter and a capacitive voltage multiplier. The current-fed inverter feeds a parallel resonant tank circuit. The power is controlled by varying the output voltage of the controlled rectifier. Fig. 8 shows the layout of the induction heating power supply system.

Technology demonstration

During the initial demonstration trials, no-load operations were carried out with empty cold crucible, to assess the no-load coupling losses in the system. Subsequently, the crucible was charged with sodium borosilicate glass having an electrical resistivity of 1 ohm cm and graphite start-up heating rings. Complete melting

Fig. 8 : Induction heating power supply system

Fig. 9 : Engineering scale cold crucible under operation

with solid feeding (glass frit of 10 mm average size). The thickness of the protective skull of solidified glass was found to be a strong function of the power induced in the glass melt. Convection currents with radially inward flow were observed in the molten glass and these currents resulted in a faster melting of the glass frit. Fig. 10 shows molten glass pool conditions inside the engineering scale cold crucible.

of 100 kg glass in about six hours was established. The average temperature of molten glass pool was 1150°C at 80 kW power level. Thus, the start-up melting and direct electromagnetic induction heating of molten glass were established. Fig. 9 shows the engineering scale cold crucible under operation.

An average melting rate of 20 kg/h at 1150°C was established

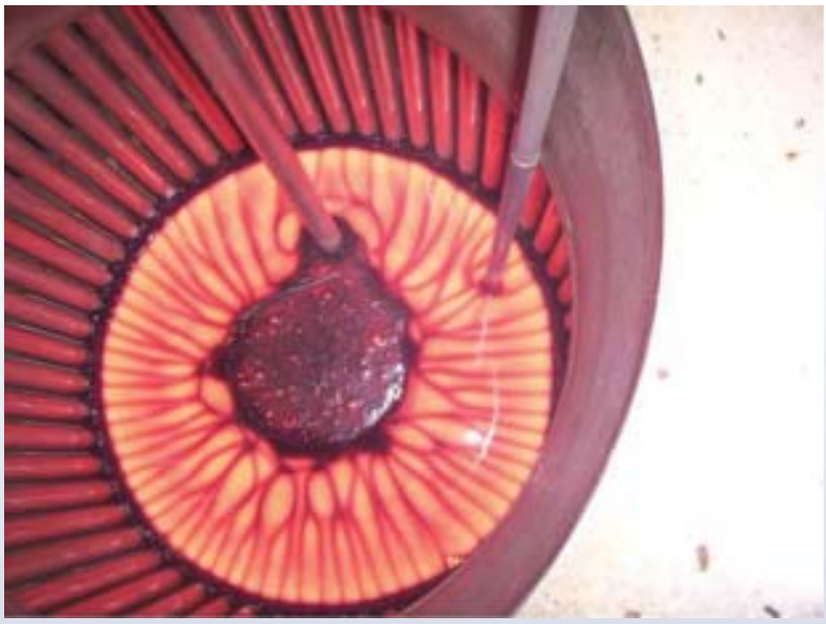


Fig . 10 : Molten glass inside the engineering scale cold crucible

Fig. 11 : Glass pouring from the engineering scale cold crucible

Glass draining subsystem

In conventional melter used for vitrification, the freeze valve is energised by a dedicated high frequency inductor. In such designs, the freeze valve experiences cyclic thermal loads and high temperature glass corrosion. In the engineering scale cold crucible, a totally water-cooled mechanical plug has been employed for draining product glass from the melter. The water cooling ensures problem-free operation and long life of the freeze valve. Fig. 11 shows the glass pouring through the water-cooled freeze valve.

Future work

In the next phase of the CCIM technology development, vitrification of inactive, chemically simulated waste solution will be demonstrated. Feeding and off-gas treatment systems required for the demonstration of the liquid-fed cold crucible induction melter will be established.

