

Positron BDS tunnel

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2016/12/08

LCWS2016, Morioka

TDR positron BDS tunnel

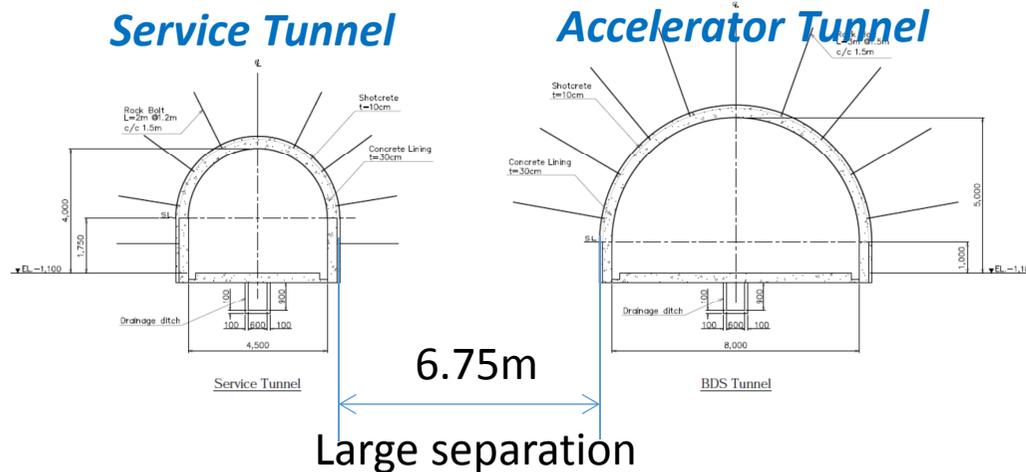
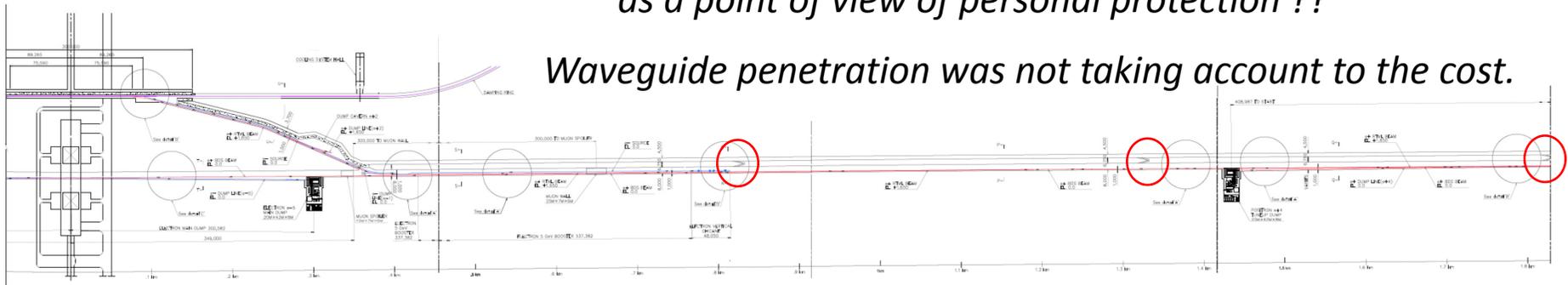
Basic design of BDS tunnel is twin tunnel.

Access tunnel was every 500m in drawing (not counting to cost).

- Do we need more access tunnel

as a point of view of personal protection ??

Waveguide penetration was not taking account to the cost.

