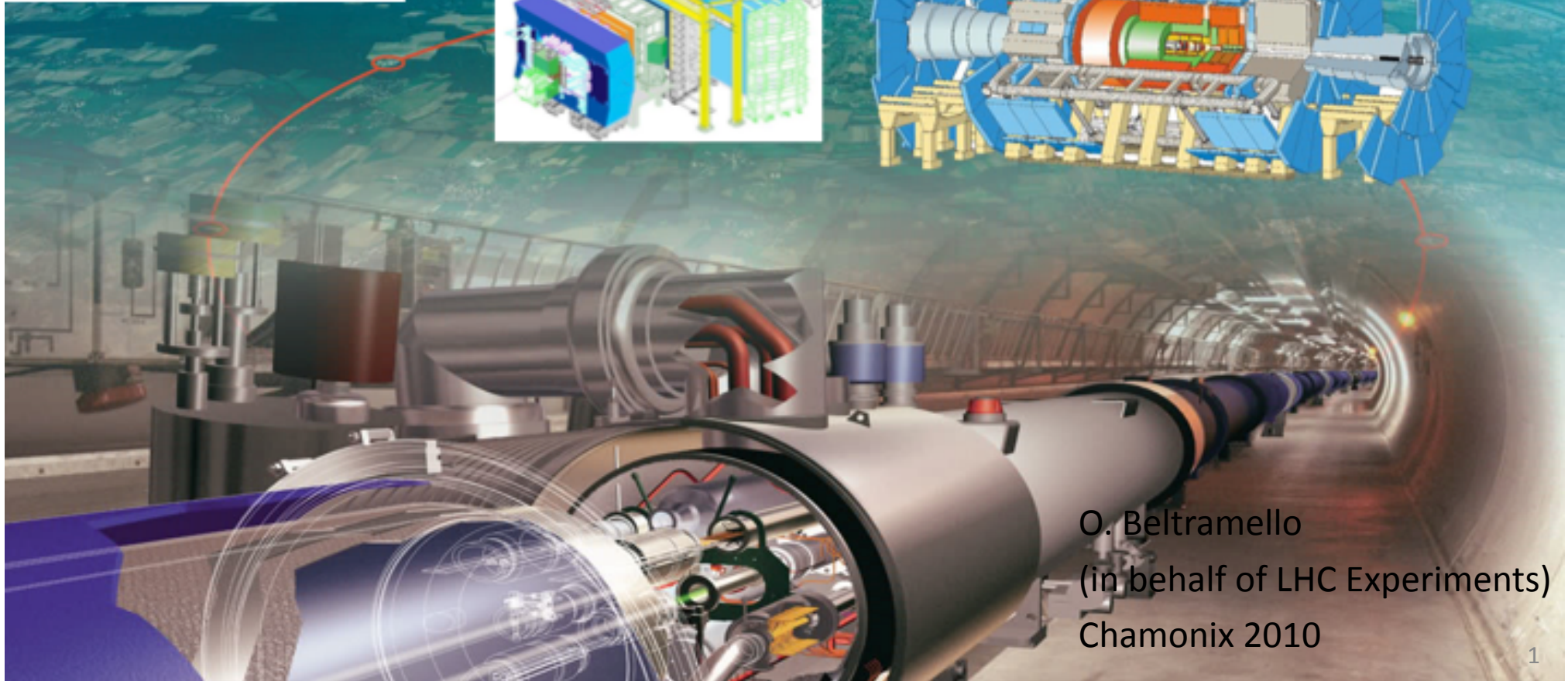
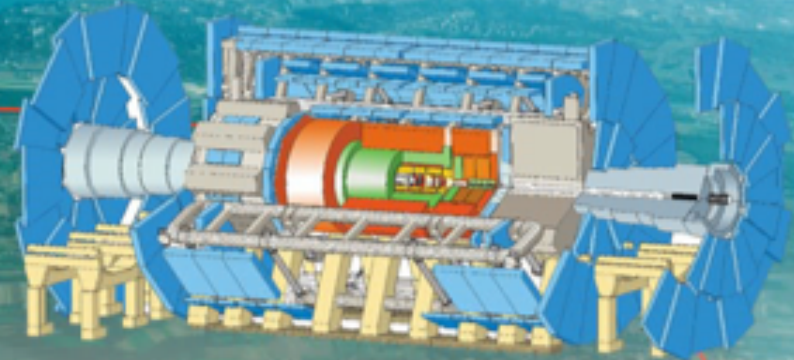
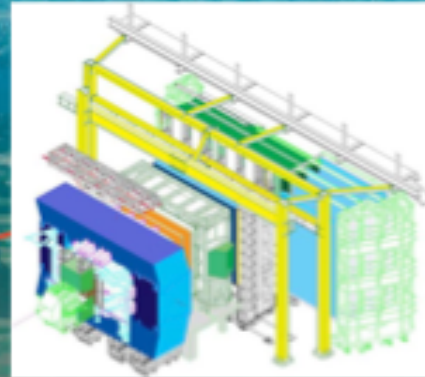
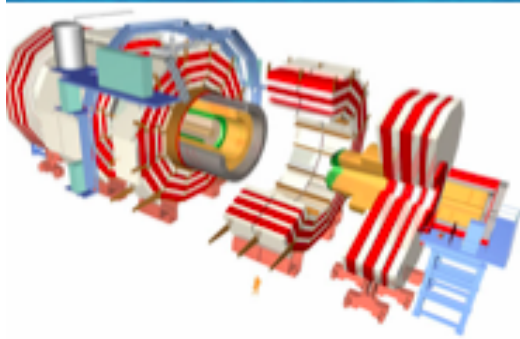


