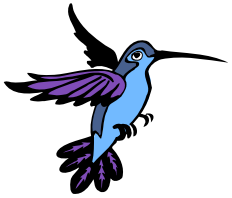# Commissioning the access system

Machine checkout workshop
November 8th 2007

M. Gruwé

Layout

- Access system:
  - Principle
  - Main constituents
  - LASS and LACS related consoles in CCC

- Tests:
  - Local tests
  - Integration tests
  - Functional tests
  - Global tests

- From global tests to start of beam

LHC access system

- Responsibility of TS/CSE group

- LACS: LHC Access Control System:
  - <u>Ensures physical barriers</u> outside and inside the LHC, by means of grids, doors, access points, etc…
  - <u>Identifies people</u> and controls their access authorizations

- LASS: LHC Access Safety System:
  - <u>Ensures the protection of the personnel</u> against the hazards arising from the operation of the accelerator and from the injection and circulation of the beams.
  - Acts on specific equipment (EIS = Important Safety Equipment)
  - By interlocking EIS:
    - Sets the accelerator and equipment conditions in order to allow access to authorized personnel
    - Allows the restart of the equipment and the accelerator when the access is finished
  - Controls the external envelope and the division of the various zones into sectors
    - so that no-one is left in when LHC is functioning
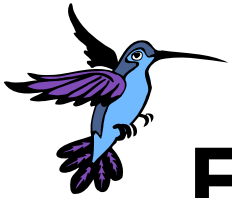   - and so that it is safe for people to access when LHC is stopped

EIS (Elément Important de Sûreté)

- EIS:
  - Either a dangerous piece of equipment
  - Or a piece of equipment which protects from some danger
- EIS-a: EIS-access
  - Doors, grids, mobile shielding walls, access point (MADs and PADs)
  - Search boxes, radiation veto, access key distributing system
- EIS-m: EIS-machine
  - Equipment related to access safety when operating the machine (irrespective of beam presence)
  - All located around point 4:
    - RF equipment
    - Electron stoppers
- EIS-b: EIS-beam
  - Beam controlling equipment.
  - EIS-c: EIS-circulating beam, to stop the circulating beam:
    - Power converters to essential elements
  - EIS-i: EIS-injected beam, to forbid injection of beam:
    - Mobile elements (TED, TBSE)
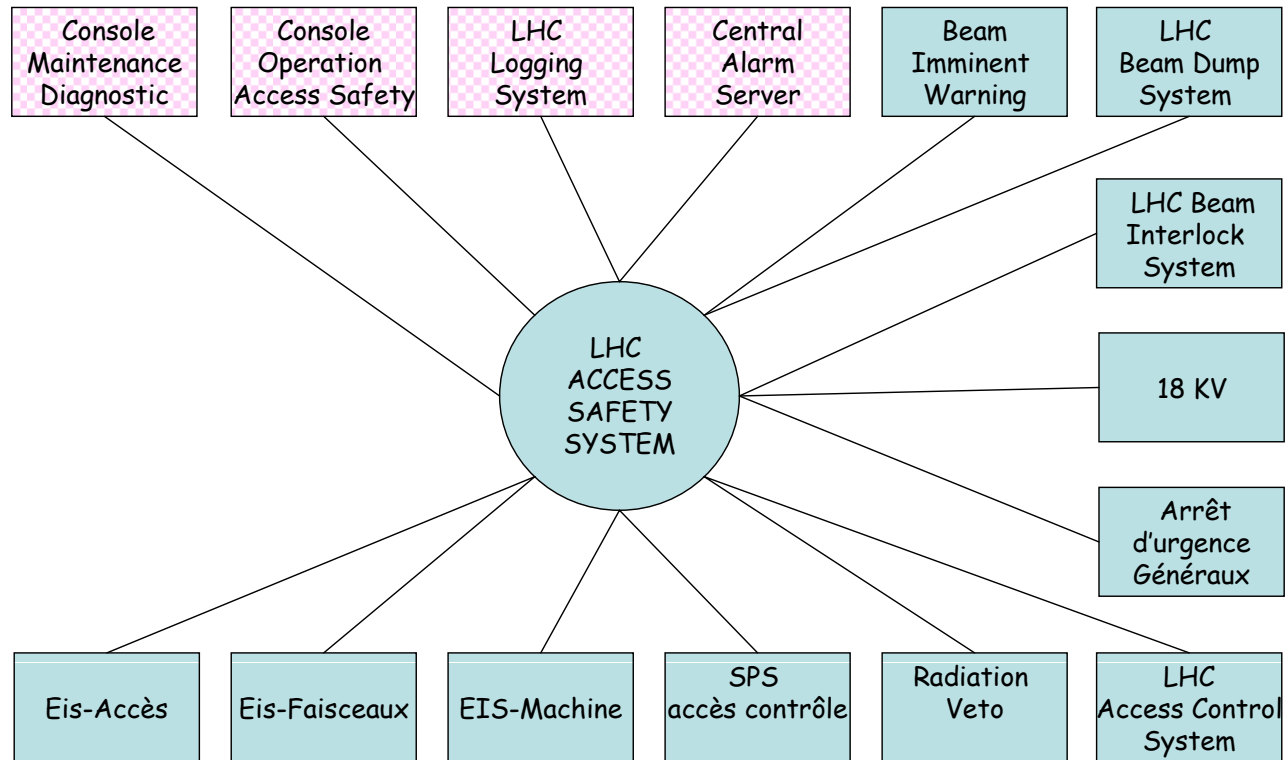   - Power converters to essential elements : dipoles, septa, kickers