बी एआरसी न्यूज़लेटर
BARC NEWSLETTER

COMMISSIONING OF SLUDGE LANCING EQUIPMENT (SLE) AT KAPS SITE

A Sludge Lancing Equipment (SLE) developed by the Reactor Engineering Division (RED), BARC for steam generators (SG) of Kakrapar Atomic Power Station (KAPS), Nuclear Power Corporation of India Limited (NPCIL) has been successfully commissioned at KAPS, by a team of RED and KAPS personnel during early July 2006. This equipment will ensure long service life of the steam generators of the nuclear power plants, by permitting periodic removal of corrosion deposits from steam generators.

The steam generator is a vital and complex component of a nuclear power plant. During years of plant operation, corrosion products and other solids deposit in the form of sludge on the tube sheet of the steam generator. The sludge formation not only adversely affects the steam generator performance, but also diminishes its service life, if left unchecked. Although the plant operators take utmost care to reduce sludge formation, periodic sludge removal from steam generator is an essential part of the strategy to ensure high availability and service life of the equipment. In the SLE developed by BARC, high velocity narrow water jets or water lances are used for dislodging and removing hard and strongly adhesive sludge, from the steam generator tube sheet. This goes a long way in preserving the integrity of tube to tube sheet joint as well as of the steam generator as a whole.

A team of BARC and KAPS officials after the SLE commissioning

Station Director, KAPS along with BARC and KAPS SLE team after witnessing the site commissioning. Some SLE modules are visible in the back drop.

NPCIL in the past, used SLE, procured from foreign suppliers. However, due to uncertain after-sales service, the availability and performance of the imported SLE have not been satisfactory. In view of this it was decided to develop the SLE indigenously in BARC, in response to a tender floated by NPCIL. The cost of Indian SLE is around Rs. 2 crores. An imported SLE would have been three times costlier.

The SLE built by BARC, incorporates a remotely operated state-of-the-art robot, technically called Jet Manipulator Assembly (JMA), with sophisticated computerised controls. The JMA directs high velocity water jets, to dislodge sludge from the steam generator tube sheet. A remotely operated camera unit called Remote Visual Inspection System (RVIS) has been provided, to carry out visual inspection of the steam generator. This system displays images of the steam generator internals before and after lancing. The dislodged sludge remains suspended in water and is filtered from the sludge water by passing it through a series of increasingly fine filters. The sludge-free water is recycled in a closed loop and is pumped back to the steam generator in the form of continuous high velocity water jets or lances.

A number of officials both from NPCIL corporate office and power stations, were given a weeklong hands-on training in BARC, for operation of SLE.

The SLE was formally handed over to NPCIL and subsequently delivered to KAPS in the year 2005. During July 2006 a team of engineers from RED, BARC commissioned the SLE at KAPS with active support and participation from the KAPS staff. Site commissioning involved arranging various SLE modules in an optimum configuration and their integration, followed by pre-commissioning checks of process equipment, controls and instrumentation. Station Director, KAPS and other senior officers of NPCIL witnessed a demonstration of continuous SLE operation at rated operating conditions and were quite satisfied with the performance.

The SLE built by BARC, has been cleared by NPCIL, for future actual SG lancing campaign.

बी एआरसी न्यूज़लेटर
BARC NEWSLETTER

THEME MEETING ON "SEISMIC QUALIFICATION OF NUCLEAR FACILITIES"

