Recent CFS activity in Japan

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2019.10.30 LCWS2019, CFS, Sendai International Center

Background of Civil Engineering Design

- Design of accelerator tunnels and detector hall has been conducted by the international working groups under GDE and LCC.
- **Site specific design**, especially for facilities on ground and its connection to the accelerator, has been conducted by the working group under the Tohoku ILC planning office.
- **Comprehensive civil engineering integration** is underway by the CFS team from KEK and Tohoku ILC planning office. The draft will be discussed with the international ILC-CFS working group.

Recent Activity on CFS in Japan (1)

- **The design group has been enhanced** to create a basic planning document that serves as input for basic and detailed designs during the preparation phase.

  It consists of members from the KEK ILC Group, KEK Facility Department, and Tohoku ILC Research Group.

- **AAA (Advanced Accelerator Association)**

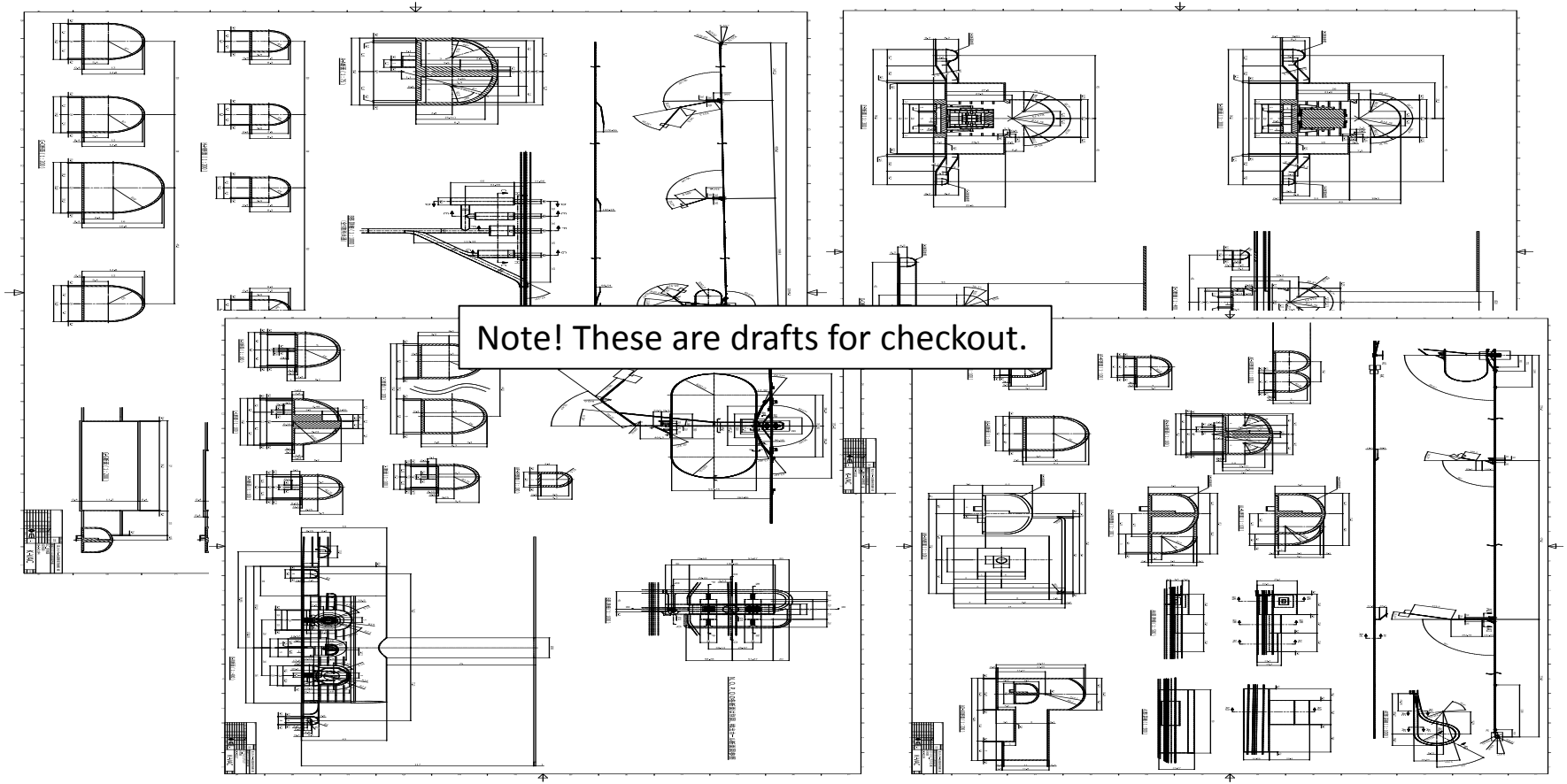
  Working group has been established to support CFS design, particularly for **groundwater treatment, beam dump civil design, and earthquake resistance.**

Recent Activity on CFS in Japan (2)

- **ILC Facility Evaluation Subcommittee of the Rock Mechanics Committee, the Japan Society of Civil Engineers**
  - Evaluate the validity of ILC civil engineering design **at the Kitakami candidate site** from the viewpoint of rock dynamics.
  - Closed committee because it includes the site specific confidentials.
  - Expect a report will come by March 2020.

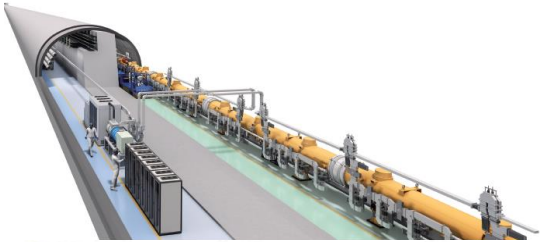
Note: 2012, Guidelines for the civil engineering work of International Linear Collider (ILC) facilities; Rock Mechanics Committee in Japan Society of Civil Engineers. It was the subcommittee for the establishment of standard specifications for the civil engineering work of Internal Linear Collider

We are collecting and integrating drawings for the CFS basic plan.

