ACCESS SYSTEM AND RADIATION MONITORS SUMMARY

M. Gruwé, T. Ladzinski, CERN, Geneva, Switzerland

INTRODUCTION

This session was devoted to the LHC Access System and the Radiation Monitors of the LHC and its injector chain. The session was composed of six presentations. The objective of the first three talks was to assess the current system [1] as well as to present and discuss the hot topics [2],[3] that could result in modification proposals. Two following presentations addressed the impact of the potential future modifications and discussed the possible improvements of access control stability and efficiency [4],[5]. Finally, the last talk presented the current status of the radiation monitors and its possible impact on the LHC availability [6]. This paper does not summarise each of the presentations individually, but rather presents the key points of the talks. Furthermore, significant points of the session discussions are presented.

ORGANISATIONAL ISSUES

Access coordination responsibilities

The responsibility and coordination of both the activities requiring access as well as safety in the LHC is shared by two departments: Beams and Engineering. In the Shutdown and Technical Stop periods, the EN/MEF group is responsible for planning and coordination. In the Commissioning phase the EN/MEF maintains the general overview of planning while BE/OP plans the detailed actions and coordinates the activities. The preparation for Beam Operation and the Operation itself is planned and coordinated by the BE/OP group. The BE DSO is responsible for safety matters in the LHC during the Technical Stops, Commissioning and Operation periods, while the EN DSO steps in during the Shutdown period. The TSOs and site coordinators from EN/MEF group assume their responsibility regarding access all the time.

The *Patrol* and *Restricted* modes, which are used in the Technical Stop, at the end of the Shutdown period, in the Commissioning phase and during the preparation for Beam Operation, require manning the access console. The BE/OP group might need more help from people trained and habilitated to give access while the LHC is not in Beam Operation.

Avis d'Exécution de Travaux

The EN/MEF group proposed the introduction of a new tool to help coordinate and plan activities requiring access to the LHC. It is planned that the new tool will be put in place before the next shutdown and will replace the current ADI ("Avis d'Intervention") and AOC ("Avis d'ouverture de chantier") thus streamlining the process of preparing underground interventions and providing means of controlling who is supposed to enter the LHC at any moment in time. This single document should include links to other safety related documents of interest for the given zone and time window (VIC, DIMR, locking out of equipment, hot works permits etc.). The document shall include specific list of people that will intervene in the LHC. It should be possible to edit the list of personnel after the approval of the document. In the discussion that followed it was stressed that for zones where the DIMR ("Dossier d'Intervention en Milieu Radioactif") is needed, the AET should be prepared well in advance [7]. Certain activities in the Shutdown period take long time and require a large number of personnel, thus it might be hard to monitor access with the tool as very big teams might be registered with the AET [8].

The visits of the VIPs will in principle not be covered by the AET mechanism [9], as there is a special procedure for them [10]. Furthermore, their needs are different and the visitors do not have the necessary training [11],[12].

SECTORISATION

Current Sectorisation

The term "sectorisation" refers to the division of the LHC into smaller entities, called sectors. The access sectorisation is the most visible one, as the sectors are delimited with physical barriers and restrain free movement underground. The current access sectorisation fulfils the safety functions for which it has been designed: it helps protect the personnel from ionizing radiation.

Circulation through the inter-site doors

Circulation through the inter-site doors is only possible when the two adjacent tunnel zones are in the *General* mode. This is a severe constraint for the personnel intervening in the tunnel while the machine is in the *Restricted* mode. The *Restricted* mode used in the Commissioning phase (powering) precludes the passage through the doors in order to keep track of the exact number of people in each zone. This information is important for the Fire Brigade in case of an evacuation alarm [13],[14]. The access control system cannot give fully reliable information regarding the number of people inside a zone, because of the number of evacuation exits. Only when the LHC is patrolled and in the *Restricted* mode, the count of delivered safety tokens (the restricted access keys) is fully reliable [15].

The door positions could be readjusted, but only in a minor way, as their emplacement was chosen with the radioprotection constraints in mind. Recently all position drawings [16] have been formally approved [17]. Furthermore, once the operation starts, some tunnel zones risk being almost inaccessible and hardly ever in *General* mode (e.g. the collimator areas in points 3 and 7).

