INSIDE

From the Director's Desk

History of Electronics and Instrumentation Group

Instrumentation is ears & eyes of the Process Plant and Computational system is the brain. Electronics & Instrumentation Group (E&IG) is responsible for the development of state-of-the-art Instrumentation system and Full Scope Training Simulator for Fast Breeder Reactors & associated Fuel cycle facilities. This group is also responsible for assuring the availability of state-of-the-art distributed computational systems for the development of Fast Breeder Technology. History of EIG comprises of history of Electronics & instrumentation Division, Computer Division, Medical Division and Innovative Instrumentation Section.

History of Electronics and Instrumentation Division:

In 1969, a historic decision was taken to deploy fault tolerant indigenous TDC-316 based Safety Critical Real Time computer system to supervise the reactor core of Fast Breeder Test Reactor (FBTR) against blockage of coolant flow in the fuel subassemblies. When FBTR attained criticality on 25th October 1985, TDC 316 computers were supervising and controlling the reactor. Dedicated team consisting Mr.S.A.Weling, Mr.P.Sreenivasan, Mr S.R.Singh, Mr S.Athinarayanan, Mr C.Boopathy, Mr A.V.Chandrasekar, Mr N.C.Samantha and Mr P.Swaminathan realized this prestigious project. Mr.Gourievidis from CEA, France was the consultant. The application software was developed in assembly language. Shri Dilipkumar from ECIL coordinated the manufacturing of the computer system at Electronics Corporation of India Ltd(ECIL), Hyderabad. When the system arrived at IGCAR,FBTR site was not ready to receive the same. The system was temporarily installed at Central Water Chilling Plant. The system was provided with magnetic tape, card reader and line printer. To

Central Data Processing System at FBTR, installed In May 1983

start with, the system was used by reactor design team for running simple FORTRAN jobs. Incidentally this was the first computer system in the campus for running FORTRAN jobs. Dr H.N.Sethna, Chairman AEC congratulated for installing Computer system for solving scientific jobs. But he cautioned that the system would have lived it's life by the time FBTR goes critical. The system was subsequently shifted to FBTR site and commissioned with the Plant. The system had only 64KB magnetic core memory. So every bit was precious for storing the application programs such as core temperature supervision, discordance supervision, general supervision, start-up check and fine impulse test routine. A rugged teletype unit, housed in adjacent place to control room, was the first one to indicate the criticality of FBTR. The trend of period signal from start-up channels showed continuous positive value, confirming the criticality of FBTR. Mr.C.V.Sundaram, the then Director of the Center, was happily observing the trend of period signal from computer room.

Though the design of FBTR I&C systems was finalized and orders placed on ECIL, Hyderabad for development and fabrication, Mr.N.Srinivasan, Director of the Center visualized the need to have design and development laboratories in all the fields of science and engineering. The mandate was to have world class laboratories capable of designing future fast reactors and associated fuel cycle facilities indigenously. This vital decision was vindicated when most of the advanced countries withdrew support to our programme in May 1974.

The R&D programs of Material Sciences & Instrumentation Programme were started in 1974 under the able guidance of Dr.G.Venkataraman, Principle Physicist of the Center. Mr.V.Subramanian was the officer-in-charge of Instrumentation Programe (IP). Mr.S.Nagaraja and Mr.N.S.Murthy from 17th batch of BARC training school were the first two engineers to join IP. Starting from scratch, the small team initiated work on procurement and design of Electronic Systems. After a year, the team was strengthened by more engineers Mr.S.Ilango Sambasivan, Mr.B.Krishnakumar, Mr.T.V.Karthikeyan, Mr.A.K.Rawat & Mr.K.Sundar and from there-on the team started growing steadily. The initial projects were custom made instruments and Signal Processing Systems for physics experiments. The main focus was on the capability to design electronic systems starting with fundamental concepts and take it to a final shape. This approach has remained the main strength of the programme. There is always challenge in developing Instrumentation system which is not available in the market. For example, accurate position measurement system was developed for charge/discharge flask of FBTR. At present, development of strategic control systems for control rod drive mechanisms and Fuel handling systems of Prototype Fast Breeder Reactor (PFBR) is in progress.

The late seventies saw the emergence of "Microprocessors" which revolutionized the entire electronics industry and the world. Intel had released its 8-bit microprocessor 8085 and the team at IP enthusiastically plunged into this new and exciting field. By this time, Mr.R.Narayanan, Dr.K.Neelakanta, Mr.S.Chandrasekaran, Mr. V. Muralidharan, Dr.L.Pathak & Mr K.Vijaya Bhaskar had also joined IP and microprocessor kits were procured to have familiarization with hardware and software. The young group of engineers, at that point of time realized the need to standardize on the system bus and an in-house design was adopted for all the systems. 8085 Central Processing Unit (CPU) card, Random Access Memory (RAM) board, Erasable Programmable Read only Memory (EPROM) board, Analog to Digital Converter (ADC) board & counter/Timer boards were designed successfully and fabricated. The printed circuit board fabrication was outsourced and the component assembly was done in-house. Software development was fully indigenous starting from 8085 monitor for system programming to the required applications software. One of the important 8085 based system developed by Mr.S.Ilango Sambasivan was to measure the displacement of FBTR Reactor vessel. Even today the system is working satisfactorily.

In 1981, the Central Data Processing System (CDPS) became part of Computer Centre with mandate to set up state-of-the-art computational facilities for the growing Centre. The Instrumentation Programme was renamed as Electronics & Instrumentation Programme (EIP). Both the activities were brought under Mr.S.A.Weling designated as Project Engineer(E&I). EIP was sanctioned an amount of Rs.1 Crore to build its own laboratory under the VI plan. The present
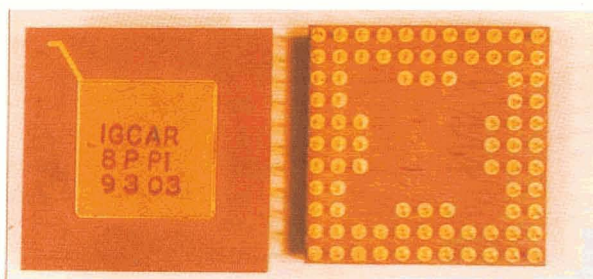
Programmable Peripheral Interface ASIC.

The first ASIC From DAE Developed at IGCAR in 1993

building was completed in July 1983 and EIP was renamed as EIL. For the first time in Department of Atomic Energy, Application Specific Integrated Circuits (ASIC)were designed by and fabricated at ITI foundry, Bangalore by Mr.V.R.Seshadri. Alarm sequencer ASIC is installed in FBTR to detect sequence of alarms.

After successfully installing a few data acquisition systems for the R&D facilities at the Center, EIL was asked to design and develop a Data Acquisition System for the Heavy Water Board (Kota) and the Madras Atomic Power Station-II. The control room of MAPS-II was equipped with a Color Graphic Information System and the entire hardware and software were designed in-house. 19" Raster Colour Graphic Terminals were deployed for the first time in any control room of a nuclear reactor. This development later paved the way for its use in other reactors. The data acquisition System for HWP (K) was implemented with a ECIL computer Super-16 as the central computer and 8085 microprocessor based systems as front end systems, all interconnected through RS-232 interfaces in a "STAR" architecture. In HWP (K), most of the signals were of the pneumatic type (3-15psi) and the scanning of these was implemented with "SCANIVALVE", a pneumatic multiplexer controlled by microprocessor. Based on the experience gained from HWP (Kota), EIL designed and developed Distributed Data Acquisition Systems for HWP (Tuticorin)& HWP, (Manuguru). The Supervisory Control and Data Acquisition System at HWP (Manuguru) had a novel architecture

with Remote Terminal Unit (RTU) as front end systems connected in a 'STAR' architecture to 3 Unipower-30 computers in a fault-tolerant architecture. The operating system used on these mini computers was Versados, a real time operating system. At a higher level, the mini computers and the PC based Graphic User Interface (GUI) stations were inter-connected by Ethernet. This architecture has today evolved into the three tier Distributed Digital Control System for the Prototype Fast Breeder Reactor (PFBR) with a Dual optical fiber based Local Area Network. TELELOGIC CASE Tool based software engineering lab is setup for development of application software for the Supervision and Control of PFBR.

The aged TDC 316 systems of Fast Breeder Test Reactor are replaced by state-of-the art 32-bit Real Time Computer systems, which are developed in Electronics & Instrumentation Division. The new

system has novel features such as memory error detection & correction facility, on-line testability of Input/Output cards and testable watchdog timer. Similar 32-bit based systems will be used for safety critical as well as for safety related supervision & control of Prototype Fast Breeder Reactor (PFBR). The technology is transferred to ECIL for mass production of Real Time Computer Systems for PFBR. Further microcontroller based Remote Data Acquisition unit and Switch Over Logic Circuit for PFBR were also developed in-house.

A task force, with Shri P.Swaminathan as Chairman was set up for replacing aged Real Time Computers of FBTR. Separate 32-bit based systems were installed at FBTR, one for safety critical functions and another for safety related functions. The application software was developed honoring MISRA-C guidelines to ensure reliability of application software. Water-Fall model was used for developing the application software. The entire hardware and application software have undergone extensive external verification and validation. Operation Superintendent of FBTR carried out extensive Validation tests with live signals. The performance of the systems is excellent.

Due to the non-availability of safety logic systems from other countries, it was decided to develop the same in-house. Two different

Dr. R. Chidambaram, former Chairman AEC witnesses
the Real Time system developed by IGCAR for HWP (Tuticorin) in December 1996.
On his left is Shri D.S.Lamba, Director (OL), HWP (T).

Shri B.Krishnakumar explaines the features of 32-bit Central Processing Unit based board to Dr Anil Kakodkar Chairman, AEC and Dr Baldev Raj Director,IGCAR & GSO during January 2007.

teams of Electronics & Instrument Division developed diverse safety logic systems for PFBR. All the nine control & safety rod mechanisms (CSRDM) are connected to conventional 2/3 voting Safety logic system. ASIC was also developed for carrying out Fine Impulse Test. Diverse Safety Drive Rod mechanisms (DSRDM) are connected to self testing, inherently safe pulse coded safety logic systems. Technology of both safety logic systems is transferred to ECIL for the production of Industrial grade version. Detailed Reliability analysis was carried out to ensure that the developed system satisfies the specified reliability.

Thus the famous statement of the department, **'Technology denied is technology gained'** is realized at IGCAR. As part of diversification, EID is looking beyond Reactor Instrumentation. At present EID is actively engaged in the development of Electromagnetic Time domain Survey System in collaboration with Indian Institute of Technology-Chennai. The system will be used to detect deposits of uranium ore up to a depth of 500M.EID is also installing modern security systems for Kalpakkam site such as scanning radars on eastern and western sides of the site, networked day and night vision cameras along the boundary wall, Biometric hand geometry systems based access control systems etc. MEMS based accelerometers and associated signal processing systems are also being developed by EID.

History of Computer Division

Computing Power and its utilization in an R&D organization is one of the indices of the quality and the extent of research & development done in that organization.

Modern safety critical Real Time Computer System for FBTR

Advanced Computing adds a new dimension to scientific research. This compliments traditional theoretical and experimental approaches to scientific research. The use of computing tools has become vital to most of the fields of science and engineering for performing precise computations leading to innovative R&D.

Initially, the R&D computing requirements of the Centre were met with the IBM 370 system in IIT, Madras by sending the punched cards once in a day. The scientists used to assemble at a specified location in the evening to collect their outputs.

Realizing the importance of scientific computing, efforts were initiated in the formative stages of this Research Centre to establish an in-house centralized computing facility by Mr.N.Srinivasan, then Project Director, RRC. Dr.G.Venkatraman was entrusted with the responsibility of acquiring the state-of-the-art computing systems. Those were the days when many brands of computing systems were denied to DAE due to embargo. However, Dr.Venkatraman with his vision and complete involvement obtained required approvals from Electronics Commission which was mandatory in those days. His vision and elegance in deciding a proper location for the computing facility has resulted in establishing the Computer Centre at IGCAR that is appreciated by everybody, to date.

A team headed with Mr.S.A.Weling, Project Engineer (Electronics and Instrumentation) procured Honeywell Bull DPS-8 computer system for the center.

Though its processing power was 0.75 Millions of Instruction per Second (MIPS) which is very small from present day standards, it was one of the powerful computer systems in the country in those days. The DPS-8 System, commissioned in 1982, was a proprietary System from Honeywell Bull and had a main memory of 4 Mega Byte (MB), eight hard disk units of 200 MB capacity, 4 Magnetic tape units, 2 card readers, 2 line printers and a plotter. The Operating System

Delegates from CEA, France admire the features of Pulse coded Safety Logic system for PFBR in January 2007

supported concurrent time sharing and batch processing. The software included FORTRAN, COBOL, Pascal Compilers and DM IV Database Management Systems. To facilitate easy usage of the computer system, the time sharing terminals were located in all the laboratories. Because of its proprietary nature, the complete system was maintained in-house by a well trained team of engineers headed by Mr.P.Sreenivasan.