Safety organization and Safety status of the Experiments



O. Beltramello
(in behalf of LHC Experiments)
Chamonix 2010

The LHC Experiments have implemented very high safety standards in the experimental areas in order to be ready for LHC operation

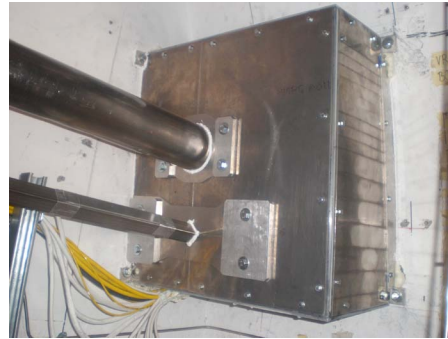
(Run period and Shutdowns activities and in case of re-occurrence of an Accidental He release in tunnel areas) :

- The experimental caverns have been pressure protected and sealed.
- The Alarm 3 systems are operational and under maintenance control.
- A reinforced Safety Structure and Organization has been set up :
 - A strong activities analysis, approval and planning structure
 - And a key role : the SLIMOS
- A close collaboration with the CERN Fire Brigade has been developed
- The Radioprotection strategy has been set up and is operational.

Experimental caverns and Service Caverns Protection against Accidental Tunnel He release:



Survey galleries doors and walls



Survey holes (ATLAS)



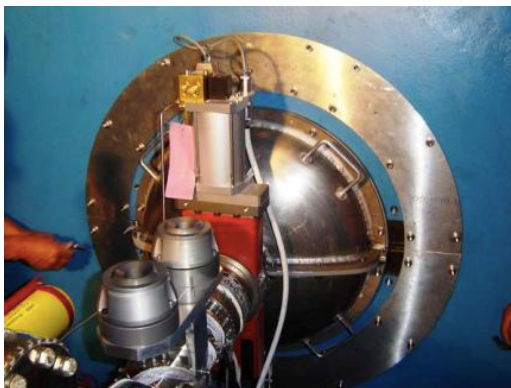
All caverns exits (CMS)
(cable trays, doors, etc..)



TAS region (CMS)



UX-Tunnel I/F (LHCb)



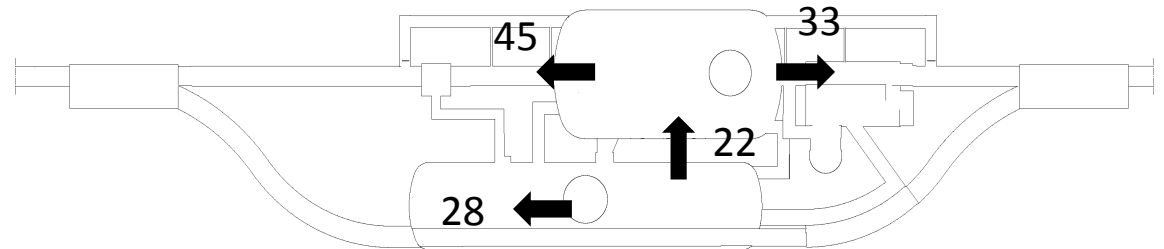
1/26/10 TAS region (ATLAS)

Separating structures have been redesigned to be

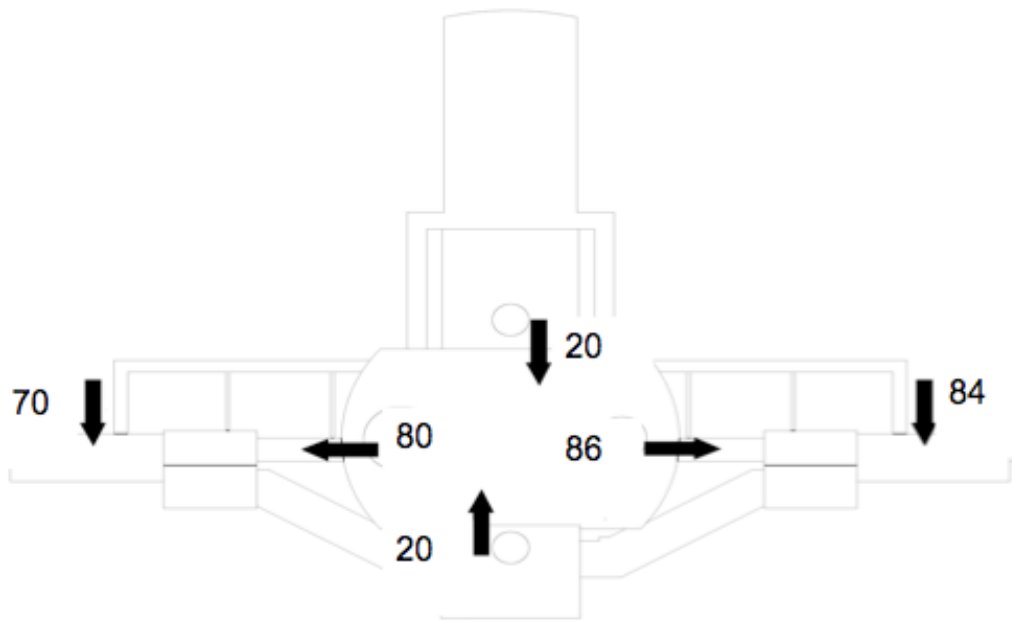
- ✓ pressure and temperature resistant
- ✓ fire protecting
- ✓ very tight sealing
- ✓ and meeting ALARA and survey equipment requirements

