Drive Beam transfer lines in the main tunnel

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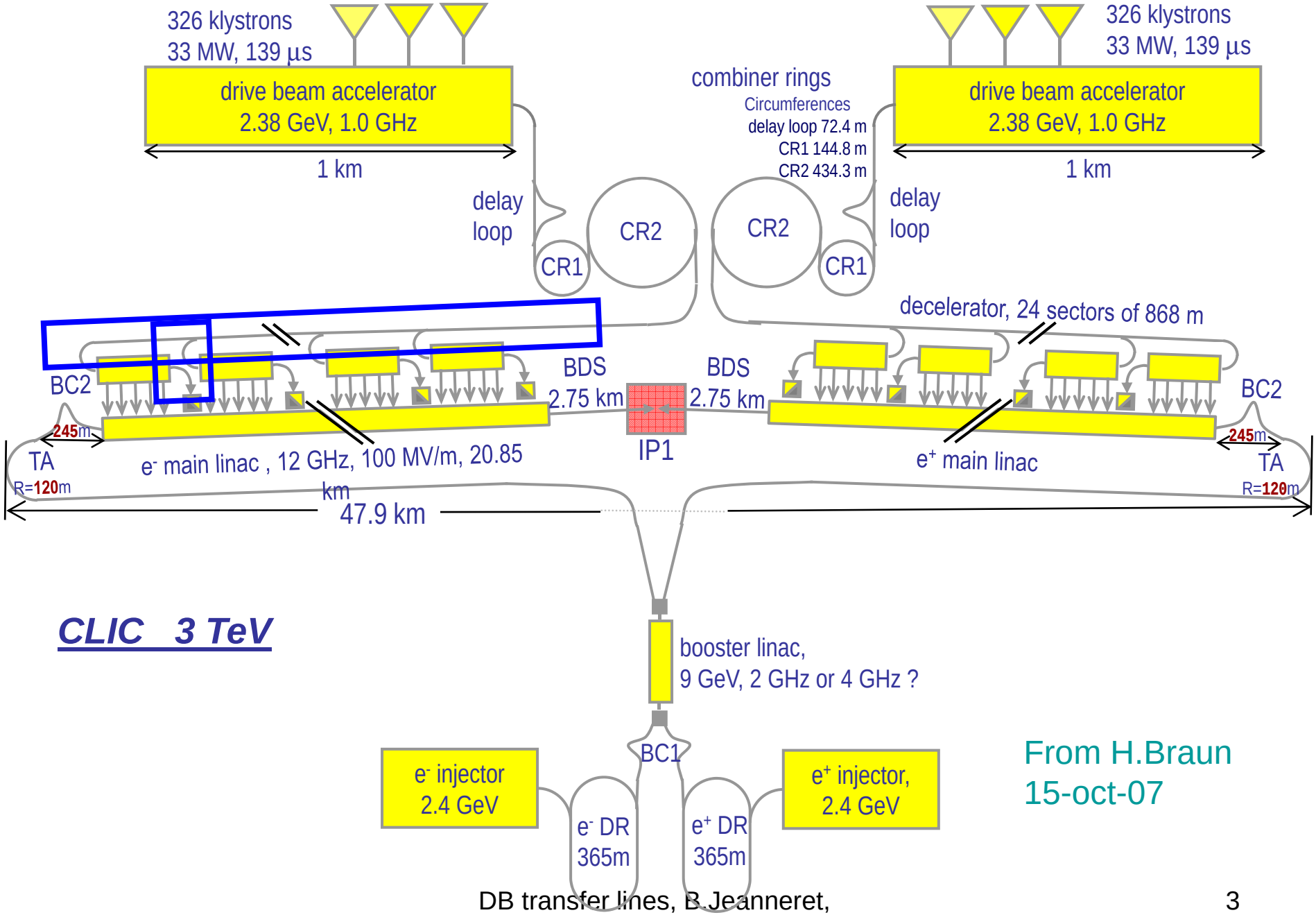
CLIC Workshop , 16 Oct 2007

Outline

- Long DB transfer line
- Issues related to turnaround
- Issues around the dump sections