Mr S.K. Sharma, Chairman, AERB inaugurating the theme meeting

A theme meeting on Seismic Qualification of Nuclear Facilities, organised by the BARC Safety Council Secretariat, was held on 21st July, 2006 in the Central Complex Auditorium, BARC, Trombay. The meeting was inaugurated by Mr S. K. Sharma, Chairman, Atomic Energy Regulatory Board. About 350 delegates from BARC, NPCIL, BRIT and AERB including the safety co-ordinators participated in the meeting. In his inaugural address Mr Sharma reiterated that nuclear installations the world over, withstood seismic events, because of stringent design and construction qualification criteria. Mr Sharma emphasised the need for periodic re-evaluation of old structures, to ensure that they meet the prevailing seismic design qualification requirements. He also drew attention to the need for seismic qualification of a large number of temporary structures and non-nuclear installations, built along side the nuclear facilities. Mr H. S. Kushwaha, Chairman BSC and Director, HS&EG in his keynote address dealt with regulatory review and seismic qualification requirements of nuclear facilities. He explained the changing standards of seismic qualification criteria and the experience and feed back from India and abroad. Dr D. N. Sharma, Chairman, Organising Committee and Head, RSSD gave a brief introduction on the functioning of the BARC safety framework and on the theme meeting. Mr S. K. Mishra, Convenor, Organising Committee and Officer-in-Charge, BSC Secretariat welcomed the participants. Mr K.T.P. Balakrishnan, BSC Secretariat proposed vote of thanks.

The Programme Committee under the Chairmanship of Dr A. K. Ghosh, Head, RSD selected the topics for discussion. Seven presentations on different aspects of seismic events and qualification of structures, systems and components were made as listed in the

Mr H.S. Kushwaha, Chairman, BSC & Director, HS&EG delivering the keynote address

	Topic	By
1.	Earthquake Basics and Seismic Instrumentation	Dr. Falguni Roy, Seismology Division, BARC
2.	Determination of Earthquake Design Basis	Dr. A. K. Ghosh, Head, RSD, BARC
3.	Seismic Design and qualification of Systems, Structures and Components (SSCs)- Part A	Dr. G. R. Reddy, RSD, BARC
4.	Seismic Design and qualification of Systems, Structures and Components (SSCs)- Part B	Shri R. S. Soni, NRG, BARC
5.	Seismic Design and qualification of Systems, Structures and Components (SSCs)- Part C	Shri A. G. Chhatre, NPCIL
6.	Seismic Design and qualification of Systems, Structures and Components (SSCs) – Part D	Shri K. Bhargava, A&CED, BARC
7.	Seismic requalification, retrofitting and response control techniques.	Dr. G. R. Reddy, RSD, BARC

List of presentations made during the Programme

A view of the participants during the theme meeting

Table. The delegates took active part in the lively discussions that followed each presentation.

Mr K. K. Vaze, Head, Reactor Structures Section, RSD chaired the sessions and summed up the presentations and the discussions. Mr Ved Singh, NRG presided as the secretary during the sessions. In the concluding session, Mr H. S. Kushwaha was felicitated on his completing 60 years. Mr S. K. Sharma highlighted the achievements of Mr Kushwaha. Mr Kushwaha thanked the participants for the felicitations. Dr V. D. Puranik, Head, EAD proposed a vote of thanks.

बी एआरसी न्यूज़लेटर
BARC NEWSLETTER

WORKSHOP ON "NEUTRONS AS PROBES OF CONDENSED MATTER" (NPCM-XII); A REPORT

A workshop on "Neutrons as Probes of Condensed Matter" (NPCM-XII), jointly organized by UGC-DAE-CSR and the Solid State Physics Division (SSPD), BARC, was held at BARC, Mumbai on February 24-25, 2006. The workshop consisted of lectures covering various aspects of neutron scattering and a visit to the neutron scattering facilities at the Dhruva reactor. The participation in the workshop was open to faculty and research students from universities and institutes in India. In addition to creating awareness about applications of neutron scattering techniques to materials science, the workshop aimed at generating fresh proposals for collaborative research, through interaction with the experts during the workshop.

The response to the announcement of the workshop was overwhelming. There were about 130 applications from all corners of the country which indicated the

Group photograph of the participants and other dignitaries who attended the workshop

immense interest in the subject. However, this being a two-day workshop, participants were selected on the basis of their subject fields and their potential as users. Finally about 44 candidates were selected.

A total of 36 persons, comprising 25 faculty members and 11 research students from various universities and institutes in India, participated in the workshop. Dr. R. Mukhopadhyay, SSPD, BARC and Dr S.K. Deshpande, UGC-DAE-CSR Mumbai Centre, were the coordinators for the workshop.

