



**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



BETWEEN THE ACCIDENT AND TODAY...



Immediate measures

- Repowering of sectors took place one month after accident
- Access conditions defined in the repowering procedure
 - ◆ Access forbidden even at very low current
 - ◆ Access to neighbouring areas forbidden (buffer zones)
 - ◆ Some restrictions to occupancy in SX buildings



Measures for shutdown

WG to define the working and transport conditions in the LHC tunnel during 08/09 shutdown based on risks of cryogenic nature.

- | | |
|------------------------------|---|
| 1. Nominal conditions | LHe, 1.9K, $p < 18\text{bar}$, operational |
| 2. LHe storage | LHe, 3-5K, $p < 18\text{bar}$ |
| 3. PIM cooling | GHe, 20-120K, $p < 18\text{bar}$ |
| 4. Floating | GHe, 20-300K, P_{atm} |
| 5. Warm | 300K, P_{atm} |



Specific cases

- **First active warm-up / cool-down of sector**
80-300k **No access – No work**
- **From second active warm-up / cool-down**
Restricted access mode
Announce accesses and activities to CCC
- **Passive warm-up of whole sector**
Access allowed
- **Warm-up of standalone magnets and QRL**
80-300K **No access – No work**



TASK FORCE...



Mandate

- **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 environment with respect to Safety of personnel and explain the development of the environment, in relation with original risk analyses (incl. tests) performed.**
- **Recommend preventive and corrective measures for the Safety of Personnel in the LHC underground**



Membership

- **Safety and cryogenic experts;**
- **Participants proposed by Departments**
 - ◆ ***Safety Commission:*** R. Trant (Chair),
B. Delille,
C. Vollinger (scientific secretary)
 - ◆ ***Beams Dep. :*** G. Roy
 - ◆ ***Technology Dep. :*** L. Tavian
 - ◆ ***Physics Dep. :*** E. Thomas
 - ◆ ***Safety Commission :*** G. Lindell
 - ◆ ***Engineering Dep. :*** J. Inigo-Golfin



Communication

- **Reporting to the Directorate**
- **Informing**
 - **Department Heads concerned (BE, EN, TE, PH)**
 - **Relevant committees (SAPOCO / BFSP)**
- **Sensitive information will be gathered, exchanged and interpreted by the TF :**
 - **Confidentiality – No Minutes**
 - **Working documents available on restricted EDMS site**



Organisation

- Official mandate received 1st week January 2009;
- First meeting 21st January 2009;
- Two meetings per week (including this week)
- **Aim at concluding within 30 working days;**
- Preliminary conclusions to be presented to an external advisory committee of safety experts (e.g. from BNL, DESY, FNL, JFL) .



Meeting agenda

Date	Topics
21 January	Introduction, mandate, organisation
23 January	Presentation: R. Trant ; Brainstorming
28 January	Presentations: R. Nunes, J. Inigo-Golfin, L. Tavian <i>TF-recommendation to DN200 positioning</i>
30 January	Presentations: Ph. Lebrun, M. Chorowsky
2 February	Presentation: B. Delille Discussion: R. Schmidt / J. Wenninger Summary of intermediate results: C. Vollinger
6 February	Presentation: P. Bossus
<i>Till end February</i>	<i>Six more meetings</i>



→ Recommendations

Preventive and Corrective Measures :

- Rules and procedures applicable
 - ◆ Eg. Accessibility of different areas in different operational conditions...

- Modifications of systems and infrastructure
 - ◆ Ventilation doors ?
 - ◆ Resync ventilation and access sectorisation ?
 - ◆ Interlocks on powering ?...

- New systems and infrastructure
 - ◆ « blast doors » ?...



Constraints

- **Powering tests access constraints**
 - ◆ **Must be known ASAP for shutdown planning**

- **Long Shut Down works constraints**
 - ◆ **What can be done during this shutdown ?**
 - ◆ **What will be the ground rules for shutdowns ?**
 - eg emptying helium for sectors where transport activities take place...



FIRST QUESTIONS AND THOUGHTS...



Safety of personnel...

Present within the installations :

- **Workers** (staff, users, contractors) (visitors ?)
- **Intervention teams** (fire brigade...)

Assume no impact on Public or Environment

**Envelope scenario already included in Safety Reports
(RPS, PUI) sent to FR and CH Safety authorities...**



... underground areas...

Tunnel areas

- ◆ Arcs and straight sections
- ◆ Cryomagnets and good fraction of cryogenic lines and installations

Service areas

- ◆ « Accesible while powering in tunnel areas »
- ◆ Separate ventilation
- ◆ Numerous installations and services, including cryogenics...

Non-interlocked areas

- ◆ Experimental areas (USA15, USC55, UX85, PX24) + PM32
- ◆ Separate ventilation

Each case is specific... scale/translate S34...



... following accident...

As a consequence of accident

- ◆ **Fact finding on this accident**
- ◆ **« What if » scenarios**

As a consequence of the consolidation decided in response to the accident

- ◆ **additional DN200 pressure relief valves.**
- ◆ **any other measure (procedural or technical) taken as a consequence of the initial accident and which could modify the environment...**



... accident of 19-09-09

Taking into account the redefined MCI...

... and any other scenario (fixed point, beam...)

**Scope limited to cryogenic accidents with
release of cryofluids, caused by any
source.**



Four factors...

1. **Oxygen Deficiency**
2. **Ambient and air temperature**
3. **Pressure wave**
4. **Noise from flushing**



...and their effects

What would have happened to a person in the LHC underground during the accident ?

- ◆ **In the D area ?** **ODH, T, blast, noise**
- ◆ **In the S34 tunnel ?** **ODH front speed, shock wave, T**
- ◆ **At P3 or at P4 ?**
- ◆ **In a neighbouring sector ?**
- ◆ **In caverns, at access points, at the surface, ... ??**



Translate the accident

What could have happened to e.g. Atlas with the same accident on the inner triplets ?

Does this modify or supplement previous answers?

Ditto for CMS ? Alice ? LHCb ?

Bottom of T12, T18 ?

Any other relevant locations?



« Equivalent scenarios »

Brainstorm to find other possible (plausible) causes for loss of He containment:

- Electrical origin ? : see 19 Sept. 2008
- Beam loss ?
- Tunnel collapse ?
 - ◆ Ceiling / wall / floor collapse due to water pressure, earthquake, unknown “caverns”
- Any other mechanical origin ?
 - ◆ *transport activities*
 - ◆ *break of fixed point*
- Fire *provoking loss of He containment* ?
 - ◆ Refer to studies done by Fabio
- Chemical origin : any “good idea”... UPS batteries ?
- Others



Risk assessments

By subsystem:

- ◆ **electrical , cryogenics, magnets, ...**

Possible interactions between subsystems

- ◆ **electrical failure scenario → cryo. failure scenario**

Transient modes:

- ◆ **magnetic forces, EMC, ...**



Risk analysis

- **Gathering data for a global LHC risk assessment...**

- **Management risk assessment needed ?**
 - ◆ **What impact is accepted on machine ?**
 - ◆ **What impact is accepted on personnel ?**
 - ◆ **What impact is accepted on operability ?**



Interim conclusion

We still have more questions than answers...

Work has started in gathering all info necessary to come to meaningful conclusions.

This week is your chance to give us your input, express concerns and refine with us the boundary conditions...