Interfaces to LASS

Console Maintenance Diagnostic · Console Operation Access Safety · LHC Logging System · Central Alarm Server · Beam Imminent Warning · LHC Beam Dump System · LHC Beam Interlock System · 18 KV · Arrêt d'urgence Généraux · LHC ACCESS SAFETY SYSTEM · Eis-Accès · Eis-Faisceaux · EIS-Machine · SPS accès contrôle · Radiation Veto · LHC Access Control System

LASS stopping the beam
(interface to LBDS)
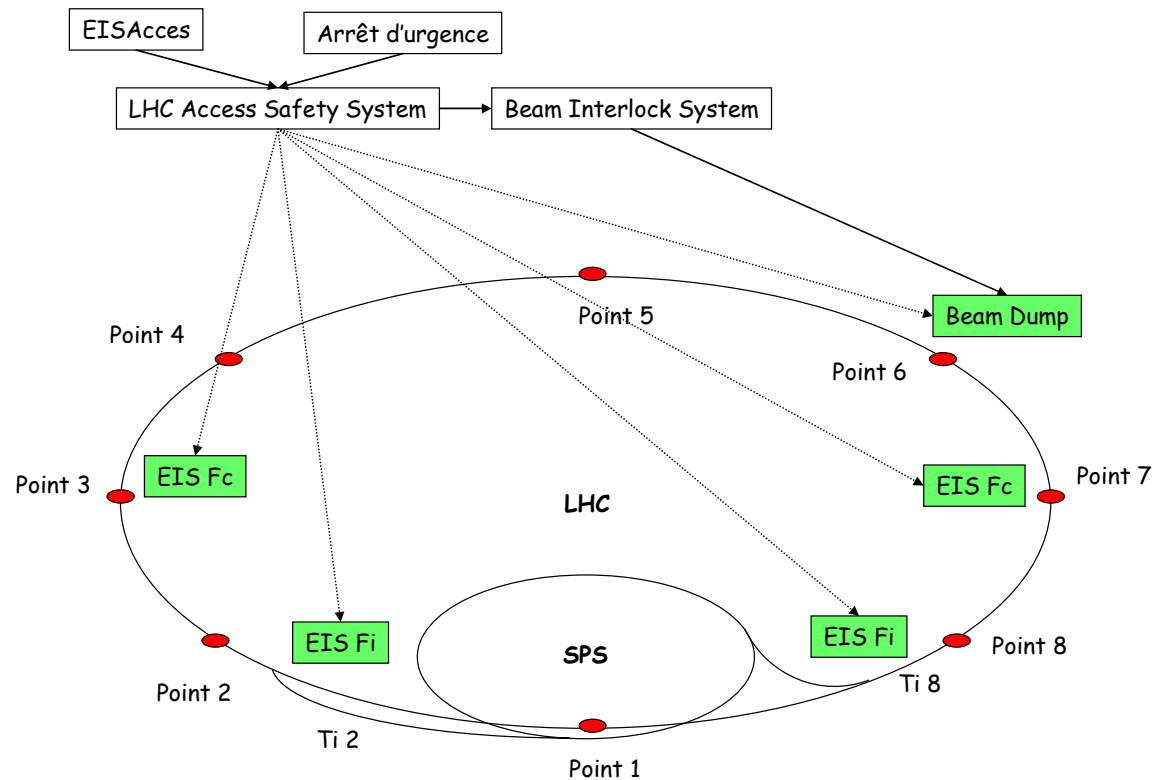
LASS modes

