



CERN ventilation concept

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Workshop on XFEL Tunnel Ventilation and Air Conditioning - 25-Oct-2010

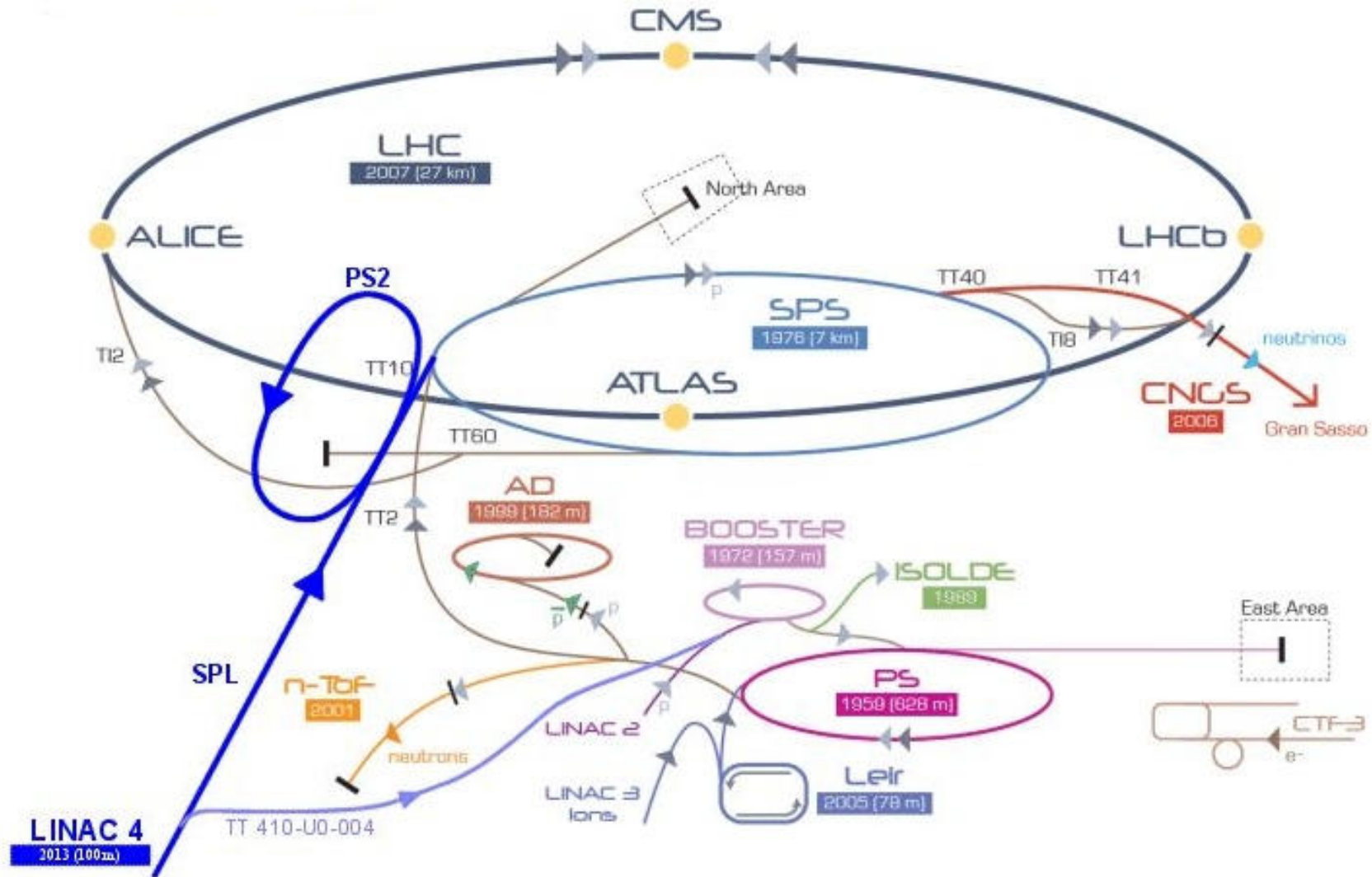


Plan

- Introduction (CERN, EN/CV group)
- LHC tunnel and experimental area ventilation
- Linac4 ventilation
- CLIC ventilation



Introduction - CERN





Introduction - EN/CV (1/2)

Cooling towers (450 MW)	22
Chilled water production stations 6-12°C (73 MW)	35
Cooling stations (raw water, demineralized water, C_3F_8 , C_6F_{14})	150
Pipelines	800 km
Water distribution pumping stations :	5'400 m ³ /h



