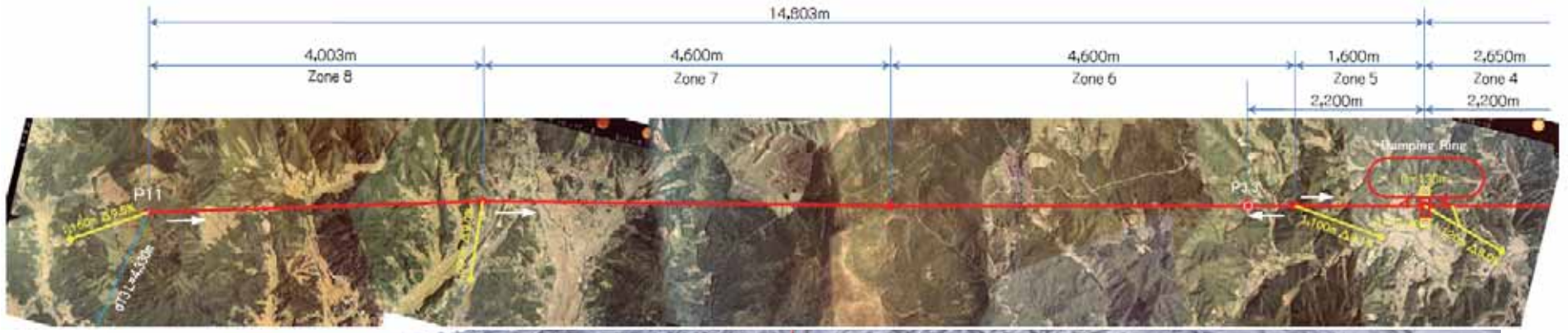
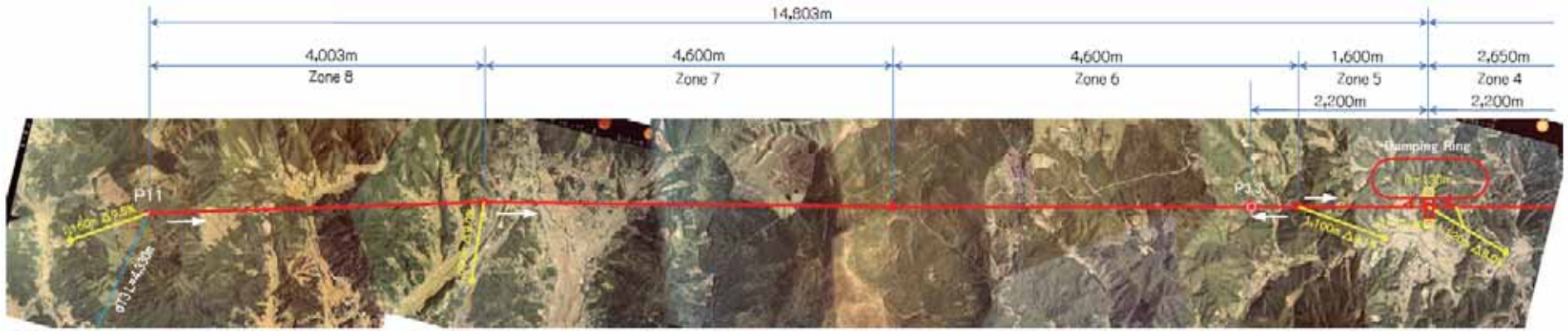


DESIGN CONCEPT OF ILC CFS IN MOUNTAINOUS SITE

Masakazu Yoshioka (KEK and AAA)

June 1, 2010



I will talk about the *basic concept* of the design work of the ILC tunnel in mountainous sites of Japan. Details will be reported by Miyahara-san. All the work have been carried out under the collaboration with veterans of Japanese general construction companies

