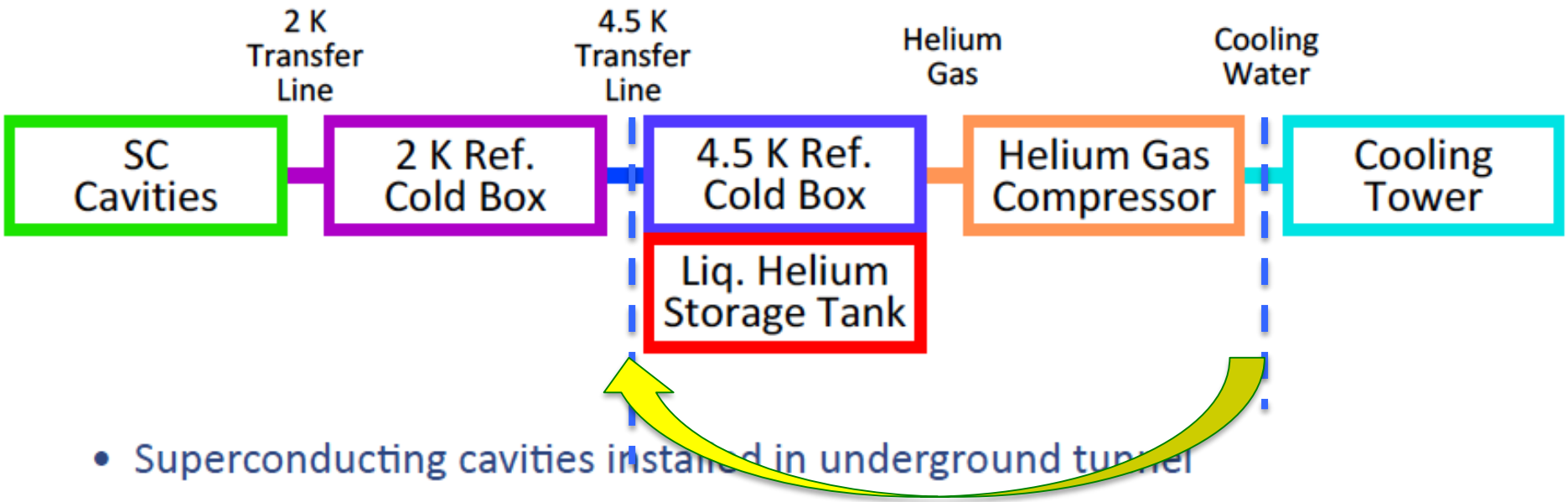
ILC Cryogenics Layout: A draft consensus for the Change Request

CFS and Cryogenics Two-days Workshop at CERN

27 and 28, July, 2015

Basic Components of Cryogenic Systems

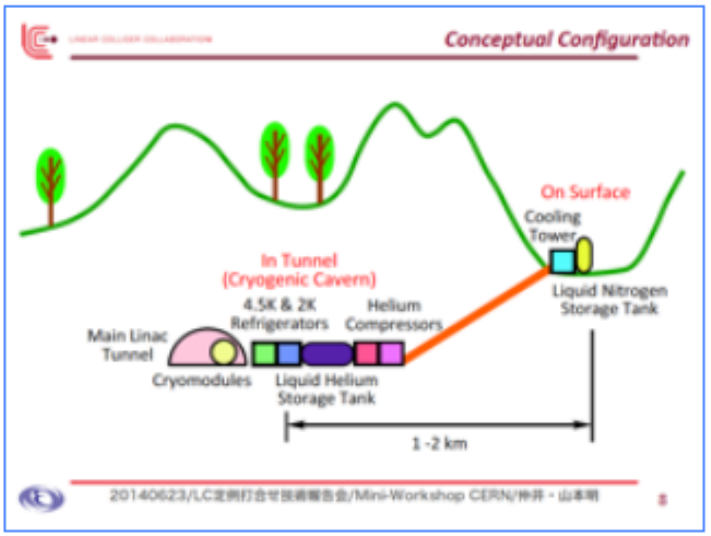


- Superconducting cavities installed in underground tunnel
- 2 K refrigerators required for keeping of 1.3 GHz cavities at or below 2 K
- Cooling at or below 2 K requires 4.5 K refrigerators
- Most of electric power for cryogenic systems consumed by helium compressors
- Heat removal necessary for heat generation at helium compressors as much as consumed electric power (cooling water, cooling towers)

