3. RESEARCH SUPPORT ACTIVITIES

3.1 HIGH VACUUM LABORATORY

A.Kothari, P.Barua and D.K.Avasthi

Lab Activities:

It is a central supporting lab and the group is responsible for maintaining essential vacuum components and equipment. Centralized purchasing of vacuum components was done. The lab provides support to users for various vacuum related problems and leak testing. Various vacuum and electronic problems during experiment in facilities were also attended to. Vacuum related training is given to scientist trainees and research scholars. The group was involved in phase detector installation before Linac-I module.

Pelletron Support:

Regular support to Pelletron lab is provided during maintenance and in other vacuum related work. These is regular involvement in vacuum activities during terminal stripper foil changing work. Beam line valve BLV-04 had a leak in bellow causing frequent problem in vault area. Replacement work of the bellow was taken up during maintenance. Overhauling of Getter pump GP-03 and GP-04 was also carried out and their cartridges were replaced.

Sweeper Installation:

Active participation was there in the installation work of high energy sweeper (placed after analyzer magnet). Proper support for positioning of sweeper were installed and sweeper was put accurately in alignment with the beam axis. A single slit was also installed before phase detector.

3.1.1 Beam Line Maintenance and Installation

A.Kothari and P.Barua

Phase-II beamline installation work has been started and major components of zero degree beamline have already been aligned and installed. The installation work of zero degree is expected to be over by mid of April 2003. We also take care of the complete vacuum related maintenance of beamlines of LIBR, Bio-Science, Material Science, HIRA, GDA and GPSC.

3.1.2 Fast Valve (BLV 02-1) Replacement

A.Kothari and P.Barua

Fast Closing valve BLV 02-1 developed a body leak and was operating with spray sealant in disabled condition. This valve was taken out and another similar valve installed in place, maintaining the alignment position. The valve firing was also tested by simulating vacuum disturbance.

3.1.3 LIBR Chamber Recommissioning

A.Kothari and P.Barua

Recommissioning of LIBR experiment chamber was carried out in order to change the orientation of different ports with respect to beam, for some specific requirement. Besides, a four jaw manual slit and a collimator with linear motion were installed and aligned with beam axis.

3.1.4 Design and Fabrication of Diesets

A. Kothari and R. Ahuja

Four diesets of different shapes were designed and fabricated for punching holes of required size (as that of the connector) on panels of controller boxes. All the components of dieset i.e. Punch, punch plate, die plate, base etc. were designed and detailed drawing supplied for getting the same manufactured. With the available punching machine these can be used for punching Aluminum plate up to 2.5 mm thickness and S.S. plate up to 1.5 mm thickness. The cost of each dieset has come out to be 1/4th of the general market price.

Fig. 1 : Drawing of dieset

3.2 MAINTENANCE OF MAGNETS AND POWER SUPPLIES

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

Routine maintenance during the maintenance period is done to keep the up-time of the Beam Transport System maximum. Routine maintenance consists of the following tasks:

Monitoring of output ripple and stability.

Calibration and testing of safety interlocks.

Cleaning electronics card and other components.

Cleaning heat sink cooling path and changing damaged hose pipes.

Changing faulty power transistors, fuses from the transistor banks.

Temperature monitoring of all magnets at full load current to find out the water flow blockage.

Cleaning blocked coils if any and changing damaged hose pipes.

Some major maintenance jobs done during the last year are described below:

Repaired Scanner power supply.

Changed output power protection diode of MQX_LX power supply.

Repaired the regulation module of MQY_04 power supply.

Repaired the interlock module of MQX_LX power supply.

Changed complete capacitor bank of MQY_LX power supply to solve ripple problem.

Repaired corroded transistor bank heatsink of MQX_03 power supply.

Modifications done: Frequency of Y-Scanning modified from 0.4 Hz to 0.1 Hz.

3.3 DETECTOR DEVELOPMENT LABORATORY

P.Sugathan, Akhil Jhingan and T.Varughese

This year the development activities of the laboratory involved setting up of focal plane detectors for experiments with light radio-active ion beams and recoil tagged gamma spectroscopy study using HIRA. The silicon annular strip detector setup was installed at HIRA focal plane and used in the RIB experiments. For particle identification of light ions a new gas ionization detector was fabricated. A split anode gas ionization chamber, and two large area position sensitive multi wire proportional counters were also designed. Fast timing preamplifier for MWPC were designed and fabricated. Plastic scintillator materials and Solar cells were tested for timing and charged particle detection. Support is also provided to various other experimental groups in fabrication, testing and maintenance of detectors. Wire winding unit has been used to make wire frames for large area detectors.

3.3.1 Gas Ionization Chamber

Akhil Jhingan, P. Sugathan, Thomas Varughese and Rajiv Ahuja

A split anode gas ionization has been fabricated. The detector to be used at the focal plane consists of an anode segmented into three parts, a cathode and a Frisch grid. The lengths of the three sections of the anode are 32 mm, 60 mm and 200 mm respectively with 1 mm separation between electrode. Anode to Frisch grid separation is 10 mm and that of frisch grid to cathode is 50 mm. Width of the detector is 90 mm. Electrodes have been fabricated using 3.2 mm thick glass epoxy sheet. Field between cathode and Frisch grid is shaped by a resistive gradient. The entrance window of the detector extends 12mm into the first segment of the anode to minimize the dead region.

3.3.2 Fast Timing Amplifiers

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

A five channel fast timing preamplifier for signal readout from MWPC electrodes has been fabricated. Four of the channels are made of inverting type and one channel non-inverting. The inverting channels are used for the delay line signals from position sensing electrodes of the MWPC whereas the anode signal is given to the non-inverting channel of the amplifier. All channels have a gain of 200. Preamp was tested with MWPC and MCP. A rise time of 2 ns was observed for MWPC anode and time resolution of 500 ps was observed with MCP.

3.3.3 Auxilliary Detectors

P .Sugathan, A. Jhingan, R. Ahuja and B. P Ajith Kumar

Plastic Scintillator:

A sheet of plastic scintillator (20"x20"x0.5") developed by cosmic ray lab at Ooty has been given to our lab for testing and evaluation purpose. The indigenously developed material was tested for timing performance and compared with commercially available plastics. A 2" ∅ circular piece of plastic was machined, polished and mounted on Phillips XP-2020 PMT. The detector was tested with gamma and neutron sources. The detector showed good time response and n-gamma discrimination. Rise time of ~ 3 ns was observed for the anode signal and this is comparable with commercially available plastic detectors.

Solar Cell:

Commercially available bare solar cell chips with an active area of 1 cm x 1 cm were tested for charged particle detection. Using a standard fission source, ^{252}Cf this chip was found to give good quality signal in unbiased condition. Fission fragments were well separated in energy and for alpha particle energy of 6 MeV, energy resolution obtained was 120 KeV FWHM with zero bias condition.

3.3.4 Discrete Delay Line MWPC

Akhil Jhingan and P. Sugathan

A 2-Dimensional position sensitive MWPC was fabricated using discrete surface mountable inductors and capacitors as delay line readout. The discrete values are chosen so that the delay line had 50 ohm impedance and a delay of 2 ns per tap. The MWPC was tested with alpha source at 3 torr of iso-butane gas. Rise time of the order of 5 ns was observed from the delay line.