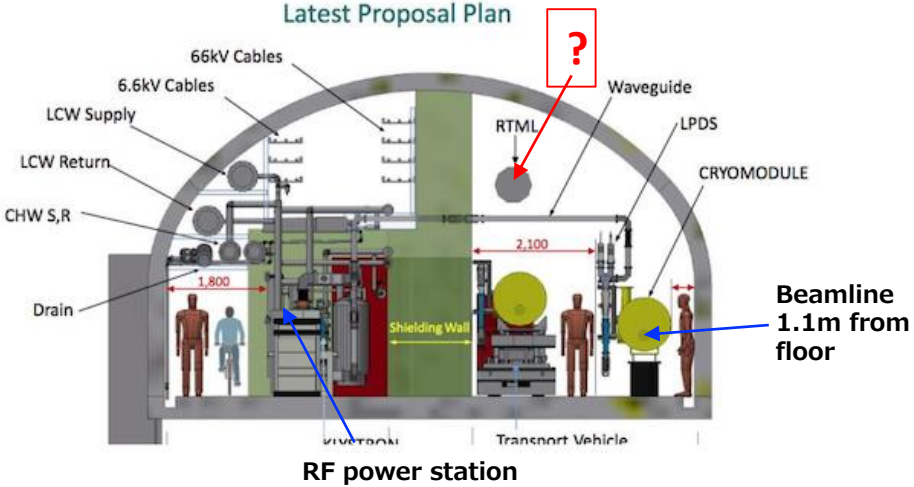


for Discussions

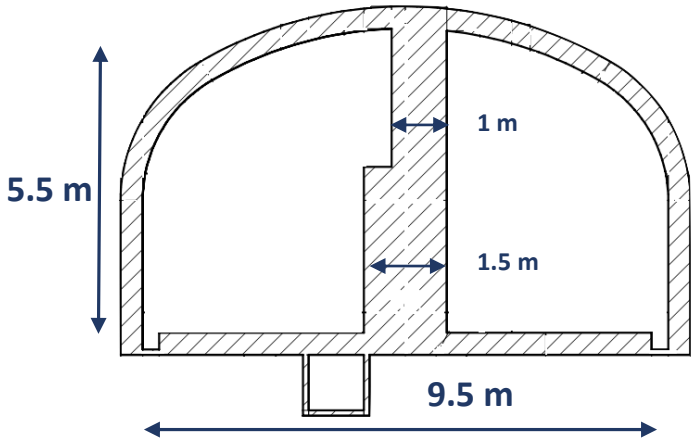
Main Linac (ML) tunnel



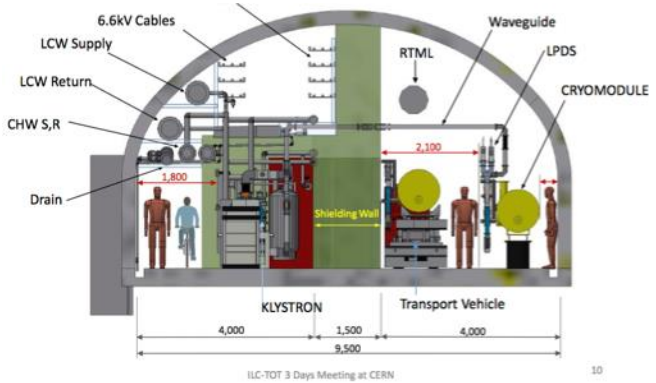
ML Tunnel Cross-section



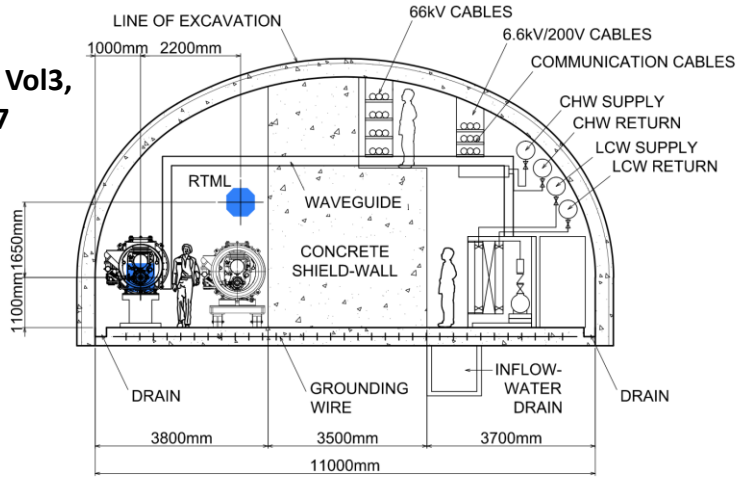
- ML section is about 70% of the ILC-250 (end to end).
- Follow the geoid
- Central radiation shield will be put after finishing the tunnel.



Where does RTML pass through the ML tunnel?



TDR Vol3, p167



The upper left figure is often used after the change request of central wall reduction.

It was prepared only for discussion of equipment layout and its layout has not been determined.

- In particular, **RTML is above the waveguide and is higher than that of TDR.**

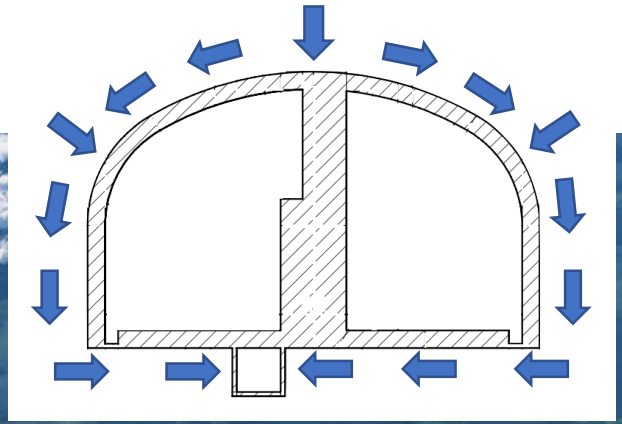
  It is misleading and brings many considerations on beam dynamics, installation and alignment.

- **RTML position in the current optics design has never changed from TDR.**
- **This figure should be modified.**

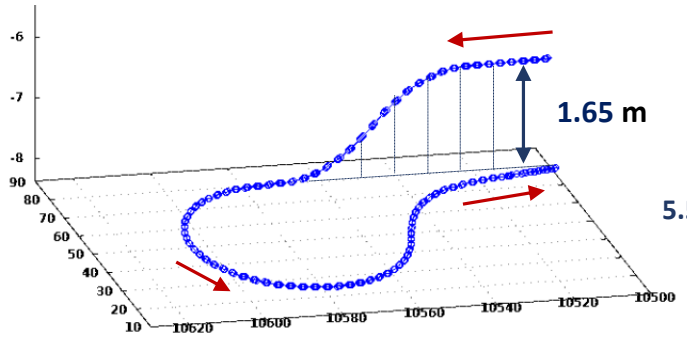
Handling of groundwater outside the tunnel

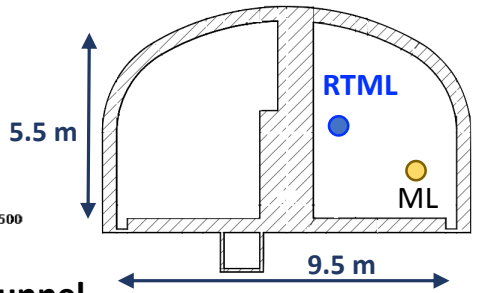
Inflow water assumption
・**1.0 tons/min/km (max)**
・5.0 tons/min/Access Point (max)

About 30,000 tons/day



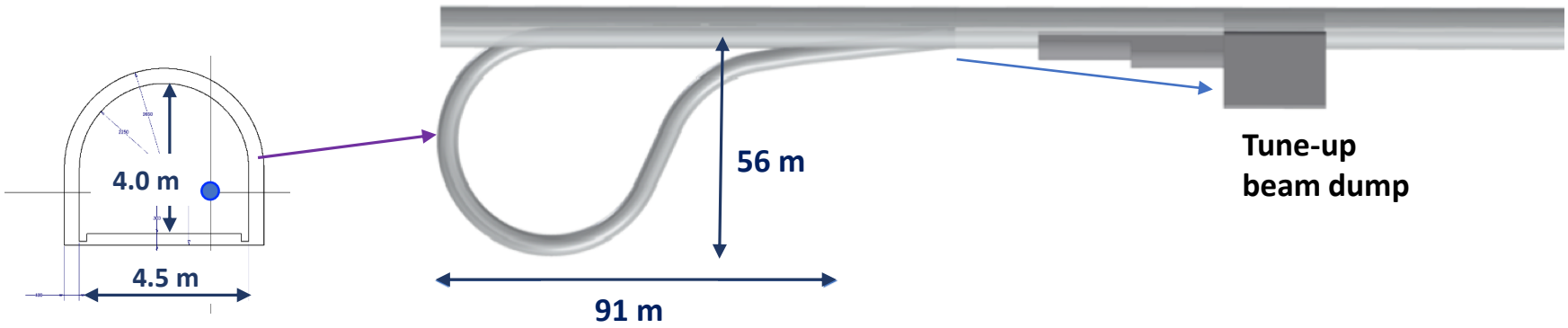
Turn-around



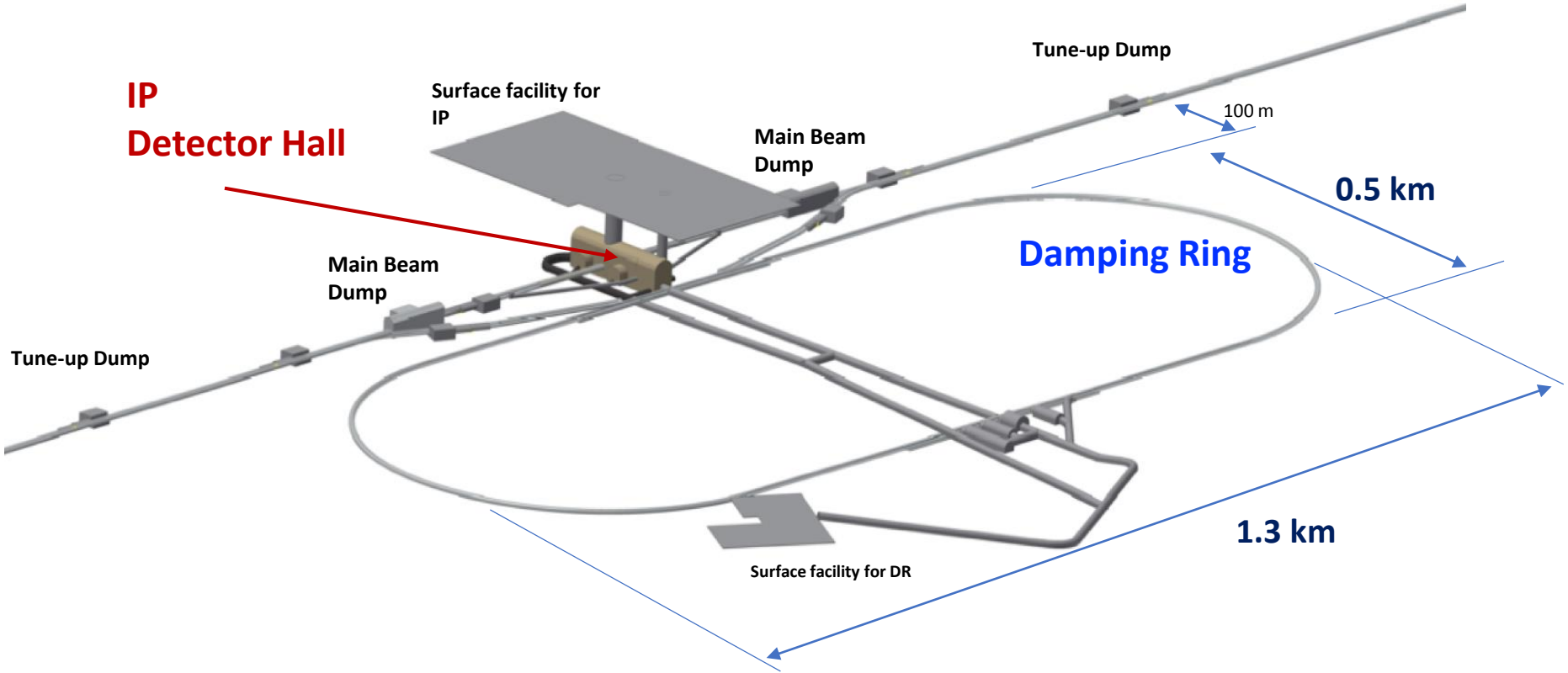


ML tunnel Will be extended beyond the turn-around;