The workshop began with some introductory remarks by Dr. J.V. Yakhmi, Associate Director (S), Physics Group, BARC, during a brief and informal function at the B-block Auditorium, Modular Labs, BARC, on February 24, 2006. Brief remarks were made by Dr P. Chaddah, Director, UGC-DAE-CSR, Dr. S.L.Chaplot, Head, SSPD, BARC and Dr P.S. Goyal, Centre Director, Mumbai Centre, UGC-DAE-CSR. They all expressed the view that the success of the workshop should be judged on the basis of good experimental proposals, which should finally end up in a good quality research publication. Dr. S. Kailas, Associate Director (N), Physics Group, BARC indicated the possibilities of support given by the Board of Research in Nuclear Sciences, DAE, to the university researchers.

The scientific sessions began with a talk by Dr. Chaplot on "Neutron Scattering- Principles and Facilities", followed by a talk on "Neutron Experiments under Collaborative Reserach Schemes" by Dr.P.S.Goyal. This was followed by a visit to the Dhruva reactor hall, where the participants could see the existing neutron spectrometers and interact with BARC scientists.

The second day's sessions were held at Multipurpose Hall, BARC Training School Hostel. There were eight talks on neutron powder diffraction including magnetic systems by Dr. Amitabh Das; structure of disordered materials by Mr. PSR Krishna, single-crystal diffraction by Ms. R. Chitra; small angle scattering by Dr. V.K. Aswal and Mr. A.K. Patra; inelastic scattering by Dr R. Mittal; quasi-elastic scattering by Mr. S. Mitra and neutron reflectometry by Mr. Surendra Singh. All the speakers are experts in their fields and are working on instrumentation at the Dhruva reactor.

The workshop concluded with a feedback session. The participants expressed their satisfaction with the workshop and several faculty members showed keen interest, in utilizing the neutron scattering facilities, through collaborative research schemes.

बी एआरसी न्यूज़लेटर
BARC NEWSLETTER

FUEL BEHAVIOUR UNDER ACCIDENT CONDITIONS: BRNS THEME MEETING

A series of theme meetings were jointly organised by the Nuclear Fuels Group, BARC and the Directorate of Engineering, NPCIL, on High Burn-up Issues in Nuclear Fuels (HBINF-2005). Each meeting was devoted to a particular aspect of fuel pin behavior, under normal and accident conditions. The 3rd theme meeting in this series was organised on "Fuel Behaviour under Accident Conditions" on March 24, 2006, at the Briefing Hall of the Nabhikiya Urja Bhavan, Anushaktinagar, Mumbai.

Mr S. A. Bhardwaj, Director (Tech), NPCIL welcomed the delegates. The meeting was inaugurated by Dr. S. Banerjee, Director, BARC.

In his opening address, Dr. Banerjee stressed the need for understanding the behaviour of fuel under off-normal and accident conditions. He emphasized the urgency to generate indigenous database on the behaviour of fuel, cladding and integral fuel rods, to understand and model the fuel pin behaviour during off-normal and accident conditions. Dr. Banerjee also released the proceedings of the 2nd theme meeting on "Cladding Corrosion, Embrittlement and Pellet-Clad Interaction", on this occasion. Mr D. N. Sah, Convener, HBINF-2005 proposed a vote of thanks.

The theme meeting was organised in three technical sessions as follows:

Technical Session I	:	Assessment of Fuel Safety in Nuclear Power Plants
Technical Session II	:	Modelling of Fuel and Cladding Behaviour during Accident Conditions
Technical Session III	:	Out-of Pile Simulation Tests on Fuel Pins

Dr S. Banerjee, Director, BARC inaugurating the 3rd theme meeting of HBINF-2005

Mr S. A. Bhardwaj, Director (Tech), NPCIL welcoming the delegates of the 3rd theme meeting of HBINF-2005.

