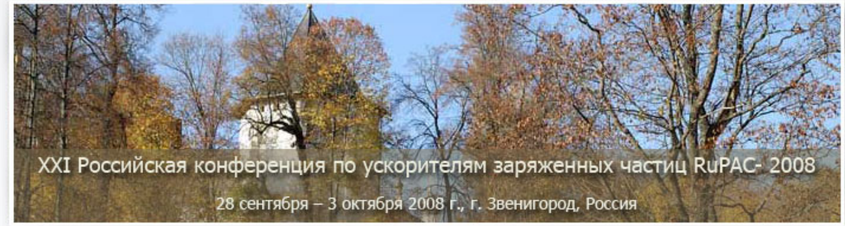


# STARTING-UP AND ADJUSTMENT WORKS ON CRYOGENIC VACUUM SYSTEM OF THE SUPERCONDUCTING HIGH-FREQUENCY SEPARATOR

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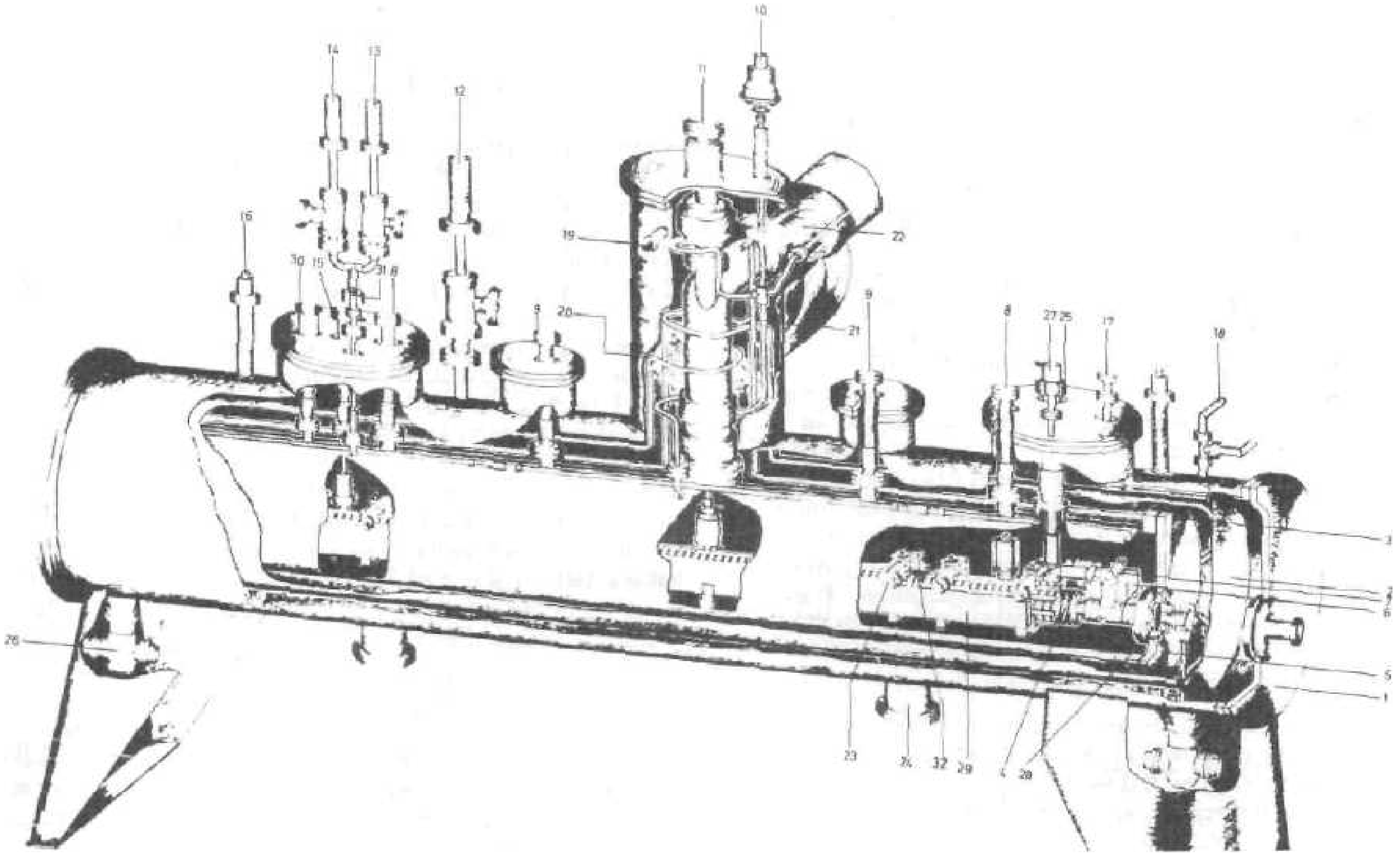
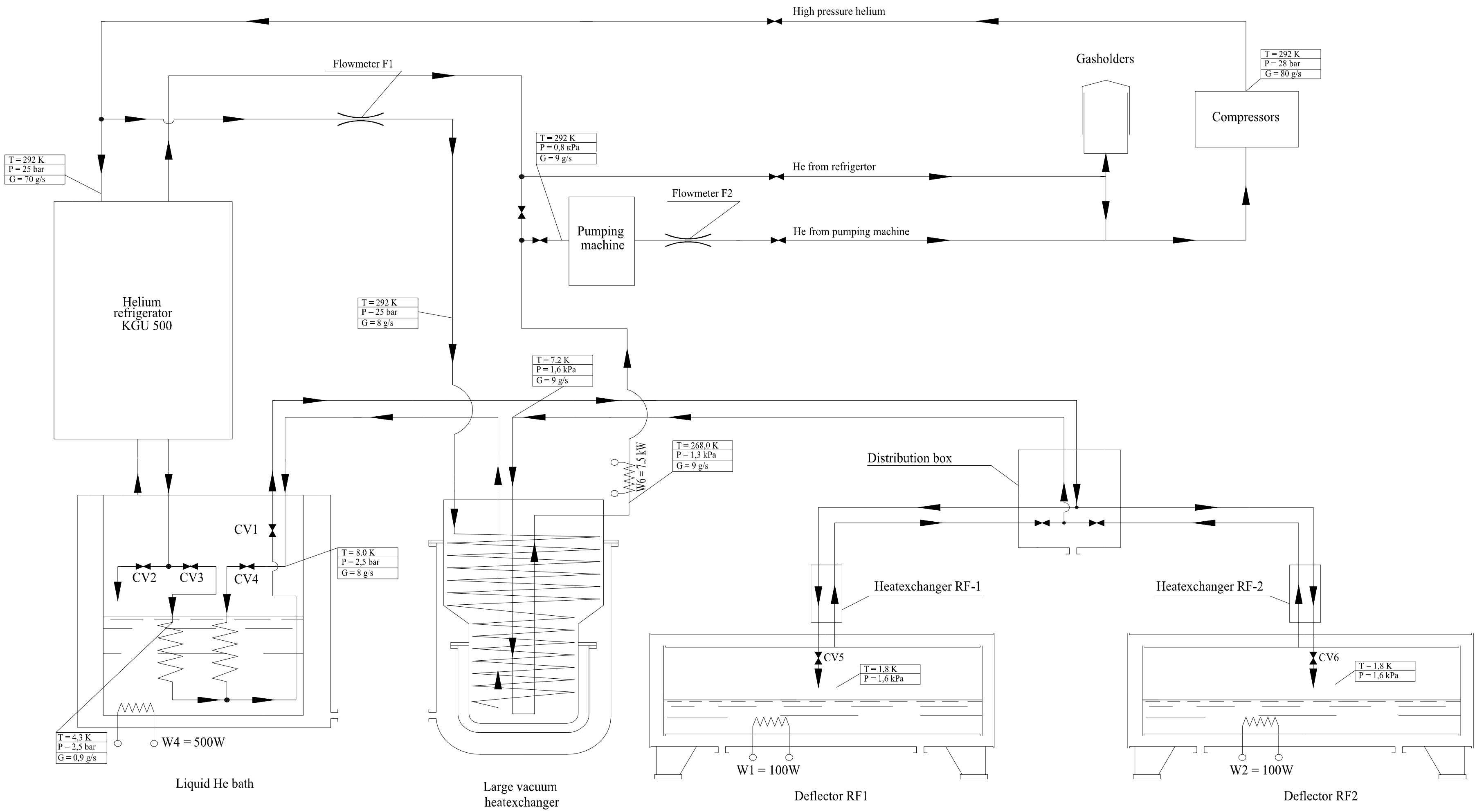
# He II cryostat for the superconducting RF particle separator



