ILC GLOBAL Design Effort

The Current ILC Twin Tunnel Design

Wilhelm Bialowons and Nicholas Walker · MPY

Twin Tunnel Design

Source: Status of CFS Design and Cost Study,
Jean-Luc Baldy, Atsushi Enomoto, Vic Kuchler,
Parallel Session at Valencia November 7, 2006

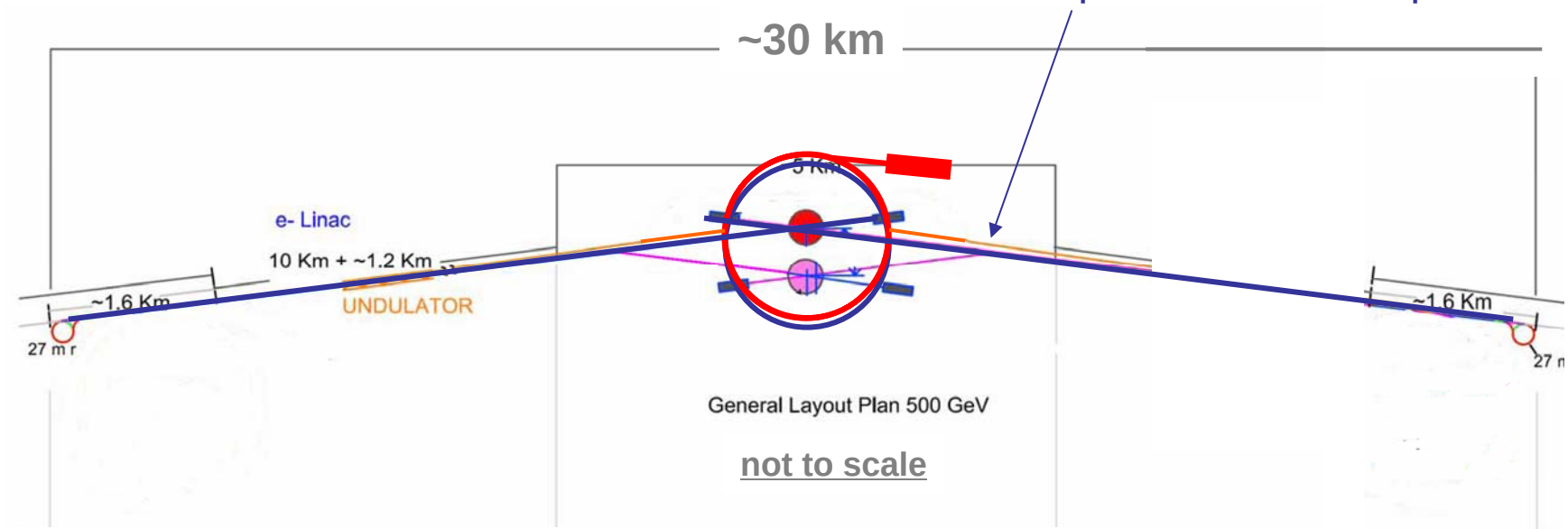
Outline

- **Recent ILC Baseline Configuration**
- **Design of Main Linac Beam and Service Tunnel**
- **Design of a Shaft for TBM Installation**
- **Layout of Experimental Hall with Two IPs**
- **Sample Sites**
- **Time Schedule**
- **Summary**

Baseline Configuration with Central DRs

Baseline Configuration

Long 5GeV low-emittance transport lines now required

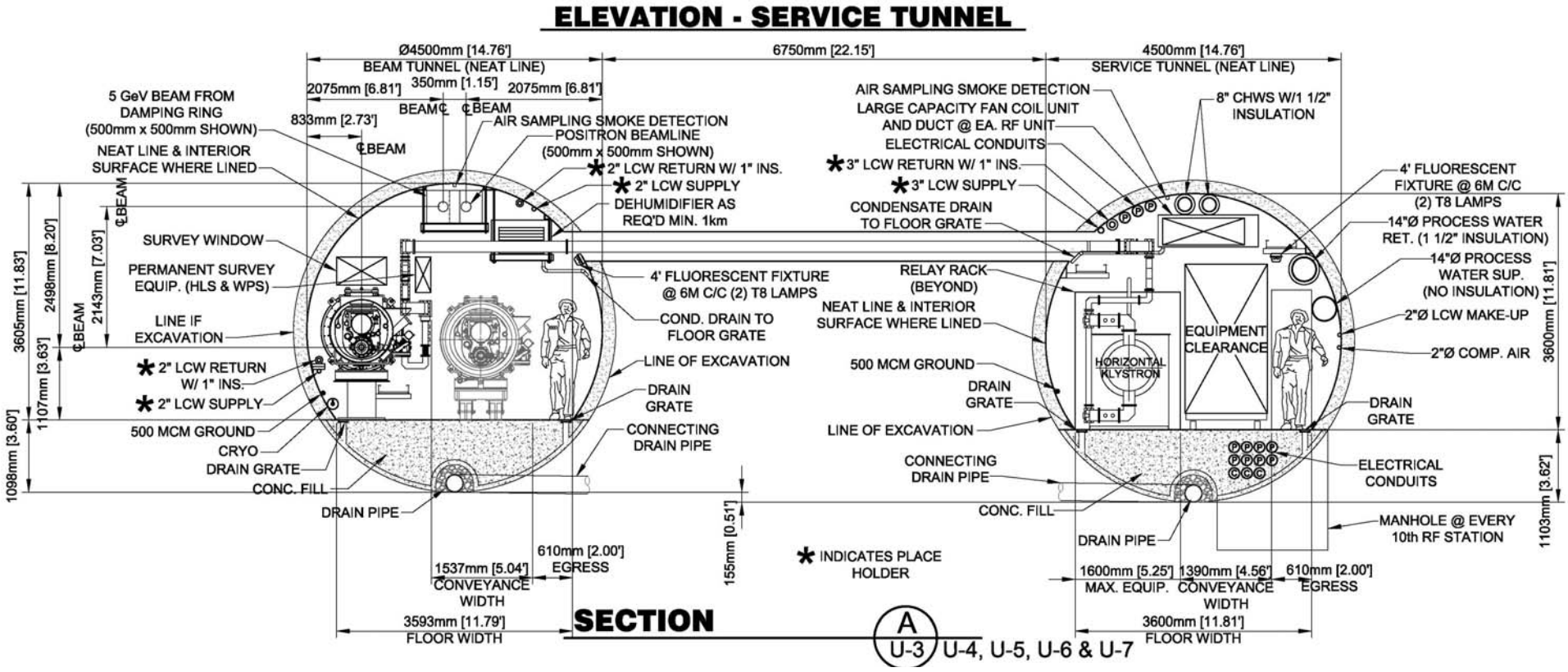


RDR baseline has centralised injector complex

(e+e- DRs in same tunnel)

