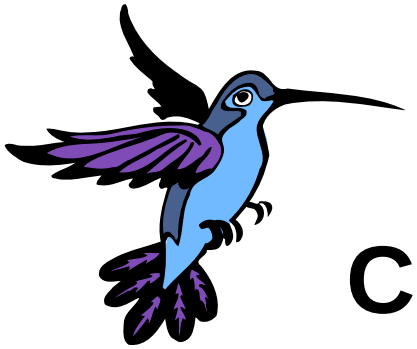
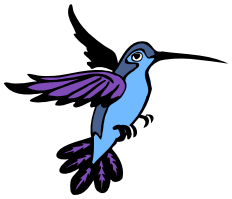


Commissioning the access system

Machine checkout workshop

November 8th 2007

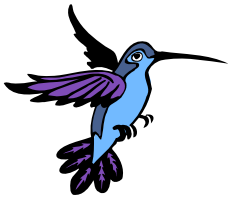
M. Gruwé



References

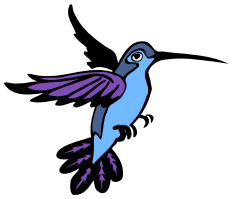
- LASS:
  - Functional specification: edms 362437
  - Glossary: edms 456552
  - Detailed technical specification: edms 571277
- LACS:
  - Functional specification: edms 386759
- Tests:
  - Planning of functional tests: edms 809577 (Eva Sanchez-Coral)
  - General view of LHC Access tests: edms 497865 (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



Layout

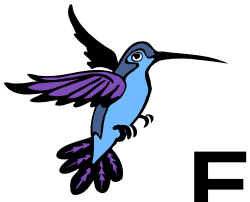
- Access system:
  - Principle
  - Main constituents
  - LASS and LACS related consoles in CCC
- Tests:
  - Local tests
  - Integration tests
  - Functional tests
  - Global tests
- From global tests to start of beam



LHC access system

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

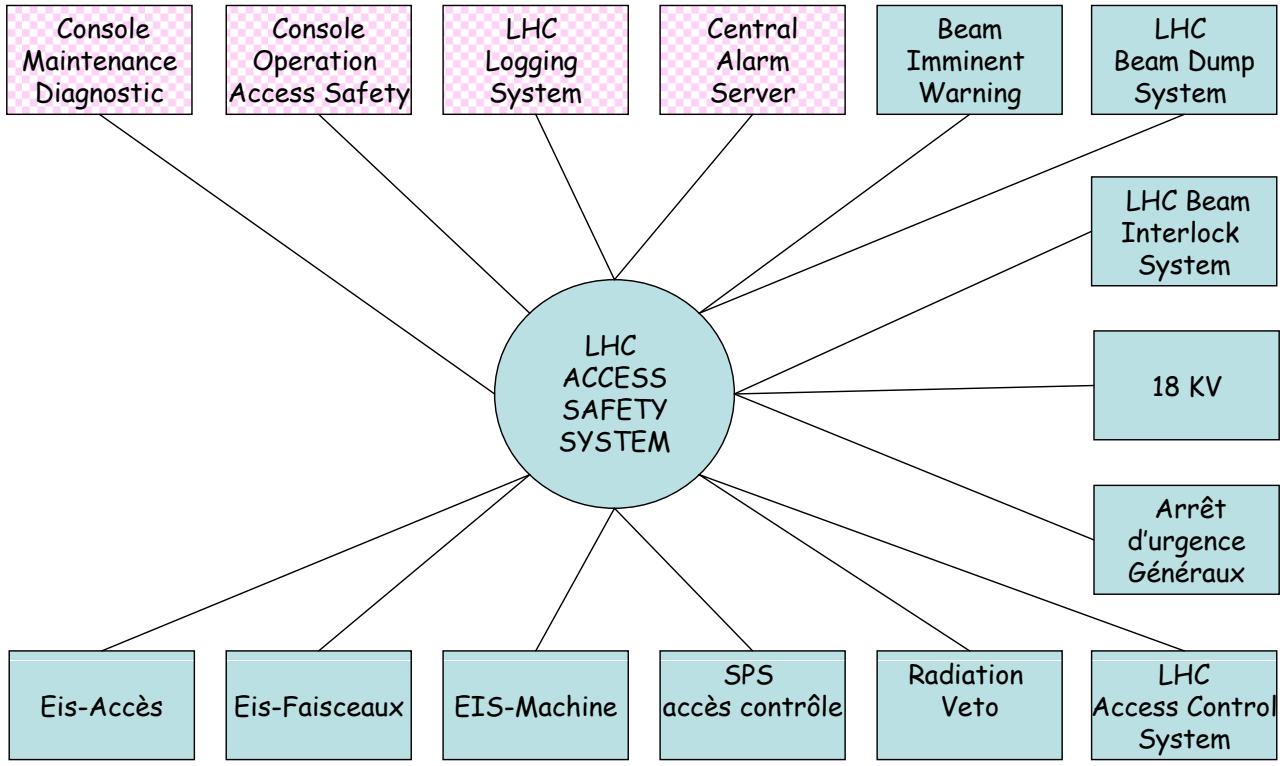
- LASS: LHC Access Safety System:
  - Ensures the protection of the personnel against the hazards arising from the operation of the accelerator and from the injection and circulation of the beams.
  - Acts on specific equipment (EIS = Important Safety Equipment)
  - By interlocking EIS:
    - Sets the 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



