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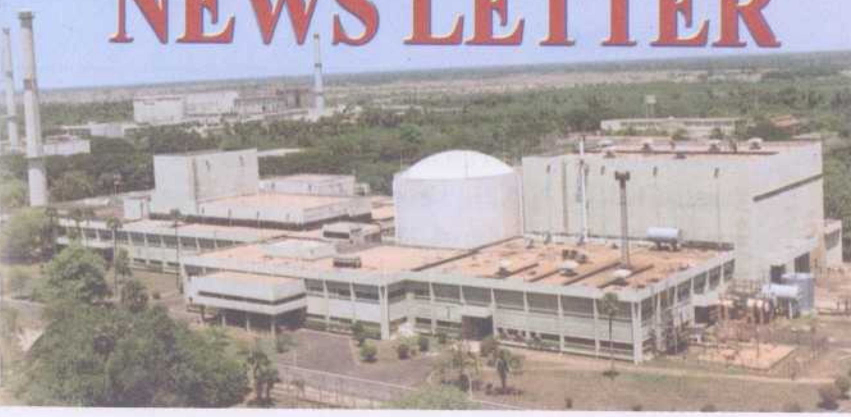
NEWS LETTER



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INDIRA GANDHI CENTRE FOR ATOMIC RESEARCH
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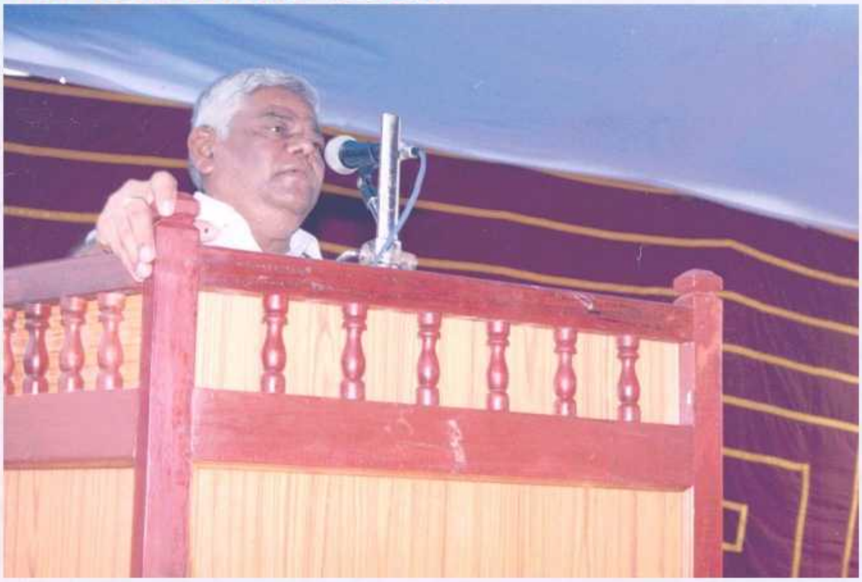
OCTOBER 2003

INSIDE THE NEWSLETTER

From the Director's Desk



Administrative Approval and Financial Sanction by the Government of India for PFBR

The Cabinet Committee on Economic Affairs (CCEA), Government of India has approved on 2nd September 2003, the construction of 500 MWe Prototype Fast Breeder Reactor at Kalpakkam, at an overnight cost of Rs.2800 crores and completion cost of Rs.3492 crores. The estimated unit energy cost is Rs.3.25. PFBR is a sodium cooled, pool type and mixed oxide fuelled reactor. The approval from the CCEA has been received, after the reviews by various ministries were obtained, viz. Planning Commission, Ministry of Finance & Company Affairs, Ministry of Power, Ministry of Heavy Industries & Public Enterprises and Ministry of Environment & Forests. The Atomic Energy Commission had approved the construction of PFBR in October 2002. The project will be constructed by a new Govt. Company, under the Department of Atomic Energy, named as *Bharatiya Nabhikiya Vidyut Nigam*, which is being registered at Chennai. All the formalities for creation of the company are expected to be completed by end October, 2003. Personnel for the company will be drawn mainly from IGCAR and NPCIL. IGCAR has the scientific and technical expertise in FBR, whereas

NPCIL has the project management capability. Six PHWRs being constructed by NPCIL, have short construction periods of about 5 years. Therefore, considering the modern management techniques and increased industrial capabilities, the PFBR construction schedule of seven years may be reduced by about a year.

