3. RESEARCH SUPPORT FACILITIES

3.1 HIGH VACUUM LABORATORY

M. Archunan, A. Kothari, P. Barua and A. Mandal

Installations and alignment of new setup and modification of earlier installations was a major activity last year. These activities are described in subsequent headings. Besides, other installation related work was also carried out. A new Gas cell was installed at the end of experimental chamber in AMS; a new target ladder was also installed and aligned with beam axis. Three patch panels have also been made and installed one each in control room, rack-8 (Super Buncher) and rack 16(LINAC-I)

Centralized purchasing of essential vacuum components from local and import is done regularly to maintain essential components in stock. Contaminated penning gauges are cleaned and tested regularly to maintain stock of gauges in working condition, for replacement. Regular involvement with the pelletron group exists for maintenance activity, scheduled and emergency, requiring vacuum operations, maintenance of vacuum pumps and installation of critical components.

3.1.1 Phase II Beamline Installations

Installation of GPSC beam line and all beam line components (Faraday cup, BPM, Beam line valves, Pumping cross, Ion Pump, Getter Pump, Gauges, Quadrupole, etc.) was completed with proper alignment with beam axis. Vacuum system with all controllers and interlocks has been installed and beam line vacuum was established in the beam line. (Fig. 1)

Fig.1. GPSC Phase II Beam line with Neutron Chamber

Installation and alignment of Neutron Chamber in GPSC Phase II experimental line was done. Installation of turbo pumping system for the chamber was done and required vacuum established. Alignment and height adjustment of detector mounts for the chamber was also carried out.

Phase II Material Science Beam line was modified to install a beam tube with foil cross before BPM. For this pumping cross and pumps had to be removed from the line. The Beam line valve, Faraday cup and BPM assembly was shifted towards the experimental facility to accommodate the foil cross and they were realigned with beam axis. The foil cross was installed before BPM and calibration of the foil holding ladder movement was done. Accordingly drift tubes were cut and fabricated to fit the intervening space. Finally the pumping cross and pumps were reinstalled and vacuum was established in the beam line.

Switching Magnet II gets isolated from all pumping device when all the beam line valves are closed, so no pumping takes place in that area for the same period. To take care of vacuum load in this situation an Ion pump was installed in the area The XRDA chamber with housing and stand were permanently fixed by grouting and alignment of the chamber was done within 0.5 mm accuracy.

3.1.2 Modifications in Radiation Biology Beam line:

Radiation Biology Beam line has been modified for a new experimental facility that is being designed and setup in the line. For this beam line valve BLV L1-2 was changed from DN 40 Vat valve to DN 63 CFF valve, to increase the opening as the size of the sample to be irradiated is 40 mm. A new 4 inch cross was designed, fabricated and installed for mounting camera, quartz and other experiment related accessories.

3.1.3 CAMAC interfacing of phase II beam line components

Cables for CAMAC interfacing were laid for all phase II beam line components. . All the cable connections have been completed and tested successfully. Controllers for Ion pump, Getter pump, Faraday cup and Beam line Valve were installed in phase-II zero degree and other three phase II beam lines. The interlocking and CAMAC interfacing connections were also completed and tested successfully during trial runs and experiments in experimental facilities.

3.1.4 Beam Line Maintenance

Beam line valves of GDA, BLV L6-1 and BLV L6-2 had through leaks so valve seat of both the valves were replaced by new seats. Ion pump performance had also gone down due to vacuum accidents in the line. So it was replaced by a newly overhauled Ion pump. Overhauling of the pump included cleaning, electro polishing, fitting new elements, baking at high temperature and finally testing ultimate vacuum in a testing setup.

One magnet coil in the Quadrupole of Phase -II zero degree line got burnt, so the quadrupole had to be taken out from the line for coil replacement. It happened because the cooling water flow inside the coil stopped due to some blockage and the temperature sensor also failed to work. So the insulation of the coil got burnt due to high temperature. After replacing the coil, it was put back in the line with proper alignment.

3.1.5 Installations in Ion Source Test Bench Setup

New components have been added in the Ion Source Test Bench. A double slit was installed before analyzer magnet and aligned with the beam axis. Zero position of the slits was adjusted and linear motion calibration of slits was checked and found ok. During the installation the height of the exit port of analyzer magnet was also corrected to beam height. An Electrostatic Quadrupole Triplet and a steerer were installed after analyzer magnet to focus and steer the beam. After that a Faraday cup, BPM and a valve was installed and aligned. A Target chamber was installed and aligned at the end of beam line for experimental work.

3.1.6 Alignment and Installation of the Soft landing Setup

The soft landing setup which is a decelerating lens system had to be coupled with the beam line of the new ECR Ion Source, the PKDELIS. Before the coupling of the setup, a HV gate valve, a drift tube having a water-cooled slit, an assembly housing a Faraday cup and a variable aperture slit had to be added to the beamline. The alignment of the soft landing setup and the above mentioned components were completed accurately.

3.1.7 Installation of Setup at GPSC for inner shell ionization experiment

A target chamber, modified by user to incorporate the basic equipments required for the inner shell ionization experiments, was installed at the exit of GPSC and the target ladder was aligned with beam axis. A Faraday cup, used as a beam dump was also installed after chamber. Remote control for target ladder movement was fabricated and installed. The setup was protected by vacuum interlock from any vacuum accident. (Fig. 2)

Fig. 2. Setup at GPSC

3.1.8 Alignment of the Atomic physics experimental chamber and 90^0 beam line of LEIBF

The problem encountered in the atomic physics experimental chamber was that it was not possible to collect all the correlated products as observed in the time-of-flight (TOF) spectrometer and imaging detector installed inside due to misalignment. The ion beam was entering inside the chamber at a weird angle and was not interacting with the target gas jet properly. Also the beam had to be collimated to 1 mm. diameter which demands a very precise alignment. We dismantled the beam line, removed the gate valve after magnet port and took reference from the magnet pins. The horizontal plane was defined by the magnet central cut using water level. First we aligned the BPM and the 4-jaw slit and then we calibrated the slit. After that, we aligned the electrostatic quadrupole and the scanner as a single unit. The material science chamber was quite off and had to be adjusted and aligned. Finally, the atomic physics chamber was aligned with 1 mm. diameter collimator. Thereafter, we aligned the electrostatic analyzer assembly, the needle for the gas jet and the TOF assembly one after the other. The beam test following the alignment showed that most of our problems were solved and excellent experimental results were obtained.

3.1.9 Design and Fabrication of Vacuum Interlocking System for Experimental facilities

A vacuum Interlock controller has been designed and tested for vacuum systems and experimental facilities. It automates the sequence required for pumping a vacuum chamber from atmosphere to ultimate vacuum. It works as a failsafe system and prevents any vacuum accident due to manual error. It has been installed in different places like Rebuncher and Material Science II facility.

3.2 MAINTENANCE OF MAGNETS AND POWER SUPPLIES

S.K. Suman, Rajesh Kumar, A.J. Malyadri and A. Mandal

Different type of water cooled electro magnets, power supplies and supporting instruments are used in the pelletron system. All these are regularly maintained by Beam Transport System group to keep the uptime of Beam Transport System maximum. Following major jobs were done in this year.