3.3.5 Precise Gas Pressure control system for Focal Plane Detectors

P.Sugathan, A.Jhingan, T.Varughese and Manoj Kumar

A precise gas flow control system has been installed at HIRA focal plane to control and regulate the iso-butane gas pressure used in gas detectors. The system is based on MKS mass controller with a control valve and a differential pressure sensor. The system used at the focal plane MWPC detector controls the pressure to an accuracy of 0.01 torr and found to be very stable for long duration

3.3.6 Local Data Acquisition at HIRA focal plane

P.Sugathan and A.Jhingan

A dedicated low cost data acquisition system has been installed at the focal plane of the spectrometer. For experimental setup involving large number of detectors and readout electronics, it is required to have a dedicated data processing setup locally. The present system consists of single rack containing a CAMAC Crate, NIM

BINs and a PC. The data acquisition is based on the low cost stand alone version of "*FREEDOM"* which uses home made crate controller and 16 channel Phillips ADC. The system is connected to the data acquisition network and remote accessing is possible.

3.3.7 Timing PPAC

Golda K.S., P. Sugathan, S.K. Saini and S.K.Datta

A small area timing Parallel Plate Avalanche Counter (PPAC) was developed for particle identification using Time of Flight set up. Cross sectional view of the detector is shown in Fig. 2. This is a two electrode detector with circular electrodes of 25 mm diameter separated by a distance of 1.5 mm.

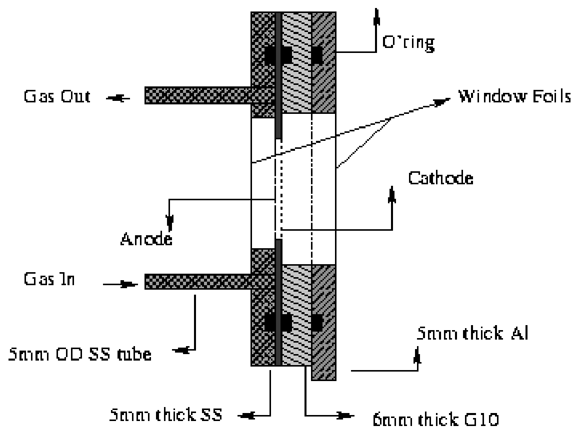

Fig. 2 : Cross sectional view of PPAC

Two detectors were fabricated; one Parallel Grid Avalanche Counter (PGAC) with two wire mesh grid as the electrode and the other PPAC with metalized Mylar foil as electrodes. For PGAC, gold plated Tungsten wire mesh of 30 lines per inch and for PPAC, two micron thick aluminized Mylar foil were used. The electrodes were mounted on G-10 pcb sheet and enclosed in metallic housing with two mylar windows. The detectors were operated with iso-butane gas in the pressure range 4-6 torr at a bias voltage of ~ 600V/Torr/cm. By making a TOF setup with the PPAC as the front detector followed by a fully depleted silicon detector at the back, the timing resolution was measured using ^{252}Cf fission source. The anode signal from PPAC, after amplification using fast pre-amplifier, was fed to CFD and the output was used as the start signal of the TAC with the stop signal generated from the timing discriminator output of the silicon detector. Both TAC out put and the energy out of Silicon detector were given to a 4k ADC and data was collected using NSC data acquisition system. Time resolution of the detector set up was measured to be ~ 600ps for higher mass fission fragments. To find out the intrinsic time resolution of PPAC, a Time of Flight set up with two identical detectors is planned and the work is going on.

3.4 TARGET DEVELOPMENT LABORATORY

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

Target Development Laboratory at NSC provides facilities to the users for the preparation of targets used for the experiments with NSC Pelletron. Several targets have been prepared in the last year for the studies in Nuclear Physics, Atomic Physics, Materials Science and Bio Science. Following gives an account of the attempts made by various techniques for the preparation of targets. There were 108 and 91 evaporations attempted in HV and UHV evaporator respectively. There were 12 foils prepared using rolling technique. In addition to this, 600 carbon stripper foils of less than 5 $\mu g/cm^2$ thick are also prepared for NSC Pelletron. The target preparation facility was used by 49 different users during this year.

The experiment performed jointly by NSC and National Physical Laboratory (NPL) under DST funded project on ion beam induced mixing at the interface showed interesting results. The thin film samples used in this experiment were deposited using electron beam under UHV condition at a base pressure of 1.5×10^{-8} torr. The thin films were deposited on Si wafers. A 50nm thick layer of Si was deposited on the substrate to avoid the interference of the native silicon oxide layer during ion beam mixing. A layer of V of thickness 50nm was deposited on this Si layer. And finally, 50nm thick Si protecting film evaporated to avoid the oxidation of the V layer. During deposition the pressure in the evaporator was between 1×10^{-8} to 3×10^{-8} torr. The samples were irradiated by 120 MeV Au ions using 15 UD Pelletron at NSC for fluences at a range of 1×10^{13} to 1×10^{14} ions/cm^2. To estimate the ion beam induced mixing at the interface both Rutherford Backscattering Spectroscopy (RBS) and Secondary Ion Mass Spectroscopy (SIMS) experiments were performed. A brief report of this is given in Materials Science section.

Studies on Stripper Foils and Developments:

The carbon stripper foils used as strippers in the Pelletron are prepared in this laboratory. The foils are prepared by evaporation of carbon from high purity graphite using electron beam and condensation on releasing coated glass slides under high vacuum condition. The thicknesses of the foils are less than 5 $\mu g/cm^2$. Various techniques are used in different laboratories for the preparation of the carbon foils. The usable life of these foils are limited by the defects produced by the bombarded ion beam, also, depends very much on the preparation technique used. The basic processes of stripper foil degradation are understood from the in-depth study by Dollinger et. al. [1]. The degradation of stripper foils is reported to be due to the thickening at the region of interaction with beam, and subsequent rupturing from the periphery due to strain developed radially inwards. A systematic study has been performed to understand the role of ion beam induced defects to produce modifications in the stripper foils. Stripper foils were irradiated by 12 MeV Ni, Ag and Au beams. The transmitted ion beam current was measured from Faraday cup at column bottom of NSC Pelletron, in regular intervals using a computer program. The measured transmitted ion current showed similar trend for all the ions. Fall in transmission was observed after initial constant current. This initial constant current region varied for different ions used for irradiation. The vacancies produced by all these ions in carbon were calculated using TRIM Monte Carlo simulation program. Using this result, the onset of the fall in transmission was observed to be after accumulation of the same number of vacancies in the irradiated region, independent of the ion producing these vacancies. It is known that the fall in transmission of ion current is due to the increase in multiple scattering as the thickness of the carbon foils increase with irradiation. Thus this study shows that the thickening process in the carbon foils is initiated by the accumulation of certain amount of damage in the irradiated region.

We have started some work to design a new type of carbon stripper foil by sandwiching a thin film of C_{60} between two thin carbon foils. The size of each C_{60} molecule is 0.7 nm diameter, and it contains only 60 carbon atoms. So collapsing of such a molecule under ion bombardment may create a large open space in the structure and generate some space for the structure to shrink. There are reports of formation of onion like and finally diamond like structures under high energy, high current irradiation with heavy ions [2] and high current electron beam irradiation [3] of fullerene and carbon nano-tubes. In both cases, the temperature of the region of interaction has been measured to be 1000-1200K. This is near to the temperature expected in a tiny beam spot at a stripper foil, leading to the possibility of formation of these structures. The formation of these structures may add to the strength of these foils. Thus the stripper foil lifetime might be enhanced.

A 1 $\mu g/cm^2$ layer of C_{60} was sandwiched between two carbon layers of 2 $\mu g/cm^2$ each. Since the vapor pressure of C_{60} material is quite high, two carbon layers have been used to protect the C_{60} layer from evaporation due to temperature rise from ion beam interaction. To start with, 2 $\mu g/cm^2$ of carbon were deposited on a detergent coated glass substrate by electron beam evaporation. Next, 1 $\mu g/cm^2$ of C_{60} were deposited by thermal evaporation from a Ta boat with a perforated Ta cover. The 99% pure C_{60} powder was purchased from Aldrich. The deposition rate was kept very low to avoid breaking of C_{60} molecules. Finally another 2 $\mu g/cm^2$ of carbon was deposited to cover the C_{60} layer. The foils were then floated in water and finally, fixed on the standard stripper foil frames. The UV-vis absorption spectra of such sandwich foil shows absorption peaks similar to those reported to be due to hexagonal planes in the C_{60} structure. Systematic studies of the lifetime of these foils are in progress.

