LHC ACCESS – WHERE DO WE STAND

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Abstract

The LHC access system consists of two subsystems, the LHC Access Control System (LACS) and the LHC Access Safety System (LASS). The prototype of both subsystems has been installed in the TCR and is under acceptance testing - the results of these tests are discussed. Extensive work has also been done on the man machine interface and the supervisory system. The current challenge for the project team is now the upgrade from a functional prototype to a robust system that can be confidently installed in the LHC.

Finally the installation schedule and the constraints are mentioned.

INTRODUCTION

The LHC Access project is in its design and realisation stage. A pilot installation of the LHC access system has been realised. The pilot installation concerns the access control equipment, the access safety control equipment, the control room's software, and the external interfaces.

A prototype of the hardware and software of the LHC Access Safety system has been done, a contract for the realisation has been established, the concept of the system has been presented to the French Nuclear Authorities, a diversified redundant system has been introduced.

In order to verify that the global architecture fulfils the safety requirements, the safety objectives of the systems have been clarified, the safety functions have been defined and a detailed functional safety study of the architecture and interfaces performed [2].

BACKGROUND

The LHC complex is divided into a number of zones with different levels of access control [3]. Inside the interlocked areas, the personnel protection is ensured by the LHC Access System. This system is made of two parts: the LHC Access Safety System and the LHC Access Control System [13]. During machine operation, the LHC Access Safety System ensures the collective protection of the personnel against the hazards arising from the operation of the accelerator. By interlocking the LHC key safety elements, it will permit access to authorized personnel in the underground premises during the accelerator shutdowns and will deny access during accelerator operation.

Complementary to this, the LHC Access Control System, regulates the access to the accelerator and the numerous support systems. It allows a remote, local or automatic operation of the access control equipment that verifies the users' authorization, identifies them, locks and unlocks access control equipment and restricts the number of users working simultaneously in the interlocked areas [5]

LHC ACCESS CONTROL SYSTEM

The contract for the realisation of the LHC Access Control system runs since September 2004.

The technical specifications for the Design, Supply, Installation and Maintenance of the system were documented in [12].

The global system engineering has been completed according to the requirements baseline [14], however some specific study concerning the scaling of the system still remains to be done. A pilot installation that consists of a Personal Access Device, Material Access Device, 8 sector doors, and all the control infrastructure of a LHC Access Point has been installed, integrated and commissioned in the former TCR.

Acceptance testing was carried out according to the quality procedures setup in [15].

The lessons learned from this pilot installation are:

- The "way is long" from a prototype integrating all the functions of the system to an installation that is ready to go on site. All the maintenance and supervision aspects need to be carefully studied and planned.
- Contract follow-up: serious difficulties were encountered with the contractors in this stage, this was due to a lack of resources affected to the project as well as the absence of regular project documentation provided by the contractor. Unfortunately the threat of the GO/NO milestone, foreseen in the contract, ending the design stage of the project, had to be flourished. The positive results were the allocation of senior and experienced resources. Nevertheless, a delay of three months needs to be recuperated and will force the parallel installation in the LHC points 8, 7 and 4. In case of deviation from the plan strong action shall be taken earlier.
- As several functionalities such as the patrol or the veto radiation were given a higher degree of safety, they were moved to the LHC Access Safety System. This forced several iterations, slowed down the realisation of the system and induced additional expenses. Limpid specification and validation of the system functional analysis are a mandatory practice.
- Off-the-shelf equipment: the original idea was to build the LHC Access Control System using off-the-shelf equipment. However, the pilot installation shows that many modifications are required to fulfil the specific CERN requirements. Examples are: integration of the biometry identification, the access control server, token distributors, etc.

LHC ACCESS SAFETY SYSTEM

In 2005, the activities of the LHC Access Safety System concerned the following topics:

- Specification of the systems and the interface with the machine elements.
- Prototyping of the selected hardware and software.
- Demonstration to the French Nuclear Authorities that the system fulfils the safety requirements.
- Set up of a contract for the realisation of the system.

The specification of the system and its interface with the machine elements is documented in the following references [7],[8].

Prototyping activities: the chosen Siemens safety programmable logic controllers have been tested in a prototype connected to the access control LHC0 facility. Difficulties were encountered with the definition of the proper interfaces between the two systems and demonstrated the need to document them carefully. The same remark applies to the safety PLC which goes in a failsafe fallback mode in case of incoherence between the redundant input signals.

The project strategy to demonstrate that the system fulfils the safety requirements is based on the rigorous follow-up of the IEC 61508 functional safety standards. The complete lifecycle is applied to the design of the system [1],[2],[10].

The concept of the architecture based on Siemens Safety PLCs has been presented to the French Nuclear Authorities. After discussion it has been decided to complement this architecture with a cable loop that will stop the accelerator in case of intrusion. It brings a new level of redundancy and independence between the two systems. A complete project documentation based on this concept has been prepared [9],[11].

For the realisation of the system a call for tender has been released leading to the pre-selection of three companies. The consortium Cegelec-SEMER has been selected. The work started in October 2005 with a review of the specification.

INSTALLATION

The definition of the cabling is progressing, the LHC site 8 is now completed and the work is now focused on the LHC sites 1, 4 and 7. The cabling definition requires the validation of the LHC access sector definition. This definition is progressing and is today completed at 70% [4]**.** The various requirements for the installation of the access equipment were documented in [16]. All the items to be installed were collected in the Assembly Breakdown Structure of the system [17].

Other activities that revealed to be time consuming were the integration of all the access equipment in the integration database as well as the preparation of the locations for all the system racks particularly at the pits head. Very good progress is done in this activity.

The team that will plan and supervise the work is ready to apprehend its task.

CONTROL ROOM INFRASTRUCTURE

The LHC Access system control room infrastructure is a complex software made of heterogeneous bricks namely:

- The access safety console for the selection of the beam or access mode (hardware man-machine interface).
- The access control console for the selection of the various mode of operation.
- The audio and video components.
- The monitoring systems.

The functions of all these bricks have been defined in a comprehensive set of documents and discussed with the AB/OP representatives.

CONCLUSIONS

Despite difficulties encountered at the specification level, or with the contractor, the project evolves according to plan.

The Challenge for the project team is now the upgrade from a functional prototype to a robust system that can be confidently installed in the LHC.

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