Mr S.S. Bajaj, Director (Safety), NPCIL, initiated the session with the presentation on "Accident Scenarios and Fuel Response in NPPs". Nine theme talks were delivered by eminent scientists and engineers who are engaged in study/analysis of fuel behaviour under off-normal and accident conditions in thermal reactors as well as in fast reactors. Mr P. Puthiyavinayagam of IGCAR, Kalpakkam presented an overview on fast reactor fuel behaviour under accident conditions. Mr R.S. Rao from AERB, Mumbai, delivered a talk on different criteria for fuel channel integrity of PHWRs under accident conditions. Dr. B. K. Dutta of BARC delivered a theme talk on fuel pin integrity assessment in thermal reactors, under large scale transients. Mr S.G. Markandeya of BARC presented information on the computer codes and their validations, for the fission product release from nuclear fuels, under accident conditions. Mr.D.N.Sah delivered a theme talk on the OXYCON model for predicting the oxygen distribution in Zircaloy cladding of PHWR fuel, during LOCA condition. Results from the safety-related experiments conducted on PHWR fuel pins, were presented by Ms Suparna Banerjee of BARC. Mr H.G. Lele of BARC presented an overview of fuel-related thermal hydraulic safety research.

A panel discussion, chaired by Mr S. A. Bhardwaj, was held at the end of the presentations. The panel discussed three important aspects of accident behaviour of fuel, namely
i) modelling
ii) fission product release and
iii) failure mechanisms.

Mr D. N. Sah emphasized the need for experimental work on the following:

- Oxidation behaviour of hydrided / irradiated cladding
- Thermal shock behaviour of fuel pins
- Deformation and ballooning behaviour of fuel pins
- Transient fission gas release from fuel
- Tests on irradiated fuel/fuel pins inside hot cells
- Fuel behaviour under dry storage conditions.

Mr Markandeya stressed the need for study of fission product release, by simulation tests on irradiated fuel samples. Mr. Lele proposed collaborative experimental work for the validation of models. He also underlined the need to study the Pressure Tube/ Calandria Tube (PT/CT) contact conductance during simulated severe fuel damage condition. Mr K. Anantharaman of BARC pointed out that the current specified limits are for UO_2 fuel and their applicability to Thoria- based fuel should be examined.

The panel recommended formation of a core group to discuss and prepare the roadmap for further work to be taken up in various laboratories.

बी एआरसी न्यूज़लेटर
BARC NEWSLETTER

60TH NATIONAL WORKSHOP ON "RADIOCHEMISTRY AND APPLICATIONS OF RADIOISOTOPES": A REPORT

The BRNS-IANCAS 60th National Workshop on "Radiochemistry and Applications of Radioisotopes" was held at the P.G. Department of Chemistry, Sambalpur University, Jyotivihar, Sambalpur, Orissa during August 17-23, 2006.

The workshop was inaugurated in a function presided over by Prof. P.K.Mohapatra, the acting Vice-Chancellor and Dr. V.K. Manchanda, Head, Radiochemistry Division, BARC and President, IANCAS was the chief guest. Prof. B.K.Mishra, Head, P.G. Dept. of Chemistry welcomed all the resource persons and participants to the Workshop. Prof. D.C.Dash, Convener, Local Organising Committee thanked the guests. He lauded the efforts of IANCAS and BARC in educating the public through workshops. He also informed that Nuclear Chemistry was a part of the post graduate curriculum and this workshop would help in introducing experiments as part of the course. Dr. R. Acharya, the Coordinator, IANCAS spoke about the objectives and course content of the workshop. Prof. B.K.Mishra gave an overview of the departmental activities including research activities.

At the inaugural function: Seated (L to R) are : Prof. B.K.Mishra, Head, Chemistry Dept., Sambalpur Univ., Dr. R. Acharya, coordinator, IANCAS, Prof. P.K.Mohapatra, Acting Vice-chancellor, Dr.V.K.Manchanda, Head, Radiochemistry Division and President, IANCAS and Prof. D.C.Dash, Local Coordinator of the workshop.

