Status of Cryogenics Design for ATF2-SC magnet in KEK

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OUTLINE

- Progress of the cryostat design work
- R&D of Low Vibration Cooling System

Infrastructures (reminder)

- Infrastructures at ATF2

LHe supply	Very limited

(supplied only by dewar, from Cryogenics Science Center)

- It can be supplied for pre-cooling and re-cover for quench.

Cryogenics facility	None
Space for Liquefier around ATF	??
GHe recovery line	Yes
Human resource for cryogenics operation	None

We would like to propose our plan which can be operated under limited infrastructures at ATF2!! and can be consistent with BNL's magnet cooling design.

Proposed the cryogenics system at ATF2

- Cooling scheme @ ATF2
  - "A re-condensation cooling type" with low vibration Cryo-coolers
  - Vibration Control -> Mixture of LCGT scheme & SCGR scheme

Cooling scheme for 4K connection box at ATF2

Heat loads by Current leads into 4K level
300A x 4 leads (0.6 W, 0.15W/lead) by HTC conductor
20A x 10 leads (Total 0.56 W, 0.056W/lead) by Low RRR Cu

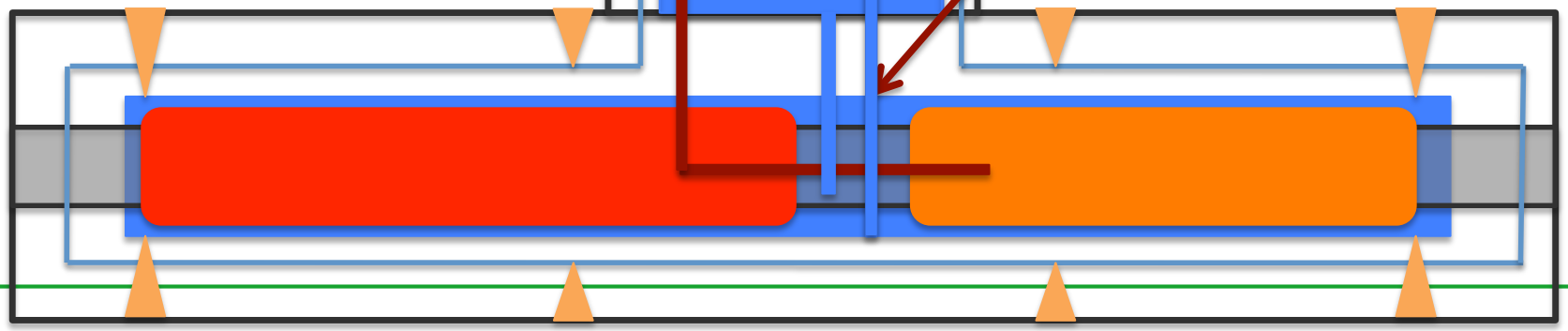
One 1.3W/4.2K Plus tube type cryocooler as 20K cooler

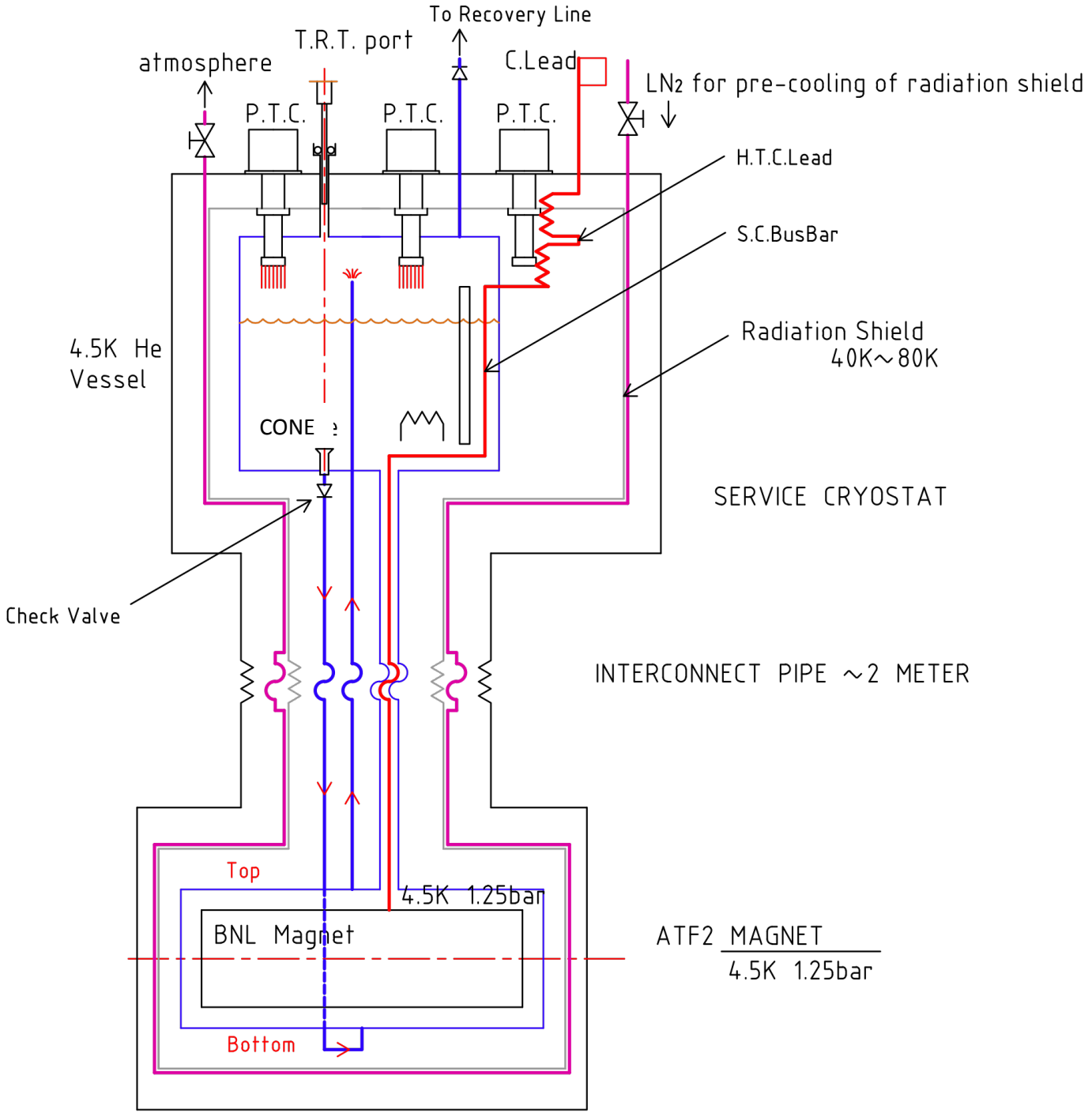
Three Plus tube type cryocooler will be mounted with low vibration mounting