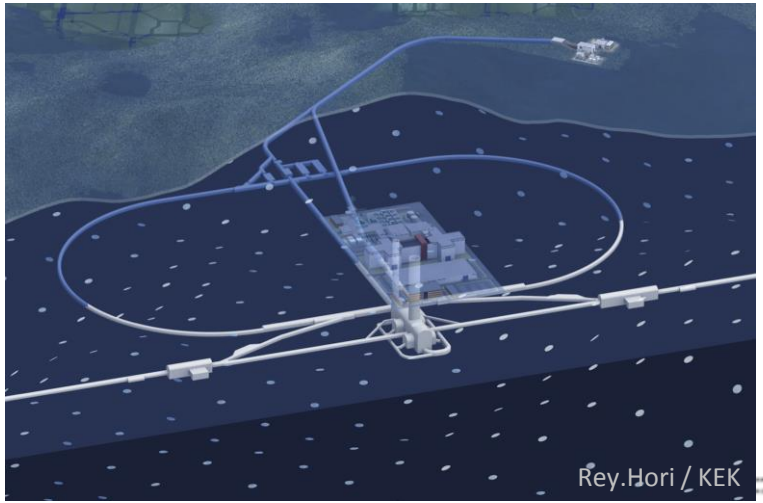
- Make a future extension of ML easily.
- Enhance the safe evacuation of turn-around.



Layout of Central Region

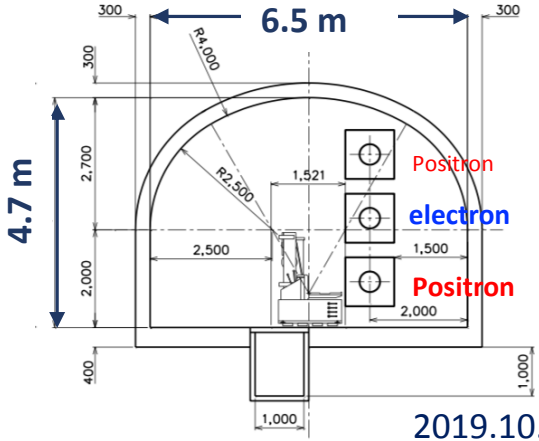


Damping Ring

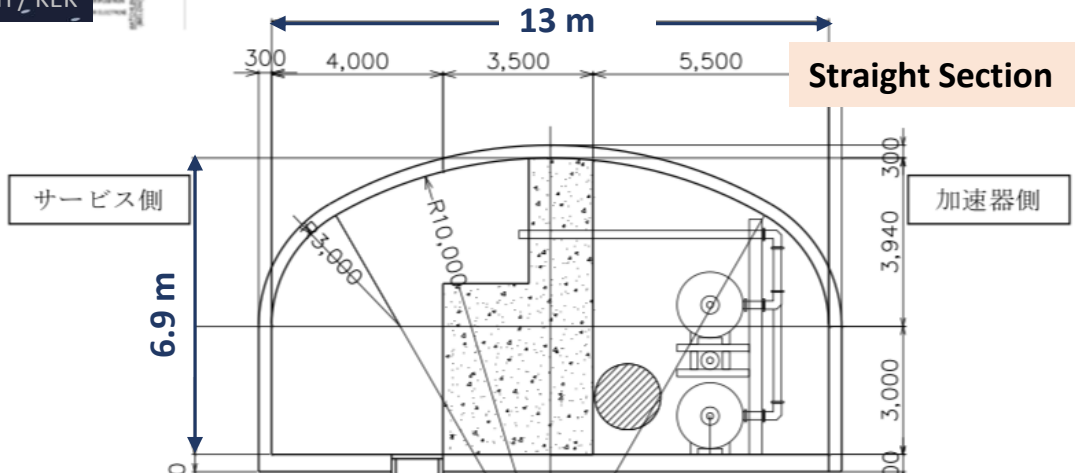


- Circumference: 3.2km
- **Start with two rings**
- **The arc section of the ring is a single tunnel without a central shield.**
- **Straight section is Kamaboko with a 3.5m central shield.** (TDR)

Arc Section

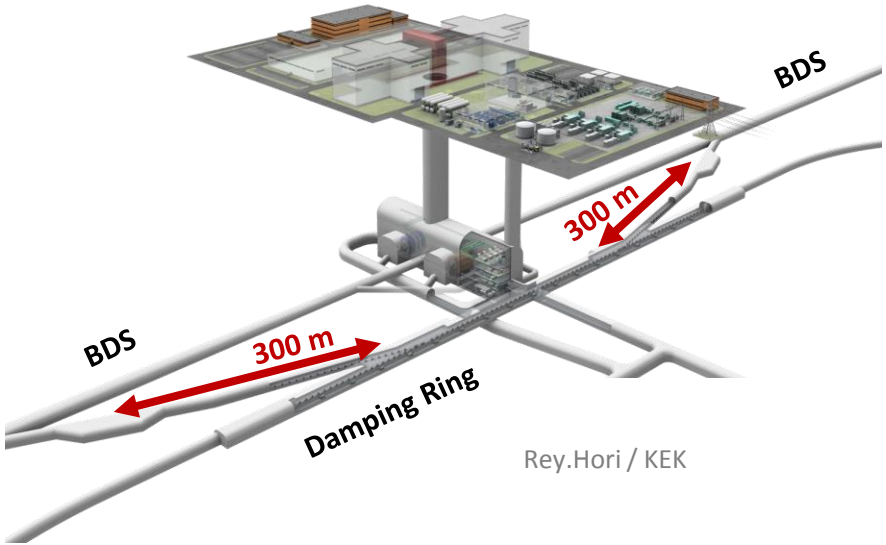


Straight Section



LTR/RTL

Between DR and BDS tunnel



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Beamlines

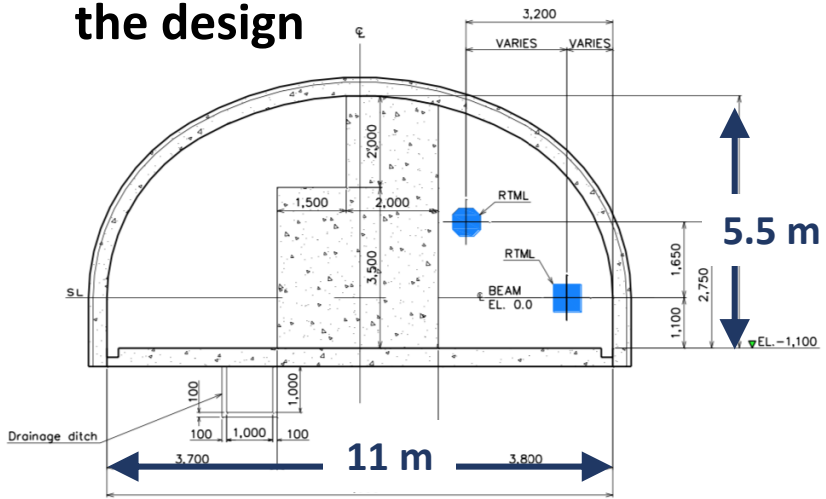
- Injection to DR
- Extraction from DR with tune-up dump
- Spin rotator