Breakdown Maintenance: A few breakdowns occurred which were rectified in very short time. Nature of breakdown maintenance attended this year was Interlock failure, Transistor failures, Output drifting problem, CAMAC control failure, Water leaks etc.

Routine Maintenance: Routine maintenance of all magnets and their power supplies has done twice in the last year to keep up-time of Beam Transport System maximum.

Following tasks were carried out in the maintenance.

Stability testing of bending magnet power supplies.

Output ripple monitoring of all power supplies and minimizing it by repairing /replacing different capacitor filters.

Interlock testing of all magnet power supplies.

Readback calibration of all magnet power supplies.

Dust cleaning of electronic cards of all magnet power supplies.

Checking input and output power connections for loose contacts.

Changing faulty power transistors.

Changing corroded heat sinks of power supplies.

Changing damaged hose pipes.

Temperature monitoring of all magnets at full load current to locate the coils heating more than the specified temperature and cleaning them with high pressure water or sulphamic acid.

3.3 Detector Laboratory

P. Sugathan and A. Jhingan

Detector Laboratory at IUAC provides experimental support to various users in setting up charged particle detectors and readout electronics. New detectors and electronics have been designed and developed for new experimental facilities. Apart from various developmental activities, the group is involved in various user experiments in nuclear reaction dynamics using heavy ion beams. Detector lab provided special training on experimental activities for Scientist Trainees and JRF students.

3.3.1 Large area position sensitive annular PPAC.

A. Jhingan, T. Varughese, Sugathan. P, R.K. Bhowmik and H. Wollersheim[1]
[1]GSI, Germany

A large area Annular PPAC has been designed and developed for particle gamma coincidence setup for Coulomb excitation experiments in Gamma Detector Array. The annular detector consists of two circular electrodes, an anode and a cathode with 202 mm outer diameter and 50 mm inner diameter. The detector is designed to provide angular co-ordinates of the charged particles and recoils. The cathode plane is made up of thin aluminised polypropylene foil of 6 micron thickness.

The cathode plane is segmented into 16 parts to provide angle ϕ information at 22.5 degree resolution. The foil was stretched and pasted on a commercially available custom designed 2.4mm thick G-10 PCB. The anode plane is made of 2.4mm thick PCB which has concentric rings segmented into two halves. The rings are interconnected by delay line chips. Position of the rings will provide theta readout. Thickness of each ring is 2.54 mm. The electrodes were mounted inside a aluminum housing. A conical chamber for mounting target was also fabricated. The detector was tested off line with 241Am alpha source. Good signals were observed with high gain fast current amplifiers from GSI. The aluminum detector body was observed to be deformed under atmosphere pressure. A new steel body is currently under fabrication.

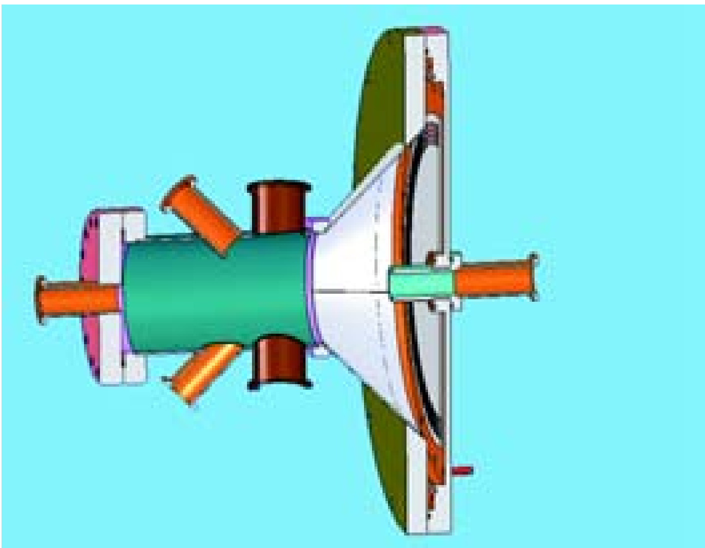

Fig. 1. Large area position sensitive annular PPAC

3.3.2 CsI + PIN photo-diode detector for particle identification and gamma detection

J. Gehlot, A. Jhingan, P. Sugathan and R.K. Bhowmik

CsI based charged particle detector has been assembled and tested for pulse shape discrimination properties using standard zero-cross technique. A 10mm x 10mm x 5mm CsI crystal optically coupled to a 10mm x 10mm PIN photo-diode was used in the testing. PIN diode detector characteristics have been done using different combinations of diodes & pre-amplifiers. Indigenously developed low noise charge sensitive pre-amplifiers were used for the test and a comparative performance study was done using commercially available detectors and electronics. Measurements were carried out with different shaping time constants for energy and timing parameter. To estimate the timing resolution from CsI(Tl) detector, a time coincidence was setup using fast BaF2 detector and CsI detector. Measurement showed FWHM of 11ns for time coincidence between gamma and electron from Cs137 source. For pulse shape discrimination setup, both zero cross and charge comparison method were tried. A typical PSD spectrum taken with gamma and alpha source is shown in fig.2. The Z/C is plotted against energy.

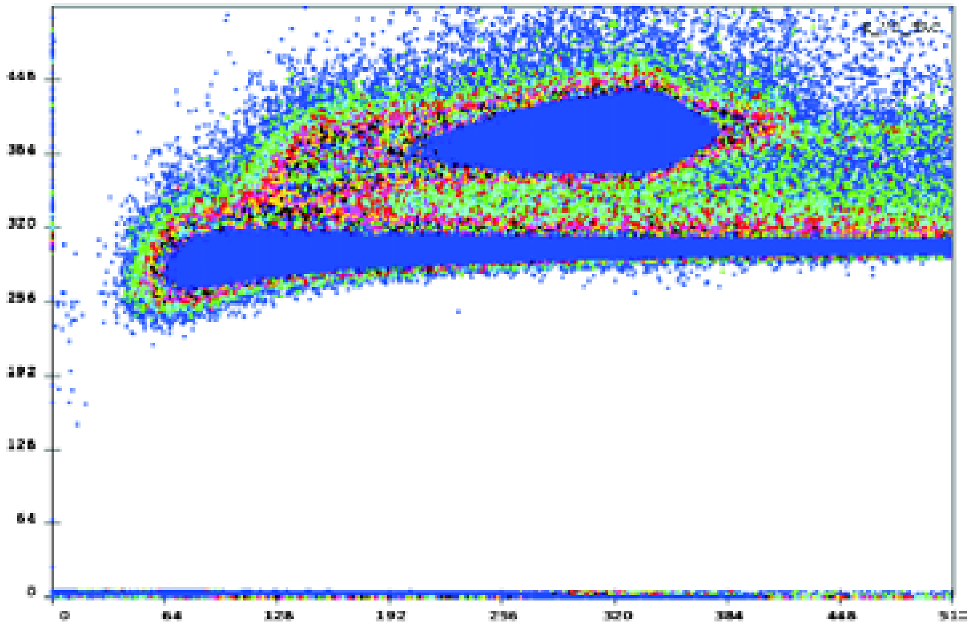

Fig. 2. Gamma and alpha particle discrimination using zero-cross method using CsI+PIN detector.