1 vacuum tank; 2 80 K shield: 3 He II tank 4 niobium deflector; 5 Kapton window; 6 getter pump; 7 angle valve for deflector vacuum; 8. 9 frequency tuning; 10 expansion valve; 11 RF-coupling; 12,13,14 safety valve; 15 RF-probing; 16 setting mechanism; 17 vacuum stud; 18 el. leading; 19 N2-loop (shield); 20 He-loop (shield); 21 He-flow line; 22 He-return line; 23 deflector chassis; 24 vacuum-stud (insulation vacuum); 25 vacuum-stud (deflector vacuum); 26 position indicator (deflector for beam tube); 2 7 LHe-level indicator; 28 superinsulation; 29 guide rails for deflector; 30 preheater line; 31 lead for el heaters; 32 RF-joint

# Deflector mounting in channel

# Flow chart of the cryogenic and vacuum plant cooling the superconducting RF deflectors

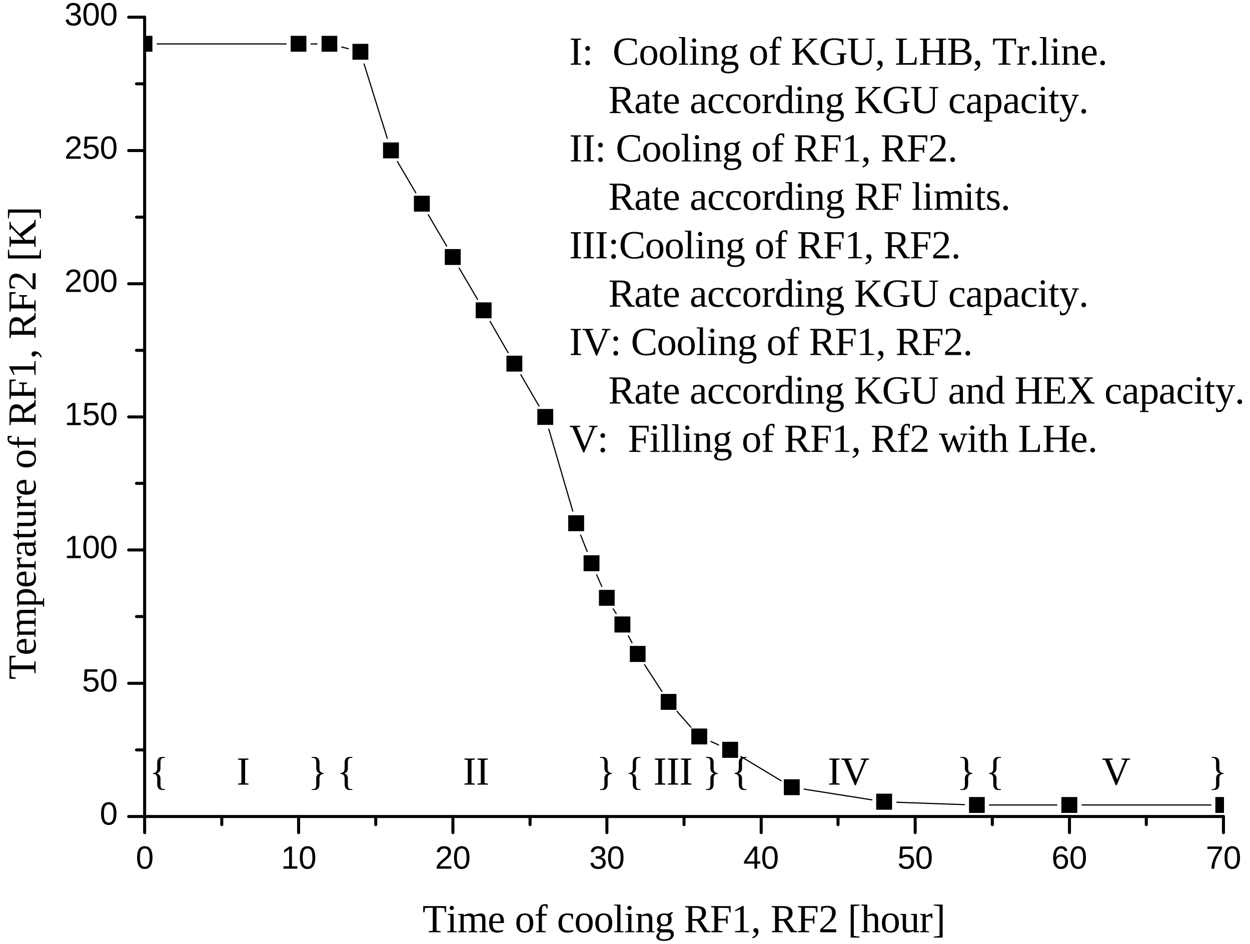


# Heat loads to cryogenic units CVS at He temperature

| CVS unit | Heat load [Watt] |
|---|---|
| Liquid He intermediate bath | 5 |
| (RF1 + RF2) deflectors | 18 |
| Large vacuum heat exchanger, cryogenic transfer lines from HEX to (RF1 + RF2) deflectors | 150 |
| Cryogenic tube from liquid He intermediate bath up to HEX (calculated value) | 10 |
| RF load in RF1 + RF2 (calculated value) | 25 |
| Total to CVS | 208 |

