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# ***Recent Development of DRFS*** ***(Based on Japanese CFS Tunnel Plan)***

***S. Fukuda***  
***KEK***

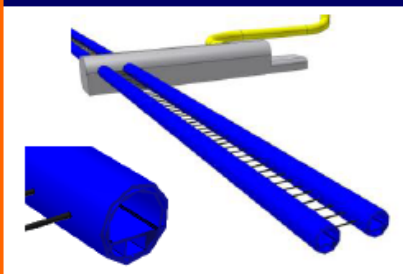
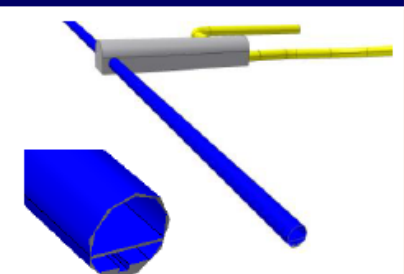
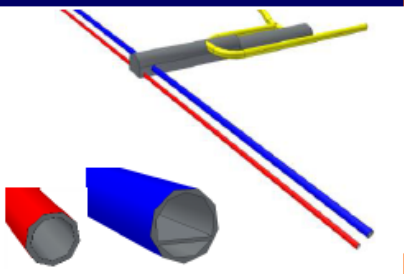
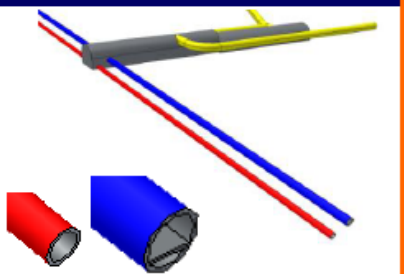
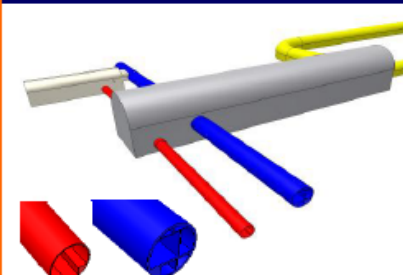
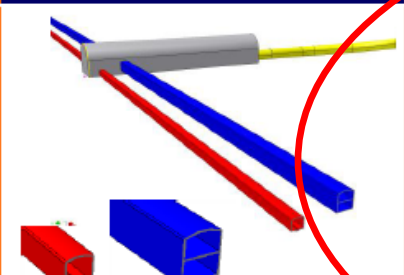
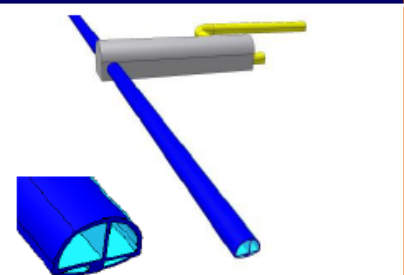
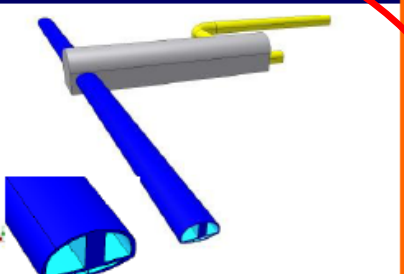


## *Tunnel Plan of Japanese Mountain Site Development by Japanese CFS Team*

- ***Japanese CFS Team got a Budget to develop Japanese Site CFS in FY2010.***
- ***There reported the Plan which includes the NATM Method for Tunnel Excavation in May 23, 2011.***
- ***There were several interested points which had more advantages than TBM.***
- ***Some difficulties which involved in the single tunnel DRFS before were potentially solved and we started the design based on this tunnel layout.***