3.3.3 CdTe crystal based detectors

The CdTe crystals developed by Anna University Crystal Growth Centre has been assembled & tested for radiation detection purpose. After making metal contacts on a 1 mm thick, 3mm diameter crystal, it was mounted on a charge senstive pre-amplifer box and operated as reverse biased junction detector. The I-V characteristics of the detector was measured to estimate the resistivity of the crystal using Keithly sourcemeter. The detector was tested for gamma ray detection sensitivity. Using ^{241}Am source, the signal for 60 Kev X ray line was observed in the test setup.

3.3.4 Pre -Amplifiers

New Design of charge sensitive pre-amplifiers to be used inside vacuum has been tried out. A prototype system has been developed and tested in vacuum. The preamplifier has good rise time characteristics and has been tested for different gains from 200mV/pC to 2V/pC with detector capacitances upto 300pF. A typical pulse shape from 40 micron, 150mm^2 totally depleted SSBD exposed to ^{241}Am alpha is shown below. The pre-amplifer has a charge sensitivity of 450mV/pC and the timing ouput is differentiated by a timing amplifier of gain 200 with time constant of 1ns. Rise time of ~5ns is observed.

Fig. 3. Output pulse from pre-amplifer for silicon detector and alpha source

3.3.5 Position Sensitive photon detector as charged particle detector.

The two dimensional position sensitive photo diodes are widely used in various industrial & space satellites for position control applications. Properties of such detectors show that they can be used for charged particle detection and ion imaging. We have tested a 20mm x 20 mm photon detector for its response to charged particle using alpha source from ^{241}Am source. The detector is made of high resistive silicon of 350 micron thickness. Two contacts are formed on each side by evaporation of gold strips on opposite edges. The fractional ratio of charge signals from the contacts on same side gives the relative position information. The total energy is obtained by sum of the signal from either side. The measurments were performed in vaccum using alpha particles from ^{241}Am source. For determination of position resolution a mask with a series of 1 mm wide openings at 4mm apart was placed in front of the detector. Custom made low noise charge sensitive pre-amplifes were used for signal inputs. The four signals were stored event-by event in computer and analysed offline. The figure below shows the two- dimensional image of the mask in front of the detector.

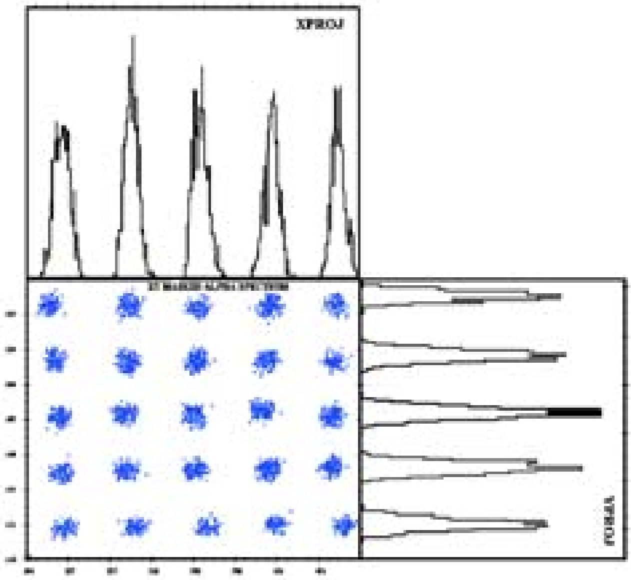

Fig. 4. The 2 dimensional image of a mask with 1 mm opening at at 4 mm separation.

3.3.6 Fast Timing Preamplifier

A. Jhingan, C.P. Safvan and P. Sugathan

Fast Tiiming preamps were fabricated for use with fast timing detectors such as MCP and proprtional counters. The preamps were used in an apparatus for studying ion-ion coincidences arising from multiple ionization of molecules by photo absorption. The experiments were carried out at the Indus-1 synchrotron of the Centre for Advanced Technology, Indore. They served as the first amplification stage for signals derived from a microchannel plate for detecting ions and electrons. The preamps worked very well during the entire course of experiments, which spanned about 2 months. Their performance was reliable and predictable. Output noise was well below the 50 mV threshold set for pulse counting. The gain of the amplifiers was about 80, and resulted in 8 ns wide 2—2.5 V pulses (negative). This was adequate for driving a CFD which generated fast negative logic pulses for time-of-flight measurement using a TDC.

3.4 TARGET DEVELOPMENT LABORATORY

D. Kabiraj, Abhilash S.R. and D.K. Avasthi

During this year Target Development Laboratory has extended facilities to 74 different users from various universities and institutes in the areas of Nuclear Physics, Atomic Physics and Materials Science. Following gives an account of the attempts made using various techniques for the preparation of targets. There were 134 and 41 evaporations attempted in HV and UHV evaporator respectively. More than 24 foils were prepared using rolling technique. We have developed technique for preparing foils of very soft metals like Sn using Teflon instead of standard stainless steel casing. This way sticking of the metal on stainless steel surface could be avoided. In addition to this, 600 carbon stripper foils of less than 5 $\mu g/cm^2$ thickness were also prepared for NSC Pelletron. There were 57 attempts made to prepare composite thin films using the DST funded Fast Atom Beam source. The composite films include metal-oxide, metal-polymer systems. There is a plan to develop an evaporator to prepare thin films using electron beam evaporation technique under maximum background gas pressure of $1x10^{-3}$ mbar. This will help to prepare compound thin films like oxides with proper oxygen stoichiometry and can be used in many other applications.

3.5 RF & ERLECTRONICS LABORATORY

A. Sarkar, S. Venkataramanan, B.K. Sahu, K. Singh, A. Gupta, A. Pandey and B.P. Ajith kumar

3.5.1 RF Power Generator for PECVD Application

In order to enhance the deposition rate as well as production rate of Amorphous silicon solar cell using PECVD technique at BHEL, ASSP, Gurgaon, we continued our efforts and successfully developed and delivered a solid state broad band VHF power generator (75-150MHz, 300 watts) along with a suitable matching network.

3.5.2 Implementation of High Density Electronics Module for GDA at IUAC

After successful implementation of electronics for Clover array at IUAC, similar concept has been adopted for replacing electronics for existing GDA at IUAC. A double width NIM module houses Shaping amplifiers, TFA and CFDs, Anit Coincidence Logic circuits for two HPGe detectors with AC Shield.

3.5.3 Development of Pulse Shape Discrimination Module for IUAC neutron Array

In order to fulfill the large requirements of PSD circuits for IUAC neutron array, we have initiated a development of prototype PSD circuit having various functions. A single width NIM module houses circuits required for 2 such detectors having Shaping amplifier, PSD circuits, TAC and TOF logics etc. So far, 3 prototypes have been made and overcome various problems encountered in the prototype circuits. A low cost charge sensitive preamplifier for Dynode is also developed and implemented.

3.5.4 Control Electronics for coarse approach mechanism for STM

Scanning Tunneling Microscopy (STM) has been proven to be an excellent instrument for studying the conducting surfaces and their electronic properties. Coarse approach mechanism for STM (scanning tunneling microscope) tip, called piezo-tube walker, is based on a piezo-tube moving inside a triangular prism shaped cavity. This walker walks like a six legged insect moving its legs one by one and then belly following. Its motion is found to be linear with applied voltage above threshold voltage.