先端加速器科学技術推進協議会

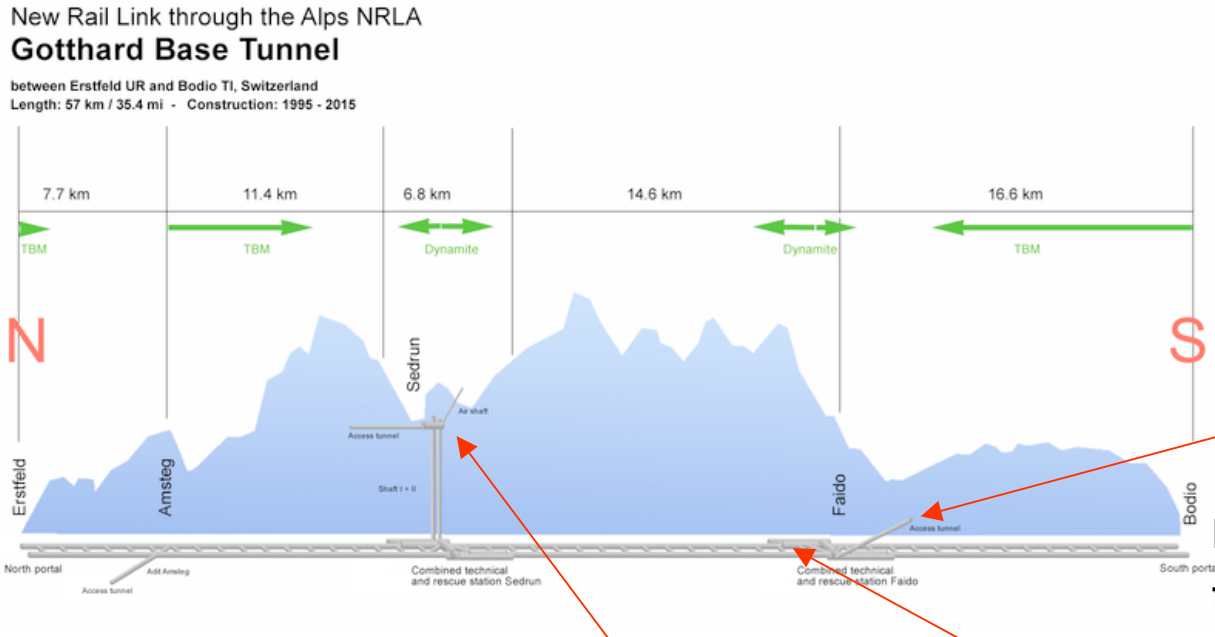
Advanced Accelerator Association Promoting Science & Technology

S. Shikama (Kumagai), N. Kawabata (Tobishima), K. Fukuda (Shimizu), T. Akojima (Kajima), K. Akiyoshi (Obayashi), I. Sekine (Toda), K. Ryoke (Taisei), T. Kokubo (Takasago), *H. Sasao (Tekken)*
KEK: M. Miyahara, A. Enomoto, *K. Hosoyama, M. Yoshioka*