Preparation of enriched Gd target from Gd_2O_3 by reduction:

The isotopically enriched rare earth metals are mostly available from the suppliers in oxide form and are very expensive. So the preparation of metallic thin film targets from very small amount of such oxides is always very difficult. For reduction temperatures ~ 1000° C, resistive heating method is used with modified Ta boats. For the materials with higher reduction temperature, electron beam heating is required to attain this temperature. A modified electron beam gun, namely electron heated crucible is mostly used for this purpose. We have used the existing 6 kW electron beam gun with modified crucible made out of Ta to perform reduction of Gd_2O_3. The crucible temperature of 2100-2200° C is required for combined reduction/distillation of Gd [4]. A cylindrical crucible of inner diameter 3 mm and length 7 mm was used and was made out of Ta rod. These dimensions were chosen to minimize the loss of metal during evaporation. Freshly prepared Hf power used as reducing agent was mixed with the oxide powder and placed in the crucible. The crucible was placed in one of the hearths of the electron gun. The electron beam spot was adjusted to hit the wall of the crucible and not the material. The electron beam current was adjusted to raise the crucible temperature to attain the reduction temperature. The reaction between the oxide and Hf produce Gd metal and gets evaporated simultaneously. The vapor was collected on the backing material. The prepared film was found out to be metallic and shiny. The X-ray fluorescence spectroscopy (XFS) results confirm the absence of Hf and Ta in the evaporated films.

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3.5 ELECTRONICS & RF LABORATORY

Ajith Kumar B.P., Abhijit Sarkar, B.K. Sahu, S. Venkataramanan, Kundan Singh, Ruby Shanthi, S.J. Venkataesh, Ashutosh Pandey, Arti Gupta, Kusum Rani and Mamta Jain

3.5.1 Development of PCI Card

The PCI Local bus concept, developed to break the PC data I/O bottleneck, opens the door to increased system speed and expansion capabilities. The PCI Local bus moves high speed peripherals from the I/O bus and places them closer to the system's processor bus, providing faster data transfer between the processor and peripherals. At NSC we have developed ISA cards for different applications i.e. ISA card for CAMAC Crate Controller interface to PC, ISA card for Shaft Encoder knobs interface to PC, ISA card for 8-Channel stepper moter control from PC, etc. The ISA is now obsolete as modern PC's are coming with PCI slots that supports much higher data rates. A PCI card has been made using AMCC S5933 PCI MatchMaker for this purpose. The first prototype is done and being used as a shaft encoder driver in LEIBF control.

3.5.2 Development of CAMAC Modules

FPGA based 12 bit 16 channel scanning ADC:

A 12 bit 16 channel Scanning ADC has been implemented successfully using the XILINX FPGA technology. FPGA device was used to replace 24 TTL chips. All the 16 analog inputs are scanned sequentially, sampled, digitized and stored in the sixteen registers. The value of any register can be read on the read lines by selecting that corresponding channel using CAMAC commands. This ADC gives an accuracy of ± 1/2 LSB. Six such modules have been produced for Phase II related applications such as Vacuum gauge and Cryogenic instrumentation signal readings and tested successfully.

Crate Controller:

A prototype FPGA based CAMAC Crate Controller has been developed and tested for functionality. This would replace existing TTL discrete IC based design.

Production of CAMAC modules:

The development of "24V Sensing Input Gate" single width CAMAC module was reported last year. Five such modules have been assembled for the Phase II application. Six numbers of CAMAC Crate Controllers of existing design and eight number of PC-ISA card have been produced for LINAC control system.

A device driver software is developed for the "STR615 CAMAC CONTROLLER and PCI Interface". This driver software uses the interrupt (LAM-Interrupt) driven method for data transfer.

3.5.3 Electronics Activity related to INGA at NSC

Trigger generator for Multi-Crate data Acquisition System:

The Trigger Generator module of the Data Acquisition System was redesigned to synchronize the operation of multiple crates collecting fragments of the same event. In addition to the existing function, it generates a TAG for each event and transmits to all the satellite Crates. The "TAG READER" module enables the TAG to be read with each fragment. They also send a signal to the TG when all the signals are read. The TG will wait for these signals from all the participating Crates to clear the BUSY flag to get ready for the next event.

Gate and Stretcher module:

Two numbers of 16 channel Gate & Stretched modules have been assembled in a Single width NIM cabinet and implemented for INGA-HIRA Clover detector array. It accepts common Master Gate from multiplicity logic and four VETO signals from corresponding Clover timing logic units. The Master gate, VETO and timing output from individual Clover segments are AND-ed in order to generate ADC gates. The ADC gate width can be stretched up to 20 μs.

Liquid Nitrogen Filling System:

An automatic Liquid Nitrogen Filling System has been assembled and installed for INGA-HIRA Clover detector array setup. Differential line driver has been used to reduce the noise effect. It is built with audio ALARM to indicate system failure.

Clover Electronics Module for INGA at NSC:

A prototype NIM module containing Shaping amplifiers, TFAs, CFDs and logic circuitry for processing signals from a Clover detector with Anti Compton Shield (ACS) has been developed. The circuits are realized in high density daughter card form using SMD components, while keeping the features and specifications at par with commercially available modules. Two numbers of Pre-production modules are assembled and being successfully used in beam with INGA-HIRA setup. The content of this double width NIM module is shown in Fig. 3.

Fig. 3 : Clover Electronics Block Diagram

The high resolution spectroscopy amplifiers have fixed 3 μs shaping constant and 3 fixed gain settings (2, 4 & 6 MeV full scale) which are jumper selectable. The DC baseline is stabilized with Gated BLR, while P/Z and BLR (manual) threshold adjustments can be remotely voltage controlled. The unipolar output has the dynamic range of 8 volts across 50 ohms. Typical resolution achieved is 2 keV at 1.33 MeV.

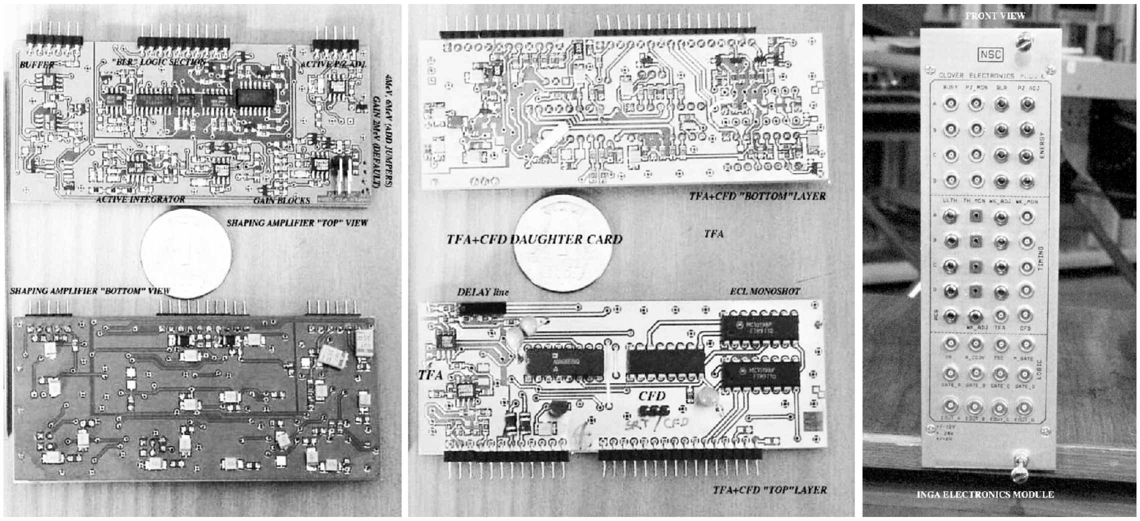

Fig. 4 : Clover Electronics module (left) spectroscopy amplifier board (middle) TFA & CFD board (right) front panel

Four TFAs with fixed time constants and gain settings are provided for processing TIMING signals from Clover detector. These amplifiers have rise time of better than 10 ns across their dynamic range of ± 2.5 volts across 100 ohms. The CF Discriminator with amplitude & rise time compensation (ARC) is realized with fixed delay of 25 ns and fraction of 0.3. The Lower Level Threshold, WALK adjustment and Monitoring are possible on front panel. The CFD outputs from the individual Clover elements with width of 50 ns and dead time of 2 μs are available internally.