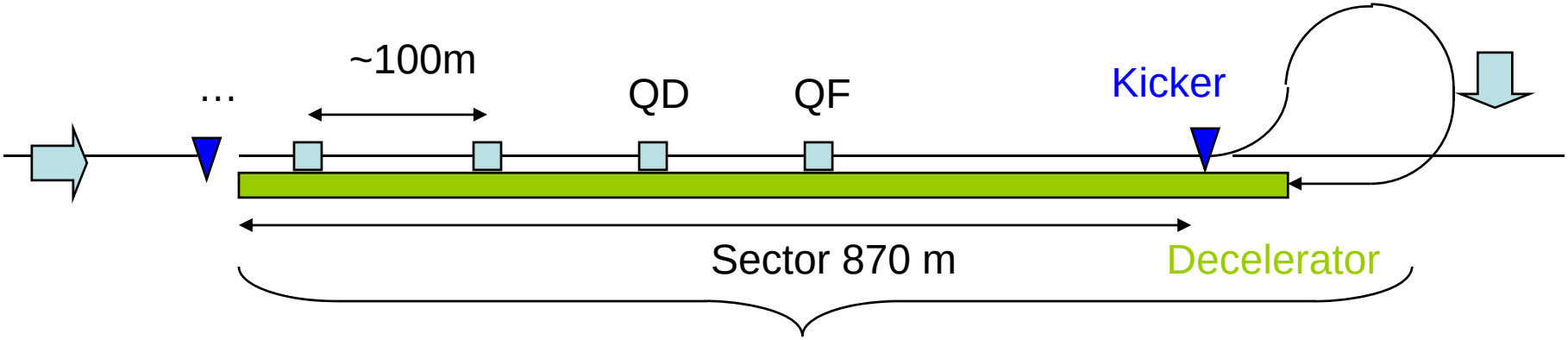


CLIC 3 TeV

From H.Braun
15-oct-07

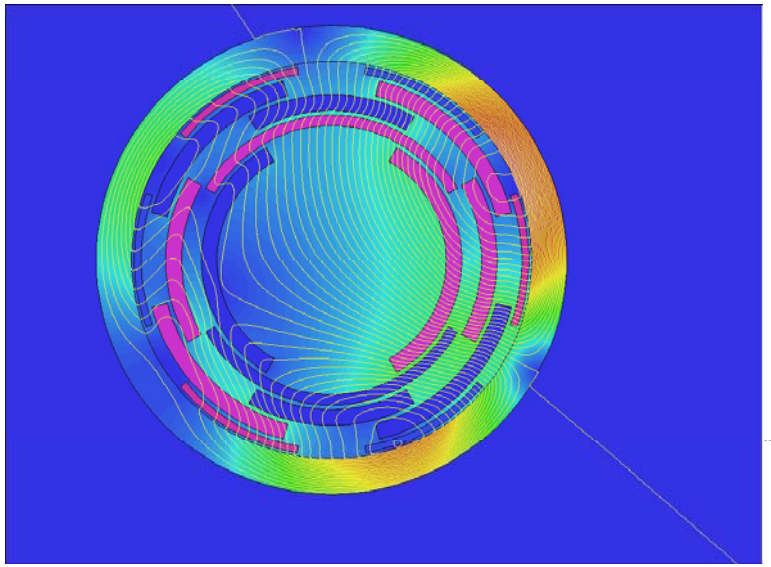
Long DB transfer line

- Aim : transport the Drive Beam trains from the central area of the site towards the head of the Main Linac
- Deflect a train in each turnaround, one after the other



A combined magnet for the long TL - I

Low fields allows for ‘cos(nϕ)’ design



This exemple contains : Bh, Bv, Q, Qs, S

(borrowed w/o permission from P.Belochitskii, T.Eriksson and T. Zickler, CERN/AT/MEL/2007/TZ, oct 2007)

- Need
  - Q with GL = 0.25 Tm/m
  - B h & v for orbit correction
  - S for chromatic correction
  - Useful radius : 25 mm
- First pass Ansys for Q :
  - r_Q_coil_in = 30mm
  - I=30 A, nI=330 Aturn
  - wire 9mm^2
- Get (to be refined) :

