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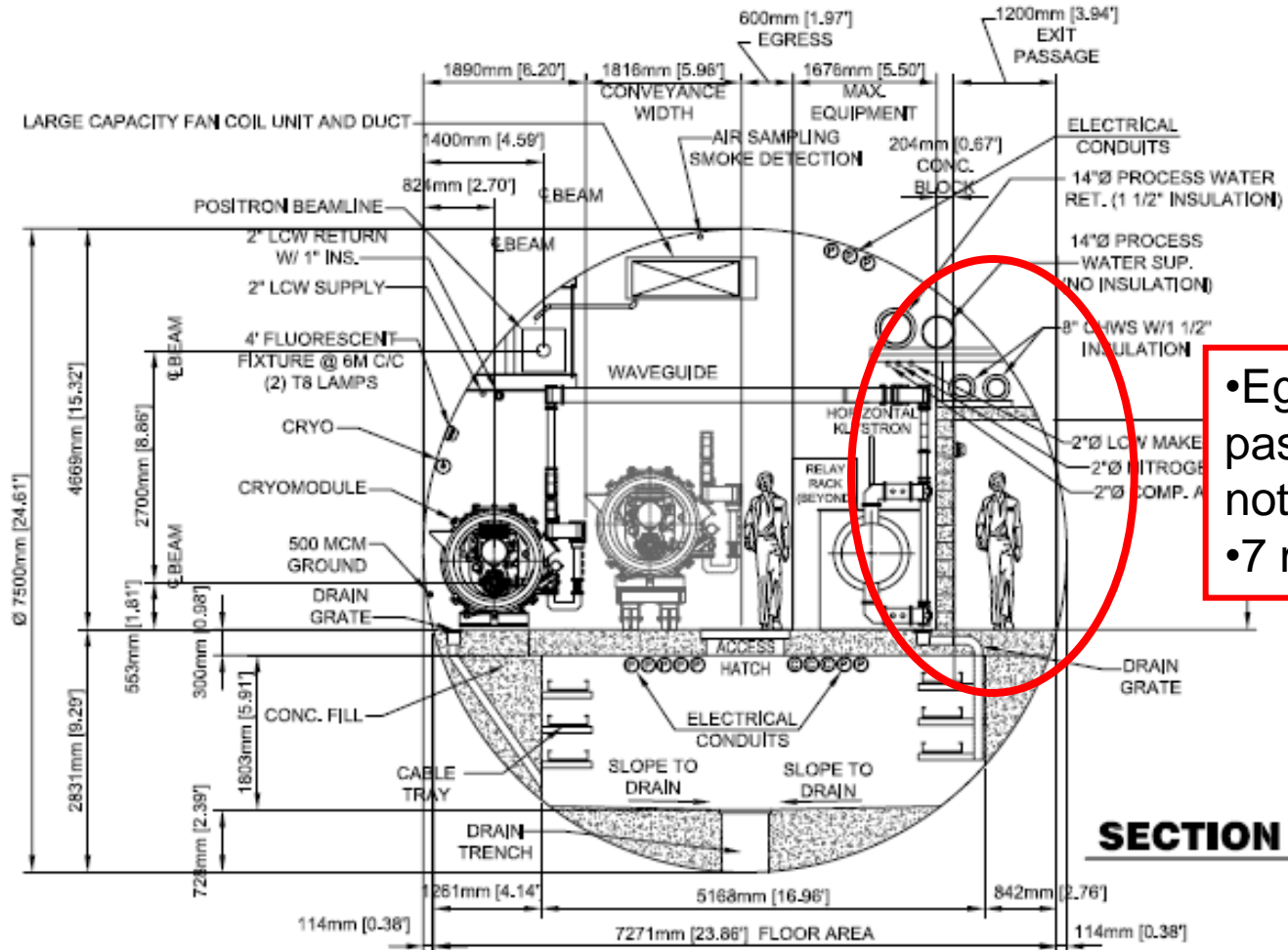
RDR configuration for Mountain Region

S. Fukuda/KEK



7.5 m Diameter Single Tunnel

(FNAL Drawing)



• Egress passageway not needed;
• 7 m Ø ok

BAW1 RDR Config For Mntn Rgn (S. Fukuda)



7.5 m Diameter Single Tunnel

RDR Case

- **Single tunnel RDR case: tentative drawing of tunnel diameters are 7.5m (FNAL) and 6.5m (KEK). Elimination of egress passage way reduces the tunnel diameter to less than 7m (FNAL)**
- **Layout to be developed for RDR Single tunnel plan :**
 - Common layout should be included such as air ventilation and He evacuation
 - Same space for egress passage as other scheme such as DRFS
 - Same configuration of CFS with other scheme
- **Problems to be solved are almost the same as the DRFS case. :**
 - Radiation shield of the HLRF and LLRF components
 - Availability Evaluation especially for the MTBF of 10 MW MBK and Pulse modulator (or Marx Generator)
 - Maintenance Scenario
- **Who is responsible for design the RDR single tunnel?**

