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INSIDE THE NEWSLETTER

From the Director's Desk

NEW YEAR MESSAGE

Dear Colleagues,

I wish a very Happy New Year and Pongal to you and your families. The year 2003 has been very eventful in the history of the IGCAR, thanks to the efforts put in by all of you. I recollect here the important achievements of the centre. We received the clearances from the Planning Commission, Ministries of Power, Finance, Industry and Environment and Forest of Government of India, which culminated in the final approval from CCEA on 2nd September 2003, for the construction of 500 MWe Prototype Fast Breeder Reactor. À new PSU company called Bharthiya Nabhikiya Vidyut Nigam Limited (BHAVINI) has been established in October 2003 for the construction and operation of PFBR. All the construction activities are being transferred to them. Manufacturing technology has been practically completed. The completion has come handy, just when we are starting on the construction of the project.

The Fast Breeder Test Reactor has operated well, taking the mixed carbide fuel bum-up to 1,23,000 MWd/t. In July 2003, we loaded the PFBR MOX fuel pins, with U^{233} content, in FBTR for test irradiations. A major part of the U^{233} was separated earlier in our centre. The MOX pins have reached a bum-up of 25,000 MW d/t.

The PIE of 1,00,000 MWd/t bum-up mixed carbide fuel has been completed successfully. The design of PFBR nuclear and conventional systems has been practically completed and issue of tender documents is in progress. The supporting R & D in various disciplines has also made progress. There are certain R & D activities, which are causing concern. We need to put in more efforts on them. The reprocessing of carbide fuel began with unirradiated pins in June 2003 and with the irradiated pins in December 2003. This is an important achievement and is a result of efforts put in over 20 years. We have to increase our activities in re-processing and radioactive waste areas.

We have to make efficient use of the available manpower for steering the centre to its stated objectives in light of surrender of 10% of posts as per the Government directive . The performance of the centre with respect to budgetary goals has been excellent, due to frequent follow up at all levels.

Several dignitaries visited Kalpakkam and appreciated the works being done here, the most important being the recent visits of the President of India and the Chief Minister of Tamil Nadu.

With respect to General Services Organisation (GSO), we have completed the construction of various category houses and school building in a short time. Further construct ion is fast progressing. Anupuram township is now self-sufficient in water supply and other amenities.

The goal for 2004 is total completion of the design and R&D for PFBR.

(*S.B. Bhoje)*
Director, IGCAR & GSO

Irradiation of PFBR Test Subassembly in FBTR

Fast Breeder Test Reactor (FBTR) started its major miss ion of serving as a test-bed for irradiation of advanced fuels, when the irradiation of MOX fuel chosen for Prototype Fast Breeder Reactor (PFBR) commenced on 21st July 2003 in the 11th irradiation campaign. The core for this campaign consists of 25 MK-I and 13 MK-II fuel subassemblies (SA), in addition to the PFBR test fuel SA. Driver fuel of PFBR is a mixed oxide of Pu and natural U with two different compositions viz. 21 and 28% of PuO_2 for the two enrichment zones . The fuel is designed to operate at a peak linear heat rating (LHR) of 450 W/cm and target bumup of 100 GWd/t . The flux in FBTR core is 2.3 E15 $n.cm^{-2}.s^{-1}$, whereas the flux in PFBR is 8.0 E15 $n.cm^{-2}.s^{-1}$. To achieve the LHR of 450 W/cm with the lower flux in FBTR, the PFBR test fuel is enriched with U^{233}, thus retaining the chemical composition as in PFBR fuel. Typical fuel composition of the pellets of the PFBR test fuel is 29% PuO_2, 38% oxide of U^{233} and balance 33% oxide of natural Uranium. The composition has been designed such that when the high grade MK-I fuel in the first ring is operating at peak LHR of 320 W/cm, the test SA will have a peak LHR of 450 W/cm at the core centre.

PFBR test SA has 37 pins containing MOX fuel pellets housed inside a typical FBTR hexagonal sheath, which is shown in fig.1. The fuel pin diameter is the same as in PFBR fuel SA. The fuel clad and hexagonal sheath are made of 20% cold-worked D9 alloy. Annular pellets similar to PFBR dimensions are used. Stainless steel rods are used as axial blanket pins on either side of fuel pin bundle. Active fuel column length is only 240mm as against 320 mm for FBTR fuel. The test SA generates 350 kWt at 450 W/cm. The SA has been fitted with a zone IV orifice at top to get a minimum sodium flow of 1.9 kg/s to satisfy the design limits . In addition, the steel blanket pin dimensions are slightly different from standard FBTR blanket pin dimensions in order to modify the hydraulic characteristics of the SA. The hydraulic design of the SA was validated by testing dummy SA in water.

It will take 484 effective days of operation at LHR of 450 W/cm to achieve the target bum-up of PFBR fuel. For the 11th irradiation campaign the PFBR test SA has been loaded in core centre as LHR of FBTR MK-I driver fuel SA is limited to 320 W/cm. When the LHR of the MK-I will be raised in the later campaigns, the PFBR test SA will be relocated in the core to limit its LHR to the design value of 450 W/cm.

Histogram of operation of the 11th irradiation campaign is shown in fig.2. The campaign was terminated on 23rd December, when the control rods reached close to the allowed top limit of 405 mm. During this campaign, the

