REFURBISHING OF THE CERN PS COMPLEX PERSONNEL PROTECTION SYSTEM

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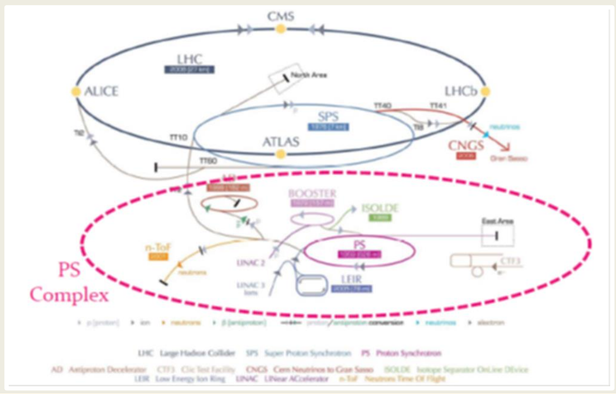
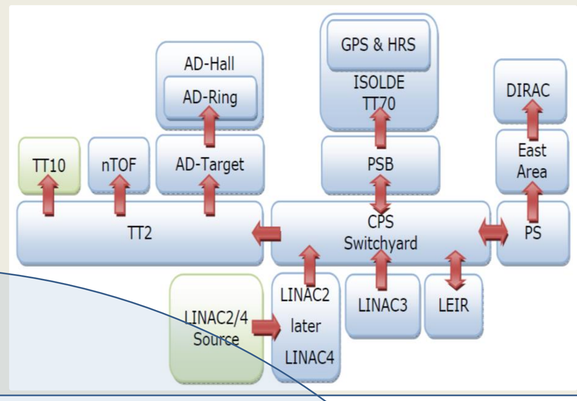
In 2010, the refurbishment of the Personnel Protection System of the CERN Proton Synchrotron (PS) primary beam areas started. This large scale project was motivated by the obsolescence of the existing system and the objective of rationalizing the personnel protection systems across the accelerator complexes at CERN to meet the latest recommendations of the regulatory bodies of the host states. A new generation of access points providing biometric identification, authorization and co-activity clearance, reinforced passage check, and other radioprotection related functionality will allow access to the radiological areas. Using a distributed fail-safe PLC architecture and a diversely redundant logic chain, the cascaded PS Access Safety System guarantees the personnel safety in the 17 machine zones of the PS complex by acting on the important safety elements of each zone and on the adjacent upstream ones. It covers radiological and activated air hazards from circulating beams as well as laser and electrical hazards.

The Proton Synchrotron (PS) is the backbone of CERN's accelerator complex, accelerating particles to 26 GeV/c. The PS is part of the Large Hadron Collider injection chain. As represented in the figures below, the PS accelerator complex is made of several machines, some of which can work independently and have specific operation modes.



The PS PPS is a regulatory requirement and is essential for the protection of personnel working in the PS accelerator complex against ionizing radiation, Xrays, lasers, and electrical hazards.
The system is designed to comply with:
- Safety Integrity Level 3
- IEC 61508 - IEC 6151

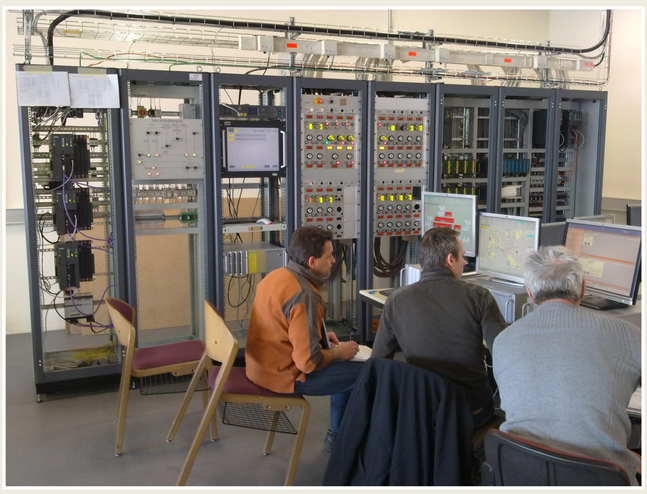
It is composed of two complementary subsystems, the PS Access Control System (PACS) and the PS Access Safety System (PASS) and it acts on:
- 19 access points & 123 EISAccess of other types
- 60 EISBeam

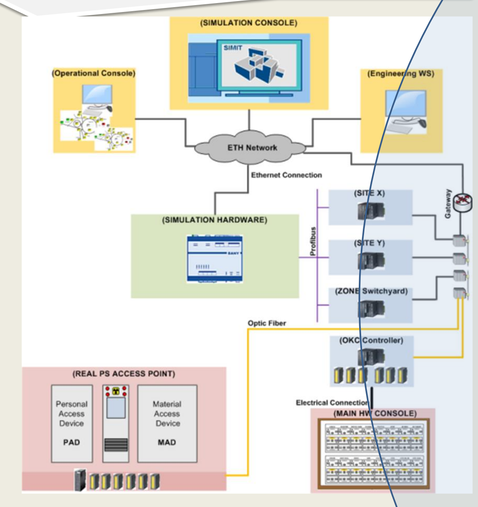


PS PPS Test Platform:

1. Validation of the technical solutions, reliability and safety testing of the system
2. System testing before on-site installation; simultaneous testing of three adjacent cascaded zones.

