# Protection of underground areas and He release to surface

- Review of present situation;
- Shortfalls of the present situation;
- Strategy to consolidate/upgrade He release.

# Present situation: Protection of experimental areas

- Experimental premises at Pt 1,2,5 & 6 have been sealed and are protected in case of overpressure from the tunnel

  (See Olga and Mauro's presentations in this session)
- Visits to assess the readiness for powering phase II made systematic controls of these protections, their minutes are available in:
  - ATLAS ➔ EDMS N° 1027686
  - ALICE ➔ EDMS N° 1027705
  - CMS ➔ EDMS N° 1027714
  - LHCb ➔ EDMS N° 1027632

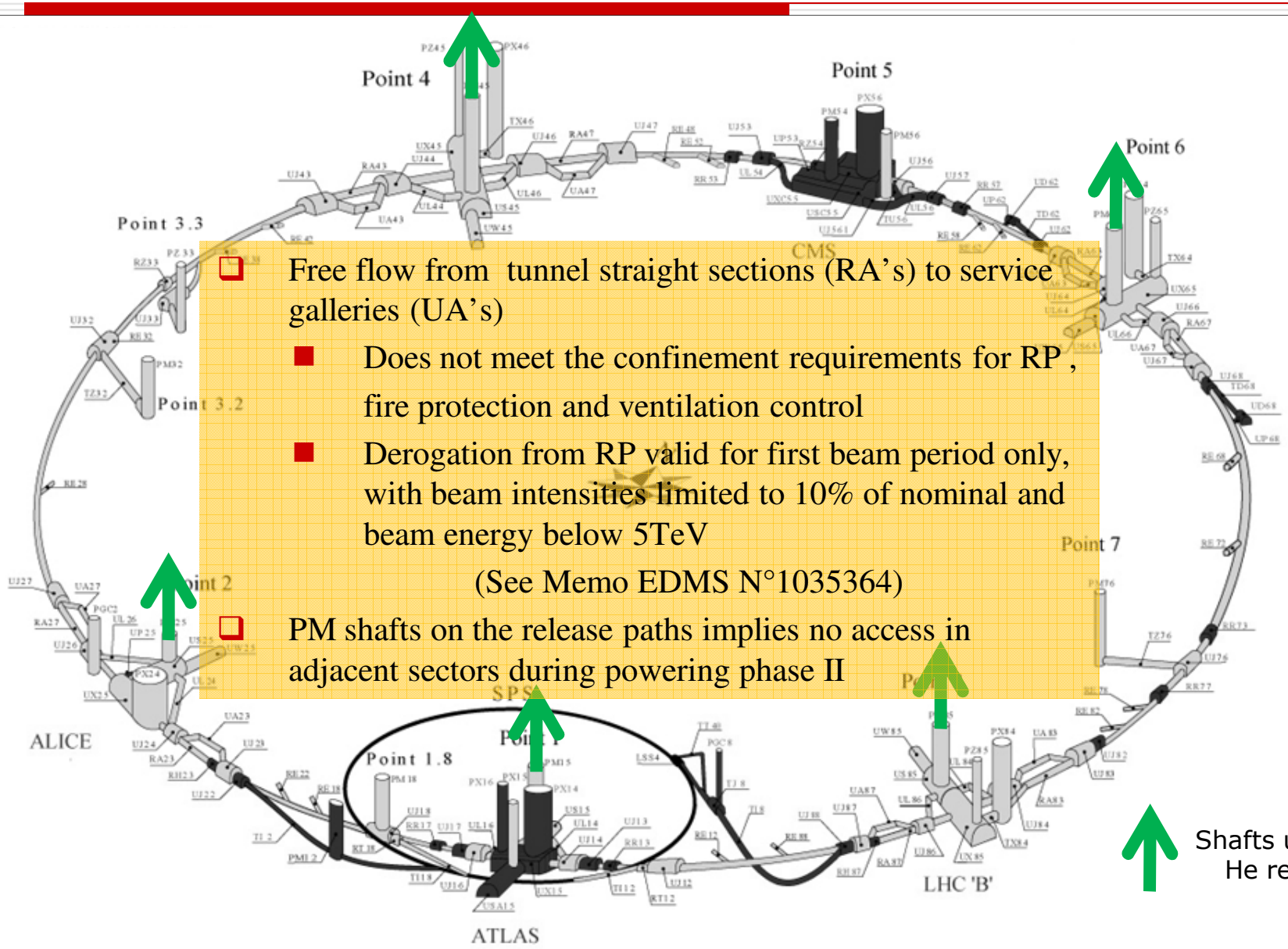
Crucial participation and thanks to **Experiments, EN/HE, EN/MEF, GS/ASE, DGS/GS, DGS/RP, BE/ASR, BE/OP**

# Present situation: He Release to surface

- Ventilation doors and partitions have been modified or added to control the He release to the surface through the PM shafts, taking account of the pressure build up in case of a MCI.
- Doors between the LHC tunnel and the UA service galleries have been temporary removed to ease the passage of large He flows.
- The He release paths to surface are:
  - RA➔UA➔UL➔US➔PM➔SD at points 2,4,6 & 8
  - RA➔UL➔US15➔PM15➔SD1 at point 1

  with doors acting as pressure release valves both at the UL-US interfaces and on the surface buildings.