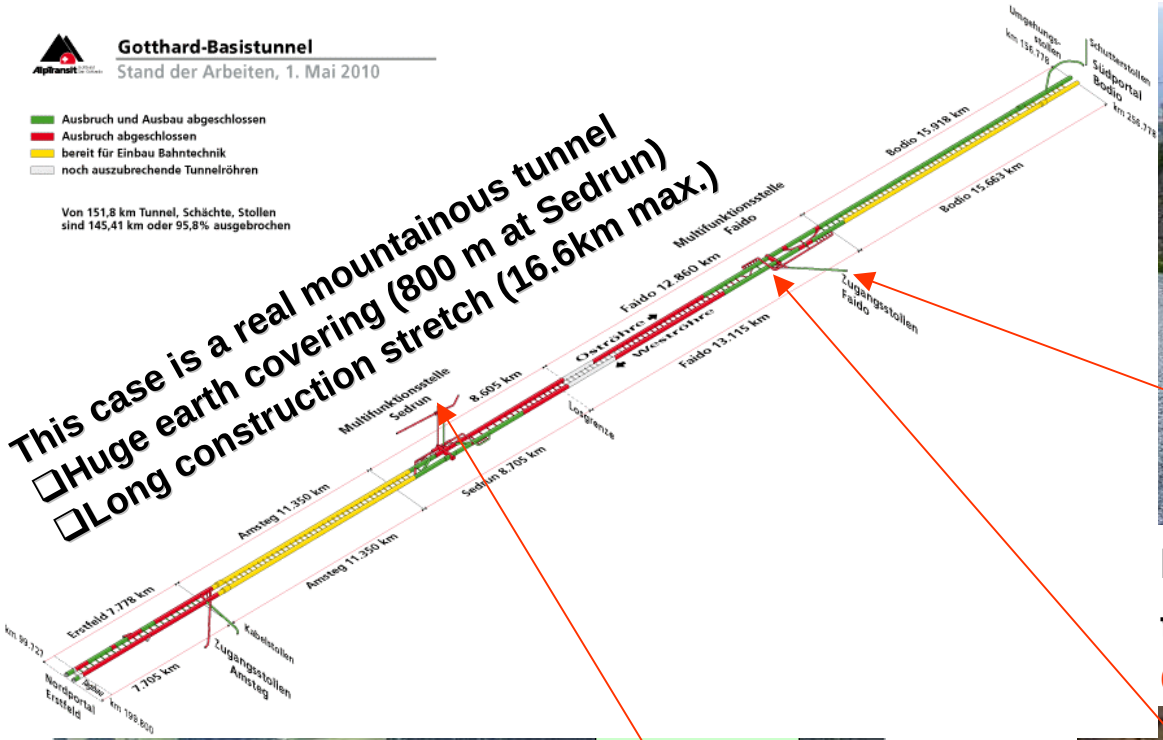
WG series	Date		Theme
1st	2008/10/8	preliminary phase	Kick-off WG: discussion about mission
2nd	2008/11/14		Report of visiting to SNS, BNL and FNAL by KEK delegation
3rd	2009/1/16		Study GDE activities for CFS
4th	2009/5/13		Study GDE activities for CFS
5th	2009/9/10	study on single tunnel scheme in mountain region	kick-off studies of "single tunnel" scheme in mountain regions
6th	2009/10/23		Study (continued)
7th	2009/11/30		Study (continued)
8th	2010/2/1		Prepare report
9th	2010/4/15		Finalize report

The CFS working group was created in Oct.8, 2008 as one of the activities of AAA. Since then, we have had many meetings as listed here.
The new scheme of “a single main tunnel” with “a sub-tunnel” was proposed in Sep. 2009 after studying SB09 design and learning many experiences of real tunnel excavation. The first presentation was made at the GDE meeting (Beijing) by Enomoto-san. The report was edited and finalized in April, 2010.

In 2006, we visited Gotthard Base Tunnel for the study of a REAL MOUNTANOUS TUNNEL and found that the ILC tunnel in Japanese sites is (should be) different from this case.



Investigation team to study the *"real mountain tunnel"*; Gotthard Base Tunnel (2006)

