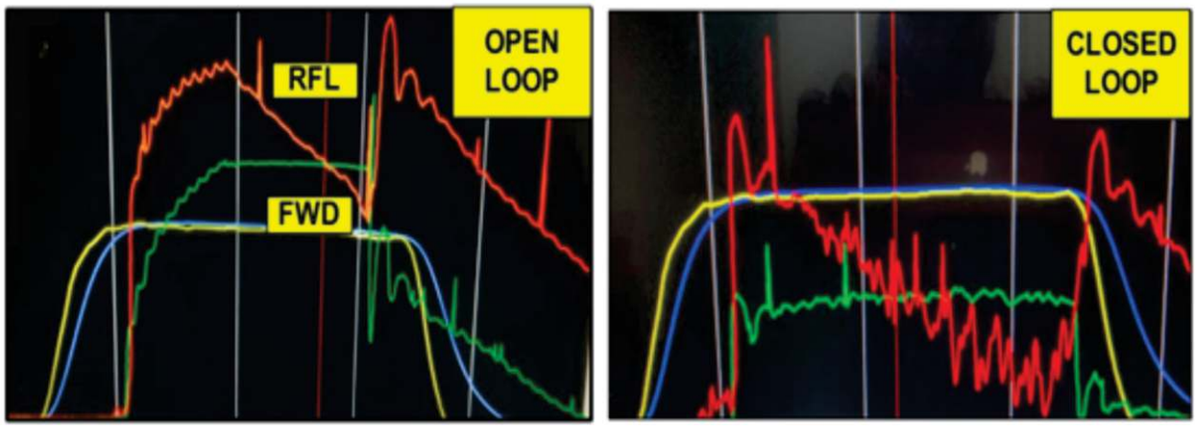


Fig. 3.34 Open Loop and Closed Loop Operation Outputs of RF System

BPM-Beam Test

BPM and its support electronics have been installed in the beam line after successfully testing the electronics in offline mode by Stretched Wire Method. Electron Beam with energy ~1.2 MeV has been produced by UV LASER based Cu photocathode emission. Measurement has been done with BPM data and Solenoid Magnet data. Focusing and steering of beam achieved with Solenoid and Steerers. Non-centric beam undergoes angular steering by solenoid field of the order 0.3 mm position change in y-axis per 1A change in solenoid current as per BPM average data.

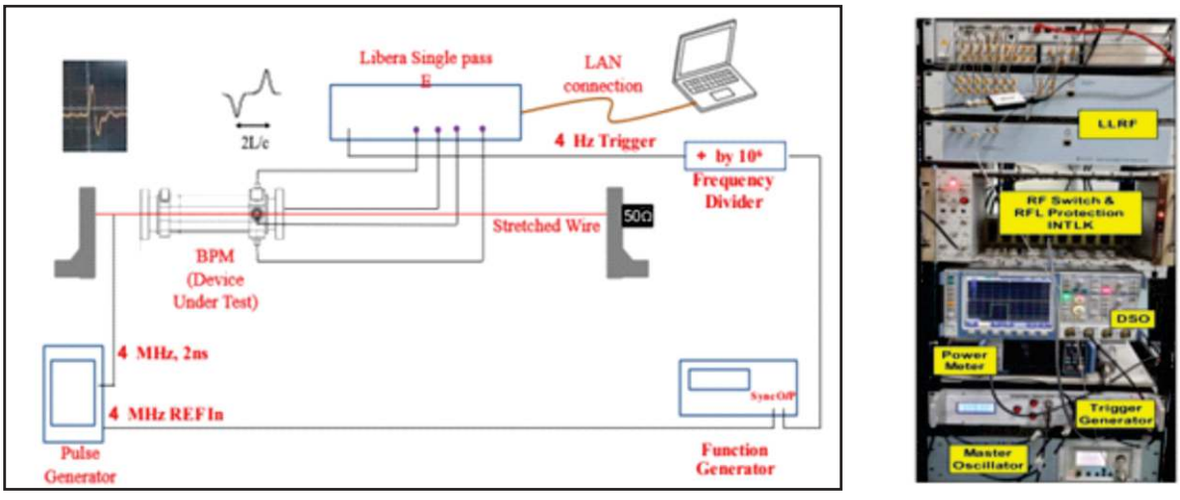


Fig. 3.35 Stretched Wire setup for Testing BPM and LLRF Test Setup Electronics

3.1.12 ION SOURCE GROUP

Radhakishan Gurjar, Mukesh Kumar and Dr. Ambuj Tripathi

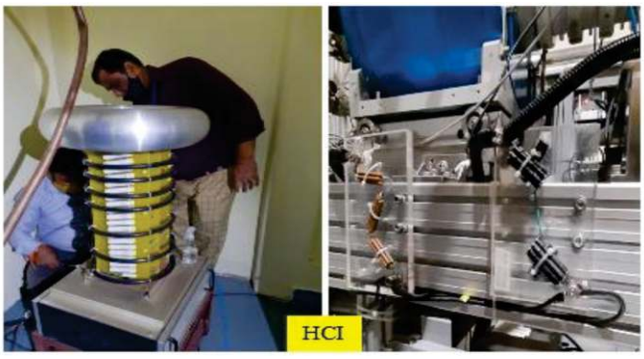
The Ion Source Group (ISG) is an Accelerator Facility Central Support Group (AcSCG), which takes care of the activities of ECR Ion sources on high voltage platform and associated electronics including High Voltage power supplies (HVPS), Light Link Interfaces, HTS Coils related electronics, system operation and maintenance. The group also provides technical support to other groups regarding HVPS and development activities.