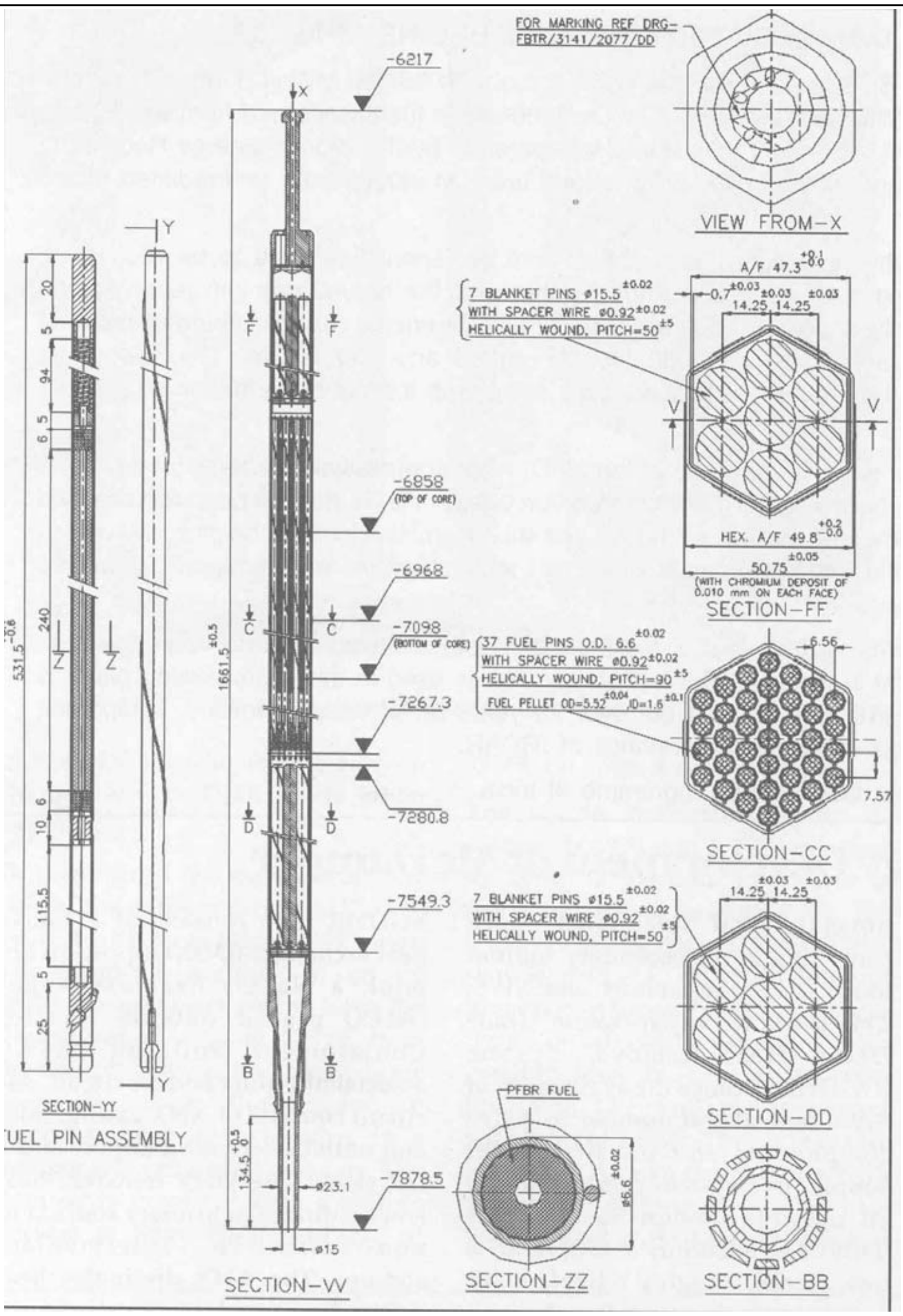

Fig.1 : PFBR Test Fuel Subassembly

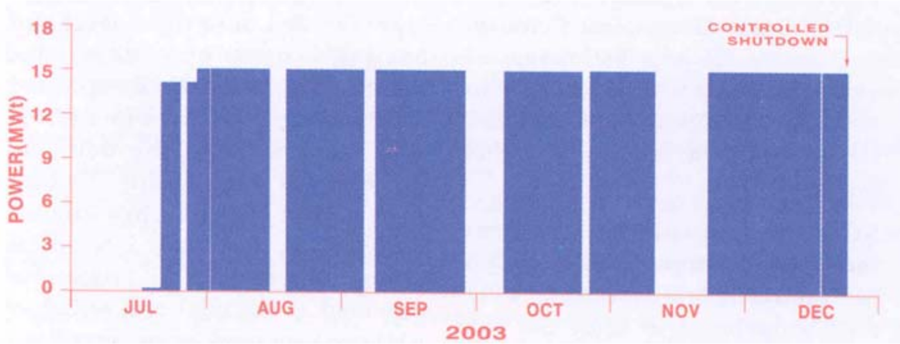

Fig.2 : Operation Histogram of FBTR during 11th Irradiation Campaign

reactor was operated at 15 MWt, with an availability factor of 82%. The campaign lasted for 122 EFPD. The PFBR test fuel has logged a burnup of 25.7 GWd/t. The reactor generated about 44 GWh of thermal energy, of which about 1028 MWh came from the PFBR test SA. TG remained synchronized to the grid for 75 D, generating 1.774 million units of electrical energy.

While it is possible to simulate LHR and bum-up by irradiating PFBR fuel in FBTR, displacement per atom (dpa) and clad damage fraction (cdf) cannot be simulated fully due to the lower flux in FBTR. For the operating parameters of FBTR, the cdf that can be achieved will be about 0.12 as against the PFBR design cdf of 0.3. However, the irradiation will help in understanding the behaviour of the MOX fuel chosen for PFBR. Since U^{233} will be used in the third stage of India's nuclear energy programme, the present irradiation campaign is expected to provide some useful and valuable insights into its behaviour as well.

(G.Srinivasan, V.S.Krishnamachari and P.V. Ramalingam)

REPROCESSING OF IRRADIATED FBTR FUEL BEGINS AT IGCAR

The reprocessing of irradiated Fast Breeder Test Reactor (FBTR) fuel with 25,000 MWd/t burn-up has been started in a pilot plant called Lead Mini Cell (LMC) on 22nd December 2003. The fuel discharged from FBTR, has been taken to the reprocessing plant. The plant is licensed for operation by the Atomic Energy Regulatory Board (AERB) after a series of commissioning trials, with natural uranium carbide and un-irradiated mixed plutonium-uranium carbide fuel.

In fast breeder reactor fuel cycle, the plutonium and uranium from the spent fuel have to be recovered, purified and refabricated for recycling back into the reactor. By this way, the natural uranium reserves can be fully used to enhance the capacity of power production . FBTR uses a unique mixed carbide of uranium and plutonium and has achieved a burn-up 1,23,000 MWd/t without any fuel failure. The spent fuel subassemblies were removed from the reactor at various stages of burn-up for fuel performance evaluation, by post irradiation examinations.