- "Access" mode:
  - LASS functions are:
    - Forbid switching ON dangerous equipment
    - Forbid injection and circulation of beams
    - Forbid access to a zone if one EIS-m or EIS-f is not SAFE
- "Beam" mode:
  - LASS functions are:
    - Lock the EIS-access
    - Stop beams and switch off all dangerous equipment in case one EIS-access has been forced.
- Transition mode:
  - To go from one mode to another
- Mode "Mise en sécurité":
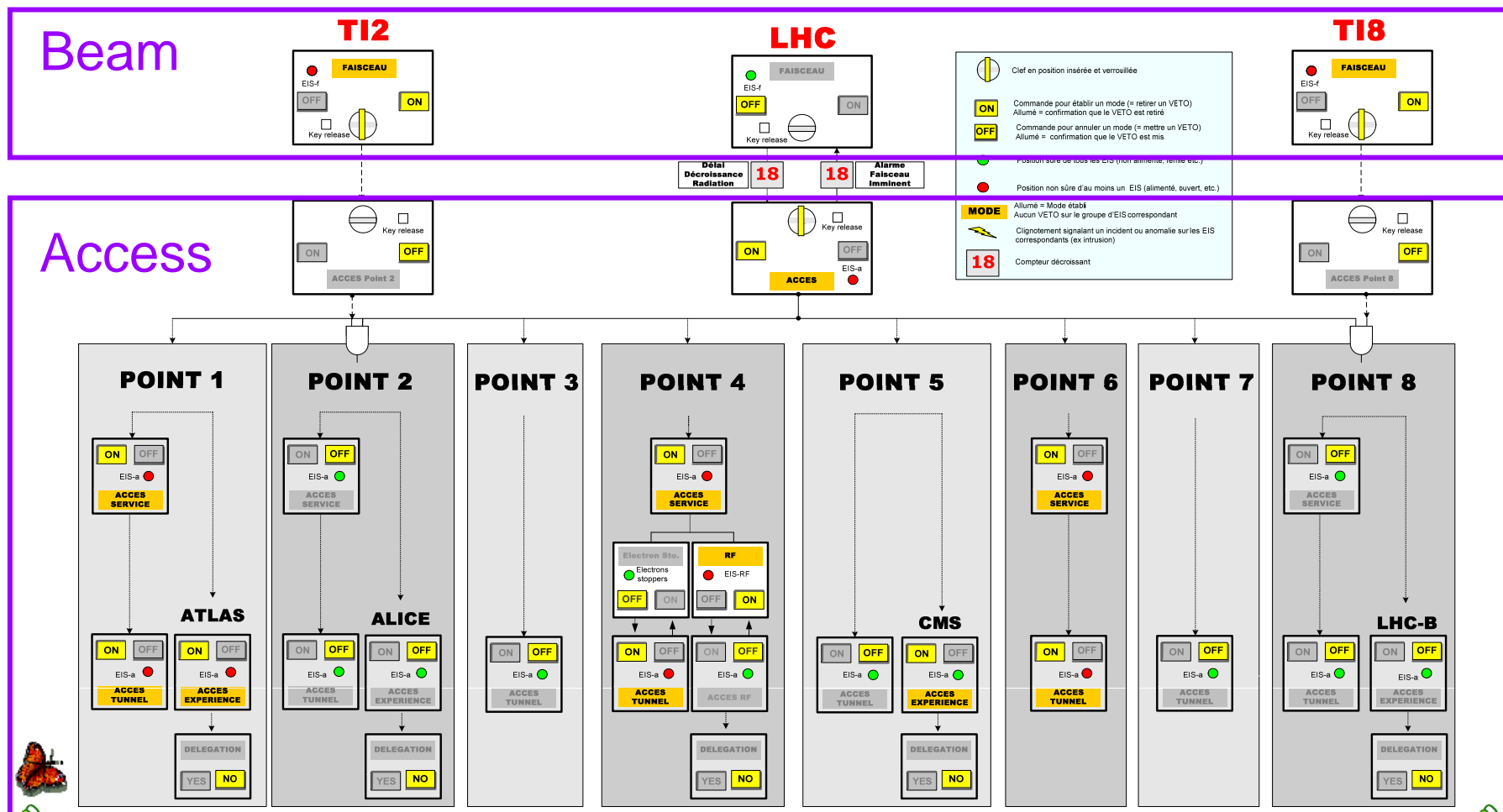 - No access nor beam is allowed: all EIS are locked