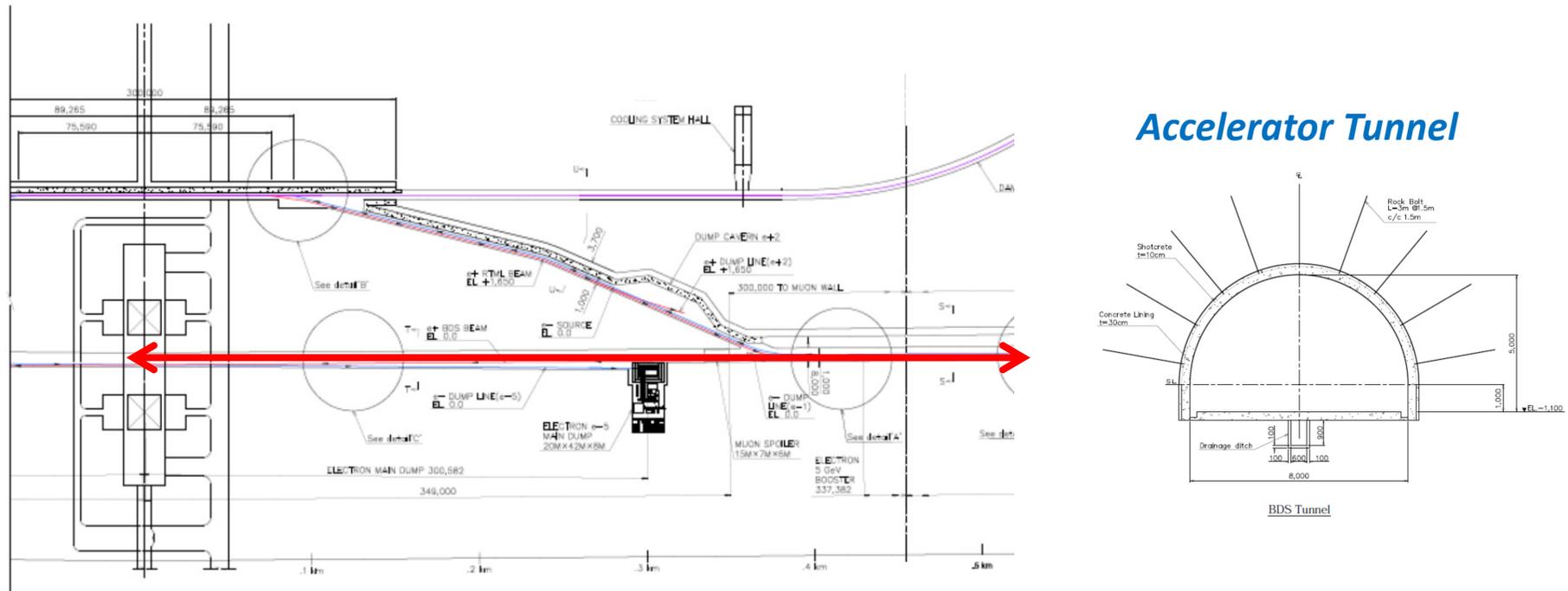


The cost of access tunnel and wave guide and cable penetrations are expensive.

Can we make the BDS tunnel Kamaboko tunnel as ML tunnel ?

Detector hall to LTR line (TDR design)

Especially for the BDS tunnel between detector hall and LTR line is accelerator tunnel only.



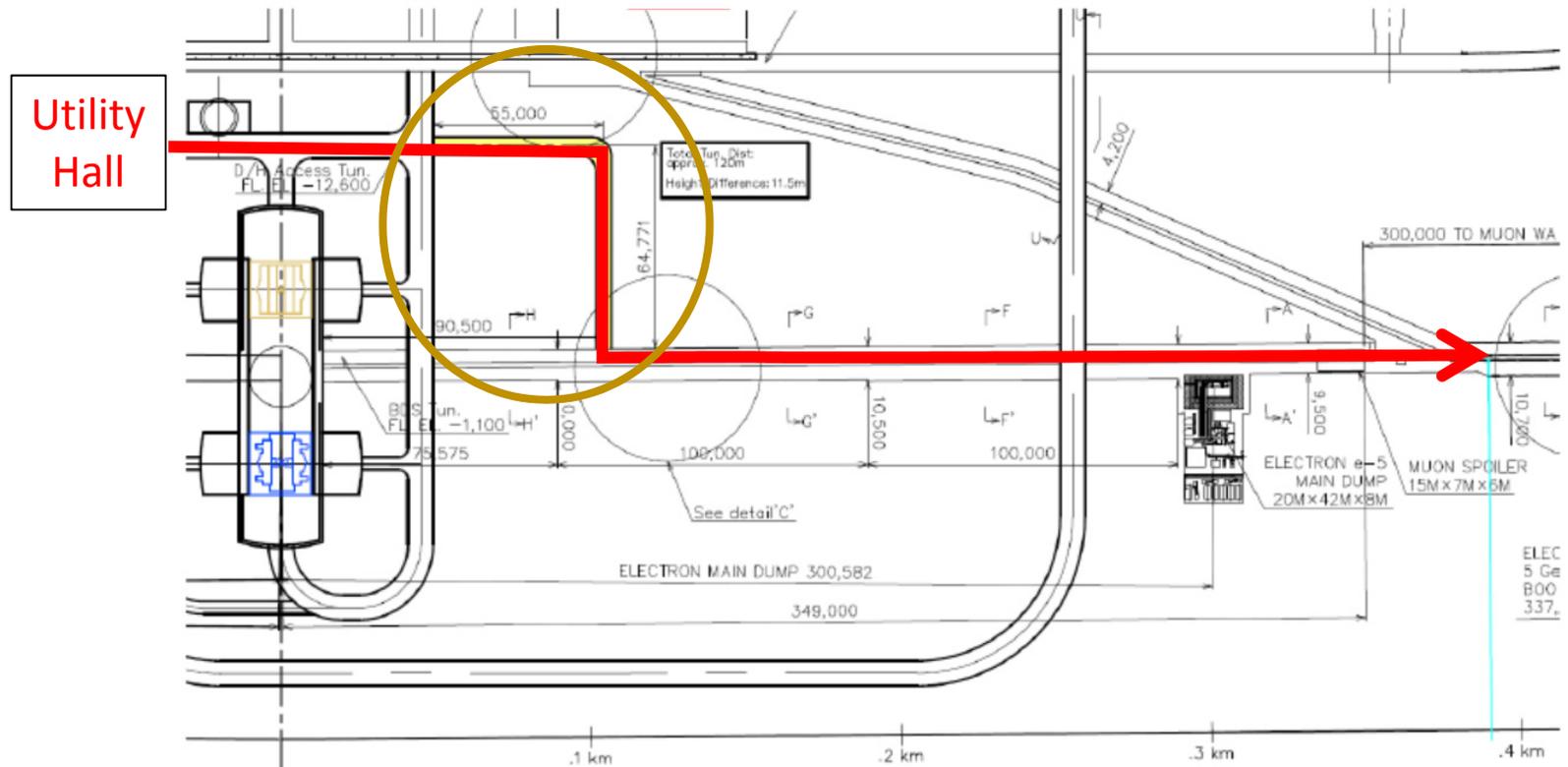
No emergency exit in this section (Personal Protection).

