A ventilation system for the FCC tunnel

M. Nonis, G. Peon – CERN EN Department / CV Group

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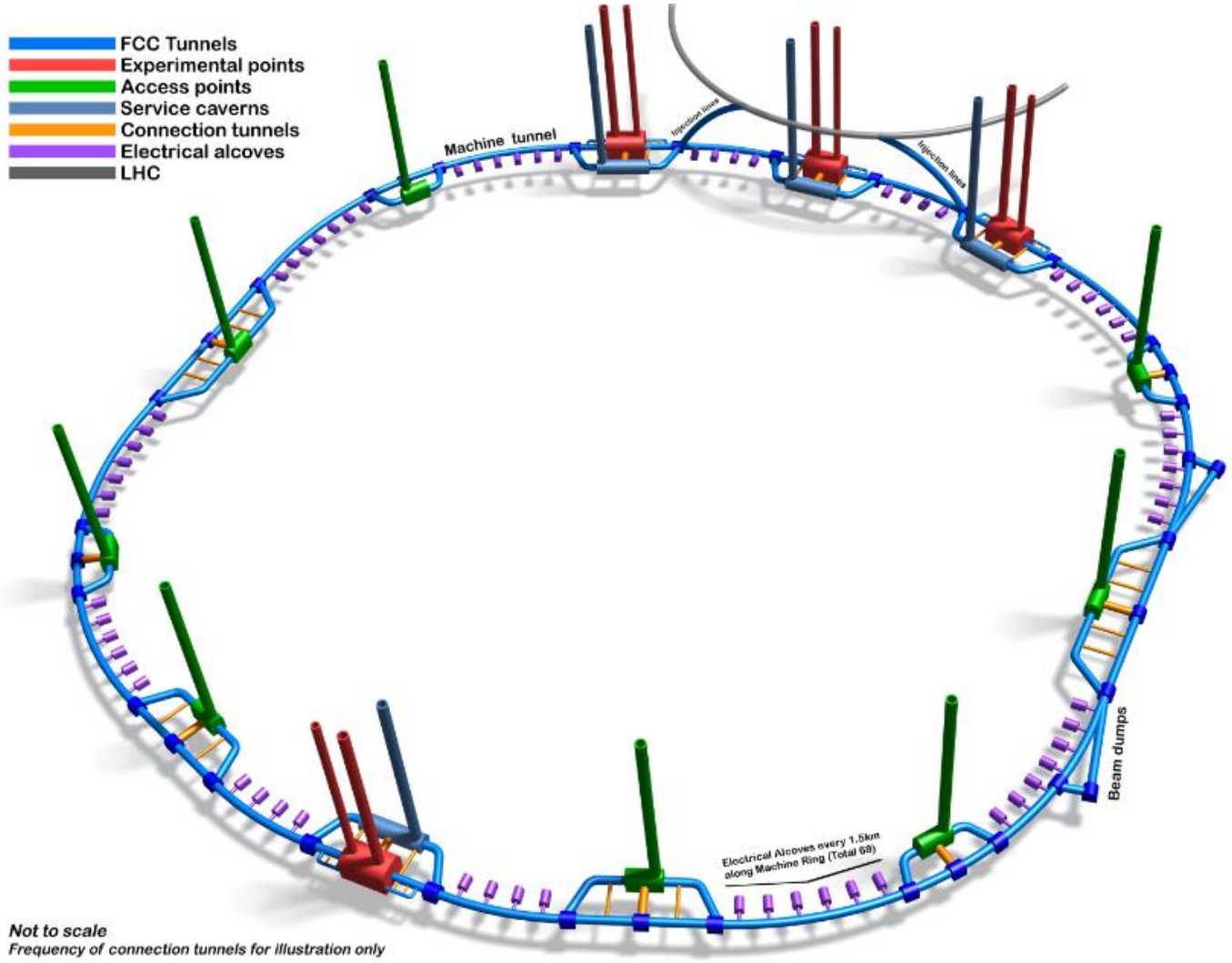
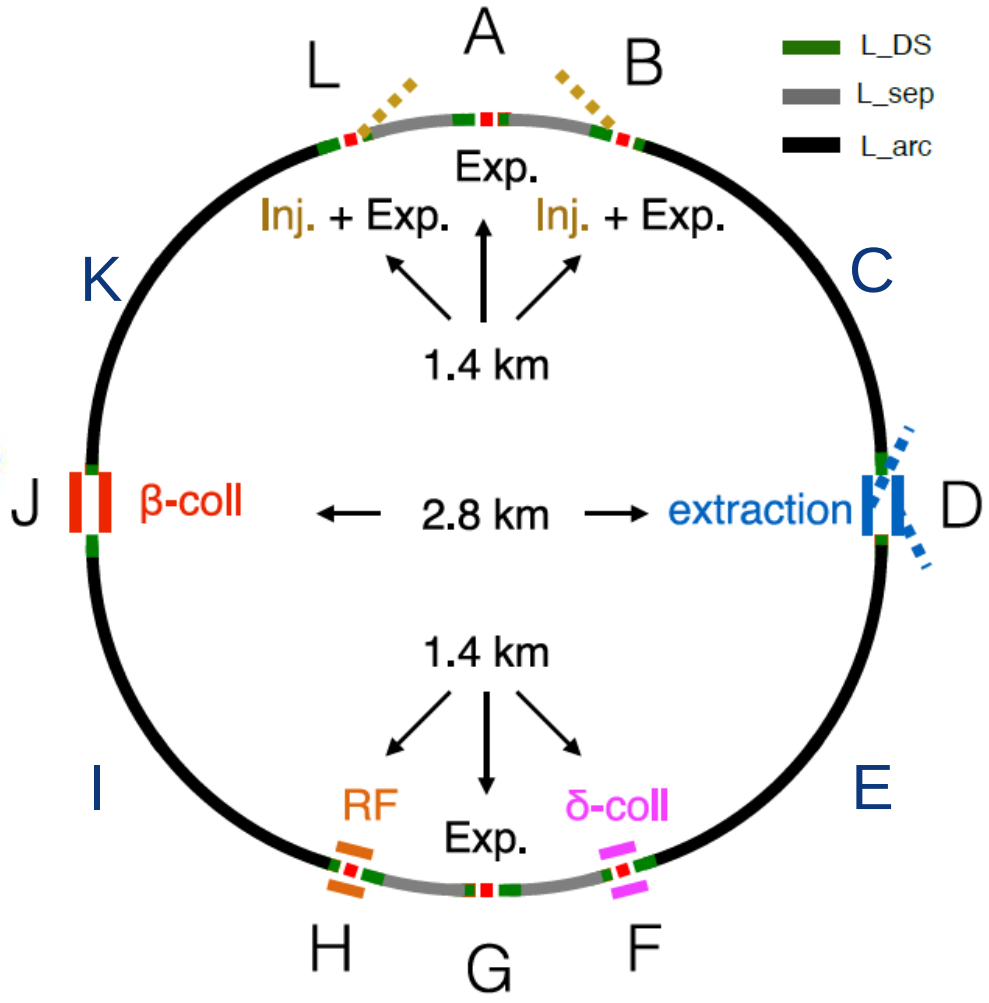
Content