LASS console

LACS modes

- Closed mode:
    - No access is allowed: beam or other hazards could be present
    - Prerequisite to LHC beam operation
- Test mode:
    - Access restricted to a list of registered specialists, in certain conditions
    - For example during RF tests
    - All accessing personnel must take their own safety token at access point
- Restricted mode:
    - Access allowed after approval by control room operator
    - All accessing personnel must take their own safety token at access point
- Patrol mode:
    - When search being conducted in the zone
    - Access allowed after approval by control room operator
    - All accessing personnel must take their own safety token at access point
- General mode:
    - Access allowed without prior approval by control rooms

Console for changing access modes

Select ALL	Zone service		Zone Tunnel				Zone experimentale	
Point 1	PM15	PM18	UJ14	UJ16			ULX15	UPX16
Point 2	PM25		UJ23	UP23	UJ27		PX24	
Point 3			PZ33					
Point 4	PM45	PZ45	UJ43	Uj47	Ux46			
Point 5			PM56	UPX56	UP55	UL55	USC55	
Point 6	PM65		UJ63	UP63	UJ67			
Point 7			PM76					
Point 8	PM85		UJ83	UJ87			UX85	

Mode selection | General | Restricted | Patrol | Closed

VALIDATE   CANCEL

LASS view
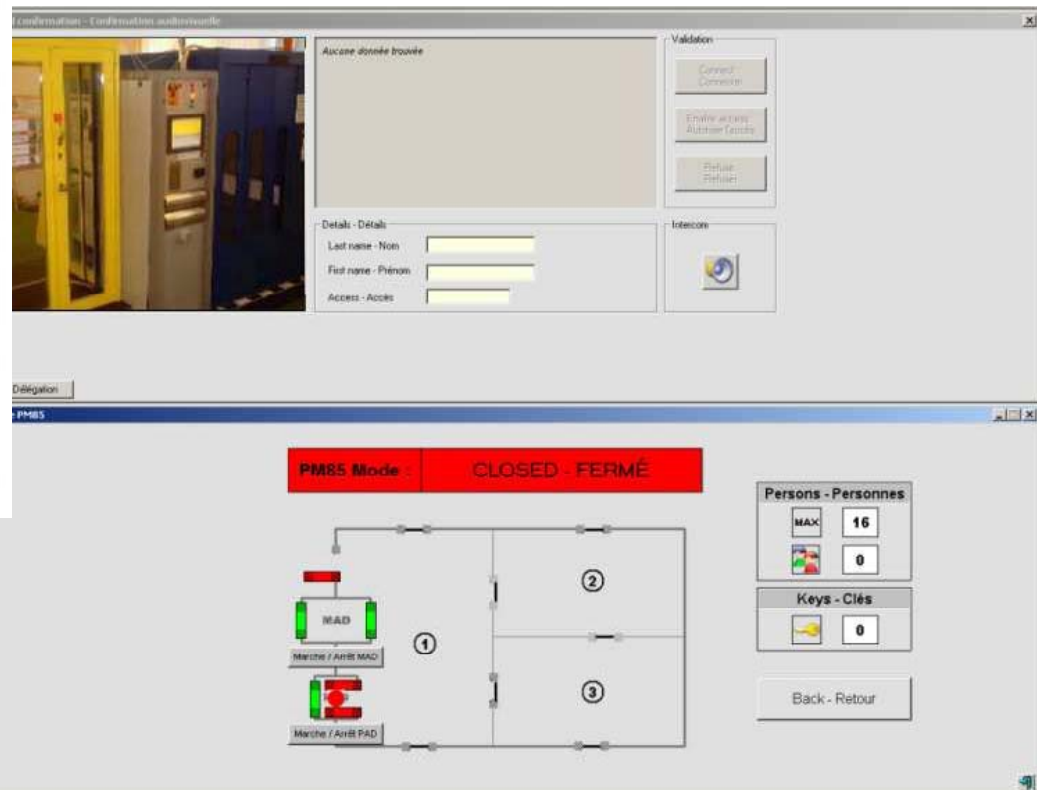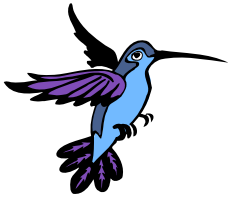
IHM supervision of LASS
