स्थापना दिवस
Foundation Day

अप्रैल / April 30, 2019

इंदिरा गाँधी परमाणु अनुसंधान केंद्र के संस्मरण
Memoirs of
Indira Gandhi Centre for Atomic Research

सत्यमेव जयते

भारत सरकार / Government of India
परमाणु ऊर्जा विभाग / Department of Atomic Energy
इंदिरा गाँधी परमाणु अनुसंधान केंद्र / Indira Gandhi Centre for Atomic Research
कल्पाक्कम / Kalpakkam - 603 102
तमिलनाडु, भारत / Tamil Nadu, India

1971

April 30 : Organisational Setup for Reactor Research Centre (RRC) at Kalpakkam.

September 30 : Administrative Approval and Financial Sanction Orders by Dr. Vikram Sarabhai

ORGANISATIONAL SET UP FOR THE REACTOR RESEARCH CENTRE
NEAR KALPAKKAM

In order to plan and execute the facilities at the Reactor Research Centre near Kalpakkam, a Planning & Implementation Committee has been set up for a period of three years. During this period the programme and broad policies drawn up by the Planning and Implementation Committee will be approved by a Policy Committee.

(this committee will function within the BARC.)

The constitution of the above Committee, their terms of reference etc. are given in Annexure.

Government of India
Department of Atomic Energy

DAE(M)/3(14)/71

Madras-6,
September 30 1971

OFFICE MEMORANDUM

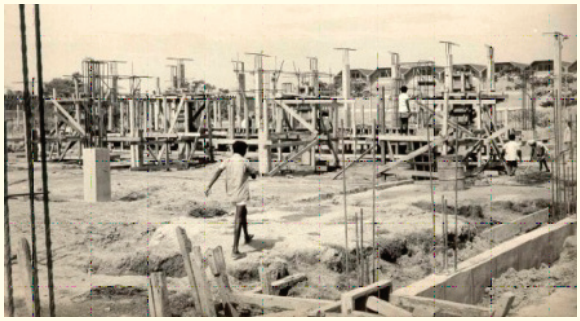
Sub: Setting up of a Fast Breeder Test Reactor at the Reactor Research Centre near Kalpakkam

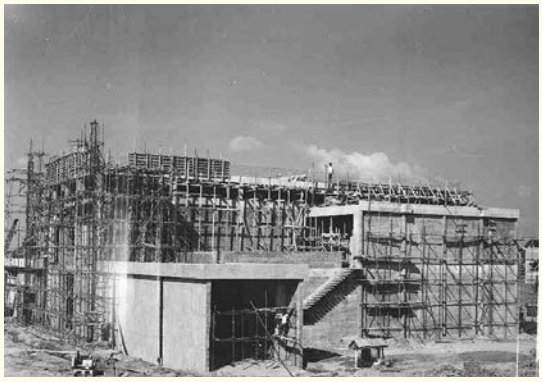
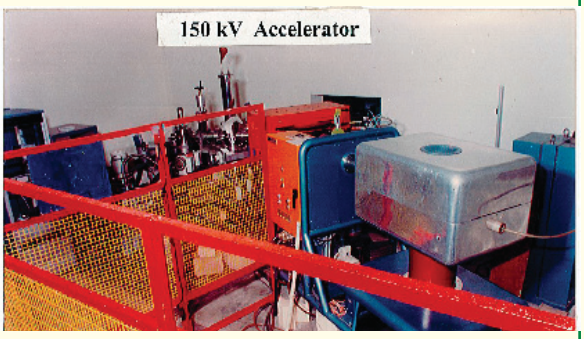
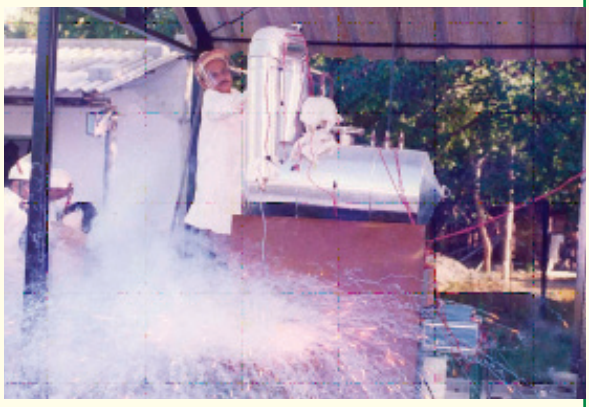
The undersigned is directed to convey the administrative approval and financial sanction of the President to the setting up of a Fast Breeder Test Reactor at the Reactor Research Centre near Kalpakkam at

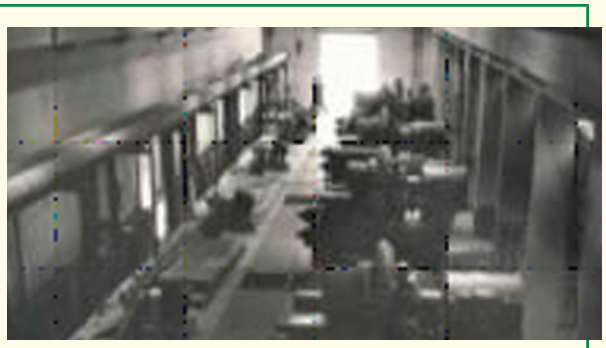
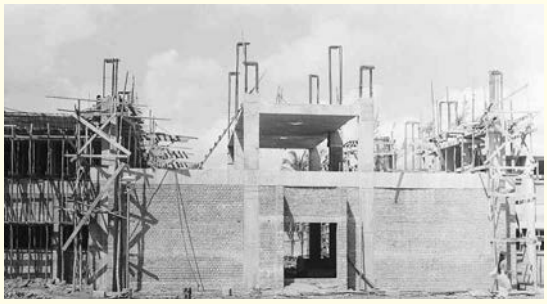
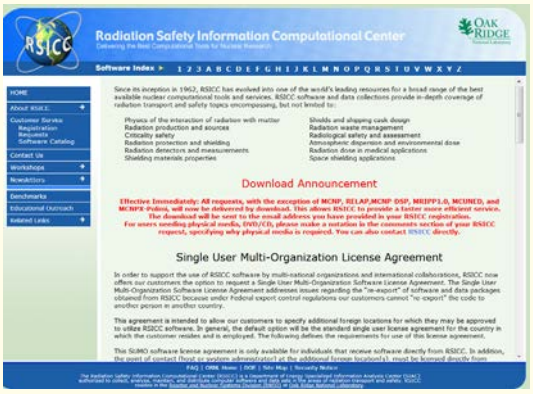
(Administration and Accounts established. Budget coordination and monitoring started.)

1972	
Rock Breaking at Fast Breeder Test Reactor construction site	
Construction of Fast Reactor Fuel Reprocessing Development Laboratory (FRDL) for development of reprocessing technology encompassing process, process chemistry, equipments, remote & hotcell systems for closing the fuel cycle for fast reactors.	
Library was established with about 1500 books, and 5000 Technical Reports.	
1973	
Construction of Central Design Office (CDO)	
Construction of Central Workshop	

1974	
Initiation of R&D programs of Material Sciences and Instrumentation.	
Establishment of Metallurgy program to support various materials related causes and cater to all the material engineering and technology related R&D needs of Indian FBR program.	
1975	
Completion of civil construction of FRDL	
Construction of Central Water Chilling Plant	
Established Central Workshop	
1976	
Commissioning of engineering test facility & inactive analytical labs of FRDL with associated ventilation and utility systems	 ctive analytical laboratory under construction at FRDL

500 kW Sodium Test Facility commissioned with 3 t sodium.	
Establishment of Safety Research Laboratory (SRL)	
Construction of Radiochemistry Laboratory (RCL) commenced	
Materials Science Laboratory established to provide R&D support on Materials for FBR program	
1977	
First actinide compound studied under pressure in a Diamond Anvil Cell in the world.	
Construction of Radio Metallurgy Laboratory	

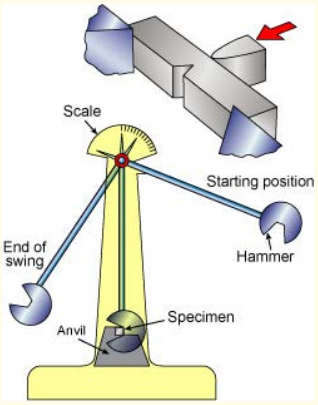
Fabrication and erection of 450 mm dia underground chilled water lines from CWCP to various facilities of IGCAR during 1977.	
Construction of induced draft 3840 TR Cooling Towers for central water chilling plant during 1977.	
1978	
Radiochemistry laboratory became partially operational (inactive facilities)	
150 kV Accelerator Commissioned	
Sodium Fire study initiated to understand the chemistry of sodium burning.	

Central Water Chilling Plant (CWCP) established with 4 nos. of 500 TR, HS 17- R11 Centrifugal Chillers to meet air-conditioning and ventilation requirements of FBTR, RML, RDL and RCL	
Construction of Materials Development Laboratory	
1980	
FBTR Control Rod Drive Mechanism tested in Engg. Hall-I for its qualification.	
Development of radiation transport code ASFIT at SRL and is listed in Radiation Shielding Information (RSIC) in ORNL, USA.	
Metal Forming Lab in MDL with the setting up of 100 Kg vacuum induction melting unit, hot rolling and in-house designed hot torsion facilities	

1981

Constitution of PFBR Working Group (PFBR-WG) for preparation of feasibility report for PFBR with Shri. N. L. Char as chairman

Using Instrumented Charpy Impact tester at MDL. The rise in the ductile to brittle transit in temperature of the service exposed end shield material (3.5 Ni steel) of RAPS was carried out.



1982

Computer centre and Electronics Instrumentation Laboratory established

Establishment of Radiological and Biological Dosimetry with a single arm chair for whole body counting. A pre war steel room was commissioned to reduce the background radiation and lung monitoring was carried out for radiation workers.

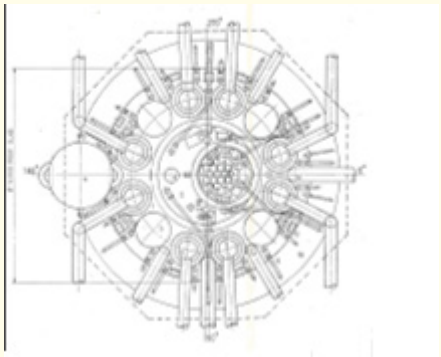
Establishment of Health Physics services at FBTR and in other radioactive facilities.

Book Information Retrieval Database System, the first online catalogue was made available over the Time Sharing System

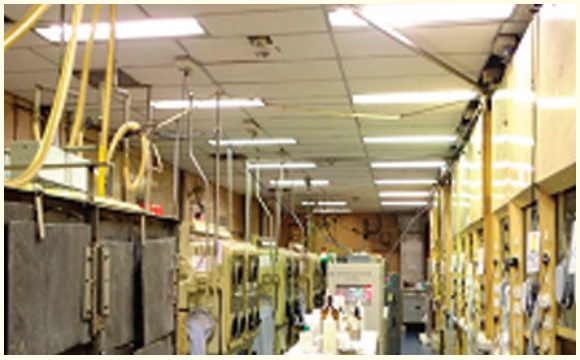
The DPS-8, a proprietary system from Honeywell Bull commissioned with main memory of 4 Mega Bytes, eight hard disc units of 200 MB capacity, 4 Magnetic tape units, 2 Card readers, 2 Line printers and a Plotter.

1983

Conceptual design of PFBR based on four loop concept proposed by Working Group.

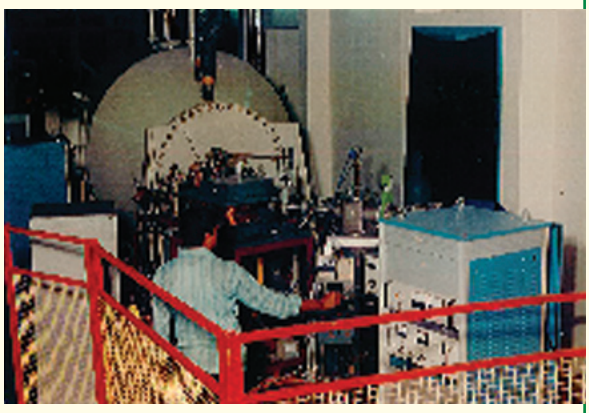


Regulatory clearance obtained for the commissioning and operation of active analytical laboratory of FRDL, one among the first such facilities to be licensed for handling radioactive material in the Centre.



The first facility for handling aqueous solutions containing Pu established. Studies on the chemistry of reprocessing of fast reactor fuels were initiated.

Commissioning of an in-house developed 2 MV tandem Accelerator, various ion beam analytical studies using PIXE, RBS and NRA.



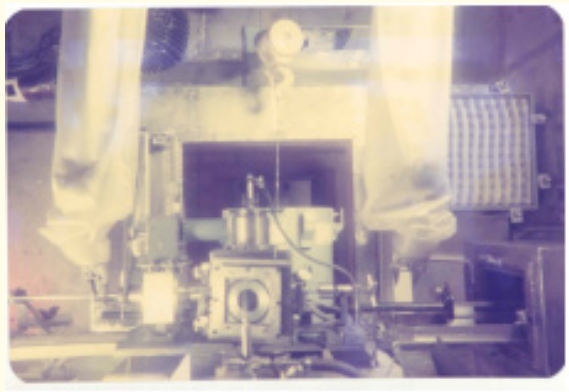
Central Data Processing System Installed at FBTR executed programs for core temperature discordance and general supervision. In addition, it performed startup check and finite impulse test

1984

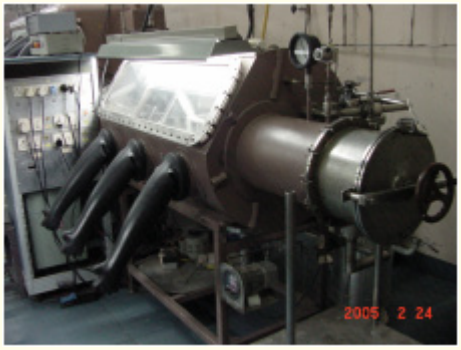
Sodium Purification facility, first in the country was commissioned in Hall-I for purifying 150 t of FBTR sodium. The purified sodium was then transported to FBTR from Hall-I.

First Criticality of FBTR on October 18, 1985 at 22:02 Hrs

The first campaign of handling radioactive material in RML hot cells was the remote welding of pin containing irradiated Antimony Oxide pellets. This component was a part of the auxiliary photo-neutron source required for the startup of FBTR to achieve first criticality.

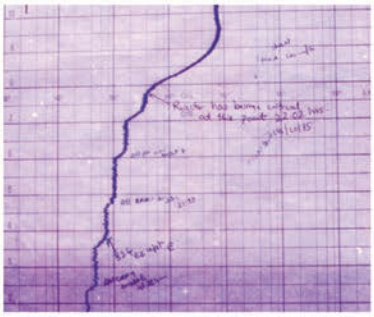


First of its kind sodium handling facility in the country established, with Special glove boxes for handling alkali metals .Na-K coolant was prepared in large quantities in glove box for use in FBTR in the cold trap section



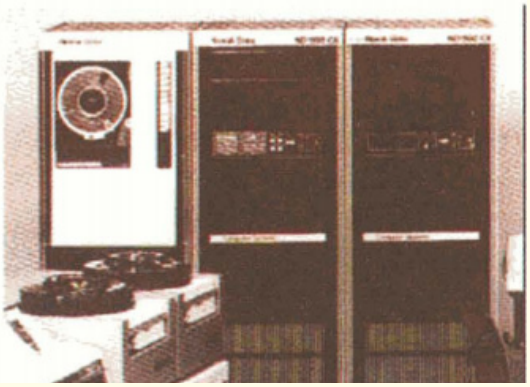

All eyes on Kalpakkam


FBTR goes critical

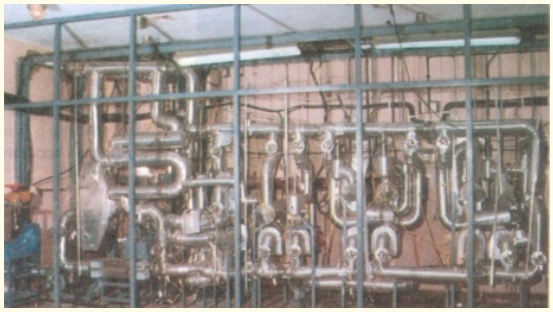


Development of the high pressure-high temperature cell for materials synthesis and electrical resistivity measurement up to 10 GPa and 1300 K.`


High presssure high temperature resistivity apparatus (circa 1985)

Ultrasonic velocity measurement using pulse echo technique instrument Installed for RML	
The first in-house melting of 100 kg of Alloy D9(15Ni-15Cr alloy), the clad tube and hex can material for PFBR carried out at MDL using vacuum induction melting. This initial melt served as the feedstock for all testing, characterization and property evaluation studies carried out in MDL leading to selection Alloy D(as the core structural material for PFBR.	
1986	
Publication of first IGC News letter highlighting significant scientific works being carried out by researchers and recording the important technical events.	
1987	
Temperature Scanner and Data acquisition for HWP Kota installed; Guide tube profiling Instrument delivered for FBTR; Norsk Data ND560 system with 2.2 MIPS and graphics terminals was commissioned	
Facility for reprocessing of Thorium fuel (J-Rod of CIRUS reactor) was established. This facility served as a hot test bed for validating critical process and hot cell equipments developed for fast reactor fuel reprocessing.	

Radioactive Sodium Chemistry Loop (RASCL) designed, built and commissioned to test long term performance of electrochemical on-line monitors for hydrogen, oxygen and carbon impurities in sodium & transport of radionuclides in liquid sodium.