Yoke diameter	150	mm
Weight	80	kg
Quad power	40	W
B + S power	<50	W

Many thanks to M. Bajko for expertise and advice

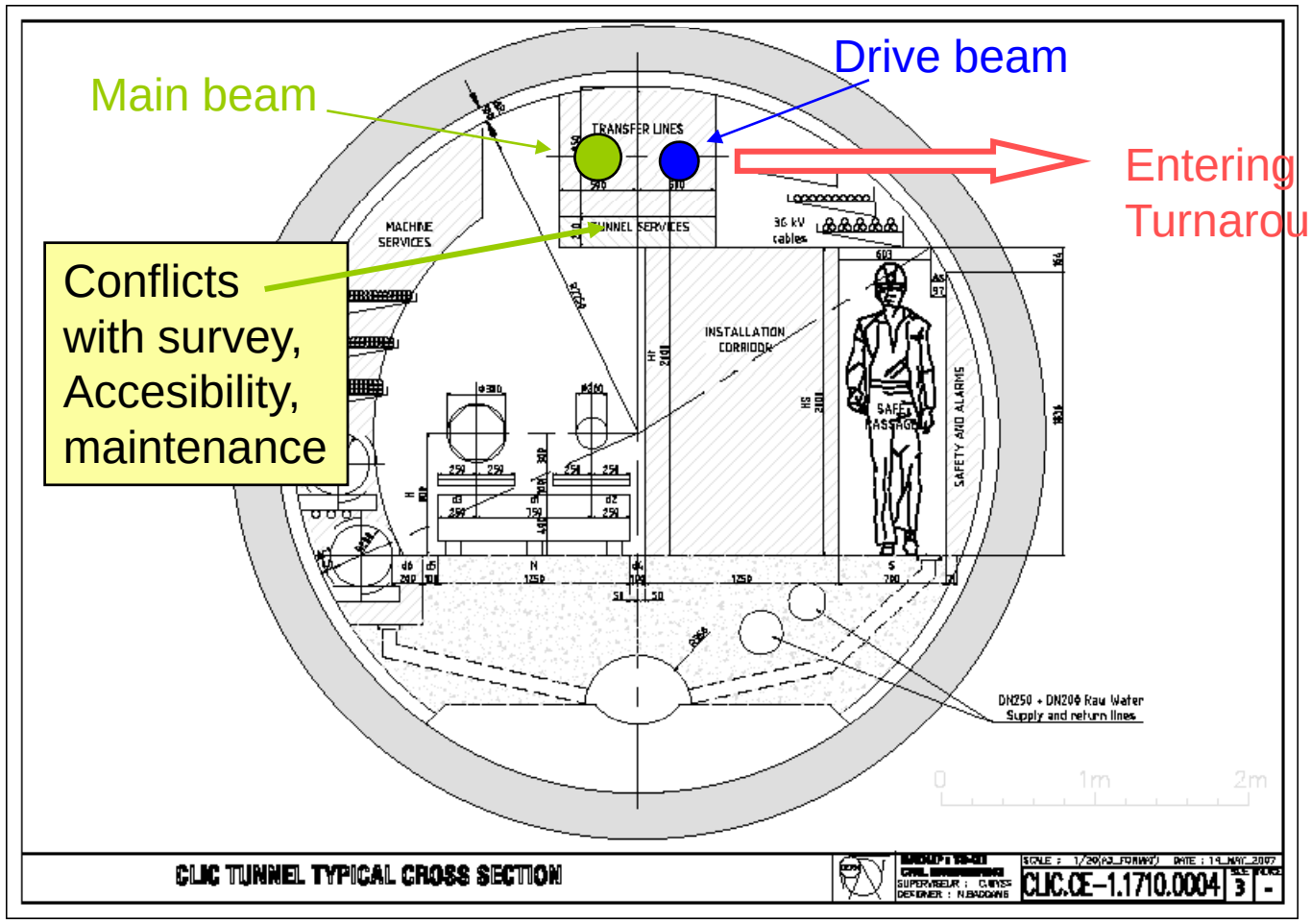
A combined magnet for the long TL - II

- Compact monolithic & low-weight object,for ceiling installation
- Thin power and cooling lines

- Remains to work-out :

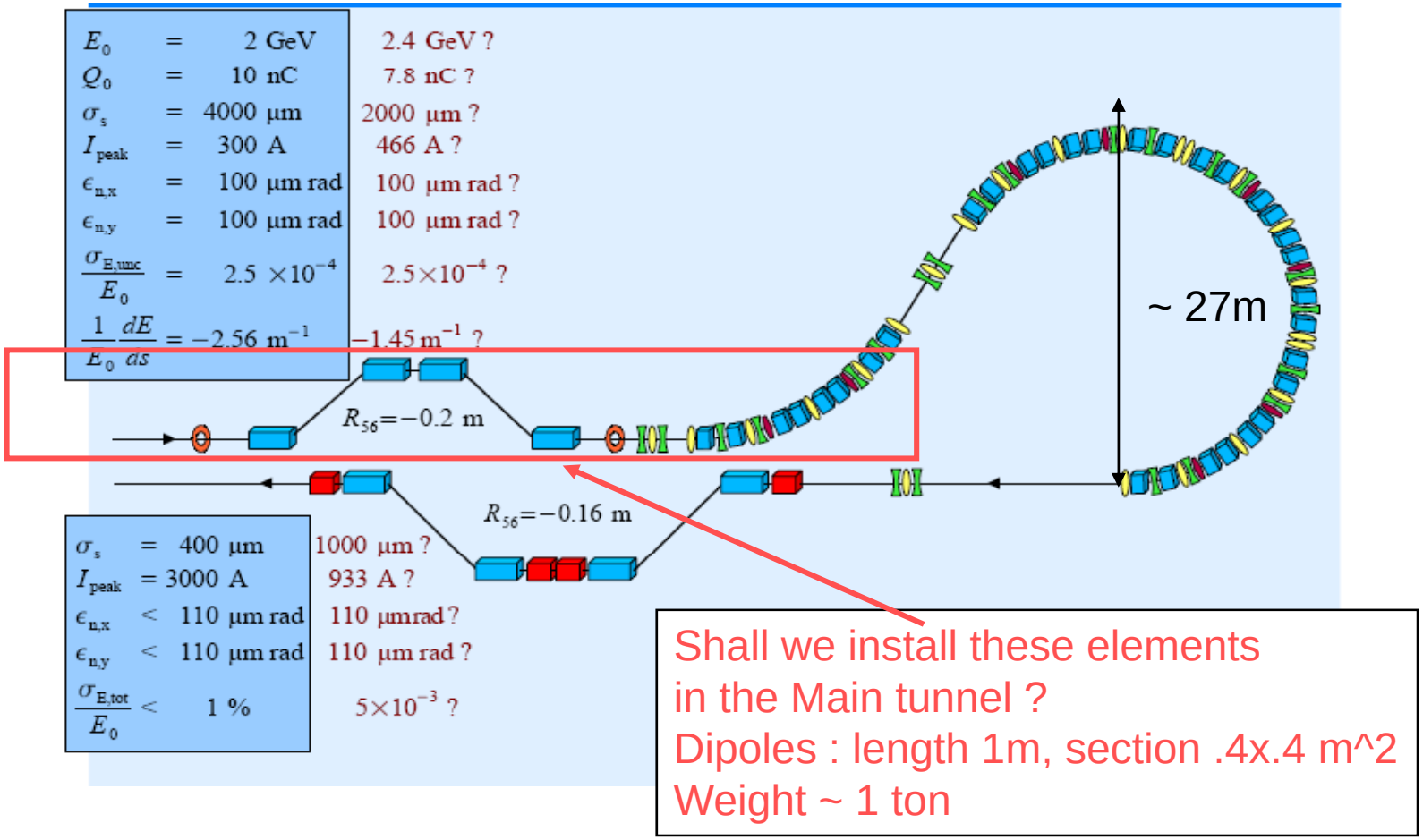
  - Detailed design, body field errors
  - Compensation of end-field errors
  - Powering (I vs. V …)
  - Cooling (air, water)
  - Overall engineering (reliabilty, cost, …)

