Large Scale He Hydrodynamic CERN Facilities

2000-2001 : GReC Experiment in hall SM18

200?-200? : He Pipe Experiment in hall 180

Large Scale He Hydrodynamic CERN Facilities

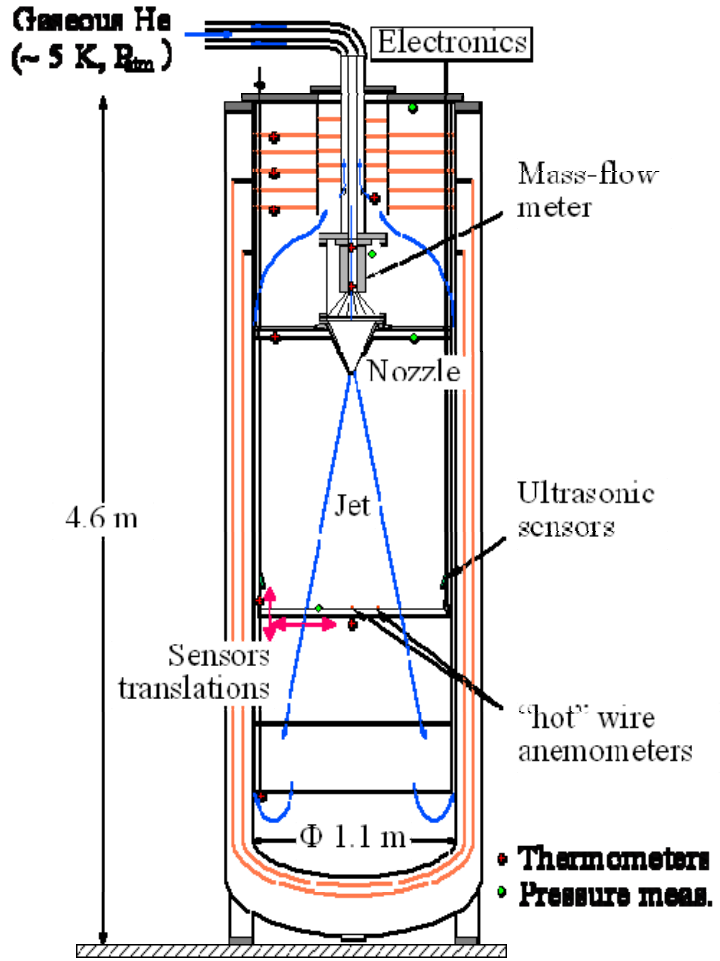
PART 1

GReC Experiment in hall SM18

Collaboration :

CERN (GENEVA, SWITZERLAND),
CRTBT (GRENOBLE-FRANCE)
LEGI (GRENOBLE-FRANCE)
ENSL (LYON - FRANCE)

GReC Experiment
Large axisymmetric turbulent jet



GReC Experiment

Cryogenic requirements

- Gaseous He flow as cold as possible (~4.5-5 K)
- No liquid droplet allowed at all (single phase)
- Flow rate as high as possible
- As stable as possible steady-state conditions during the measurement period (a few hours)

GReC Experiment

Cryogenic facility available and compatible :

6kW @ 4.2 K LINDE cryoplant in SM18

- 300 g/s LHe @ 4.2K , atm. pressure
  $\Rightarrow$ Re ~ 10^7, $R\lambda \sim 6000$
- Availability of a distribution valve box with removable transfer lines

SM18 Hall
Largest cryogenic test facility at CERN

Cryogenic test area for the big LHC magnets and RF cavities

SM18 Helium Cryogenic infrastructure SUMMARY

He cryogenic equipments connected to hall SM18 :

- P18 : 18 kW @ 4.5K, atm. p. AL refrigerator (~770 g/s LHe), feeding a 25 000 liter LHe dewar
- Network of LHe distribution and recuperation transfer lines
- Large pumping unit 400W @ 1.8 K (10 mbar)
- 2 x 100 000 liters LHe storage vessels

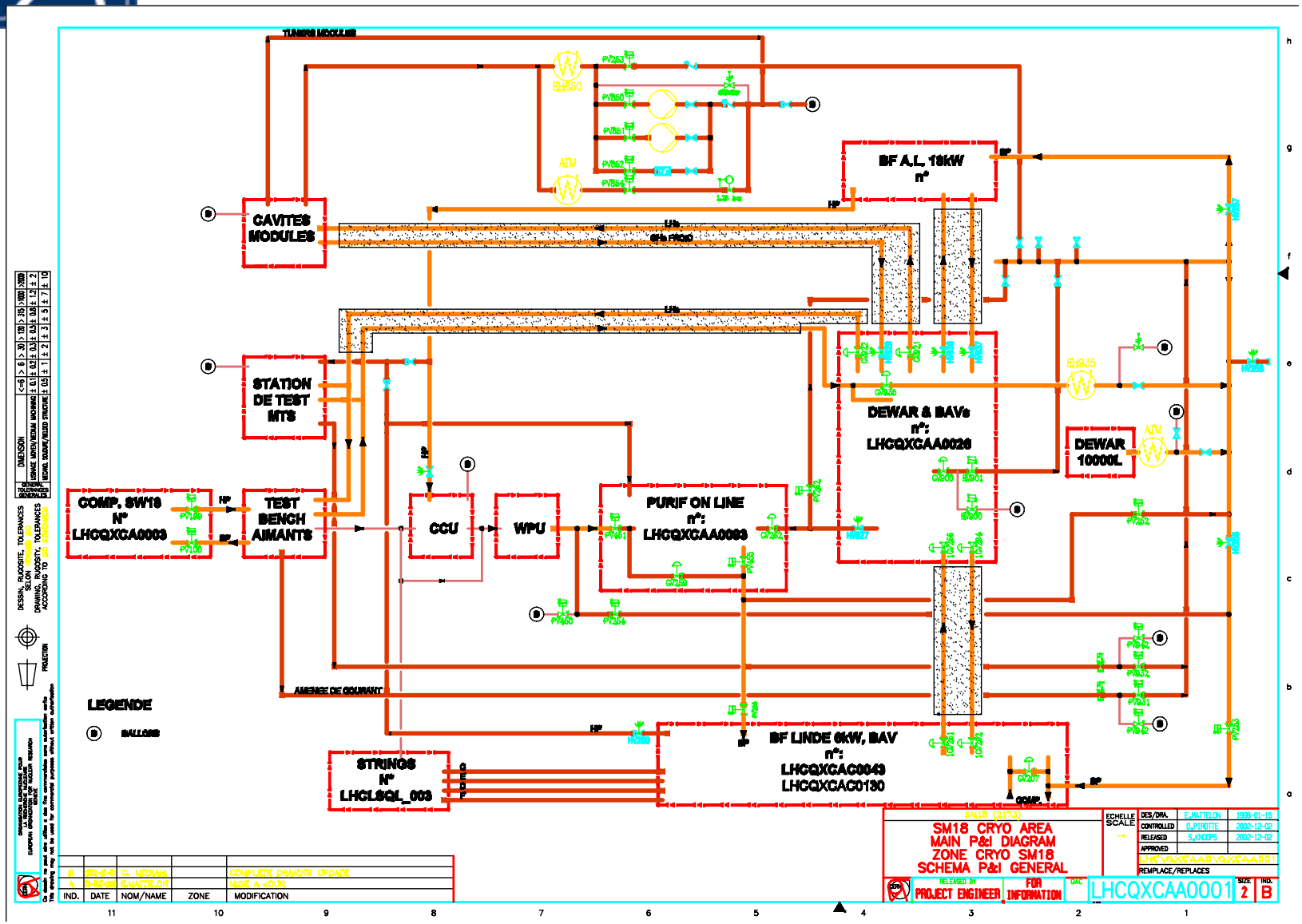
SM18 Helium Cryogenic infrastructure SUMMARY (2)