- Main input parameters
- Ventilation of the main tunnel
  - In normal operating conditions;
  - In degraded conditions:
    - Unavailability of an Air Handling Unit
    - Smoke or Helium Release Detection
- Ventilation of particular areas:
  - Electrical Alcoves
  - Underground premises at the different points
- Conclusions & next steps

Main Input Parameters: Layout of the FCC

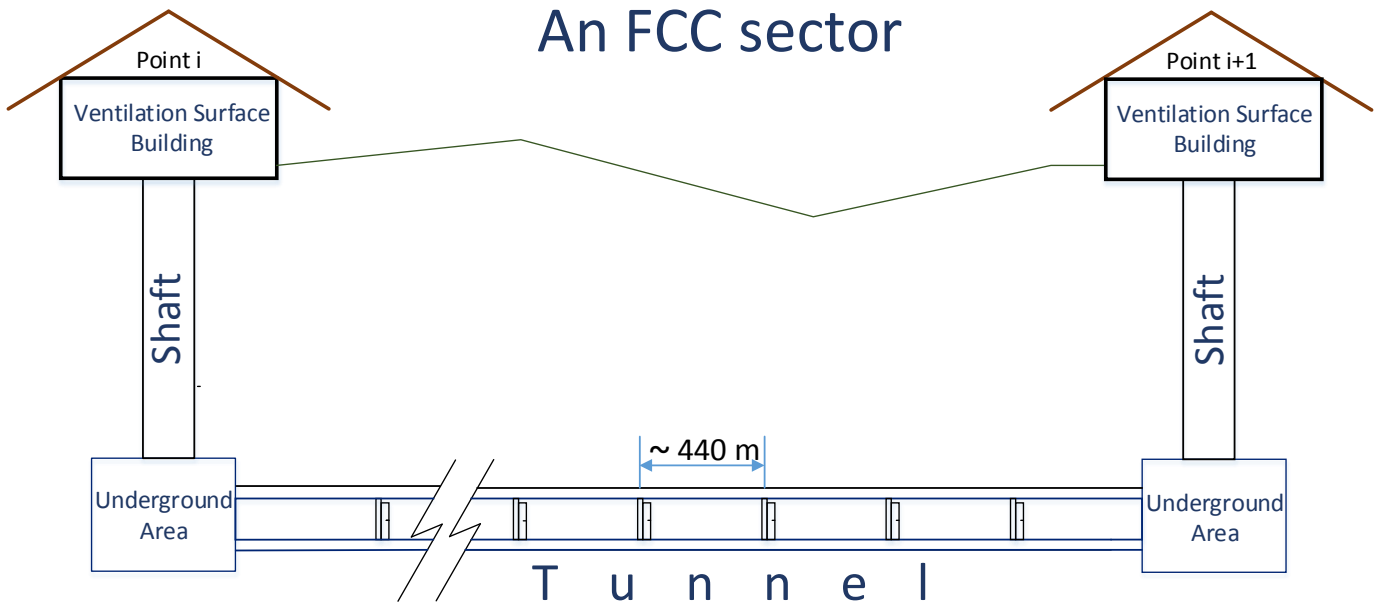




Main Input Parameters: Geometry and Temperature

General Input data	
Cross section area	17.7 m^2
Max. sector length	10.5 km
Max. Temperature (running conditions)	32°C (to be confirmed)
Max. dew point Temperature	12°C (to be confirmed

Compartment Input data	
Number of Compartments	24
Compartment length	440 m
Volume Compartment	7788 m^3



Main Input Parameters: Estimated Loads in the Sectors to the Air

SECTOR	FROM MAGNETS (kW)	TRANSMISSION LINE(kW) (normal conditions)	OTHERS (kW)	TOTAL (kW)
A-B	60	13	39	112
B-C	110	21	65	196
C-D	140	24	75	239
D-E	120	24	75	219
E-F	110	21	65	196
F-G	50	12	39	101
G-H	50	12	39	101
H-I	110	21	65	196
I-J	120	24	75	219
J-K	140	24	75	239
K-L	110	21	65	196
L-A	60	12	39	111

Main Input Parameters: Tunnel Wall Temperature

- It depends mainly on:
  - The depth;
  - The overburden;
  - Water infiltrating from near-surface;
  - Warm inflowing waters form water-bearing zones;
  - Rock thermal conductivity

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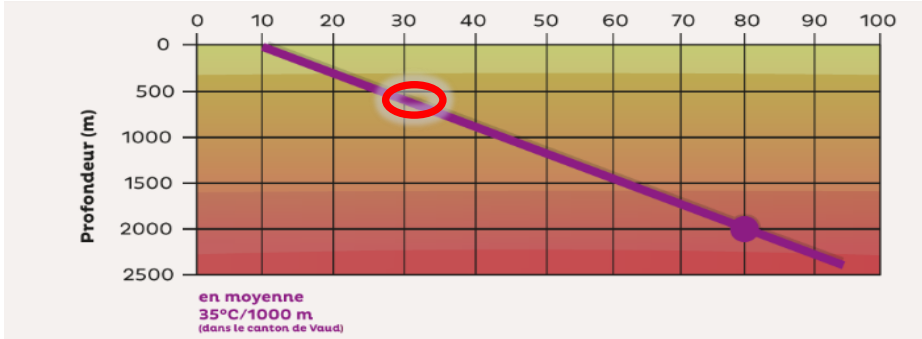
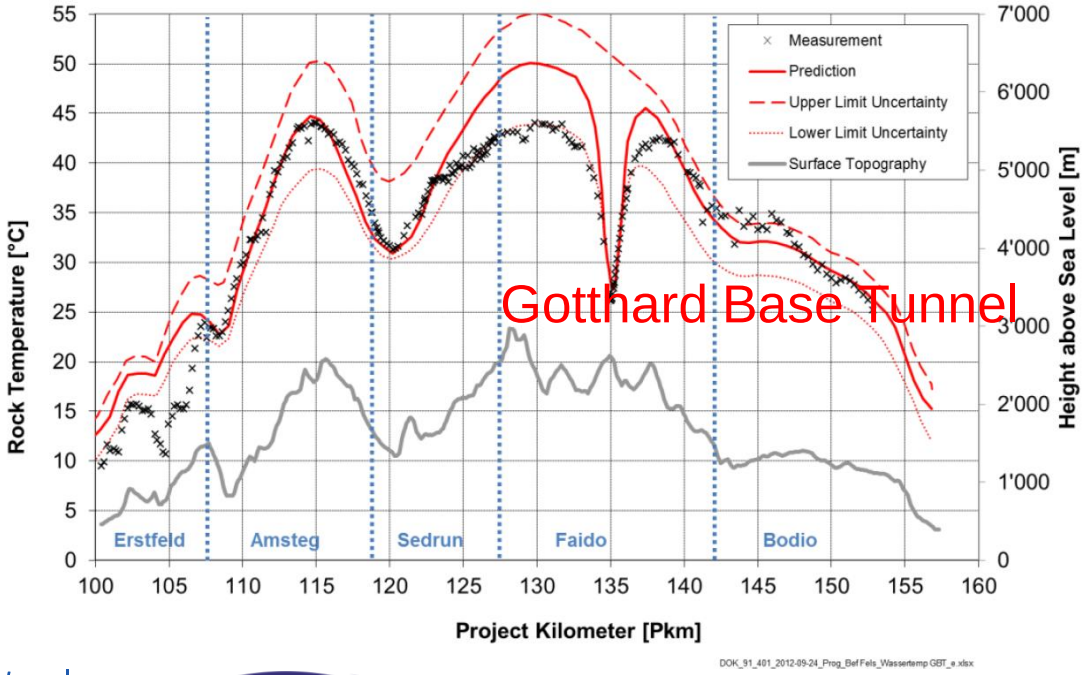
Main Input Parameters: Tunnel Wall Temperature