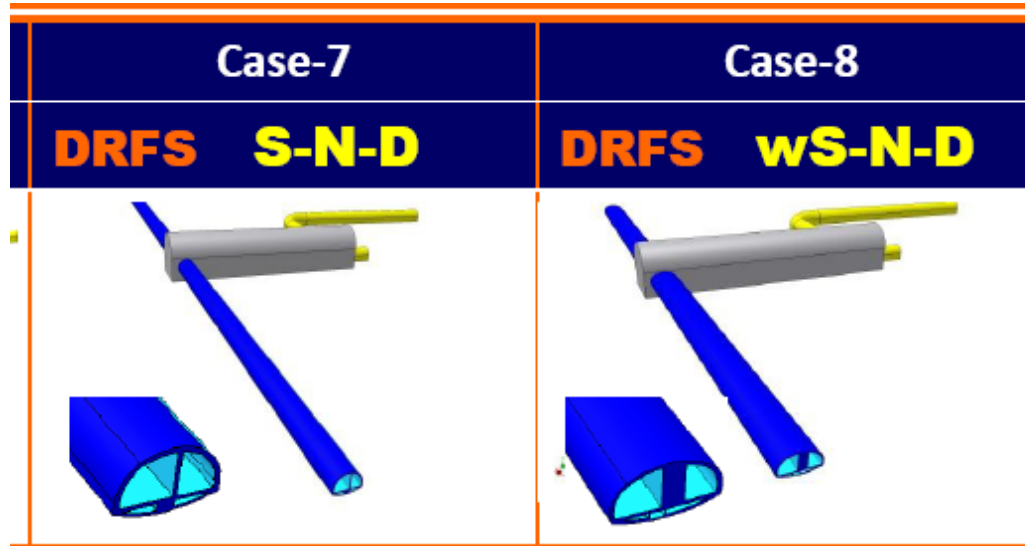
## 2. Model Compared

### 8 Schemes : Case Study for MLT Cost Estimate

Case-1	Case-2	Case-3	Case-4
<b>RDR D-T-R</b>	<b>RDR' S-T-R</b>	<b>XFEL JS-T-X</b>	<b>KCS JS-T-K</b>
			
Circle/Twin T	Circle/Single T	Circle/Single T	Circle/J. Single T
Case-5	Case-6	Case-7	Case-8
<b>DRFS JS-T-D</b>	<b>DRFS JS-N-D</b>	<b>DRFS S-N-D</b>	<b>DRFS wS-N-D</b>
			