Anti-Compton shield signal received from ACS Preamplifier is processed with identical TFA + CFD as mentioned above but without dead time. The raw timing logic signals received from CFDs from Clover detector and ACS detector are further processed to affect Anti-coincidence. The logic functions performed are Pileup Rejection, Individual ADC Gating, Anti-Coincidence output and Delayed STOP signal for TDC. All these logic outputs are buffered and available in standard logic levels on the panel.

The Clover Electronics Module essentially contains a mother board where individual blocks in daughter card form are inserted. The rear panel receives the inputs like "ENERGY" and "TIME" signals from Preamplifier through Lemo connectors. The Front panel provides the various monitoring points like P/Z Mon., BUSY, WALK-MON, Energy OUT, ADC GATE and other Logic related signals (TDC STOP, ACOIN.) through Lemo connectors and manual control of various adjustment like P/Z Adj., BLR Threshold adj., WALK adj., LLTH adj., through multi-turn potentiometers. The TFA and CFD outputs corresponding to ACS are provided on front panel for convenience.

Improvements in High Density Spectroscopy Amplifier

The existing high density Spectroscopy amplifier card for Clover HPGe detector with fixed shaping time (3 μs) is suitable for gamma ray spectroscopy and provides manual adjustment of noise threshold for baseline restoration control. To use this amplifier card for other spectroscopy applications like X-ray spectroscopy, we have developed amplifier cards with 0.5 μs, 1 μs, 2μs, 6μs and 10 μs shaping times. A prototype circuit for auto noise level detection is also tested and will be implemented shortly.

3.6 ELECTRICAL GROUP ACTIVITIES

U.G. Naik and Raj Kumar

Electrical group is actively involved in taking up new projects and dedicated for maintaining 100% uptime of the electrical installations.

MAINTENANCE

3.6.1 Stabilised Power Arrangement

Maintained 1 MVA and 500 kVA stabilizer catering to major loads such as A/C plant-II and Helium Compressors and the clean power to NSC Pelletron cum experimental areas with 100% uptime without a single break in the supply. Serviced 30 kVA stabilizer and 80 kVA stabilizer.

3.6.2 UPS Systems

This year NSC has procured and installed about 2 nos. of 2000 VA UPS dedicated to some computer and controls of low temp. lab and High vacuum laboratory. NSC has a previous base of about 15 UPS ratings from 2-10kVA. During the present year all UPS were very healthy and had 100% uptime. Routine maintenance was carried out by the manufacturer's authorized service centre and the faulty batteries were replaced.

3.6.3 Power Factor Compensation

Electrical group has made all efforts to keep up with the unity power factor thereby saving almost Rs. 5 lakhs on the energy billing.

3.6.4 Maintenance of Phase-I & II Electrical Installations

The electrical Group is proud to declare here that during this year we did not have even a single breakdown, hence keeping the uptime at 100%. Phase-I electrical installation was put in to operation from Nov.1989. It has two nos. of 11 kV H.T. feeders from

DESU, 2x1000 kVA, 3x500 kVA transformers, HT Panel, LT panel, 2x70 kVA, 2x 320 kVA, 1x 100 kVA D. G. Sets and cabling. Electrical distribution network has about 20 nos. of Power Distribution Panels consisting of several ACB's and TPN switches besides lighting and power circuits. To list a few we have carried out following major works in maintenance works along with day to day and routine maintenance in the year 1998.

Replacement of transformer oil for 3x500 kVA.

Dehydration of oil for 2x1MVA and OCB's.

Air Circuit Breaker servicing-20 nos.

Calibration and setting of Over Current and Earth fault relay-48 elements.

Periodic maintenance of LT panels, Distribution boards and other accessories, Lighting, Fixtures, lighting and power circuits.

Testing and treating of earth pits-80 nos.

Painting of LT panels of Phase-II

By timely doing these maintenance, this group has maintained system in a very healthy and efficient manner and this has reduced the down time.

3.6.5 Surveillance Video Cameras

Maintained the surveillance system having 7 Nos. of out door Video Cameras with outdoor pan/tilt units, 16 channel color Duplex Multiplexer have been installed, in the front part of the Campus on 16ft. high poles. There was not a single failure of any camera observed during the year.

3.6.6 Energy Saving

Energy savings continued in the areas where we had installed the energy saving time switches in the previous years. However during this year electrical group has emphasized to CPWD to incorporate energy efficient lighting in the future projects handled by them. One more step has been taken in the direction of energy saving. All the lighting circuits in side the laboratory building has been supplied with a stabilized and reduced voltage thereby saving energy of the order of 20%.

PROJECT WORKS

3.6.7 Beam Hall-II

Electrical power distribution, laying of cable trays and cables through protection and controlling system was designed, procured and installed in beam hall-II vault, zero degree line beam hall-I and right up to switching magnet beam hall-II. Cable trays are also laid in C&D area phase-II and along the wall in beam hall-II. Flexible Plica conduits required for Phase-II beam hall installations were also procured.

3.6.8 Beam Hall-II Stores

Electrical group planned, designed and got the installation made through CPWD successfully. The group has also planned for providing a separate emergency line to the users in this area. The order for this work has already been placed.

3.6.9 Development of Remote Control System for Helium Compressors & Central Control Room for Cryogenics

The helium refrigeration system for LINAC has been in operation for quite some time. The operation of the plant was quite cumbersome. It was very difficult to manage the whole system by one operator during abnormal conditions as the distance between the two parts of the system i.e. helium compressors and the liquifier is around 100 meters and that too at an elevation difference of about 10 meters. To overcome this problem we have developed a central control room which houses the manual remote control panel of helium compressors along with all the status read backs and analog data displays. Along with the manual remote control panel a computer control system is also developed for operation of compressors, which also stores all analog data from the compressors for future performance analysis. The computer control system also has data acquisition system for complete cryogenic system. The computer & data acquisition system has been developed using VME bus crates, which runs on real time operating system.

Along with the existing control features we have developed and added two more features in the system. They are oil pump timer bypass system which helps in developing the oil pressure and oil pressure bypass system which helps in starting of warm system without waiting for oil pressure to come up. Two more displays have also been added in the system - digital display of compressor loading turns in the compressor room as well as in the control room and all electrical data displays. The monitoring of loading turns has been developed using opto-sensor and up down counter. One additional oil drain facility has also been developed for gas management system using high-pressure solenoid valve, which drains the oil from the system automatically as per the time setting set in the system.