The doors positions are monitored via LACS

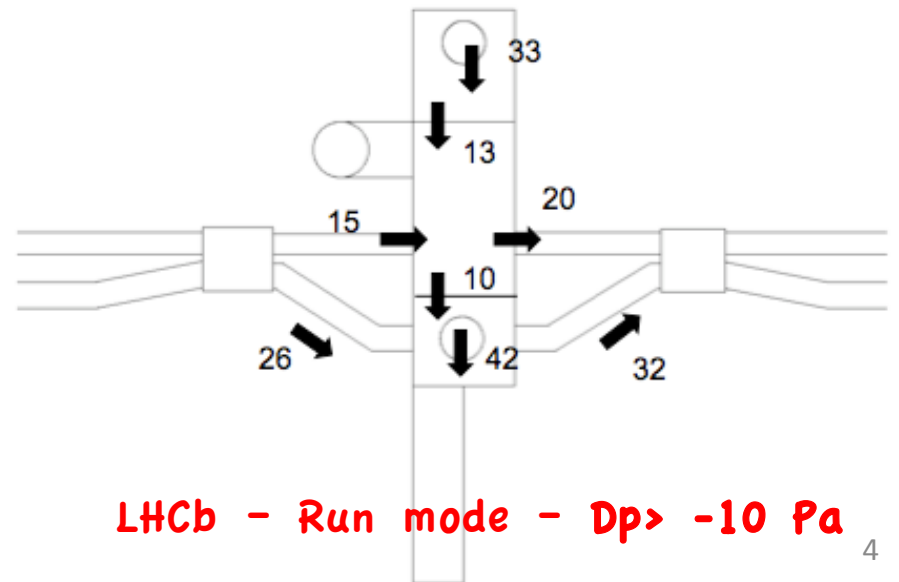
✓ As consequence and thanks to the collaboration with EN-CV:
as side benefits for Fire protection and radioprotection,
the overpressures between the experimental caverns and the tunnel have been
highly improved.



CMS - Run mode - $Dp > 22$ Pa



ATLAS - Run mode - $Dp > 20$ Pa



LHCb - Run mode - $Dp > -10$ Pa

Alarm level 3 systems

Their coverage have been reinforced.

An example :

The CMS survey galleries are linked to the tunnel volume.

As consequence, ODH detectors have been implemented for an early detection in case of re-occurrence of an He release in tunnel area.

The evacuation matrix are under revision.

The alarm level 3 systems have been audited.

They are operational and under maintenance control.



The Experiments safety organization and structure have been reinforced

Collaboration Institutes
Safety commission
CERN departments
All CERN Safety Committees,
Fire Brigade, DSOs, etc...

GLIMOS					
Experimental Safety Officers	Experiment Radioprotection Group	Safety Engineering and Database Team	Work Package Analysis Team	SLIMOS Shift Leader in matter of safety	Patrol Team
Technicians, Engineers, physicists Experimental areas safety officers	Engineers and Physicists Organize, implement and perform RP tasks for experiments. Under DG-SCR authority	Engineers and Physicists General safety projects Responsible of the Safety systems (DSS Sniffers, etc..)	Engineers + independent Safety Coordinators (for access period) Access and activity coordination in Experimental areas	Engineers and Physicists Safety responsible in Control Rooms	Technicians, Engineers, physicists Patrols leaders Patrollers
CSO Cryogenics FGSO Flammable Gases LSO Laser ESE Electrical TSO Territorial	RSO Radiation Safety Officer ALARA responsible RPE (radioprotection experts) RPA (radioprotection assistant)	Database development and maintenance.			

➤ Work Package Analysis structure : Activities and access control organization during LHC Run period

- ✓ The activity manager creates a work declaration to request access to caverns
- ✓ He provides the appropriate safety and working information

Work description
Criticality
Schedule

- System affected, description of the work, [working procedures](#)
- [Estimated time of intervention, region of access, warning time](#)
- [Criticality of access](#) :
 - Medium criticality, access request between fills
 - Low criticality, access during the next planned short shutdown period
 - Long shutdown access : annual maintenance , long term installation or intervention, ...