The yearly activities related to maintenance, upkeep and development are summarized below:

Preventive Maintenance Schedule of ISG Instruments:

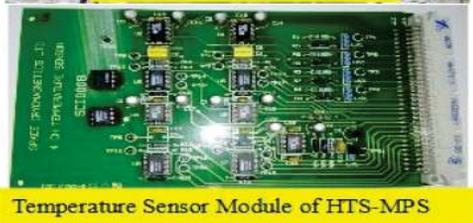
The group performs yearly scheduled preventive maintenance of every instrument to preserve its life, performance and to ensure breakdown-free operation during the year long continuous operation.

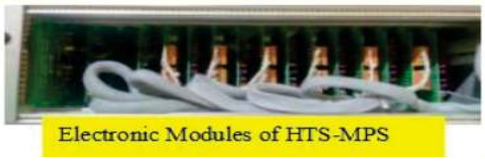
- In HCI ion source High Voltage Power Supplies (HVPS), the Deck HVPS (200kV), Extractor & Focus HVPS were cleaned, all the loose connections were checked and operated by remote control. Besides this bleeders were cleaned & covered with acrylic sheet.
- In NIBF ion source High Voltage Power Supplies, the Deck HVPS (-200kV), Extractor & Focus H V P S was cleaned, all the loose connections were checked and operated from console.



Break Down Maintenance of Ion Source Group (ISG) :

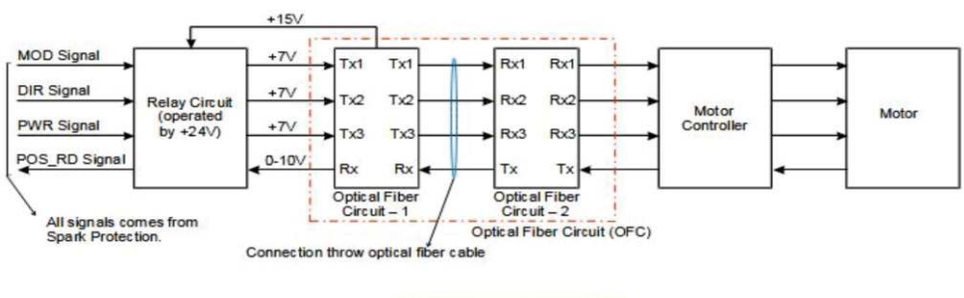
Sl. No.	Breakdown problem & reason	Related Lab	Loss of time
01	The Bias power supply (-1kV) was found to be which was attributed to suspected spark. Bias power supply was replaced by -10kV power supply	HCI	2hours
02	The Problem in multiplier stack of deck HVPS (400kV). Components were found to be faulty, which was attributed to suspected spikes. The faulty components of the stack were changed.	LEIBF	One day
03	The Problem in deck HVPS (-200kV) was de-loaded and found to be faulty which was attributed to discharge path. Hence the HVPS could not achieve full bias.	NIBF	One day
04	The Tripping problem in High Temperature Solenoid Magnet Power Supply (HTS-MPS). Problem in temperature sensor module. (Repair & Maintenance of HTS Magnet Power Supply)	HCI	2weeks



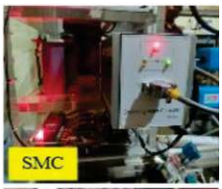


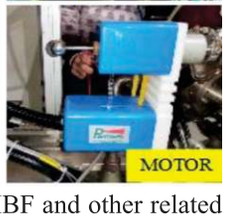
Development Activities :

Sputtering Motor Controller (SMC) for HCI facility: Sputtering motor controller was developed and utilized for forward and backward motion (In or Out mode) of the sample to be sputtered for development of metal ion beam. This unit was installed on HCI deck and working fine.



Block Diagram of SMC





Light Link Interface : These modules are developed for HCI-ECR ion source, LEIBF, NIBF and other related Pelletron control equipments on high voltage platform and voltage to frequency conversion upto 1MHz.

