LASS and LACS status

L. Ponce
CERN, Geneva, Switzerland

Abstract

The LHC access system has been progressively put in operation starting from Spring 2008 and has been used in different configurations during the LHC commissioning phases (powering tests, beam operation and shut-down). Based on the experience gained during these phases, several modifications have been requested for improving personal safety as well as operational efficiency for the next run. The main performances and issues of the LACS/LASS found during the first year of operation will be presented. The status of the implementation for a more efficient operation in 2009 will then be reviewed. In preparation of the re-powering of part of the machine in parallel with accesses, possible interlocking of the access system with the power converter will be finally discussed.

INTRODUCTION

During the 2008 year, the access system has been progressively put in operation and finally intensively used for more extended purposes than protection against radiation hazards. It has been used to control co-activities in the underground areas during the powering tests and to protect people against electrical or cryogenic risks.

Most of the existing problems are linked to the intensive use of the system in RESTRICTED mode for extended periods to control interleaved activities by a large number of people (up to 320 keys taken per day spread over the whole LHC machine) whereas it was designed for a short access of a limited number of people in a delimited area.

Looking at the 2009 planning, we should expect again a significant number of interventions requiring controlled access as soon as a sector is cold.

The powering tests period will be more affected by the pending problems than beam operation because of the duration and frequency of access periods, and so the requested modifications of the system are needed in place prior to the start of the powering tests.

HARDWARE AND SOFTWARE STATUS

Regular meetings between AB/OP group representatives and Access Team Project took place to follow-up the problems found during operation of the system and to propose evolutions for a better operational efficiency. The change requests have already been presented in the LHC Performance Committee [1] and documented [3].

LHC Access Control System (LACS) status

The system has been in operation for several months but the treatment of non conformities, identified during the first months of operation, and implementation of the new requests are still pending.

The main issues for operation due to non-conformities are

- the problem of key distribution/restitution due to the incorrect behaviour of the system when communication is lost during an access sequence. When this occurs, the users cannot take or give back a key, thereby blocking the usage of the Personal Access Device (PAD) till an external intervention of the Access piquet.
- the false patrol drop when a user is going through the PAD via the normal procedure (i.e without forcing any emergency device). This was not a safety problem, but caused a lot of extra patrols during the cold check-out and the re-powering period.
- the reliability of tracing of people in underground areas because of the possible inter-site circulation in GENERAL mode and wrong execution of the exit sequence which leads to wrong counting of people in zone. Having the correct counting and traceability is essential for any Fire brigade intervention.
- the stability problem of the application on the CCC consoles, this is not safety critical but very painful for operation and users because of waiting time.

A new version of the LACS software have been deployed at the beginning of December, for testing in real conditions. The problem of key restitution seems to be understood and fixed but there were only a few days of tests and in only three sectors. A second phase, with a new release of the LACS software, initially planned for mid-January, has been postponed to mid-March for deployment on the test bench (so-called LHC0). This new version should correctly handle errors in the procedure in case of loss of communication with the UTL (Unité de traitement local).

Furthermore, during the yearly maintenance campaign, new holders for the PAD position contacts will be installed in order to avoid the spurious drop of the patrol during the standard entrance/exit procedure.

In order to make “people in zone” counters more reliable, a technical solution is still under investigation. While for the other issues, there are no proposed modifications as diagnostics is still going on.

As already mentioned, most of these issues are troublesome in RESTRICTED mode when the system is intensively use. As such, the final tests of the implemented

changes will not be possible before switching back to RESTRICTED mode, when we already need the system to perform as specified. Therefore, the Access Team Project should try to check the internal alarms in order to start as early as possible the validation of the new software.

LHC Access Safety System (LASS) status

The LASS contract phase is finished. The system is operational and few non-conformities have been identified during the beam operation [2]. The detailed list of issues has been documented [3] and only the main problems are discussed in what follows.