# Cold mass and specific heat of the CVS components

| Component name | Material | Mass [kg] | Specific heat [J/(g K)] | | | | |
|---|---|---|---|---|---|---|---|
| | | | 290 K | 80 K | 20 K | 10 K | 5 K |
| Transfer line | Stainless steel | 1000 | 0.480 | 0.202 | 0.0113 | 0.005 | 0.001 |
| Cavities cryostats | Stainless steel | 356 | 0.480 | 0.202 | 0.0113 | 0.005 | 0.001 |
| Cavities | Niobium | 520 | 0.260 | 0.173 | 0.0113 | 0.0022 | 0.0006 |
| Helium inventory in the cold units: KGU 500-4.5/140, LHB, HEX, transfer line, cavities cryostats | | From 0.66 kg at 290 K up to 54.3 kg at 5 K | 5.193 | 5.197 | 5.260 | 5.462 | 8.10 |



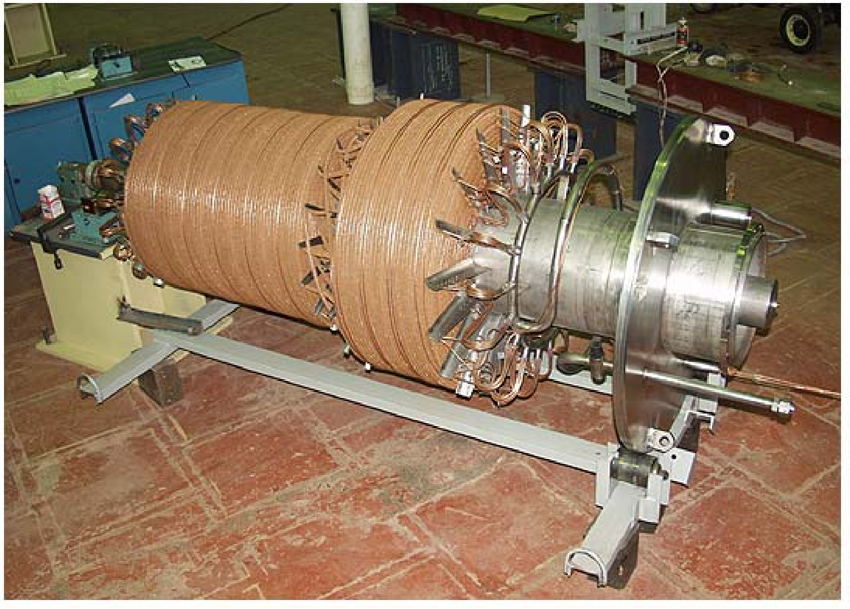

**Cooling down of the RF separator superconducting cavities by CVS.**

# CVS operation mode

- A special CVS operation mode was developed and implemented when with the refrigerator down the transfer line warms up to 14 K within 15-16 hours, and not all the transfer line has this temperature, but only part of it adjacent to the HEX.
- The idea is that when a turbine of the KGU 500-4.5/140 is broken down not to stop but to keep operation of HEX as a satellite refrigerator. In this case the imbalance, the extra cold helium flow rate is generated not by liquefier, but it comes from the cavities cryostats due to the liquid evaporation owing to the heat leaks.
- This method has one more interesting feature, that is the satellite refrigerator operates at variable temperature level: from 1.8-4.3 K in the cavities cryostats up to 12-14 K in the transfer line. According our experience, 15 hours is quite enough to eliminate most complex emergency situation.

# KGU-500

# HEX mounting at IHEP



# Cryogenic transfer line

# Slide-valve pumps

# Roots blowers

# CONCLUSION

- Operational modes of the unique cryogenic and vacuum system for cooling the superconducting cavities down to 1.8 K by superfluid helium with mass flow rate up to 10 g/s are being investigated.
- This CVS provided filling of two RF cavities cryostats with 1000 litres of the superfluid liquid helium that enabled to separate the charged particles beam and concentrate the K-mesons.
- The satellite refrigerator operation mode was developed and implemented with variable temperature level and with low pressure flow imbalance due to the liquid helium evaporation by heat leak to the cavities cryostats.