- In the FCC:
  - Sectors F-G, G-H and H-I are those with highest overburden (max. 600 m)
  - Very rough estimations result in peak temperature of about 30ºC but lower average in the sectors
  - A deeper study needs to be done

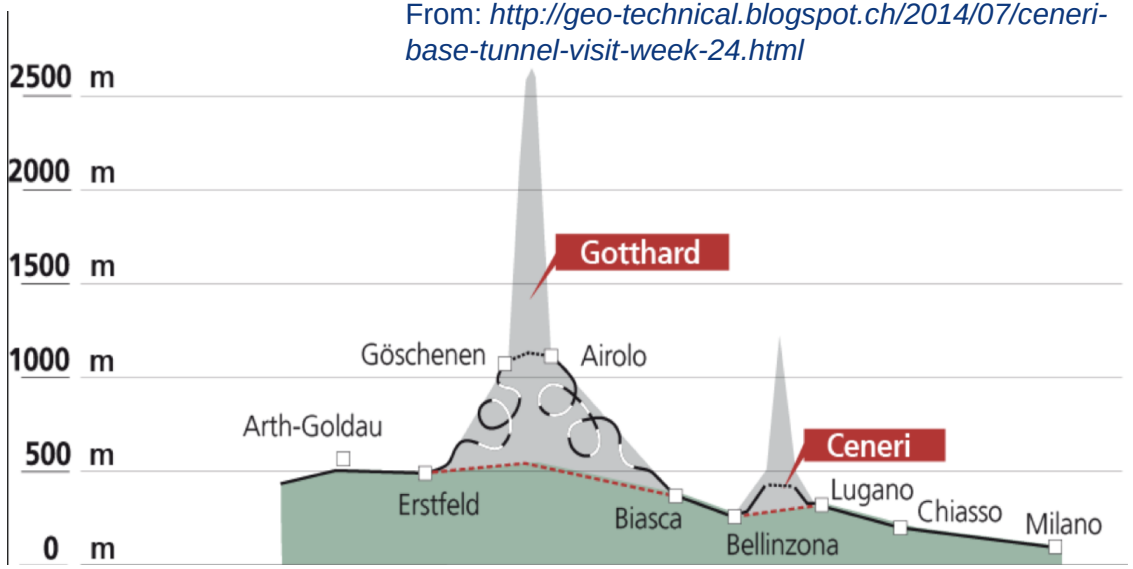


Evolution de la température dans le sous-sol dans les conditions du Plateau suisse. Source S. Catin CREGE

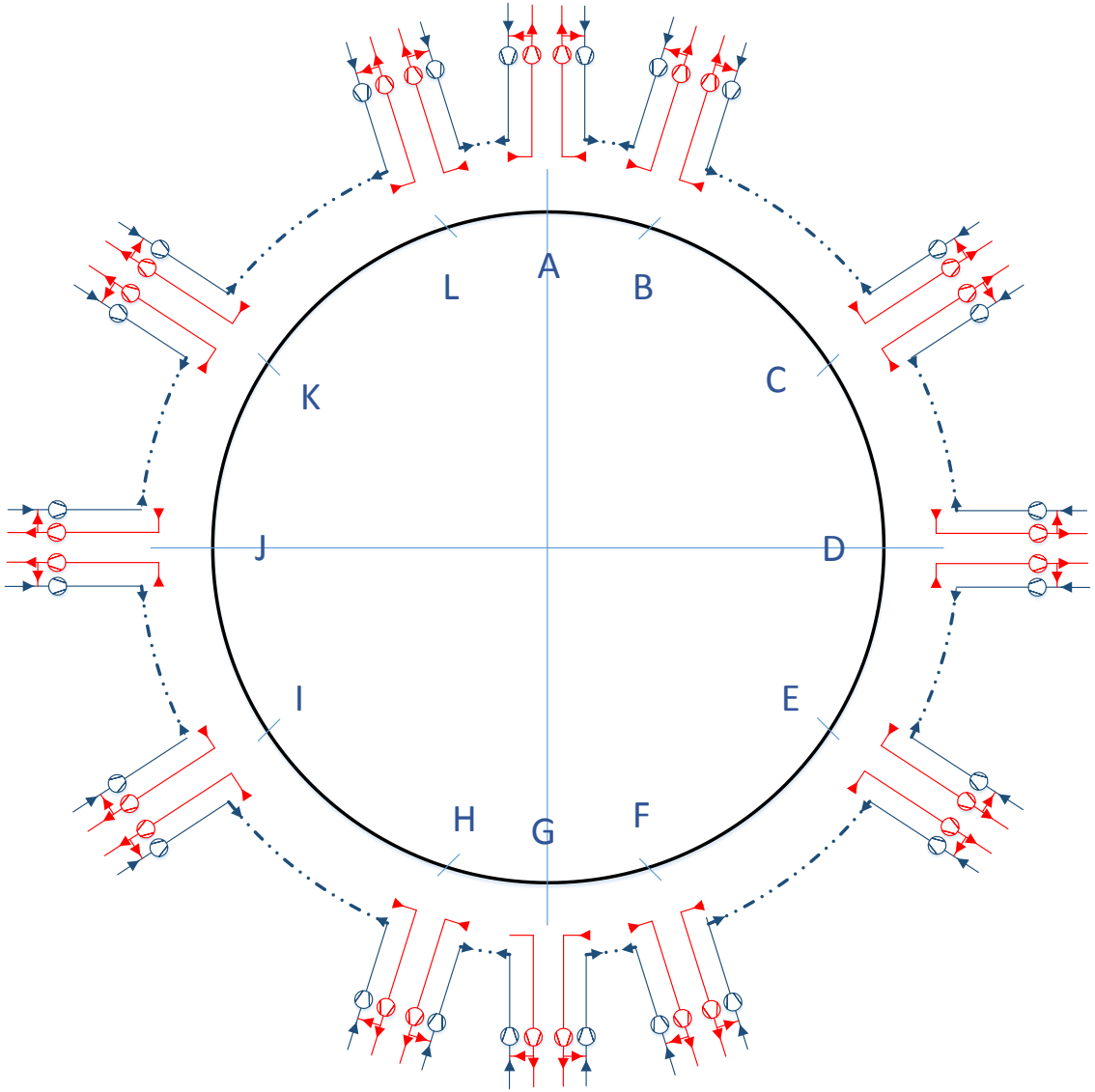
From:*http://www.hbi.ch/fileadmin/downloads/pdf/publikationen/04_Verification..._WTC-2013_Genf.pdf*