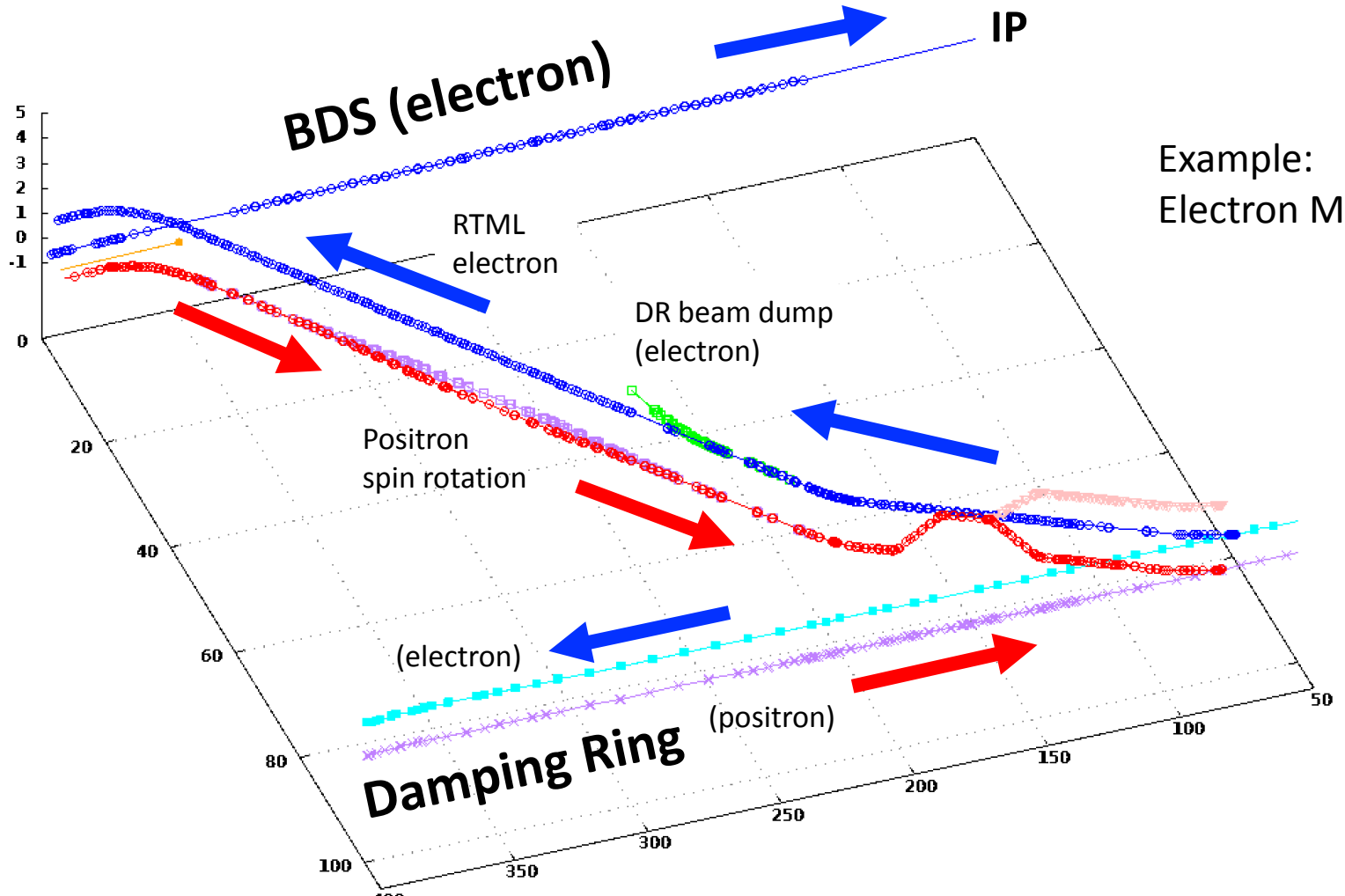
TDR design:

Kamaboko with 3.5m central shield

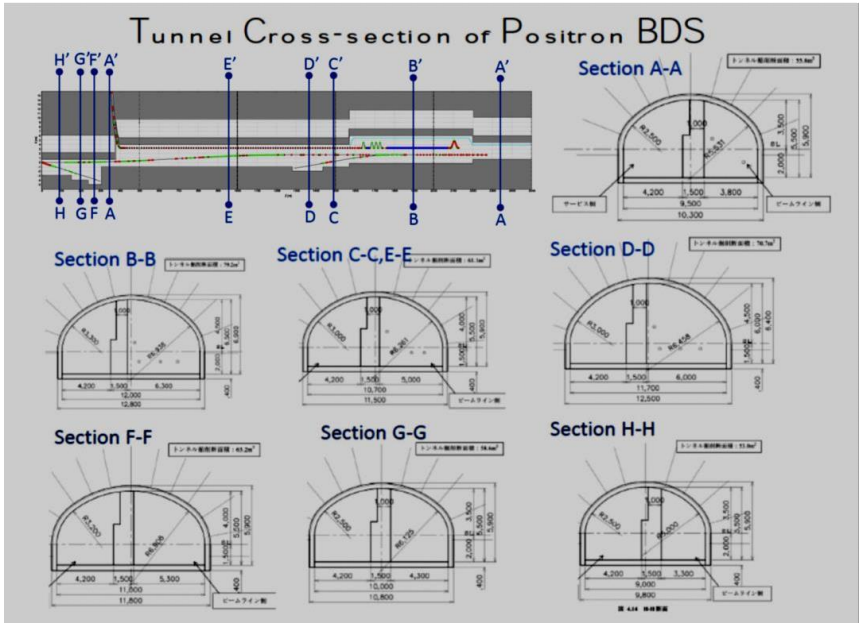
Do we need it?

Check the requirements and optimize the design




IP
BDS (electron)
RTML
electron
DR beam dump
(electron)
Positron
spin rotation
(electron)
(positron)
Damping Ring
Example:
Electron ML side

BDS tunnel (PM-8 to PM+8)



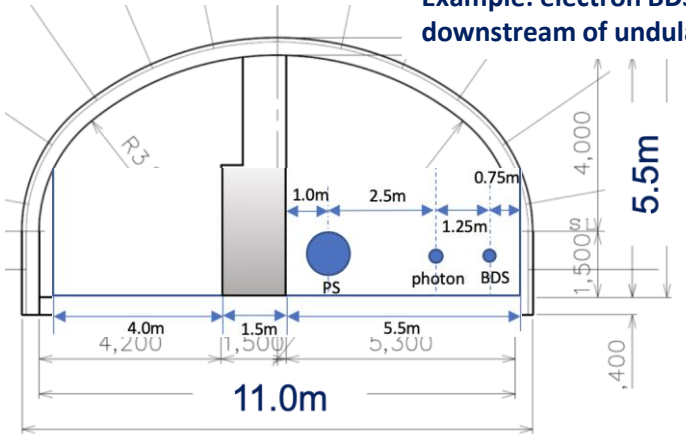
CR-015: Fig.5 tunnel cross-section model for cost estimation

ChangeRequest-015: Single tunnel for e+ BDS (TDR was two tunnel scheme.)

From the construction point of view, it is desirable to **simplify the design**.

- Discussion has been started by the CFS group in Japan.

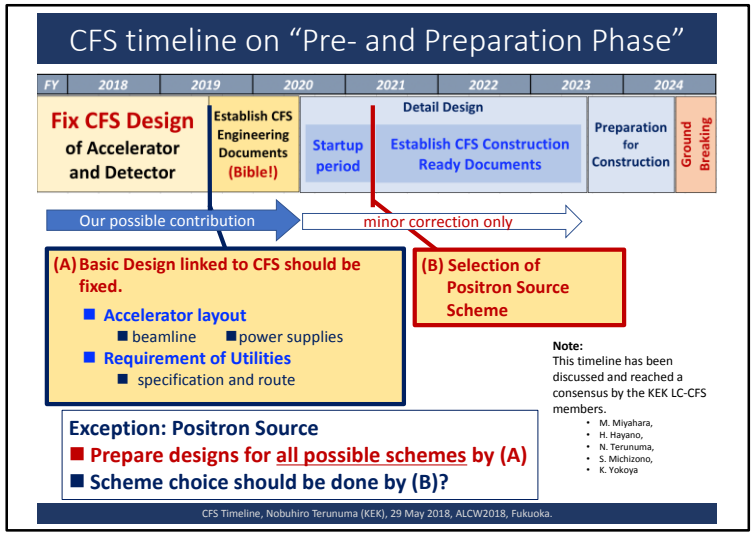
Example: electron BDS; downstream of undulator



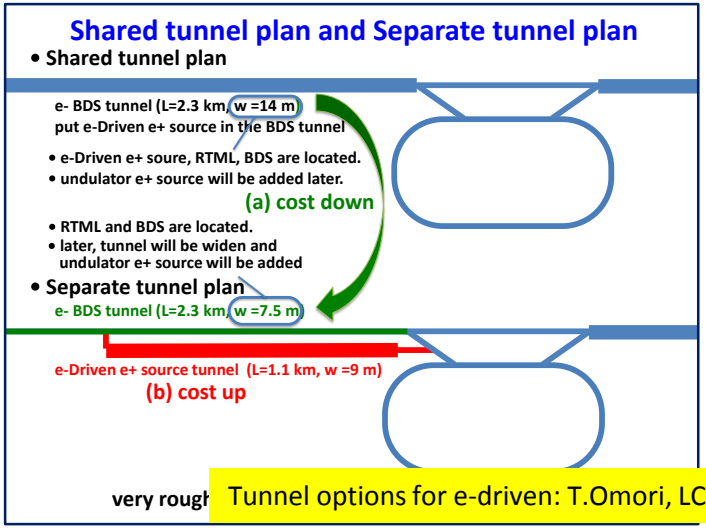
- The **11m-wide kamaboko tunnel along the BDS beamline** is a candidate.

