

# THE UPGRADE PROJECT OF THE BEIJING ELECTRON POSITRON COLLIDER'S (BEPCII) PERSONNEL SECURITY INTERLOCK ENTRANCE GUARD SYSTEM

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## *Abstract*

The upgrade project of the Beijing Electron Positron Collider's (BEPCII) personnel security interlock entrance guard system is set up based on the Beijing Electron Positron Collider's (BEPC) personnel security interlock system. By establishing personnel security interlock entrance guard system of the BEPCII, this article introduces the system design principia, and describes the means to implement some functions such as patrol ID card, passes in and out with staff ID card, zero count interlock, departure confirmation, dose interlock (personnel staff dose interlock, tunnel dose interlock), the image that personnel staff pass in and out is shoot the writing, language broadcasting and the lamplight blink is prompted, the LED displays releasing against message, acquisition tunnel personnel staff signal, for electronic publication at these conference series.

## INTERLOCK REGION DIVISION

With the many years running experience and requirements of the BEPCII, the interlock region of the accelerator is divided into four regions: the linac, the nuclear physics experiment hall, the store ring accelerator and the synchrocyclotron radialization experiment hall. And entrance guard system is established on the based of the former system.

## SYSTEM DESIGN PRINCIPLE

### *Optimized switch off*

When designing the system, we must firstly take it into account that the accelerator must stop whenever the door of interlock region open and close. It means that the door signals interlock with the synchronization trigger in the linac, when doors open, synchronization trigger disables, and the linac stops; the signals of the nuclear physics experiment hall interlocks with the trigger of the bend magnet at the end of the linac; the bend magnet trigger disables when doors open; the signals of store ring accelerator doors interlock with the RF trigger, when doors open, the RF trigger disables, the storage ring accelerator stops. The signals of synchrotron radiation experiment hall's door interlocks with injecting trigger. When doors open, beam injection trigger disables.

### *Invalidation protection*

The principle of "invalidation protection" has been sufficiently considered when the system is designed. Entrance guard system adopts separatory and centralized intelligent system construction, every security interlock

door is an intelligent system which could work independently, and is equipped with spare bells. All security interlock doors are connected to the computer center through ring topology.

### *Redundance*

Considering that the main function of entrance guard system is to manage and control the personnel passing in and out, and take part in the interlock control, the system must have some degree of redundance. For example, the host computer use double machine working together mode, once the host computer appears problems when running the double-machine working mode, the hypotaxis computer would work with the host computer mode automatically.

## PERSONAL SECURITY INTERLOCK DOOR SYSTEM COMPOSING

### *Entrance guard system composing*

PLC is the key tech of the BEPC personal security interlock system. While BEPCII personal security interlock system still keeps this part, then introduces automatic door technique, and sets up the personal security interlock door-prohibit system, at the meantime it consummates the security interlock measures. Here we mainly introduce entrance guard system, i.e. BEPCII personal security interlock system.

BEPCII personal security interlock door-prohibit system consists of automatize door, entrance guard control unit, indoor/outdoor inductive card reader, point-control lock, door magnistor, go in/out emergent button, voice and light prompt, photography snatch record, LED display, leaving affirm, dose interlock, person moving detector, central computer etc.

### *Door locale control unit*

- Security interlock door

The Security interlock door is used for working staff in and out the accelerator interlock region, at the time of normal operating, the security interlock door is allowed to be used. The security interlock door interlocks with the accelerator, when once the door opened, the accelerator must be stopped. The security interlock doors connect networks with card readers, card reading control unit and entrance guard system.

- Equipment door

The equipment door is used for large-sized equipments passing in and out at the time of stopping and overhauling

machine. When the accelerator working normally, this door is closed and disallows to use. Even so, the door should be included under entrance guard system's specting inspection. That is to say once the door is opened, the entrance guard system will send out the light and voice warning signal and inform the central computer when the accelerator is in the state of running. There is personal moving detector in the equipment door, as soon as somebody enters the equipment door, the accelerator will be down.

- Entrance guard control unit

Entrance guard control unit is the control core of the locale control unit, which connects other locale control units. It answers for checking up cards information, inspecting the state of the open doors, inspecting the state of emergent in-and- out door button, driving electrical control lock action, creating many kinds of in and out events information etc

- Inductive card reader

Inductive card readers employ 32 bit RF inductive cards, and have fine anti-jamming ability. For the different purposes, the cards include work cards, equipment cards, visit cards and currency cards etc. only the cards accredited could take effect. The computer management system can set up in and out right for every cards, prohibit the person who hold the unaccredited cards. In and out right should include period of validity, employ times, the time of validity etc .

- Electrical control lock

Electrical control lock is local executing executive unit, which completes the operation of discharge and decline personnel in and out.

- Door magnistor

Door magnistor is used to inspect the door state of open and close, Entrance guard control unit can produce two alarm events: "illegally open door" and "door not close in fixed time" by inspecting its opening state. Door magnistor switch signal has two way: one is given to PLC, the other is given to entrance guard system.

