

# Brief strategies and its Action Item (blue)

## 1. Total keeping inventory : 120 %

- GHE : 100 %
  - Buffer tank (max P=2.0MPa) vs high pressure cylinder bundle (max P=15MPa)
- LHE : 20 %
  - 20% of LHE is for the redundancy.
  - LHE storage dewar is centrally managed near the central campus (Where to install).
  - Dewar size ~ 120000L x 1 @ staging<sup>1</sup>

## 2. Pipeline connection between each cryo-plant/island and the LHE storage Dewar

- If inventory loss occurs in one plant, pipeline system to supply He gas from the LHE storage Dewar is required.
- Detail of the pipeline system is now under consideration.
  - Single
  - Outer Dia. 150mm

## 3. Refrigerator specialized for the LHE storage Dewar @ 120000L is considered.

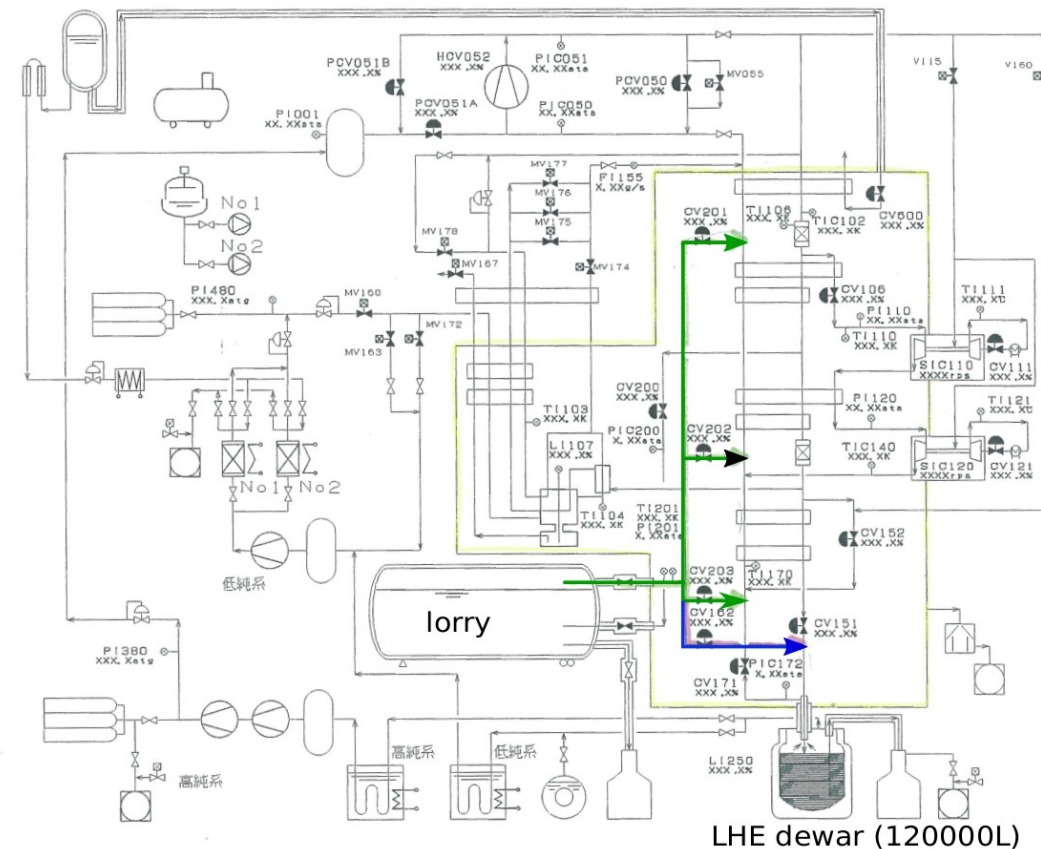
- for keeping the liquid level and temperature for long term.
- for receiving liquid helium from container (lorry)

# Buffer tank vs High-pressure cylinders/bottles

- **Buffer tank system is better.**
  - From viewpoint of high-pressure gas regulation.
    - System is (mostlikely) not “closed” and complicated.
  - From the technical view point.
    - Buffer tank system (middle pressure system)
      - Standard small screw comp can be employed.
        - 2520MSC-LBM (MYCOM) , 69.3g/sec, 332kW, 58t/h
    - High pressure cylinders/bottles
      - Dedicated oil removal system and purification system is needed.
      - Large multistage compressor system is also needed ( to obtain boil off mass flow rate of 70 g/sec during blackout).
      - Lack of redundancy (when some kinds of failures are occurred in the multistage compressors.)
      - \*In case of buffer tank system (with middle pressure), Even though some kind of trouble is occurred in the recovery comp, we can select a part of MC temporarily.
  - From the viewpoint of cost.
    - A large-scale multi-stage compressor is required to secure the evaporation flow rate (max 70 g/sec) during black out.
    - Multi-stage compressor for > 2520MSC-LBM (MYCOM) , 69.3g/sec, 332kW, 58t/h
    - Special oil removal and purification system for Multi-stage comp induces cost increasing.

# LHE Storage Dewar and its refrigeration system

- Dewar volume : 120000 L.
- Evaporation / day = 1%/day
  - corresponding cooling capacity :
    - 550W @ 4.5 K
  - The cold box has direct transfer mode from lorry to the Dewar.
  - Following figure is receiving mode of LHE from container (lorry)
    - Such kind of refrigeration system was already developed by LINDE and CERN.
  - Using such refrigeration system, LHE can be stored in the 120000L Dewar for a long term .
  - Maintenance procedure is also now under consideration.



→ Depending on the return gas, CV201, 202, 203 are open and closed.

→ Direct transfer mode from lorry to LHE dewar using JT (CV162).

- **Home-work:** if it can be allowed to be built under a category of "refrigeration system" or can be harmonized with the "refrigeration system". !!

# Pipe line design studies between each Cryo Island

- Pipe structure: single pipe
- **Boundary condition: Diameter 150mm**
- We are studying the flow conditions, pressure conditions, and operation methods that can be established for a diameter of about 150 mm.
  - For example, If the pressure drop is quite large through the long pipe line, some kind of pump to get the pressure head is installed in the pipe line.
  - Helium gas is charged into the tank by moving the MC to prevent backflow when the buffer tank pressure is higher than outlet press of the pipe.
  - More detail configuration is now under consideration with cryogenic company.