Arnaud Vande Craen (TE-MSC)

HFM Test Station
Main Cryostat

EUCARD : ESAC Review – CEA Saclay

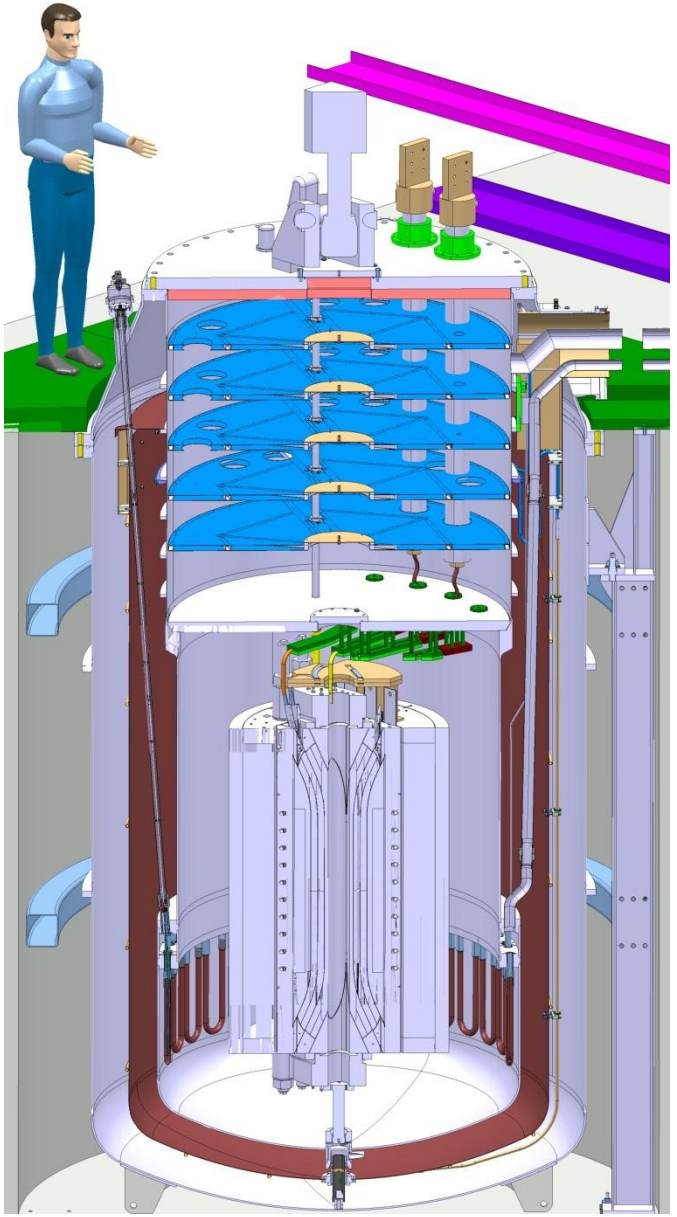
Summary

- Introduction
- Design
- Status
- Conclusion

Introduction

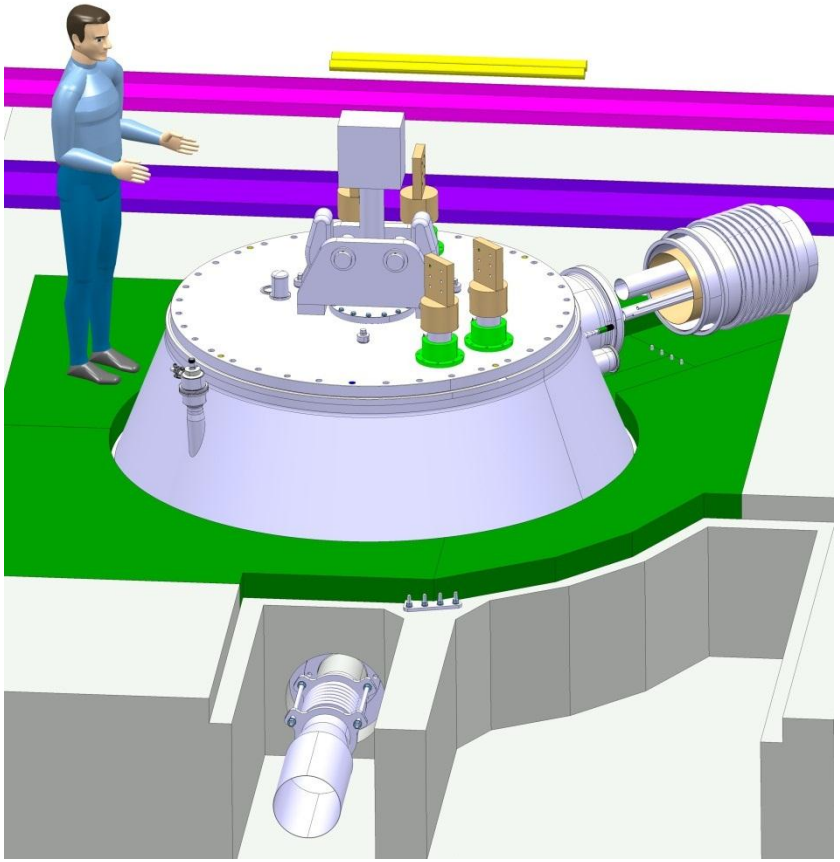
Introduction

- Vertical cryostat
  - “Claudet bath” principle
  - Few cryogenic connections
- Installed in a pit
  - Support structure in the pit
- 4 parts
  - Vacuum vessel
