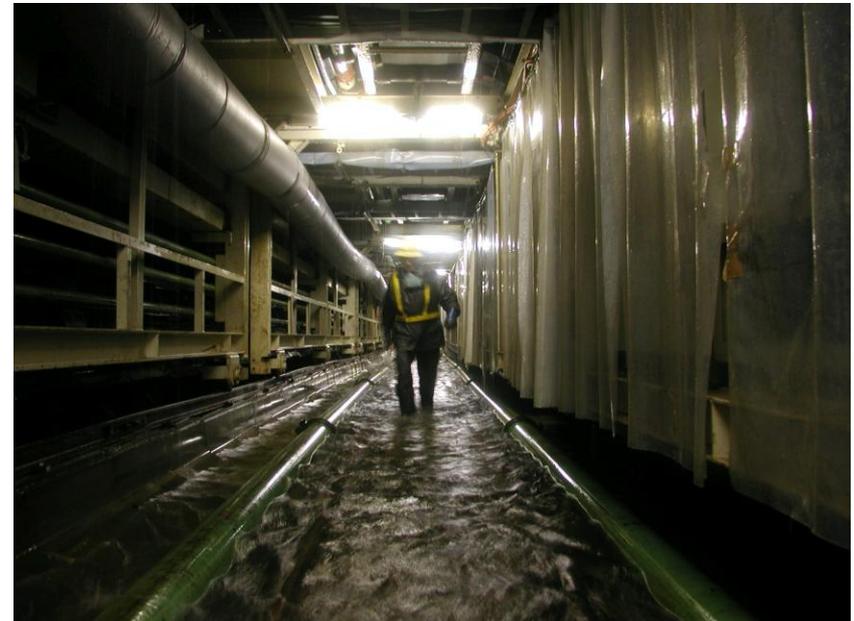


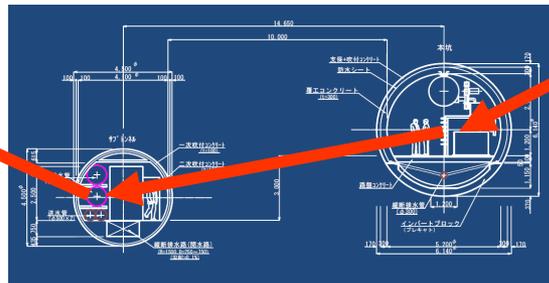
**Comments:  
Masakazu Yoshioka (KEK & AAA)  
June 2, 2010 for CFS review**

**HIDA tunnel is not the Japanese standard but “the worst” case.  
BUT we should learn its experiences.  
Solving underground water problems is essential for  
successful tunnel excavation in mountainous regions.**





**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.**



In order to apply SB2009 single tunnel scheme **strictly** to the Japanese mountainous site, we have to make many vertical shafts with thick earth covering.

Problems of the deep vertical shaft, where earth covering is 100~400m

- ❑ Large scale infrastructures are needed for the excavation;
  - ❑ Hoisting winch,
  - ❑ Tower facility,
  - ❑ Drainage pump,
  - ❑ Air ventilation when blasting,
  - ❑ Concrete placement.
- ❑ Many stage heat exchange system for cooling water is needed;
  - ❑ Diameter of the cooling water pipe in the tunnel is restricted <400 mm,
  - ❑ We need many cooling tower facility on the land surface,
  - ❑ We have to place many stage plate heat exchanging system,
    - ❑ High construction cost,
    - ❑ Lay down efficiency,
    - ❑ High operating cost.



