

COOLING & VENTILATION INFRASTRUCTURE

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CLIC CEIS Working Group Meeting 22/06/2018

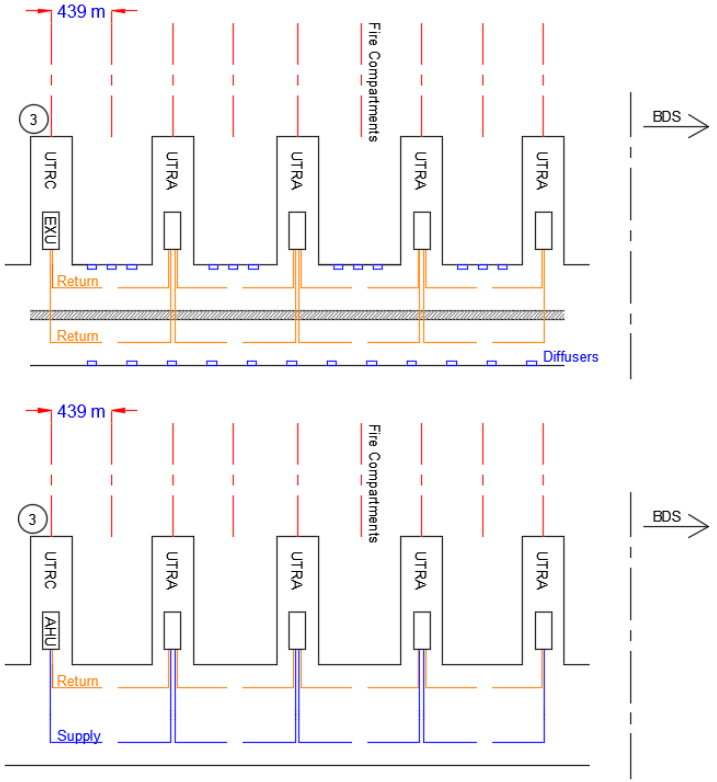
Outline

1 – CV systems, air infrastructure

2 – Open questions

3 – Future work

Main Tunnel

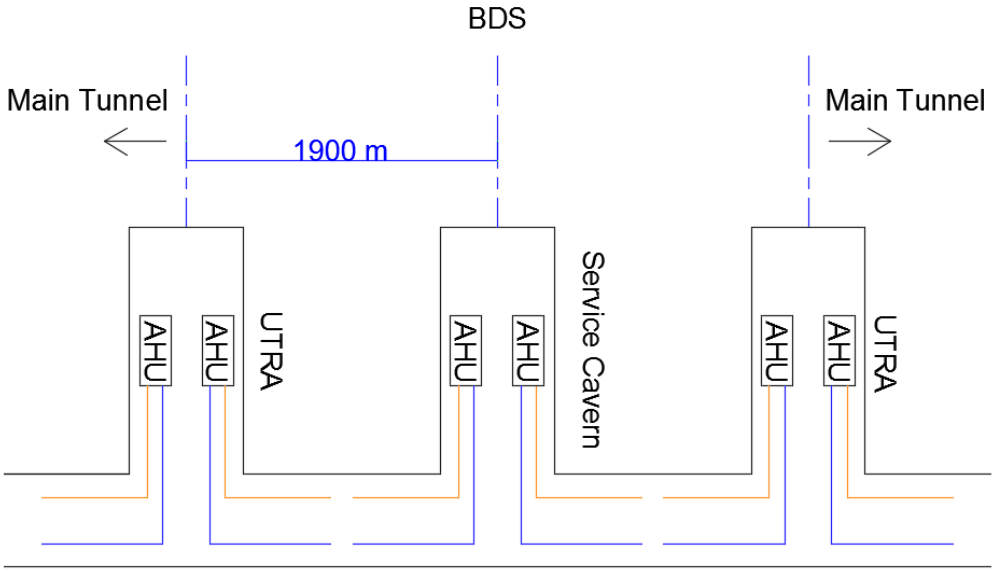


Designing for:

- 28°C
- 0,188 kg/s water p/module

Site	Heat Loads		Flow Rate AHU/EXU	ΔT	System
Main tunnel, two beam	Updated + lighting	248 W/m	129888 m³/h	5°C	Transversal flow, AHUs in alcoves
Main tunnel, klystron side		250 W/m	130843 m³/h		Transversal flow, AHUs / DXUs in service compartment
Main tunnel, modules side		225 W/m	117858 m³/h		