*Consumption of a 45'000
habitants town.
10% overall consumption Geneva
Canton*





Introduction – EN/CV (2/2)

HVAC

Fire fighting

Compressed air

Demineralized water production

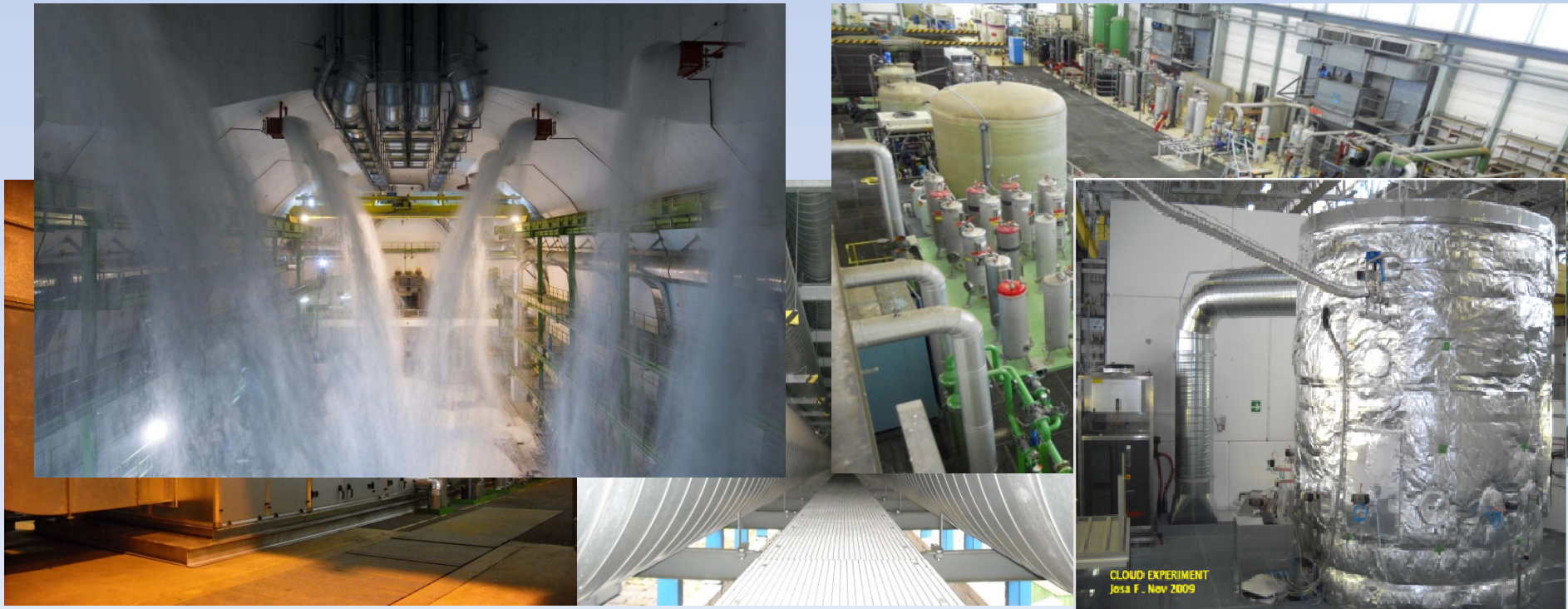
1'500 units

from 2'000 to 120'000 m³/h per unit

800 points

14 stations; distribution network 200 km

20 m³/h - 0.1 µS/cm





Functions of a ventilation system

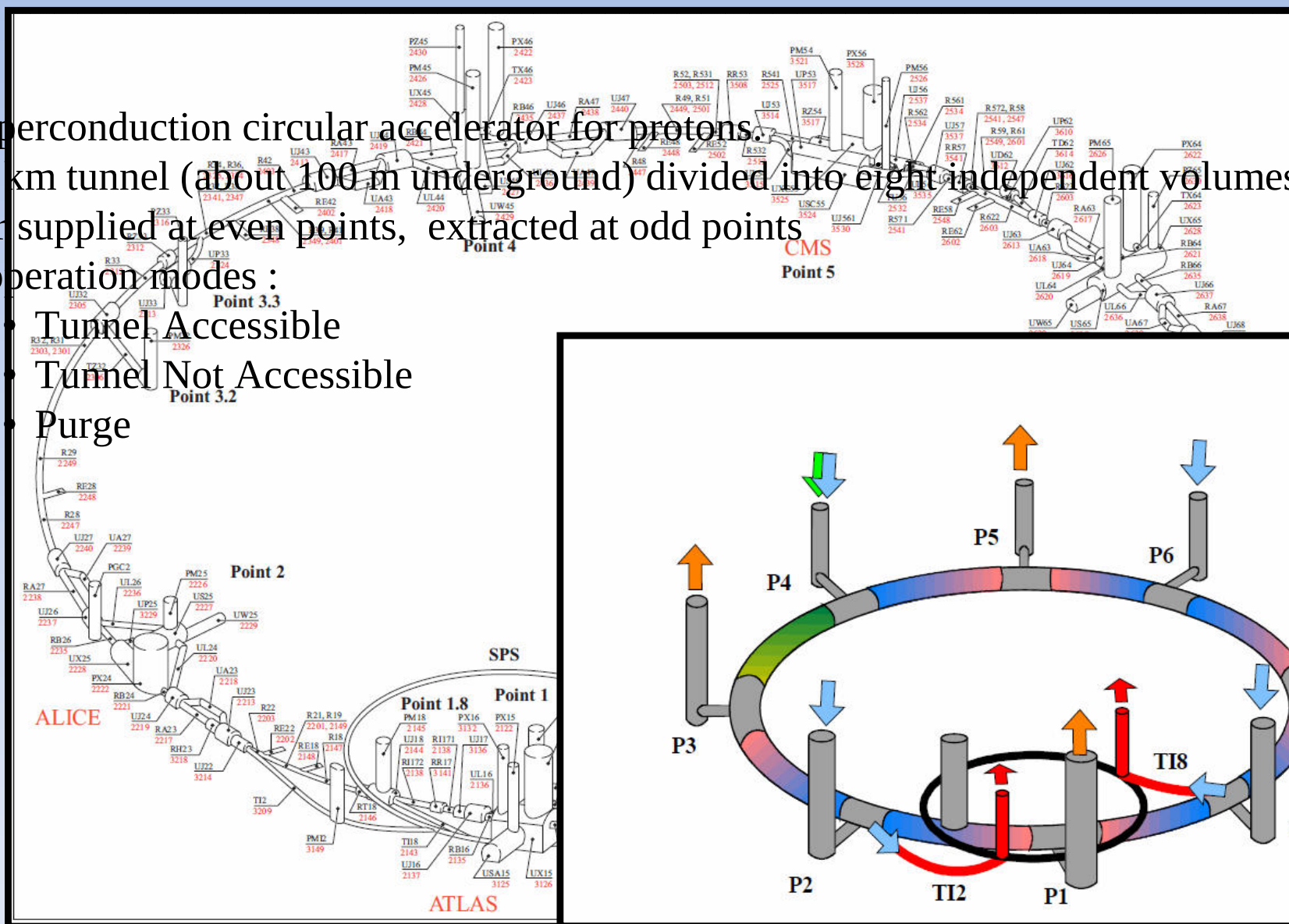
According to ISO17873

- Confinement
- Purification
- Monitoring of the installation
- Cleaning of the atmosphere
- Conditioning
- Comfort



LHC – sector ventilation (1/4)

- Superconduction circular accelerator for protons.
- 27 km tunnel (about 100 m underground) divided into eight independent volumes
- Air supplied at even points, extracted at odd points
- 3 operation modes :
 - Tunnel Accessible
 - Tunnel Not Accessible
 - Purge

