

11th October 2016

FCC-ee MDI meeting

– Civil Engineering

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Cost & Schedule Study

Two companies have been awarded contracts to undertake a cost & schedule study:

- **ILF**

- Gotthard Base Tunnel : Cost Analysis
- Ceneri Base Tunnel 15km tunnels
- Brenner Base Tunnel :55km tunnels



- **Geonconsult / Synaxis**

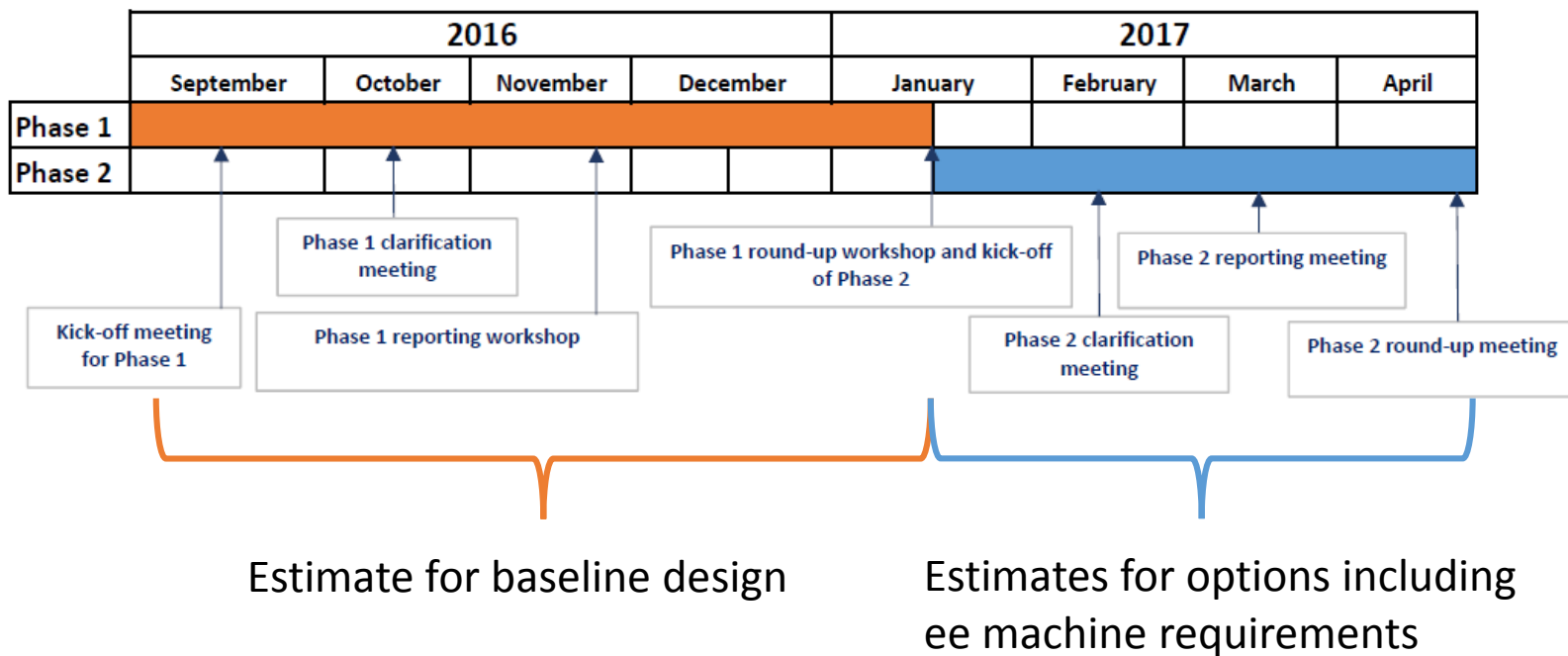
- HSR Graz, Styria, Austria: 2x33km tunnels
- Tel Aviv LRT, Red Line : 9Km tunnels, 6.5m diameter
- CMS shafts/caverns
- Lausanne Railway Station, East Exit
- Several surface buildings at CERN (eg POPS, ISOLDE)





Cost & Schedule Study

The study is split into 2 phases, the ee machine requirements are to be considered in Phase 2.





