The ESRF Accelerator Facility Personnel Safety System.

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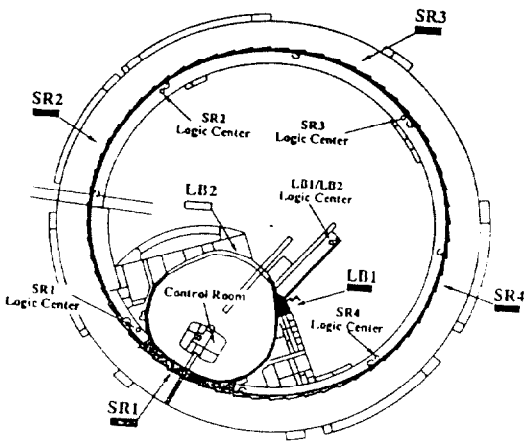
Abstract

The personnel safety system designed for the ESRF accelerator facility is a unified system covering the three accelerators (linac, booster synchrotron and storage ring) and the two transfer lines. The system, built and installed by NE Technology, uses the dual guardline interlock module, developed at SERC Daresbury Laboratory for the SRS. It is, therefore, a redundant, hardwired system completely independent of the machine control system, although comprehensive monitoring of the system status via the computer interface is a feature.

1. INTRODUCTION

The ESRF accelerator facility's personnel safety system defines safe operating conditions and then authorizes the operation of the three accelerators and two transferlines by presenting "permit to operate" interlocks to the accelerator facility.

Figure 1: General layout of the system.



The system is based on the dual guardline interlock module, developed at Daresbury Laboratory for the SRS personnel safety system. All details of the system's design are described in ref. [1]. The safety system is a redundant relay based system. The system's redundancy is maintained from the interlock inputs (e.g. double contact emergency buttons, two independent door contacts per door, ...) through the dual guardline logic up to the interlocked accelerator components (two interlock contacts per item, two vital parameters per accelerator, e.g. electron gun and RF power for the linac).

The different logic elements of the safety system are grouped into five so called logic centers. The LB1/LB2 logic center, incorporating three logic crates, provides the necessary elements for the linac, transferline 1 and booster operation. The SR1 center, equally including three logic crates, provides the elements for the area interlocks for the SR1 area, and the logic for the transferline 2 and storage ring permits. Finally, three identical logic centers, each having one logic crate deal with the area interlocks for SR2, SR3 and SR4 respectively.

Although the safety system functions independently of the computer control system, all logic centers are linked via a RS422 interface to a VME computer, which is connected to the general Ethernet network. Comprehensive monitoring of the system in the central control room is provided in this way. This VME interface is also used to transmit the necessary commands to the safety system, such as initiating a search, setting an area in controlled access, etc.

2. MODES OF OPERATION

The accelerator tunnels include six different areas, separated from each other by interlocked firedoors. The following modes of operation are defined by the safety system, via a system of beammode keys in the central control room:

Linac only mode

This mode allows the operation of the linac without injection in the booster (the permit for the booster injection pulsed magnets is not raised). The areas LB1 and LB2 must be searched and interlocked in this mode. In this mode, linac operation is interlocked to radiation monitors inside SR1.

Linac and booster mode

This mode allows the operation of the linac and the booster without injection into the storage ring. The areas LB1, LB2 and SR1 must be searched and interlocked in this

mode. Machine operation is interlocked to radiation monitors inside SR2.

Filling mode

This mode allows the filling of the storage ring. All areas must be searched and interlocked and the safety shutters in the front ends must be closed.

Stable stored beam mode

When a stable stored beam in the storage ring is obtained, the safety shutters can be opened. If the linac and booster are switched off, access into the areas LB1 and LB2 is possible. The storage ring operation is in that case interlocked to radiation monitors inside these two areas.

3. CONTROLLED ACCESS FACILITY

Each of the six areas is equipped with a controlled access facility. A person wanting to enter the tunnel must use a magnetic card reader which is installed next to the chicane door. The card reader system only serves to identify the person and check whether he is allowed to enter (via the 6 digit PIN code on the magnetic card). If the request is accepted, the card reader system provides the contact to the personnel safety system and the access control is then based on a safety key system. The doors can only be opened by removing a safety key which is directly interlocked into the logic chain, thus giving the permits for the corresponding accelerator. Therefore, every person entering the tunnel in controlled access has such a safety key with him, and, as long as one key is missing on the key pannel, the accelerator's permit cannot be raised again.

4. RADIATION MONITORING SYSTEM

A number of radiation monitors are installed in the rooms adjacent to the accelerator tunnels. The monitors used are high pressure ion chambers for gammas and high sensitivity BF3 counters for neutrons. Note that the storage ring operation is not interlocked to these radiation monitors. Detecting an accidental beam dump in the storage ring is indeed of no use, since the radiation hazard will cease in a very short time with all the stored beam lost. Therefore, only the linac is interlocked to these monitors because this is the only source which can sustain a continuous loss of electrons. The only exception to this rule are the radiation monitors inside LB1 and LB2 during access in these areas with a stable stored beam in the storage ring.

1.The Daresbury Personnel Safety System by D.E.Poole and T.Ring, SERC Daresbury laboratory