We must taking account of

- how to transport main electric power line (66kV line ; all of ML power).
- how to transport electric power line (6.6 kV ; distribute to BDS tunnel).
- how to transport cooling water to be distributed to BDS tunnel.

Access tunnel from central region to BDS section

Small access tunnel is proposed from central region to BDS service tunnel.



The specification of the access tunnel is

- 5m width
- 10% slope.

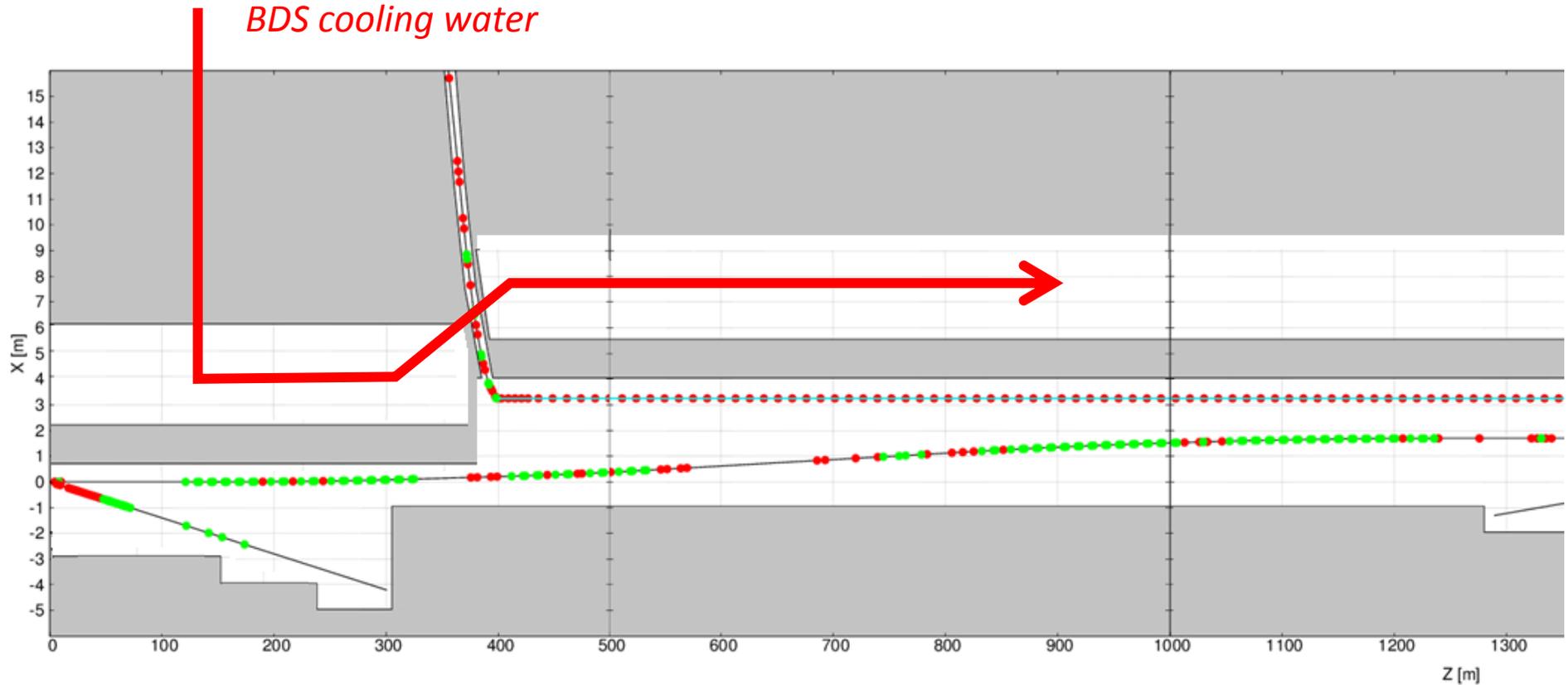
Power cable and cooling water can be passed through the access tunnel.

The tunnel can be also used to emergency exit.

Electric power distribution

Main power line will be distributed through the BDS service tunnel to ML
The BDS tunnel from detector hall to LTR line is also changed to Kamaboko tunnel.

