Waveguide Layout and Penetration Waveguide Fabrication for the PEFP 100MeV Accelerator

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1. Introduction

The Proton Engineering Frontier project (PEFP) proton linear accelerator has been developed and will be installed in Gyeong-ju site [1-2]. The 20MeV accelerator has been operated in Korea Atomic Energy Research Institute (KAERI) site [3], and the 100MeV accelerator system has been designed and constructed, which includes the accelerating machines, RF systems, high voltage power supplies, beam line equipments and so on. The waveguide layout was done to install the high power RF (HPRF) systems for the 100MeV accelerator, and the waveguide sections penetrating into the accelerator tunnel were fabricated to the bending structure for the radiation shielding.

2. Waveguide Layout

The specifications of the RF system for the PEFP 100MeV accelerator were summarized in Table 1.

The layout of the HPRF system and waveguide was done to install in Gyeong-ju site. Figure 1 shows the side view and the top view of the waveguide layout to install the HPRF system. The HPRF systems including klystrons, circulators, and waveguide components are installed at the second floor of the klystron gallery, and the accelerator is located in the tunnel. 1MW RF power from the klystron is transmitted to each accelerator in the tunnel through the concrete floor of 2.5m for the radiation shielding. The waveguide sections penetrating into the tunnel were designed to the bending structure for the radiation shielding and the waveguide in the tunnel have the straight section to adjust the waveguide for installation. The gas barriers are inserted for the protection of the circulator and serving barrier from water leakage. Figure 2 and Figure 3 show the waveguide layout for the 3MeV RFQ and the 20MeV DTL respectively. One klystron drives 4 tanks of the 20MeV DTL, so RF power from the klystron is split 4 ways by magic-Ts.

Phase shifters are installed to adjust the initial RF phase, and the waveguide length is determined for in-phase at each tank. Figure 4 shows the waveguide layout for the 100MeV DTL. One RF system drives a DTL tank in 100MeV DTL case.

Table 1: The specifications of the PEFP RF system

Parameter	Specifications
Operating frequency	350MHz
RF power (peak)	1.6MW
RF Duty	9%
Pulse width / rep. rate	1.5ms / 60Hz
Transmission line	WR2300 waveguide
Stability of RF field	±1% in RF amplitude, ±1deg. in RF phase