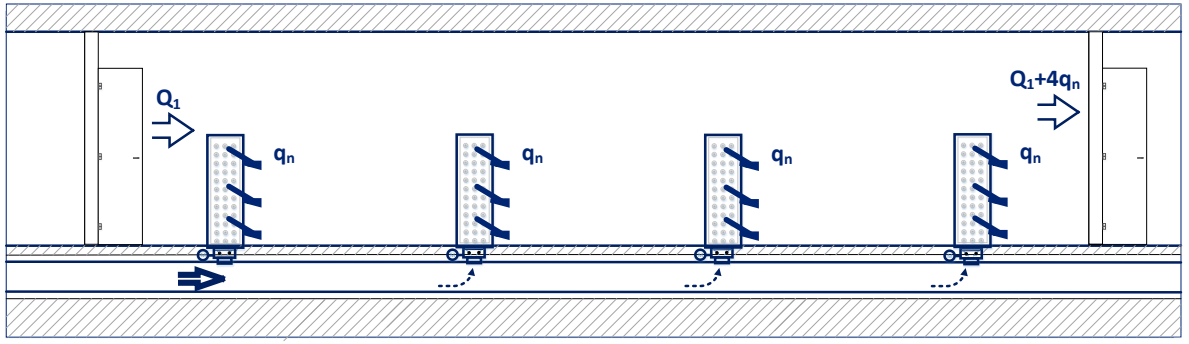
From: *http://geo-technical.blogspot.ch/2014/07/ceneri-base-tunnel-visit-week-24.html*



Ventilation of the tunnel in normal conditions (I)



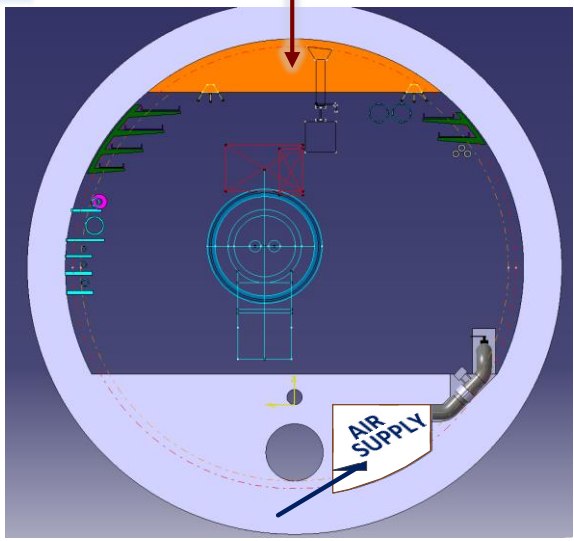
Ventilation of the tunnel in normal conditions (II)



For Air recycling

Smoke/He Extraction

Smoke/He Extraction

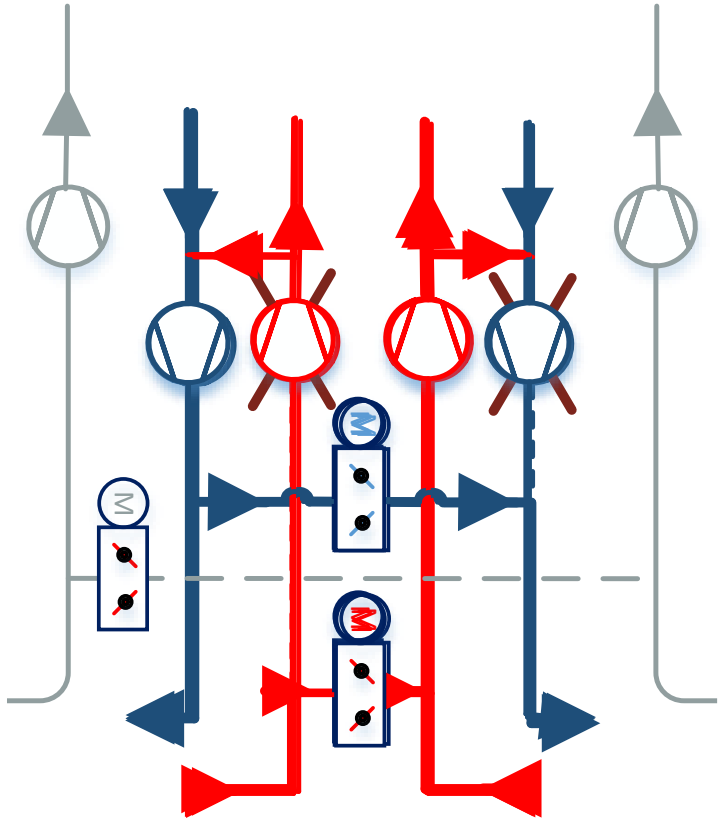


Ventilation of the tunnel in normal conditions

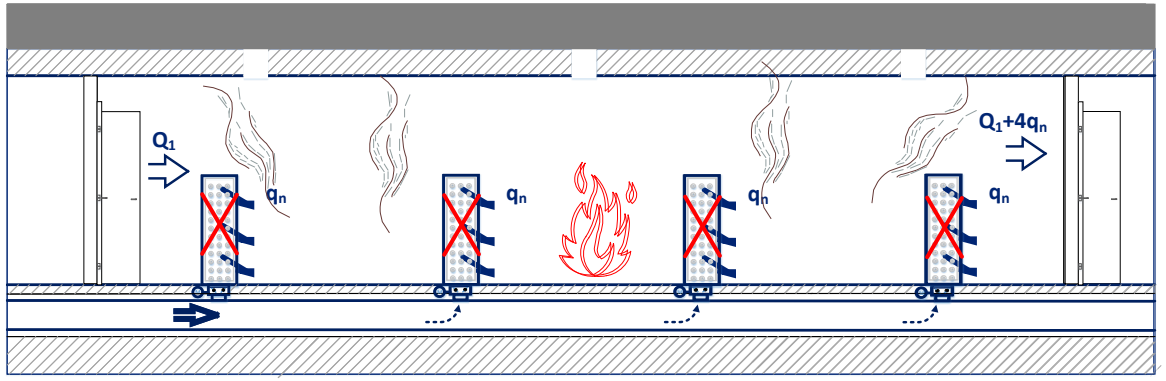
Ventilation parameters	
Normal operation air flow	2 x 25,000 m^3/h
Flushing air flow	2 x 50,000 m^3/h
Air supply points per Compartment	4
Air flow per supply point (normal operation)	520 m^3/h
Air flow per supply point (during flushing)	1041 m^3/h
Time to complete air renewal	1.8 h
Maximum air speed	0.78 m/s
Cooling capacity in normal operation, DT=15K	250 kW
Estimated Head Loss (Pa) (supply in flushing)	3300 Pa

Ventilation in degraded conditions: Back-up between AHUs

- If one supply or extraction AHU stops, the other unit, at the same point, can take over and increase the flow rate to double the flow;
- The same principle will also be applied for the smoke or He extraction system.