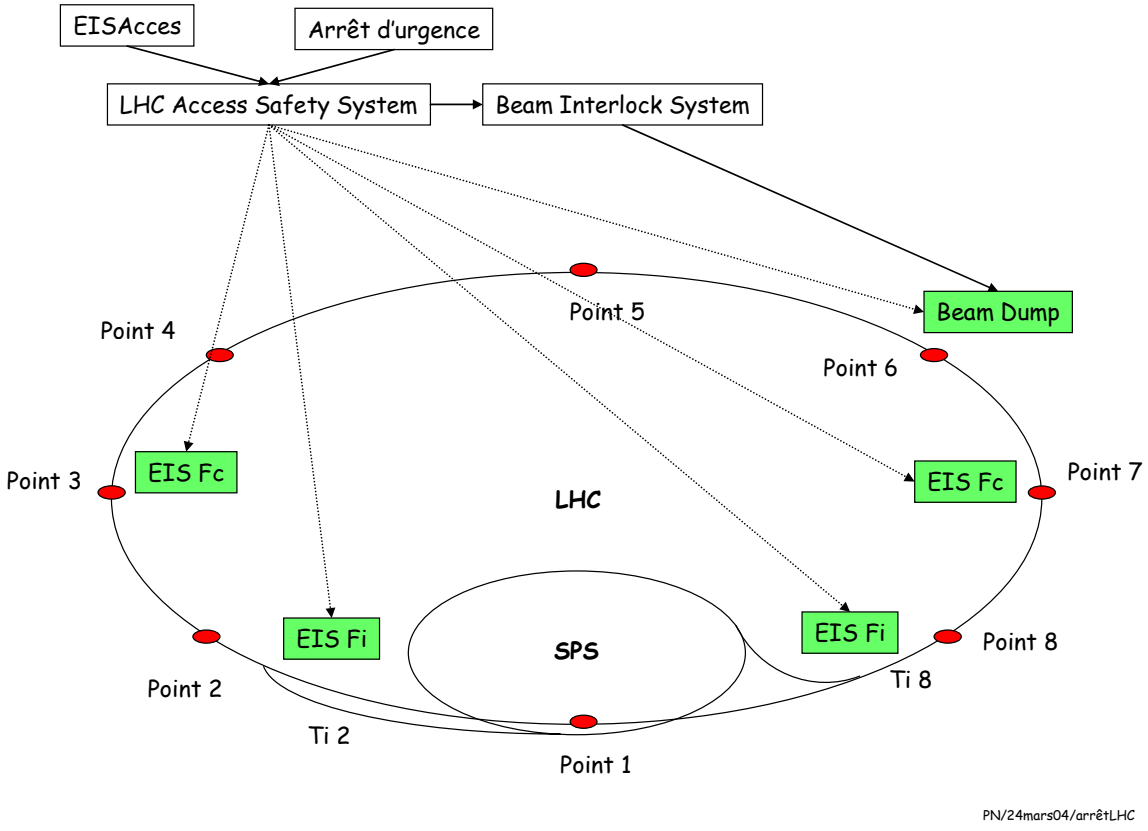
EIS (Elément Important de Sûreté)

