

## DATA MANAGEMENT AND TOOLS FOR THE ACCESS TO THE RADIOLOGICAL AREAS AT CERN

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### Abstract

As part of the refurbishment of the PS accelerator complex Personnel Protection System, the Radiation Protection (RP) checkpoints and buffer zones, for the radiological controls of equipment removed from the beam areas, have been incorporated into the design of the new access points. Integration of the RP and access control equipment has been very challenging due to lack of space in many of the zones, and it provides an integrated access concept to the primary beam areas. Although successfully carried out, our experience from the commissioning of the first installed access points shows that the integration should also include the software tools and procedures. This paper presents an inventory of all the tools and data bases currently used (\*) in order to ensure access to the CERN radiological areas according to CERN's safety and radioprotection procedures. We summarize the problems and limitations of each tool as well as the whole access process, and propose a number of improvements for the different kinds of users. The aim is to optimize the access process and the operation & maintenance of the related tools by rationalizing and better integrating them.

(\*) Access Distribution and Management, Safety Information Registration, Works Coordination, Access Control, Operational Dosimeter, Traceability of Radioactive Equipment, Safety Information Panel.

### INTRODUCTION

The Personnel Protection System (PPS) is a vital component of every accelerator facility. Its role is to ensure safe access of personnel to the accelerators and safe operation of beams. Further to the PPS several other systems are involved in the process of granting physical access to CERN accelerators. CERN is also under an obligation to follow both internal safety rules [1] and those imposed by the Nuclear Authorities of the Host States [2] [3].

Refurbishment of the Personnel Protection System in the PS accelerator complex [4] at CERN has been an opportunity to integrate technical features to facilitate and enforce procedures for personnel and material controls. Integration of the hardware for the different systems in the existing infrastructure with significant space constraints has been one of the main challenges of the project. Another critical aspect was the integration of the software associated to the different interfaced tools.

This experience has motivated to launch a larger scope analysis, object of this paper, covering all the phases, procedures and tools required to access and exit CERN radiation areas.

### ACCESS PROCESS OVERVIEW

The following phases and tools can be identified as necessary for the access process:

#### *Zones and Access Criteria Definition*

From a software perspective, the zones are defined by the Department Safety Officers and the Access Control service, via the Safety Officer Support tool (SOS) and stored in the Foundation database, which is CERN's global administrative data repository. An access zone is defined in the database by one or more valid locations (Patrimony database), one or more access control points (Access database), and specific criteria to fulfil in order to have access authorisation to the zone, like safety and technical training, personal dosimeter, etc. The CERN Geographic Information System (GIS) provides a geographical view of CERN sites and the possibility to geographically locate assets.

#### *User Identification and Authorisation*

This phase consists of person registration (CERN HR identifier), iris biometry enrolment and the distribution of person's access card and personal dosimeter (DIS). The possession of the DIS when entering a zone is ensured by the access RFID chip enclosed in the physical support of the DIS. For access into the Limited Stay Areas, the user must also obtain an operational dosimeter (DMC). The above mentioned services are located in the same building, and the procedures streamlined in order to make the whole process more efficient. Users shall then follow the necessary training for each zone for which access is needed, and explicitly request access to each zone justifying their reasons. This access request is handled by CERN's Electronic Document Handling (EDH) and is approved by every person's supervisor and Zone manager. Users have to follow safety courses using CERN self-training interface (SIR), or in-class courses.

#### *Activity Preparation and Follow-up*

The planning, scheduling and approval of activities in the different beam areas is performed using the Intervention Management Planning and Coordination Tool (IMPACT) [5]. Activities are reviewed and

approved by the Zone manager and the relevant safety officers. An estimate of the personnel exposure and radiological risks associated to the intervention is performed and a DIMR (“Demande d’Intervention en Milieu Radioactif”, described later), can be linked to the IMPACT activity for additional review and approval.

No personnel entry is permitted without an approved IMPACT declaration. This implies full integration with the Access Control System.