Two 1.3W/4.2K Plus tube type cryo-coolers use as re-condensation cooler

Tubes for pre-cooling and thermo siphon mode

KEK's design responsibility





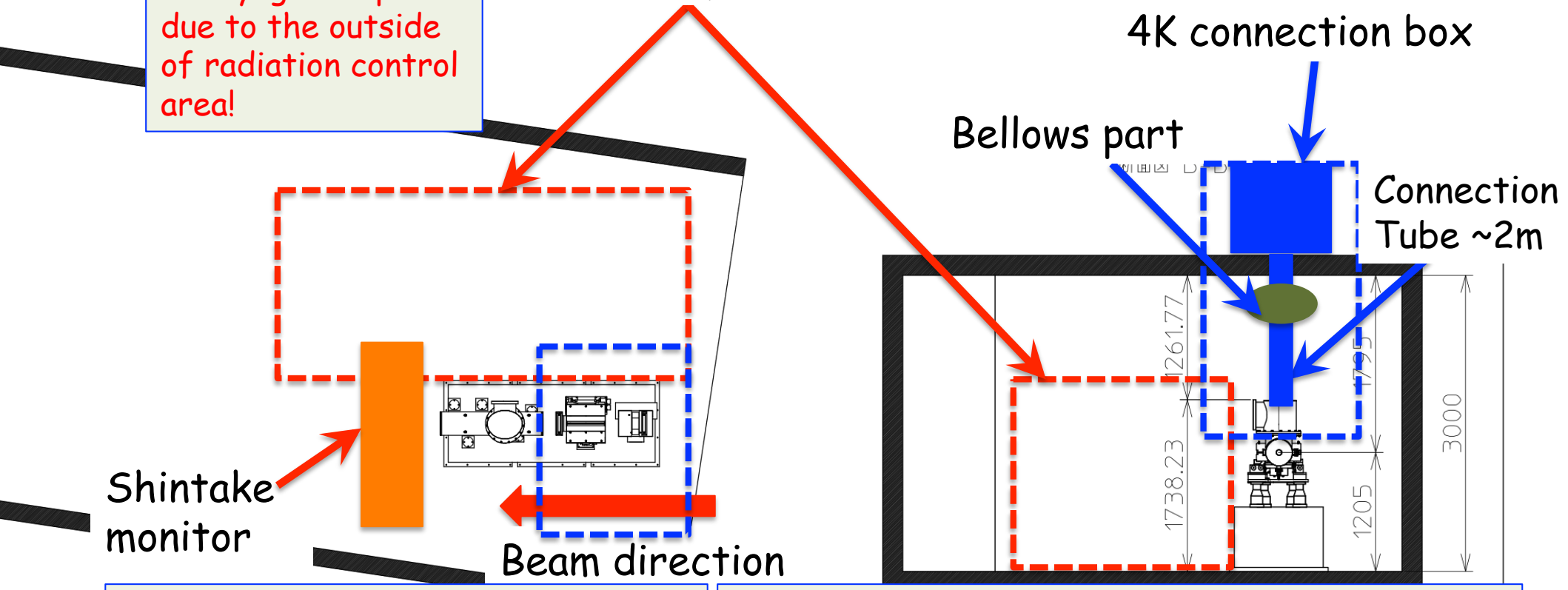
Flow diagram translated from the cooling scheme

Proposed set up plan in the tunnel at ATF2

Advantage one.
Easy maintenance of cryogenics part due to the outside of radiation control area!

For working and walking space

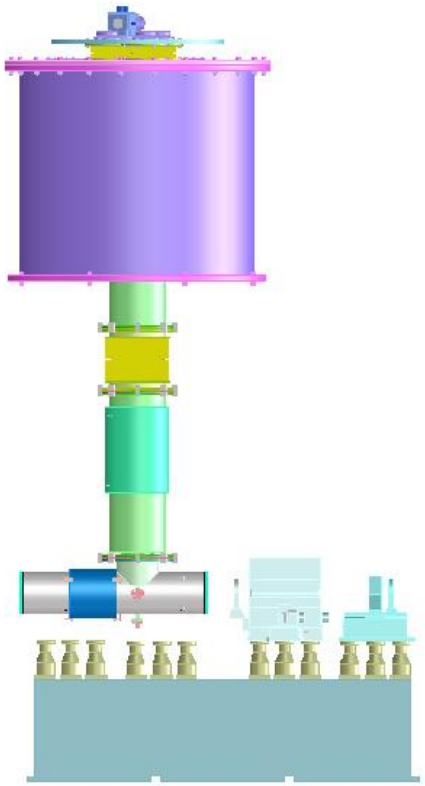
This is good solution at ATF2!