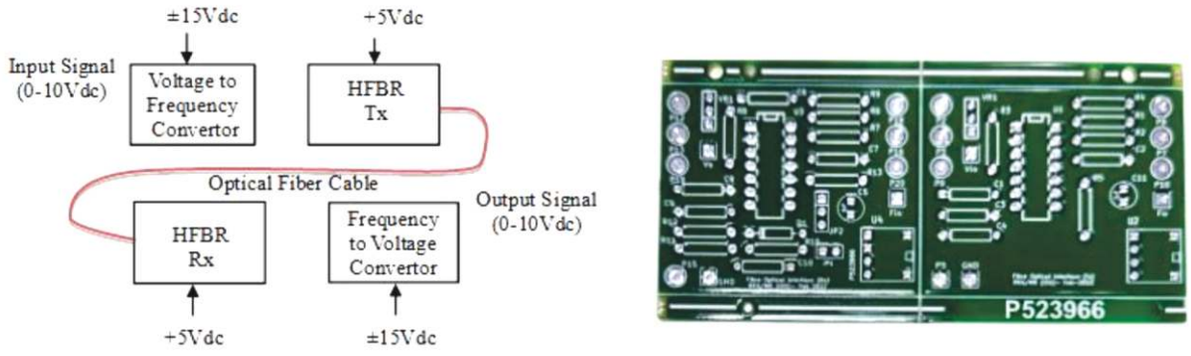


Figure 3.36: Block diagram and PCB of light link interface

3.1.13 REMOTE CONTROL LABORATORY

Kundan Singh, Deepak Kumar Munda, R Ruby Santhi

Quad channel VME board for scanner power supply controls

At present the beam scanner power supplies are remotely controlled through CAMAC modules. In the process of CAMAC to VME migration we need to control these power supplies through VME bus based hardware. To the best of our knowledge these modules are not available commercially off-the-shelf (COTS). The module needs to be re-designed in the VME form factor. Since we have already developed, digital/analog IO, IGOR VME boards for our accelerator control applications therefore we have decided to take up this development in-house. The circuit design for four channels was freezed, 4-layer PCB (printed circuit board) was designed in single width, 6U, VME board space.

The board logic and VME interface for the VME board is designed using Field Programmable Gate Array (FPGA). The technology is being used in all commercial embedded designs and is going to stay for another decade or more. The firmware writing for FPGA chip , in VHDL language, is going on and the module will be tested in coming year.

Output Specifications :-

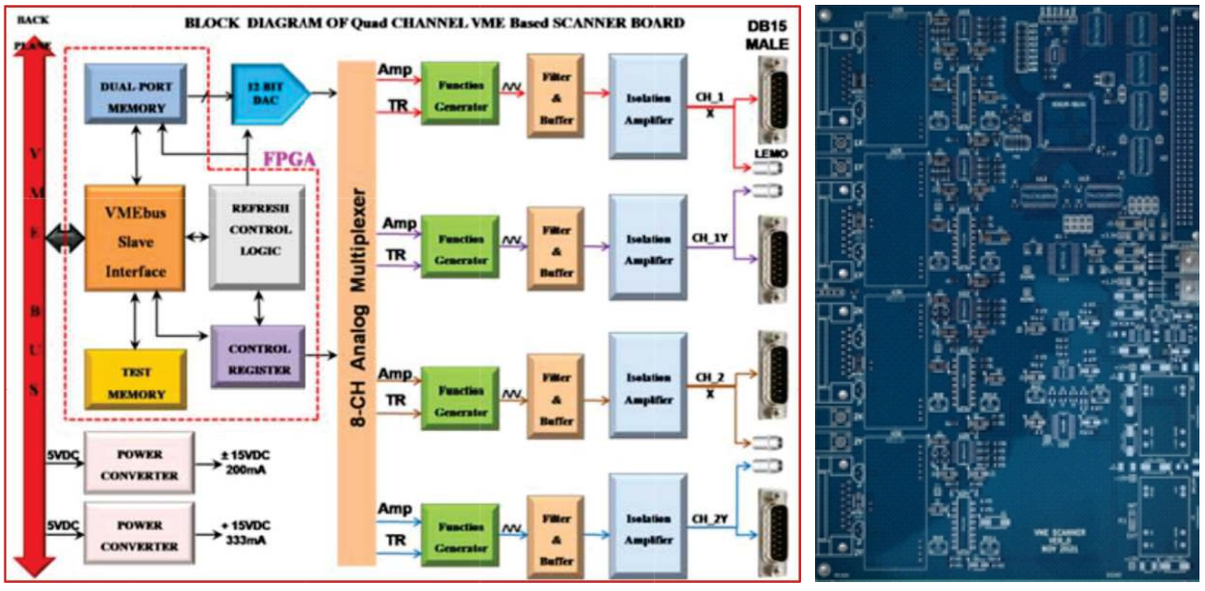
Triangular Wave

Voltage Vpp (Approx) : 40mV ~ 5V

Frequency (Approx) :

Channel 1_X : 4Hz ~ 50Hz
Channel 1_Y : 100mHz ~ 1Hz
Channel 2_X : 4Hz ~ 50Hz
Channel 2_Y : 100mHz ~ 1Hz

VME Form Factor



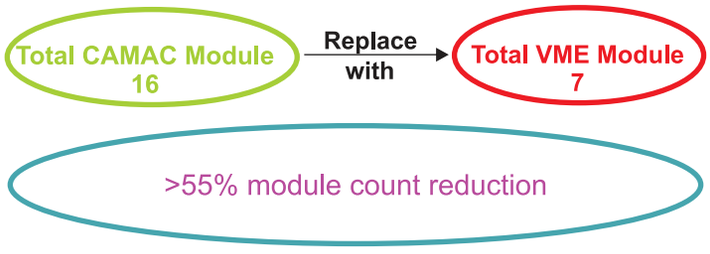
Present Status :

- Schematic and 4-layer PCB made
- Components procurement is in process
- FPGA firmware is being written in VHDL (going on)

CAMAC-to-VME system migration at Pelletron Accelerator

Since the CAMAC hardware is age old system and has reached the technological obsolescence. The migration from CAMAC system to VME system was started, in phased manner. With the help of Pelletron group, the control of all the beam line devices, controlled or monitor from 255 Level CAMAC server, was fully migrated to VME server. Special cables were made to interface VME modules to Spark protection modules (without intermediate router boxes). Due to high density of VME modules, 16 CAMAC modules has been replaced with 7 VME modules. So it is a ~ 55% reduction in module count with this new system. This whole exercise has been carried out without disturbing the beam time schedule. The machine ran with this new control hardware at 255-Level more than a year now without any problem. The new VME server is integrated with the existing main control console at control room. The hardware changes are taken care in the server software and are not visible to the operation personnel. The "Pcli" GUI is kept same.

