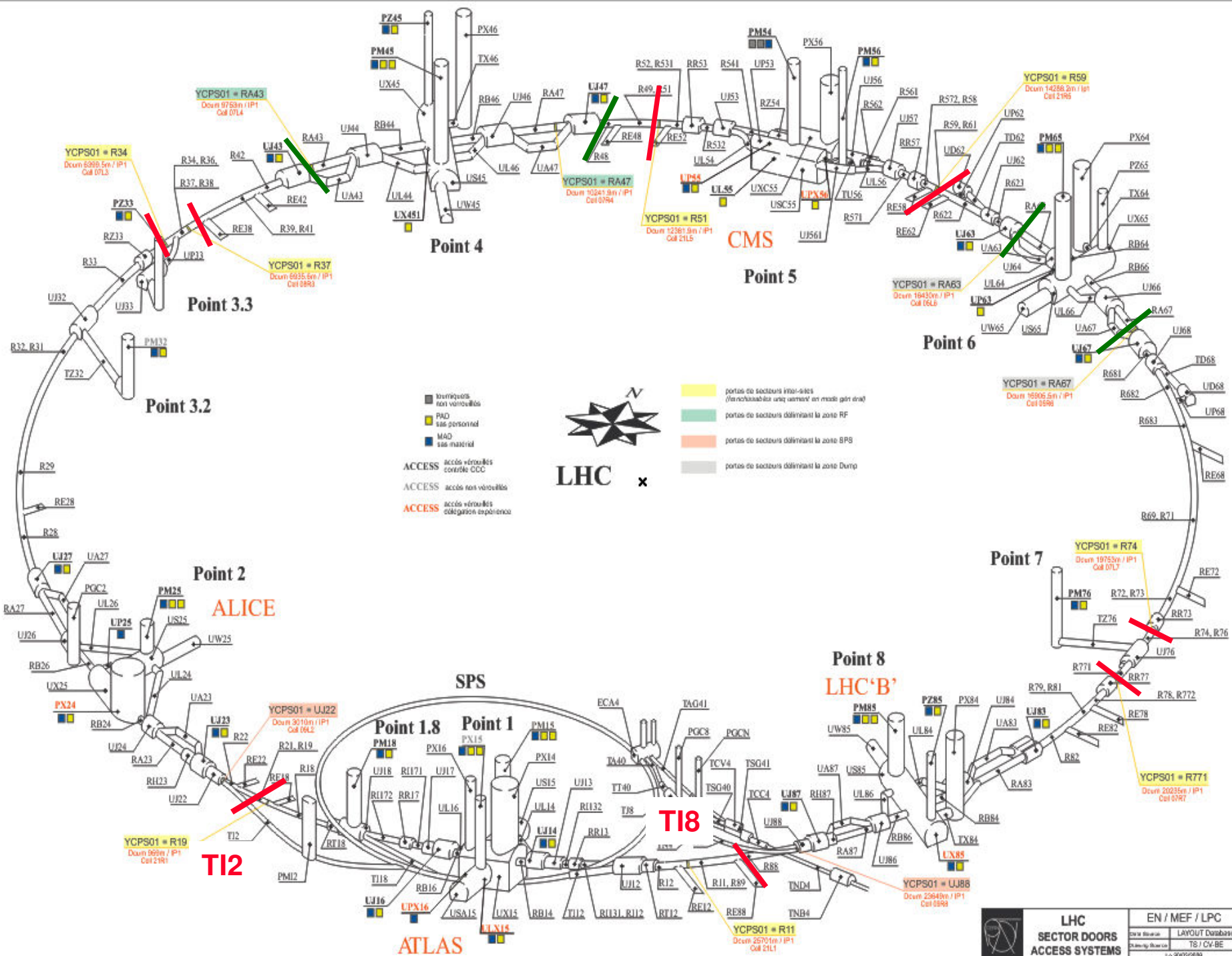




A new sectorisation for the LHC ?

