Design Progress

for Asian Single Tunnel Configuration

Masanobu Miyahara

KEK

Outline

Outline of the Asian Single Tunnel Configuration

- Design Scheme at the CFS Review Meeting

Design Progress after the Review

- Some Changes of the Design Scheme
- Layout of Access Hall and Caverns

Consideration about the ML-Tunnel Section

- The ML-Tunnel Cross Section
- Issues about the Tunnel Construction Cost

Summary

Outline of Asian Single Tunnel Configuration

Main Tunnel (ML-T)

- Superconducting Cryomodule
- Klystron, RF Power Sources
- High Voltage Power Line

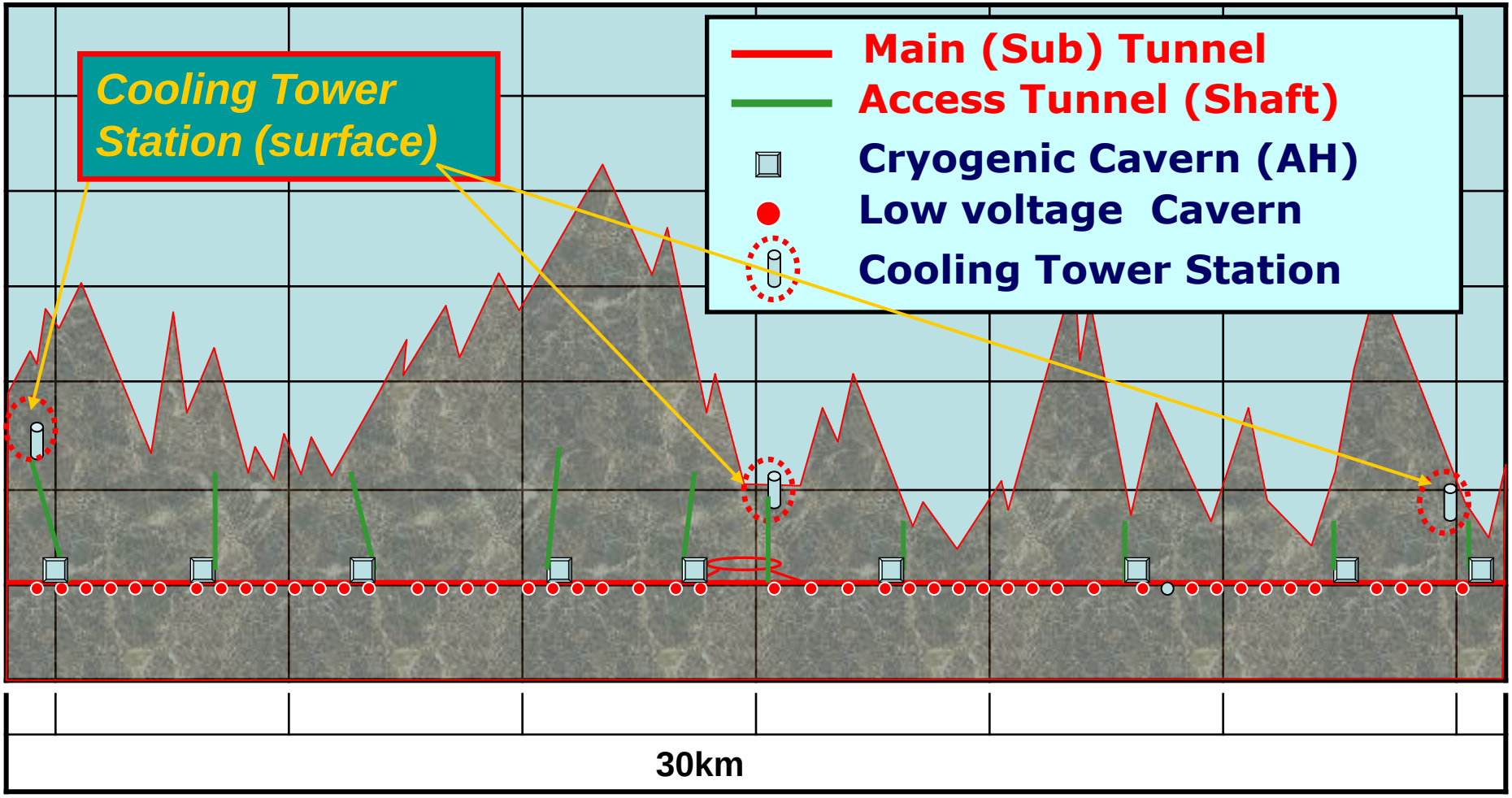
Sub Tunnel (ST)

- Transfer Line of the Cooling Water System
- Drainage Canal for Ground Water Inflow
- Access Route for Maintenance
- Escape Route for Emergency