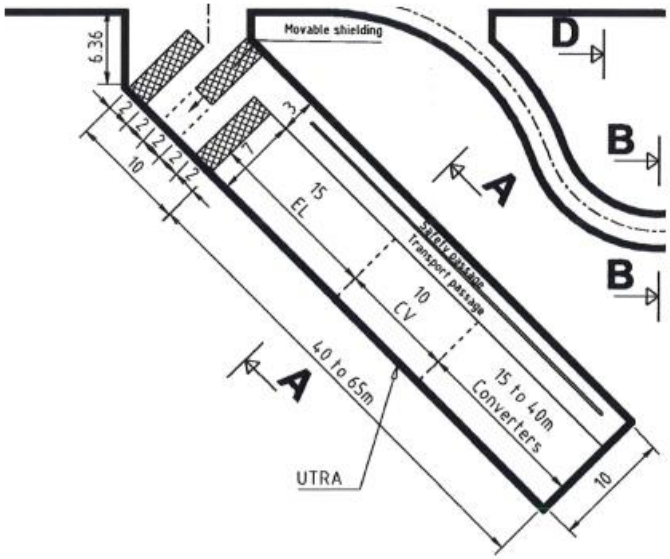
BDS

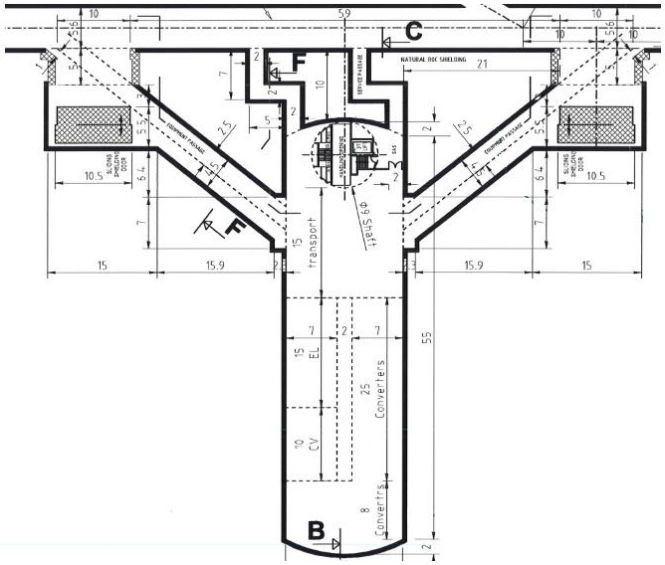


$$\frac{HL_{BDS,cdr}}{HL_{tunnel,cdr}} = 35\%$$

Site	Heat Loads		Flow Rate AHU	ΔT	System
BDS	35% tech HL tunnel + lighting	177 W/m	100493 m^3/h	5°C	Transversal flow, AHUs in alcoves

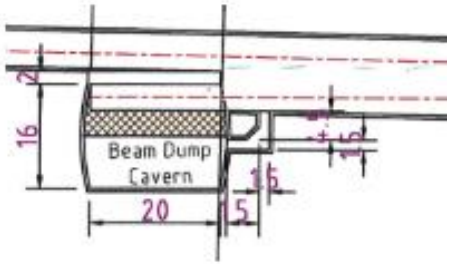
Caverns

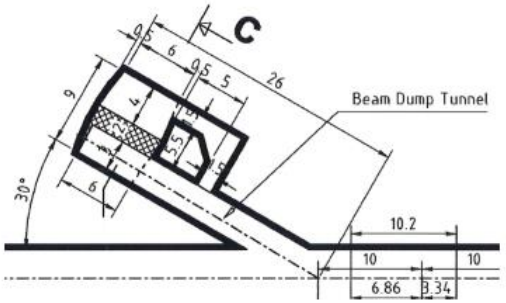




Site	Heat Loads		Flow Rate AHU	ΔT	System
Service Cavern	**Unknown HL**	-	-	5°C	Dedicated AHU inside the caverns
UTRA, UTRC	CDR + lighting	99 kW, 104 kW	59081 m³/h , 61946 m³/h		
Cavern 1.3 , 1.4 , 2.1 , 3.1	**Unknown HL**	-	-		
Cavern 2.2 , 3.2	CDR + lighting	158 kW, 158 kW	94233 m³/h , 94233 m³/h		
BC2 Cavern e^+ / e^-		30 kW	17910 m³/h		