  - Helium vessel
  - Thermal shield
  - Insert
- Magnet hanging from lambda plate



Integration on ground level

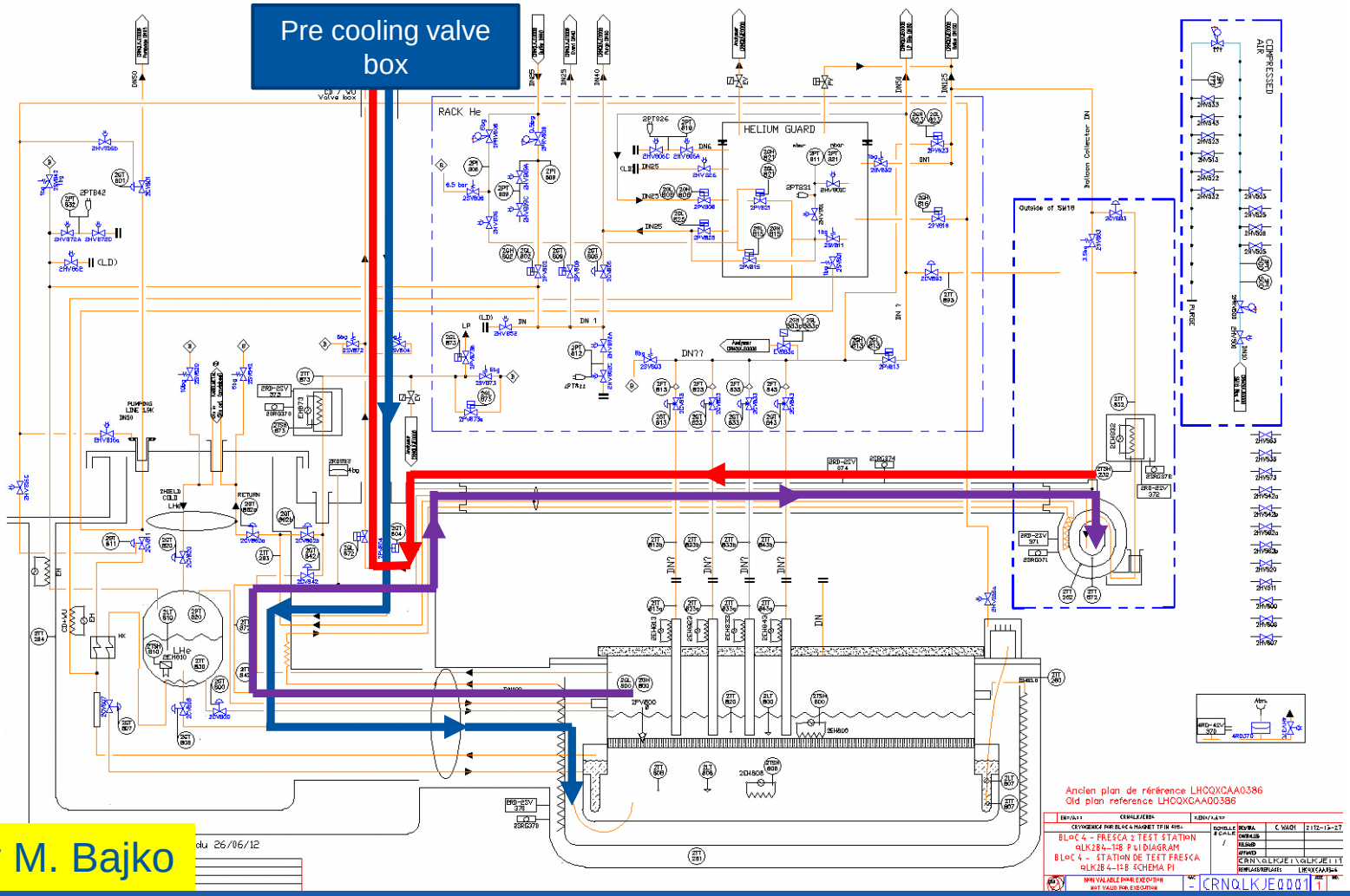
- Jumper to valve box
- Exhaust line
  - DN 300
  - In a trench
  - Release outside of SM18
- Current leads
  - 20 kA for main magnet
  - 10 kA for insert
- Instrumentation
  - Magnet
  - Helium vessel
    - Level gauge
    - Heaters
    - Temperature sensor



