

# Current Status of CFS Drawings

## CR Tunnel Configuration

M. Miyahara /KEK

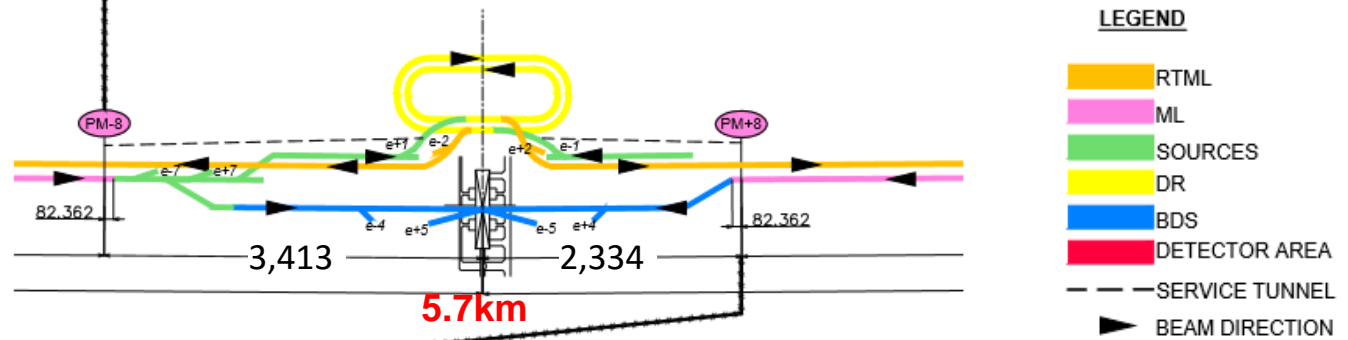
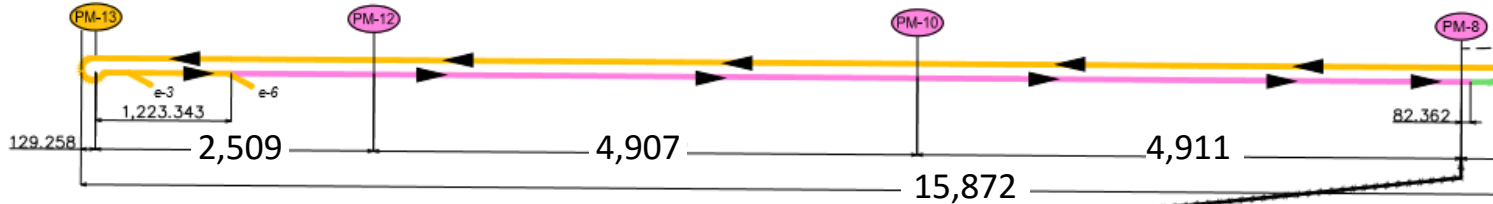
ECFALC2016 at Santander, May 31

# Contents

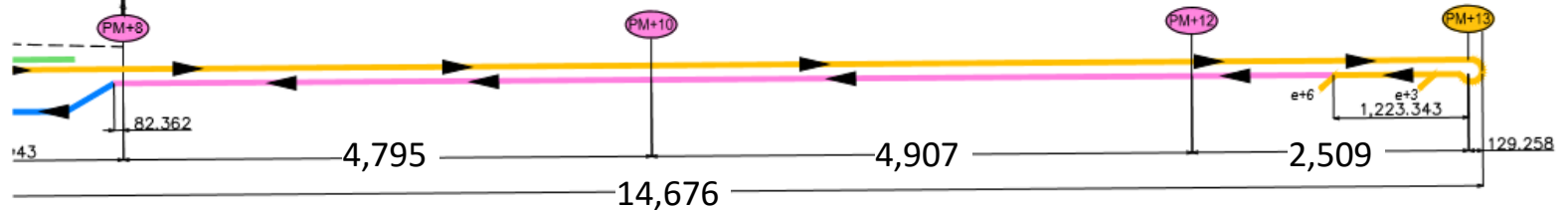
- Overview of Asian CR Tunnel Configuration  
Twin tunnel & Single tunnel
- Cost Comparison Study  
Preliminary study as a starting point

