

# HI-13 TANDEM ACCELERATOR RADIATION PROTECTION SYSTEM

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## Abstract

After more than 20 year's operation, the radiation protection system of HI-13 Tandem Accelerator laboratory needs to be upgraded in order to provide for higher personnel protection reliability, more convenience of worker's operations and farther display integrity of the working states. This new radiation protection system compose of seven protective doors control units and seven emergency door-open buttons , 23 groups of states indicators, 17 groups of alarms, 17 groups of workshop-empty units , L.E Faraday cup and IMAG Faraday cup, as well as computer control and display system based on PLC.

Pre-empty section is prerequisite before close the protective doors to ensure nobody be exposed irradiation environment otherwise the door-open would be disabled. Even thought somebody left, pushing nearby alarm button and inner emergency door-open button will induce glittery signal and simultaneous door-opening. L.E Faraday cup and IMAG Faraday cup execute immediate beam interruption once accident occurred. The enough distributed indicators indicate the real time states of all the work fields. All the above devices and units are interlocked follow some complex but logical protective rules. In addition, computer workstation is built supported by radiation protective programs. Accordingly, after full information and operation action signals are collected and transferred to it, this computer workstation can complete full-sides status monitoring and provide convenient control and display interfaces as well as pop adequate prompt frames.

## PROJECT BACK GROUND

The radiation protection system of HI-13 Tandem Accelerator laboratory had served more than 20 year's since it was built in 1987. New injector system and high resolution AMS system completed in 2006 request this system providing with higher personnel protection reliability, more convenience of worker's operations and farther display integrity of the working states.

## UPGRADE

Now a computer workstation is built supported by radiation protective programs. Accordingly, after full information and operation action signals are collected and transferred to it, this computer workstation can complete full-sides status monitoring and provide convenient control and display interfaces as well as pop adequate prompt frames. As shown as Fig 2. This new radiation protection system compose of seven protective doors control units and seven emergency door-open buttons , 23 groups of states indicators, 17 groups of alarms, 17 groups of workshop-empty units , L.E Faraday cup and IMAG Faraday cup, as well as computer control and display system based on SIEMENS PLC.

In a main work interface enough distributed indicators indicate the real time states of all the work fields. In addition, the Faraday cups, protection doors and alarm buttons are interlocked follow some complex but logical protective rules which ensure the safe-guarantee functions.

## PROTECTIVE RULES

- Injector system for pre-accelerated voltage has up to 300kV, high voltage generation warning and door opened warning are installed outside the HV protection fence in order to avoid the electro-shocked risk. Opening of the fence will lead to shut down the HV power supply.
- Pre-empty of the work region is requisite before close all the protective doors and it ensure nobody be exposed irradiation environment. In the empty procedure, 17 groups of empty buttons installed on the wall along the in-out path must be pushed in set sequence otherwise the door-close would be disabled.
- Even thought somebody left, pushing nearby alarm button and inner emergency door-open button will induce glittery signal and simultaneous door-opening. line and interrupt the beam.
- L.E Faraday cup and IMAG Faraday cup execute immediate beam interruption once any accident occurred, for example: illegal access of the work region .
- A key is necessary to get the authority of going into the work region .

## IMPROVED REGULATION

Considering sometimes working inside the work region is necessary, three unlock states is set , which are HV unlock, beam accelerated unlock and high radiation unlock. HV unlock is used for observing discharge or un-normal phenomena in the tank. With beam accelerated unlock and high radiation unlock, researchers can open the protection door without interrupted the beam. For radiation dangerous will exposed on the unlock state, only permitted operator with licence can unlock the interlock.

In original protection system, accelerator's complete shutting down will happened once any illegal operation occur , for example an illegal protection door-opening. However, the system's restart need pretty long time. In new protection system, Faraday cup extending in the beam tube is accept as an priority method to shut off the beam and with this replacement, the tandem accelerator is only be the last standby method to stop the beam transfer.

## CONCLUSION

The HI-13 Tandem Accelerator Radiation Protection System is into operation for 3years. Complied with particular operation regulations, the protection system fully reach to the purpose of reliable personnel protection.