MDI-CFS Meeting/20140905

Cryogenic System - Overview

LINEAR COLLIDER COLLABORATION

Designing the world's next great particle accelerator

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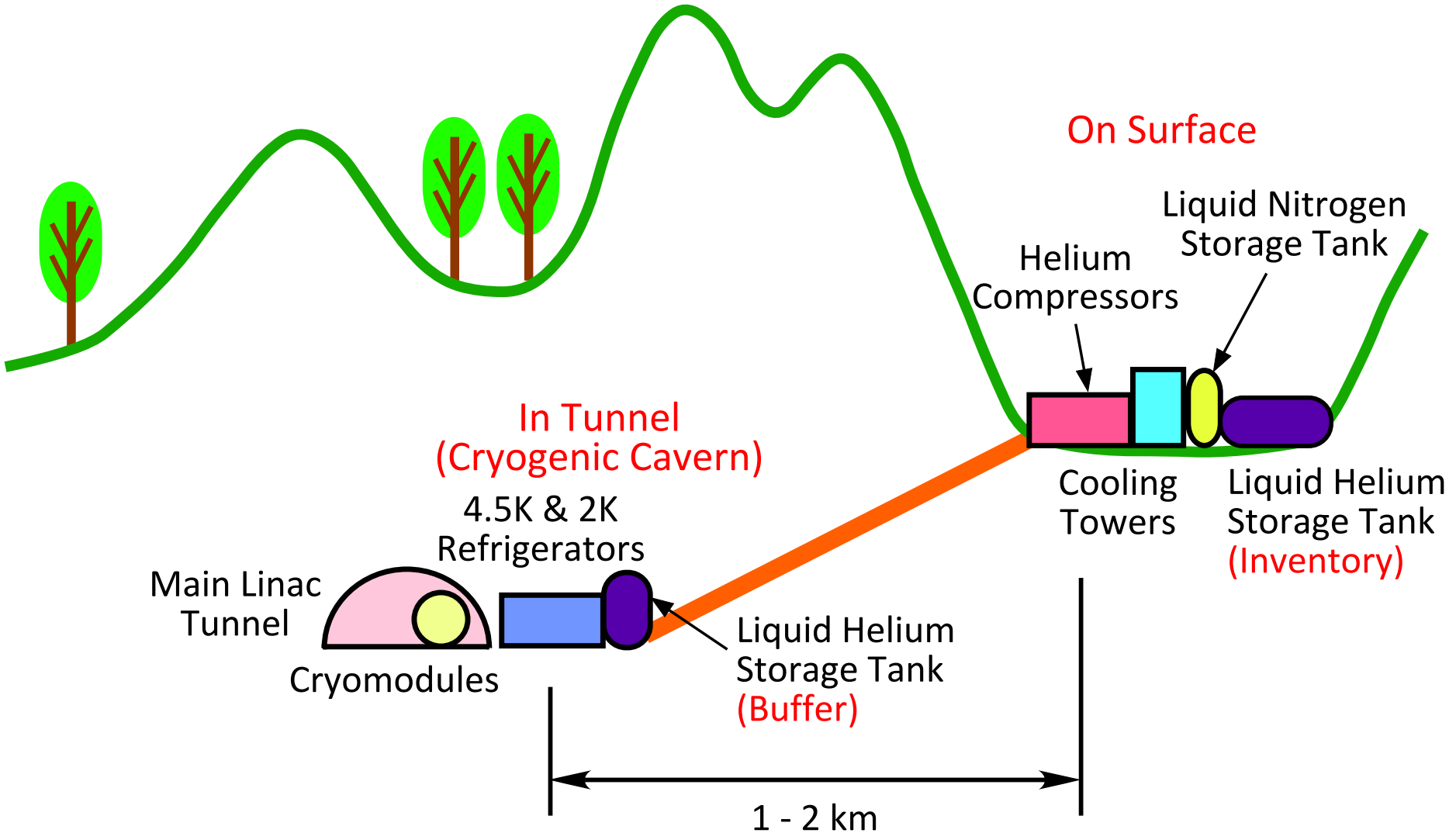
Main Subjects to Be Discussed