An electronic circuit is specially constructed, using micro controller and triacs etc., to operate this walker and has six synchronized high voltage outputs. A voltage step is applied to each of the six sections of the tube, one by one, moving them along the same direction. Then the voltage on each leg is slowly brought down to zero at the same time. This constitutes one step of the piezotube walker. The direction of motion can be controlled by polarity of the applied voltage. We are using isolated 220V AC, passing it through the triacs and triggering the triacs at peak voltage. 50 Hz zero cross detector circuit has been designed which triggers the micro controller to mark the peak voltages on either polarity. This module has been interfaced with PC to feed the number of steps to move forward or backward. This is used with the STM electronics developed at IUAC and is capable of attaining atomic resolution for HOPG samples.

3.5.5 Development of spare modules for multi-harmonic buncher electronics

Several spare modules for the multi-harmonic buncher electronics have been fabricated and tested in the laboratory. These modules include Distribution Module, 12 MHz Harmonic Generator, Buncher Level Amplifier, Drive Filter and Sum Amplifier, two Input Filters and Control Buffer. The fabrication of the Harmonic Feedback Control Modules is in progress.

3.5.6 Development of RF multiplexer unit with CAMAC control

During the operation and tuning of Linac cavities it is necessary to monitor the RF amplitude and phase of different cavities from remote as per requirement. It is difficult to accumulate so many signals through patch panel. A RF multiplexer unit is being developed using two 8 to 1 RF multiplexer blocks. The control for switching is given by TTL logic signals. A CAMAC module is developed by modifying the existing output register module to give inputs for the selection of particular channel. By using this module one can select any of the eight channels from remote through CAMAC control. The data entry for the module is done as per the present control system guideline. The co-axial switch unit is being tested with the specific CAMAC module. Three such units are being produced and tested.

3.6 ELECTRICAL GROUP ACTIVITIES

U.G. Naik and Raj Kumar

Electrical group has succeeded in keeping its installation uptime to nearly 100% with proper maintenance schedules and monitoring arrangements. This group has also successfully completed the projects and works envisaged and approved for the year.

MAINTENANCE:

3.6.1 Captive Power Arrangement

This year has seen a major increase in the power breakdown although for short durations. This made us think and we put one of the helium compressors on generator supply on every cycle of the plant operation. The group has shown ever readiness in running the systems round the clock and within short notices have taken care of breakdowns. Group has managed the emergency power requirements with the available generator sets but quite soon in coming financial year have plans to increase the captive source capacities.

3.6.2 Stabilized Power Arrangement

The group has managed to have another year of 100% uptime without a single break in the supply through 1MVA and 500 KVA stabilisers catering to major loads such as A/C plant-II, Helium Compressors and the clean power to NSC pelletron cum experimental areas with.

3.6.3 UPS Systems

Electrical group has maintained 50kVA, 3 phase, UPS dedicated to feed motor loads and some computer controls for High Current Injector systems besides a previous base of about 20 nos. of UPS rated from 2-10kVA. Only the 5kVA and above capacity UPS are put on AMC with manufacturer. Otherwise rest are all maintained by the group. During the present year all UPS were very healthy and had 100% uptime. Routine maintenance was carried out by the manufacturers authorized service centre and the faulty batteries were replaced.

3.6.4 Power Factor Compensation

Electrical group is very happy to declare that for yet another time we achieved average power factor almost near to unity through the entire year. This has been clearly put on record in the energy audit report from external energy auditors. Our system power factor without correction is about 0.85 and by raising it to near unity we save around Rs.45 lakhs a year from energy billing.

3.6.5 Minus Meter for Housing Colony

After a lot of persuasion with the electricity department the electrical group has got a breakthrough in getting a separate energy meter installed for metering energy consumption of housing colony, hostel, flat lets, guesthouses and canteen. Since this is being charged at domestic tariff we have savings to the extent of Rs. 5 lakhs annually.

3.6.6 Communication Equipments

Electrical group maintains the hand held radio stations (Walkie-talkie) and base station. Till now we have 14nos. of hand held stations and one base station. The system is working fine. The group takes the responsibility of getting the revalidation of license periodically from the Ministry of telecommunications.

3.6.7 Maintenance of PHASE-I & II Electrical Installations

The electrical Group is proud to declare that during this year the installations have performed efficiently and without any breakdowns keeping the uptime at 100%. This was possible to achieve only with dedication and strict maintenance schedules. A few of the major yearly maintenance activities carried out are listed as below.

- Air Circuit Breaker servicing- 20 nos.

- Periodic maintenance of LT panels, Distribution boards and other accessories, Lighting, Fixtures, lighting and power circuits.
- Servicing of DG sets 60kVAX2nos, 2X 320 kVA, 1X 100 kVA-twice a year.
- Maintenance of street lighting.

3.6.8 Energy Saving

Energy savings measures taken earlier continued in the areas where we had installed the energy saving time switches.

PROJECT WORKS:

3.6.9 Installation for Beam Hall-II

Power distribution panels for the HYRA facility are installed and made operational with a temporary power capacity of 250kVA so that the planned facility testing can be carried out. The cable tray and cabling in HYRA area for all the magnets and other components is in progress.

Power to the experimental areas is also in progress. Distribution panels are already in place and cabling will be done soon.

3.6.10 Development of Helium Expansion Engine Drive

Four quadrant DC drive of helium expansion engine developed multiple problems like fuse blowing and over speeding of engine due to follower card OPAMP going into saturation. The problems were intermittent. It used to run the engine but not at all reliably. We tried to analyze and solve the problem but could not succeed due to its intermittent nature.

After studying the overall functionality of the drive we have designed an indigenous drive which is very reliable and rugged. The design is made in such a way that it is totally compatible with the existing control system of the engine. The drive consists of variable SCR based 0 – 200 V DC armature power supply and fixed 200 V DC full wave field power supply suitable for 7.5 HP DC motor/generator. The power generated during generator mode is being converted into heat though custom made heaters. The heating load is being controlled actively through PWM based driver and MOSFETs. PWM card is being controlled by 4-20 mA DC signal current supplied by PLC. Redundant over speed protection is being provided by connecting a fixed heating load across the armature and through PLC. Manual control on the heating load is also provided for the situation of any electronic failure. This drive has been tested rigorously for ascertaining its ruggedness. We have had three complete successful runs until now using this drive. This has been developed at 30% cost of imported drive.

3.6.11 LT Distribution Boards

Group has procured and installed various LT distribution boards:

- LT panel for domestic loads
- LT panel for future DG#6
- LT panel for recovery compressors
- LT panel for AHU/water circulatory pumps for BH-III

3.6.12 PHASE-II Part-II Installations

Electrical group has been working in close co-ordination with the CPWD to ensure that the requirements as per the user input and as per the standards are followed in the project by CPWD to the possible extent.

This year we have tested and taken over guest house, lab-I and Lab-II, A/c plant-III and 2nos. of housing blocks. We have also tested and taken over 1000kVA Transformer, associated bus trunking, LT panel, distribution boards. The group has taken special efforts in getting the housing blocks tested for earthing and meggering of the installations.