1988

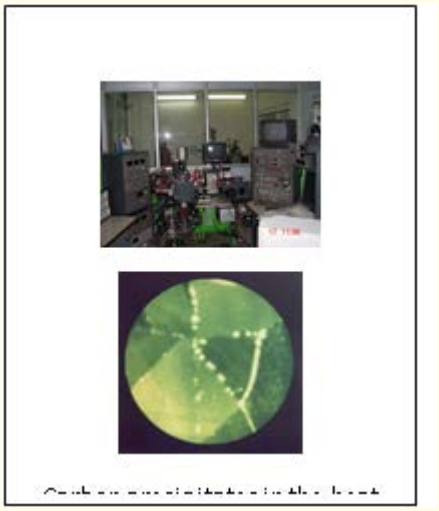
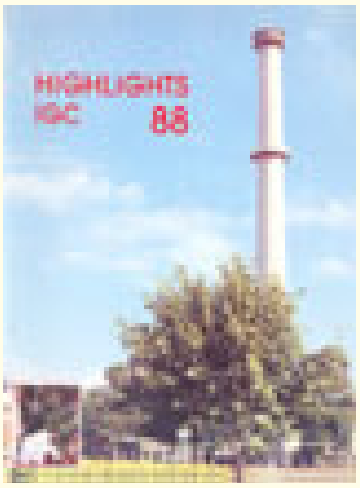
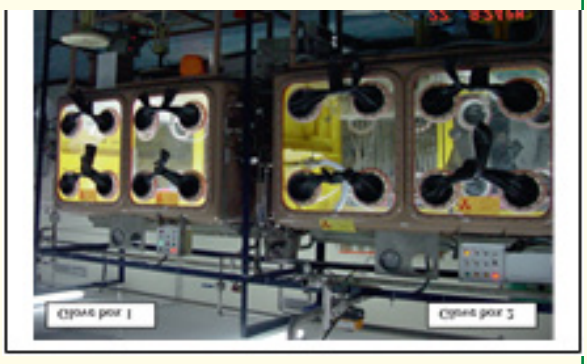
Hydrogen in Argon Detection (HAD) Electronics delivered to FBTR; Colour graphics system for MAPS installed;Generator Slot Temperature Monitoring System for MAPS Installed

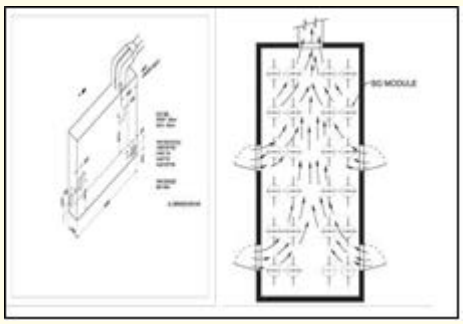
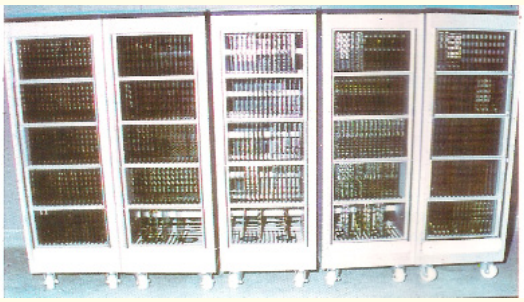
1989

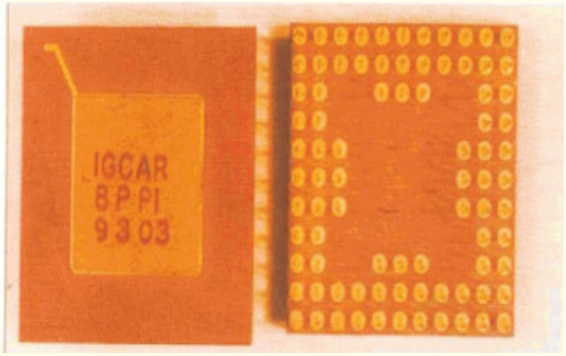
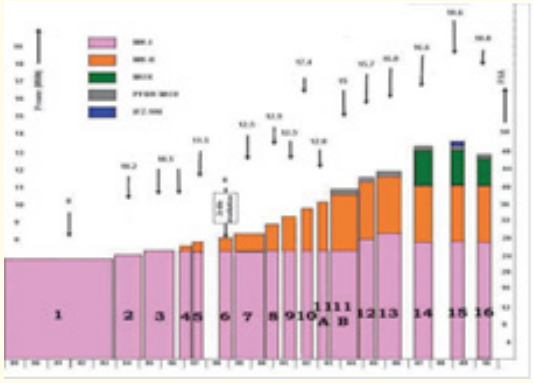
First J-rod reprocessing campaign successfully completed and the recovered Uranium-233 used as driver fuel for KAMINI reactor.

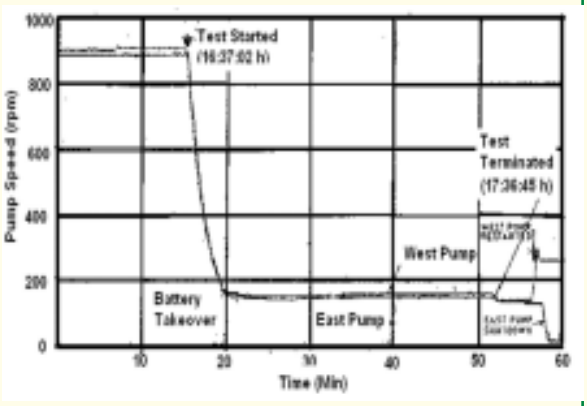
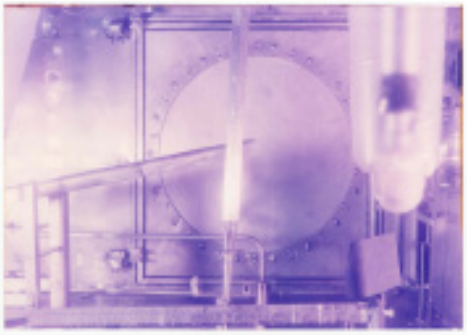
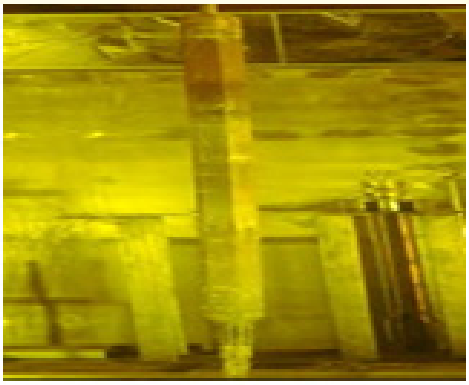
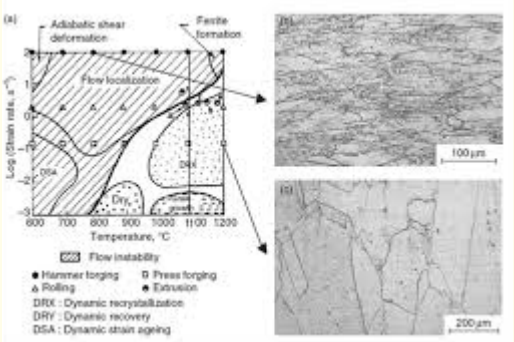
Engineering Hall III completed

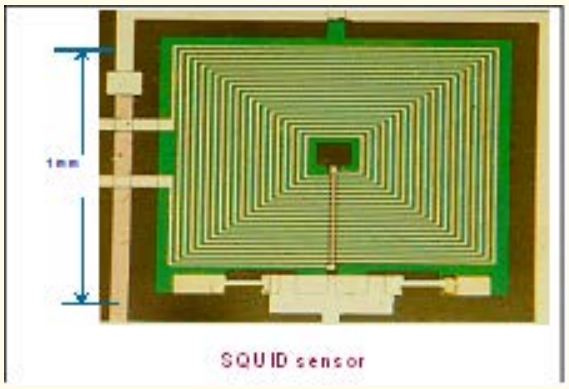
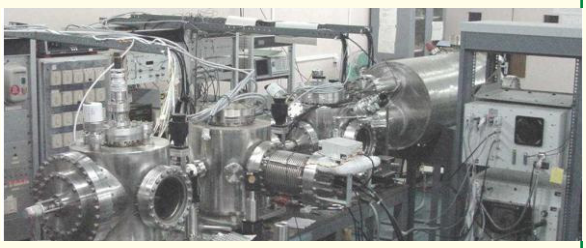
HALL-3 building of FRTG

Installation of Secondary Ion Mass Spectrometer for high resolution surface analysis	
Completion of design of all major components and submission of the Detailed Project Report of PFBR to DAE	
First IGC highlights recording important events, milestones, research and development activities of IGCAR.	
1990	
Process Information System for RAPS, HWP Kakrapar Installed; Displacement Measuring Device (DMD) commissioned at FBTR	
Normal Paraffin Hydrocarbons an import substitute for n-dodecane was developed successfully. The know-how was transferred technologically. Macroporous bi-functional phosphinic and ion exchange based resins were also developed.	

Comprehensive safety criteria for PFBR design was evolved by IGCAR design team with the input from BARC, NPC and issued by AERB	
Barcode and RDBMS for Books Circulation System in library were introduced. CD-ROM Databases were introduced.	
1991	
IGCAR feeder-2 at MAPS 25 MVA, 230 / 33 kV transformer was commissioned to feed power supply to IGCAR loads through overhead line. This feeder replaced TNEB feeder.	
Reactor power increased to 1 MWth	
1992	
SCADA unit commissioned for HWP Manuguru and Tuticorin	

Industrial and Fire Safety Training launched	
1993	
Indigenous PPI 8255 ASIC fabricated for first time in DAE as an indigenous substitute for imported IC from Intel	
Establishment of Particle Irradiation Facility (PIF): Facilities of PIF were opened to university students under UGC-DAE scheme.	
FBTR raised to full power (10.5 MWt) for Mark I core	
Commissioning and Post Irradiation Examination (PIE) of fuel pin from MAPS was carried out.	
1994	
First Aid Training by St John Ambulance initiated.	

Safety related engineering tests completed in FBTR.	
Experimental fuel pins assembled in Irradiation Capsules in hot cell of RML. These were subsequently irradiated in the 5th ring of FBTR core for different equivalent full power days (EFPD) ranging from 16 to 100 to study the evolution of the fuel structure, swelling and cracking behaviour.	
RML Hot cell facility with inert gas recirculation system successfully commissioned and irradiated sub-assembly with 25,000 MWte burnup release from FBTR for Post Irradiation Examination.	
The first major processing map for the SS304 material generated from the metal forming lab	
1995	
Synchro sensor based diverse measurement electronics was indigenously developed and deployed to display the absolute co-ordinates of the Charge/discharge Flask for FBTR	

First superconducting device fabrication Laboratory in India established Josephson junctions & SQUID sensors fabricated.	
Indigenously developed variable low energy positron beam setup (VLEPB).	
READIT biennial series conference initiated.	
Laser Mass spectrometer system (LIV-MS) indigenously developed. Measurement of vapour pressures of UO2, UC, ThO2 and graphite at 3000-6000 K using LIV MS & MALDI successfully carried out.	
Development of MAO Bell cell at MSL	
1996	
Commissioning of Silicon Graphics Power Challenge Server and Indy/Indigo Workstations based on MIPS RISC processors with aggregated performance of 600 MFLOPS	
Sodium Ionization Detector (SID) successfully developed and deployed for deduction of sodium fire in case of any leak.	

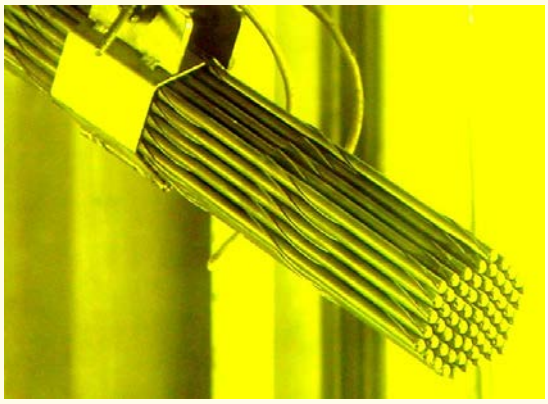
KAMINI reactor attained criticality Octobe 29, 1996

Precision Nuclear clean assembly shop set up to manufacture Spare CRDMs for FBTR

1997

Commencement of Construction of Lead Mini Cell (LMC), a unique, first of its kind facility for validation of fast reactor fuel reprocessing technology. This facility was renamed as CORAL (COmpact facility for Reprocessing of Advanced fuels in Lead cells).

Post Irradiation Examination of FBTR Mark I mixed carbide fuel sub-assembly after attaining 25 GWd/t burnup successfully under taken.



KAMINI reactor reaches rated power of 30 kWth

Turbine Generator of FBTR successfully synchronized to southern grid.

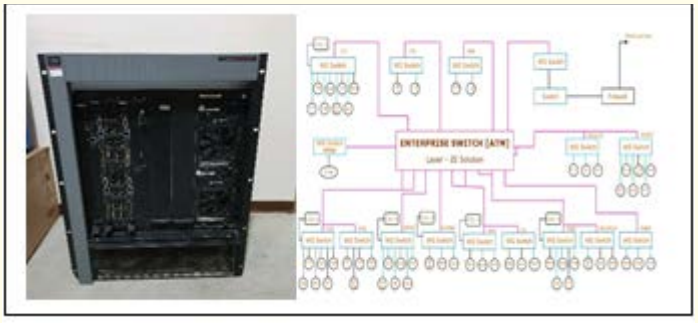
1998

Two tone uni-axial electrodynamics slip table installed and commissioned at SML to study the vibrational characteristics of FBR components using scaled down models.

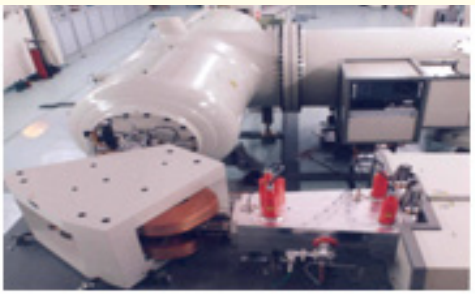
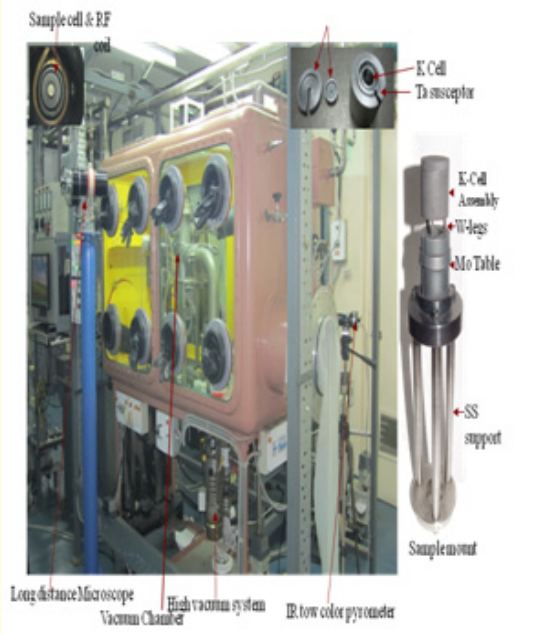
Qualification of hydrostatic bearing at 2t slip table

1999

Commissioning of ATM based 155Mbps bandwidth campus network with composite optical fibre cable of single mode and multi-mode first time in DAE.

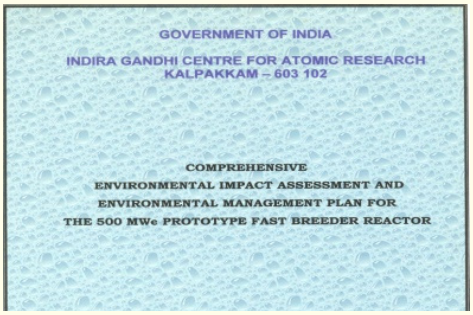


Centrifugal Sodium pumps for PFBR were developed using scaled down models tested at FRTG. The hydraulic characteristics as well as design parameters were optimized based on these tests.

Irradiation Experiments designed and carried out in FBTR to determine the in-reactor creep behavior of indigenously developed zirconium alloys (Zircaloy 2 and Zr 2.5%Nb alloy).	
2nd campaign for the reprocessing of irradiated J-rod fuel was completed and the recovered Uranium-233 used for testing PFBR MOX fuel composition in FBTR.	
Concrete pouring integrity of Kaiga Inner Containment dome was evaluated by radiometry technique by HASL	
2000	
1.7 MV Tandetron accelerator for Radiation damage in D9, D9I alloys and Ion beam synthesis of nanostructures,	
A first of its kind experimental facility for measuring melting transitions, based on the spot-technique of fuel materials established.	

Digital Library concept successfully introduced with access to Digital contents like Bibliographic databases, full text standards, Journals provided on intranet. Web OPAC services introduced.

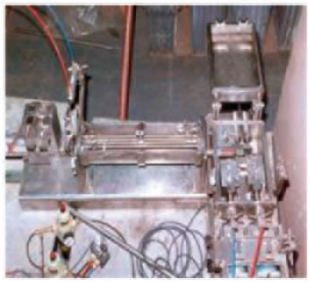
A rapid Environmental Impact Assessment report prepared for PFBR with extensive site specific data.



The public hearing organized for PFBR at Kanchipuram collectorat, the first to be conducted in DAE and clearance obtained for the project.

Civil construction of SGTF facilities completed

2001



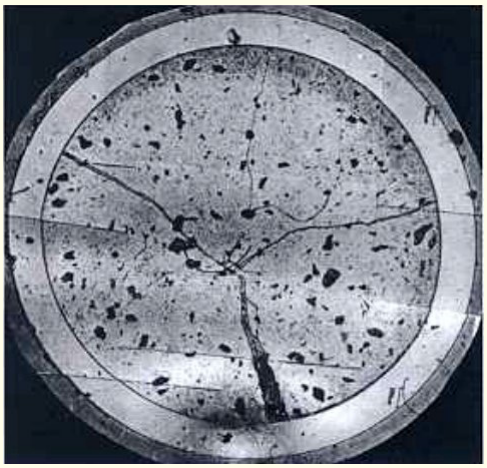
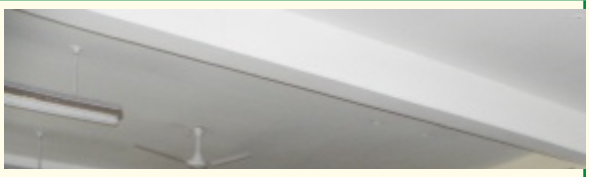
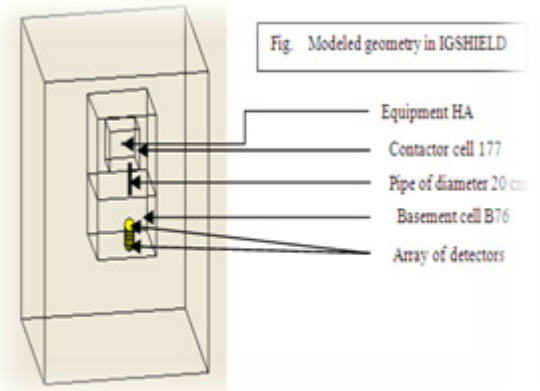
Single pin chopper with microprocessor based controller amenable for remote operation and maintenance

Electrolytic Titanium dissolver for Pu rich spent fuel dissolution in high acid conditions

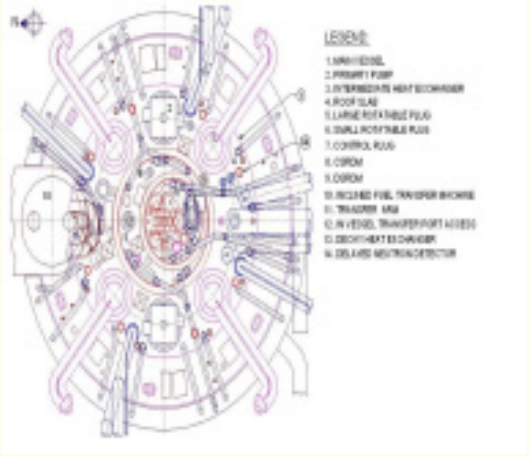
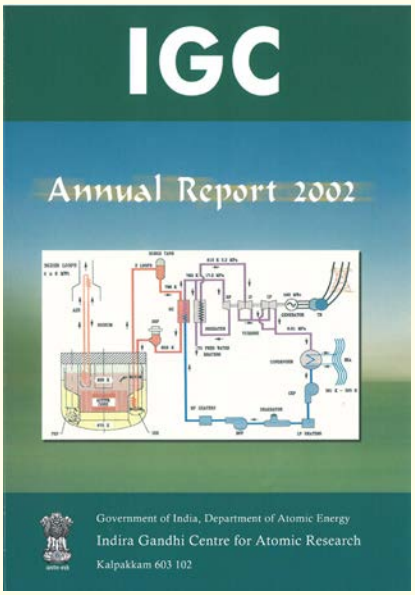
High speed centrifuge for feed clarification for separation of insolubles upto 0.5 microns size

Centrifugal extractors with short residence time to minimize solvent damage

Successful development and completion of mock trials of unique & first of its kind equipments for FBTR fuel reprocessing such as single pin chopper, Electrolytic dissolver, high speed centrifuge, centrifugal extractors, special stainless steel incell crane, alpha tight fuel handling system etc.