Outline:

- Current situation justification: RP + ventilation
- Current situation drawbacks: large closed sectors
- Should new sectors be defined ? Smaller, larger ?
- Should the LASS/LACS cover other risks ?
- Should the LASS accept more interlocks ?
- Conclusion



- Inutilisés non ventilés
 - PAD sas personnel
 - MAD sas material
- ACCESS accès vérifiés contrôle CCC
- ACCESS accès non ventilés
- ACCESS accès vérifiés catégorie expérience

- portes de secteurs inter-locks (sauf exceptions sans câblage en mode gén éral)
- portes de secteurs délimitant la zone RF
- portes de secteurs délimitant la zone SPS
- portes de secteurs délimitant la zone Dump



Justification

LACS/LASS was designed to **protect personnel & public**

- Stray radiation from the beam
 - The 'outer envelope'
- Contamination from activated air and gases
 - + various zones
- Ionizing radiation from RF cavities
 - Sector doors around Point-4
- Ionizing radiation from induced activity
 - 'Small' Points 3 and 7
 - + sector around Point-6...

+ Note: The RP-veto also limits the access in some areas.



Justification

To protect people from **stray radiation from the beam**

- Beam conditions are interlocked with the LASS (EIS):

if people → no beam

- LACS/LASS prevent people from being in LHC with beam :

if beam → no access



Justification

To protect people from radio-**activated air** and gases

- LACS can give access to service areas (that have not 'seen' the beam) while forbidding (or delaying) access to primary beam areas (tunnel areas).

→ access sectorisation should map ventilation sectorisation.



Justification

To protect people from ionizing radiation from **RF cavities**

- RF cavities are in the middle of a large zone (Point-4), but inside a dedicated sector
- RF cavities are interlocked with the LASS



Justification

To protect people from **induced radio-activity**

- Some zones/sectors will stay in «restricted» or «closed» mode when the level of induced activity will be significantly dangerous.

This is the case around the 'dump' area at Point 6.

This is also the case around Points 3 and 7 (collimators), where unfortunately there is only an access-controlled point at the surface.



More justification

On an **exploitation** point of view, as well as on a **safety** point of view, it also helps to reduce the size of the sectors:

- Some zones/sectors can stay in «restricted/patrolled» or «closed» mode when adjacent sectors can be accessed.
- In case of a loss of a “search” (or “patrol”), only the given sector(s) must be patrolled.
- Smaller sectors help to localize the people underground.



First conclusion

The current sectorisation of LASS/LACS fulfils the safety functions for which it has been designed, i.e. **protect people** from ionizing radiation !

BUT.... !

For LACS/LASS:

“LHC Point” = access shaft(s)

+ (part of) half sectors* on each side



While Hardware Commissioning is done

(full)sector by sector*

e.g.: HC people are complaining (a lot) about the strong access restrictions in powering Phase II.



* nomenclature

The word “sector” is not used the same way by everyone;
there are

- “HC sectors” ~ “machine sectors : from one point to the next one
- “access sectors” ~ “octant” ~ “points” : from a mid-arc to the next one
- an “arc” = only the curved part of an HC sector
- More types of “sectors” ?