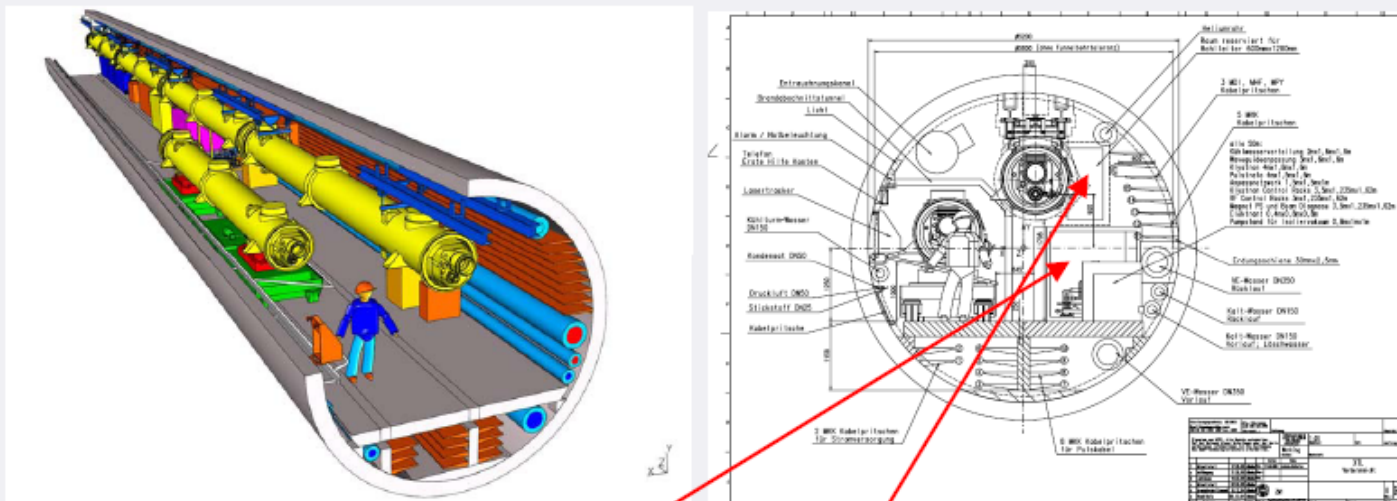


Purpose of This Presentation

- This presentation: Request from Project Manager
 - Though nobody of HLRF team has been responsible for the single tunnel plan of the RDR configuration, the project manager strongly request us to show the single tunnel plan of RDR configuration.
 - I suppose that both of currently proposed two configurations for a single tunnel plan have not been completed and matured, and PMs desire to revisit the RDR plan.
 - One of PMs, Marc had a presentation of XFEL-like configuration.
 - Since the single tunnel plan of the XFEL-like configuration is not adequate for the ILC in the mountain region, RDR configuration for the mountain region is presented.
- All components of HLRF and LLRF are installed in the single tunnel underground.
- Layout, tunnel diameter and possible solutions are presented.
- Same problems for the complete single tunnel plan, such as DRFS, are issues to be recognized and need to be discussed.

RF System Requirements

Layout of the RF Station in the Accelerator Tunnel

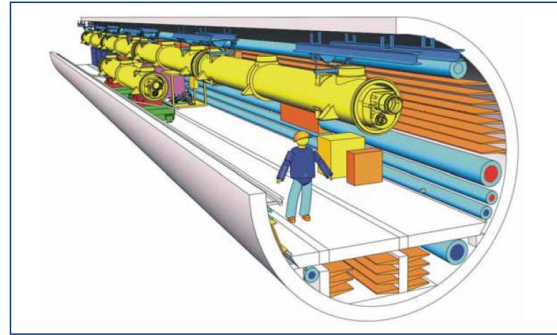
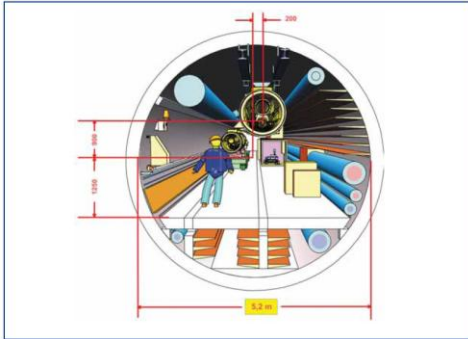


- Tunnel components (klystrons, pulse transformers, aux. power supplies etc.) will be installed under the cryo module.
- The waveguide distribution will be installed on the side of the cryo module.
- These components are not accessible during accelerator operation.



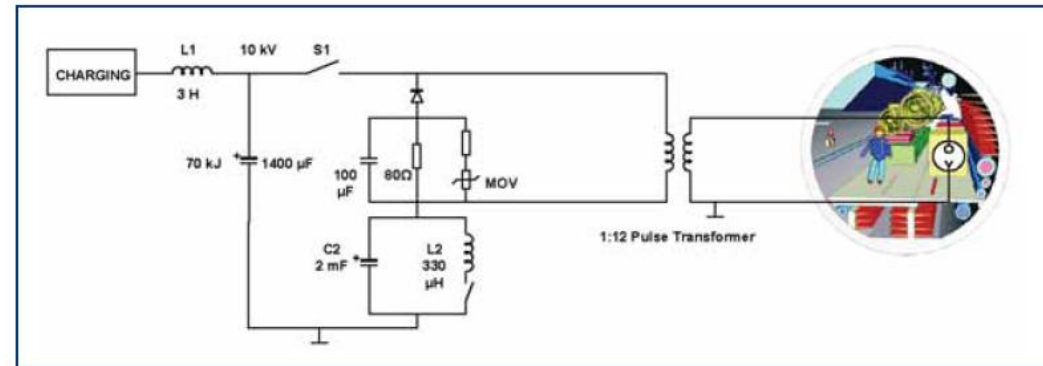
Single Tunnel Plan of the DESY XFEL

From RDR of XFEL



Cryomodule is hanged down
From ceiling
->Criticized this structure in
DRFS case.
vibration, installation, etc.