Main tunnel cross-section



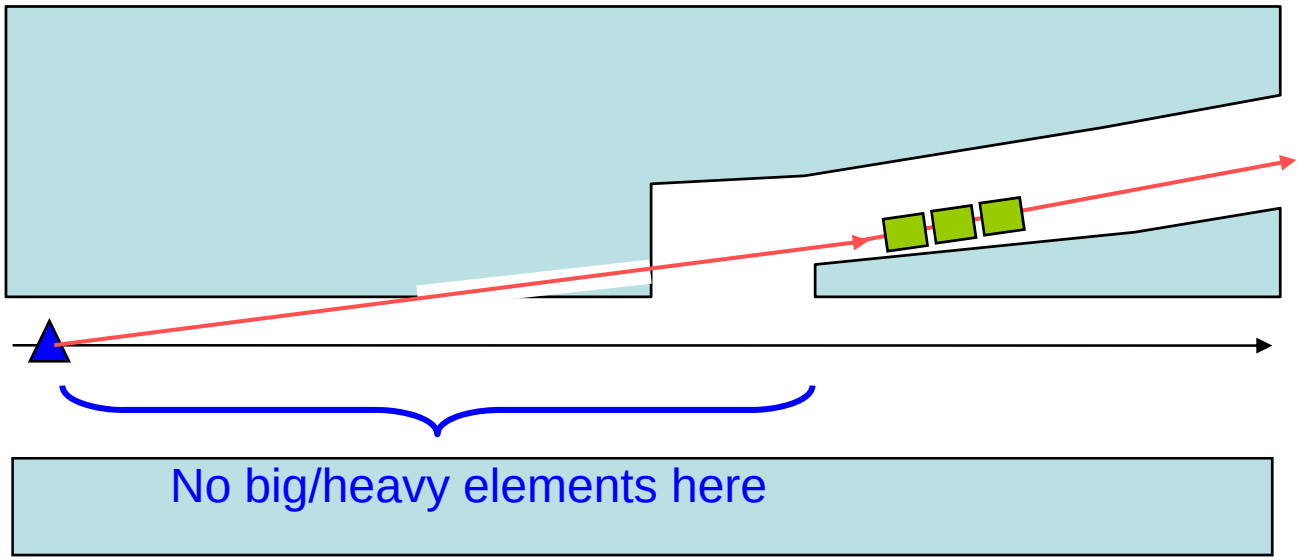
Turnaround :
A first look at integration issues

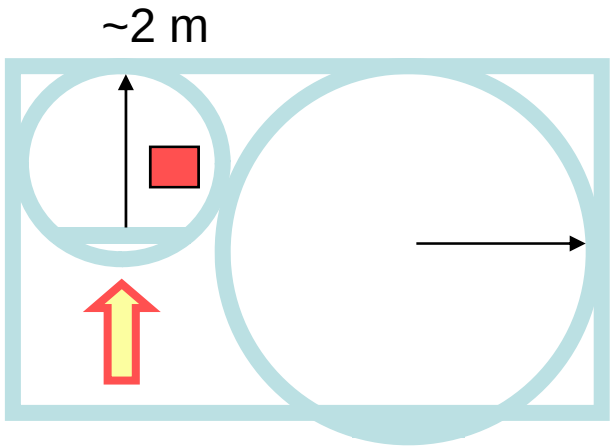
Turnaround as of today , F. Stulle/PSI (this w'shop)



