

PLS Preinjector Linac Vacuum System*

Y. K. Kim, J. S. Bak, M. H. Cho, W. Namkung,
H. S. Oh[†], Y. B. Kwon[†], F. He[‡], H. J. Yang[‡], H. F. Chen[‡]

I. Introduction

The vacuum system of the PLS preinjector linac consists of four major parts which are the electron gun, two accelerating columns, 13.06-meter waveguide network and 8.75-meter buncher waveguide system. The preinjector linac must be operated under high vacuum condition to prevent electrical breakdown by the high rf field and excessive scattering of the electrons by residual gas molecules. The vacuum system should satisfy the following design goals: the pressure of the accelerating columns and the waveguide network should be less than 1×10^{-7} Torr, 1×10^{-8} Torr for the klystron window, 1×10^{-6} Torr for the buncher waveguide system, and 1×10^{-8} Torr for the electron gun.

II. Arrangement of the Vacuum System

There are four 70 l/s ion pumps for two accelerating columns, the waveguide network and the buncher waveguide system, and two 150 l/s ion pumps for the klystron window and the electron gun. Three 70 l/s ion pumps for two accelerating columns and the waveguide network are connected to a manifold pipe. There are twelve vacuum measuring units in the preinjector linac. Each measuring unit has three different gauges which are a pirani, a penning, and a B-A type gauges. All the gauge controllers, ion pump controllers, a valve driver and one interface crate which are installed in two 19" standard racks are located in the klystron gallery.

In order to protect the electron gun, an all-metal pneumatic gate valve is used for the isolation of the electron gun part from the rest of the linac. One waveguide valve, one CF50 right angle valve and one venting valve are installed for the replacement of the klystron. The buncher waveguide system is isolated by the ceramic window from the main vacuum system.

Interlock vacuum levels for the preinjector linac are set to 5×10^{-8} Torr for the electron gun, 1×10^{-7} Torr for the klystron waveguide window, and 1×10^{-6} Torr for the accelerating columns. If the vacuum pressure of any sub-system exceeds its interlock level, the gauge controller sends a signal to the interlock circuit. When this occurs, the trigger signals of the electron gun and the modulator are turned off, and then the pneumatic gate valve is closed automatically.

III. Installation and Commissioning

For the preinjector linac installation, we carried out the components assembling and the leak detection in two steps. In the first step, all centerline components including the beam

* Work supported by POSCO and MOST

† POSCON, Pohang

‡ IHEP, Beijing, PRC

analyzing station and the waveguide network in the tunnel were assembled and leak-tested. After the installation of these parts, four ion pumps located at the tunnel were operated to keep these components under a good vacuum condition. In the second step, the electron gun, klystron gallery waveguide network, buncher waveguide system, and dummy loads of the accelerating columns were assembled and leak-tested. The leak rate for assembled flanges (total 164 joints) was tightly controlled to be less than 1.5×10^{-10} Torr-l/s. During the installation, dry nitrogen gas of 1.05 kg/cm² pressure was continuously flushed into the accelerating columns and the assembled waveguide network to avoid the contamination of inner surfaces by the exposure to the atmosphere. Rough pumping of the preinjector linac was performed by a 110 l/s TMP unit. Typically, it took 2.5 hours for roughing ($\sim 1 \times 10^{-5}$ Torr) and approximately 8 hours for the final target vacuum.

The microwave power conditioning for the whole vacuum system was carried out for three days. At 1:00 a.m. of November 29, 1991, the first electron beam reached to the beam analyzing station. The beam energy was about 40 MeV. Since then, the system pressure was maintained by increasing rf power gradually and by beam loading till December 7. At 11:35 of December 7, the beam energy reached 61.2 MeV with the klystron output power of 22.5 MW. At that time, the vacuum pressure was approximately 2.65×10^{-8} Torr in the electron gun, 1×10^{-7} Torr in the accelerating column, 8.90×10^{-8} Torr at the klystron waveguide window and 1.42×10^{-7} Torr in the buncher waveguide system. Figure 1 shows the whole history of the vacuum pressure of the preinjector linac.

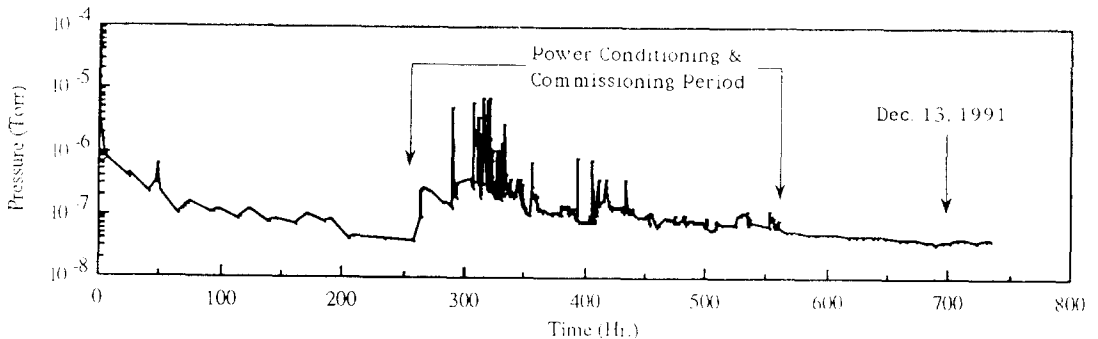


Fig. 1 Vacuum Pressure History of the Preinjector Linac

VI. Conclusion

The vacuum system of the PLS preinjector linac has been installed and commissioned. The system has been working without any trouble. The system pressure has been improved continuously, and now it is approximately 2.63×10^{-9} Torr in the electron gun, 4.15×10^{-8} Torr in the accelerating columns, 7.85×10^{-9} Torr at the klystron waveguide window, and 2.45×10^{-8} Torr in the buncher waveguide system under no rf power and beam loading condition.

Reference

Preinjector Installation Manual, MA/LN-92001, PAL/POSTECH, January 3, 1992