# Area Designation – Key Plan

## ***e- MAIN LINAC***



## ***E+ MAIN LINAC***

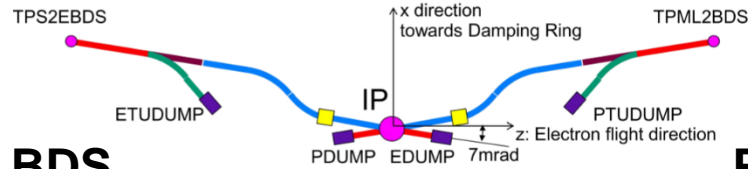


# ILC Beam Delivery System Beamlines

## Conceptual Overview

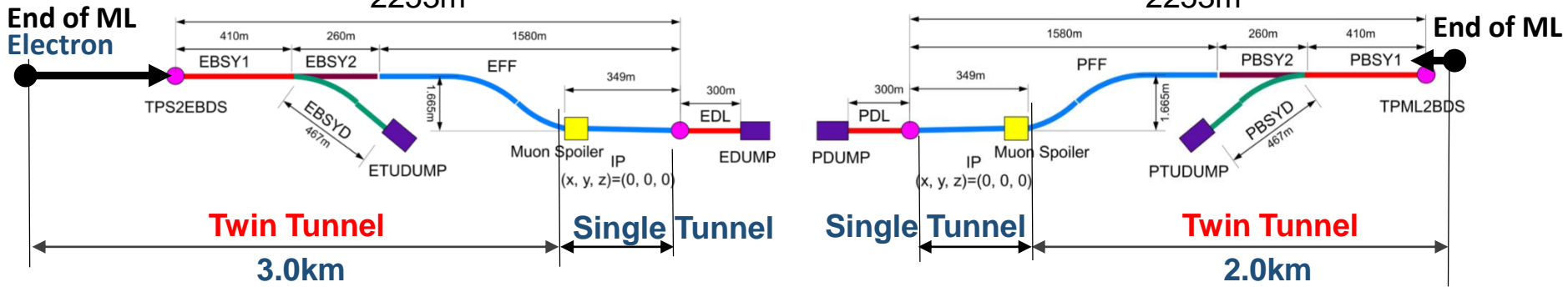
B.List,  
DESY-IPP24.2.2012

### BDS Overview



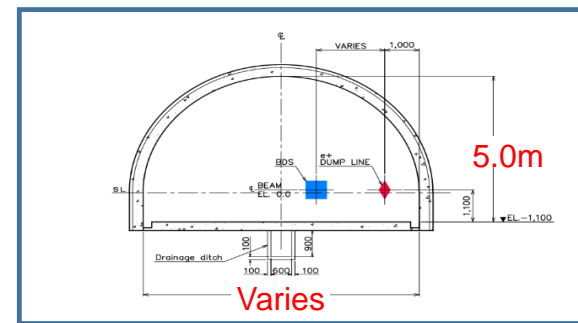
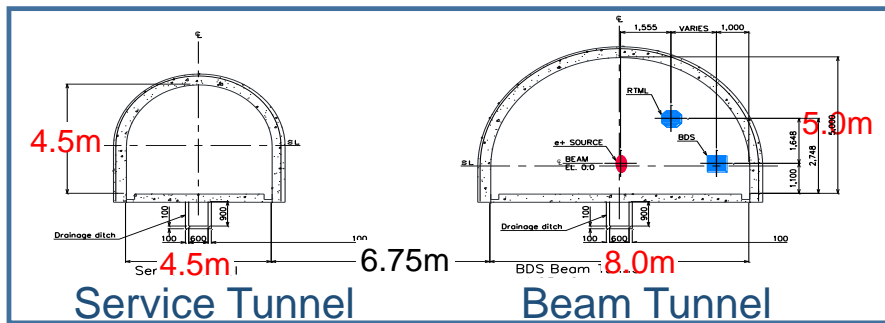
### Electron BDS 2253m

