

STAARQ test station

Station Test Aimant Accélérateur Quadripole

Hervé Allain, Jean-Marc Gheller, Nicolas Commaux, Patrick Graffin, Michael Massinger, Denis Bouziat,...

3rd International Magnet Test Stand Workshop - 11/06/2019 - Uppsala

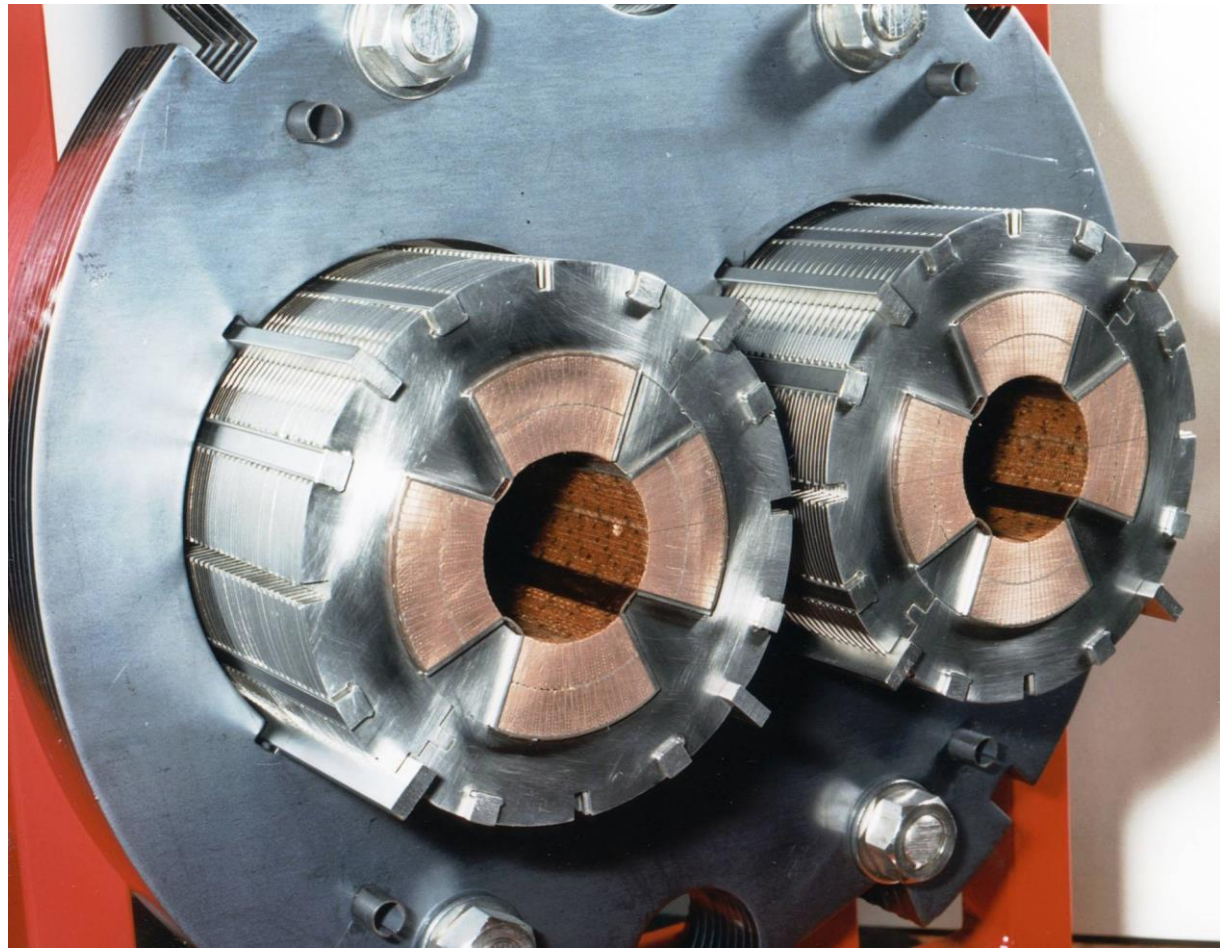
FROM RESEARCH TO INDUSTRY

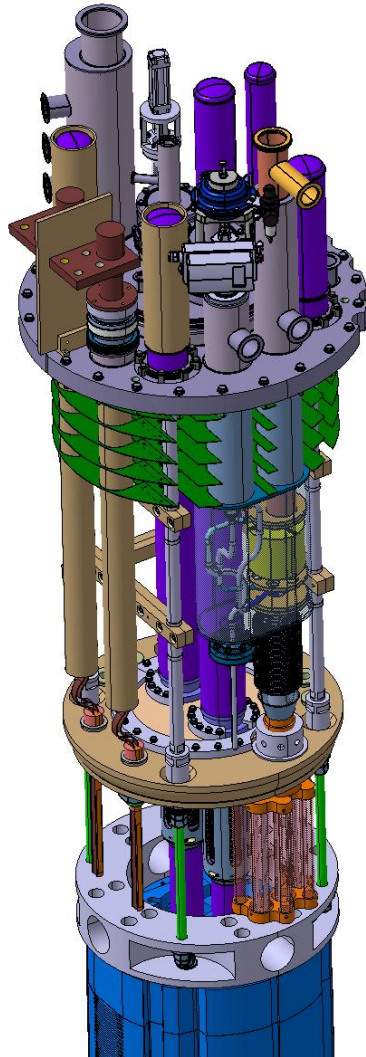
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OUTLINE