During beam operation, we had an unexplained patrol drop in point 2. As it happened in the shadow of other accesses, it did not cause a beam abort, but triggered two extra patrols.

Another important problem from the safety point of view is the launching of the Beam Imminent Warning (BIW) instead of the evacuation sirens in case of two independent Important Safety Elements-beam (so-called EIS-B) becoming UNSAFE. The distinction between the two signals is fundamental for the right behaviour of the users. In case of 2 EIS-B UNSAFE, people should evacuate, whereas in case of beam imminent warning, there is in addition to the possibility to inject beam a deliberate action of an operator to do so. Should the BIW sound and users are in the LHC, they should immediately press any emergency device to signal their presence.

A third issue is the connection between the SPS interlocks chains and the LHC access systems which make the logic of the interlocks in point 2 and 8 wrong. As there is only one combined signal, it is not possible to distinguish between one or more EIS-B UNSAFE. Adding the fact that the BIW is triggered in case of 2 EIS-B UNSAFE, manipulations of only one element in the SPS line have triggered many times false BIW, mainly in point 8.

A strict procedure for validation of LASS upgrades is required by the Access Team Project to guarantee the level of safety specified. This procedure has been presented in the LHC Performance Committee [1]. It includes:

- a test platform validation phase, an update of the documentation and the upgrade itself
- a complete set of non-regression tests which requires a period of no access and/or the closing of the whole machine for a couple of days.

The GS/ASE group should request to be included in the planning for the next release.

The last update of the LASS done end of October has fixed the last non-conformities of the system and should solve the patrol drop in point 2. The new version has been tested and validated by the Access Project Team, but the DSO tests are still to be done for final acceptance. The next release is targeted for mid-April and the scope is to include most of the change requests from operation and the SPS signals sorting out.

MATERIAL ACCESS DEVICE (MAD) PROBLEM

Description of the problem

During the 2008 operation, the presence detection in the MAD was not efficient enough to guarantee against intrusion. Therefore, some compensatory measures were put in place, which consisted of directly monitoring or locking the MAD when in RESTRICTED mode. To enter or exit material, the users had to call for a guard to come on site and activate the MAD with a dedicated key. The guards were the operation crew during the beam operation and the CSA (Centre de Surveillance des Accès) and/or the site managers after the 19^{th} of September.

During the last months, the Access Team has investigated several possibilities to make the presence detection more reliable. A test of the best possible adjustment of parameters for movement detection with the installed hardware has been organized end of January. Although the system has been clearly improved, preventing accidental intrusion due to wrong usage of the MAD, it is still possible to enter too easily when deliberately trying: the first try by an operator was successful.

Consequences for safety of personnel

The risks associated to the weak performance of the presence detection in the MAD are:

- in GENERAL mode, it is possible to enter in a controlled area without proper access rights (the most common example seen)
- in RESTRICTED mode, an undetected entry allows the presence of persons when re-establishing potentially dangerous conditions (during the powering or during beam operation)
- in CLOSED mode, there is no impact as the MAD is not usable, being blocked by the LACS.

Unfortunately, the RESTRICTED mode does not provide the specified functionality of personal detection and there will be no new solution available for the next start-up. Therefore, temporary compensatory measures will have to be put back in place as soon as the RESTRICTED mode is needed.

Several solutions can be foreseen. The first one is to block the MAD which would mean no access with material in RESTRICTED mode. This solution is not realistic because it places a lot of constraints on the users (for examples no bike).

Another solution is to systematically patrol the areas after access and just before powering. As the RESTRICTED mode has been designed to give access while preserving the patrol, this solution is equivalent to not using the RESTRICTED mode. Again, this proposal would lead to a lot of organizational constraints: grouping as much as possible the accesses, multiplication of the patrols and a procedure (forcing a patrol between the access period and the re-

powering/beam) would replace interlocks, i.e Patrol SAFE signal.