### Positron BDS 2253m



### Twin Tunnel

### Single Tunnel

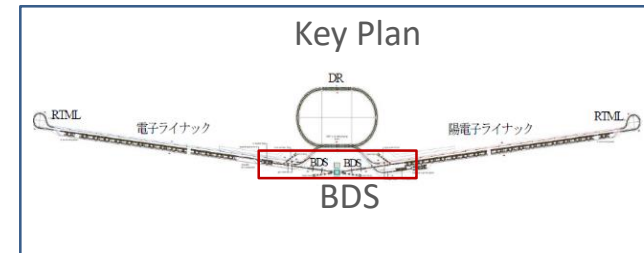
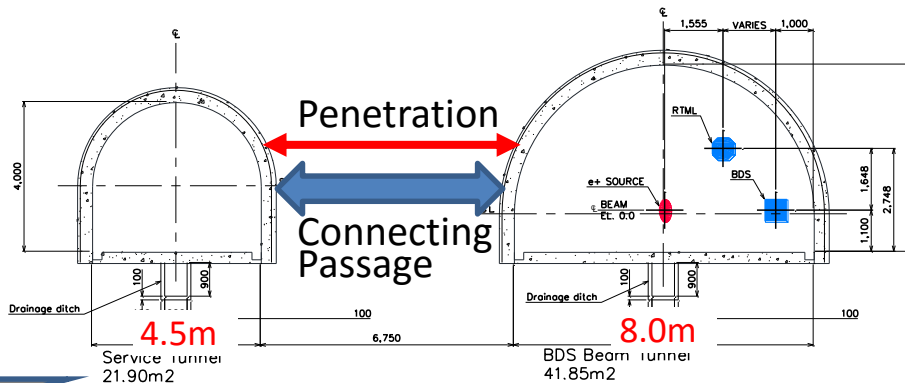


# BDS Tunnel Configuration

Pre-study

- From the twin tunnel in TDR, reconsideration to the single tunnel
- BDS group is currently reviewing the equipment layout

Baseline



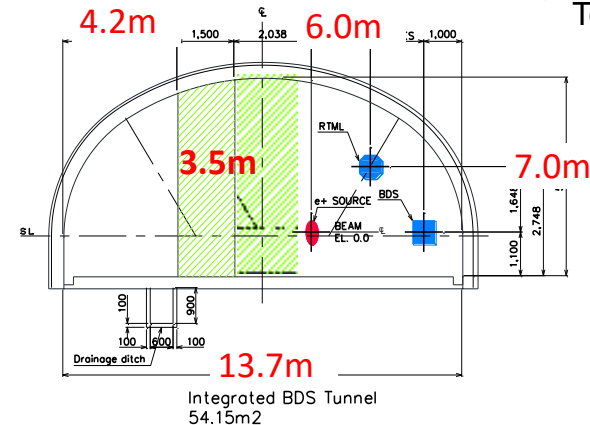
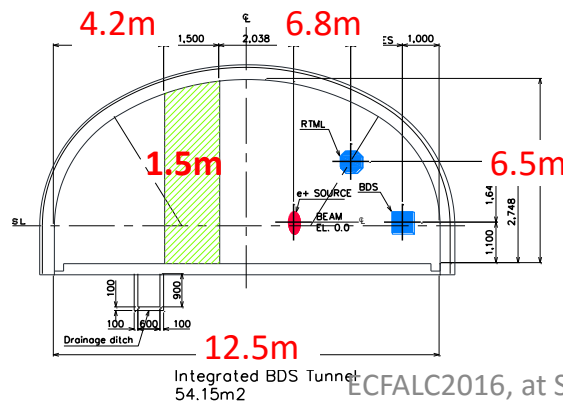
Integrated option\_A

