CLIC
PBS Internal Review – Transport & Handling

MICHAL CZECH – INGO RUEHL

EN-HE

PiP Transport Resume

Included in the document:

- Update of all transport and handling operations for 380 GeV CLIC project based on CDR Volume 1 for 3 TeV
- Summary of the type main equipment to be transported in the underground structures
- Update on the surface transport and handling with a focus on Drive beam injection complex with ~2km long builing
- Access shafts update (2 lifts for redundancy, different layout)
- Underground equipment update with focus on the Klystron option (two sides (DB – number of the equipment, Klystron – number of the equipment, two sides of the tunnel, T&H solutions for the machine and Klystrons
- Cost considerations Review

PiP Transport Resume

Not included in the document

- Information which did not change since CDR Volume 1 (transport and handling in the Drive Beam option – Special Transport Vehicle in particular)
- Supports for the machine installation (note and reference to CDR Volume 1)
- Klystron option klystron side transport and handling solution detailed study as the studies on this part of the tunnel are still ongoing
- Detailed cost estimations with prices

PBS Costing Tool Resume (TRANSPORT)

Estimations and assumptions were made based on:

- Price of the equipment on the day of estimation
- Existing contracts, e.g.:
  - S172 Altéad: transport and handling operations
  - Supply of cranes <10t capacity – B1xxx - BONFANTI
  - Supply of cranes >10t capacity – B1xxx – C…..
  - Replacement of LHC lifts – B1455/EN – SCHINDLER
- LHC experience

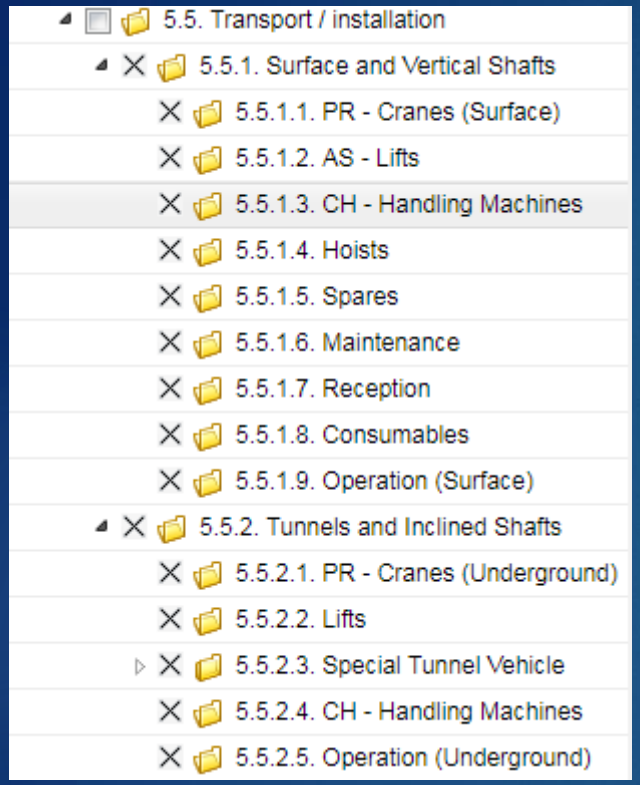
Studies included:

- Surface transport around the host site and to shafts
- Lowering down shafts
- Underground transport and installation

Studies did not include:

- Transport to the host site (this should be included in the equipment procurement costs)
- Beam Dump transport and installation
- Inclined access tunnel personnel and equipment transport
- Coordination of installation activities

Breakdown structure DB & Klystron option



Difference between the Drive Beam solution and Klystron solution:

- Surface - ~2km building (5x5 t cranes)
- Underground – (rail system on the Klystron side of the Klystron tunnel)