### **Merit of inclined access tunnel;**

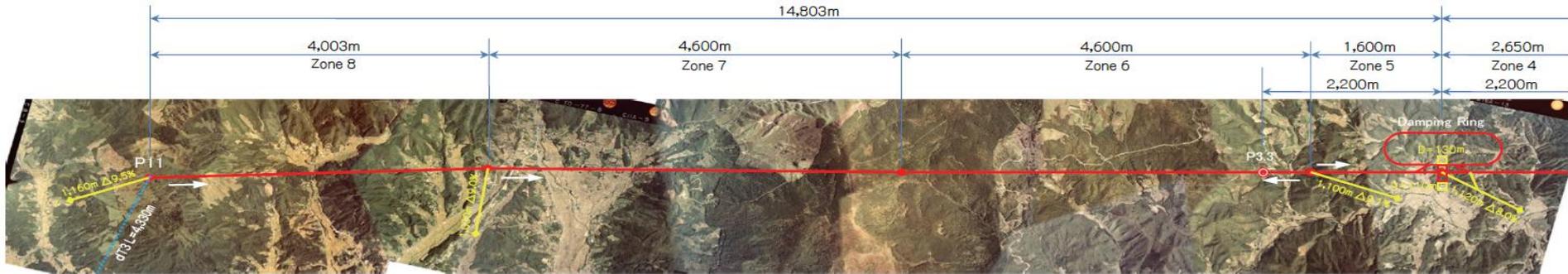
- Drastic cost reduction in comparing with vertical shafts,**
- Efficient use of existing public road,**
  - We can chose the route from the public road to the access point freely,**
  - Convenient to carry in accelerator components into the tunnel,**
- On the other hands, we have to construct approach roads to the vertical shafts,**
  - The access point to the vertical shaft on the land surface is determined by the main tunnel configuration.**

### **Merit to minimize the development of land surface;**

- Keep natural environment.**

### **As bonuses, we can have many merits;**

- Escape route,**
- Drainage underground water,**
- Convenient for the maintenance,**
- Reduction of excavation cost of the main tunnel,**
- Avoid groundwater flow into the main tunnel, where radiation controlled area.**



***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.

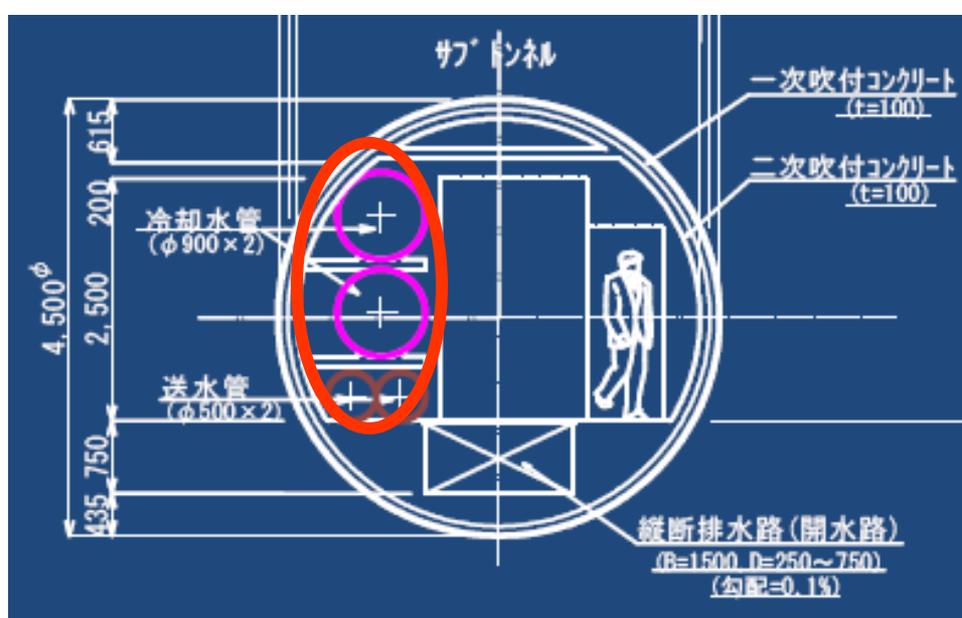
→The total length of the access tunnel between the main tunnel to the surface facilities should be as short as possible.