Dr.G.Venkataraman, through his vision had felt that Computer Aided Design, a very new concept in those days, will play a major role in the reactor design and analysis of the fast reactor system, the main mandate for the centre. Accordingly, with the support of Dr.R.Chidambaram, then Director, Physics Group, BARC had procured CAD Systems based on Norsk Data ND 560 with powerful graphics terminals and advanced CAD Software.

These CAD Systems were extensively utilized by Reactor Engineering Group for the early design of PFBR. Further the scientific computing power was enhanced by two Super 32/70 Super mini computers which were manufactured by M/s. ECIL and later by RISC based servers and advanced graphic visualization workstations.

The architecture of new generation computers started using distributed parallel architecture as opposed to the omni present Von Neumann architecture that processes data in serial fashion. In parallel architecture a computational job is executed at a higher speed using a number of computers working on various parts simultaneously. These parallel systems based on commonly available microprocessors are highly cost effective and there is no theoretical limit on the speed achievable. Using this technology, a significant milestone has been achieved in scientific computing at IGCAR through the commissioning of a High Performance Computing Cluster with 32 Itanium-2 processors. This cluster delivers a maximum sustained performance of 156 Giga Floating point Instructions per Second (GFlOPS). The system is powered by the 16

Compute Nodes and a Management Node based on the state-of-the-art Itanium-2 processors in Dual Processor configuration. High speed Gigabit Ethernet interconnect is used for communication between the nodes. The computing systems are extensively used for design and analysis of sub systems of PFBR.

After the superannuation of Mr.S.A.Weling on 31st January,1995, Dr.S.M.Lee was appointed as Director of Safety, Health, Instrumentation and Electronics Group (SHINE) with Mr.P.Srinivasan as Associate Director, Electronics Group. Dr.S.M.Lee took keen interest in upgradation of the computational power to meet the user requirements and setting up of a campus wide network.

The centralized high performance computing facility is made accessible to the desktops of all the authorized users across IGCAR through the campus-wide high-speed Asynchronous Transfer Mode (ATM) based network setup. This is further upgraded to gigabit Ethernet network.

In the area of Grid Computing, Intra-DAE Grid Network has been established for sharing heterogeneous computational and information resources across DAE organizations in an organized and uniform manner. A Computational Grid Centre has been set up with necessary hardware / software infrastructure and computational resources at IGCAR for deploying Grid Applications. Software developments in the fields of grid resource management and information systems are being carried out for efficient management.

Honeywell Bull DPS 8/46
Magnetic Disk Drives

Honeywell Bull DPS 8/46
Computer System

Honeywell Bull DPS 8/46
Terminal Operation

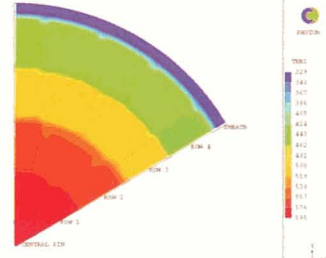Norsk Data ND560 Computer System

Flow Simulation with STAR-CD

Spent FSA Temp. profile using PHOENICS

FSA Head Finite Element Modeling
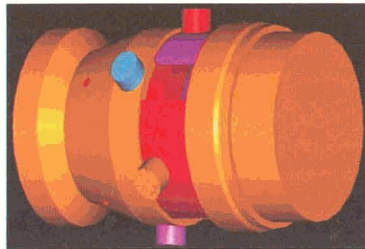

Welding simulation using SYSWELD

In 1994, Dr.C.K.Mathews, Head, Radiochemistry Programme took the initiative in starting E-Mail services at IGCAR through a 1.2 Kbps dial up modem connection with IIT, Madras. Later, in 1996, Computer Division has established a more reliable VSAT based ERNET connectivity with a speed of 9.6 Kbps, considered significant speed in those days. With this, Internet and E-Mail Services were made available to the scientific community at IGCAR. Later, these services were extended to all the laboratories through ISDN lines and dial up modems. The Internet, E-Mail, scientific computing and other services were made available on the desktops of engineers and scientists through the campus network. Meanwhile, with the increased popularity and realization of its utility, the internet demands have grown and Computer division had augmented these resources significantly to meet the users' requirements. At present, 12 Mbps Internet bandwidth is made available and is being augmented to 34 Mbps through fiber optic leased lines. With the connectivity to Internet, network security has become an important activity of the Computer Division and security measures are implemented and enhanced often enough to be up-to-date and secure. These security measures are continuously reviewed and augmented through the installation and administration of Firewall, intrusion detection and prevention system, antivirus, anti-spam, anti-spy ware measur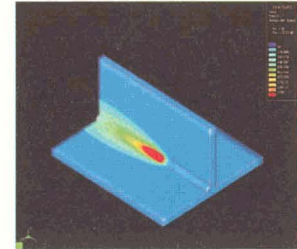es. Also, to meet to secured communication requirements of the Department, a private VSAT based network called Anunet was commissioned, thus connecting all DAE units.

With well established and maintained set up, the internet and e-Mail have become the main stay of communication, Information access and dissemination for all the scientists & engineers. With the increased usage, the data communication facilities have been constantly enhanced. The campus network was upgraded to the state of the art 1 Gbps Ethernet and 1 Gbps connectivity was provided to all the laboratories / buildings of IGCAR. A state-of-the art Video Conference Facility was also commissioned on 28th Feb, 2004 to provide easy interaction with industries and other units of DAE. Selection committee meetings and various steering committee meetings are being held through Video conference mode. Dedicated optical fiber cable is being used for video conference meetings between IGCAR and BARC.

With all these developments, IGCAR can claim to have one of the best Data Communication Service set-ups in the country.

The computing power of the Centre has been progressively increased from 0.5 MFLOPS (in 1982) to 156 GFLOPS (in 2006), thanks to rapid processor technology advancements over the years.

Anunet Communication System at IGCAR

Inauguration of Video Conference Facility by Dr. Anil Kakodkar
Chairman, AEC in February, 2004

To ensure safety in the operation of any nuclear power plant, comprehensive training of its operators in all phases of the plant operation is essential. This training is given not only to new operators but also on a periodic basis to the qualified operators as a refresher course to maintain their skill at peak levels. Full Scope Replica Training Simulator provides quality training for plant operating staff and hence enhances the plant uptime. Realizing the importance of Training Simulator for PFBR, in-house development of such Training Simulator was initiated as Xth Plan Project. The simulator software is being developed on a simulator development platform at IGCAR under the guidance of Mr.S.C.Chetal, Director,REG. The control panels and console panels for the simulator are fabricated by ECIL. Computer division is actively engaged in integrating the modeling software of various subsystems of PFBR. After completing this project, development of Training Simulator for Fuel Reprocessing Plant will be taken up.

Computer Centre has established a state-of-the-art 3-D Plant Modeling and Visualization & Walkthrough Facility. The facility is extensively used by the Reactor Design Group to model and visualize complexity of various nuclear components of PFBR such as main vessel, safety vessel, inner vessel, grid plate, core support structure, Intermediate Heat Exchanger (IHX), primary pump, control plug, roof slab, steam generator and air heat exchanger. System has been effectively utilized for checking the interference and animation studies and to generate effective plant walkthrough.

With the superannuation of Dr.S.M.Lee on 29th Feb,2004,Mr P.Swaminathan was designated as Director, Electronics and Instrumentation Group (E&IG). The Innovative Instrumentation Section headed by Mr.B.Saha and Medical Division Headed by Dr.Mangala Nagarajan were also included as part of E&IG.

The operations of Computer Division and Development Processes of Instrumentation systems at Electronics and instrumentation Division are ISO certified from 25th March, 2006 onwards.

History of Innovative Instrumentation Section:

The sensor research programme at the Innovative Instrumentation Section (IIS), formerly known as the Ultra Sensitive Devices and Technique Section (USDTS), under the guidance of Mr.B.Saha unfolded with the evolution of a generic approach for design of powerful sensing tools, enabling instrumentation with reduced electrical, electronic and mechanical hardware. An integrated view of detection and measurement led to conceptualization of unconventional approaches, followed by laboratory creation of unique, easily realizable and inexpensive pulsating sensors for diverse physical and physico-chemical parameters. The features such as (i)flexibility in sensor design, (ii) primary signal generation directly as trains of digital pulses with nominal power supply needs, (iii) ease of wired or wireless transmission of pulses over long distances, and (iv) their ready adaptability with digital systems for data processing and presentation in multi-channel modes, facilitated laboratory development of total instrumentation packages for meeting diverse real-time monitoring needs in IGCAR.

Efforts ushered in highly cost effective means for monitoring of conductivity, temperature, differential pressure, low pressure, leakage of conducting liquids, levels of conducing and non-conducting liquids, position/displacement, absorbed radiation dose, chemical-/ thermo-emf, mineral oil degradation, illumination level etc. Complete systems have been made and deployed for applications in process monitoring, leak surveillance, trace analysis and field measurement as well as for miscellaneous investigations in static and dynamic systems. Further, combination of different types of sensors permitted development of automated miniature facilities which are being used extensively for rapid electro-analytical and thermo-analytical measurements in basic research and in rapid chemical assay with small volumes. Besides, the sensors permitted quick development of specific devices for capturing of rapidly changing situations in support of engineering R&D. All applications made through such in-house developed pulsating sensors ought to qualify as international benchmarks when measured against the parameters such as cost, simplicity, reliability and, above all, performance.

Substantial returns in a short time within a decade starting from conceptual stage and the unlimited

Development of Pulsating Sensors for Conductivity, Electrochemical potential, Temp., P& ΔP", Position, Level, Illumination, Radiation dose, Leak detection, etc.

possibilities arising out of this totally indigenous programme, are the basis for the following vision: (i) deployment of pulsating sensors for process control, simultaneously with respect to diverse parameters, in highly demanding situations, (ii) continuation of exploratory efforts to cover more areas of high precision measurement through further innovations, (iii) acceleration of drive towards simplification of plant / process monitoring and analytical instrumentation in fast and thermal reactors, associated fuel cycles, and related basic research or engineering development activities, and (iii) enabling research, educational and industrial establishments across the country to absorb these readily affordable means for meeting many of their sensing and instrumentation needs.

Obsolescence rate of hardware & Software and migration of trained staff are the highest in the field of electronics, instrumentation and computer technology. To beat obsolescence, the highly dedicated staff of E&IG always remember the famous statement of Levis Carroll in "Alice in Wonderland":

It takes all the running you can do, to stay in the same place.

If you want to get somewhere else, you must run at least twice as fast as that!

The knowledge generated in each project is very well documented and stored in Knowledge server. Electronic Colloquium provides forum for conversion of tacit knowledge to explicit knowledge. Project teams are carefully formed with proper mix of senior scientific officers and junior scientific officers. Regular project progress meetings provide another forum for transfer of knowledge among the staff.

History of Medical Division

Medical Division is responsible for providing effective health care for nearly 27000 CHSS beneficiaries located at Kalpakkam Township, Anupuram Township and at Chennai. Health service at Kalpakkam was started in July 1967 with Dr.D.Ramamurthy as Medical Superintendent. Dr.Seethadevi, Dr.D.Jacob and Dr.Mangala Nagarajan, successive Medical Superintendents, expanded the Medical facilities at Kalpakkam. Today, DAE hospital is equipped with Modern medical laboratory, Modern operation theatre, Male & Female medical and surgical ward, Pediatric ward, Xray and Scanning unit, ECG and Treadmill facility etc. After the superannuation of Dr.Mangala Nagarajan on 31st August, 2004, Dr.A.Vijaya was designated as Head, Medical Division. Both Medimeet and Para-Medimeet were conducted in April 2005, thus providing opportunity for Medical officers of various DAE units to exchange their professional experiences.

Day-to-day operation of the laboratories of Medical division is ISO certified. To cater to the growing needs of residents of Anupuram Township, modern peripheral Hospital is being constructed at Anupuram. The social balance sheet is also healthy with regular free health camps organized in nearby villages with the motto *"Service to Mankind is service to GOD."*

Thus, Electronics & Instrumentation Group is a very specialized and vibrant team of professionals meeting the diverse challenges of the Centre with commitment, dedication and excellence.

(Baldev Raj)
Director, IGCAR

Medical Checkup by Dr.A.Vijaya, Medical Superintendent, during a Medical Camp in the neighbouring village

Experimental Demonstration of Stability of PFBR Core Subassemblies under Seismic Excitations

The core subassemblies of Prototype Fast Breeder Reactor (PFBR) are supported on the grid plate (GP) in free standing condition. These subassemblies will get closely packed once displacements / deformations due to creep and swelling get accumulated to an extent, once the inter subassembly gaps are closed. For each subassembly (SA), while its self weight is acting downward, there is an upward fluid force due to buoyancy, pressure and drag effects which generates an upward acceleration of 0.24 g (maximum). Further, a safe shut down earthquake can cause a peak upward acceleration of 0.88 g. Under such scenario, the major concern is that the core subassemblies should not get lifted off from the GP. In order to demonstrate the same, an experimental set up has been designed in a novel way to simulate the upward fluid pressure while the subassemblies are subjected to simulated seismic excitations on the shake table. Based on the tests, it has been ensured that the subassemblies will not get lifted off due to seismic excitations generated at the GP where they are supported.