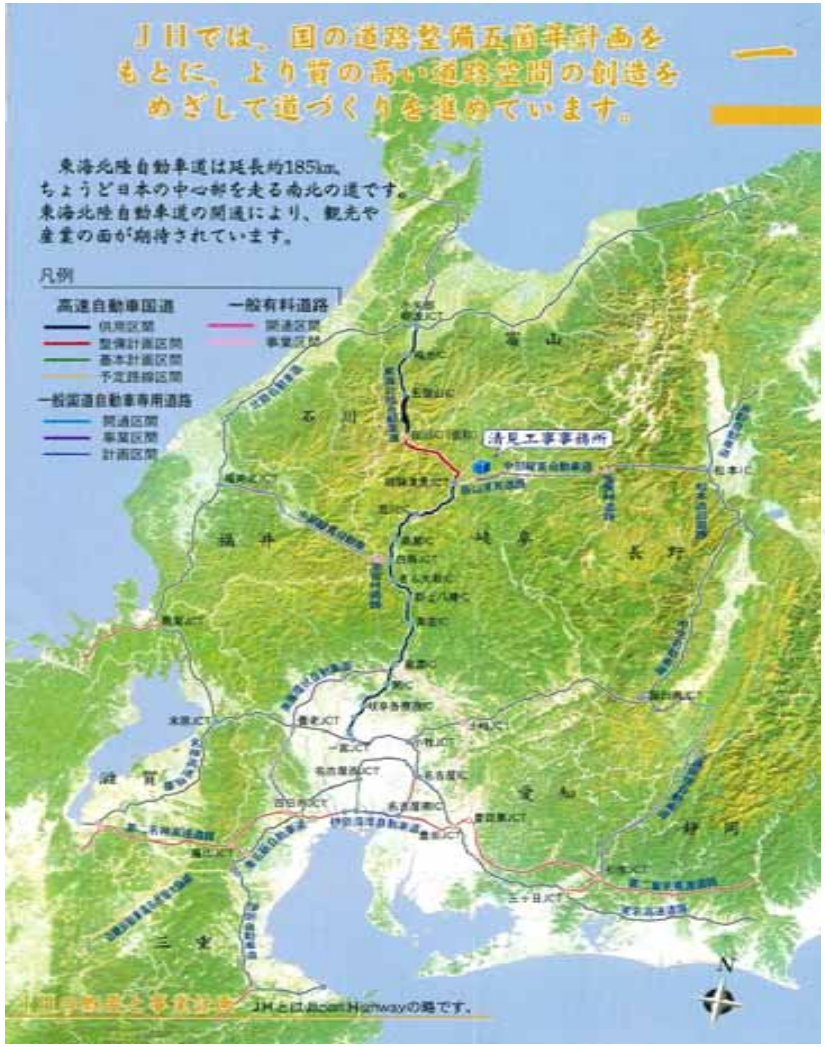


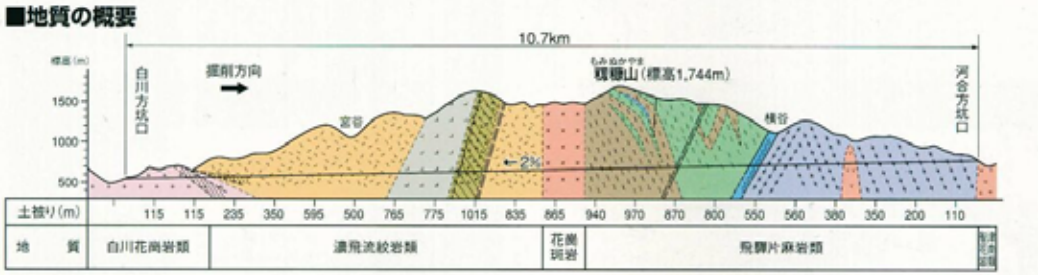
This case is a real mountainous tunnel
- ❑**Huge earth covering (800 m at Sedrun)**
- ❑**Long construction stretch (16.6km max.)**

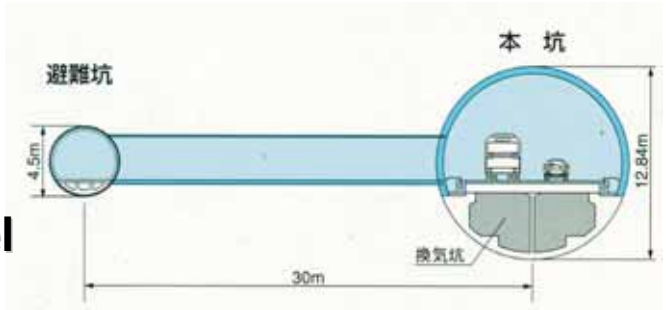
Investigation team to study the *"real mountain tunnel"*;
Gotthard Base Tunnel (2006)

Next topics is the
Lessons from experiences in Japan
-Case of HIDA tunnel for the High-way

Lessons from experiences in Japan







Main tunnel

Escape tunnel

Hida tunnel (granite region locations)

Very good!!