The operation of the compressors may be done from any of the three panels - local control panel in the compressor room, manual remote control panel in the control room and through computer. The system can be operated from any of these panels but from one place at a time. The controls can be changed from one panel to another during the run without disturbing the operation. The status read backs and digital data are available at all three places all the time irrespective of the control facility.

3.6.10 Harmonic Analysis of Clean Power Distribution System of NSC

A complete harmonic analysis of clean power distribution system has been carried out this year. The maximum load in the Pelletron and experimental facilities are of non-linear type, which generate lot of current harmonics in the distribution system. The following table shows the level of total harmonic distortion in few loads.

Load	**UPS Systems**	**Emergency Power**	**Analyzer Magnet**	**H V Deck - LEIBF**	**Pelletron E. Power**	**Switching Magnet**
%THD	74.00%	62.00%	15.20%	32.00%	47.00%	58.5%

Combining all above harmonic producing loads generates around 18% current harmonics at the point of common coupling i.e. distribution transformer. The limit of current harmonics at the point of common coupling should not exceed 8% as per the standards. These harmonics cause losses in transformers, cables, capacitors etc. and produces vibrations in motors, which can be dangerous to Pelletron. The harmonics can also disturb thyristor firing by disturbing the zero crossing of voltage waveform.

A complete survey of harmonic filters has been done and found that passive filters are not the foolproof solution in research facilities where loads are changing quite frequently. We have decided to go for active harmonic filtering where actual harmonic spectrum is generated using IGBT based inverters working on PWM technique and fed to the bus near the non-linear loads in opposite phase. In the first stage we are going to install a 30 ampere phase current and 90 ampere neutral current capacity active filter at the emergency power distribution bus.

3.6.11 Phase-II Part-II Installations

Electrical group has furnished all the electrical requirements of NSC to CPWD after a very close co-ordination with different NSC laboratories and the concerned users. The group has also made the preliminary design required for our Centre in line with the installations of Phase-I.

3.7 Computer and Communications

E.T. Subramaniam, S. Bhatnagar and Sumit Mukherjee

The focus of the group this year was on the continued upgrade of Internet access facilities, reorganization and upgrade of the Centre's central server pool, networking infrastructure, desktop computing, software, printing and backup facilities. The telephone infrastructure was also upgraded to cater to future requirements. Apart from this routine maintenance of the computer and communications infrastructure focussed on the goal of maximum availability. Some of the developments during the year are described below:

3.7.1 Internet and mail

Services were successively added this year to the Centre's 256 kbps Internet link through Spectranet. A new domain name nsc.res.in was registered for use with servers on the Spectranet link. Besides a significant increase in the number of users of the Squid proxy server, a separate mail server was installed on this domain. The Centre's web page was placed on the nsc.res.in domain (http://www.nsc.res.in), in addition to the older www.nsc.ernet.in. Uptime of the 64 kbps radio link through Ernet was significantly enhanced this year, mainly due to a router upgrade.

The servers running the nsc.res.in system (nsc.nsc.res.in running the proxy, web and firewall services and mail.nsc.res.in running the mail server) were upgraded this year to Pentium-4 server configurations. The public domain software (Linux/Squid/Apache/TIS/Qmail) running all services on this domain have proved secure, efficient and easy to manage.

3.7.2 Central computing facility

The pool of three Linux Terminal Servers introduced last year to cater to 60 diskless desktop PC nodes was reorganized and upgraded to enhance performance. The two academic LTS servers were merged and upgraded to a single 2.4 GHz Pentium-4 based Intel server with 1 GB of RAM and a 80 GB hard disk. An additional 80 GB hard disk is used to take regular backups of user data. The administration LTS server was also upgraded to a similar configuration. The upgrades have resulted in greater application speeds for the user, removed the occasional glitches the older servers were subject to, and the uptime has been very acceptable. This major upgrade was effected with almost no server downtime.

With the ORCAD suite now the most popular electronic CAD software in the Centre, more floating licenses for all components of the suite have been obtained, and a separate license server set up in the central facility. Most regular users of ORCAD now have access from desktop clients.

After the phasing out of the HP735 and Tata Elxsi systems, the Centre has not had a dedicated system for numerical computation. The central linux systems have resources adequate only for smaller jobs, and the need for a high-performance system has been felt for some time. To this end, the initial steps for the setup of a parallel high-performance Linux cluster have been taken, and a small cluster with a server and six P-4 based compute nodes set up in the central facility. The cluster runs on a dedicated switched 100 Mbps network and uses the public domain LAM-MPI clustering software. A thorough test with real applications in molecular modeling and materials science, and an expansion of the cluster, is expected to be taken up in the coming year.

A move towards a networked printing solution for the Centre's printing requirements was started this year, with the addition of a networked large-format plotter and a duplex high-capacity laser printer to the existing network printer in the academic net, and a A3 laser printer to the administration network.

3.7.3 Desktop computing and local networks

Twenty desktop PCs were added to meet various requirements, pushing the total number of PCs in the Centre to more than 150. An upgrade and extension of the local network and an augmentation of the PC pool was also required to support the new INGA data acquisition system.

3.8 AIR CONDITIONING, WATER SYSTEM AND COOLING EQUIPMENTS

P. Gupta and A.J. Malyadri

3.8.1 Central AC Plant

NSC's Central Air Conditioning / Low temperature Cooling System of Phase - I 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 have logged in approximately 72,000 hours each. Other rotary equipment have logged in about 1,07,000 continuous run hours. The yearly maintenance costs have been maintained at approximately 3% of the installed project cost. The equipment being into their fourteenth 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 set forward the reliability of the equipment. Considering the age of the equipment, a replacement policy has been taken up in the Xth plan period, based on the real time health of the individual 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 and supervision provided to the contracts, thereby affecting substantial savings in the price paid for the operation and maintenance contracts.

A new system was added to the Beam Hall - II extension labs, consisting of 3 x 10 TR cooling capacity. The complete engineering for the same was done by CPWD.

3.8.2 Water Systems

NSC'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 58,000 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. A new deioniser plant has been commissioned to cater to the proper water quality. The safety record of the plant for the year was 100%.

3.8.3 Cooling Equipment

Availability of these equipment was recorded at around 95%. New equipment was added to cater to additional requirements. Several replacements are being done in a phased manner.

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 laboratories and large number of user community. Workshop has been involved with various developmental activities of new systems as well as large scale production of beam line components right from the inception of NSC. This year most of the beam line components used for the Phase II beam lines are fabricated in the NSC workshop. Workshop continues to assist the in house fabrication activities of LINAC as well as the Cryogenic activities. 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, three 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, Solid Works for the design and the drafting purposes.

Welding shop is having four high quality TIG welding facility. 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.

The new Electron Beam Welding facility is fully operational. After the parameter development for the Niobium material, we have successfully welded the Niobium Resonator parts. The first bare Niobium cavity is completed. The welding of transition flanges will be done shortly.

The specifications of the EBW machine are as follows.

Electron gun	-	15 kW
Welding chamber size in mm	-	2500 (L) x 1000(W) x 1000(H)
Chamber vacuum achieved	-	8 x 10^{-7} mbar

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.

NSC 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 Ph.D. Students enrolled in NSC.

Workshop activities

A lot of efforts have been made for the procurement of equipment, tools and consumables for the smooth functioning of the workshop as well as the user requirements. A good inventory of the materials and tools procured is maintained for this purpose. These are often used mainly for the upcoming facilities like Phase II Accelerator (LINAC), Low Energy Ion Beam Facility (LEIBF), and Ion Source Test Bench etc. Workshop always gives top priority to the urgent jobs coming from users and Pelletron laboratory for the successful completion of the experiment.