The responsibilities of IGCAR with respect to PFBR are to carry out the R&D required for design validation, design and engineering of the reactor, manufacturing technology development for the materials and components, pre-project activities and obtaining all the statutory approvals for the project. Site excavation has started on August 18th 2003 and would be completed in about five months. Tendering actions for safety vessel, main vessel, inner vessel, CSRDM, DSRDM, thermal baffles, core support structure and steam generators are already under process. The Indian industrial capability will also enhance considerably with the manufacture of high precision components.

IGCAR is thankful to the Government of India for the approval of PFBR Project, which is a major milestone in the history of Department of Atomic Energy and that too during Golden Jubilee Celebration year of DAE. The project approval is a matter of pride and joy for IGCAR and also for the whole DAE. We will strive hard for the success of the project.

(S. B. Bhoje)
Director, IGCAR

Ground Breaking Function for the Commencement of Excavation Work on Nuclear Island of PFBR

PFBR nuclear island houses the safety related buildings. It consists of Reactor containment building, steam generator buildings, fuel building, radioactive-waste building, control building and electrical buildings, which are connected together as a single structure. This is supported on a common raft foundation on hard rock which covers an area of approximately 85 m x 76 m. The other buildings in the nuclear island are supported on individual foundations on weathered rock. For construction of the buildings, it is necessary to expose the rock surface by excavation. The weathered rock is approximately 14 m below existing ground level and hard rock is nearly 16 m below the ground level. Further the hard rock needs to be excavated to a depth of 0.6 m to 2.6 m for raft foundation. To reduce the construction time after project approval, nuclear island excavation work was planned as a pre-project activity and the Work Order was issued on August 5th 2003. The excavation involves approximately 5.4 lakh m^3 of sand/ clay, 0.27 lakh m^3 of weathered rock and 0.48 lakh m^3 of hard rock. This is targeted for completion by February 2004. Hard rock excavation is done by controlled blasting to avoid damage to nearby structures and MAPS.

The excavation work commenced with "Ground Breaking Function" at 1100 hr on Monday, August 18th 2003, which was graced by Dr. Anil Kakodkar, Chairman, AEC & Secretary, DAE, Dr. B. Bhattacharjee, Director, BARC, Shri S. B. Bhoje, Director, IGCAR and Heads of other DAE Units.

Shri S. B.Bhoje, Director, IGCAR, in his welcome address, enumerated various steps involved in the design & construction of PFBR, highlighted the detailed R&D efforts carried out at IGCAR and the rich experience gained in operating the FBTR over the years. He emphasized the role of IGCAR in the construction of PFBR in terms of five areas of responsibilities viz., (i) Research & Development (ii) Design and Engineering (iii) Manufacturing Technology Development (iv) Preproject Activities and (v) Statutory Clearances. He also pointed out that the construction of PFBR will be carried out by a new company, where the managerial skills of NPCIL and the scientific and technological expertise of IGCAR will be utilized effectively. The company will derive necessary support from BARC, NFC, ECIL, HWB and other DAE units. Shri Bhoje in his address also mentioned that necessary clearances have been received from Planning Commission, Ministry of Finance, Ministry of Power, Ministry of Environment and Forests and Tamil Nadu Pollution Control Board to the project and the approval from the Cabinet is expected shortly. Discussions are in progress with AERB for its clearance for the first pour of concrete. Shri Bhoje highlighed the importance of the PFBR project in the context of nuclear power generation and said that the progress of the project will not only be watched within the country, but also by people all over the world.

Dr. Anil Kakodkar, Chairman, AEC and Secretary, DAE in his remarks said that embarking on the construction of PFBR is indeed an important and landmark day in the history of DAE. The launch of power generation using fast reactors is a major step in utilising the abundant thorium resources available in the country. Dr. Kakodkar mentioned that the vision 2020 document of the DAE has included 4 x 500 MWe FBR, after PFBR. He said the successful construction and operation of PFBR is very important on this road map to power generation using fast reactors. He underlined the importance of the time management in meeting various deadlines for a project of this magnitude and said that the best human resources in terms of R & D personnel and project management have to join hands in realizing the PFBR project. He congratulated the Scientists and Engineers of IGCAR in their efforts and wished all success for the project.

Dr. B. Bhattacharjee, Director, BARC in his address lauded the efforts in embarking on the construction of PFBR and said that concerted and collaborative efforts by various DAE units are the key to the success for a project of this dimension. He highlighted the role of BARC in the development of fast reactor technology in terms of various key inputs such as the fabrication and supply of carbide fuel for the FBTR and the development of new facilities for the fabrication of oxide fuel for PFBR. He said the satisfactory performance of pressurized heavy water reactors in power generation has instilled the confidence in public for accepting the nuclear power on par with other power generation methods. Dr. Bhattacharjee said the realization of power generation through fast reactors is a major milestone and concerted efforts should be put in towards this.

