FRESCA2 TEST PLANS @ CERN

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on behalf of

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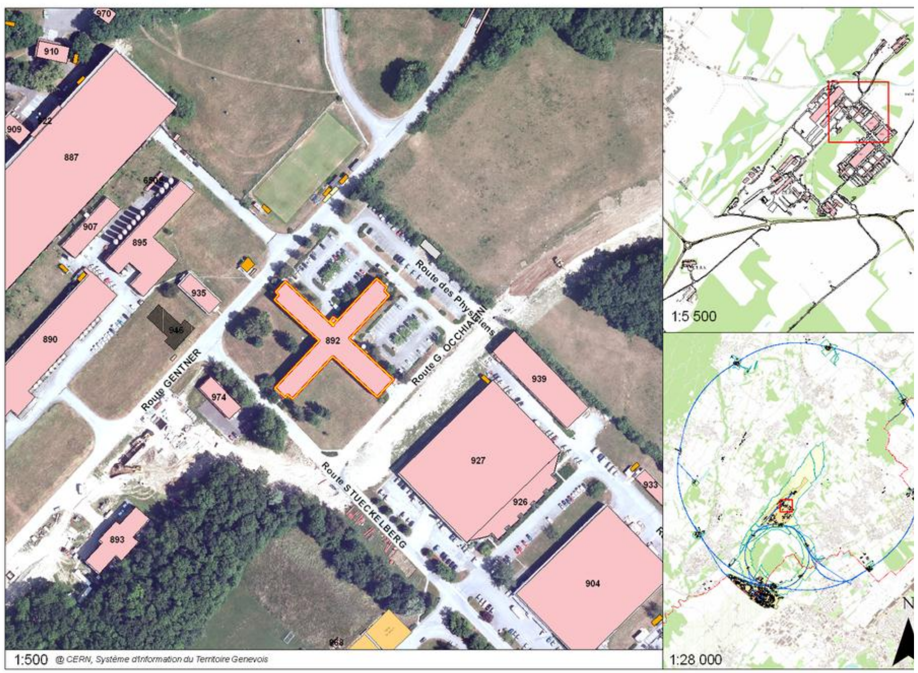
Summary

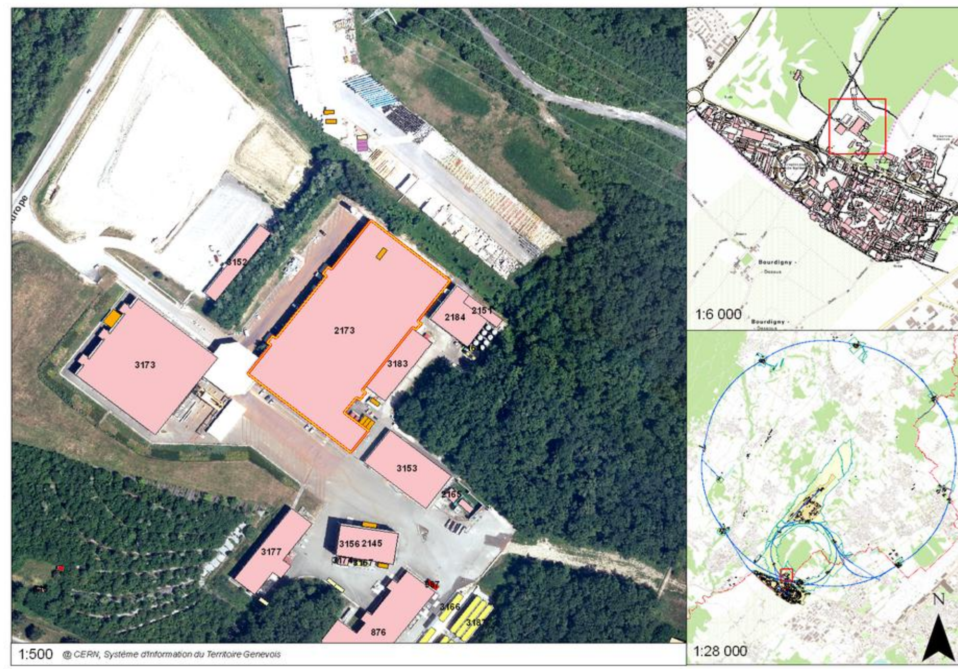
- Cryogenic test station status at CERN
- Inputs and constraints for the test station design
- Which cryostat we can use? Characteristics
- Main ingredients of the HFM test station
- Status of the main ingredients
- Integration. Some details.
- HFM cryostat conceptual design
- Which measurements can be done?
- When the cold test can take place?