1. INTRODUCTION
2. CRYOSTAT DESIGN
3. COOL DOWN/HEAT LOAD
4. LIQUEFIER
5. PROCESS
6. SCHEDULE
7. CONCLUSION



7.65 meter

Proposal STAARQ project:

Training and magnetic characterizations

Tests conditions considered:

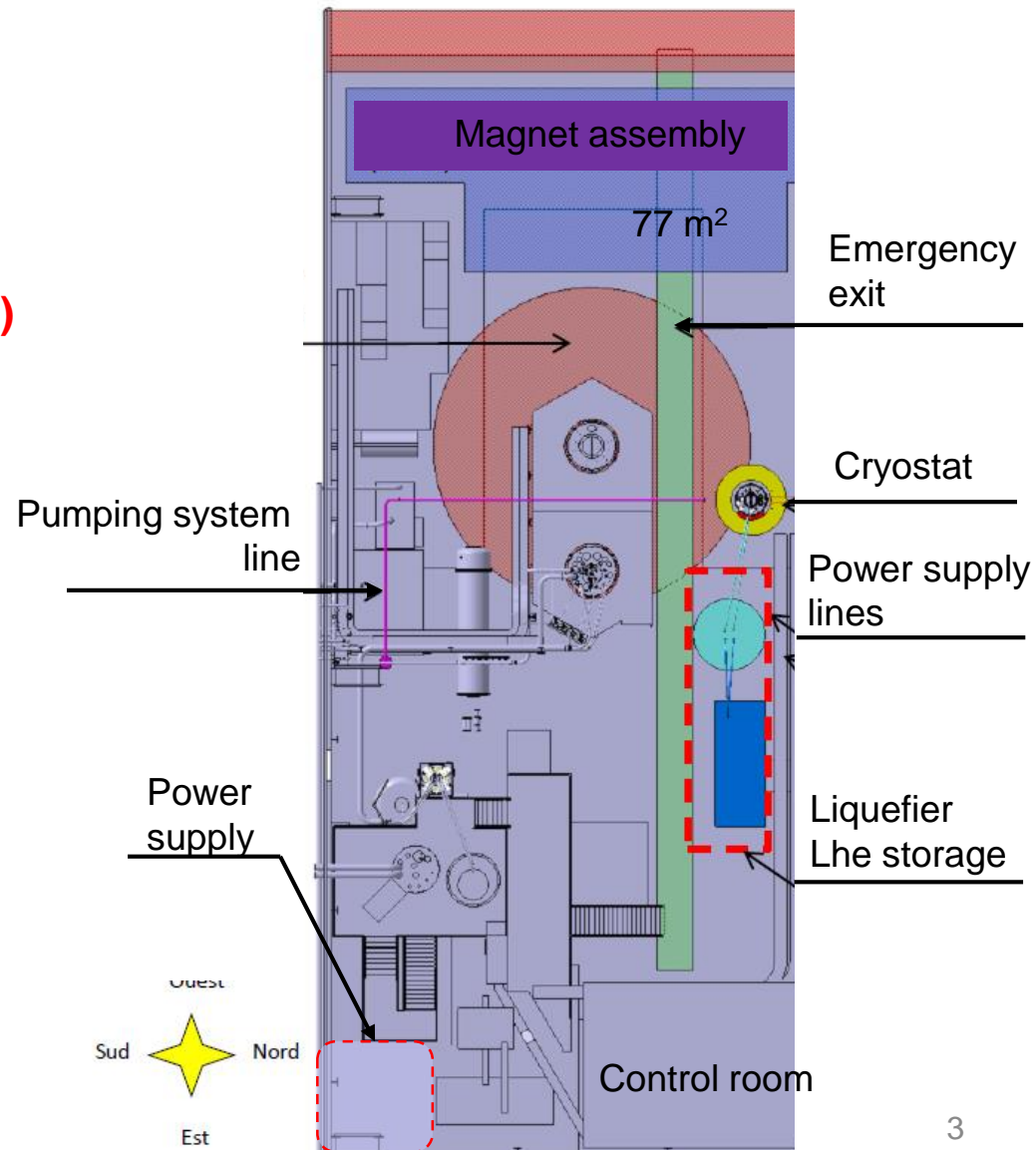
**Magnet @ T 1.9 K, Pressurized (1 bar)
Rotating coil @ room T (with anti cryostat)**

Projet MQ (expected July 2020)

L = 3.45m
 \varnothing 452 mm
 double aperture / \varnothing 56 mm
 distance axes : 194 mm
 I max : 13 kA
 weight : 4060 kg

Projet MQYY (expected september 2020)