Introduction

PFBR core consists of a central fuel region enveloped by blanket region, which in turn, are surrounded by neutron reflectors. Physically the core is made up of different types of subassemblies, 1757 in total, supported on the GP and one typical SA mounted on the GP is shown Fig.1. The heat generated in the subassemblies is removed by the coolant sodium flowing axially through them. In order to provide the required flow, the pressure of sodium in the GP is maintained at about 0.7 MPa, which develops an upward lift on each of the core SA. A maximum hydraulic lifting force, equal to 24 % of weight of SA is possible, in case of pump running at 110 % of design flow rate. During normal operating condition of the reactor, the net gravitational acceleration acting on each SA (even though it is less than 1 g) is always downward and hence there is no fear of any uplift. However, there exists a concern during seismic events, in particular, under vertical excitation component. The seismic analysis of reactor assembly indicates that the peak vertical acceleration of GP can be as high as 0.88 g under SSE (Fig.1). The safety criteria to be respected is that under combined effect of self weight, upward fluid force and seismic excitations, no SA should get lifted off. This critical safety issue has been resolved by experimental investigations. This article presents the details of the investigation.

Assumptions

Assumptions are made appropriately to yield conservative results. Since, an isolated free standing single SA is considered, the resistance offered by the adjacent SA is ignored. The fluid pressure developed under 110 % of design flow
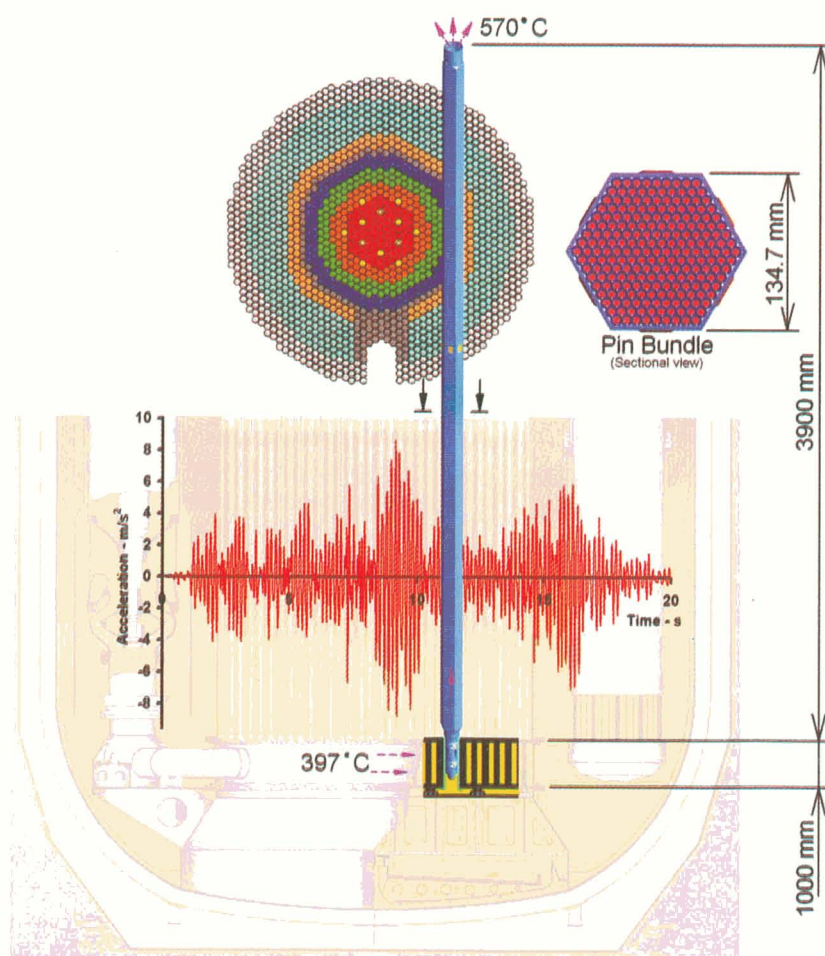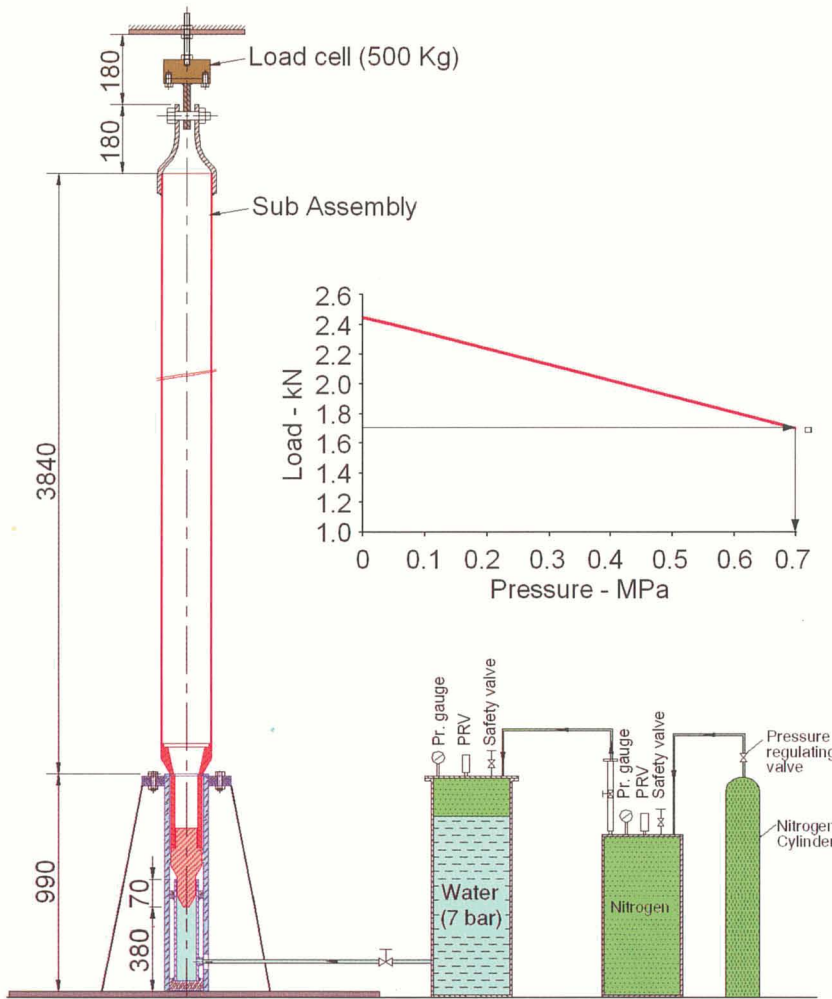

Fig. 1 Essential input data

Fig 2: Simulation of upward force

is simulated. Pure vertical excitations are combined with the fluid pressure. However, the effects of horizontal excitations are studied through separate tests.

Experimental Simulations Test Mockup

The SA mock-up used is one of the core subassemblies manufactured for PFBR. The fuel bundle is replaced with an equivalent bundle of steel rods of 8 mm diameter, having mass equal to that of prototype. Further, the GP sleeve manufactured for PFBR is used for the test mock-up. Since the test mock-up is geometrically similar, having the same mass and boundary conditions, the stiffness and inertial forces are simulated exactly in the test.

Net upwards force acting on the SA

Under normal operating condition, the loads acting on the fuel SA are: self weight of 250 kg (downward force), buoyant force plus coolant pressure force plus drag force of fluid which are acting in upward direction. The net upward force is computed as 0.24 x weight of SA. The peak vertical seismic excitation acting on the SA during a safe shutdown earthquake is 0.88 g (Fig.1). It is worth mentioning that the net upward acceleration (0.88 + 0.24 = 1.12 g) exceeds 1.0 g. The upward fluid force is simulated by pumping water under pressure using the setup shown in Fig.2. The SA is made to freely hang through a load cell so that it can measure the

weight of the SA accurately. Further, with the O-ring seal between foot and sleeve, it is possible to apply and sustain pressure up to 1 MPa without offering any significant constraint for the vertical motion. The pressure to be applied at the bottom of SA to generate the targeted upward lift force equal to 30 % of the weight of SA (an additional force equal to 6 % of weight of SA has been considered to account for the possible uncertainties) is established by measuring the load with the specific pressure applied at the bottom. The measured weight by the load cell is plotted as a function of applied pressure at the bottom in Fig.2. The reduction in weight is due to the upward lift provided by the pressure. The pressure to be applied at the bottom is 0.7 MPa for simulating the required upward force. The required pressure is applied by a water pump attached with the test setup through a hose, which provides excellent flexibility during dynamic displacement of test assembly under seismic base excitations after mounting on the shake table.

Seismic Excitations

Test has been done by using tri-axial shake table of 10 t capacity. Experimental setup is shown in Fig.3. A dedicated data acquisition system with 64 channels is used for capturing the structural response under seismic excitation. Three LVDTs are used for measuring the relative displacement of the SA with respect to GP top. Acceleration time history measured by the accelerometer, mounted on the GP support location, ensures that the support structure has sufficient rigidity and hence, the vertical excitations imposed on the table are transmitted to the mock-up without any distortion. The setup is subjected to vertical excitations with the peak accelerations to ensure the realistic transmission of seismic excitations to the SA.
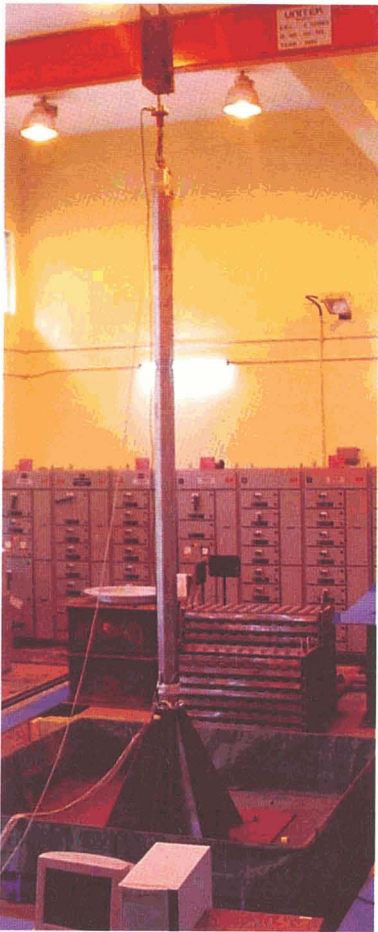
Fig.3: SA mounted on shake table testr setup

Fig.4 : (a) SA Displacement for 0.5 g (vertical); (b) SA Displacement for 1.0 g (vertical); (c) Displacement for 1 g (multi-axial)