The reprocessing of the carbide fuel is being taken up in the LMC, with progressively increasing burn-up to validate the process technology. The irradiated fuel of the composition used in FBTR, has not been reprocessed anywhere in the world. The process involves disassembling the fuel subassemblies, cutting the pins, dissolution of the fuel in concentrated nitric acid and use solvent extraction technology for recovering and purifying uranium and plutonium from the spent fuel .

The reprocessing of FBR fuels is different from that of the thermal reactors, because of the very high level of radioactivity and plutonium content in the fuel. The technology, that is used in this reprocessing plant, is totally indigenous, benefiting from R&D work carried out over 20 years on process chemistry, equipment, materials, instrumentation and control in various laboratories of IGCAR.

This is an important milestone in the fast reactor programme of India.

Technology Development of Air Damper

In the PFBR, after a reactor shut down, nuclear heat continues to be generated in the core due to the radioactive decay of the fission products and radioactive nuclei produced during the reactor operation. This heat, referred to as the "decay heat", has to be removed to restrict their temperatures within design safety limits so as to maintain integrity of core, fuel sub-assembly, primary containment and other structures. Hence, after a planned reactor shutdown or after a SCRAM (emergency reactor shutdown), the decay heat is to be removed with very high reliability. Safety criteria followed for plant design require the non-availability of Decay Heat Removal (DHR) function shall be less than 10-7 per reactor-year. To achieve this, two diverse and independent DHR systems are provided.

During planned shutdown and in some of the upset conditions when the Steam-Water System (SWS) is available, DHR is through the normal h eat transport path consisting of the secondary sodium loops, steam generators and SWS. This is known as Operation Grade Decay Heat Removal System (OGDHRS). Since the availability of SWS depends on number of active components and off-site power supply, this system cannot cater to all possible Design Basis Events (DBE). The reliability of OGDHRS is low. Hence, a highly reliable DHR system removing heat directly from the hot pool of the reactor is provided. This system is named as Safety Grade Decay Heat Removal System (SGDHRS). Following all events in which SWS is lost or both secondary sodium loops are lost, DHR is carried out through this system.

SGDHRS consists of four independent loops, each having 8 MWt heat removal capacity (at a hot pool temperature of 820Ê (547°Ñ)). It is a passive system except for the air dampers on the airside. Each SGDHR loop consists of a Na/Na heat exchanger (DHX) dipped in hot pool, a Na/Air h eat exchanger (AHX) placed outside Reactor Containment Building (RCB), associated piping and air circuit. Air circuit consists of AHX casing, inlet and outlet ducts, air dampers and a tall stack. The DHX transfers heat from radioactive primary sodium to non-radioactive intermediate sodium. The AHX dissipates heat from intermediate sodium to atmospheric air. The air dampers at the inlet and outlet are (two-louvre type) divided in to two halves and one half is motor operated and the other half is pneumatically operated for ensuring diversity. Provision is also there to open the dampers manually at damper site. During normal plant operation, to minimize the heat loss, pneumatic & electrical motor operated air dampers provided at the inlet and outlet of AHX are kept crack open permitting certain amount of natural circulation in the SGDHRS to enable smooth change over to DHR mode when required.

During normal reactor operation, the side of the damper facing AHX is in contact with air at 820k (547°C) max. The damper is designed to operate at this temperature and to have the design


Fig.1: Photograph showing the Air damper

life of 40 years. Diversity in the design of louvre and bearings are used to ensure that under no circumstances both louvers in a damper will fail simultaneously. The damper is provided with a sealing system to have leak tightness of 99.9% on cross sectional area.

The inside dimension of the air damper is 2870 mm x 2750 mm and its depth is 300 mm. The frame is made of carbon steel IS 2062, the louver is of SS- ASTM A240 TP316, shaft is of SS- ASTM A479 TP316 and the seal is of Inconel 625. The damper frame is internally insulated with ceramic fibre blanket of 200 mm thickness. The insulation is covered with liner of SS409. The air leak rate allowable at room temperature with a pressure difference of 1200 mm water column (WC) is 0.92 kg/s and at 833 K (560°C) with a pressure difference of 300mm WC is 0.5kg/s.

Development of one air damper was taken up with M/s. FOURESS Engineering, Bangalore, to evaluate the performance of the Air Damper at 833 K (560°C) to check for the structural integrity, sealing and proper opening / closing of the damper and the integrity of the shaft and bearing. The damper was designed, manufactured and tested by M/s. FOURESS Engineering, Bangalore. A test set up with blower, burner to generate hot air and required instrumentation to measure temperature, pressure and flow was made to carry out the testing at room temperature and at 833 K (560°C). The actual leak rate achieved at room temperature was 0.58 kg/s and for hot air test at 833 K (560°C) was 0.24 kg/s which is nearly 50% of specified value. The damper was opened and closed using both the drives and also manually at 833 K (5600C), the performance o f the drives and bearings are satisfactory. The structural integrity of the components after hot air test was checked and found satisfactory. After completion of the test the damper was delivered at site in July 2003 and fig.1 shows the photograph of the Air damper.

(S. Athmalingam, N. Mahendran and V. K. Sethi)

OBITUARY

Shri R.P. Kapoor, Associate Director, Reactor Operation & Maintenance Group (ROMG) had suddenly passed away on October 15th, 2003 due to sudden illness at Chandigarh. Shri R.P. Kapoor was a B.Tech in Chemical Engineering from IIT, Delhi and MS in Nuclear Reactor Technology from University of Aston, UK. He joined the Department of Atomic Energy in 1968 and belonged to the 11th batch of BARC training school. He is major contribution was in the preparation of Technical Specification document for FBTR and Reactor containment building integrated leak test during first phase commissioning of FBTR. During the second phase of FBTR commissioning when steam generator became operational and turbine was rolled and synchronized to grid, Shri Kapoor became the Head of the Reactor Operation Division. Later he became Associate Director of ROMG. During his tenure, driver fuel attained the design linear heat rating of 400 W/cm and crossed a burn up of 100 Gwd/t, which was a landmark achievement. Shri Kapoor had made significant contributions in various capacities such as member of IGC-CWMF safety committee, chairman of licensing committee for FBTR operation etc. He had also steered the commissioning of the 30 kW KAMINI reactor, which is being utilize d for neutron radiography and activation analysis. He was also involved in various deliberations on Preliminary Safety Analysis re port of PFBR. He had received many awards and honours for his varied contributions. At a time when his valuable experience is needed most for PFBR, his sudden demise is an irreparable loss.

