STATUS REPORT OF 15UD PELLETRON ACCELERATOR AT INTER UNIVERSITY ACCELERATOR CENTRE, NEW DELHI, INDIA

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15 UD Pelletron accelerator of IUAC, New Delhi, India, has been operating well from the last SNEAP report. This accelerator has been operational since 1990 and total number of chain hours logged in, till now is 95736 hours. The maximum voltage achieved, after unit wise conditioning, is 14.3 MV and the up time for the last one year is around 88.84%. Beam utilization is around 56.85% of total time. Apart from regular operation and maintenance of 15 UD Pelletron accelerator, few developments were also carried out. All of these developments and major maintenance work are mentioned below.

Developmental Activities :

1. Modification in Ion Source Test Bench :

Indigenously developed electrostatic quadrupole and an electrostatic steerer were installed in the Ion Source Test Bench line. The main feature of this quadrupole is that it can work in singlet, doublet or in triplet configuration, as desired. The function of these quadrupole and steerer is to improve the beam optics after mass analyzer magnet. Controllers for these quadrupole and steerer were also developed in house. An experimental chamber is installed at the end of this line to check the quality of developed beam. Effect of these newly installed components was tested with ^{28}Si beam of different energies (from 40 keV to 100keV). Total beam currents from ion source and mass analyzed beam currents were observed at different parameters of newly installed quadrupole and steerer. It was observed that these components play major role in increasing the beam transmission. The quadrupole was operated in doublet as well in triplet configuration and beam transmission was maximum in triplet configuration. Beam spot of ~3 mm to 5 mm was also seen on CsI crystal, mounted on target ladder in the experimental chamber.

2. Area interlocking for LINAC and associated experimental areas :

A prototype area interlocking system was designed, fabricated and installed for LINAC and associated experimental areas of LINAC. Presently, 15 UD Pelletron accelerator is being used to inject the beam into LINAC through 0° line of switching magnet–I (associated with Pelletron accelerator). Super Buncher, LINAC, rebuncher and other associated beam line components, like quadrupoles, steerers, Faraday cups, beam line valves etc. are installed after switching magnet–I. Area where all of these components are installed is nomenclatured as Vault–II. Beam from LINAC will be then switched to different experimental lines (presently four) by another switching magnet (switching magnet–II). Individual search and secure boxes are installed for each area, which gives alarm on activation. This alarm alerts everyone before interlocking the associated area. One has to interlock all these areas through search and secure boxes before injecting the beam into LINAC. If area interlocking of any of these areas fails, beam stops before switching magnet–I in vault–I. This interlock system was used frequently in LINAC test runs.

Major Maintenance Works :

During mentioned period, there were four tank openings, two for schedule and two for breakdown maintenance. A few of the major maintenance works are mentioned below.

1. **Replacement of terminal ion pump (IP T–1) by recycled ion pump**

   In one of the scheduled maintenance, while loading fresh foil strippers in terminal, one of the ion pumps in terminal area (IP T–1) got operated in atmosphere, therefore it was essential to check its condition.. Although IP T–1 was showing a vacuum read in the range of 10^{-6} T and measured 200 G ohm when tested with megger at 1 kV, it was opened. The condition of this pump was quite bad. Therefore, this pump was replaced by recycled one. This recycled pump was tested, before installation, for its ultimate vacuum and it was in the range of 10^{-8} T. The performance of this pump was checked which was quite satisfactory.

2. **Charging system maintenance**

   Grooved surfaces of both pulleys were oiled with turbo pump oil to solve the problem of pulley dust at terminal. Alignment of few idler wheels were adjusted. One of the damaged nylon insulators, attached to the alignment bolt of charging chain #2 pillow block and two damaged insulator sleeves, used to mount pillow block of charging chain #1 were replaced by in house fabricated ones.

3. **Replacement of Column Support Post**

   Severe cracks were observed across the gap #15 in one of the column support post (P–4), installed in unit #11. These cracks made the column support post P–4 mechanically week. Therefore, the damaged column support post was replaced by new one.

4. **Replacement of bearings associated with rotating shafts**

   Lots of rotating shaft maintenance work was put on for the above mentioned period. This mainly includes replacement of bearings in the coupler boxes between rotating shafts. Total number of nine coupler boxes in low energy section and eight coupler boxes in high energy section were repaired. All the bearings of these mentioned coupler boxes were also replaced by new bearings.