CAMAC		VME	
N	Module	N	Module
2	ADC 16 CH 3512	7	VMEADC64 IUAC
5	ADC 16 CH 3512		
6	ADC 16 CH 3512		
11	ADC 16 CH 3512		
1	DAC 10 BIT 3110	9	VME DAC64 IUAC
4	DAC 10 BIT 3110		
12	IGOR IUAC	15	VME IGOR IUAC
13	IGOR IUAC		
14	IGOR IUAC	16	VME IGOR IUAC
15	IGOR IUAC		
16	IG3471	2	VME DIO IUAC
3	OR 3074		
22	IG3471	3	VME DIO IUAC
7	OR 3074		
9	IG3471	4	VME DIO IUAC
10	OR 3074		



Tesla Meter Readout

Scanning the field and picking up the beam intensity is a regular exercise in HCI ECR source. One needs to read the field value, using Tesla meter, and plot it against the beam intensity. The approach was to develop a cost effective common standalone server or using Serial-2-VME module to read all tesla meters (DTM151 Model) installed in the beam line. The application program "pserv" is developed/modified for both approaches and the Tesla Meters readout is incorporated with accelerator control system at HCI facility. It is tested in lab with dedicated RS232 server as well as VME server. The final implementation is done through VME server using quad VME-2-serial module. A single VME module can support 4-tesla meters independently. Two tesla meters are placed at HCI high voltage (HV) DECK and other two are located after first acromat bend in the HCI beam line.

3.2 UTILITY SYSTEMS

3.2.1 ELECTRICAL GROUP ACTIVITIES

U. G. Naik, Raj Kumar

Electrical system of IUAC is having following power source installations:

Electrical Sub-stations:

- 11/0.433 kV Main sub-station of 4.5 MVA capacity having two HT supply – 1 No.
- 11/0.433 kV Packaged compact sub-station of 1.6 MVA – 1No.
- 11/0.433 kV Packaged compact sub-station of 1.0 MVA – 1No.

DG Sets:

- 3x750 kVA DG Dets synchronized and controlled through PLC panel.

UPS Systems:

- 3x300 kVA true online UPS System – 1 Set
- 3x60 kVA true online UPS system – 3 Sets
- 2x60 kVA true online UPS system – 1 Set

Solar Power Plants:

- Grid interactive solar power plant of 100 kWp capacity- 1 No. (Owned and maintained by IUAC)
- Grid interactive solar power plant of 120 kWp capacity- 1 No. (Owned and maintained by external agency)

Servo Voltage Stabilizers:

- 415 V, 3 Phase, 1000 kVA – 1 No.
- 415 V, 3 Phase, 500 kVA – 1 No.

Apart from above power sources we have following electrical power & lighting systems:

- Normal power distribution panels
- DG power distribution panels
- UPS power distribution panels
- Lighting distribution panels
- Light fittings and fixtures
- Street and compound lighting
- General earthing and dedicated clean earthing systems
- Power factor compensation panels

This group is primarily responsible for maintaining the electrical installations of IUAC and to develop adequate electrical infrastructure for the new facilities from time to time. All the above main installations are being operated and maintained by IUAC through outsourced manpower.

3.2.1.1 Maintance activities:

Maintanace of electrical installations of substation, office blocksand residential colony