# Shortfalls of the present situation




- Free flow from tunnel straight sections (RA's) to service galleries (UA's)
  - Does not meet the confinement requirements for RP , fire protection and ventilation control
  - Derogation from RP valid for first beam period only, with beam intensities limited to 10% of nominal and beam energy below 5TeV

  (See Memo EDMS N°1035364)
- PM shafts on the release paths implies no access in adjacent sectors during powering phase II

Shafts used for He release

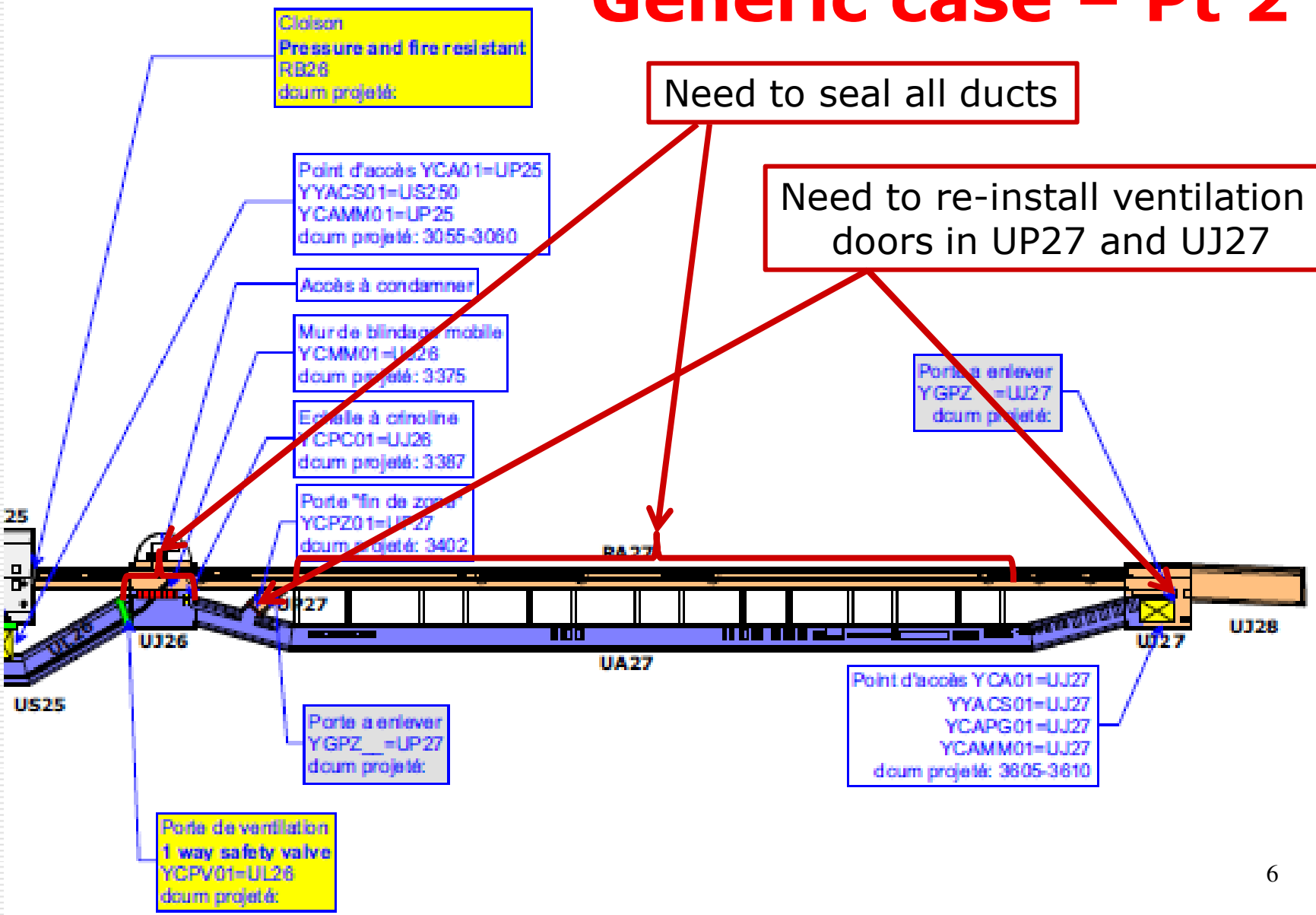
# Consolidation of Safety in underground areas

The consolidation and upgrade of the He release to surface will follow a 2 steps strategy:

1) Fulfill RP, fire & ventilation requirements concerning the separation of underground ventilation sectors;
2) Study and implement new He release paths to remove constraints on the access matrix.