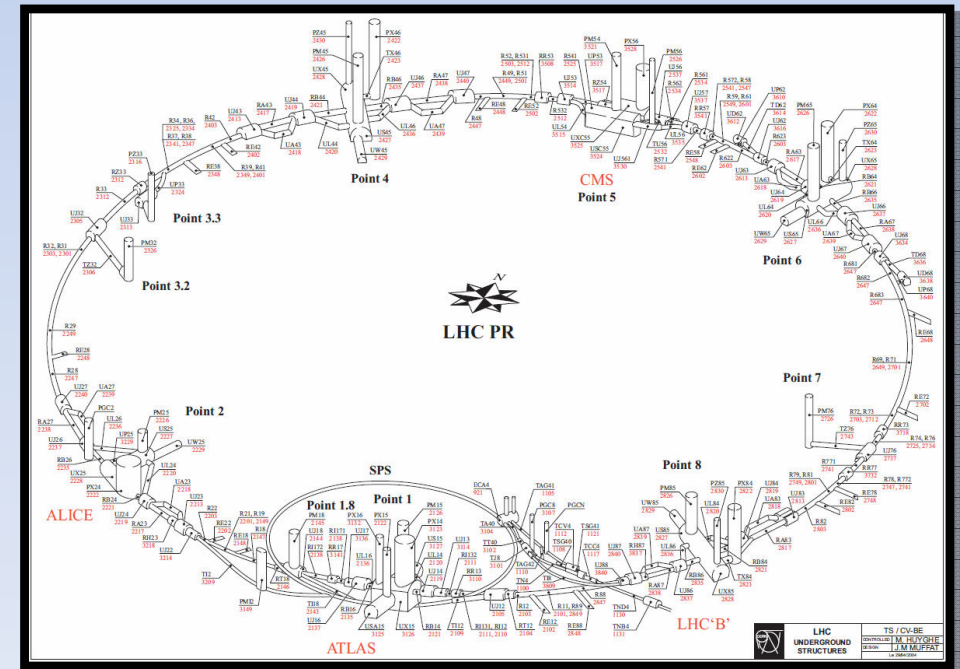




LHC – sector ventilation (4/4)

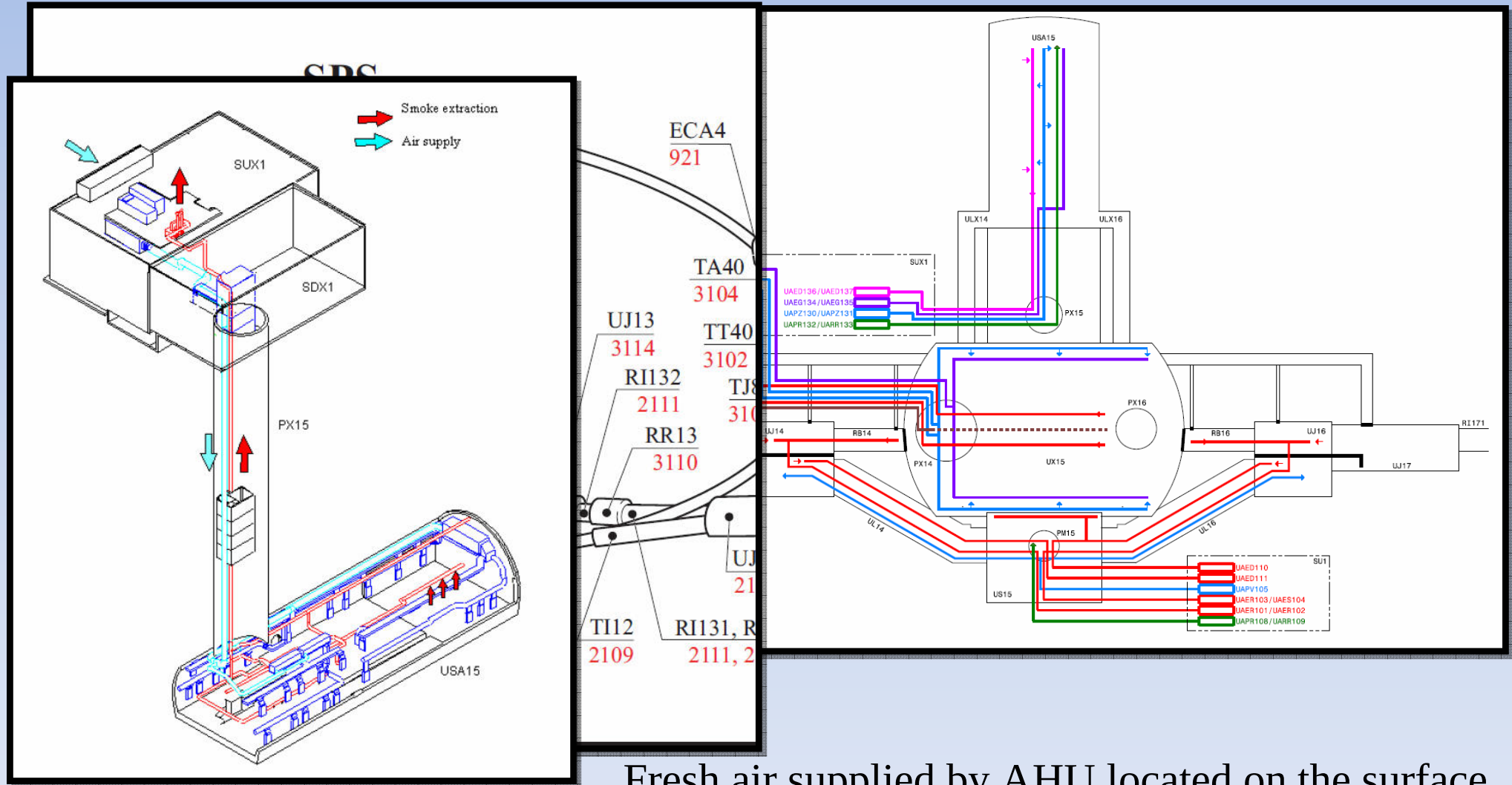
- Air flow rate for a tunnel sector (supply)
 - Tunnel accessible: 18.000 m³/h
 - Tunnel not accessible: 36.000 m³/h
 - Purge: 64.000 m³/h
- Heat dissipation in a sector : between 110 and 240 kW
- Supply temperature at 18°C and dew point <12°C