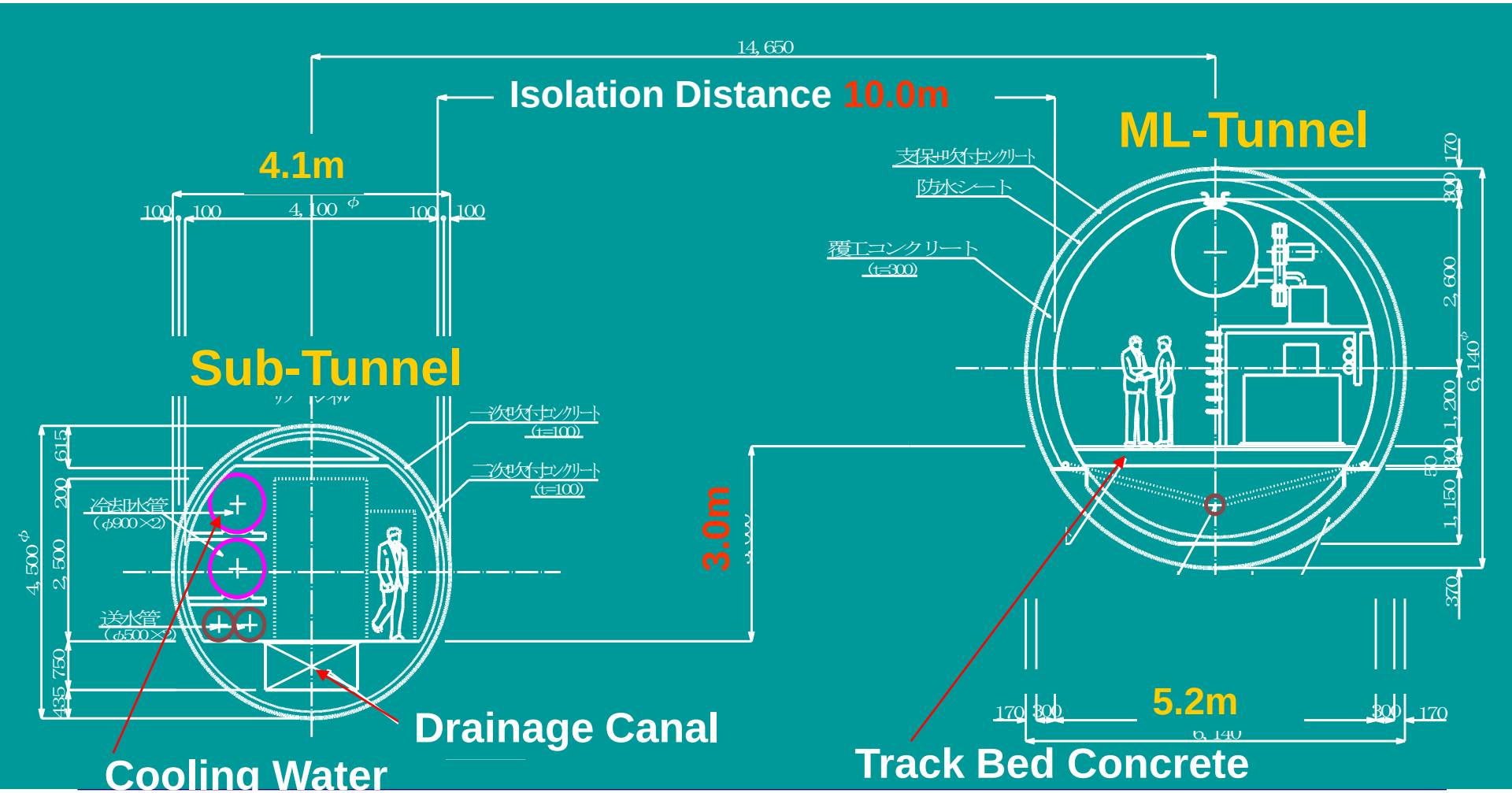
Above Ground Facility

- Only 3 Plants of Cooling Tower Station

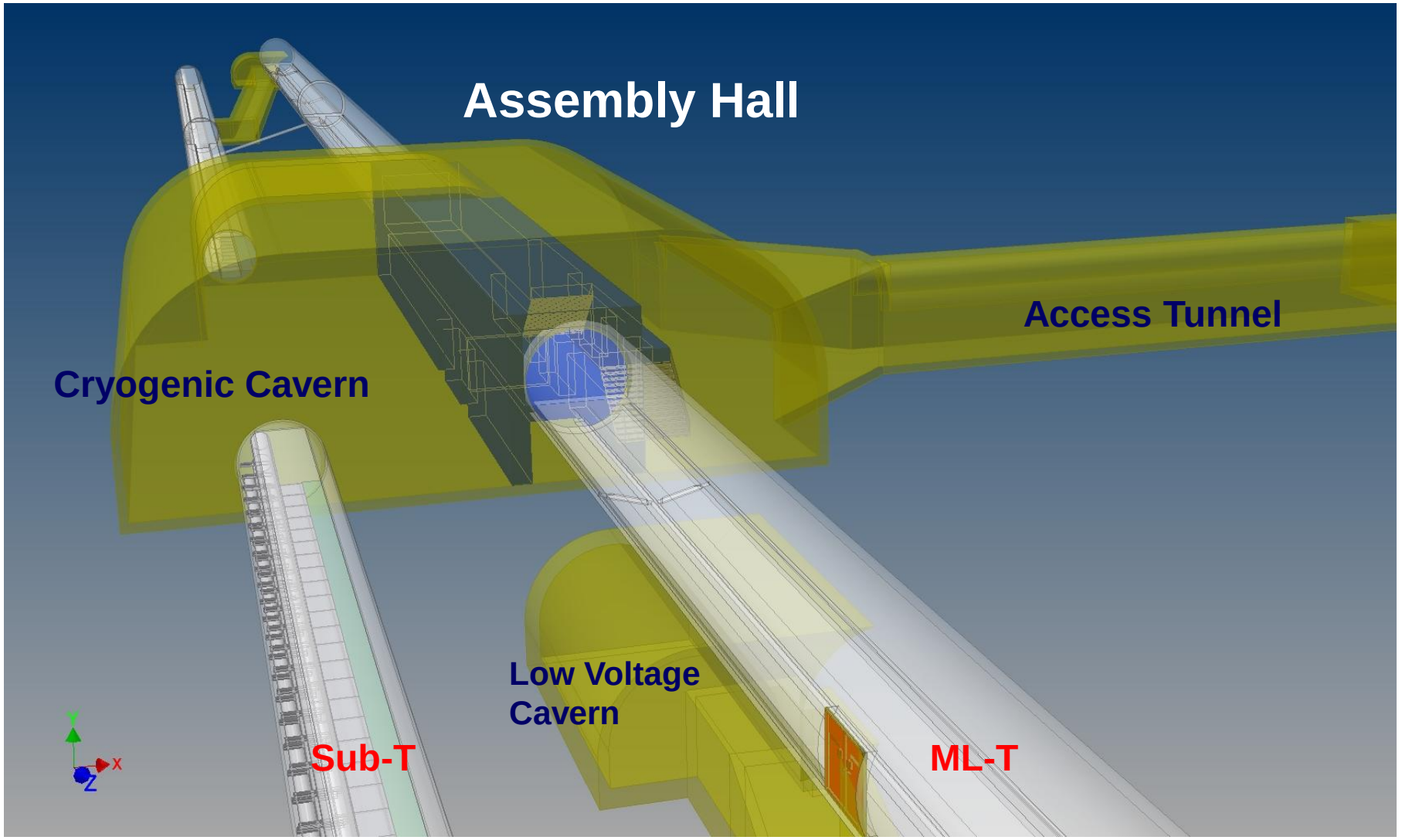
Overal Facility Layout : after completion



Tunnel Spacing (ML-T & Sub-T)



Main Linac Facilities



Design Progress after the Review

- Some Changes of the Design Scheme
- Overall Facility Layout of ML-T

Design Progress (1)

Review the Heat Energy Flow

- Point Number of the Cooling Tower Farm
  3Plants ⇒ 6 plants

- Placement of the Machine Room (Local Cavern)
  about 600m intervals in the Main Linac Tunnel
  Corresponding to the 16 RF unit of Main Linac.

- Review of the Temperature Condition of the Cooling Water Circulation Loop to the Various Component

  Primary Loop : $\Delta t = 10℃ \Rightarrow \Delta t = 20℃$
  Secondary Loop: $\Delta t = 5℃ \Rightarrow \Delta t = 10℃$

Design Progress (2)