Workshop is associated with most of the labs for the design, fabrication and installation of the experimental set ups. All the five people associated with this group are fully conversant with machining as well as welding techniques. Knowledge of CAD and CNC systems proved to be very useful for the development of experimental set ups. Most of the beam line hardware are being fabricated in the workshop. Apprentices enrolled in the workshop enhanced the work output from the workshop considerably. Workshop personnel take both theory classes and practical works for the apprentices engaged with NSC.

Apart from the large number of emergency and short jobs, the following are the list of main jobs and projects undertaken by the workshop group.

HIRA-Clover detector mount Design and Fabrication

This was one of the major projects undertaken by the workshop. The entire structure was designed and 3-D modelling was done to maximise the fabrication accuracy. All the components including welding fixtures were made, machined and then welded using the in house facilities. The structure was successfully fabricated as per the accuracy level specified. It is being used for the experiments for mounting Clover detectors.

Beam Hall- II beam line components

All the beam line components like drift tube, Tees, Crosses, and beam line stands and brackets etc. for the upcoming beam lines of the Phase II beam hall are fabricated.

Ion source Test bench Components

All the components like housing for ion source, drift tube, Tees, Crosses, and beam line stands and brackets, magnet stands etc. for the upcoming Ion Source Test Bench are fabricated.

Electrostatic steerer

An electrostatic steerer has been designed and fabricated at NSC workshop for the Ion Source Lab.

Multi cathode Ion source Mounting

We have designed and fabricated a mounting arrangement for the new multi-cathode mounting system in the ion source room.

High vacuum chamber

Focal plane High vacuum chamber (500 mm diameter with 20 nos UHV ports) was fabricated. The main feature of this chamber are four rectangular ports for the slit manipulation and a couple of angular ports.

Slow tuner

Slow tuner components for two units were made including gas circuit connections.

Steerer Magnets

Five numbers of Steerer magnets including the heat sinks were made and it will be installed in the beam lines.

Liquid Droplet Source in LEIBF

Assembly and testing of Liquid Droplet Source for LEIBF line was done. This was fabricated in NSC workshop last year.

ECR plasma chamber

An ECR Plasma chamber is machined at our workshop, as per the dimensional accuracy requirement.

Interaction chamber

One chamber was designed for the liquid droplet source of LEIBF setup, and it will be fabricated at TIFR.

Multi Purpose Irradiation chamber

Design and drafting of a high vacuum chamber to be used in the Phase II materials line is completed. The machining of the chamber is going on in the workshop.

UHV stripper chamber

A UHV stripper foil chamber was designed and fabricated in workshop successfully. This is a multi-port chamber with Wilson seal for the target ladder movement.

MCP mounts

We designed a MCP mounting set up which is used in the MCP chamber fabricated in the workshop.

New Die and punch sets

We designed and made new die and punch set for punching holes on the electrical and electronic panels. These sets are designed to be used with the existing punching machine.

Goniometer repair

The X-axis travel system developed some problem during some experiment. A temporary solution was found and spares were ordered.

Resonator Fabrication

Indigenous fabrication of the first Niobium Resonator is successfully nearing completion. All the machining requirement of Niobium parts are being performed at our workshop facility. Fixtures for machining as well as for the EBW welding are being fabricated in the workshop. The E- beam welding of the bare niobium cavity is successfully completed. The remaining welding of transition flanges and S.S jacket welding will be done soon.

Fabrication of motorised mounts

Workshop developed a motorised linear motion arrangement for the detector as well as target mounting.

Faraday cup, etc

A retractable type Faraday cup along with sample mounting arrangement and detector mounting arrangement was designed and fabricated for Materials science experimental set up.

Electrostatic Analyzer

Designed and fabricated a Electrostatic Analyzer for the materials science experiment.

3.10 HEALTH PHYSICS

S.P. Lochab and R.G. Sonkawade

Health physics group is taking care of personnel monitoring of radiation workers, radiation monitoring in the vicinity of the Pelletron Accelerator and is also involved in the various activities of the research and development work. All the beam lines are provided with visual system to indicate the presence of the beam in particular beam line.

3.10.1 Development of Nano-Phosphor

R.G. Sonkawade and S.P. Lochab

The recent work undertaken by our group is the development of the nano-phosphor for radiation detection. Due to the growing applications of the nano-technology we are characterizing and studying the various types of nano-phosphor developed by different chemical synthesis routes. Nano-phosphors can be used in the field of low energy excitation flat panel displays, Radiation dosimetry, X-ray storage films and the nano-sensors in the field of radiation detection, etc.

(i) Thermoluminescence and Photoluminescence Characteristics of Nanocrystalline $K_2Ca_2(SO_4)_3$:Eu

R.G. Sonkawade[2], A. Pandey[1] and P.D. Sahare[1]

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The $K_2Ca_2(SO_4)_3$:Eu phosphor was developed in nano-crystalline form using the co-precipitation technique. Formation of the compound was confirmed by studying the x-ray diffraction pattern that matched with the standard data available (JCPDS card no. 20-867). Broadening in the x-ray diffraction lines was used to determine the particle size . The detailed study of the thermo-luminescence (TL) and photoluminescence (PL) characteristics were done on bulk and nano-crytalline samples. The TL glow curve of the compound has a simple structure with a prominent peak at 406 K and a small peak at 462 K. TL sensitivity of the phosphor is found to be more than that of TLD-100 (LiF) but quite less compared to TLD-700H (LiF:Mg,Cu,P). The presence of two overlapping bands at around 400 and 450 nm in the PL emission spectra of the phosphor (both unexposed and exposed to gamma radiation) suggests the presence of Eu^{2+} in the host compound occupying two different lattice sites. Moreover a reduction in TL sensitivity on decreasing the particle size (from 125 mm to 18.6 nm) gives a better understanding of the TL mechanism involved in the concerned phosphor. Fading and reusability of the phosphor are also studied and it is found that the phosphor is quite suitable for radiation dosimetry.

(ii) Effect of Sr^{2+} Co-Doping on the Thermoluminescence and Photoluminescence Characteristics of $K_2Ca_2(SO_4)_3$:Eu Phosphor

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$K_2Ca_2(So_4)_3$:Eu,Sr samples were prepared by solid-state diffusion method. The nano-particles of the same material were also prepared by chemical co-precipitation method. The formation of samples was confirmed by XRD (JCPDS card no.20-867). The particle size in case of nano-particles was also calculated from the XRD broadening by using Scherrer's formula and was found to be approximately 18nm. Both the samples were irradiated by γ-rays of Co^{60} source. Comparative studies of thermo-luminescence (TL) and photoluminescence (PL) of the samples were done. Only single glow peak appears at around 425 K in all the doped samples. However there is a decrease in TL intensity after co-doping with Sr^{2+}. There is further decrease in the intensity of the nano-particles of all the doped and co-doped samples. The decrease in the intensity with Sr^{2+} co-doping is attributed to the energy loss due to various non-radiative allowed Sr-transitions after energy transfer from Eu^{2+}. In photoluminescence one peak around 420nm appears due to Eu^{2+} transitions from e_g to t_{2g} levels of $4f^6 5d$ configuration to $^8S_{7/2}$ levels at ground state and several other peaks appear due to Sr^{2+} after excitation by 350nm which is also the excitation wavelength of Eu^{2+}. This clearly indicates the energy transfer from Eu^{2+} to Sr^{2+}. The further decrease in the intensity in case of nano-particles as compared to conventional powder is attributed to the volume to surface ratio of the nano-particles. The sensitivity of this phosphor is six times more than LiF-TLD 100 and seven times less than LiF:Mg,Cu,P. Re-usability is excellent. There is very low fading around of about 10% in one month. This would make the phosphor useful as TLD for environmental radiation monitoring. The nano-particle size of the nano-materials could find their usefulness in various applications.