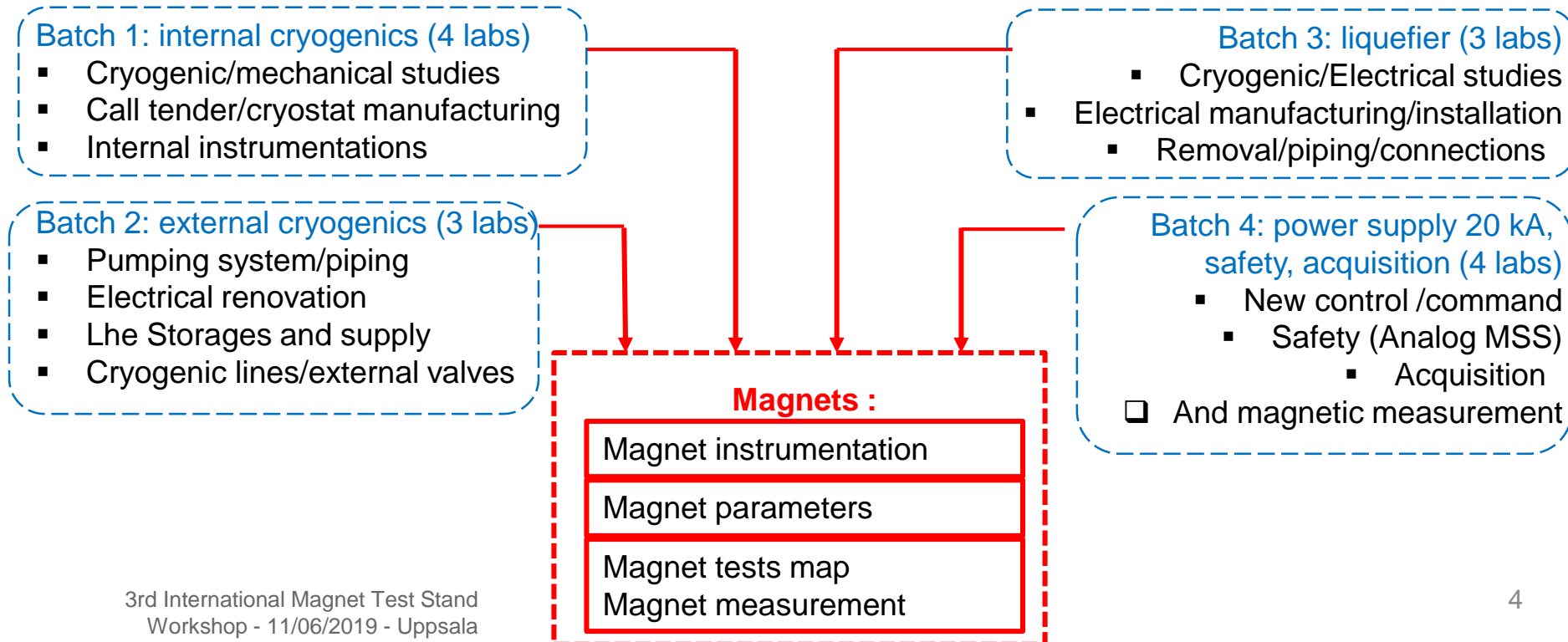
L = 4.035 m
 \varnothing 614 mm
 double aperture / 90 mm
 distance axes : 194 mm
 I max : 6 kA
 weight : 8970 kg