While delivering a Keynote Address on "DAE activities: At a Glance", Dr. Manchanda gave an account of the present scenario of Indian research and power reactors and future plans. Another special lecture on Waste Management was delivered by Dr.V.K.Manchanda after the inaugural session. Two other special lectures were delivered by Dr.(Mrs.)Meera Venkatesh, Head, R.Ph.D, BARC, Mumbai and Mr. P.R.Mohanty, GM, Heavy Water Plant, Talcher.

A total of 130 participants mostly Chemistry faculty members of University and nearby colleges, Research Scholars and P.G. students of Chemistry, Life Sciences and Physics disciplines attended the workshop.

A team of 9 resource persons (8 from BARC, Mumbai and one from BRIT, Vashi) conducted the workshop. Two school-level and one college-level workshops were also conducted in the city with a lecture on Radioactivity and demonstration experiment and more than 500 students availed the benefit of this one day programme.

During the Valedictory Function Prof. B.K.Mishra gave his remarks on the Workshop and thanked IANCAS and the resource persons for smoothly conducting the workshop. Prof. D.C.Dash, gave his remarks by thanking Dr. Machanda, Dr. Meera Venkatesh, Dr. Mohanty, the co-ordinator of the workshop and all the resource persons who gave various lectures and conducted the practicals. The feed-back from the participants was good for the course contents and lectures, whereas utility got a mixed grading. Dr. (Mrs.) Meera Venkatesh, Chief Guest at the valedictory function donated the instruments to the host institute and encouraged them to make use of the instruments for teaching.

The practical Co-ordinator of the Workshop Mr. R. Govindan gave vote of thanks on behalf of all the resource persons.

भा.प.अ.केंद्र के वैज्ञानिकों को सम्मान

BARC SCIENTISTS HONOURED

Ms Rajni Pande

Ms Shweta Roy

Ms T. Basak

S.V.L.S. Rao

P. Singh

रजनी पाण्डे, श्वेता रॉय, टी बसक, एस.वी.एल.एस.राव एवं पी.सिंह द्वारा लिखित बीम डायनामिक्स फॉर 1 जी इ वी प्रोटॉन लिनॉक फॉर एडीएस नामक शोधपत्र को नवंबर 1-4, 2006 के दौरान भापअ केंद्र /टीआइएफआर, मुंबई में आयोजित डीएई-बी आर एन एस इन्डियन पार्टिकल एक्सलरेटर कान्फेरेन्स (InPAC-2006) में मौखिक प्रस्तुति पुरस्कार से सम्मानित किया गया।

A paper entitled "Beam Dynamics for 1 GeV Proton LINAC for ADS", authored by Rajni Pande, Shweta Roy, T. Basak, S.V.L.S. Rao and P. Singh has been awarded the oral presentation prize during the DAE-BRNS Indian Particle Accelerator Conference (InPAC-2006) held at BARC/TIFR, Mumbai during November 1-4, 2006.

बी एआरसी न्यूज़लैटर
BARC NEWSLETTER

Mr S. P. Srivastava

श्री एस.पी.श्रीवास्तव,अभिकल्पन एवं विनिर्माण केंद्र को दिसंबर 7-9, 2006 के दौरान हैदराबाद में नॉन-डेस्ट्रक्टिव टेस्टिंग के राष्ट्रीय सम्मेलन में कन्वेन्शनल रेडियोग्राफी -ए फ्यू चलेंजिंग एप्लिकेशन्सज नामक तकनीकी शोध-पत्र को औद्योगिक स्तर का श्रेष्ठ पोस्टर पुरस्कार प्रदान किया गया। इस शोध-पत्र के सह-लेखक श्री टी.जी. उन्नी, श्री एस. पंडारकर, श्री के .महाजन एवं श्री आर.एल. सुथार हैं ।

Mr S. P. Srivastava of the Centre for Design and Manufacture has been awarded the Best Poster Paper Prize in Industrial Category for a technical paper 'Conventional Radiography – A Few Challenging Applications' at the National Seminar on Non-Destructive Testing at Hyderabad during December 7-9, 2006. Co-authors of this paper are Mr T.G. Unni, Mr S. Pandarkar, Mr K. Mahajan and Mr. R.L. Suthar.