Shield wall width : 1.5 m  
 BDS gallery : 6.8 m  
 Service gallery : 4.2 m  
 Total 12.5 m

Integrated option\_B

Shield wall width : 3.5 m  
 BDS gallery : 6.0 m  
 Service gallery : 4.2 m  
 Total 13.7 m

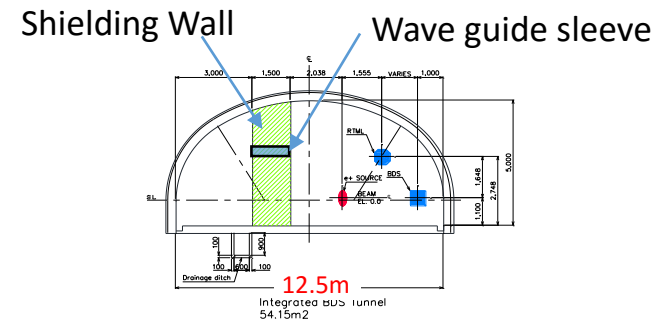
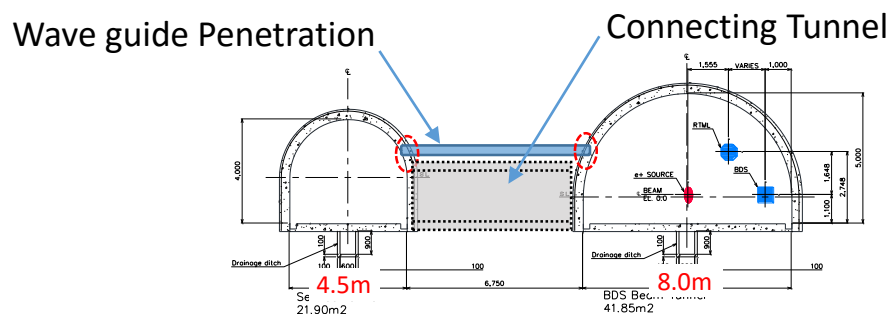
Revision



# Merit & Demerit of Two Schemes

## Twin tunnel and Single tunnel

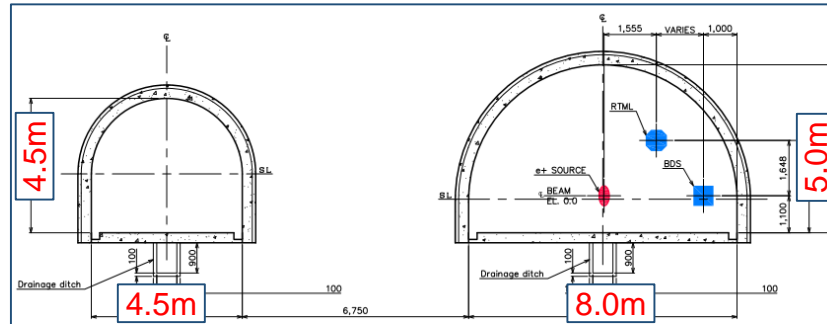
Item	Twin Tunnel	Single Tunnel
Const. Schedule	Slightly longer	Slightly shorter
Const. Cost	<ul style="list-style-type: none"> <li>- Depend on the cross section dimension (Width &amp; Height)</li> <li>- Great impact depending on the penetration</li> </ul>	
Functional characteristics	<ul style="list-style-type: none"> <li>- Need the <b>Penetration</b> for: Wave guide, Cable, Plumbing</li> <li>- <b>Connecting Tunnel</b></li> </ul>	<ul style="list-style-type: none"> <li>- Sleeve for wave guide</li> <li>- Small Passage</li> </ul>
	No shield wall	Necessity of shield wall
	Waterproof Difficulty	