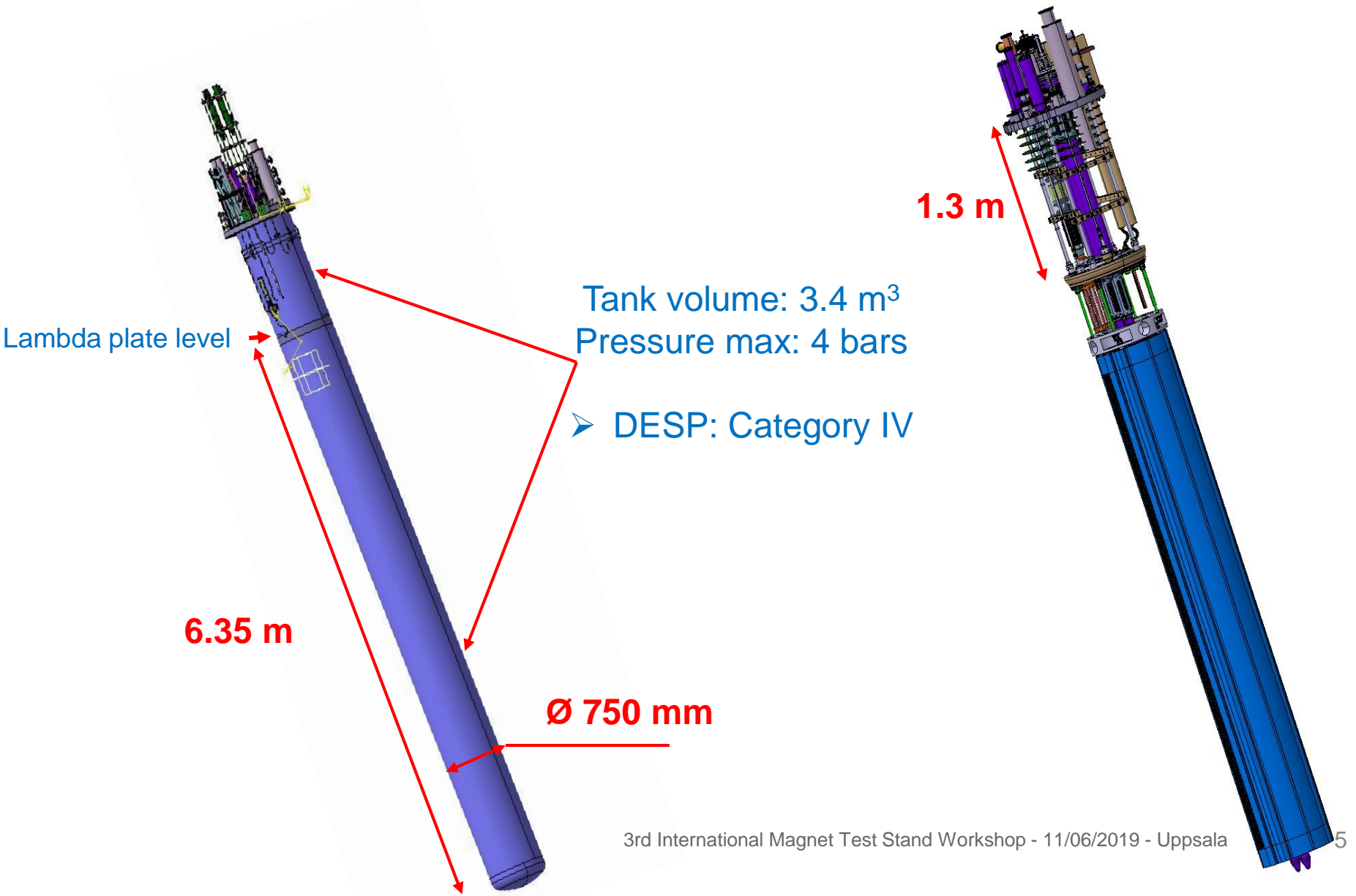
Project divided into 4 batches:

- Batch 1: **internal cryogenics** (leader H. Allain)
- Batch 2: **external cryogenics** (leader N. Commaux)
- Batch 3: **liquefier** (leader N. Commaux)
- Batch 4: **power supply 20 kA, safety, acquisition** (leader D. Bouziat) and Magnetic measurement (leader D. Simon)

Project coordinator : JM Gheller
 Coordinator DIS: J Relland
 Leader MQ project: C Lorin
 Leader MQYY project: D Simon



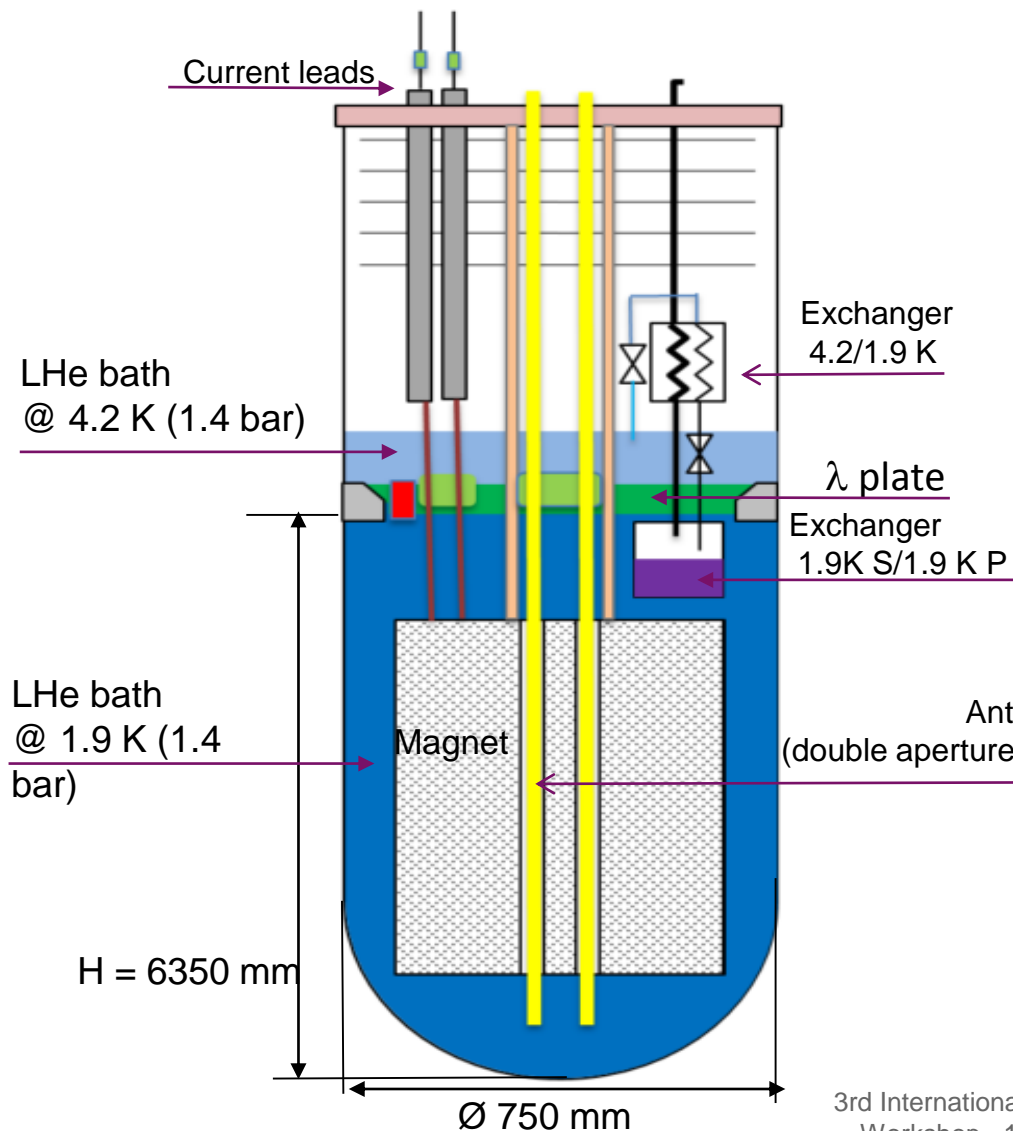
INNER CRYOSTAT (I)