Shri R. Prabhakar, Project Manager, PFBR construction Group, thanked all the dignitaries and the participants of the function.

(R. Prabhakar)

PFBR Manufacturing Technology Development

Steam Generator Evaporator

Steam Generator (SG) is an integrated once through type, counter current heat exchanger with sodium on shell side and water/ steam on tube side. Sodium heated SGs are one of the critical components of a fast breeder reactor. Reactor power availability depends upon the performance of this equipment. Even a minute leak of high pressure water/steam into sodium on the shell side can cause sodium water reaction. The tube to tubesheet weld joint chosen was of

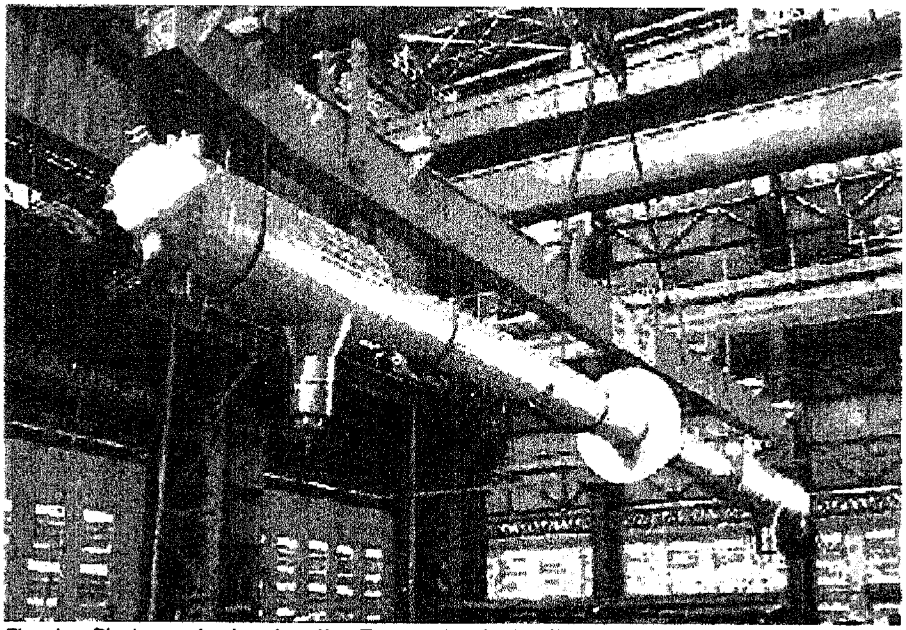


Fig. 1 : Photograph showing the Evaporator in BHEL workshop. The evaporator has now been transported to IGCAR.

raised spigot type which is welded from the bore side. This type of weld joint has many advantages i.e. 100% volumetric examination of the weld, eliminates crevice corrosion between tubesheet and tube that may lead to failure as in the conventional rolled and welded joint, increased ligament for a given tube pitch and increased fatigue life.

Manufacture of SG evaporator was taken up through the Indian Industry and involved the following development works.

a) Drilling and machining of tubesheet with spigot.

b) Bore welding by pulsed GTAW process in 5 G position without filler wire.

c) Bending of 18 m long tubes.

d) End machining of 18 m long tubes to match spigot.

e) Forming of shell pullout and eccentric reducer.

f) Establishing tube to tubesheet weld repair and plugging technique.

g) PWHT of entire component in furnace

SG-Evaporator was ordered on M/s. BHEL, Trichy to develop technology of the same. Tube size of the PFBR SG is the same as used for evaporator meant for technology development i.e., 17.2 mm OD and 2.3 mm wall thickness. The material used for evaporator was 2.25 Cr-1Mo while PFBR SG will be of Gr 91 material.

Each tube to tubesheet weld is subjected to preheat, PWHT, microfocal X-ray examination, weld profile measurement, hydro test and helium leak test under vacuum. To get acceptable quality of tube to tubesheet welds, number of weld trials were carried out before qualification of welding procedure.

The assembly of tube bundle is carried out on row by row basis. The tube bundle support is of aluminized Inconel 718. Shells over the tube bundle are in two halves and were assembled progressively. Completed equipment of SG-Evaporator was handed over to Director, IGCAR in July 2003 by M/s. BHEL, Trichy. Figure 1 shows the photograph of the completed steam generator.