- *No duct in the tunnel*
- *Limited cooling capacity*
- *Evacuation issues*
- *Size of « fire sectors »*
- *Delta T, Delta RH along the tunnel*





LHC – experimental cavern ventilation (1/2)

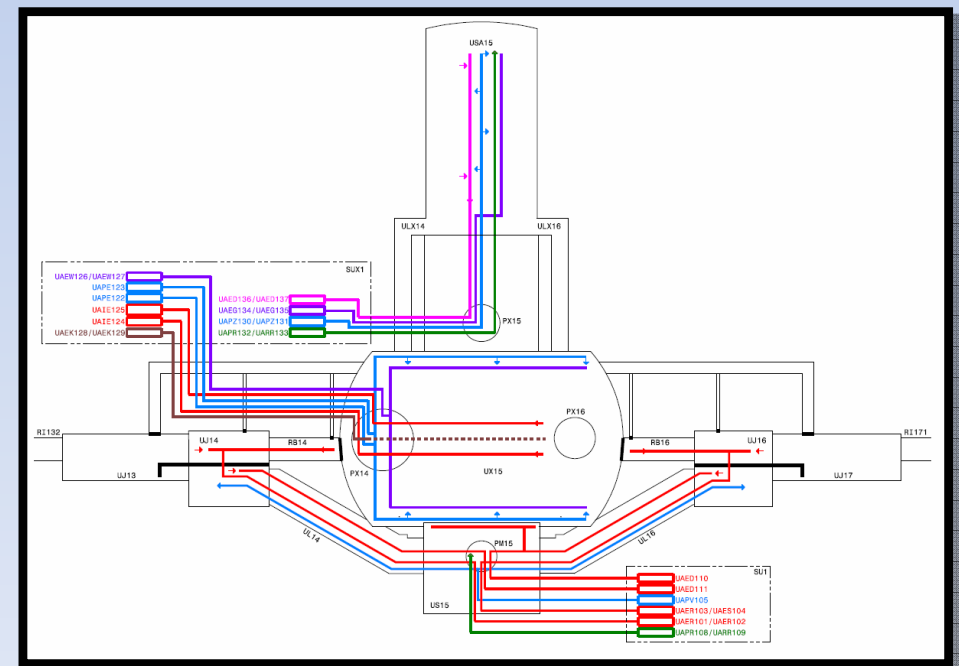


Fresh air supplied by AHU located on the surface
 Local ventilation, AHU in recycling mode
 Dedicated cold smoke and gaz extractions



LHC – experimental cavern ventilation (2/2)