Positron Source

- **Scheme selection will be done by the end of the first year of preparation phase.**
- Prepare the CFS design for all possible schemes.

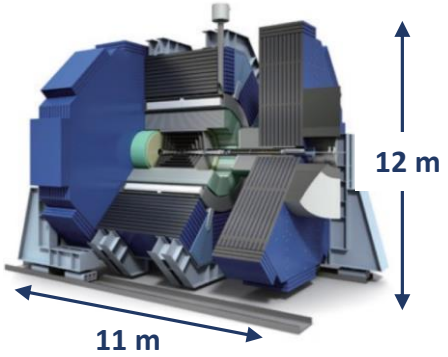


- **For undulator scheme, draft CFS design exists as that for BDS.**
- **For e-driven schemes, CFS design will be conducted by following the current discussions**, for example, the separate dedicated tunnel for flexible construction/commissioning strategy **.**

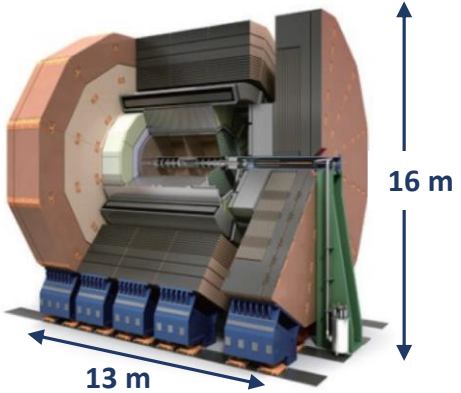


Tunnel options for e-driven: T.Omori, LCWS2018

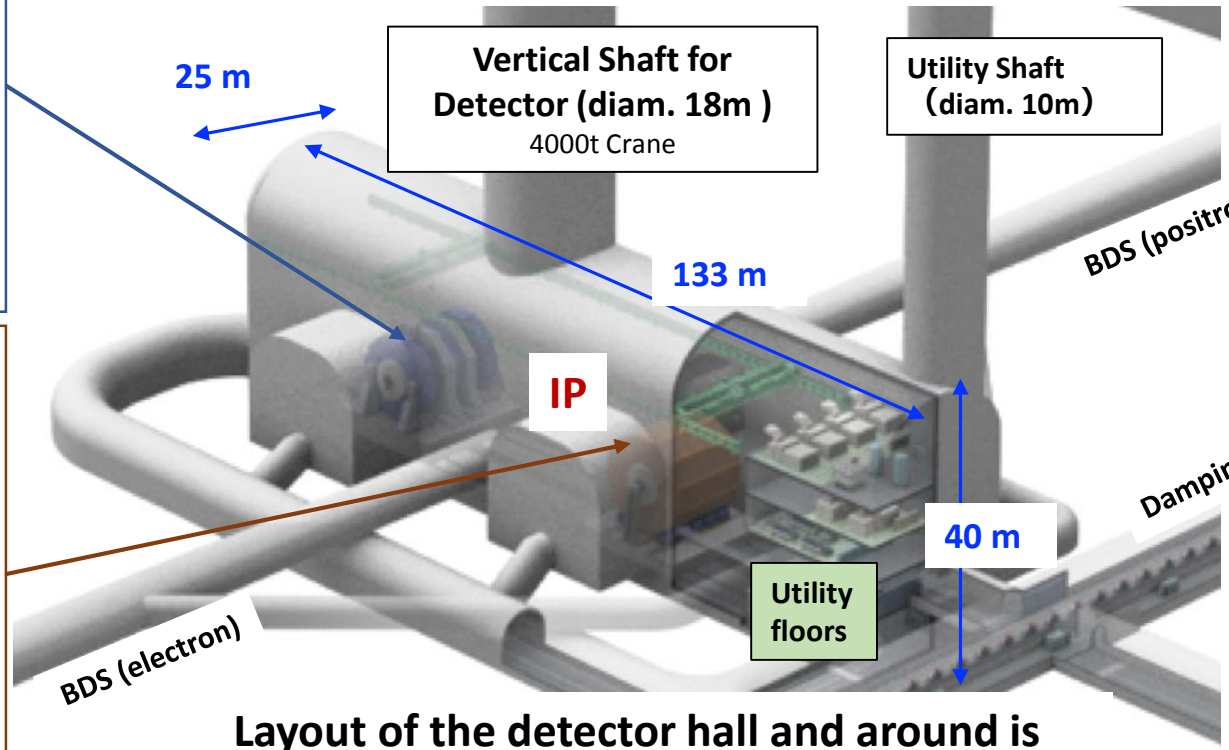
Detector Hall



SiD検出器, 重量 8,000t



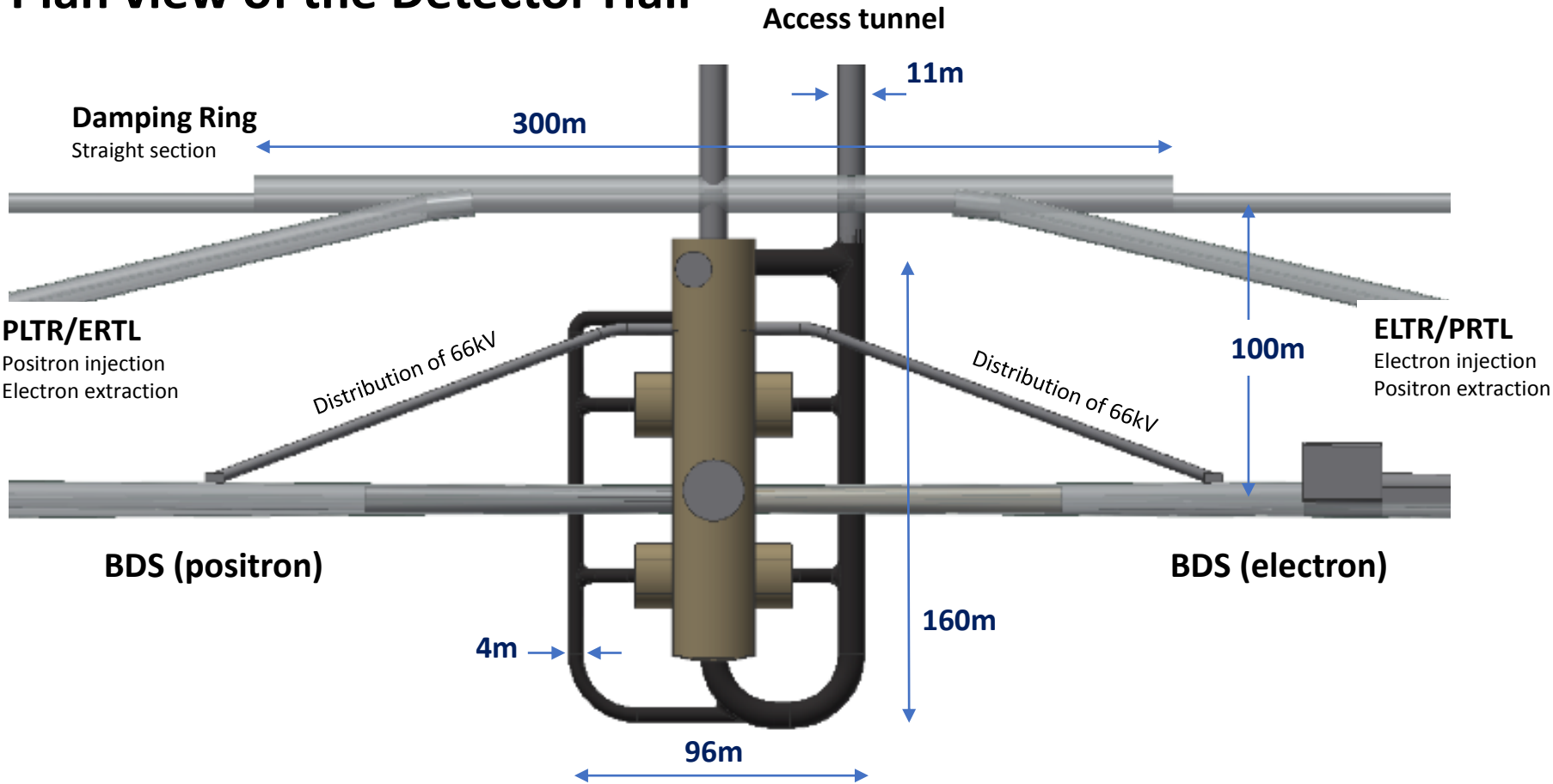
ILD検出器, 重量 15,000t



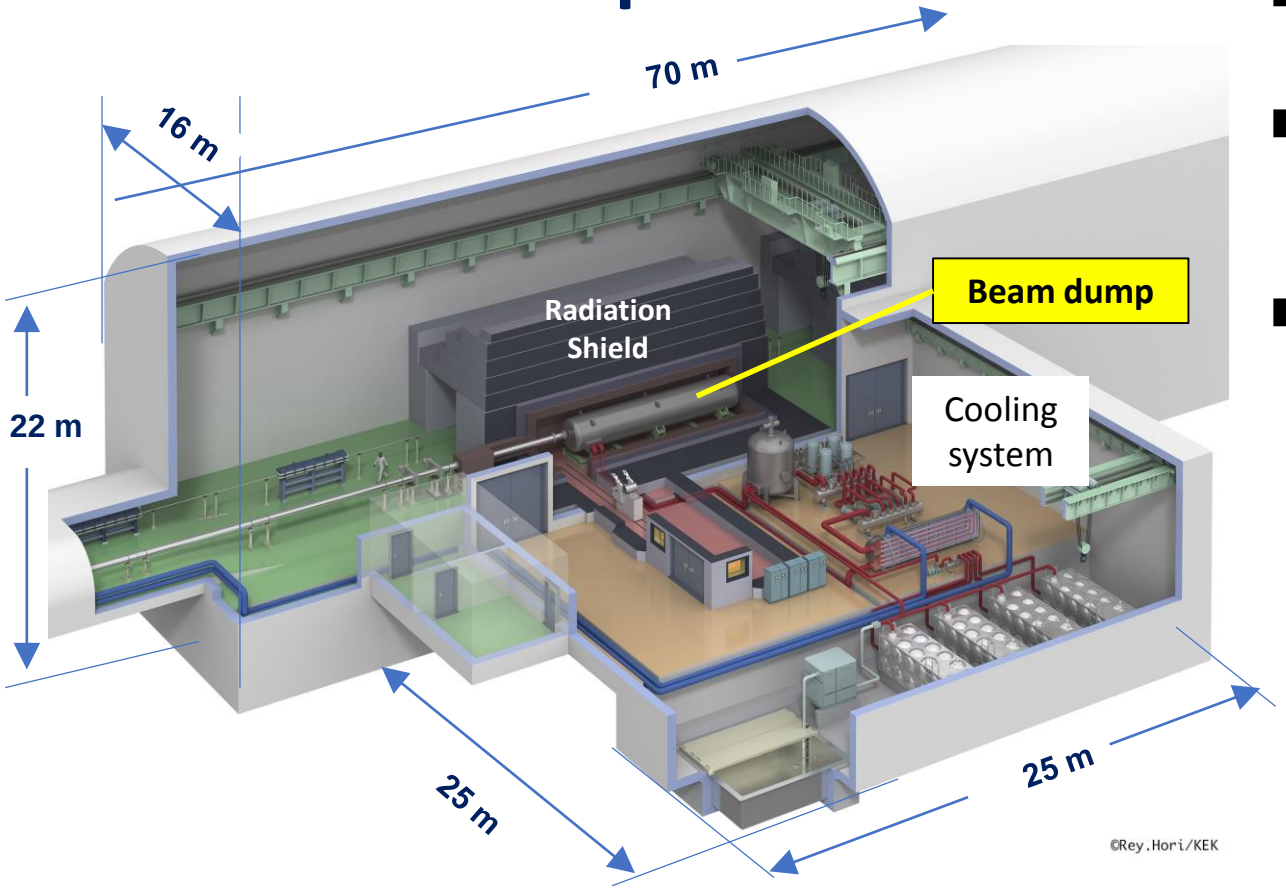