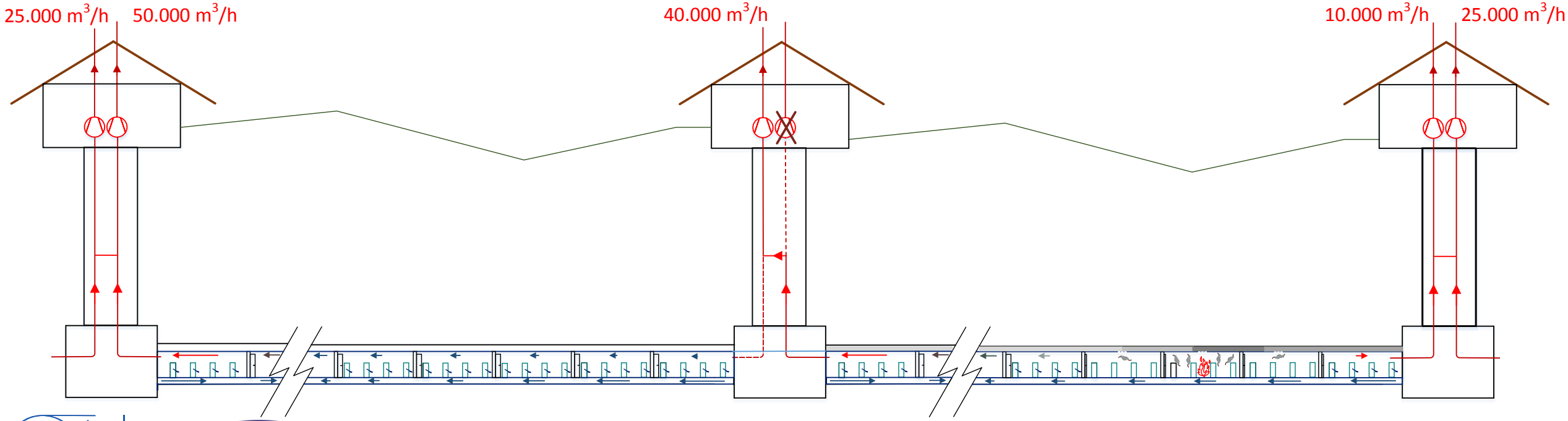


Ventilation in degraded conditions: Smoke or Helium release detection

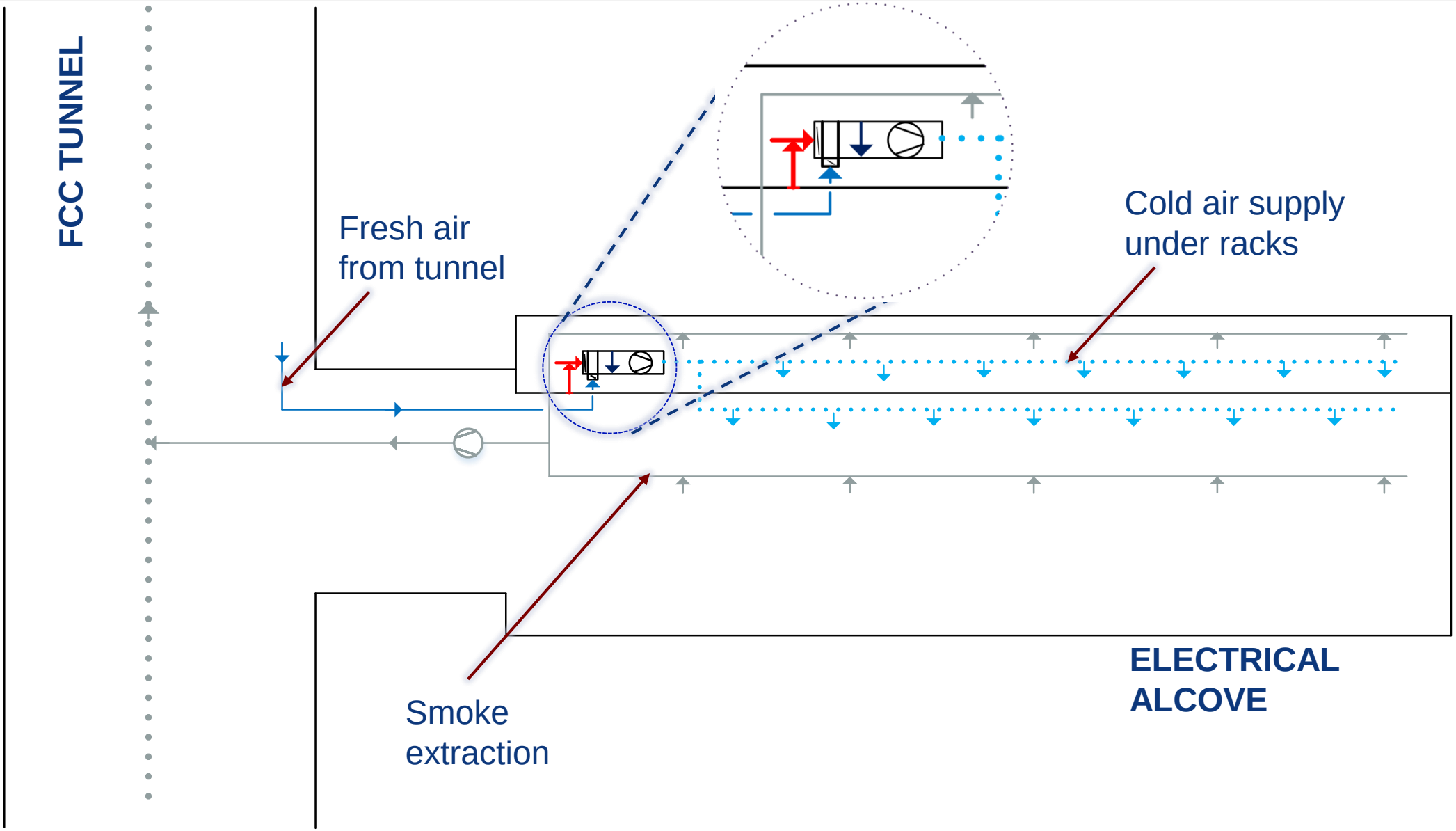


Ventilation in degraded conditions: worst case scenario

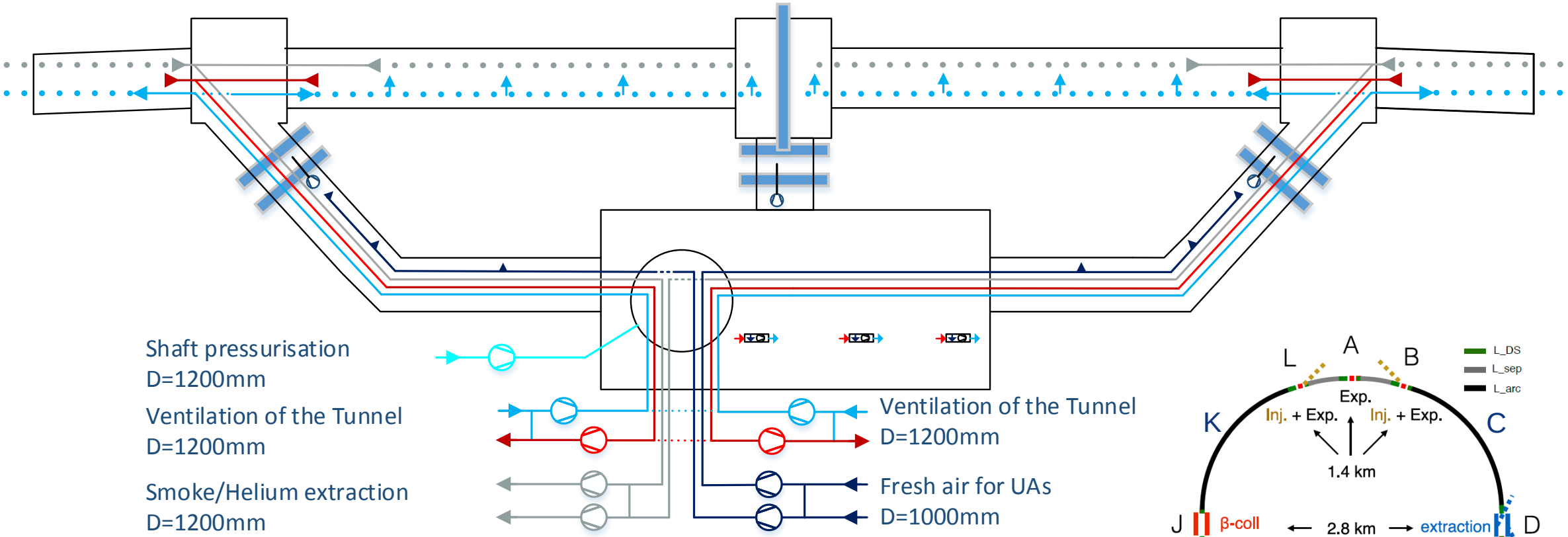
- Combination of previous scenarios:
  - Extraction AHU breaks down;
  - During an emergency situation (smoke or helium release);
- Interaction between extraction units of two adjacent sectors
- Assuming nom. flow 25000 m^3/h and max. flow 50000 m^3/h



Ventilation of the Electrical Alcoves



Ventilation of points Cryo (C, E, I and K)