Large Component 80 t Sodium Test Facility (LCTR) constructed for full scale testing of select critical components of PFBR in sodium under simulated reactor conditions.	
Metallography as part of PIE of FBTR Mark I mixed carbide fuel subassembly with a burnup of 50 GWd/t under taken. PIE data generated enabled the extension of burn-up to 100 GWd/t.	
11 kV sub-stations NCSS-1 to feed power supply to NRGPK facilities, PRP, NDDP and townships, commissioned	
Code IGSHIELD for gamma shielding design and analysis successfully developed. This code for radiation transport has been widely used in the shielding design of PFBR and other active facilities	
2002	
Construction of CORAL completed and towards its cold commissioning, uranium runs were completed with clearance from regulatory authority.	

Design and development of indigenous VME32 based Cards (photo), Switch Over Logic Card and Realtime Terminal Unit for PFBR; Design, Installation & Commissioning of I&C systems for SGTF	
11 kV substation for SGTF (PDC II) established to feed HV and LV power supply to SGTF facility and gets power supply from CSS. PDC-I, PDC-II and CSS forms a 11 kV ring.	
In Sodium Test Facility (INSOT)to study the mechanical properties such as fatigue and creep -fatigue interaction of PFBR component materials under the influence of flowing sodium.	
Occupational Health Centre to provide Medical assistance for occupational injury/illness. Periodic Medical Examination (PME) for occupational workers initiated.	
FBTR Power raised to 17.4 MWt at design LHR of 400 W/cm. Fuel reaches burn up of 100 GWd/t	
Commissioning and dedication of Central Air-Conditioning plant of 3 x 80 TR capacity horizontal twin screw chillers at Radio Chemistry Lab.	
Commissioning and dedication of Central Air-Conditioning plant of 2 x 112 TR capacity vertical twin screw chillers at Condensed Matter Physics Laboratory(CMPL).	

Detailed Project Report for two loop design of PFBR submitted	
Experimental facility for the predicting fatigue crack growth and to demonstrate LBB in large diameter pipe bends to rule out Double Ended Guillotine Break (DEGB) in sodium piping. A postulated initial crack has been created in the bend and its growth is monitored. The cycling load on pipe bend is simulated through actuators.	 LBB demonstration in large pipe bends
Technology Development of Critical and Over Dimensional Components such as main vessel, inner vessel, roof slab and grid plate for PFBR successfully completed.	
IGC Highlights renamed as IGC Annual Reports	

2003	
Regulatory clearance for the Hot Commissioning of CORAL obtained and successfully completed reprocessing of low burn up fuel.	 First batch of spent fuel pins being charged into CORAL facility
PFBR Nuclear Island design Completed and regulatory clearance for first pour of concrete. Construction of Site Assembly Shop for PFBR	 Site Assembly Shop
Accord of administrative approval and financial sanction for PFBR by Government of India leading to formation of a company called BHAVINI Government of India accorded administrative approval and financial sanction in September 2003. Since then, continuous design support is being provided by Design Group to BHAVINI for successful manufacture, construction, component erection and commissioning of PFBR	
Experimental demonstration of structural integrity of PFBR reactor assembly for core disruptive accident at TBRL, Chandigarh under taken through a series of experiments.	 TRIG-III series tests at TBRL (after test)
Installation and commissioning of creep fatigue interaction test facility at SML.	
Library got renamed as Scientific Information Resource Division	

2004

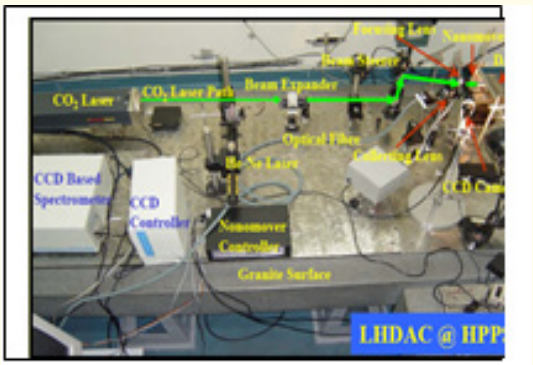
Site and excavation clearance for PFBR and first pour of concrete on October 19, 2004

Phased clearance obtained from regulatory authority for processing spent fuel with progressively increased burnup and accordingly the reprocessing of fuel with burnup 25,000 MWd/T and 50,000 MWd/T was completed successfully in CORAL. With these campaigns, all the initial challenges were resolved and the process was fine tuned, establishing the process parameters.

Establishment of Cluster LINUX HPC computing facility developed in MSG for computation of ground state properties of materials. It is mainly used for density functional theory based first principles calculations of defects and solute formation and migration energies, molecular dynamics studies of radiation cascades, Lattice kinetic Monte Carlo studies in ODS alloys and first principles cluster expansion technique for alloy phase diagram calculations.

Positron density calculations: 215 atom relaxed supercell of TiC–Vc

Open air sodium fire studies carried out with 40 kg sodium in pool fire configuration at HASL.

10 ton multi axial shake table: Installated and commissioned at SML. This system was one among the unique facilities available in the country during that time and was used for seismic qualification of most of the safety related components of PFBR and PHWR	 R&D Studies in piping using 10 t shake table
2005	
Development of Hardware based safety system such as Pulse Coded Safety Logic (PCSL),Safety Logic with Finite Impulse Test (SLFIT), Reactor Inlet Temperature Monitoring System (RITMS), Primary Pump Speed measurement System (PSPSMS), Central Subassembly Temperature Monitoring System (CSATMS), Eddy Current Flow Measurement System (ECFMS), Relay based damper control for PFBR. Commissioning of Safety Logic with FIT(SAFIT) for FBTR.	
Development of Laser Heated Diamond Anvil Cell facility for synthesis of novel materials.	
Aerosol Test Facility was commissioned to carry out physical and chemical characterisation of sodium and fission product aerosols. Study was carried out in collaboration with CEA, France for sodium aerosol carbonation.	

- Pre-Project sanction from Atomic Energy Commission obtained for Fast Reactor Fuel Cycle Facility (FRFCF)
- Pre-Project activities like siting, preparation of preliminary project report, conceptual designs and estimate completed.

- Safety clearance obtained for processing of 100 GWd/t irradiated FBTR fuel and campaign completed successfully.

- Dedication of 550 TR Energy Efficient, Eco-friendly Centrifugal Chiller unit No.6

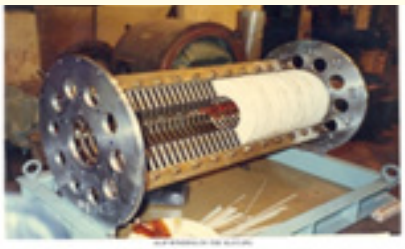
2006

Unipower-30 was replaced with VME32 Based CPU and I/O cards for CDPS, FBTR

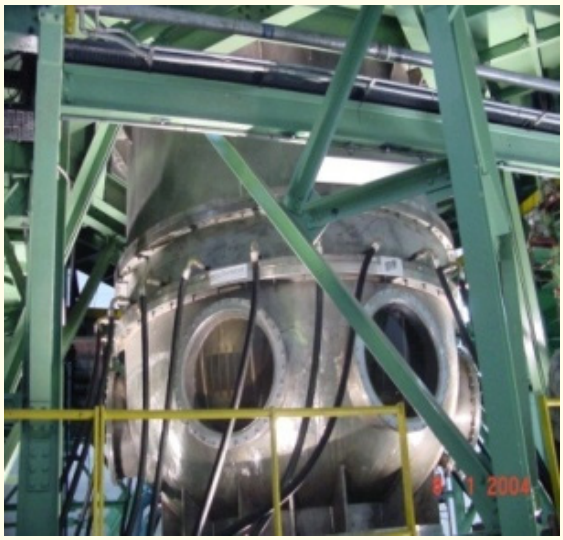
Regulatory consent for siting the FRFCF facility from Atomic Energy Regulatory Board (AERB) obtained.

View of FRFCF site prior to construction

Annular Linear Induction Pump (ALIP) designed, developed and tested in sodium loop.



1/4th scale model of PFBR primary circuit (SAMRAT) completed. Various thermal hydraulics and flow induced vibration phenomena related to PFBR was investigated in this facility using water as working fluid.



For the first time, reprocessing of spent fuel with burnup as high as 1,55,000 MWd/T was successfully carried out at CORAL with maximum recovery, meeting the product purity and decontamination factors even with respect to troublesome fission products (Zirconium, Ruthenium) in single cycle of solvent extraction.
Commencement of equipment installation and piping for Demonstration fast reactor Fuel Reprocessing Plant (DFRP) for regular reprocessing of FBTR fuel and demonstration for PFBR fuel. Installation of several first of its kind equipments, complex piping systems, ACVE & utility systems, electrical and I&C systems were commenced

Fuel transfer system at DFRP

FBTR Mark-I, Mark-II and MOX fuel pin chopper at DFRP

DFRP Sampling Robot

DFRP incell piping

Novel fast separation procedures were developed using HPLC and SFE. Burn-up of FBTR and PHWR spent fuels were carried out for the fist time using HPLC.
A supercritical carbon-dioxide extraction facility in glove box was set-up to successfully demonstrate recovery of actinides from waste matrices.

Burn up reaches the limit of 155 GWd/t for Mark I fuel - MOX fuel loaded

RFID based Integrated Library Management System introduced. This enables patrons self-check-out/check-in, high-speed inventory, surveillance gate, identification of misplaced books, etc.
.

BARC Training School at IGCAR Campus started functioning from September, 2006

Ratcheting test facility at SML commissioned.

2007

Boron enrichment plant designed and commissioned to produce 65% 10 B enriched boron required for PFBR control rods. Ion exchange chromatography process has been developed and successfully employed. The technical know – how was transferred to HWB to produce 10 B on industrial mode.

Regular reprocessing campaigns of FBTR spent fuel with varying burnup carried out in CORAL.

- Grid plate fluence measurement
- DND experiments completed

East DND line connect to detector pit

- Orientation for first batch of Engineering Graduates (Mechanical, Chemical and Electronics and Instrumentation) commenced. First twenty TSO's from IGCAR Training School successfully completed their training and graduated in Sep, 2007. Distinguished Academician, Prof. J.B.Joshi, the then Director, UDCT, Mumbai was the Chief Guest for the function and Dr. Anil Kakodkar, the then Chairman, AEC & Secretary, DAE presided over the occasion.
- Induction of first batch of Research Scholars under HBNI-IGCAR

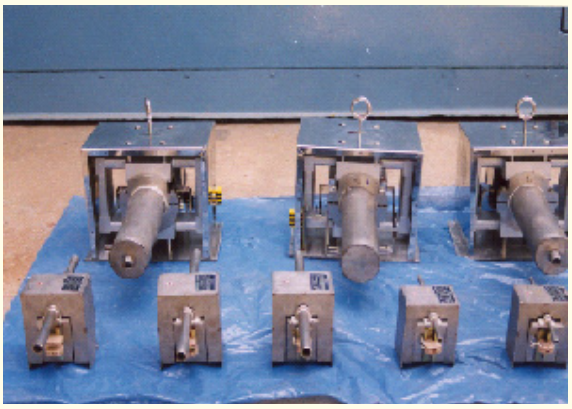
First Graduation function

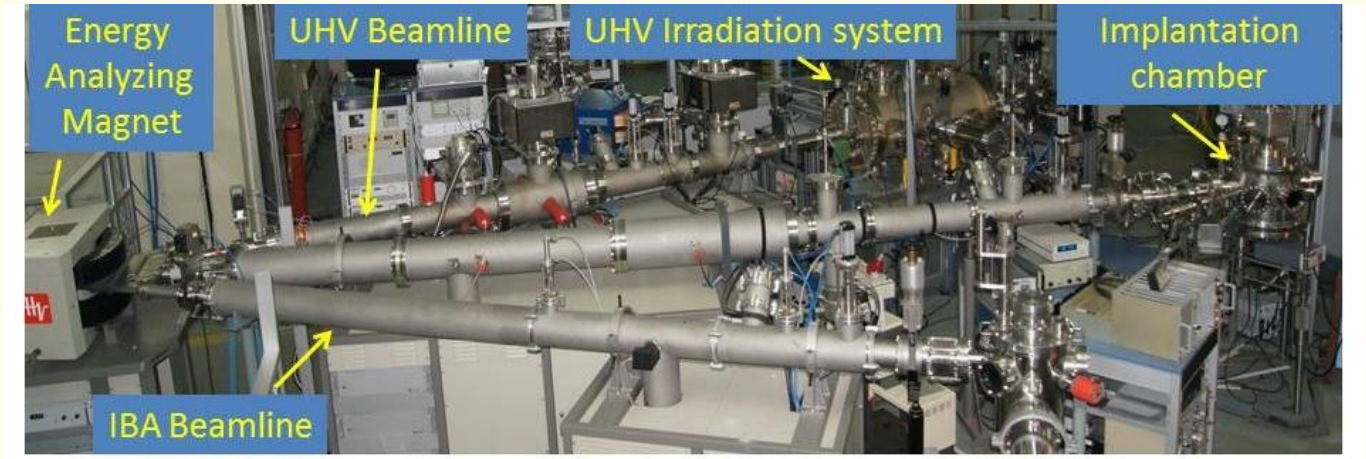
Desktop design of In-house Publications & Prepress activities initiated.

Orientation Programme on Nuclear Fuel Cycle Chemistry and Nuclear Reactor Physics for TSO's commenced

Electrochemical hydrogen meter (ECHM) for detecting hydrogen in liquid sodium developed and installed in FBTR, as well as in Phenix reactor and in SUPERFENNEC sodium loop in Cadarache, France as part of IGCAR-CEA collaboration on fast reactor safety.

Various flow sensors viz. Permanent Magnet flow meters, Eddy Current Flow Meter, etc were developed, calibrated and standardized at FRTG to cater the needs of PFBR as well as in house sodium loops.



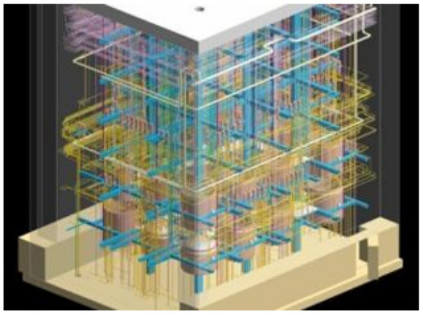


Installation of the UHV irradiation end stations, setting up of state-of-the-art UHV ion irradiation facilities.

Knudsen effusion mass spectrometry (KEMS) system indigenously developed. This system is for measuring vapour pressures of nuclear fuel materials.

Series of field dispersion experiments for dispersion model validation were conducted within the site at Kalpakkam by releasing a tracer gas (SF6) and sampling them by automatic air samplers.

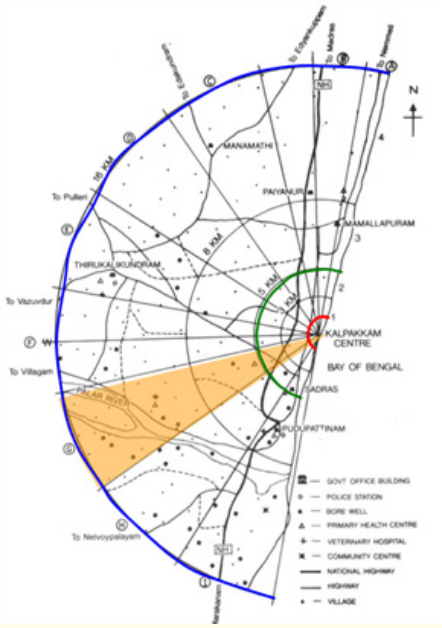
Modification of SG modules for raising sodium temperature	
Technical clearance for safety vessel erection and upper lateral shield construction was obtained.	
2009	
The clearance for erection of major equipment was obtained from AERB	
Once-through steam generator test facility commissioned.	

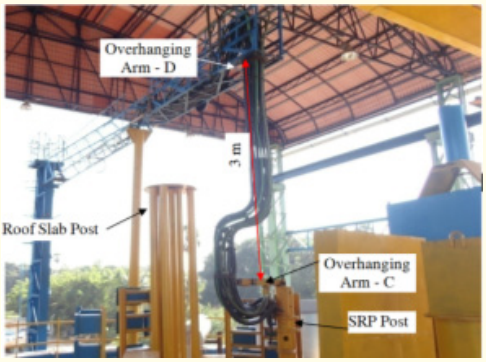

- Design and detail engineering of Fuel Reprocessing Plant (FRP) of Fast Reactor Fuel Cycle Facility (FRFCF), meant for commercial scale reprocessing of spent fuel from PFBR completed
- Independent service systems such as electrical systems (Class III and Class IV), compressed air, general use water etc were erected for DFRP.
- Regular reprocessing campaigns of FBTR spent fuel with varying burnup carried out in CORAL

Transfer of technology for the production enriched elemental boron to Heavy Water Board.

DSS for the first time developed indigenously at RSD. Successfully used for Off-site Emergency exercise at Kalpakkam.

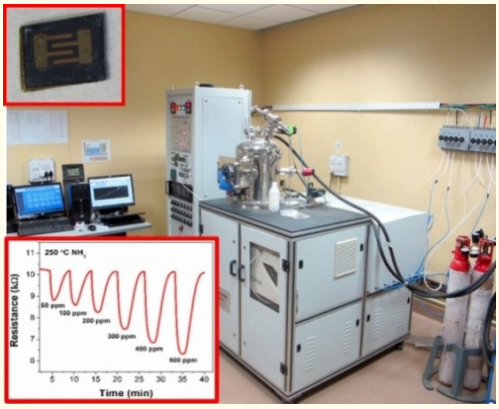
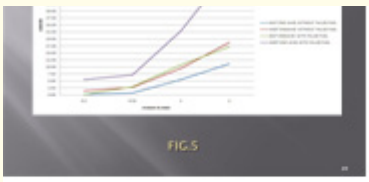


A 1:1 scale layout top shield model for PFBR commissioned. It geometrically simulates all the components that are located over top shield.