Circle/J. Single T	Bullet/J. Single T	Wagon Roof/Single T	Wagon Roof/Single T

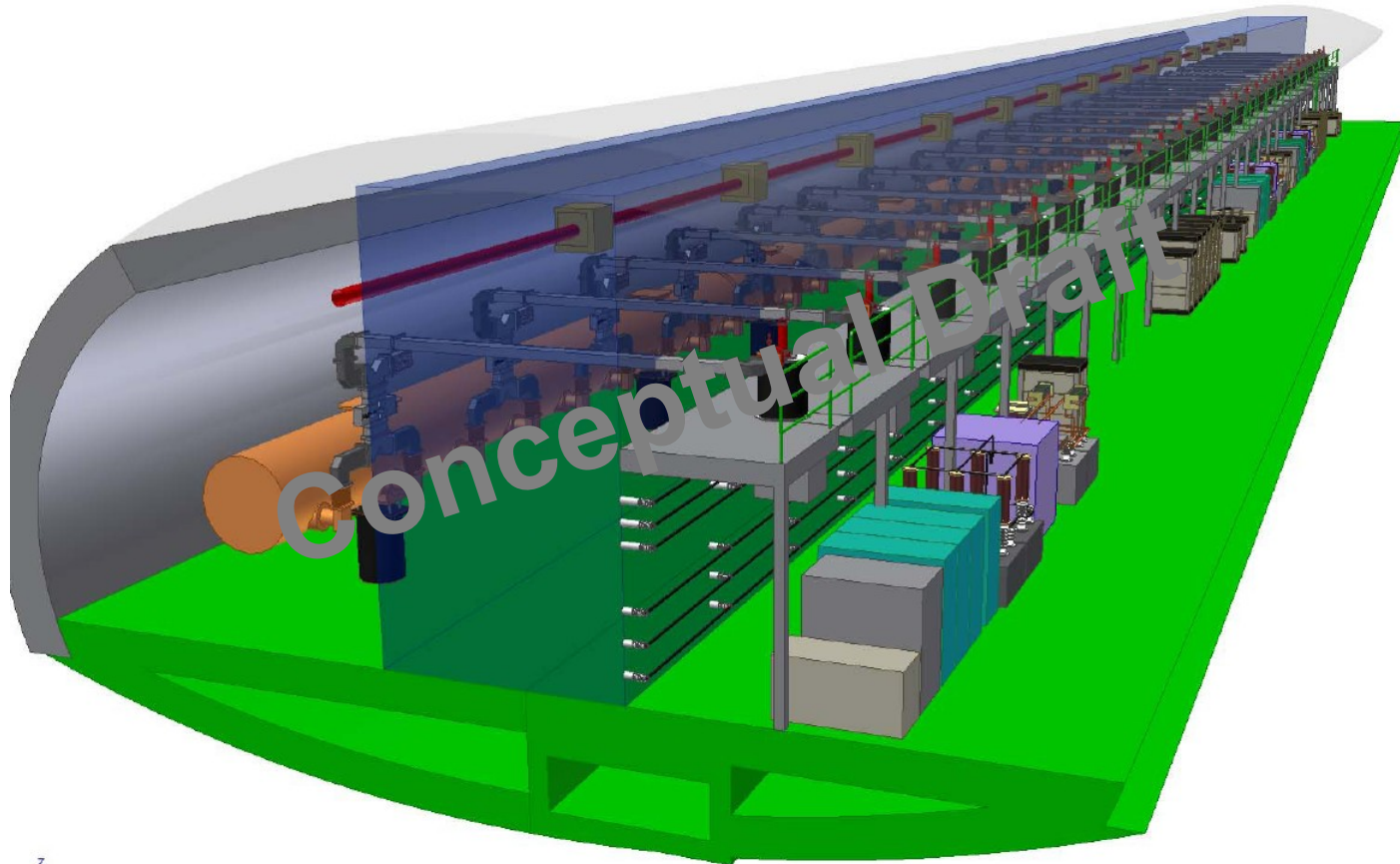
## Benefits of Wagon-Roof Type Tunnel

- Cost Benefit in the Mountain Region such as Japanese Site
- Some Cases Reasonable Construction Period comparing with TBM
- Wider Cross Section of the Tunnel comparing with TBM
- Case-8 was adopted to new DRFS application