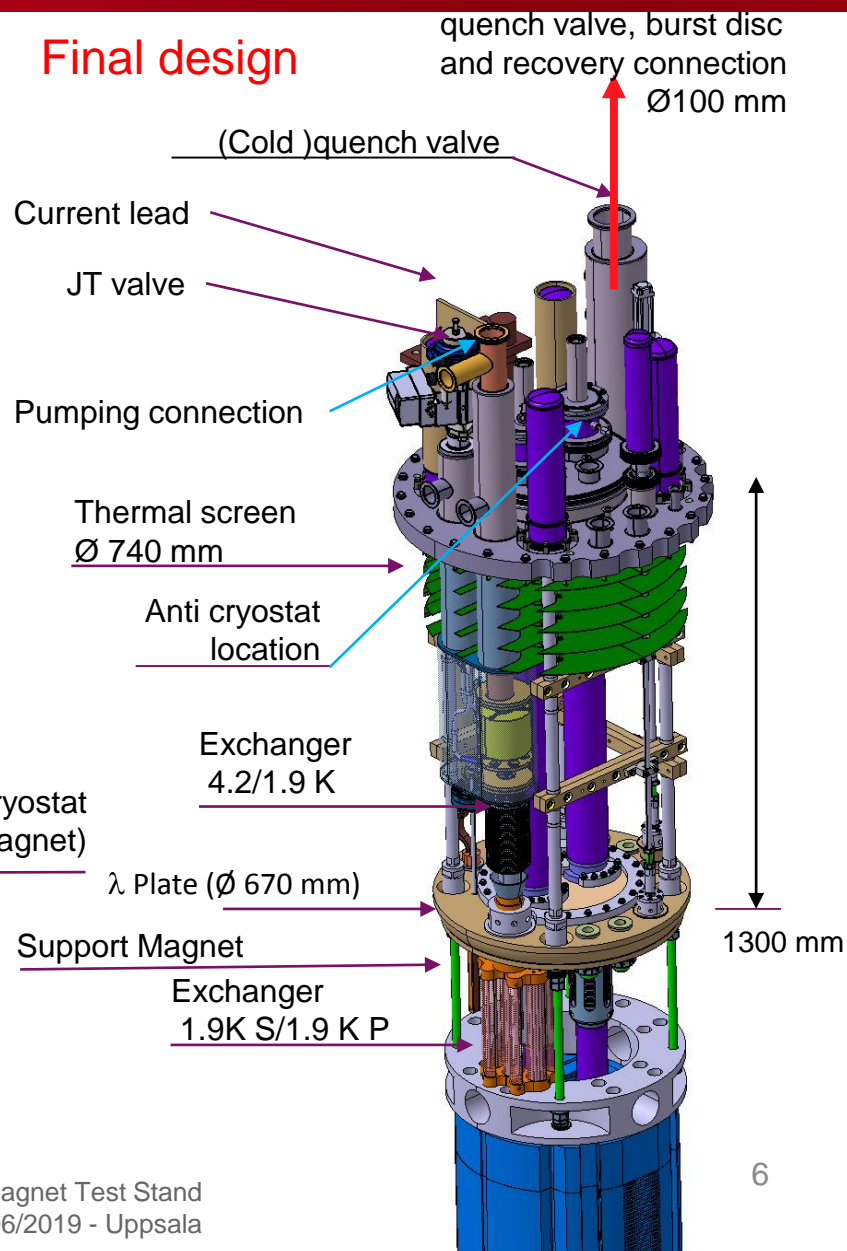
INNER CRYOSTAT (II)