Discussion of Results

Excitations corresponding to peak acceleration of 0.5 g and 1.0 g are applied and the accelerations are measured at the GP top portion. The applied accelerations and the average relative displacements w.r.t GP top surface, measured by LVTDs are shown in Fig.3. The random variation of displacements for the peak acceleration of 0.5 g (Fig.4a) indicates that there is no impact and hence SA always gets attached with grid plate. Further, the discrete displacement peaks observed for 1.0 g (Fig.4b), imply that there are impacts from which it is inferred that the SA gets lifted off. However, the magnitude of lift off is insignificant (< 2 mm). In order to investigate the effects of horizontal excitations, tests are repeated for 1.0 g peak acceleration, by way of applying seismic excitations in all the three X, Y and Z direction using the input time history correspond to the GP location. The random variation of displacement response with peak value < 0.3 mm, indicates that there is no lift off of SA (Fig.4c). This further demonstrates that there is no risk of instability or lift off of subassemblies under seismic loading.
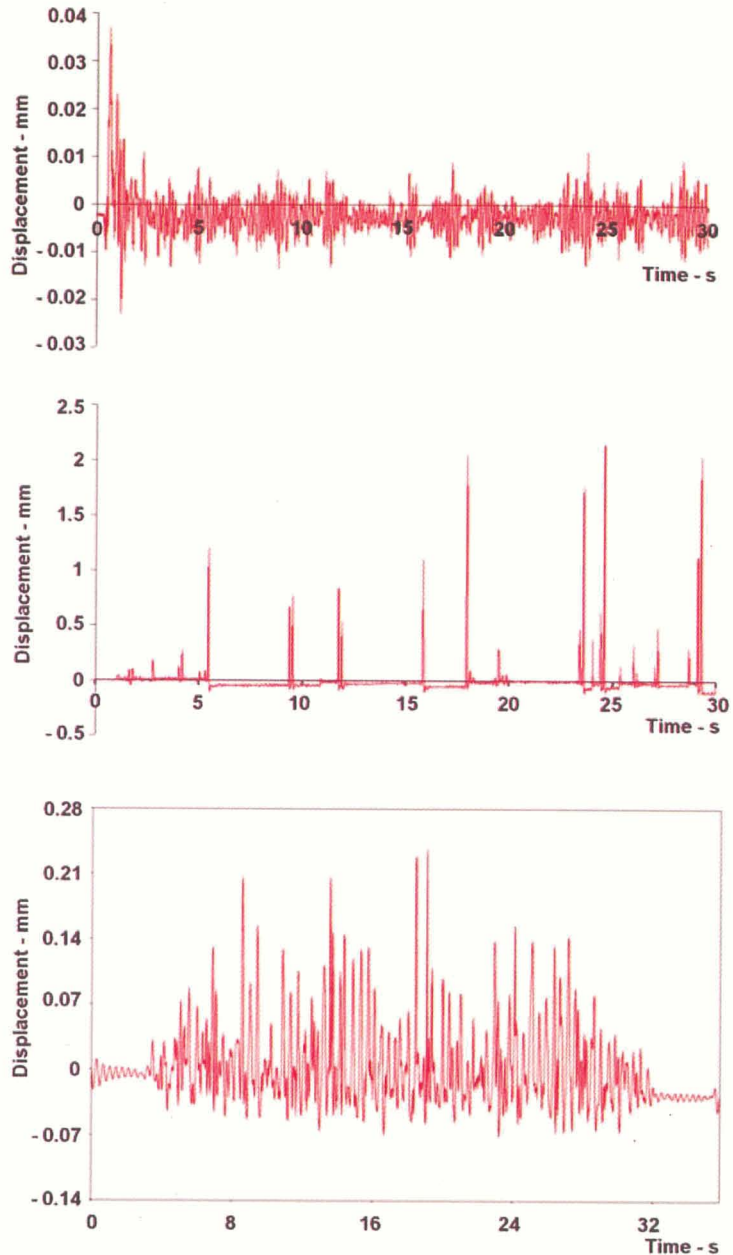
Conclusion

Design and development of a novel test setup to apply simultaneously upward fluid pressure along with the seismic excitations is an innovative idea. It is an important study towards demonstration that there is no fear of lift off of the core subassemblies under seismic events.

(Reported by P.Chellapandi, S.D.Sajish, V. Rajan Babu, P.Puthiyavinayagam and S.C.Chetal, Reactor Engineering Group)

Steam Generator
Using Module Water Flow Signal

Hydrodynamic flow instability in Once through Steam Generators (OTSG) is one of the important problems in the design and operation of Liquid Metal Fast Breeder Reactors (LMFBRs). Under certain operating conditions, water flow in OTSG is susceptible to instability due to the close coupling between the thermal and hydraulic processes. Sustained flow oscillations due to instability are undesirable since they result in flow mal-distribution among the tubes or in SG modules resulting in thermal stress, mechanical vibrations and system control problems. It is therefore, necessary to predict the conditions, under which instability occurs so that the system may be designed to operate always under stable conditions.

Many types of dynamic instabilities can occur in a SG tube, which can be ascribed to a number of different causes, viz. propagation of pressure or density waves, variation of flow patterns and thermodynamic non-equilibrium between the phases in the superheated steam region. However, the cause of the main type of instability important for the design of SGs is the propagation of density waves. This type of low frequency instability is referred to in literature as parallel-channel, density wave, time delay or mass flow-void feedback instability.

Dynamic instability (density wave oscillation DWO) occurs because of the phase mismatch between the primary perturbation (water flow) and the response to this perturbation (pressure drop). As many tubes are operating under essentially constant pressure heads, this mismatch can lead to sustained/ diverging oscillations. For example, when water flow is reduced, or sodium flow is increased, vapour generation rate and pressure drop change. Time delays between these processes can, under certain operating conditions, cause sustained oscillations, leading to the onset of dynamic instability. This has been experimentally studied by many investigators and empirical correlations have been developed.

Water flow oscillation in tubes manifests as oscillations in the steam temperature at the tube outlet/ pressure fluctuations. However it is difficult to instrument individual tubes in SG for such measurement in an operating plant. If the flow oscillation in the tube manifests itself in the overall module flow, then fluctuation in the overall flow/flow noise could be utilized for on-line
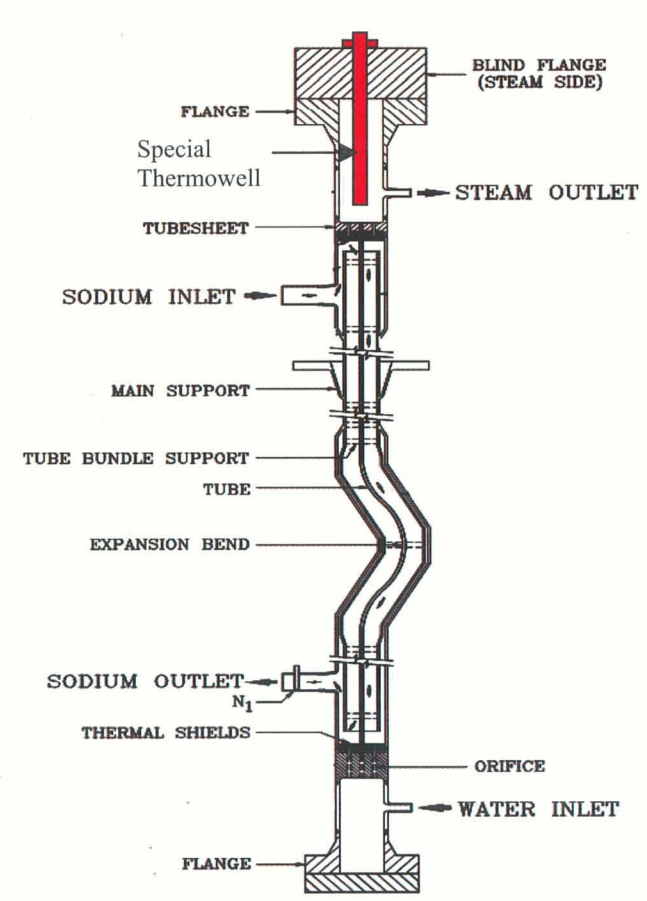

Fig-1 SGTF-Steam Generator

stability measurements. Towards this experiments were conducted in the sodium heated once through steam generator in SGTF (Fig-1). To confirm the extent of oscillation in the steam temperature and in inlet water flow, 3 tubes out of 19, were monitored besides overall module flow.

Main objective of the present study was to assess the occurrence of dynamic instability in SG through module inlet flow perturbations, confirmed by ΔP measurements across the orifice at entry to the tubes and steam temperature fluctuation measurement at the outlet of tubes.

In the first phase, Flow Instability measurement was carried out at 20% Power level (1.1 MWt). By decreasing the SG outlet pressure, instability regime was approached. Fluctuations in the steam outlet temperature and in the inlet flow were monitored continuously to detect the onset of instability phenomenon.

Instrumentation

For temperature fluctuation measurement, K-Type thermo-couples installed at the steam outlet of 6 SG tubes (Tube No: 4, 5, 7, 11, 12 and 18 in Fig-2) were monitored continuously in the DAS. Fig-3 shows the specially designed mounting arrangement for thermocouples in SG tube outlets. 3 tubes in the periphery (Tube No: 4, 7 and 18), in which the thermocouples have been mounted, are provided with Differential Pressure Transmitters across the orifice at the bottom tube sheet for measuring flow fluctuations.

During the stable operation of steam generator at 1.1 MWt power (20 % of nominal power), the fluctuation in the steam temperature measured from the thermocouple installed in various SG tube outlets is around 2-3⁰C.

During the operation in the unstable region, the mean outlet temperature in all the tubes was
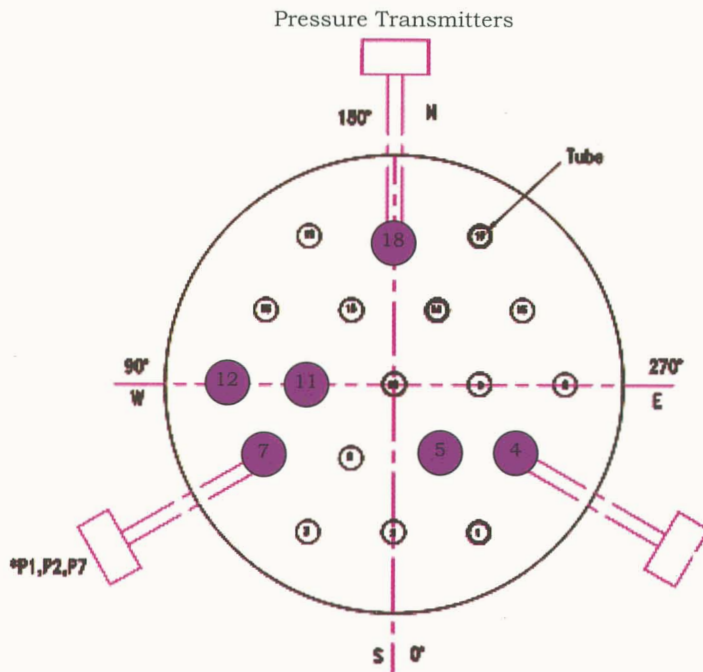

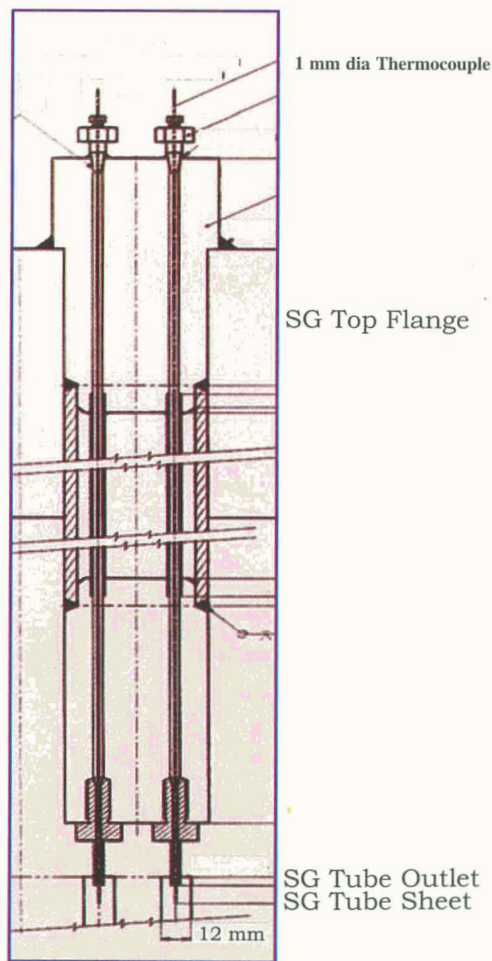Fig-2 Details of Tube Thermocouples and DPTs

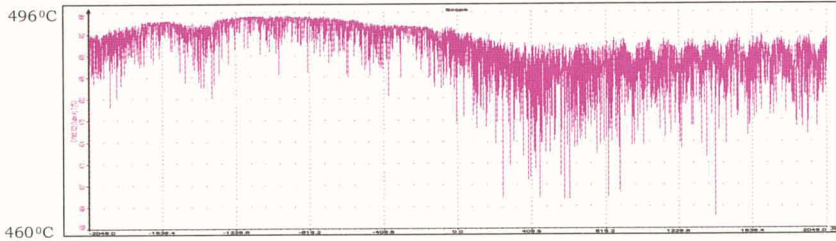Fig-3 Special Thermowell for Thermocouples

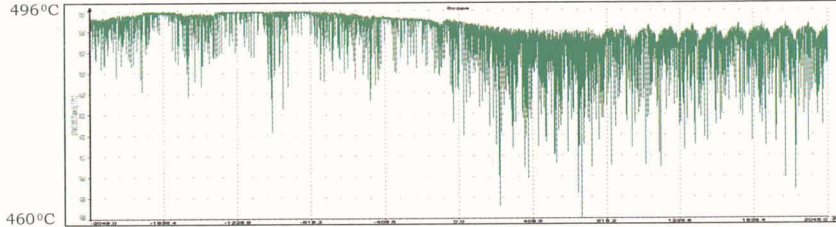Fig-4a Steam Outlet Temperature fluctuation (Tube 4)

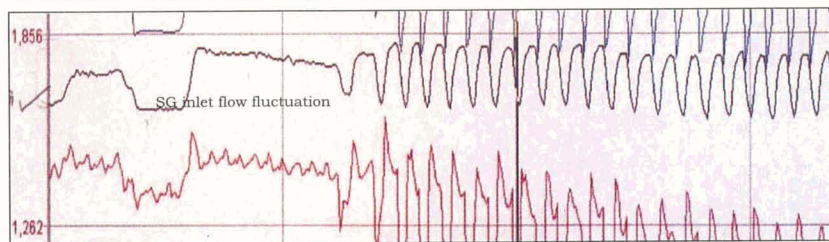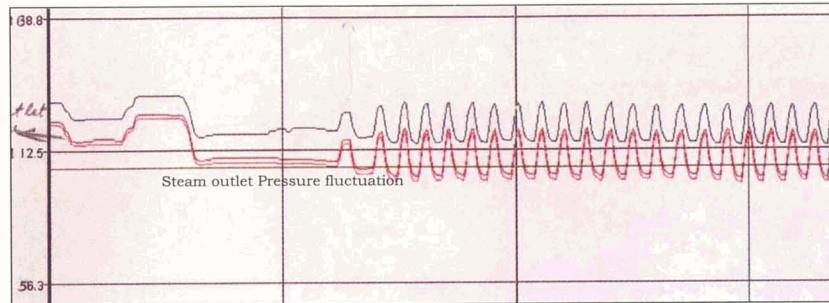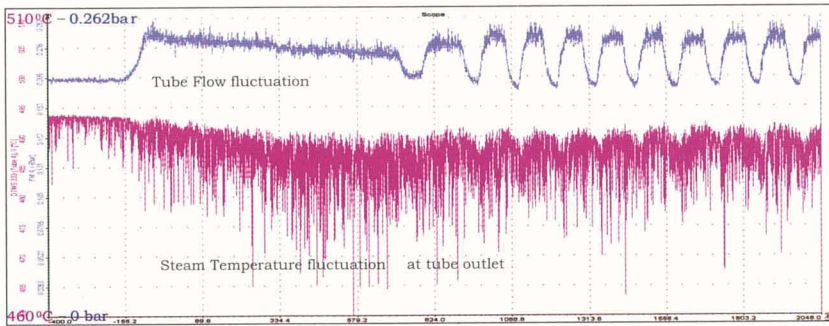Fig-4b Steam Outlet Temperature fluctuation (Tube 7)

Fig-5 Instability Build-up

found to be decreased and very large fluctuations in temperature readings are observed (Fig-4a & Fig-4b).

