PROGRESS ON THE UPGRADE OF THE CYCLOTRON RADIATION SAFETY SYSTEM

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During the past fourteen years the NSCL radiation safety system employed a conventional programmable logic controller (SquareD SyMax Model 400) and off-the-shelf microswitches. The system monitored the states of accelerator and experimental vault interlock switches and radiation detector relays, and provided a programmable platform for safety logic. The system issued appropriate signals to the cyclotron rf programmable logic controller and several rf power supplies. We are in the process of updating the radiation safety system to include more redundancy and components having safety-specific design and function. Our progress is outlined below.

The programmable logic controller has been replaced by a Pilz Model PSS 3100 programmable safety system [1]. This system has a failsafe section, which is triply redundant, that is, the failsafe section uses three voting processors from different manufactures to analyze signals and logic conditions. It also has a standard section, which may be utilized as a standard PLC. The PSS system was initially installed for K500 commissioning, and has now been expanded to the K1200 personnel access interlocks and neutron monitor relays using decentralized I/O modules. Each of these modules contains eight inputs and eight outputs, with two test-pulse outputs. The decentralized I/O communicates with the PSS 3100 using SafetyBus-p [1], an open bus system design for the serial transmission of safety—related information. The safety processor and decentralized I/O modules provide monitored pulse trains to selected functions considered high-risk, such as door switches, rf bypass functions, emergency stops, and ion source injection line beam stops. I/O failures, open or shorted switch contacts or cables are detected by the processor, which halts its process in a known way. Safety to Category 4 as per EN 954-1 [2] is achieved for these devices.

All interlock switches were replaced by ones designed for safety applications, for example, positive-break contact key switches with redundant contacts and positive-mode mounting where possible.

The PSS system will be expanded to include safety devices in the A1900, Transfer Hall, and experimental vault areas. We will use newly available DI16 modules, which are distributed input modules similar to the DI8O8 modules, but have 16 inputs. They will be connected into the system using the SafetyBus-p bus.

Six new neutron area monitors were purchased and installed for K500 cyclotron and coupling line commissioning. The detectors, Eberline model SWENDI-II s [2], are ^{3}He-filled tubes moderated by polyethylene and tungsten, providing dose response for up to 40 MeV neutrons. The control boxes are connected in a local Ethernet LAN so that dose rate displays are available at server and client computers. It is planned to purchase control boxes for the existing NSCL BF3 neutron detectors.

References

1. Pilz Automation Safety L.P., Pilz North American Headquarters, 24850 Drake Rd., Farmington Hills, MI 48335.

2. European Standard EN 954-1: Safety of Machinery — Safety-related Parts of Control Systems Part 1: Design of Control Systems.

3. Eberline Instruments, 504 Airport Road, Santa Fe, NM 87505.