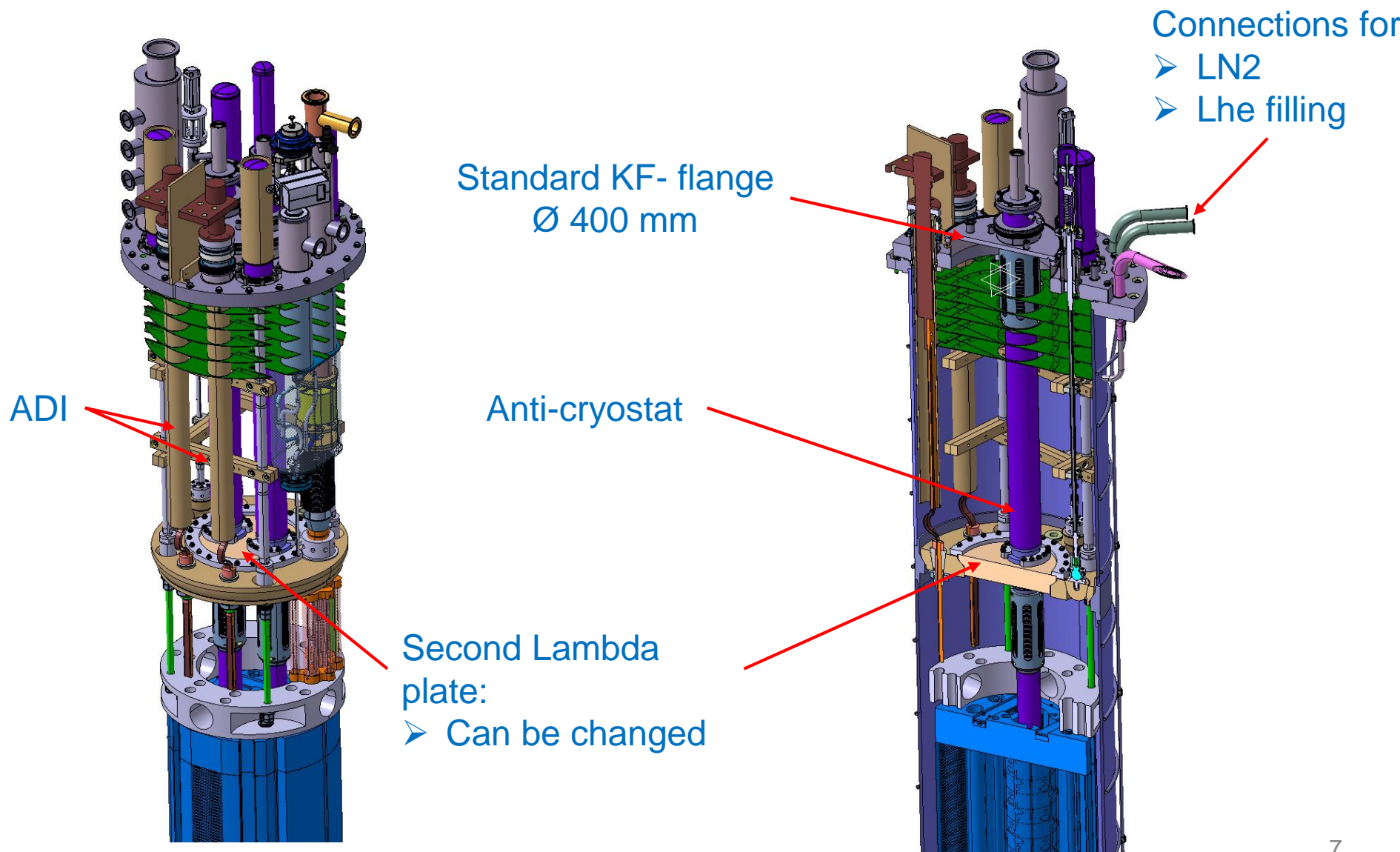
Conceptual design – inner cryostat



Final design



INNER CRYOSTAT (III)



- Cool down and liquid helium filling:
 - MQ: 5 days (4 tons)
 - MQYY: 9 days (9 tons)
- Time to go down to 1.9 K (from 4.5 K): 8 Hours (possibility to go faster)