He cryogenic equipments available in hall SM18 :

6 kW @ 4.2 K LINDE cryoplant

- 300 g/s LHe @ 4.2 K , atmospheric pressure
- Additional separate LN2 precooler
- Feeds the 25 000 liter LHe buffer dewar (backup for the 18 kW during LHC magnets tests)
- Distribution Valve Box : TLs to Dewar (fixed) + string (removable)

SM18 Helium Cryogenic Infrastructure
General Flow Scheme

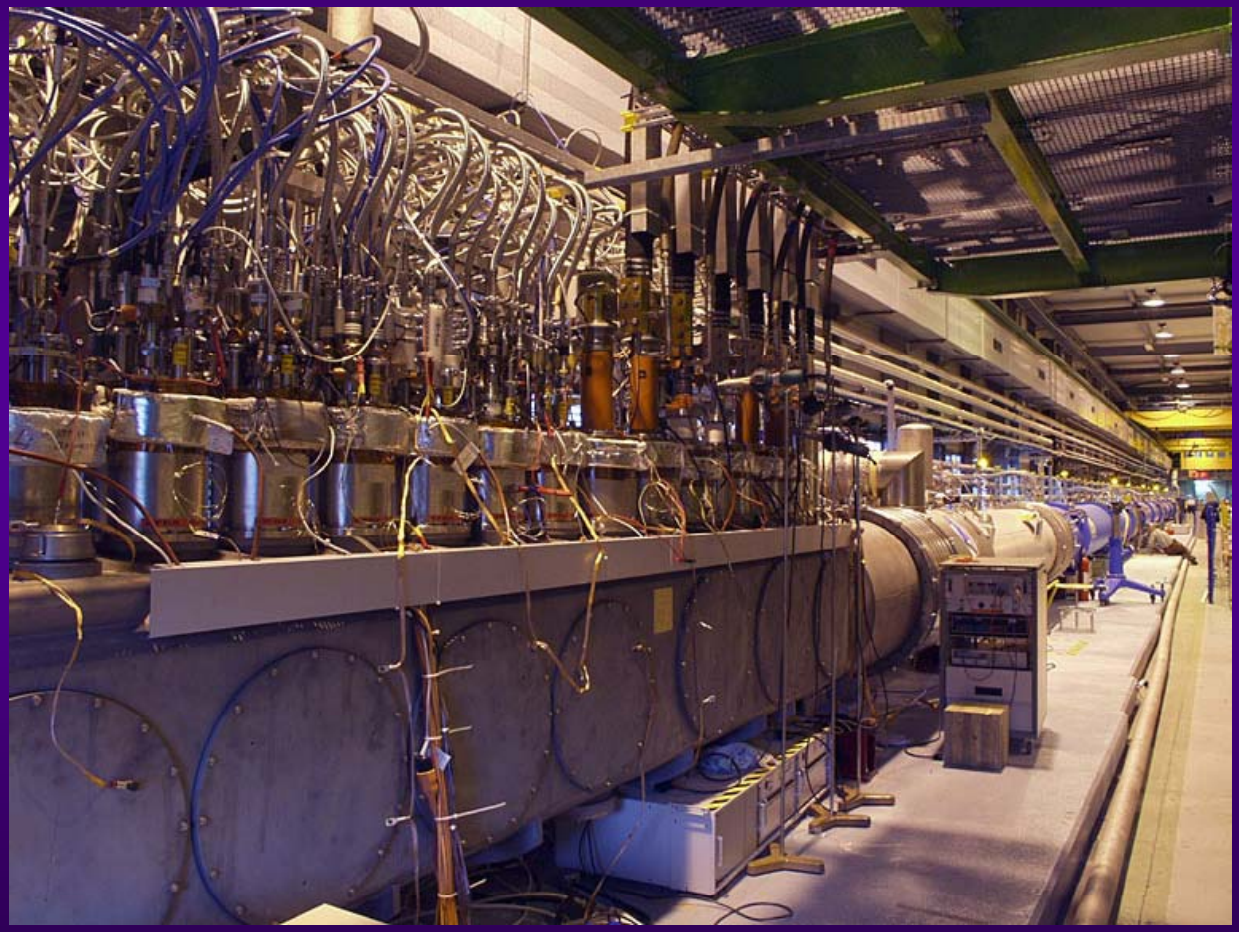


SM18 SC Magnets Test Benches

SM18 Magnets + Cavities Test Stations

SM18 Magnets Test Benches

6kW LINDE Cryoplant: recuperated from LEP and re-installed in SM18 for the LHC magnet string (Proto of a full cell of the LHC magnets lattice)



6kW LINDE Cryoplant: recuperated from LEP and re-installed in SM18 for the LHC magnet string