5.5.1.1.	PR - Cranes (SURFACE)	0y	0y
		8,000,000	CHF
5.5.1.2.	AS - Lifts	0y	0y
		400,000	CHF
5.5.1.3.	CH - Handling machines	0y	0y
		5,000,000	CHF
5.5.1.4.	Hoists	0y	0y
		100,000	CHF
5.5.1.5.	Spares	0y	0y
		500,000	CHF
5.5.1.6.	Maintenance	0y	0y
		250,000	CHF
5.5.1.7.	Reception	0y	0y
		50,000	CHF
5.5.1.8.	Consumables	0y	0y
		300,000	CHF
5.5.1.9.	Operation (SURFACE)	0y	0y
		4,000,000	CHF
5.5.2.1.	PR - Cranes (UNDERGROUND)	0y	0y
		400,000	CHF
5.5.2.3.1.	Vehicles	0y	0y
		10,000,000	CHF
5.5.2.3.2.	Unloading transfer	0y	0y
		7,000,000	CHF
5.5.2.3.3.	Power rail	0y	0y
		1,500,000	CHF
5.5.2.3.4.	Special adaptation	0y	0y
		3,000,000	CHF
5.5.2.3.5.	Guidance infrastructure	0y	0y
		700,000	CHF
5.5.2.3.6.	Integration studies	0y	0y
		800,000	CHF
5.5.2.3.7.	Mock up	0y	0y
		800,000	CHF
5.5.2.3.8.	Inspections	0y	0y
		100,000	CHF
5.5.2.3.9.	Spares	0y	0y
		1,000,000	CHF
5.5.2.3.10.	maintenance	0y	0y
		500,000	CHF
5.5.2.4.	CH - Handling machines	0y	0y
		4,000,000	CHF
5.5.2.5.	Operation (UNDERGROUND)	0y	0y
		3,000,000	CHF

TOTAL	51,400,000 CHF

ISSUES

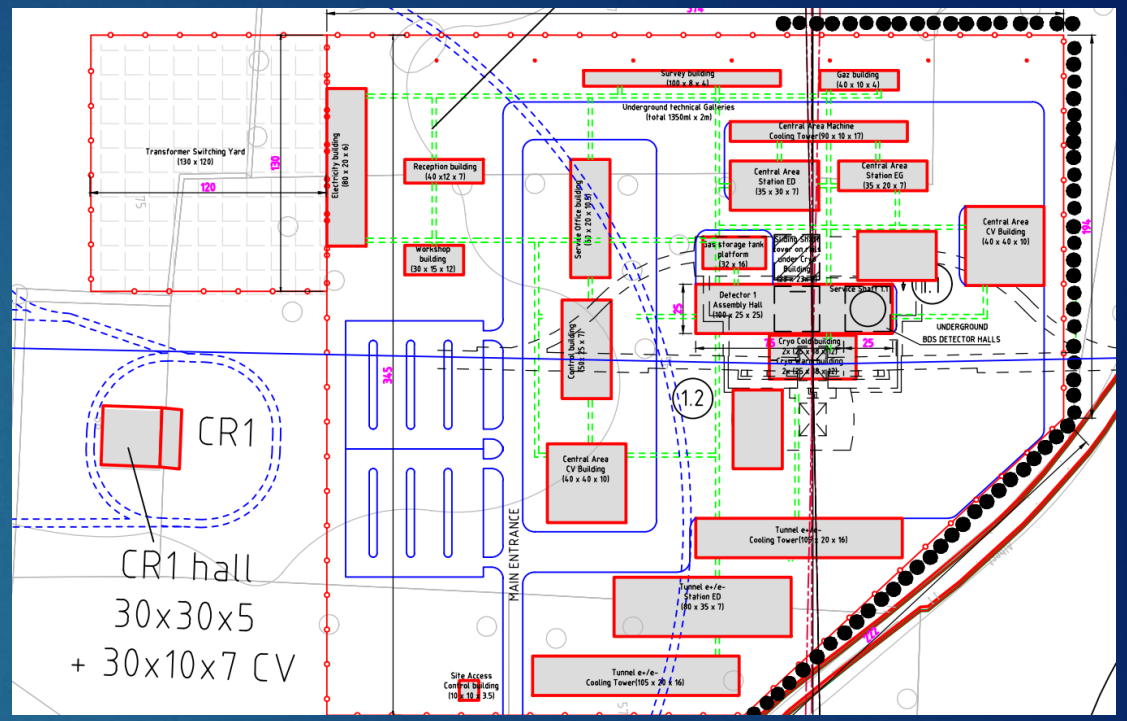
- More studies are needed in order to obtain detailed cost estimate.
- The biggest changes in the budget can be caused by the transport solution in the Klystron side of the Klystron option.
- Based on the LHC experience and calculation considering number of the equipment, installation rate is high in comparison to LHC machine installation (possible solution would be to work on 2-3 shifts)