Hida tunnel (weak geology case)



Fighting with groundwater



Fighting with collapse, earth pressure……,

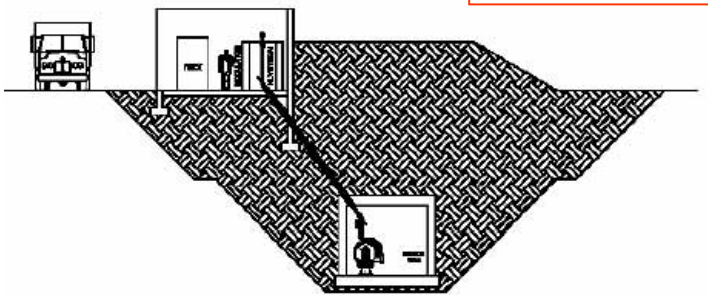
An important lesson from these experiences:

Solving underground water problems is essential for successful tunnel excavation in mountainous regions.

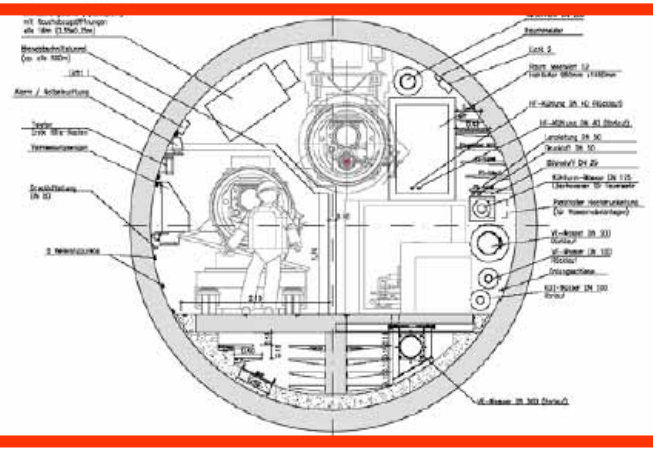
Location and configuration of the high-way tunnel is mainly determined by the surface geography

But the BIG advantage over the transportation tunnel cases - for the ILC, we can choose a more optimal site.

SB2009 single tunnel scheme



- Shallow sites
  - Cut and cover like solutions
  - "service tunnel" on the surface



- Single tunnel
  - European XFEL-like solution
    - availability / reliability

DRFS

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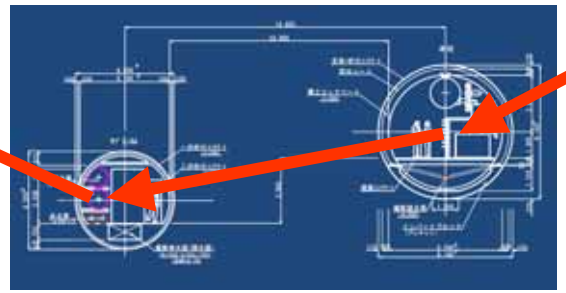
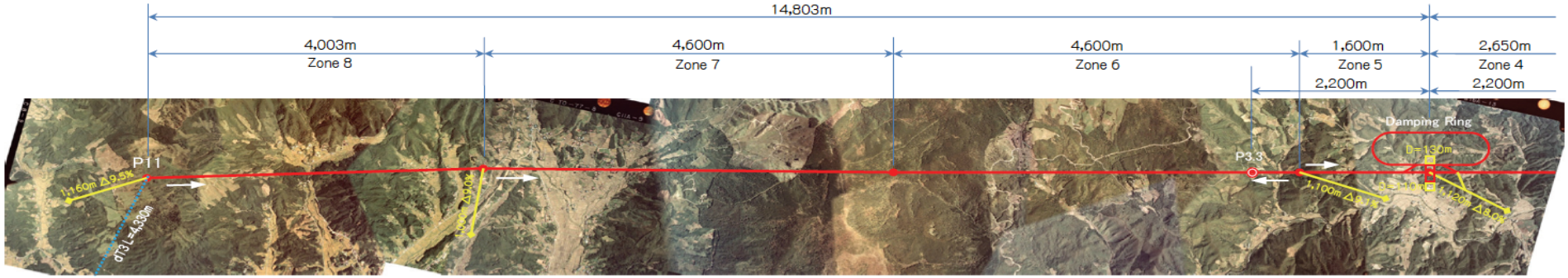
The purpose of the WG is to make a realistic (conceptual) design of the SB09 single tunnel scheme, which based on our experience fits in the likely Japanese site (hilly area)

Another necessary condition; Management of energy flow from the commercial electric grid to accelerator components installed in the tunnel, and then from the tunnel to the cooling towers located on the ground surface is essential for the successful tunnel design in mountainous regions.