Shaft pressurisation
D=1200mm

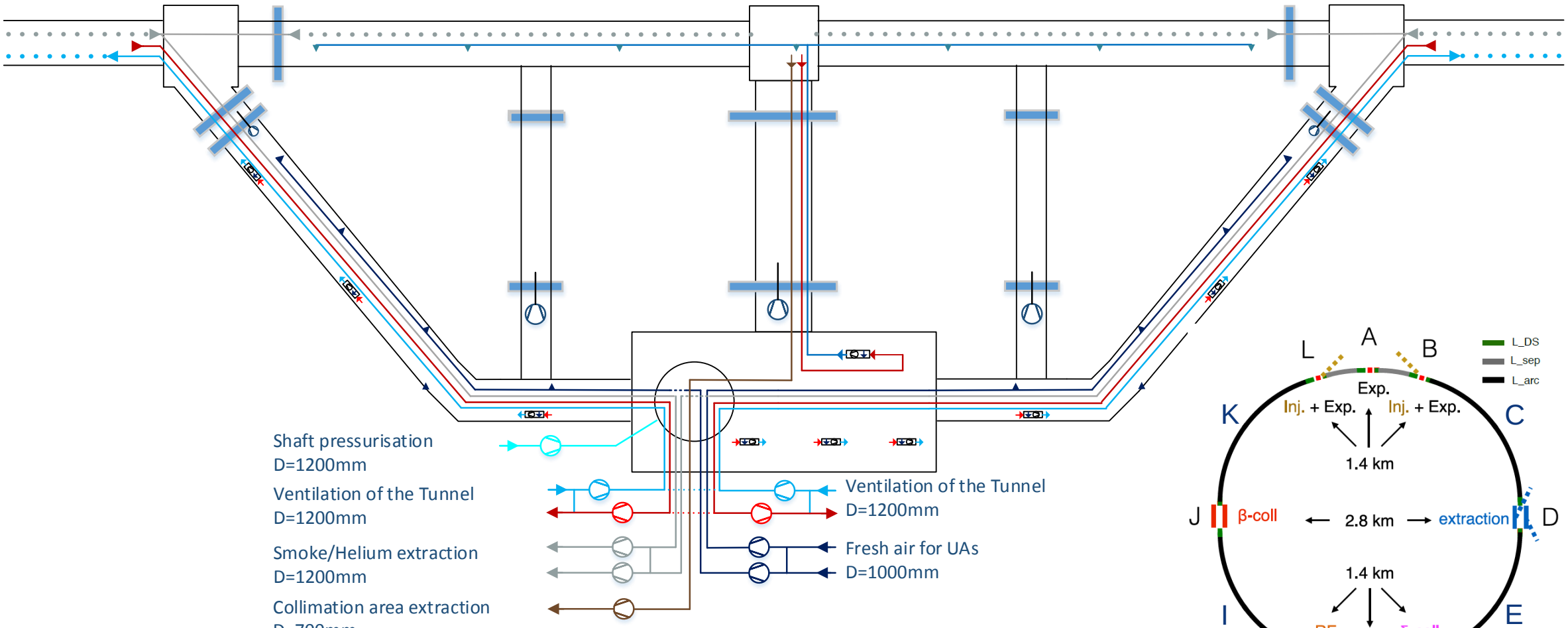
Ventilation of the Tunnel
D=1200mm

Smoke/Helium extraction
D=1200mm

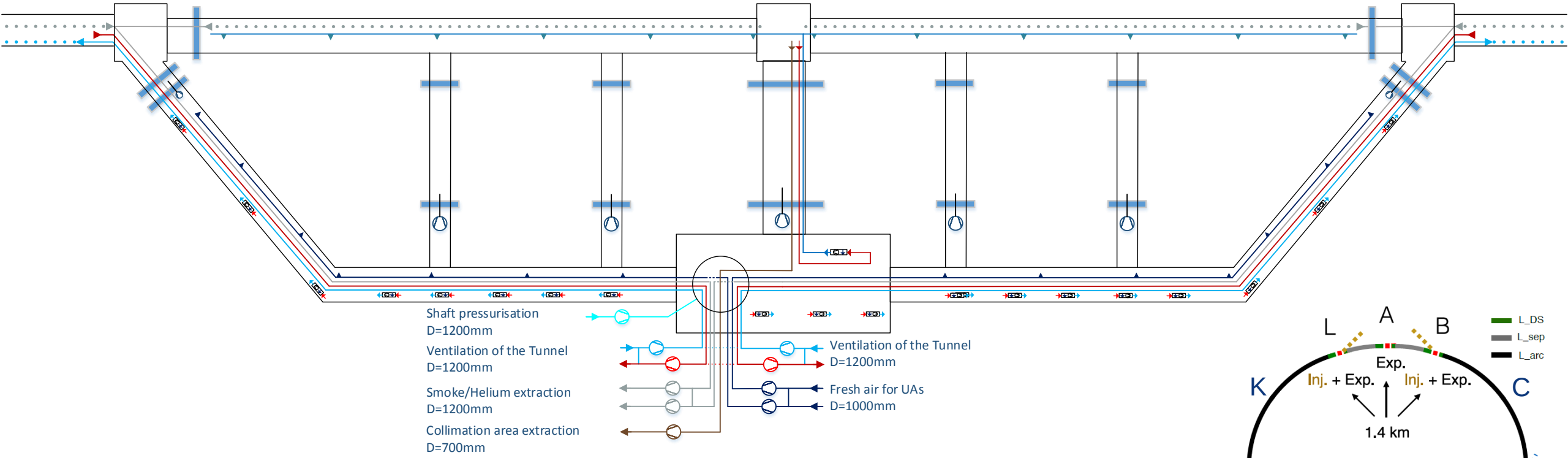
Ventilation of the Tunnel