3.7 COMPUTER AND COMMUNICATIONS

S. Mookerjee, S. Bhatnagar and E.T. Subramaniyam

The focus of the group this year was on the major expansion of the infrastructure resulting from the networking of new buildings. In addition, the development of simulation of ion beams in matter, and the development of data acquisition and analysis software to support experimental activities in different fields was continued.

Computing infrastructure

A major upgrade of the networking infrastructure was undertaken, necessitated by the need to network the new laboratory, workshop and guest house buildings, as well as the annexe to the beam hall. To accommodate the large number of new network nodes (provision has been made for 200 new nodes), the entire network is being moved to a segmented network with fibre optic connectivity between switches. This would facilitate a smooth switchover to a 1G network with the potential to accomodate many times the current network size. In the first step, the fibre backbone covering both the existing and the new buildings was laid. A total of 1400 metres of optical fibre was laid. 4 new Cisco managed switches were installed, and 60 new nodes are operational in the new lab buildings.

The conversion of the printing infrastructure to a fully networked model was completed, with the addition of new network printers. The central facility, mainly used by students and visitors, was revamped and expanded to full physical capacity. It now has ten Linux and two WindowsXP terminals, besides scanners, monochrome and colour laser printers and a large-format inkjet plotter. A test wireless network has also been set up in this facility. The Centre's Internet link through Spectranet was upgraded to 1 Mbps on a 1:1 contention ratio, a significant change from the earlier 768 kbps (1:3).

The administration and academic Linux servers were upgraded to dual-Xeon processor based systems with 4GB of RAM and 160 GB of hard disk running Fedora Core 4.

3.8 AIR CONDITIONING, WATER SYSTEM AND COOLING EQUIPMENTS

P. Gupta, A. J. Malyadri and Bishamber Kumar

Central AC Plant

IUAC's Central Air Conditioning / Low temperature Cooling System of Phase-1 consisting of 400 TR Central AC plant, performed with 100% uptime. Proper maintenance ensured that the safety record of the plant was maintained at 100% and the power consumption kept at optimum levels. The reciprocating compressors (1,3&4) have logged in approximately 81,000 hours each and new compressor has logged in (Comp#2) 5500 hours. Other rotary equipment have logged in about 1,27,750 continuous run hours. The yearly maintenance costs have been maintained at approximately 2.6% of the installed project cost. The equipment being into their seventeenth year of sustained operations have far outlived their economic lives. In the current year, plenty of repair activities were carried out. This was essential to reset the reliability of the equipment.

The Phase-II, Central AC Plant with a Centrifugal Chiller and with its installed capacity of 250 TR performed to an uptime of 100%. The plant catered to the cryogenic activities and was used extensively for picking up the Phase-I heat loads. This affected a huge energy saving.

The highlight of the operation and maintenance of the above systems was the in-house responsibility. Supervision was provided to the contracts, thereby affecting substantial savings in the price paid for the operation and maintenance contracts.

Water Systems

IUAC's centralized water system of phase-I, feeding low temperature cooling water of a total heat removal capacity of 115 TR, potable water supply and the gardening water supply performed to an operational uptime of 100%. This was possible due to the stringent maintenance practices that were followed over the years. The mechanical systems have already overshot 79,000 hours beyond their expected life span. A strict monitoring on the water quality ensured that the flow paths are in healthy condition. Numerous replacement works were carried out.

IUAC's centralized water system of phase-II, feeding low temperature cooling water of a total heat removal capacity of 80 TR, Liquid Helium Cooling water of approx. 350 TR, potable water supply performed to an operational uptime of 100%. This was possible due to the stringent maintenance practices that were followed over the years. A strict monitoring on the water quality ensured that the flow paths are in healthy condition. Numerous replacement works were carried out.

Cooling Equipments

Availability of these equipments was recorded at around 95%. 16 Nos. of Geysers have been installed in new Sumeru-III. New equipments were added to cater to additional requirements. Several replacements are being done in a phased manner.

New Construction

Planning for the Phase II, Part -II works in association with CPWD was completed. The construction work is being claimed to have been completed by CPWD. However, IUAC has observed that many issues need to be resolved, before IUAC can actually take over the plant for smooth functional operation on round the clock basis.

3.9 Mechanical Workshop

Rewa Ram, S.K. Saini, R. Ahuja, S. Sunder Rao and Jimson Zacharias

The Mechanical Workshop is serving as an in house machining and welding facility for the 15 UD Pelletron accelerator, supporting various laboratories and large number of user community. Workshop has been involved in developmental activities of new systems as well as large scale production of beam line components right from the inception of NSC. This year also most of the beam line components used for the new beam lines was fabricated in the NSC workshop. Workshop continues to assist all the in house fabrication activities of LINAC, RFQ, HCI, INGA as well as the Cryogenic component developments.

The major facilities of the workshop are the Machine-shop, Welding-shop and the state of art Electron Beam Welding (EBW) machine facility.

The Machine-shop is equipped with a CNC lathe, four conventional lathes, two milling machines and radial drilling machine. Most of these machines are of HMT make, fitted with DRO's for achieving higher accuracy and better productivity. Apart from these we have cylindrical grinder, tool and cutter grinder, horizontal and vertical band saw machines, sand blasting machine etc for the general requirement. We also have the CAD facility, SolidWorks for the design and the drafting purposes.

Welding-shop is having many high quality TIG welding facilities. Some of the TIG machines can give pulsed arc for the thin section welding. Air plasma cutter with a capacity to cut up to 40mm thickness of stainless steel is used extensively. Aluminum welding and Oxy- acetylene cutting and brazing set ups are also available. We have a micro-plasma machine from Air Liqiude, France for very thin section welding.

The new workshop building is ready and the machines can be relocated shortly. Some new machines like a lathe and a milling machine will be installed in the new workshop building. A five axis Vertical Machining Centre of BFW make, may be added in the new workshop facility shortly.

The Electron Beam Welding facility is fully operational. Fabrications of fifteen resonators are in full swing.

All the machines, mentioned above, are working in good conditions, because of timely maintenance and careful handling. Apart from the people engaged in the workshop, other academic personnel and students are also capable of handling the machines.

IUAC workshop is providing apprentice training for the ITI passed students in both welding shop as well as in machine shop. Basic workshop training is provided for the scientist trainees and Ph.D. students enrolled in NSC.

3.10 Health Physics

S.P. Lochab, Birendra Singh and R.G. Sonkawade

Health Physics Group is involved in the field of radiation research, development and safety aspects. Radiation physics has emerged over the years as a separate discipline of research and development activities. Increasing use of particle accelerators of various types have opened up new avenues for research in this field. Currently health physics group is actively involved with different universities on various aspects of radiation research. A good setup for the environmental radiation monitoring and research is setup in health physics section which includes the low background counting system, monitoring of radon, thoron facility and characterization of the thermo-luminescent material and conducting polymers. Total six universities are utilizing the off-line facilities available in this laboratory. There are another two universities linked with the Pelletron accelerator facility for the thermo-luminescence material development and characterization. Two other universities are involved on the characterization of conducting polymers and its possible aspects of charged particle, neutron & electron dosimetry. The low background system is used by in-house and outside university and college users for the analysis of radio nuclides in the soil, exposed targets, for product identification and activity measurement of exposed AMS targets using nuclear reactors. This is presently used by many universities and colleges; a good work has been published with this system. One of the major activities is the dosimetry of the fast and thermal neutron using the Solid State Nuclear Track detectors (SSNTD) with the lithium Borated and Polyethylene moderator for the separation of thermal and fast neutrons respectively. Our group is also involved with the Monte Carlo Simulation for the design of radiation safety. Development of new shielding materials for mixed fields of gamma and neutron radiation is also undertaken by us.