Cryogenic test station at CERN till 2010

A. Test station with 4 vertical cryostats for stand alone magnets located in Prevessin (building 892)

B . Tests station with 10 benches in horizontal position, optimized for the main LHC magnets located in point 18 (building 2173)

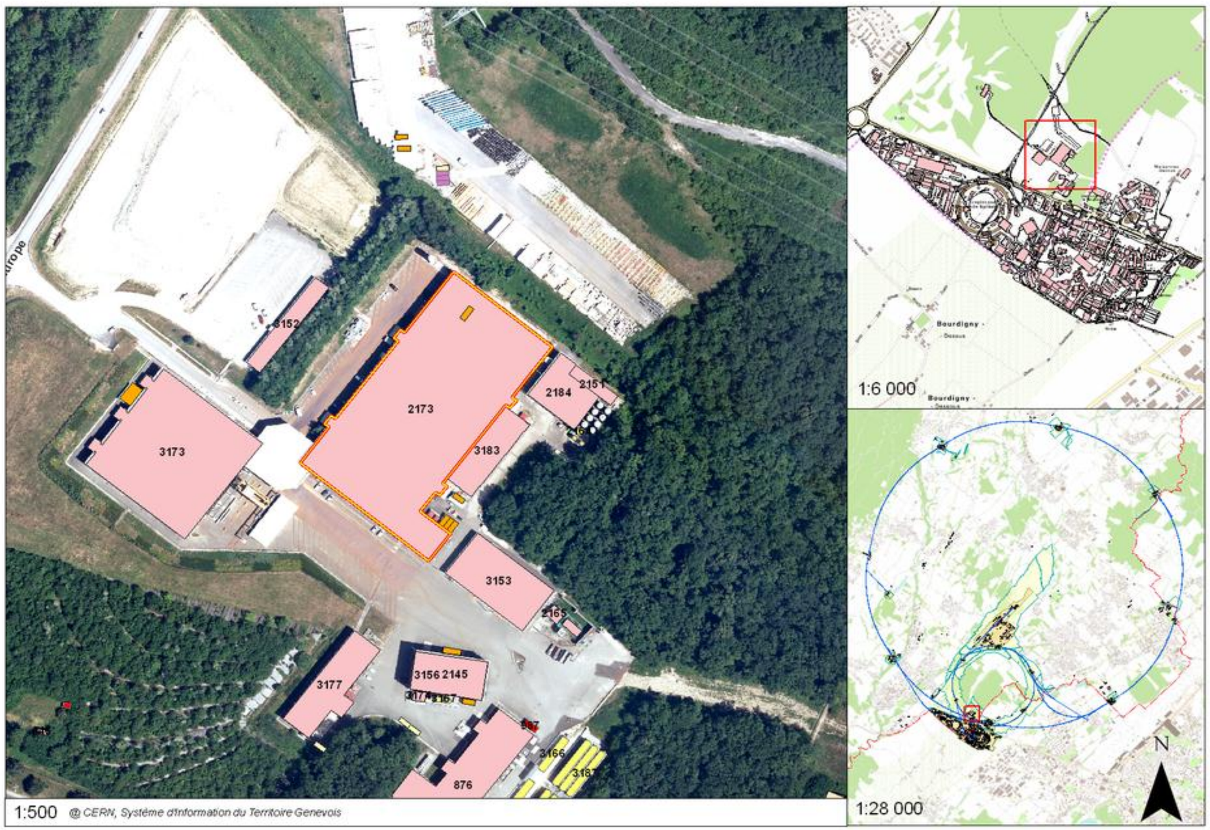