### *Authorisation Distribution and Management*

The Access Distribution and Management System (ADaMS) retrieves from all relevant databases (Foundation, HR, Training, Dosimetry, etc.) data to verify users’ credentials against the criteria defined for each Zone. Users can consult their access authorisations via the ADaMS web interface.

### *Access to Radiation Controlled Zones*

Access to Primary Beam Areas is done by passing through an Access Point (AP) of the PPS. The user is identified via his integrated access card/DIS on the RFID reader of the mantrap named Personal Access Device (PAD). The user is authorised against the ADaMS pre-calculated list. Once inside the PAD, the user has to pass an iris biometric check to be authenticated (access card matches the person) in order to enter into the zone. Depending of the access mode, the user might take a safety token (key) to signal his presence in the zone and prevent beam injection. Access to other radiation areas is done by other means like access card/DIS, electronic/physical locks.

### *Personnel Dose Protection and Traceability*

The use of both a personal dosimeter (DIS), and an operational dosimeter (DMC), are mandatory in Limited Stay Areas. The DMC system is integrated with IMPACT for setting-up the DMC alarms threshold (individual and activity dose rate level) and for the follow-up of individual and collective doses of the concerned activity. In order to ensure these functions, the DMC must be activated prior to entry using the concerned IMPACT activity number, and read upon exit, using the DMC reader installed in the RP checkpoint.

### *Radioactive Material Traceability*

In compliance with legal requirements enforced at CERN, all material and equipment removed from radiation areas must be subject of a radiological control performed by a RP Officer and tracked if radioactive. This task is accomplished using the Traceability of Radioactive Equipment at CERN (TREC)[6] application and associated hardware. Devices which are not already in the system are labelled with a code bar and a reader is used to automatically generate the radiological control request which is sent to the RP group. Once the control is performed, the database associated to TREC is updated and the user informed of the control results and associated transport requirements.

### *Data Distribution Mechanisms*

Most of the above listed systems are integrated via database synchronisation mechanisms. Zone data is propagated once per day from the CERN Foundation DB to other systems such as EDH, IMPACT, ADaMS. The access card & biometrics databases are integrated with the Access Control systems but have propagation delays of a few minutes. IMPACT is synchronously interfaced with ADaMS in order to limit the entry to the approved activities. EDH permissions are propagated to Foundation every few minutes; ADaMS requires 3-4 minutes to evaluate all the conditions required before generating the access authorisations. The Access Control System fetches the authorisations periodically resulting in average delays of 8-16 minutes, and propagates them to the access points every minute. Furthermore, Access Control systems are designed to be robust to unavailability of any of the other systems involved, i.e. the access points can work off-line using a local copy of the authorisation and biometry databases.

### *Operation and Maintenance Tools*

CERN equipment is registered in the Computerized Asset Maintenance Management System (CAMMS) for a complete equipment lifecycle’s traceability and support of maintenance tasks. TREC and IMPACT are fully integrated with the CERN CAMMS tools.

## **EXPERIENCE AND IMPROVEMENTS PERSPECTIVE**

The renovation of the PS Personnel Protection system has been a very useful experience; it has shown that the ergonomics of the access process is not only a matter of technology but also a matter of optimised procedures. The different problems encountered and new objectives identified have helped us to gain better insight of the procedures and systems involved in the “Access to the Accelerators”. The new concepts and improvements that have been introduced / identified from the early phases of system design up to the early commissioning phases are presented hereafter.

### *Access Point Concept*

The integration studies done in collaboration with the CERN Engineering Design Office quickly demonstrated the lack of available space and the obsolescence of the surrounding technical infrastructure making the integration of the future PS PPS equipment, the RP checkpoint and buffer zones (which had not been foreseen at the beginning of the project) very difficult or even impossible. The project budget had to be increased to cope with the additional cost of the necessary infrastructure work (new buildings construction, refurbishing).

As indicated in Figure 1, a RP checkpoint for the DMC reader and contamination monitors are foreseen in the vicinity of each access point, and where required, also a buffer zone equipped with a TREC console.