Dr B.N. Pandey

डॉ बी.एन. पांडे, विकिरण जैविकी एवं स्वास्थ्य-विज्ञान प्रभाग को भारतीय विकिरण जीव-विज्ञान सोसाइटी के द्वारा संस्थापित एम.आर.राजू पुरस्कार प्राप्त हुआ। इन्हें नवंबर 20 - 23, 2006 के दौरान बीएचयू, वाराणसी में आयोजित इफेक्ट ऑफ लो डोज़ रेडियेशन इफेक्टस ऑन ह्यूमन हेल्थ एन्ड एनवारनमॅट,पर पांचवे लोराड अन्तर्राष्ट्रीय सम्मेलन में ड्रिफ्ट फ्राम डीएनए-सेंट्रिक रेडियेशन टारगेट्स : इज़ पैराडिम शिफ्ट इन रेडियेशन बयोलोजी की प्रस्तुति हेतु एक प्रशस्ति-पत्र एवं 5000 रुपए की राशि का पुरस्कार प्रदान किया गया । डॉ पांडे को भारतीय विकिरण जीव-विज्ञान सोसाइटी की कार्य-समिति (2007-2009) का सदस्य भी निर्वाचित किया गया ।

Dr B.N. Pandey of Radiation Biology & Health Sciences Division, has received the "M.R. Raju Award" instituted by the Indian Society of Radiation Biology. The award consisting of a citation and a cash prize of Rs. 5000/- was given to him for his presentation "Drift from DNA-centric radiation targets : Is paradigm shift in Radiation Biology?" at the 5th LOWRAD International Conference on Effect of Low Dose Radiation Effects on Human Health & Environment", held at BHU, Varanasi, from November 20-23, 2006. Dr Pandey was also elected as a member of the Executive Council (2007-2009) of the Indian Society of Radiation Biology.

