Overview of the Machine Protection System

Goals
- Controlling the operating range
- Limiting health increase resulting from the beam power inside the machine devices
- Minimizing radiations (function not addressed in this paper)

Architecture
Many types of device act upstream the system: failure detectors, vacuum losses, beam diagnostics... MPS system reacts on the beam by decreasing the beam duty cycle (ECSF) and by inserting an ad hoc beam stop. MPS system is composed of:
- PLC interlock: triggers slow beam cut and controls operating range
- Fast electronic protection system: triggers fast beam cut and warn PLC interlock
- Command Control System: provides HMI, operating alarms, archiving, threshold management

Machine Protection System HMI
"MPS" HMI lets operators and accelerator engineers monitor MPS states, alarms and tune some beam losses thresholds.

Thresholds
For each diagnostic used in the MPS context a threshold management subsystem will be implemented either inside the device’s electronic or in a separate electronic card.

When the threshold is exceeded an alarm is issued to the fast electronic protection system (Figure 2). The latter should decide to cut off beam.

The functions about threshold management are listed under mentioned:
- Complete thresholds offline
- Apply threshold
- Modify some threshold online
- Verify threshold

Conclusion and next steps
- Many people involved
- Current step: Consolidating requirements
- Next step: Deweave with system should implement which function and catch links and dependencies between subsystems
- Still a lot of work to do before implementing

Beam Power Raise
Guides operators for raising progressively the beam power. Steps are given by a 3D matrix, the 3 axes are:
- Machine Path: From the source to an ad hoc beam stop, corresponding to the beam power level
- Beam Power Mode: 300W, 3kW, 25kW, 5.6kW... 200kW
- Beam Type: Deuteron, proton, H2+, H3 1+, heavy ion...

PLC Interlock is in charge of checking the machine status and condition.

Method and tools
Method
- Use UML Diagrams (principally 7 of them)
- Help to formalize requirements
- Help to formalize documentation

Steps
- Identify use case
- Make a mockup
- Specify navigation
- Specify interaction between actors and system (view as a black box)
- Specify interaction between component of the system (white box)
- Determined object and interaction between object
- Without implementation choices
- Add implementation choices
- Coding

VP UML
- Case tools support UML, SysML, FR diagram (database modeling)
- Roundtrip with JAVA
- Roundtrip with database
- Powerful integration between diagrams
- Generate documentation

See also
POSTER OF C. BERTHE ET AL, "MACHINE PROTECTION SYSTEM FOR THE SPIRAL2 FACILITY", THIS CONFERENCE.