Restoring Komag

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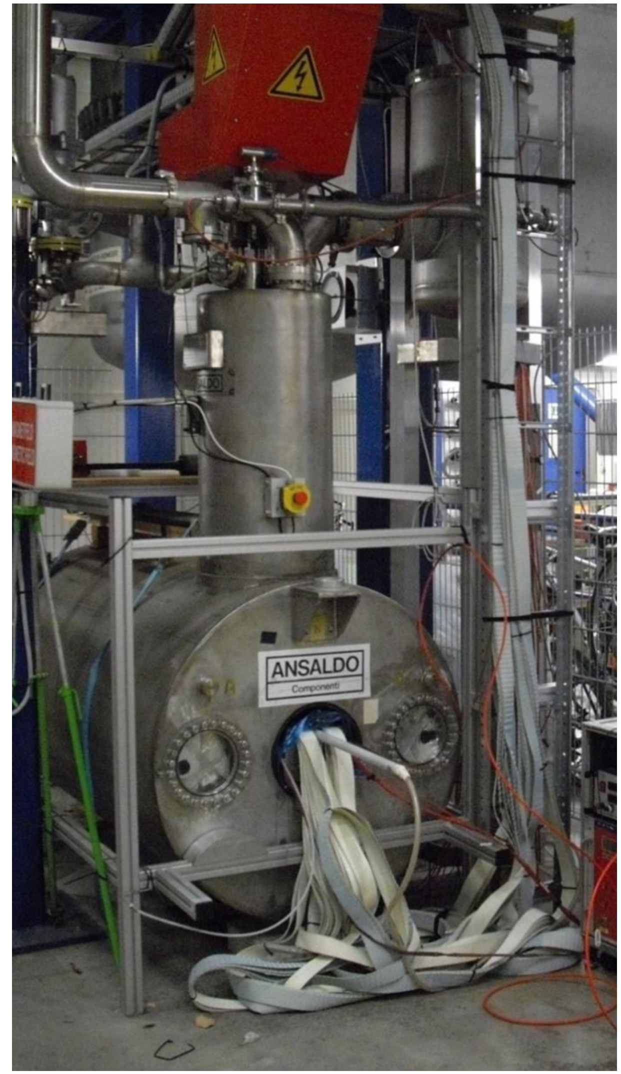
Consideration of restoring and modifying Komag for a stand alone operation without the refrigerator.



<u>Contents</u>

1. Magnet parameters
2. Stand alone operation

Magnet Parameters (1) Magnet & Coil Parameter

Length	1.2 m
Internal diameter	0.37 m
External diameter	0.47 m
B_{max} (on axis)	5.0 T
Operating current	1000 A
Overall current density	4167 A/cm^2
$(NI)_{max}$	5.0 10^6 Aturns
Stored energy (without iron)	1.4 MJ
Stored energy (with iron)	1.5 MJ
Self inductance (without iron)	2.9 H
Self inductance (with iron)	3.2 H
B_{max} (on conductor)	5.4 T
Sucking force	50 kN
Torque (10 mrad misalignement)	2000 Nm
Coil weight	630 kg