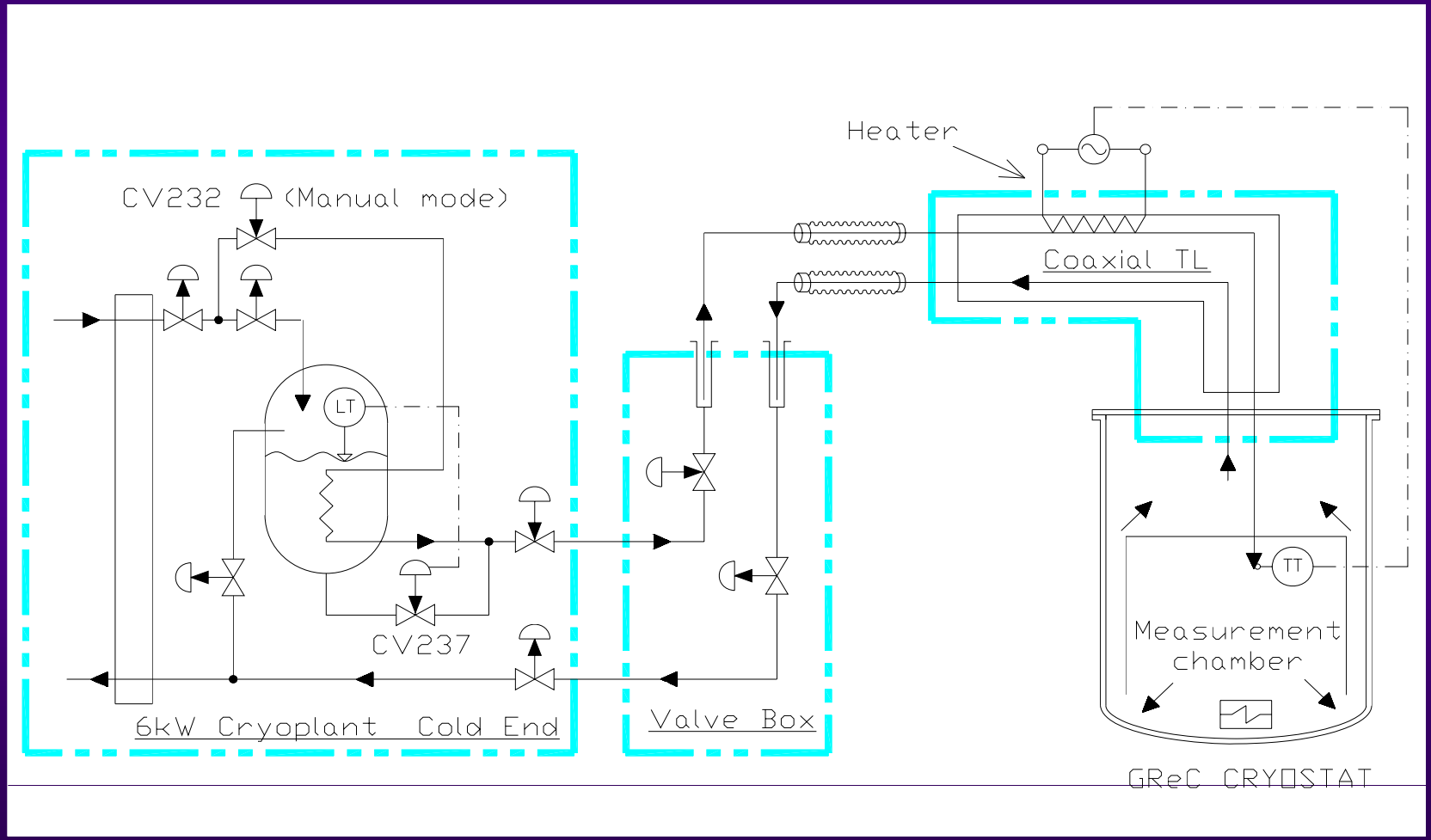
GReC Experiment

Solutions for the cryogenic requirements

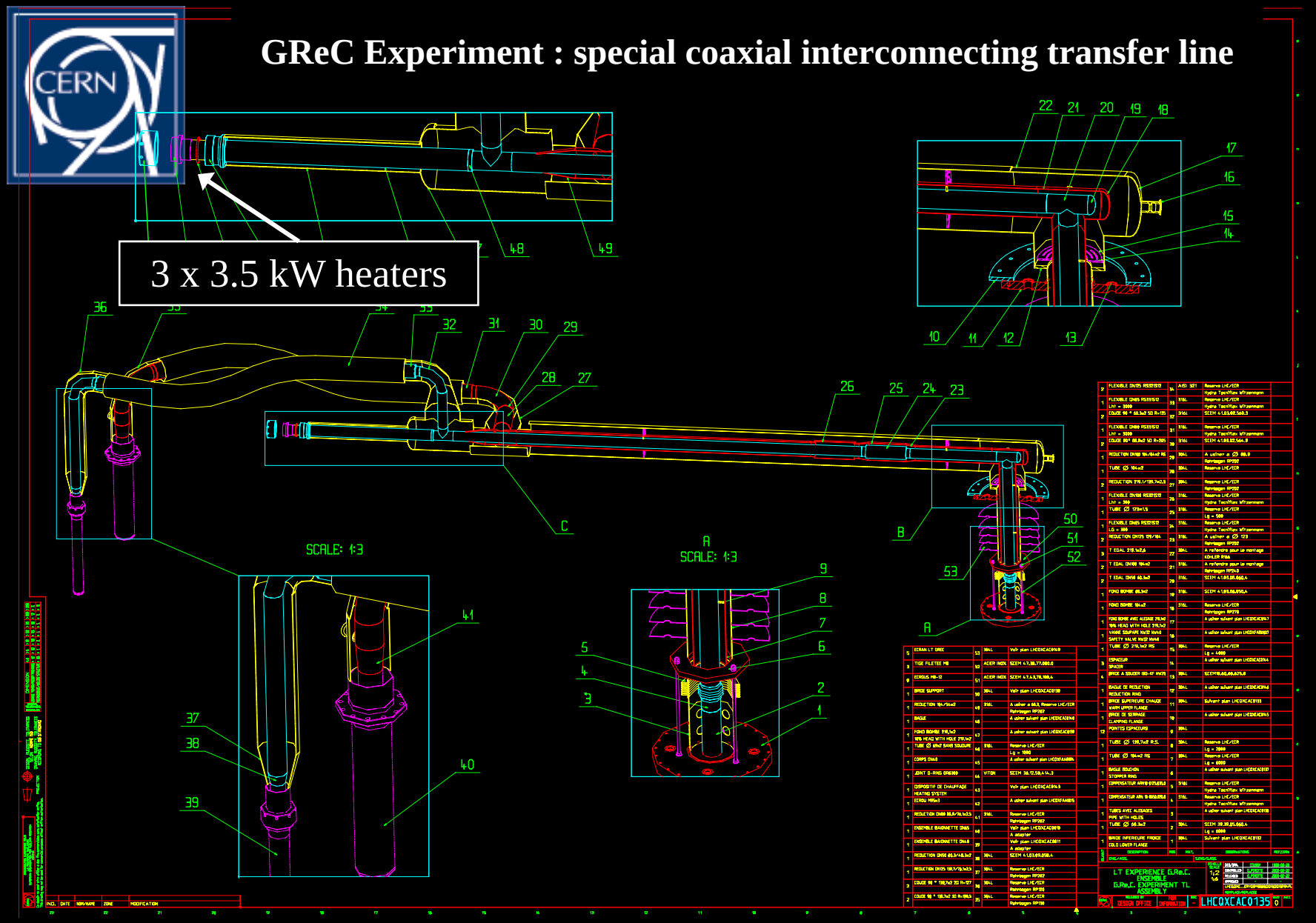
Recycling of a cryostat used for the tests of LEP cavities