Turnaround tunnel

- Is it reasonable to hang elements at the ceiling ?
  - Linear weight ~ 1ton / m
  - Restricted space for good survey
- Shall we consider a tunnel which is shifted upwards ?
- Optics & layout to be reviewed with civil-engineering constraints

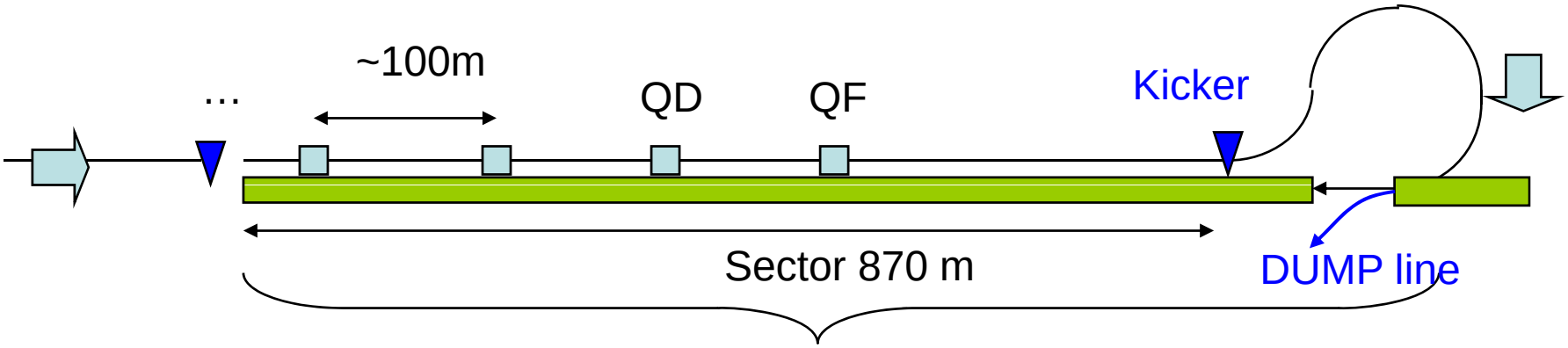




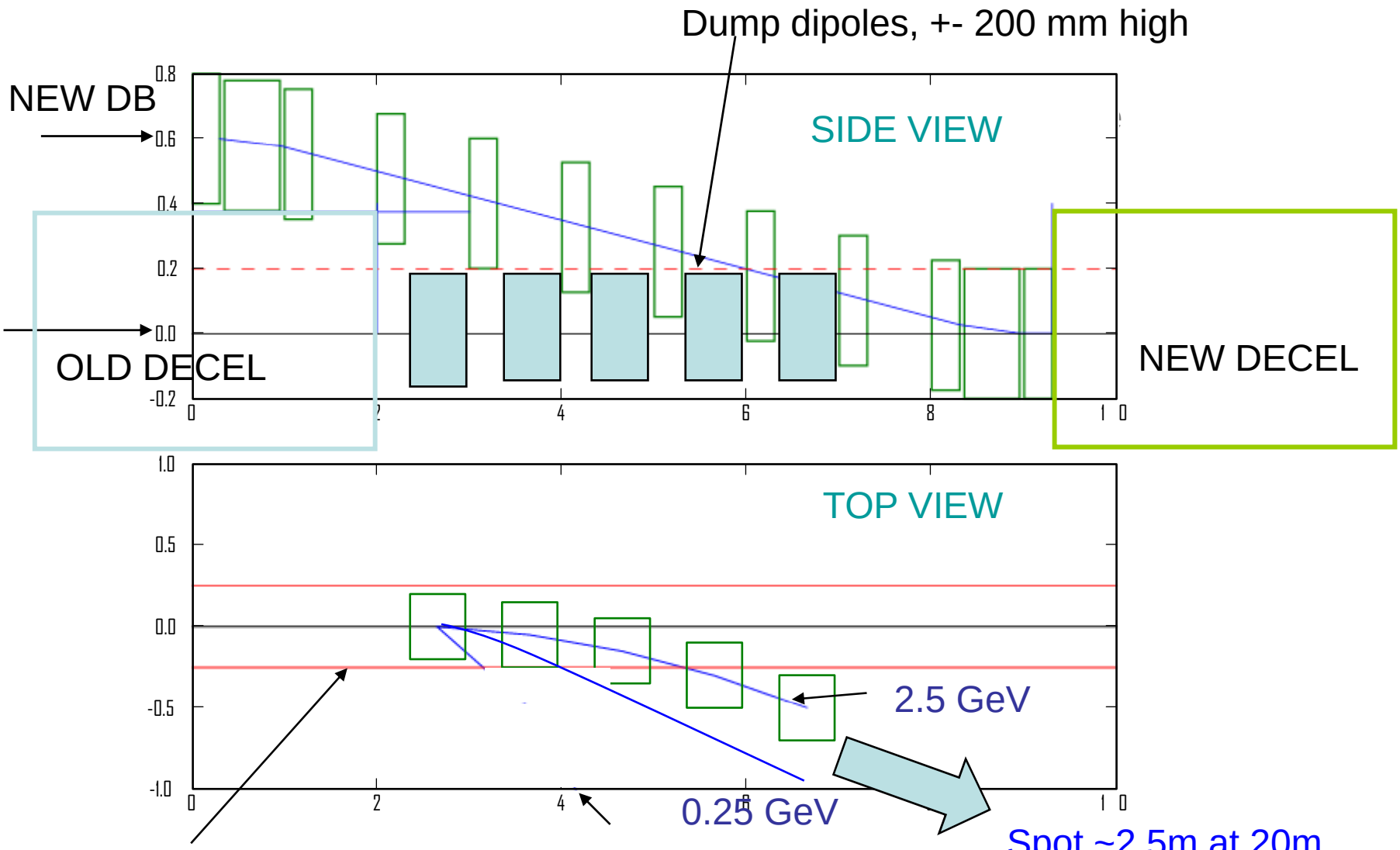
- Minimize disruptive impact on
- main tunnel continuity
- ensure turnaround stability
- more easy installation ?