Access sectors versus ventilation sectors

Following the "*Task Force on Safety of personnel in the LHC underground areas"* recommendations [18], a number of overpressure doors have been installed to protect the personnel from the risks of major helium release. The access system has not been redesigned and a need to readjust the access sectorisation to the ventilation sectorisation becomes apparent. Especially, the current situation imposes strong access restrictions during the Powering Phase II (e.g. while Powering Phase II takes place in LHC sector 5-6, no access is permitted from inter-site door R37 to R74) [19]. A possible solution to this problem would require adding more access points. However, the current postulates are biased by the recent sector 3-4 repair experience; long term needs should be studied [14] and risk analysis performed.

The re-adjustment of the ventilation sectorisation was discussed during the Workshop [3],[4]. Opinions converged as to the need for sealing of cable passages between the tunnel and service areas and the addition of a ventilation door next on the tunnel side of access points leading from the service to the tunnel zones.

INTERLOCKS

The LHC Access Safety System (LASS) protects the personnel from radiation hazards. Increasing its scope to protect people from other risks was a subject of discussion during the Workshop. Today, some of the access system signals are used in the Software Interlock System (SIS) [1]. This system is a support tool for the operator, helping to enforce the absence of personnel during the Powering Phase II [20]. It prevents powering above the Phase I current limit when people are in the zone and stops the power converters of the relevant zone in case of an intrusion. The implementation uses the SIS to generate the necessary logic between the access conditions and the current read in the power converters and to send commands to the power converters via the Power Interlock Controller (PIC), notably a *slow power abort* in case of an intrusion. The reading of the signals from the access system to the SIS is done via a long chain of different software modules supplied by the GS/ASE and BE/CO groups. In order to pass from a support tool to a full-fledged interlock system [21] a direct hardware link would be needed between the LASS and the converters. An alternative in the form of a LASS-PIC interlock would require a thorough risk assessment.

Other areas of interest for access interlocks include fresh air supply and the new overpressure doors. Again, risk analysis is required in order to proceed any further.

ACCESS SYSTEM PERFORMANCE

Electromechanical issues with EIS-access

In 2009 several electromechanical problems were encountered with a number of Elements Important for Safety (EIS) devices - access point elements & doors. They were particularly visible during the Hardware Commissioning phase, when the areas are patrolled and a malfunctioning device may cause a patrol drop and lead to the costly re-patrolling of an area. The most significant problem was with the personnel access device where two issues were identified: possibility of simultaneously opening of both internal and external doors and faulty contact readings resulting in the access safety system seeing both doors open (and consequently dropping a patrol), while the access control system sees one of the doors closed. The first was corrected by a software patch applied just in time for Beam Operation, while the second issue has not been completely solved so far. Electromechanical problems were also identified with the restricted access key distributor modules. The impact in 2009 was blocking the possibility of switching from the access mode to the beam mode after a short stop with interventions requiring access.

LHC Access Safety System

Only a few minor modifications were applied in the new version deployed in 2009. From the users' perspective a new way of treating the connection with the EIS-beams of SPS injection chains by the LASS was considered a big improvement. No spurious triggering of the evacuation alarms in Points 2 and 8 was observed following the modification. Improved connection with the LHC EIS-beams in order to allow the necessary EIS testing flexibility is currently being studied [4].

Improving Access Fluidity

The number of access requests has put a lot of pressure on the CCC access console operators. During the last 6 months (1.08.2009 – 31.01.2010) more than 180'000 accesses in the LHC took place. Out of these ~ 33'500 were in *Restricted* mode, requiring operator intervention. This gives more than 190 restricted access transactions per day, with a peak on January 14th, when 670 tokens (restricted access keys) were given. A subjective analysis by one of the console operators [5] showed that an experienced operator may reach a performance of treating one call per minute (thus allowing no more than 60 persons to enter per hour). However, on busier days the time required to treat one call can easily reach five minutes. In 2009 most of the time was spent asking the person requesting access the ADI number and verifying it. Not surprisingly, one of the improvement postulates is the introduction of an automatic filter using the new AET mechanism. This would filter out all the access requests originating from people whose interventions have not been scheduled and fully authorised.

In addition, correction of a few persistent bugs and new ergonomics of the console windows to allow ease of treating in parallel several access requests is being considered. Introduction of biometry data on the token chip and thus eliminating dependency on the network was also proposed. In 2009 several network related problems were observed with the access control system.