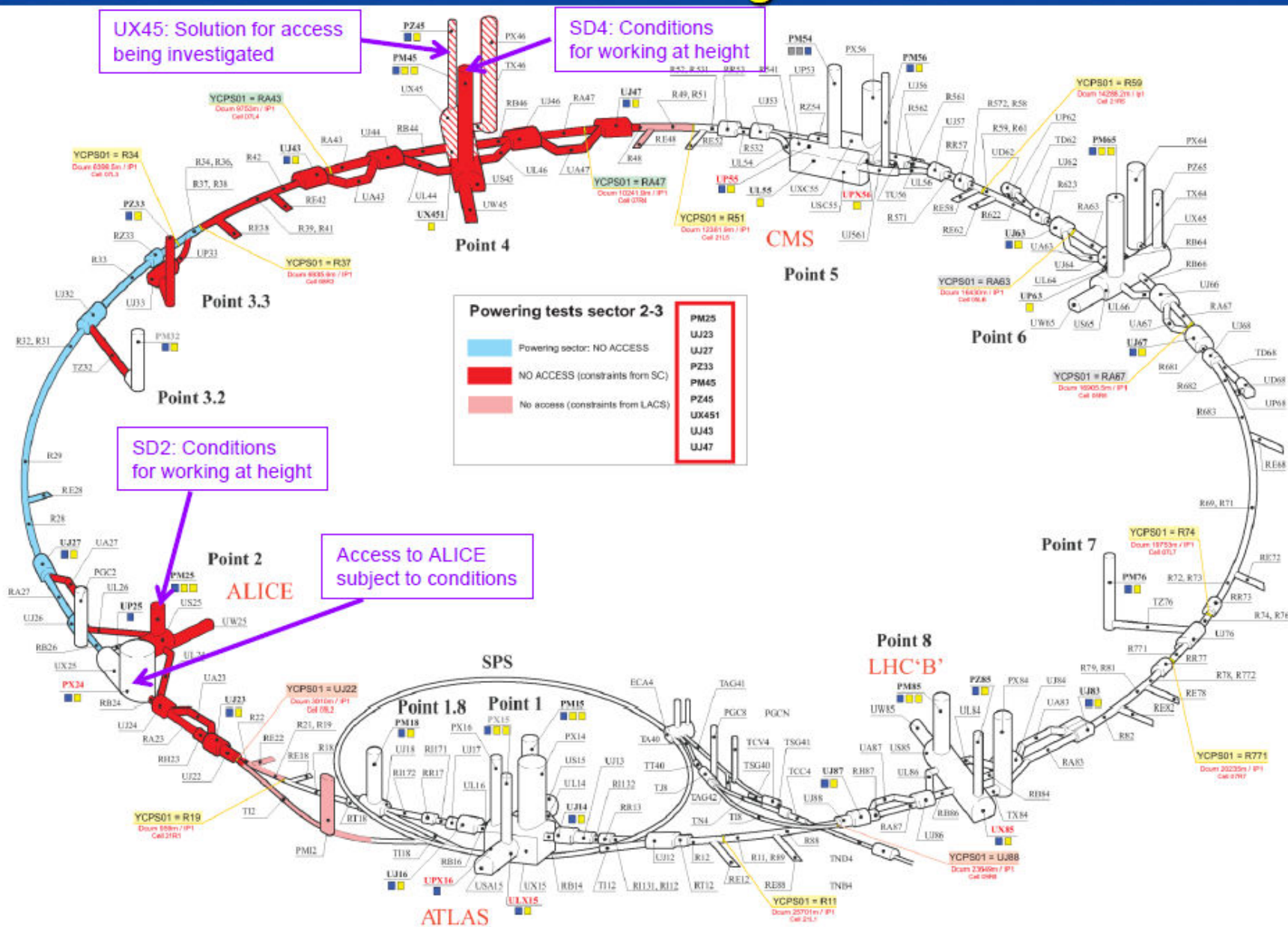


+ new justification

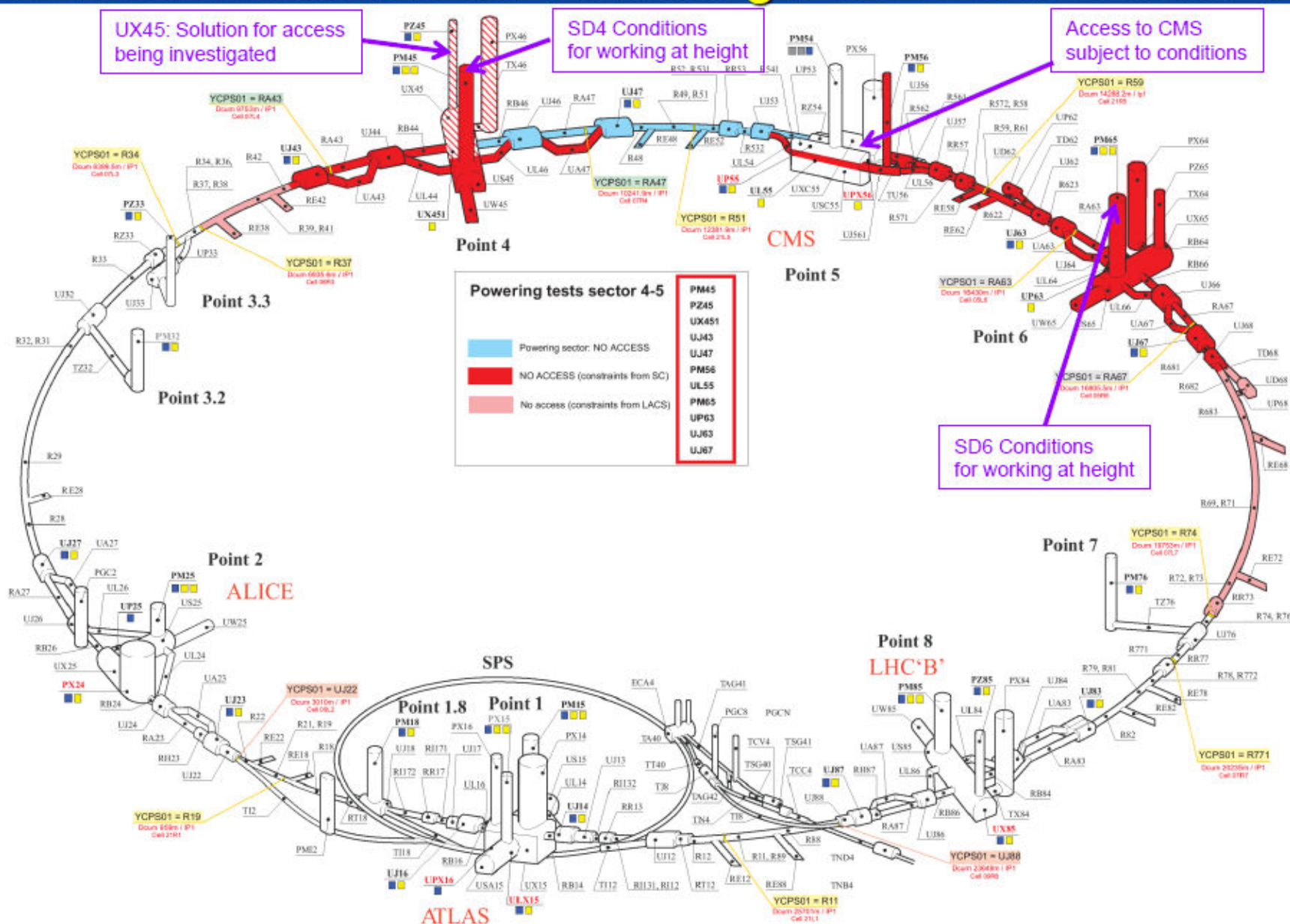
After the incident of September 2008, “ventilation sectors” are modified (temporary removal of ventilation doors), and LASS/LACS is also used **to protect personnel from the risk of a major Helium release**

...without having been redesigned

Access restrictions for Powering Phase II in Sector 2-3



Access restrictions for Powering Phase II in Sector 4-5





Proposal for a solution - 1

Add **more doors, more access points** (= more zones) to decrease the size of the sectors and be more flexible:

1.1. On an **exploitation** point of view;

- Some zones/sectors can stay in «restricted/patrolled» or «closed» mode when adjacent sectors can be accessed.
- In case of a loss of a “search” (or “patrol”), only the given sector(s) must be patrolled.