Characteristics of hilly areas:

→**They are not the real mountains but rather complicated configurations of the surface and earth covering**

Basic conditions for the design:

→**We should be freed from the restrictions, which comes from the above characteristics, as much as possible.**

→**The number of the access points between the tunnel and the surface facilities should be as few as possible.**

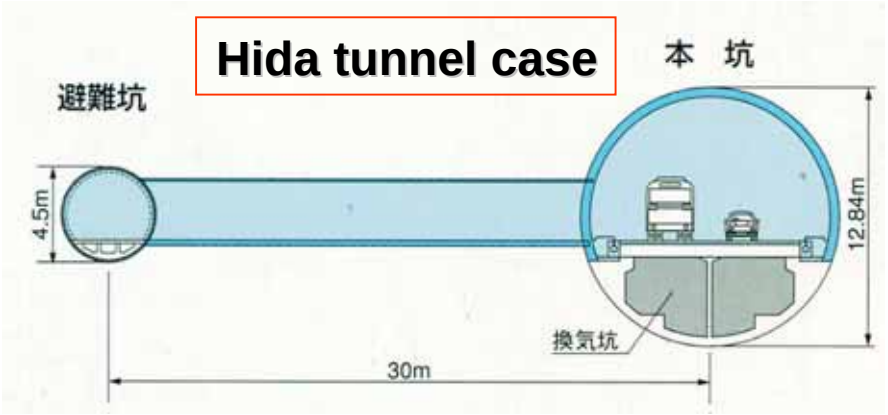
→**The total length of the access tunnel between the main tunnel to the surface facilities should be as short as possible.**

The most important technical criterion to be satisfied:

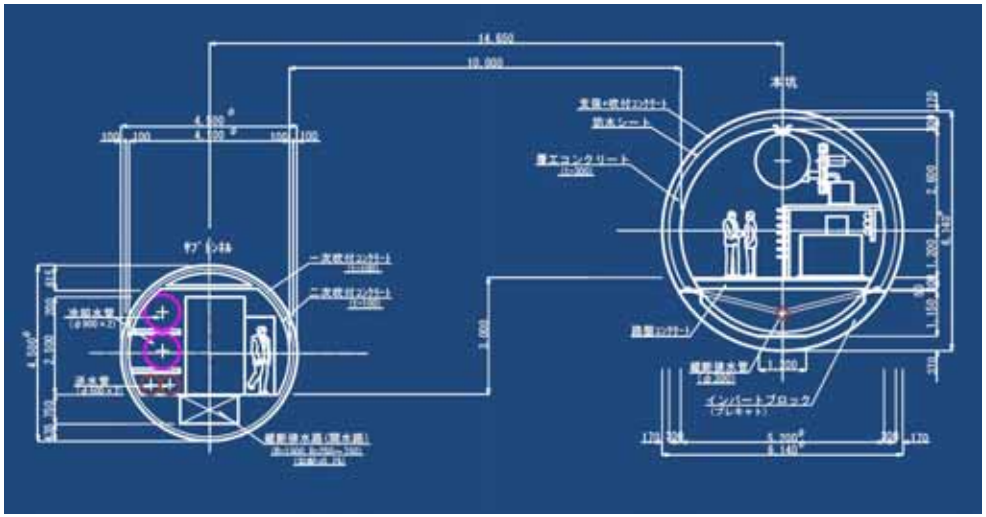
→**long distance heat transport with large bore cooling water pipes should be possible.**

Answer: make a sub-tunnel to install large bore cooling water pipes for heat transportation.

Hida tunnel case



Proposed ILC mountainous region tunnel



It looks like the RDR double tunnel.