Another important improvement introduced at the access point level, is the separation of the safety token distribution from the PAD cycle. At the entry of the PS PPS access points, there are two access card readers, one for the safety token distribution and another to enter through the PAD. The token distribution process is independent of the entry/exit PAD cycle, and can occur in parallel, increasing the potential flow of users through the PAD, w.r.t. the LHC accelerator PPS.

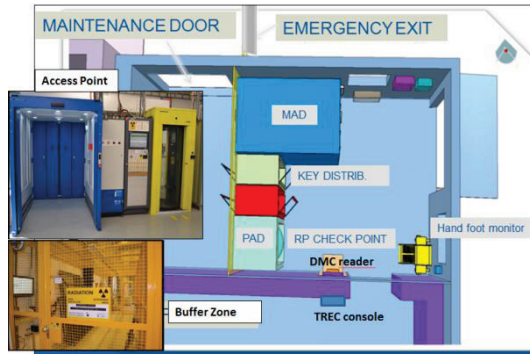


Figure 1: Access Point and RP checkpoint & Buffer Zone.

### Operational Dosimeter and Access Integration Improvements

Despite the successful physical integration of the RP equipment in the access point layout, experience gained after the first exploitation of new access points showed that the integration of the related software tools and procedures had not been foreseen. The RP and Access specialists are currently studying how to ensure the proper use of the DMC in conjunction with the access point.

In particular, for Limited Stay areas, the objective is to ensure that the DMC is activated upon entrance into the area and the dose read-out and deactivation upon exit.

Another issue which has been identified concerns the local display of the IMPACT activity numbers which are needed for the DMC activation. The current practice is to post every morning the list of active IMPACT activities next to the DMC readers but this task is time consuming and cannot reflect changes occurring during the day.

The DMC reader is equipped with a very basic user interface and controller, and the programming possibilities within the system are very limited. Implementing CERN specific needs would require costly development and commitment of the supplier. Several solutions are being studied; all of them imply linking the DMC activation with the entry access sequence:

1. Deploy a parallel system, called Impact to Dosimetry (I2D) based on a PLC that retrieves valid IMPACT lists, displays it on a dedicated touch panel and transmits it to the DMC reader for its activation. This PLC could be later interfaced with the access equipment and integrated to the access sequence. This option offers the following advantages: little software and hardware maintenance w.r.t. a PC-based solution, ease of interfacing with serial communication protocols, scalability, openness to

future added functionalities, native capability to interface electrical equipment, compactness, cost, and most importantly, deployment capacity in places where no access point is present to easily control a single door, like in the buffer zones. A prototype (Figure 2) has been developed to validate the concept, and the PLC to database direct connection has been successful. Integration of the DMC reader is now the focus of this new promising development.

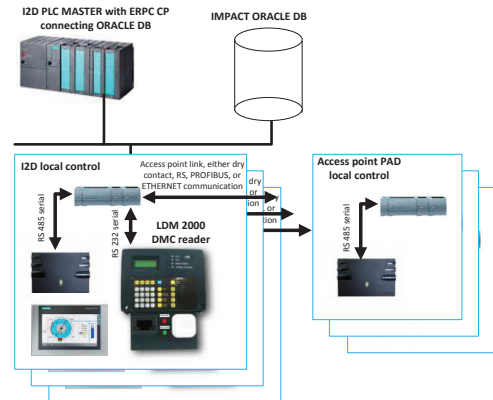


Figure 2: I2D Architecture and Interfaces.

2. A DMC reader remote antenna could be installed inside the PAD, which could check if the DMC is activated. Only a valid DMC activation detection, for example before the iris biometric check, would allow the user to enter the zone.
3. A DMC reader could be installed on the PAD, which would require the user to authenticate both with the access card/DIS and an activated DMC. This option requires that the DMC reader is capable of performing this function. This would also require the user to badge twice, with the access card and with the DMC.