3.10.1 Development and study of new TLD phosphors

Nano and micro particles of $Ca_{0.03}Ba_{0.97}SO_4$:Eu, nano particles of $CaSO_4$:Eu, LiF:Mg,Cu,P were prepared and studied for their TL properties. Nine different types of TLD-materials i.e. KCS:Eu, KCS:EuCe, $LiNaSO_4$:Eu, $BaSO_4$:Eu, $CaSO_4$:Eu (annealed in Argon gas), $CaSO_4$:Eu, $CaSO_4$:Dy, $Ca_{0.03}Ba_{0.97}SO_4$:Eu, annealed in Argon gas), $Ca_{0.03}Ba_{0.97}SO_4$:Eu, were exposed to ^{7}Li (24MeV and 48MeV) and ^{107}Ag ions in the fluence range of $1 \times 10^{9} – 5 \times 10^{11}$ and thermo luminescence were recorded by taking 2mg of the samples each time. It was observed that there was growth of some extra TL peaks at lower temperatures. This might have occurred due to the implantation of a few ions in host materials. However, the same samples exposed to gamma rays did not show such a glow peak.

(i) Thermo luminescence and Photoluminescence Study of $Ba_{0.97}Ca_{0.03}SO_4$:Eu.

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A highly sensitive thermo luminescence (TL) phosphor based on $Ba_{1-x}Ca_xSO_4$:Eu (0=x=1) has been prepared by the chemical co-precipitation technique. It has been found that TL sensitivity of the material changes on varying the value of x with the maximum occurring at x = 0.03. For this value of x the sensitivity is even more than that of the commercially available phosphor $CaSO_4$:Dy (~ 2.3 times more). Photoluminescence (PL) and XRD studies performed on the phosphor throw much light on the reasons for such a behavior. Moreover, the phosphor $Ba_{0.97}Ca_{0.03}SO_4$:Eu has a constant glow curve shape and a linear gamma-ray dose response over the range 0.1 to 50 Gy which makes it suitable for radiation dosimetry.

(ii) TL and PL studies on CaSO4:Dy nanoparticles

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Nanocrystalline CaSO4:Dy of grain size 30nm has been prepared by the chemical co-precipitation method and its photoluminescence (PL) and thermo luminescence (TL) characteristics have been studied. The PL emission spectrum of the nanophosphor resembles that of microcrystalline phosphor. Both the spectra show the two well known bands at 482 and 573 nm. However, a shift towards lower wavelength of the excitation peaks has been observed on decreasing the particle size from micrometer to nanometer. This has been attributed to the extension in the band gap of Dy^{3+} ions. The glow curve of the nanocrystalline materials has four major peaks at around 411, 498, 569 and 652 K. The TL intensity of the nanophosphor has been found to be less than that of its corresponding microcrystalline phosphor. Various peaks have been identified and separated using glow curve deconvolution (GCD) method. Trapping parameters for various peaks have been tabulated for the nanocrystalline materials and

compared with those of the microcrystalline materials. It has been found that, there is change in the order of kinetics, while going from micro- to nanocrystalline powder. The TL intensity saturates at high doses with negligible fading making the nanocrystalline phosphor useful for application to estimate high exposure of gamma rays.

(iii) Modification in TL characteristics of $K_2Ca_2(SO_4)_3$: Eu by ^{7}Li ion beam

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Highly sensitive $K_2Ca_2(SO_4)_3$:Eu Thermoluminescence detector phosphor was irradiated at room temperature by ^{7}Li ion beams of 24 and 48 MeV for different ion fluence in the range 10^9 - 10^{12} ions/cm^2 using a 16 MV Tandem Van de Graff type Electrostatic Pelletron Accelerator. The samples from the same batch were also irradiated by γ-rays from Cs^{137} source for comparative studies. Glow curves of the ion beam irradiated samples mainly consists of two prominent peaks at around 392 and 411 K while the γ-rays irradiated samples show only one peak at around 411 K. The appearance of the new peak (392 K peak) may be attributed to the defects/trapping centers due to ^{7}Li ions that have been implanted deep inside during irradiation and act as a source of emission of thermo luminescence (TL). This was confirmed from the glow curve structure of Eu, Li ion co-doped samples.

3.10.2 Radiation Shielding of PKDELIS ECR Ion Source

S.P. Lochab, G.O. Rodrigues, R.G. Sonkawade and Birendra Singh

PKDELIS ECR ion source is a high current source used for injecting (accelerating) beam into Linac. It operates at 14.5 and 18 GHz. The maximum RF power is 1.7 KW. Two HTS (High Temperature Superconducting) coils can be energized up to a maximum current of 181 Amp and 145 Amp on injection and extraction respectively.

Radiation survey of this unit was done at different parameters on the higher side. The radiation survey was started with Thyac III (Victoreen, USA) survey meter and UMo LB 123 (BERTHOLD Technology) radiation survey meter. It was found that without lead shielding around the ECR ion source, it can not be used for higher values. Sliding radiation shielding system was designed and installed around ECR source. Radiation survey was done after the new shielding. A little modification is required at few positions so that it can be used during operation within full parameter range.

3.10.3 Natural Radioactivity in the Common Building Construction Materials

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The activity concentration of the natural radio nuclides namely U-238, Th-232 and K-40 is analyzed for the radiation shielding bricks, hematite aggregate, and other common construction materials using the Low Background Counting setup of HPGE detector. The radiation shielding bricks used in this facility are formed with the ratio of (1:1.5:3) cement, hematite sand, and hematite aggregate from Rajasthan, India. The activity concentration varies from 29±1 Bq/kg to 98±4 Bq/kg for U-238, 20±2 Bq/kg to 112±2.8 Bq/kg for Th-232 and 230±5 Bq/kg to 1908±15.6 Bq/kg for K-40. Thorium and Potassium activity found in the granite materials are higher, followed by radiation shielding material compared to other common construction materials. Uranium activity concentration found in the Cement is higher compared to radiation shielding material and other common construction materials depending upon geological factors. Naturally occurring heaviest toxic element is found in traces in almost all types of rocks, soils and sands. Due to its property of getting dissolved in aqueous solution in hexavalent (U^{6+}) form to precipitate as a discrete mineral in tetravalent (U^{4+}) form, uranium forms in earths crust where geological condition becomes favorable. The absorbed dose and the indoor effective equivalent dose in the radiation shielding material and the common building construction material were found to vary from 34.65 $nGyh^{-1}$ to 191 $nGyh^{-1}$ and from 0.17mSv to 0.93mSv. The absorbed dose and the effective equivalent dose found in the granite is higher, followed by radiation shielding material and other common construction materials. The activity concentrations of U-238, Th-232 and K-40 found in all the samples are well below the permissible levels. A detailed analysis of the common building construction materials in terms of natural radioactivity and its effective dose for the industrial activities and the living population, has been carried out.