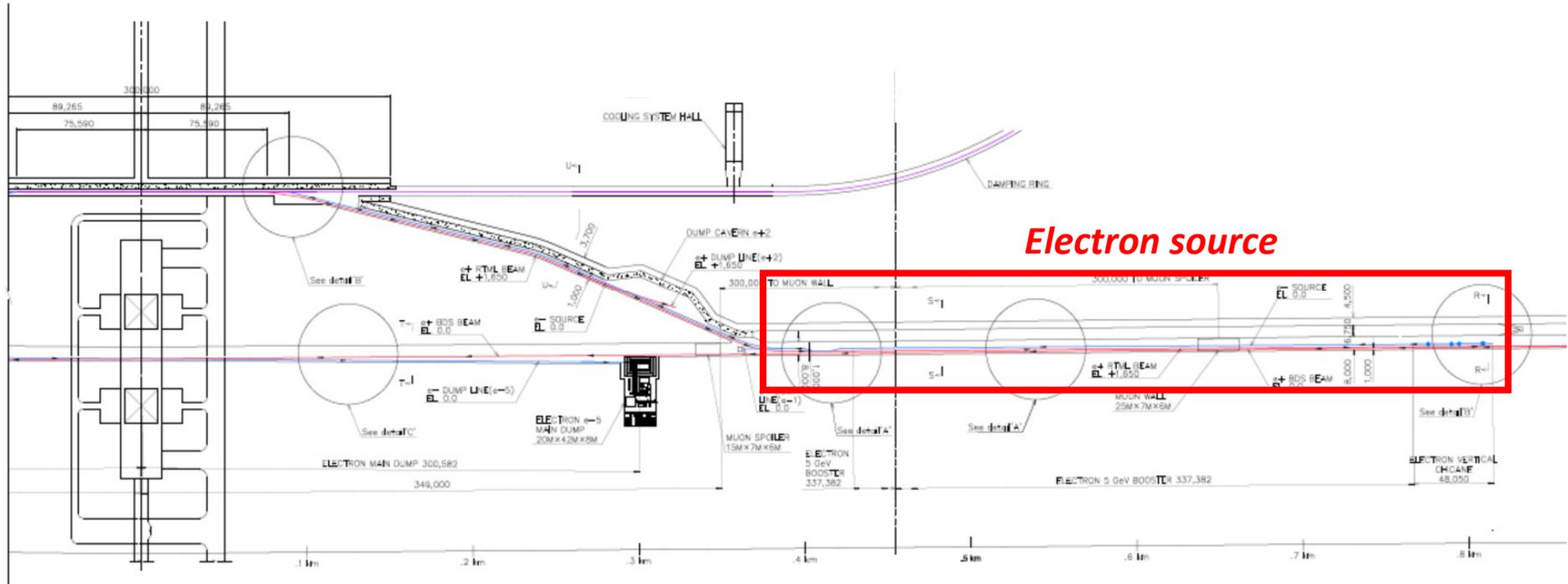
Main power line (66kV power line ; All of ML)
BDS power line (6.6kV power line)
BDS cooling water



We can make the power transfer line to ML
by making Kamaboko tunnel in between detector to LTR.

Electron source (TDR design)

We have an electron source in positron BDS tunnel.



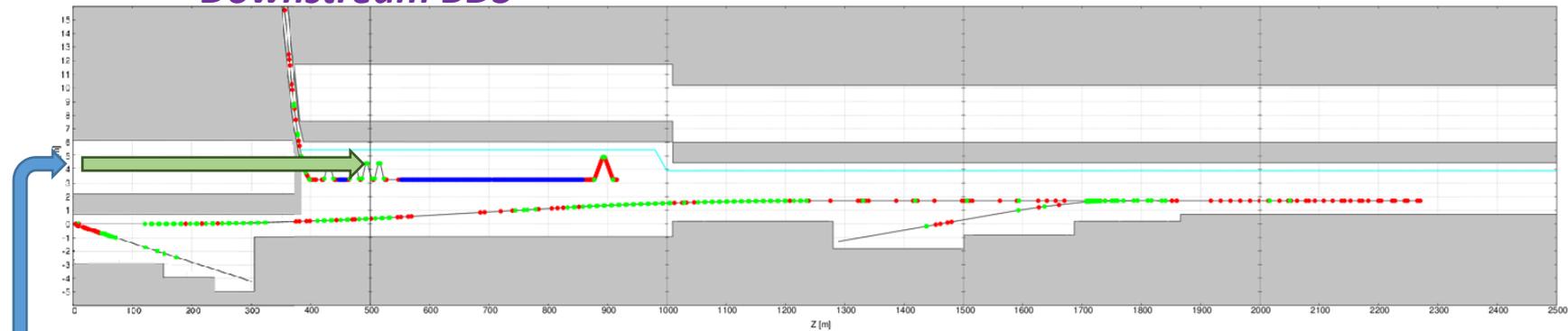
It is very important to design

- where to put the helium cold box and compressor.
- how to transport the 2K helium to cryomodule of electron source.

Where to put electron source ?? (1) - Cryomodule

We have 2 candidates of Kamaboko positron BDS tunnel.