Magnet cooling

- 3 Phases
  - 300 K – 80 K
    - 8 hours
    - Cold gaseous helium
  - 80 K – 4.2 K
    - 8 hours
    - Liquid helium (1 bar)
  - 4.2 K – 1.8 K
    - 36 hours (1.5 days)
    - Heat exchanger in cryostat

Cooling from 300 K to 80 K



Courtesy M. Bajko

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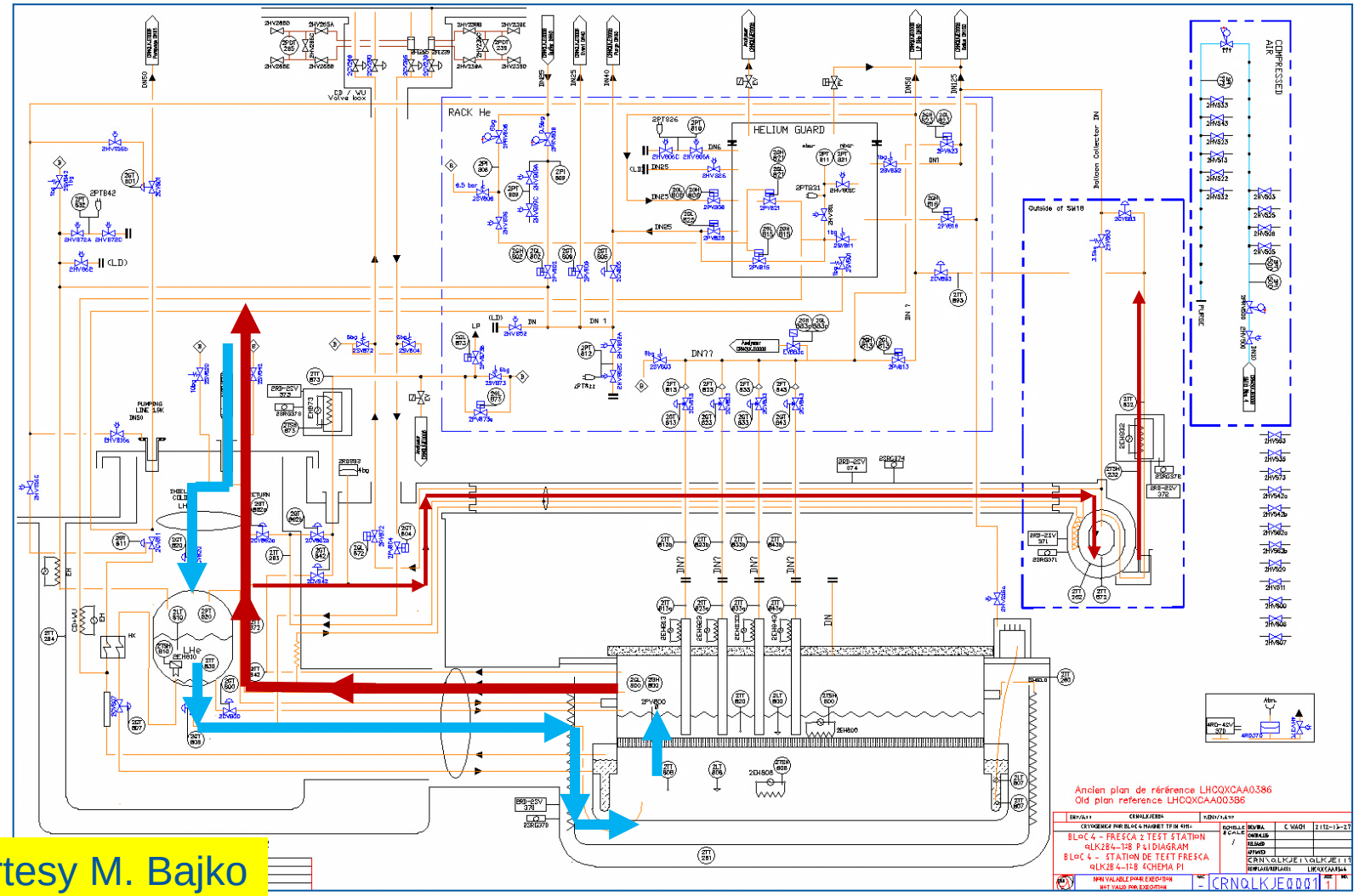
Cooling from 80 K to 4.2 K