- Emergency button

Emergent button(indoor/outdoor emergent button, emergent button) uses crashing glass form. In emergent cases, it can stop the machine by breaking the class with hands. Emergent button is used in the special cases, such as fire, flood etc.

- Photography snatch record

To enforce the inspect power of entrance guard system, we add the digital photography record system. Camera is set above the interlock, and snatches the records of the personnel brushing cards in and out.

### *Other interlock units*

- Leaving confirmation units

The system sets the unit "leaving tunnel confirm" at the main passageway out of the accelerator interlock region

and at every control rooms' doors. Only the leaving affirmation is accepted, it affirms that the person has left the interlock region, and the accelerator could then start-up .

The purpose of unit "leaving tunnel affirm" is to force the staff to leave the interlock region in the physics space after affirmed the leaving, then the accelerator could run. It is ensured that there is nobody in the interlock regions when the accelerator starts working.

- Patrol and clear field

The clear field refers to the process that before the accelerator works, the personnel enter the accelerator interlock region to check whether there is anybody stayed in. If there is, the personnel brings them out of the interlock region.

Patrol and clear field use the card readers set inboard the security interlock door as the identification unit of "clear field route" ahead of operation. With setting the software, the personnel should clear the route in terms of the setting route before the machine works, and after the clear is over, the accelerator can start-up. This function is able to force the patrol personnel to reach all the passage doors to ensure them closed, which could guarantee the "clear field" and the "clear over" ahead of operation.

- Person moving detector

Person moving detector is set in the interlock region (inside the accelerator tunnel), which has three kinds of functions: the first is able to orientate the position of the personnel in the interlock region; the second is to alarm when the person go into the interlock region without brushing card; the third is to stop the accelerator when it finds somebody moving at the machine work time.

- Individual dose interlock unit

Individual dose interlock unit is a independent individual dose computer management system. The system is joint with the entrance guard interlock system, and the personnel's individual dose is periodically input in the system. Entrance guard system can automatically contrast the personnel who brush card and enter the interlock region with his individual dose value, and prohibit the personnel entering who exceed the limited annual standard dose.

- Voice and light prompt and LED display unit

All security interlock automatize doors have voice and light prompt unit. When the card is brushed, besides notifying the personal name, the voice broadcast can offer the different voice prompt, such as " you have entered the linac interlock region, please put on the dose card, and attention to safty" etc. If the security interlock door is not closed, the alarm light glitters until the door closes. In addition, there are LED display units in every control room, at the main passageway, above the security interlock door, which can display the running state (preparing, working, stopping), the number and names of staff in the interlock region, and issue the information needed.

## THE MAIN FUNCTIONS OF THE ENTRANCE GUARD SYSTEM

The Main functions of the entrance guard system are as follows:

- (1) To repeat broadcasting before start-up.
- (2) To clear field.
- (3) When the accelerator is in “ready” state, the alarm system in the interlock region starts to work and to remind the personnel to leave the accelerator tunnel immediately by the means voice and light; all the security interlock doors close, and the personnel can not come in, i.e. the personnel can only come out but not come in with brushing card.
- (4) When the accelerator is in “work” state, the security interlock doors are opened only
- (5) When the accelerator is at the “stop” state, it is useful(valid) to brush the inductive cards.
- (6) The signal of the security interlock door, the signal of the security button in the tunnel, the signal of entrance guard system ready(including the signal of the personnel number and the signal of the urgency button for in/out door etc ) can directly interlock with the accelerator by the PLC.
- (7) The emergency stopping button in the tunnel. There are emergency stopping button units at notable places of the tunnel every other some distance, which is used for emergency events. When the button is pressed, the accelerator is stopped, and the entrance guard system opens the security interlock doors related to the interlock

region by telecontrol, and at the same time, it is permitted to come in by brushing cards.

(8) The interlock function of the personnel’s “zero count “ in the accelerator tunnel. The entrance guard system can automatically count the personnel who come in/out the interlock region, and interlock with the accelerator with the counting result. When the result is not zero, the accelerator can not work., even if all the security interlock doors have been closed and all personnel have left the tunnel with leaving affirmation except one., but only one have not carry the leaving affirm, the accelerator could not start-up.

(9) The function of “ leaving the interlock region affirm” . When the card holder brushes the card on the “leaving affirm” unit which is out of the interlock region, he is really considered to leave the interlock region. The accredited work card holders can enter the prescribed right door, and go out of the nearest door by brushing cards and make the leaving affirm at any “leaving affirm” place with brushing cards.

(10) The other security interlock units are the LED display, the voice and light clue, the photography snatch at main entrances, the individual dose interlock, the body inspector in the tunnel, the double backup etc.

## CONCLUSION

The security interlock entrance guard system was set up in Oct. 2002, and has been running well. The whole system reach the design specification.