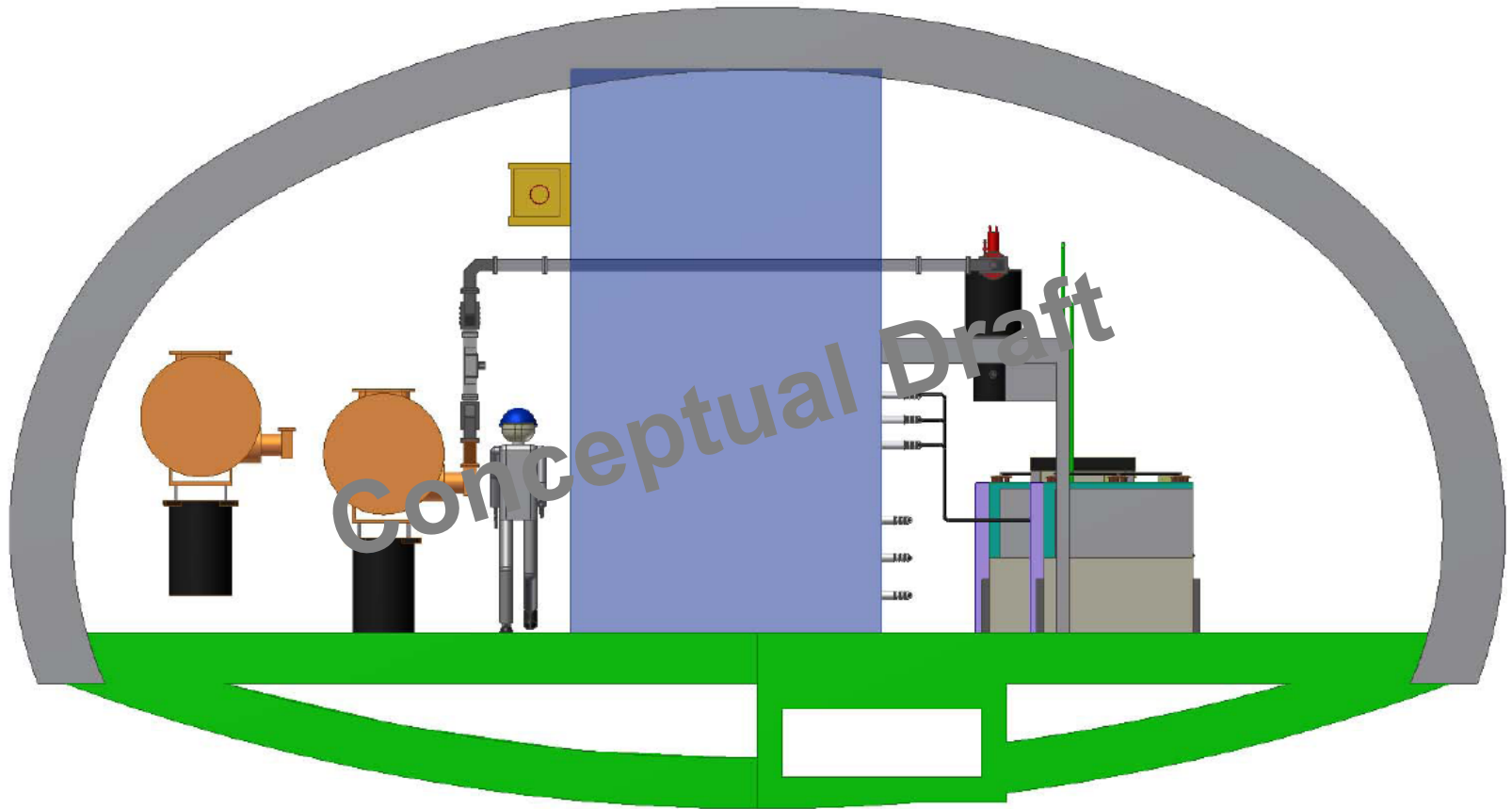


# DRFS Conceptual Layout Using New CFS Plan (Bird's Eye View)





# DRFS Conceptual Layout Using New CFS Plan (Cross Section View)





## Characteristics and Benefits for the New Tunnel Layout

- *CFS team says there are no serious cost-up when the **shielding material (Wall) was set in the middle of the tunnel.***
- *This has big advantages for the radiation shield issues. Electric parts and equipment are protected from the large radiation dose and life time is prolonged.*
- *There is a possibility that the engineers can enter to maintain the system during the operation. This enables us the another scenario for the AD&I issues.*



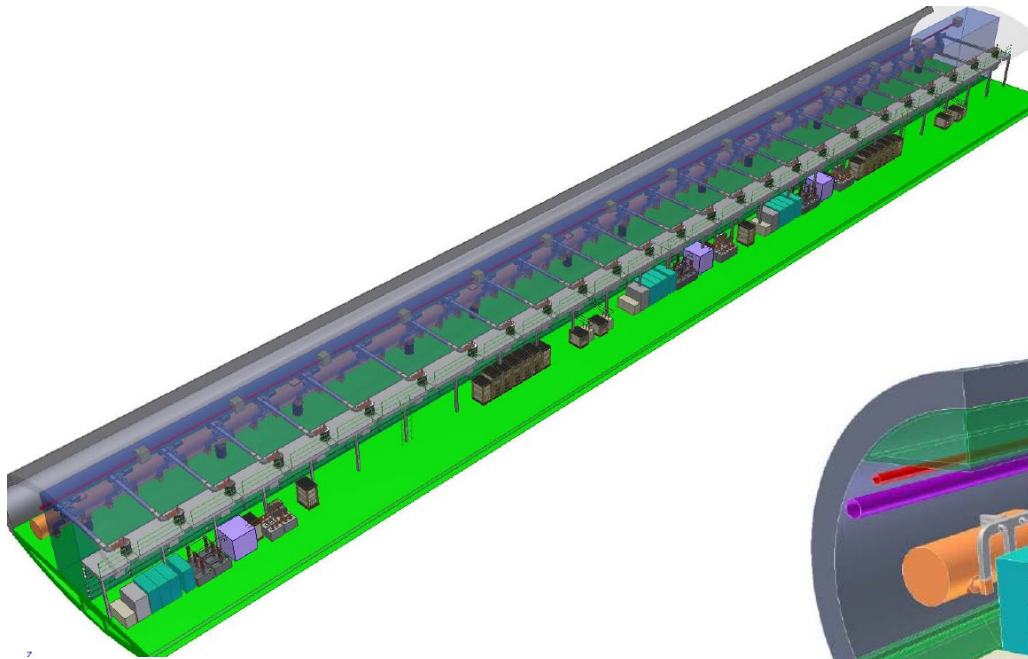
## ***Characteristics and Benefits of DRFS for the New Tunnel Layout***