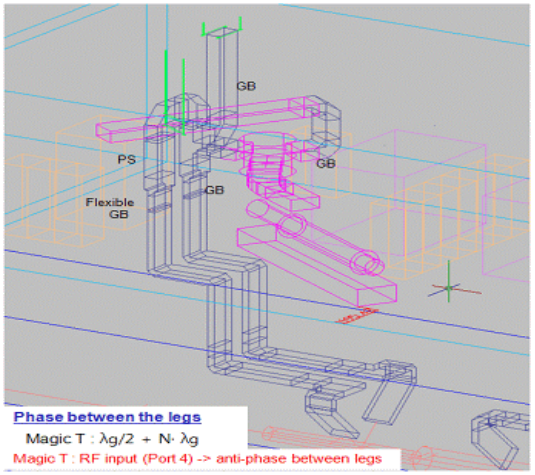

Fig. 2: Waveguide layout for the 3MeV RFQ

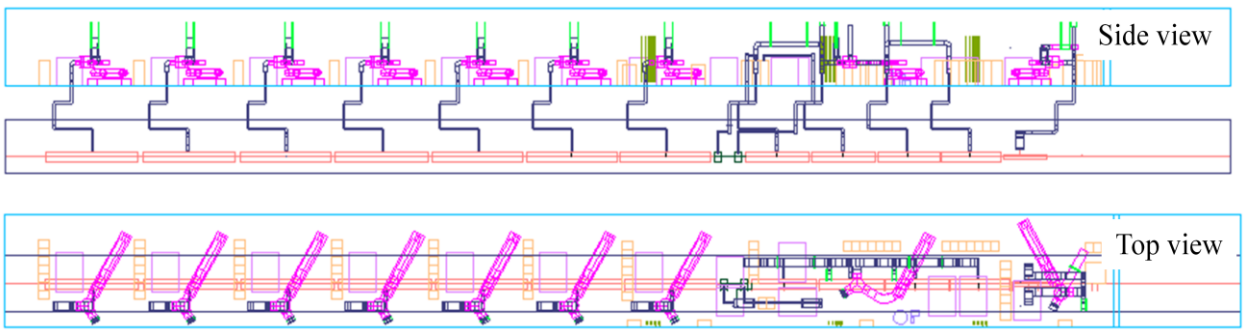

Fig. 1: HPRF system and waveguide layout for the 100MeV accelerator construction

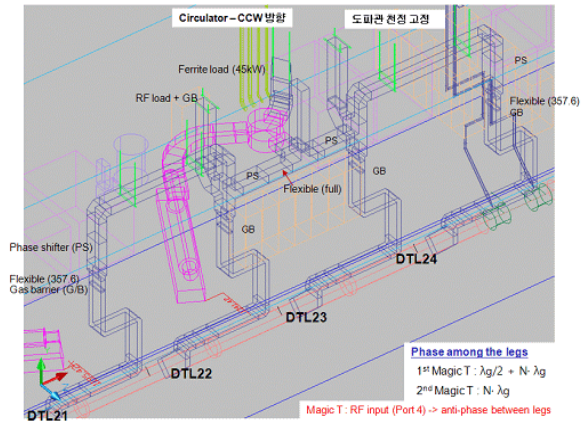

Fig. 3: Waveguide layout for the 20MeV DTL

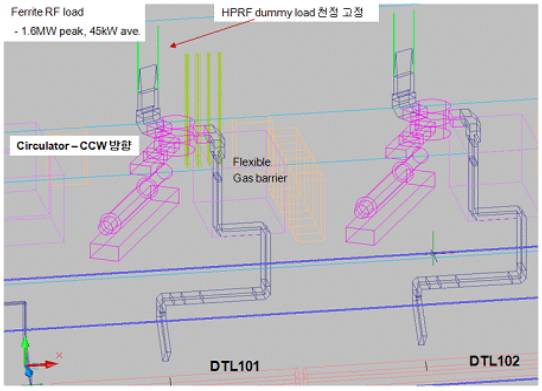

Fig. 4: Waveguide layout for the 100MeV DTL

3. Penetration Waveguide

The waveguide section penetrating into the concrete floor was fabricated to the bending structure of WR2300 half height and was made into a piece of waveguide to prevent the moisture and any foreign debris inside concrete block. Leakage from the penetration waveguide is inspected with the pressure of 0.25 psig. VSWR should be also measured within 1.04. Figure 5 shows the fabricated penetration waveguide, and Figure 6 shows VSWR measurement by using a network analyzer (Agilent, 5071C). The measured VSWR was 1.064.

Fig. 5: The fabricated penetration waveguide

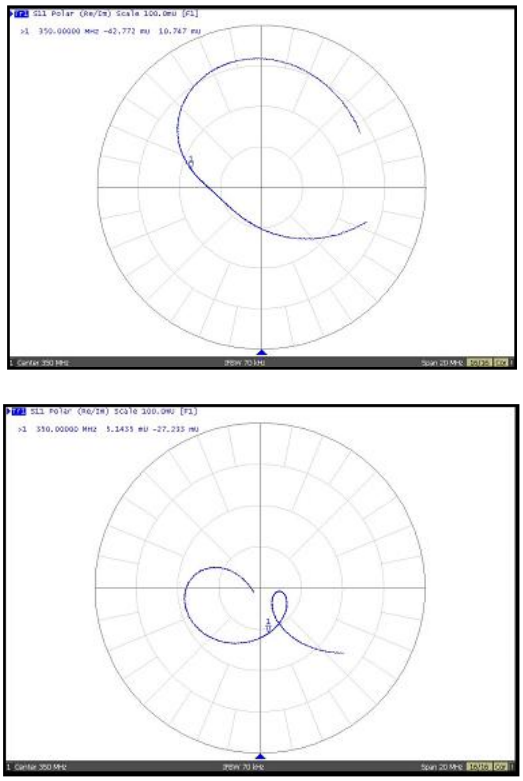

Fig. 6: VSWR measurement for the penetration waveguide section.

4. Summary

The waveguide layout was done to install the 100MeV HPRF system including the 3MeV RFQ, 20MeV DTL, and 100MeV DTL. The RF system is installed at the second floor of the klystron gallery and the 100MeV accelerator is located in the tunnel. The waveguide section penetrating into the concrete floor was fabricated to the bending structure for the radiation shielding and was made into a piece of waveguide to prevent the moisture and any foreign debris inside concrete block. The measured VSWR was 1.064, but it will be correct.

Acknowledgements

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REFERENCES

[1] B. H. Choi, “Status of the Proton Engineering Frontier Project”, Proc. of Particle Accelerator Conference, Knoxville, Tennessee USA, 2005
[2] B. H. Choi, “The Proton Engineering Frontier Project”, Proc. of International Particle Accelerator Conference, Kyoto, Japan, 2010
[3] H. J. Kwon, “Operation of the PEFP 20MeV Proton Linac at KAERI”, Proc. of International Particle Accelerator Conference, Kyoto, Japan, 2010