# BDS Tunnel Configuration Study

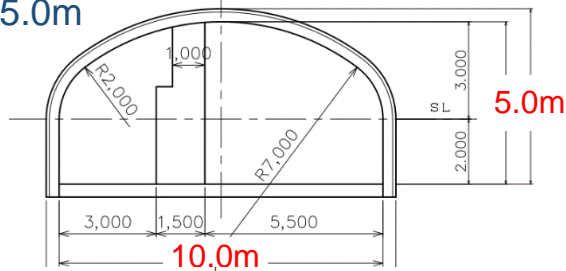
## TDR Baseline

BT- W8.0m\*H5.0m  
ST- W4.5m\*4.5m



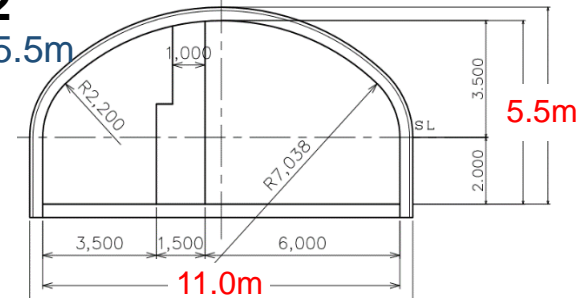
## Option-1

W10.0m\*H5.0m



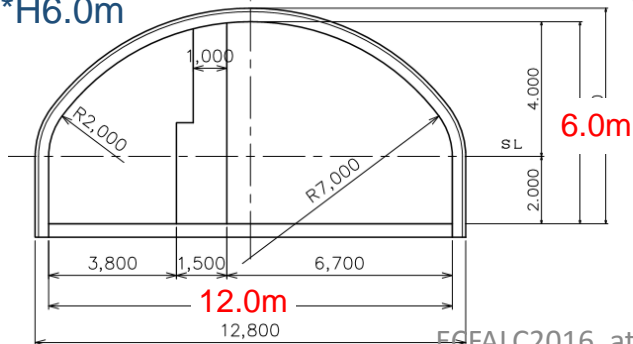
## Option-2

W11.0m\*H5.5m



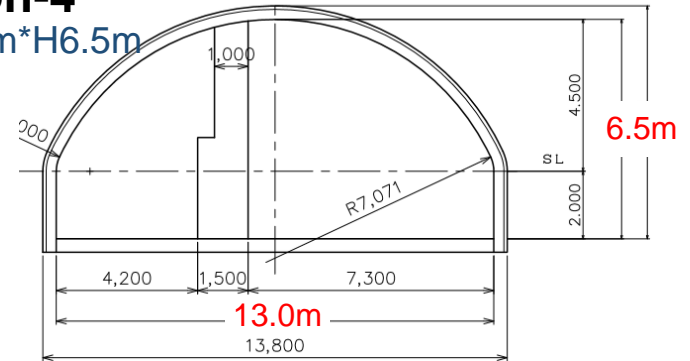
## Option-3

W12.0m\*H6.0m



## Option-4

W13.0m\*H6.5m



# CR Tunnel Construction Cost Study

## Cost Comparison of Twin-tunnel & Single-tunnel

■ Latest study including the cost of Penetration & Connecting passage

	Baseline		Option_1 w10.0, h5.0		Option_2 w11.0, h5.5		Option_3 w12.0, h6.0		Option_4 w13.0, h6.5	
	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY
<b>Beam Tunnel</b>										
<b>Width (m)</b>	8.0		10.0		11.0		12.0		13.0	
<b>Height (m)</b>	5.0		5.0		5.5		6.0		6.5	
<b>Excavation</b>	41.9	1,220	54.5	1,510	63.7	1,730	73.2	1,950	83.1	2,180
<b>Shield W</b>	-	-	-	410	-	425	-	440	-	455
<b>Sub total</b>		1,220		1,920		2,155		2,390		2,635
<b>Service Tunnel</b>	4.5		-		-		-		-	
<b>Excavation</b>	21.9	890	-	-	-	-	-	-	-	-
<b>Sub total</b>		890		-		-		-		-
<b>Penetration</b>		860								
<b>Connecting tunnel</b>		80								
<b>Sub total</b>		940								
<b>Total unit cost</b>		3,050		1,920		2,155		2,390		2,635
<b>Cost impact (L=5,040m)</b>		15,372 MJPY		9,677 MJPY		10,861 MJPY		12,046 MJPY		13,280 MJPY
<b>Ratio</b>		100%		63%		69%		78%		86%