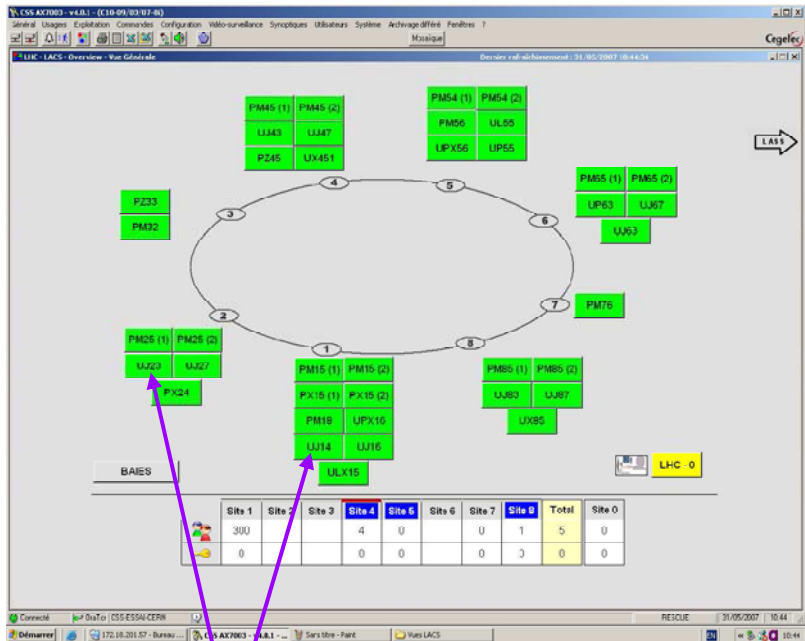
Access point

Access system tests

1. **Local acceptance tests:**
   - Test locally each EIS-a and interfaces with EIS-b, EIS-m and other machine equipment

2. **Integration tests:**
   - Test each EIS-a and interfaces with EIS-b, EIS-m and other machine equipment in control rooms

3. **Functional site tests:**
   - Test scenarios of dangerous events of the site

4. **Functional inter-site tests:**
   - Test scenarios of dangerous events for several sites together

5. **Global tests and final tests:**
   - Test scenarios of dangerous events for the whole LHC machine

6. **DSO tests and OP acceptance tests**

Functional site tests

- Tests performed per
  - LHC operational mode (Access, Access=>Beam, Beam, etc...)
  - Dangerous Event
    - presence of people inside the machine
    - access authorized when high radiation level
    - beam circulating
    - intrusion

- Tested safety functions:
  - Search and token functions (behavior of sector search and search transfer)
  - Test interlock chain RF/ES (Point 4)
    - Interfaces => EIS-m, EIS-a
  - Test partially interlock chains LHC, TI2, TI8
    - Interfaces => BIW, BIC, AUG, EIS-b, EIS-a, SPS
  - Radiation veto functions
  - Patrol functions and procedures
  - Local delegation (Experiments, RF)
  - Intrusion
  - Passage Access => Beam
  - Passage Beam => Access