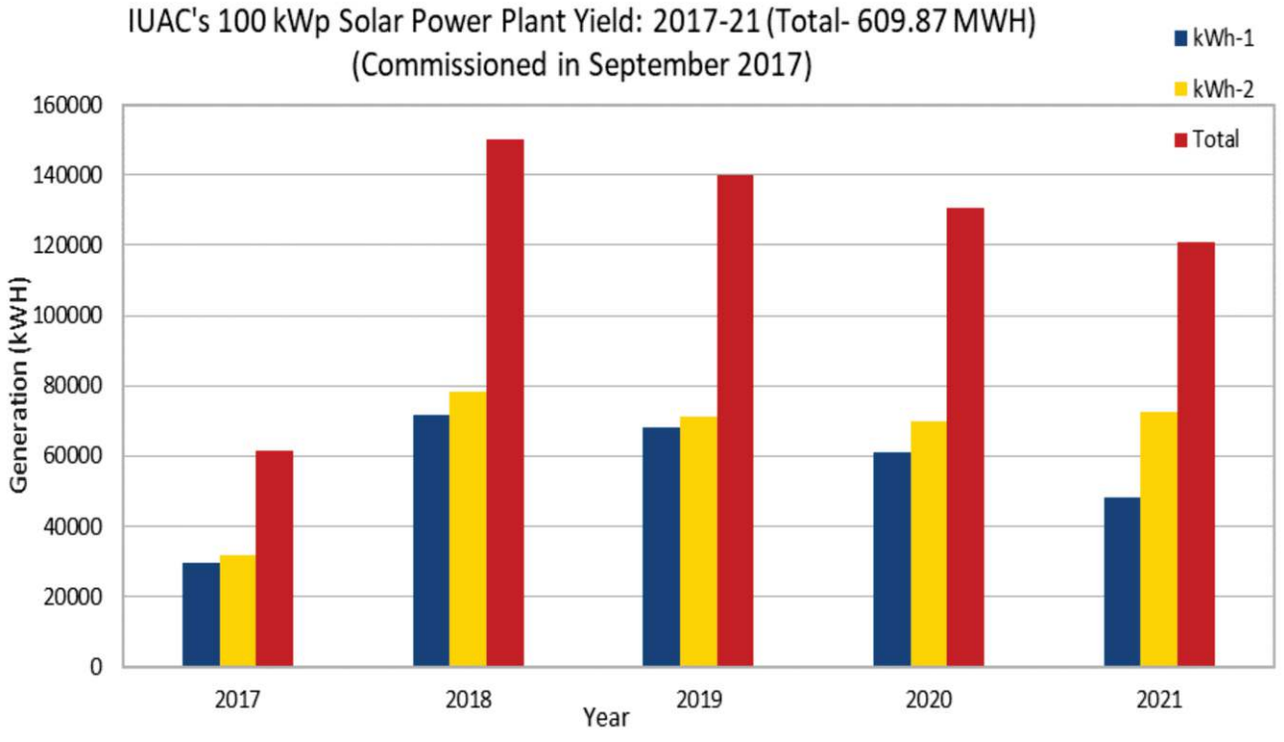
Maintenance of all above electrical installations has been carried out as per schedule during the year through outsourced staff except UPS system maintenance. All UPS systems are being maintained through AMC contract. However, all the consumables required are being purchased by electrical group.

Besides the day-to-day routine maintenance following major schedule maintenance works are carried out annually.

- RMU service for the packaged substations.
- Servicing and calibration of all protective relays of HT & LT Panels.
- Dehydration of transformer oil for 6 Transformers.
- Servicing of all OCB and ACBs.
- Annual servicing of DG Sets.

Roof top solar system

IUAC owned roof top grid interactive 100 kWp (2*50 kWp) solar power generation plant is operational and maintained in healthy condition. Total power generation of year 2021 has been 1,21,365 kWH. Maximum monthly power generation during the year has been 14,857 kWH in the month of March 2021. Periodical maintenance and cleaning of solar PV panels is carried out throughout the year to get maximum power out of it. We have already recovered capital investment on this plant within 4 years of generation. Yearly generation chart of the plant is as shown below.



Power Factor Compensation

There are following power factor correction panels in our distribution system.

- 350 kVAr, 7 stage power factor correction panel – 2 Nos.
- 300 kVAr, 7 stage power factor correction panel – 1 No.

Electrical group is very happy to declare that yet again we achieved average power factor of >0.99 lag for the year. Our system power factor without correction is about 0.85 lag. This has been possible due to regular upkeep of power factor correction capacitors, contactors and other switchgears of the panels.

Fire detection and alarm systems

There are following fire detection and alarm systems installed in IUAC.

- Addressable fire detection system at Auditorium
- Addressable fire detection system at 2nd floor lab complex.
- Conventional fire detection systems at main lab building, LEIB building, new guesthouse, Beam Hall-3, engineering building, Beam Hall-2 stores.

All above fire detection & alarm systems are in healthy condition and are being maintained regularly through AMC.

3.2.1.2 Renovation of new guest house, housing colony, food court and council room

Renovation of housing blocks are in progress since last 2 years. Complete rewiring is being done in phase-1 housing blocks which were in use since 1990 all with exposed wood batten wiring. In phase-2 hosing all light fittings, fans, switch sockets etc are being replaced. During last year around 10 houses have been completed out of total 35 flats renovated so far.

Apart from flats in housing colony, we have also renovated New Guesthouse, Food court, Council room and Director's office. We have replaced all light fittings, wiring, distribution boards, switch & sockets etc during renovation.

3.2.2 AIR CONDITIONING, WATER SYSTEM, COOLING EQUIPMENTS, COMPRESSED AIR SYSTEM, FIRE HYDRANT SYSTEM.

Bishamber Kumar, S.S.K.Sonti , Dr. S. Muralithar

AC SYSTEM

IUAC's central air conditioning / low temperature cooling system of Phase-1 consisting of 400 TR Central AC plant performed with 100% up time. Maintenance ensured that the safety record of the plant was maintained at 100% and the power consumption kept at optimum level. 2x200 TR chillers installed in 2013 have run 39000 hours each. Some rotary equipment have logged 231000 continuous run hours.

The Phase-II&III, screw chiller based central AC plants performed to an up time of 100%.
Ph-II cooling tower are overhauled. Ph-III chiller was made working and the parts were replaced.

The highlight of the operation and maintenance of the above systems is the in-house supervision, optimisation of operation parameters, timely maintenance of rotating machinery and elctricals led to least breakdown time and significant savings in operation and replacement costs..