(T.K. Mitra, P. Ramalingam, V.K. Sethi)

Annular Linear Induction Pump (ALIP)

Annular Linear Induction Pump is an electromagnetic pump which is used for pumping liquid sodium in auxilliary circuits. In ALIP stator produces a linearly travelling field which induces current in sodium. Interaction of this current with the stator magnetic field generates the pumping force. Inner core laminations provide return path to flux linking with the sodium. The operating principle of ALIP is similar to an induction Motor.

170 m^3/h flow rate 415 V, 3 phase, 50 Hz Annular Linear Induction Pump was manufactured through Indian Industry. The design was carried out in-house in EDG earlier.

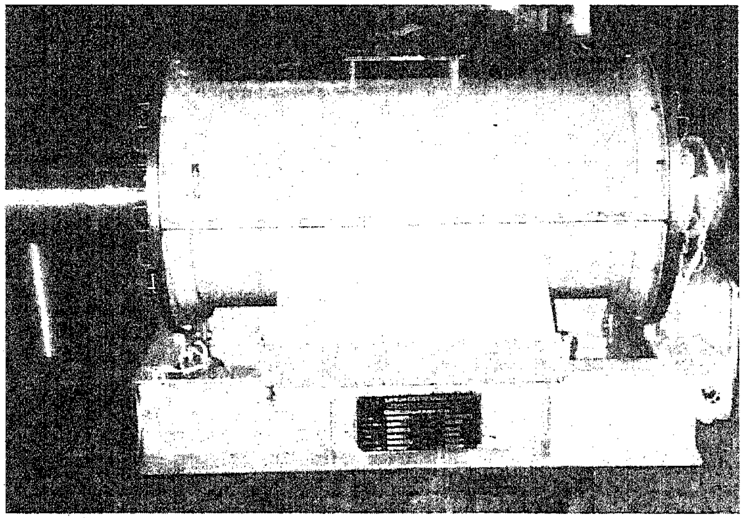


Fig. 2. Photograph showing the Annular linear induction pump.

The ALIP manufactured essentially consists of

a) Stator with 3 phase winding.

b) Sodium duct.

c) Inner core lamination.

d) Assembly and testing.

All the electrical tests such as high voltage test, IR test, inductance and surge test were conducted successfully in addition to hydrostatic and helium leak test on the duct. Annular Linear Induction Pump was received in April 2003. Figure 2 shows the Photograph of the completed pump. Its performance testing will be carried out in a sodium loop in EDG.

(P. Ramalingam, B.K. Nashine, V.K. Sethi, R. Prabhakar)

Indigenous Development of Materials for PFBR

The major materials required for fast breeder reactor are stainless steels type AISI 316LN, 304LN, carbon steel A 48 P2 and Alloy P91 (modified 9Cr-1Mo). The estimated requirement for the construction of one reactor is about 3000 tonnes of stainless steels and 220 tonnes of carbon steels and 400 tonnes of modified 9Cr-1Mo materials. Most of the materials used in the construction of Fast Breeder Test Reactor (FBTR) were imported. Considering the quantities of steel required for one PFBR plant of 500 Mwe capacity, it might appear that import of these materials is cost effective. However, in view of the possible embargo and sanctions on nuclear grade materials, it is absolutely necessary for our energy independence to develop indigenous sources for the requirements of materials. Hence, it has been decided to develop indigenous sources by IGCAR for the supply of materials for the major components of PFBR in collaboration with public sector undertakings and private industries.

Fabrication of large sized components like main vessel measuring 12.9 m in diameter and 12.94 m in height, require long and wide plates in order to reduce the number of welds since welds are viewed as potential sites of weakness. 304L(N)/316L(N) plates up to 3 m wide, 8 m long and 120 mm thick are needed. In the first phase 12 mm thickness of 1.5 m x 4 m plates of Stainless steel type AISI 316 LN has been developed successfully by Alloy Steel Plant (ASP), Durgapur. With the modernisation and upgradation of technology carried out by some of the steel plants by the installation of electric arc furnace melting, coupled with secondary refining processes like VOD, it is now possible to manufacture stainless and low alloy steels of close chemical composition and low inclusion contents within the country. However, the major difficulty lies not as much in achieving the desired chemistry and quality of the steel but mainly in producing plates of large sizes and thickness required for PFBR. ASP, the largest producer of plates, can meet our requirement of stainless steel plates in terms of chemical composition and cleanliness level but does not have the infrastructure to produce plates of the required dimensions. ASP can supply solution-annealed plates of 1400mm width, 4000 mm length and a maximum of 12mm thickness. Therefore, it is necessary to develop infra structural facilities for producing large size plates (width up to 3m, length up to 8 m and thickness up to 120 mm) if the requirements are to be met indigenously. It was recognised that within the SAIL family there are facilities for rolling carbon and low alloy steels to wider and longer dimensions than available at ASP. The possibility of producing stainless steel plates of larger dimension by combining facilities within SAIL plants has been explored. In this endeavour, 316L(N) slabs meeting stringent specifications on chemical composition and inclusion rating were produced at ASP using the VOD furnace by concast route and these slabs rolled at Rourkela Steel Plant (RSP) to plates of dimensions 2000 mm x 8000 mm x 30 mm. It required upgradation of furnace at