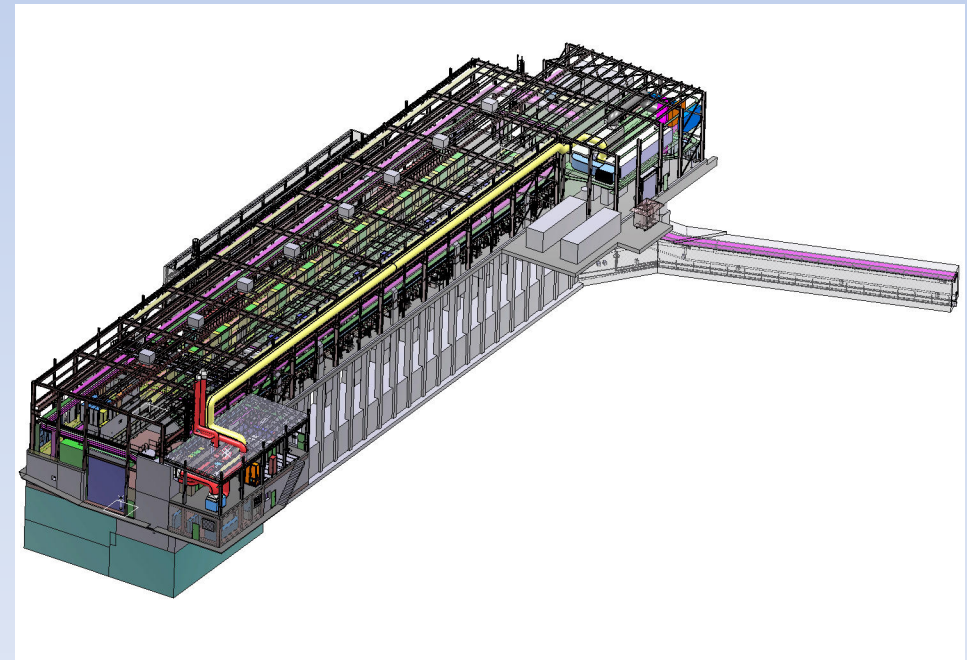
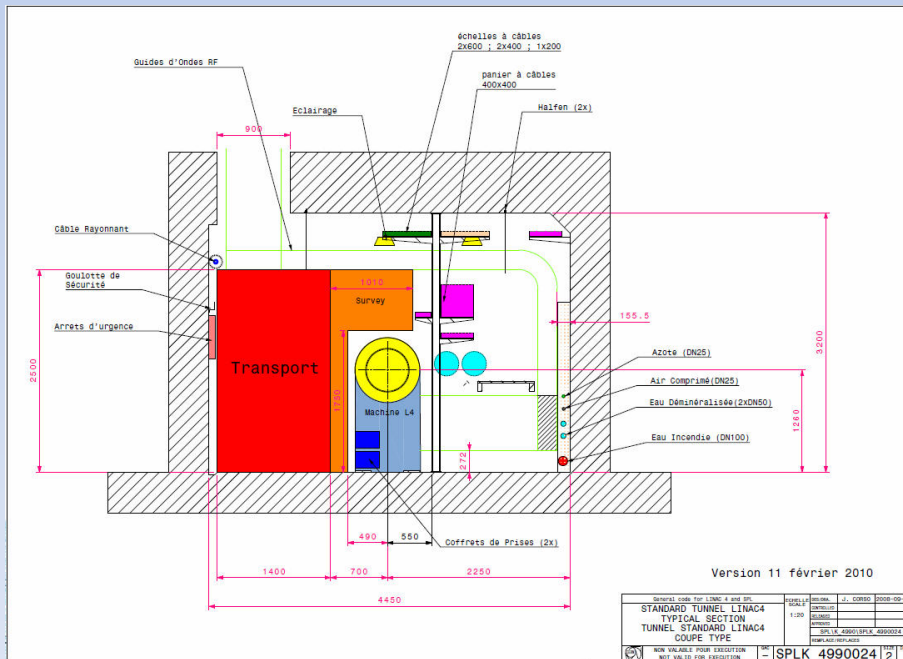
- Most of the equipment located on the surface
- Dynamic confinement
- Up to 16 operation modes (access, purge, cap closed, gaz extraction, ...)





Linac4 Ventilation (1/3)

- Linear accelerator for negative Hydrogen ions
- 100 m tunnel + 50 m transfert line (12 m underground)
- Air supplied at the High Energy side, extracted at the Low Energy side