Supercritical Fluid Extraction Studies on Nuclear Materials

Critical temperature (T_c) is the highest temperature above which a substance cannot be liquefied however high the pressure be and the critical pressure (P_c) is the minimum pressure required to liquefy the same at its critical temperature. A supercritical fluid is defined as any substance that is above its critical temperature and critical pressure. Supercritical fluids possess the properties of gas-like diffusivity and viscosity, low surface tension and liquid-like density. These properties help the supercritical fluids to easily penetrate through the pores of a sample matrix and extract the components of interest efficiently. Raising the pressure often increases solubility, while raising the temperature decreases it. The pressure and temperature dependent solvating power has provided the impetus for adapting supercritical fluid technology to many extraction and separation requirements. Supercritical fluids provide faster, cleaner and efficient extractions as they generally become gas after the extraction and escape leaving the dissolved solute.

Some important applications of supercritical fluids include decaffination of coffee and tea, palm oil extraction, extraction of medicinal compounds from herbs, extraction of food and agricultural products, removal of undesirable agents from semiconductor wafers and pesticides from vegetable raw extracts etc.

Supercritical water is being used in the recent past for oxidation of toxic organic wastes. For over a quarter of century, carbon Dioxide has been primarily used as the solvent in extraction processes performed under supercritical conditions. In addition to its convenient critical temperature (31.3°C) and critical pressure (72.9 atm), it is also non-toxic, nonflammable, environmental friendly and inexpensive.

Conventionally used techniques for the recovery of actinides from different waste matrices generate relatively large amount of secondary liquid waste with proportional consumption of solvents. But the supercritical fluid extraction (SFE) technique enables the same task with minimum or no waste since the fluid escapes as a gas after extraction, reducing the burden of secondary waste generation considerably. This is obviously an attractive feature especially in nuclear industry where the main concern is accumulation of radioactive waste. In addition, the SFE technique-obviates, in many cases the cumbersome pre-treatment of waste matrix. Supercritical fluids also promise removal of radioactive particles and hazardous metals from mixtures of solid and liquid waste. Removal of actinides from contaminated surfaces is also reported. Thus SFE can be used to decontaminate shoe covers, lab coats, lab wares etc. on routine basis.

SFE - System

The SFE system employed in Fuel Chemistry Division consists of a solvent delivery system (reciprocating pump), a modifier pump, a constant temperature oven and a back pressure regulator [Fig.1]. Extraction vessels of 1, 50 and 100 mL capacity were employed for the extraction studies.

Removal of Uranyl nitrate from tissue waste using SFE.

The removal of uranyl nitrate from tissue paper matrix was carried out with modified SC-CO_2. À systematic investigation was taken up on the effect of drying temperature and drying period of tissue paper matrix on the extraction efficiency. Complete extraction of uranium was observed from tissue samples dried for about 10-15 minutes at 333 and 363 K whereas tissue samples dried at 393 K exhibited drastically reduced extraction efficiency [Fig.2]. Further investigations using IR and XRD technique indicate d a possible chemical bonding of the uranyl ion with the cellulose of the tissue matrix at higher temperatures causing incomplete extraction. Hence optimization with respect to the drying temperature of waste matrix is essential for efficient recovery. Complete extraction of uranyl nitrate from absorbent sheet, frequently used for wet experiments in fume hoods and glove boxes was achieved using modified SC-CO_2. The same technique was also employed successfully to recover uranyl nitrate from soil samples. The initial experiments were carried out with small extraction vessels (1,10 and 50 m1 capacity). Subsequently, indigenously fabricated higher capacity extraction vessels (100 and 500 ml) were also tested for their performance and safety aspects .

We are presently designing a glove box facility incorporating the SFE system to recover plutonium from waste. The next stage involves scaling up operation using higher capacity extraction vessels for treating larger amount of radioactive waste.