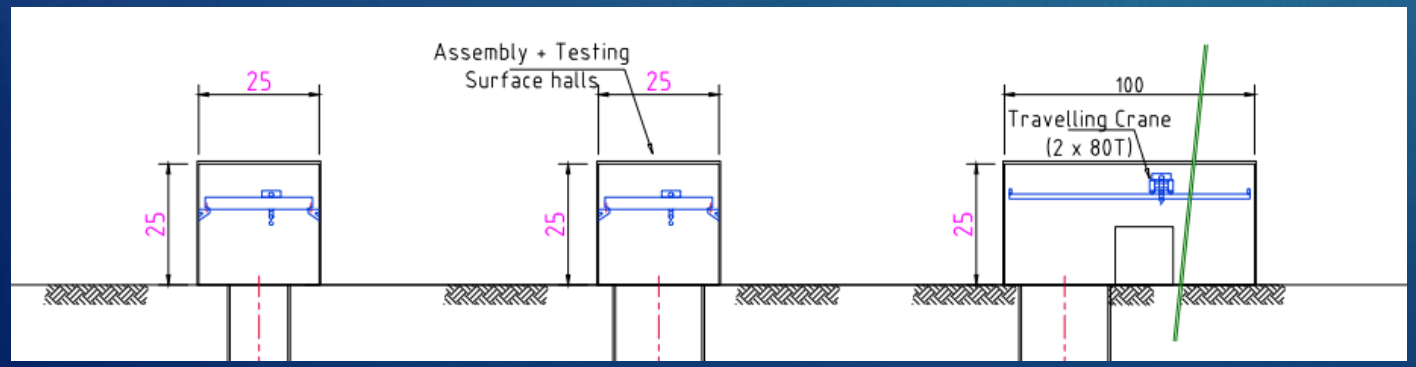
Thank you

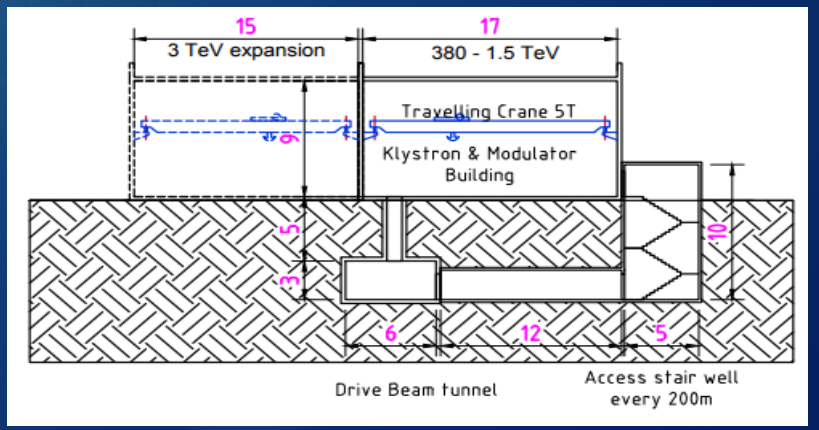
Estimations - CRANES

- Crane needs based on LHC buildings
- Cranes prices estimated based on the buildings' dimensions (R. Rinaldesi EN-HE-HEM)