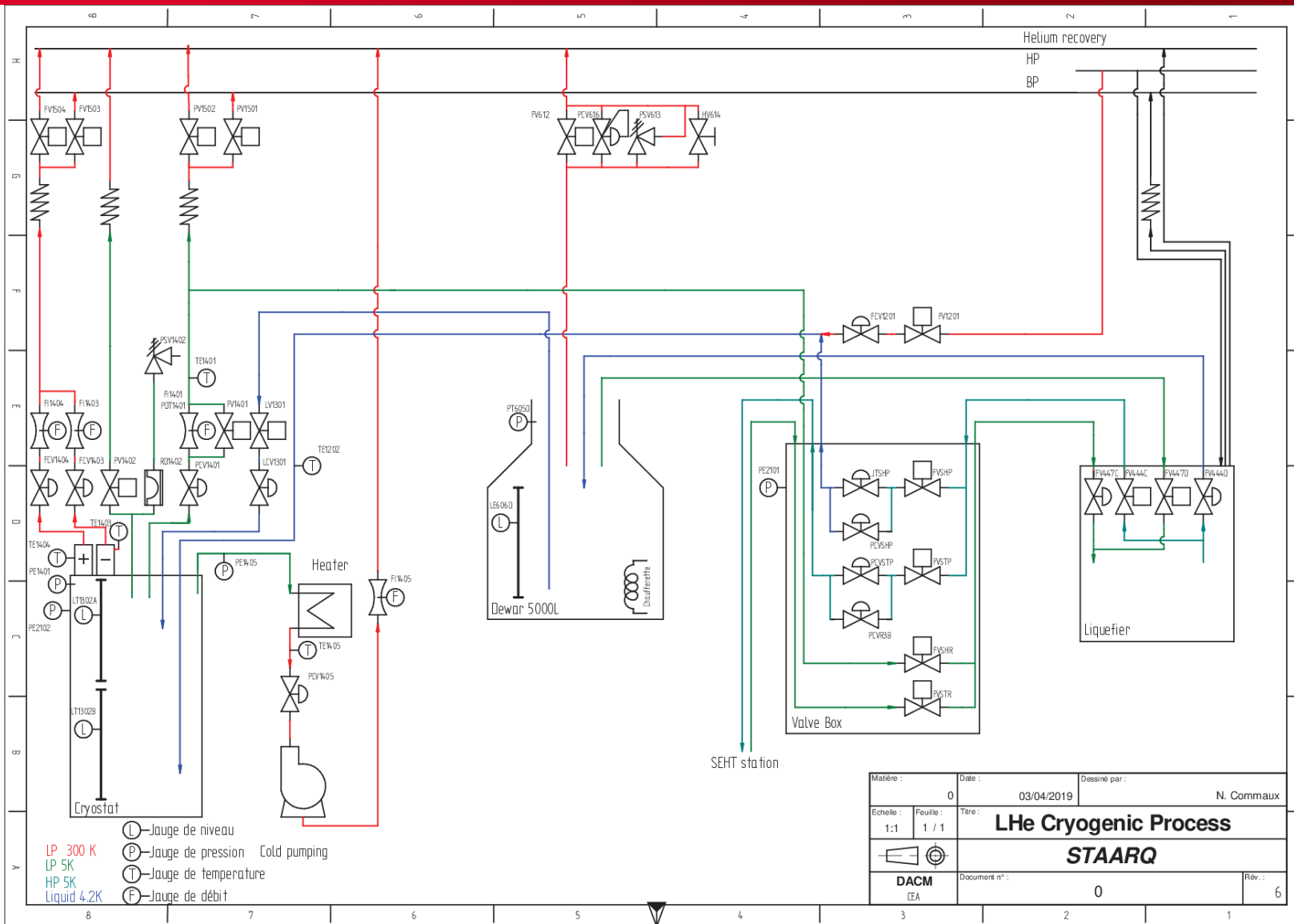
Heat load and liquid helium consumption

| | Heat load (W) | Liquid helium mass flow |
|-------------------------------------|---------------|----------------------------|
| 4.5 K bath | 60 W | 3 g/s or 87 l/h |
| 1.9 K bath | 25 W | 1.25 g/s or 36 l/h |
| | | |
| Total (4.5 K and 1.9 K bath) | 85 W | 4.25 g/s or 123 l/h |

- Liquefier for the STAARQ station: early Air Liquid Helial
- Modified to run both as a liquefier and a refrigerator
- 50L/h in liquefier mode and 180W of cooling power in refrigerator mode
- Coupled to a 5000L dewar
- Undergoing an upgrade of its instrumentation and control system