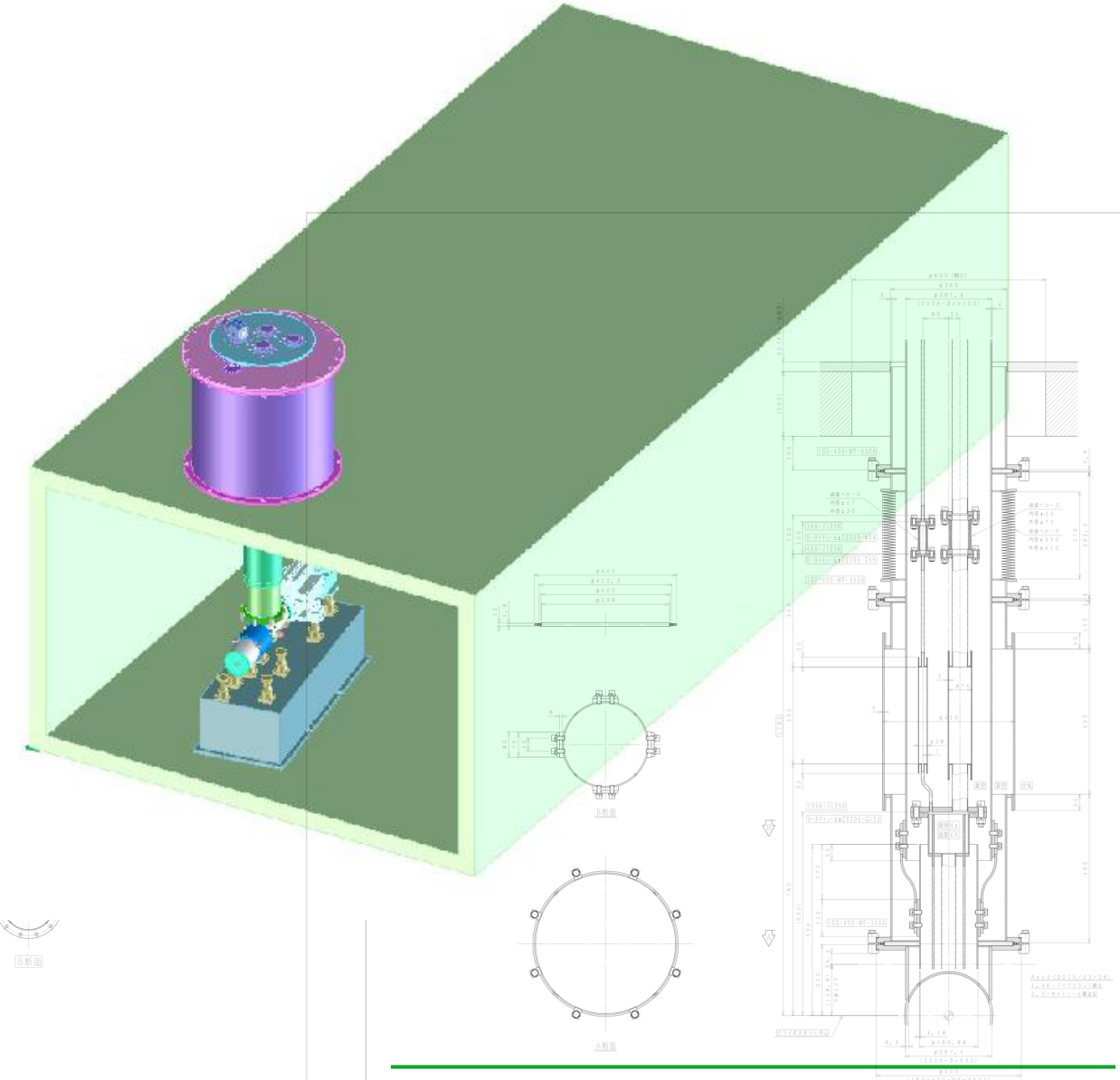


Advantage Two.
It easy to supply Lhe for pre-cooling and recovery after quench.

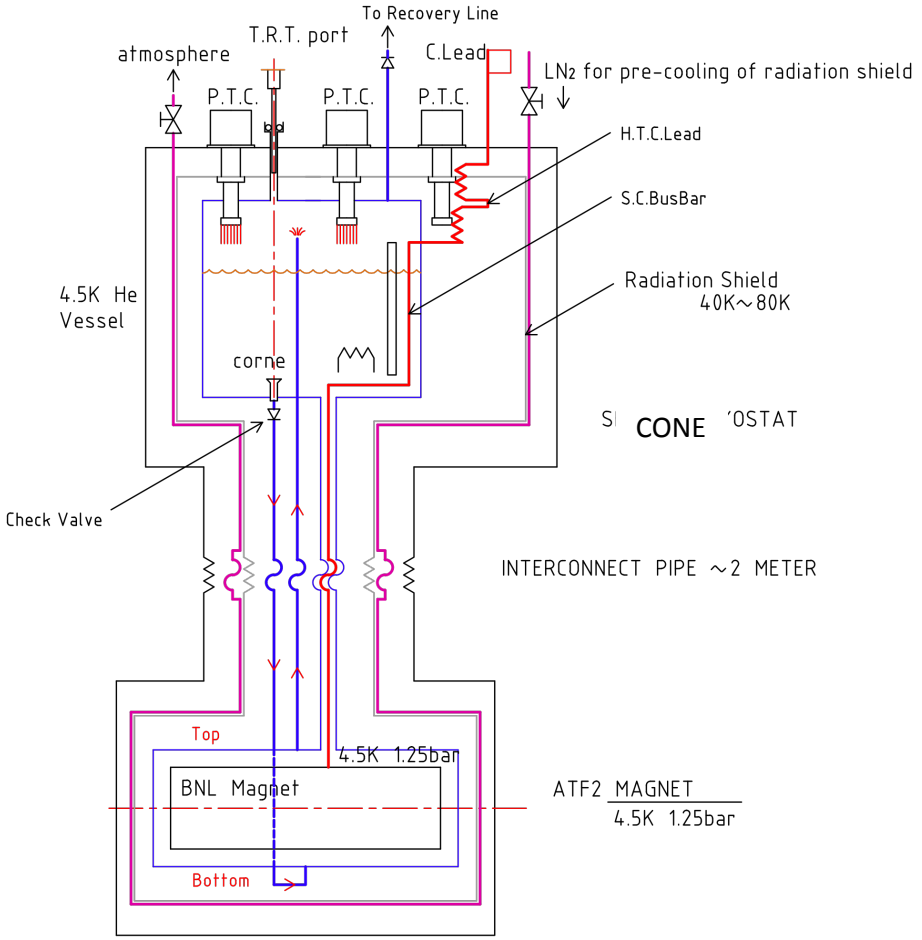
Advantage Three
To adopt the BOX with huge of mass of shield block, it will be reduced mechanical resonances.