Much work ahead

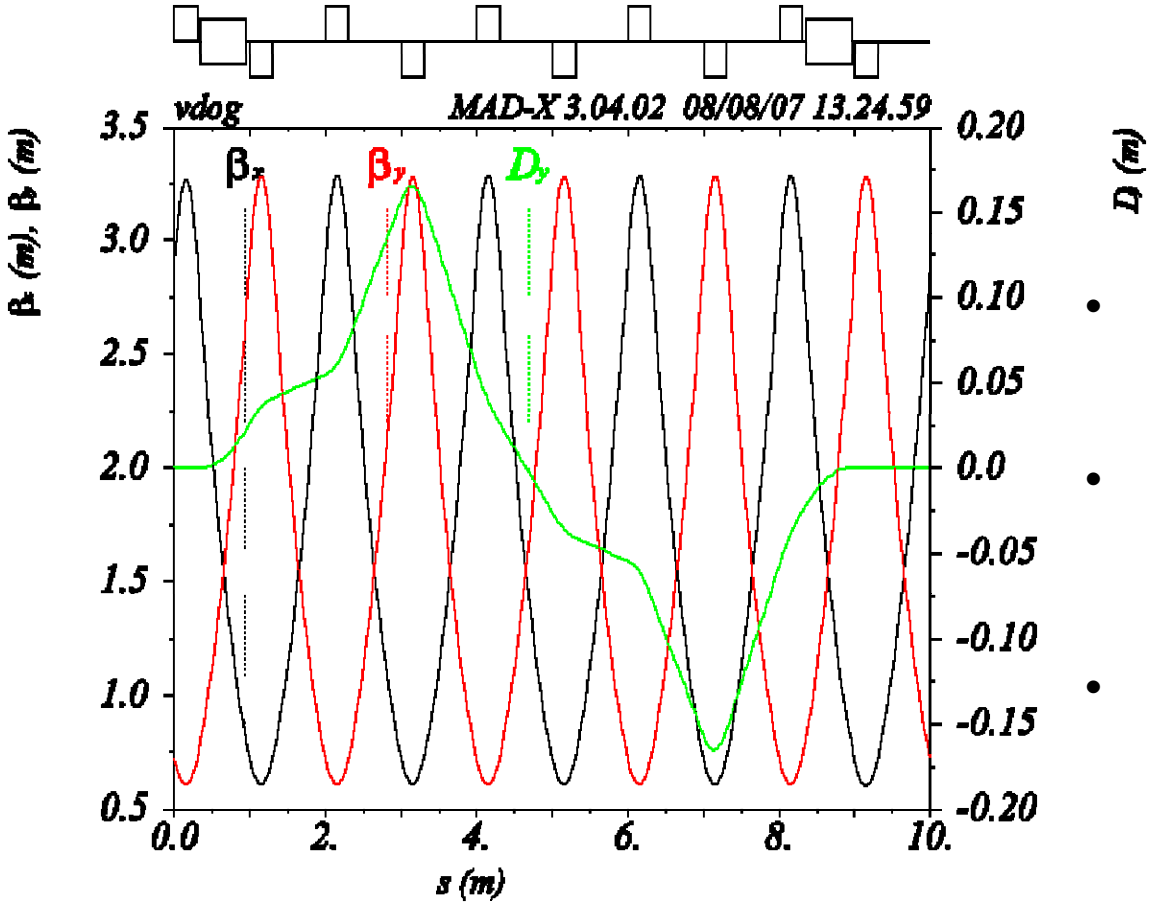
Drive Beam dumps :
A first look at integration issues