Experimental Sites			Length	Width	Height	CRANE	CRANE CAPACITY	Price [CHF] single crane	Remarks
153	Exp. Site	Central Area CV Building	40	40	10	YES	Palan 1t (14x1 t)	205,000	7.5 t crane
154	Exp. Site	Central Area Machine Cooling Tower	90	10	17	YES?	3.2 t 2 t (8x2t)	960,000	3.2 t crane
155	Exp. Site	Central Area Station ED	35	30	7	YES	PUMPING STATION	150,000	5 t crane
156	Exp. Site	Central Area Station EG	35	20	7	YES	PUMPING STATION	120,695	5 t crane
158	Exp. Site	Cryo Cold Building	50	18	12	YES	2x 20 t	370,000	
159	Exp. Site	Cryo Warm Building	50	18	12	YES	2x20 t	370,000	
160	Exp. Site	Detector Assembly Hall	100	25	25	YES	2x80 t	1,400,000	
167	Exp. Site	Tunnel e+/e- Cooling Tower	105	20	16	YES	???	150,000	3.2 t crane
168	Exp. Site	Tunnel e+/e- Station ED	80	35	7	YES	PUMPING STATION	200,000	5 t crane
169	Exp. Site	Workshop Building	30	15	12	YES	10 t	150,000	
201	Exp Comp.	Booster CV Building x2	30	30	10	YES	5t x2	300,000	
207	Exp. Comp.	Drive Beam Cooling Tower x2	90	10	16	YES		120,000	3.2 t crane
209	Exp. Comp.	Drive Beam Injector Building	2560	30	9	YES	5 x 5 t	1,525,000	
210	Exp. Comp.	Drive Beam Station ED	75	42	7	YES	PUMPING STATION	210,000	5 t crane
211	Exp. Comp.	Drive Beam Station EG	42	20	7	YES	PUMPING STATION	125,000	5 t crane
219	Exp. Comp.	Main Beam Cooling Tower	75	10	16	YES		115,000	3.2 t crane
221	Exp. Comp.	Main Beam Station ED	68	35	7	YES	PUMPING STATION	170,000	5 t crane
222	Exp. Comp.	Main Beam Station EG	35	15	7	YES	PUMPING STATION	110,000	5 t crane
254	Access	Shaft Access building	35	20	25	YES	2 x 20 t	780,000	100 m shaft crane
255	Access	Station EG	20	15	7	YES	PUMPING STATION	105,000	5 t crane
256	Access	Workshop Building	30	15	12	YES	10 t	145,000	





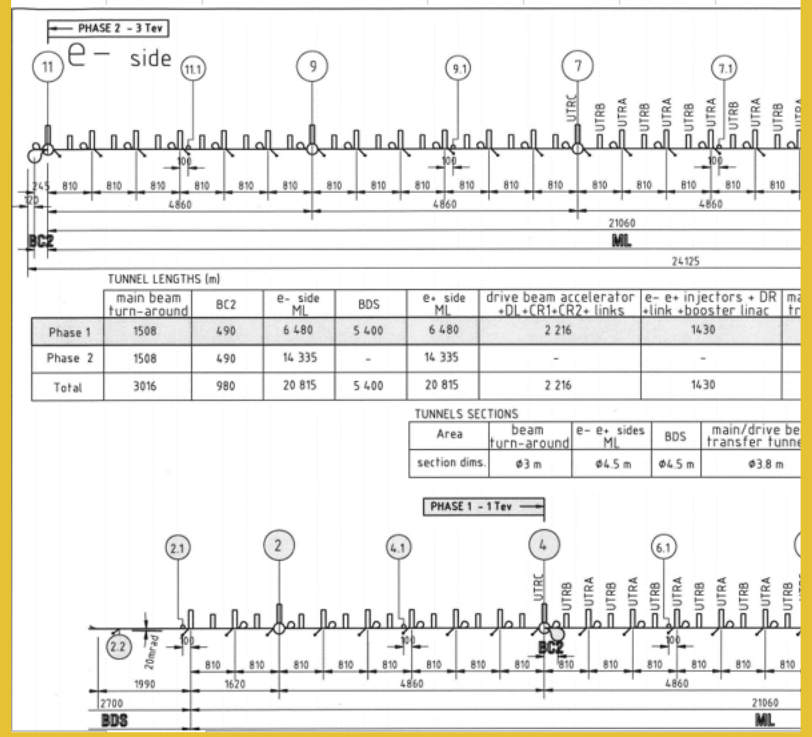


Links and estimations – Special Transport Vehicle

CLIC component breakdown

Aim of the document:	Input for cost estimate of alignment syste	
Author: M.Czech based on 2007 G. Riddone	Last revision:	23.03.2018