State-of-the-art 3D-Visualization and Walkthrough Facility Commissioned

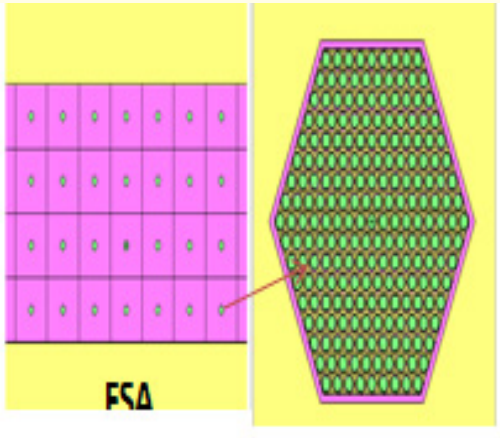
Helium leak testing of Main vessel of PFBR, BHAVINI Successfully accomplished by QAD.	
For the first time, Phased array ultrasonic testing of outer cell of steam generator at M/s L & T, under taken by QAD.	
Ultrasonic inspection of Rocket Motor Casing fabricated using DMR 1700 under taken at Walchandnagar	
2010	
Electronics for 16m Time Domain Electromagnetic System Completed and flight trial conducted using DHRUV helicopter.	
IFSB Building Constructed	

Exposure Facility for Gas Sensing and detecting various toxic gases in ambient set-up. Hazardous gases from ppm level down to ppb level can be detected in-situ.	
MCG system with 37 channels made operational. MEG system with 86 channels tested. Using this system, various research investigations have been carried out on both healthy volunteers and on patients with different cardiac dysfunctions from DAE hospital, Kalpakkam and JIPMER, Puducherry. These investigations are aimed towards highlighting the unique diagnostic information provided by MCG which is not readily observed in those of the conventional voltage based techniques like Electrocardiogram (ECG).	
An engineering scale facility established for pyrochemical processing of U (1 kg U per batch) and its alloys (U-Zr, sodium-bonded U-Zr, U-Gd-Zr). Automation, remote handling and handling of moisture sensitive salts were demonstrated.	
A Round Robin Exercise (RRE) involving 15 research institutes across the country for benchmarking flow field modelling successfully accomplished by RSD.	
Completion of PFBR fuel SA irradiation (up to target burn up of 112 GWd/t) • Management of first fuel clad failure • Closing of FBR fuel cycle (loading of fresh fuel SA with pins made up of Pu recycled from FBTR fuel SA	

• Technology Development for Main Vessel-Roof Slab Weld Joint Mock-up successfully accomplished.	
• As part of the technology development for PFBR 800 mm thick Narrow Gap Weld fabricated by L&T, Hazira, successfully inspected using Phased Array UT by QAD.	
2011	
Development of Distributed Digital Control System for PFBR	
Mini Sodium Fire Facility (MINA), Sodium CAbleFire Facility (SOCA) and Sodium Fire Experimental Facility (SFEF) established for experiments related to accidental leak of sodium at high temperatures.	

Testing and Qualification of inclined fuel transfer machine accomplished and qualified for reactor operation.

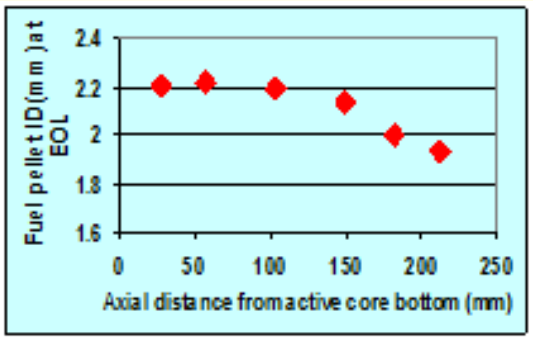
Shielding and criticality calculations for CORAL, DFRP and FRFCF under taken.



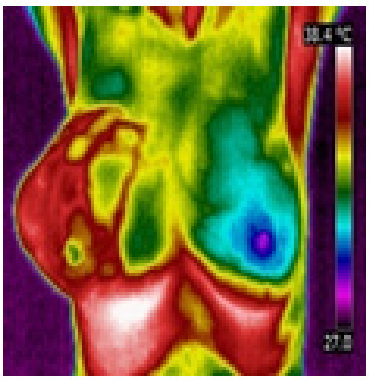
Test irradiation of sodium bonded natural U- Zr alloy at FBTR.

Top Shield Thermal Design Validation Facility setup.

Design, Test Irradiation and validation of PFBR MOX Fuel performance up to Target Burnup of 100 GWd/t accomplished.



Thermal imaging technique for early deduction of Breast cancer in collaboration with MMC.



Radiometric evaluation of PFBR Roof slab sector model, cooling box mock up, IFTB shielding rings carried out by RSD.

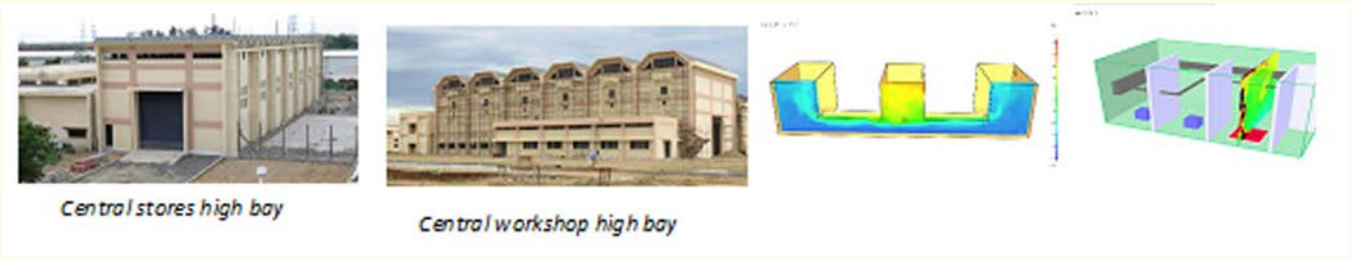
2012

Development of Fibre OpticSensor for Measuring Temperature & Sodium Leak

Construction of Civil R&D Building

Environmental impact studies conducted and completed and consent for FRFCF from the Ministry of Environment and Forest (MoEF) obtained.

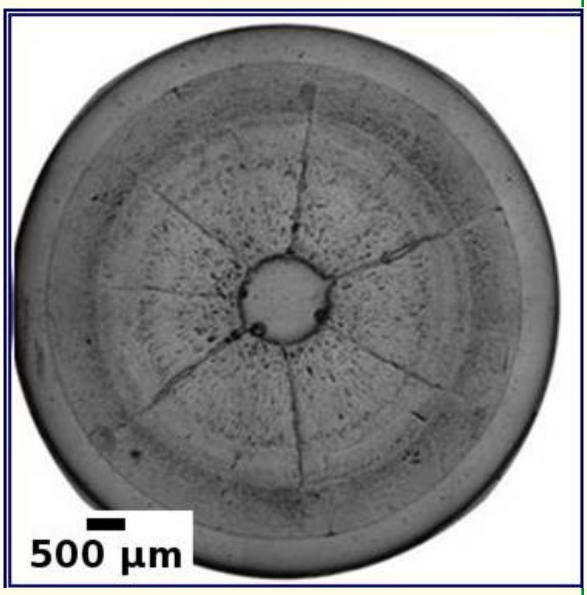
The Detailed Engineering design was completed and the engineering construction drawings of civil, mechanical, electrical and I&C systems were prepared. In order to ease the difficulties during construction of Fuel Reprocessing Plant (FRP) and Waste Management Plant (WMP), extensive 3D modeling of complex piping systems was completed.



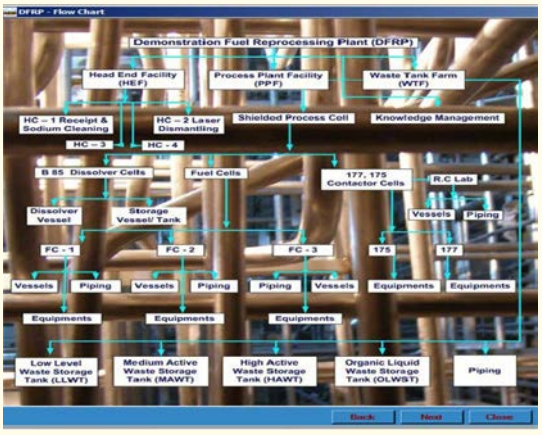
As part of infrastructure, civil construction of buildings for Central Workshop, Central Stores and Main Power Station, Approach Road and Construction Water Facility was completed.

Fire hazard analysis (FHA) for all plants of FRFCF was completed and AERB approval for the same was obtained.
Distribution in a glove box FFPFHA for diesel dyke of FRP-WTF

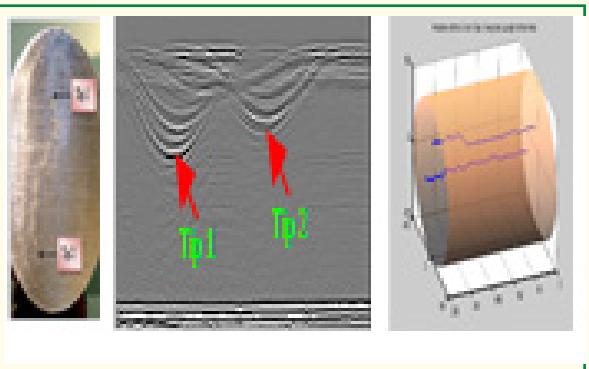
PIE of PFBR MOX test sub-assembly with a taget burn-up of 112 GWd/t successfully accomplished. The examinations have indicated that the MOX fuel can safely attain the desired target burn-up in PFBR.



Asset and Knowledge Management System (AsKMe)- Archiving more than 40,000 documents, records and drawings pertaining to Demonstration Fuel Reprocessing Plant



For first Time Of Flight Diffraction (TOFD) for Rounds object successfully accomplished.

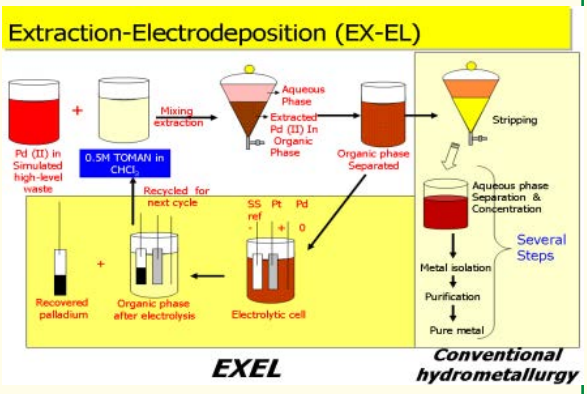


High Temperature Pin-on-Disc Tribometer for Materials Testing in Liquid Sodium Environment

To study the in-sodium friction and wear behavior of various reactor materials and coatings in flowing sodium, a high temperature pin-on-disc tribometer has been designed and developed in collaboration with an equipment manufacturer as per ASTM G99 standard. This tribometer has been successfully fabricated, installed and commissioned in a sodium loop at IGCAR in the year2012. Testing of various material combinations have been carried out in flowing sodium at 550°C using this set-up.

First of its kind demonstration of deployment of Room Temperature Ionic Liquids in Fuel Cycle

Room temperature ionic liquids for nuclear fuel cycle applications as diluent and electrolytic medium was established. Task specific ionic liquids for specific separations were also synthesized. Electrodeposition of uranium and lanthanides was demonstrated.

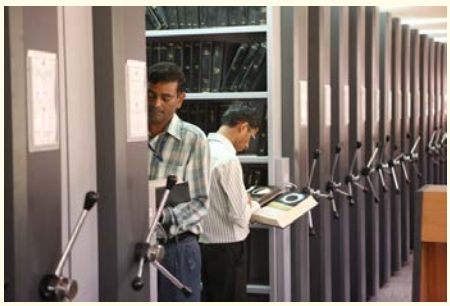


Testing of PFBR high temperature neutron detector and Kalman filter

Irradiation of Yttria for Sr-89 production

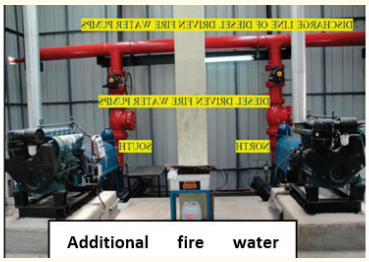
SADHANA Facility to study the thermal hydraulic behavior of Safety Grade Decay Heat Removal (SGDHR) system, designed, fabricated, erected and commissioned in IGCAR.

Compact Shelving introduced in LIbrary



2013

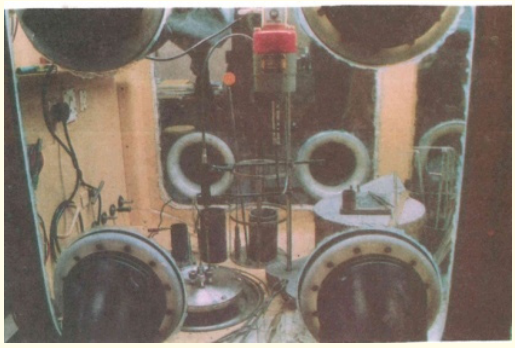
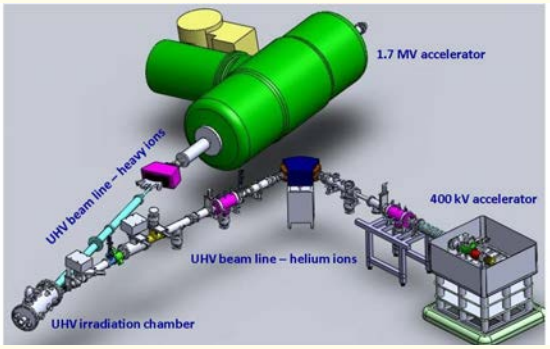
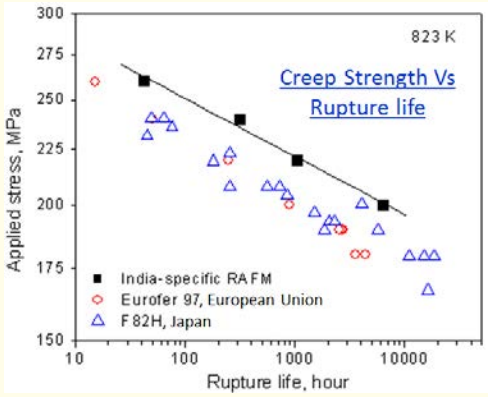
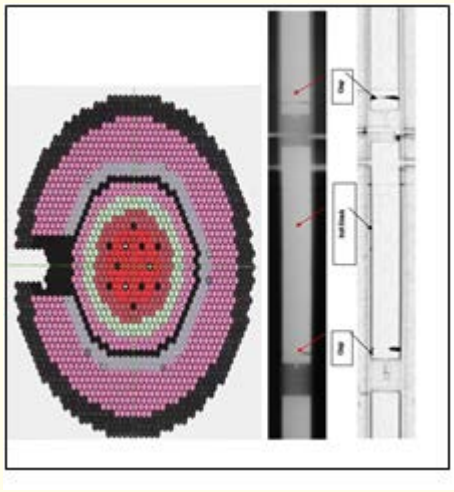
PSR for relicensing of FBTR



Safety up gradation of FBTR (Including Post Fukushima modifications)

Modifications to prevent water entry based on revised DBFL

Indigenous design confirmation of large sized Primary Sodium Pumps (PSP) was carried out by extensive theoretical and hydraulic model testing of pump to predict the performance for prototype pump including cavitation and paint erosion studies.

Fabrication of Sphere-pac fuel pins by Sol-Gel process – first time in DAE. A remotely operable facility have been developed in-house, tested and commissioned.	
Electrorefining of U-Pu-Zr alloy in 50 g per batch was demonstrated in laboratory scale.	
Duel ion irradiation facility established. Studies on effect of helium to dpa ratios on void swelling in ODS alloys, evaluation of multi beam synergies on defect annealing in SiC carried out.	
Indigenous development of Indian Reduced Activation Ferritic-Martensitic (INRAFM) steel for India's Test Blanket Module (TBM) in ITER	
Indigenous development of Ferro boron as a cost effective alternate shielding material for future fast reactor designs. Indigenous fabrication of outer shield subassemblies having nuclear grade Ferro boron would entail a cost savings of about 30 Crore. The irradiated test subassembly has also been subject to extensive PIED for qualification of its performance under irradiation.	

Regular reprocessing campaigns of FBTR spent fuel with 1,55,000 MWd/t burnup carried out in CORAL

Core flow monitoring mechanism for PFBR Manufactured

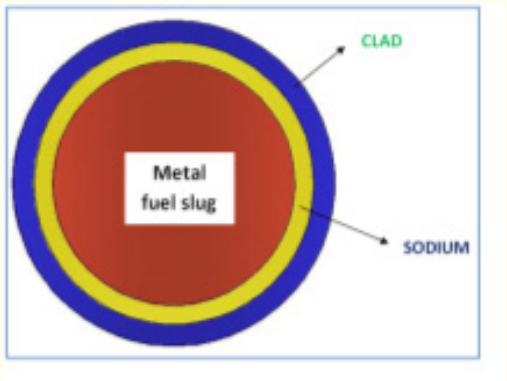
Molten fuel-coolant interaction studies are being carried out in SOdium – Fuel Interaction facility (SOFI) and THErmite MElt Facility (THEME).

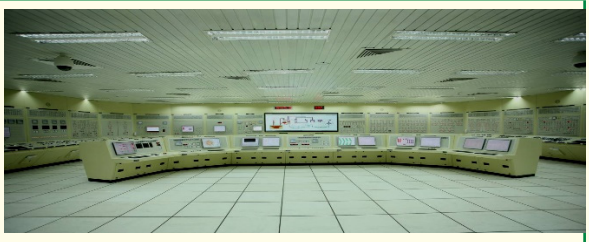
Cabinet sanction obtained on July 3, 2013 for FRFCF project. AERB permission for construction of FRFCF obtained.

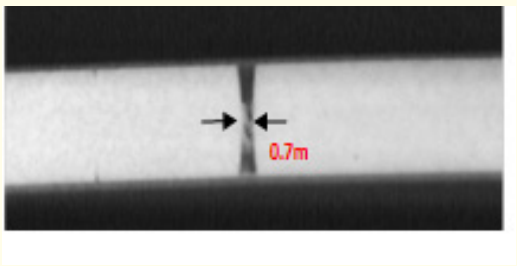
- Construction Of Hter Building
- Structural Dynamic Lab
- Main Gate Complex
- FBR Annex Building
- Construction Of Engineering Hall –IV
- Construction Of Training School & Training Centre

I&C for fuel handling, shutdown and process systems for PFBR design, developed and commissioned.

The design of metal fuel pin for test irradiation in FBTR is carried out by satisfying both the thermal and structural design criteria. The pins are designed for a target burnup of 100 GWd/t. Five special SAs (ISZ100) containing three metal fuel pins in each are successfully loaded in FBTR.



2014	
Classes Started in New Training School Building of IGCAR	
Installation of modular workstations; High end server. Zero clients systems for the users of library for accessing the resources	
Ambient air quality monitoring Facility established. Monitoring PM10, PM2.5, Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2) and CO.	
PFBR Full Scope replica simulator commissioned at BHAVINI training facility	
Minor Actinide Partitioning from HLW generated from FBTR carbide fuel (155 GWd/t) reprocessing successfully demonstrated .	

Atmospheric Plasma Spray and High Velocity Oxy-Fuel Spray Facility established.	
X-ray radiography of fuel pins of failed fuel subassembly after a burn-up of 148.3GWd/t carried out for assessing the stack length, pellet integrity etc.	
Tests were conducted on transfer arm for PFBR to verify its functionality. Endurance tests conducted to ascertain its performance at desired PFBR environment.	
Consent from Tamil Nadu Pollution Control Board (TNPCB) to establish FRFCF facility under air obtained. Ground breaking pooja of FRFCF project performed on March 6, 2014.	
Establishment by ESG of 6.6 kV PDC VIII substation and Electrification of 2 mgd plant.	

The buckling test facility was established to carry out buckling test on scale down models of reactor assembly components.

Test set for buckling test of main vessel dished end.