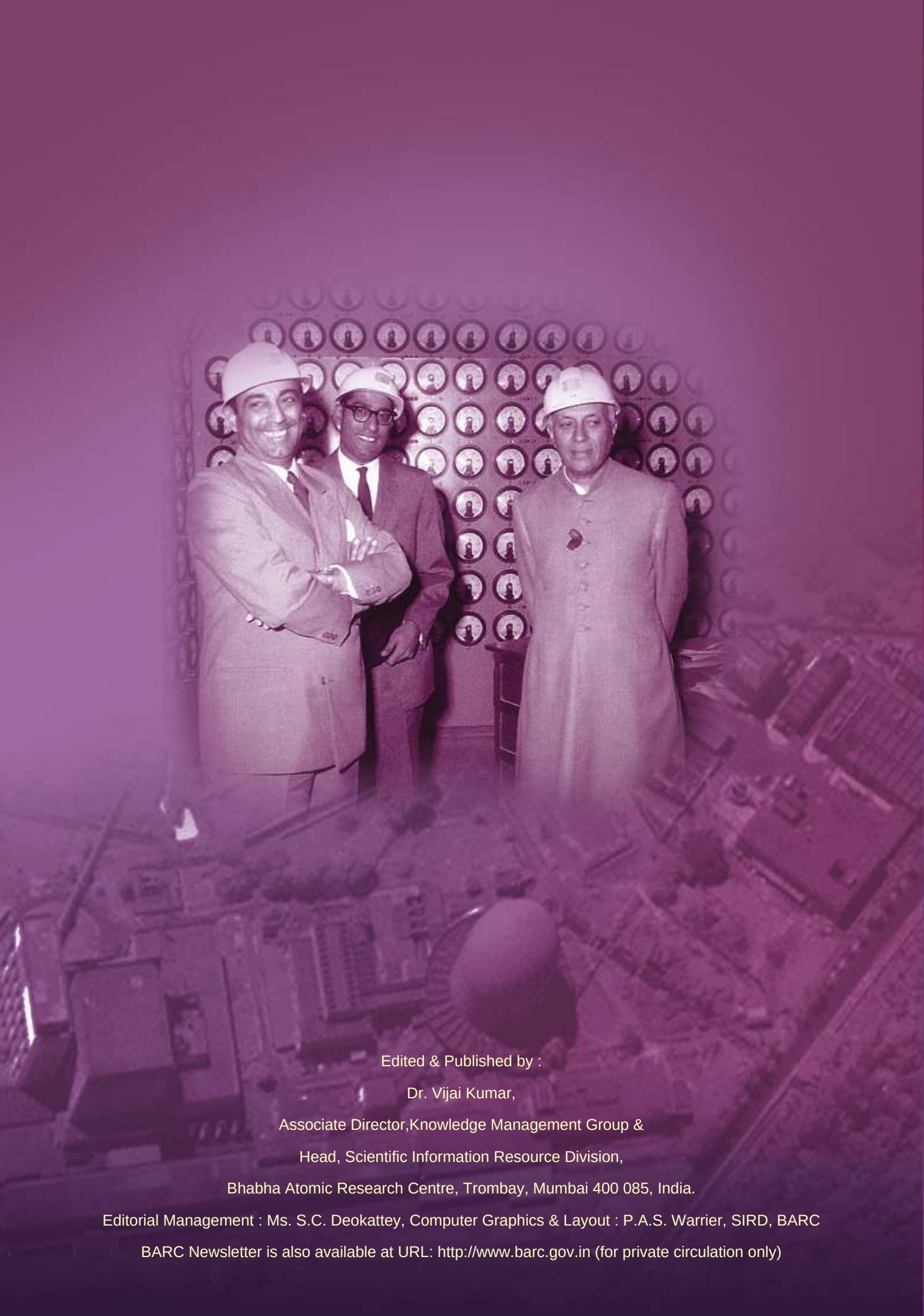
डॉ पी.बी. वाघ, अनुप्रयुक्त भौतिकी प्रभाग (एपीडी), भाभा परमाणु अनुसंधान केंद्र को जनवरी 29-31, 2007 के दौरान डॉ बाबा साहेब अंबेडकर मराठवाडा विश्वविद्यालय, औरंगाबाद के भौतिकी विभाग के द्वारा आयोजित नैश्नल कान्फरेंस ऑन करन्ट ट्रन्डस इन मेटीरियल्स रिसर्च फॉर एडवान्सड टेक्नालोजी (एनसीएमआरएटी) सम्मेलन में "कास्टिंग एन्ड करेकटरैज़ेशन ऑफ एइरोजल ऑबजक्टस इन मेटेलिक मोल्डस", नामक शोध-पत्र के लिए सर्वश्रेष्ठ शोध प्रस्तुति पुरस्कार से सम्मानित किया गया। श्री एस. वी. इंगले एवं डॉ. सतीश सी. गुप्ता, अनुप्रयुक्त भौतिकी प्रभाग, भाभा परमाणु अनुसंधान केंद्र भी इस शोध-पत्र के सह लेखक हैं।

P. B. Wagh

S.V. Ingale

S.C. Gupta

Dr. P. B. Wagh of Applied Physics Division (APD), BARC, received the first prize for Best Oral Paper Presentation Award for the research paper entitled "Casting and Characterization of Aerogel Objects in Metallic Moulds"; presented at the National Conference on Current Trends in Materials Research for Advanced Technology [NCMRAT], organized during 29-31 January 2007, by the Department of Physics, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. Coauthors of the research paper were Mr. S. V. Ingale and Dr. Satish C. Gupta, Applied Physics Division, BARC.



Edited & Published by :

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Associate Director,Knowledge Management Group &

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)