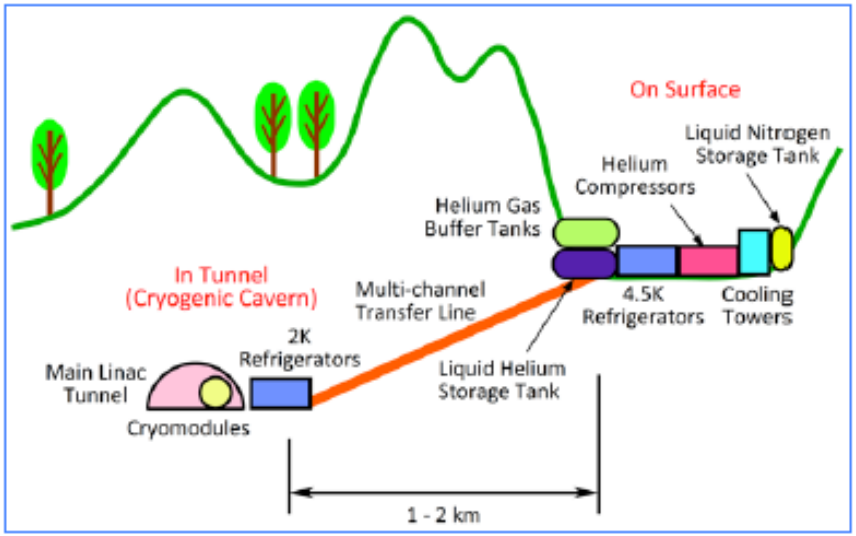
Change Request, to be submitted

Main Cryogenics Layout on Surface

ILC-TDR Baseline

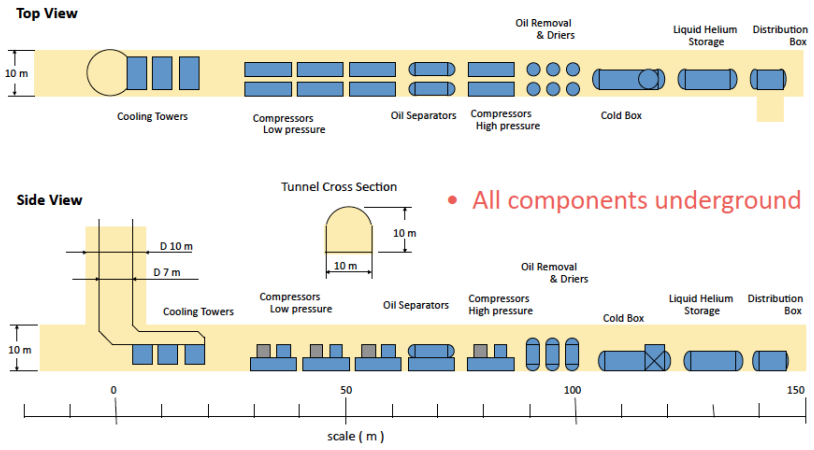


New Baseline to be proposed to CMB



LINEAR COLLIDER COLLABORATION

Cryogenic Component Configuration (1)