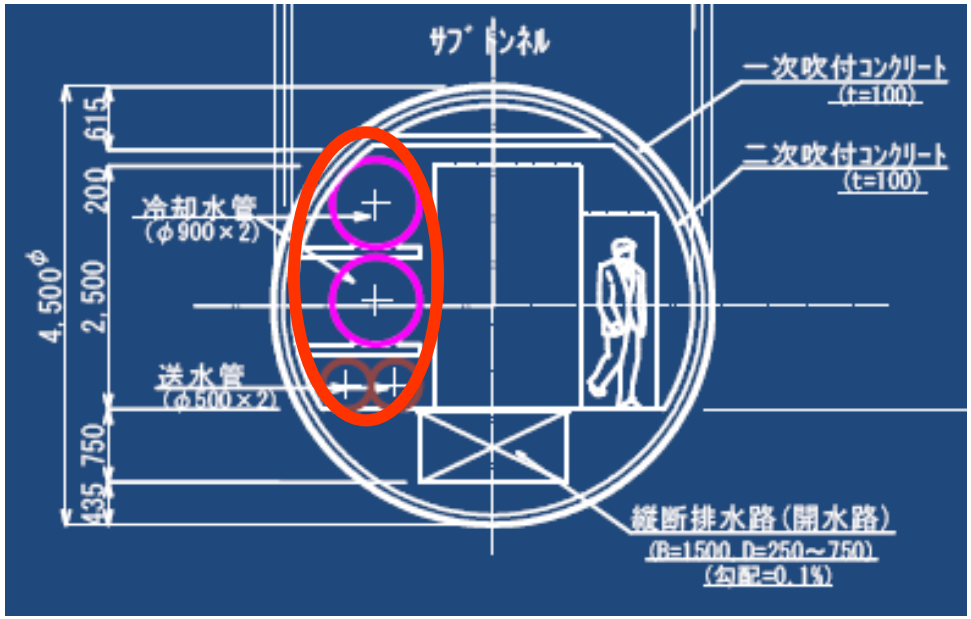
BUT,
all active accelerator components are installed in the main tunnel.

IN THE SUB-TUNNEL
no active components are installed, and it can be used for
- **escape,**
- **drainage underground water,**
- **maintenance,**
- **etc.**

Minimum number of cooling tower stations on the ground surface → 3

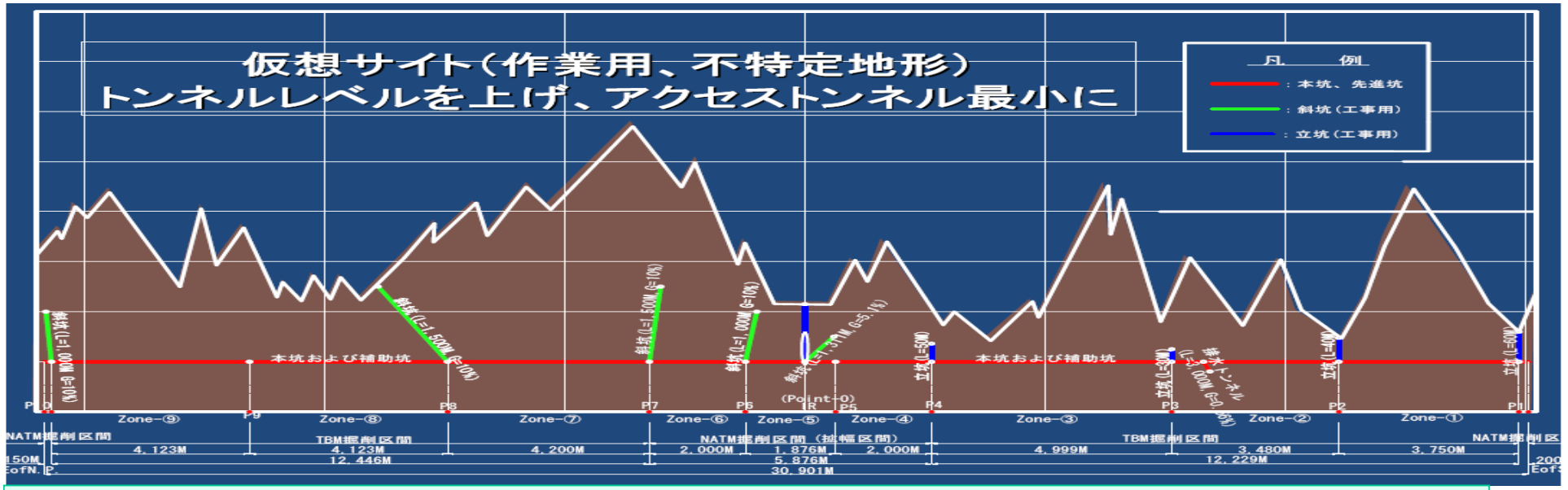
Helium plant installed in the underground cavern→Hosoyama-san