Tunnel diameter of 5.2m



No egress space during the cryomodule
Installation, maintenance space.

Modulators are on the surface.
Long HV cables from surface to tunnel.



Why ILC doesn't choose XFEL-like configuration

- At the RDR, ILC didn't choose XFEL-like configuration, since the single tunnel restricts the activity for the maintenance.
- Vibration problems for cryomodule hanged from ceiling. (Snowmass?)
- Long HV cables (about 10 kV) from the surface to tunnel may be possible source of the HLRF trouble.
- Availability Issues:
It is necessary to evaluate the MTBF of the 10MW MBK, while so far no data about it.

Review of RDR Configuration in two tunnel

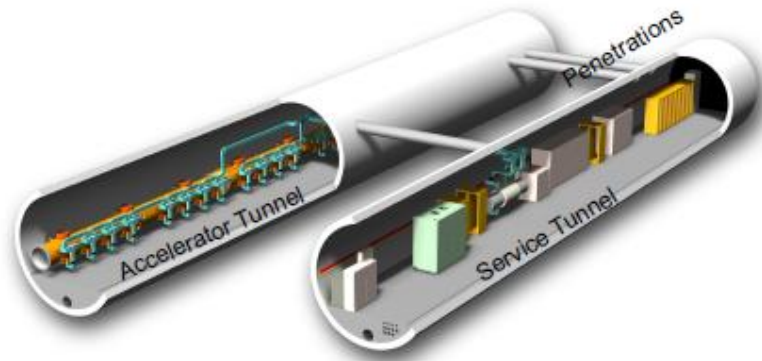


FIGURE 1.3-6. Cutaway view of the linac dual-tunnel configuration.

Finally RDR of ILC chose the two Tunnel configuration: accelerator tunnel and service tunnel.
No HLRF facilities on the surface.

Availability and maintainability

One HLRF unit comprises three-Cryomodule with 26 cavities.
RF power is delivered from service Tunnel in the two-8m-WR770 waveguides System.

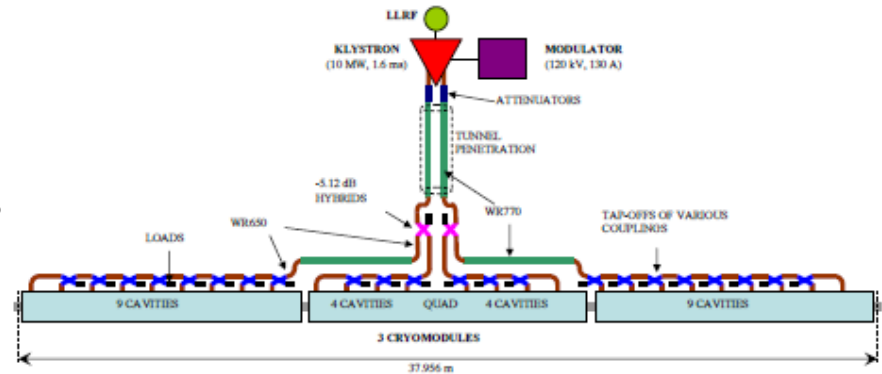
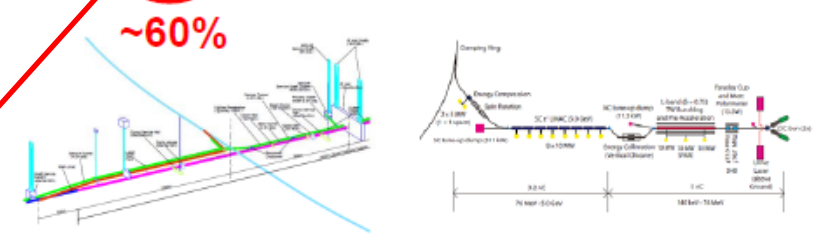
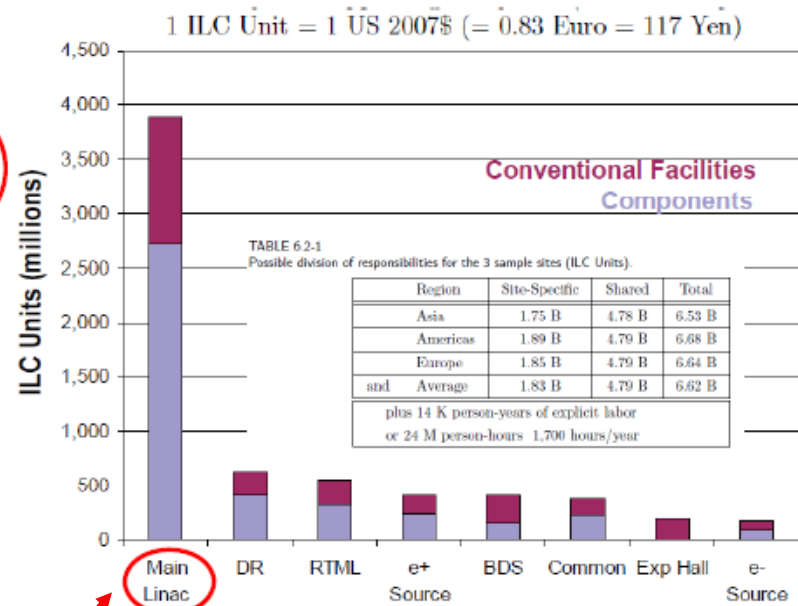
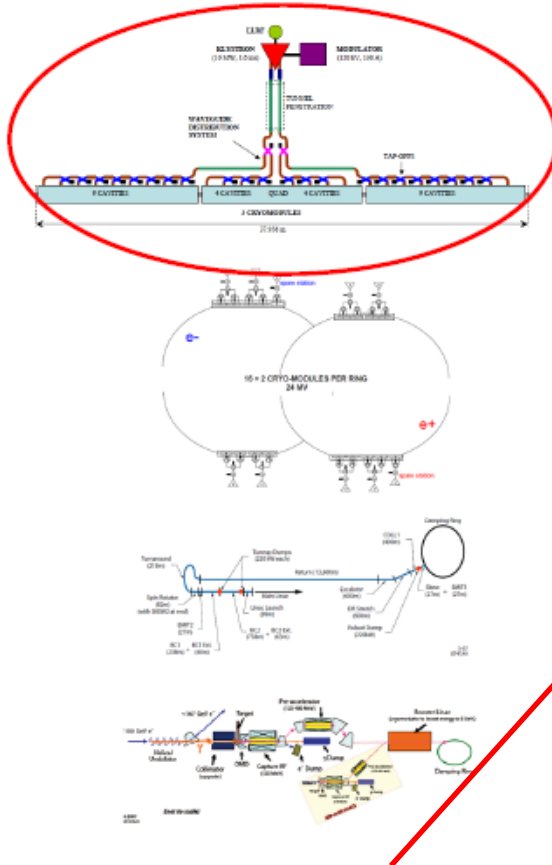