➤ Notice: Cost of TDR Baseline include the construction cost of the **Penetration & Connection Passage**

**Confidential**



# Summary

- This time cost study is still rough estimate just civil works.  
(including the penetration for wave guide and connecting passage)

This study result:

The Single tunnel cost is considerably lower than the Twin tunnel with the Penetration

- To optimize the tunnel structure in CR (BDS):

We (CFS) need the following requirement:

- Overall layout plan of various accelerator equipment.
- Tunnel dimension in the local area such as Collimation, Beam Source, Beam Dump, Muon wall & Muon spoiler, etc.
- Energy supply facilities including Cryogenics.
- Solution of the machine Installation and maintainability.
- Shielding structure, Safety issues (Evacuation)

# Appendix

# Construction cost comparison of Twin tunnel & Single tunnel

- In case of Twin-tunnel scheme:  
We should Compare the total cost of twin tunnel construction  
Total cost = Tunneling + Penetration + Connecting Tunnel

Assumption on the estimate:

- Outline of the Penetration construction for wave guide
  - Grouting for groundwater proofing
  - Horizontal boring of bedrock;  $\Phi 500$ -L7.0 m
  - Steel pipe casing;  $\Phi 300$
  - Number of work places; 35places/km (@4.5 unit of Cryomodule)
- Connecting Tunnel (For utility use and refuge) :
  - Cross-section: w2.5m  $\times$  h2.5m
  - Construction interval: @200m
  - Concrete wall finishing:
  - Shielding door, Fire protection door, etc.

# CR Tunnel Construction Cost Study

## Cost Comparison of Twin-tunnel & Single-tunnel

■ This table showed at the **CRWG-Mini workshop** in Apr. 2016

**Confidential**

	Baseline		Option_1 w10.0, h5.0		Option_2 w11.0, h5.5		Option_3 w12.0, h6.0		Option_4 w13.0, h6.5	
	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY	Qt. m3/m	Amount kJPY
<b>Beam Tunnel</b>										
<b>Width (m)</b>	8.0		10.0		11.0		12.0		13.0	
<b>Height (m)</b>	5.0		5.0		5.5		6.0		6.5	
<b>Excavation</b>	41.9	1,220	54.5	1,510	63.7	1,730	73.2	1,950	83.1	2,180
<b>Shield W</b>	-	-	-	410	-	425	-	440	-	455
<b>Sub total</b>	1,220		1,920		2,155		2,390		2,635	
<b>Service Tunnel</b>	4.5		-		-		-		-	
<b>Excavation</b>	21.9	890	-	-	-	-	-	-	-	-
<b>Sub total</b>	890		-		-		-		-	
<b>Total unit cost</b>	2,110		1,920		2,155		2,390		2,635	
<b>Cost impact (L=5,040m)</b>	10,634 MJPY		9,677 MJPY		10,861 MJPY		12,046 MJPY		13,280 MJPY	
<b>Ratio</b>	100%		91%		102%		113%		125%	

➤ Notice: Cost of TDR Baseline does not include the **Penetration Cost**

➤ BDS service tunnel length  
 e+ : 2,330 m - 350 m = 1,980 m  
 e- : 3,410 m - 350 m = 3,060 m  
 Total approx. 5,040 m