Further complementary improvements that could contribute to proper DMC use:

- Display the list of the valid IMPACT numbers on an existing on-site display screen;
- Ask each user during the Entry Cycle, via an on-screen message in the PAD, to verify the proper DMC activation;
- Emit a recorded audio message for entry and exit PAD cycles, to activate and read his DMC respectively;
- The access control system logs could be crosschecked by the RP team with the DMC system records to verify whether for each PAD entry/exit cycle, an activation/reading of the DMC has been done. In case of error, the user could be contacted.

### DIMR – IMPACT Improvements

The purpose of the DIMR is to assess the individual and collective doses and optimize interventions in radiation areas. It is established between the intervention responsible, the concerned Radiation Safety and

Radiation Protection officers. The preparation of a DIMR consists of three steps with each a different tool is used: first, Work Dose Plan (WDP) preparation using a MS Excel template, then, depending on the level of radiation risk, approval of the DIMR via EDH, and finally, DIMR and associated individual and collective doses registration in the IMPACT activity.

Future IMPACT development will include the integration of the whole DIMR procedure which will facilitate its preparation and ensure coherence.

### *Data Management Improvements*

The basis of the tools used for the management of the CERN 'safety zones and access criteria' were developed 15 years ago and few evolutions have been made to cope with new projects such as the LHC and the PS Access systems. The new projects with their specific technologies meant a four-fold increase in the number of workers in controlled areas and more than 200 hundred access zones compared to 10 in the past. This requires appropriate training of personnel and real-time information about users' permissions and requirements for access to each zone. In this context, the improvements proposed are the following:

- Implement a global view of the CERN safety zones with their dependencies and hierarchy;
- Implement an N:M mapping between zones and access points, specifying in a clear and complete way all the access points required to pass through (complete path) in order to enter to each zone and the required access permissions;
- Use the CAMMS database as the access points' common data source for all the other systems;
- Use the GIS portal capabilities for making available useful information concerning the CERN locations (i.e. under access control and which type);
- Implement a Visitor access rights mechanism that generates controlled exceptions.

The final goal is to have a unique repository for the "Zones & Access Control Points & Access Criteria", from where data is propagated rapidly and as much as possible automatically to the different systems concerned. Last but not least, the information provided to users in the different systems should be coherent, and clear enough to allow users to take any required action.

### *Authorisations Management Improvements*

The definition of access authorisations associated to zones which relate to each other is tricky, especially if they are "owned" by different Zone managers but it would be worth it to consider them in the generation of access grants.

The concept of Role-Based Access Control should be applied to physical access, as is already the case in most Logical Access Systems. For example, by default, a set of access permissions are given automatically to a person because he has a specific role. In this case, definitions of Role Managers are indispensable.

Another automated way of generating and assigning access permissions would be via rules which combine multiple criteria from HR or other egroups-based rules. This would reduce and simplify considerably the individual EDH access requests per-zone.

In order to ensure coherence and profit fully from the above concepts, they should be introduced in all the different systems concerned: Foundation, EDH, ADAMS, IMPACT, CAMMS and Access Control.

## CONCLUSIONS & FUTURE PLANS

The LHC Access System is in production since January 2008 and has met all the safety requirements. The knowledge and experience gained has allowed us to introduce improvements in the architecture, system design, end-users processes, and interfaces, which we have applied in the refurbishing of the PPS of the PS accelerators complex and the upgrade of the LHC PPS itself. The on-going deployment of the new PS PPS has allowed us to identify the new improvements presented in this document. These improvements are crucial, as the personal protection system and all the tools required for a safe and efficient access to the CERN accelerators are of vital importance for their operation.

Some of the improvements presented in this paper are currently under study and the associated cost evaluated by the different groups concerned. A number of improvements could be implemented independently but others require coordination and common commitment. Our final goal is to define long-term solutions applicable to all CERN accelerators which ensures/reinforce the application of CERN safety rules and also provide an efficient and rationalized operation of the Personnel Protection systems and optimum use of resources.

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