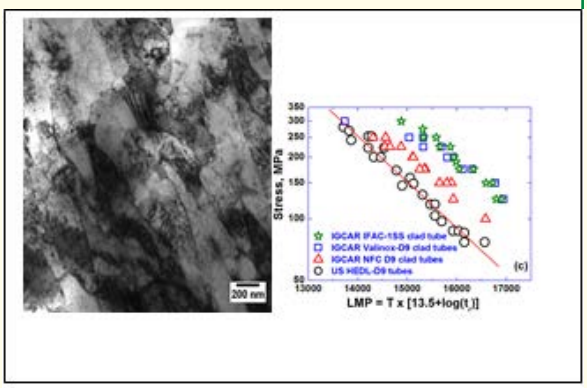
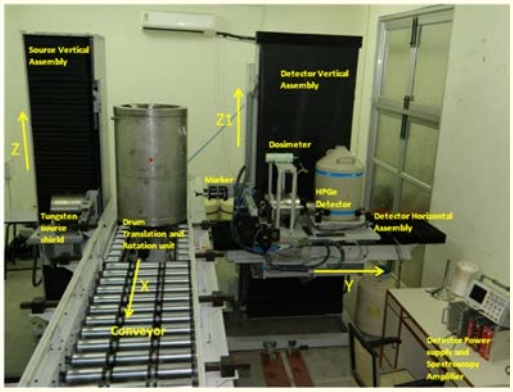
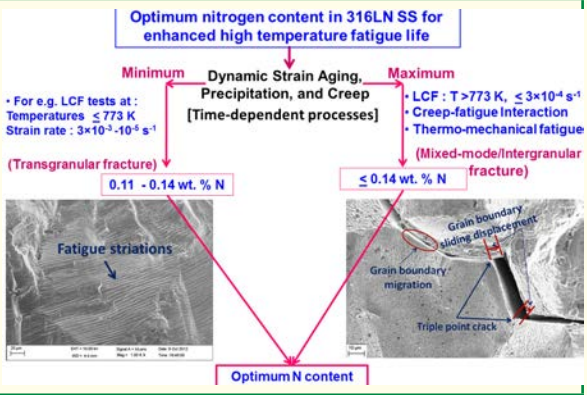
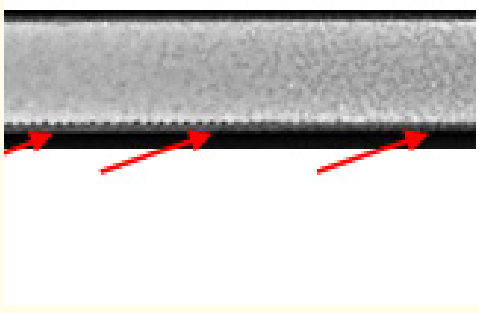
Full scale prototypes of Absorber Rod Drive Mechanisms & Absorber Rods have been extensively tested under simulated seismic condition at a dedicated facility established for multi support excitation at Structural engineering Research Center, Chennai.

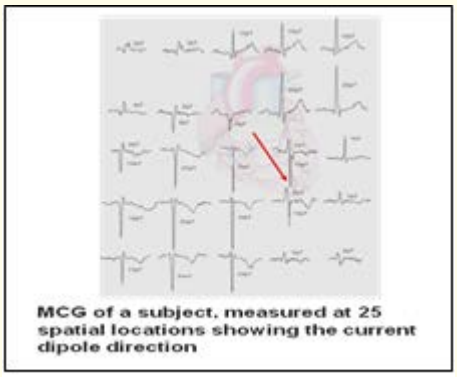
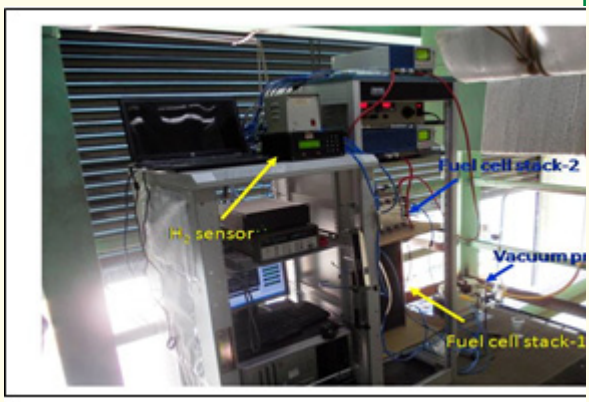
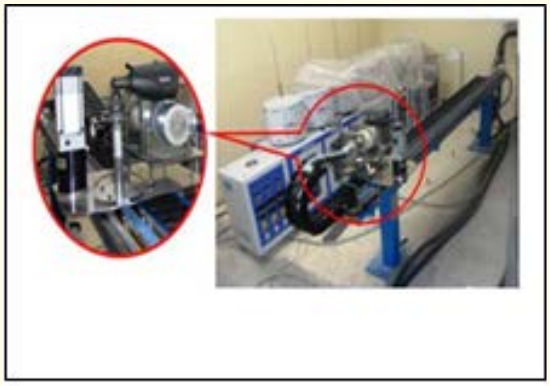
2015

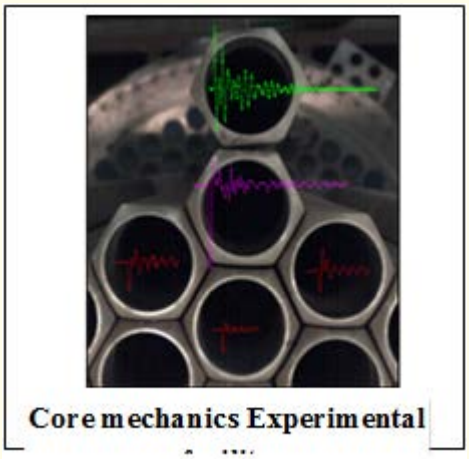
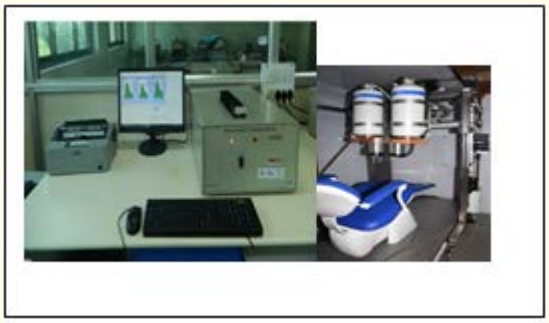
180 TFLOPS Supercomputing Cluster with 400-nodes based on 12-core Intel Xeon Ivy-bridge processors was commissioned; Silicon based MEMS Pressure Sensor fabricated

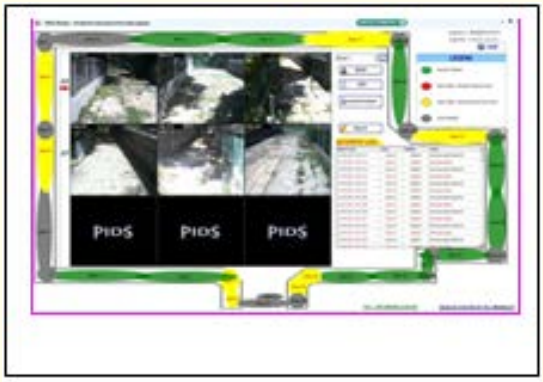
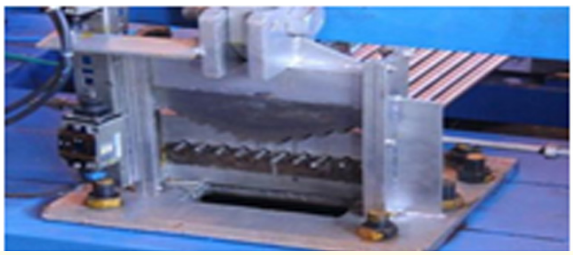
Soil excavation, dewatering and controlled blasting were undertaken in a progressive manner in the nuclear island of FRFCF.

Excavation reached moderately weathered Rock III level at -18.0 m to -23.0 m with associated dewatering system. Confirmatory geotechnical investigations, geological mapping and ground improvement studies were completed for the entire site.

First pour of concrete was accomplished on May 25, 2016 at Waste Management Plant site of FRFCF.	
Advanced Fast Reactor Clad (IFAC-1) stainless steel for Sodium Cooled FBRs Indigenous Developed.	
Gamma Ray Tomography system Commissioned	
Nitrogen Enhanced 316LN Austenitic Stainless Steel for Primary Components of Sodium developed and characterized.	
X-ray Radiography Analysis of Irradiated MOX Sphere-pac and Pellet Fuel Pins carried out.	

Clinical survey with MCG system.	
Proton Exchange Membrane Fuel Cell (PEMFC) based Electrochemical Burner for Hydrogen (ECBH) was deployed for hydrogen mitigation in the simulation experiments at the Steam Generator Test Facility (SGTF), FRTG using a model secondary cold trap.	
100 T Multi Axial Shake Table commissioned. This is the largest facility in India and one of the few such facilities in the world. The facility caters the needs of not only the entire DAE unit but also for the public and pvt sector companies doing the nuclear business.	
RABITS (Rupture And Ballooning In Tubes) facility Commissioned. This facility is developed to study the onset of plastic instability (ballooning) in fuel clads at various combinations of heating rates and pressure.	

A dedicated Core Mechanics experimental facility established and experiments were conducted to study the response of free standing reactor core of SFR under transient loading conditions.	 Core mechanics Experimental
Environmental radiation monitors such as LAN based Environmental Gamma Dose Loggers, online Area Gamma Monitors, off-line Gamma Tracers, Argon Fluence Monitors and Autonomous Gamma Dose Loggers are installed. Two rings of monitors around the stack established to provide real-time input to the Nuclear Emergency Response Decision Support System for event detection and source term estimation.	
Radiation dosimetry Laboratory consisting of biological dosimetry, personal monitoring, retrospective dosimetry and technique for severe exposure dosimetry established with due accreditation from AERB and BARC	
Submission of KAMINI reactor PSR & renewal of license to operate	
Regular reprocessing campaigns of FBTR spent fuel with 155 GWd/t burnup carried out in CORAL.	
Established Two Million Gallons Per Day Capacity Sea Water Desalination Plant	

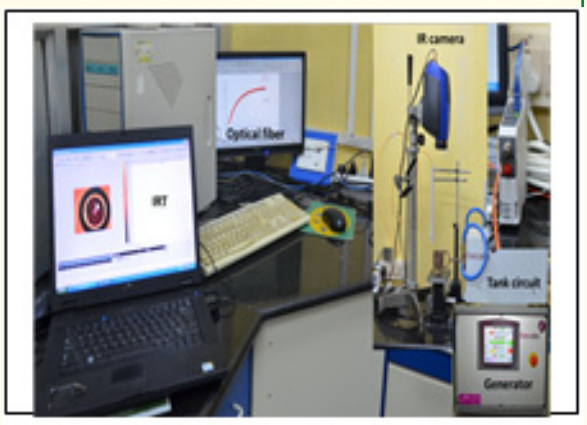
2016	
Wireless Sensor Network(WSN) devices such as sensor node, router node, gateways and Base station were designed & developed indigenously and deployed for nuclear and industrial applications	
As per the recommendations of AERB, the existing physical protection system (PPS) of FBTR is refurbished with Perimeter Intrusion Detection System(PIDS), Interior Intrusion Detection System, IP based Perimeter CCTV Surveillance Systemand Interior CCTV Surveillance System	
Multi Fuel Pin chopper for FRP of FRFCF was developed and dummy fuel pins along with spacer wire chopped.	
Sodium Aerosol dispersion experiment in open atmosphere under taken. Sodium aerosol toxicity evaluated by burning 40 kg Sodium at an exclusive facility at Edaiyur and aerosol formation and transport studied.	

PFBR SG Inspection System (PSGIS) has been indigenously designed and fabricated for inspection of SG tubes using Remote Field Eddy Current (RFEC) testing probe. Inspection of 100% tubes in 8th SG (547 tubes) and 10% tubes in the remaining seven SGs has been completed. In total, more than 900 SG tubes have been inspected.

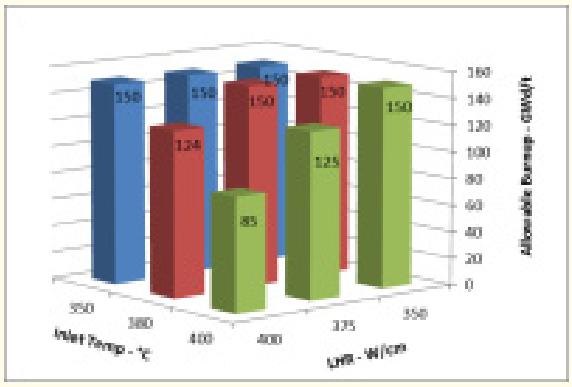
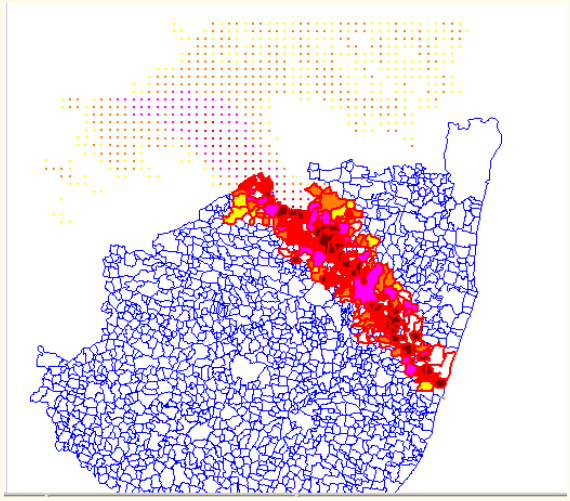
Construction Of Mmg Phase-Ii Building
- Construction Of Eid&Rtsd Lab Building
- Construction Of Substation Building For Eh-V

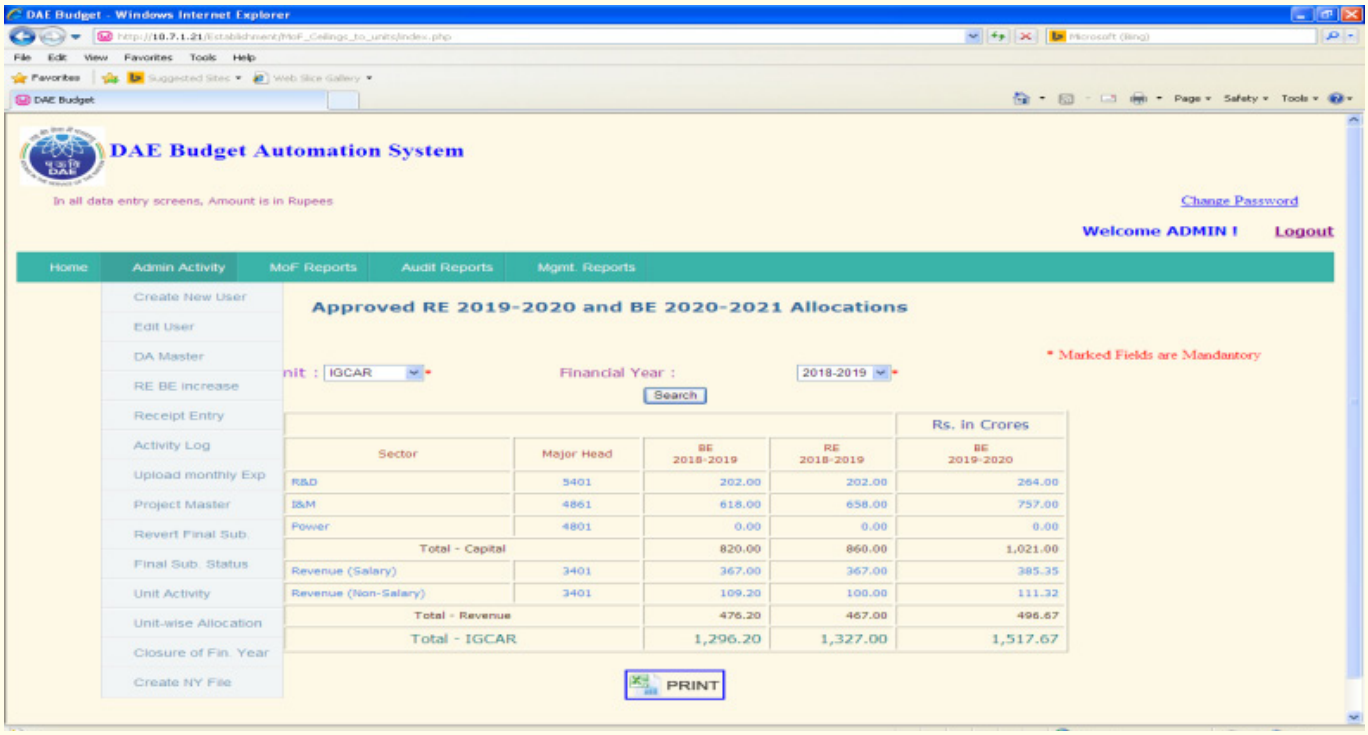
The mandate of CORAL was met by reprocessing of FBTR fuel with burnup as high as 155 GWd/T, and the recovered fuel was loaded back in FBTR, thereby closing the fast reactor fuel cycle.

Infrared thermography based magnetic hyperthermia facility developed.



A high sensitive, modular remote field eddy current (RFEC) instrument and flexible probes were developed in NDE Division for in-service inspection (ISI) of PFBR steam generator (SG) tubes.

Facility for the fabrication of sodium bonded Metal Fuel Pin comprising U-6% Zr, EU-6% Zr, U 19% Pu 6% Zr for test irradiation in FBTR commissioned.	
Performance Assessment of the FBTR Carbide Fuel at Higher Operating Conditions carried out and burnup limits derived.	
Commissioning of Online Nuclear Emergency Response Decision Support System (ONERS-DSS): The ONERS-DSS has been installed and is operating in live mode at Kalpakkam, at AERB HQ, Mumbai, and is being adopted by NPCIL for other NPP sites.	
Thermal Imaging Facility for non-ionizing radiography Infrared Commissioned for various engineering applications.	