1.2. On an **safety** point of view;

- Smaller sectors help to localize the people underground.

Drawbacks from this proposal:

- Increase of complexity
 - Decrease of reliability
 - **Cost**
- + ... ? (see Rui's talk)



More questions about more doors

Would they be desirable on the long term ?

In which case would they be useful ?

Would that solution be satisfactory for the
exploitation ?

Answer to come from exploitation team.

Would that solution be satisfactory on a **safety** point
of view ?

Probably YES, but risk analysis needed



More drawback

The famous 'inter-site' **sector doors**

→ People cannot cross in <restricted mode>

Note: This seems well accepted during short stops in beam periods.

This seems unacceptable during long shut-downs or hardware commissioning phase.

Put the sectors in <general mode>

Drawbacks from this proposal:

- Loss of patrolled sectors
- No precise access control

Not a real problem : 'generic Adls', exemptions...

Solution : put (and pay) a guard at the surface

- Lesser precise localisation of people underground

Real safety issue !



New role of the LASS ?

Should the LASS/LACS also protect people from **other risks** such as electricity ?

In particular, should the **magnet power converter** be interlocked with the LASS ?

Note, interlocking the PC of the cold magnets would not only protect people from electricity, but from a potential major He release.



Current situation

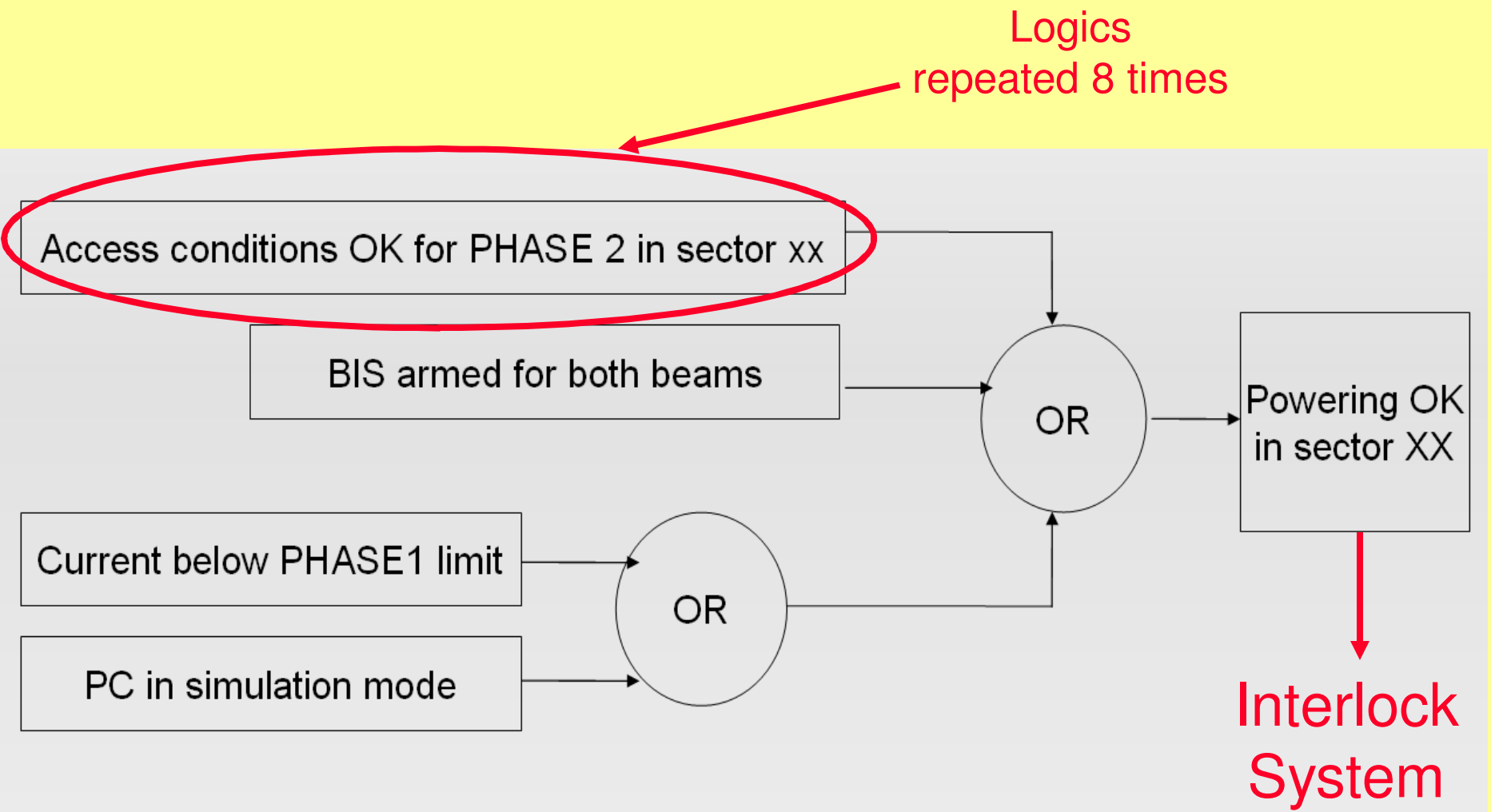
In order to protect people from a major He release (resulting essentially from the electrical powering of the magnets*), a new interlock has been added.