FIGURE 1.3-5. RF unit layout.

Construction Cost Profile



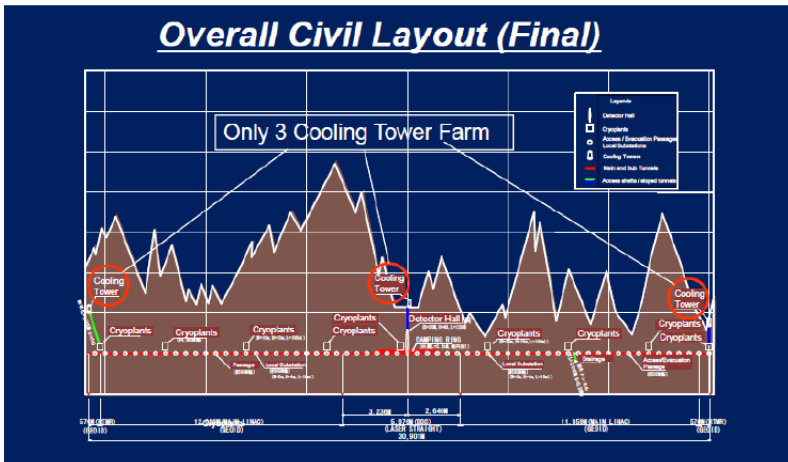
Need to reduce the ML cost → Single tunnel configuration again (SB2009)



Requirement for the Configuration of Mountain Region

Site Layout Example

- Asian Region-

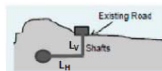


General Requirements for ILC Sites

- Uniform geology
- Tunnel depth < 600m
- Avoid residential area, because
- hard to get acknowledgement from the inhabitants from the view
- point of radiation problem and public construction
- Avoid active fault
- Avoid major epicenters (M>7) having taken place since 1,500
- Avoid large fault (W > 1m), especially those running parallel to the tunnel route
- Enough electric power supply
- We need about 350 MW
- Enough length to accommodate 50km tunnel
- Examined on 51 items for each candidate site

Access to Underground Tunnel

- By Shafts and Horizontal Tunnel s-



Horizontal Tunnel (L_h) and Vertical Shaft (L_v)

Point ID	A		B		C		D	
	L _x (m)	L _y (m)	L _x (m)	L _y (m)	L _x (m)	L _y (m)	L _x (m)	L _y (m)
P11	0	140	150	90	575	205	750	240
P7	560	220	50	410	300	100	80	210
P8	525	210	150	645	300	140	830	265
P9	1,330	170	150	430	0	150	450	385
P2	130	70	730	345	0	80	110	255
P4	130	100	500	430	205	60	90	255
P6	140	100	1,350	485	94	240	250	390
P10	100	80	1,375	410	240	70	480	220
P12	0	110	700	445	400	110	320	270
P13	370	130	400	445	540	100	570	260
	3,336	1,330	5,555	4,075	3,500	1,365	4,720	2,840

Access to Underground Tunnel

- By Horizontal (Sloped) Tunnel s-



Sloped Tunnel Length (m) and Cost (kY)

Point ID	A	B	C	D
P11	1,215	502	1,608	1,859
P7	1,585	1,250	1,005	1,407
P5	1,577	2,161	1,507	1,708
P3	1,713	2,663	1,206	2,613
P12	1,501	2,563	904	1,960
P13	1,403	2,764	854	1,909
P2	1,157	3,467	1,005	2,311
P4	653	3,068	1,005	2,211
P6	938	3,467	1,650	2,211
P10	771	1,960	703	1,909
Total (m)	12,493	24,471	11,455	20,098