Development of a special removable interconnecting transfert line

GReC Experiment
Simplified Test Set-up Flow Scheme



GReC Experiment : special coaxial interconnecting transfer line



GReC Experiment

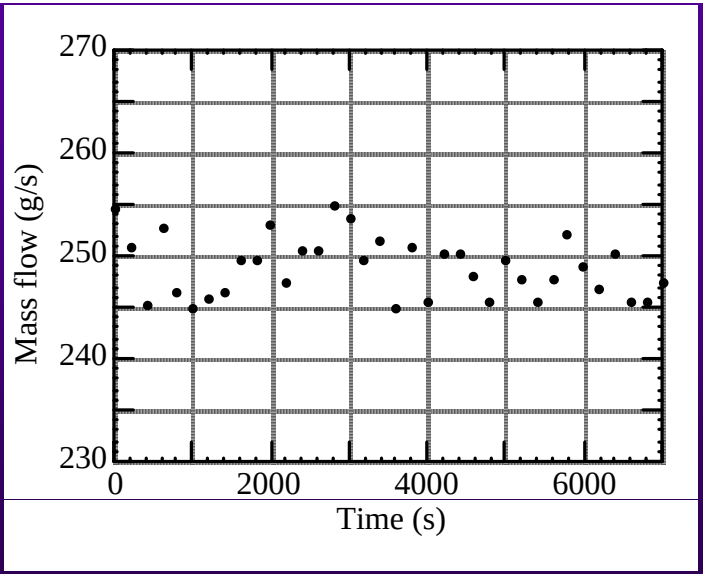
Head of the special coaxial interconnecting transfer line

GReC Experiment Results & Stability

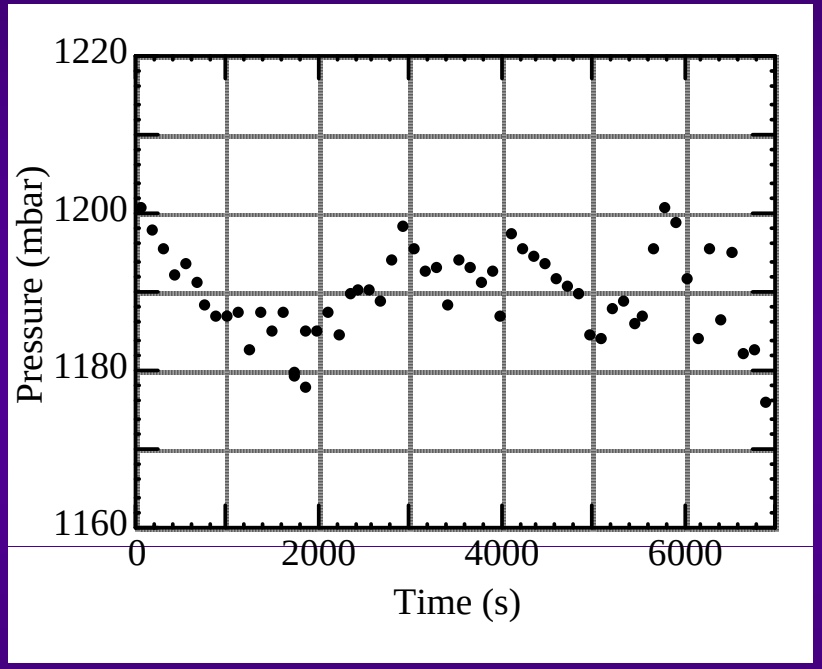
Mass flow (g/s)	U_{nozzle} (m/s)	$U_{average}$ (m/s)	u' (m/s)	Re_{nozzle} (10^7)	R_λ
20	2.5	0.3	0.08	0.077	1750
80	9.8	1.2	0.42	0.31	3500
260	32.3	3.9	1.5	1.01	6100