# Separation of underground ventilation sectors

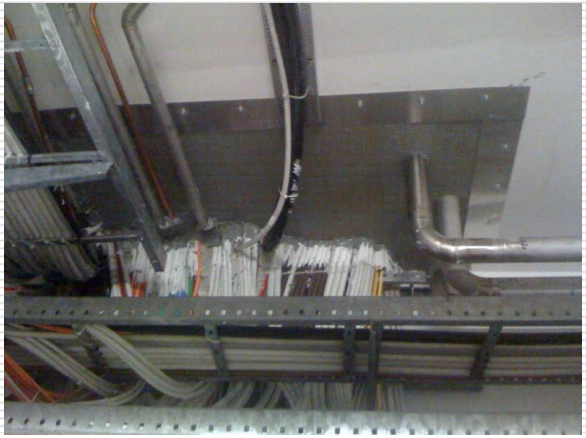
## Generic case – Pt 2



# Separation of underground ventilation sectors

- Sealing of all ducts:

Many options were developed to seal the experimental caverns:


- ➔ Need full inventory of all ducts to be sealed
- ➔ Need to define sealing technique most adequate for each cases (presence of cable or tubes, type of cable, need for cooling, etc…)

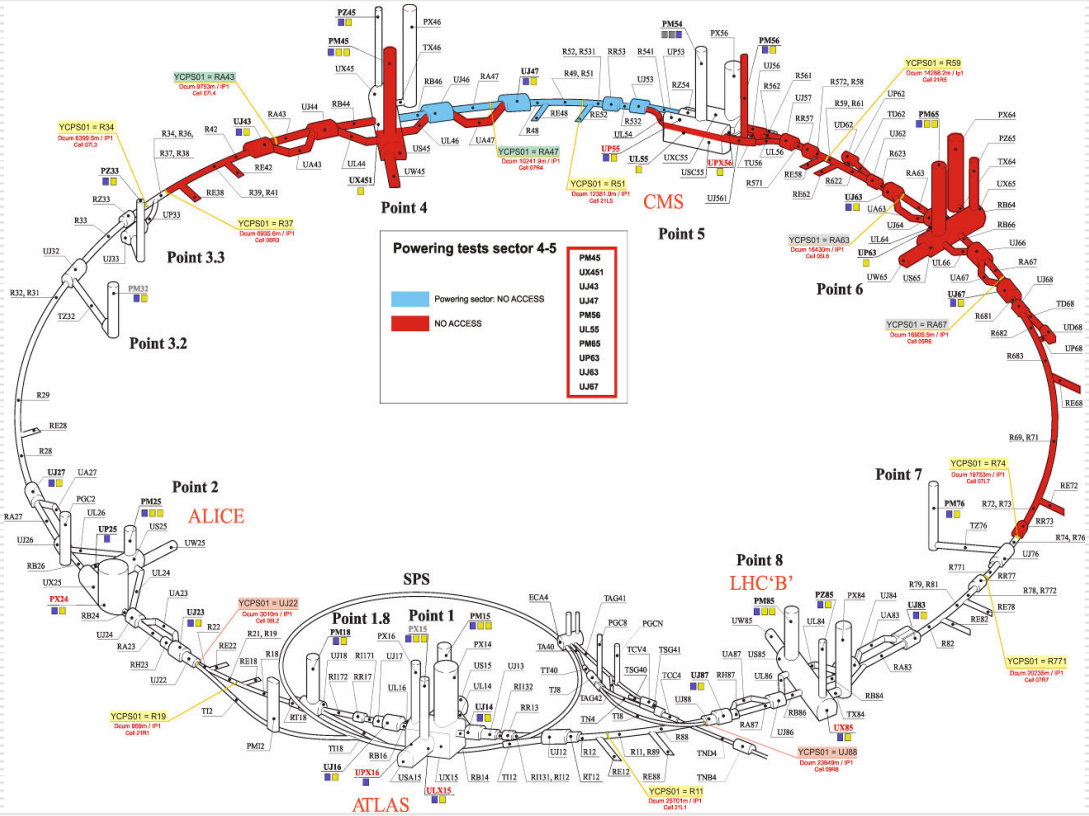
- Re-installation of doors in UP's and UJ's:
  - ➔ Doors need to act as pressure release valves (open with ~10mb overpressure) : opening mechanism and position monitoring required