Surface facilities are strongly limited



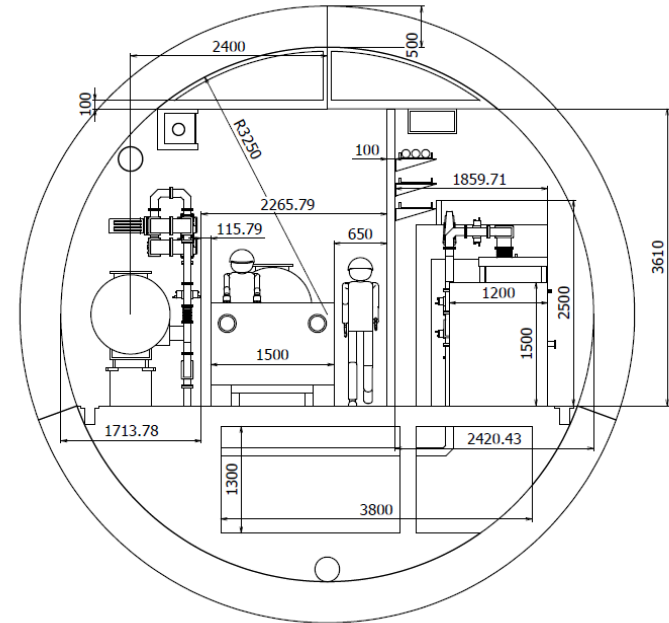
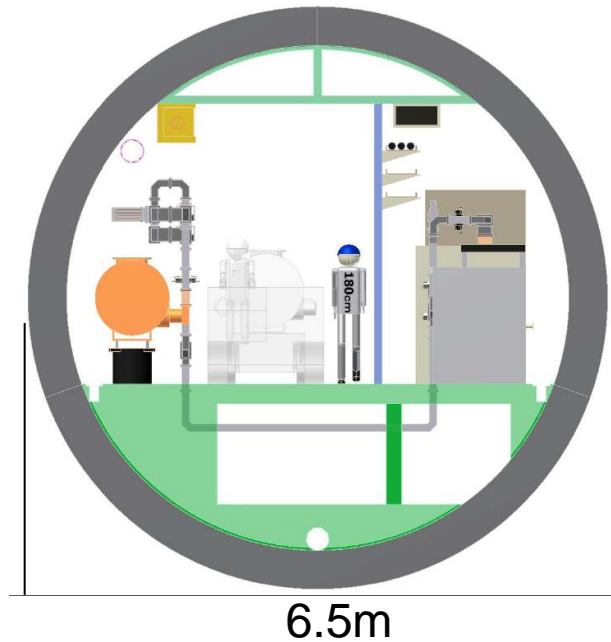
Preliminary Study: Single tunnel configuration for RDR.

- Considering the ILC site in the mountain region, preliminary study of single tunnel configuration for RDR is presented.
- RDR=10MW MBK+Modulator(+ Pulse transformer) or Marx Generator
- No large HLRF facilities on the surface and nearly complete single tunnel layout for RDR are studied.
- Tunnel diameter of 6.5m is considered.
- Merit and demerit of this configuration are discussed later.



3D of RDR single tunnel plan (Bouncer Modulator)-(1)