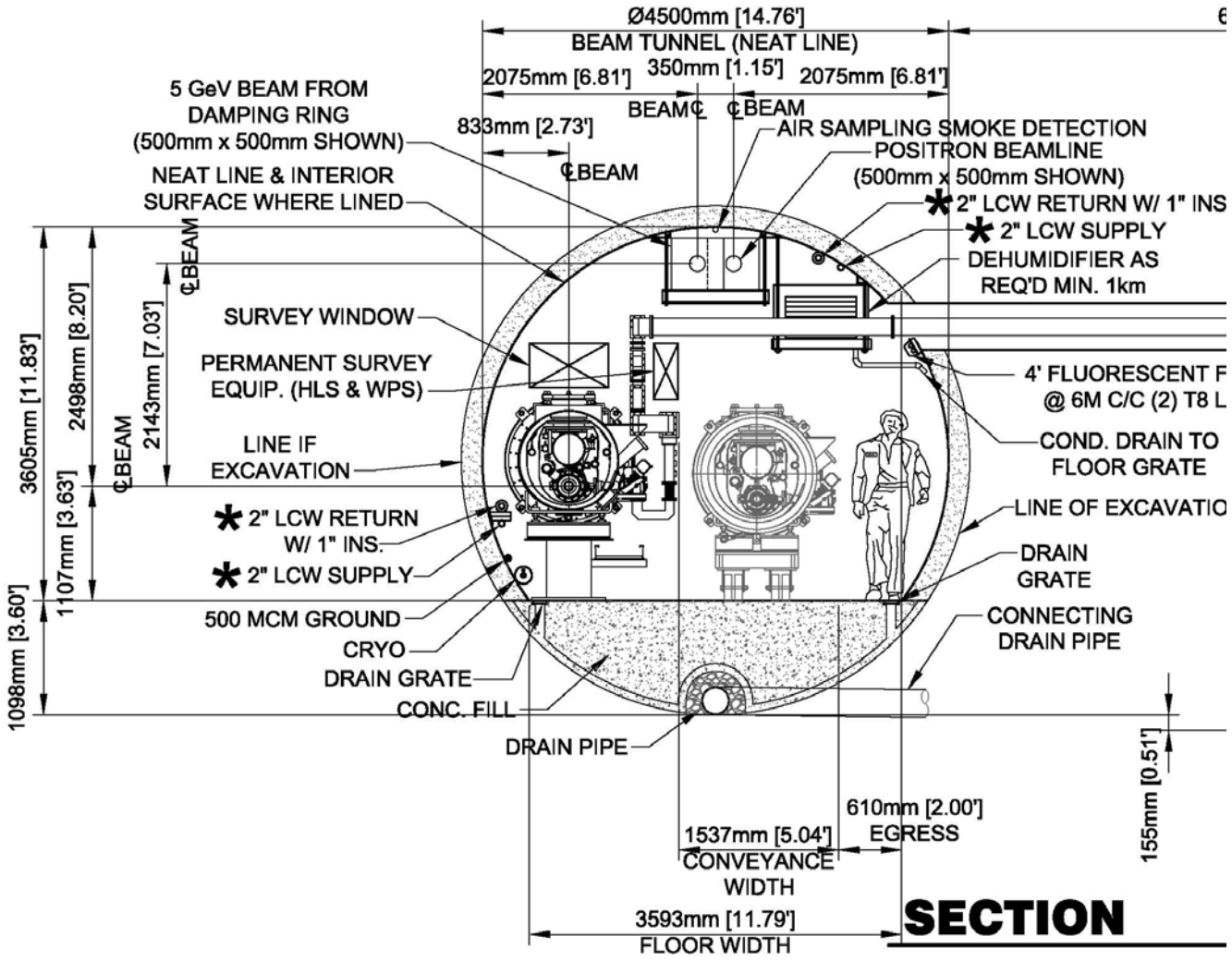
Twin Tunnel Cross Section

From CFS - Fermilab

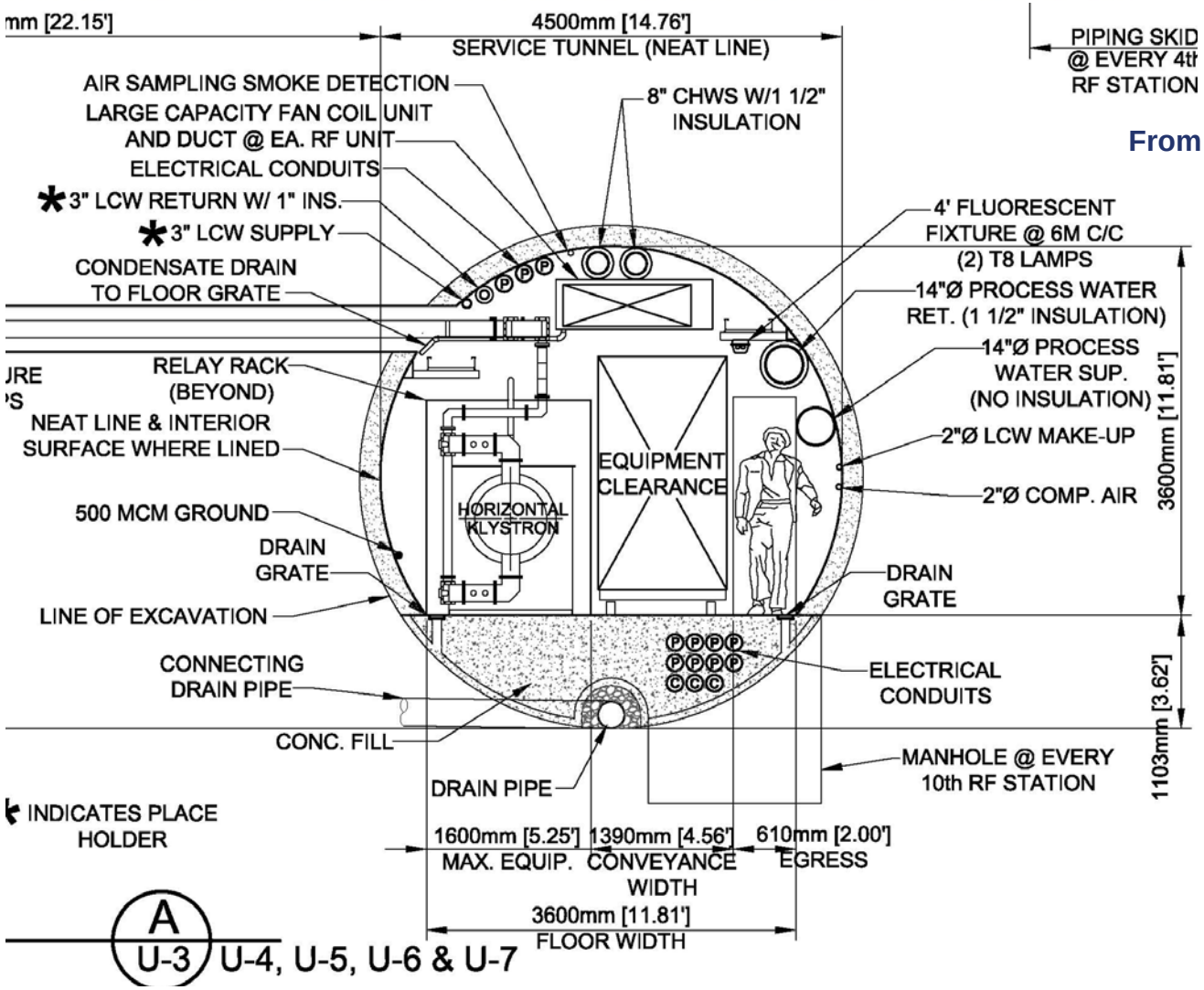


Beam Tunnel Cross Section

From CFS - Fermilab



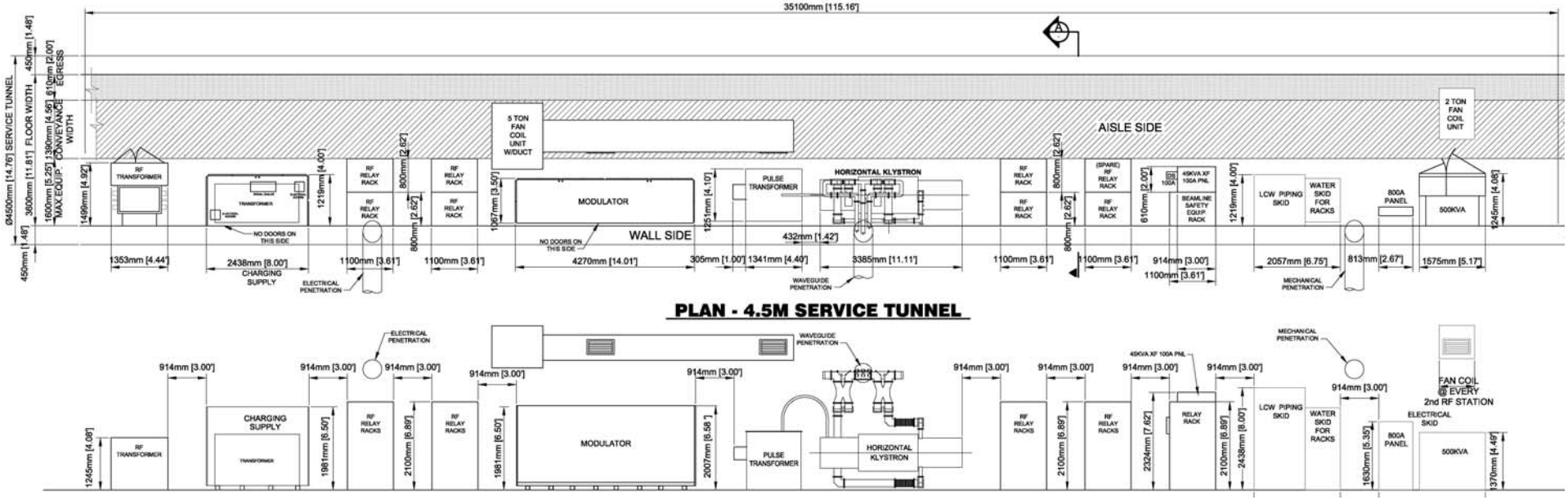
Service Tunnel Cross Section



From CFS - Fermilab

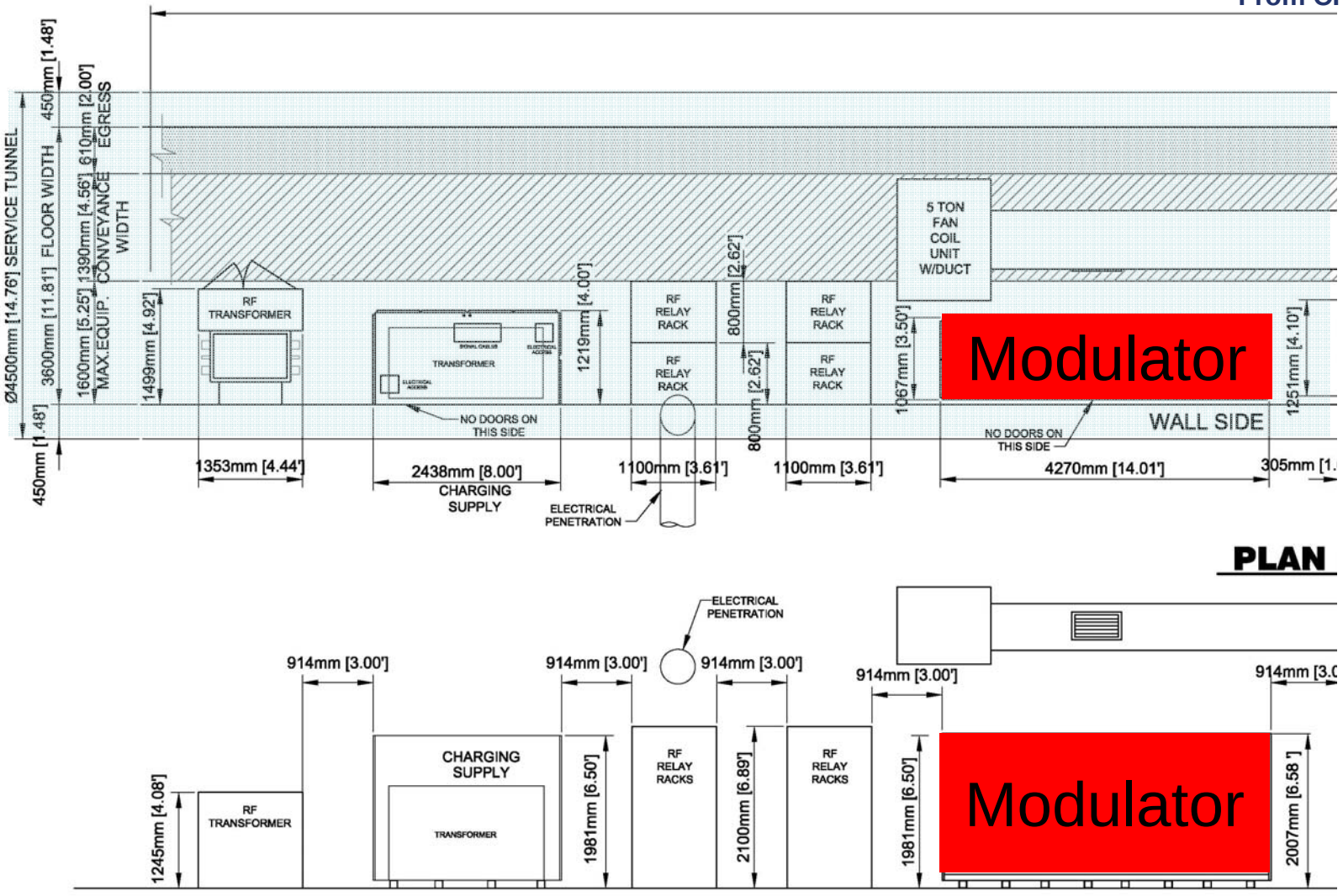
Service Tunnel View (One RF Unit)

From CFS - Fermilab



Service Tunnel View (Detail 1)

From CFS - Fermilab



Service Tunnel View (Detail 1)