- **Optimum Cryogenics Layout**
  - Locations of main compressors and helium inventory, and possible variations from view points of
    - Safety for liquid and gas handling (helium and nitrogen), such as suffocation (anoxia) and radioactivation of helium (tritium)
    - Cost effective construction, operation, and maintenance
    - Preservation of natural environment (silence, scenery ...)
    - Mechanical vibration from compressors
- **Input to CFS design**
  - Within a period of ~ one year,
    - A goal to establish a basic consensus on the cryogenics layout, by LCWS-14, October, this year

Outcome from CERN Mini-Workshop in June (1)

- **Component Location:**
  - Surface: Compressor, main liquid and gas helium inventory storage tanks, and liquid nitrogen storage (CE),
  - Underground: Cold box, Distribution boxes, and small liquid helium dewars for buffering.
- **Compressor**
  - In addition to the main oil removal system, a switchable full–flow dryer may be integrated in the MC system for moisture removal. nitrogen gas is required for charcoal (oil vapor remover) and for dryer regeneration.
  - He gas evaporated from CM may be collected through safety/control valves, and the system may remain at medium pressure, during shutdown of the machine. It requires baby-sitter compressors.
  - It is advised not to use gas bags and high-pressure recovery compressors.
- **Helium Storage**
  - Liquid helium as primary storage and helium gas storage for flexible operation. A compact helium liquefier system is required to keep liquid and gas helium balance for a long shut-down.
  - Helium inventory to be received with LHe containers (for efficient transportation and handling).
- **Cold Box (CB)**
  - Cold box (4.5 K and 2 K) may be compound as a cost effective design.
  - No liquid nitrogen usage is advised from a safety view point.