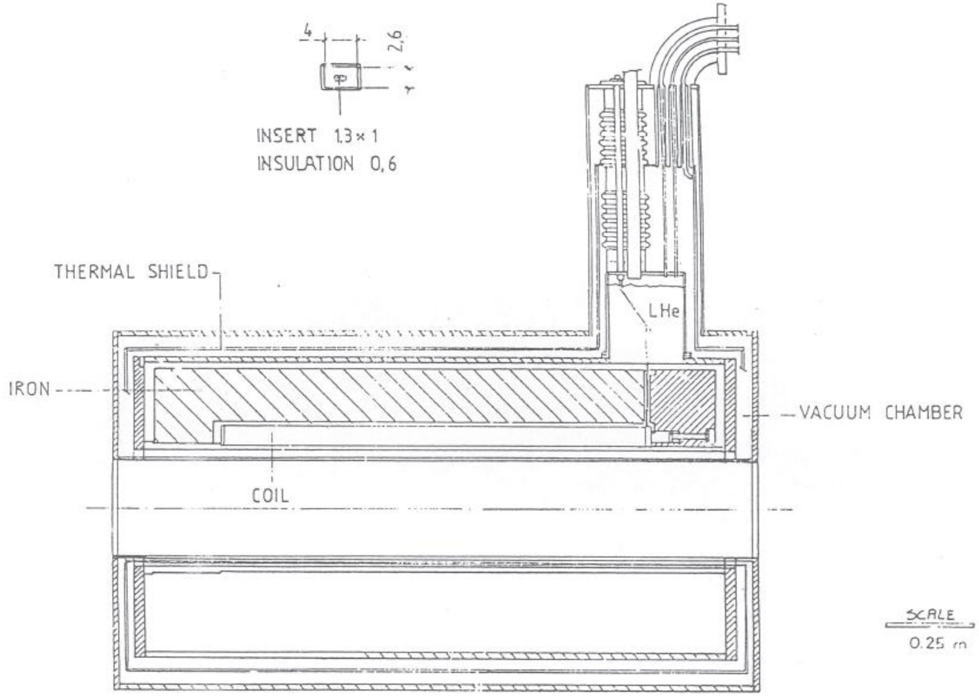
Magnet Parameters (2) Superconductor, Quench Protection

Material	NbTi/Cu
Dimensions (without insulation)	4×2.6 mm^2
Dimensions (with Kapton insulation)	4.3×2.9 mm^2
Critical current (B=5.4 T at 4.3 K)	1600 A
Critical current density (conservative)	1300 A/mm^2
NbTi/Cu	1 : 7
Residual resistivity ratio (Cu) RRR	200
Filament number (diameter)	600 (50 μ)
Twist pitch	50 mm
Dump resistor	0.3 – 0.4 Ω
Hot spot temperature	120 K
Discharge time constant	20 – 15 s
Maximum delay for quench detection	1 s

Magnet Parameters (3) Cryostat & Cooling Specification

Cryostat overall length	1.84 m	
Internal diameter	0.28 m	
External diameter	1.04 m	
Iron yoke weight	4000 kg	
Helium vessel weight	860 kg	
Vacuum chamber weight	1300 kg	
Thermal loads (T=4.3 K , safety factor 2)	10 W	5 ~ 10 W
Thermal loads (T=60 K , safety factor 2)	30 W	15 ~ 30 W
Current leads (I=1000 A)	0.18 g/s	
Current leads (I=0 A)	2.4 W	
Power supply	25 kW	
Maximum current	1250 A	
Maximum ripple (resistive load)	±0.05%	
Long term stability	±0.05%/h	