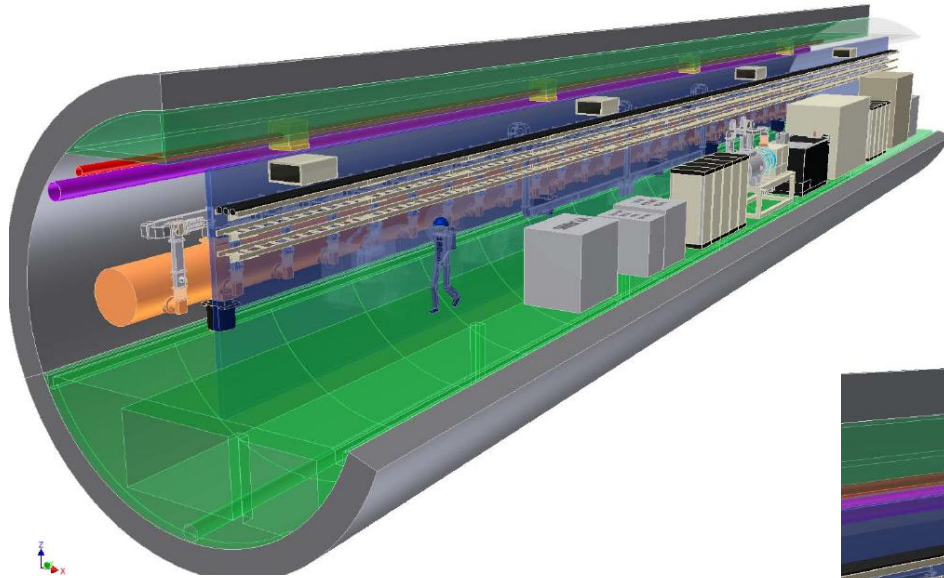
Cross Sectional View



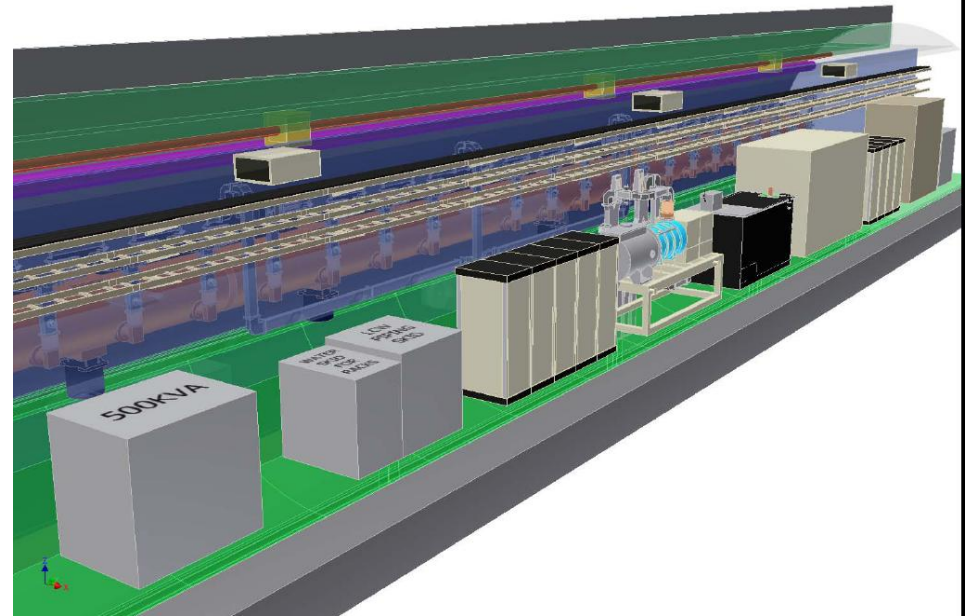
Cryomodule is installed on the floor to avoid the vibration problem which possibly affects to the beam instability.
RF Power distribution system are under the passage in the middle of the tunnel.



3D of RDR single tunnel plan (Bouncer Modulator)-(2)

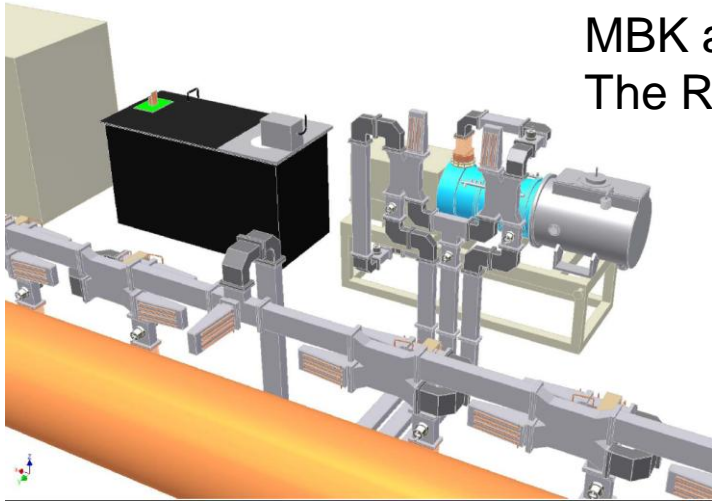


Birds eye view of the tunnel

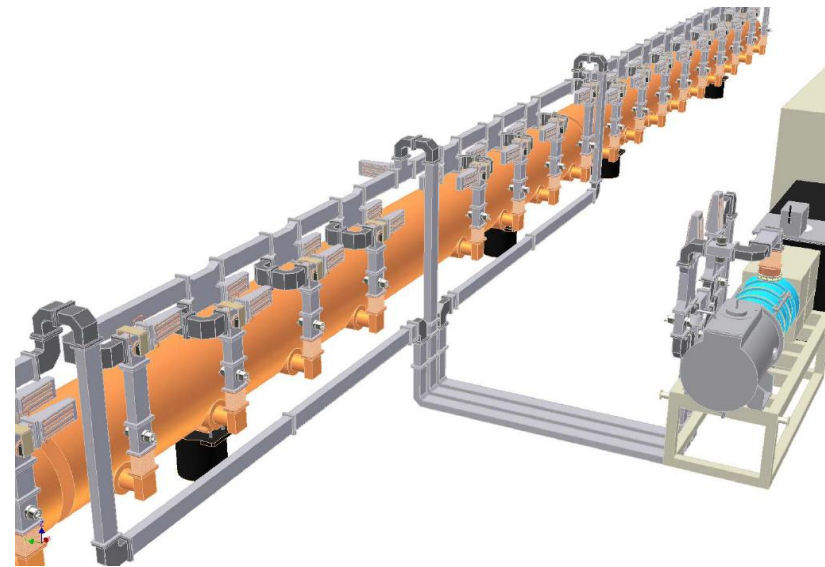


So far we can install all required Components which were listed up In RDR design.

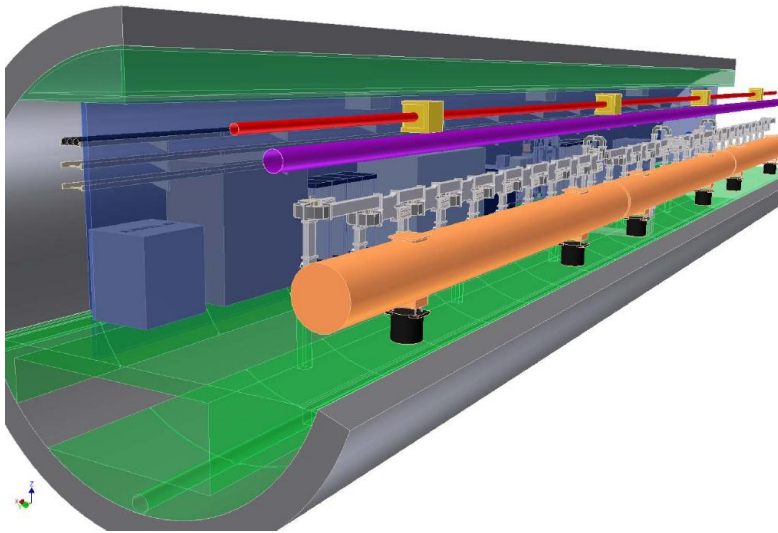
3D of RDR single tunnel plan (Bouncer Modulator)-(3)