Table I : Chemical composition of the plates produced at RSP.

Element	*316 LN*		*Modified 9Cr-1Mo*			*A48P2 material*			
	Specified	*Achieved*	*Specified*	*Achieved on*		*Ladle*		*Product*	
				12 mm plates	*30 mm plates*	*Specified*	*Achieved*	*Specified*	*Achieved*
C	0.024 – 0.03	0.021 – 0.026	0.08 – 0.12	0.08 – 0.12	0.11 – 0.12	0.2 max	0.13	0.22 max	0.134
Cr	17 – 18	17.52 – 17.57	8 – 9.5	9.45 – 9.50	9.25 – 9.43	0.2 max		0.2 max	0
Ni	12 – 12.5	12.08 – 12.15	0.4 max	0.13 – 0.14	0.13 – 0.14	0.3 max		0.3 max	0
Mo	2.3 – 2.7	2.32 – 2.36	0.85 – 1.05	0.98 – 1.0	0.95 – 1.0	0.1 max		0.1 max	0.003
N	0.06 – 0.08	0.071 – 0.078	0.03 – 0.07	0.062 – 0.068	0.065 – 0.068				
Mn	1.6 – 2.0	1.66 – 1.69	0.3 – 0.6	0.39	0.38 – 0.39	0.8 – 1.5	1.23	0.8 – 1.5	1.199
Si	0.5	0.34 – 0.36	0.2 – 0.5	0.48 – 0.5	0.45 – 0.48	0.35 max	0.245	0.4 max	0.26
P	0.03	0.023 – 0.027	0.02 max	0.020 – 0.022	0.018 – 0.02	0.03 max	0.016	0.035 max	0.014
S	0.01	0.014 – 0.016	0.01 max	0.008 – 0.01	0.007 – 0.008	0.008 max	0.002	0.012 max	0.002
Ti	0.05	0.006 – 0.009							
Nb	0.05	0.006 – 0.007	0.06 – 0.10	0.096 – 0.1	0.096 – 0.1			-	0.002
Cu	1.0	0.071 – 0.076				0.25 max		0.25 max	0.006
Co	0.25 max	0.055 – 0.072							
B	20 ppm max.	12 – 15 ppm							
Al			0.04 max	0.020 – 0.024	0.019		0.078		0.065
V						0.05 max		-	0.003
Eq. Carbon = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 (for A48P2 plates only						0.46 max	0.335		

Table II: Mechanical properties of stainless steel 316LN, Modified 9Cr-1Mo and A48 P2 plates produced at Rourkela steel plant (RSP).

Property	*Specified (minimum)*	*Achieved*
Material: Stainless steel 316LN		
	Tensile	
YS at room temperature (MPa)	220	270-303
UTS at room temperature (MPa)	525	550 – 575
Elongation at room temperature (%)	45	48 – 51
YS at 823 K (MPa)	110	154
	Impact energy (daJ/cm²)	
Solution Annealed condition	14 (minimum)	15.2 – 27.5
Aged at 1023 K for 100h	10 (minimum)	14.9 – 18.4
Material: Modified 9Cr-1Mo		
	Tensile	
YS at room temperature (MPa)	415 (minimum)	435 - 539
UTS at room temperature (MPa)	585 – 760	621 – 755
Elongation at room temperature (%)	20	20.5 – 26
YS at 798 K (MPa)	385	390 – 415
	Drop Weight	
RT_{NDT}	< -15°C	-20°C
Material: A48P2		
	Tensile	
YS at room temperature (MPa)	285	286-324
UTS at room temperature (MPa)	470 – 550	478 - 498
Elongation at room temperature (%)	25	30 – 35
Short transverse room temperature RA	35 % avg.; 25 % indv.	69 % - 74 %
RT_{NDT}	< -20°C	-45°C
	Impact energy at -20°C (daJ/cm²)	
Longitudinal thickness	5.0 (avg.); 3.5 (indv.)	17.0 to 42.5
Transverse skin	3.5 (avg.); 2.6 (indv.)	16.6 to 41.9
Transverse thickness	3.0(avg); (indv.)	14.7 to 41.6