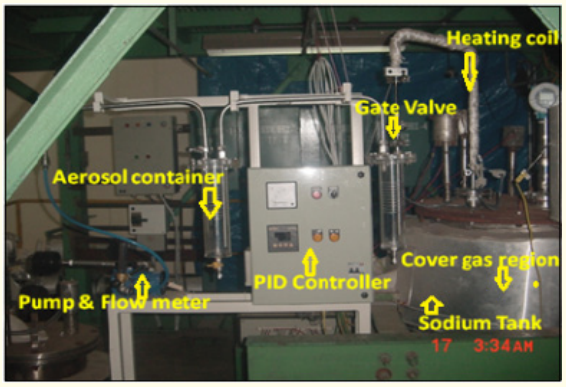
Development and Implementation of DAE Budget Automation System

Replacement of leaky SG module with qualified spare SG module

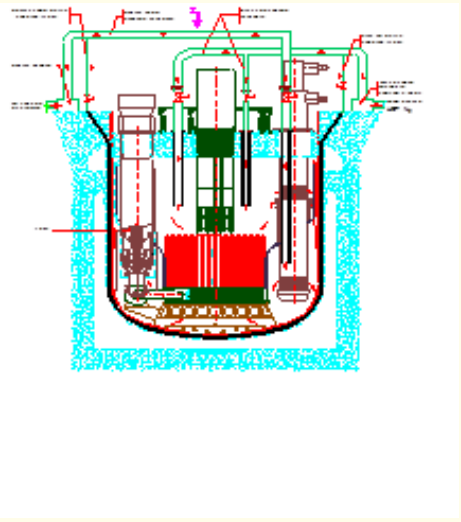
Installation & commissioning of Integrated Control & Information system for KAMINI reactor

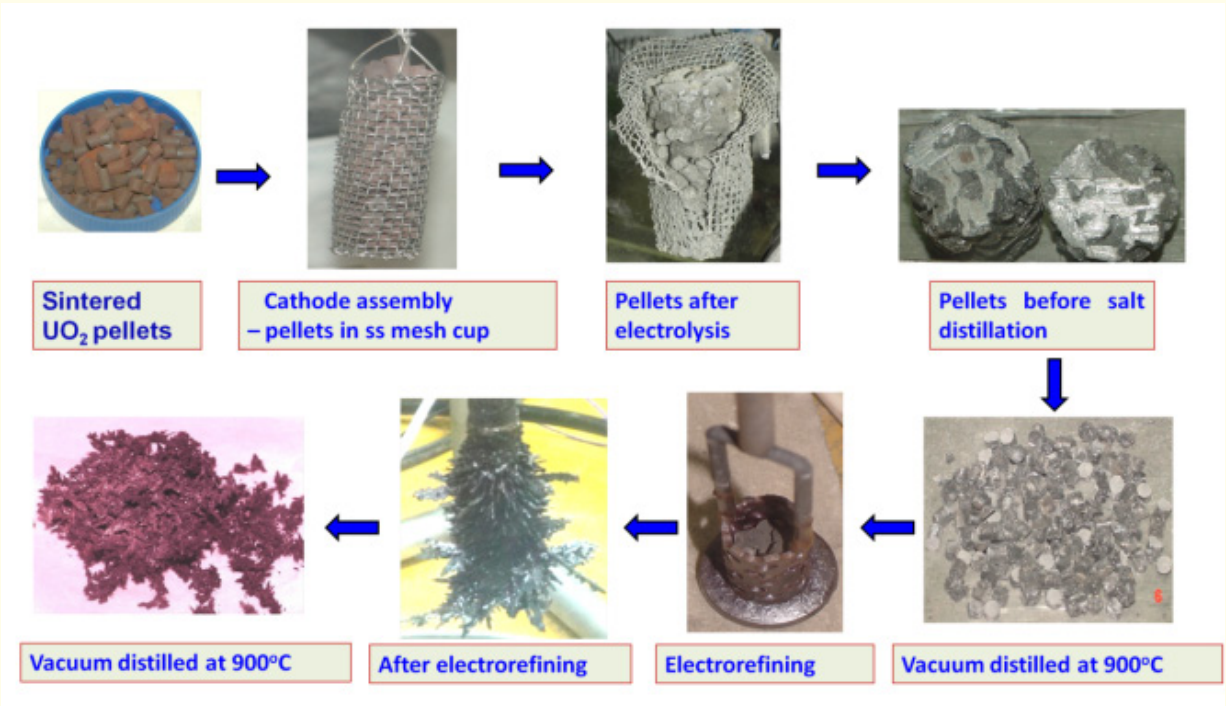
Kalam Science Yatra was organized as a part of India International Science Festival held in Chennai. The yatra was set off from the memorial of former president APJ Abdul Kalam at Rameswaram. A van carrying the burst of Dr Kalam, portraits of other scientists, models of science experiments showcasing the benefits of science and technology went through various educational institutions for the benefit of students and public.

Techniques for characterizing Na metal aerosols developed and Na aerosols characterized in the cover gas of SILVERINA loop for various parameters.

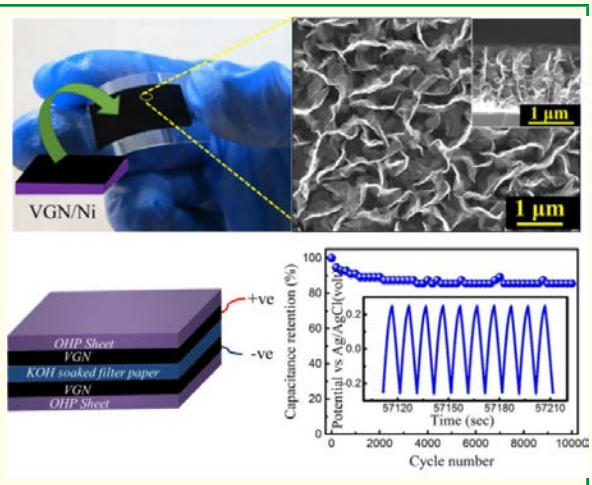
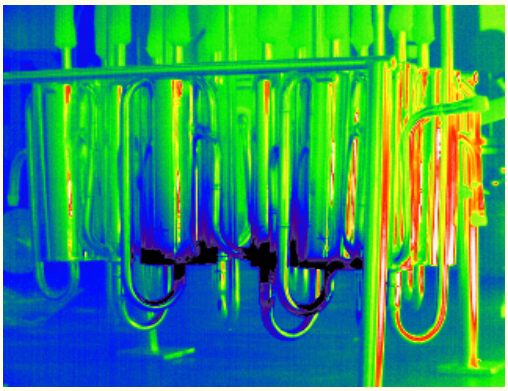
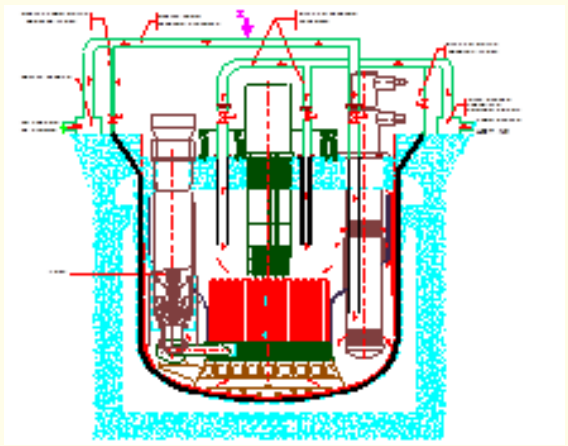
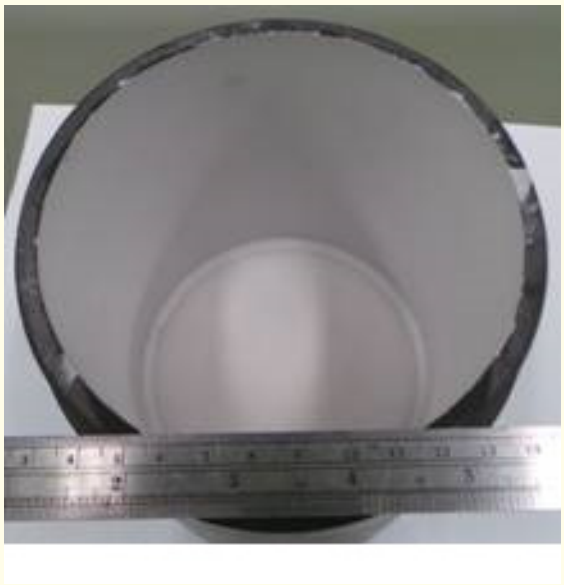


Technical support & expertise provided towards Clearance for commissioning for integrated preheating and sodium filling in secondary loops in PFBR.

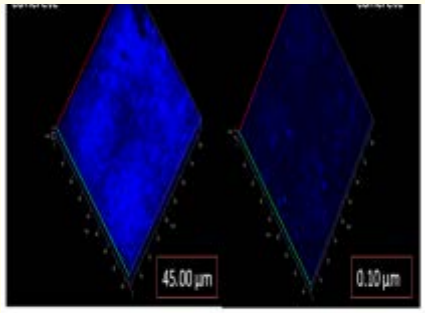




Electroreduction of UO_2 to U that could serve as one of the possible head-end step for metal fuel pyroprocessing demonstrated. Electroreduction of UO_2 carried out in 200 g batch. Reduced U was further electrorefined and product was consolidated by induction melting.

Vertical Graphene Nanosheets grown on Ni substrates were chemically etched and transferred onto polymer substrates to fabricate flexible supercapacitor device.	
Detection of failed nozzle joints in sixth stage mixer settler of reprocessing plant was carried out successfully by combining Helium leak testing and Infrared Thermography	
Ultrasonic inspection methodologies have been developed for the three critical weld joints of PFBR main vessel. The methodologies have been successfully demonstrated by detecting 10% wall thickness deep defects in dissimilar welds and triple joint welds. A guided wave based methodology has also been developed for inspection of inaccessible shell weld in core support structure (CSS) of PFBR.	
To enhance the life and durability of Atmospheric Plasma Spayed (APS) yttria coating on internal surfaces of High Density Graphite (HDG) crucibles, an oxidation protective interlayer coating of Silicon Carbide (SiC) is developed by combined Chemical Vapour Infiltration/ Chemical Vapour Deposition (CVD/CVI). The durability of yttria coating, deposited by plasma spray process on high density graphite crucibles with silicon carbide interlayer was successfully demonstrated in the melting of U-Zr alloy at 1500 °C.	

High performance concrete is developed by adding of 40 % flyash, 1% TiO2, 1% CaCO3 nanoparticles and 2% sodium nitrite (corrosion inhibitor). The nanophase modified concrete showed an enhanced compressive strength, split tensile strength and reduced rapid chloride penetration as compared with conventional concrete.



Completion of construction of Head End Facility (HEF) for dismantling of FBTR & PFBR fuel SAs. Unique equipments such as laser dismantling machine which can handle three types of sub assemblies has been developed, manufactured and installed.


HEF civil building under construction


HEF civil building after completion


Laser dismantling machine


HEF hot cells

An "Irradiation Capsule Fabrication Facility (ICFF)" for encapsulating fresh nuclear fuel pins has been commissioned .

Regulatory clearance was obtained from AERB to handle fully sealed, qualified and leak tight fresh nuclear fuel pins.

A robotic vehicle named as Dissimilar Metal Weld Inspection Device (DISHA) has been developed, for carrying out periodic in-service inspection of dissimilar metal weld between the roof-slab and main vessel of PFBR. DISHA is designed to perform remote visual examination and ultrasonic testing of the weld at 120°C. The room temperature qualification of DISHA was conducted successfully and validated on a dedicated mock-up test rig.

Under Sodium Ultrasonic Scanner (USUSS) using high temperature piezoelectric transducers developed for viewing components immersed in opaque-sodium.

Civil construction of service buildings viz, DG building, Air compressor room, Power station and Chilling plant was completed. 33 kV electrical substation was installed and commissioned at Main Power Station (MPS) of FRFCF

DG building

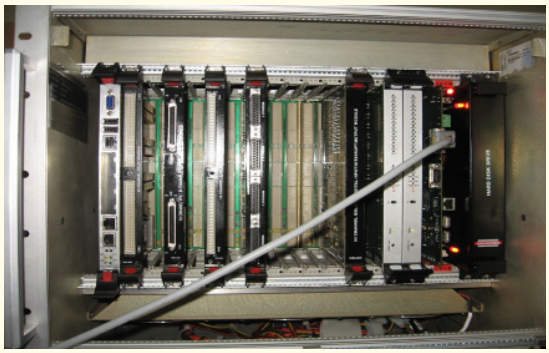
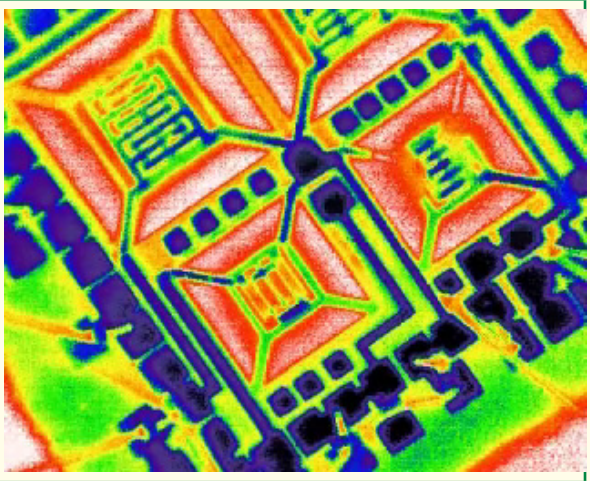
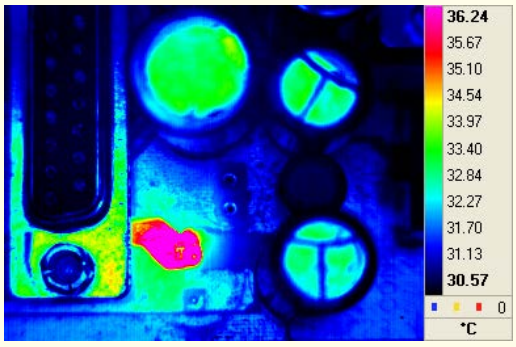
Air compressor building

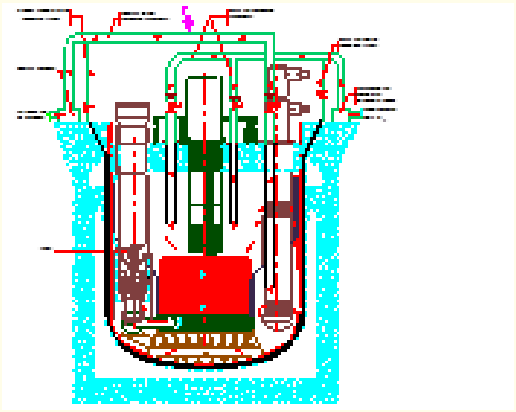
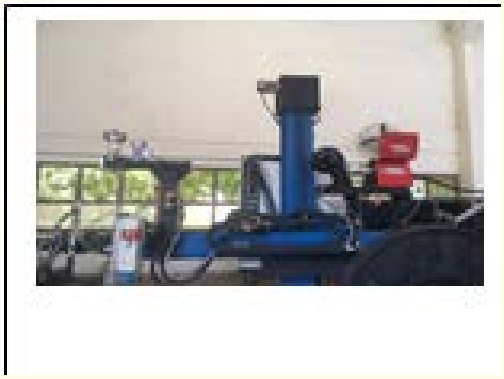
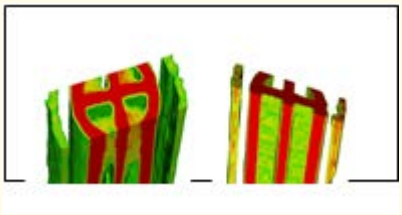
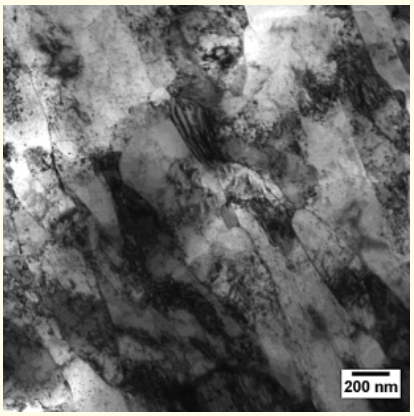
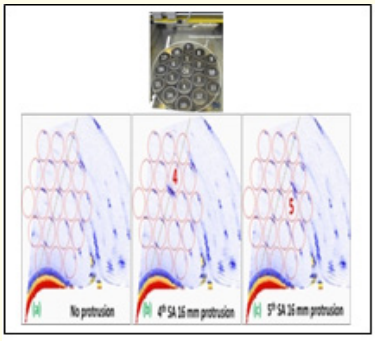
33kV sub-station at MPS

Civil construction of warehouse facility in FRFCF for storage and preservation and testing of equipment like fume hoods, glove boxes, chopper, compact press completed. Procurement of all major raw materials such as special quality stainless steel plates, pipes and lead ingots accomplished.

WARE HOUSE – 1 & 3

Commissioning of 60 kWp grid connected solar panel on SGTF substation & 60 kWp solar panel on PDC VII to feed power supply to the grid.

Plutonium Continuous Air Monitor for Reprocessing Plants, indigenously designed and developed.	
A diversified compact PCI bus based CPU card based on an ARM-9 processor, along with a set of Input/Output (I/O) cards developed.	
Thermal characterization of surface micro-machined micro-hotplates for chemi-resistive gas in collaboration with Chemistry and Electronic Divisions, BARC carried out.	
Failure Analysis of PCB used in Neutronic Instrumentation of KAMINI Reactor using Infrared Thermography carried out.	
A multipurpose sodium Facility for Component Testing (SFCT) with three test vessels and purification circuit has been erected for sodium testing of scaled down components of future FBRs.	

Technical support & expertise provided towards Clearance for commissioning for integrated preheating and sodium filling in secondary loops in PFBR	
CNC Plasma Transfer Arc Machine, Enabling Hardfacing of Components with Stellite /Colmonoy established	
Tomography of Chocked and ultrasonic cleaned CE bowl to detect blocked flow paths in radioactive Annular Centrifugal Extractor carried out.	
2018	
ODS steels based on 9Cr and 18Cr variety and having Yttria and Zirconia nanaoscale dispersions synthesized and their microstructure characterized using advanced microscopy and diffraction techniques.	
Ultrasonic signal analysis techniques have been developed for under sodium ultrasonic scanning (USUS) for detection of subassembly (SA) protrusion in PFBR and demonstrated the performance on a 1/10th scale PFBR core model in under-water studies.	

Civil construction of infrastructure buildings viz, Administrative building and Central Surveillance Safety and Health Physics (CSSHP) Building and service buildings like Ammonia Cylinder Storage buildings and Inflammable stores was completed.

Various process and analytical equipment like X-Ray Radiography equipment, Glove box adaptable Hydrogen detection system, Total Gas Analyser & Alpha spectrometer for FFP (phase- I) were procured.
Controlled atmosphere enclosures like glove boxes and fume hoods are procured

Installation and commissioning of fire detection & alarm system and CCTV surveillance system completed for infrastructure area of FRFCF.

The civil construction of Core Sub assembly Plant and Waste Management Plant reached the Finished Floor Level (FFL).

Civil raft foundations of Fuel Reprocessing Plant completed through two mega pours of 7200 Cu-m and 8200 Cu-m involving placement of temperature controlled concrete, with one of them being the single largest ever in DAE till date.

The consent from TNPCB issued earlier in 2014, to establish the facility under Air Prevention & control of Pollution Act 1981 and Water Prevention & Control of Pollution Act 1974, was extended upto 2023 or commissioning whichever is earlier.

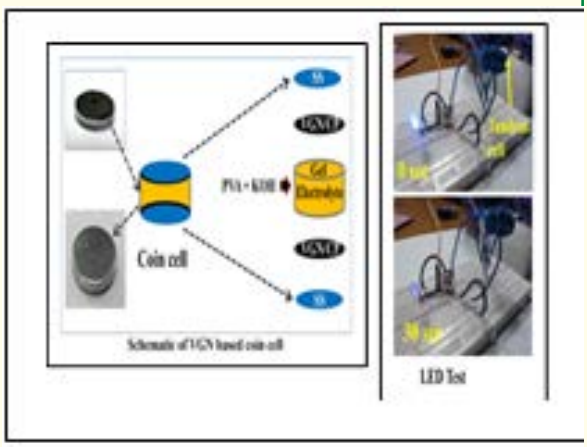
Civil construction of Training Centre of FRFCF with Green building features completed with eco-friendly variable refrigerant flow AC system to achieve Gold Certification and the centre inaugurated by Chairman AEC on June 27, 2018.