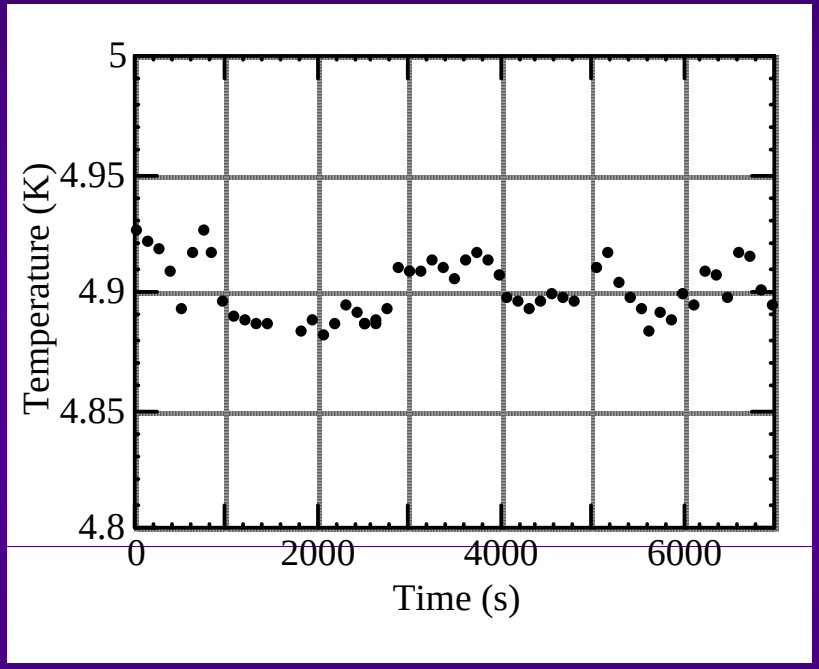
Mass flow stability < 2%

250 ± 5 g/s



GReC Experiment Results & Stability





Pressure stability

1190 ± 12 mbar

Temperature stability

4.90 ± 0.03 K

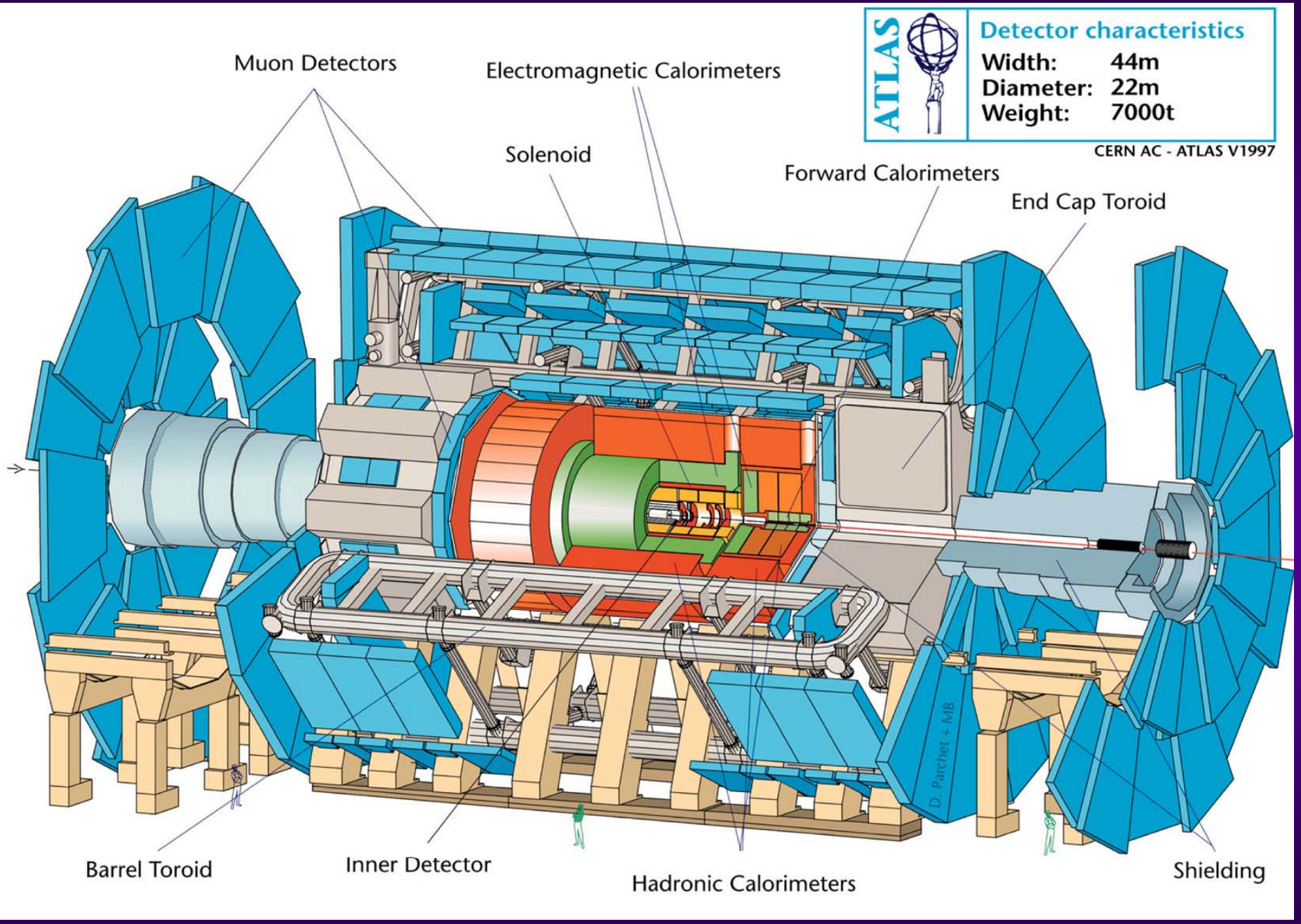
Large Scale He Hydrodynamic CERN Facilities

PART 2

He Pipe Experiment in hall 180

Collaboration :

CERN (GENEVA, SWITZERLAND),
NEEL (GRENOBLE-FRANCE)
LEGI (GRENOBLE-FRANCE)
ENSL (LYON - FRANCE)


ATLAS
Detector characteristics
Width: 44m
Diameter: 22m
Weight: 7000t
CERN AC - ATLAS V1997
Muon Detectors
Electromagnetic Calorimeters
Solenoid
Forward Calorimeters
End Cap Toroid
Barrel Toroid
Inner Detector
Hadronic Calorimeters
Shielding
D. Parchet + MB

Halls 180+191 : ATLAS assembly and cryogenic test area for huge parts of the detector : SC magnets + LAr calorimeters

Helium Cryogenic infrastructure based on a 1.2 kW @ 4.5K Linde cryoplant

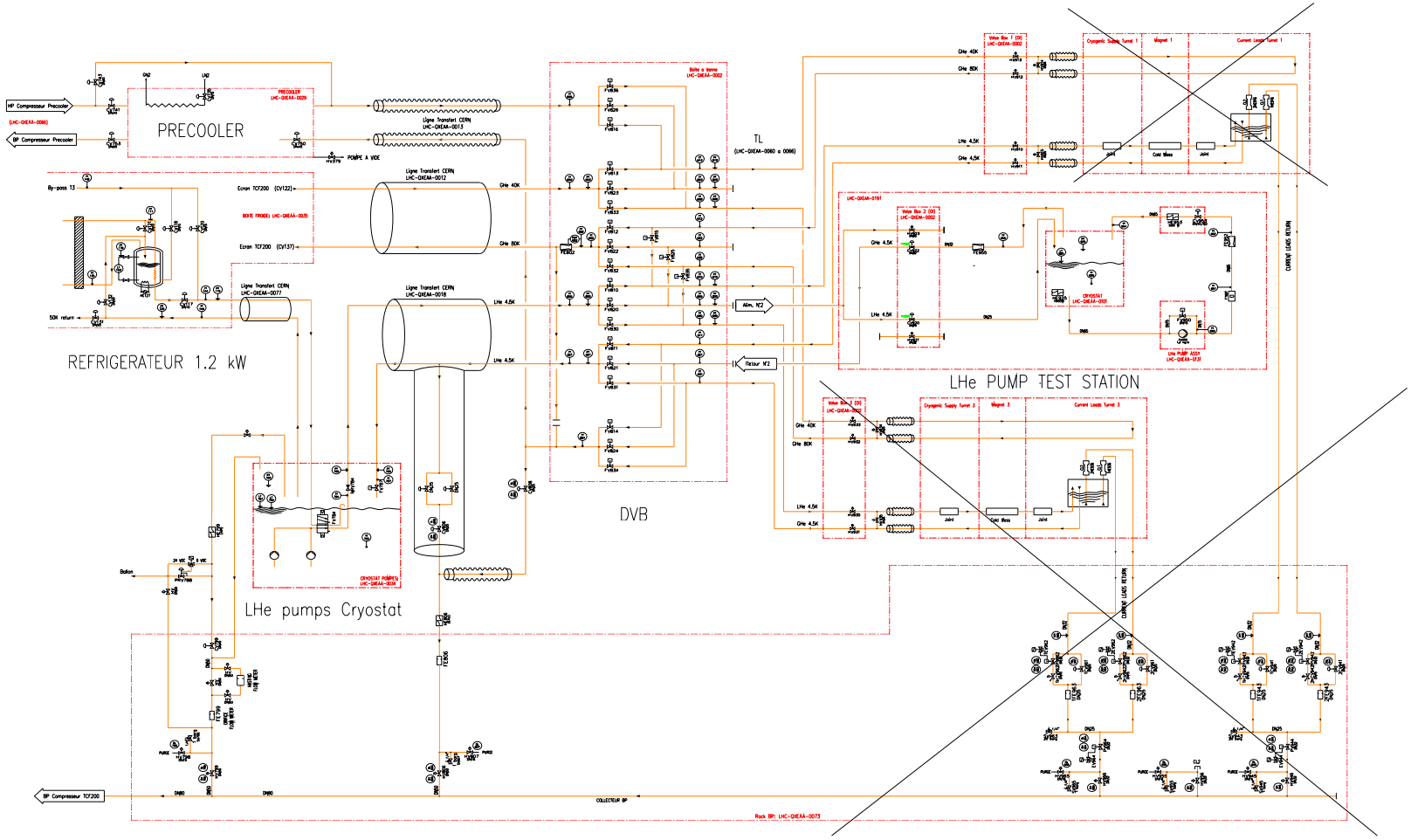
He cryogenic equipments available in hall 180 :