3.10.4 Dosimetry in the environment of 15 UD Pelletron accelerator using plastic track detectors

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In the present work, inhalation dose rates and annual effective dose contribution from the mixed field of radon and thoron present in the atmosphere of the accelerator building mainly due to building material used were measured, as it is very much essential from health and hygiene point of view to assess the total radiation dose (gamma, neutron, radon and thoron) received by the radiation workers in the accelerator facility. Though there is no direct link of radon, thoron and their progeny with the Pelletron accelerator, yet it is important to measure them in the premises from the view point of health safety. The average radon concentration, annual effective dose and life-time fatality risk found in concrete block houses are 66.21 ± 7.34 Bq m^{-3}, 1.13±0.10 mSv and (0.88 ± 0.09) $\times 10^{-4}$. The source of the radon, thoron and daughters in the accelerator building is the construction material.

The inhalation dose, radon and thoron concentration in the Pelletron building were found to vary from 0.681 $mSvY^{-1}$ to 1.599 $mSvY^{-1}$, 19 ± 2 Bq/m^3 to 64 ± 5 Bq/m^3, 1.2 ± 1Bq/m^3 to 62 ± 4 Bq/m^3, respectively. The concentration of radon daughters was found to vary from 2.05mWL to 6.92mWL and the concentration of the thoron daughters was found to vary from 0.03mWL to 2.18 mWL. The annual effective dose from radon and thoron (PAEC) was found to vary from 0.47$mSvY^{-1}$ to 0.98$mSvY^{-1}$. The life time fatality risk factor was found to vary from 0.38×10^{-4} to 0.98×10^{-4} with average risk factor is 0.57×10^{-4}. In addition, the gamma and neutron radiations are also generated in the accelerator facility. The gamma and neutron radiation dose were measured using the Thermoluminescence badge and CR-39 films respectively. There gamma radiation dose was not found to be significant during the experimental time. The neutron dose was found to vary from 0.20 mSv to 0.50 mSv, and in few cases it had gone upto 1.85 mSv. The annual neutron dose found in the study period was 26.50 mSv and the average received dose per person is 0.473 mSv, whereas the collective dose recorded was 0.0265 person Sv. The inhalation dose due to radon and thoron in the air conditioning facility was found slightly higher than the non air conditioned part. It also varied with height, which may be due to different ventilation rate. The gamma and neutron radiation dose was measured using the Thermo luminescence dosimeter and CR-39 films, respectively.

3.10.5 How Safe Is Fly Ash As Building Construction Material In Dwellings

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Fly ash generated from conventional coal based power plants is disposed off in ash ponds in the form of wet slurries and is being used as stowing material for underground coal mines, for manufacturing bricks, asbestos sheets, Portland Pozzolona cement, land filling etc. In the recent past, there has been increasing interest in making fly ash brick houses due to light wt. of the bricks particularly in hilly areas and earth quake prone areas. It was not known until recently that the fly ash is a potential radioactive air pollutant and it modifies radiation exposure. As the fly ash is burnt coal ash and contains concentrated amount of radionuclides, tracking radon concentration in it is fundamental for radiation protection, health and hygiene point of view. Measurement of indoor radon and its progeny levels was carried out in dwellings made up of fly ash bricks using LR-115, Type II plastic track detectors. The average radon concentration, annual effective dose and life-time fatality risk is 99.34 $\pm$ 10.53 Bq m^{-3}, 1.71 $\pm$ 0.18 mSv and (1.32 $\pm$ 0.14) $\times 10^{-4}$ respectively in brick houses, 70.55 $\pm$ 7.34 Bq m^{-3}, 1.20 $\pm$ 0.12 mSv and (0.94 $\pm$ 0.09) $\times 10^{-4}$ respectively in plastered brick houses, 122.42 $\pm$ 6.16 Bq m^{-3}, 2.09 $\pm$ 0.10 mSv and (1.63 $\pm$ 0.08) $\times 10^{-4}$ respectively in fly ash houses, 66.21 $\pm$ 7.34 Bq m^{-3}, 1.13$\pm$0.10 mSv and (0.88 $\pm$ 0.09) $\times 10^{-4}$ respectively in concrete block houses and 115.17 $\pm$ 13.02 Bq m^{-3}, 1.98 $\pm$ 0.22 mSv and (1.54 $\pm$ 0.17) $\times 10^{-4}$ respectively in mud houses. In the measurements, we found that radon concentration was maximum in Fly ash houses. The measurements indicate moderate levels of radon concentration in fly ash samples in itself and fly ash brick houses compared to other type of houses. However, the obtained values are well below the permissible limits of 3-10mSvY^{-1}. For comparison the radon concentration in some typical dwellings made up of Baked Mud Bricks, Concrete Blocks and Mud Houses was also carried out.

3.10.6 Evaluation and Estimation of Residual radioactivity for the decontamination and decommissioning of Accelerator Components

In the accelerator facility at IUAC most of the time the contamination and residual radioactivity levels are well below the permissible limits. Due to the acceleration of light ion, residual radioactivity in the accelerator facility was found near the Analyzing Magnet, single slit, BPM-5, FC-04-1, beginning of switching magnet bellows, at the target and the ladder etc. In such cases a decontamination procedure is followed. The decommissioning of accelerator and beam line components will be done only after the contamination check with proper decontamination steps. An attempt is being made to measure the residual radioactivity in the shielding concrete bricks collected from the beam dump area using gamma ray spectrometry with HPGE detector of good resolution. It was found that the presence of Cs-134, Mn-54 and Na-22 is due to the thermal neutron capture reaction. The activity of these radio nuclides found in this facility is very low almost at the levels of background, so there is no need of proper decommissioning of these beam dump shielding materials as it will not lead to any health hazards. The residual radioactivity found in the case of such accelerator components, will be for a short period ranging from a few hours to in some cases a few days depending on the energy of the beam, ion species and current. The decommissioning of such vital components exposed for long duration needs to be monitored carefully, before handling by any personnel. This is very useful tool for deciding upon the decommissioning of such radioactive facilities.

3.11 CIVIL WORKS

M.K. Gupta and Manohar Lal Chandela

Civil section is associated with the following activities:

(a) Major Projects
(b) Minor Projects
(c) Minor Works
(d) Maintenance Works
(e) External Cleaning of the Campus
(f) Liasion with various outside and Govt. agencies for statutory approvals and civic problems

Important Civil Activities during 2005-06:

Following important Civil works were undertaken during the year 2005-06 in addition to routine civil maintenance and minor works:

(a) Construction of 2 nos. Sumeru-III blocks under Phase II-Part II Project
(b) Construction of new Workshop building under Phase II-Part II
(c) External painting of Phase-II housing
(d) External painting of hostel complex
(e) Internal painting of Phase-I housing
(f) Internal painting of hostel complex
(g) Procurement of furniture for new Guest house
(h) Epoxy floor coating in the floors of new Labs. of LEIB building
(i) PVC partitions in new Labs. in LEIB building
(j) PVC partitions in Beam hall-II
(k) Construction of new car parkings near main gate and Sumeru-I block
(l) Replacement of RCC drain covers in front of Hostels
(m) Construction of ramp and steps on the side of LEIB building
(n) Repair of boundary wall at main gate
(o) Construction of wooden table counters for computers in R.N.239