Safety aspects
Radioprotection
ALARA

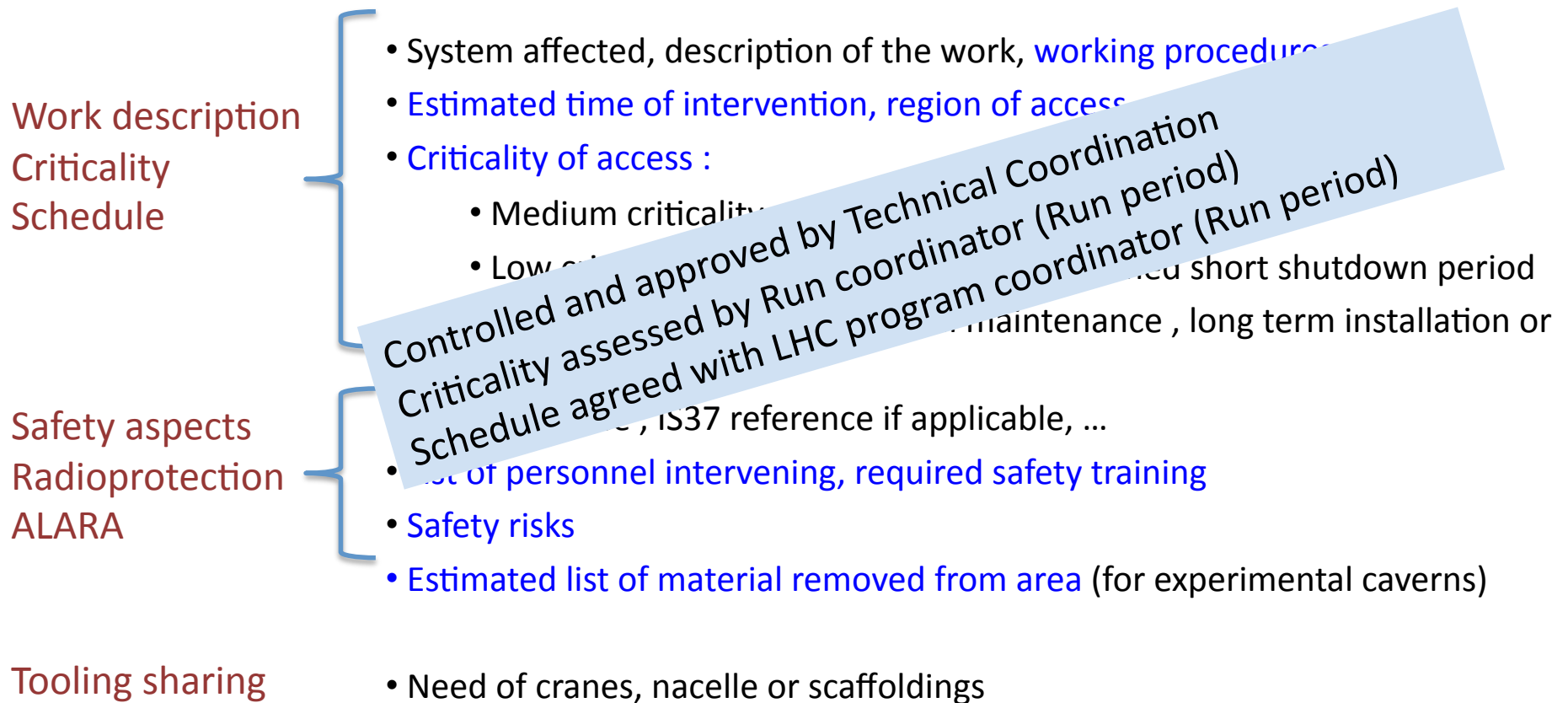
- WPA reference , IS37 reference if applicable, ...
- [List of personnel intervening, required safety training](#)
- [Safety risks](#)
- [Estimated list of material removed from area](#) (for experimental caverns)

Tooling sharing

- Need of cranes, nacelle or scaffoldings

➤ **Work Package Analysis structure :**
Activities and access control organization during LHC Run period

- ✓ The activity manager creates a work declaration to request access to caverns
- ✓ He provides the appropriate safety and working information



- **The SLIMOS (Shift leader in matter of safety):**
a Key role in the Experiments Safety Organization.

The Experiments Safety, Infrastructure and Access data converge to a central location: the SLIMOS desk.

These data are treated by the SLIMOS to which the GLIMOS delegates part of his safety duties together with the necessary authority.

The SLIMOSes are specifically trained for their safety duties.
They follow regular information/instruction campaigns .

Weekly feedback and training meeting with the GLIMOS (ATLAS).



What are the SLIMOS main activities ?

The SLIMOS coordinates the experimental cavern opening and closing process during the Beam period.

- ✓ Check the safety conditions of the cavern
- ✓ Coordinate the RPE / Safety team interventions (RP veto removal, material activation controls,...), coordinate the Patrol intervention if required,..
- ✓ Check the ventilation status and caverns overpressures (ATLAS, CMS)
- ✓ Run the access opening and closing procedures with CERN Control Center
- ✓ Strictly control the person and material going in and out during the intervention.

He coordinates actions after level 2 and level 3 alarms inside the Experimental areas: Interaction with the Fire Brigade, the CERN Control Center and the Infrastructure and Experiment Experts.

A link through the web to all SLIMOS data and procedures: the SLIMOS handbook

ATLAS Operation Page
Information for Shifters

SLIMOS & Infrastructure Handbook

Introduction
Procedures
Links

Homepage

- › Topics
- › Phone Numbers
- › Desk Intro & Troubleshooting
- › Desk Intro (old)
- › SLIMOS Training
- › List of Acronyms
- › Useful Links

Alarm Systems

- › CSAM
- › DSS
- › LASER Console
- › CIC Alarm Screen

Access / Control

- › Underground Access
- › Safety Controls
- › SSA
- › LACS/LASS
- › FPIAA
- › Web Cams
- › Diode Panels
- › Patrol

Infrastructure

- › Electrical Power
- › Power Cut
- › Cryogenics
- › Cooling & Ventilation
- › Detector FE Cooling
- › Gas System
- › Magnets
- › LHC and Beam

Safety Systems

- › DSS
- › Sniffer
- › Emergency Buttons Panel
- › Foam system
- › Seismic
- › Minimax
- › Temperature sensors

Fire Brigade Interventions

- › ATLAS Mapping
- › Intervention Procedures
- › Fire Brigade Information

Alarm / Action Matrixes

- › ODH Matrix
- › Flammable Gases Matrix
- › Fire Matrix
- › AUG Matrix

Radiation Protection

- › RP Procedures
- › RAMSES
- › Radiation Gate Monitors

1/26/10

Other Safety Matters

- › ATLAS Visits
- › ATLAS Safety Equipment

Procedures for
SLIMOS
RPE / RPA
Patrollers
Guides
Point 1 Users

Links through web to :
GLANCE (DSS)
System data (from DIP)
Etc..