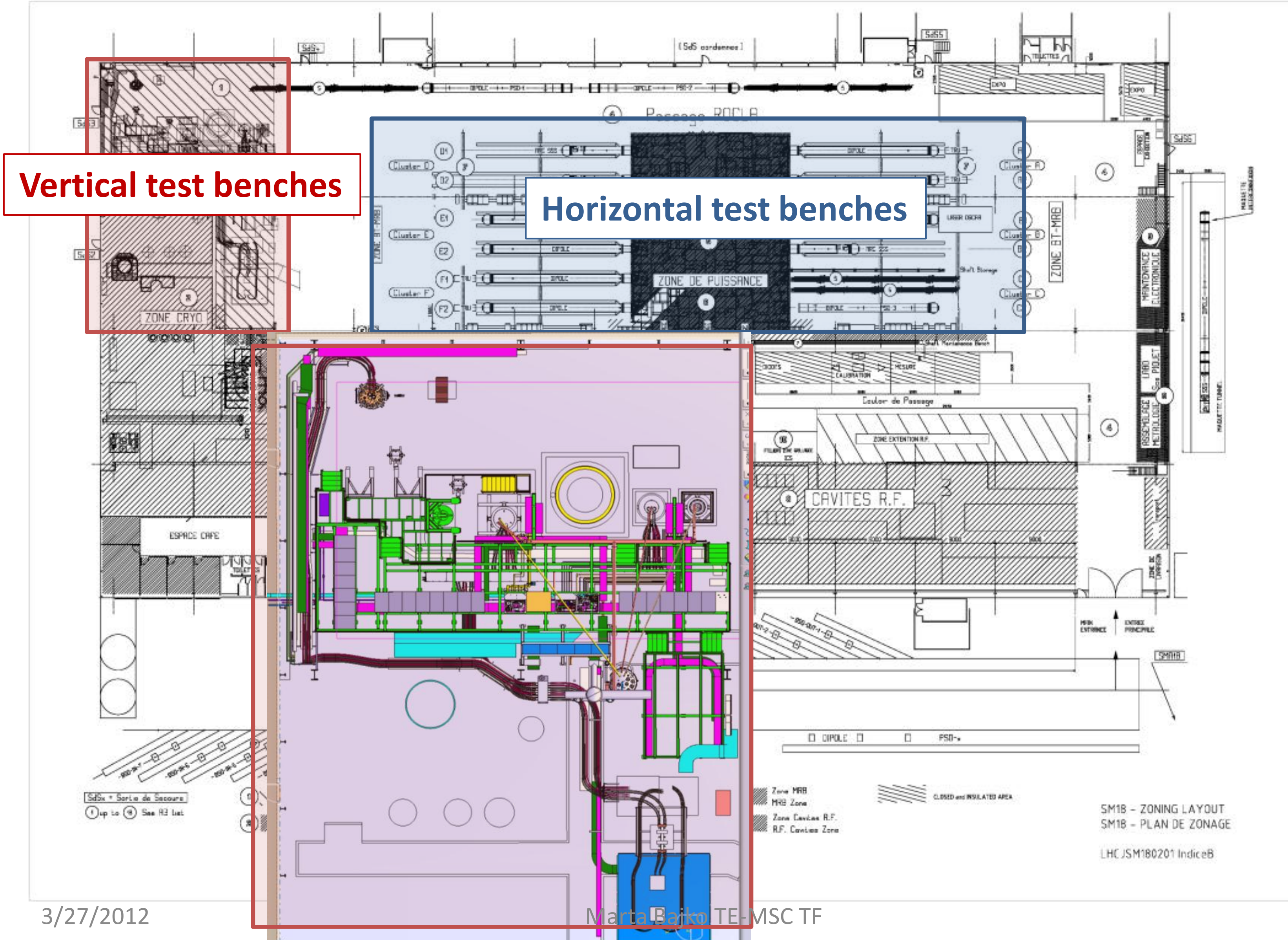
Cryogenic test station at CERN from 2011

Tests station with 10 benches in horizontal position, optimized for the main LHC magnets, 3 vertical cryostats and supercritical test station

located in point 18 (building 2173 called SM18)