Status of integration and functional site tests (I)

- Point 1:
  - Functional tests: week 46
  - Including access points in UJ14 and UJ16
  - Including SSA (Safety System Atlas)?
- Point 2:
  - Functional tests: Done
  - Some NC
- Point 3:
  - Functional tests: Done
  - Some NC
- Point 4:
  - Functional tests: Done
  - Some NC

Status of integration and functional site tests (II)

- Point 5:
  - Integration tests: weeks 45, 47 and 48
  - Functional tests: weeks 49
- Point 6:
  - Integration tests: weeks 45, 46 and 51 (?)
  - Functional tests: week 51 (?) or week 2, depending on cool down
- Point 7:
  - Functional tests: Done
  - Some NC
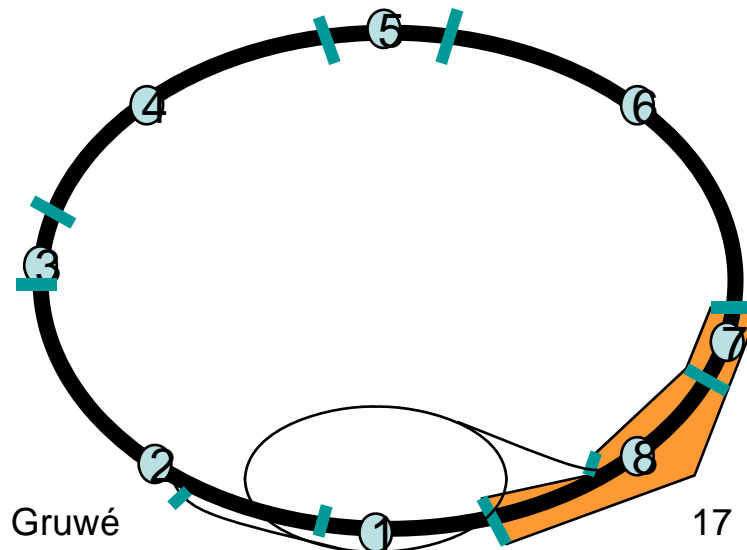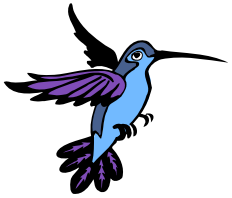- Point 8:
  - Functional tests: Done
  - Some NC

Functional inter-site tests

- Tests performed only after site tests completed successfully
- Tested safety functions:
  - Intrusion
  - Interlock chain LHC
    - Test interfaces => BIW, BIC, AU, EIS-b, EIS-a
  - Interlock chain TI2, TI8
    - Test interfaces => BIW, BIC, AU, EIS-b, EIS-a, SPS
  - Passage Access => Beam
  - Passage Beam => Access
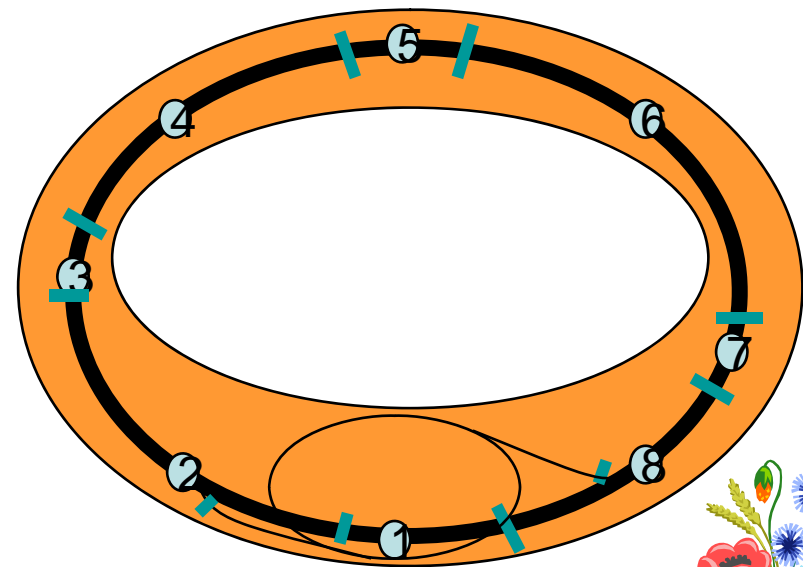 - Search for inter-site doors