Example of 3-D Design work for the Connection Box





Criteria of Design Parameters Part-1

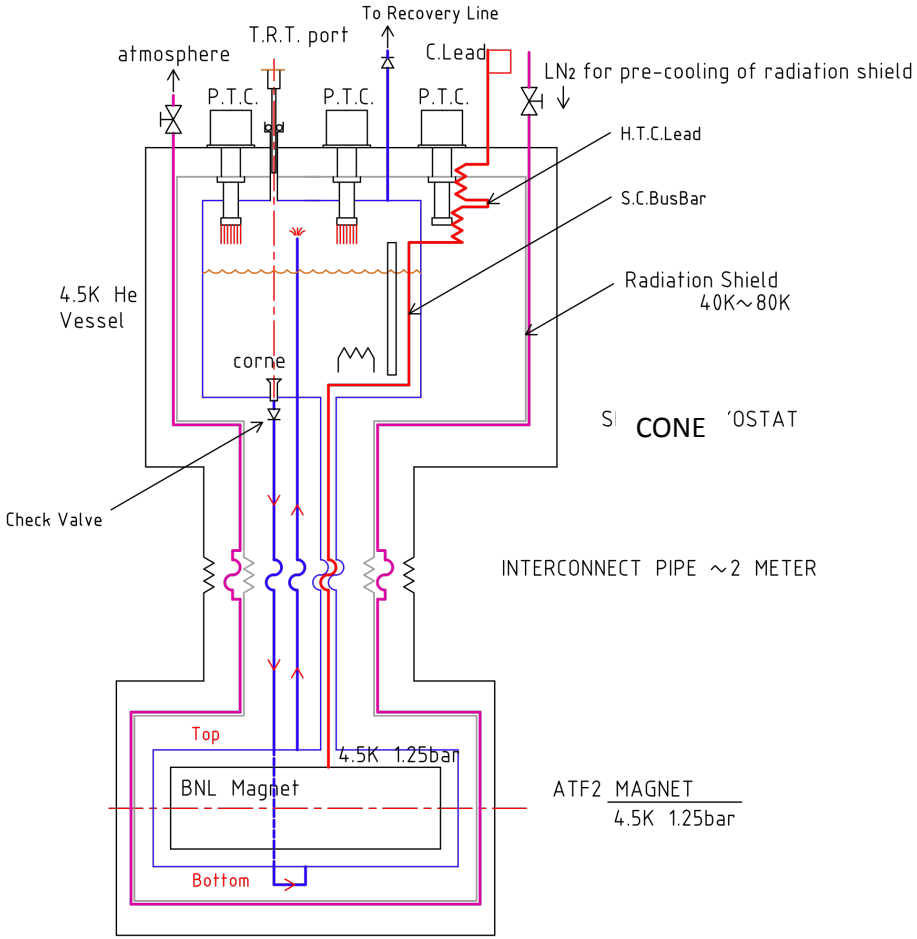


Magnets are cooled in He I at ~4.5 K, 1.25 bar
With Thermo Siphon Loop

At our design parameters

- Heat Load
  < 2.5 W (magnet part)
  < 2 W (re-condensation part including heat load by C.L.)
- Re-condensation
  : Re-condensation with P. T. Coolers
- Operation Pressure
  : P_O = 1.25 ~1.3 Bar
- Operation Temperature
  : T = 4.5 K
- Design Pressure
  : P_D = 1.5 Bar
- Test Pressure
  : P_T = 1.625 Bar
  = P_O x 1.25

