# SUMMARY: SAFETY

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## LIST OF PRESENTATIONS

1. Task Force on Safety of personnel in LHC underground areas following the accident in sector 3-4 on 19-09-2008, Ghislain Roy on behalf of the Task Force
2. Safety Organisation, John Etheridge and Ruediger Schmidt
3. Access & LACS/LASS, Laurette Ponce
4. Safety systems (AL3) and systems relevant to Safety, Steve Hutchins
5. Possible scenarios for a safety upgrade of the ventilation system, Joaquin Inigo-Golfin
6. Emergency preparedness, Enrico Cennini

## TASK FORCE ON SAFETY OF PERSONNEL IN LHC UNDERGROUND

During powering tests on 19th September 2008 an electrical arc occurred at an interconnect of two superconducting magnets in sector 3-4 causing a loss of helium containment and consequently a massive cryogenic spill into the LHC machine tunnel which was in closed mode (no access). Immediate preliminary revision of access conditions to the LHC underground areas neighbouring to powering test areas were done. Furthermore, a working group revised for the 2008/9 shutdown and repair activities, the working and transport conditions in the LHC machine tunnel with respect to the cryogenic hazard.

Following a first technical task force [1] a second task force on "Safety of personnel in LHC underground areas" started their assessment beginning of 2009. The mandate of the Safety task force, ongoing at the time of the Chamonix 2009 workshop, is to:

- Establish the sequence of facts related to Safety of personnel, based on e.g. AL3 data and FB emergency intervention records.
- Analyse the LHC underground environmental conditions with respect to Safety of personnel and explain their development, in relation with original risk analyses (incl. tests) performed.
- Recommend preventive and corrective measures for the Safety of Personnel in the LHC underground.

## SAFETY ORGANIZATION

The shutdown 2008/9 is characterized by many parallel repair and maintenance activities in all the LHC underground. The end of the shutdown will have overlap with on the one hand ongoing repair and maintenance activities and on the other hand with first powering tests.

The planning, coordination, site management and support from the safety coordinators are well established [2]. The procedures to be followed for the safety preparation of any work are documented in the "Work and Safety Coordination Plan of the LHC Accelerator 2008-9" [3].

For safety during powering tests the experience of 2007/8 proved the effectiveness of the provisions presented during the LHC Safety Day 2007 [4]. Following the lessons learned from 19th September 2009, a two phase approach for the powering tests is envisaged [5]:

- Phase 1: low current powering tests
- Phase 2: high current powering tests.

The critical current separating phases 1 and 2 are to be defined in the forthcoming weeks as well as for phase 2 the access conditions to the underground areas.

## ACCESS & LACS/LASS, SAFETY SYSTEMS (AL3) AND SYSTEMS RELEVANT TO SAFETY

The experience of the hardware commissioning, machine check-out and beam operation during 2008 as well as the recovery phase from 19th September 2008 gave valuable input for improvements of the LHC access safety as well as access control system [6]. The improvement of the Material Access Device as well as the usage of the access system for other than radiation hazards, e.g. electrical or cryogenic hazards, shall be looked at.

At CERN those safety systems which require an immediate intervention of the rescue service are defined as level 3 alarm systems (AL3). Those systems are: automatic fire detection, oxygen deficiency monitoring, flood alarms, flammable gas alarms, emergency phones ("red phones") and lift alerts, evacuation alarms and emergency stops. The LHC alarm systems are spread over 8 out of 33 geographical zones of the CERN Safety Alarm Monitoring system (CSAM), which monitors the status of in total ~20'000 all over CERN and transfers the information over two separate communication systems to CERN's Safety Control Room (SCR) as well as CERN's Central Control Room CCC). The information is also redistributed to local display terminals for use during an emergency intervention. The required LHC alarm systems are in place and perform well despite some shortcomings [7].

The Safety International panel project aims at providing all up-to-date Safety information for the local underground area at the access point and via CERN's intranet.

## POSSIBLE SCENARIOS FOR A SAFETY UPGRADE OF THE VENTILATION SYSTEM

The existing LHC ventilation system is inherited from LEP. It has undergone no upgrade to conform to the more

recent standards. Recent ISO standards provide a relevant referential for possible improvements. The major improvement axes would be:

- confinement and infiltration,
- availability and reliability,
- monitoring and
- procedures.

However, full adherence to the ISO standards is impractical and costly for the LHC. Improvement of some aspects is very affordable (door contacts, independent alarms) while some other modifications (filtration of smoke, back-up electrical supply) are very costly and require careful consideration [8].

## EMERGENCY PREPARDNESS

The emergency preparedness for serious incidents comprises three different processes: emergency response, continuity and recovery. Each process shall be planned and organized in advance according to the adapted emergency management method. The experience of 19th September 2009 including the following days and weeks gave valuable input for the improvement potential of CERN's emergency preparedness [9].

## CONCLUSIONS

The relevance of the lessons learned both technically and from a Safety point of view, following 19th September 2008, for the restart and the running of the LHC in a safe manner was addressed by almost all topics on the agenda of the Chamonix 2009 workshop.

The outcome of the Safety task force, running at full speed, is essential and whenever possible intermediate results will be provided.

For the ongoing shut-down activities an evolving Safety culture is observed and continuous improvement process shall be facilitated by improved and supplemented supporting tools.

The risk assessment of the proposed two phases of the powering tests with respect to the access conditions is being detailed and the results shall be submitted as soon as possible to the Safety taskforce.

The evolvements, identified following the 2008 experience, for the access system and related procedures mainly for the operational phases before beam operation needs to be implemented before the re-powering can start. Specification and implementation of the access system as a barrier only with respect to the radiation hazard of the LHC, needs to be revisited in view of other major hazards as experienced in September 2008.

The LHC Safety systems are in place and performing well. The identified additional software tolls (CSAM test mode) and detector hardware (level 3 alarm sensors) shall be implemented now. The Safety Information Panel project should be implemented as soon as possible.

The identified development potential of the LHC cooling and ventilation system, inherited from LEP, shall be analyzed and the first measures be implemented before the re-start of the LHC.

While the emergency intervention process is well developed, the continuity & recovery part of the emergency preparedness process needs to be elaborated.

## ACKNOWLEDGEMENTS

I would like to thank all speakers of the Safety session as well as everyone who contributed outside the session.

## REFERENCES

[1] P. Lebrun, the Sector 3-4 Incident, these proceedings.
[2] J. Etheridge, Safety Organisation, these proceedings.
[3] S. Hutchings, LHC Work and Safety Coordination, https://edms.cern.ch/document/978710/2.
[4] Safety during Hardware Commissioning, http://indico.cern.ch/conferenceTimeTable.py?confId=22150.
[5] R. Schmidt, Safety during powering tests, these proceedings.
[6] L. Ponce, Access & LACS/LASS, these proceedings.
[7] S. Hutchings, Safety systems (AL3) and systems relevant to Safety, these proceedings.
[8] J. Inigo-Golfin, Possible scenarios for a safety upgrade of the ventilation system, these proceedings.
[9] E. Cennini, Emergency preparedness, these proceedings.