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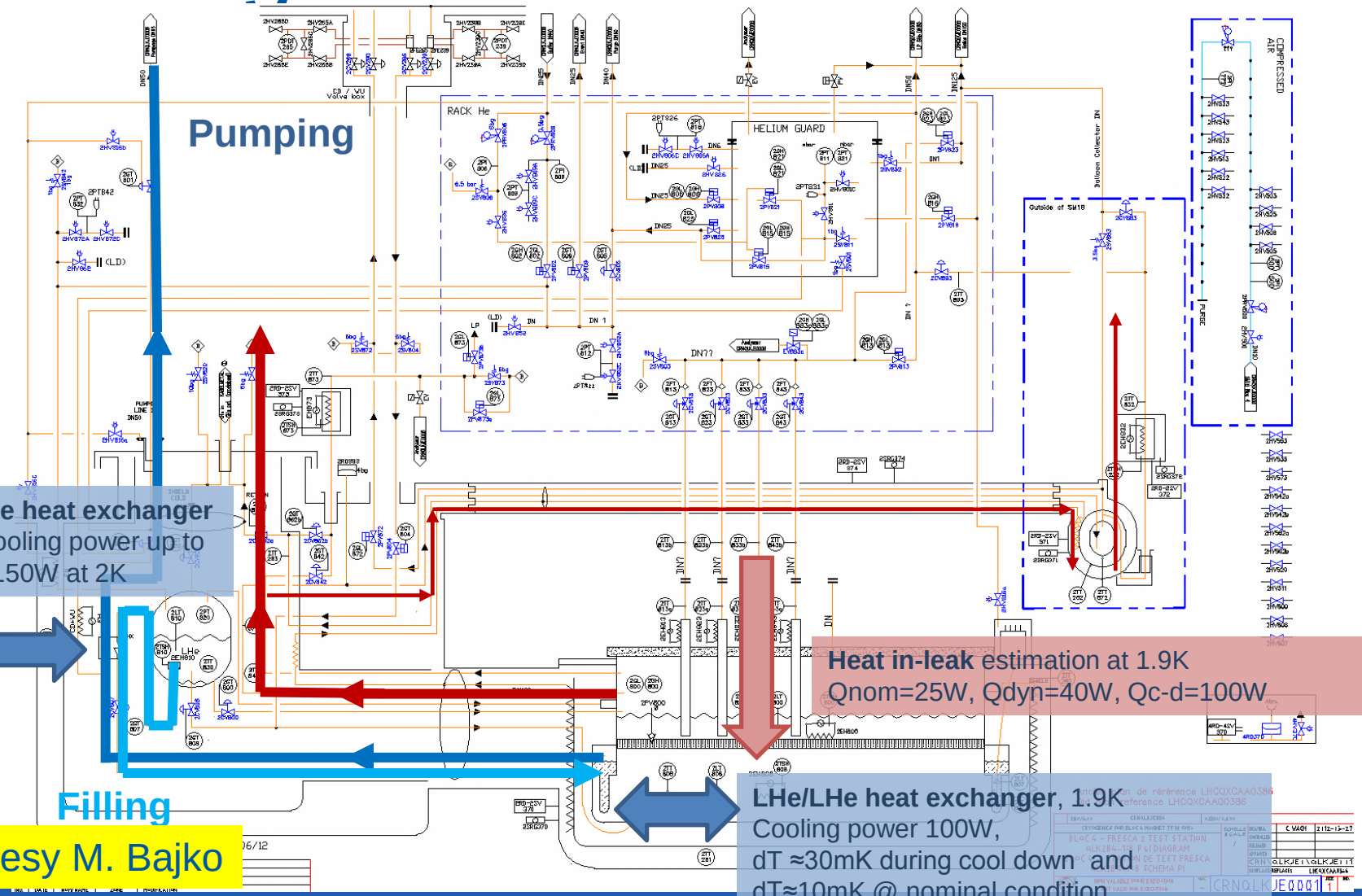
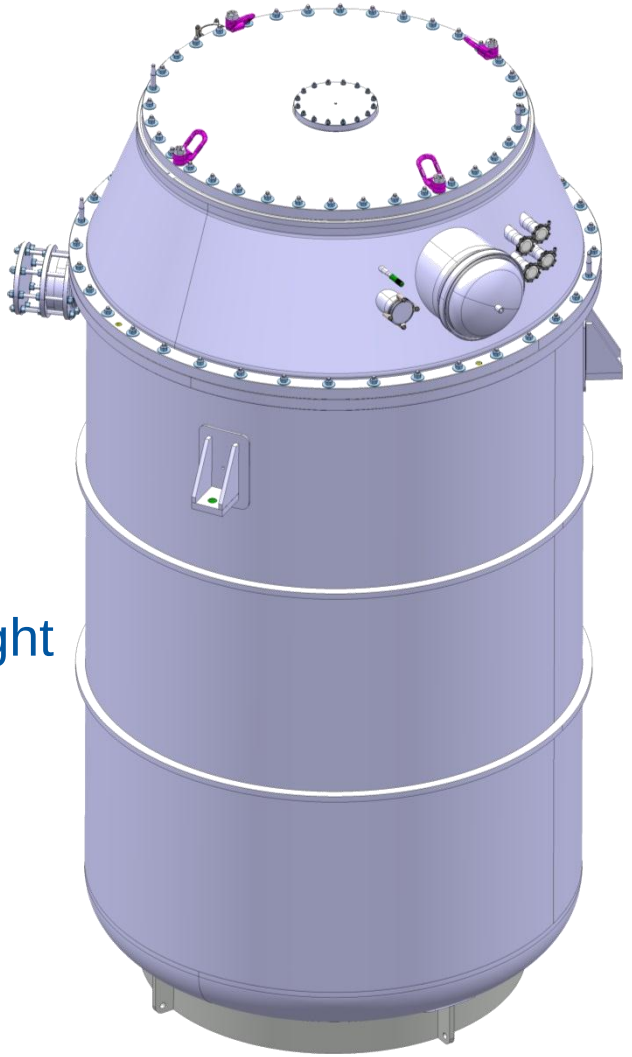
Cooling from 4.2 K to 1.8 K