* The Safety Task Force has concluded that other causes would not lead to a significant risk.

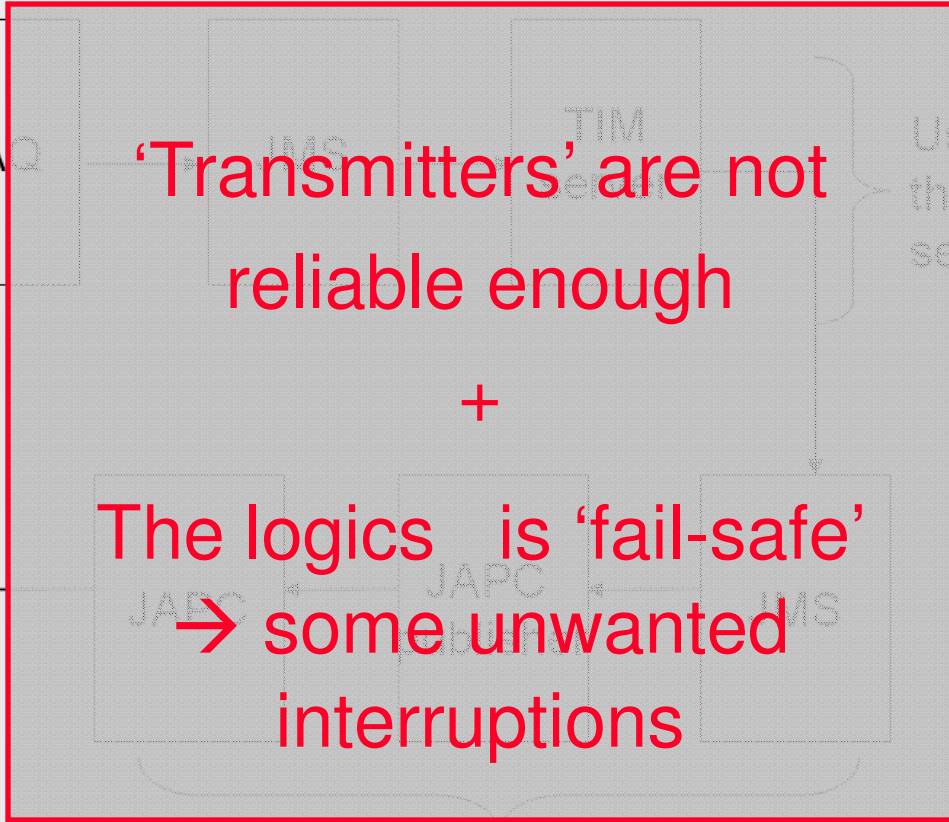
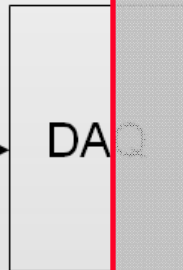
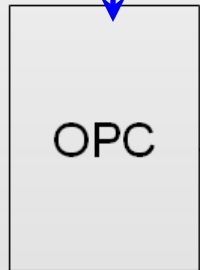
(Reminder: risk = severity x probability)