The observed fluctuations in the steam temperature is found to be varying by about 18-24 °C in Tube No 4, 5 and 7 and was observed to be 10-15 °C in Tube No 11 and 12.

Fluctuations, periodic in nature were observed at the output of the differential pressure Transmitters connected across the orifice in tube 4 and 7 during the instability phenomenon. The peak-to-peak amplitude of oscillation is found to be around 0.06 bar and the period of oscillation is 125 seconds.

Fig-5 shows the variation of both the Thermocouple output and the differential pressure transmitter output for Tube No-4. Similar pattern of oscillation is observed in the temperature and in the DPT output for Tube No-7 also. Oscillation observed in flow, in Tube No-4 and in Tube No-7 was found to be in the same phase.

It is also observed that during the instability phenomenon, the SG outlet pressure (117.6 bar) was showing a sinusoidal oscillation similar to that observed in the temperature and DPT outputs (Fig-5). A similar trend is also observed in the module feed water inlet flow to SG during instability. The amplitude of oscillation is measured to be approximately 180-200 kg/h (Fig-5).

The experimental results have indicated the feasibility of an instrumentation scheme for on-line measurement of dynamic instability in once through Steam Generator in an operating plant.

(Reported by Anup Kumar, V.Vinod, V.Prakash, Fast Reactor Technology Group)

Distributed Operator Information System for Augmented Boron Enrichment Plant
ABEP

Boron in nature contains two isotopes ^{10}B and ^{11}B. Natural abundance of ^{10}B is 19.8% and ^{11}B is 80.2%. Since ^{10}B is having higher neutron absorption cross section, it has to be enriched for PFBR and FBTR applications. For PFBR, enrichment of ^{10}B up to 65 % is essential. It is achieved in Boron Enrichment Plant (BEP). For FBTR and sensor applications, enrichment more than 90 % is required. ABEP is designed and commissioned for this purpose. Ion Exchange Chromatography is the process utilized for enrichment. In this plant, various plant parameters such as pH & Conductivity of elute, Level, Flow and Pressure of the fluid are to be monitored continuously for reliable and safe operation of the plant with ease. The Instrumentation & Control system for the plant was executed by EID. The scope of work was sensors, transmitters, cabling, UPS and Computer based Operator Information System (OIS) along with Offline analysis package for the stored data.

Operator Information System (OIS):

The main purpose of the Operator Information System is to monitor all the plant parameters and tracks the progress of the process at single point. Data stored by the OIS is used for further analysis of the process.

Specification of OIS:

1. Input Signals   Analog : 50
   Digital : 180
2. Scan Time   Analog : 10 Sec
   Digital : 1 Sec
3. Display modes   Mimic, Bar, Trend, Overview, Tabular, Digital, & Summary
4. Regroup facility   Bar, Trend etc
5. Configuration   I/O cards & Network
6. Storage 1 (Year)   Data & Events
7. Hardcopy   Current alarm Signals, Event Summary & Displays
8. Online Diagnostics Process   Data Acquisition System & Display Stations

Architecture of OIS:

OIS consists of one VME bus based Data Acquisition System (DAS) in which field signals are terminated. Two Process Display Stations (PDS), one is located in the ABEP control room and another one in BEP control room. These control rooms are linked with fiber optics Local Area Network (LAN). Network enabled printer is used for printing the current alarm signals, shift based events summary and different forms of displays. A dedicated printer is provided for printing the events as and when it occurs. Figure 1 shows the architecture diagram of OIS of ABEP.

DAS consists of on line testable in house designed and developed 32 bit 68020 based CPU card with Error Detection And Correction facility, 42 channel analog inputs and 30 channel digital input cards. No operating system is used. Fig 2 shows the photograph of the Data Acquisition System which consists of VME rack with CPU and I/O cards, Instrumentation power supply and DAS power supply.

Software:

The complete software of the OIS consists of four modules as follows.

· Embedded Software
· Communication Software
· Data management with storage and retrieval
· Data Presentation with Human Machine Interface (HMI)

Embedded software which is running in DAS is written in C as per MISRA C guidelines and fused in EPROM. The main functions of DAS are scanning the input signals at regular intervals, packet formation, sending the packets to all PDS connected in the LAN. Analog packets are sent at every 10 Sec. Digital packets are sent at every 1 sec. Healthiness of the DAS is monitored and health packet is sent at every 1 min. Error packets are sent as and when error occurs. I/O card base address, enable or disable the

BEP Control Room   **ABEP Control Room**

Display Stations

Printer

Fiber Link
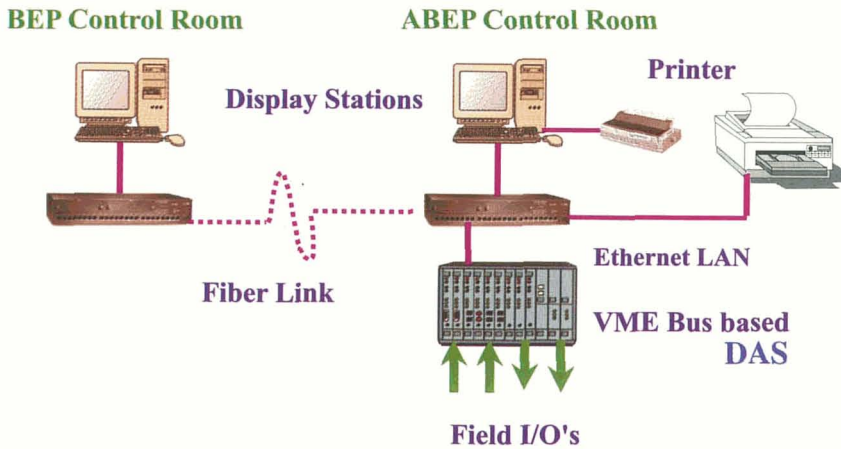
Ethernet LAN

VME Bus based DAS

Field I/O's

Fig 1: Architecture Diagram of OIS

I/O cards, setting the IP address, MAC address, gateway and subnet mask address are configurable. These configurations are password protected.

Communication software provides communication between DAS and PDS and among all PDS connected in the LAN.TCP protocol is used for Communication between DAS and PDS and among all PDS. RS_232 is used for configuration of DAS. Communication module is running in both DAS and PDS.

Data management and data presentation modules are running in PDS. Data management module receives the data and validates the data then process the data to engineering unit. One-year data and events are stored with mirroring for fault tolerance which is used for further analysis. Analog, digital signals are scanned at the rate of 10 sec & 1 sec respectively and stored at every 30sec. Data presentation module provides HMI which has the following functions

· Display data in different formats

Mimic, Trend, Bar, Alarm overview, Tabular, Digital, Current alarms.
· Dynamic Regrouping with password protection
· Diagnostics
   Status of Data Acquisition System (CPU and all I/O cards) and Process Display Stations connected on the LAN.
· Hard copy on demand for Current Alarms, Events and displays
· Online Help

HMI is menu-based interface developed in Visual Basic runs under Microsoft Windows. ActiveX controls are generated for the different forms of displays.

Designing Human Machine Interface:

HMI is designed with special features which are listed below:

• Consistent User Interface
• Simple, Easy to Learn
• Fixed Window size
• Windows can be positioned anywhere in main window
• Tool tip text is used for all controls
• Color of Current value represents the status of signal
• All the opened windows are updated in every 10 Sec
• Maximum. 4 sub groups can be viewed at a time in a group
• Menu selection with mouse or keyboard
• Quick Response Time

Fig 3 shows the typical mimic diagram for high pressure stream. pH and Conductivity values are displayed as text for each ion exchange columns . Text color will change according to the status of the signals. As a standard practice green color is meant for operational, red color is indicative of high alarm, blue is indicative of low alarm and magenta color is provided for disabled signals. In the same way, the color of the valve indicates the position of the valve. i.e fully open, partially closed, fully closed etc.Fig 4 shows the Alarm overview panel. As explained earlier, color of the panel indicates the
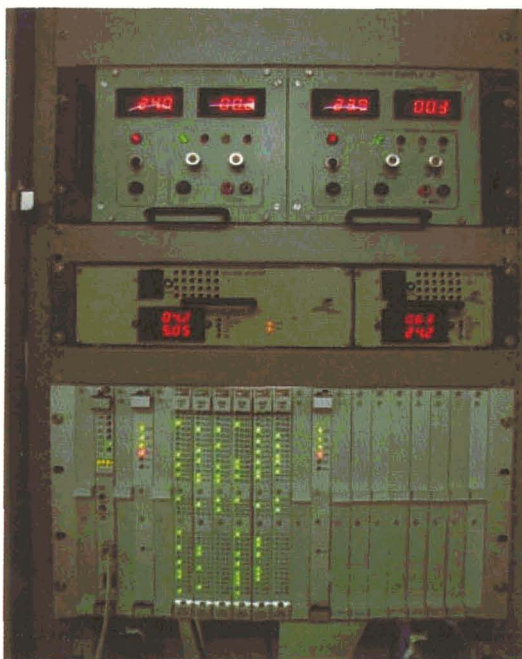
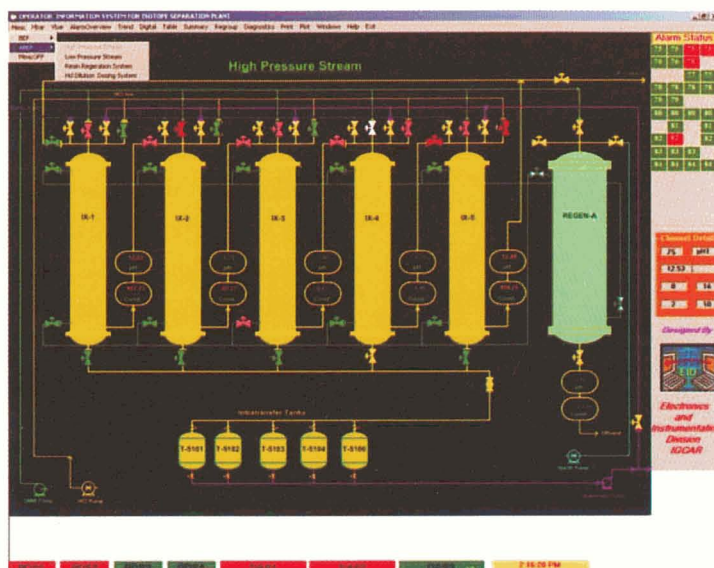Fig 2: Photograph of the Data Acquisition System

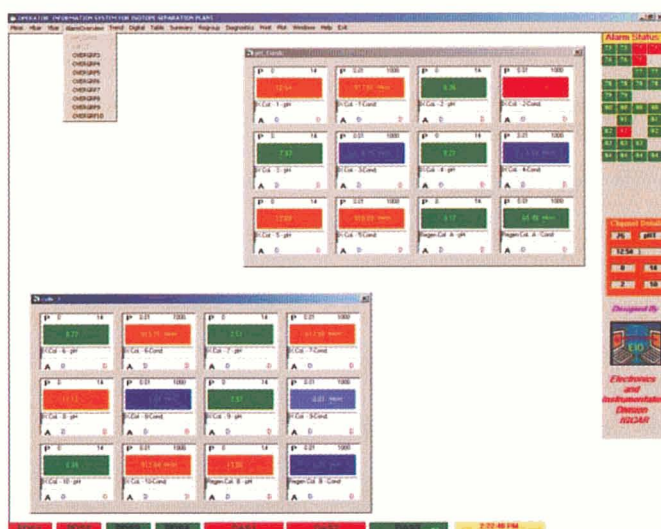Fig 3: Mimic Diagram of High Pressure Stream

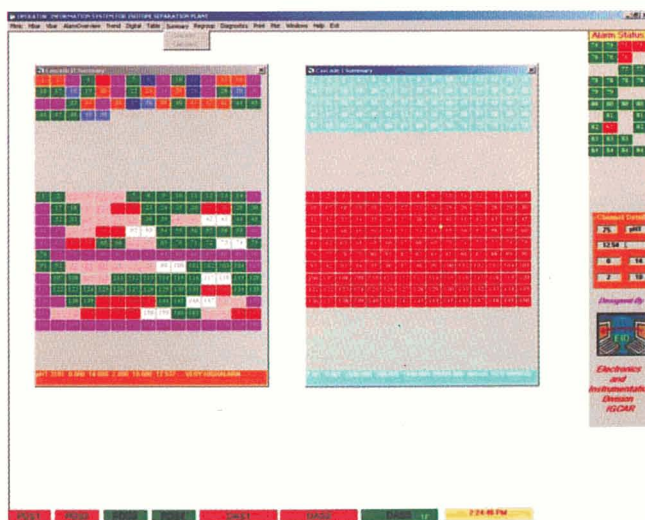Fig 4: Alarm Overview panels

Fig 5: Summary of all channels

status of the signal. Process and alarm values are displayed in the panel itself. 10 groups are available for each display. Maximum 4 groups can be viewed at a time.