WATER SYSTEM

IUAC's centralized water system of Phase-I feeding low temperature cooling water having a total heat removal capacity of 115 TR performed to an operational up time of 100%. This is due to the stringent maintenance practices, which were followed over the years. The system has overshot 194700 hours from its expected life span.

IUAC's centralized water system of Phase-II&III feeding low temperature cooling water also performed to an up time of 100%. Pumping system for supply of process water to HCI beam hall-III was commissioned and is in operation on need basis.

A strict monitoring on the water quality has ensured that the flow paths are in healthy condition. The maintenance costs were kept significantly low as compared to world class bench mark values.

150 KLD Sewage Treatment Plant (STP) performed satisfactorily. This has led to saving in water cost upto 10% of the billed cost.

Uninterrupted potable water has been made available to IUAC campus throuth the MCD supply and in house borewells.

Gardening water has been provided for campus horticulture work by supplying the reprocessed water conserving the potable water.

COOLING AND HEATING SYSTEM

Availabilty of portable water chillers, water coolers, window / split / package air conditioners, electric water geysers etc. was recorded at 99%. With in house maintenace, there is significant saving the cost.

COMPRESSED AIR SYSTEM:

Compressed air plant (Ph-I&II) consisting of three nos. of screw compressors each of 150M^3/Hr capacity, 4 nos of air dryers, pre/fine/oil removal filters with capacity of 2500 lpm @ 9.00 Kg/cm^2, Storage Tank of 25 cum have been maintaining uninterrupted air supply to IUAC Lab campus round the clock throughout the year. Pneumatic connections are provided to different labs / area / instruments as and when required.

FIRE HYDRANT SYSTEM :

For Fire safety purpose pressurised water hydrant system including underground Water tank, electric / diesel engine water pumps have been installed. With this continuous water pressure is maintained in the water hydrant line. Wet risers, down comers, hose reels, hose pipes, boxes, hydrant branches have been provided in and around different buildings i.e. Material Science building, Engineering Building, New Guest house and auditorium.

WORKS CARRIED OUT DURING THE YEAR:

- Servicing of LEIBF De-Humidifier
- Providing of split air conditioner in First Floor Rooms of GH-II suit rooms.
- Providing of split air conditioner in MRI, LEIBF, NAND Data Room.
- Quarterly / PM / breakdown visits of 2 nos of 200 TR, 2 nos of 250 TR water chilling units.
- Procurement of spares for the system i.e. pumps, electric starters, desert coolers, window air conditioners, water coolers, geysers, v-belts, bearings, piping etc. as per requirement.

- Rewind of electric motors of HVAC system, WAC, desert coolers etc.
- PM / breakdown maintenance of desert coolers, geysers, air washer, canteen exhaust system etc.
- Descaling work of condensers and evaporators of 200 /250 TR water chilling units.
- Cooling tower Ph-II parts replacement and Ph-I electric motor bearing replacement.
- Dehumidifier heaters & Micro switch replacement.
- Attended to break down complaints (250) of window/ split air conditioners, water coolers, desert coolers, geysers etc.
- Drinking water pipe line leak search, repair and piping replacement work.
- BH-III water seepage pumping to drain out the water on regular continuous basis.
- Testing of Potable Water Samples and STP
- Records : Maintaining records of spares, consumables, maintenance works & Assets etc. on computer and different registers.

INSTRUMENT AIR SYSTEM :

- Daily check for oil level, condensate drain.
- Weekly cleaning of the heat exchangers of air compressors and air dryers, air filter, room filters etc.
- To provide pneumatic connections to new instruments as and when required.
- Procurement and Replacement of Pre / Fine / oil filters , regulators etc.

FIRE HYDRANT SYSTEM :

- Regular check up for operations of pumps, fire hydrant, wet risers, hose reel boxes etc.

3.2.3 MECHANICAL WORKSHOP AND ANCILLARIES

G. K. Chaudhari, Sanjay Kumar Saini, Thomas Verughese, K. K. Mistri, Bipin Bihari Choudhary, Davinder Kumar Prabhakar and S. Ghosh.

The various divisions and responsibilities of the Mechanical workshop are given in the following:

1. Machine shop and Welding shop
2. Electron beam welding machine facility
3. Portable fire extinguisher
4. Design and Installation of various beam line components
5. Elevator, Overhead cranes and shifting of heavy equipment
6. Managing the requirement of Industrial gas cylinders at IUAC

Mechanical Workshop (MG-III)

S.K.Saini, B.B.Choudhary ,*DK Prabhakar , *T.Varughese, (*Till Sept 2021) G. K. Chaudhari** (**In absence of SKS and BBC from Sept.2021)

The MG-III caters the need of designing and fabricating the mechanical components needed to operate and maintain the accelerators, experimental facilities and the beam line of IUAC. The Job-requests are submitted through email and they are diverted to different sub-sections either for the design followed by the fabrication and Quality Control (QC) or directly for the fabrication and QC.

The major facilities in the workshop are Machine shop and Welding shop.

Machine Shop is equipped with four conventional Lathe machines, two Milling machines, a Radial Drilling machine, a cylindrical grinder, a tool and cutter grinder, a horizontal and a vertical Band Saw machines. A sheet metal processing machines are being procured. In addition, to this IUAC workshop has a five axis Vertical Machining Centre and a CNC Lathe machine.