***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.***



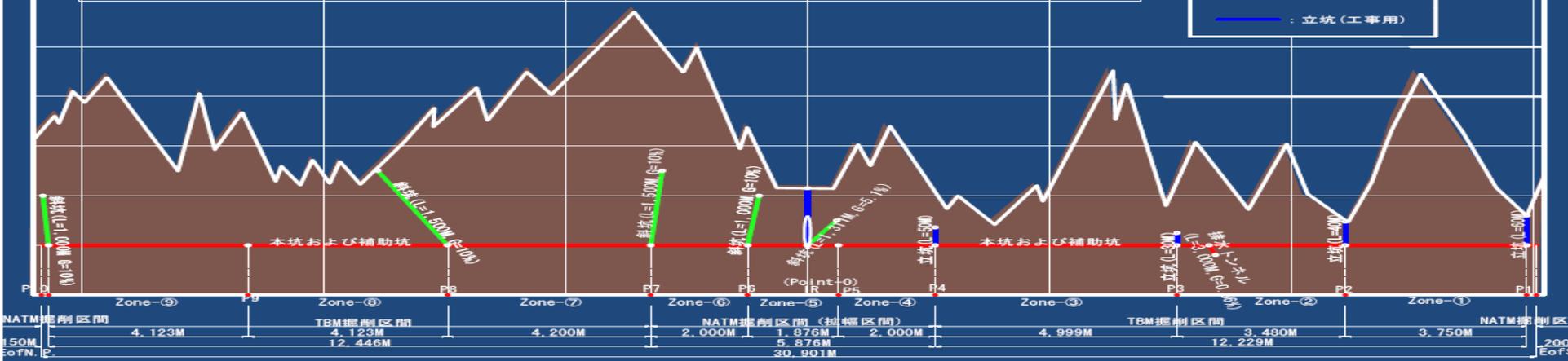


**We can expect that a large portion of the cost for the sub-tunnel construction can be offset with:**

- 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.**

# 仮想サイト(作業用、不特定地形) トンネルレベルを上げ、アクセストンネル最小に

- 凡 例
- 本坑、先進坑
  - 斜坑(工事用)
  - 立坑(工事用)

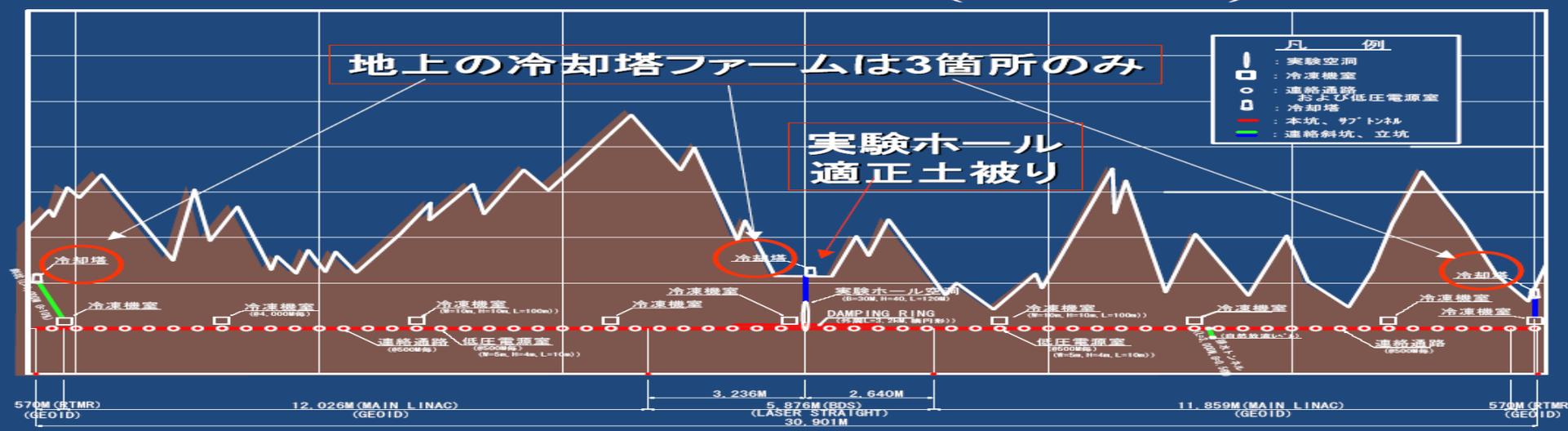


Hypothetical site (varied topology): have the tunnel level as high as possible and minimum access tunnels.

# 地上の冷却塔ファームは3箇所のみ

- 凡 例
- ! 実験空洞
  - 冷凍機室
  - 連絡通路
  - 冷却塔
  - 本坑、サブトンネル
  - 連絡斜坑、立坑

# 実験ホール 適正土被り



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.**