5. **Problem associated with fiber optic cables**

   Accelerator tank had to be opened twice in the month of March 2006 for breakdown maintenance. The reason for these breakdown maintenance were the damage in fiber optic cables. During conditioning of machine after scheduled tank opening maintenance, machine sparked at 12.5 MV. After this spark the communication inside tank for the devices inside terminal and HEDS stopped. None of the ion pumps in terminal and in HEDS were getting ON. This problem was thoroughly investigated and concluded that the problem is inside tank. The tank was opened and found that four bunches of fiber optic cables (three from terminal to tank bottom and one from high energy dead section to tank bottom) got damaged in unit #22. All these fiber optic cable bunches were replaced by new one, but again all of them got damaged in unit #29 and 30. This second damage was also after a spark. As there was no spare cables left, all these cables were repaired using indigenously developed mechanical splicers. The problem of these damage in tandem was investigated and found that accelerator tank was not properly grounded and full length spiral wraps, which are used to hold these bunches, were laying in high electric field. To beat this problem, tank was properly grounded and it was made sure that no spiral wrap should be there for full length (across full unit). These precautions solved the problem of fiber cable damage and repaired fiber cables worked fine. In next scheduled tank opening maintenance these repaired fiber cables were replaced by new one.

Pulsing System Operation and maintenance

Multi harmonic buncher (MHB), installed in pre–acceleration stage of pelletron accelerator, is exclusively for LINAC operation. This MHB is also being regularly used to deliver pulsed beam to users of Pelletron accelerator as well. Repetition rate of MHB is 12 MHz. The pulse beam users generally require the repetition rate of 4MHz. or in submultiples of 4 MHz. Old beam pulsing system of IUAC comprises of a chopper (used to chop the beam at repetition rate of 4 MHz.), a traveling wave deflector (used to get repetition rates at submultiples of 4 MHz.), and a buncher (used to bunch the beam) are installed in pre acceleration section of accelerator. Chopper and traveling wave deflector (TWD) have to be operated along with MHB to get the desired repetition rates of either 4 MHz. or submultiples of 4 MHz. To operate chopper and TWD along with MHB, an interface is designed which enables to drive chopper and TWD by the master clock of MHB. Beam time of 785 hours (98 shifts) was utilized by pulsed beam users. Out of these 785 hours, 195 hours (24 shifts) were used for ^{28}Si pulsed beam, 342 hours (43 shifts) for ^{19}F pulsed beam and 248 hours (31 shifts) for ^{16}O pulsed beam. All of these runs were quite stable. Once TWD was repaired for its proper operation.

Ion source maintenance work

MC – SNICS ion source was opened, after venting it with argon, and dismantled completely for maintenance. All the components of ion source were cleaned thoroughly using sand blast technique and then washed with alcohol. The source was then assembled back. During operation it was observed that focus parameter of einzel lens was not holding even 1 kV and its value was continuously tracking with extractor value. This lead to the opening of einzel lens. Deposition of Cs layer was observed in einzel lens. The opened einzel lens was kept in alcohol bath for cleaning. Another spare einzel lens was tested and installed. Thereafter the MC – SNICS ion source was installed back in high voltage deck. 5 grams of fresh Cesium was also loaded in the Cesium reserviour. Cathodes were loaded in 40 position cathode wheel, according to requirement, time to time. Total ion source was evacuated and baked to deliver beam. The high voltage deck, high voltage stacks, filters and General Purpose Tubes (GP tubes) were also cleaned properly.

GP tubes were not able to hold even 200 kV due to deposition of Cesium vapours as Cesium oven and line heater is always ON for the operation of MC–SNICS ion source. Therefore, the conditioning of GP tube was done. Lots of X–rays were observed during conditioning. These GP tubes were conditioned to hold 300 kV.

First experiment using LINAC

First time LINAC has been used to boost the energy of ^{28}Si beam. 130 MeV, $^{28}Si^{+10}$ beam from Tandem was injected to LINAC and accelerated further by five niobium resonators of the first LINAC cryostat to get the energy boost of 21 MeV and increases the energy up to 151 MeV. First experiment has been conducted at IUAC by using the energized beam from Tandem–LINAC combination. A stable beam of 148 MeV was then delivered for an experiment to study fusion–fission reaction dynamics using neutron multiplicity measurement.