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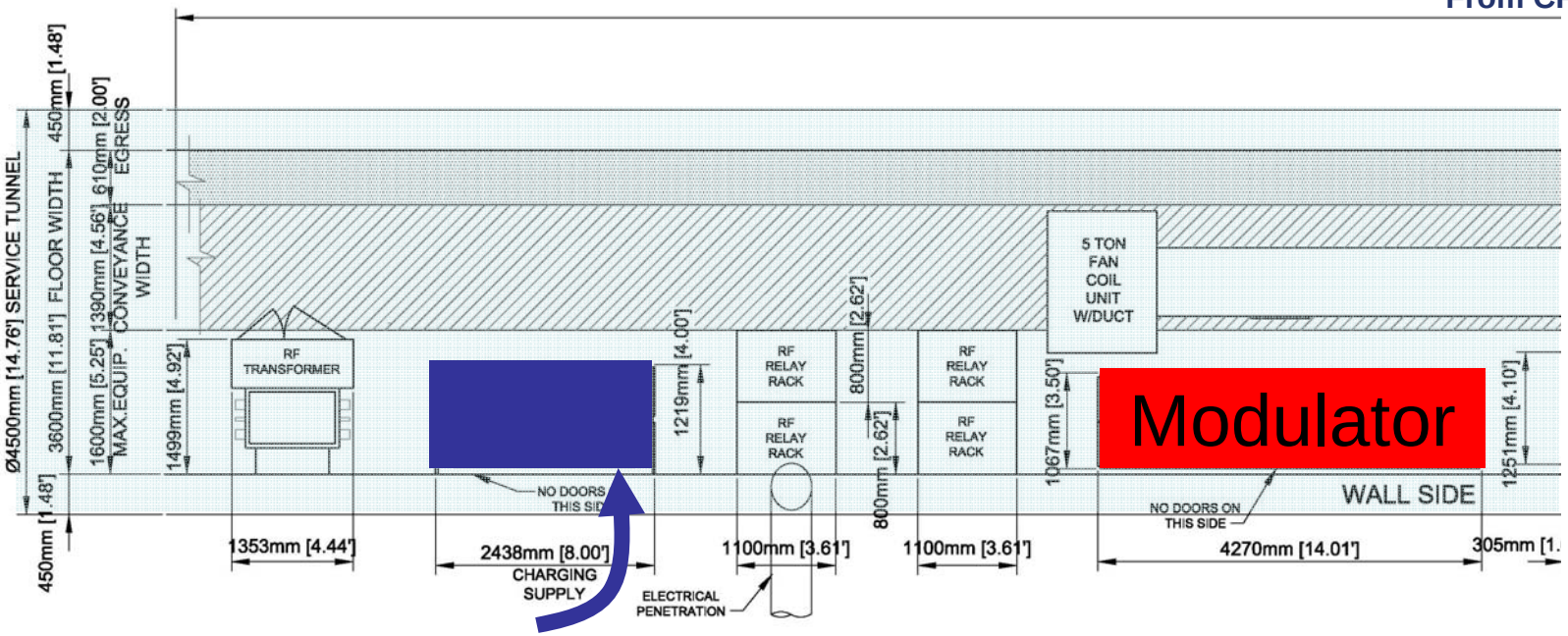
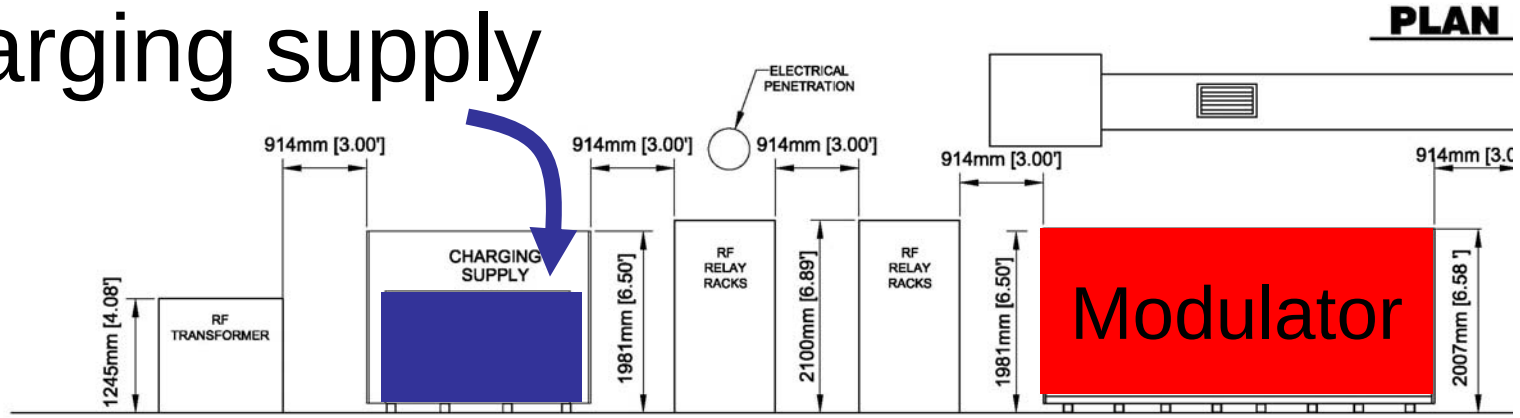


Charging supply



Service Tunnel View (Detail 1)

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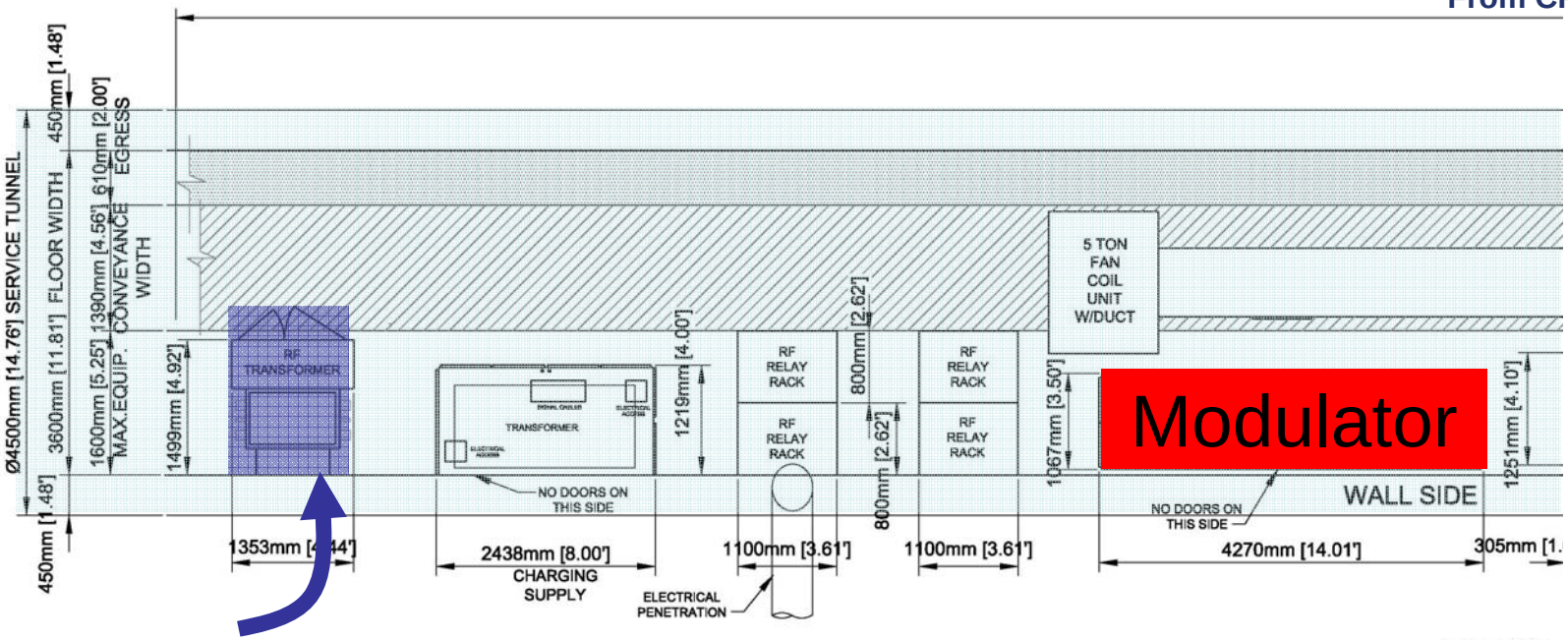
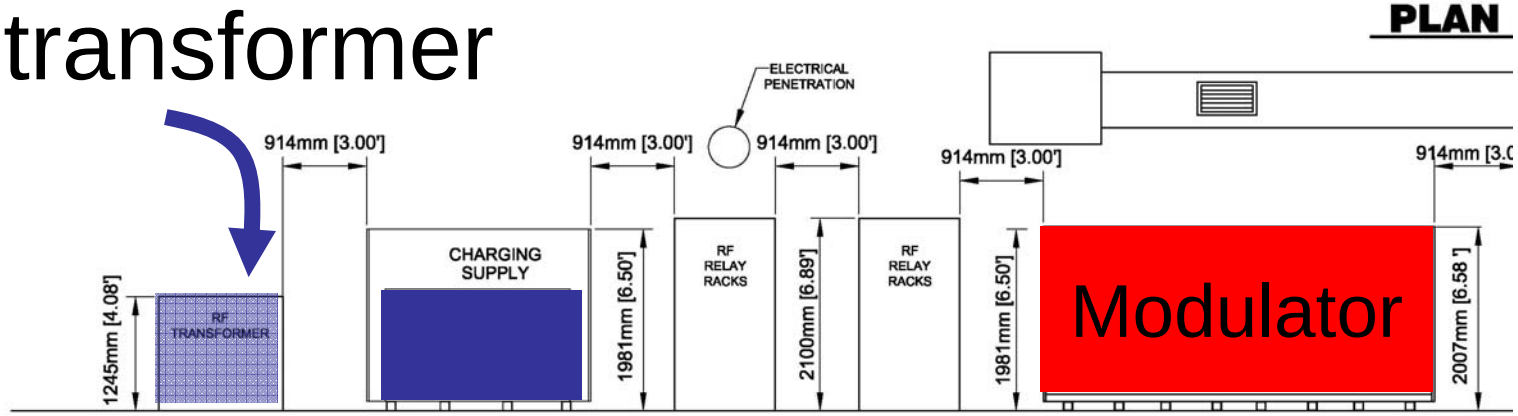
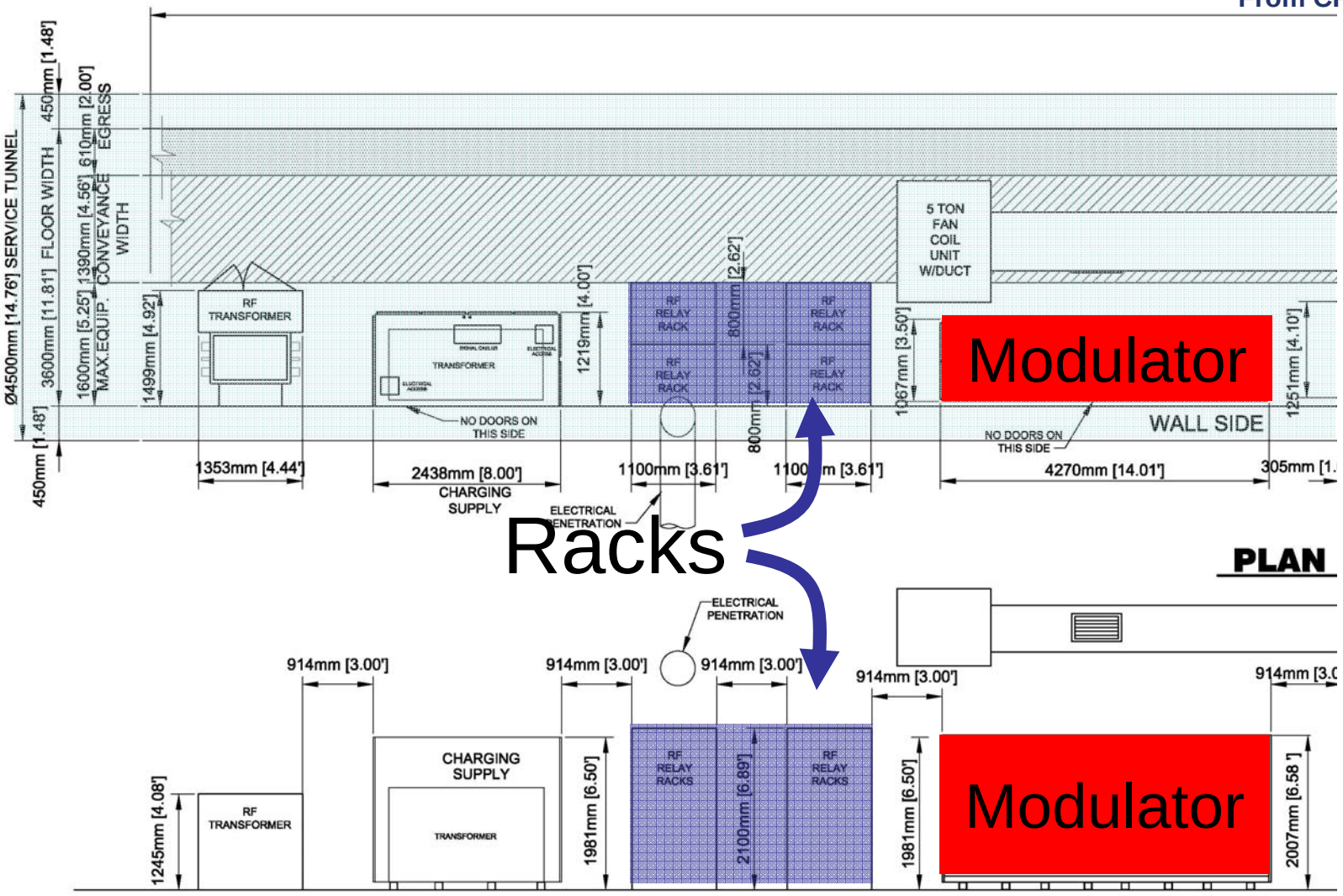