Cryogenic test station SM18 layout



The inputs and constrains for the HFM test station

Magnet parameter description	FRESCA2	LD1	HTs Insert	Unit
Maximum current Iss@ 1.9 K	**14.9**	**18.1**	**10**	kA
Free aperture diameter	**0.1**	**0.1**	**0.02**	m
Maximum length	**2.5**	**2.5**	**0.75**	m
Maximum outer diameter	**1.03**	**1.36**	**0.1**	m
Maximum weight	**9**	**15**		t
Maximum stored energy @ Iss @ 1.9K	**6.5**	**9.2**	**1**	MJ
Inductance	**63**	**56**	**20**	mH
Max ramp rate	**150**		**150**	A/s
Splice dissipation	**3.5**			W
Maximum heat dissipation (when ramping)	**10**	**10**	**<1**	W

Requirement	Value
Estimated Lifetime of the high field magnet test facility	> 20 years
Number of thermal cycles (293 K to 1.9 K and back)	≤ 200
Quenches	≤ 4000
Number of powering cycles of the magnet	≤ 10000
Number of powering cycles of the inserts	≤ 5000
Environmental conditions in the experimental hall	200 mT
Radiation levels	No radiations

Cooling time from 300 K to 80 K: 3 days

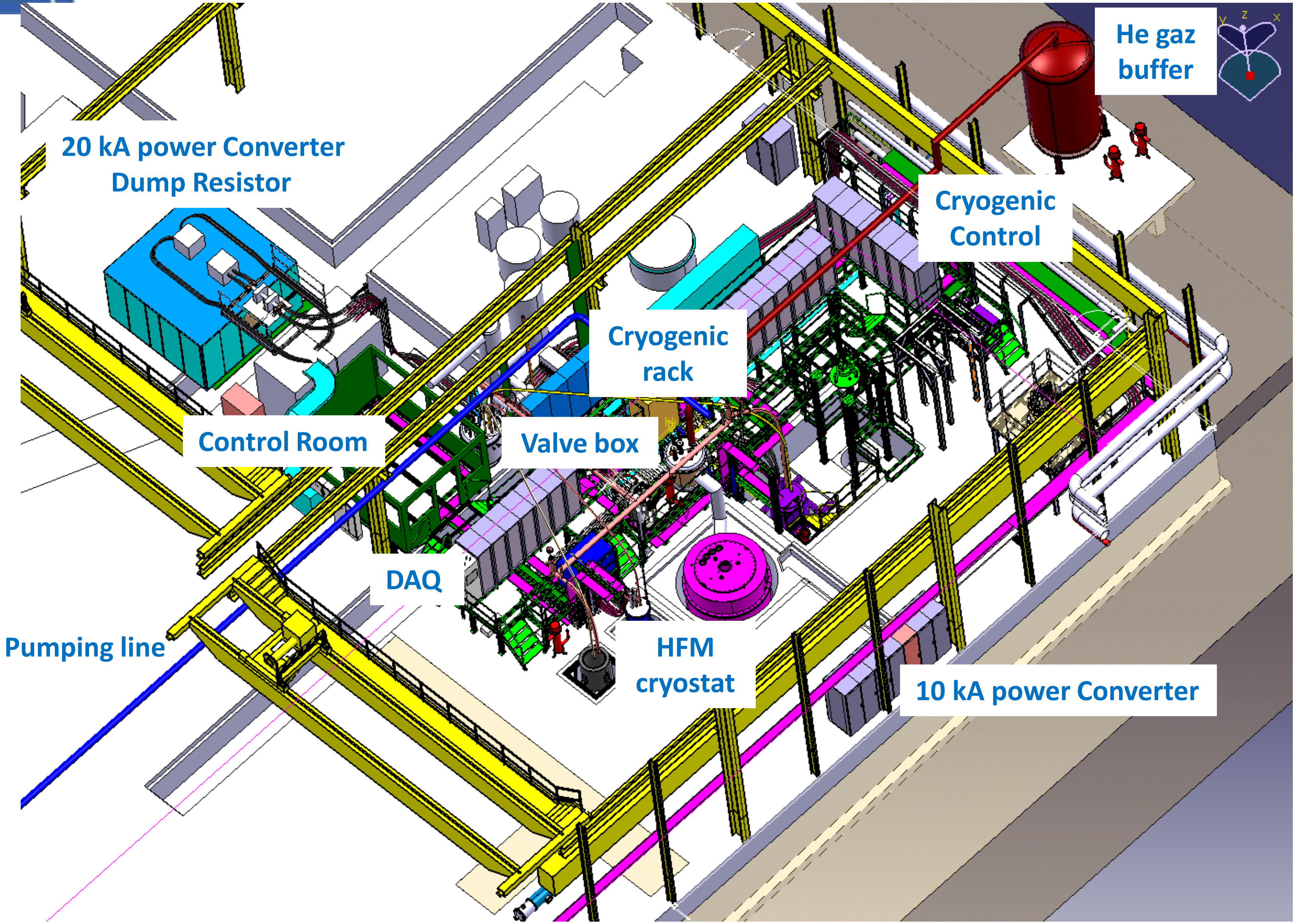
The EXISTING vertical cryostats characteristics