Beam Dumps

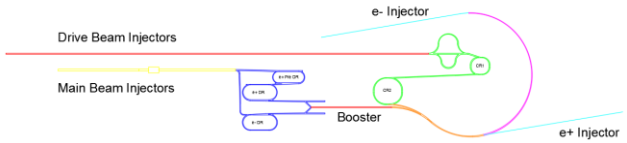




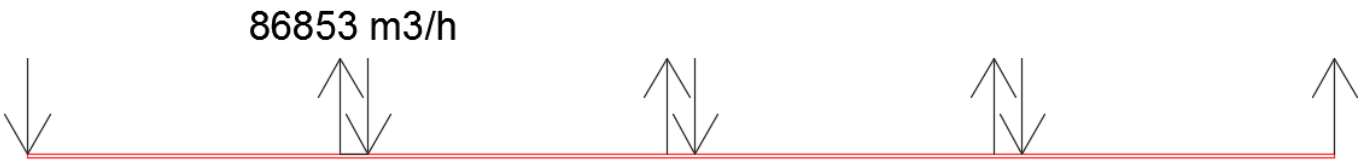
- Beam dumps should be closed spaces
- Air recirculation + "fresh air" from the tunnel – flow rate?

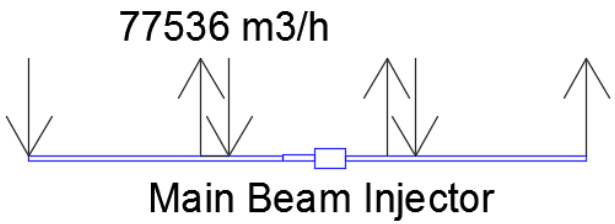
Site	Heat Loads		Flow Rate AHU	ΔT	System
Drive beam dumps	CDR + lighting	6 kW	3684 m^3/h	5°C	Dedicated AHU inside the beam dump caverns
Main beam dumps		143 kW	85493 m^3/h		

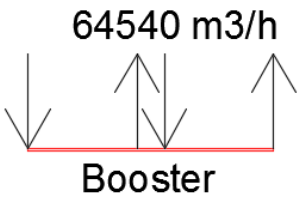
Injectors, Booster, Damping Rings



- Many surface CV buildings
- Is recycling allowed? (RP)

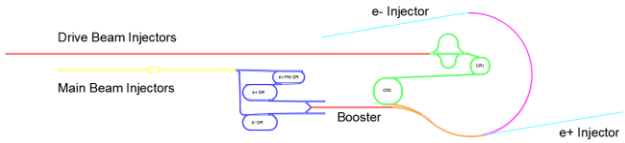


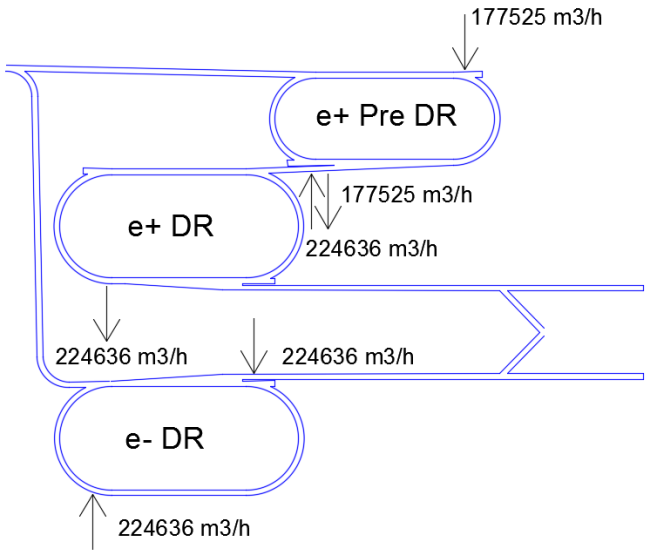




Site	Heat Loads	System
Drive beam injector	Updated values (Alexej) + lighting	Longitudinal flow, AHUs at the surface
Main beam injector		
Booster		
Pre-damping ring e^+		
Damping ring e^+ and e^-		