- [Patrol Procedure](#)
 - [Start of Patrol](#)
 - [Follow the Patrol](#)
 - [End of Patrol](#)
- [Toroid area detailed Patrol Procedure](#)
- [Infrastructure area detailed Patrol Procedure](#)

The **Patrol Procedure** [ATC-TY-EY-0090 \(EDMS 887042\)](#) provides the general procedures for the SLIMOS, the head of patrol and the patrollers, but also the UX15 topology and subsectorisation.

The patrol of ATLAS requires a minimum of 1 head of patrol, 4 patrollers and the SLIMOS. The patrollers will follow the patrol as per the following procedures:

- The **Toroid area detailed patrol procedure** is in : [ATC-TY-EY-0101 \(EDMS 909906\)](#).
- The **Infrastructure area detailed patrol procedure** is in : [ATC-TY-EY-0102 \(EDMS 909907\)](#).

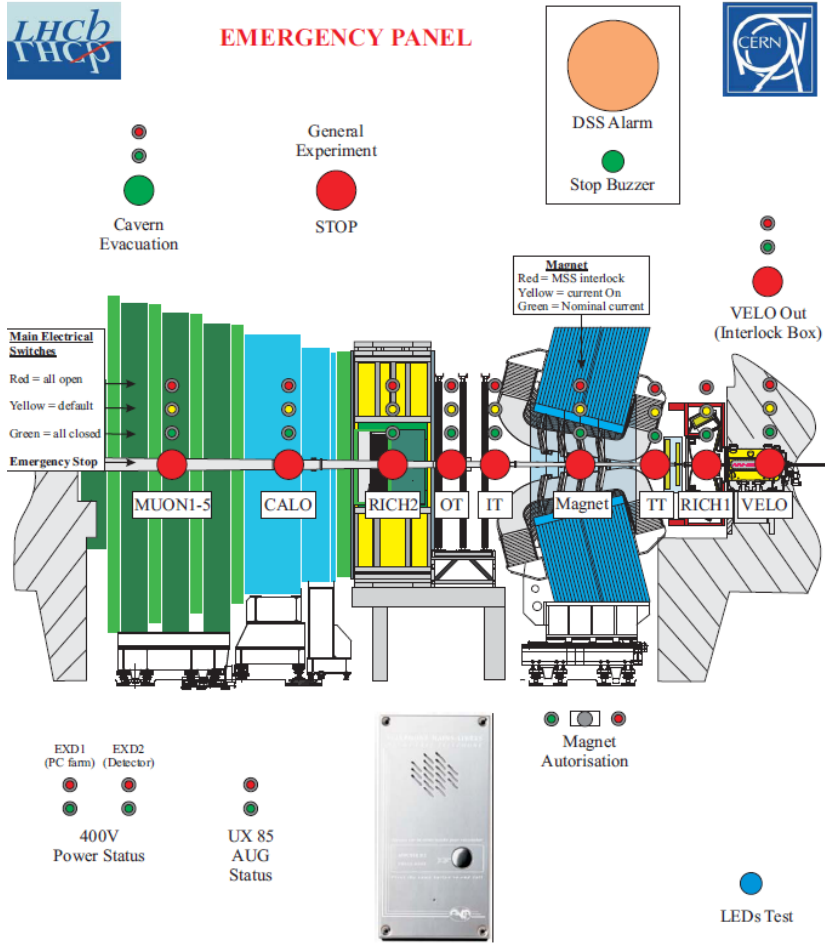
The list of the **On Call Patrollers** can be found [here](#).

Start of Patrol

SLIMOS Tasks	Important Notes
<p>1 - SLIMOS shall control the environment safety parameters:</p> <ul style="list-style-type: none"> • that there are no level 2 or level 3 alarms active undergrounds. • the level of radiation (via RAMSES), if necessary he can request the intervention of the RPE technicians. • The safety conditions of UX15 <p>2 - SLIMOS calls the 5 patrollers on-call to ATLAS control room</p>	<ul style="list-style-type: none"> • The SLIMOS is the only person authorized to initiate a patrol inside the ATLAS interlocked area. This function can be delegated to the ATLAS SLIMOS on shift. • Before authorizing the beginning of a patrol, the SLIMOS shall control the environment safety parameters of the infrastructure area of the cavern and of the detector and trenches area in case of a patrol of the Toroid Zone. <p>The Patrollers and the Head of Patrol shall first come to ATCR collect all relevant information from the SLIMOS :</p> <ul style="list-style-type: none"> • Subsectors of ATLAS cavern to be patrolled. • Reason of patrolling : they need to know if there is potentially one of several person inside the patrolled areas. • Detector configuration status : run configuration, access scenarios configuration, ... • Any relevant safety issue, ...

ATLAS - SLIMOS Handbook

Safety and Infrastructure parameters consultable at SLIMOS desk and through the web.