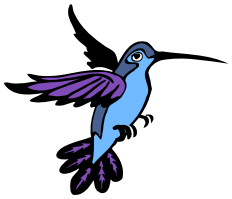
- EIS:
  - Either a dangerous piece of equipment
  - Or a piece of equipment which protects from some danger
- EIS-a: EIS-access
  - Doors, grids, mobile shielding walls, access point (MADs and PADs)
  - Search boxes, radiation veto, access key distributing system
- EIS-m: EIS-machine
  - Equipment which has to be OFF in order to allow access to the machine
  - 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



LASS stopping the beam (interface to LBDS)

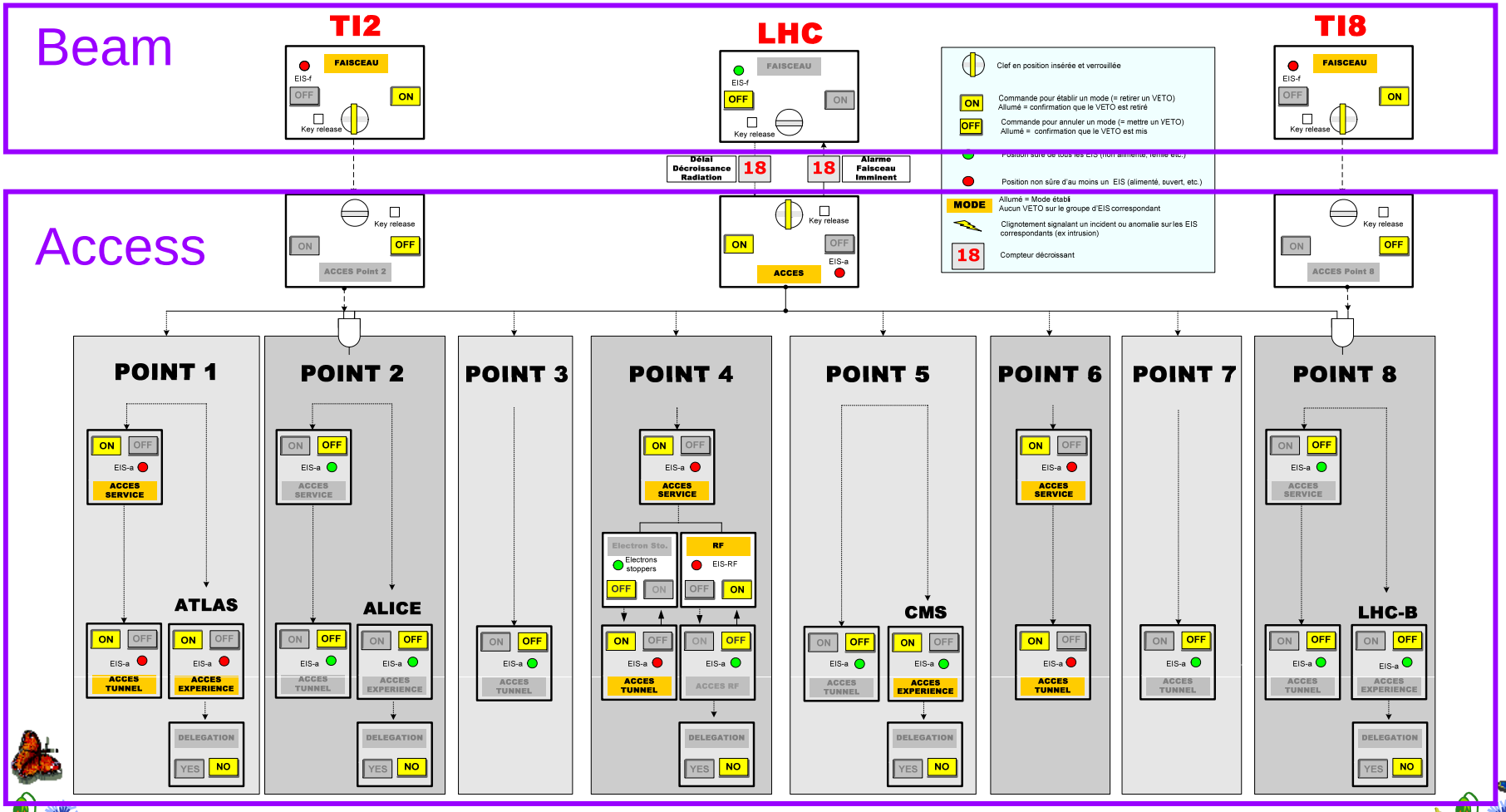


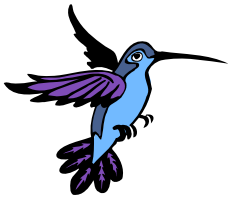


LASS modes

- "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

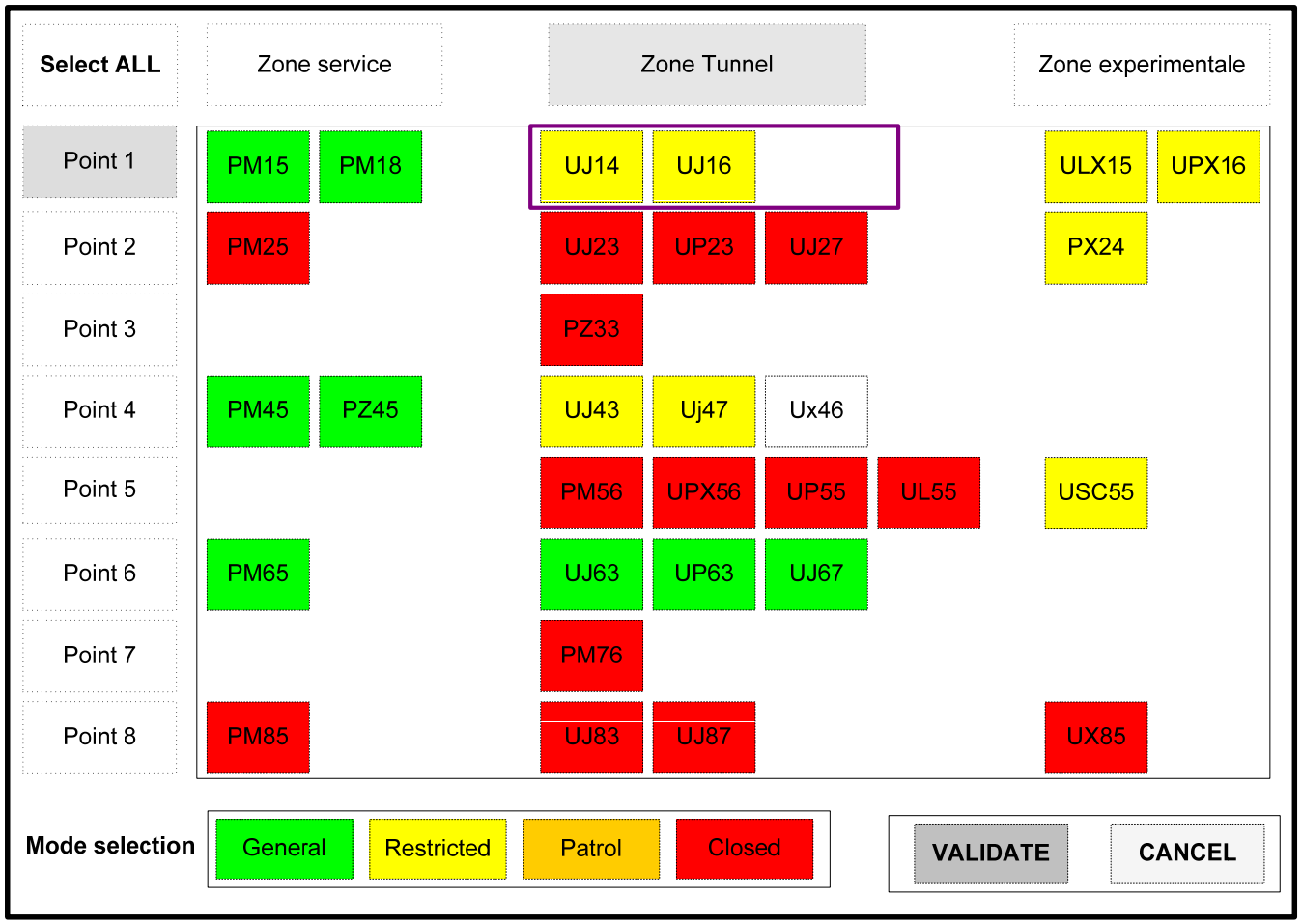




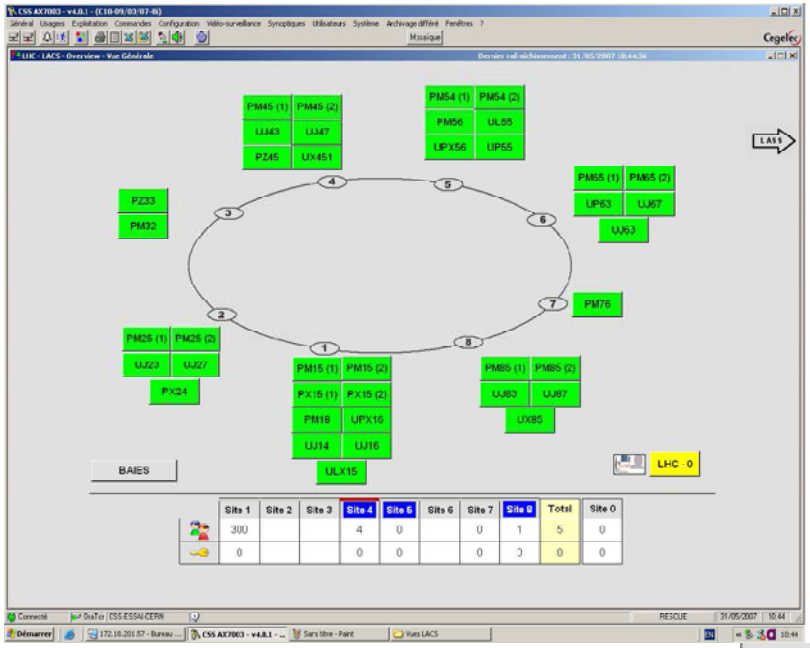
LACS modes

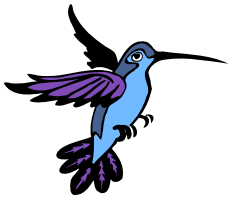
- Closed mode:
  - No access is allowed: beam or other hazards could be present
  - Prerequisite to LHC beam operation
- Test mode:
  - Access restricted to a list of registered specialists, in certain conditions
  - For example during RF tests
  - All accessing personnel must take their own safety token 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