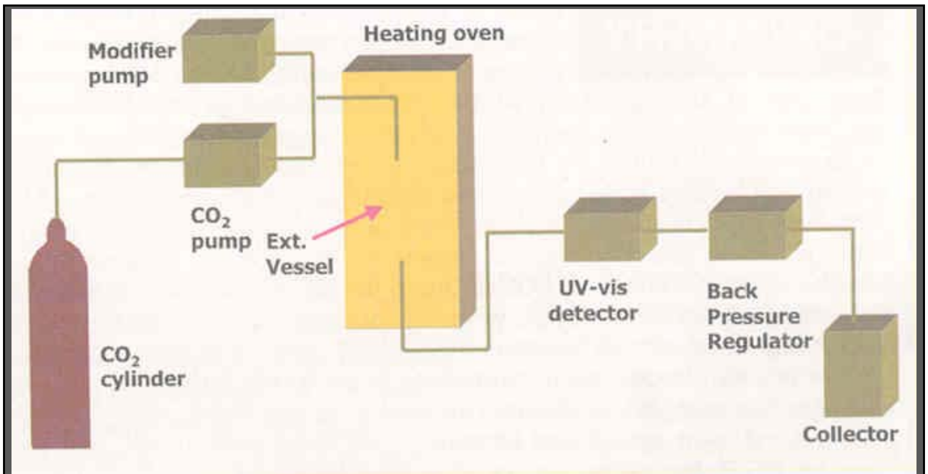

Fig.1 Schematic diagram of SFE

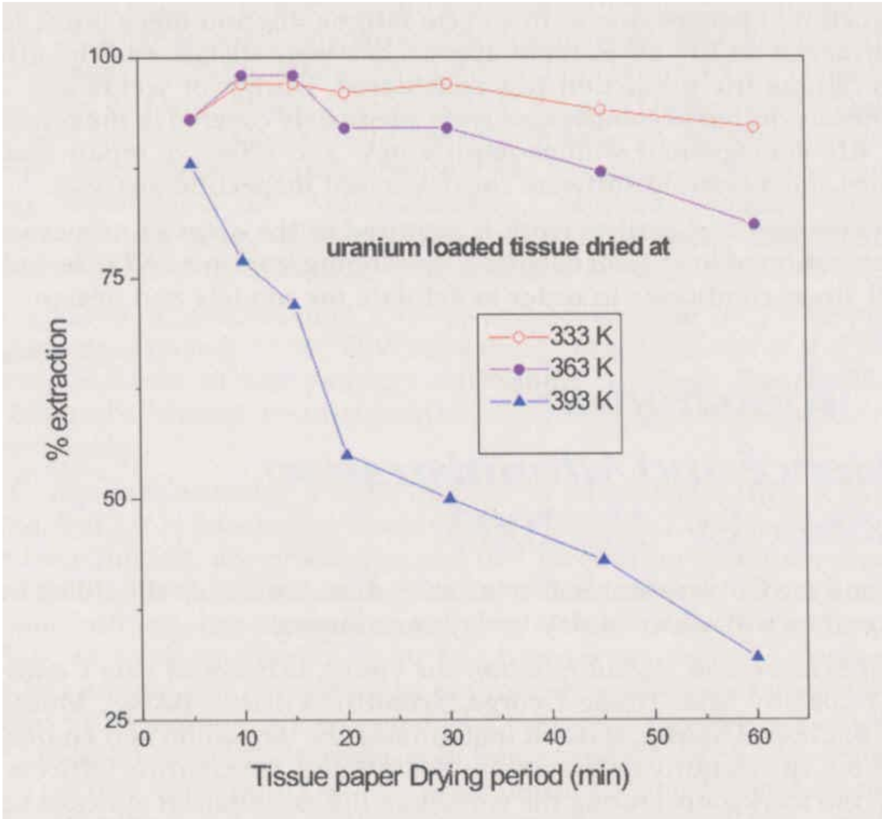

Fig.2 SFE of uranyl nitrate from tissue waste

SFE of Silicone oil from Urania microspheres prepared through Sol-Gel Process.

Internal gelation process is one of the important sol-gel routes for the preparation of UO2 microspheres in which homogeneous release of ammonia by decomposition of hexamethylenetetramine (HMTA) is used for the conversion of solution droplets in to hydrous gel particles . In this process, silicone oil is used as the gelation medium. After the gelation, the silicone oil is removed from the micro-spheres by washing with carbon tetrachloride. This leads to generation of a large amount of radioactive liquid waste. To obviate this disadvantage, extraction of silicone oil using SC-CO_2 was investigated.

The UO_2 hydrate spheres prepared from sol-gel process were washed with NH_4OH and then dried and the spheres were then subjected to SFE. About 200g of spheres was processed in three batches. The quantification and confirmation of complete extraction of silicone oil was carried out using IR spectroscopic technique along with the monitoring of weight change in collection vessel. The integrity of the microspheres after the extraction was found to be undisturbed and was comparable to that of conventionally washed spheres. The SFE is thus found to be an excellent alternate method with little generation of liquid waste for the removal of silicone oil from microspheres produced through sol-gel route .

The technique also holds tremendous potential for the extraction and recovery of plutonium and other actinides, rare earths and other nuclear materials such as zirconium from a variety of matrices. In the coming years, supercritical fluid extraction promises to be an important technology for adoption in the nuclear fuel cycle.

(N.Sivaraman, R. Kumar, T.G. Srinivasan and P.R. Vasudeva Rao)

Highlights of Symposia / Seminar / Conferences

4th Conference on Creep, Fatigue and Creep Fatigue interaction

(October 8-10, 2003)

The 4th Conference on Creep, Fatigue and Creep-Fatigue Interaction was held at Indira Gandhi Centre for Atomic Research (IGCAR) during October 8-10,2003. More than 150 delegates from India and abroad, drawn from academic institutes, national laboratories and private industries and public sector undertakings attended the conference. Delegates from Germany, Japan, Canada, United States of America, South Korea, in addition to eminent experts from within the country participated in the Conference . Sixteen invited papers and 45 contributed papers were presented over 10 technical sessions. Dr. S.L. Mannan, Associate Director, Materials Development Group, in hi s welcome address spoke about the steady growth in this conference series both in terms of participation as well as in the number of papers presented, since the first conference which was held in the year 1987. The conference was inaugurated by Dr. Baldev Raj, Director, Materials, Chemistry and Reprocessing Groups. In his inaugural address, he pointed out that this conference was being held at an appropriate time when the construction activity related to India's first Prototype Fast Breeder Reactor (PFBR) has commenced at Kalpakkam. In the design of PFBR structural components, creep, low cycle fatigue and creep-fatigue interaction play a very critical role. He highlighted the importance of understanding the high temperature behaviour of welds since the integrity of welded components is largely determined by the behaviour of the weld joints.

The papers presented in the Conference covered a wide spectrum, encompassing both basic research as well as engineering applications. There was emphasis on behaviour of welds, multi-axial loading, modelling, components testing, thermo-mechanical fatigue, super plasticity, condition monitoring and failure analysis There were several papers dealing with mechanisms of creep, fatigue and creep-fatigue interaction and development of new materials for high temperature applications. Micro-structural changes due to low cycle fatigue, thermo-mechanical fatigue and creep-fatigue deformation and their influence on life assessment approaches were discussed. The effect of mean stress, temperature and hold time on fatigue life prediction was considered. Design of welds and use of realistic strength reduction factors for welds for safe design of components were adequately covered in the conference. It was pointed out that reliable repair and life management studies require new and effective repair methods, probabilistic tools, evaluation of uncertainties and advanced software for risk based inspection analysis.

At the end of the three day deliberations, it emerged that further work is required in the areas of numerical and micro-structural modelling and simulation, generation of long-term database, developing improved NDE techniques, and testing of components under multi-axial stress conditions in order to validate the models and design.

(S. L. Mannan)

Workshop on "Ethics in Science and Administration"

October 14 -17, 2003

Ethics in Government organisation is a must and the Government is also insisting that all officials should be trained periodically on this aspect to realise the importance of ethics in day to day functioning.

With this in view, a workshop on Ethics in Science and Administration for young officers of this Centre was conducted in batches during October 14-17 2003 by Mrs. Tessie George, Scientific Officer, BARC, Mumbai at Library Meeting Room, HBB, IGCAR. Shri S.B. Bhoje, Director, IGCAR inaugurated the workshop and emphasized the need for ethics in Government offices. About 90 Scientific Officers from IGCAR and 22 Scientific Officers from BARC Facilities at Kalpakkam participated in the workshop. During the workshop the essentials of ethics in science and technology as well as in personal life were emphasized. The need for self-motivation in the field of R&D, especially in Government organisations was explained. Effective communication skills and netiquette i.e., the etiquette required while communicating through e-mail, were taught to the participants.