- ***By adopting the 2-layer scheme of electric equipments and klystrons, there are lot of free footprint space.***
- ***There are large spaces for the z-direction***
- ***Power Distribution System (PDS) becomes simple again and has a cost benefit.***
- ***Cryomodules are installed on the floor.***
- ***PDS has a space to replace a magic-T to a variable hybrid, if there are requirements in the case of cavity deterioration.***

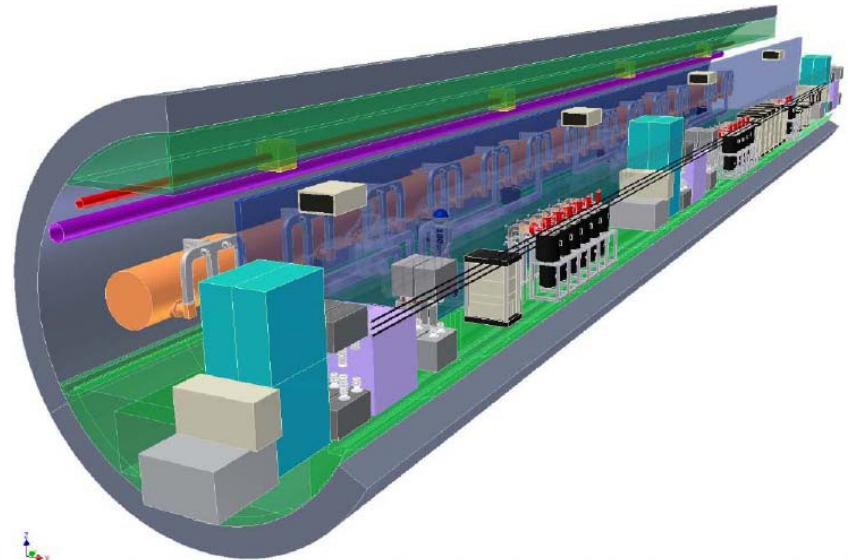




# Comparison between the old and new configuration



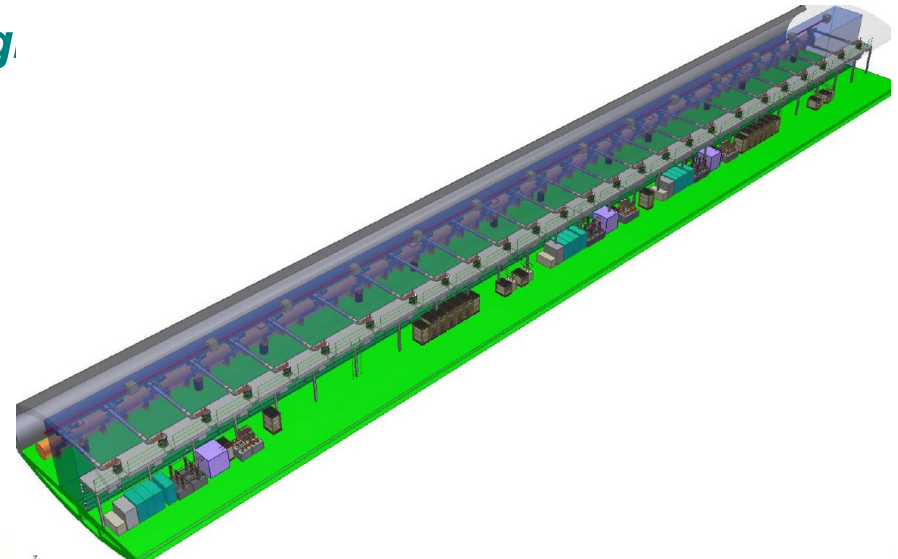
New Configuration



Old Configuration

## *Another merits for the tunnel layout*

- In every 4 RDR units (150m), we have a space to set skid etc. and possible to eliminate local cavern.*
- In every 150m or more, we can set the passage from accelerator tunnel to service tunnel.*
- If man can enter to service tunnel during the operation, it is possible to eliminate stand-by module of DRFS power supply and has a g. cost benefit.*



## Summary

- *We have just started the layout design based on the new NATM tunnel for Japanese site, and there are a lot of checking the concerned issues.*
- *More detail report including cost, period of construction and site dependence are required by the CFS team.*
- *For the first glance of design, there are lots of advantages for DRFS system and further detailed design should be proceeded.*