Input:
Drive beam (B. Jeanneret); Main beam injector (S. Dobert, L. Rinolfi), Damping ring (Y. P



TUNNEL LENGTHS (m)

	main beam turn-around	BC2	e- side ML	BDS	e+ side ML	drive beam accelerator +DL+CR1+CR2+ links	e- e+ injectors + DR +link +booster linac	ma tr
Phase 1	1508	490	6 480	5 400	6 480	2 216	1430	
Phase 2	1508	490	14 335	-	14 335	-	-	
Total	3016	980	20 815	5 400	20 815	2 216	1430	

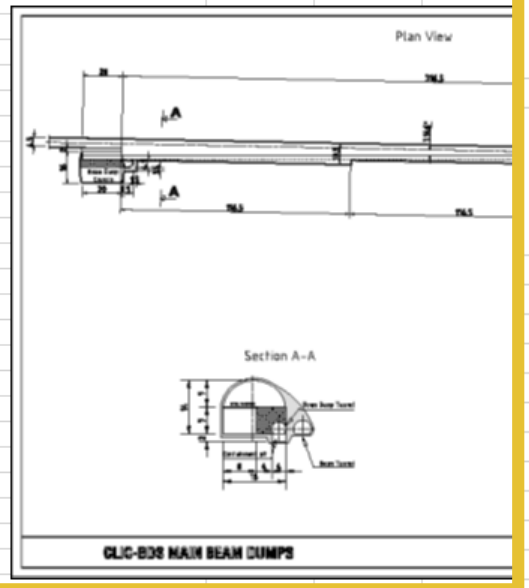
TUNNELS SECTIONS

Area	beam turn-around	e- e+ sides ML	BDS	main/drive be transfer tunne
section dims.	⌀3 m	⌀4.5 m	⌀4.5 m	⌀3.8 m

Beam dump

Main beam dump	(x1 per linac)
# of dipoles	30
# of quadrupoles	30
# of assemblies	2
Total # of elements	120
tolerance	0.1 mm

Drive beam dump	(x24 per linac)	(x8 per li
# of dipoles	30	30
# of quadrupoles	30	30
# of assemblies	48	16
Total # of elements	2880	960
tolerance	0.1 mm	0



Number of c

MB	DC
	TI
	Pre
	Da
	BC
	Lin
	Ce
DB	Lin
	De
	CR
	CR
	Lin
MB	Ma
DB	Dri
MB	Ma
DB	Dri
MB	BC
MB+DB	Mc
MB	ML
	Be
MB	Ma
DB	Dri

CLIC INSTALLATION BASIC LOGISTICS	
No of units to install	33000
years available for beam line installation	1
working days per year	210
units to install per day	157
No of units on convoy	2
No of convoys in sector	4
load at shaft x	30
travel	24
unload 1	15
travel	5
unload 2	15
travel	18
load at shaft x+/- 1	10
wait for other convoys to load	90
sub total	207
No of units on convoy	2
No of convoys in sector	4
travel	24
unload 1	15
travel	5
unload 2	15
travel	18
load at shaft x+/- 1	10
wait for other convoys to load	90
sub total	177
no of working hours per day	16
no of units per day per sector	43.38983
number of sectors available for installation	3.621652
no of convoys needed	14.48661
convoy allowance for maintenance	2
total convoys	16

	380GeV
	# of elements
	217
(e+)	177
	0
	3390
	16
	475
	200
total	***4475***
	1400
	240
	400
	1200
	1200
total	***4440***
	4800
	2000
	500
	1920
	136
	5952
	7100
total	***13052***
	466
	120
	960
TOTAL	32869