A way to avoid alternating low and high Decelerators – now baseline

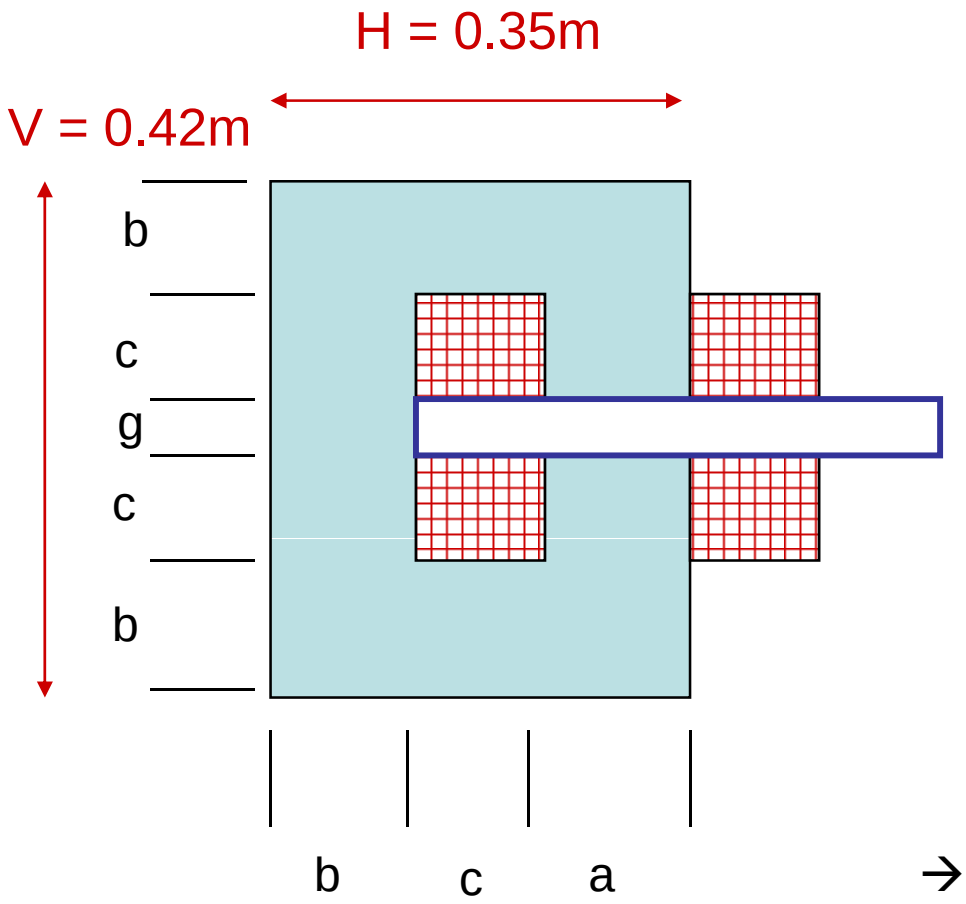


Optics



- Regular FODO identical to DB
  → same Quad/strength
- $\mu = 2\pi$ between dipoles to allow for D=D' =0 before and after
- Dipoles :
  - L = 0.6m
  - α = 0.075 mrad
  - B=1.04 T