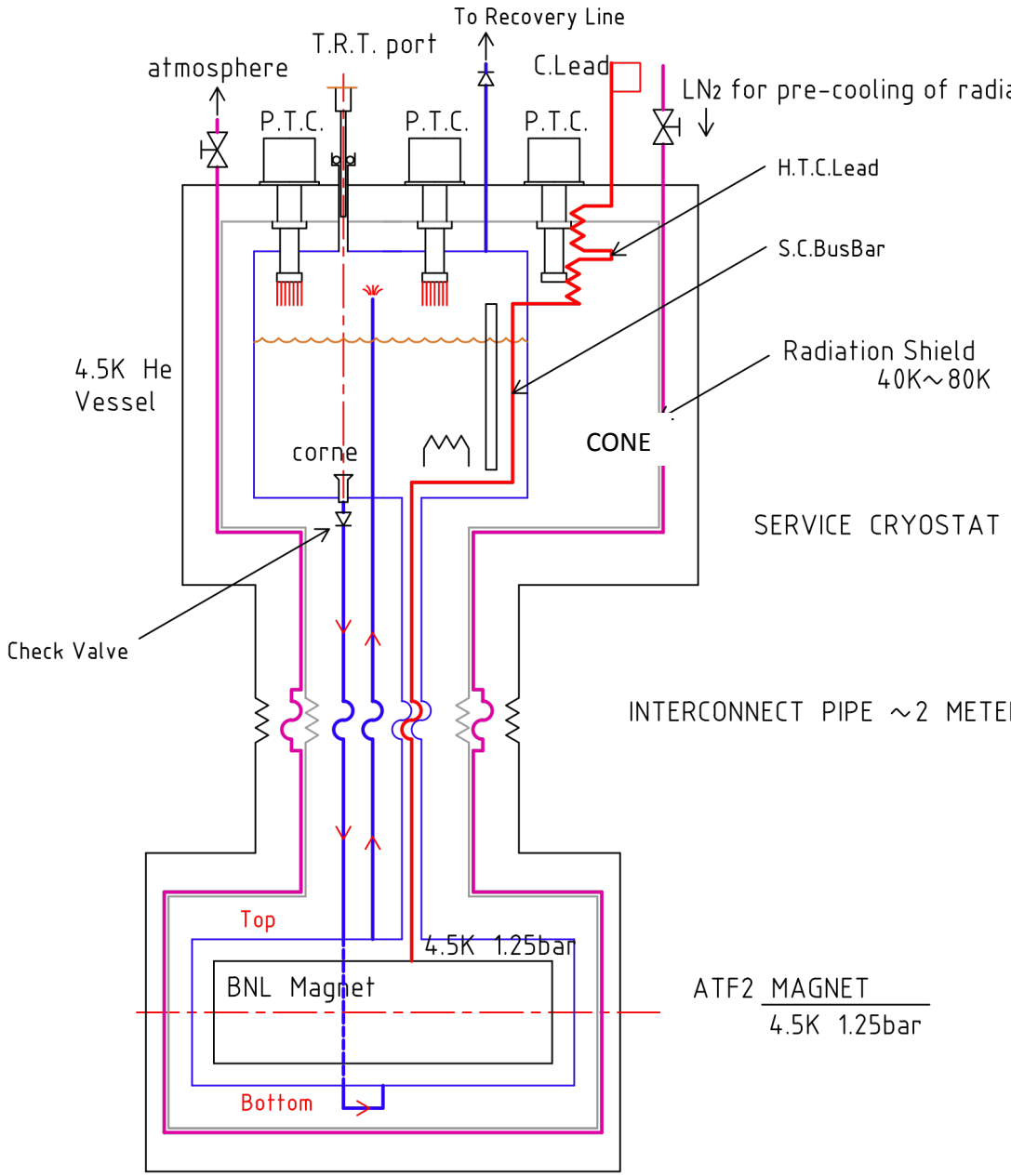
Criteria of Design Parameters Part-2

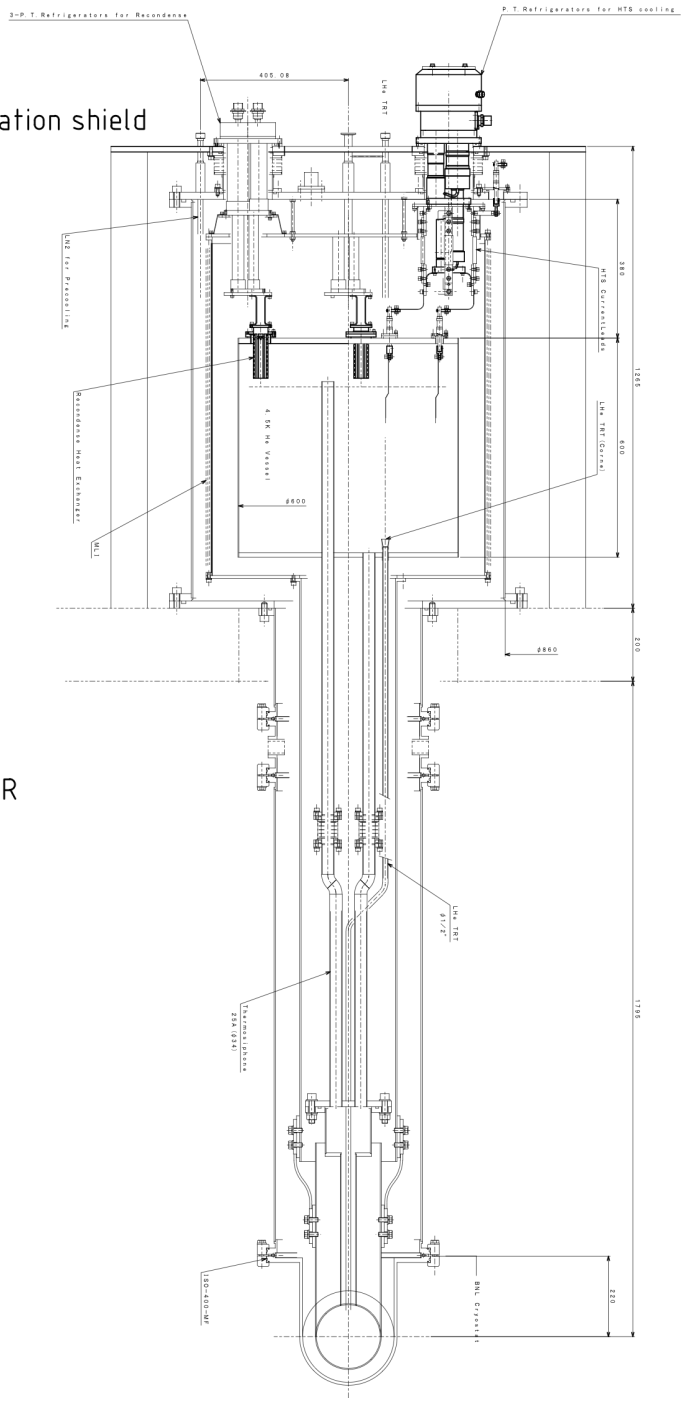


At our design parameters
- Piping
  - ✓one pare of pre-cooling tube for radiation shield
  - ✓one pare of thermo siphon loop
  - ✓one pre-cooling tube for 4K

Need to confirm parameters compatibility between BNL and KEK again!
Fix it as soon as posible.

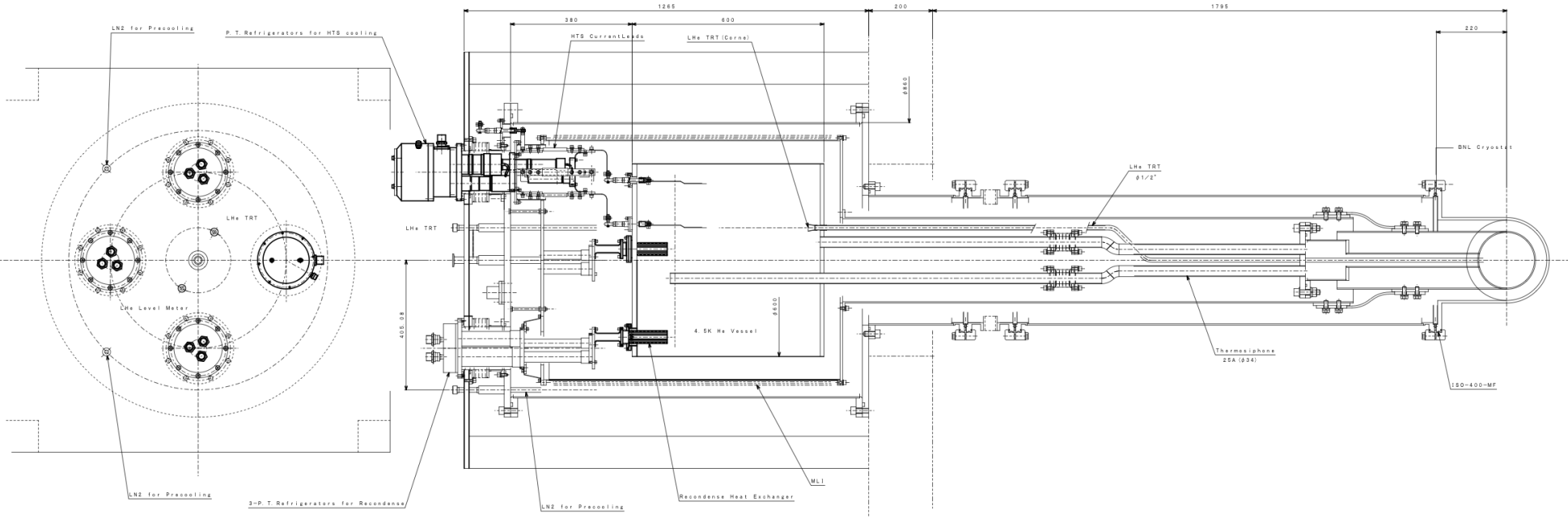
Magnets are cooled in He I at ~4.5 K, 1.25 bar
With Thermo Siphon Loop

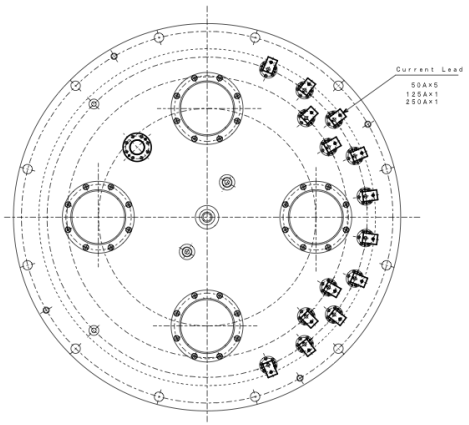




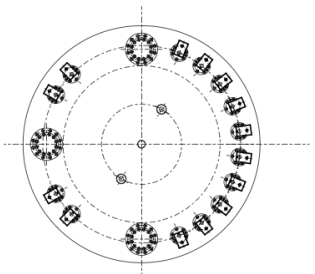
Cross cut view of the cryostat

Comparison of flow diagram and cryostat design!

