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Status and test results of the HPRF system for PEFP 20MeV linear accelerator

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1. Introduction

The 100MeV, 20mA proton linear accelerator for PEFP (Proton Engineering Frontier project) is being developed [1][2]. As a low energy accelerator, 3MeV RFQ and 20MeV DTL composed of 4 tanks were constructed. To accelerate 20MeV proton beam, two sets of 1MW, 350MHz RF system are required for each accelerating structure. RF power from 1MW klystron is split into two legs and four legs by magic tee to drive RFQ, DTL tanks respectively. The high power RF system was already installed and has been operated to drive the RFQ and DTL.

2. HPRF system for 3MeV RFQ

The HPRF system for the 3MeV RFQ is summarized in Table 1. The operating frequency is 350MHz and the required RF power is 460kW including the additional loss which originated from the Q-degradation [3]. A 3MeV RFQ has two RF input ports and the RF power from a 1MW klystron is divided into two legs by a magic tee to drive a cavity because of the power limitation of the RF window.

Table 1: HPRF system summary for the 3MeV RFQ

Accelerating structure	**RFQ**
Frequency (MHz)	350
Energy range (MeV)	0.05~3
Beam current (mA)	20
Required RF power (kW)	460
No. of 1MW Klystron (ea.)	1
No. of coupler (ea.)	2

Figure 1. The installed HPRF system for RFQ

The HPRF system for the RFQ was installed as shown in Figure 1, and the klystron was tested up to 600kW in a pulse mode operation. The pulse width and repetition rate are 50μs and 1Hz respectively. The klystron was operated up to 350kW routinely. The forward RF power and cavity's RF power in the HPRF test for the RFQ are shown in Figure 2.

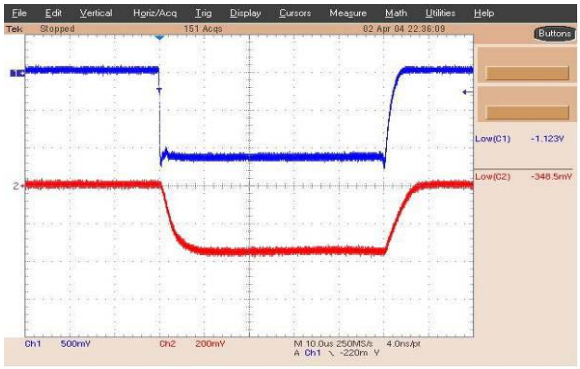

Figure 2: The measured RF signal in the HPRF test for the 3MeV RFQ

3. HPRF system for 20MeV DTL

The HPRF system for the 20MeV DTL is summarized in Table 2. The DTL is composed of 4 independent tanks and driven by a single RF source, which has a feature with regards to the way to control the independent amplitude, phase and resonant frequency of each tank [3]. The RF power from a 1 MW klystron is split into four legs to drive the four tanks of the DTL - that is one RF port per one tank - by magic tees which power balance is less than 1%. Each leg has a phase shifter (+/-22.5°) to adjust the phase of the RF field in each tank [5].

The HPRF system for the DTL was installed as shown in Figure 3, and the klystron was tested up to 800kW in a pulse mode operation. The pulse width and repetition rate are 50μs and 1Hz respectively. The measured RF signal in the RF test is shown in Figure 4.

Table 2 : HPRF system summary for the 20MeV DTL

Accelerating structure	**DTL**
Frequency (MHz)	350
Energy range (MeV)	3~20
Beam current (mA)	20
Required RF power (kW)	895
Tank1	(225)
Tank2	(225)
Tank3	(224)
Tank4	(221)
No. of 1MW Klystron (ea.)	1
No. of coupler (ea.)	4 (1ea./tank)

Figure 3: The installed HPRF system for the DTL

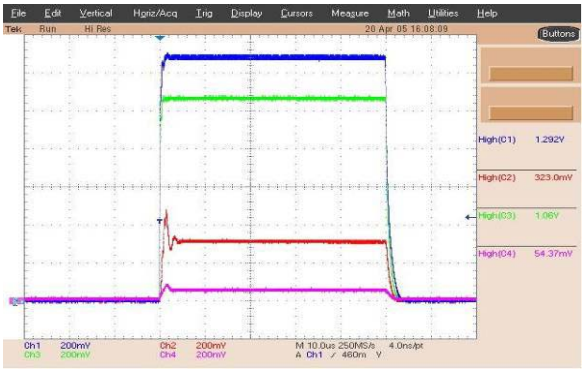

Figure 4: The measured RF signal in HPRF test for the DTL klystron

3. Summary

The high power RF system for the PEFP 20MeV proton accelerator composed of the 3MeV RFQ and the 20MeV DTL has been installed. The klystron for the RFQ was tested up to 600kW and operated routinely to drive the RFQ in a pulse mode operation. The klystron for the DTL which consists of 4 tanks was tested up to 800kW in pulse mode operation. The pulse width and repetition rate was 50μs and 1Hz respectively. The high power RF system has been operated to drive each accelerating structure and will be used to accelerate 20MeV proton beam.

4. 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] Y. S. Cho, et al, “Development of 100MeV Proton Accelerator”, Proc. of XXI International LINAC Conference, Gyeongju, Korea, 2002

[3] Y. S. Cho, et al., “Test Results of the PEFP 3MeV RFQ Upgrade”, Proc. of Particle Accelerator Conference, Knoxville, Tennessee USA, 2005

[4] Han-Sung Kim, et, al., “Initial Test of the PEFP 20MeV DTL”, Proc. of Particle Accelerator Conference, Knoxville, Tennessee USA, 2005

[5] H, J, Kwon, et al, “The RF power delivery system design and its component characterization for PEFP DTL”, Proc. of Particle Accelerator Conference, Portland, Oregon USA, 2003