The much used *Restricted* mode has also been reviewed. One of the improvement possibilities would be the introduction of a token-less (the token only protects from accidental beam operation) *Restricted* mode. However, since the token can also be used e.g. as a protection from the Powering Phase II risks, efforts shall rather be put into improving the rapidity of the token delivery. The enhancement of the *Restricted* mode procedure would allow multiple keys distribution for a group entering together, i.e. a separation between the safety token delivery and the Personnel Access Device (PAD) entry cycle.

Material Access Device

The detection of people trespassing through the Material Access Device (MAD) has been a major challenge in the recent years. Although accessing through this device is strictly forbidden, technical methods of enforcing this restriction are deemed necessary in order to avoid accidental and unnoticed entrance. The current improved, camera based micro-movement detection algorithm has reached a point of equilibrium between the desired sensitivity versus rate of false detections. This equilibrium is fragile as the process is prone to external environmental condition variations, clearly visible on the surface (natural light, equipment wet or covered with melting snow etc.). We are currently at the limit of what is possible with the approach taken. The imminent introduction of a fail-safe mechanism for the detection software (no usage of the MAD, should the software encounter internal errors) will further decrease the availability of the device.

A change in the strategy might imply searching for a different technological solution to replace or complement the existing one (technological redundancy). However, the market does not offer off-the-shelf products suitable for the LHC environment. It might therefore be desirable to extend the approach taken by the LHC experiments and introduce either a remote (from the control room) operator video control in order to open one of the MAD doors or have guards on site.

RADIATION MONITORS

Currently two systems are in use at CERN. The RAMSES system for the LHC and the Arcon system for the LHC injectors [6].

RAMSES has proved to be reliable; it was designed using the industry standards to match SIL 2 requirements. It is decentralised and autonomous, equipped with internal batteries. The detector-alarm units continue to operate even if the rest of the system fails. All the LHC areas are well covered with monitor stations. In case of a channel failure, radiation monitoring is ensured by the remaining channels.

The Arcon is an old technology system. In case of failure several channels are affected and a whole area remains without radiation monitoring. Spare parts are a major issue. For the injector chain the spare parts could be obtained from the experimental areas. Continuing with Arcon causes a major operational risk, as a faulty equipment results in a beam stop of 1-3 days.

The Arcon system is to be phased out and replaced by RAMSES. The first phase (RAMSES-light) for the LHC injectors is planned to take place before the end of the next shutdown.

CONCLUSIONS

No blocking problems with the personnel safety have been reported during the session. The availability is an issue both with the access system as well as with the radiation monitors. Arcon should be phased out of the injector chain. The presentations and discussions of this session have helped identify areas to be corrected before the next LHC shutdown period in order to enhance access fluidity, secure the MAD etc. Several topics related to the access system are only identified, but need further elaboration of long term needs and risk analysis by the LHC Access Working Group (sectorisation changes, additional interlocks).

REFERENCES

[1] L. Ponce, “How did the LHC access system perform in 2009?”, these proceedings

[2] J. Coupard, “How should the access system be operated while LHC is not in beam operation?”, these proceedings

[3] M. Tavlet, “Is there a need for re-sectorisation and/or additional interlocks?”, these proceedings

[4] R. Nunes, “Impact of safety related requirements and evolutions on LASS and LACS”, these proceedings

[5] T.Hakulinen, “How to achieve satisfactory performances of the access system: stability, efficiency, operation, fluidity?”, these proceedings

[6] D. Forkel-Wirth, “Arcon/Ramses: current status and operational risks”, these proceedings

[7] D. Forkel-Wirth, comment during the Workshop

[8] F. Bertinelli, comment during the Workshop

[9] S. Myers, question during the Workshop

[10] Procedure: “Access of Visitors in LHC Underground Areas (Accelerator & Experiments)”, edms: 903078

[11] Ch. Griggs, comment during the Workshop

[12] M. Tavlet, comment during the Workshop

[13] P. Collier, comment during the Workshop

[14] S. Myers, comment during the Workshop

[15] R. Nunes, explanation during the Workshop

[16] S. Di Luca, “Sectorisation accès des zones faisceau du LHC et localisation des éléments importants de sûreté d’accès”, edms: 342640

[17] M. Gruwé, reply to a question by N. Catalan Lasheras during the Summary session

[18] Task Force Report: CERN-ATS-2009-002

[19] M. Gruwé, “Access Restrictions in LHC and SPS during LHC Powering Phase II”, edms: 1010617

[20] M. Gruwé, reply to a question by S. Myers during the Summary session

[21] R. Trant, comment during the Workshop