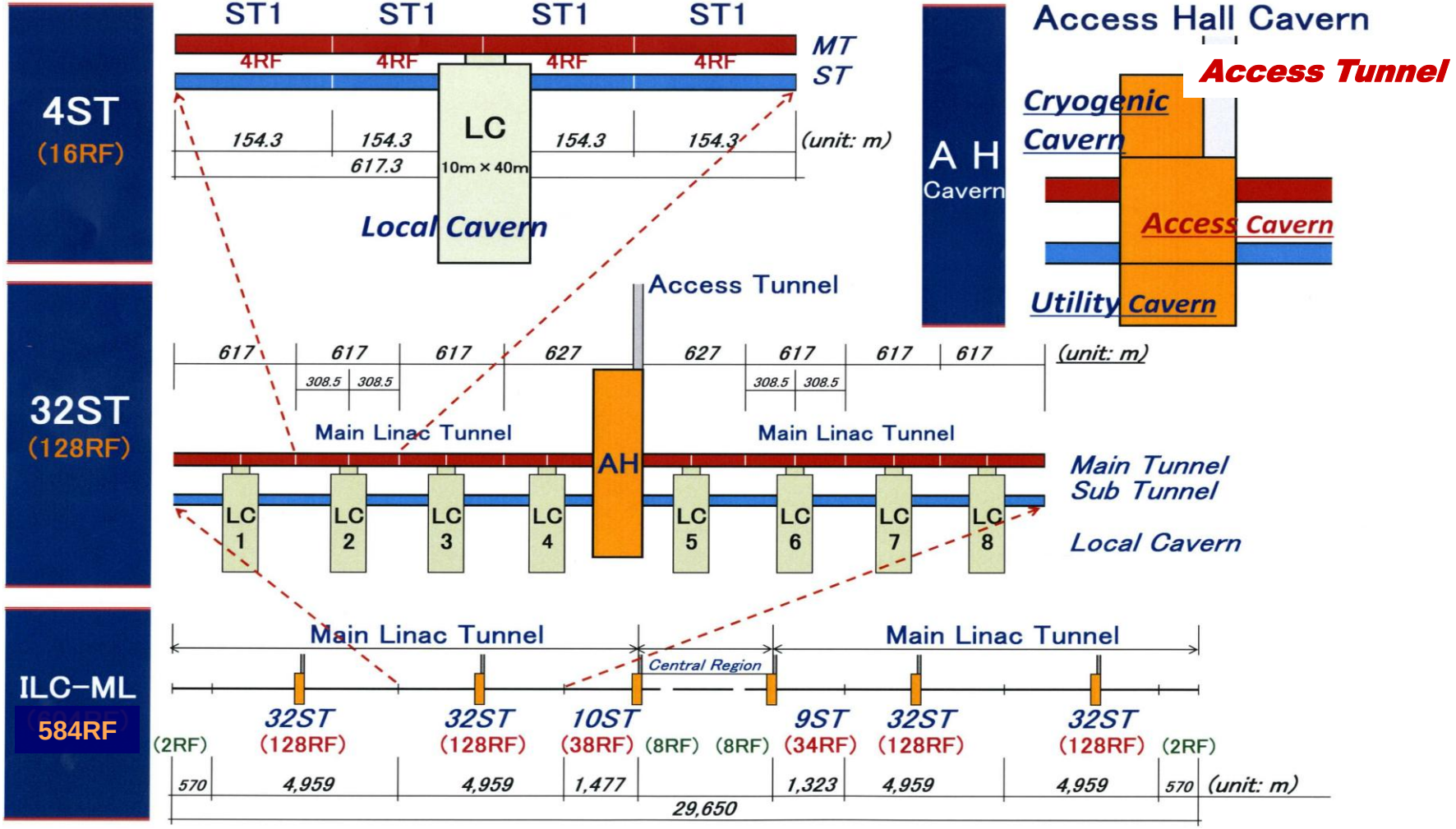
Layout of Cryogenic Facility and Cavern

- 2K and 4K Ref. Cold Boxes are Installed in the Same Cryogenic Cavern at 5 km Intervals.
- Cryogenic Cavern must be Connected in the Terminal Area of the Access Tunnel.
  - Large component such as Ref. Cold boxes and He. Compressor Units are Installed via Access tunnel
  - This Access Tunnel holds enough big Section to Carry a Construction Machine such as TBM others.
- When a Helium Gas Leak Occurred We can Secure the Escape Route to Two Direction via a Sub-tunnel.