The participants appreciated the content of the workshop and the presentation by Mrs. Tessie George. The specific ideas given by Mrs. George regarding balancing of work at office and personal life at home were also appreciated. There was a general opinion that this kind of workshop needs to be conducted at periodical intervals for various levels of officers and staff.

(S.S. Boopathy)

Nuclear Fuel Cycle Technology: Closing the Fuel Cycle (INASC-2003)

December 17-19, 2003

The 14"' Annual Conference of the Indian Nuclear Society with the theme "Nuclear Fuel Cycle Technology: Closing the fuel cycle"was organized at IGCAR, Kalpakkam during 17-19, December, 2003. This conference was also the 1st BRNS Conference on Nuclear Fuel Cycle. The Conference was inaugurated on 17th December by His Excellency, Dr. A.P.J. Abdul Kalam, President of India. Selvi J Jayalalithaa, Hon. Chief Minister of Tamil Nadu released the souvenir as well as the Conference Proceedings. The conference had the unique distinction of participation of the former Chairmen of AEC (Dr. Raja Ramanna, Dr. H.N. Sethna and Mrs Sethna, Dr. M.R. Srinivasan and Dr. P.K. Iyengar) as well as former Directors of IGCAR (Prof. C.V. Sundaram and Dr. Placid Rodriguez). In addition, a large number of senior colleagues of the department, including Heads of Units of DAE participated in the conference and contributed to its success through their presentations.

Welcoming the dignitaries to the Conference, Shri S.B. Bhoje, Director, IGCAR indicated the importance of the Fast Breeder Reactor programme for meeting the energy needs of the country and also the recent strides taken by the Department towards setting up of 500 Mwe electrical Prototype Fast Breeder Reactor. Dr. R. Chidambaram, Principal Scientific Adviser to the Govt. of India and the President of the Indian Nuclear Society indicated that closing the fuel cycle was an important choice for our country to enable us to utilize our limited resources of uranium and the vast resources of thorium, while such a choice is not necessarily required for other countries. The Conference has thus come at an appropriate time to review our strengths in this important area.

Inaugurating the Conference, His Excellency, Dr. A.P.J. Abdul Kalam suggested that nuclear energy would be a very important component of our energy planning in the years to come and that the Department should plan to revise its projection of 20000 Mwe by the year 2020 to at least 50,000 MWe, in order to keep pace with the developmental requirements and increase the contribution of nuclear energy. He also cautioned that energy and water would become two important national issues in the coming decades and the Department of Atomic Energy as well as other scientific departments should work together to address these issues . Selvi J Jayalalithaa, Hon. Chief Minister of Tamil Nadu complimented the efforts of the Department in setting up nuclear reactors especially in the

State of Tamil Nadu. She noted that Water Desalination Plant is being set up at Kalpakkam and suggested that every nuclear reactor should henceforth have an associated water desalination plant, to provide water to the deficient states . She also indicated that her Government would provide all the necessary support to the Nuclear Energy Programme. Dr. Anil Kakodkar, Chairman, Atomic Energy Commission described the importance of thorium utilization and closing of the fuel cycle as important ingredients of the nuclear energy programme. Dr. Baldev Raj, Director, Materials, Chemical and Reprocessing Groups, IGCAR gave the vote of thanks.

During the inaugural function, INS Awards for the year 2002 were presented by His Excellency, Dr. Abdul Kalam. The Awardees included Prof. C.V.Sundaram, former Director of IGCAR (INS Homi Bhabha Life Time Achievement Award), and two of our younger colleagues, Dr. Arun Kumar Bhaduri and Dr. Â. Puma Chandra Rao (INS MEDALS). Following the inaugural session, the medal winners made a presentation regarding the work and their achievements.

The Conference attracted a large number of participants from within the country and also 18 participants from abroad. Split into 8 technical sessions, the Conference covered a wide range of subjects related to the nuclear fuel cycle from mining, ore processing and fuel fabrication to fuel reprocessing and waste management and also some of the futuristic areas such as Accelerator driven sub-critical systems. Dr. Anil Kakodkar, Chairman, AEC gave a keynote address describing the emerging dimensions of the nuclear fuel cycle programme in India. He pointed out that an early establishment of fast breeder reactors is necessary for India in view of our modest uranium resources and relatively higher cost of production in view of very lean ore concentrations in India. He also pointed out that fast reactors have emerged as a preferred choice for next generation systems internationally because of their potential strengths in terms of safety, sustainability, waste transmutation economic production etc. We thus have a unique opportunity to be in the forefront of this technology on the basis of the R & D that has been carried out for decades at IGCAR. Sri. B. Bhattacharjee, Director, BARC, in his invited talk, highlighted the R & D related to AHWR fuel cycle, and described various challenges to be met towards developing the fuel cycle of AHWR such as clean-up of U-233 (removal of U-232), advanced routes for fuel fabrication and management of radioactive waste. Dr. V.K.Chaturvedi, CMD, NPCIL, dwelt at length on the economics of PHWRs, VVERs and TAPS BWRs and stressed the need for R & D on new processes and technologies that would reduce the fuel cycle costs. Dr. C. Ganguly, CE (NFC) gave an account of the current status of fabrication of conventional as well as advanced fuels for PHWRs and LWRs in India and indicated that timely delivery of high quality fuel was one of the factors which has paved the way for high plant load factors achieved by the nuclear reactors in our country. Dr. Baldev Raj presented the highlights of R & D on fast reactor fuel cycle and emphasized the need for long term R & D on innovative fuel cycles which would enable faster growth of the nuclear power programme at the same time meeting safety and economic requirements. Invited speakers from various units of DAE described the status of the activities and challenging issues in the respective fuel cycle programmes. Participants from France, Japan, Vienna (IAEA), Switzerland, Russia and USA provided a glimpse of the progress made in fuel cycle R &'D internationally. One session was devoted to ADS based fuel cycle.

In addition to the 23 invited talks, there were 131 contributed papers from various units of Atomic Energy as well as other Research Institutes. The contributed papers were presented in two poster sessions, which were well attended. The papers clearly brought out the vast amount of research expertise in the areas related to fuel cycle. It is significant to note that papers on reprocessing and waste management constituted almost 40% of the papers, indicating the thrust on R&D in these areas.