Downstream BDS

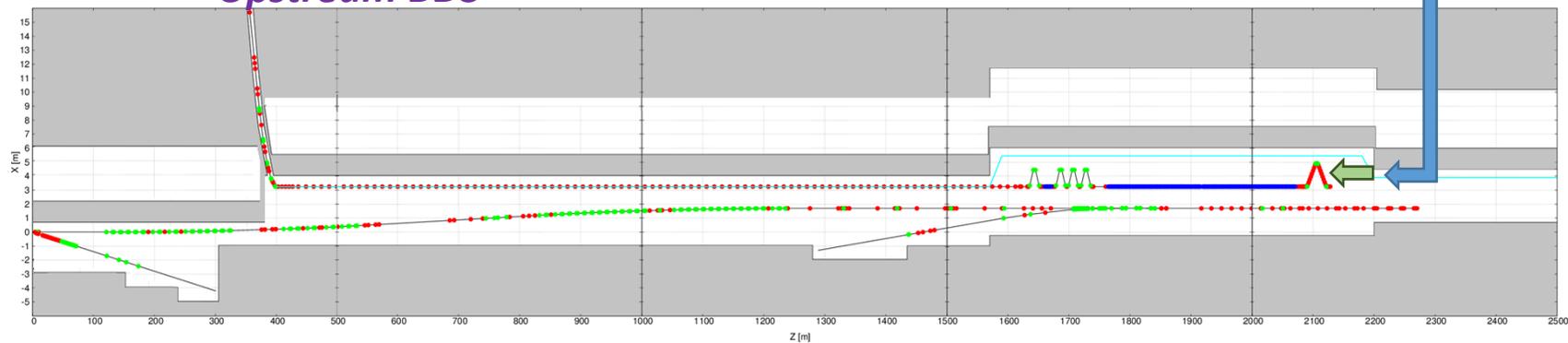


Detector Hall

Helium cold mass is put to detector hall, and transport with about 500m helium transport line

ML compressor hall on GL
ML cold box cavern

Upstream BDS



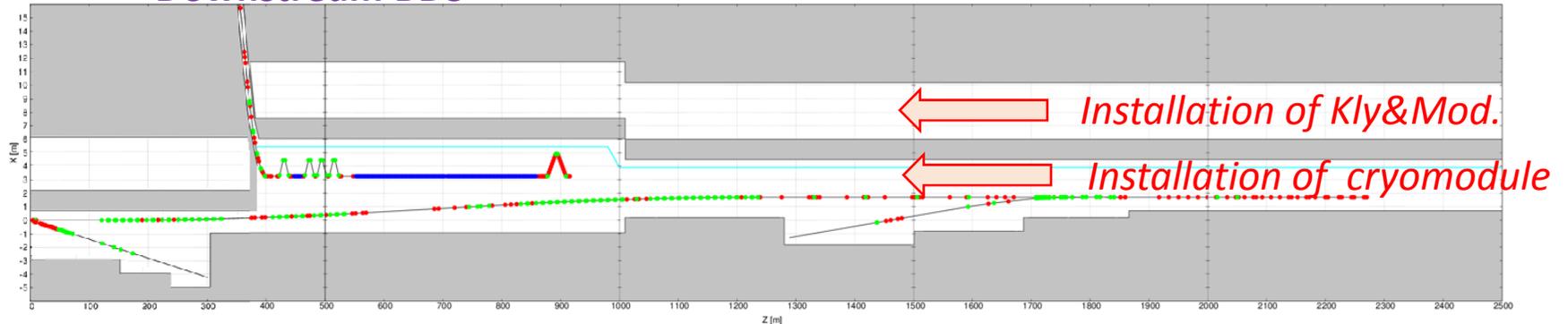
ML access tunnel

Helium cold mass is put to ML access tunnel as well as main linac, and transport with less than 100m helium transport line

Where to put electron source ?? (2) - Cost

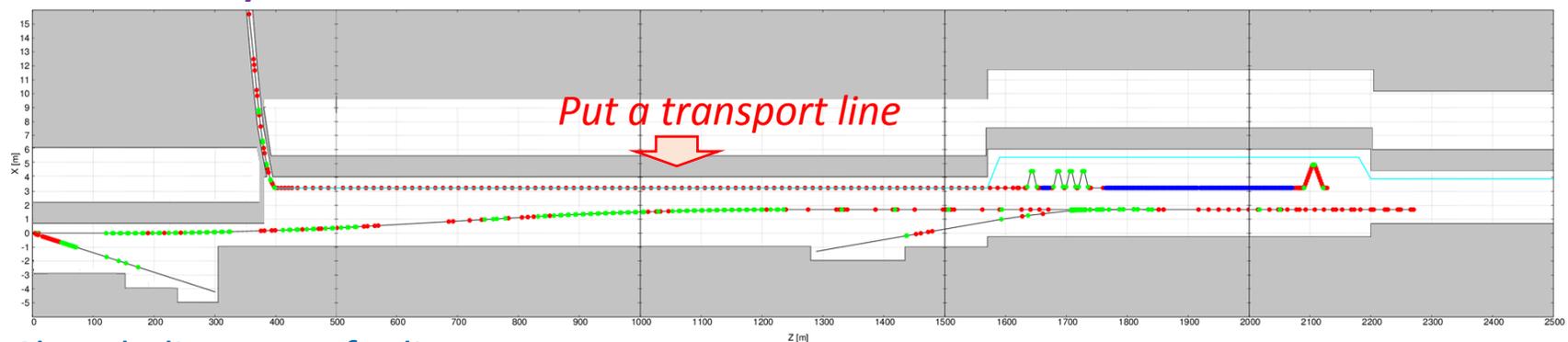
Tunnel cost by assuming 4.2m service tunnel for both schemes are almost same.

Downstream BDS



- Long helium transport line.
- No electron transport line.
- Difficult to reduce tunnel width for RF devices and cryomodule installation.