Welding shop is having high quality TIG, MIG welding machines, few of them have pulsed arc feature for welding of thin sections. The shop is also equipped with Air plasma cutter with a capacity to cut up to 40 mm thickness of stainless steel. Conventional Oxy-acetylene cutting and brazing set-ups are available for brazing and cutting jobs. A portable SS weld cleaning machine is procured and being used extensively.

This year, a total of ~900 jobs were received (~ 629 for machine shop and ~180 for Welding Shop) which consists of ~ 2000 components and they are fabricated from different materials such as Aluminium, Mild Steel, Copper, Stainless Steel 304, brass, G-10, Hylum, plastics, etc.

In the last academic year, no jobs were outsourced to outside vemndors.

Auxiliary Support Activities (lift cranes):

S. K. Saini, DK Prabhakar (Till Sept 2021 and B B Choudhary (From Sept 2021)

- Kone Lift: Regular servicing and renewal of license.
- EOT Cranes/ Hoist: Maintenance/servicing is being done at regular intervals and breakdown maintenance as and when required.
- Hydraulic Trolleys/ pallet trolleys – Maintenance and upkeep
- Shifting of heavy equipments: (e.g. 2.5 T Magnet, , Undulator, etc.)
- Issue, upkeep, Distribution and maintenance of industrial and speciality gas cylinders, maintenance of regulators.
- Inspection – Annual Service Platform

Quality Control laboratory:

D. K. Prabhakar (From Sept 2021)

Recently a quality control lab is established by MG-III. Measuring instruments such as vernier caliper, micrometer, height gauge, CMM are inducted into the lab. Following task are done in this lab

- Coordinate Measuring Machine ROMER CMM was made operational and is being used routinely.
- Machined components are inspected for dimensions deviations and other parameters are also checked for quality, if any defect is found, it is reported to the shop floor person of the workshop.

Design Department:

Thomas Verughese and D. K. Prabhakar (From Sept 2021)

Design department of IUAC has designed various components and prepared drawings of following parts and systems. These drawings are prepared as per IS-2102 medium class for general tolerance.

- Upcoming FEL facility - laser beam view pipe, Camera fixture, beam line structure base plate, Undulator beam pipe support structure, Quadrupole base plate. CTR (THz) chamber, etc.
- PSPC chamber modification.
- Aluminum shield for cold head.
- Designed an aluminum Ion-Trap Vacuum Chamber, for ION Trap Facility at IUAC.
- Heat sinks from RF and magnet labs.
- Detector frame.
- Electrostatic analysis chamber.
- Electron beam system modification.
- 3D Drawing to decide the second door entry for NAND facility.
- HIRA FP chamber exit flange for testing the small area MWPC detector.
- Pumping cross for LEIBF.
- Proton beam line facility

Auxiliary Support Activities (fire fighting equips):

Thomas Verughese and D. K. Prabhakar (Since Sept 2021)

- Renewal of license of fire safety for IUAC main building, annexure buildings and auditorium was done. Refilling of 320 nos of portable extinguishers.
- Audits of fire extinguishers of auditorium were carried out; accordingly a list is prepared and after estimation, procurement process is started.

Electron beam welding machine:

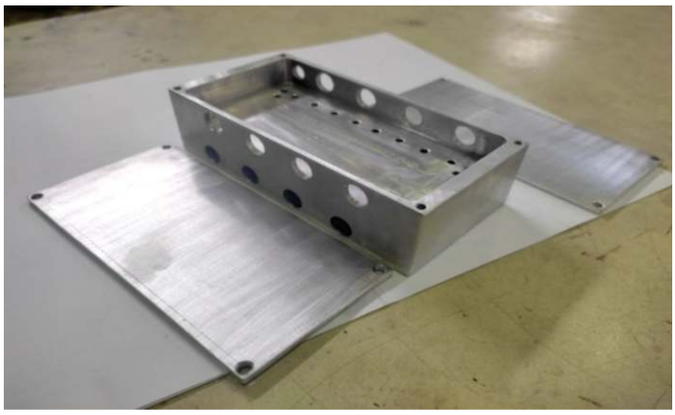
(K. K. Mistry and G. K. Chaudhari)

- Electron beam welding machine is mainly responsible to welding of the Niobium parts of Quarter Wave Resonators. The machine also caters the need to weld the niobium joints of the other resonators being developed in various national laboratories like, RRCAT and VECC.

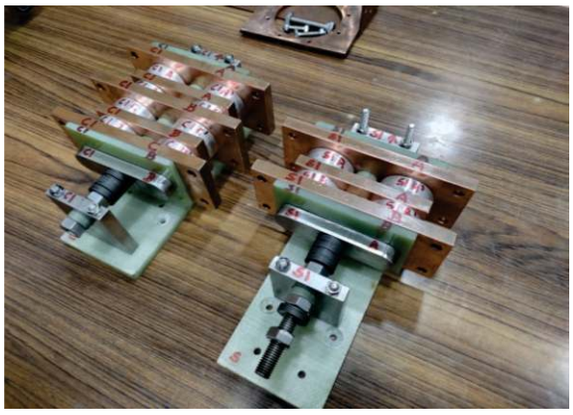
IUAC workshop is providing Apprentice Training for the ITI passed students in both welding shop as well as in machine shop. Basic workshop training is provided for the scientist trainees and Ph.D. students enrolled in IUAC.