Design

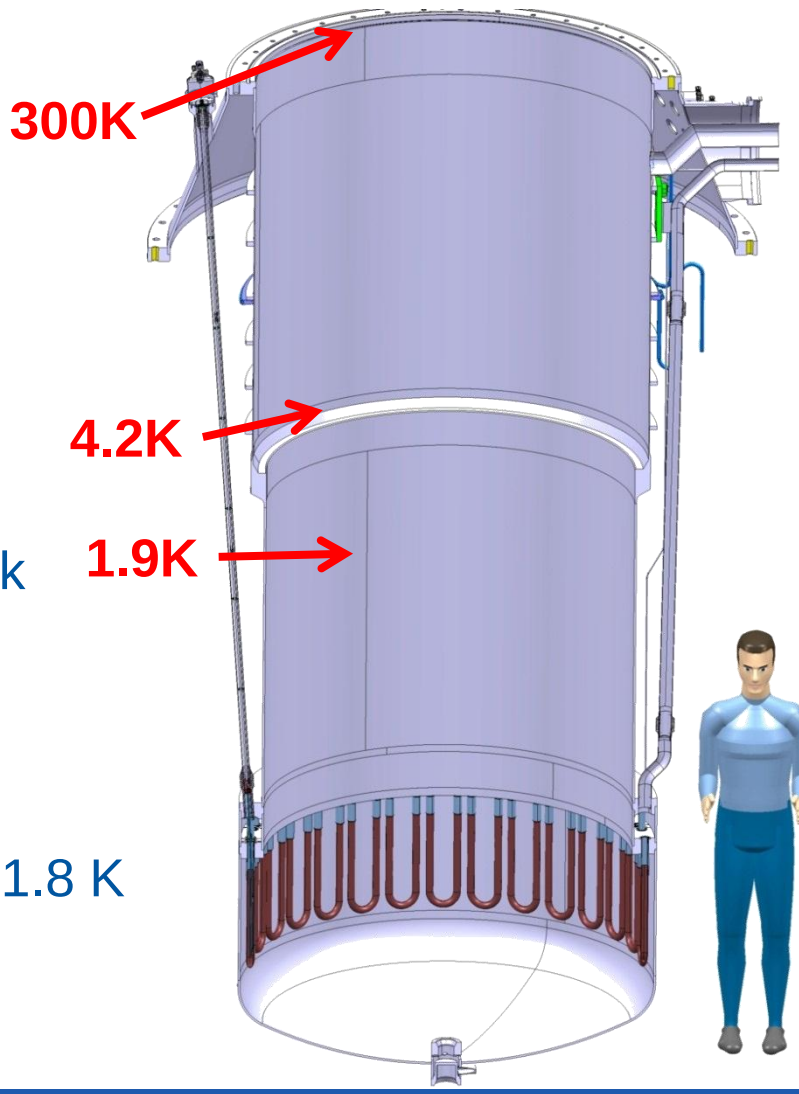
Vacuum vessel

- Dimensions
  - 4.6 m height
  - 2.3 m diameter
  - 4.8 tons
- Stainless steel (304L)
- Conical cover
  - Limit deformations due to magnet weight
- 3 supports ➔ Isostatic
- Static vacuum
  - Protection using burst disk