Fig 5 shows summary of all the channels in a single window. One for BEP signals another for ABEP signals. Channel number is displayed in this small panel. Standard color of the panel indicates the status of the signal. By clicking on each panel details of the channel are displayed at the bottom of the window.

Security of OIS:

Only OIS application software will be running in the system and all other applications are blocked for security reasons. To exit the application password is provided. All configuration and regrouping of signals are done with password. Only Close button is provided to each window

Documentation & User Training:

A one day training programme on the I&C system was conducted on 5th September 2007 for the benefit of ST&HD staff, at EID Lecture Hall. Shri P. Swaminathan, Director, EIG handed over the hardcopy of all the documents to Shri G. Vaidyanathan, Director, FRTG and softcopy of all the documents along with source code on CD media was handed over to Shri P. Kalyanasundaram, AD, FRTG. Hands on training were given to all the users about the system in interactive manner. Hardware & software of the system were explained in detail. The PDS software is optimized with 5000 lines of Visual Basic code results in 5MB of executable code. The OIS for ABEP is installed & commissioned and working satisfactorily for the past 6 months.

(Reported by T.Sridevi, M.Vincent and S.Ilango Sambasivan, Electronics & Instrumentation Division, EIG)

Kokilamedu Lake-
Prompt Habitat for Avian-diversity
an enchanting Eco-zone

Biodiversity describes the variety and array of life on Earth. Variety (or diversity) is not only the spice of life, but also is essential to life. The diversity of biological life (biodiversity) exists at three scales. These range from genes to species to ecosystems. Loss at any point in the scale, ripples through the other scales of biodiversity, indicating the interrelated nature of the system. A common measurement of biodiversity is the total number of species found in an area.

India accounted for 7.8% of the global recorded species; unfortunately this precious bio-diversity is now being lost at an extremely rapid rate. Department of Atomic Energy (DAE) has all along been maintaining a good green belt in and around its campus at different units not only to preserve but also to enhance the biodiversity. In this context, a study on terrestrial biodiversity at Kalpakkam has been initiated. As a first step, taxonomic data on avian diversity at Kokilamedu Lake has been collected.

Kokilamedu Lake is situated towards north-eastern side of IGCAR, but within the DAE campus. The lake is about 1000 m long, 80 m wide and its maximum depth is about 7 ft. The lake size and depth has been reduced due to heavy siltation by Tsunami.

Once you reach the lake, the sight is so refreshing that you forget your day's toil and wish to remain there a little longer. It is a home for flora and fauna with abundant vegetation with variety of faunal composition. Very big honeycombed with plantation of casuarinas and eucalyptus, more number of cane-brakes around shallow water ponds, groves of palm trees and extensive grass fields in every depression make the location an ideal home for birds. Fishes and other water organisms constitute the staple food for the birds and they are available in copious amount in the lake. Riparian areas, generally supports high levels of natural biodiversity. The combination of water, lush vegetation and connections to other landscapes provides opportunities for many species. Riparian zones have been found to contain up to seven times more bird species than surrounding grassland communities. It creates important corridors that link a variety of ecosystems together, in which, species and genetic material travel easily through these small, but unique, pieces of the landscape.

Evergreen vegetation at Kokilamedu lake with undisturbed environment and brooding branches of the trees with the loads of beautiful birds, is indeed a memorable sight. It is believed that most of the birds that visit Vedanthangal, about 65 kilometers from Kalpakkam, also visit Kalpakkam's brackish water lake. Kalpakkam also has some

Panoramic View of KKM Lake

Group of great cormorant

Little Grebe

Red-wattled lapwing

Nest of Black Drongo

Spot billed pelican

Flock of Painted Storks

excellent places for many migratory birds some of them considered to be 'rare' elsewhere. The birds make nest and breeding takes place according to their climatic affinity. Nesting area of Red-wattled lapwing, Black Drongo, Painted Storks were noticed near lake. During a short span of 3 months of survey 60 avian species have been identified.

Riparian areas, especially, casuarinas and eucalyptus forest support the highest breeding bird densities and diversities at Kokilamedu lake. Over 65% of bird species rely on riparian forests for all or part of their lifecycle. These areas are particularly critical for forest birds as they migrate across the prairies and step at riparian areas, for rest and re-fuelling. The Environmental and Industrial Safety Section of Safety Group, plan to revive the lake and enhance the avian diversity and sustainability. An intranet website is being created exclusively for nature lovers.

additional attractions for the birds. The lake is within the security boundary of DAE campus, which means no intrusion in the area. Even the presence of a human being is very rare and the birds can enjoy total privacy.

Riparian areas are often structurally very complex as it sustains different varity of plants. This structural diversity is one of the aspects that make them attractive to so many wildlife species. The birds before breeding first choose a right place with suitable climatic condition to prorogate their progeny. Kokilamedu lake is one of the

(Reported by: Dr. K.K. Satpathy, E&ISS and Dr. M. Selvanayagam, Loyola College, Chennai)

Forum for
Young Officers

Animation of Heat Transport System of PFBR

Shri **A Sambasiva Rao**

A. Sambasiva Rao obtained his B. Tech (Computer Science Engineering) from Mother Theresa College of Engineering and Technology, Peddapalli, Jawaharlal Nehru Technological University, Andhrapradesh. He is from the 48th batch of BARC Training School and joined IGCAR in September 2005.

Animation is defined as the process of displaying several fairly similar but slightly different static images at a rapid refresh rate on computer screen to give continuous motion effect to humans. Thus animation technique is used to create moving images. Each and every image of the animation is called a frame. The rate at which frames are displayed is called frame rate. Typical frame rate should be greater than or equal to 12 frames per second. Based on storage of frames in computer memory, animations (images) are classified into two types.

(1) Bitmap animations:

In this type, images are stored in memory by storing color attribute (typically occupies 3 bytes to represent RGB value) of each pixel in addition to their position information. Thus it occupies very large memory. The displaying software simply reads color value of each pixel and draws on the screen according to the stored position information.

(2) Vector animations:

In this type, images are stored in memory by a group of graphic symbols. In computer memory, a graphic symbol is represented by

- A basic graphic construct like line, rectangle, circle, pixel, polygon etc.
- Properties of that graphic construct like origin, starting point and ending point etc.
- Stroke color and fill colors etc.

- Algorithm of the basic construct, used to redraw. The displaying software reads and draws each graphic symbol. Thus it requires software modules to generate drawings on the fly from the given graphic constructs using the specified algorithms and the specified attributes. Thus vector animation occupies very less memory and demands less bandwidth for internet transfers. Hence these are very suitable for web applications. The additional advantage of this method is that new drawing algorithms can be implemented as soon as they are invented. Macromedia Flash animation tool, used to develop the following animation, uses this method.

Prototype Fast Breeder Reactor (PFBR) is a 1250 MWt, 500 MWe Liquid Metal Cooled Fast Breeder Reactor (LMFBR) under construction at Kalpakkam. It is a pool type reactor consisting of reactor core, primary sodium loop, secondary sodium loop, steam water system and electrical system. The Primary sodium system transfers the heat generated through fission in the reactor core to the secondary sodium system through Intermediate Heat Exchangers (IHX) maintaining safe operating temperature of core subassemblies and main vessel. Secondary sodium circulation system transports the heat from the secondary sodium to steam-water system through once-through steam generators (SG) and

dampens the pressure surges reaching the IHX. This system also prevents the leakage of radioactive sodium from primary sodium circuit into steam-water system. The main function of steam water system is to produce superheated steam using once-through steam generators and utilize the steam to drive the Turbine, Generator to produce 500 MWe power. The additional function is to supply feed water to steam generators at required pressure, temperature and quality. A 2-dimensional animated heat transport flow sheet for PFBR, as shown in Fig. (1), has been developed at computer division using **Macromedia Flash MX Professional 2004** software, **to give a detailed visualization of various flows like primary sodium, secondary sodium, steam and water etc. in heat transport system of PFBR.** Following paragraphs describe about the tools/softwares used for the development along with their important features and the methodology adopted etc.

Macromedia Flash is an animation cum web-design tool from Macromedia Company. It uses vector graphics to produce animations. This software has several salient features that allow us to develop accurate, small sized, good looking and high quality animations. Macromedia flash player is used to view animations (.swf files) created by flash.

Overview of FLASH Features:

The **Tween** feature of flash is used to change the shape of an object (shape tween) and to change the position of an object (motion tween) in an animation. Shape tween is applicable to ungrouped objects whereas motion tween is applicable to grouped objects. Motion tween can also be used to scale, rotate, and skew the objects. Tween is defined as the "set of frames in an animation except the first and last frames".

In **Flash**, Tween is generated automatically provided the first and last frames are developed by the animator. So, No. of frames in a tween = animation time in seconds * Frame rate -2.

The **Layers** Feature is used to define front and back objects in an animation. Drawing made on a layer is visible as long as it isn't covered up by something on another top layer. In addition, the objects that are on different layers can be moved independently so that actions on one layer don't affect other layers. This feature is equivalent to Z-index in many other graphical softwares. There is no limit for number of layers. Masking feature is used to create masks (small transparent windows) in a layer, so that moving objects on a bottom layer can be seen as a scrolling banner from top layer. The actual moving object and mask should be on different layers. Guide layer is used to define guide path, along which an object has to move in motion tween. Action layer is used to write program. This can not exist independently; always it has to be linked with the main layer to which the result of the program is applied.