Layout of the detector hall and around is under discussion with MDI

Rey.Hori / KEK

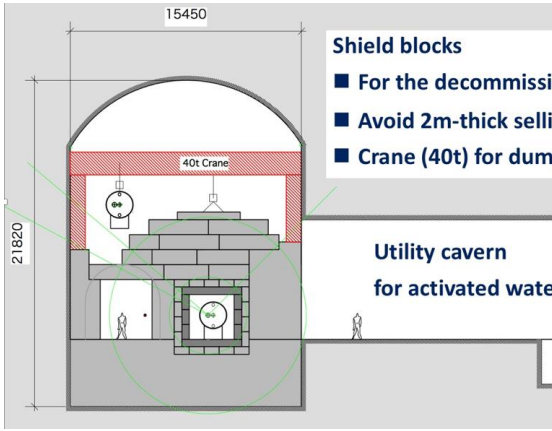
Plan view of the Detector Hall



Main beam dump

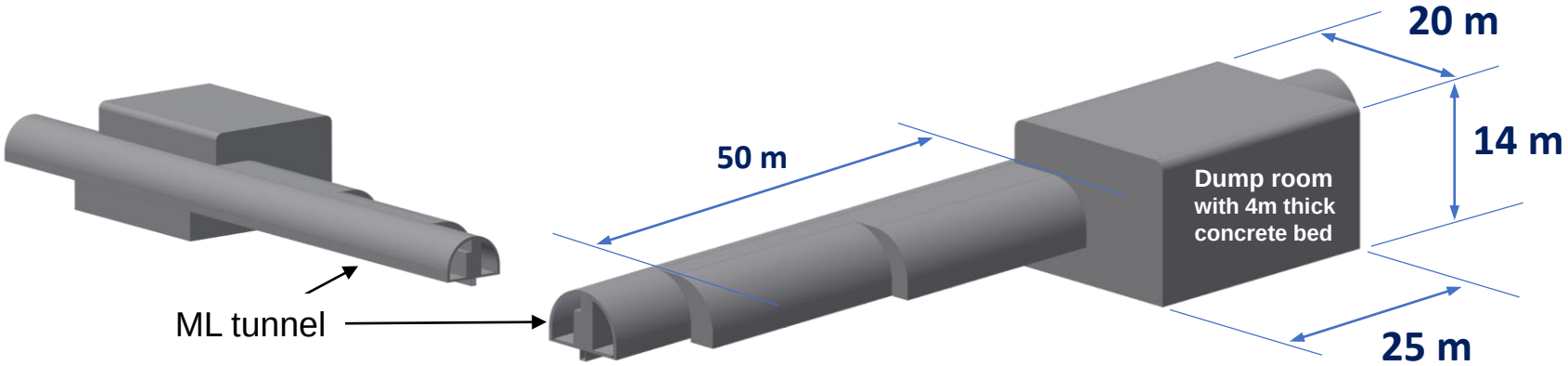


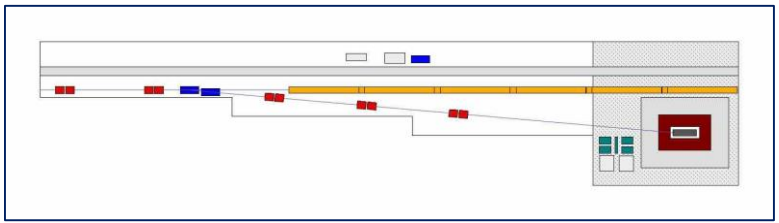
- Big cavern to install the 5m-thick shields.
- Water dump capable for 18MW beam power (1TeV).
- Enable the future de-commissioning



Tune-up beam dumps

- 60kW (9 points) and 400kW (2 points)

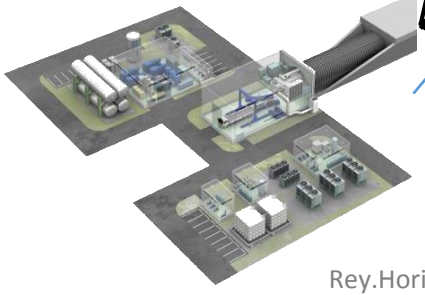




Tunnel cross section
will be simplified.

Surface Access Stations

Site-specific design of Surface Access stations. arrangement can be optimized and re-arranged site-by-site.



surface design
access stations
16,600m² 5 area
to be further discussed.