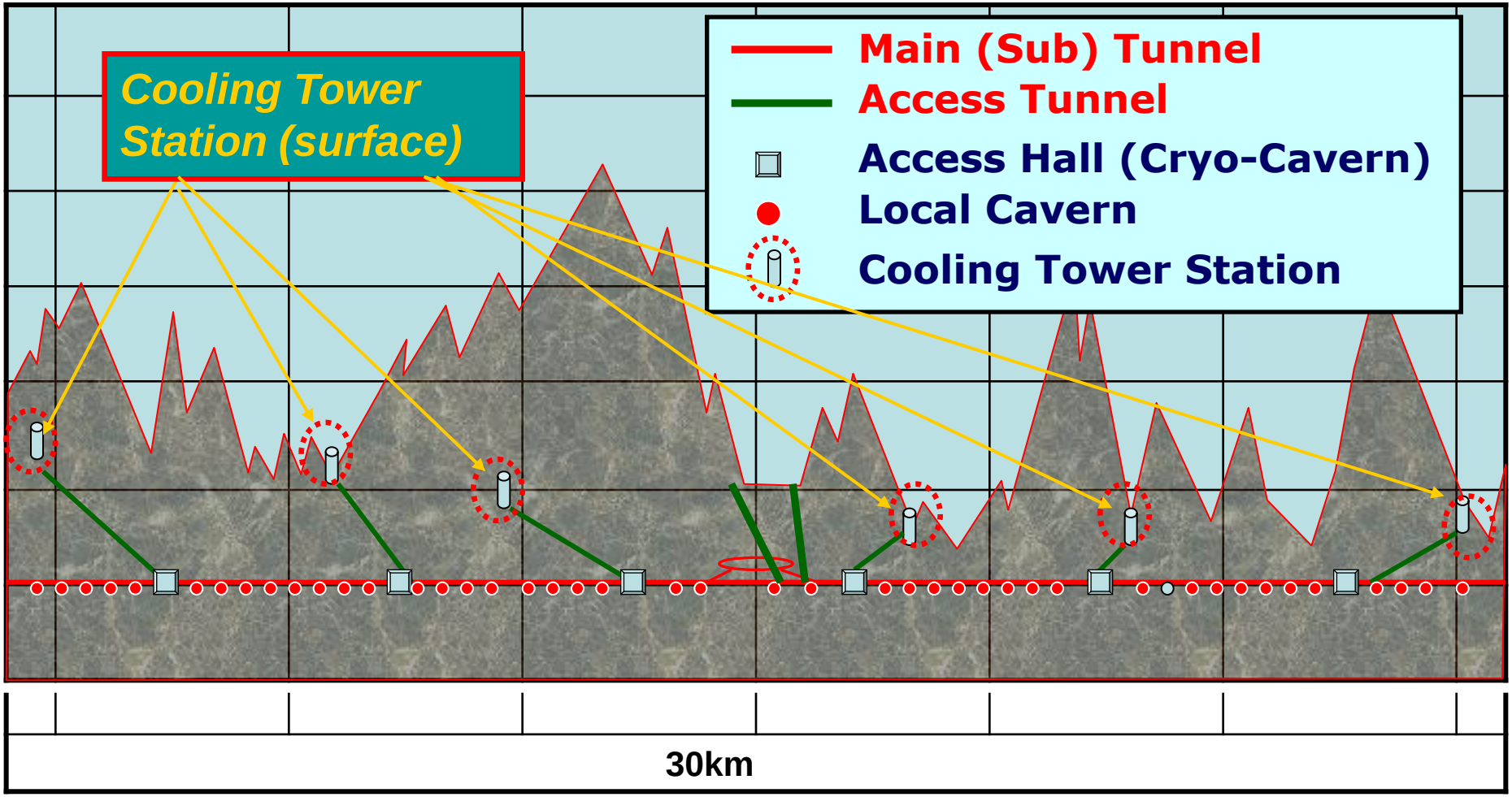
Main Component of Accelerator Tunnel

- **Accelerator Tunnel is consist of following Underground Structure according to DRFS**
  - **Main Tunnel (MT)**
  - **Sub Tunnel (ST)**
  - **Access Hall Cavern (AH)**
  - **Local Cavern (LC)**
- **Installed Facilities in each Underground Structure**
  - **Main Linac Tunnel (ML-T)**
    - Cryomodule, Klystron, RF sourse, Hi-voltage Power Line,,,