LHCb - Emergency panel

FSM not updated for more than 15 min!

MAGNETS

BarrelToroid	MAINTENANCE	OK	X
CentralSolenoid	FAST_DUMP	OK	X
ToroidEndCapA	MAINTENANCE	OK	X
ToroidEndCapC	MAINTENANCE	OK	X
Cryogenics	READY	W	✓

Operation

- Systems
- Services
- Infrastructure
- LHC machine

ATLAS MAGNET SYSTEM

Magnet status

Parameter	Toroids	Solenoid
Magnet status	Maintenance	Fast dump
Magnet set current [A]	29800.00	7730.00
Magnet actual current [A]	0.05	47.83
Power converter voltage [V]	0.06	0.02
Earth leak current [mA]	-0.27	0.00
T max busbar temperature [C]	20.10	20.30
T max dump resistor [C]	19.20	19.30

Services status

Parameter	Toroids	Solenoid
Cooling water circuits	OK	OK
Power converter water leak	N	N
Current meter water leak	N	N
Busbar water leak	N	N
Earth resistor water leak	N	N
Power converter status	OK	OK
Earth leak current breaker	ON	OFF
Magnet safety system	OK	OK
Vacuum heater system	OFF	OK
Quench heater status	OK	OK

Temperature

Toroids	Solenoid
ECT A: 55.83 K	180.41 K
Barrel: 66.28 K	
ECT C: 56.08 K	

Pressure

Toroids	Solenoid
ECT A: 8.24e-07 bar	1.10e-08 bar
Barrel: 9.15e-07 bar	
ECT C: 1.00e-08 bar	

Message from the Magnet Operator

Time Range: Y Axis: Save Other: 11 kg auto

✓ Tor Current: 0.05 01/07/2010 03:50:43 PM:184 ✓ Set Current: 47.83 01/07/2010 03:50:41 PM:779
 ✓ ECTA Temp: 55.83 01/07/2010 03:50:43 PM:184 ✓ Barrel Temp: 66.28 01/07/2010 03:50:43 PM:184
 ✓ ECTC Temp: 56.08 01/07/2010 03:50:43 PM:184 ✓ Sol Temp: 180.41 01/07/2010 03:50:41 PM:779

01/07/2010 03:50:41 PM:221 Tor Current: 0.05 Sol Current: 47.83 ECTA Temp: 55.83

General DCS help Help Info

ATLAS - Magnet Status

Collaboration between the Experiments and the Fire Brigade

Due to the complexity of the Experiments (especially ATLAS), the Fire Brigade requires specific information and assistance for their interventions in the Experimental Areas.

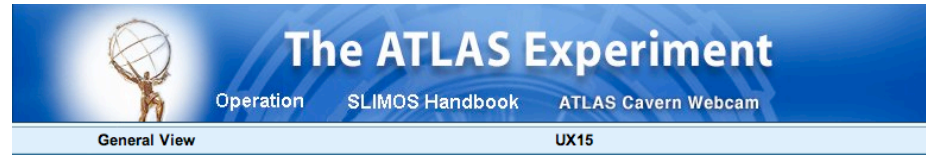
A collaboration program has been set up between the LHC Experiments and the Fire Brigade :

- ✓ The General Emergency Procedures under finalization
- ✓ An experimental site familiarization is organized by CMS and LHCb.
- ✓ Formal Experiment training delivered by ALICE and ATLAS to all Fire Brigade intervention teams (procedures, topology, specific risks,...).

Specific information for the FB intervening team available via web and at SLIMOS desk.

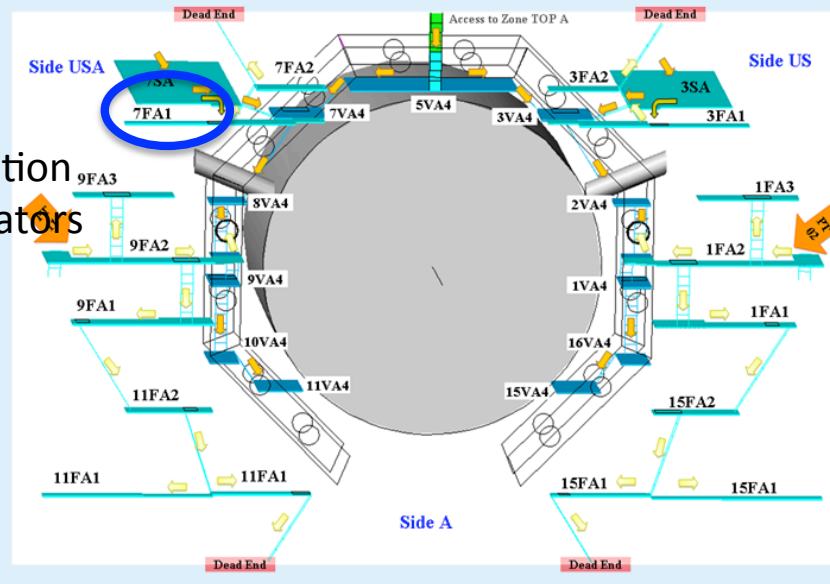


An example of complexity : the ATLAS TOROID area



UX 15 Zones

| TOR - USA | TOR - US | TOR - TOP | TOR - Bottom | TOR - S3&S7 | HS - USA | HS - US | HO - A | HO - C |



View from side A | Isometric View | View from side C



Location identification
Specific naming convention used by ATLAS collaborators and the Fire Brigade