(iii) Thermoluminescence Characteristics Of Pure and Doped nano-crytalline $K_2Ca_2(SO_4)_3$ for Environmental radiation dosimetry

R.G. Sonkawade, S.P. Lochab and D.Kanjilal

The nano-particles of the $K_2Ca_2(SO_4)_3$ material having effective atomic number of 15.5 were prepared by chemical co-precipitation method. The orthorhombic crystal structure formation of samples was confirmed by XRD (JCPDS card no.20-867). The particle size in case of nano-particles were also calculated as ~35nm from broadening of XRD peak and by Gaussian fit using Scherrer's formula. The nano-particles were irradiated by γ-rays of Co^{60} source. Thermo-luminescence (TL) study of these samples were carried out. During thermo-luminescence only single glow peak appears at around 423 K in the doped samples. The sensitivity of this phosphor is ten times less than that of the commercially available sample TLD700H (LiF:Mg,Cu,P). The TL- characteristics of the sample is shown in Fig. 6. The observed sensitivity response of Eu(III) - doped nano-material sample is less compared to the commercial samples which could be due to increase in surface to volume ratio, leading to lesser number of defects within the volume of the crystal. The good thing observed with this phosphor is that it is covering a wide range of dose like commercial phosphors though its sensitivity is less. The nano-phosphor re-usability is found quite excellent. There is very low fading around of about 5% in one month.

This type of phosphor could be useful as TLD material for environmental radiation monitoring. The nano-crystalline samples are found to be more stable for long term use.

A comparison of TL-glow curve for different samples is shown in Fig. 5.

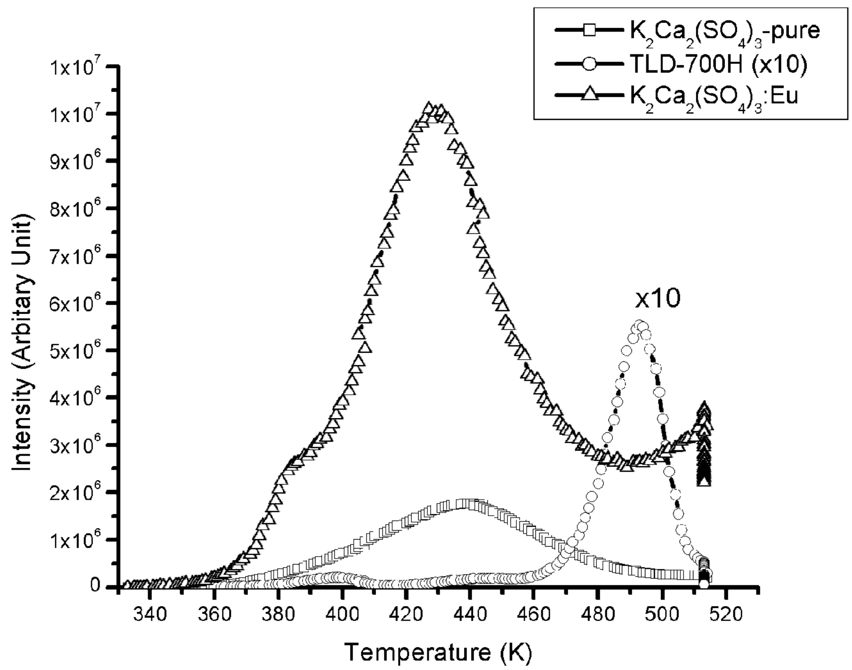

Fig. 5 : Comparison of TL-glow curve for different samples

3.10.2 Radon Monitoring in the Water & Indoor Air

R.G.Sonkawade and S.P.Lochab

Radon is a naturally occurring radioactive gas that may cause lung cancer if present in high concentration. Most of the minerals in the earth's crust contain some concentrations of naturally occurring radioactive materials. Natural water usually contains dissolved radon due to the presence of ^{226}Ra, a member of natural ^{238}U decay series, in soils and rocks. The radon levels were measured in indoor air and different tube-well water samples of Nuclear Science Centre (NSC) premises. Measurements were done by using alphaGUARD. Radon levels were found to be more or less same in all water samples and was found to vary from 1645 Bq/m^3 to 3869 Bq/m^3. The de-ionized water was found to have radon concentration in the range of 1569 Bq/m^3 to 2213 Bq/m^3. The pH value of water samples was also measured. No correlation was observed between radon concentration and pH value of the water samples. In addition, radon levels were also measured in some houses of NSC premises by using the same technique. The indoor radon level was found to vary from 3 Bq/m^3 to 75 Bq/m^3. The radon levels in kitchen and bedrooms were found some what higher than those in other parts of the house. The indoor radon concentration was recorded higher in the night and lower in the afternoon. However, the measured radon levels in drinking water and indoor air are well below the permissible levels.

3.10.3 Radiation Shielding Calculation with PACE & MCNP Code

R.G.Sonkawade, S.P.Lochab and S.K.Dutta

A few simulation of radiation shielding calculation of the accelerator charged particle ion beam has been done using computer codes PACE (Projection Angular -Momentum Coupled Evaporation) and MCNP (Monte Carlo Neutral Particle). The present MCNP code gives the radiation simulation of gamma, electron and neutron. With the help of the PACE code (assuming a particular thickness of the target) the neutron and gamma energy spectra were calculated. The same neutron and gamma energy was used in the input of MCNP simulation code and the results were matched with the practical values. Calculations were done for the different ions at the maximum energy available from LINAC. It was verified that the carbon beam produces maximum neutron out put compared to other ions (42 mrem/hr.pnA at beam energy of 150 MeV).

Further work is still going on this project for finding out the best suited shielding material for gamma and neutron in the accelerator facility.

3.10.4 Shielding Calculations for Modified Plan of BH-II

S.P. Lochab and R.G. Sonkawade

Slight changes are being made in the plan of BH-II. Outside design is not changed. The modifications of the design have taken place only for inside partitions of different beam lines in BH-II.

Shielding calculations have been carried out according to the revised layout of beam hall II. Calculations have been done for ^{12}C ions of energy 150 MeV and a maximum current of 20 particle-nA. Dose level outside BH-II is taken to be 0.1 mrem/hr. Inside the BH-II, which is considered as controlled area, (between any two partitions of two beam lines) the dose levels is taken as 1.0 mrem/hr. Table 1 shows the additional shielding requirements at different points outside the beam hall.

The Safety Committee for Medical, Industrial and Research Accelerators visited Nuclear Science Centre and gave approval of the modified drawings at present for one year.

Table 1 : Addition to the shielding wall thickness

Areas in Beam Hall-II	Distance of wall from target point (m)	Wall thickness (cm) p=1mrem/hr = 2.4n/cm^2/sec	Wall thickness (cm) p= 0.1mrem/hr = 0.24n/cm^2/sec	Existing wall thickness (cm)	Additional wall thickness required (cm)
SC2 to MS	2	55.3	76.8	60	17cm*
SC2 to Electronics Area	2.7	50.0	71.5	60	12cm*
SC1 to	3.2	46.6	68.1	60	8cm*
MS to corridor	3.5	44.8	66.3	60	6.3cm*
Bio to MS	2.1	54.1	75.6	60	5.6cm*
HYRA to Electronics area	3.6	44.35	65.8	60	5.8cm*
HYRA to corridor	2.1	54.1	75.6	60	5.6cm*
LEIBF & Cryogenic room	7	68	100	80	20cm*
D5	7.2	--	48	30	18cm* plan=30
D8	6.8	--	63 ordinary or 30 cm ord. + 20 cm heavy	30	20cm* plan=30

**Maximum permissible level = 0.1 mrem/hr*

3.11 CIVIL WORKS

M.K. Gupta

Civil section is associated with the following activities:

Major Expansion Projects

Civil Maintenance

Civil Minor Works and Minor Projects

External Cleaning of the Campus

Liaison with various outside and Govt. agencies for statutory approvals and civic problems

Civil Activities During 2002-03

Following important Civil works were undertaken during the year 2002-03 in addition to routine civil maintenance and minor works:

Covering of first floor balconies of Phase I housing and Flatlets

M.S. Platform extensions in Beam Hall-II for working on various vessels and equipment

Establishment of Cryo Control room in Beam Hall-II Pantry area

Construction of a pit in Beam Hall-II floor for lowering down Cryostat

Painting of Phase-II housing colony

Construction of covered car parking in Phase-I housing colony

Repairing/renovation of Storm water canal in NSC by stone pitching

Construction of a horticulture tank behind Kamdhenu-II housing

Proper routing of housing septic tanks sewage effluent towards Lab. Septic side by a network of Tank, pipes and pump.