  - **Sub Tunnel (ST)**
    - Cooling Water Pipes, Drainage System (Canal and Pumps),,,
  - **Access Hall Cavern (AH, @5km)**
    - Cooling unit, He-Compressor, air conditioning, Power Station,,,
  - **Local Cavern (LC, @617m)**
    - Heat Exchanger, Refrigerator, CW-Pumps, Booster Pumps, Air Conditioning System, Sub Station, other Utility Facilities,,,

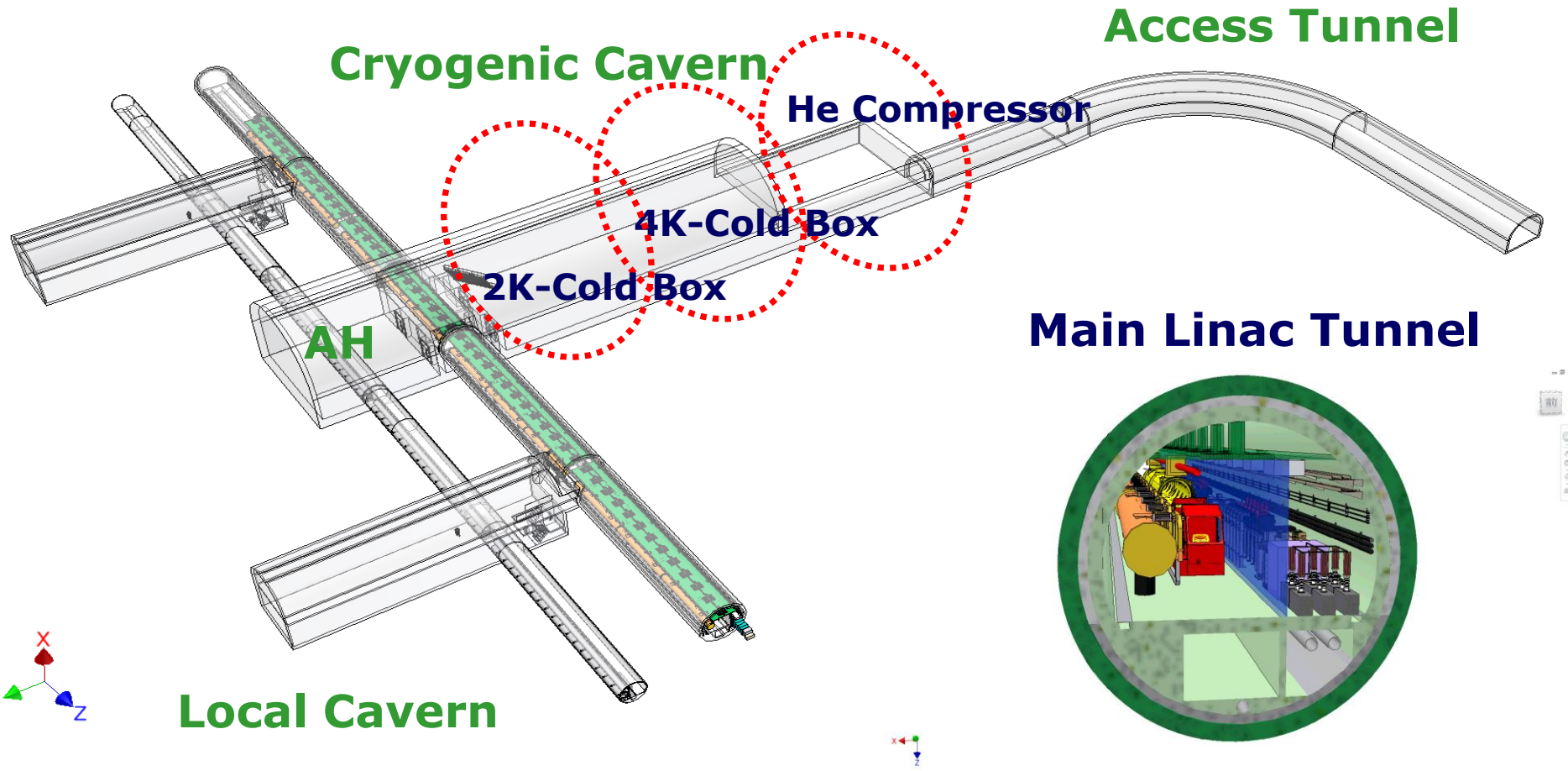
Overall Facilities Layout of the ML-Tunnel