RSP to carry out solution annealing of stainless steel and normalisation of modified 9 Cr-l Mo steel plates. It was also necessary to have facilities for pickling and passivation. These issues were resolved by modifying their furnaces and design of proper gadgets for materials handling and water quenching. The temperature capability of the furnace in the RSP, SAIL has been enhanced to 1373 K by carrying out modifications on the fuel line and refractory linings. Vendors have been developed to carryout edge cutting, pickling and passivation of stainless steel plates. The plates of 2 m width, 8 m length and 30 mm thickness in stainless steel and modified 9Cr-1Mo have been rolled at RSP with slabs produced at ASP. For A48P2 Carbon Steel plates, steel was melted and processed fully at RSP producing plates of 2m width, 8m length and 30mm thickness. A brief account of these efforts is given below.

AISI 316 LN Plates: 316LN plates were solution treated at 1323 K (1050°C) by heating the plates in a bogie hearth furnace and quenching into a pool of water. IGC tests as per our specifications were also carried out and found satisfactory. After pickling the 316LN stainless steel plates, some scale cracks were observed on the surface. The depths of these cracks were found to be within 0.3 mm to 0.6 mm. These cracks were removed by grinding the surfaces to a depth of 0.6 mm. After grinding surfaces were examined by DP technique and found to be free from any cracks. The measured ferrite content is in the range 0 to 0.57 FN Ferrite Number. The inclusion content is within the specified limit.

Modified 9Cr-lMo Plates: After normalising and tempering tensile tests were carried out to evaluate the tensile properties of these plates. The desired ductility level was not obtained in the first attempt in two plates. It has been inferred that the non uniformity in the temperature existing at the inside of the furnace was the main reason for not achieving the desired properties. The furnace burners were modified and tempering time was increased. After the re-treatment, all the plates achieved the desired properties.

Table I gives the summary of specified and achieved chemical composition of the plates produced in RSP. All the plates met the UT requirements of PFBR specifications. The various properties specified as well as achieved on these plates are given in Table II.

Although, there were several challenges to our efforts to produce the PFBR materials indigenously, remarkable progress has been achieved in producing PFBR grades of 316L(N) SS, mod.9Cr-1Mo steel and A48P2 grade carbon steel indigenously. Plates have been produced in large dimensions required specially for the manufacture of PFBR components, in collaboration with SAIL. Following these successful efforts at indigenisation, the Indian industry has achieved confidence to manufacture all major materials in product forms required for various components of Prototype Fast Breeder Reactor.

(S.L. Mannan, S.C. Chetal, Baldev Raj, S. Venugopal and B.S.C. Rao)

MOX Fuel Irradiation begins in FBTR

India's fast breeder reactor programme is on the threshold of an important milestone of starting the construction of Prototype Fast Breeder Reactor (PFBR), a 500 MWe nuclear power plant at Kalpakkam. Design of PFBR and associated R&D is the responsibility of IGCAR. PFBR uses mixed oxides of uranium and plutonium, with plutonium oxide content around 25%. The fuel is in the form of sintered pellets with central hole. Sintered pellets of fuel making a stack of 1000 mm are stacked inside cold worked D9 clad tubes and sealed to make one fuel pin. PFBR requires around 40,000 such pins to make the core. The fuel is designed to operate at a peak linear heat rating of 450 W/cm and to give a peak burnup of 100,000

MWd/t. Though large experience is available in the use of mixed oxide fuel in fast breeder reactors operating abroad and burnups in excess of what is targeted for PFBR fuel have been achieved in some of the reactors, it is necessary to carry out integral irradiation experiments of the fuel to validate the design and fabrication specifications of the fuel pins. Towards this objective, a subassembly with 37 pins of PFBR fuel design and which adapts externally to the dimensions compatible with FBTR core has been loaded in FBTR for irradiation testing starting from the 11th irradiation campaign of the reactor beginning from 21st July 2003. Since the driver fuel, the indigenous mixed carbide fuel, is highly enriched in plutonium (70% in PuC) it is necessary to have high fissile enrichment in the test fuel also to achieve required linear heat rating. In order to get necessary fissile enrichment in the test fuel without changing the plutonium oxide content, the uranium-233 has been added to the uranium used in the fuel to an extent of 50%.