RF transformer



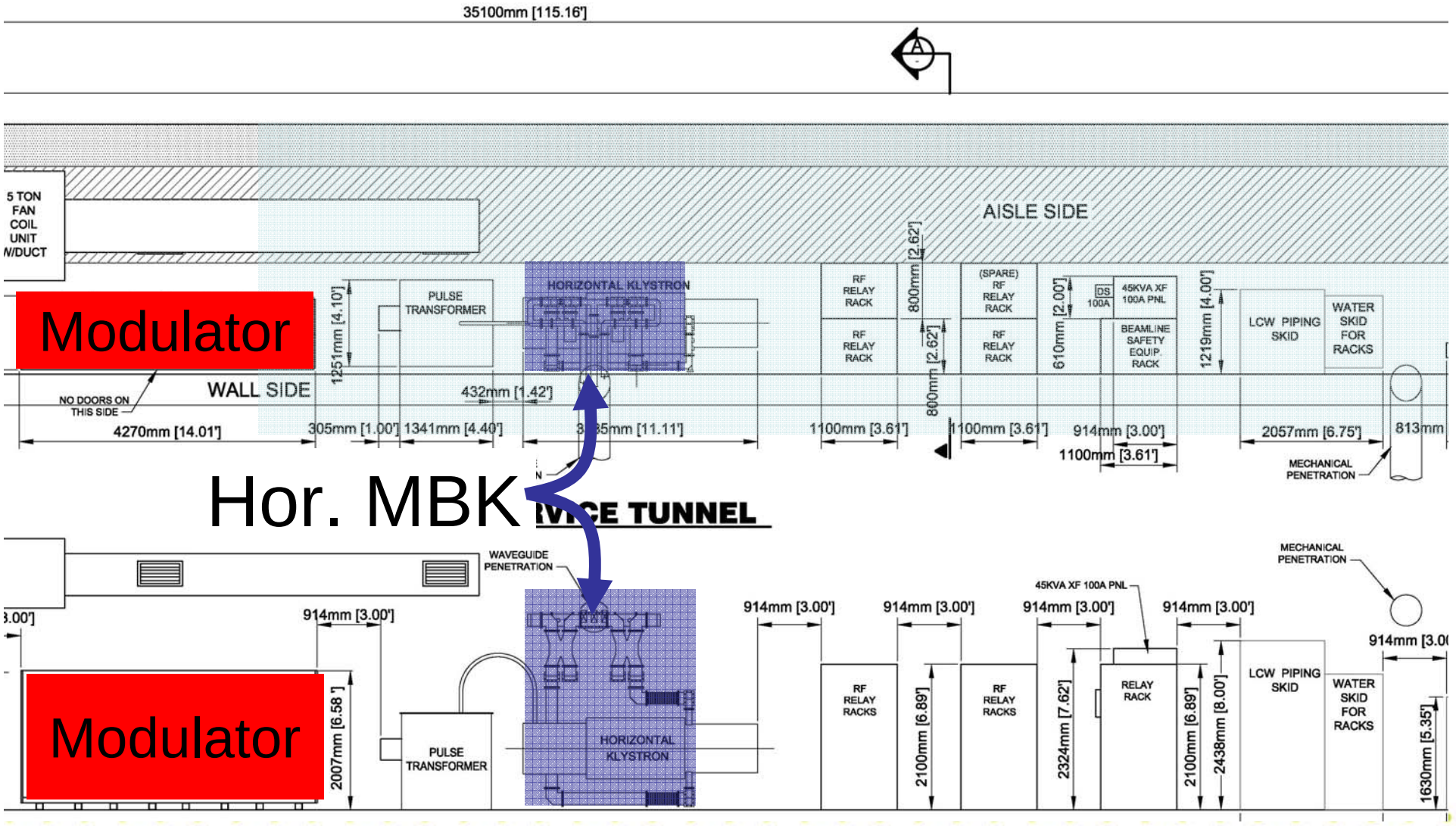
Service Tunnel View (Detail 1)

From CFS - Fermilab



Service Tunnel View (Detail 2)

From CFS - Fermilab



Service Tunnel View (Detail 2)

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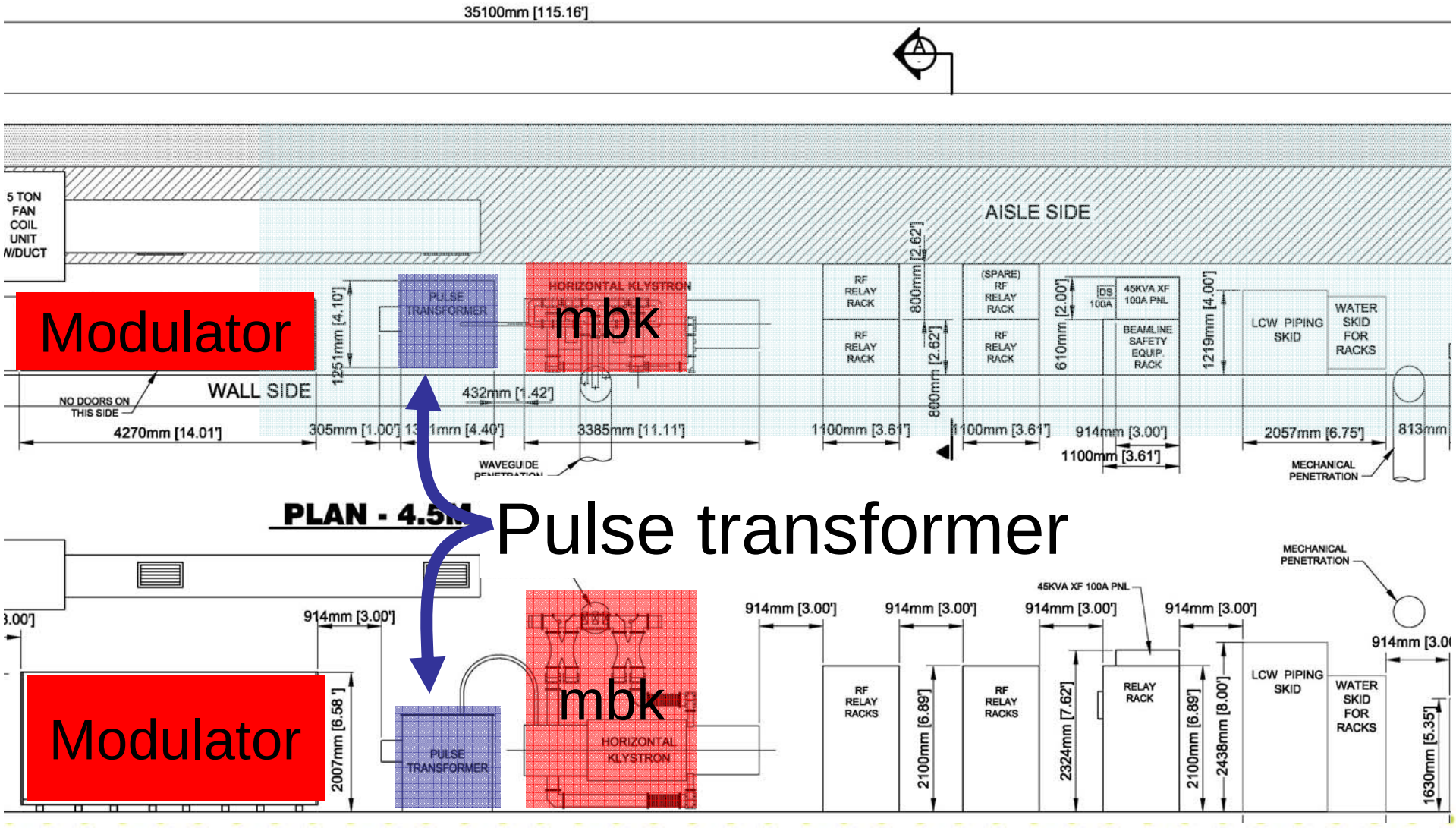

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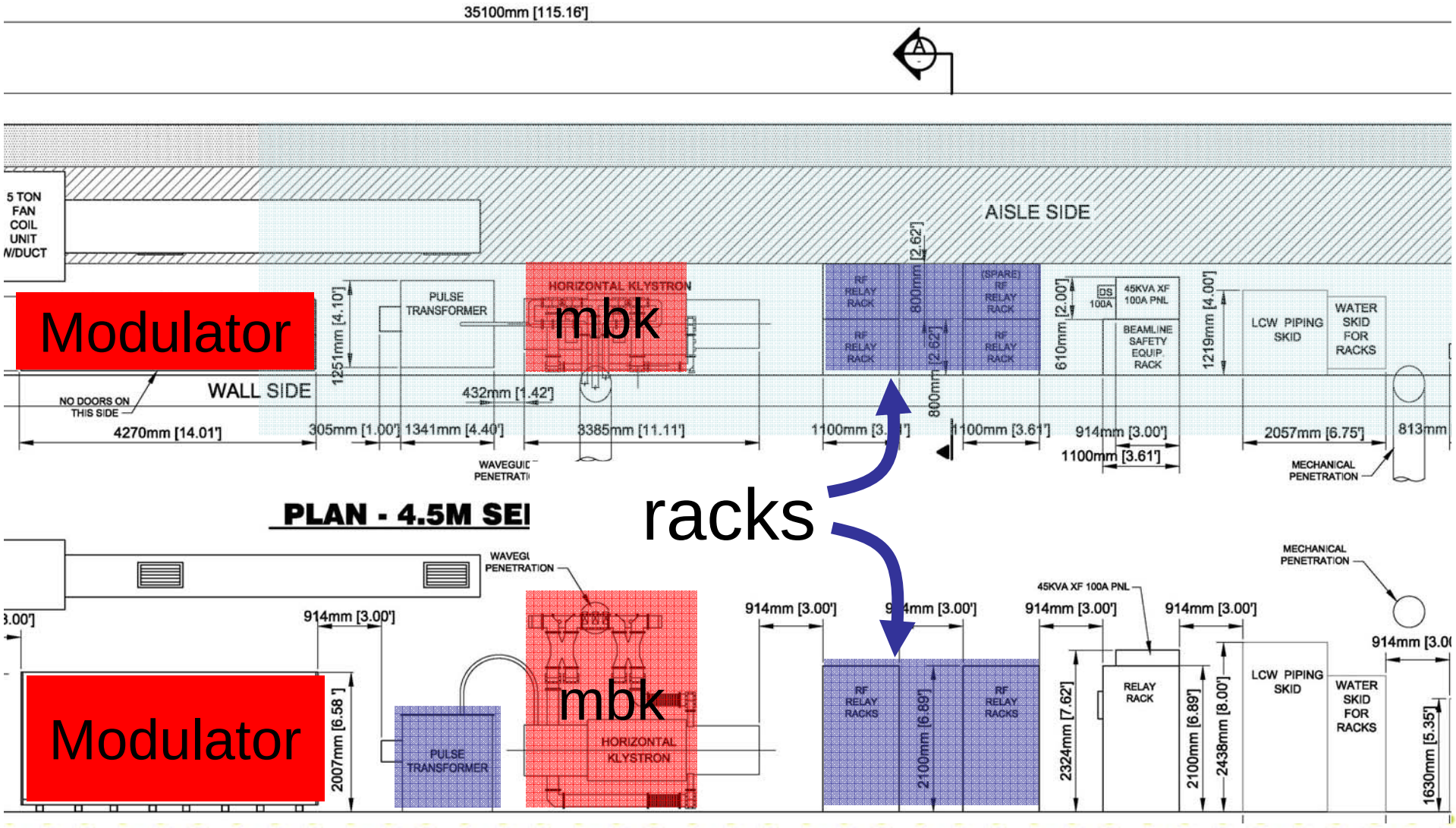