The last proposal is a human control of the MAD usage, either local as done during 2008 operation or remotely from a dedicated control room, but such a solution has to be developed. Based on the experience from 2008 with the local control of the MAD and the number of access requests, this proposal seems to be the only viable solution, but with dedicated guards for the task, twenty four hours a day and seven days a week. For a remote control which would save manpower, a proper infrastructure for video surveillance has to be put in place as the CCC access consoles will have to be used for the key management. Of course, a more permanent solution must be investigated for longer term and to meet the MAD automatic usage functionality.

POSSIBLE INTERLOCK WITH THE POWER CONVERTERS

During the 2008 hardware commissioning period, it was requested for safety of personnel that during the powering tests above 1 kA, the sector should be empty. This was guaranteed by a patrol, but as there is no interlocking between the power converters and the access system, the application of the rules is the sole responsibility of the Engineer in Charge. Again, the experience of last year showed that it was sometimes very hard to check that all conditions are met before starting the powering or to avoid an access being given during the test, because of the number of involved actors in the CCC.

Concept

Following the 19^{th} of September, to reinforce the respect of the rules for access, the interlocking of the Access system with the power converters was raised. A small group has started to evaluate the feasibility of the proposal for a short term implementation, independently of a more general reflection on the use of the interlocks which would require a full safety study before deployment.

The first task will be to (re)-define a matrix of access conditions in the different underground zones versus the possible level of current in the powering zones, following the recommendations of the Safety Task Force. As the Access system has been designed for protection of personal against radiation hazard, an hardware link between the power converters and the Access System would be a major change and would clearly need a complete safety study. This cannot be reasonably foreseen for the next powering tests period in 2009.

To date, the only communication of the Access system with CMW is through the alarms published via TIM. Therefore as a short term solution to help the Engineer in Charge to apply the procedures, a proposal is made to create a fixed display providing the Access Status of a zone versus the powering conditions and to provide a proof of concept before the next run.

Possible implementation

The principle of the soft interlock would be to use the Software Interlock System (SIS) to generate the logic from the LASS alarms and send commands to the power converters via the Power Interlock Controller (PIC). The commands could be either a give/remove PC permit, a fast Power abort or a slow power abort. in order to prove the concept, all of these interlocks will be tried and a use-case matrix of access conditions will be used.

The safety and the reliability aspect of the implemented software interlock will then have to be carefully evaluated to be developed beyond a fixed display. As the interlock will be based on systems which do not participate in personal safety (Alarms, SIS, PIC,...), the risk of false trigger and the efficiency for personal protection should be questioned.

OTHER ORGANIZATIONAL ISSUES

On top of the Access System problems, other issues linked with the management of the access appeared during the 2008 run and should be improved for 2009.

Problem for finding patrollers

During 2008, the organization of the patrol was based on a call for volunteers sent by e-mail to a list of persons who had participated to the DSO tests. Unfortunately, the goodwill of the people decreases rapidly with the number of patrols and if it was not a problem to find volunteers for closing the machine for the first injection test, it became more and more difficult to find available people on a day to day basis (even several times per day) during the re-powering tests.

A patrol requires manpower and time to be performed and must be included in the powering test planning.

Problem for rearming doors

Because of wrong usage of the Access System, a lot of doors are forced opened in the LHC, even in GENERAL mode when the normal opening of most of the doors, including the inter-sites doors, is possible. It is a serious safety problem, especially for the external envelop doors, as when forced opened, anybody can penetrate the controlled area. Again, if it was not really a problem to find people to rearm these forced doors at the beginning of the powering tests, it became more and more difficult with the strongly increased number of interventions needed.

To avoid furthermore problems for the next months, mandate and priorities of interventions have to be agreed with the different actors who can perform the tasks : The CSA guards, the site managers, the teams on shift in the CCC, and operation crew. As a proposal, for the external envelop of the LHC (mainly surface doors), the CSA guards could perform the rearming of the doors as they already get the alarms and already have a procedure for guarding the doors till rearming.