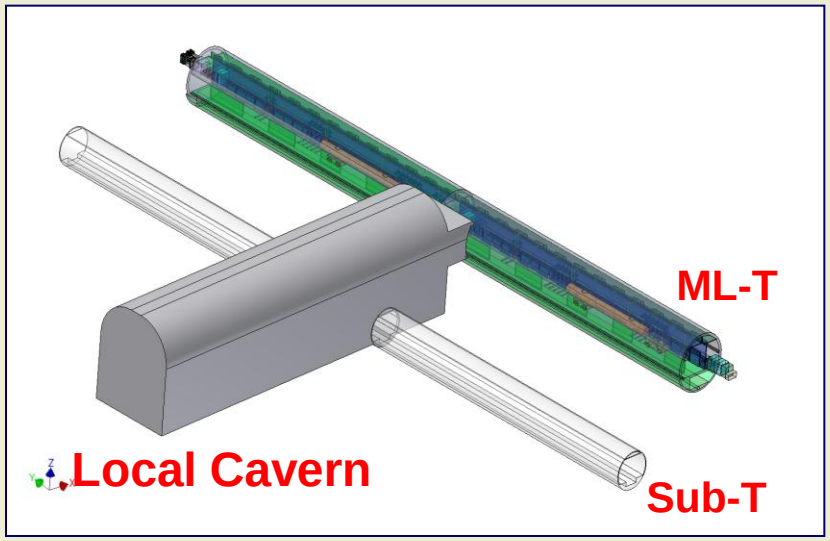
Overal Facility Layout : after completion