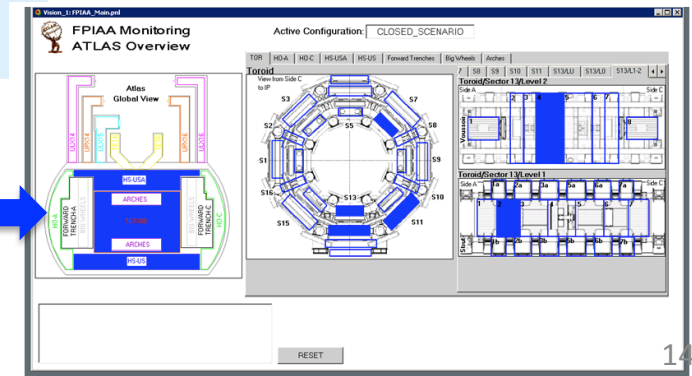
How to access fast the areas ? →

Routing	Risks
<p>Doors : PT02 PT03 PT11 PT12 for F platforms (HS-US/USA - level 4); PT01 for sector 3S (HS-US level 7); PT10 for sector 7S (HS-USA level 7)</p> <p>Complex zone with platform rings: * 2 rings per side: 1 ring of F platforms (cyan) and 1 of V4 platforms (blue) * All the rings have NO connection with other zones (Dead ends) except access to zone TOR - TOP from platform 5VA4 (green/blue) * Platforms 7FA1 and 7FA2 can only be accessed from sector 7SA * Platforms 3FA1 and 3FA2 can only be accessed from sector 3SA</p>	<p>Platforms not accessible: - Side A: 11FA2, 11FA1 - Access blocked with rubalise in 9FA1 platform</p> <p>Places where harness is required : Small platforms in 7SA / 3SA without personnel protections (in the lower part of the zone)</p>

What are the risks and specific access difficulties ?

- Harness area
- Holes
- Ladders
- Etc..

And ... Fire Brigade team progression followed and assisted by the head of intervention and the SLIMOS In control room using FPIAA tracking system



The Experiments Radioprotection Strategy and Implementation

- ✓ The Experiments RP strategy has been defined and agreed with DGS-RP group.
- ✓ Experiments Radioprotection Experts and Assistants (RPE / RPA) have been certified by external national RP authorities and are regularly trained by DGS-RP. They perform RP tasks in low risk areas ($<15\mu\text{Sv/h}$).
- ✓ The RP procedures have been issued in collaboration with the Experiments and DGS-RP : **material control, traceability, veto removal, ...**
- ✓ Most of the radioprotection tools and devices have been implemented.



An example of more than 1 year of Radioprotection strategy operational : ATLAS Experiment.

Since Sept 2008, LHC first Beam :

- ✓ The RPE/RPA shifts are active :
 - during working hours in Shutdown period
 - 24H/7D in Run period.
- ✓ The Material control and traceability console is operational (common approach between experiments : ATLAS, CMS, LHCb, soon ALICE):
All material going out of the experimental caverns is measured, labeled and traced in the database.

ATLAS Equipment Traceability

Search Equipment Register New Equipment Set Radiation Background Close all tabs Save All Manage User Roles

21TYCER0000748

Print Equipment Label

Equipment Information

Equipment ID	21TYCER0000748
Description	structure platform S5-C
Other ID	
Registration Date	2010/01/08 10:09:56
Equipment Responsible	RDLOUIS <input type="button" value="Change"/>
ATLAS System	General Infrastructures & Services
Equipment Type	Standard Type <input type="button" value="New"/>
Weight [kg]	
Material	
Length [mm]	
Width [mm]	
Height [mm]	

Position

Current Position: SSC

New position:

Position History

Radiation - ○ SX1 / ○ ULX15

Current radiation thresholds:
Updated on: 1/26/10

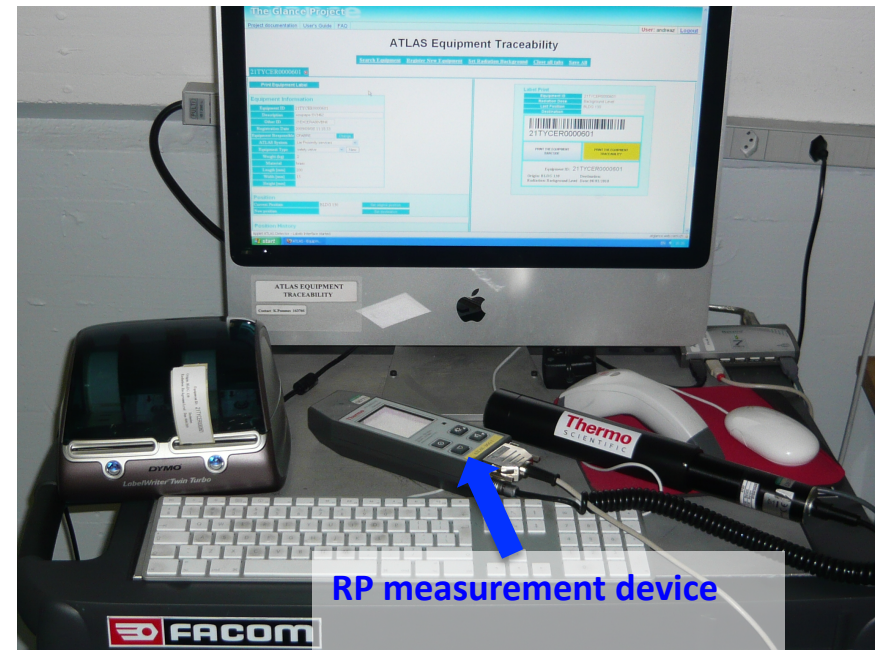
Equipment Destination Selection

Select a Zone:

OR Select a Functional Position:

SCHEMATIC VIEW OF DETECTOR BARREL

Database – Glance interface



✓ **Radiation Gate monitors** have been installed at UX15 cavern exits and at radioactive buffer zone exit to detect any radioactive material going through.