A few pictures of some major equipment which were fabricated at IUAC workshop

Detector Housing



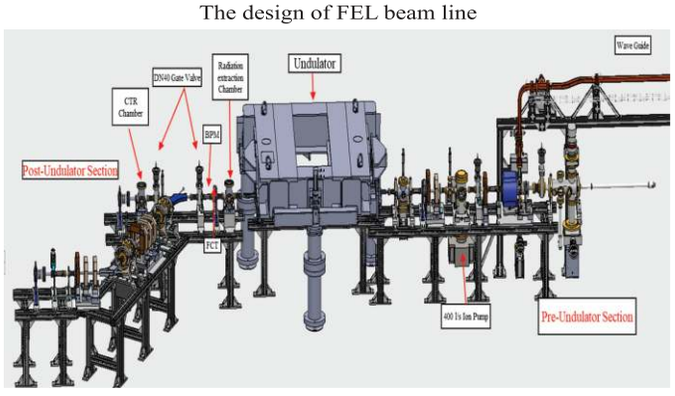
Diode Assembly for MRI



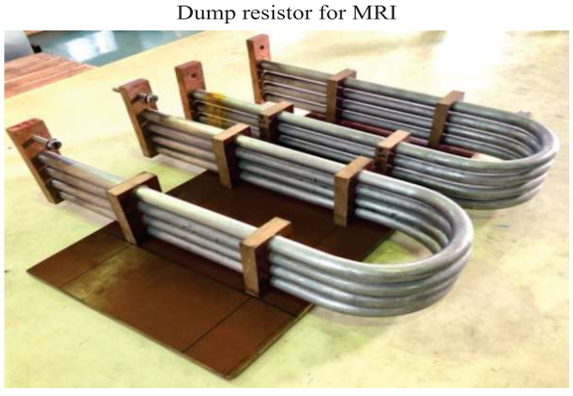
2.75” CFF cross

Laser Beam View Port

The design of FEL beam line

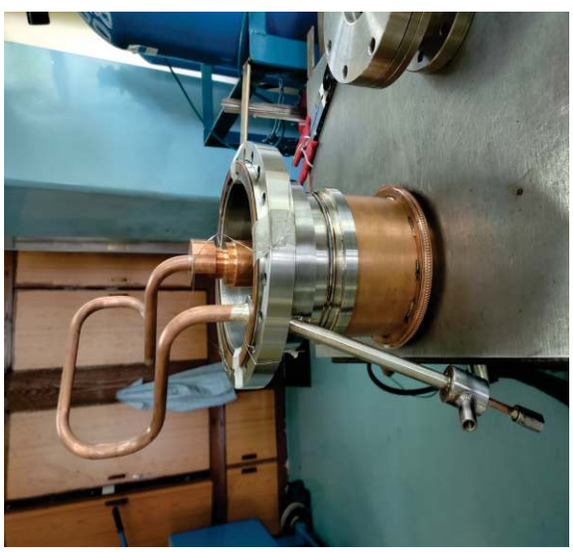


Dump resistor for MRI



Various components and assembly parts of FEL

Power Coupler For RFQ



3.2.4 CIVIL ENGINEERING GROUP

Harshwardhan, Raj Kumar, N. Madhavan, D. S. Gangwar (consultant)

IUAC campus is situated on a total plot area of 25 acre with built-up area (or ground coverage) of approximately 15000 m^2. The total covered area of all floors is around 25000 m^2. Centre has an academic or laboratory complex, utility buildings, auditorium, housing complex, hostel and guesthouse complexes. The civil engineering department takes care of day-to-day maintenance of all buildings, roads, sewerage system in campus including modifications, up-gradation, new construction activities and liaisoning with external agencies such as DDA, SDMC, Delhi Fire Service, Forest Department, RMB etc. for various statutory requirements such as building plan and construction approvals, fire safety approvals, property tax related issues etc.

The following are some of the important civil works undertaken in addition to routine civil maintenance and minor works through CPWD under deposit work mode.

- Up-gradation / renovation of 88 Nos. of flats in IUAC housing complex: The renovation work is completed in 32 flats and work in 3 more flats is near completion.
- Up-gradation / renovation of IUAC canteen has been completed.
- Renovation work of New Guesthouse has been completed.
- Renovation of Director's Room & Council Room has been completed.
- Construction of 16 Nos. Type-III (Sumeru II type) flats (proposal under process).

Following works has been carried out and completed directly by IUAC:

- Installation of Boom Barrier at IUAC Main Gate.
- Construction of connecting corridoor, MS platform and stairs for making separate entry from FEL control room to BH-3 basement.
- Installation of Organic Waste Converter (OWC) and associated civil works.
- Structural analysis of Beam Hall-1 and Beam Hall-3 including STAAD simulation.
- All civil works for Material Characterization and Measurement Centre (MCMC).
- Civil works for setting up of Applied Superconductivity Laboratory.
- Replacement of all roof sheets of car parking and electric sub-station area.
- Replacement of defective cisterns and glass door in auditorium.