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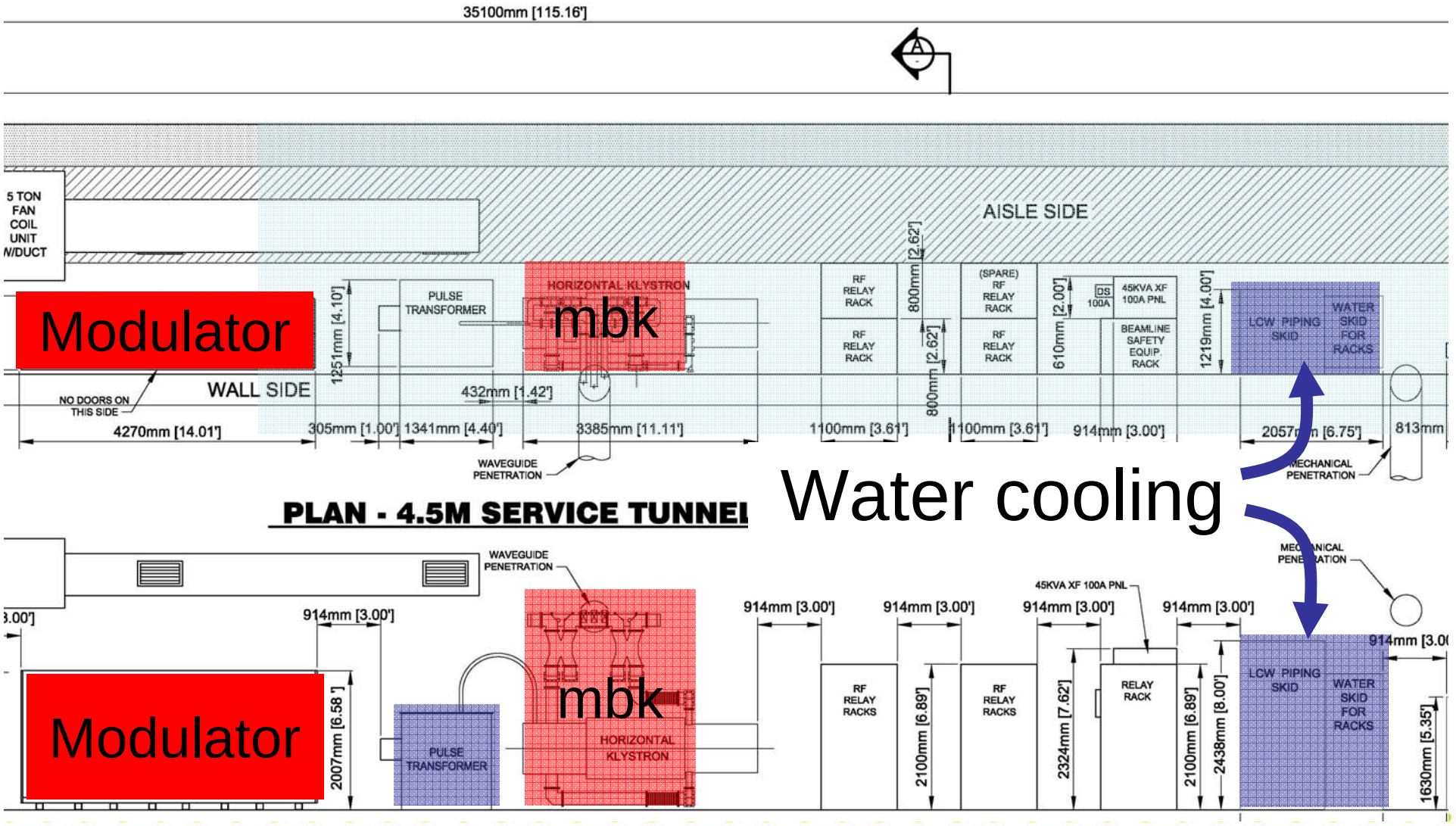
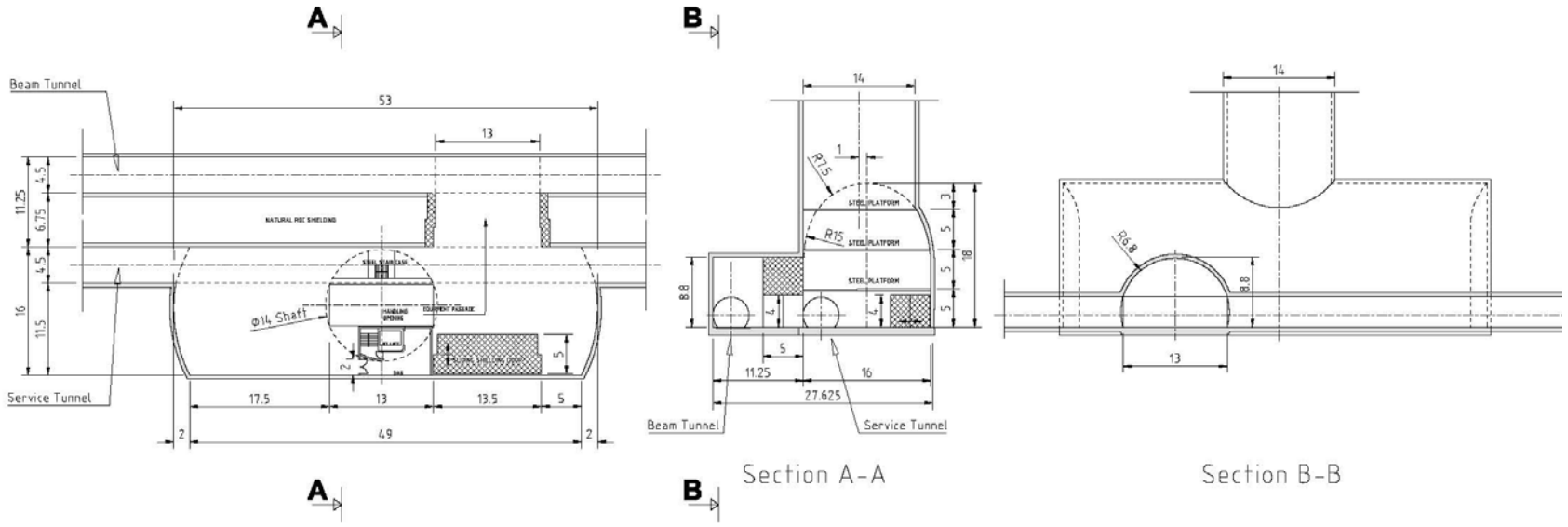


Design of a Shaft for TBM Installation

From CFS - CERN

SHAFTS 2, 4 + 3, 5 + 10, 11

(for TBM Installation, access and services)



Design of a Shaft for TBM Installation

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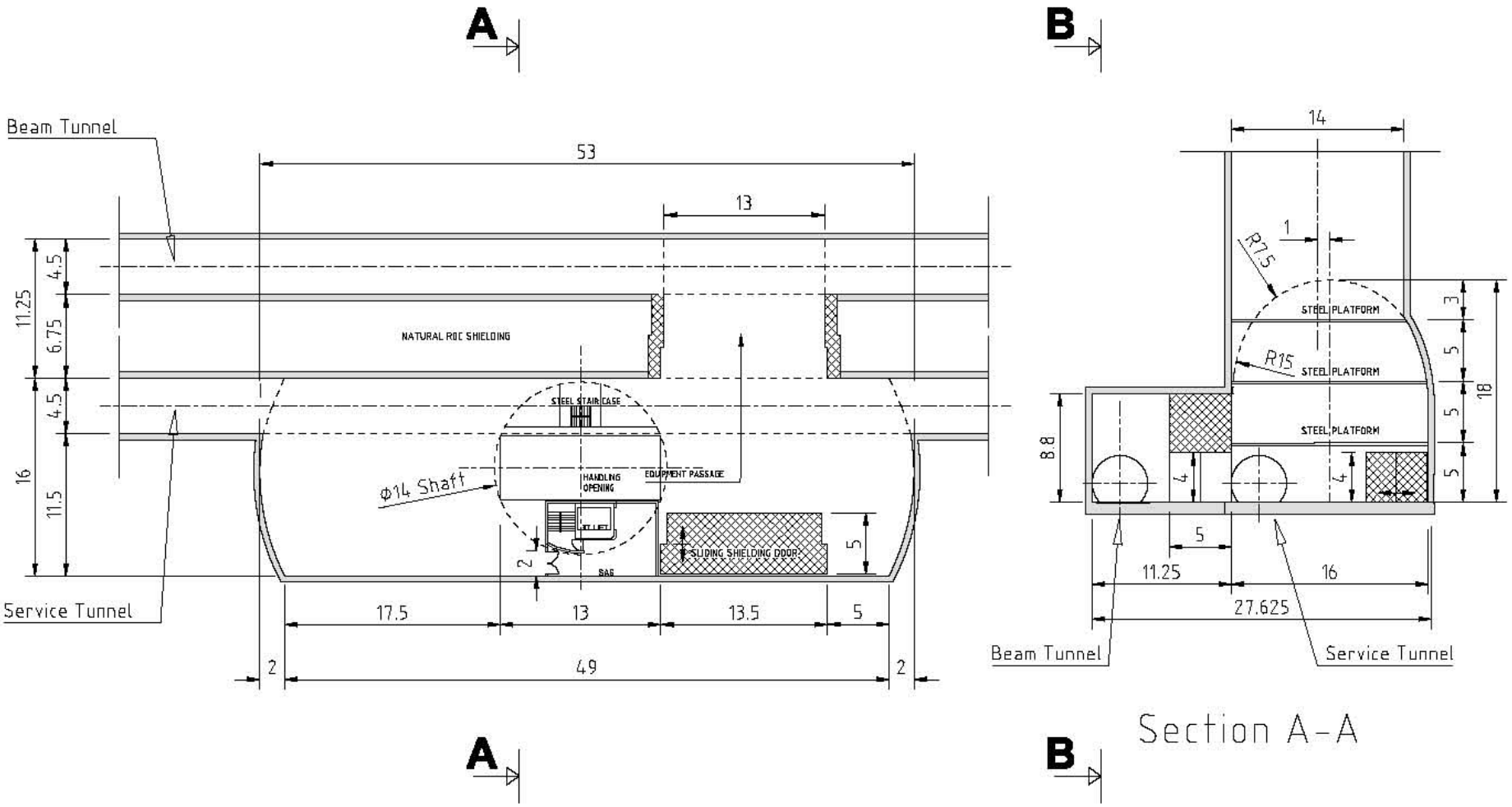
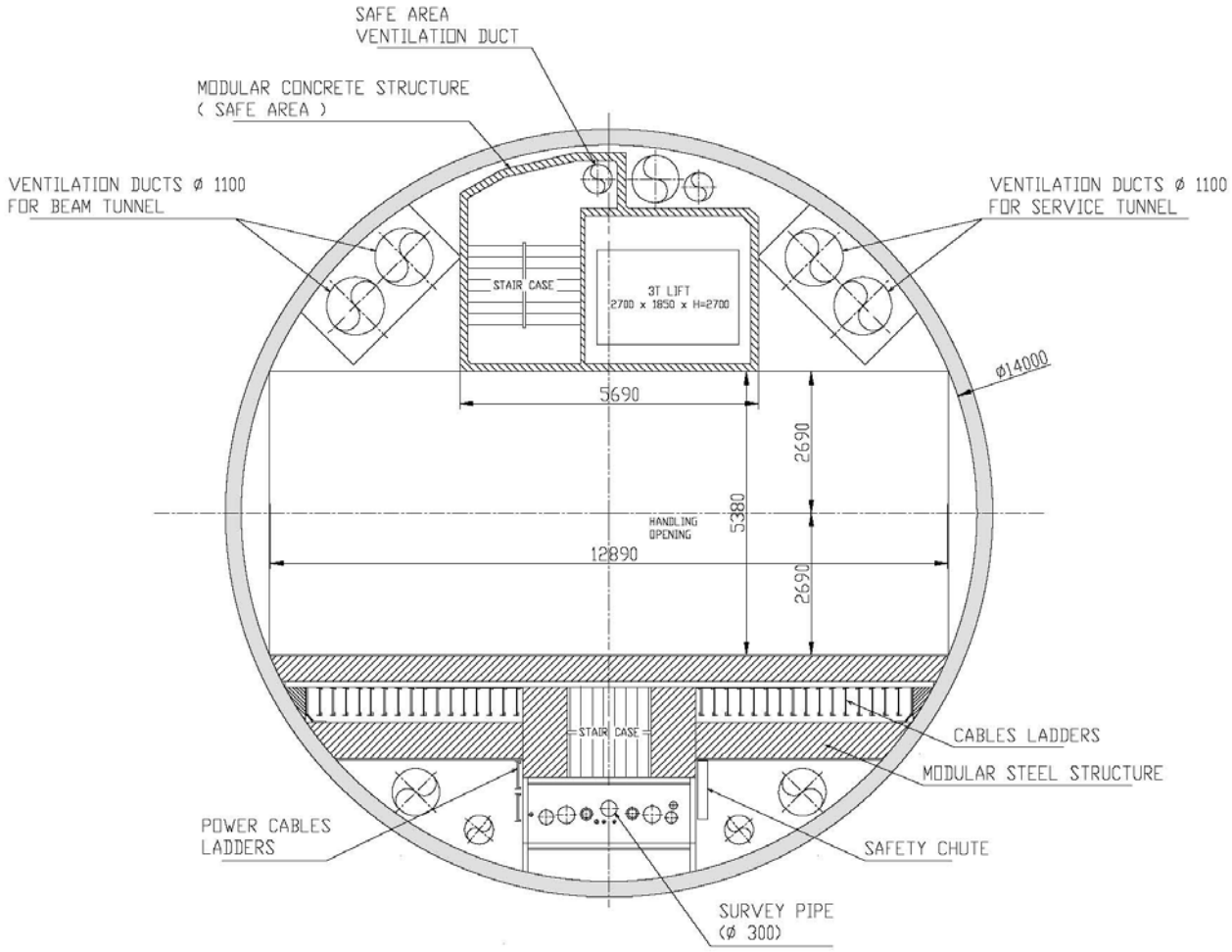