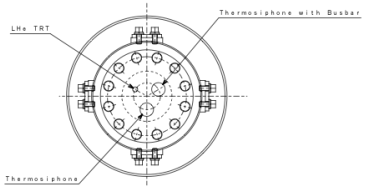




Top View (Cryostat)



Top View (4. 5K He Vessel)



OUTLINE

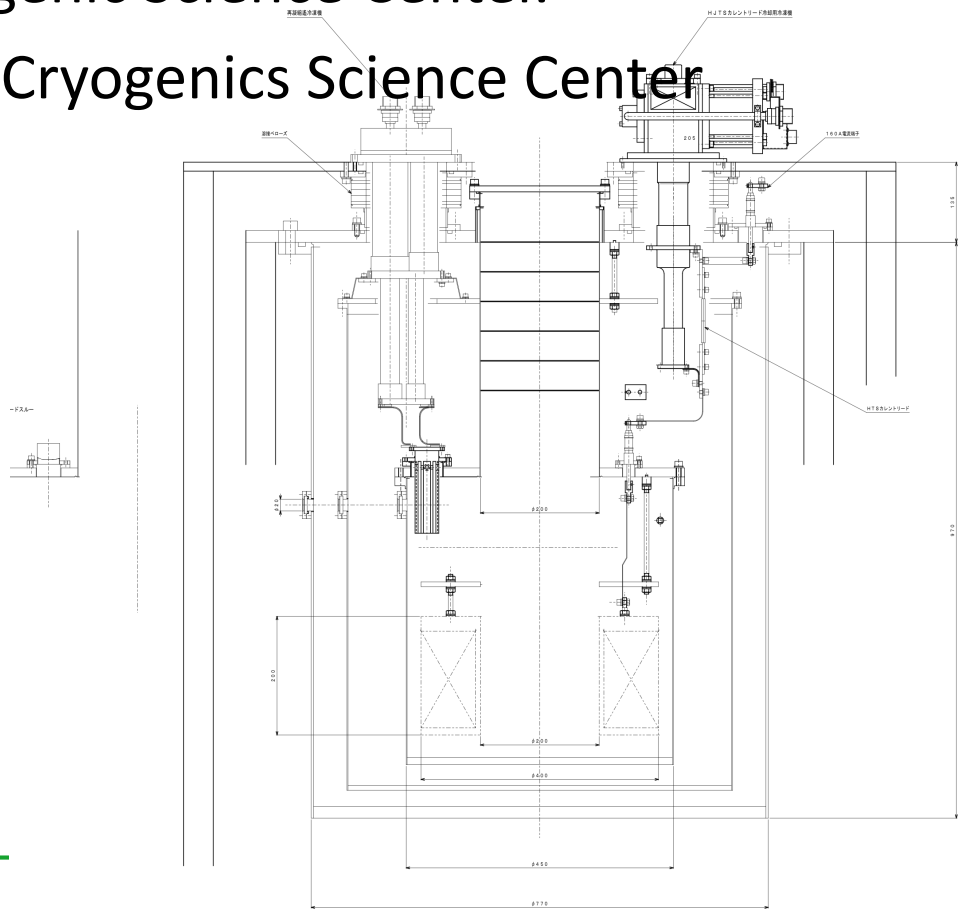
- Progress of the cryostat design work
- R&D of Low Vibration Cooling System

R&D of Low vibration cooling system

- We are jointed g-2/EDM solenoid group, and co-operated R&D project to develop low vibration cooling system.
- R&D project of low vibration cooling system with *thermo siphon loop* has been launched in Cryogenic Science Center.
- A few money are founded from Cryogenics Science Center for R&D.

In one year:

- build prototype of cooling system
- study how to reduce vibration in *thermo siphon cooling system*
- Yamaoka-san join R&D group, and will design a suspension flame for cold head.



Open to Discussion

- How do KEK's requirements incorporate into the BNL design? Is it possible? too late?
- When does BNL fix final design of the magnet cryostat?
- KEK would like to confirm compatibility of design parameters.
  - Design Pressure
  - Operation Pressure
  - Piping design
  - Number of C. Lead
- KEK would like to discuss the interface part between the magnet cryostat and the connection box with BNL for the detailed design work.
- Who does take care of S. C. wires for bus-bar?
- Who does design S. C bus-bar in the cryostat?

  It needs to design pipe size of thermo siphon loop.

Open to Discussion (cont.)