Upstream BDS



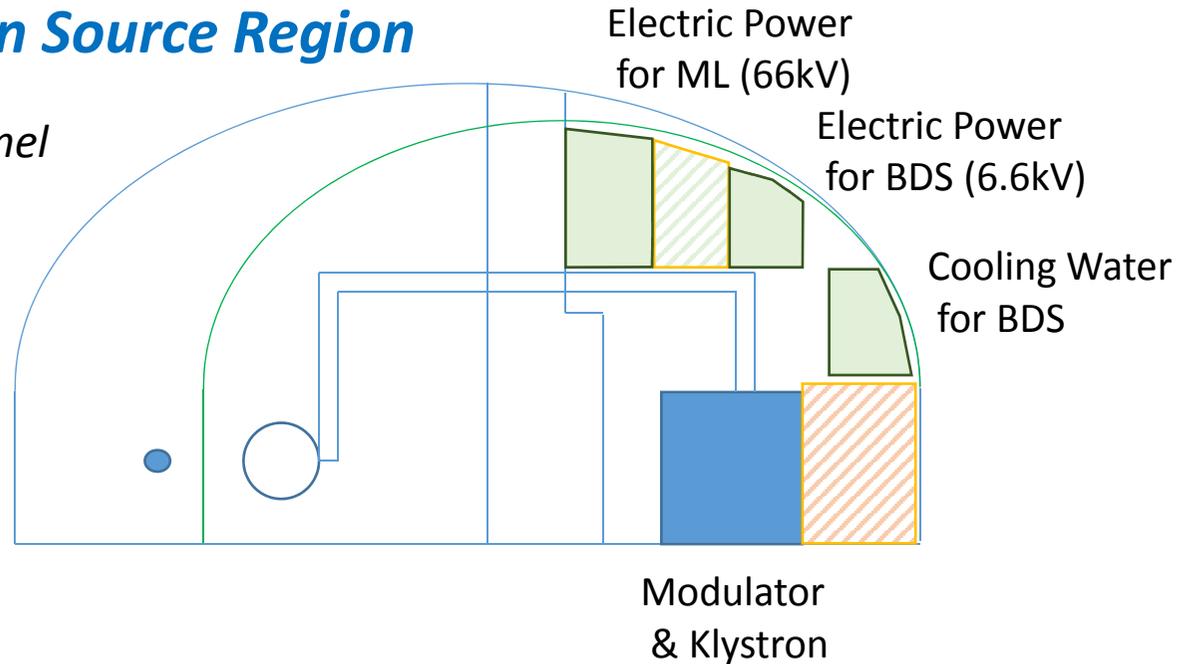
- Short helium transfer line.
- Need an electron beam transport line.
- Have a possibility to reduce the tunnel width for no SC devices after electron source.

Kamaboko Tunnel for BDS section

BDS tunnel for Electron Source Region

The devices in service tunnel is same to ML

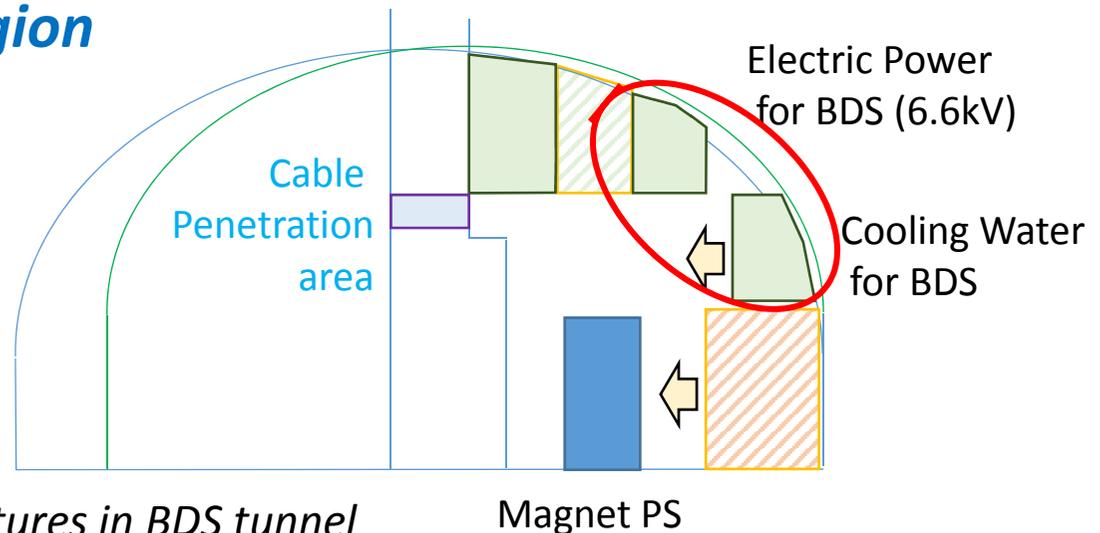
Same tunnel width is required to ML.



BDS tunnel for Other Region

We only put the magnet PS and electronics for monitors.

Possibility to shorten the service tunnel width.