1.2 kW @ 4.5 K TCF200 LINDE cryoplant

- 60 g/s LHe @ 4.5K , atmospheric pressure
- Refrigerator can be boosted with LN2
- Additional separate LN2 precooler
- Availability of 2 x 100 g/s LHe immersed centrifugal pumps
- DVB with 3 shielded distribution lines
- Modular TF with an up to 1.5 kg/s LHe centrifugal pump

⇒ *Insertion of the He pipe experiment (module)*

Helium Cryogenic infrastructure based on a 1.2 kW @ 4.5K Linde cryoplant



He Pipe Experiment

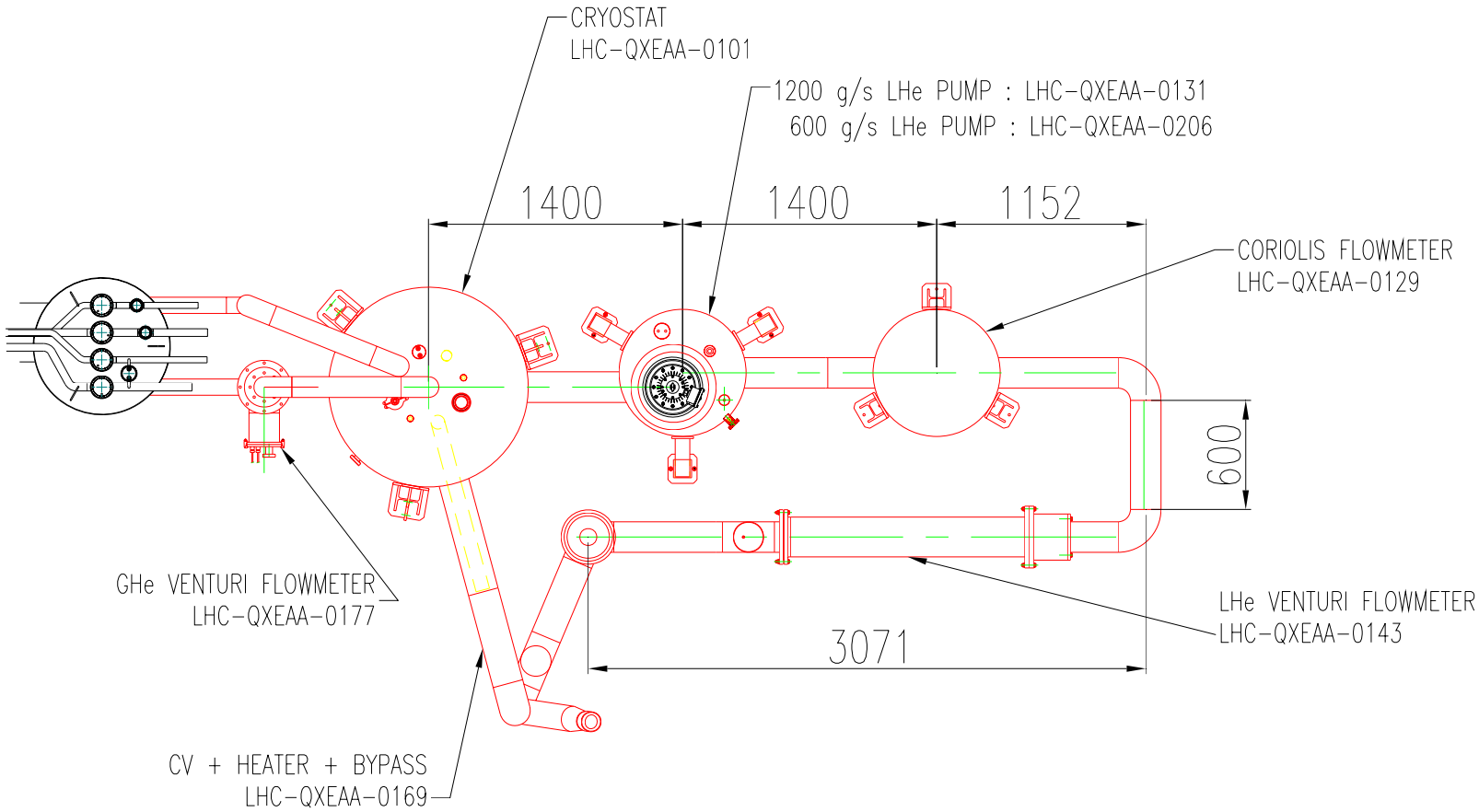
Profit of

- the availability of the largest LHe forced flow at 4.5K : centrifugal pump of 1.5 kg/s, ΔP=400 mbar
- the modularity op the installation