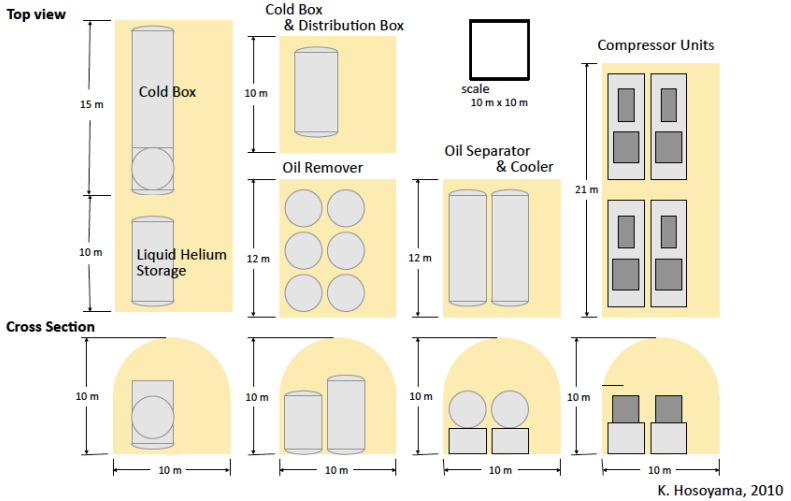


- All components underground

K. Hosoyama, 2010

LINEAR COLLIDER COLLABORATION

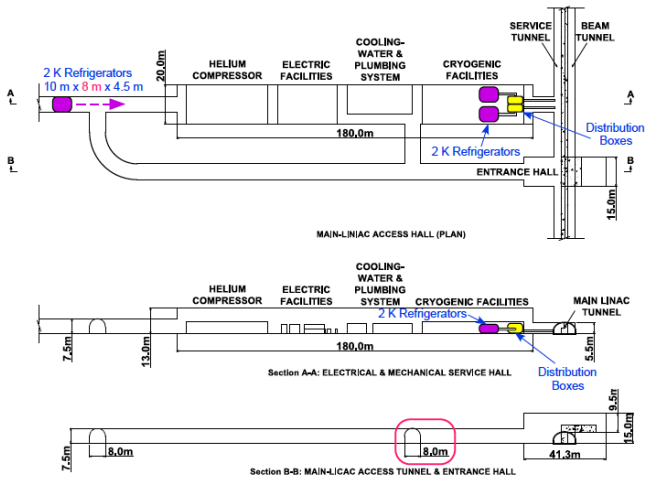
Cryogenic System Components



K. Hosoyama, 2010

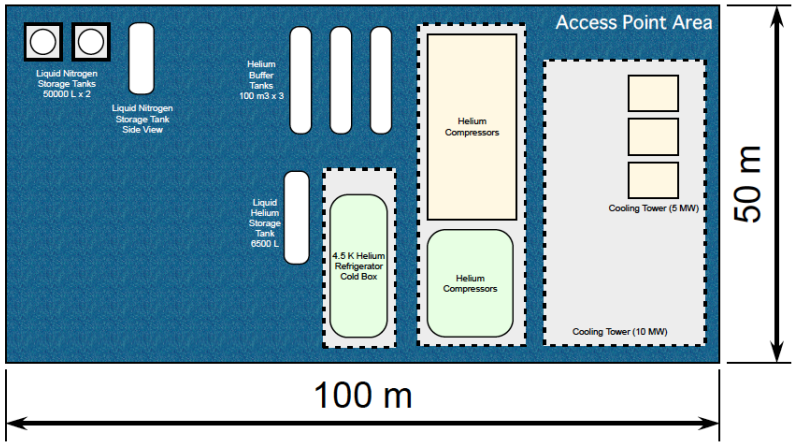
LINEAR COLLIDER COLLABORATION

Cryogenic Components in Cryogenic Cavern



LINEAR COLLIDER COLLABORATION

Cryogenic Components on Access Point Surface



Some Comparisons

ILC – TDR Baseline

Main components underground

Features:

- Scenic preseravation on surface
- No major cryo-transfer-line
- Lower cryogenic operational cost because of no 1 km transfer line.
- A cost driver: Covern:

  13m(w) x 180m (l) x 10m(h)

  =23,000 m^3

New Baseline in preparation

May components on surface

Features:

- Safety
- Accessbility in daily operation
- No concern for MC vibration
- He storage flexibility
- Smaller acess tunnel sizee because of no installation of 4.5 K Cryo-plant Under G.
- A cost driviers:
- Saving caver cost:

  → 23,000m^3x 0.5 = ~ 11,500 m^3

  → 200 CHF/m^3 x 2.30E4 = 2.3 MCHF
- Additional transfer line cost:

  → 2 kCHF/m x 1,000 m = 2 MCHF

Summary

- All cryogenic components except 2 K refrigerators and distribution boxes will be installed on surface
- Cryogenic components on surface and underground will be connected with multi-channel transfer lines
- Consideration of scenic preservation for cryogenic components on surface is necessary
- Cost can be reduced by constructing 10 identical cryogenic plants for main linacs
- Distribution boxes of two adjacent cryogenic plants may be interconnected for redundancy (but higher cost)
- Number of cryo strings for 1 cryo unit should be fixed to 21
- Total length of multi-channel transfer lines differs according to location
- Construction cost should be re-evaluated as cryogenic configuration change

Conclusion

- It has been a consensus to propose a new baseline cryogenics layout with major components located on surface,
- Cost balance is basically neutral (and to be further investigated,
- The Change Request can be submitted before LCWS2015.