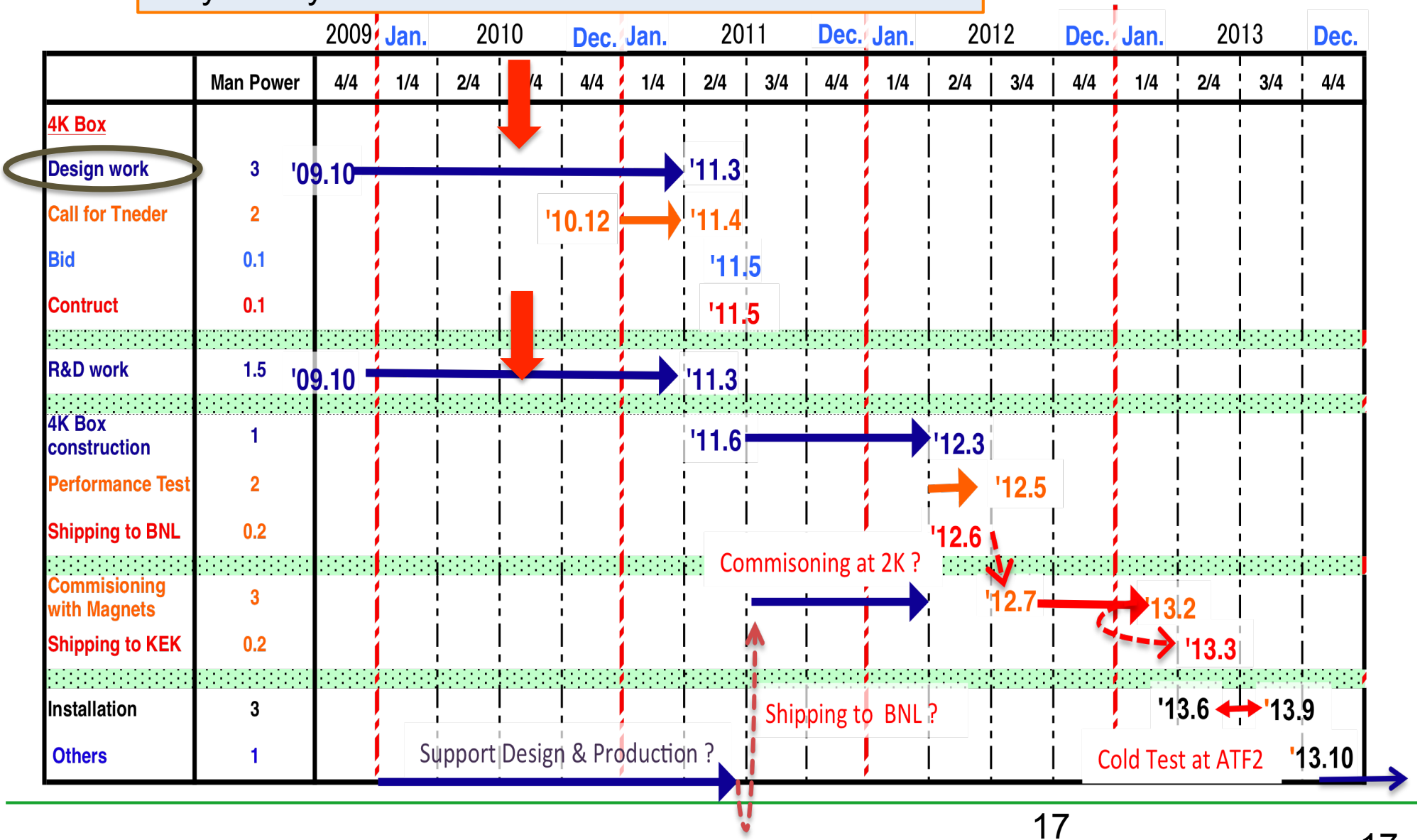
- When does bus bar design fix in the magnet cryostat?

  KEK want to know BNL's bus bar design to fix ours.
- When can we discuss interface part to fix final design?

  KEK want to fix ours design as soon as possible.
- KEK would like to know that BNL have contacted with TUV to clear High Pressure Gas Regulation.

Proposed Schedule (Construction & Installation)

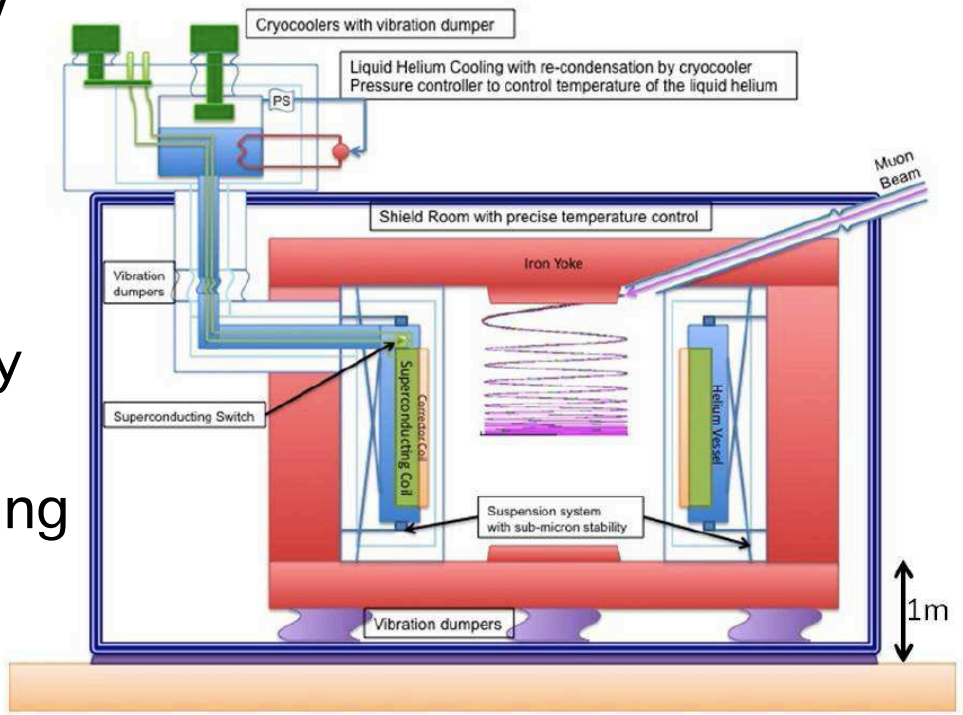
We are here! Design and R&D work are continuing very slowly in KEK.