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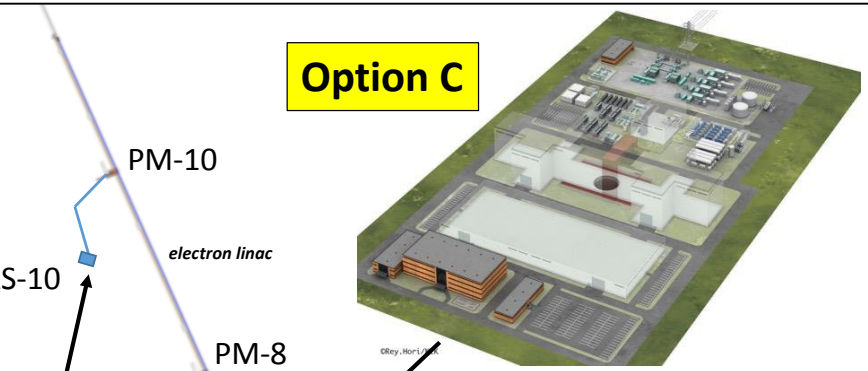


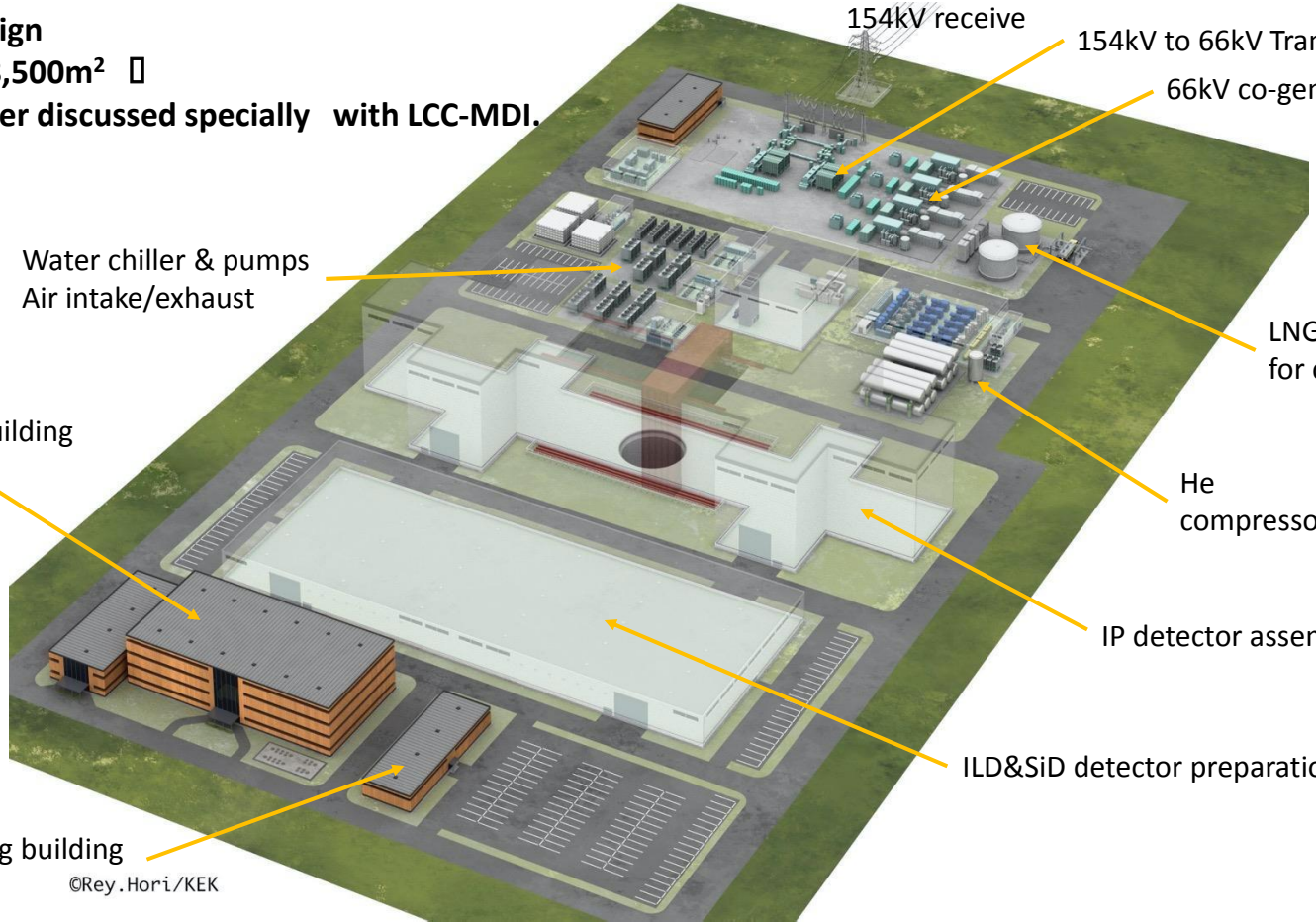
surface design
IP area 78,500m² □ area
to be further discussed
specially with LCC-MDI.

Area of surface building (Tohoku Study)

AS+10: 4778m²
AS-10: 4778m²
AS+08: 3706m²
AS-08: 3404m²
AS-0: 21185m²
AS-0a: 668m²

H. Hayano, LCWS2017, Strasburg

surface design
IP area 78,500m² □
to be further discussed specially with LCC-MDI.



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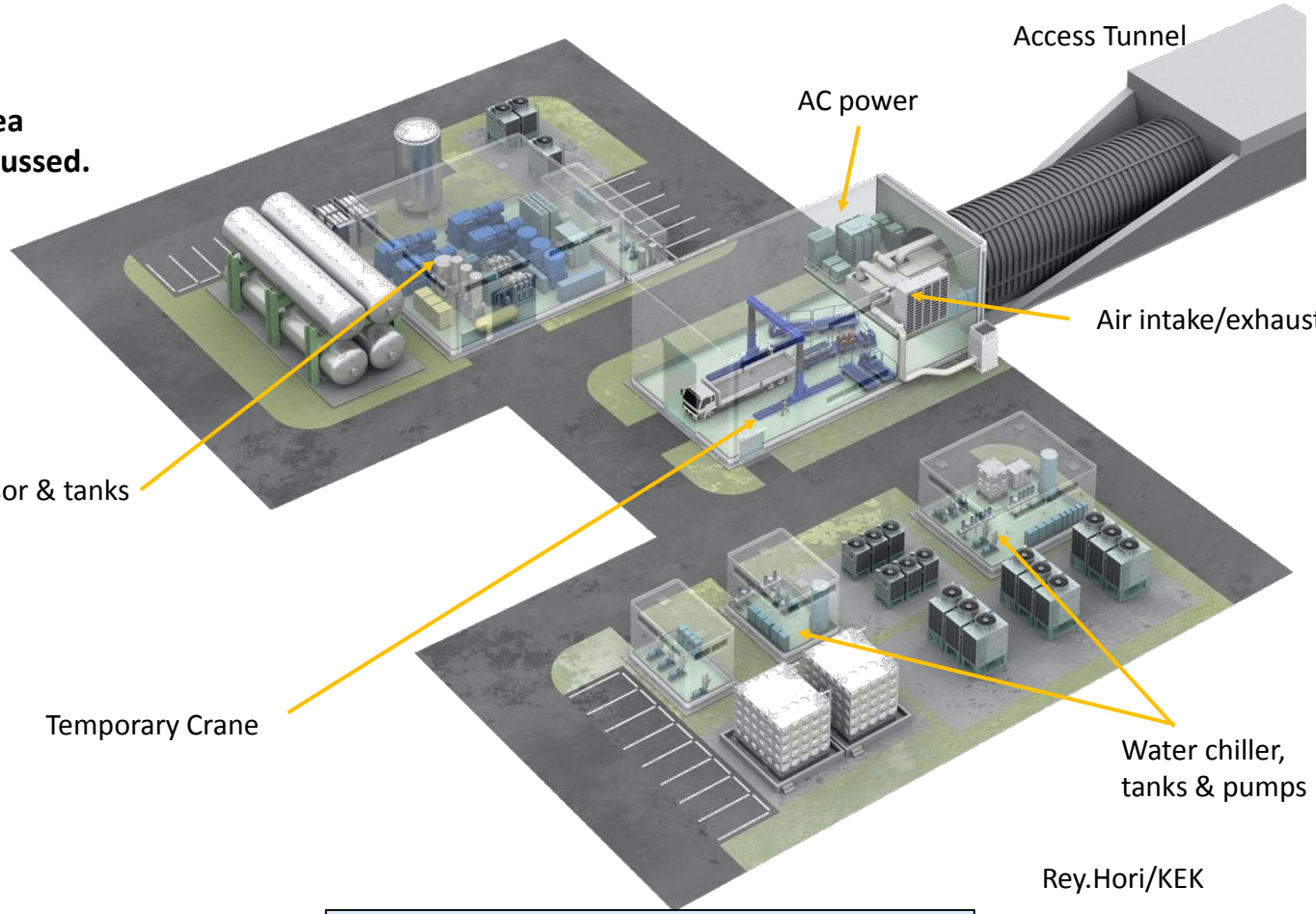
surface design
access stations
16,600m² 5 area
to be further discussed.