Parallel to the technical programme of the Conference, two Discussion Meetings were held on a) Recent Trends and Issues in Radioactive Waste Management and b) ADS based fuel cycles . These meetings were aimed at focused discussions on the status of the programme and the R&D issues . The meeting on ADS based Fuel Cycle was chaired by Dr. S.S . Kapoor, Homi Bhabha Chair Professor, DAE and the meeting on Waste Management was chaired by Shri S.K. Sharma, Vice Chairman, AERB. Both these meetings provided intense discuss ions on those important topics.

The Concluding session was chaired by Shri S.B. Bhoje, Director, IGCAR wherein a report on the Satellite Meeting, MRPI 2003 was presented by Dr.K.B.S. Rao, Head, MMD, MDG. The proceedings of the discussion meetings were summarized by Dr. P.R. Vasudeva Rao. Dr. S.E. Prasad, Secretary, INS expressed his appreciation to Dr. Baldev Raj, Dr. Lee and their teams for the excellent organization of the conference in terms of the technical content as well as the local arrangements .Awards were presented by INS to three contributed papers adjudged as the best among the 131 papers, by a panel of judges. These awards were given by Sri. S.B.Bhoje. Shri S.E. Kannan, Head, ESD and Secretary, Organising Committee proposed a Vote of Thanks. From the feedback received from the participants, it was very obvious that the INSAC 2003 Conference had provided a very good forum for discussing the issues related to fuel cycle in a comprehensive manner.

(P.R. Vasudeva Rao and S.E. Kannan)

Conference on Materials and Technologies for Nuclear Fuel Cycle Covering Materials, Robotics, Process Instrumentation and Inspection Technologies (MRPI- 2003)

December 15-16,2003

A two-day conference on Materials and Technologies for Nuclear Fuel Cycle with focus on Materials, Robotics, Process Instrumentation and Inspection Technologies (MRPI 2003) was organized at Structural Engineering Research Centre, Chennai during December 15-16, 2003 under the auspices of Board of Research in Nuclear Sciences, Indian Nuclear Society (Kalpakkam Branch) and The Indian Institute of Metals (Kalpakkam and Chennai chapters). MRPI 2003 addressed the contemporary developments that have taken place in the enabling technology areas of materials, welding, sensors, automation and robotics, process instrumentation and monitoring, manufacturing technologies and non-destructive inspection, with emphasis on exploring their applicability to various programmes in DAE. A total number of 32 invited talks and a keynote lecture were delivered in oral sessions, while 50 contributory papers were presented in poster sessions.

During the opening remarks of MRPI 2003, Dr. Baldev Raj, Director, MCRG, IGCAR and Chairman, Steering Committee of MRPI 2003 stressed the need and importance of closing nuclear fuel cycle and had clearly brought out the challenges to be tackled. Shri S.B. Bhoje, Director, IGCAR, in his presidential address emphasized the importance of development of indigenous technologies in several spheres simultaneously to meet the challenging goals that are inherent in the back end of fuel cycle. In the inaugural address, Shri G.P. Srivatsava, Chairman and Managing Director, ECIL stressed the importance of developing user friendly, faster and cost effective automation and control introduction in nuclear power plants and reprocessing plants with special emphasis on diagnostics, safety and reliability of the control systems.

The deliberations at the conference have clearly brought out the competence and confidence of Indian industry in manufacturing robots as well as their control and instrumentation. It has emerged that the robot system design, fabrication and integration needs combined involvement of personnel from DAE units, DRDO, IITs, NITS and several medium and large scale industries in private sector.

It has become apparent that normal grades of 300 series of stainless steels fail to meet more stringent requirements prevailing in nuclear fuel reprocessing and waste management applications. Research and Developmental efforts at BARC led to production of nitric acid grade 304 and 310 stainless steels and the technology of manufacturing large diameter pipes has also been mastered. Though the structural materials for the dissolver and evaporator tanks of fuel reprocessing of fast reactor fuels have so far been pure Ti, the development of alternative materials such as Ti-5Ta-1.8Nb with better corrosion resistance for boiling nitric acid applications has become inevitable. The physical metallurgy, fabrication, corrosion aspects, similar and dissimilar metal welding technologies for Ti-5Ta-1.8Nb have been developed at IGCAR and NFC, Larsen and Toubro, Mumbai has presented their expertise in the fabrication of mega size stainless steel tanks needed for chemical processing plants. The companies like Metallic Bellows in Chennai have mastered the technologies relating to the manufacture of bellows needed for power plant and other applications in strategic sectors. IGCAR and IIT Chennai have developed enormous basic understanding on the welding science and technology of several grades of stainless steels and titanium alloys. Modeling of welds using ANN for prediction of various welding process parameters has been developed at IGCAR. The advantage of techniques like scanning Kelvin probe for detecting the corrosion in sensitive areas has been emphasized and demonstrated. The fundamental aspects, and technology for producing wear resistant coatings on various components and tribology have been discussed. The advances in the development of glasses that have taken place in the country have been addressed.

The changing pattern and emerging trends in the distributed and digital control instrumentation, intelligent controllers, design aspects of safety critical instrumentation, signal processing strategies, eddy current instrumentation and machine vision applications for automated inspection were discussed. The latest developments on ultra sensitive digital tracking system sensors and their deployment in radioactive laboratories and facilities were highlighted. The importance of non-destructive testing towards producing high quality components in reprocessing units has been discussed. MRPI 2003 provided an excellent opportunity for DAE personnel to establish formal contacts towards forging successful partnerships with enthusiastic industrialists and academic institutes in the on-going and near term programmes of DAE.

(*K. Bhanu Sankara Rao*)

Forthcoming Symposia / Seminar / Conferences

Annual "Quality Circles Awareness Day”

February 16, 2004

Annual "Quality Circles Awareness Day-2004" is planned to be held on February 16th 2004 at the Convention Centre in Anupuram Township. Quality circles from Kalpakkam schools, DAE Hospital, GSO, MAPS & IGCAR are expected to take part in the competition and present various case studies . Guest lectures from experts in the field from IGCAR and Chennai will form part of the programme. Last date for receiving entry of case studies is January 9, 2004.

