THE MACHINE PROTECTION SYSTEM FOR THE INJECTOR II

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Abstract

The IMP takes the responsibility for the development of Injector II. The target energy index of it is 25Mev, which is an intense beam proton accelerator with high operation risk. In order to implement cutting the ion source beam in time when the beam position offset happened, the Injector II Machine Protection System is developed based on FPGA controller and PLC. This system aims to prevent device damage from continuous impact of intense beam, as well as obtains and stores status data of key devices when failures occur to implement failure location and analysis. The whole system is now operating stable in field, and the beam cutting time is less than 10μs.

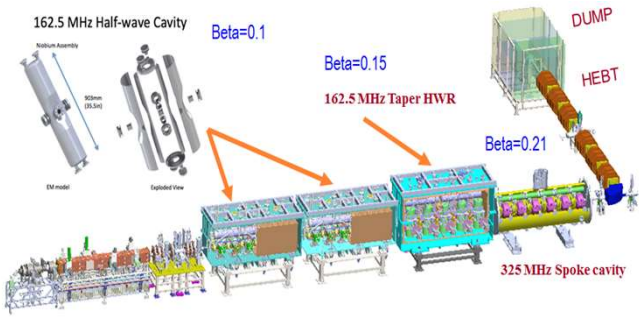

Fig. 1 The Injector II proton linear accelerator

1 Introduction

The ADS injector II is a Chinese Academy of Sciences pilot special linear accelerator pre-research device. Its acceleration chamber (Fig.1) mainly consists of an RFQ accelerating chamber and four CM superconducting cavities. CM1 and CM2 were installed with six HWR010 cavities respectively, CM3 was installed with five HWR015 cavities, and CM4 was installed with six SPOKE021 cavities provided by the Institute of High Energy Physics Chinese Academy of Sciences. The final beam energy (acceleration value) of the injector II proton linear accelerator is 25MeV.

2 Overall structure of the MPS

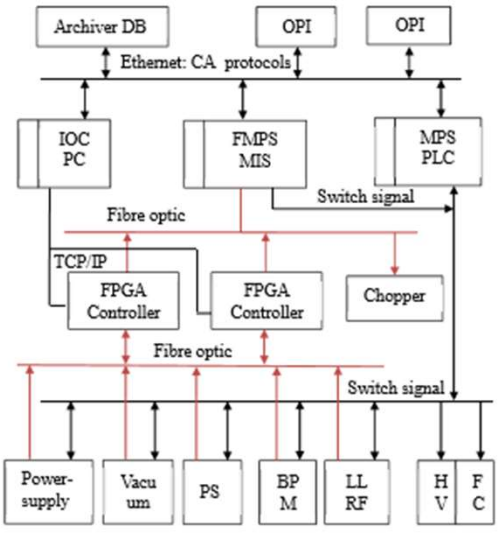

Fig. 2 Injector II MPS structure diagram

The injector II machine protection system (Fig.2) is based on the FPGA control board and the PLC device, and can achieve the system response time at a μs-level from the FPGA controller and ms-level from PLC system for the control protection respectively.

3 Key hardware module

Fig. 3 Front-end FPGA control board and optical signal transceiver module.

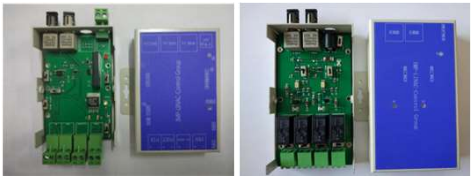

Fig.4 Left:The photoelectric conversion module on the device side is mainly used to interconnect the signal between the low level equipment and the front-end FPGA controller.

Fig.4 Right: The relay module is used to convert the optical signal to the switching signal.

As shown in Fig. 5, the Machine Interlock System (MIS) is a set of interlocking protection systems jointly developed by the Shanghai Institute of Applied Physics of Chinese Academy of Sciences and the Cosylab Corporation. The purpose of MIS is to provide a secure, reliable and fast response interlock protection system for the accelerator.

Fig. 5 MIS crate and function module

4 Conclusion

In May 2017, the 25 MeV superconducting linear accelerator (ECR+LEBT+RFQ+MEBT+4CM) completed the construction and started pulse commissioning. The 26Mev pulsed beam commissioning was successful on June 5th, 2017 and on next day - June 6th, 2017, 25MeV continuous beam commissioning was successful as well. During the above beam commissioning process, the MPS system has been demonstrate to be stable and reliable.