Electric power stations are also installed in the tunnel (with the exception of the main power station connected to the commercial grid)

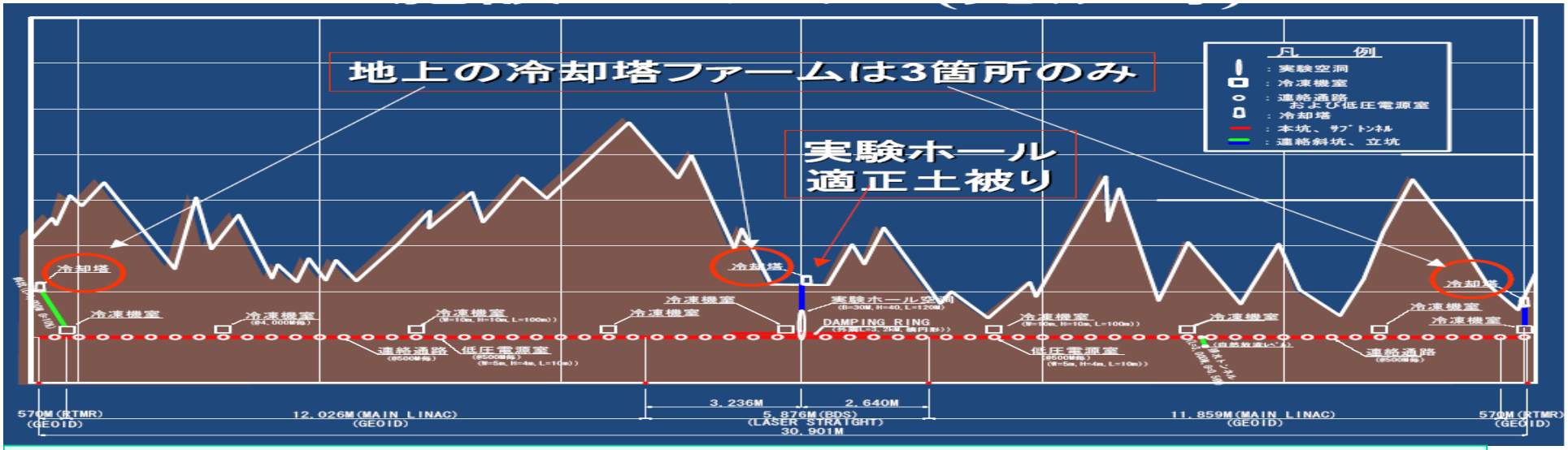


We can expect that a large portion of the cost for the sub-tunnel construction can be offset with:

- ❑**Reduction of the main tunnel construction cost,**
  - ❑**Lower risk**
- ❑**Reduction of the surface facilities,**
- ❑**Reduction of number of vertical shaft,**
- ❑**Reduction of access tunnel length,**
- ❑**Easy drainage of underground water,**
- ❑**Simple escape route for evacuees,**
- ❑**Can be used as a maintenance route,**
- ❑**Etc.**



Hypothetical site (varied topology): have the tunnel level as high as possible and minimum access tunnels.



Only 3 above ground cooling tower farms.　　Experimental Hall, appropriate earth covering.

Conclusion

The single tunnel with sub-tunnel design seems to be a reasonable plan for a mountainous region.

Further studies for purpose of cost estimation are needed.