Magnet Outlook and Drawing



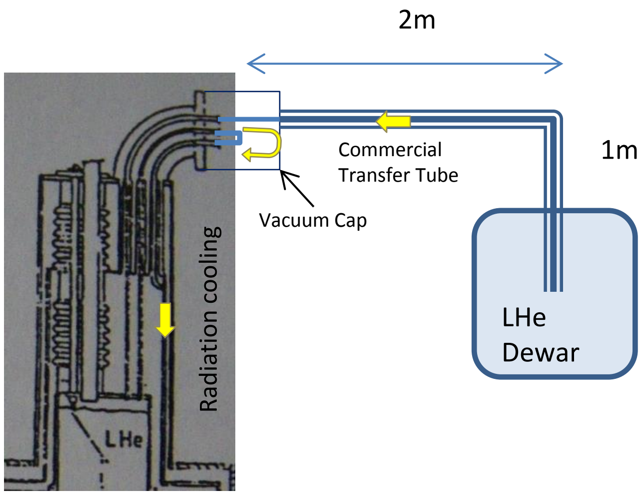
Cold Mass

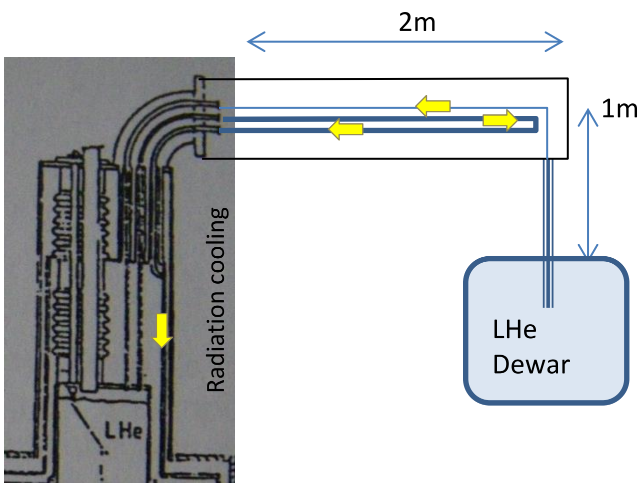
Coil : 630 kg <= Cu

Iron Yoke : 4000 kg <= Fe

LHe vessel: 860 kg <= Fe

Modification for Stand Alone Cooling





Stand Alone Case 1

- Effective use of vapor helium gas.
- A vacuum cap is set on the multi-port of the cryostat. And vapor gas from LHe reservoir go to a thermal shield line through the by-pass tube.
- Commercial transfer tube is available.
- **LHe consumption is 371 L/day**.
- Cryostat modification \500,000 = ₵ 3,700

Stand Alone Case 2

- Effective use of vapor helium gas.
- Multiple transfer tube with thermal shield is manufactured. Vapor gas flow through the thermal shield cooling line in the TRT and return to the magnet cryostat. It cools the thermal shield in the cryostat.
- **LHe consumption is 274 L/day**.
- Cryostat modification and new transfer tube need \4,000,000 = ₵ 30,000

Pre-cooling & Necessary Cryogen

Cold Mass

Coil : 630 kg   <= Cu

Iron Yoke : 4000 kg <= Fe

LHe vessel: 860 kg <= Fe

Cu 630 kg, Fe 4860 kg

Required Cryogen for Precooling

300 K -> 4.2 K

  Fe : LHe 33.6 L/kg

  Cu : LHe 31.2 L/kg

300 K -> 80 K -> 4.2 K

  Fe : LN2 0.53 L/kg, LHe 1.44 L/kg

  Cu : LN2 0.46 L/kg, LHe 2.16 L/kg

Required Cryogen for Komag Precooling

300 K -> 4.2 K

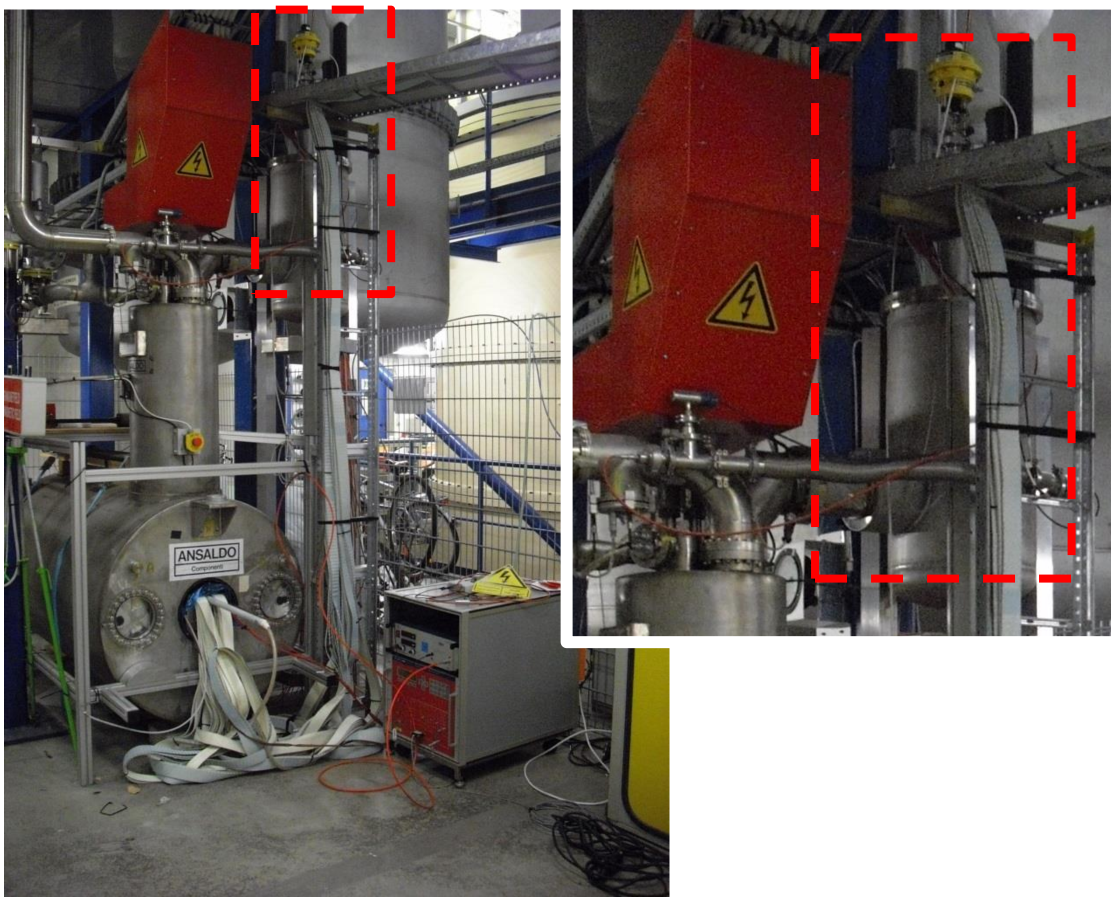
  LHe : 183000 L   <=   Too large quantity