D=1200mm

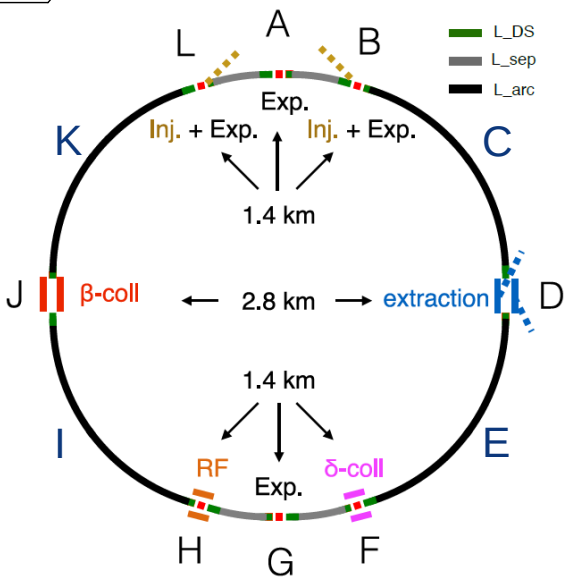
Fresh air for UAs
D=1000mm

Ventilation of δ collimation point (F)

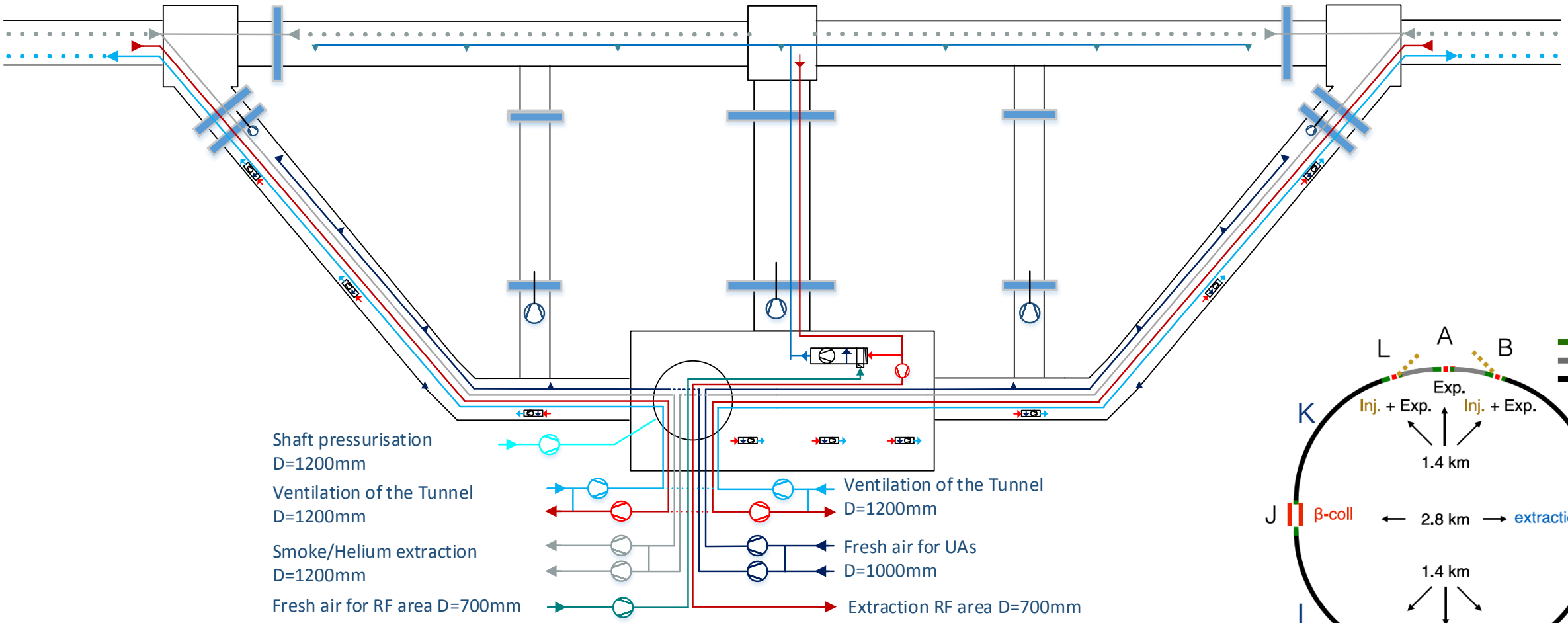


Ventilation of β collimation point (J)