software interlock
≠ powering interlock

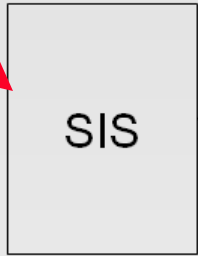
Principle of the software interlock



LASS



Used to provide the sum signal per sector (GS/ASE)



Used to publish the access conditions to the SIS (BE-CO)

?



Further questions...

Is it possible to implement the LASS_{to}PC-interlock ?

Where would the logics be included ?

What would be the drawbacks ?

What would this new interlock imply ?

Would it be desirable ?

When would it be useful ?

Would that be enough ?



Is that feasible ?

+ Where would the logics be included ?

+ Any drawbacks ?

To be studied by GS-ASE...



What would this new interlock imply ?

- It would introduce a possible '***new sectorisation***'* :
- Larger sectors in which current sectors would be grouped by software (PLC),
 - Larger sectors adjustable to the needs of powering tests.
- + It would forbid to test or use the magnets during an access in the new large sector !**

* «magnet-test sectorisation» ? ... ?



Would it be desirable ?
When would it be useful ?

This '*new sectorisation*' would certainly be desirable and **useful during the hardware commissioning.**

(proven)

Would it be desirable **during 'cold check-out'** ?

Will the 'cold check-out' be made sector by sector, or at once ?

Answer to come from exploitation team.



Would it be enough ?

- Would it be enough with respect to exploitation ?

Answer to come from *exploitation team*.

- Would it be enough with respect to safety ?

OK for today's conditions.

In the longer term...?



Would it be enough in the long term ?

- Safety wise, the current software interlock would probably be enough to protect people from a major **Helium** release during HC and cold check-out.
- Should it be more reliable (SIL ?, hardwired...) ?
- More requests to come ??
- More needs to be identified ??

E.g. Interlock on warm magnets ?



Should LASS/LACS cover other risks ?

- To be sure to cool the equipment wherever needed, to bring enough **fresh air** to people and protect them from **activated air**, a reliable **ventilation system** is needed.

(see Mauro's talk)