300 K -> 80 K -> 4.2 K

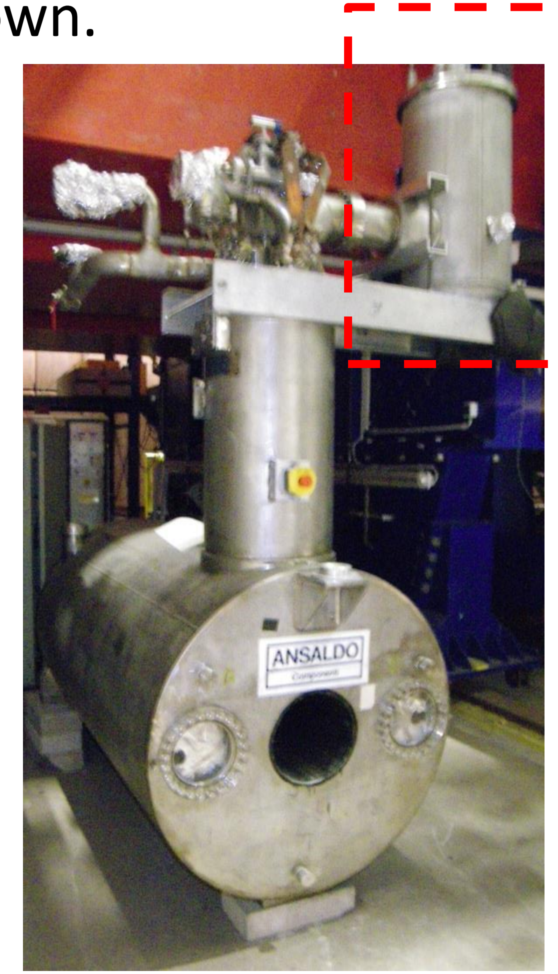
  LN2 : 3000 L, LHe : 8400 L

Cryostat Outlook with Service Ports

Drawings of Service Port is required.
Joint Type of Pipes should be known.