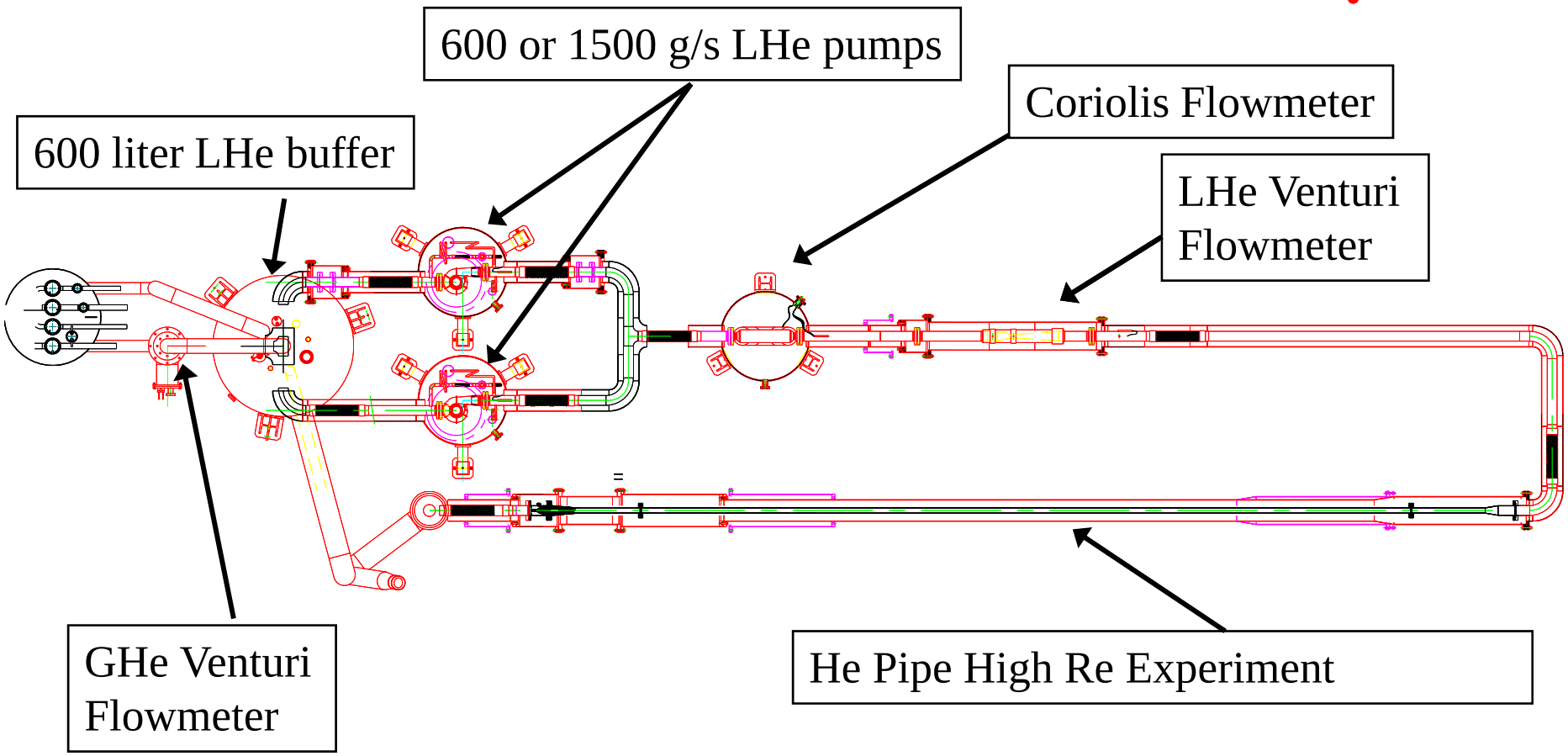
⇒ *He Pipe Experiment to study confined and wall-bounded turbulence for*