3.12 COMPRESSED AIR SYSTEM AND MATERIAL HANDLING EQUIPMENTS

K.K. Soni and Bishamber Kumar

i) Compressed Air System: Compressed air plant (Ph-I & PH-II) consisting of reciprocating compressors (2 Nos), screw compressor, air dryer & filters with capacity of 3000 lpm @ 9.00 kg/cm^2 have been maintaining uninterrupted air supply to tower, Beam Hall- I, Beam Hall -II building, round the clock. Pneumatic connections have been extended to all the labs. Further to ensure dew point of the air, the compressed air is passed through two number refrigerated type air dryers of 4300LPM capacity. Ultra high filters of boro silicate and carbon filters are provided in different location of the compressed air to provide clean air free from dust and oil particles. Since Reciprocating compressors are more power consuming and are sources of excess oil contamination in the compressed air, 2 nos. of these are replaced by one Screw Air Compressor of 2208 Lpm capacity. Compressed air piping has been extended to Lab I, Lab II and New Workshop building. An additional GA-15 air compressor is being added to the system to meet the increased requirement of Compressed air and also to make the system more reliable.

ii) Industrial Gases: Various industrial gases required in different labs have been made available from time to time. Special gases like Isobutane and mixture gases are also procured for labs.

iii) Elevator: Elevator has been running smoothly and monthly preventive maintenance of the same is carried out to minimize the operational break down.

iv) Material Handling System: Periodic maintenance / servicing of more then 10 E.O.T cranes and electric hoists of various capacity varying from 1 Tonne to 7.5 Tonnes are being carried out periodically and the same have been working smoothly. Two more cranes of 2 Tonne capacity are installed in EBWM room and Material Storage area. A 2 Tonnes EOT Crane has been installed in new workshop building to handle the heavy items during machining of parts and also for maintenance of Machines. All the cranes are put on remote control operation for safe handling of machines.

v) Fire Extinguishers: Annual refilling and periodic maintenance of all the fire extinguishers have been carried out. New fire extinguishers have been installed in newly constructed BH II store area, Lab I and Lab II area and Workshop building. Some more signal including the “Escape route” in emergency is added in the building with GLOW LIGHT which shines even in darkness .Demonstration for use of Fire extinguishers have been arranged and all the users and IUAC employees are trained to use the fire extinguishers in case of fire.

3.13 DATA SUPPORT LABORATORY

V.V.V. Satyanarayana, R. Ruby Santhi and P. Sugathan

Data Support Laboratory provides user support to various experimental groups setting up NIM & CAMAC modules for data acquisition during experiments. Apart from providing regular user support & maintenance of the setup, we have developed a few electronic modules and serviced a number of NIM modules. The lab had procured new modules, cables & connectors for data acquisition purpose.

3.13.1 Pico Ampere Current Amplifier

Current Integrators are used for measuring the dc or average pulse beam currents used in ion beam experiments. With the current integrators available at IUAC, one can measure the beam current in the order of nano amperes. For measuring currents in pico -ampere range, a special pre-amplification is required in the signal conditioning circuit. At IUAC the experiments in Radiation biology and Accelerator Mass Spectroscopy (AMS), require measuring currents in the order of picoamperes. A circuit has been built to implement the amplification of signal in current integrators. This current amplifier provides a gain factor of 1000. The picoampere current amplifier is being used by radiation biology users in the Centre. More circuits are being made for other users.

3.13.2 Variable amplitude Pulser

This is a single width NIM Module which provides 50Hz fixed frequency electrical pulses of variable amplitude (0-5V) and constant rise time of 50 ns and fall time of 300 us. These pulses which are generated from this module are given to various electronic Modules to test their performance. This Module gives both positive and negative polarity pulses (0-5V) and fixed 5V pulse of 500ns width. This Module was made as per the requirement of AMS Lab in the Centre.

3.13.3 Micro Controller based Nuclear Radiation Monitor

A Micro controller based Nuclear Pulse counting System was developed to count the pulses from various detectors like G.M. Tubes, Gas flow counters etc. This is implemented using AVR Atmega8 micro controller which displays the radiation counts on an LCD display board. The in built GM tube generates tail pulses and these pulses after converting into TTL pulses are given to micro controller chip. Micro controller is programmed to display the radiation level on LCD display as per the number of pulses received. The controller board consists of 8 kbytes of Flash Memory, 512 bytes of EEPROM, 1k byte of SRAM, 3 counters, 3 nos. of 8 bit I/O ports and an RS232 port. This instrument is being used to monitor Gamma radiation levels in various beam halls in the Centre. The instrument can give an alarm if the radiation dose exceeds the set limit. Remote reading of dose rates are also implemented using RS 232 port.

3.13.4 Servicing and Maintenance

A few number of NIM Modules were serviced and repaired. The following items are serviced during the year

1) Pre-amplifiers, EG&G Ortec 142A
2) Gate & Delay Generators, EG&G Ortec Model 416A
3) Current Integrators, Danfysik Model 556
4) ADC's, Canberra Model 8075

Following Electronic modules are added to data acquisition resource pool

1. PB-5 Berkeley Nucleonics Pulse Generator – 1no.
2. 7070 Fast Com Tec 100MHz NIM ADC – 1no.
3. 2111 Canberra make Timing Filter Amplifier – 2nos.
4. 4001C EG&G Ortec NIM bin – 3nos.
5. 710 EG&G Ortec Quad bias supply – 2nos.
6. 4002P EG&G Ortec Power supply – 1no.
7. 1/3 inch CCD C-mount Camera with 50mm lens – 8nos.
8. 5 inch Black & White Monitor – 8nos.
9. 792 Phillips Dual delay Module – 2nos.
10. 794 Phillips Quad Gate/Delay Generator – 1no.
11. 7164 Phillips 16 Channel 12 bit CAMAC ADC – 1no.
12. 7186 Phillips 16 Channel 12 bit CAMAC TDC – 2nos.
13. BNC, SHV and LEMO Connectors.

3.13.5 Multi Channel Analyzer using Embedded PC

V.V.V. Satyanarayana, R. Ruby Santhi and B.P. AjithKumar

A portable Multi Channel Analyzer (MCA) system has been developed using locally available 12 bit ADC board attached to an embedded PC system. The MCA input accept 0-5V unipolar Gaussian pulses from any standard spectroscopy amplifiers and converts it into a 12-bit digital output using the ADC (AD676 Successive Approximation Register type). The on-line data acquisition is accomplished by parallel port data transfer using "mca" software developed at IUAC. The software is installed in an Embedded PC (Vortex86^{TM} from ICOP Technology) with 512MB disk capacity. The embedded PC runs a bare minimum version of Linux Operating system (Puppy Linux version). The Pulse Height Analysis (PHA) is done using off-line analysis program "freedom" installed in the system. The ADC card & PC housed inside 19"x17"x5" box can be connected to any standard VGA Monitor, PS/2 Mouse and Keyboard. The box also provides option for Ethernet connection. A picture of the setup is shown below.

Fig.1. Portable Multi Channel Analyzer (MCA) system using Embedded PC

The instrument has been used by many users for measuring thickness of thin foil (targets used in experiments). The MCA system in our Pelletron Control Room is used for pulse width measurements in beam pulsing applications.