The **Tools pane** provides various drawing tools to draw basic shapes. Some of the tools are line, select, text, free transform, eye dropper, rectangle, ink bottle etc. Many of the tools have several options to decide curvature, size, style and other attributes of the shape. The **Zooming Development Environment** feature allows us to zoom the development environment, so that we can draw even minute things very clearly in an animation. **Timeline** component of flash correlates
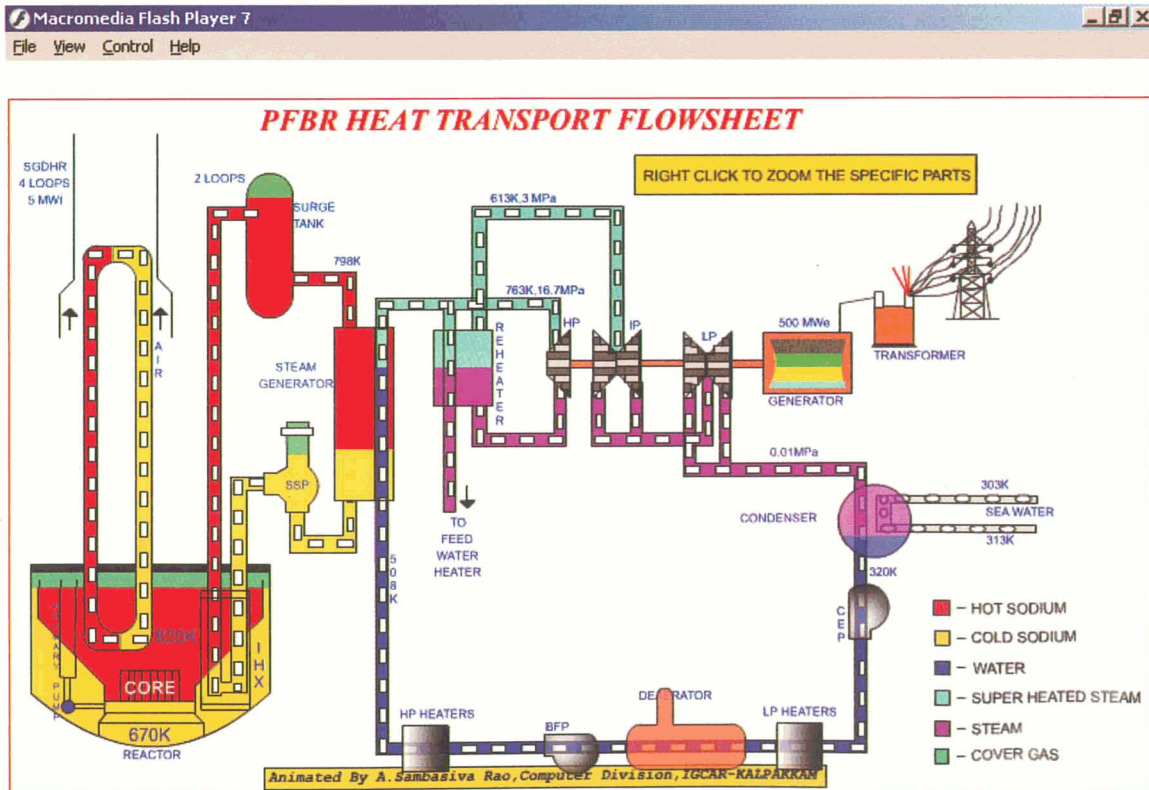

Fig. 1 A Screen shot of Animated PFBR Heat Transport Flow Sheet

Table – 1
Output formats of FLASH

FORMAT	STANDS FOR	USAGE
fla	Flash document	Source file of animation. This file will be edited to make modifications to the animation.
swf	Shock wave flash file	This is the main output file generated by flash by default. To view this, we require some animation player like **flash player**.
exe	Windows executable file	Animation can be executed directly in windows platform to see output.
html	Hypertext text markup language page	Output can be viewed in browser directly. This is very useful format in web applications.
mov	Movie file	Can be run in any video player.
hqx	BinHex file	Can be executed directly in Macintosh machines with out the use of any other software.
gif	Graphics Interchange Format	Allows us to view animation in simple graphical soft wares like picture viewer (some distortion may occur).

animation with time frame i.e. at which time what frame should be displayed is decided by it. **Frame-by-Frame animation** is used to define all frames in an animation including tween to develop custom animations.

Gradient Effect is used to define gradient (gradual change) to a color from one part of the object to other. **Alpha value** defines the transparency of a color.

· If it is 100%, then the color is opaque i.e. objects behind it if any, are not visible.

· If it is 0%, then the back object will be seen fully.

Grouping facility allows us to group different parts of an object into a single object, so that any animation applied on the object is replicable in all parts of the object. Thus each part can be animated separately then combined into a single object to apply common animation if any. Flash provides a collection of built-in animation templates called **timeline effects**. We can apply these animations to any object. It is used to create animations very easily, like exploding a piece of text, dancing text, tracking text etc. **Symbol** is an independent component of an animation, which can be reused in another animation if needed. Examples are imported graphics, imported video and imported audio, separately designed components etc. These symbols are stored in **Libraries**. Reusability of symbols is achieved by sharing these libraries across different applications. **Controls** are used to interact with user like taking input, displaying pop-up windows etc. This feature allows flash to design online

application forms in web-site design. Examples are: check box, text box, menus, combo, list etc. With the use of input from these controls, the behavior of an animation can be changed on the fly, leading to dynamicity in animations. This feature is used to simulate certain events or conditions in an animation.

Action script is the scripting language used by FLASH. It is similar to JavaScript in web-site designing. This language can be used to alter the default behavior of the animation like stopping the animation at a particular point in time or repeating the animation for a specified number of times etc. It has all programming constructs like control constructs, loop constructs, functions, operators, object oriented features and hyperlinks etc.

FLASH can be configured to generate the developed animation in many formats as shown in Table (1). During publishing process of animation, required formats can be selected.

Animation Methodology:

The PFBR Heat Transport Flow Sheet (Fig. 1) is animated as follows:

· The size of animation (during development) is fixed at resolution of 770x500 pixels targeted to 15" monitors. The developed animation can be zoomed to any resolution. The "100%" zoom level resets the animation to 770x500 resolution.

· Different components of PFBR like reactor core, steam generator, condenser, turbines and SGDHR are animated separately with proper sizes to prevent integration

problems in the final animation and stored as symbols in the library for reuse.

· Different layers are used to develop animation. Comment layers are used to write comments, Action layers are used for programming purposes, Top layers are used to draw skeletons (pipes) and bottom layers are used to develop actual animations (flow animation in pipes).

· Most of the drawings are animated using engineering approaches instead of hand-free approach, to create animations accurately and perfectly.

· Frame-by-Frame animation has been used to animate flows, Generator rotation etc.

· Conventional colors have been chosen to represent different flows like primary sodium, secondary sodium, steam, water and cover gas etc.

The animated Flow Sheet can be used to

· Give a clear picture of heat transport system of PFBR to operators.

· Give an overview of various components, their functions and interconnections.

· Monitor the process parameters including dynamic changes by integrating with the training simulator.

· Study the plant dynamics.

(A. Sambasiva Rao and Colleagues, Computer Division, Electronics & Instrumentation Group)

Conference / Meeting Highlights

WONDER – 2007

DAE Workshop on 'Nuclear Energy for National Development and Environmental Sustainability'

July 19-21, 2007 at Loyola College, Chennai

For the first time in this region, a 3-day workshop exclusively for the University and College Professors in Physical and Life Sciences and allied disciplines was jointly organized by DAE at Loyola (Autonomous) College, Chennai during July 19-21, 2007. The response was over-whelming and 250 teaching faculty were short-listed and registered. Preference was given to those belonging to Institutions situated in and around Chennai city. The Workshop was inaugurated by Dr.S.K.Sharma, Chairman, AERB. He highlighted the stringent safety standards and regulations being adhered to in Indian nuclear installations. Dr.P.R.Vasudeva Rao, Director of Chemistry, Materials and Metallurgy Groups of IGCAR in his keynote address drew the attention of the audience to the world of challenges and opportunities prevailing in the nuclear science and technology. Dr.S.K.Malhotra, Head of Public Awareness Division of DAE, Mumbai spoke on the theme of the Workshop. Shri.PV.Ramalingam, Director, Reactor Operations and Maintenance Group, IGCAR and the Chairman of the IGCAR Public Relations Implementation (PRAI) Committee proposed the vote of thanks.

The Workshop comprised of 12 invited technical lectures, practical demonstrations, informal contest, panel discussion / feed-back session and field visits to leading healthcare institutions where radioisotopes are being used for diagnostic and therapeutic purposes like Apollo Specialty Hospital, Cancer Institute (WIA - Adyar), Institute of Cardiovascular Diseases (Madras Medical Mission), Vijaya Health Centre, Dr.Kamakshi Memorial Hospital (Pallikaranai), Sri Ramachandra Medical Centre (SRMC - Porur), Advanced Nuclear Medicine Research Centre, Dr.Rai Memorial Medical Centre, Dr.Mohan's M.V. Diabetes Research Centre and Madras Isotope Laboratory.

Dr.S.K.Sharma, Chairman, AERB addressing the gathering

Dr.B.Venkatraman of IGCAR depicted various energy resources of India and brought home the fact that nuclear power is an inevitable option, while Shri.B.K.Nashine from IGCAR presented a perspective on nuclear power in India and pointed out that fast breeders are essential for ensuring an energy secure India. Dr.P.Mohanakrishnan of IGCAR organized an informal contest for the participants and declared the 'Best Teacher Awards'. Dr.P.K.Sinha of BARCF, Kalpakkam outlined the Department's strategy for nuclear fuel management. Dr.R.Venkataraman, Director (OPSD), AERB and Member Secretary, SARCOP underscored the safety and environmental aspects of nuclear power plants. Dr.R.K.Jeevanram of IGCAR touched upon the basics of radiation and its effects. Dr.S.K.Malhotra lucidly brought out the myths and realities of nuclear energy, and emphasized that the best methodology in perception management is 'repeated hammering'. The Quality Assurance Division of IGCAR innovatively illustrated the world-class QA programmes being practiced in the Department for vouching the safety in nuclear facilities.

Shri.Frederick.J. Kaplan, US Consulate, Chennai distributing certificates

On the second day, Dr.K.Raghuraman, Head International Studies Division, SPG, DAE, Mumbai outlined the lead role taken by India in IAEA in propagating the peaceful uses of atomic energy. Senior Scientists from BARC, Mumbai Dr.S.P.Ramnani, Dr.J.R.Bandekar and Dr.S.G.Bhagwat spellbound the academia with the multifaceted applications of radioisotopes in Industry, Food Processing and Agriculture respectively. Dr.S.K.Malhotra made a presentation on 'Radioisotopes in Healthcare' on behalf of Dr.Kanchan Kothari of BARC. Prof.P.C.Kesavan, DAE Homi Bhabha Chair & Distinguished Fellow at M.S.Swaminathan Research Foundation, Chennai articulated on 'Atoms for Peace: Genetical Considerations'.

The Chief Guest of valedictory function Dr.R.Krishna Kumar, Head, Dept of Nuclear Medicine, Cancer Institute (WIA – Adyar) gave away the Prizes to the 20 winners of the informal contest. He underlined the importance of radioisotopes in cancer management. Dr.K.Raghuraman captivated the participants by his informative address and made them feel proud of the contributions of Indian scientists and engineers to the UN body, IAEA. Shri.Frederick.J. Kaplan, Consul for Public Affairs, US Consulate General for South India was the Guest of Honour at the function. Shri.J.Daniel Chellappa, Head, Technical Co-ordination & Public Awareness, IGCAR, Chennai summed-up the proceedings of the Workshop. Authorities of Loyola College including the Principal, Rector, Secretary and Dean of Sciences participated in the inauguration and valediction.

The learned professors were extremely impressed and felt greatly benefited by their participation. Many of them desired to have repeat events in their institutions. They admired and appreciated the DAE programmes, and most of them vowed to be our ambassadors! The Workshop facilitated intimate interactions with the academia, and also further strengthened the research-academia linkage. Thus, the event has successfully fulfilled its objectives!

(Reported by J.Daniel Chellappa and P.V.Ramalingam, PRAI Committee)

Graduation Function of the first batch of trainees from IGCAR Training School

(L to R) Dr.Anil Kakodkar, *Chairman, AEC & Secretary, DAE* delivering the Presidential Address, Dr. M. Sai Baba, *Head,S&HRPS and Head, IGCAR Training School*, Prof. J.B.Joshi, *Director, University Institute of Chemical Technology, Mumbai* and Dr.Baldev Raj, *Distinguished Scientist and Director, IGCAR*

The first twenty graduates from the IGCAR Training School have successfully completed their training and were graduated in a glittering ceremony that took place on 4 September, 2007 (Tuesday) at 11.00 hrs in the Sarabhai Auditorium, Homi Bhabha Building, IGCAR. Distinguished Academician, Prof. J.B.Joshi, Director, University Institute of Chemical Technology, Mumbai was the Chief Guest and Dr. Anil Kakodkar, Chairman, AEC & Secretary, DAE presided over the occasion. Dr. M. Sai Baba, Head, Strategic and Human Resources Planning Section and Head, IGCAR Training School welcomed the gathering. Dr.Baldev Raj, Distinguished Scientist and Director, IGCAR gave the Director's address. A souvenir

featuring the first year of the training programme at IGCAR was released by Prof. Joshi on this historic occasion. Dr.Anil Kakodkar then delivered the Presidential address. A few of the Trainee Scientific Officers from 1st batch voiced their feedback about the courses and their stay at the hostel. Prof. Joshi gave away the prestigious 'Homi Bhabha Prize' comprising of a medallion and books worth Rs.5000 to the meritorious topper from the Mechanical Engineering discipline, Shri. Ankur Kaushik and Shri.Sukant Kothari from the Electronics and Instrumentation discipline. He also gave away the course completion certificates to all the graduates passing out. Prof. Joshi addressed the gathering with a very inspiring and thought provoking lecture. Finally, Dr. G. Venugopal Rao, S&HRPS proposed the vote of thanks.