$$Re \geq 10^7$$

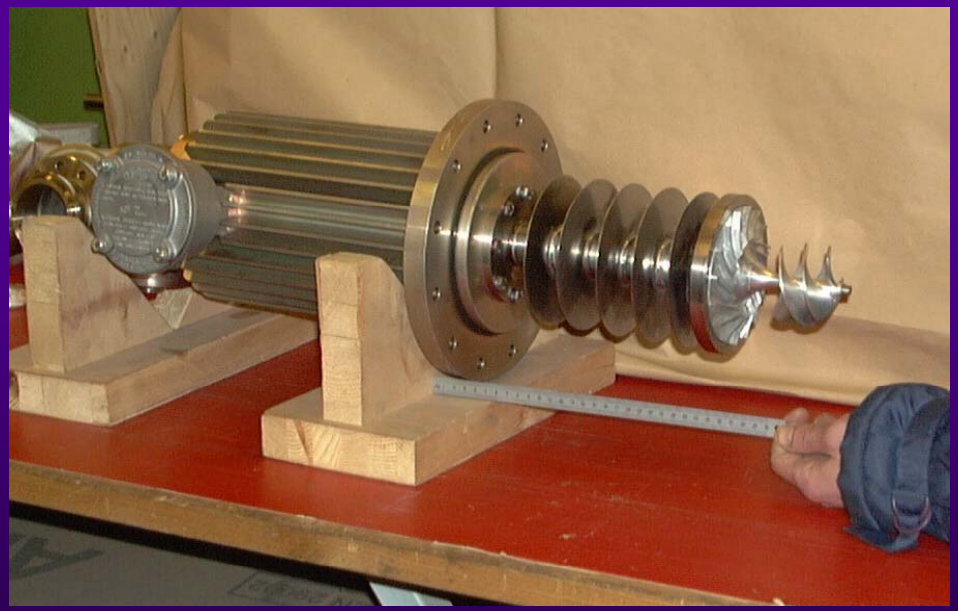
ACTUAL 1.2 kg/s LHe Pump
TEST SET-UP



PROJECT OF MODIFIED TEST SET-UP FOR He Pipe



1.2 kg/s LHe Pump Test Facility



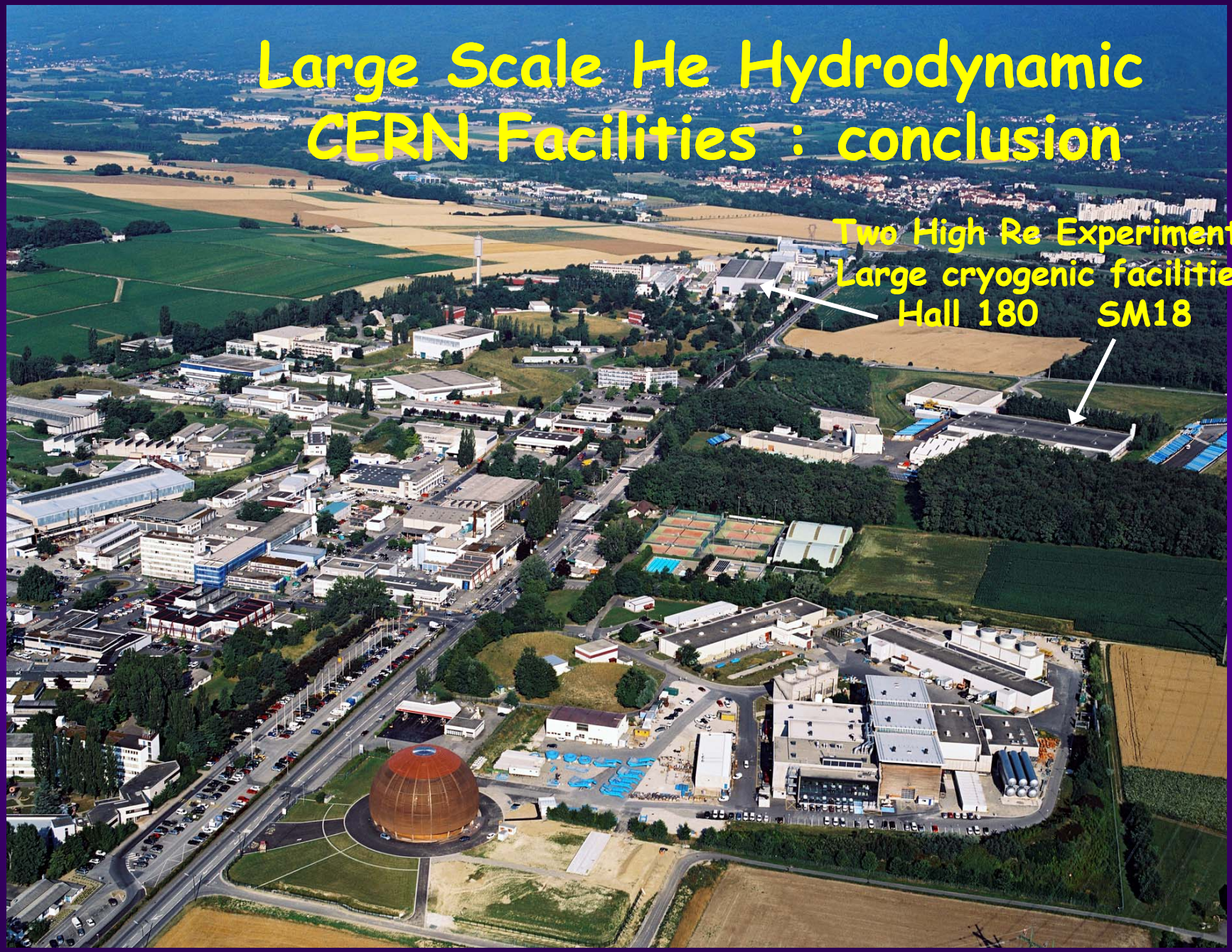
ATLAS Hall180 : BT Cryo Test Facility

Precooler, DVB + TLs

TCF200 + Pump Cryostat

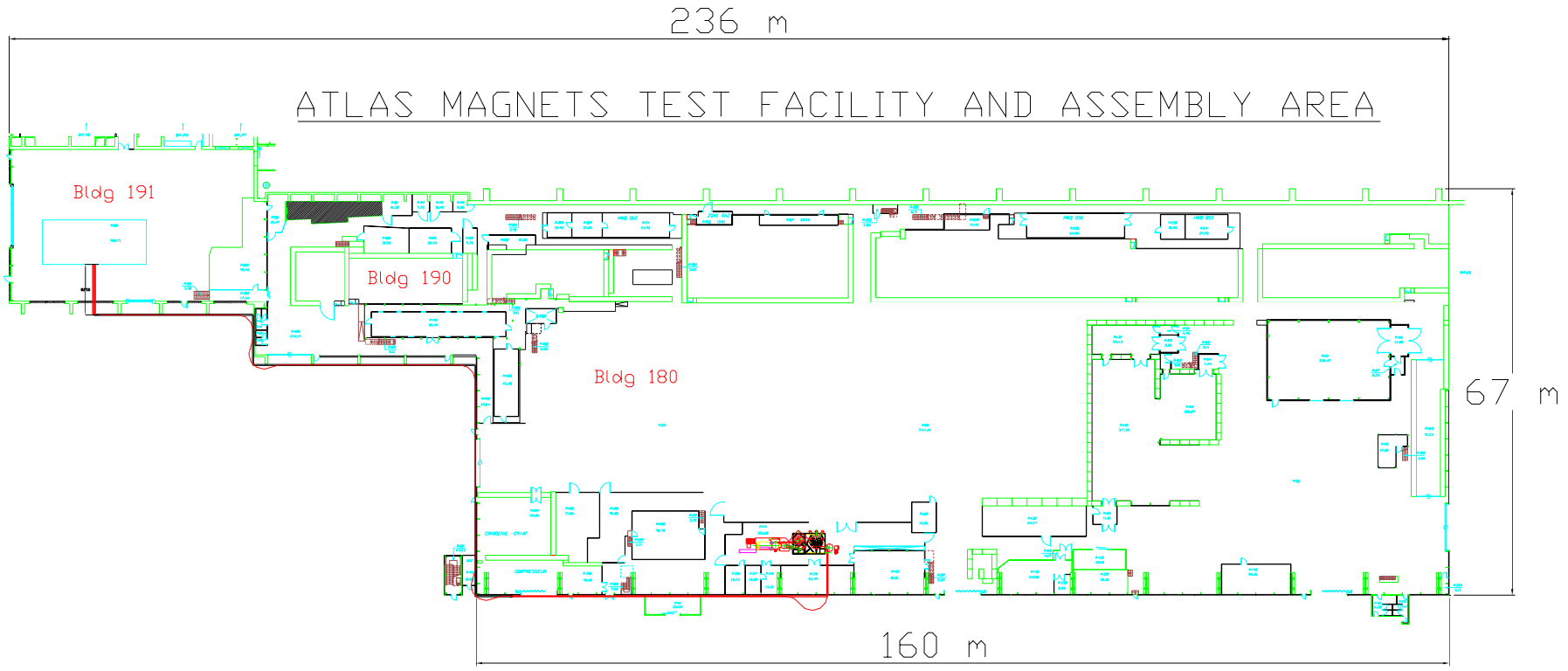
2 BT magnet test benches + 1.2 kg/s LHe pump Test Facility

Large Scale He Hydrodynamic CERN Facilities : conclusion



Large Scale He Hydrodynamic CERN Facilities : conclusion

HALL 180


236 m
ATLAS MAGNETS TEST FACILITY AND ASSEMBLY AREA
Bldg 191
Bldg 190
Bldg 180
67 m
160 m

ATLAS Hall180 : BT Cryo Test Facility

Precooler, OI VB + TLs

TCF200 + Pump Cryostat

GReC Experiment : handling tool for the transfer line