Civil construction of 60 m stack of Fuel Fabrication Plant (FFP), Reprocessed Uranium Oxide Plant (RUP) and Core Sub assembly Plant (CSP) by slip form technique completed in a record time of 60 days.

CORAL was relicensed for 5 years upto 2023, for developing new process/solvents, equipments needed to realize metallic/advanced fuels reprocessing by aqueous route.

Completion of water runs as part of pre-commissioning tests of DFRP including mockup testing and validation of all equipments.

A symmetric coincell supercapacitor device was fabricated using Vertical Graphene Nanosheets (VGN) Grown on conducting carbon paper substrates. The performance of the device was demonstrated by lighting a LED. The device exhibited a specific capacitance of ~2 mF/cm^2.

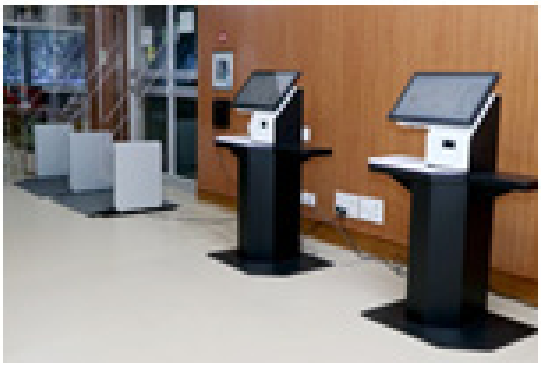


Commencement of fast Reactor Engineering Course at BARC Training School at IGCAR

Preprint server was designed and developed to enforce ethics for scientific publications from IGCAR.

Documentation on Biodiversity at DAE Complex, Kalpakkam

Today Scientific Information Resource Division (SIRD) has close to 62,000 Books, 48,000 Back volumes, 15,000 Standards, 1, 80,000 Technical reports, and provides access to more than 3500 Journals. SIRD has evolved as a state-of-the-art Library with Advanced Digital Library infrastructure and services.



About 450 TSO's have graduated from BARC Training School at IGCAR. About 200 Research Scholars, Research Associates and Visiting Scientists are in place at any given time at IGCAR

About 200 undergraduate and post graduate students from academic institutes undergo short term training at IGCAR towards their internship/project work every year

About 2000 students from various academic institutes visit IGCAR every year

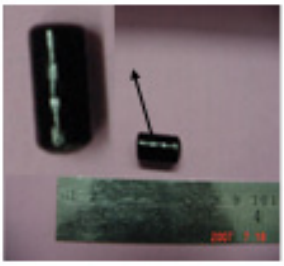
IGCAR is a preferred station for BITS summer practice school every year

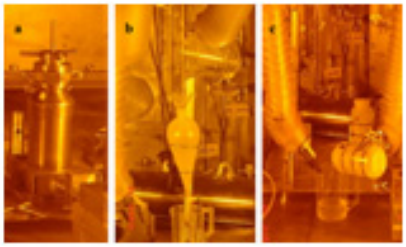
The spin-off from radiation research is found to be of immense use in the public services. The IR based medical imaging technique has been successfully applied in diagnosing the ocular surface temperature during dilation of the eyes and the breast cancer screening. The Gamma Chamber provides high strength irradiation to various materials; irradiation of floral seeds for mutation and yield enhancement is yet another example. XRF analysis is carried out on the bronze Idols at Thanjavur and Thiruvaroor.

Iron Phosphate Glass (1 kg scale) for fast reactor waste immobilization has been synthesised and characterised. 20 wt% simulated fast reactor waste has been immobilised in IPG with the composition 48 wt % Fe_2O_3 and 52 wt% P_2O_5.

A method developed for the production of 89Sr isotope by irradiating Y_2O_3 target in FBTR. Flow sheet has been developed and demonstrated.

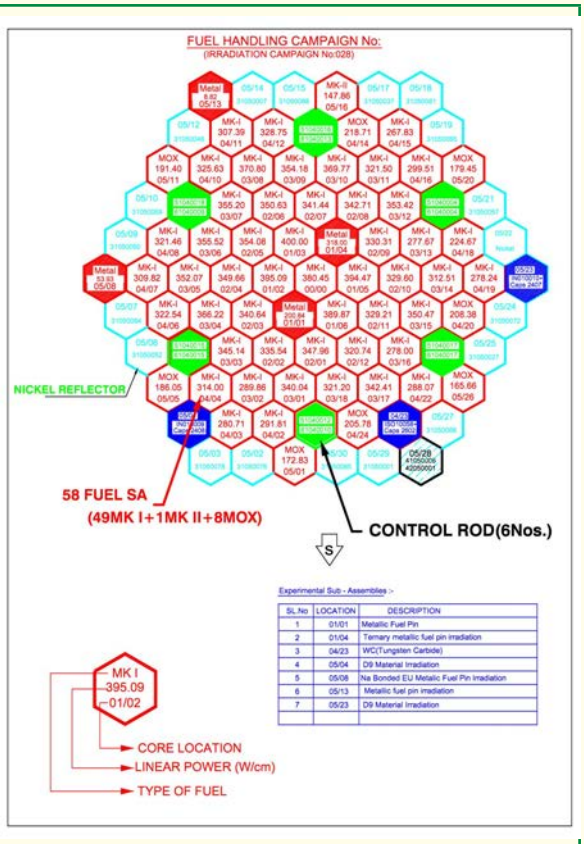
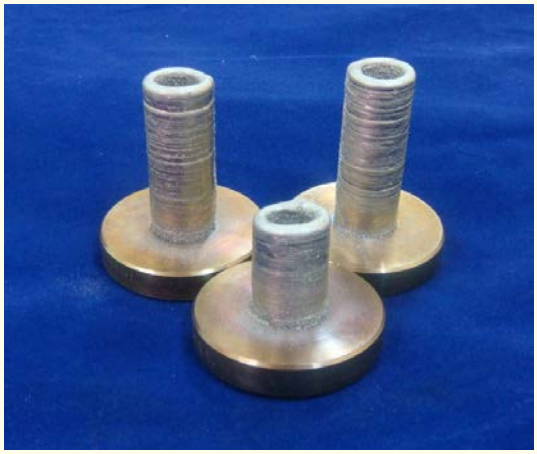
Dedication of sodium bonded metal fuel pin fabrication facility to the nation by the Honorable President of India.





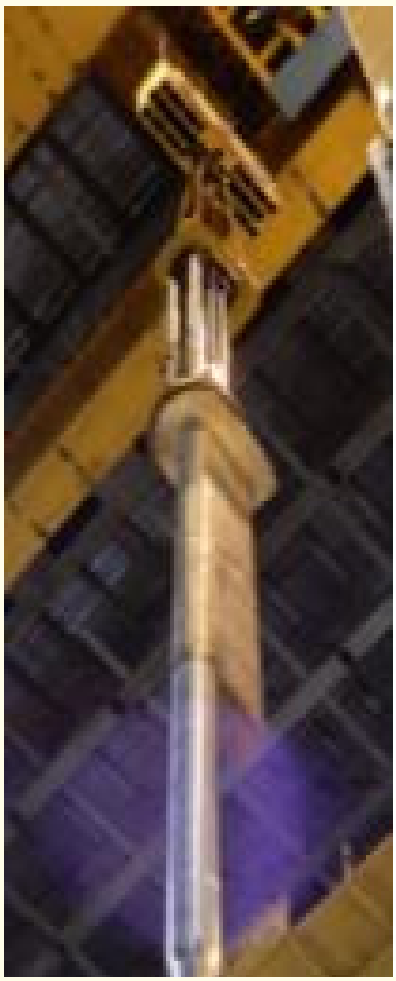
Virtual Desktop Infrastructure implemented using ultra-thin clients and centralized computing resources to support 1000 desktop users

As part of indigenization of nuclear instrumentation for critical nuclear components, leak tight triaxial and twin axial feed thru were designed and fabricated

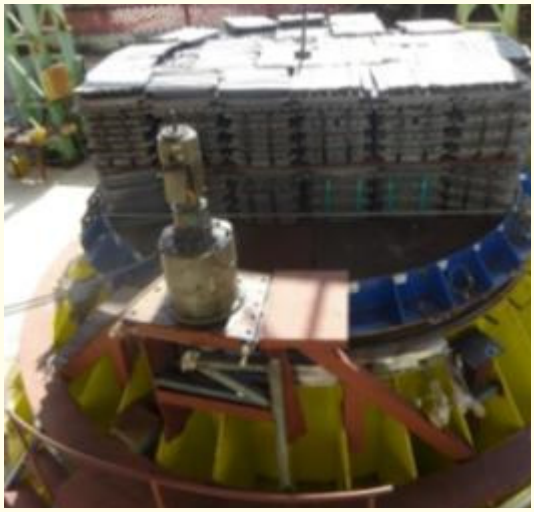
Renewal of license to operate FBTR up to 2023 FBTR reached its highest power level of 32 MWt	
Regional Calibration, AERB recognized state of art facility for the calibration of gamma survey instruments upto 10 Sv/h has been commissioned.	
Development of Colomonoy bushes by Laser Additive Manufacturing	

HpGe based lung monitor in Whole Body Counting Lab commissioned.	
2019	
A small diameter (105 mm) miniature sodium submersible Annular Linear Induction Pump (ALIP) is designed and developed to meet low flow requirements in high temperature (550 °C) sodium environment like those in Failed Fuel Location Module (FFLM).	
Using Spark Plasma Sintering, highly dense (99.92% of TD) Tungsten Carbide pellets for FBTR grid plate shielding were fabricated, characterized, and quality audited.	
Structural concrete works of waste tank farm (WTF) in FRP Block 1-2 were completed for ODC tanks. WTF ODC tanks of 212 Cu.m capacity (4.8m dia x 13.0m long) weighing about 72 Tonne were received at site and preparatory works for installation is under progress.	
Cumulative concreting of 3.55 Lakhs cu.m and engineered back filling of 20.5 Lakhs cu. m was achieved in FRFCF	
Regulatory clearance obtained for second stage of commissioning, and Acid-TBP runs commenced at DFRP.	

Transfer Arm (TA) is the in-vessel handling machine of PFBR used for transferring core SAs within the main vessel. It was manufactured at L&T and subsequently erected at Hall-3 of FRTG in IGCAR. TA was qualified for 600 cycles of operations at high temperature (2000C) in sodium environment. After successful qualification, it was erected and commissioned for room temperature operations at PFBR. Angular position of rotatable plugs and TA with respect to Core was established for each core location. During high temperature qualification trials in nitrogen environment, difficulty in operation of TA gripper was observed. Detailed investigations were carried out, based on which suitable design modifications were incorporated. After modifications room temperature qualification is completed successfully.

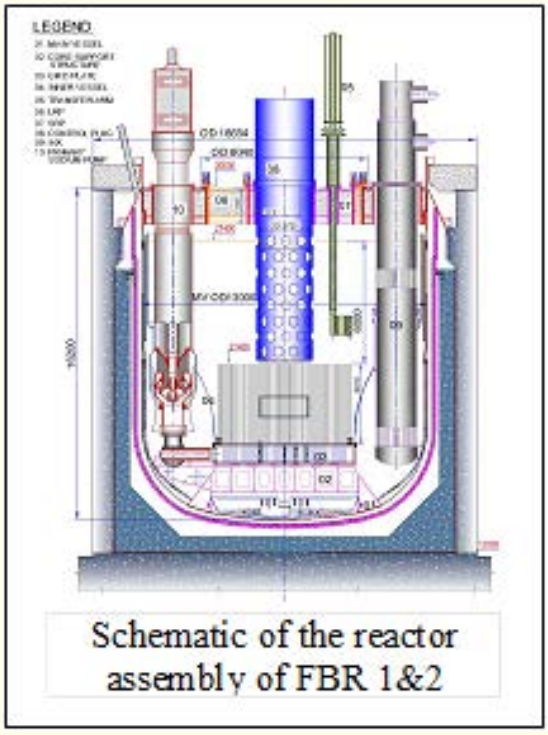


Large Diameter Bearing Qualification Rig : Large diameter bearings (ϕ5 – ϕ7m) are employed to enable rotation of rotatable plugs in fast breeder reactors to facilitate fuel handling. As an import substitute, a bearing measuring ϕ4.6 m was designed & successfully developed. Prior to certifying the bearing for reactor deployment, the developed bearing needs to be qualified under the simulated reactor operating conditions for its functionality & design life. The experimental facility for testing of ϕ4.6m bearing can simulate operating conditions such as load, temperature and temperature difference across the races etc. as in the reactor. The functionality of bearing under 230t load has been demonstrated with the facility.



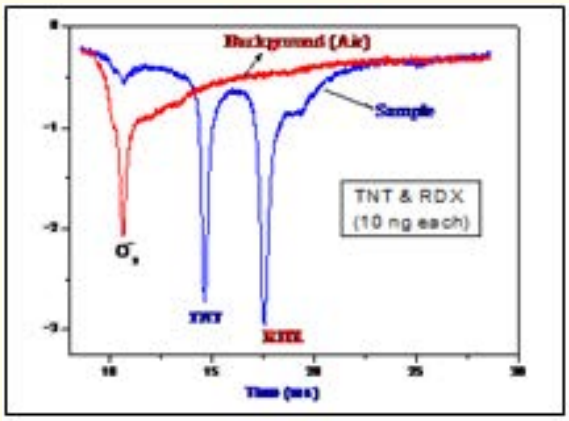
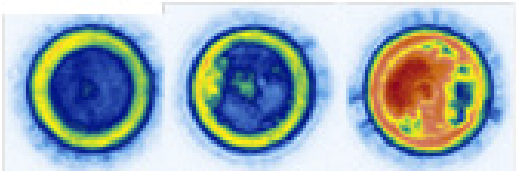
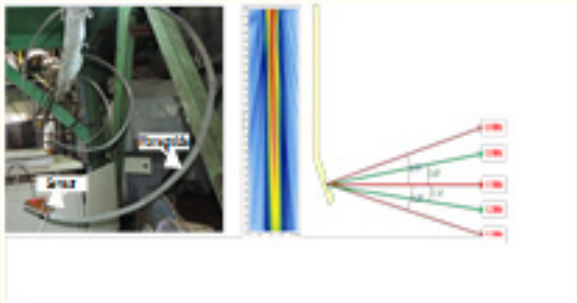
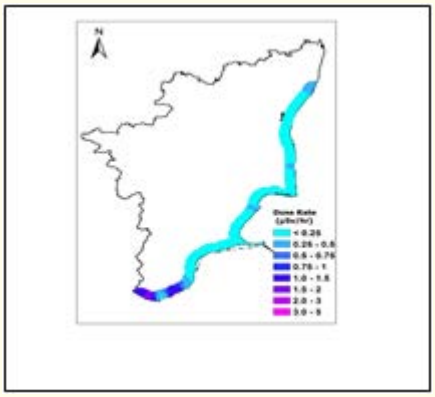
Civil construction of super structure with columns in Core Subassembly Plant reached upto 9.0m level and Solid Waste Building reached upto 12.0m level in FRFCF. Chimney of SWB erected.

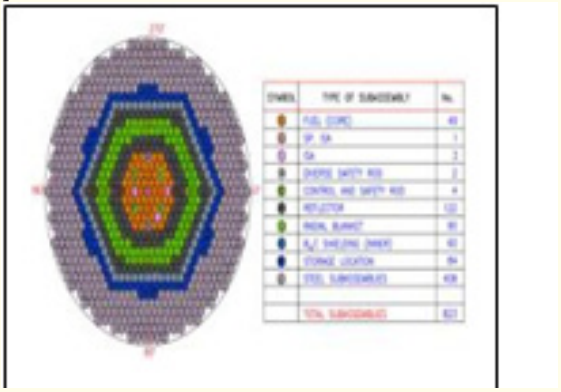
In the roadmap prepared for the Fast Breeder Reactor development beyond PFBR, twin units of FBR 1&2 each with 600 MWe capacity has been conceived. The conceptual design of FBR 1&2 has been made with enhanced safety and economic features. Economy is envisaged to be enhanced through material reduction to the extent possible and reduction of construction time by at least 2 years. Improved safety features of the reactor are targeted towards meeting the emerging safety criteria for future reactor systems which broadly meet the GEN IV reactor standards. Initial conceptual design document was prepared in February 2016 and subsequently revised in March 2019 incorporating the feedback from PFBR component erection and commissioning.



Schematic of the reactor assembly of FBR 1&2

Research facility for Irradiation studies in Sodium at HIgh temperature (RISHI) loop : Under DAE-CEA collaboration on JHR, one of the major responsibilities of DAE is to design, develop and manufacture the in-core test loop. An innovative design of U tube in-core sodium loop is conceptualized to fulfill the design requirement of very small size. It works on the principle of differential pressure in two limbs of the tube which provides oscillatory motion to the fluid contained in tube. The loop can be used for testing of both fuel and structural materials at different temperatures value irrespective of reactor primary coolant temperature.

Explosive detectors based on Ion Mobility Spectrometry (IMS) technique, designed, developed and demonstrated for detection of commonly encountered explosives at nanogram level. 12 nos. of drift tube along with amplifier were supplied to ECIL for further integration and field deployment.	
A Method for Diffusion Bonding of Piezoelectric Crystal to Metal Wear Plate developed (Pattent No. PCT/IB2019/052373)	
Study of wave propagation from metallic waveguides carried out.	
Natural radioactivity distribution on Tamil Nadu coast was measured covering 1024 km. Maximum concentration of Uranium, Thorium and K-40 is found to be 2200 Bq/kg, 80000Bq/kg and 2700 Bg/kg respectively	
IGCAR feeder-2 at MAPS commissioned. Capacity of the transformer is increased to 47 MVA to meet the 'Post Fukushima retrofit'loads of MAPS and increased power demand of IGCAR. This transformer is erected at higher elevation to meet the Fukushima requirement.	