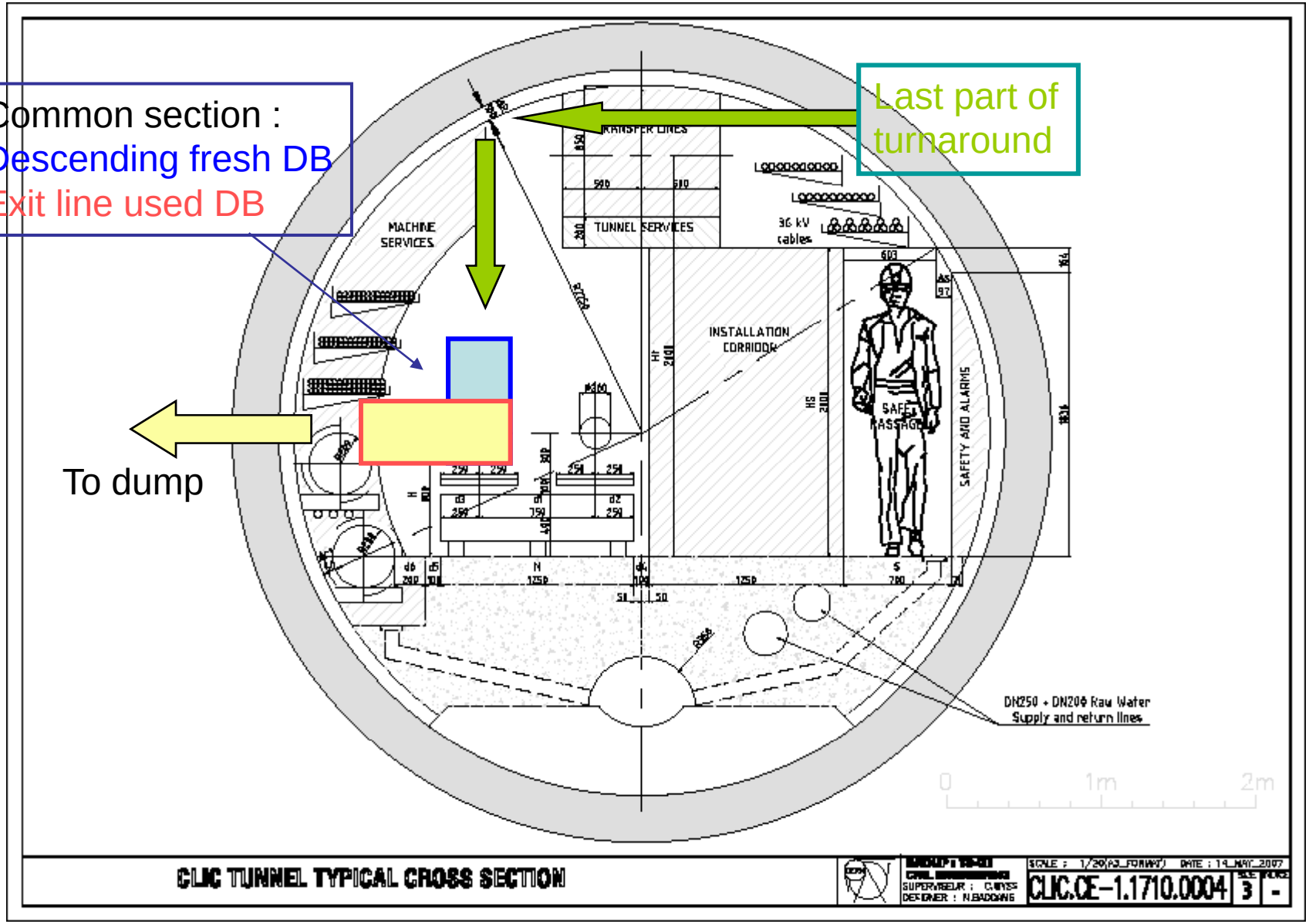
Dump dipoles (with T. Zickler)
-- preliminary --



alfa		5.00E-02	rad
len		6.00E-01	m
p		2.50E+00	gev
B		6.94E-01	T
full gap	g	3.00E-02	m
muz		1.26E-06	
I		1.66E+04	
rho_i		1.20E+06	A/m2
fill factor		7.00E-01	
full coil_area		1.97E-02	m2
coil_block		9.87E-03	m2
coil_side	c	9.93E-02	m
B_iron		1.10E+00	T
full aperture	a	1.50E-01	m
b_yoke	b	9.47E-02	
full yoke width		3.44E-01	m
full yoke height		4.18E-01	m

wire	1.60E-05
	(4x4 mm2)
I wire	1.92E+01
turns	8.63E+02
turn/bloc	4.32E+02
matrix	20.77822
check	9.93E-02
(matrix*4mm/sqrt_fil	

→ L = 0.6m, α = 0.05 rad
B = 0.7 T
H = V =~ 0.4m


Common section :
Descending fresh DB
Exit line used DB
To dump
Last part of turnaround
TRANSFER LINES
TUNNEL SERVICES
MACHINE SERVICES
36 kV cables
INSTALLATION CORRIDOR
SAFETY AND ALARMS
DN250 + DN200 Raw Water Supply and return lines
0
1m
2m
CLIC TUNNEL TYPICAL CROSS SECTION
CLIC.CE-1.1710.0004

Single height DB and dumps

- Two height Decelerator was abandonned
- Single height DB : Space taken from RF/dump : 8.0 m
- Along 10m of each sector, vertical superimposition of entering new DB and extraction of used one.
- Dump line to be designed / more beam simulation needed
- Dump proper must be better known
  - Container filled with aluminum balls and water
  - Built in-situ ? Delivered as a single unit ?

Summary

- Long transfer line
  - Small compact combined magnet can be considered
  - Conflict services / beam line / survey must be resolved
- DB Turnarounds
  - Optics exists
  - Integration requires more attention and coordinated approach
  - Civil engineering not trivial
- DB Dump line
  - Single height decelerator is an overall simplification
  - But short 10m section with two lines must be studied
  - Dump line and dump tunnel still to be designed