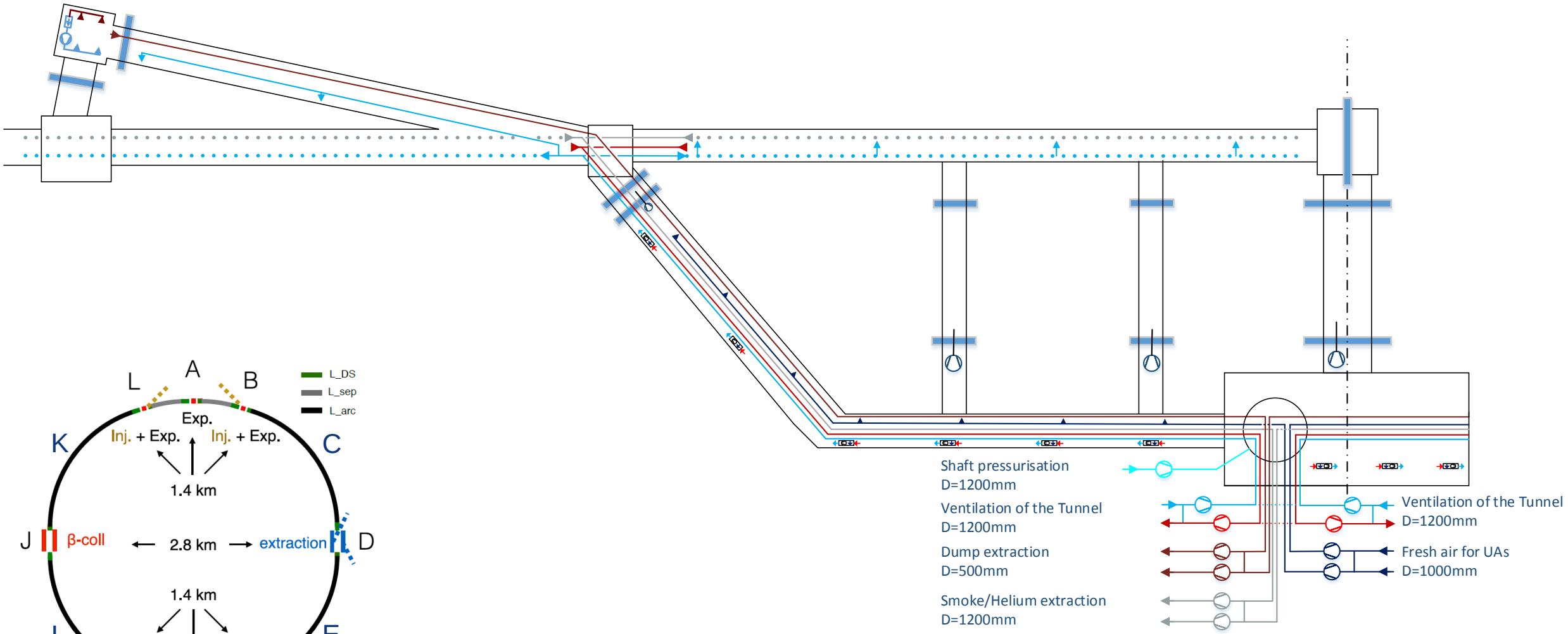




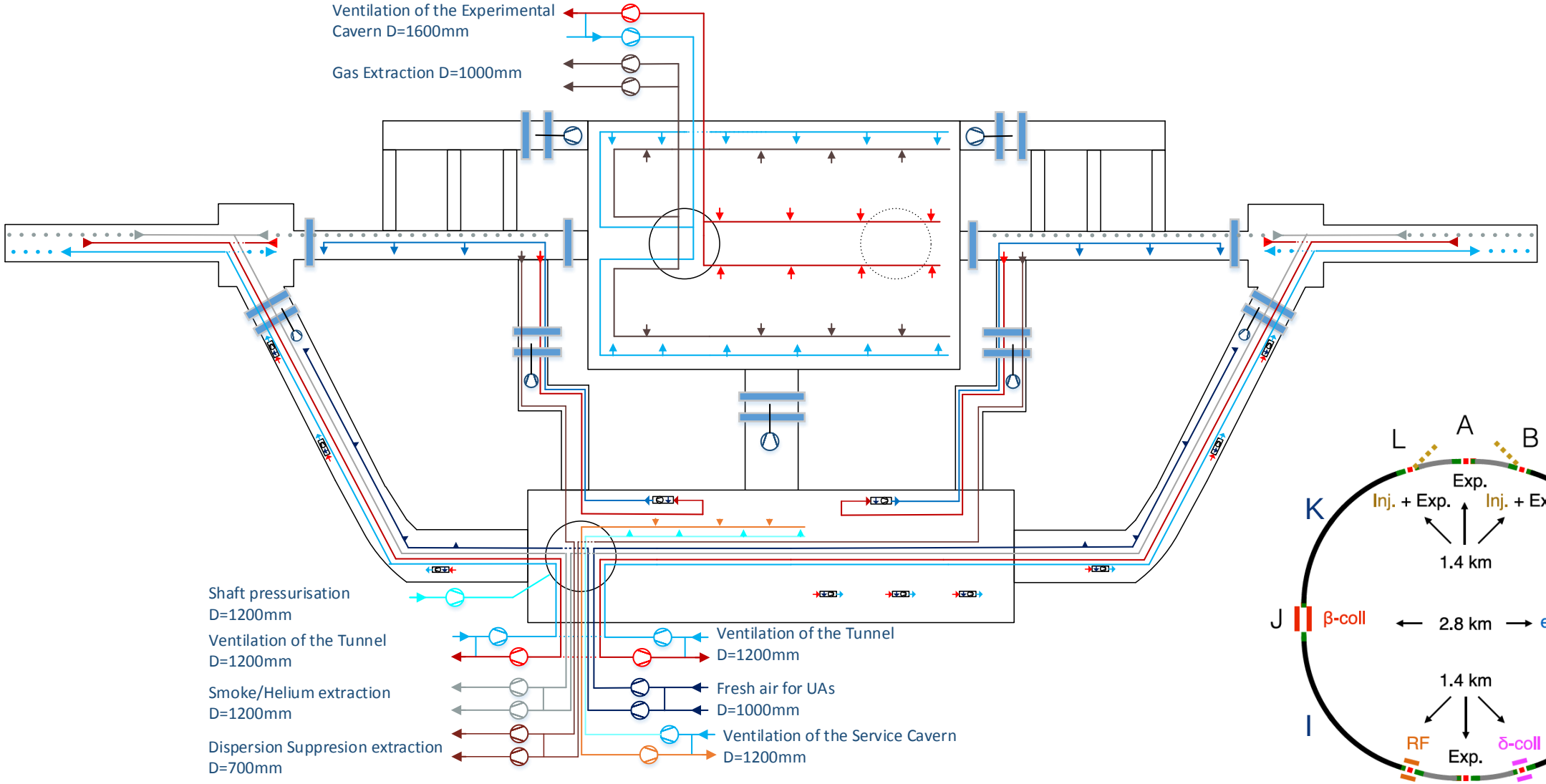
Ventilation Point H (RF)



Ventilation Point D (left side and US)

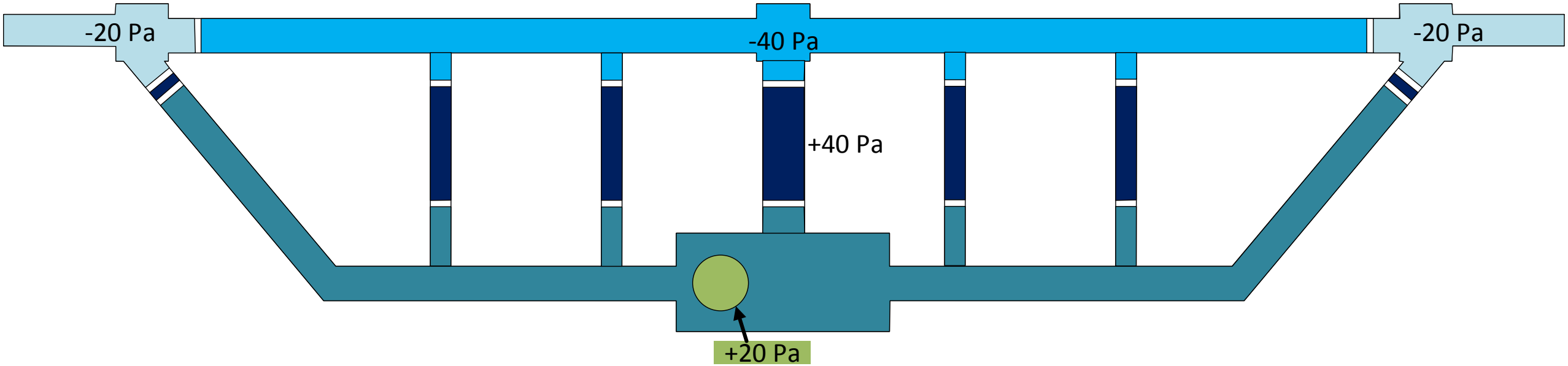


Ventilation of Experimental Points



Pressurisation of zones

Example Point J (β collimator)



Conclusions and further steps

- The design of the ventilation system is adapted to the new configuration (compartmentalised);
- Estimated heat loads to the air of the tunnel can be cooled by the air without any additional cooling
  - Though tunnel wall temperature needs further study
  - Heat load estimations need validation
- The ventilation system ensures the required functionality during normal and degraded conditions;
- The foreseen pressure differential cascade and airlocks to prevent less activated zones to be exposed to air from more activated areas has also been addressed;
- The singularities in each type of point have been addressed.
- Next steps: validation of the concept and more detailed design

THANK YOU FOR YOUR ATTENTION