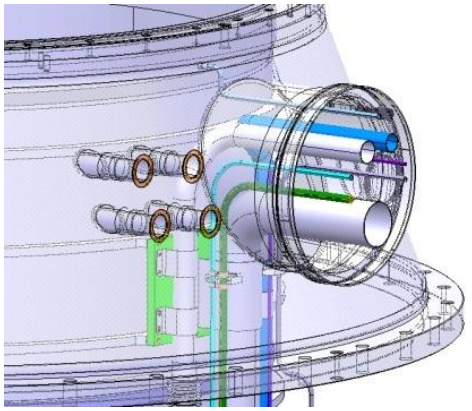
Helium vessel

- Max pressure : 5 bar
- Stainless steel (316 L, 316 LN)
- Welded to conical cover
- Neck thermalisation to limit heat in-leak
- Magnet support by lambda plate seat
- Heat exchanger for magnet cooling to 1.8 K

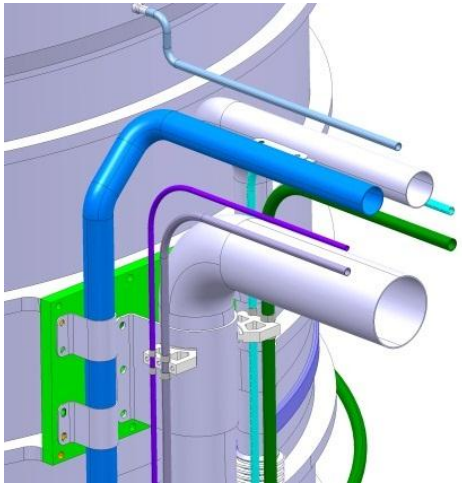


Helium vessel

- Jumper
  - Regroup all cryogenic lines
  - Connection to valve box

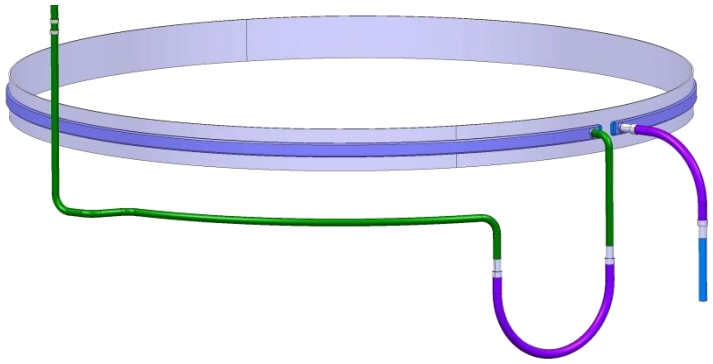


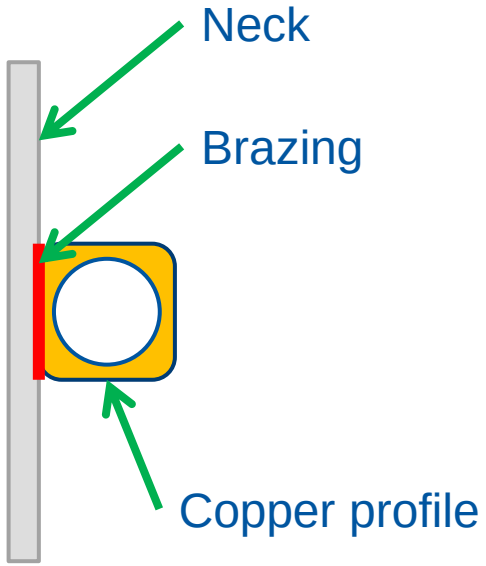
- Fixed point
  - Cryogenic lines
  - Block lines movement
  - G10 plate + Collars



Helium vessel

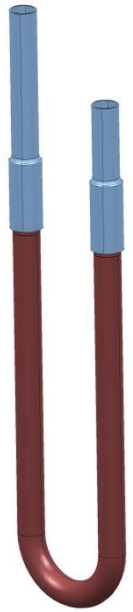
- Neck thermalisation
  - Copper profile
  - Brazed to neck (stainless steel)
  - Part of thermal shield cryogenic line

