

Abstract

The reliable protection of the ESS equipment is important for the success of the project. This requires multiple systems and subsystems to perform the required protection functions that prevent undesired hazardous events. The complexity of the machine, the different technical challenges and the intrinsic organisational difficulties for an in-kind project like ESS impose serious challenges to the distributed Machine Protection strategy. In this contribution, the difficulties and adopted solutions are described to exemplify the technical challenges encountered in the process.

Machine Protection at ESS



Increase operational availability by avoiding the escalation of events that lead to beam induced damage.

MP as a convergence of disciplines

Design and deploying a complex, very fast and reliable system while:

- Operational behaviour of the systems is not clear.
- Parts of the machine are under design in different laboratories in Europe.
- Changes in scope, schedule and cost.

Solutions adopted:

- Main requirements that define MP systems have been considered to be as good as reasonably possible.
- Continuous discussions with the responsible people to guide the design towards a solution.
- Integrated top-down analysis of damage events
- Use Case Workshops to evaluate the expected functionality.

Interfaces between MP-related systems

To make interfaces easier and consistent all over the facility:

- Standardisation in FPGA processing boards with a standard interface with the BIS .
- Standardized PLCs allowing for such standardised interface.
- Standardization in connectors and cables connected in between these logic systems.
- The fast part of the BIS has the possibility of replacing mezzanine cards in a signal conversion board to allow the connection of different types of signals and connectors.
- Interfaces definition defined in the Interface Control Documents.

Risk management

No available standard method for MP to analyse and evaluate the hazards, damaging events, consequences and protection functions.

A new method was developed taking safety standards IEC 61508 and IEC 61511 together with risk management standards ISO 31000 and ISO 16085.

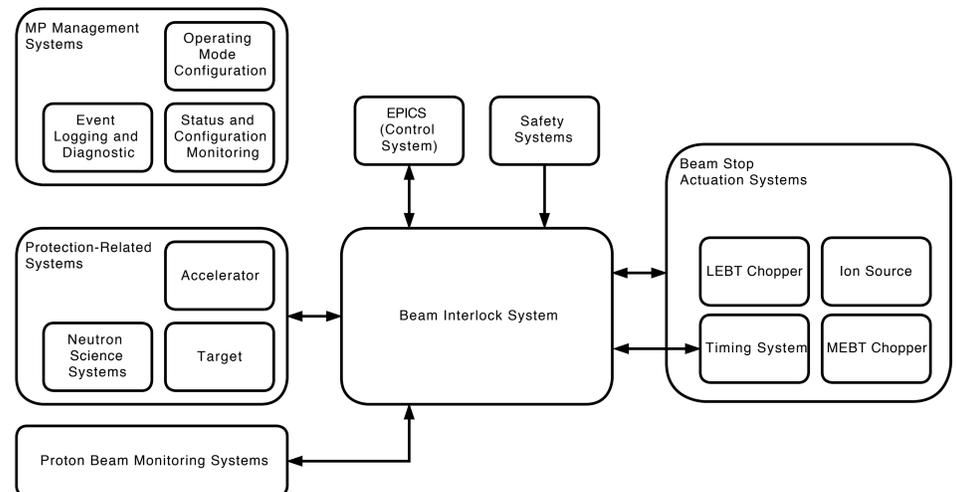


Figure 1: Machine protection System of Systems and the relation between the different entities

Local versus global protection

The protection of the machine occurs at three different levels at ESS:

Component level: the manufacturer or group building it takes care of its protection. E.g. electronic boards, power supplies.

In between elements: This protection generally involves direct relationship between components in form of services and connections. In these cases, the elements usually belong to the same system and therefore they are the responsibility of the system owner. The protection functions involved in this category are called Local Protection Functions.

In between systems: These functions usually cover beam damage events and they require stopping the beam operation to bring the machine back to a protected state. These functions are called Global Protection Functions and the ESS MP group is in charge of them.

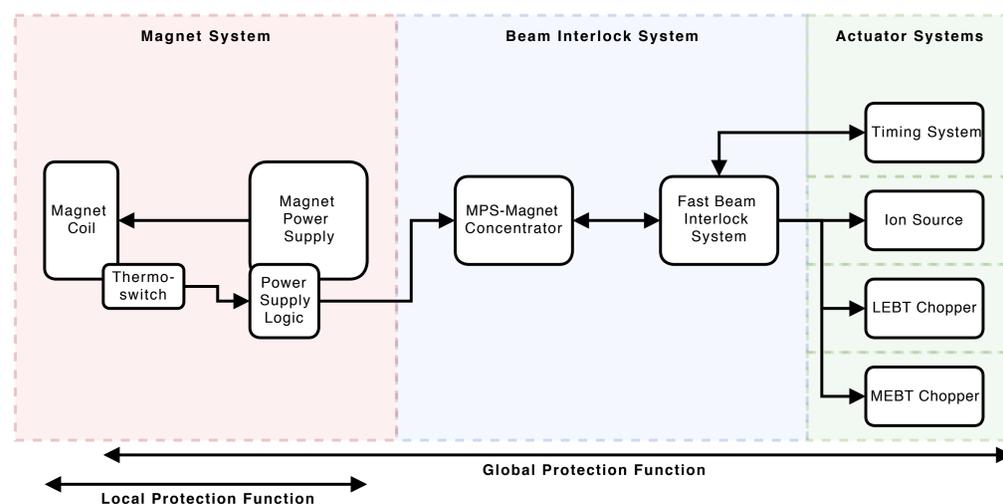


Figure 2: Example of a global and a local protection function at ESS

Conclusion

Machine protection at ESS requires special attention from many angles due to its distributed nature, its intrinsic complexity and its challenging organisational environment. Challenges are still to be overcome, but at the current stage it seems that the solutions presented are contributing to its success.