Survey and Positioning of the 100MeV Linear Accelerator

Bum-Sik Park, Yong-Sub Cho, Hyeok-Jung Kwon, Ji-Ho Jang, Han-Sung Kim, Kyung-Tae Seol, Young-Gi Song, Dae-Il Kim, Sang-Pil Yun, Jin-Yeong Ryu, Sung-Su Cha
Proton Engineering Frontier Project, Project, Korea Atomic Energy Research Institute, Daejeon 305-353, Korea
**Corresponding author: bspark@kaeri.re.kr*

1. Introduction

Proton Engineering Frontier Project(PEFP) [1] is developing a 100MeV high-duty-factor proton linac. The accelerator is composed with a 50keV proton injector, a 3MeV RFQ, DTL tanks and a beam dump. Additionally 10 beamlines are also developing to supply the 20MeV and the 100MeV proton beam for the proton beam application [2-4]. As an installation process, we built the align network and did the survey work with laser trackers. On the basis of the survey result, all of the accelerator components were positioned in the tunnel. In the same time, the 20MeV linear accelerator operated until the end of last year was delivered from the KAERI to Gyeongju site.

2. Survey

2.1 Coordinate System

The align network was installed on the tunnel wall as shown in Fig. 1. The distance between each align network is the 5m for right side and 10m for the left side. The total number of the tunnel networks is 42 and the height of the fixed position is 1.8m.

For the blue line survey, the coordinate system was setup. The vertical axis(+Y) was setup by the NIVEL(Leica co.). The Z axis and the origin were determined by using two permanent references as shown in Fig. 2. These positions are linked to the construction coordinate system. The coordinate system can be extended by using 5 see-through holes from the 1st floor to the 3rd floor.

2.2 Blue Line Survey

Two laser tracker systems were used to lay out the anchor bolt positions of DTL supports as shown in Fig. 3. The temperature of the tunnel was 7°C in the winter because the utility was not operated. The difference in temperature is 20°C compared to the operation condition. So, the thermal expansion rate, 1.2X10-5/°C for the concrete, was considered to determine the anchor bolt positions. Fig. 4 shows the fluctuation of the tunnel floor level. The maximum difference is more than 30mm in the level for the accelerator position. To compensate the floor level error, steel plates which have different thickness were adopted.

Fig. 1. Align networks were installed on the tunnel wall. The distance is 5m and 10m for right side and left side. The height of installed position is 1.8m from the tunnel floor.

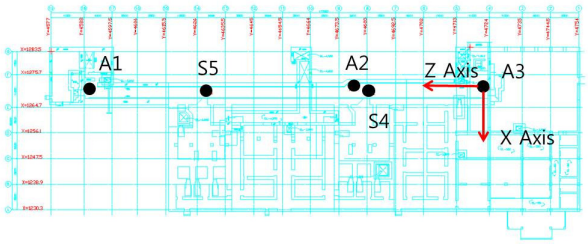

Fig. 2. Coordinate system of the 100MeV proton linac. A3 is the origin and the Z axis was setup by using the coordinate of A1. The coordinates of A1 and A3 are linked with the coordinate system used for the construction.

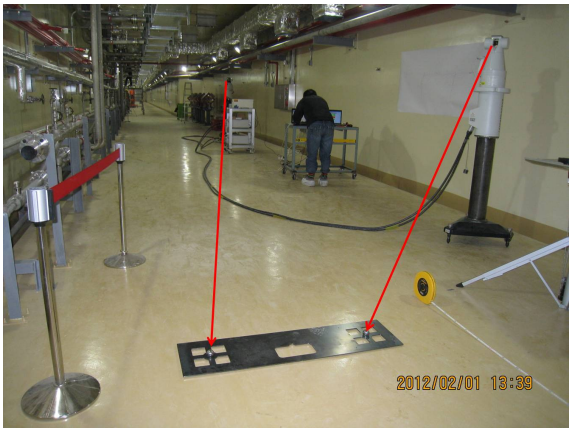

Fig. 3. The anchor postion was determined by using two laser trackers. The jig position can be adjusted in real time monitoring condition.

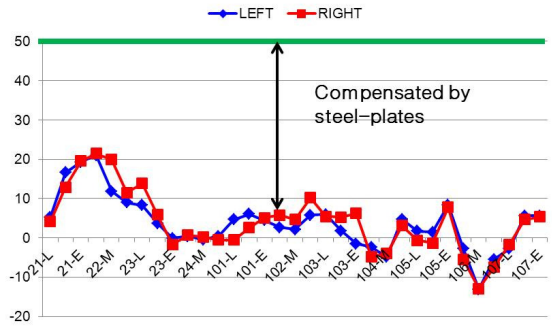

Fig. 4. Floor level for the DTL support position. The deviation was compensated by using steel-plate which has the various thickness.

3. Positioning of the 100MeV Linac

3.1 Delivery of the 20MeV Linac

The 20MeV linac was operated in the KAERI site until the end of last year . It was delivered from Daejeon to Gyeongju site. It is about 220km away by the freeway. The accelerator components were delivered by using the vibration-free vehicle.

3.2 Installation of the 100MeV Linac in the Tunnel

After the blue line survey, anchor bolts were installed for each support. Since there is no crane in the tunnel and the path is narrow, we make rollers and carriers to install the heavy components as shown in Fig. 5. Fig. 6 shows the 100MeV linac positioned in the accelerator tunnel.

Fig. 5. DTL tanks were moved from the assembly area to the tunnel. Carriers and rollers were used.

Fig. 6. 100MeV proton linear accelerator positioned in the tunnel from the injector to the beam dump.

3. Conclusions

The installation of the 100MeV linac is underway. All of accelerator components were positioned through the blue line survey work. Beamlines and RF systems are also being installed. The beam commissioning will start in November 2012.

Acknowledgment

This work was supported by Ministry of Education, Science and Technology of the Korean Government.

REFERENCES

[1] K. Y. Kim, Y. S. Cho, J. Y. Kim, K. R. Kim, and B. H. Choi, The Proton Engineering Frontier Project: Accelerator Development, Journal of Korea Physical Society, Vol.56, p.1936, 2010.
[2] J. H. Jang, Y. S. Cho, H. J. Kwon, Ky Kim, Y. H. Kim, "Design of the PEFP 100MeV Linac", Proceedings of LINAC 2006, Knoxville, Tennessee USA, p. 130, 2006.
[3] Y. S. Cho, H. M. Choi, S. H. Jan, I. S. Hong, J. H. Jang, H. S. Kim, K. Y. Kim, Y. H. Kim, H. J. Kwon, "Development of PEFP 20MeV Proton Accelerator", Proceedings of EPAC 2006, Edindurgh, Scotland, p. 1609, 2006.
[4] In-Seok Hong, et al., "Conceptual Design of the PEFP Beam Line", EPAC'08, Genoa, Italy, 2008