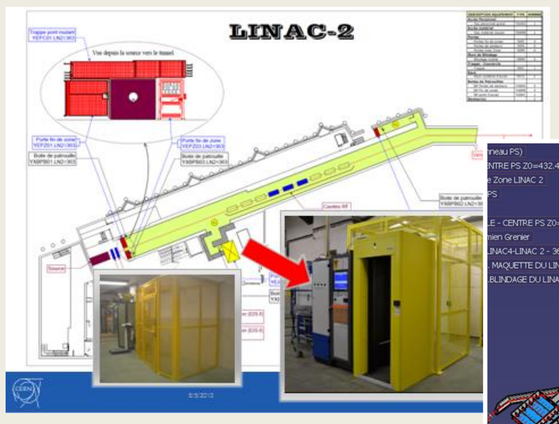
Safety testing based on the SIEMENS SIMBA solution. [TUCOCA04]

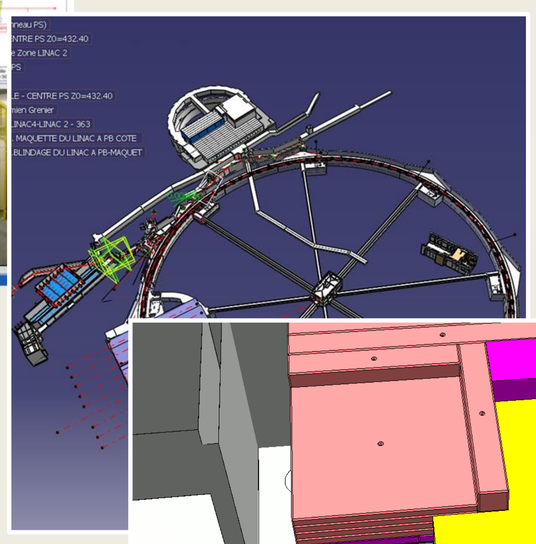


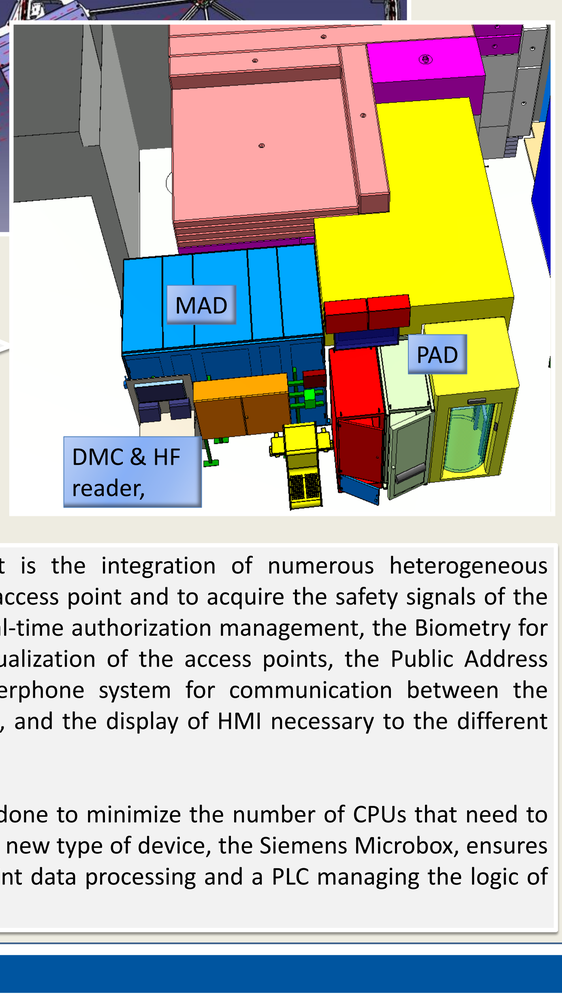


REFERENCES
[1] Eva Sanchez-Corral Mena et al., "Data management and tools for the access to the radiological areas at CERN.", MOPPC057, these proceedings.
[2] T. Hakulinen et al. , "Application of Virtualization to CERN Access and Safety Systems". MOPPC054
[3] T. Hakulinen, et al., "Revisiting CERN Safety System Monitoring", MOPPC055, these proceedings.
[4] P. Ninin, "IEC61508 Experience for the Development of the LHC functional safety systems and future perspectives",Icalepcs 2011 proceedings.
[5] F. Valentini et al., "Formal Methodology for Safety- Critical Systems Engineering at CERN", TUCOCA04, these proceedings.
[6] P. Ninin et al., chapter 12, "Safety of Computer Architectures", WILEY, ISBN 978-1-84821-197-1