For the envelop of the powering zones, where underground access is needed, the task could be performed by the site managers during working hours or by the shift team as a closed envelop is a condition for powering test.

A clear mandate agreed with the concerned persons would avoid a lot of discussion time when requesting the rearming of the forced doors.

Problem of information flow for access management

One of the main complaints from the users of the system was the long waiting time and procedure to get a key for access when in RESTRICTED mode. This was of course due to the large number of accesses but was largely worsen by the multiplicity of procedures to grant access.

During the long period in RESTRICTED mode after the 19^{th} of September, several alternatives to the "Avis D'Intervention" (ADI) were tried without clear improvement. One of them was a restricted list of persons derived from the general LHC-TNL list applied at the PAD level to automatically filter the access: this implies no action for operator, but only people on the list can enter. This provides a nominative filtering of people, which is already provided by the LACS, whereas what is really needed is a filtering of the authorized activities.

For 2009, in order to improve the flow of information and then accelerate the entry procedure, it is envisaged to put in place a unique procedure for the whole period from the end of the cool-down till the operation with beam. This procedure will be based on access requests made by the users via a system derived from the already well known ADI. The requests are approved by the machine coordinators, who could be different for the different periods, but using the same tools. Then a web interface used by the operators to grant access will be automatically filled from the ADI or directly by the Engineer in Charge for access granted on the spot.

Some software development is necessary to put the system in place but it should be possible to provide the tools for the first sector switched to RESTRICTED mode.

Problem of LACS versus operation constraints

In order to be more operational, the LACS application has to be optimized for the usage in real conditions. The customization is an iterative process and needs a certain reactivity of the application developers. If all the requirements cannot be fulfilled for the given deadlines, the operation crews prefer to adapt to pragmatic technical solutions rather than pushing the deadline. In practice, there are conflicting constraints between the LACS contractor and the OP group needs. On the LACS contractor side, the start of software implementation is triggered by a written specification from Access Team Project and not by the OP request. Whereas on the operation side, outstanding modification requests (requested for more than one year [2]) should be implemented before we switch back to restricted mode.

For non safety critical aspects, the process from identifying the problem to issuing of the specification has been taken too long, to the detriment of defining the possible implementations. Systematic delays in software delivery by the contractors result in a very lengthy process for fixing non conformities and for improvements of the performance.

CONCLUSIONS

As for the last run, the Access System is ready for operation with beam. The last LASS non-conformities have been fixed and the few problems observed during beam operation should not appear anymore. The main worry is the safety during the period before beam operation, when in RESTRICTED mode, because of the personnel detection in the MAD problem and the pending LACS improvements.

During the Shut-down period, in GENERAL mode, the tracking of people in the underground area is an issue. How to guarantee that the proper zone is empty when we have dangerous conditions?

For the access system to be adequate to safe use during the powering phase, specifications (and implementation) have to be revisited. This will be a major change of the system and as the LACS/LASS projects contracts are reaching the end, the future developments, maintenance and manpower available at the contractors level should be questioned.

ACKNOWLEDGMENTS

I would like to thank all the operation group for the feedback and the help in the preparation of this presentation, especially M. Gruwé and A. Macpherson. I would like also to address a special thanks to all the patrollers, the site managers and TI for the patience and availability to help managing access problems.

REFERENCES

[1] Presentation at the 9^{th} LHC Performance Committee held on 14/11/2008

[2] Commentaires LACS/LASS 17 decembre 2008, https://edms.cern.ch/document/982366/1
Commentaires sur le LASS/LACS: jeudi 2 octobre 2008, https://edms.cern.ch/document/972013/1

[3] LACS/LASS CHANGE REQUESTS FOR 2009 START-UP, M. Gruwé and L. Ponce, EDMS 982783 https://edms.cern.ch/document/982783/0.1