Monitoring of the ventilation and ventilated sectors

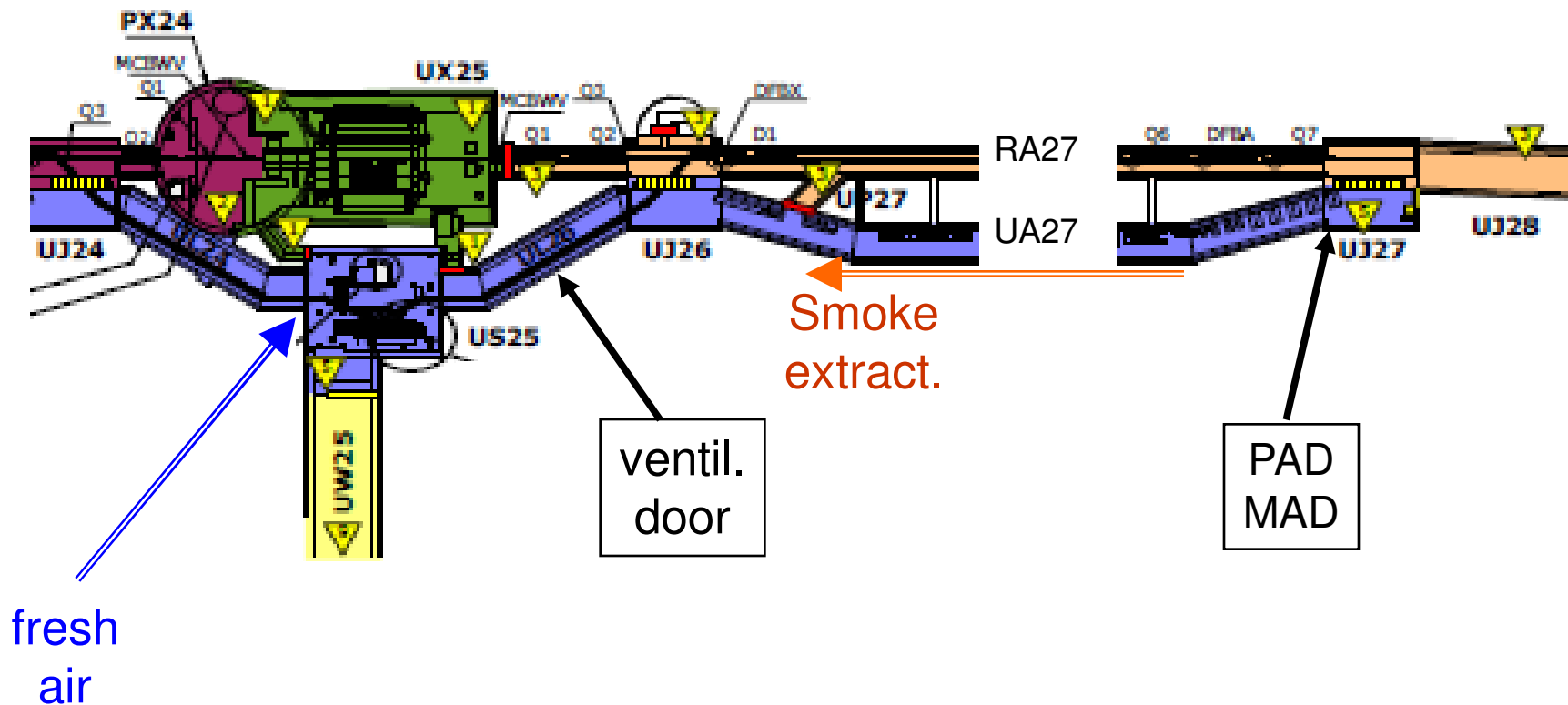
1. Fresh air to **cool** down the **equipment** ; not a personnel safety issue → not treated by LASS
2. Fresh air to **people**, needed during **access**
 - to be monitored by EN-CV ?
 - signal sent and treated by LASS/LACS ?
 - + CSAM & evacuation ?
 - Risk analysis required



Monitoring of the ventilation and ventilated sectors

3. Ventilated sectors and **ventilation doors**

Monitoring of the ventilation and ventilated sectors





Monitoring of the ventilation and ventilated sectors

3. Ventilated sectors to separate primary beam areas from service areas (US) and from areas accessible without delay (UL, UA)
= protect **people** from **activated air**
→ monitoring by GS-ASE (sensors on doors)
+ signal sent and treated by LASS/LACS
+ possible interlocks from the **ventilation doors**
→ Risk analysis required

- Repeat: The current sectorisation of the LASS/LACS offers a safe and reliable situation (with the exception of the ventilation)
- Before changing it, there are still **many open questions**
... most of them to be answered by the “exploitation teams” and the management, in collaboration with the Safety Unit



Conclusions - 2

- We should try to map “access sectors” with “machine sectors”, with “ventilation sectors”, and add the “test sectors”
- Further study, about ventilation doors, will be done by the BE Safety Unit in collaboration with EN-CV and DGS-RP.

Thank you !