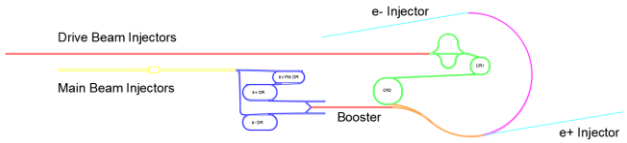
Injectors, Booster, Damping Rings

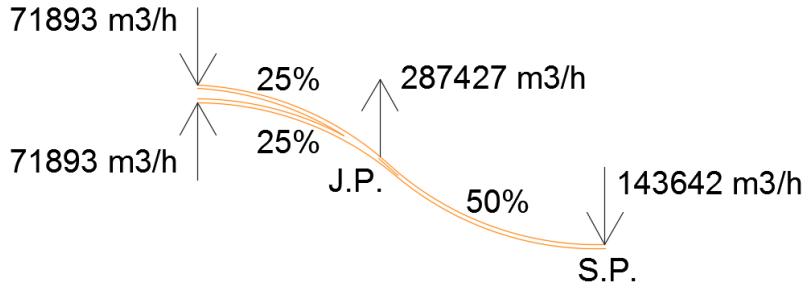


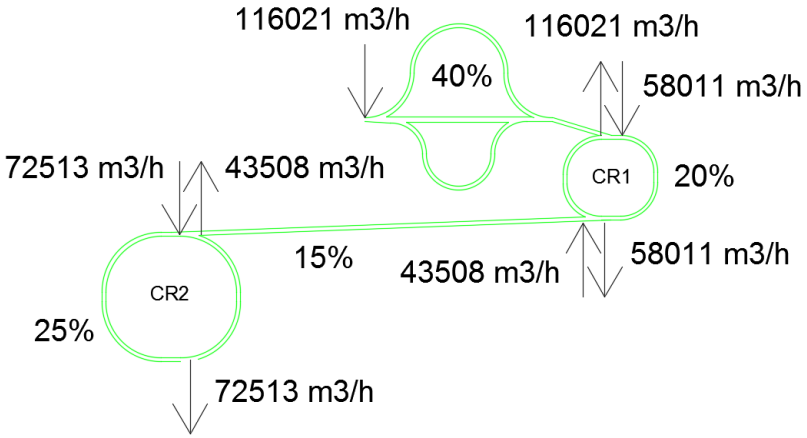


Site	Heat Loads	System
Drive beam injector	Updated values (Alexej) + lighting	Longitudinal flow, AHUs at the surface
Main beam injector		
Booster		
Pre-damping ring e^+		
Damping ring e^+ and e^-		

Transfer Lines

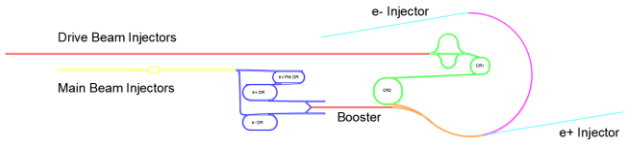


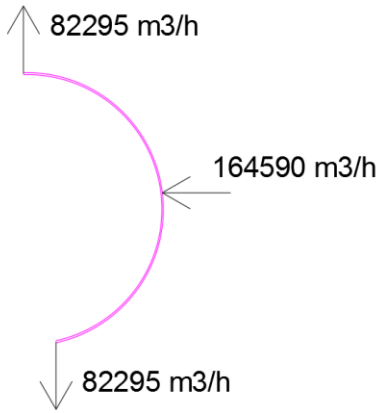




Site	Heat Loads	System
Transfer Loop	CDR + lighting	Longitudinal flow, AHUs at the surface
Frequency Multiplication		
Transfer from CR2 to J.P.		
Transfer from Booster to J.P.		
Transfer from J.P. to S.P.		
Transfer e^+ slope	CDR + lighting	Transversal flow
Transfer e^- slope		

Transfer Lines

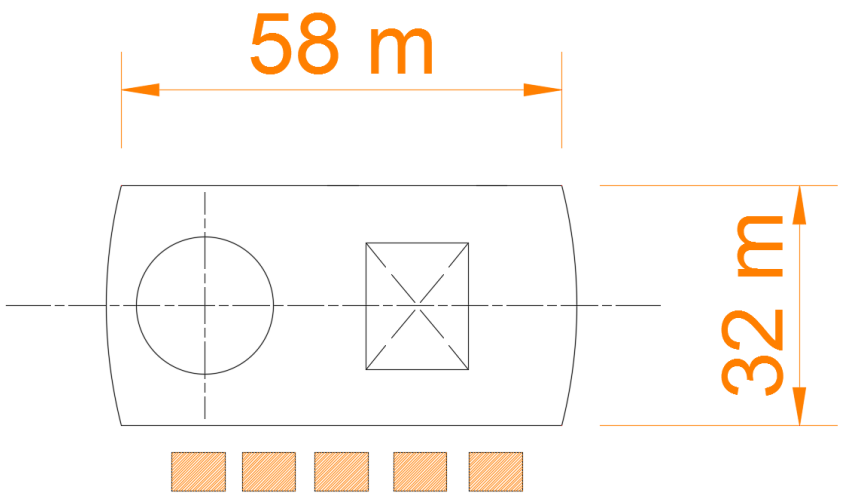




2 x R500	e+ Injector
2 x R550	e- Injector

Site	Heat Loads	System
Transfer Loop	CDR + lighting	Longitudinal flow, AHUs at the surface
Frequency Multiplication		
Tranfer from CR2 to J.P.		
Transfer from Booster to J.P.		
Transfer from J.P. to S.P.		
Transfer e^+ slope	CDR + lighting	Trasversal flow
Transfer e^- slope		