Depends on the amount of infrastructures in BDS tunnel

Evaluation of BDS power and cooling water

(5GeV SC electron source is not included.)

| ECM | | Power[kW] | | | | Cooling Water [l/min] | | | |
|------------|------|-----------|---------|---------|---------|-----------------------|--------|---------|--------|
| | | 500GeV | | 1TeV | | 500GeV | | 1TeV | |
| Temp. Rise | | 10°C | 30°C | 10°C | 30°C | 10°C | 30°C | 10°C | 30°C |
| BDS | BEND | 46.80 | 50.00 | 122.60 | 130.40 | 51.40 | 18.80 | 127.00 | 47.00 |
| | QUAD | 874.50 | 913.60 | 1418.50 | 1481.00 | 1009.60 | 420.60 | 1622.60 | 681.40 |
| DUMP | BEND | 23.20 | 24.80 | 48.40 | 49.60 | 33.68 | 12.04 | 32.20 | 24.08 |
| | QUAD | 107.00 | 115.10 | 227.10 | 236.60 | 153.74 | 55.62 | 208.40 | 113.65 |
| E-source | BEND | 60.80 | 65.60 | 60.80 | 65.60 | 71.52 | 31.68 | 71.52 | 31.68 |
| | QUAD | 52.67 | 56.67 | 52.67 | 56.67 | 75.33 | 27.33 | 75.33 | 27.33 |
| RTML | QUAD | 105.33 | 113.33 | 105.33 | 113.33 | 150.67 | 54.67 | 150.67 | 54.67 |
| TOTAL | | 1270.30 | 1339.10 | 2035.40 | 2133.20 | 1545.94 | 620.74 | 2287.72 | 979.81 |

Electric power for positron BDS is about 2MW even for 1TeV operation.

The power is smaller than ML section.

Amount of the cooling water is 2300 l/min (10 temperature rise) for 1TeV operation.

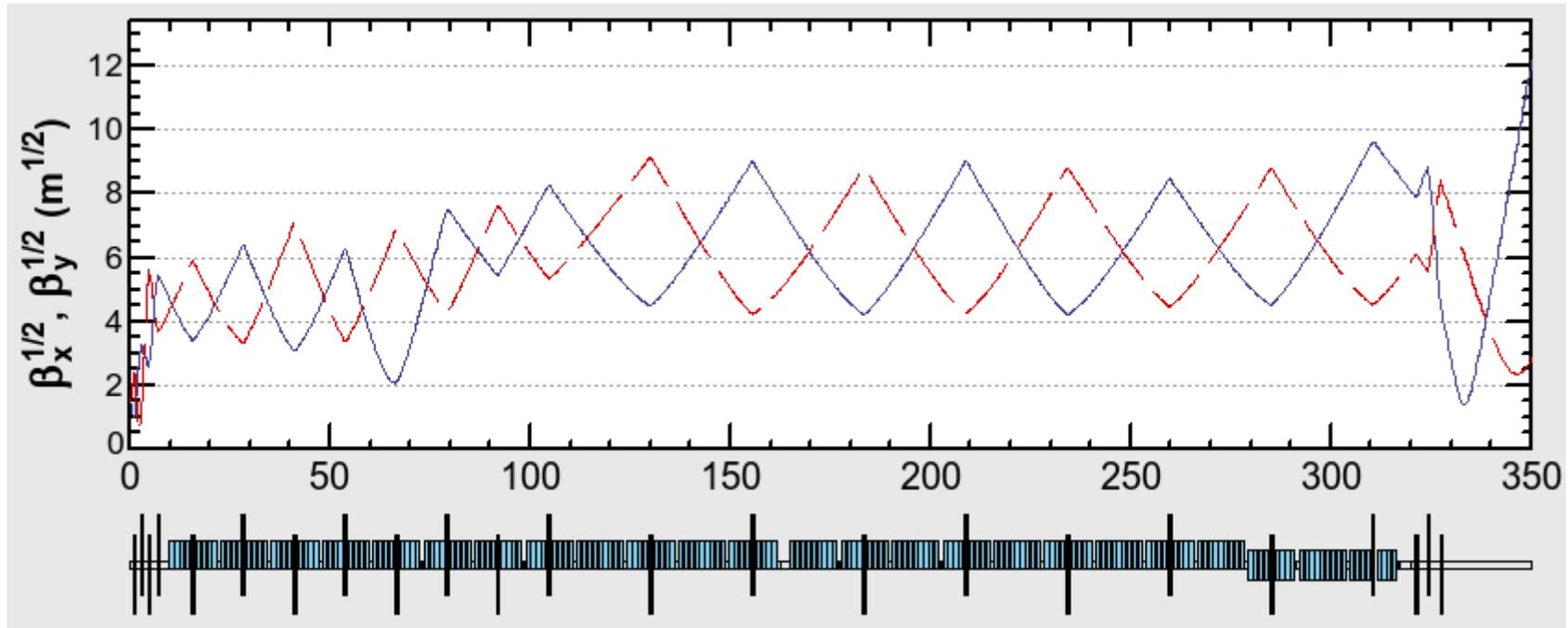
This number strongly depends upon the scheme (maximum energy and temperature rise).

- Pressure drop at magnet was assumed to be less than 0.4MPa.

- The 1MPa refrigerator system for magnet cooling water.

Electron Source

We should take account the electricity, cooling water and **cold mass** for this section.