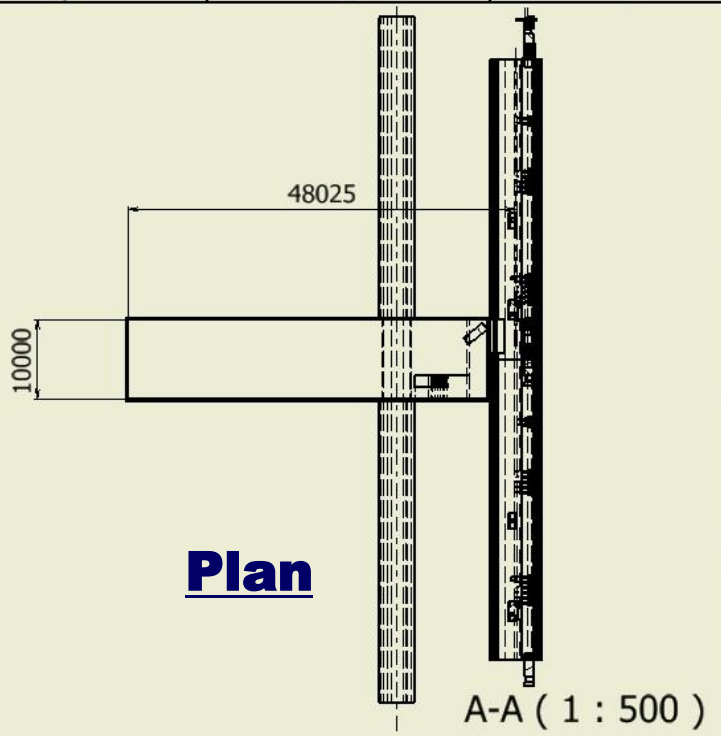
Layout Image of Cavern and ML-T



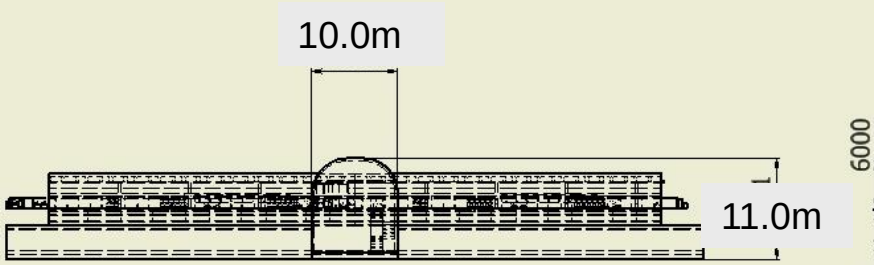
Local Cavern: Scale and Structure



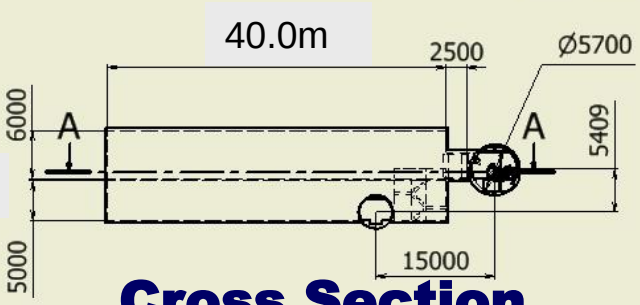
Bird's-eye View



Plan

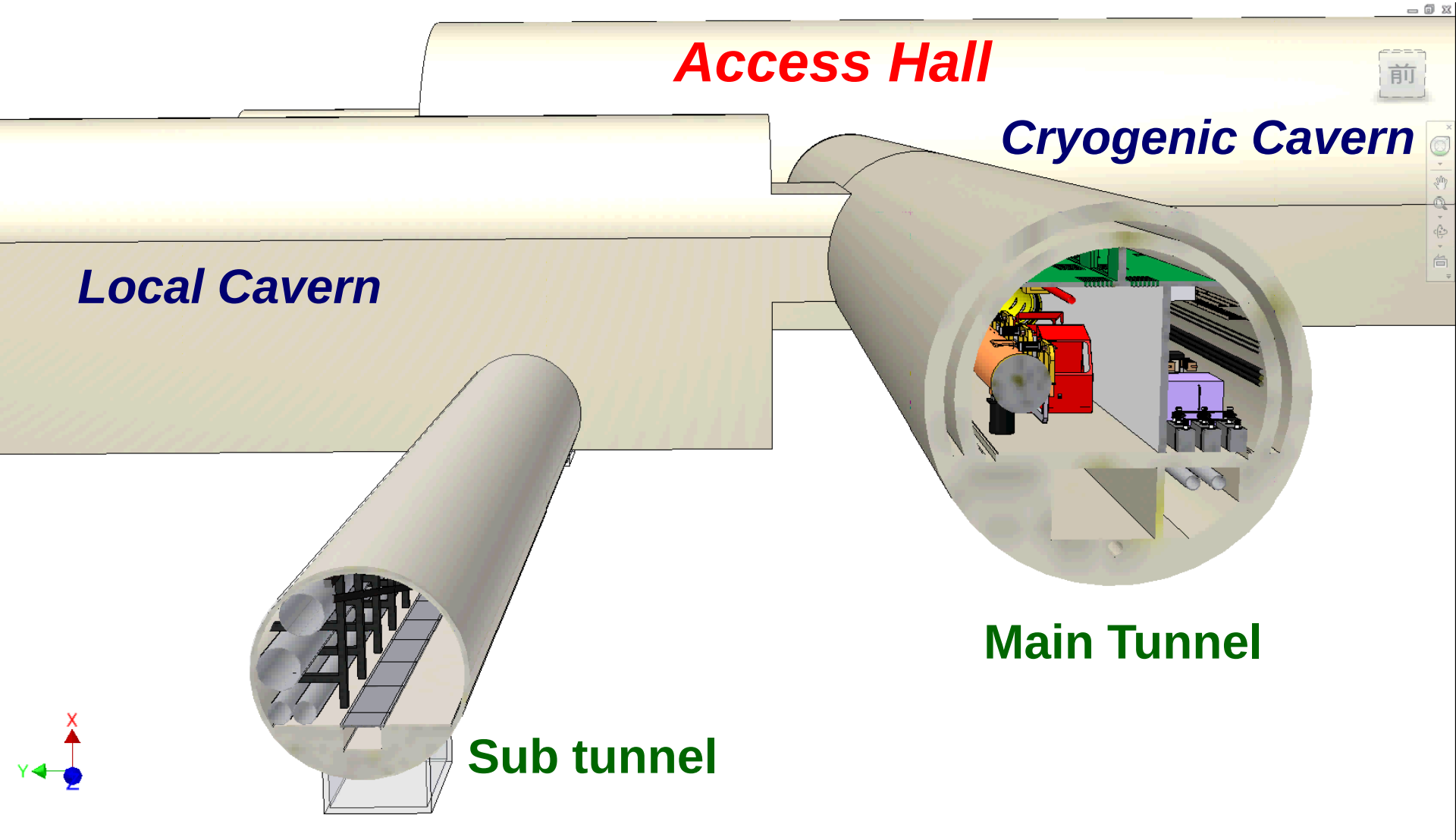


Section Detail



Cross Section

Layout Image of ML-T and Cavern



Consideration about the ML-Tunnel Section

- Investigation about the ML-T Cross Section
- Execution Cost of the TBM Tunnel

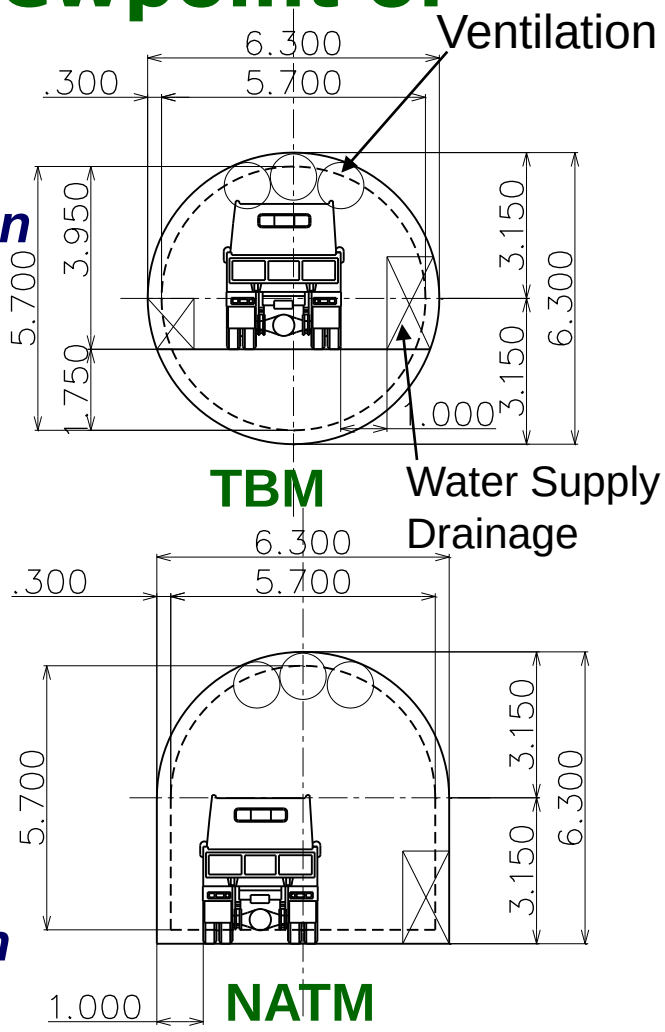
Consideration about the ML-T Cross Section

Comparison by the Shape, Construction Method

Shape	Circle Type	Bullet Type
Method	**TBM**	**NATM**
Construction *Speed*	High speed excavation in case of suitable geological condition	Middle-level (150m/Month)
Cost	Depend on tunnel length High cost in case of short distance	Not depend on tunnel length Low cost in case of short Distance
Adaptability for Cavern excavation	Special construction machine should be developed because of circular arc floor	General-use construction machine can be applied because of flat floor
Noise and Vibration	Small level	Larger level than TBM Almost reduced in deep level

Consideration from the Viewpoint of Tunnel Construction

- *Main Tunnel are used for Local Cavern Construction after the Digging Completion*
  - *Mucking way from Local Cavern*
  - *Passageway of Construction Machine and Vehicle for Local Cavern*