Layouts considered for optimisation

	Shape summary	Circumference	LSS A&G	LSS F&H&B&L	ESS length	Width	Height
V1	Current baseline	99.97	1.4	1.4	4.2	30.63	31.29
V2	Widest (D to J) [2.7km wider than baseline]	99.97	1.4	2.8	1.4	33.31	29.3
V3	Shortest (A to G) [2.2km shorter than baseline]	97.75	1.4	2.1	1.4	32.16	29.07
V4	[Similar width to baseline but 1.2km shorter (A to G)]	97.75	1.4	1.4	2.8	30.82	30.07
V5	Unsymmetrical	97.75	1.4	1.4 (BL) 2.8 (FH)	2.8	31.5	30.51



Geology of chosen layout



Alignment Shafts Query

Choose alignment option
V4-97.75-30.82-30.07

Tunnel elevation at centre: 272mASL

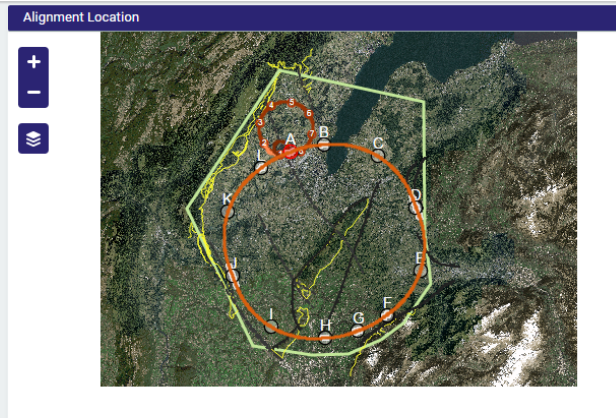
Grad. Params

Azimuth (*): -20.5
Slope Angle x-x(%): 0.6
Slope Angle y-y(%): 0

LOAD SAVE CALCULATE

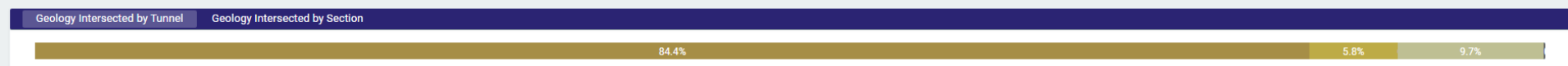
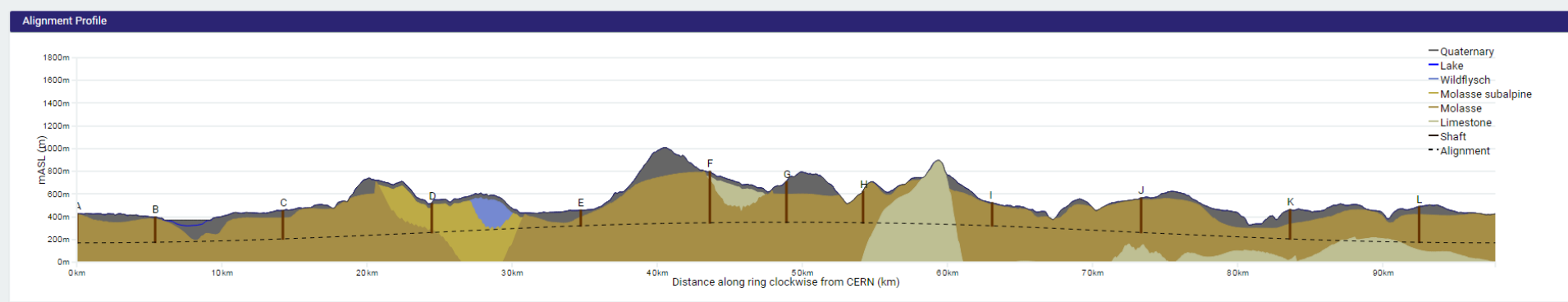
Alignment centre
X: 2500180 Y: 1107801

	CP 1	CP 2	
Angle	Depth	Angle	Depth
LHC	157m	185m	
SPS	231m	231m	
TI2	231m	231m	
TI8	160m	221m	