(K. /. John, Secretary, Organising Committee, QCAD, ESG)

DAE-BRNS National Symposium on "Nuclear Instrumentation"(NSNI-2004)

February 17-20, 2004

Scope and Objectives

Electronics and Instrumentation program of Department of Atomic Energy (DAE) has been mainly fuelled by the need in areas like Reactor and Accelerator Instrumentation, Physics experimentation and various Process Control Instrumentation requirements. Nuclear Instruments design has undergone rapid changes in the last few years with extensive usage of Hybrid Micro Circuits (HMC), ASICs and FPGAs with many foundries in India offering VLSI fabrication facilities. Indigenous development of ASICs and HMC is imperative for self-reliance for keeping pace with the technological advances and also in overcoming problems like obsolescence. BARC and IGCAR have taken an initiative in designing ASICs, HMCs and FPGAs for meeting the requirements of DAE. In order to provide a forum for exchange of ideas relevant to all these developments and to focus on these new technological issues on development activities in Nuclear Instruments, it is proposed to organize a GOLDEN JUBILEE DAE-BRNS National Symposium on "Nuclear Instrumentation-2004" (NSNI-2004) under the auspices of BRNS, during February 17-20, 2004 at IGCAR, Kalpakkam. This event aims to include a number of invited talks by experts in topics of current interest in the field, presentation of contributed papers from scientists and engineers involved in the development and usage of Nuclear Instruments.

Topics

Nuclear Instruments for Reactors, Accelerators, Physics Experiments and other applications, ASICs, FPGAs, CPLDs, DSPs, Micro Controllers / processors and System On Chip (SOC) Solutions, EDA Techniques in Nuclear Instrumentation, Mixed Signal Design, VLSI Process Technology, Detector/ Sensor/MEMS for Nuclear Instruments, Networking and Embedded Systems for Nuclear Instruments, Imaging and Image Processing in Nuclear Applications, Bio-Medical Instruments, Software tools, techniques and applications.

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IGCAR felicitates

Shri N. SRINIVASAN, Founder-Director for Padma Bhusan Award. It was a matter of great pride and pleasure for IGCAR and for the whole DAE, when the Government of India announced on the Republic Day (January 2003) the Padmasri Award to the present Director, Shri S.B. Bhoje and the Padma Bhusan Award to the founder Director Shri N. Srinivasan. À simple and warm function to felicitate Shri N. Srinivasan was held on 15th October 2003. Shri Bhoje recalled the outstanding contributions and services rendered by Shri N. Srinivasan in the four areas: Plutonium reprocessing, construction of the FBTR, Initiating the plan of action for the PFBR and enhancement of the product ion capacities of the HWP by instilling modern management techniques. Shri G. R. Balasubramanian, Technical Advisor (Retired) to Chairman, DAE, gave biographical sketch of Shri Srinivasan, highlighting the professional and personal qualities. Shri N. Srinivasan responded to the felicitation and firstly commended the inspiration and momentum provided by the successive Directors. He exhorted the staff members, particularly the younger sect ion to imbibe the culture of selfless service, passion to learn and experiment, willingness to accept challenges and devotion to work, especially when the nation has entrusted DAE with the prestigious task of construction and commissioning of PFBR.

H is Excellency President of India, Dr. A.P.J. Abdul Kalam addressing the delegates during the inaugural function of the Conference on Nuclear Fuel Cycle (INSAC-2003) at IGCAR on December 17, 2003 .

Honourable Chief Minister of Tamil Nadu, Selvi J Jayalalithaa addressing the delegates during the inaugural function of the Conference on Nuclear Fuel Cycle (INSAC-2003) at IGCAR on December 17, 2003 .

Dr. Anil Kakodkar, Chairman, Atomic Energy Commission, Selvi J Jayalalithaa, Chief Minister of Tamil Nadu, Dr. A.P.J. Abdul Kalam, President of India, D r. R. Chidambaram, Principal Scientific Advisor, Government of India, Shri S.B. Bhoje, Director, IGCAR on the dais and Dr. Baldev Raj, Director, MCRG proposing vote of thanks, during INSAC - 2003.

AWARDS / HONOURS

Shri Anish Kumar, Division of Post-irradiation Examination and Non-destructive testing (DPEND), has been selected for Shri Ram Arora International Award for the year 2004 from The Minerals, Metals and Materials Society (TMS), USA.

Dr. A.K. Bhaduri, Materials Technology Division (MTD) was awarded Homi Bhabha Science & Technology Award for the year 2002. He has been awarded Indian Nuclear Society (INS) Gold Medal for the year 2002. He has also received the prestigious National Metallurgist Day (NMD) Award -2002. Dr. Bhaduri has also been elected as a Fellow of Indian Institute of Metals (IIM).

Dr.K.Bhanu Sankara Rao, Mechanical Metallurgy Division has been elected as a Fellow of Indian Academy of Sciences, Bangalore. He has also become the Chief Editor, Transactions of the Indian Institute of Metals.

Dr. B.P.C. Rao, DPEND has been awarded Indian Nuclear Society (INS) Gold medal award for the year 2002.

Dr. S.K. Ray, MTD has been elected as a Fellow of Indian National Academy of Engineering (INAE) from January 2004.

Dr. M. Vijayalakshmi, Materials Characterization Group has been conferred with Materials Research Society of India (MRSI) Medal for the year 2004.

During the National Welding Seminar (NWS-2003), held at Baroda in December 2003, the paper entitled "Artificial Neural Network Modelling of Solidification Mode and Ferric Content in Austenitic Stainless Steel Welds" authored by M. Vasudevan, A.K. Bhaduri, Baldev Raj and E. Prasad Rao of IIT, Chennai received the H.D. Govindaraj Memorial Award for the Best Paper on Research & Development and the paper entitled “Development of Repair Welding Procedure for Cracked 5th Stage Blades of Low pressure Steam Turbine" authored by C.R. Das, S .K. Albert, A.K. Bhaduri, G. Srinivasan and V. Ramasubbu received the Eutectic Reclamation Award for the Best Paper on Repair & Reclamation Welding .

Chairman, Editorial Committee: Dr Baldev Raj, Advisory Members: Dr. S.M. Lee and Shri S.C. Chetal.
Members: Dr PR Vasudeva Rao, Dr K Govinda Rajan, Shri V S Krishnamachari, Shri M. Somasekharan and Dr. G. Amarendra.
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