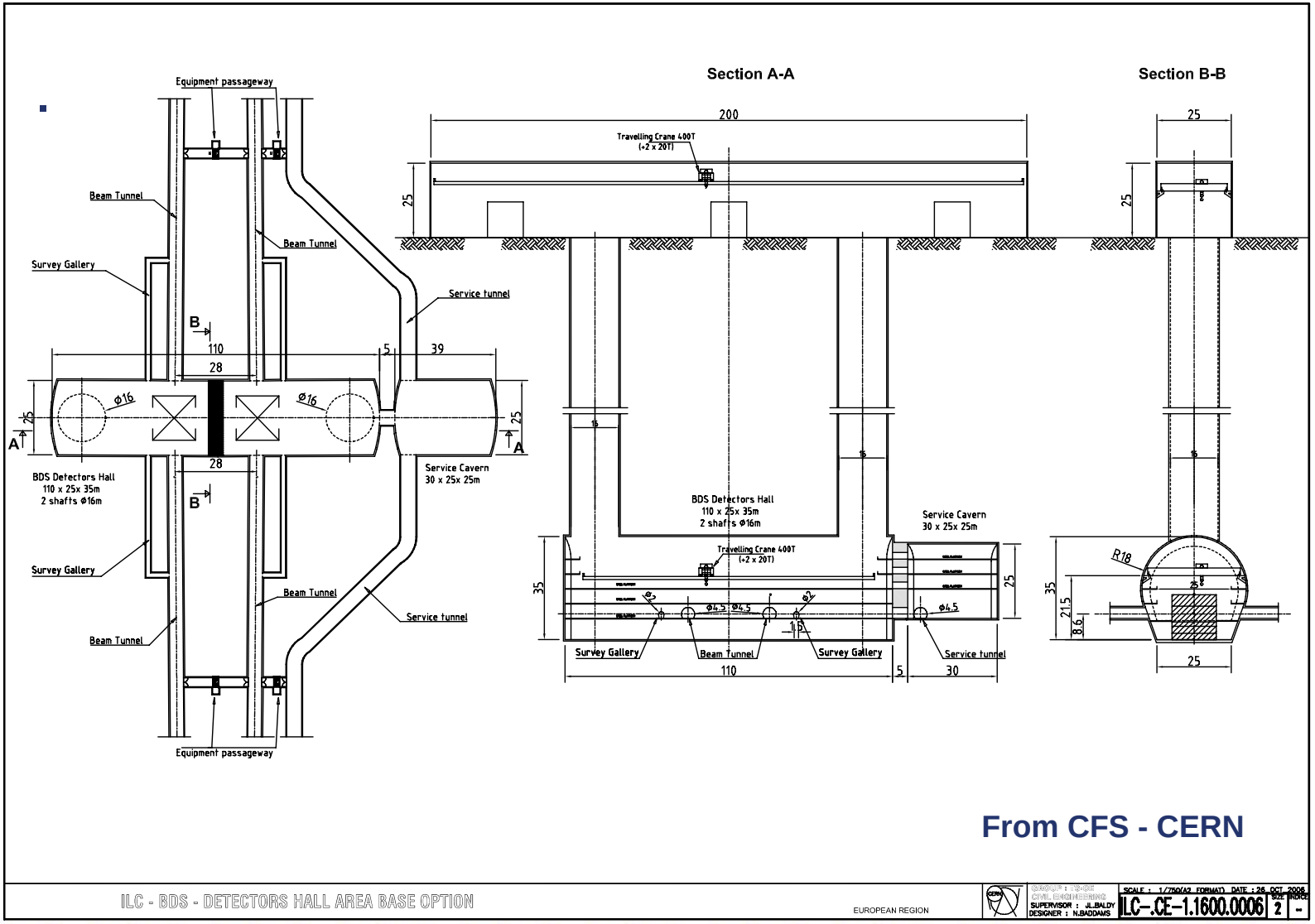
Cross Section of a Shaft

From CFS - CERN



ML SHAFTS 2, 3, 4, 5
AND RTML SHAFTS 10, 11

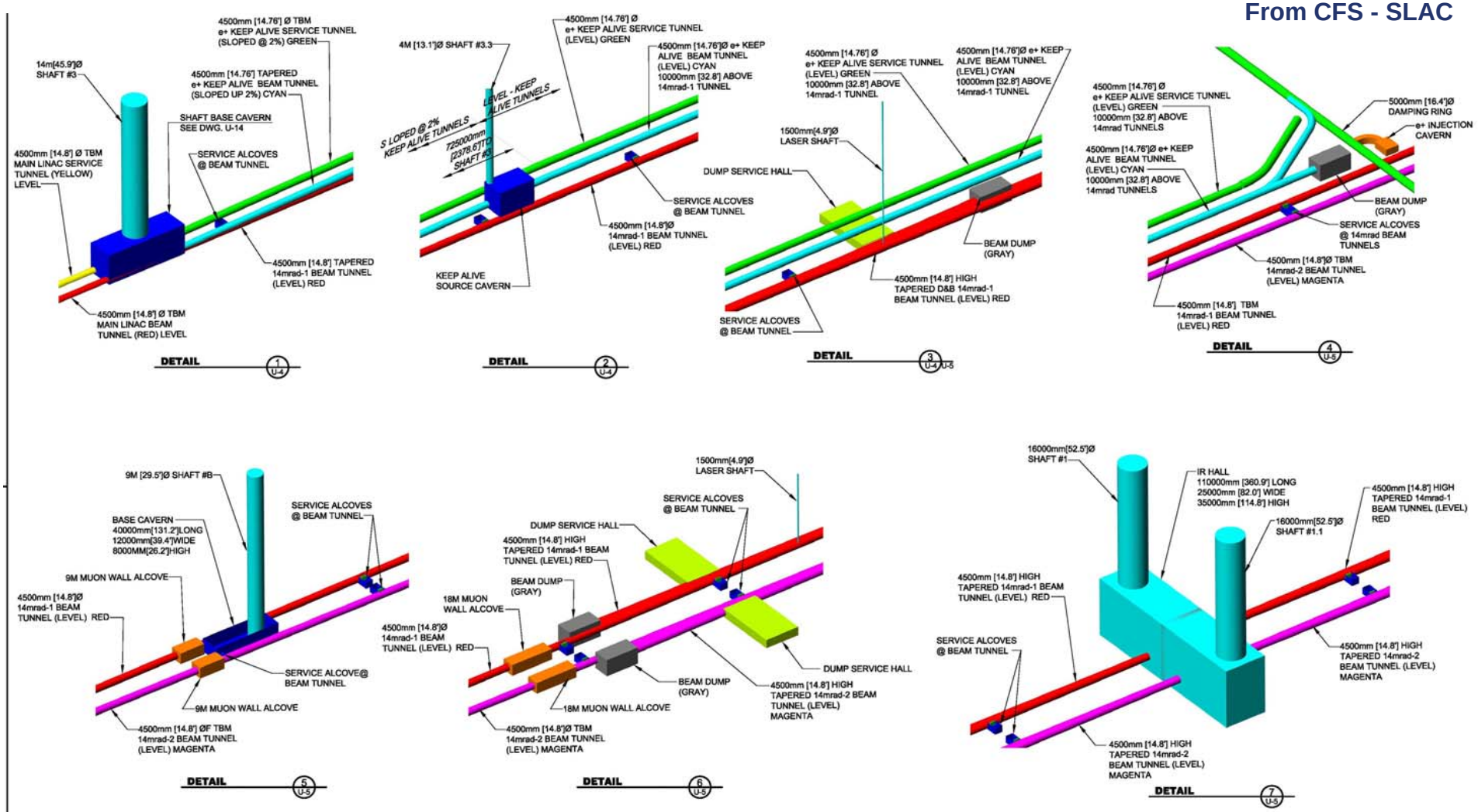
Layout of Experimental Hall with Two IPs