System Specification & Integration:







Physical Integration:

- Step 1: Functional specification of zones
- Step 2: Laser scan & 3D modeling of the zone
- Step 3: Access Point integration in 3D

Access Point:
Each access point is composed of : a Personnel Access Device - PAD, a Material Access Device - MAD, one PACS electrical cabinet, one PASS electrical cabinet including a mini-MAD, one emergency door and one maintenance door.

Located in the vicinity of the access point is also the radiation protection equipment, such as an active dosimeter reader, a hand-foot monitor and a buffer zone for the storage of radioactive materials.

The biggest challenge in designing an access point is the integration of numerous heterogeneous components such as a PLC to control the logic of the access point and to acquire the safety signals of the PASS, the access control Front-End to deal with the real-time authorization management, the Biometry for authentication of the user, the Video for remote visualization of the access points, the Public Address system for broadcasting of audio messages, an Interphone system for communication between the Machine operators and the users of the access points, and the display of HMI necessary to the different user categories.

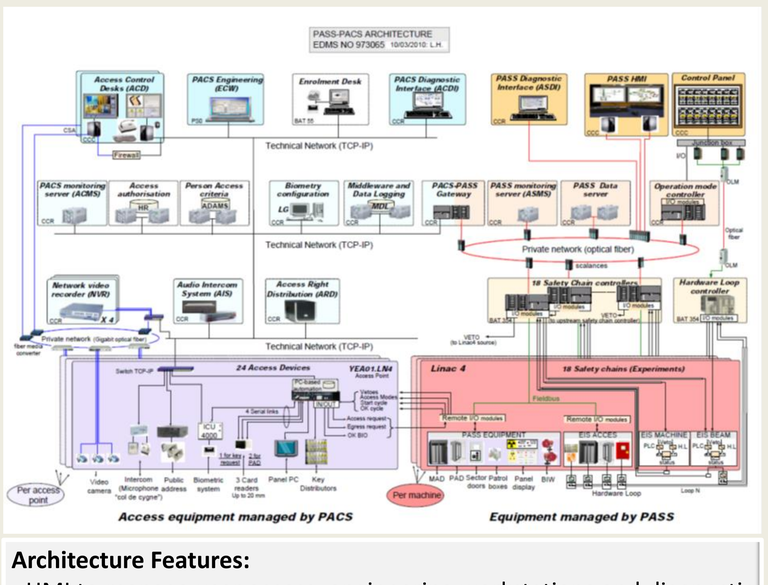
At the access point level, a particular effort has been done to minimize the number of CPUs that need to exchange information with each other. In this context a new type of device, the Siemens Microbox, ensures the dual functionality of a PC managing the access point data processing and a PLC managing the logic of the access sequence.

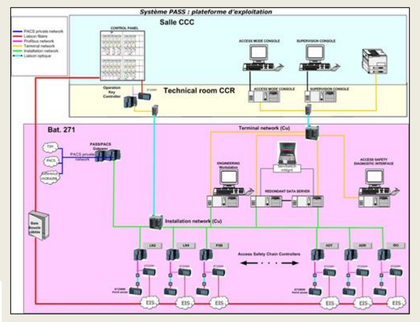
Architecture:

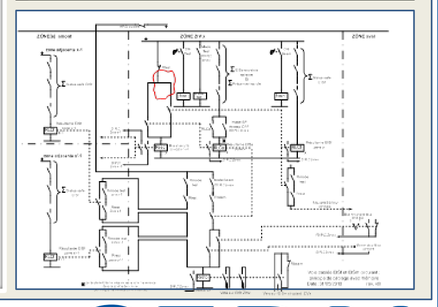
PS Access Control System:
It identifies, authenticates, and controls personnel access conditions.

PS Access Safety System:
It makes the PS safe in all operation modes by acting on Important Safety Elements for Access or for Beam. It is diversely redundant :
* Path 1: PLC based channel
* Path 2: Hardwired channel

And it complies with:
- Common Cause of Failure
- Single Failure Criterion







Architecture Features:
- HMI to manage user access, engineering workstations and diagnostic tools.
- Virtualized PACS servers on a robust and redundant standard hardware allowing simplified system administration, optimized backing-up and system snapshotting.
- For safety and maintenance reasons two dedicated private networks are used one for the PACS data and one for the PASS data, isolated from the external world by a dedicated gateway, only interfacing to the Human Resources Database and the time synchronization.

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