

Procedures to complement Safety Instrumented Systems, and mitigate the human factors, around CERN beam facilities

Thursday, 21 September 2017 10:00 (25 minutes)

The main Safety Instrumented System (SIS) around particle accelerators at CERN is the Personnel Protection System (PPS), but not all of the hazards can be mitigated by the PPS itself. Several dedicated safety systems are also in use, such as fire detection and fire fighting, gas detection, laser protection, access control, etc.

The PPS is designed to address and mitigates the main risks identified during the risk analysis. These are usually ionizing radiation (from beam and from accelerating devices), non-ionizing radiation (RF field and class 4 lasers), electrical (from any powered equipment of which insulation does not correspond to standards), and mechanical (remote-controlled movement of robots or heavy equipment). The basic principles of a PPS are: 1) If risk is present nobody can be present or access (alarms and access safety system) and 2) If someone is present (including by intrusion), the hazards must be turned-off (interlocks).

The factors influencing the functionality of a SIS can be classified in 4 classes: engineering, maintenance, operation and environment. Human factors are present in these 4 classes and must be mitigated by procedures. Example concerning the PPS are: maintenance procedures for each equipment groups responsible of sub-systems integrated in the safety systems, management of functions by-passing and the corresponding compensatory measures, operation procedures, training of any intervening personnel, emergency procedures. In case of the PPS at CERN, procedures include the validation by an independent safety officer (known as the “DSO tests at CERN”). Moreover, one must guaranty that degraded modes are (automatically) detected, and that compensatory measures are applied whenever any SIS is in degraded mode.

In addition, not all of the risks can be covered by SIS, and operational procedures to mitigate these risks are multiple: radiation-protection sweep before access, patrolling hazardous areas before closing, safety inspections, flammable gas management, check lists (“safety permits”) prior to some operations.

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Track Classification: Continuous improvement in HSE matters