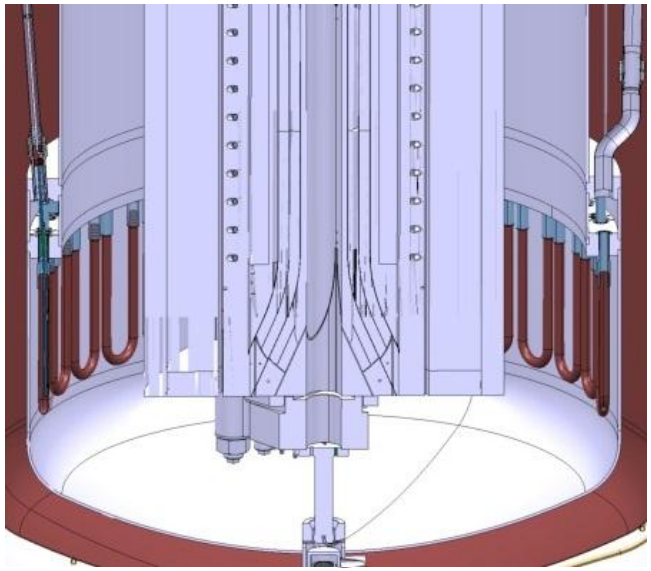




Helium vessel

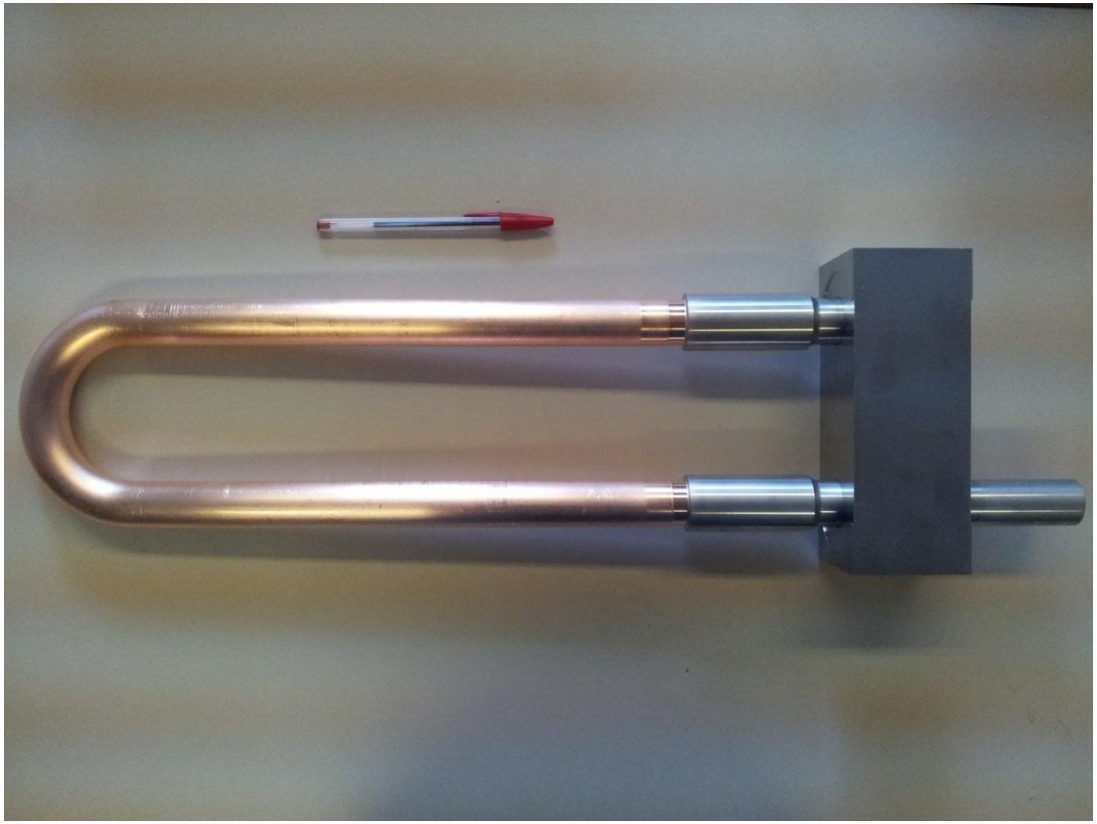
- Heat exchanger
  - Copper tube brazed to stainless steel tube
  - U shaped and welded to flange (30 x)
  - Saturated helium (18 mbar – 1.8 K) in the tubes
  - Cool-down pressurized helium (magnet) by conduction through copper
  - Cooling power ≈ 100 W @ 1.9K (1.5 day Cool-Down)