Conceptual Configuration with Access Tunnel



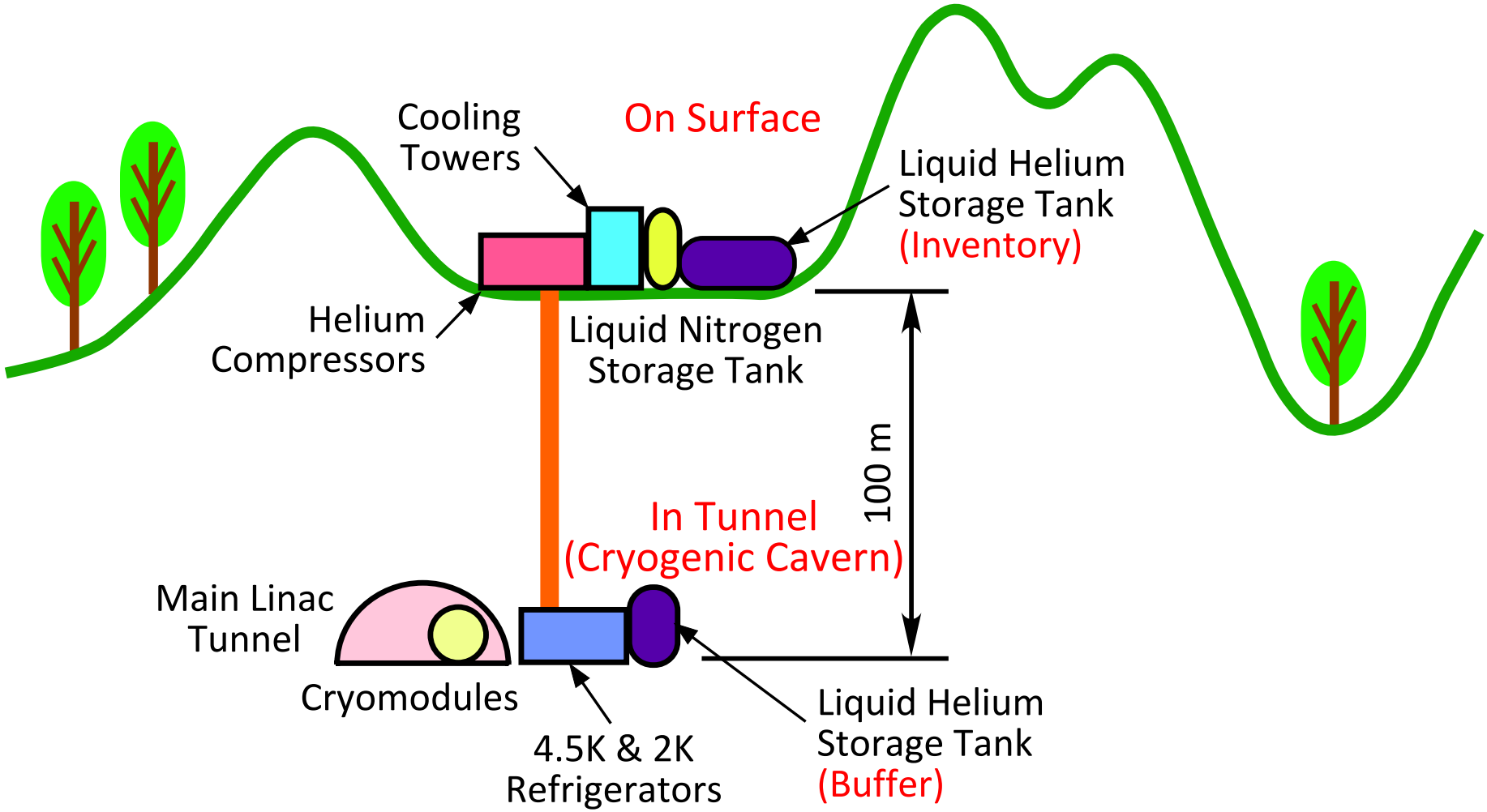
Outcome from CERN Mini-Workshop in June (2)

- **Accelerator and Detector Cryogenics at IP**
  - IP region cryogenics for detectors and accelerator, the compressor station may be unified, and the cold box locations may be optimized dedicated depending on the operational features and cold-mass inertia.
- **Energy Efficiency**
  - It may be important to innovate efficient ways of using thermal energy from compressors operation, according to "Green energy" concept.
- **Safety**
  - Safety condition at underground cavern may become much relaxed, based on the consideration above, although the safety condition remain unchanged in accelerator runnel

Outcome from CERN Mini-Workshop in June (3)

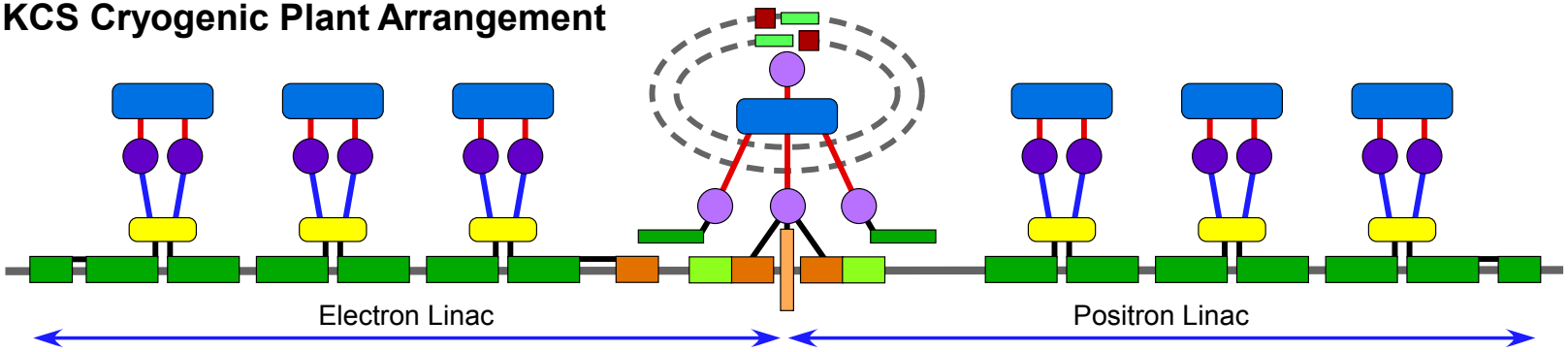
- **Civil Engineering**
  - Cryogenics can accommodate either with vertical or horizontal shaft. The driving force should be detector's installation scenarios.
  - The size of the tunnel or shaft cross section needs respect to the biggest object to be transported, and it will be probably the cold box (5 - 6 m high) for ordinal accelerator access tunnels.
  - What will be the second one in size? This may have an influence on the civil engineering and installation order including piping (plumbing) work along the access tunnel.
  - The access tunnel needs to accommodate:
    - Helium medium pressure (supply), low pressure (return), and bypass gas lines, and liquid helium transfer lines, although cooling water pipes and electric cable lines could be eliminated.