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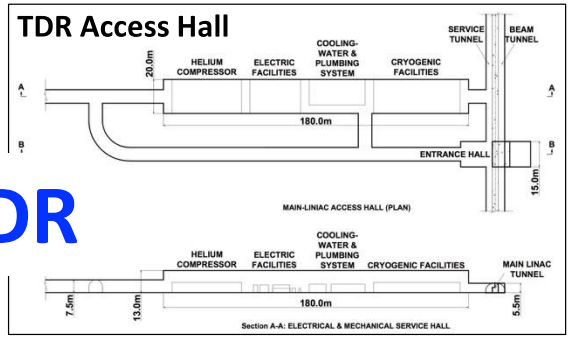
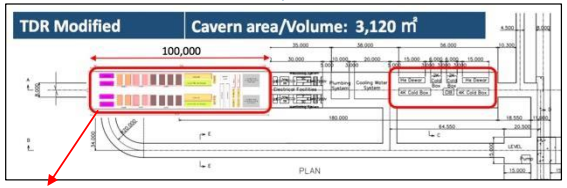
Proposal of New Access Hall shape for Main Linac

direct access of Electric, Water/Air, Helium to Main Linac Tunnel.
separate halls for electric, water, helium.
Keep enough connection room for cables, pipes, ducts, and helium trasfer lines.

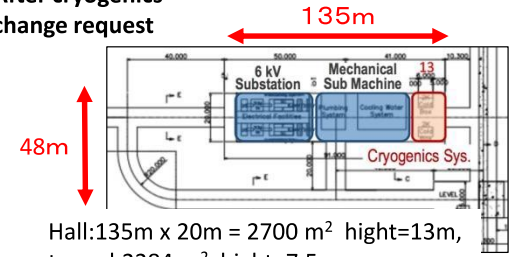
TDR





go to surface

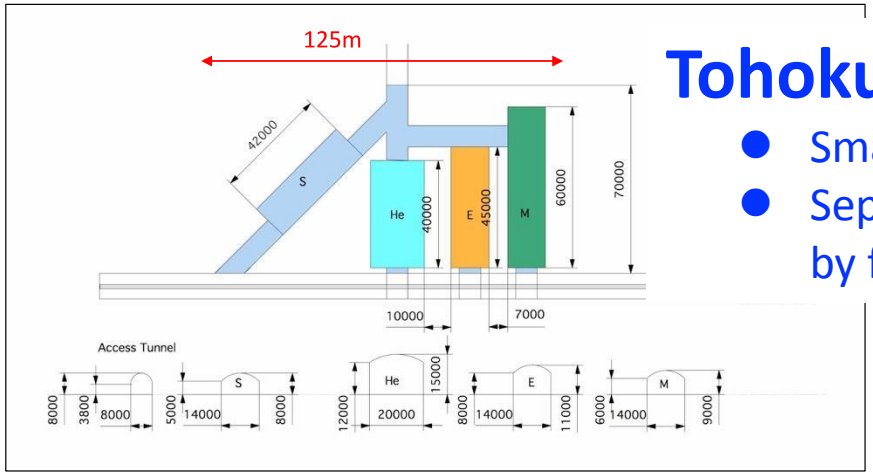
After cryogenics change request



Hall:135m x 20m = 2700 m^2 hight=13m,
tunnel:2284 m^2 hight=7.5m
total area=4984 m^2 , volume=52230m^3

Proposed Access Hall
to accommodate detail designed utilities

Hall:2858 m^2 tunnel: 904 m^2
total area=3762 m^2 total volume=38426m^3



Tohoku study

- Smaller volume
- Separate cavern by function

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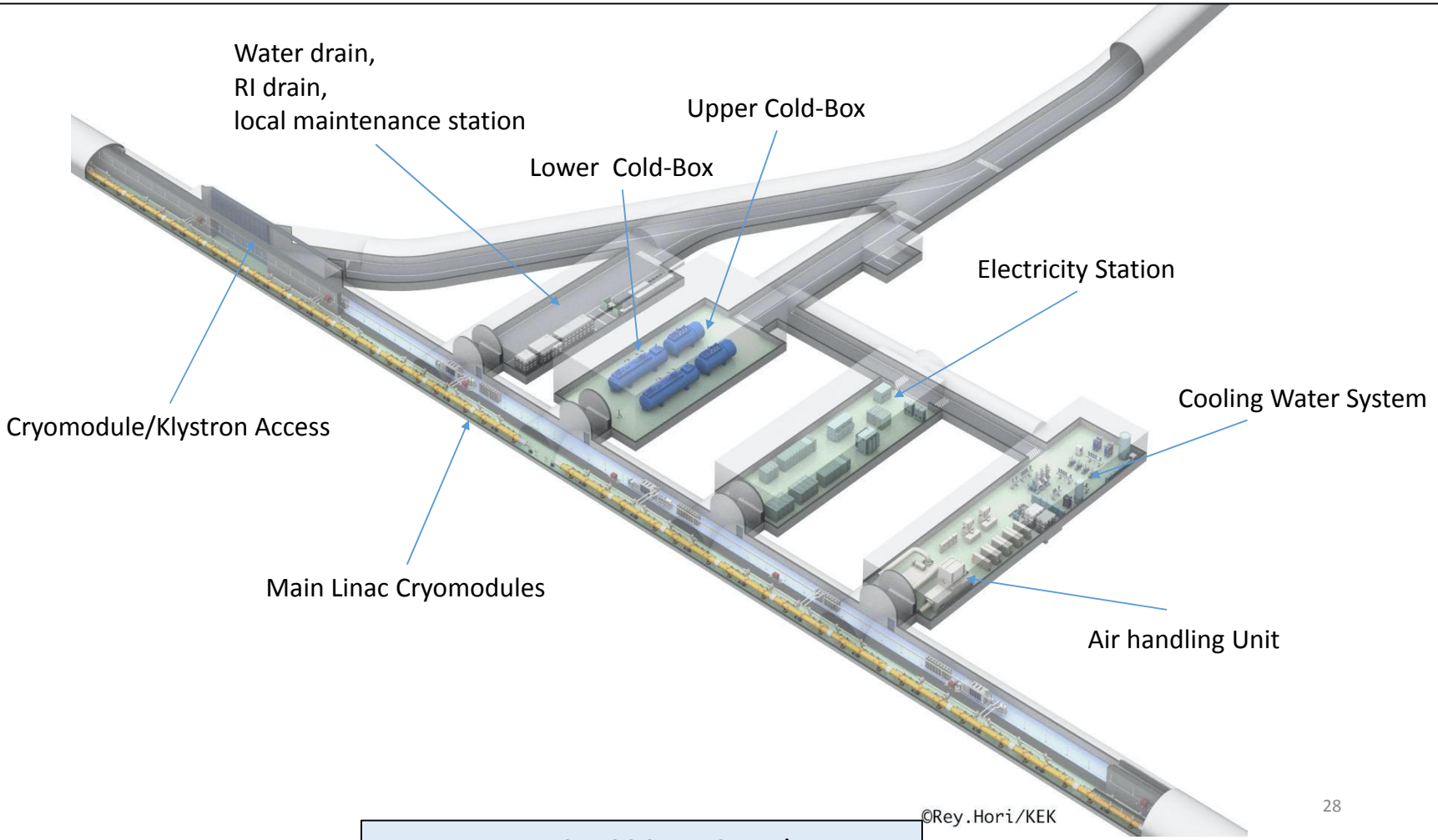
Water drain,
RI drain,
local maintenance station
Upper Cold-Box
Lower Cold-Box
Electricity Station
Cooling Water System
Cryomodule/Klystron Access
Main Linac Cryomodules
Air handling Unit
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An example of access tunnel arrangement:

It shows how large space is required for pipes and cables.

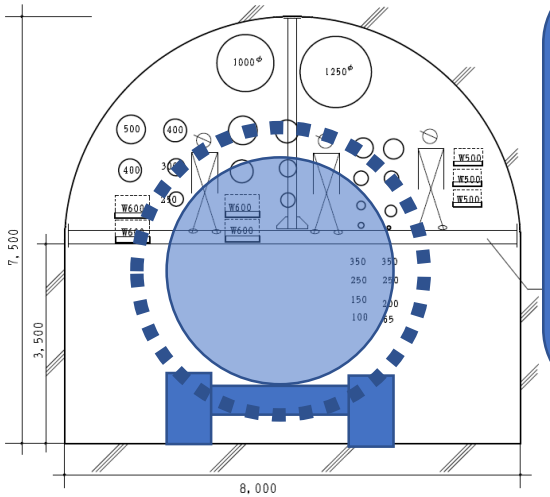
The actual layout must be determined by considering various backgrounds.

Proposal of pipes(He, Water and air), power cables arrangement in the access tunnel

This figure shows only the required space in access tunnel for cable and rack

This is not the actual installation plan

Classification		Name	Size	Quantity
Hellium plant	①	High Pressure line	300Φ	2
	②	Middle pressure line	500Φ	2
	③	Low presssure line	400Φ	2
	④	Negative pressure line	400Φ	2



Transport
Cold Box (diam. 4m)
Into access hall
In installation, repair(?)
and addition for future extension of ILC

アクセストンネル
収容配管等断面図
2016.11.16

Required space for
- ✓ Piping
- ✓ Cable rack

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