# Access matrix in LHC

Access restriction in LHC will not be modified by the first set of measures

Use of US and PM shafts to evacuate He flow condemn access to adjacent sector.
In case of sectors linked with saloon doors (6/8), ~half of LHC is closed …

Example of restriction when powering sector 4-5 ➔




➔ Need to implement alternative He release path to surface to get more access flexibility during tests

# List of alternate He release path to consider:

1) Without heavy CE, could become available in the "short term":

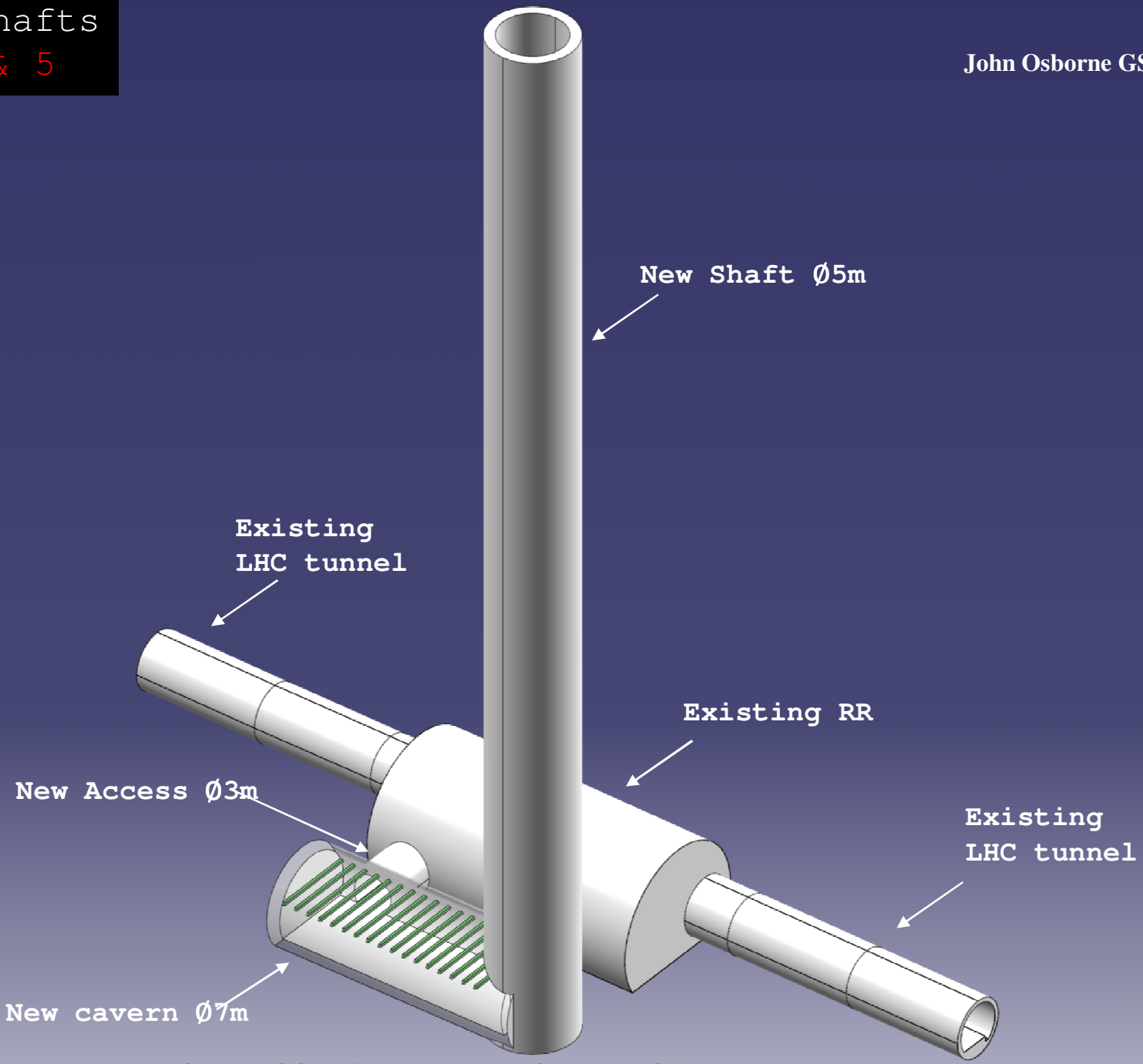
- UJ18 ➔ PM18 for Sector 1-2 — Cryo equipment
- TI2 (~1.5km long, Ø 3m) ➔ PMI2 for Sector 1-2
- UJ32 ➔ TZ32 (900m long, Ø 3m) ➔ PM32 for Sector 2-3 and Sector 3-4
- RUX45 ➔ UX45 ➔ PX46 for Sector 3-4 and Sector 4-5 — RF equipment
- UP56 ➔ UJ76 ➔ PM56 for Sector 4-5 and 5-6 — Low-β upgrade
- RUX65 ➔ UX65 ➔ PX64 for Sector 5-6 and Sector 6-7
- RA83 ➔ UGC1 (access of TBM) ➔ PX84 for Sector 7-8 — LHCb
- TI8 (~2.5km long, Ø 3m) ➔ PGC8 for Sector 8-1