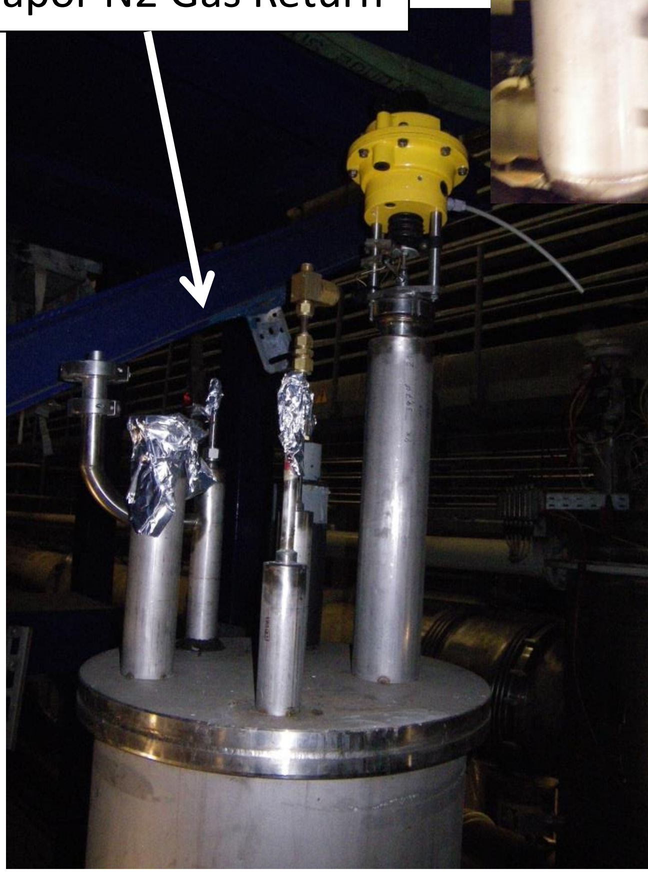
Magnet Outlook at Cryogenic Hall

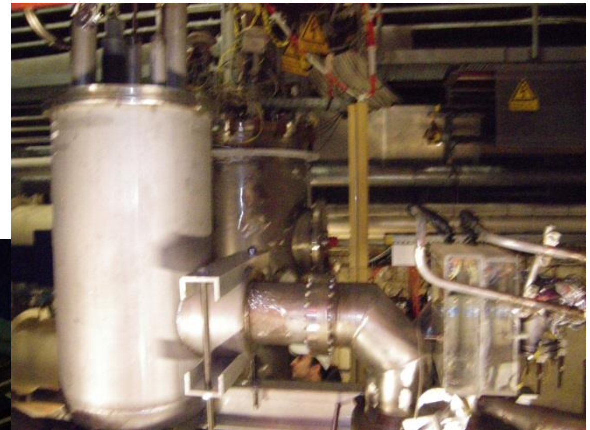


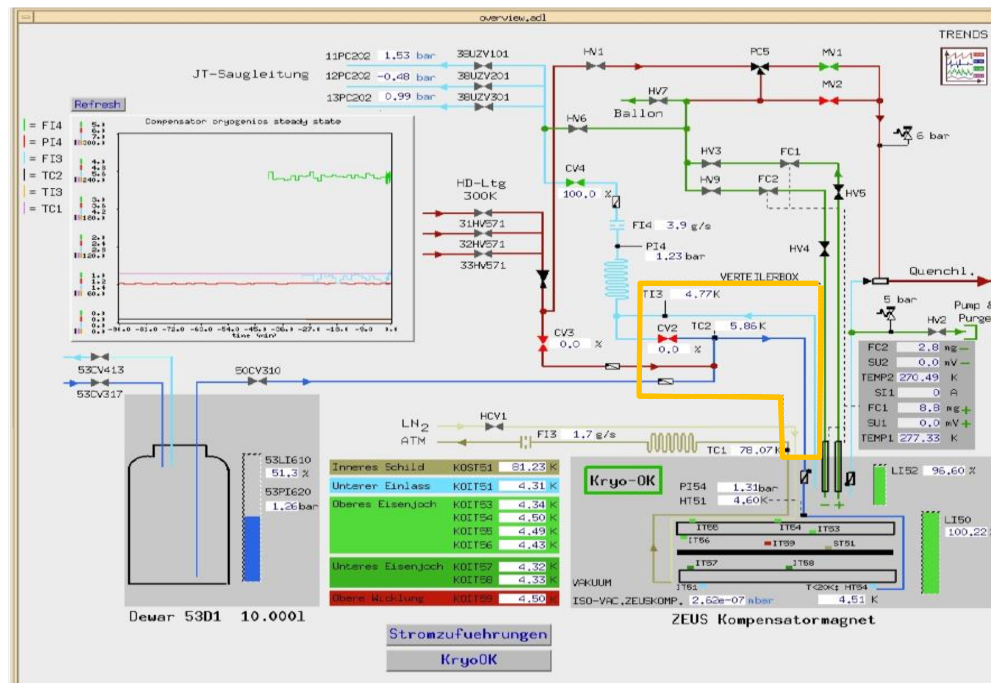
Magnet was moved to an under ground hall (HELA-B)