Detectors Hall



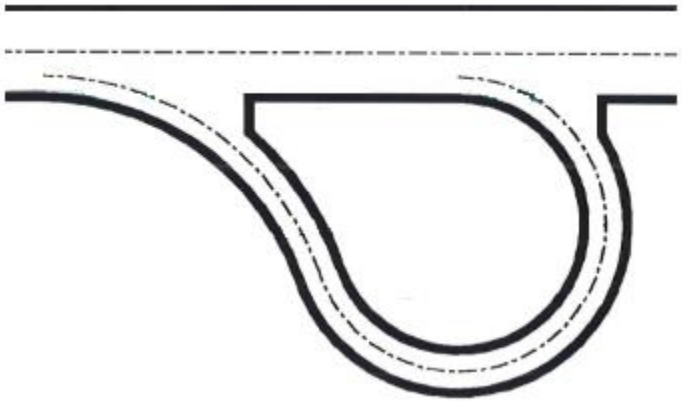
5 Large AHUs

- Gas extraction is foreseen
- 670 kW – 5 x 80'000 m³/h

❖Review Heat Loads

Site	Heat Loads	System
Detectors Hall	CDR + Lighting	High Heat Loads - Review

DB and MB Turnarounds



- AHUs inside the UTRA/C or BC2 caverns
- Supply + extraction ducts

Site	Heat Loads		Flow Rate AHU	ΔT	System
MB turnarounds e^+ and e^-	CDR + Lighting	12 kW	6873 m^3/h	5°C	Dedicated AHU inside the beam dump caverns
DB turnarounds	-	**Unknown**	-		

Surface Buildings

Site	Heat Loads	System
Drive Beam Injector	Updated values (Alexej) + 50W/m²	15 x AHU 66988 m³/h
Main Beam Injector		5 x AHU 69364 m³/h
Booster		4 x AHU 69106 m³/h
Building - Damping Rings		2 x AHU 50042 m³/h
Building - CR1 and CR2	CDR + 50W/m²	3 x AHU 76020 m³/h
Building - Injection Hall		2 x AHU 50746 m³/h

Dedicated AHUs for each surface building

Open questions

- Confirm heat load in the detectors hall
- Heat loads for service cavern and caverns 1.3, 1.4, 2.1 and 3.1
- Attribute heat loads to the surface buildings
- Determine the necessary “fresh air” for the beam dumps

Open questions

- Can we recycle air?
- Smoke extraction design and integration is still WIP
- Design for the 380 GeV or 3 TeV?

Future Work – short term

- Develop and detail the air infrastructures
- Design the water cooling plants and hydronic network

To be confirmed

Site	S/U	HL Water [kW]
Drive Beam Injector	U	5356
Drive Beam Injector	S	14191
Main Beam Injector	U	3886
Main Beam Injector	S	5126
Booster	U	1811
Booster	S	4239
Drive Beam Dumps	U	533
Drive Beam Turnaround	U	736
UTRA	U	869
UTRC	U	869
Equipment Passages for UTRC	U	0
Adittional Caverns 2.2 and 3.2	U	1000
Caverns 1.3 and 1.4	U	0
Survey Cavern 2.1 and 3.1	U	0
Main Beam Dump	U	13860
Detectors Hall - Underground	U	7500
BDS	U	14040
Main Tunnel - Two Beam	U	18563
Main Tunnel - Klystron, K side	U	12389
Main Tunnel - Klystron, LINAC side	U	13564

Tunnel BC2 e^+	U	1175
Main Beam Turn-Around e+	U	0
Tunnel BC2 e^-	U	1175
Main Beam Turn-Around e^-	U	0
BC2 Caverns	U	0
Transfer Lines e^+ from Surface to Tunnel	U	108
Transfer Lines e^- from Surface to Tunnel	U	120
Transfer Lines Loop	U	2101
Frequency Multiplication	U	12141
Tranfer from CR2 to J.P.	U	1028
Transfer from Booster to J.P.	U	1028
Transfer from J.P. to S.P.	U	2055
Pre Damping Ring	U	2733
Damping Ring e+ / e-	U	2681
Building - Damping Rings	S	1447
Building - CR1 and CR2	S	3440
Building - Injection Hall	S	1547

❖**Please confirm these values**

Questions and Remarks

Thank You for Your Attention