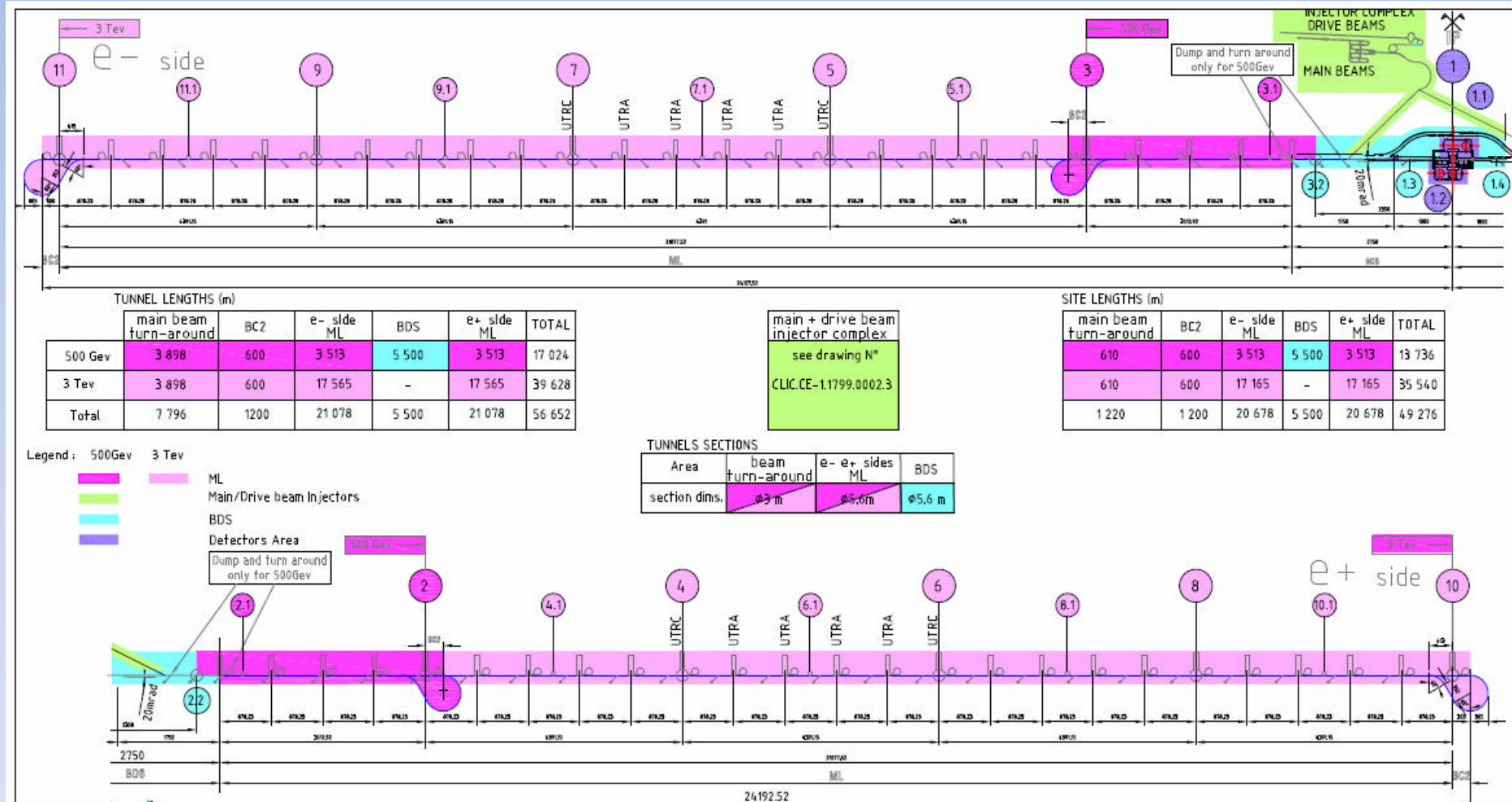


Linac4 Ventilation (3/3)

- Air flow rate
 - Tunnel accessible: 20.000 m³/h (8000 m³/h of fresh air)
 - Tunnel not accessible: 20.000 m³/h (100 % recycling)
 - Purge: 20.000 m³/h (100 % fresh air)
- Heat dissipation in the tunnel : about 15kW
- Supply temperature: 18/23°C (winter/summer)
- Dew point <12°C
- Reduced tunnel cross section
- Energy recovery possible (recycling mode)
- Lower impact on environnement