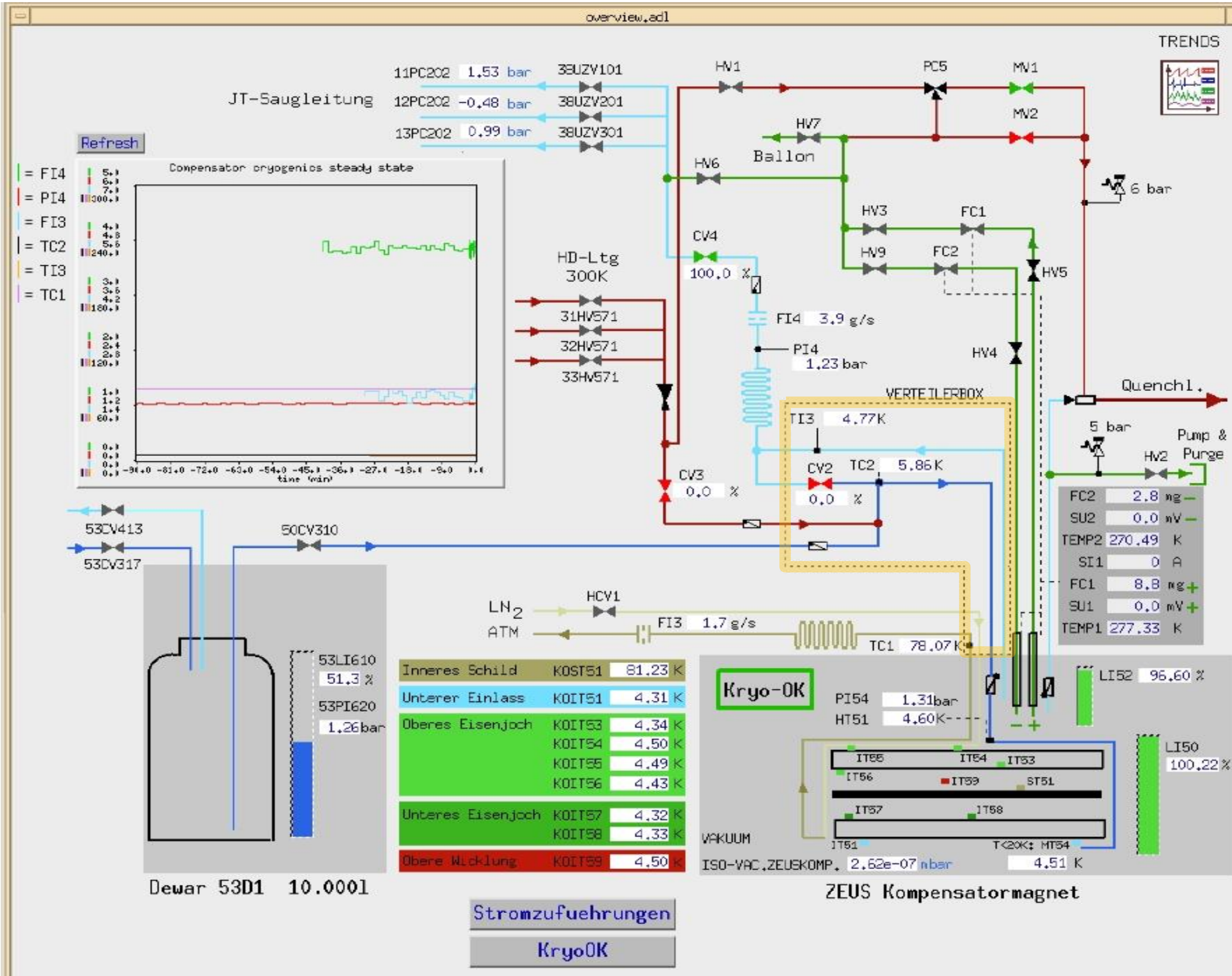
Service Ports Outlook

1. LHe Supply
2. Vapor He Gas Return
3. LN2 Supply
4. Vapor N2 Gas Return



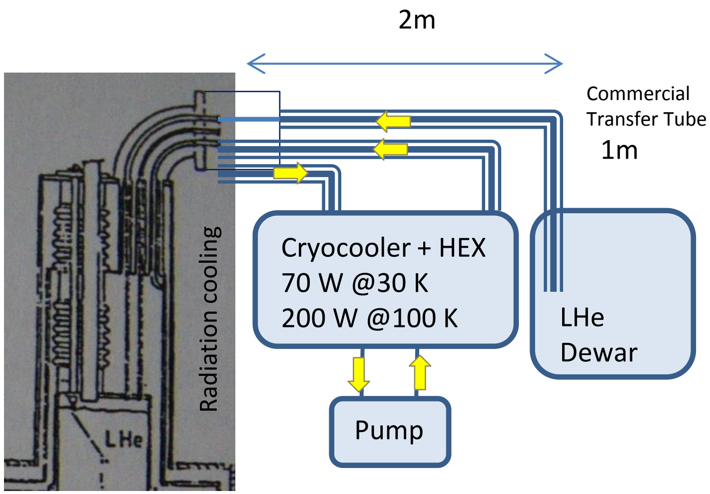






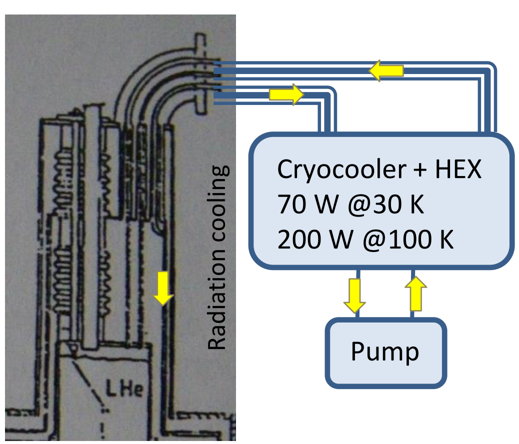
overview.adl
TRENDS
JT-Saugleitung
11PC202 1.53 bar
12PC202 -0.48 bar
13PC202 0.99 bar
38UZV101
38UZV201
38UZV301
HV1
PC5
MV1
MV2
HV7
Ballon
HV6
6 bar
HV3
FC1
HV9
FC2
HV5
CV4
100.0 %
HD-Ltg 300K
31HV571
32HV571
33HV571
FI4 3.9 g/s
PI4 1.23 bar
HV4
VERTEILERBOX
TI3 4.77K
CV2
TC2 5.86 K
0.0 %
CV3
0.0 %
Quenchl.
5 bar
Pump & Purge
HV2
FC2 2.8 mg
SU2 0.0 mV
TEMP2 270.49 K
SI1 0 A
FC1 8.8 mg
SU1 0.0 mV
TEMP1 277.33 K
Refresh
= FI4
= PI4
= FI3
= TC2
= TI3
= TC1
Compensator cryogenics steady state
time (min)
53CV413
53CV317
50CV310
LN2
ATM
HCV1
FI3 1.7 g/s
TC1 78.07 K
53LI610
51.3 %
53PI620
1.26 bar
Inneres Schild KOST51 81.23 K
Unterer Einlass KOIT51 4.31 K
Oberes Eisenjoch KOIT53 4.34 K
KOIT54 4.50 K
KOIT55 4.49 K
KOIT56 4.43 K
Unteres Eisenjoch KOIT57 4.32 K
KOIT58 4.33 K
Obere Wicklung KOIT59 4.50 K
Kryo-OK
PI54 1.31 bar
HT51 4.60 K
LI52 96.60 %
LI50
100.22 %
IT55
IT54
IT53
IT56
IT59
ST51
IT57
IT58
VAKUUM
IT51
T<20K: MT54
ISO-VAC.ZEUSKOMP. 2.62e-07 mbar
4.51 K
Dewar 53D1 10.000l
ZEUS Kompensatormagnet
Stromzufuehrungen
KryoOK

Stand Alone Cooling with Cryocooler



Steady State

- Radiation shield is kept at lower temperature of 30 K, which result in lower LHe evaporation.
- **If heat load reduce at 1 W, LHe consumption is 250 L/day**.
- Cryostat modification \2000,000 = ₡ 149,000



Precooling and Keeping at low temperature

- Precooling by using only the cryocooler takes about 1 month.
- But without LN2 handling.
- Keeping magnet at <70 K makes precooling time shorter.