U^{233} required for the test fuel has been made available from the reprocessing plants at IGCAR and BARC. The fuel pins have been manufactured by Advanced Fuel Fabrication Facility at Tarapur which is entrusted with the responsibility of manufacture of fuel pins for the first core of PFBR. The cold worked cladding tubes and the hexagonal tubes for the test subassembly made of D9 alloy have been fabricated at NFC with the raw material procured from MIDHANI. Thus, the test would demonstrate the total indigenous capability of the fuel manufacture.

The test subassembly has been designed to operate at a peak linear heat rating of 450 W/cm, when the driver fuel operates at 320 W/cm. The flow in the subassembly has been adjusted to ensure a clad mid-wall hotspot temperature of 660°C. The results obtained will be reported later on.

(S. Govindarajan)

Commissioning of Calibration Facility at Electronics Division

Accurate measurements form the basis for process instruments and in turn the product quality of the plant. All measuring devices require periodic calibration, primarily to monitor the changes in performance and the reasons for the change in performance are environment and aging. Such performance degradation is called drift and it cannot be totally eliminated. It can only be detected and contained through Calibration.

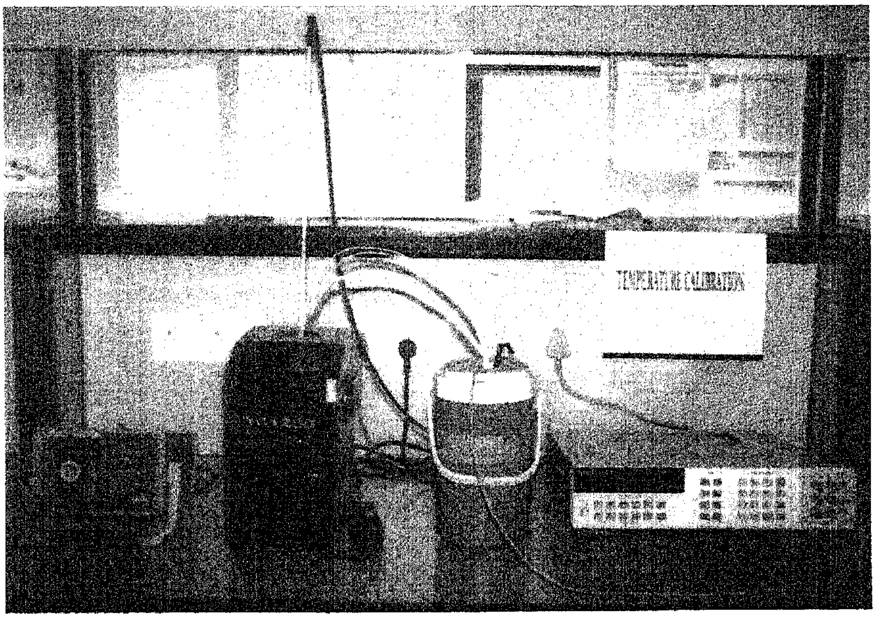


Fig. : Photograph showing Temperature Calibration Facility.

Calibration is the process in which Device under calibration (DUC) whose uncertainty has to be estimated is compared with either the Measurement Standards or calibrator whose uncertainty is known. Through comparison, the uncertainty of DUC is determined. Only calibrated instruments can give reliable results and therefore it is necessary to periodically calibrate the instruments and systems.

The apex calibration laboratory of our country is the National Physical Laboratory (NPL), New Delhi. It is also known as "primary calibration laboratory". There are a number of other laboratories, both in the government and the private sectors at secondary and tertiary levels. Earlier our instruments were calibrated at ETDC, Chennai under Ministry of Information and Technology but now a Calibration facility has been commissioned at Electronics Division for the following process variables, (a)Temperature (b) Pressure (c) Electrical Parameters.

The temperature calibration facility has been equipped with a Low Temperature bath for the range 233K to 423K with an accuracy of ± 0.3K and for the higher temperatures, a bath with a range of 423K to 1473K and accuracy of ± 3K has been commissioned. Standard sensors like S type thermocouple with an accuracy of ± 1K and Standard Platinum Resistance Thermocouple with a higher accuracy of ± 0.1K are also available.

The pressure calibration facility consists of a Dead Weight Tester which has a range of 1 to 700 Bar and an accuracy of 0.015% FSD and a Portable Pressure Calibrator of range-850 mbar to 20 Bar and accuracy 0.025% FSD.

For calibrating electrical parameters such as voltage, current, frequency, resistance and capacitance, a Multifunction Calibrator and a 8½ digit Digital Multimeter are available.