From CFS - CERN

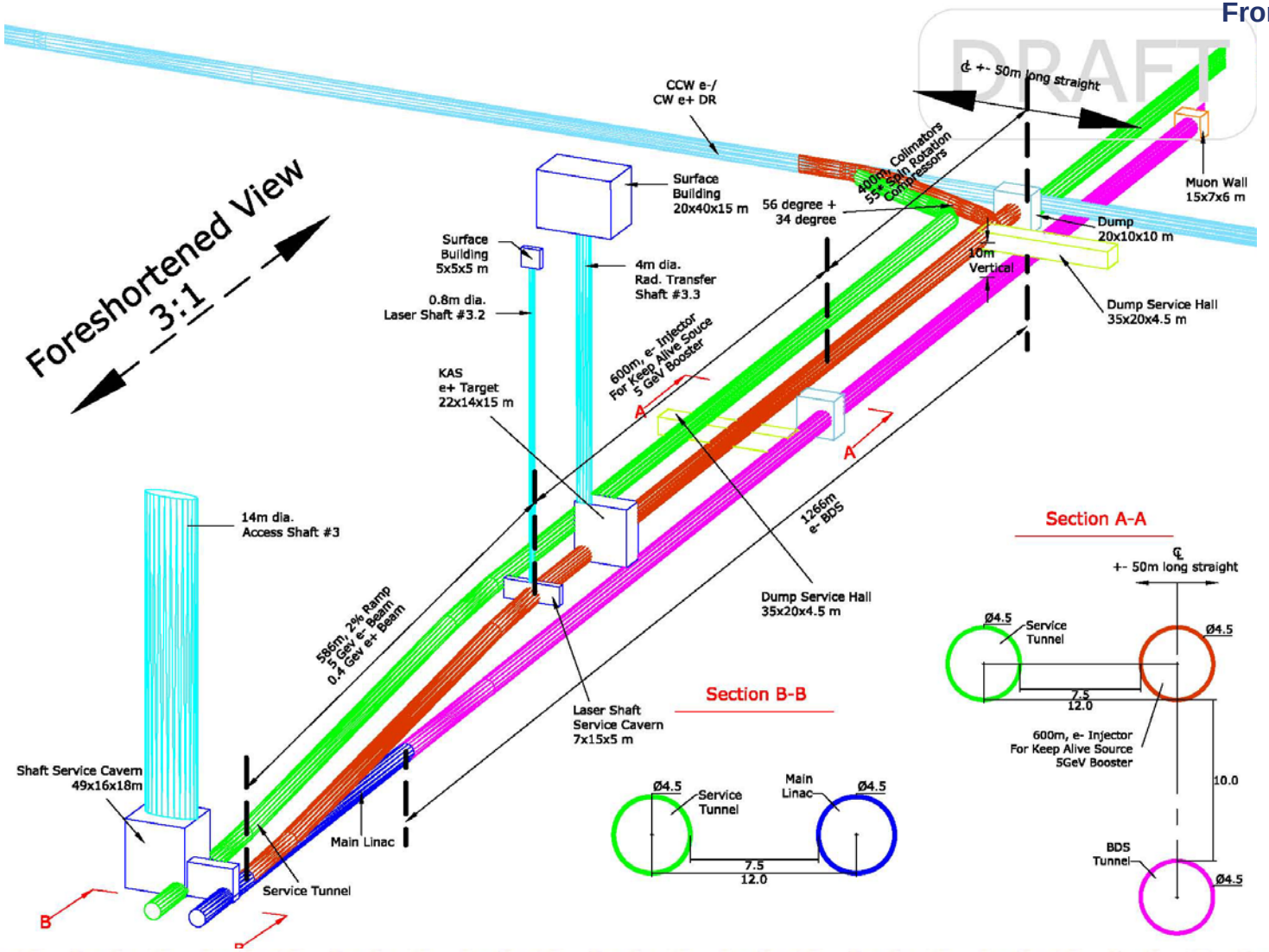
Examples of Civil Engineering Layout

From CFS - SLAC



IR and Central Damping Ring

From CFS - SLAC



Specificities for each Sample Site – AMERICAS

Situation :

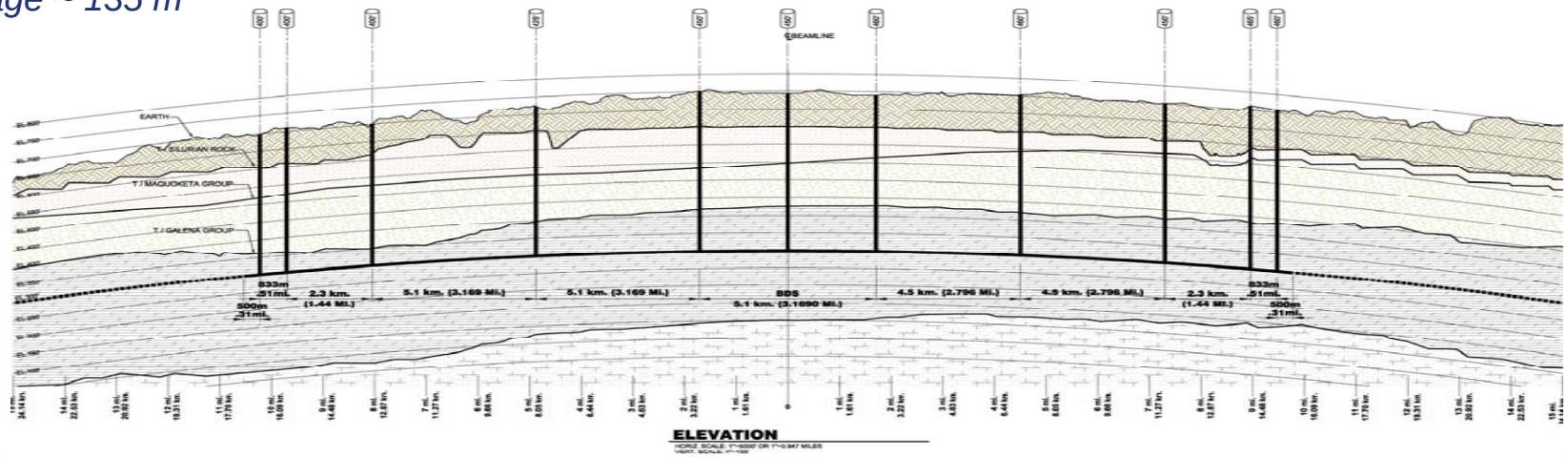
In solid rock, close to existing institute, close to the city of Chicago and international airport, close to railway and highway networks.

Geology :

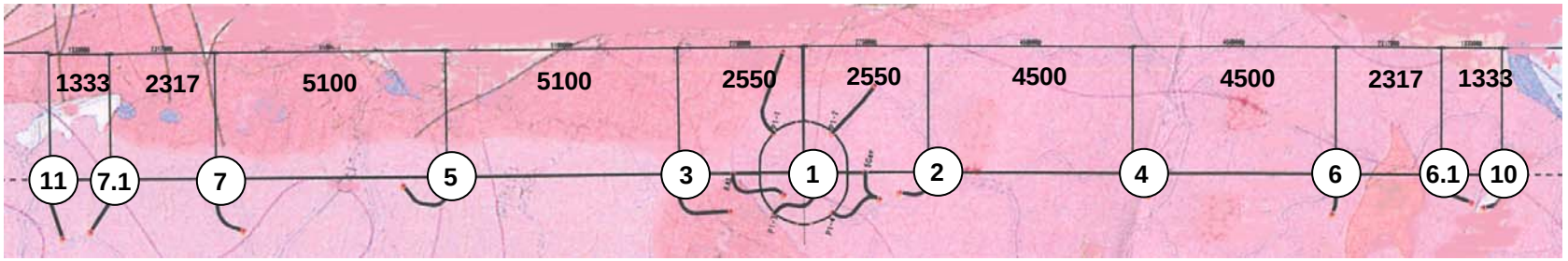
Glacially derived deposits overlaying Bedrock. The concerned rock layers are from top to bottom the Silurian dolomite, Maquoketa dolomitic shale, and the Galena-Platteville dolomites.

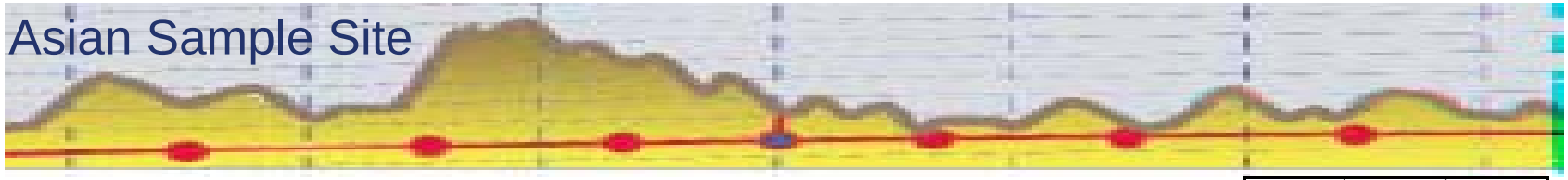
Depth of main tunnels:

Average ~ 135 m



Specificities for each Sample Site - ASIA





- Following requirements were imposed for the sample site:
- Firm and uniform geology.
- Large enough area spanning over 50km.
- Absence of active dislocations, wide faults in the neighbourhood.
- Absence of epicenters of earthquakes exceeding M6 within 50km from anywhere in the site since AD1500.
- Terrain uniformity to maintain the ILC Tunnel depths less than 600m anywhere. Granite (compressive strength~100MPa).
- Excavation: TBM (~300m/month)
- Finish: Sprayed concrete (+ Rock-bolts)
- Access by sloped tunnel instead of vertical shafts

Point	Elevation (m)	Access Tunnel Diatance (m)
11	178	1323
7	330	1455
5	344	1636
3	493	1842
1	228	(148)*
2	188	992
4	173	671
6	161	887
10	160	960
12	312	1178
13	192	1235
14	247	1382
15	361	1945
Beamline	80	

* Access shaft

Specificities for each Sample Site – CERN

Situation :

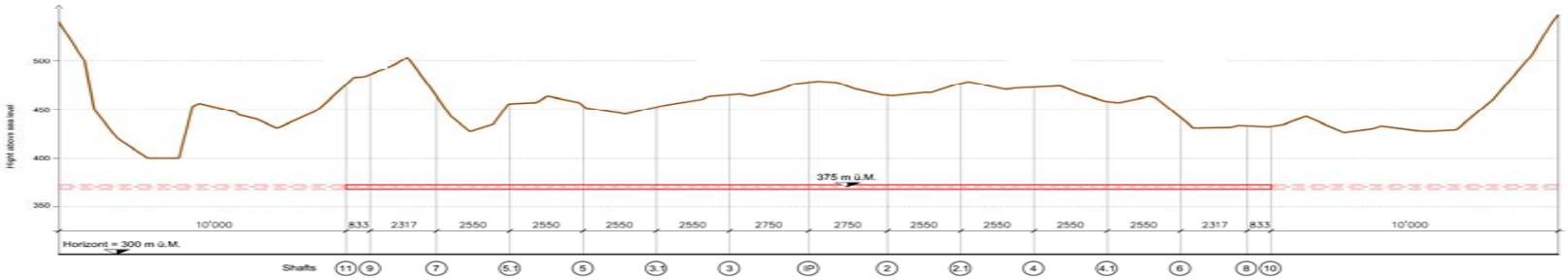
Proximity of CERN existing site with its 400 kV grid connection. Close to the city of Geneva with its international airport, railway and highway network connections.

Geology :

Solid and stable bedrock called "molasse" (sandstone), which stretches between the Jura mountains and the Lake of Geneva. A layer of moraines ranges from 0 to 50 m on top of the sandstone. Low seismic activity and no active faults.

Depth of main tunnels :

average ~ 100 m



Specificities for each Sample Site – DESY

Situation :

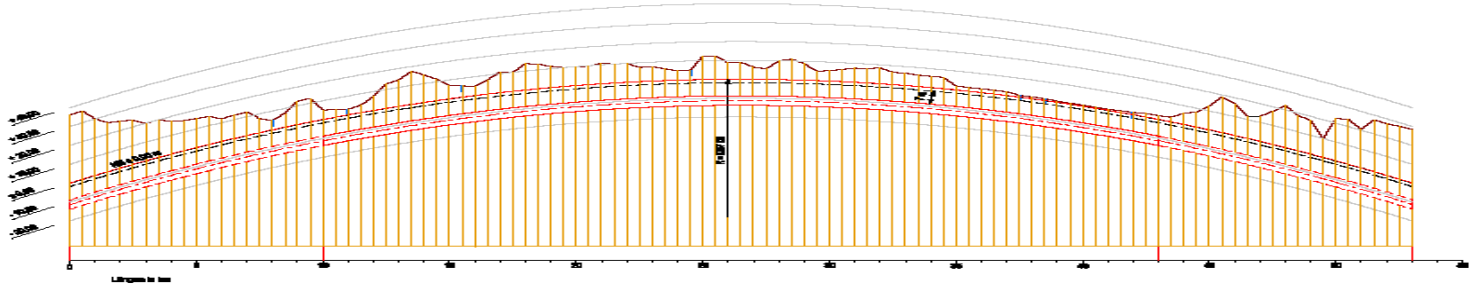
Close to DESY existing site and the city of Hamburg with its international airport and seaport. The ILC layout will follow closely the TESLA layout on the first 32.8 km and could then be extended to 50 km in the same direction. Close to railway and highway network connections.