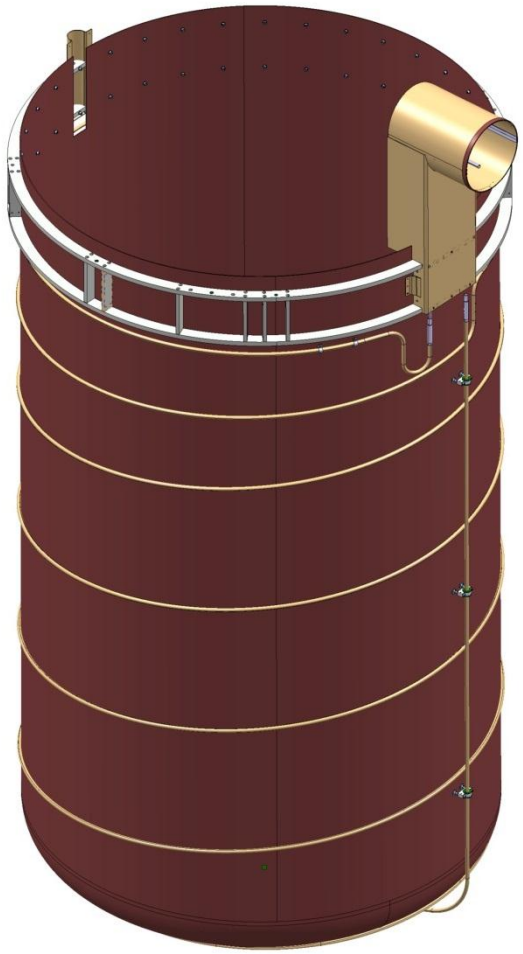
Helium vessel

- Heat exchanger prototype



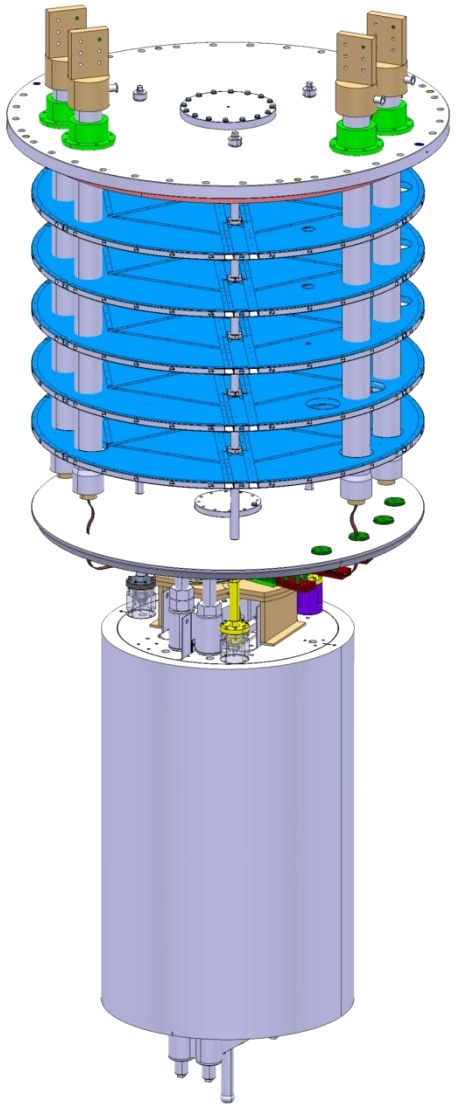
Thermal shield

- Actively cooled
- Supported from top cover
- Stainless steel structure
  - Support shield
  - Rigidity of the assembly
- Copper
  - Sheet to form shield
  - Pipe brazed on sheets for cooling



Insert (concept)

- Top plate
  - Current leads
  - Instrumentation
- Radiative screens
- Lambda plate
  - Quench valve (DN150)
  - Splices
  - Instrumentation
- Mechanical support
  - Lambda plate to top plate
  - Magnet (15 tons) to lambda plate



Status

Vacuum vessel

- Design : Finished
- Construction : In progress
  - First production meeting : 14th February 2013
- Delivery : June 2013

Helium vessel

- Design : Almost finished
- Call for tender : March 2013
- Order : Summer 2013
- Delivery : 6-7 months after order
  (Early 2014)

Thermal shield and Insert

- Thermal Shield
  - Design in progress
  - Construction in the shadow of helium vessel
  - Order expected for summer 2013
- Insert
  - Design in progress
  - Construction at CERN

Conclusion

Conclusion

- Design almost finished
- Construction in progress
  - All components at CERN early 2014
- Assembly phase to be planned
  - Assembly of the cryostat
  - Connection to other components

Acknowledgment

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Thank you for your attention !

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