The facility has been commissioned and the figure shows the photograph of the calibration facilities for the temperature measurements. Process sensors and instruments of various facilities of IGCAR are now calibrated in-house.

(G. Muralikrishna and A.R. Saroja)

Report on Quality Circles

The Quality Circles movement has organized its annual function in Madras Atomic Power Station (MAPS), Kalpakkam on 24th July 2003 and Shri. T. S. Rajendran, Station Director, MAPS inaugurated the function. Invited lectures from prominent persons of QC, TQM & Quality Circles of M/s. SRF Limited, Manali, Chennai were the highlights of the day. This was followed by case study presentations from Quality Circles of MAPS, DPS, IGCAR & M/s. SRF, Manali, Chennai. On this occasion, the *"SAMURAI"* Quality Circle from CWS has presented a case study on increased safety on the EOT crane at Central Work shop of IGCAR. Mementoes were distributed by Shri. S. Krishnamurthy, Chief Supdt, MAPS.

In another development towards awareness of Quality Circles, lectures were organized on 20th August 2003 by Shri R. S. Raghavendran and Shri K. I. John to the staff and officers of *Quality Assurance and Testing Section* of IGCAR. During this function, a case Study demonstration was performed by the "SOURCE QUALITY CIRCLE" of Health Physics Unit of MAPS, which was appreciated by all. Shri K.I. John gave a talk at AECS-II before the members of the Prospective Steering Committee of AEC Schools in Kalpakkam on 11th September 2003.

Reported by K.I. John, Secretary, Steering Committee, QC, ESG)

HIGHLIGHTS OF SYMPOSIA/SEMINARS/CONFERENCES

Workshop on "Utilisation of Energetic Ion Beams for Materials Research" July 29-31, 2003

A three day Workshop on the *Utilisation of Energetic Ion Beams for Materials Research* was organized at Materials Science Division, IGCAR during July 29-31, 2003. Shri S. B. Bhoje, Director, IGCAR, who inaugurated the workshop emphasized the importance of accelerators for simulating radiation damage in reactor structural materials. Dr. Baldev Raj, Director, MCRG in his presidential address highlighted the importance of collaborative research. Prof. V. N. Bhoraskar, Director, IUC-DAEF in his keynote address spoke about various emerging areas of research in materials science using accelerators.

The main aim of the workshop sponsored by IUC-DAEF was to review the advances in the area of accelerator based materials research and to familiarize the participants from the universities with the accelerators and associated experimental facilities at MSD. The deliberations of the Workshop included talks by experts on different topics of accelerator based material science and discussions involving the speakers and the participants. Thirty Scientists from universities all over India participated in the workshop. Fourteen invited speakers from other institutions as well as from IGCAR gave talks on various topics including interaction of ion beams with solids, effect of implantation on semiconductors, radiation damage studies on fast reactor materials, surface modification using ion beams, ion beam synthesis of nano-clusters and ion beam analysis. There were also talks on techniques like RBS/channeling, secondary ion mass spectroscopy, low energy positron beams, X-ray reflectivity and optical techniques used for analyzing the ion irradiated samples. A panel discussion was also held for identifying thrust areas and to discuss the scope and the nature of collaborative research schemes to be taken up using the accelerator facilities under IUC-DAEF scheme.

(K.G. Muraleedharan Nair)

FORTHCOMING SYMPOSIA/SEMINARS/CONFERENCES

Seventeenth National Heat and Mass Transfer Conference and Sixth ISHMT/ASME Heat Mass Transfer Conference

January –5-7, 2004

The above conference is planned under the auspicious of Indian Society for Heat and Mass Transfer in association with the American Society of Mechanical Engineers. This conference is held once in two years starting from 1971. Abstracts are invited on the subject of Heat & Mass Transfer including theory and applications. For more details visit the web site www.igcar.ernet.in/seminars/nhmtc.htm.

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Ground breaking function for the commencement of excavation work on Nuclear island of PFBR on 18th August 2003.
Dr. Anil Kakodkar, Chairman, AEC & Secretary, DAE, Dr. B. Bhattacharjee, Director, BARC, Shri S.B. Bhoje, Director, IGCAR and Heads of other DAE units participated in the function.

Dr. Anil Kakodkar, Chairman, AEC & Secretary, DAE inaugurating the 1.7 MV Tandetron accelerator facility at MSD on 18th August 2003.
Apart from basic research, the accelerator has a well organised programme on radiation damage studies of fast reactor core structural materials.

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