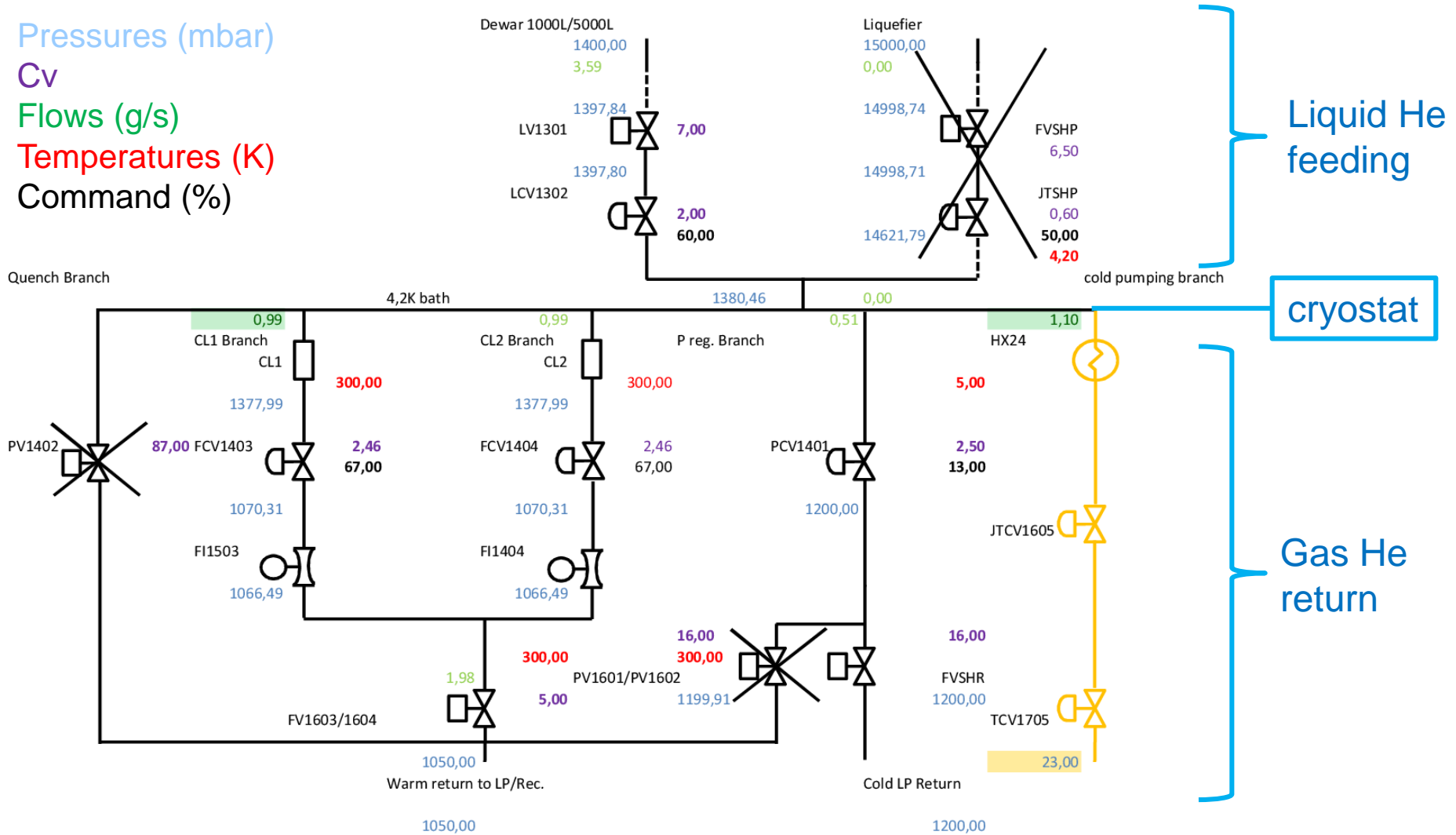
GENERAL PROCESS DIAGRAM: READY



- Operating pressure for the cryostat between 1.3 and 1.4 bars (imposed by the cold box/dewar system operations)
- **LHe flows:**

| | 13 kA | 0 kA | 4.2K standby |
|-----------------------------|-------|---------|--------------|
| Current Leads (g/s) | 1 x 2 | 0.6 x 2 | 0.6 x 2 |
| Cryostat P regulation (g/s) | 1 | 1 | 1.6 |
| 1.9 K sat. pumping (g/s) | 1.25 | 1.25 | 0 |

Pressures (mbar)
Cv
Flows (g/s)
Temperatures (K)
Command (%)



| | 2018 | 2019 | | | | 2020 | | | | 2021 | | |
|--|------------------------------|---|-------|--|-------|--------------------------------------|---------------------------------------|--------------------------|------|------|-----|-----|
| | Sm2 | Tr 1 | Tri 2 | Tri 3 | Tri 4 | Tr 1 | Tr 2 | Tr 3 | Tr 4 | Tr1 | Tr2 | Tr3 |
| Q4 Short model | UNAVAILABLE AREA | | | | | | FREE AREA | | | | | |
| STAARQ Project | | | | | | | | | | | | |
| Lot 1: Internal Cryogenic | Studies/ CAD design drawings | | | Call for tender June 2019 Cryostat manufacturing Receptions cryostat June 2020 | | | | | | | | |
| Lot 2: External cryogenic | | Studies call for tender/ order supplies | | | | Installation/tests | | | | | | |
| Lot 3: Liquefier | | Studies/ local removal Electrical renovation | | | | Manufacturing Installations/tests | | | | | | |
| Lot 4: Alim, MSS, MCS, Acquisition | | Studies /call for tender, HMI renovation | | | | Manufacturing installation/tests | | | | | | |
| Magnet/support connections Electrical/cryogenic connections | | | | | | | | Dummy load Q4 (SM) | | | | |
| Commissioning Station (2/3 month) | 06/11/2019 | | | | | | 1 st MQ expected July 2020 | | | | | |

Programmed testing: April 2021/April 2023

Conclusion

- ❖ STAARQ: double bath cryostat with pressurized superfluid bath to test MQ and MQYYP
 - Design done to be able to test other type of magnet

- ❖ **STAARQ project status:**
 - ✓ Mechanicals and cryogenic studies completed
 - ✓ Electricals studies on going
 - ✓ External cryogenic review with CERN experts done
 - Call for tender of the cryostat in June 2019
 - Liquefier removed in March 2020
 - Cryostat expected in June 2020
 - MSS A installed in the last quarter of 2020
 - Final connections (cryogenic /electrical) expected in December 2020
 - Commissioning (3 months) in the first quarter of 2021
 - Magnetic measurement from April 2021 to April 2023

Thank you for your attention

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