IHM supervision of LASS



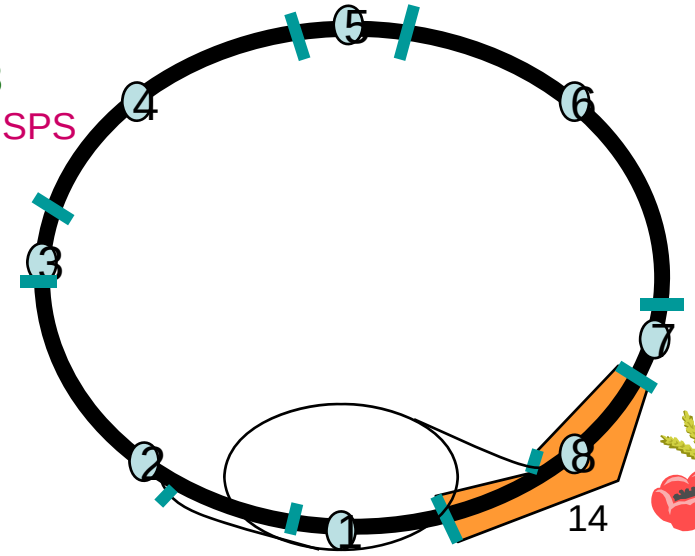


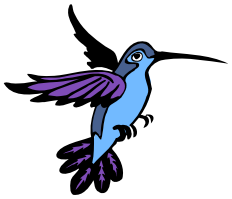
Access system tests

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

Functional site tests

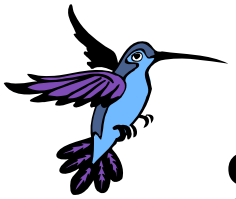
- Tests performed per
  - LHC operational mode (Access, Access=>Beam, Beam, etc…)
  - Dangerous Event
    - presence of people inside the machine
    - access authorized when high radiation level
    - beam circulating
    - intrusion
- Tested safety functions:
  - Search and token functions (behavior 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 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

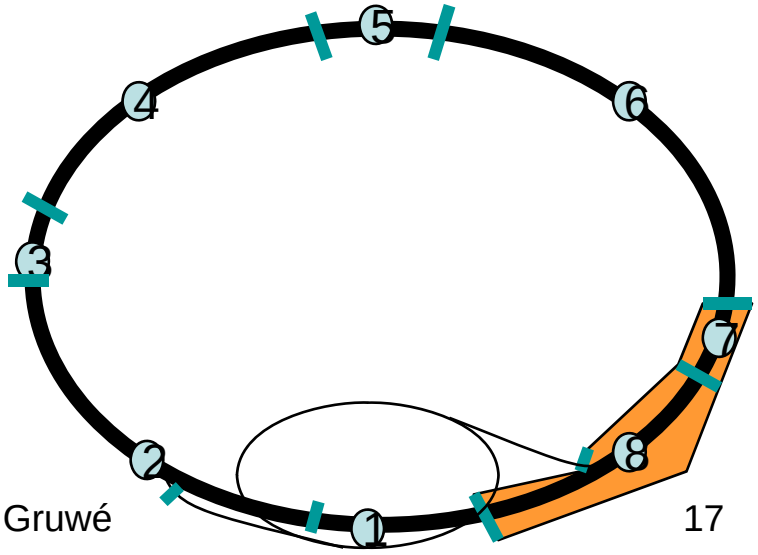


Status of functional site tests (II)

- 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

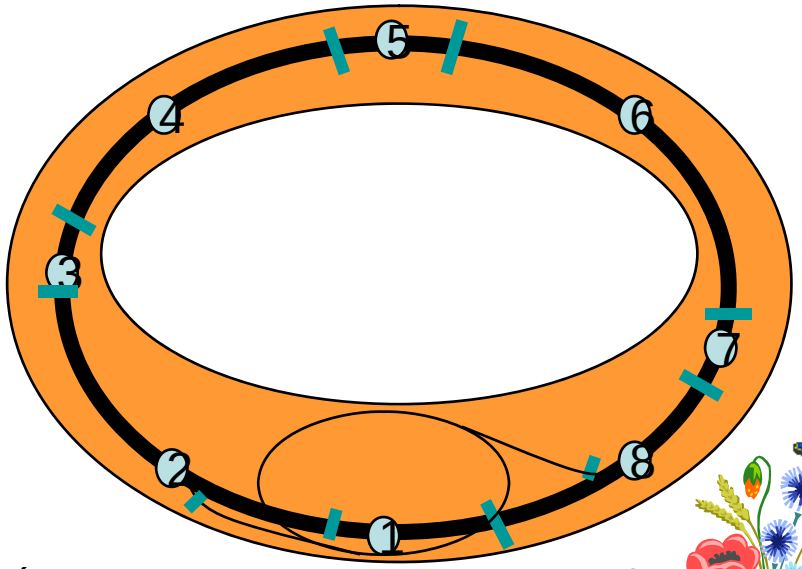
Functional inter-site tests

- 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

OP participation for training:

Patrol and access consoles

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**

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.