MBK and PDS with
The RDR configuration



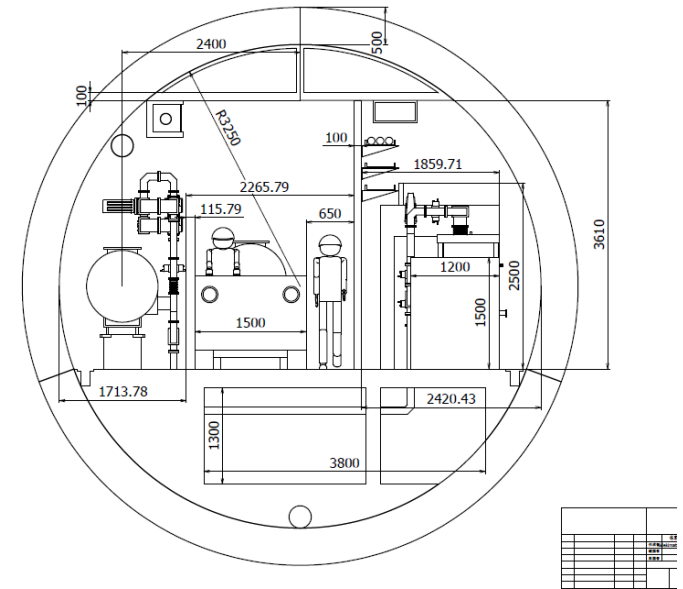
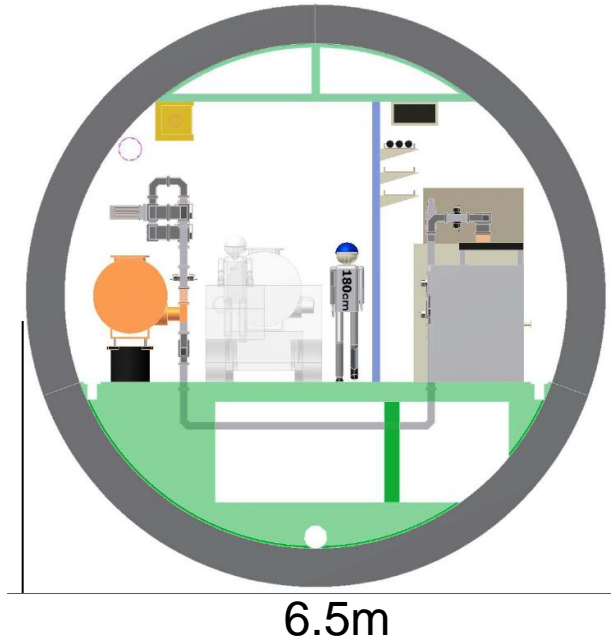
PDS around the Cryomodule from MBK





3D of RDR single tunnel plan (Marx Modulator)-(1)

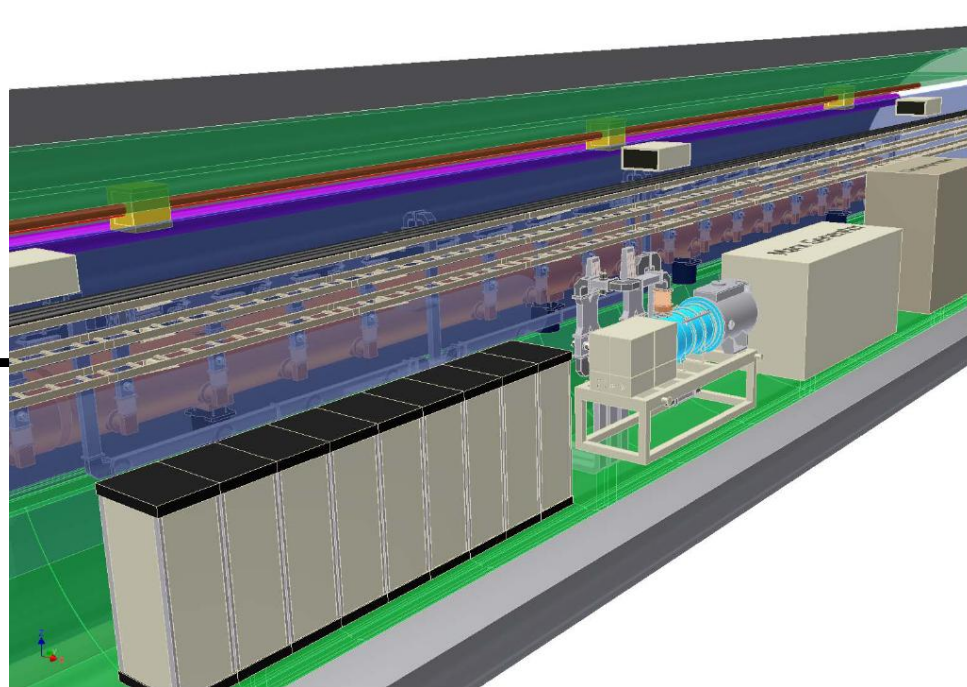
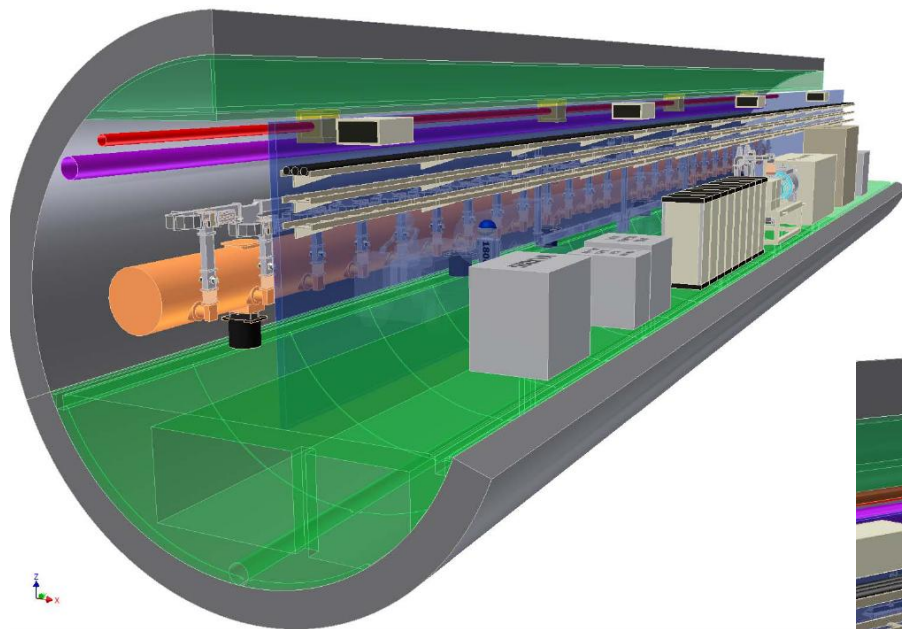
Layout employing the Marx modulator are studied.
Cross Sectional View