Appendix

SC solenoid for g-2/EDM experiment

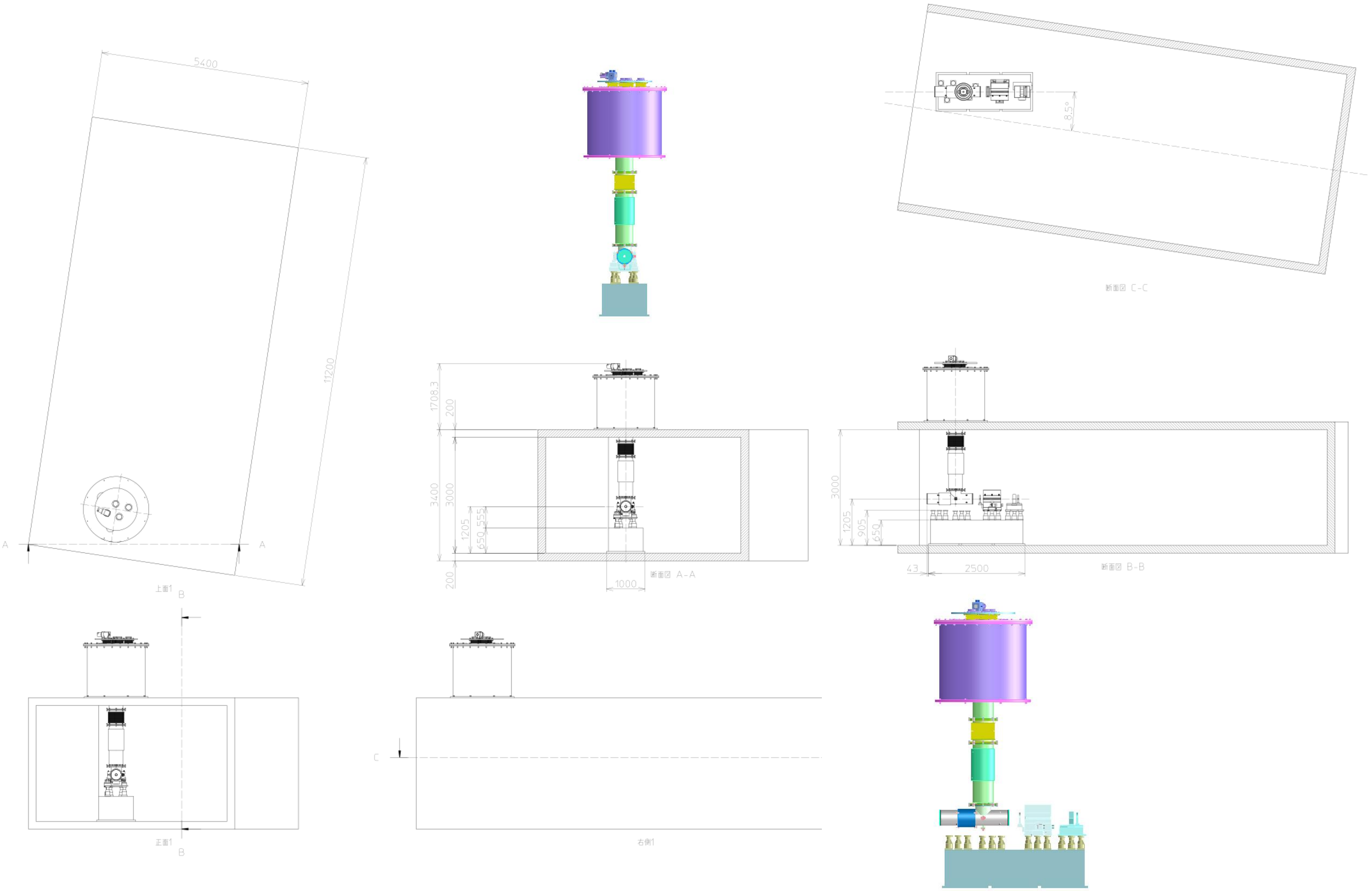
- Solenoid with very high uniformity



Employ MRI technology

- 1 ppm MRI at 3T is commercially available
- could reach 0.1 ppm by modifying MRI technology

- Items to be studied
  - Precision field monitoring system
  - Source of error field
    - Seismic ground vibration
      -> Low vibration cryogenic system



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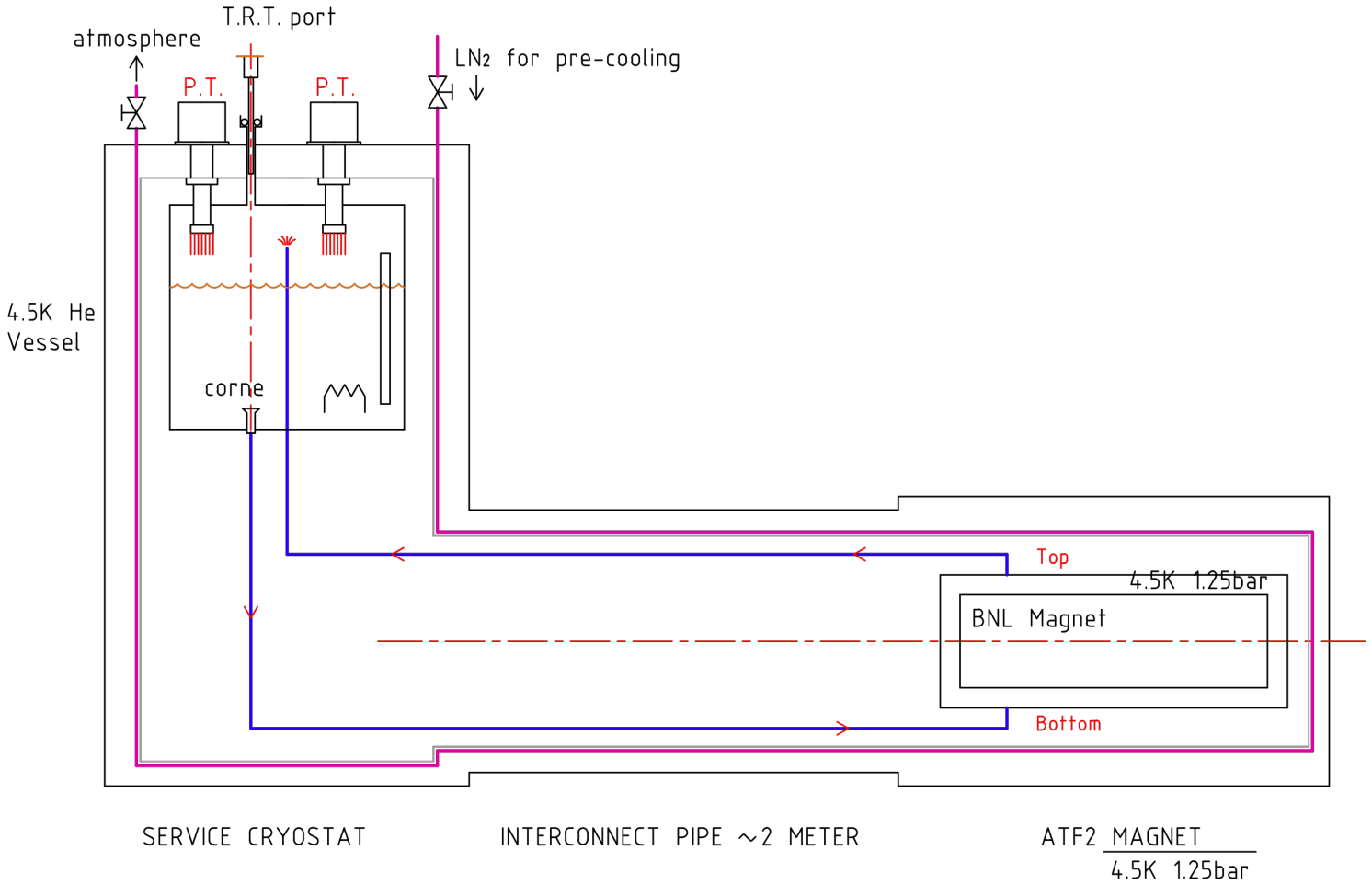

Magnet is coold in Hel at ~4.5 K, 1.25 bar