Conceptual Configuration with Vertical Shaft



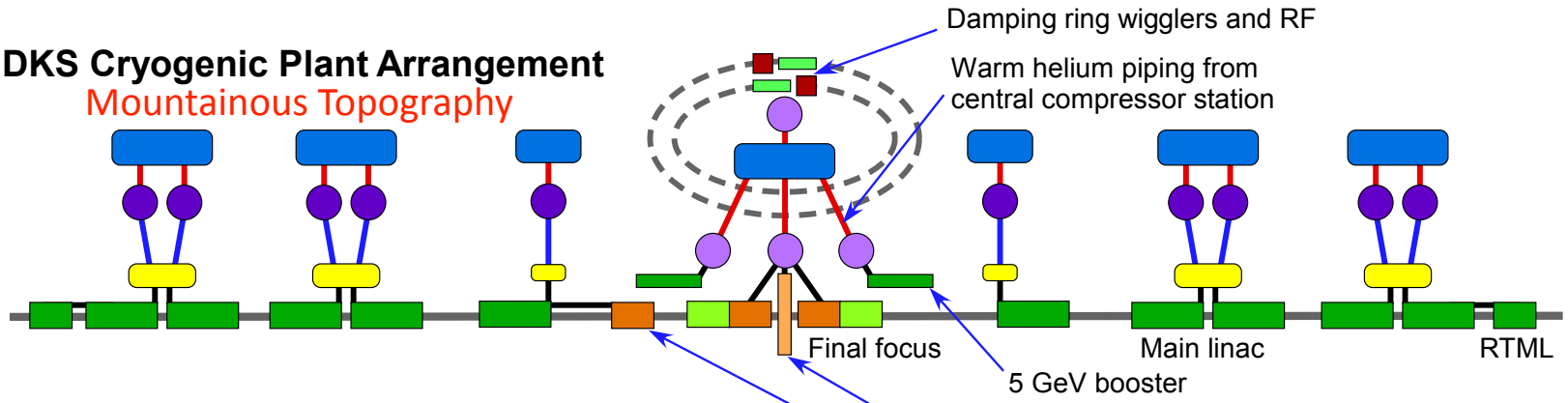
Overall Layout for Cryogenic Systems

KCS Cryogenic Plant Arrangement



DKS Cryogenic Plant Arrangement

Mountainous Topography



- Small 2 K and 4.5 K cryoplants
- Large 2 K cryoplants
- Helium compressor stations
- Cryogenic distribution boxes
- 1.3 GHz cryomodule strings
- Other SRF (damping ring and crab cavities)
- Superconducting magnets (wigglers, undulators, final focus)

Cited from ILC-TDR