Successful plasma nitriding of the mock up case ring of PFBR secondary sodium pump, made of 316LN steel has been carried out successfully. Static in-Sodium testing for 1000 h at 550 °C has attested to the quality and stability of plasma nitrided surface layer	
A 100 MWt test reactor of loop type powered by metal fuel is conceptualized as the successor to FBTR. Ternary fuel composition of U-23%Pu-6%Zr has been selected for powering the reactor to generate electrical output of 37MWe. Conceptual design choices and design features of reactor core, fuel pin and subassembly, reactor assembly, heat transport circuits, fuel handling systems, shutdown systems, electrical power systems, auxiliary services systems, instrumentation and control system, steam water system and layout have been worked out.	] 

1975-79

National Symposium on Thermoluminescence and its applications, February 12, 1975

National Safety Day, March 4, 1975

Yugoslavia Delegates, March 13, 1975

Shri Sher Singh, Commissioner of Finance, May 26, 1979

Shri B. Goldschmidt Chairman IAEA, December 13, 1979

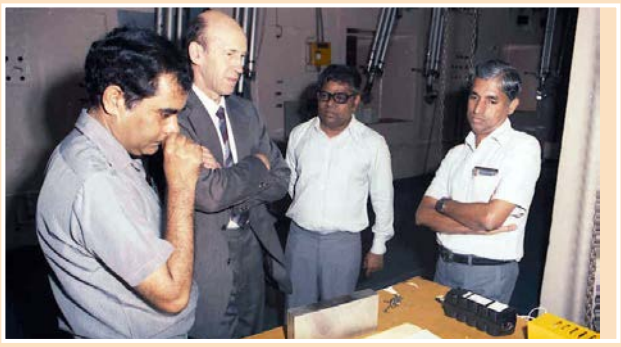
1981-1986

Members of Parliament, July 4, 1981

IAEA Seminar, November 30, 1981

IAEA 6th Workgroup Meeting, March 20, 1984

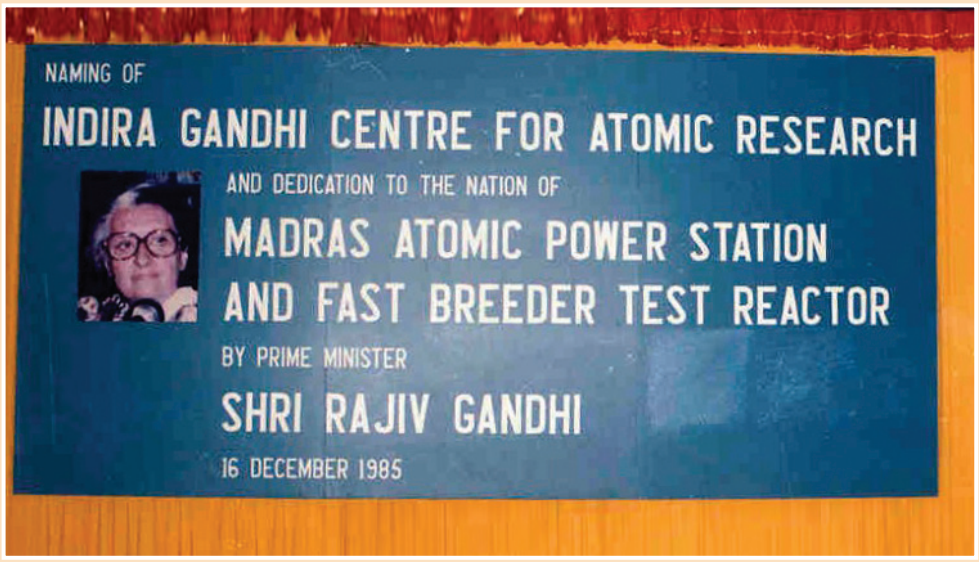
Former President Dr. R Venkataraman, 1985



IAEA Deputy Director General, March 10, 1986

IAEA Meeting, March 12, 1986

Renaming of Reactor Research Centre As Indira Gandhi Centre For Atomic Research On December 16, 1985



Arrival of former Prime Minister Shri Rajiv Gandhi at the then RRC and visit to FBTR

Planting of the Banyan Tree

The Banyan Tree as on Today

1987-1998

Former President Shri K. R. Narayanan visit to IGCAR as Union Minister, May 9, 1987

DAE Symposium on Radio Chemistry and Radiation Chemistry on January 4, 1989

Visit of Russian Delegates to RML, RCL on July 24, 1989

Dr. Chidambaram, Chairman, AEC, 1995

Former President Dr. A. P. J. Abdul Kalam, as Secretary, DRDO, 1997

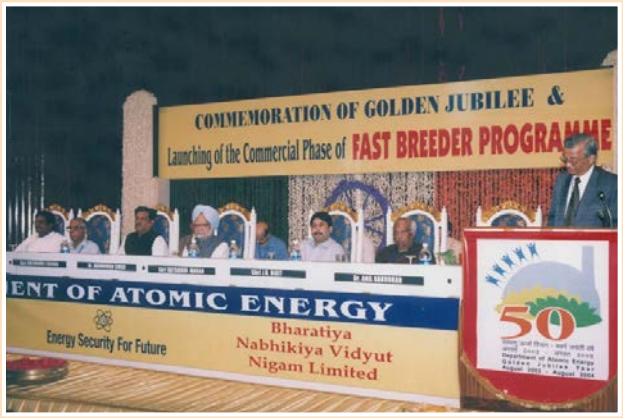
Former Prime Minister Shri Atal Bihari Vajpayee, September 15, 1998

2000-2004

DAE Safety Professionals Meet, October 16, 2000

Former Defence Minister Shri George Fernandez, November 15, 2000

14th National Conference by Indian Nuclear Society & 1st BRNS conference on nuclear fuel cycle, December 17, 2003



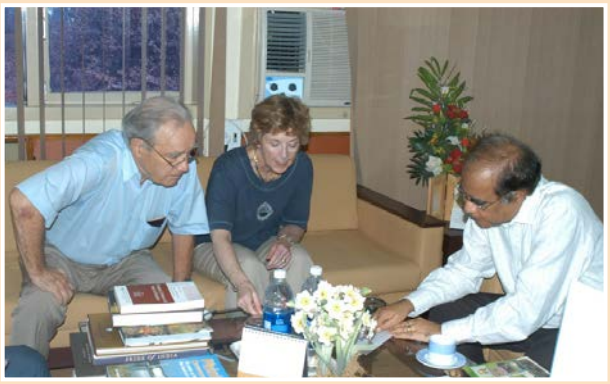
Commemoration : Starting of the commercial phase of FBTR, October 23, 2004

Professor C. N. R. Rao, Chairman of the Scientific Advisory Council, January 20, 2005

First Indo-French Technical Seminar on Fast Reactor Safety, May 11, 2005

Former President Shri Pranab Mukherjee as Minister of Defence visits RDL on the occasion of 20 years of successful operation of FBTR, July 17, 2006

Former President Dr. A. P. J. Abdul Kalam April 24, 2008



Dr. Casimir Pierre Zaleski, University of Paris, France, February 27, 2009

Prof. M. M. Sharma, Emeritus, Professor & Former Director, UICT, Mumbai, August 3, 2009

Prof. Siegfried S. Hecker, Director Emeritus, Los Alamos National Laboratory, USA, September 24, 2009

2009


Prof. Thomas Fanghanel, Director, Institute for Transuranium Elements, Europe, September 27, 2009


Dr. Jacques Bouchard, Special Advisor to Chairman, CEA & Chairman, GIF, CEA, September 27, 2009


Dr. Mohamed El-Baradei, Director General, IAEA, Vienna, September 27, 2009

Members from the Legislative Assembly for Meghalaya, October 28, 2009

A Delegation from People to People, Citizen Ambassador program, November 8, 2009

Dr. Piermaria Oddone, Director, Fermilab, January 16, 2010

Delegates from Rosatom, Russia, February 3, 2010

Prof. M. S. Swaminathan, Chairman National Commission on Farmers, April 8, 2010

Prof. S. C. Roy, Editor-in-Chief, Science & Culture, April 21, 2010

CEA Delegates for Mid-Term Annual Review Meet, July 8, 2010

Delegates from United Kingdom, July 30, 2010

Shri Prithviraj Chauhan, Minister of State for Science and Technology, October 10, 2010

Shri Patali Champika Ranawaka, Minister of Power and Energy, Government of Srilanka, October 30, 2010

Demonstration of DFRP chopper to Dr. Anil Kakodkar, Former Chairman, AEC, February 21, 2011

Dr. T. Ramasamy, Secretary, DST, February 9, 2013

CEA-IGCAR meeting, March 18, 2013

MOU CEA–IGCAR, March 21, 2013

MOU CEA–IGCAR, March 21, 2013

Shri R. K. Sinha, Chairman, AEC, August 9, 2013

Dr. G. Venkataraman, Former Director, ANURAG, DRDO, November 12, 2013

Dr. Avinash Chandra visit on January 2, 2014

Delegates from Korea Atomic Energy Research Institute, February 10, 2014

CEA Meeting, February 19, 2014

Dr. M.S. Valiathan, Former Vice Chancellor of the Manipal Academy of Higher Education, March 21, 2014

Shri S.S. Bajaj, Chairman, AERB on February 24, 2015

USNRC visit on May 5, 2015

CEA Delegates visit, November 24, 2014

Dr. Jithendra Singh, Minister of States, August 21, 2015

Delegates from Korea, February 2, 2016

Idaho National Laboratory Delegates, February 16, 2016

Plutonium 75 celebration on May 23, 2016

Delegates from International Atomic Energy Agency, May 31, 2016

CEA visit on October 3, 2017

Demonstration of Multipin chopper to Dr. M. R. Srinivasan, Former Chairman, AEC, November 15, 2017

JAEA & METI on January 8, 2018

JAEA & METI on January 8, 2018

IGCAR Director's Profile

Narayanan Srinivasan

Shri N. Srinivasan joined the Department of Atomic Energy in 1953. A distinguished chemical engineer who had been responsible for the construction of the Plutonium Plant at Trombay, Shri N. Srinivasan was designated as the Project Director for Reactor Research Centre (RRC) (renamed Indira Gandhi Centre for Atomic Research in 1985) at Kalpakkam in 1971. Shri N. Srinivasan initiated the fast reactor reprocessing program in the Centre to realise the vision of Homi Bhabha and Vikram Sarabhai. With his rich experience in the reprocessing technology, he guided the initial phase of the activities so that it could mature to a robust technology in future and provide necessary trained and experienced manpower for this crucial activity. He was Chief Executive of Heavy Water Board and later the Nuclear Fuel Complex. He was a member of Atomic Energy Commission during 1982-87. He is recipient of Padma Bhushan award from Government of India in 2000.

Chokkanathapuram Venkataraman Sundaram

Prof. C. V. Sundaram joined the Department of Atomic Energy in 1956. He was a major architect in ushering an era of production of rare, reactive and refractory metals, such as zirconium, beryllium, titanium and tantalum, utilising indigenous resources and expertise. His research contributions led to the establishment of a production plant for nuclear grade materials such as zirconium sponge, niobium and tantalum metal products at Nuclear Fuel Complex, Hyderabad. In 1982, he was invited to assume leadership of the Fast Breeder Reactor Programme of India as the Director of Reactor Research Centre (renamed Indira Gandhi Centre for Atomic Research -IGCAR) at Kalpakkam, at a crucial stage when the construction of the Fast Breeder Test Reactor (FBTR) was nearing completion. Through his dedication, hard work and inspiring leadership, he led the team of scientists and engineers in IGCAR towards the successful criticality of FBTR in October 1985. Prof. Sundaram was a recipient of several prestigious awards. For his outstanding scientific and technological achievements, Government of India honoured Prof. C. V. Sundaram with the Sanjay Gandhi Award for Science and Technology in the field of energy (1985) and Padma Bhushan Award in 1986.

Shrikant Ramakrishna Paranjpe

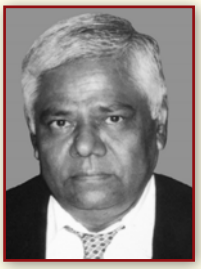
Shri Shrikant Ramakrishna Paranjpe a Chemical Engineer, joined the Department of Atomic Energy in the year 1955 and worked in Bhabha Atomic Research Centre, Mumbai. He headed the Fast Reactor Section at BARC in the year 1965 and initiated the preliminary design of a 10 MWe experimental fast reactor. In June 1971, he was shifted to Reactor Research Centre (later renamed Indira Gandhi Centre for Atomic Research), Kalpakkam as Principal Design Engineer (Head, Design Group) for executing the FBR programme. Shri S. R. Paranjpe, along with late Shri P. R. Roy under the Chairmanship of Dr. Raja Ramana boldly decided the use of mixed carbide fuel of unique composition as driver for FBTR, when there was unprecedented hindrance in the fuel supply to the nation due to Peaceful Nuclear Explosion in 1974. He played a key role in obtaining all the safety clearances for the test reactor. Shri Paranjpe guided the working group in the preparation of Detailed Project Report for PFBR and initiated a programme for testing PFBR MOX fuel composition with ^{233}U and ^{239}Pu in FBTR. He served as the Director of IGCAR, from 1990 till 1992. He built a dedicated team of scientists and engineers to pursue the fast reactor programme in India. He is the founder of Homoeopathic Association of Kalpakkam (HAK) to provide medical assistance to the poor and neighborhood villages around Kalpakkam.

IGCAR Director's Profile

Placid Rodriguez

Dr. Placid Rodriguez, joined the Department of Atomic Energy in 1960 and worked in Bhabha Atomic Research Centre, Bombay till 1974. He was leading the Mechanical Properties – Metallurgy Division of BARC from 1969-1974. In 1974, he has moved to Reactor Research Centre (later renamed Indira Gandhi Centre for Atomic Research), Kalpakkam as a senior metallurgist and established world class research laboratories for metallurgical research. He was the Director of IGCAR, Kalpakkam from December 1992 till October 2000. Dr. Rodriguez was internationally well-known for his R&D contributions in the areas of Mechanical Metallurgy, Welding Metallurgy and Nuclear Materials. He has guided and nurtured several young colleagues in the multidisciplinary fields of Science and Engineering for the advancement of fast breeder reactor technology in India. He has served with distinction as a member of Editorial Board of several reputed international journals in Metallurgy and Materials Science. He is a recipient of many National and International awards, a member of many national funding agencies for Science and Technology and has a member of the Scientific Advisory Committee to the Cabinet.

Shivram Baburao Bhoje



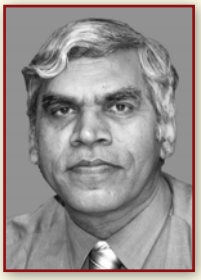
Shri S. B. Bhoje from the 9th batch of BARC Training School, joined the Fast Reactor Section, BARC in August 1967. He was deputed to the Centre d'Etudes Nucleare Cadarache, France, as a member of the design team of the 13-MW fast-breeder test reactor (FBTR) in 1969–70. In 1971 he moved to Reactor Research Centre and was in-charge of design of 40 MW Fast Breeder Test Reactor (FBTR) reactor assembly. In 1988 he became the Reactor Superintendent of FBTR. He was the Director of IGCAR during the period November 2000 – April 2004. Shri Bhoje also significantly contributed in design, R&D, manufacturing technology development, obtained statutory clearances for construction and pre-project activities of Prototype Fast Breeder Reactor (PFBR). He is a recipient of many awards. Government of India honoured him with Padma Shri in 2003.

Baldev Raj (2004-11)

Dr. Baldev Raj from the 13th batch of BARC Training School, joined Radiometallurgy division of BARC and was deputed to RISO Denmark during 1973. He was posted in the then Reactor Research Centre (RRC) in 1974 and entrusted with the responsibility of construction of Radiometallurgy laboratory. He was the Director of the Centre during 2004-2011. Dr Baldev Raj has played a pioneering role in mastering the technology of complex post-irradiation examination (PIE) of highly irradiated Pu-rich carbide fuels. He has been primarily responsible for initiating and nurturing NDE capabilities at the Indira Gandhi Centre for Atomic Research. This facility and expertise is one of the most acknowledged competence Centre. He has also provided innovative NDE solutions to challenging problems not only for the nuclear industry but also other core and strategic industries. He is also responsible for realising societal applications of NDE in areas related to cultural heritage and medical diagnosis. He is a recipient of many international awards and honors. Government of India honoured him with Padma Shri in 2007.

IGCAR Director's Profile

Subhash Chander Chetal



Shri S. C. Chetal from the 14th Batch of BARC Training School joined the then Reactor Research Centre in 1971. Since, then, he had been engaged in the field of Fast Reactor Engineering and has made significant contributions towards design of FBTR sodium systems and components. He is the principal design engineer of PFBR and has made outstanding contributions towards the material selection, manufacturing technology, R&D design and construction of 500 MWe Prototype Fast Breeder Reactor. He was the Director of IGCAR during May 2011 – Jan 2013. He is a recipient of many awards including Agni Award for Excellence in self-reliance by DRDO for titanium sponge production and Certification of Appreciation by International Atomic Energy Agency (IAEA) towards fast reactor technology.

Polur RangaRao Vasudeva Rao

Dr. P.R.Vasudeva Rao from the 16th batch of BARC Training School joined BARC in 1973 and then shifted to Kalpakkam in 1978. He was instrumental in setting up the Radiochemistry Laboratory at IGCAR. Dr. Vasudeva Rao, is a specialist in field of actinide separations relevant to nuclear fuel cycle. He was the Director, IGCAR from Feb 2013 - Aug 2015. Under his guidance, the research and development in the chemistry aspects of fast reactor fuels, coolants and control rod mechanisms was established. Thereafter, Dr. Rao was associated with DAE as Raja Ramanna Fellow. Currently, Dr Rao is the Vice-Chancellor of Homi Bhabha National Institute, Mumbai. He is recipient of many awards and honours.

Srinivasula Ananta Venkata Satya Murty

Dr. S.A.V. Satya Murty topper from the 21st batch of BARC Training School joined the then Reactor Research Centre in 1978. His work in the field of Wireless Sensor Network applications in the Nuclear Reactor domain has received international acclaim. He was instrumental in setting up a robust Internet, E-Mail and Information Security systems in IGCAR. He actively participated in development, Verification & Validation of Instrumentation and Control systems for the Prototype Fast Breeder Reactor. Under his guidance, PFBR Operator Training Simulator, Advanced Visualization Centre, High Performance Computing Systems and Computer Network facilities were established in IGCAR. He was Director of IGCAR from September 2015 to June 2016. He was also associated in establishing TDEM system for Uranium Exploration. Subsequent to his superannuation he was awarded Raja Ramanna Fellowship. He is recipient of many awards and honours..

Arun Kumar Bhaduri

Dr. Arun Kumar Bhaduri Homi Bhabha Topper from the 27th batch of BARC Training School, joined Reactor Research Centre (later renamed Indira Gandhi Centre for Atomic Research) Kalpakkam in 1984. A Humboldt Fellow from the prestigious Alexander von Humboldt Foundation, Germany. He specialized in the field of welding, hardfacing and materials joining and has nurtured an internationally acclaimed group in this area. Apart from steering the centre towards the development of materials and their fabrication technologies for Indian nuclear programmes on sodium-cooled fast reactors, he also anchors the development of materials and their fabrication technologies for fusion reactors and advanced ultra supercritical thermal power plants. He took over as Director, IGCAR in July 2016. He is a recipient of many international and national awards and honours and is also a member of Governing Council of C-MET & Senate Member of NIT Puducherry.

Acknowledgement

This memoir is an effort to record the milestones on the occasion of the Founders Day celebration of IGCAR, 2019. The Committee acknowledges the valuable contributions made by the past and present employees of the centre and associated institutions towards achievement of IGCAR.

We gratefully acknowledge the guidance and support given by the Group Directors and all their colleagues. We are also grateful to Director (P&A), IFA, DCA, officials and staff of Administration and Accounts.

We thank Director, Dr. Arun Kumar Bhaduri and Dr. G. Amarendra for their support, guidance and valuable time.

The committee greatly appreciates the valuable contribution of colleagues of Scientific Information Resource Division for the successful completion of the memoir and also for providing the photographs since the inception of Reactor Research Centre.

The committee expresses its gratitude to the contributions made by all those who were associated with the compilation of the Memoirs of IGCAR directly or indirectly to achieve its success.

Founders Day Committee

Evolution of FBTR

1972 Breaking of

1973 FBTR-ISW Rock

1973 FBTR Reactor

2019

1974 FBTR RCB North view of

1975 FBTR RCB Dome East

1977 Completed

"Biodiversity of DAE Kalpakkam campus"

DAE Kalpakkam campus stretches for about 3200 acres and is native to many species. The campus has a rich avian fauna diversity.

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