Marx modulator feeds 110kV directly to the MBK without pulse-transformer
And space saving is possible in the tunnel.



3D of RDR single tunnel plan (Marx Modulator)-(2)



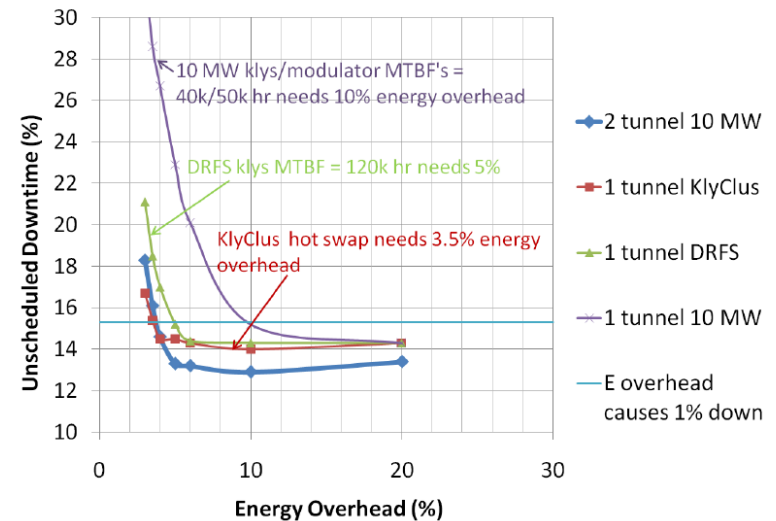


Problems for the single tunnel RDR configuration

- Complete single tunnel layout is studied in this presentation.
- There are same problems with another complete tunnel plan, DRFS.
 - Heat problems : all heat loss are taken out by water
 - Radiation Issues for the components of HLRF and LLRF.
 - It is necessary to study the maintenance scenario especially modulator/pulse trans. Is large.
 - MTBF study is required. Especially life time of MBK is important. So far no data.

Availability

- Availability simulation with the function of overhead is shown in right figure. 1 tunnel 10MW case is also shown in it.
- Since the MBK in the tunnel is the same in XFEL-like layout and complete single tunnel layout, MBK's MTBF evaluation is important.
- MBK has 6 or 7 cathodes in a tube, and one cathode failure affects whole performance of MBK. This degradation seems to be worse than DRFS's MTBF estimation: need study.





Radiation Durability of the HLRF/LLRF Components

- Radiation Durability of the HLRF/LLRF Components are also the same problems with DRFS case.
- Modulator (Both Bouncer type and Marx modulator) uses a semiconductor devices such as IGBT, and it is necessary to study about the radiation damage against them.
- LLRF front-ends are also required to install near the accelerator structure and it is necessary to study about the radiation damage against them.
- Current study uses the same radiation shield wall same as the DRFS configuration. It may necessary to add additional radiation shield lapping the special components same as the DRFS.
- Special experiment using the existing facility about the radiation damage are necessary.



Maintenance Scenario

- Cryomodule Replacement and PDS System Interference
- MBK replacement: frequency and quick replacement scenario.
- Evaluation of Modulators MTBF
- Restructuring of modulator for easy maintenance in the single tunnel configuration.
- Long shut down or frequent short shutdown to establish enough maintenance.
- This kind of scenario may be discussed before by T. Himmel?

Summary

- Preliminary study of a single tunnel configuration for the RDR-like HLRF system are presented. In this study, cryomodule are on the floor and RF power distribution system are set under the floor.
- Complete single tunnel plan without any HLRF facility on the surface is considered.
- Tunnel diameter of 6.5m can contain all required components and keep enough space of installation and evacuation egress.
-
- There are same studying items as DRFS to solve to realize the actual feasibility.
- Availability and maintainability study are necessary. For the 10MW MBK, X-FEL like single tunnel has the same availability issues with RDR single tunnel and DRFS single tunnel.
- In this RDR configuration, HLRF components are already manufactured and tested. So more feasibility study may have more positive solution.