2) With heavy CE, could be envisaged for the long term (≥ 3 years):

- Shafts close to RR13, RR17, RR53 & RR57
- PGC2, to be emptied from rubble

# RR's + shafts
## Point 1 & 5

John Osborne GS-SEM

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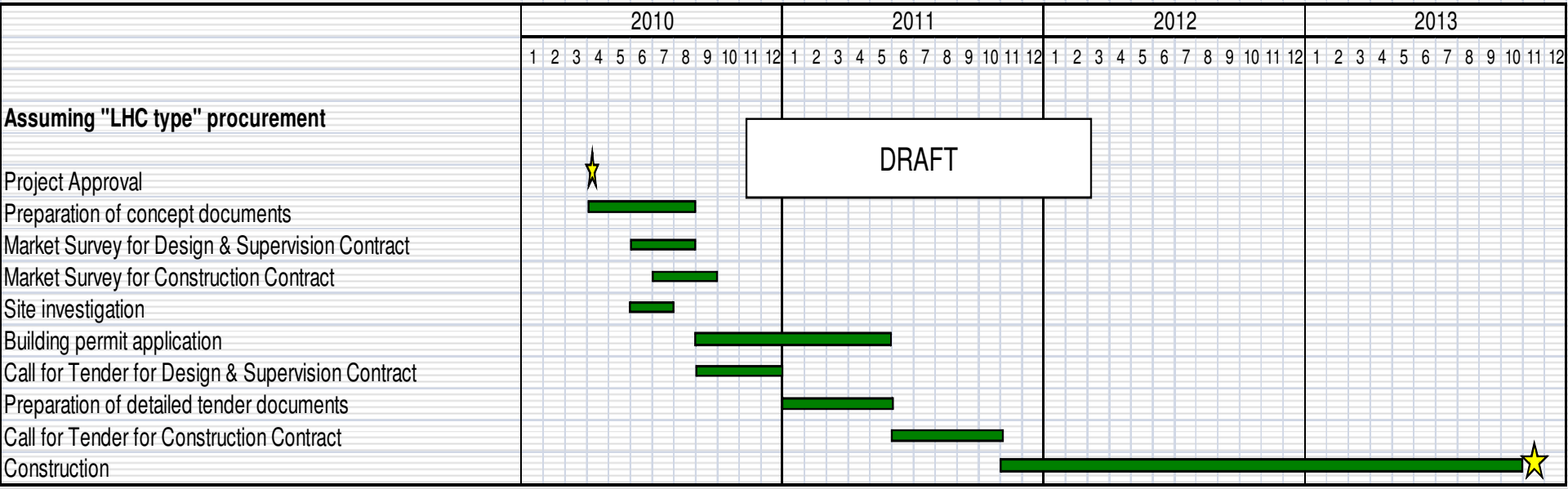
## 4 new shafts for LHC RR Caverns - Planning




Preliminary Cost Estimate ➔ 37.8 MCHF

For site preparation, 4 shafts, 4 caverns + galleries

Incl. Consultant, Drawings, Supervision &10% contingency

# Summary

- Experimental areas are sealed and safe with respect to the pressure rise in case of an MCI event.
- Ventilation doors and partitions have been modified or added, and some temporary removed, to control the He release to the surface through the PM shafts.
- Stringent access restrictions are in force during powering phase II to insure personnel safety in case of a large He release.
- The first priority for the next long shut down is to restore the separation of the underground ventilation sectors to fulfill the RP and fire protection requirements.
- Alternate paths for He release to surface will be studied and implemented to progressively improve the access conditions during powering tests. Full flexibility between LHC sectors will take several years since heavy Civil Engineering work is probably required.