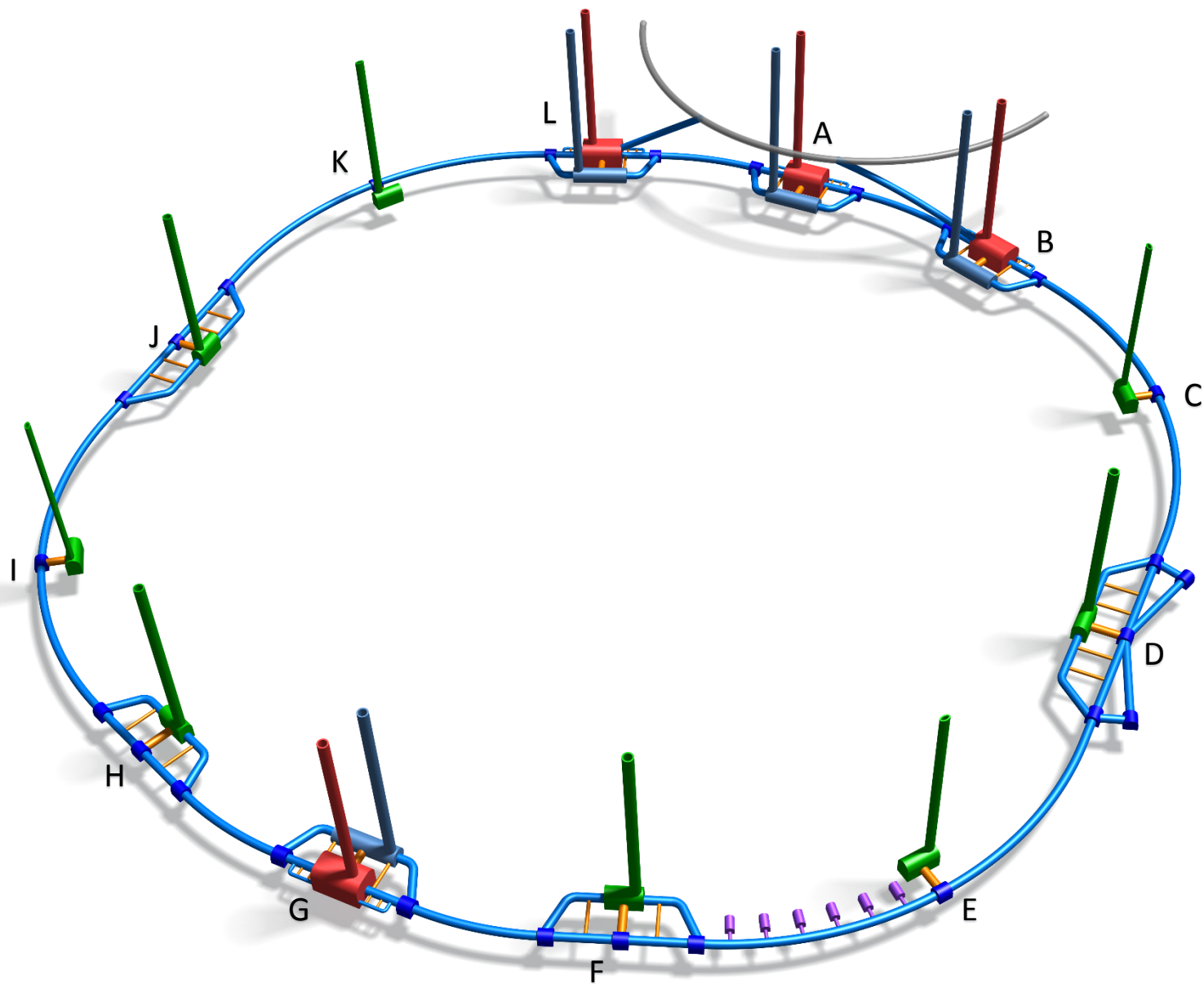
Geology Intersected by Shafts Shaft Depths

Point	Actual	Shaft Depth (m)			Geology (m)		
		Molasse SA	Wildflysch	Quaternary	Molasse	Urgonian	Limestone
A	253	0	0	0	253	0	0
B	220	0	0	15	204	0	0
C	248	0	0	63	185	0	0
D	254	196	0	40	17	0	0
E	136	0	0	57	79	0	0
F	450	0	0	40	377	0	33
G	357	0	0	109	248	0	0
H	273	0	0	0	273	0	0
I	202	0	0	12	189	0	0
J	302	0	0	13	289	0	0
K	256	0	0	124	132	0	0
L	313	0	0	68	245	0	0
Total	3264	196	0	542	2492	0	0



- Length = 97.75 km
- Minimises length of tunnel in the limestone, apart from the unavoidable location between H & I, only a small length of tunnel in Jura limestone.
- Avoids any tunnel length being in the moraines