Global tests

- Tests performed only after all site tests and inter-site tests completed successfully

- Tested safety functions:
  - Intrusion
  - Interlock matrix
  - Passage Access => Beam
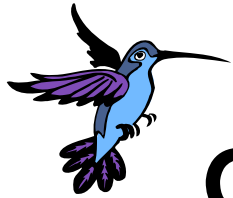 - Passage Beam => Access

Global tests: week 2 (2008) (draft)

5 days

- Closure of the whole LHC: complete search (patrol) of all zones:
  - All points (sites), all beam, service and experimental zones
- Functional tests of inter-site doors
(between LHC 6 and 7 and between LHC 8 and 1):
  - In access mode: opening of an inter-site door
- Rearming all search boxes after tests

1 day

- Functional tests of EIS-b (no power ON):
  - In access mode:
    - **Loss of SAFE position of one or more EIS-b or EIS-m:**
      - **Initial state: ACCESS LHC ON**
      - **Final state: ACCESS LHC OFF, and "imminent beam siren" ON (if more than one EIS-f or EIS-m)**
    - **To be done for EIS-b and EIS-m of LHC and for EIS-b of SPS chains 3 and 5**
  - In beam mode:
    - **Intrusion tests**
    - **Opening of one EIS-a inside the machine**
    - **AUG**
      - **Initial state: BEAM LHC ON**
      - **Final state: BEAM LHC OFF, and all EIS-b reacting appropriately (signals propagated to dump system etc…)**
    - **To be done for LHC, TI2 and TI8**

1 day

- Functional tests of EIS-b (with power):
  - In access mode:
    - **Real loss of SAFE position of one EIS-b**
    - **To be done for LHC, TI2 and TI8**

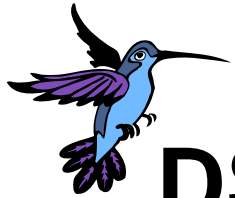> **OP participation for training:**
> **Patrol and access consoles**

DSO tests and OP acceptance tests

- **Still to be properly defined…**
  - Cannot be done till the system is fully installed.
  - But partial DSO tests should be done as soon as possible to allow time for improvement: done already for point LHC 2, but should be repeated and extended to other sites and to whole LHC.
  - Partial OP acceptance tests can be done through participation of OP in the TS/CSE (functional and global) tests and later in the DSO tests.
  - As part of the acceptance tests:
    - Giving access to a large number of people, at a few access points at the same time (test of the restricted access at access points and of the interface in CCC).
- **Need training of people**
  - As patrol leaders and patrol members
  - To use the three consoles
    - LASS console
    - Console for changing access modes
    - Console/soft for giving access
- **Training and preliminary acceptance tests done during the global tests, w2?**
  - Still to be organized. How many people? What can be done?

From "global tests" to start of beam

- After global tests, access system will be put back as it is now because of installation (no dosimeter, no biometry, no tokens,…)

- In addition:
  - Some non-conformities to be fixed
  - Points 7 and 8 have a different LASS version than other points. Will have to be upgraded.
  - Additional ventilation doors to be installed
  - Some improvements required
  - IHM supervision of LACS to be improved => new version

- DSO tests (partly repetition of functional and global tests) and acceptance of the system by OP will have to be done at some point…

- There will be new versions of both LASS and LACS available a few months later

- Maintenance tests (once a year, after shutdown) will be a sub-set of the integration/functional/global tests. Still to be defined.

References

- LASS:
  - Functional specification: edms 362437
  - Glossary: edms 456552
  - Detailed technical specification: edms 571277
- LACS:
  - Functional specification: edms 386759
- Tests:
  - Planning of functional tests: edms 809577 (Eva Sanchez-Coral)
  - General view of LHC Access tests: edms 497865 (presentation by Silvia Grau and Eva Sanchez-Coral)
  - Global tests: draft by Silvia Grau
  - Local tests: edms 815380
- Thanks:
  - to TS/CSE in general, and more specifically for this presentation, to P. Ninin, E. Sanchez-Coral and S. Grau