  - *Air Ventilation, Water Supply Line, Drainage line, Power Supply,,,*
- *In case of Circle Shape (TBM)*
  - *Limitation for the Traffic of Construction Machine and Vehicle is extremely severe*
- *In case of Bullet Shape (NATM)*
  - *General-use Machines and Vehicles can pass through easily*



Issue about the Tunnel Construction Cost
Comparison of TBM and NATM

- ***TBM Execution***
  - ***High Speed Excavation (low cost excavation) will be Possible in case of the Good geological Condition***
  - ***Not Economical in a Short Distance Execution, Because the Portion of TBM Machine Cost is Large***
  - ***As for the Tunneling of TBM Excavation, a Merit is bigger in case of Long-Distance Execution more than 10km***

- ***NATM Execution***
  - ***Construction Cost doesn't Depend on Excavation Distance as much as TBM, because General-use Machines are Applied.***

Summary

Design Study toward the Next Stage

We need :

- ***to Investigate in a General Viewpoint about the Various Caverns Layout and Cross Section of the Main Linac Tunnel***
- ***to Develop more Detailed Design Study about the Cooling Water System, Air conditioning System, Cryogenic System and Power Supply System***
- ***to do an Adapted Design Study in the Geological and Geographical Condition of the Concrete Candidate Site (Two) in Japanese Mountainous Region***