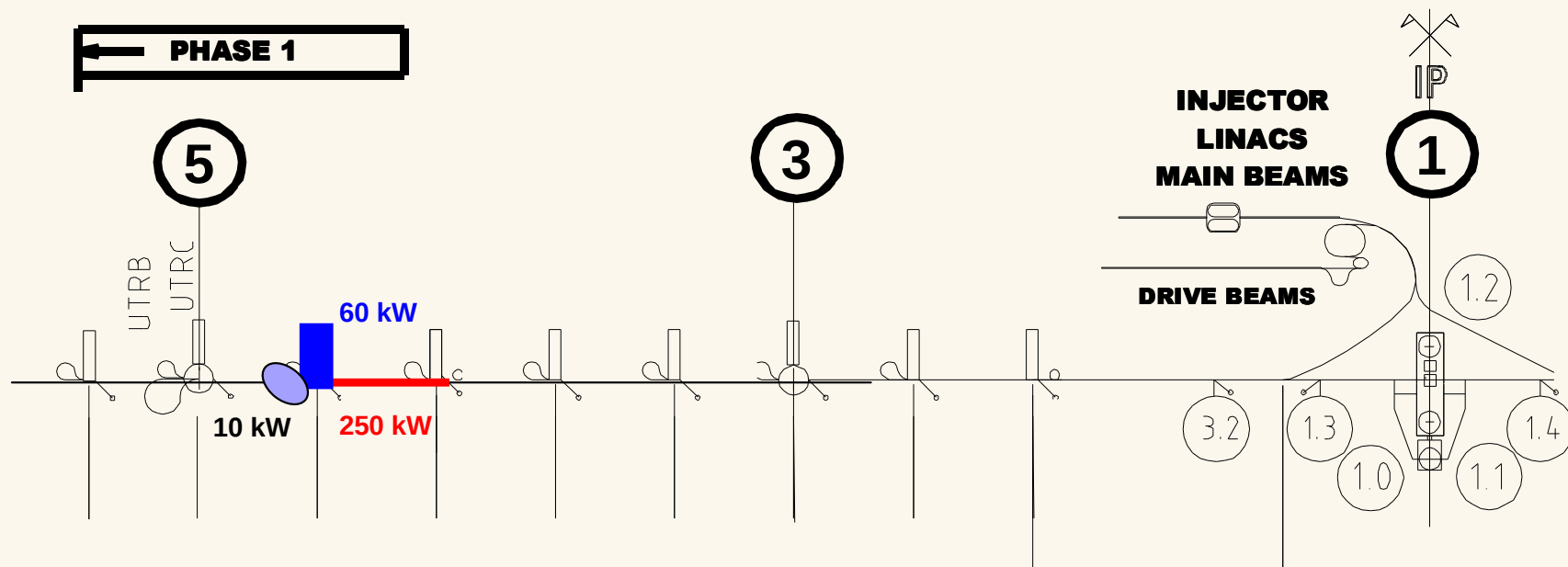
CLIC Ventilation (1/3)



- Electron-positron linear collider
- 49km tunnel, 12 access points

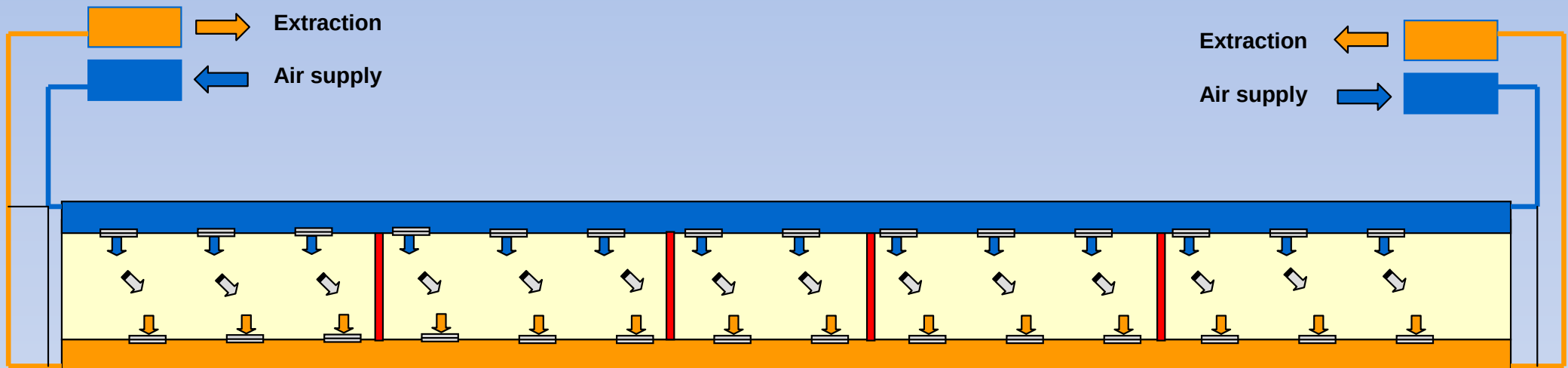


CLIC Ventilation (2/3)





CLIC Ventilation (3/3)



Possible fire resistance sectors with two emergency exits per sector

SHAFT
POINT

NEXT
SHAFT
POINT

- **Optimisation of the air flow rate**
- **Low air speed in the tunnel**
- **Optimisation of the gradient temperature**
- **Reversible and redundant operation possible**
- **Energy recovery possible, recycling of air**



Conclusions

- HVAC to be considered at the very first stage of the conceptual design
- Water cooling to be encouraged
- Operation costs to be evaluated
- Energy recovery becoming a sensitive issue at CERN