(Reported by Dr. M. Sai Baba)

First Batch of Graduates of IGCAR Training school with the Chief Guest, Chairman, Director, Senior colleagues and members of S&HRPS

Summer Training in Physics and Chemistry (STIPAC 07)

May- 28 to July- 6, 2007

Like in the past, this year too a six week summer training program in physics and chemistry (STIPAC-07) was organized by Indira Gandhi Centre for Atomic Research –Kalpakkam for students *entering* their final year of regular or integrated M.Sc (Physics/ Chemistry) during May, 28 – July 6, 2007. This *six week* long programme comprised of both theoretical lecture courses and hands-on laboratory experience through projects. This programme was aimed at motivating the students to pursue a career in research. The theme for this year's course was *Physics and Chemistry of Nanomaterials.*

Forty students (Twenty from Physics and twenty from Chemistry) were selected from about 500 applicants in physics and chemistry. The selection was done based on their academic track record and the write-up on *"why you think size matters in the physical & chemical properties of matter"*. Care has been taken to select students from as many states as possible and as many universities/colleges as possible. This resulted in selecting 20 students from within Tamilnadu and 20 students from outside representing 10 states for both the disciplines. The selected students were provided a stipend of Rs. 3000/- per month, and their travel expenses were reimbursed.

STIPAC-07 program was inaugurated by Dr. P.R. Vasudeva Rao, Director, CG & MMG on May 28th and Dr. C.S. Sundar, Head, MSD had delivered welcome address. Dr. B.V.R. Tata, Course director of summer training in physics (STIP) and Dr. T. Gnanasekaran Course director of summer training in chemistry (STIC) addressed the students by highlighting the selection procedure and the course content Dr. K. Ananthasivan, proposed vote of thanks.

The six week technical program of STIPAC course consisted of 90 hours of lectures and 90 hours of project work for both physics and chemistry students. The guest lectures were 15 and 8 for physics and chemistry respectively. The lectures were delivered by senior scientists and the guest lectures were delivered by eminent speakers drawn from reputed institutes and universities from all over India. The topics that have been covered during the lectures in physics include synthesis and characterization of nanomaterials, nanoparticle dispersions and gels and the influence of size on optical, magnetic, mechanical, electronic and transport properties. The topics that have been covered in chemistry were classified in three broad categories

namely, core subjects in chemistry, application in nuclear energy programme and nanoscience & technology. The special lectures covered a variety topics in biotechnology, nanotechnology, fluorescence of novel organic compounds, *ab-initio* quantum mechanical approach in understanding spectroscopy, sensors and storage devices. Students have gained hands on experience through their project works. They also got the opportunity to listen to the special lectures on "Random walk" and "Status of sodium cooled fast reactors with closed fuel cycle" by Dr. Baldev Raj, Director, IGCAR; "Opportunities for scientists in Fast Breeder Reactor Technology " by Shri. Prabhat Kumar, Project Director, BHAVINI and "Key elements of Periodic Table – Relevance to DAE" by Dr. P.R. Vaudeva Rao, Director, CG& MMG.

The Valedictory function STIPAC-07 was conducted on 6th July 2007. Dr. T.S. Radhakrishnan, Former Head, MSD was the chief guest of the function and delivered a lecture on "Magnetoencephalography - A method for peeping into the Brain" and gave away the certificates of participation to students . Shri. P. Swaminathan, Director, EIG delivered the presidential address on "Knowledge management". Dr. B.V.R. Tata welcomed the gathering and gave a brief of summery of technical events of STIPAC program. Students from STIP and STIC have appreciated the course content and format and Dr. V. Jayaraman proposed vote of thanks.

(Reported by Dr. B.V.R. Tata, MMG, and Dr. T. Gnanasekaran, CG)
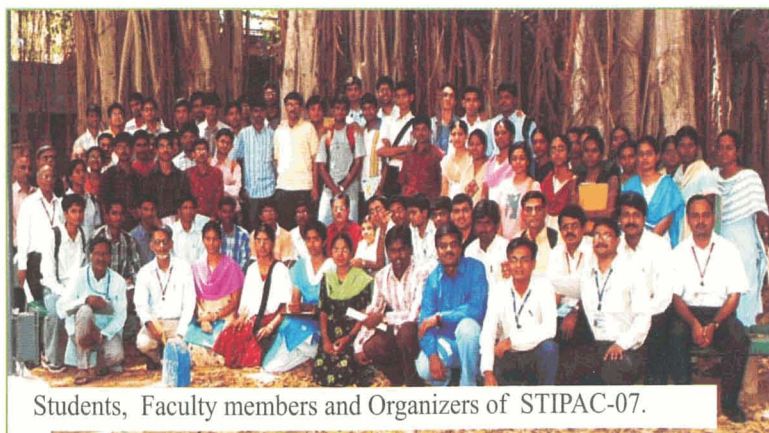
Students, Faculty members and Organizers of STIPAC-07.

National Conference on Recent Advances in Information Science & Technology (READIT - 2007)
July 12-13, 2007, IGCAR, Kalpakkam

A conference on "Recent Advances in Information Science & Technology 2007 (READIT-2007)" was organized during July 12&13, 2007 by the Madras Library Association-Kalpakkam Chapter (MALA-KC) and Scientific Information Resource Division (SIRD) IGCAR at Sarabhai Auditorium, IGCAR Kalpakkam. The theme of the conference was "Information to Knowledge: Technology and Professionals". A pre-Conference Tutorial on 'Web tools and IT enabled Services' has also been arranged on July 11 2007. About 70 delegates participated in the Tutorial.

The Conference was inaugurated by Dr. D. Viswanathan, Vice-Chancellor, Anna University, Chennai in the presence of Prof. H. P. Khincha Vice-Chancellor, Visvesvaraya Technological University, Belgaum on 12th July 2007. Shri M. Somasekharan, Head, SIRD delivered welcome address followed by the presidential address by Shri. P. Swaminathan, Director Electronics and Instrumentation Group and Chairman L&IS Committee. Prof. H. P Khincha delivered keynote address.

The conference Souvenir and the softcopy copy the conference proceedings were released by Dr. D. Viswanathan and first copy received by Prof. H. P. Khincha. Shri A. Narayanan, Leader IRS SIRD, proposed vote thanks. This was followed by the inauguration of the conference exhibition by Prof. H. P. Khincha and Dr. D. Viswanathan.

In the technical Program, about 30 papers including 5 invited papers were delivered on various topics of the conference theme including Knowledge Environment and Professionals, Library as Knowledge Centre, Document management and preservation, Digital Infrastructure and Knowledge as Commodity. About 120 delegates from different Libraries and Institutions participated in the conference. The conference covered various aspects on knowledge management in the information technology era beginning from the digitization issues to the latest web and library 2.0 aspects. This two- day conference had 5 technical sessions and one commercial session where a number of vendors gave presentation on their products and services.

The valedictory function was conducted on the 13th July evening. Dr. V. Ganesan, Head MCD gave the welcome address, which was followed by the presidential address by Shri M. Rajan, Director, SG. Shri S. Raju of PMS, MMG gave a summary of READIT 2007 Conference and highlighted salient features. The valedictory address and the technical talk on 'E-Learning' was delivered by Dr. K. R. Srivatsan, Director, Indian Institute of Information Technology and Management, Thiruvananthapuram. Finally Shri M. Somasekharan delivered the vote of thanks.

(Reported by M. Somasekharan, Scientific Information Resource Division)
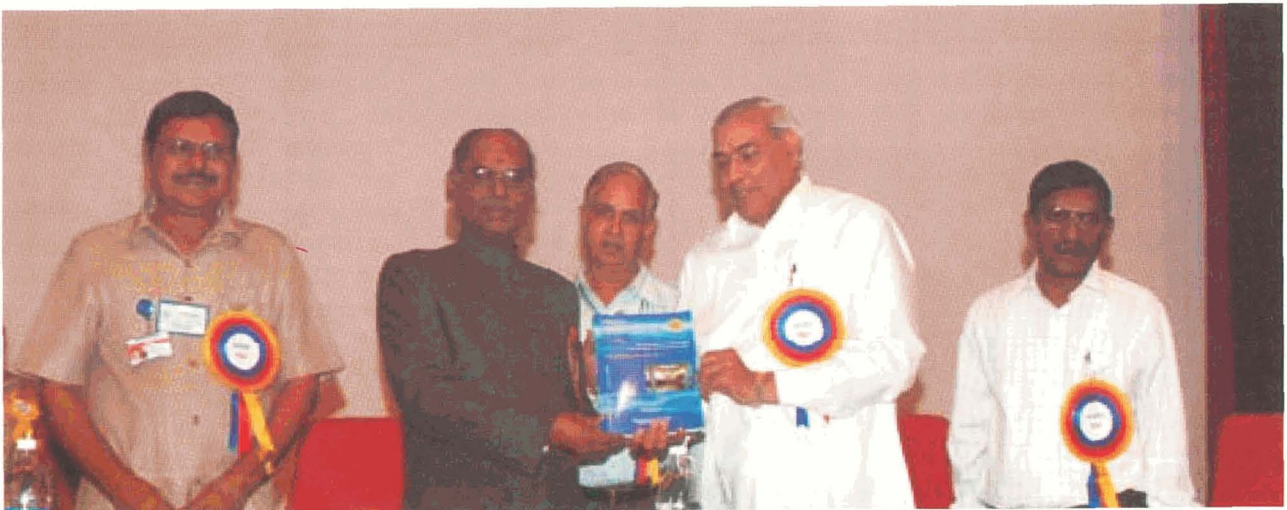
Dr. D. Viswanathan, Vice-Chancellor Anna University releases the Conference Proceedings and Prof. H.P. Khincha, receives the first copy. Shri. P. Swaminathan, Chairman, L&IS Committee, Shri. M. Somasekharan and Shri A. Narayanan are also seen.

International Symposium

on

Sustaining Global Pressures: Women in Science and Engineering (SGPW 2008)

Next Generation Challenges and Opportunities

January 3-5, 2008, Kalpakkam, Tamil Nadu, India

Organised by

Indian Women Scientists' Association (IWSA)
Kalpakkam Branch

Website: www.iwsakalpakkam.com

Indian Women Scientists' Association (IWSA) is a voluntary, non-political, non-governmental, social welfare organization founded in 1973. It has its head office in Mumbai and there are about 10 branches all over India including Kalpakkam near Chennai. The main objectives of IWSA are (i) To take science to the masses and develop a scientific temperament in the society and (ii) To be a representative body for women working in natural and physical sciences, including applied sciences like engineering and medicine.

The symposium will address important issues related to women professionals. The purpose of this symposium is to bring together a large inter-disciplinary community of women engineering professionals, scientists, entrepreneurs and academicians to enable discussions and exchange of ideas on specific issues related to women. Around 200 delegates from Industries, Educational Institutions, Research and Development organizations including leading experts from several countries are expected to participate in this unique symposium.

Topics to be covered

➢ Women Scientists in Developed and Developing Countries: Diversities and Commonalities
➢ Innovation and Creativity in the Next Generation
➢ Issues related to Women's Legislation
➢ Women as Decision Makers: Pitfalls and Barriers
➢ Motivating the girl child to a career in Science and Engineering
➢ Women Entrepreneurs in Science and Technology
➢ Women and Environment

Deadline for registration - December 1, 2007

Address for Correspondence

Dr. R. Sandhya
Convener, SGPW 2008
Mechanical Metallurgy Division
Indira Gandhi Centre for Atomic Research
Kalpakkam - 603 102, Tamil Nadu, India
Tel: +91 - 44 – 27480500 Ext.21080 (O) / 27482689 (R)   Fax: +91 - 44 - 27480075
E-mail: san@igcar.gov.in

Apex steering committee on quality circles

The Apex steering committee on quality circles (ASCQC) has taken a lead role in spreading the quality circle movement in our centre. The experts from M/s Ashok Leyland, Chennai were invited on 6th July 2007 at Sarabhai Auditorium, IGCAR, by Sri A.S.L.K.Rao, Member Secretary, ASCQC, to deliver lectures on QC tools and techniques and to present their case studies for enriching and widening the knowledge of our QC teams. Sri Y. C. Manjunatha Director, ESG welcomed the experts and addressed the invitees and participants. Shri K. Sridharan Balaji, DGM-vehicles, M/s Ashok Leyland, Chennai delivered the Guest Lecture, citing the brief history of QC and it benefits. "RAINBOW" and "WAVES" Quality circles of M/s Ashok Leyland presented the case studies and subsequently discussed with our QC members in open session. About 200 QC members from various groups of IGCAR had participated in the programme.

Shri. Y.C. Manjunatha, Director, ESG, along with Shri K. Shridaran Balaji, DGM-Vehicles, Shri C.V. Gowrisankar with their QC Team members from M/s. Ashok Leyland, Chennai

(Reported by A.S.L.K.Rao, Member Secretary, ASCQ)

AWARDS AND HONOURS

Shri. N.R. Karthikeyan from PSG College of Technology, Coimbatore has been conferred the Innovative Student Projects Award 2007 of INAE for his project work on *Study of thermal properties of copper and copper oxide nanofluids*, carried out at NDED, IGCAR during December 06-April 07.

Shri Sumantra Mandal from Materials Development and Characterisation Group has been awarded INAE Young Engineer Award for the year 2007.

Dr. S. Ningshen has been awarded the NACE International India Section (NIIS) best Ph.D award in the field of Corrosion Science for the Year 2007