Baseline Schematic



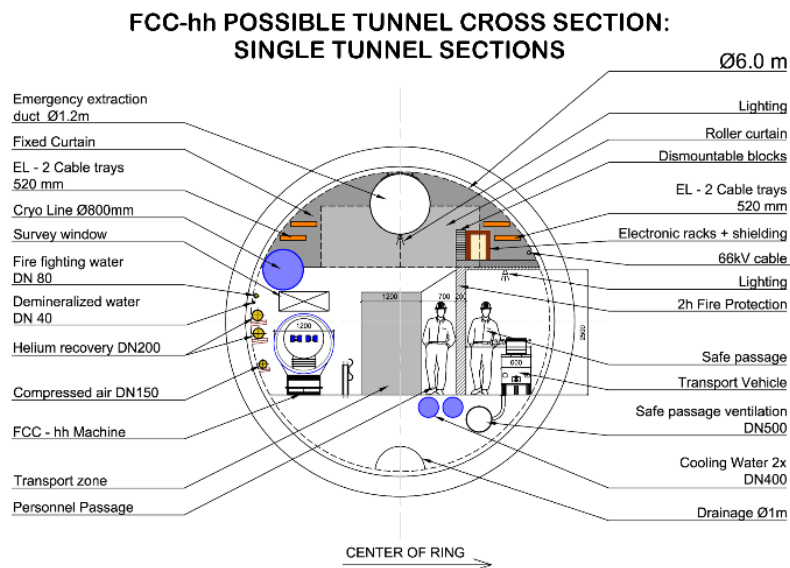


Dimensions

Structure	Locations	Dimensions
Experimental shafts	L,A,B,G	∅ 15 m
Experimental caverns	L,A,B,G	30(w) x 35(h) x 70(l)
Service caverns at experimental points	L,A,B,G	20(w) x 15(h) x 120(l)
Regular service shafts	A,B,D,F,G,H,J,L	∅ 12 m
Machine lowering service shafts	C,E,I,K	∅ 18 m
Regular service caverns	D,F,H,J	15(w) x 15(h) x 100(l)
Machine lowering service caverns	C,E,I,K	22(w) x 15(h) x 100(l)
Alcoves	Every 1.5 km	6(w) x 6(h) x 25(l)

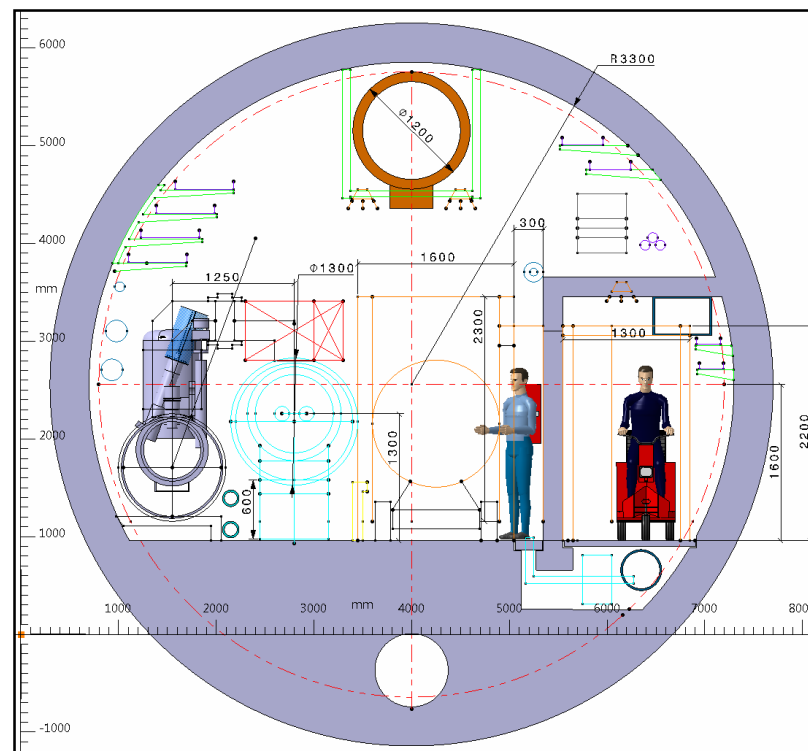
Single tunnel cross-section

6.0m tunnel



6.0m adopted for
C&S Phase 1

6.6m tunnel



03/08/2016

- **BACK UP**

Functional Sections of FCC-ee