In such case, an alarm would be given to the SLIMOS who will immediately initiate an **emergency intervention/ procedure**.

**Video surveillance ,
siren, flashes**

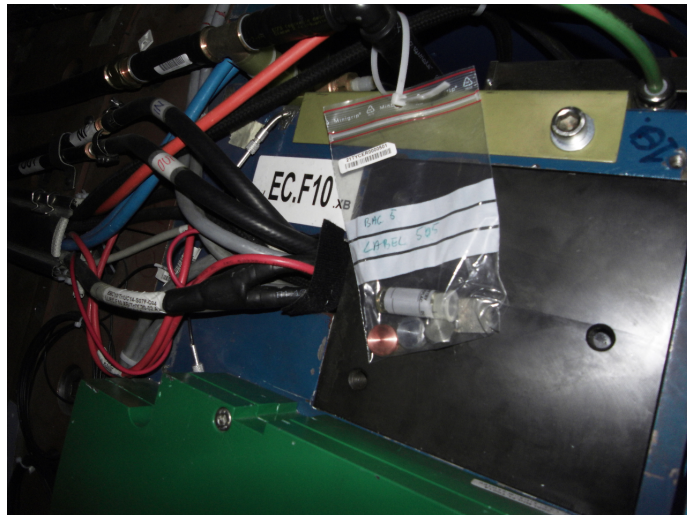


UX15 cavern exit

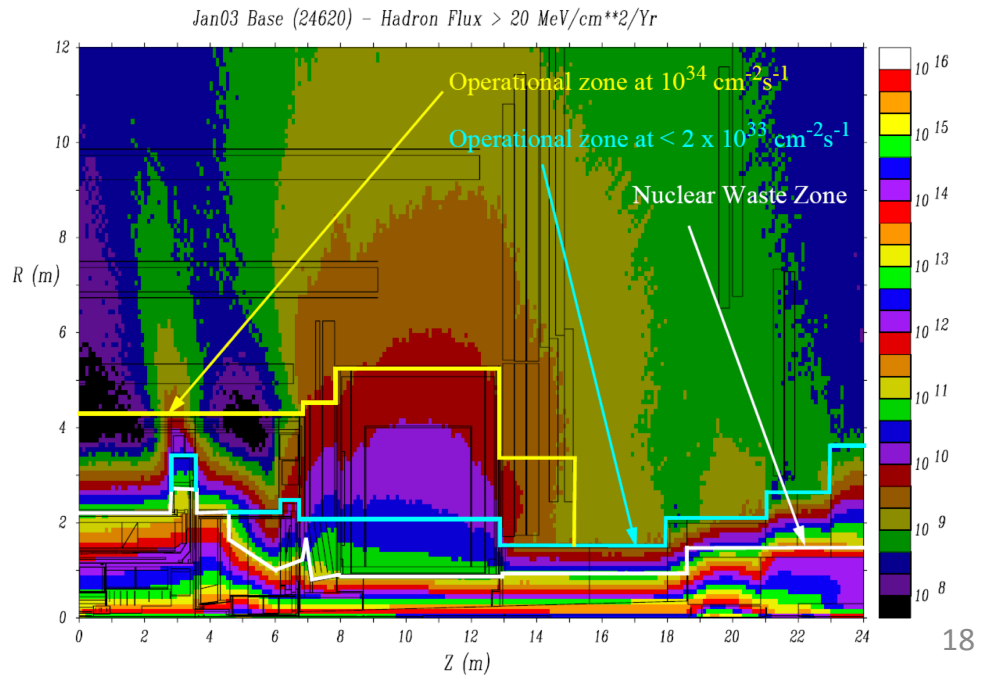
ATLAS Control Room

✓ A campaign of controls of the radiation calculations and radiation zones boundaries

≈ 95 samples (ATLAS) have been placed inside the detector and experimental area to be analyzed to confirm the radiation calculations.



Regular RP survey are performed to control dose rates calculations.



✓ **ALARA strategy (ATLAS)**

The complete **ATLAS Closure scenario** has been filmed last year in collaboration with the intervening teams in order to prepare for ALARA :

- ✓ detectors movements,
- ✓ survey activities,
- ✓ beam pipes activities,
- ✓ scaffolding and cranes activities, ...

This is a huge amount of information vital for the future ALARA optimization process.

These data are currently under treatment :

- ✓ calculation of associated dose per activity and per type of personnel
- ✓ process optimizations ..

An ALARA workshop will be organized this spring within ATLAS collaboration to report about these studies and plan future activities analyses.

As conclusion, in the 2008/2009 shutdown period, the ATLAS Collaboration has gained experience and has carefully followed the material handling and radioprotection procedures.

Conclusion

A huge effort has been done in the past years to reach very high safety levels in the Experiments.

There are nevertheless still some open issues which have to be addressed, See C. Schaefer presentation.