Geology :

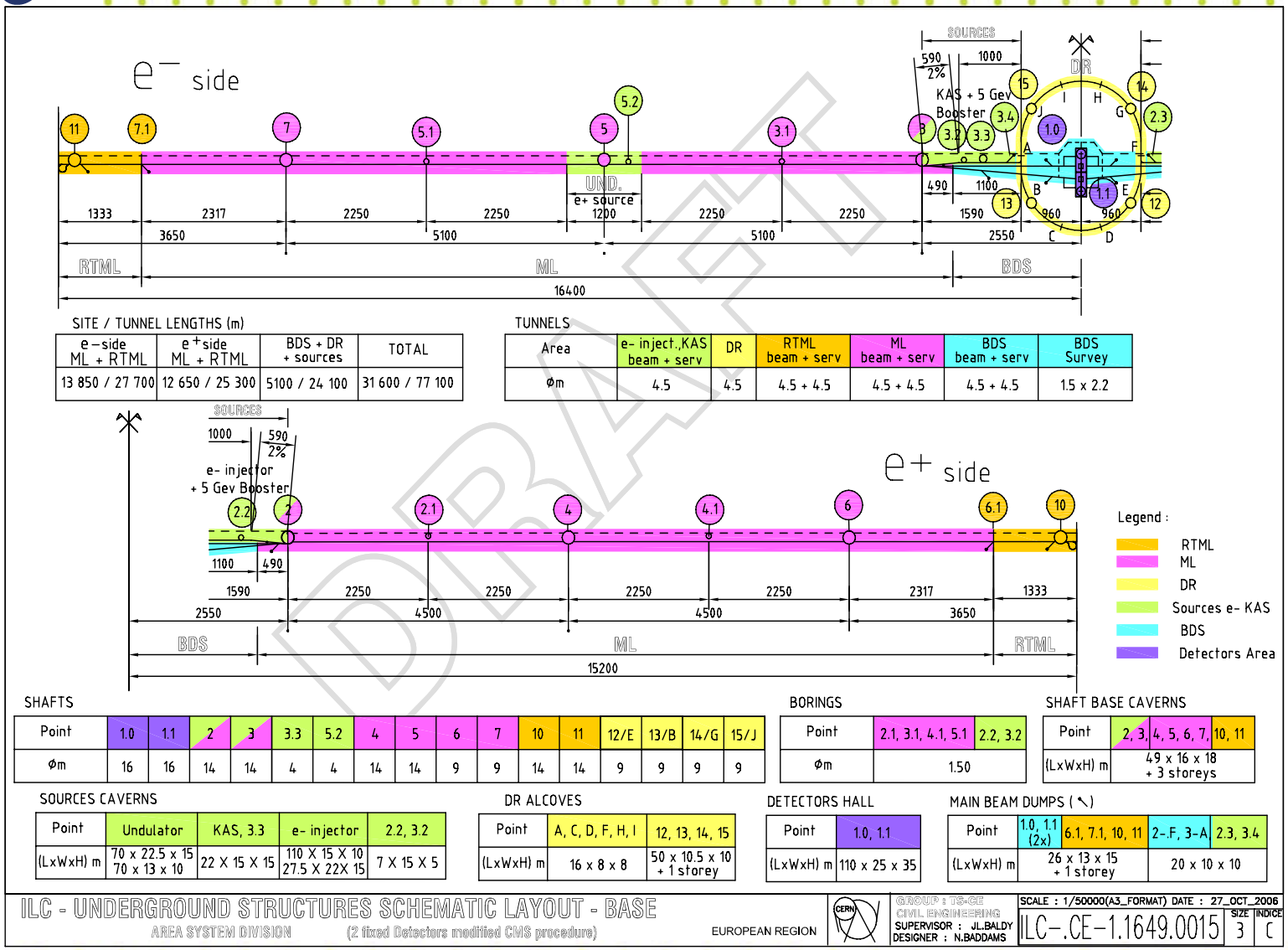
Quaternary sand and smaller part in marl. Tunnel situated below the ground water table over nearly the entire length.

Depth of main tunnels :

Shallow position, average ~ 18 m



ILC Underground Schematic Layout 2 IR



SITE / TUNNEL LENGTHS (m)

e−side ML + RTML	e+side ML + RTML	BDS + DR + sources	TOTAL
13 850 / 27 700	12 650 / 25 300	5100 / 24 100	31 600 / 77 100

TUNNELS

Area	e- inject.,KAS beam + serv	DR	RTML beam + serv	ML beam + serv	BDS beam + serv	BDS Survey
Øm	4.5	4.5	4.5 + 4.5	4.5 + 4.5	4.5 + 4.5	1.5 x 2.2

SHAFTS

Point	1.0	1.1	2	3	3.3	5.2	4	5	6	7	10	11	12/E	13/B	14/G	15/J
Øm	16	16	14	14	4	4	14	14	9	9	14	14	9	9	9	9

BORINGS

Point	2.1, 3.1, 4.1, 5.1	2.2, 3.2
Øm	1.50	

SHAFT BASE CAVERNS

Point	2, 3,	4, 5, 6, 7,	10, 11
(LxWxH) m	49 x 16 x 18 + 3 storeys		

SOURCES CAVERNS

Point	Undulator	KAS, 3.3	e- injector	2.2, 3.2
(LxWxH) m	70 x 22.5 x 15 70 x 13 x 10	22 X 15 X 15	110 X 15 X 10 27.5 X 22X 15	7 X 15 X 5

DR ALCOVES

Point	A, C, D, F, H, I	12, 13, 14, 15
(LxWxH) m	16 x 8 x 8	50 x 10.5 x 10 + 1 storey

DETECTORS HALL

Point	1.0, 1.1
(LxWxH) m	110 x 25 x 35

MAIN BEAM DUMPS (↖)

Point	1.0, 1.1 (2x)	6.1, 7.1, 10, 11	2-.F, 3-A	2.3, 3.4
(LxWxH) m	26 x 13 x 15 + 1 storey		20 x 10 x 10	

ILC - UNDERGROUND STRUCTURES SCHEMATIC LAYOUT - BASE
AREA SYSTEM DIVISION (2 fixed Detectors modified CMS procedure) EUROPEAN REGION

GROUP : TS-CE
CIVIL ENGINEERING
SUPERVISOR : JL.BALDY
DESIGNER : N.BADDAMS

SCALE : 1/50000(A3_FORMAT) DATE : 27_OCT_2006
ILC-.CE-1.1649.0015 SIZE 3 INDICE C

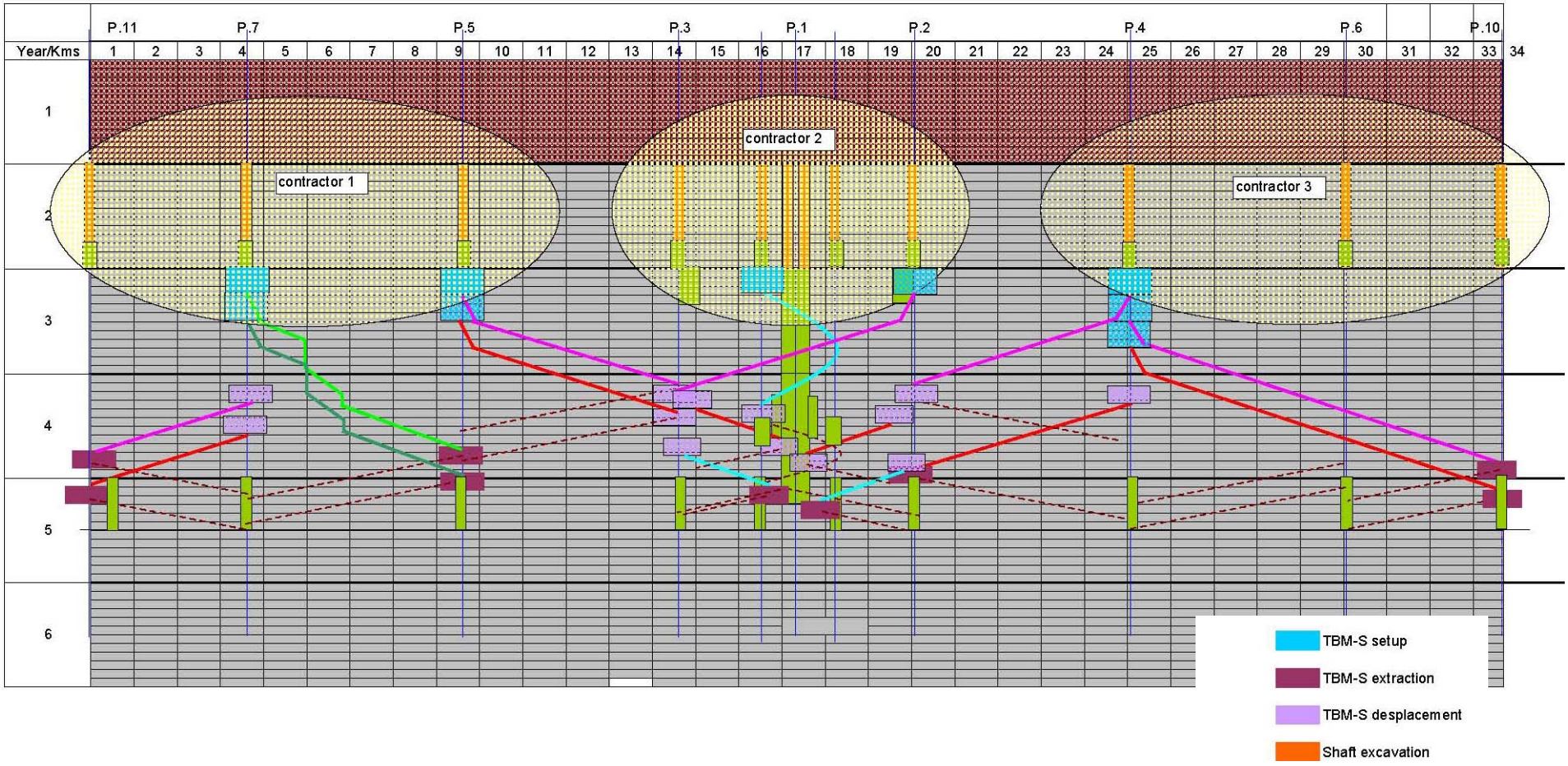
Time Schedule Issues

- Time Schedules updated to new Configuration
  - **Same schedule for Americas and Europe CERN**
  - **Specific schedule for Asia**
  - **Specific schedule for Europe DESY**
- 4.5 years for CFS Works;
  - **compatibility with 7 years overall time span still to be confirmed**
- The first year (Impact Study, Call for Tender, Selection, …) could be saved under certain Conditions
- Obtaining up to 15 TBM of the same diameter during the same period will most likely be difficult!

Time Schedule - 4.5 years - 9 TBM

ILC PROJECT
CERN Sample Site - PP

TWIN TUNNELS 4.5m + 4.5m



Summary

- Layout is optimized for a deep tunnel solution
- Two tunnel solution is mainly driven by safety and reliability arguments (in this order) even recommended by the ILC MAC
- In total about more than 70 km of tunnels (one common tunnel for the central damping rings and one Interaction Region)
- Construction time of 3.5 years is very ambitious and costly at least for the DESY and Japanese sample site