Electron Booster Linac

8 type A cryomodule (1 for backup)

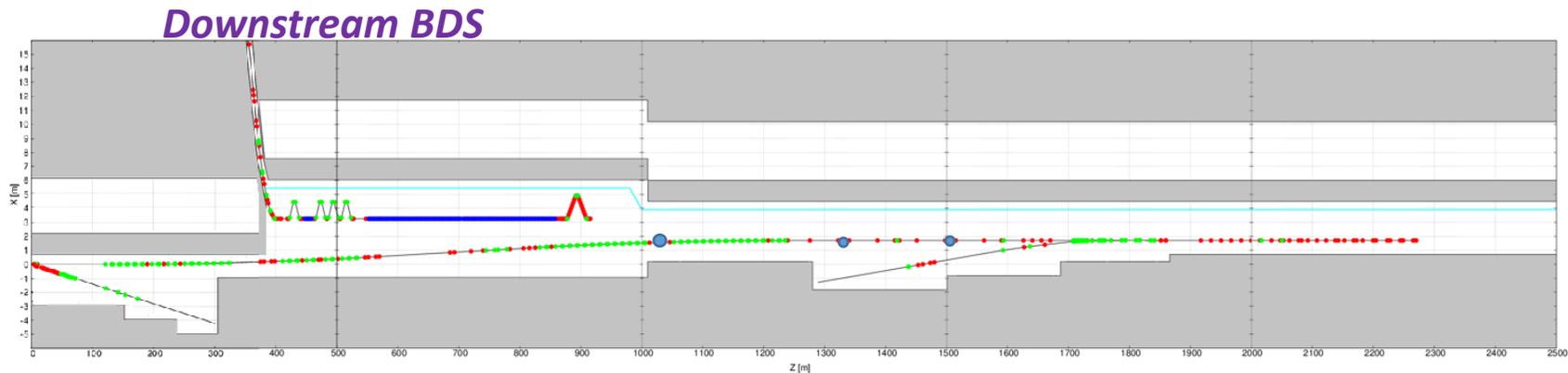
16 type B cryomodule (2 for backup)

Operated with 27-28 MV/m

Electron gun

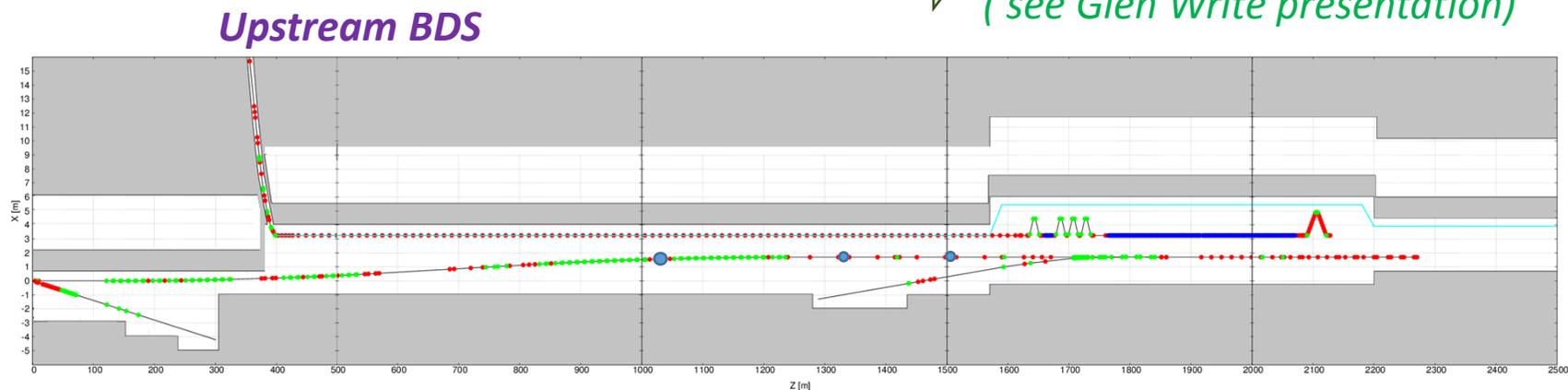
The electricity of electron gun and laser system

Where to put electron source ?? (3) - Background



*Electron source of cryomodule is located after BDS collimator.
Tunnel cross section after collimator is large.*

➡ *may be OK by using donuts spoiler
(see Glen Write presentation)*



*Electron source of cryomodule is located before BDS collimator.
Tunnel cross section after collimator is smaller.*

Upstream / downstream electron sources

| | | Downstream E-source | Upstream E-source |
|--------------------------|------------------|--|-------------------------------------|
| Cost | Tunnel | | Better, when service tunnel shorten |
| | E transport | N/A | Need 1km transport line |
| | He transfer line | 500 m | < 100 m |
| Location of cold mass | | Detector Hall | Cold box Cavern in ML access tunnel |
| Detector & Cryomodule BG | | Small impact, when we use donuts spoiler | |

*I recommend the upstream electron source for their refrigerator system of electron source.
=> We need discuss !*

Summary of electron BDS tunnel

BDS tunnel from ML to LTR

Twin tunnel => Kamaboko tunnel

- *Easy to make penetration and access tunnel*

BDS tunnel from LTR to Detector Hall

Single tunnel => Kamaboko tunnel

Make a access tunnel from detector hall to BDS service tunnel

- *To make the path of electric power line etc.*
- *To make emergency exit through service tunnel*
- *To make a access path for small equipment*
- *To make LTR tunnel compact by putting LTR PSs to BDS tunnel*

Move an electron source to upstream

- *To be able to use ML compressor to cold box areas*
- *To make the Helium transfer line shorter.*
- *Have a possibility to make narrower BDS tunnel width*

Demerit

- *Need a electron source transfer line*

Electron gun Access policy to laser room area for E-gun ?

- *Should we access to the laser room in operation.*
- *If so, we should take care of the access path to the laser room.*