Construction and taking over of Beam Hall-II Stores building from CPWD

Finalization of plans and layout of various buildings of Phase-II-Part II in consultation with CPWD

Installation of Wire mesh shutters in Housing, Flatlets and Guest house complex.

3.12 SF6 GAS STORAGE & GAS HANDLING SYSTEM, COMPRESSED AIR SYSTEM, MECHANICAL PUMPS AND MATERIAL HANDLING EQUIPMENTS

K.K. Soni, Bishamber Kumar and Rajpal Sharma

i) SF6 Storage and Gas handling :

37 Ton of SF_6 Gas is stored in 5 Nos of (150 M^3 each) pressure Vessels. With routine checks and timely maintenance, SF6 system has been performing well and gas leakage through system is minimum.. Further with operational skill, SF_6 quality has been maintained with Dew point better than - 65° C.

One of the SF_6 pressure vessels which was installed 5 years back was opened and cleaned from inside. All the O ring gaskets and fasteners of this pressure vessel was changed. Corrosion was checked and found well within limit. The tank was pneumatically tested to 1.10 times design pressure for it's future satisfactory performance. Thorough inspection and testing (as per SMPV rules) of Relief Valves installed on storage tanks were also carried out to ensure the soundness of the pressure vessels and subsequently the storage license was sent for renewal from the chief controller of explosives of India.

ii) 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 also been provided to newly installed pneumatic valves/accessories. Two numbers refrigerated type air dryers of 4300 LPM capacity are installed to supply dry air in the system. Ultra high filters of boro-silicate based are provided in different location to provide clean air free from dust and oil particles.

iii) 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 procured for labs.

iv) Elevator:

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

v) Material Handling System :

Periodic maintenance / servicing of all E.O.T cranes and electric hoists for Ph-I & Ph-II is being carried out time to time and the same have been working smoothly. Operational guidance for handling of scientific equipment/ setup from one place to other is given whenever required. Two more cranes of 2 Ton capacity are installed in EBWM room and Material Storage area. All the cranes are put on remote control operation for safe handling.

vi) Fire Extinguishers:

Annual refilling and periodic maintenance of all the fire extinguishers have been carried out. New fire extinguishers wherever needed were also procured and provided. Delhi Fire services have given the clearance from fire safety aspect for PHI& II installations including civil structures. Some more signage including the "Escape route " in emergency is added in the building with GLOW LIGHT which shines even in darkness.

Rotary Vacuum Pumps:

Periodic maintenance and repair of pumps have been carried out and a few new pumps have been procured.

Indigenous Development of Parts:

MG I has made serious efforts to develop the substitute of imported items being used in the Pelletron system and gas handling system. The following parts have been made with the help of local fabricators: Rotating Shaft & Viewports with improved design so that in case of accident breaking of the glass of the viewport the gas does not leak out. Further SF_6 filter element of dust filter and oil filters of SF_6 Compressors are also made. Shorting Rod, idler wheel assembly, are also developed.

3.13 DATA SUPPORT LABORATORY

V.V.V. Satyanarayana and P. Sugathan

Apart from providing regular user support to users, this year the Data Support Laboratory developed a few Electronics Modules, Serviced & maintained Radiation Monitors, and procured data acquisition Electronics modules, connectors, cables etc.

3.13.1 Current Amplifier

A Current Amplifier module has been fabricated to meet the experimental requirements of Radiation Biology users. In typical radiation biology experiments, users need to measure the beam current and set the sample irradiation time accordingly. For this purpose a thin foil is kept before the sample and the intensity of the current from the foils is measured during irradiation process. It is observed that this current is of the order of picoamperes and it is not directly measurable by the standard Current Integrators used at NSC. We developed a current amplifier that can amplify the foil current by providing a gain of 1000. The method used in this module is a current to voltage converter and then voltage to current converter. Pico ampere input current is converted into millivolts output with an I to V converter and this voltage again converted into nanoamperes current output using a V to I converter. This module along with Current Integrator is used to measure the current in Radiation biology experiments to control irradiation dose.

3.13.2 Calibrator Module for CANDLE data acquisition setup

The new multi-crate data acquisition system "*CANDLE*" has been used successfully during the past year. In this data acquisition setup, data from multiple CAMAC crates are collected, synchronized and then processed in the software. To synchronize the data from different crates, a trigger generator module is used. This trigger module generates strobes for different peak sensing ADCs used in the setup. Usually the trigger generator takes some time to convert its input to TTL output, and during this process, if any strobe reaches the Trigger generator's input, it will not be transmitted to the strobe input of ADC. To find out how many strobes reached the ADC and how many strobes are missed, a Calibrator module is developed. This is a combination of two 36-bit counters, one is NIM counter at the trigger generator input and the other is a TTL counter at the output. With this module, efficiency calibration of the new data acquisition setup can be tested.

3.13.3 Current Integrators

After the successful implementation of indigenously developed Current Integrators at NSC, more number of modules have been made to meet the requirements of the users. One of the major modification implemented in the module is that the digital electronic counter is replaced by a mechanical digital counter with an audible sound output. With this even a small change in input current can be identified by the audible sound.

3.13.4 4 Channel 12 Bit Peak Measuring ADCs

Last year we built one 4 channel peak sensing spectroscopy CAMAC ADC and tested it successfully. More number of such ADC were made to be used in our data acquisition system. These low cost CAMAC ADCs can be used as a direct replacement for commercially available modules like ORTEC AD811 or PHILLIPS ADCs. These ADC are designed for 12 bit resolution and 4 volt input.

3.13.5 Servicing and Maintenance

A few numbers of neutron and gamma radiation monitors installed at different locations of the accelerator and beam lines were serviced and repaired. The problem causing malfunctioning of these radiation sensors was identified as the failure of ICs and associated circuitry at the input stage of the system. The faulty components were replaced. The other items serviced include the Safety door interlock system installed in beam hall and replacement of Photo SCR and associated driver circuit components in Plasma cutting Welding machine in the Machine shop.

3.13.16 Electronic modules acquired for data acquisition resource pool

7164 Phillips 16 Channel CAMAC Peak ADCs - 2nos.

756 Phillips Logic unit -1no.

794 Phillips Model Quad gate / delay unit - 1no.

2100 Canberra Model NIM Bin / power supply - 2nos.

EG & G VT120A Pre amplifiers - 2nos.

EG & G VT 120B Pre amplifiers - 2nos.

EG & G CF8000 Octal CFD - 1no.

EG & G 575A Amplifiers - 2nos.

EG & G 974 Counter/Timer - 1no.

EG & G FTA820 Fast Timing Amplifier - 1no.

EG & G 9306 1GHz Preamplifier - 1no.

EG & G 4002P Portable Power supplies - 2nos.

EG & G 474 TFA Amplifiers - 4nos.