	Cryostat 1 (LONG) (existing)	Cryostat 2 (existing)	Cryostat 3 (existing)
Useful length (mm)	3800	1600	1400
Useful diameter (mm)	600	500	800
Cooling time 4.2 K (h)	44	5	32
Cooling time 1.9 K (h)	12	2.5	8
Working temp (K)	1.9	4.2	1.9
Working pressure (mbar)	1250	1250	1250
Max weight (t)	6	1.5	3
Max energy (kJ)	Tested: 500		
Nr of current leads	2 x 13 kA +1 x 6 kA	2 x 15 kA	2x 18 kA or 4x 200 A + 4 x 1200 A
Nr. of available inserts	1	1	2

NON of these cryostats allows testing FRESCA 2 magnet

The HFM (FRESCA2 and LD1) cryostat has to be designed on purpose, and an additional power supply of 10 kA is needed for the HTs insert powering …… together with other ancillary equipment

Main ingredients of the HFM test station



Summary of the status of the main ingredients

20 kA powering circuit

Power supply 20 kA /60 V : available
Switches: available
Cupper bus bars: available
Water cooled cables addressed
Connection to current leads addressed
Copper current leads addressed at CERN
Water distribution critical

10 kA powering circuit

Power supply 10 kA/8 V available design
Switches to be addressed
Cupper bus bars addressed
Water cooled cables addressed
Connection to current leads addressed
Copper current leads addressed at CERN
Water distribution critical

Cooling circuit

Magnet pre-cooling pressurised He
Magnet cooling
He gaz recuperation buffer
Cryogenic valve box
Cryogenic control critical

Security PLC to be addressed
DAQ available

Protection circuit

Dump resistor available for 20 kA circuit, to be addressed for 10 kA circuit
Capacitor benches available

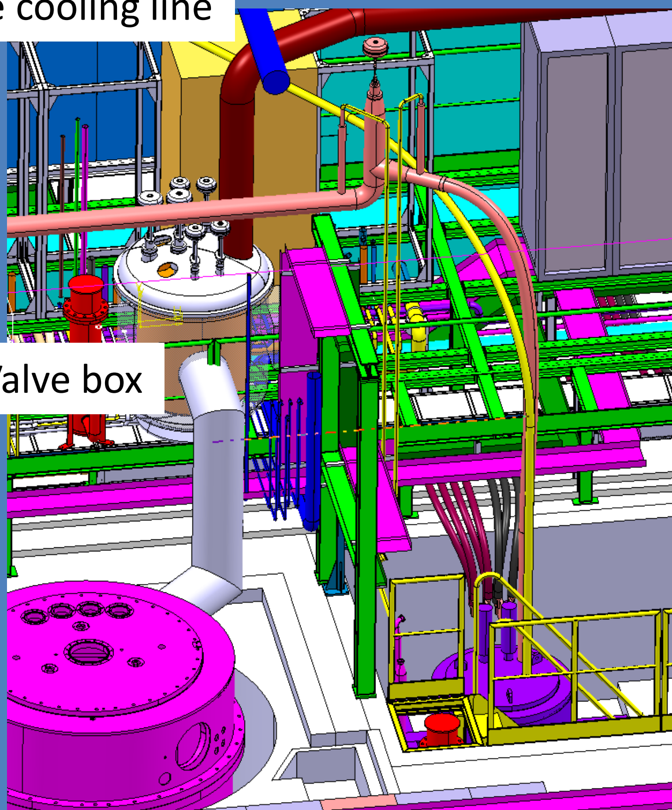
Cryostat: adressed

Integration. Some details

Hydraulic connection

He gaz recuperation to the buffer

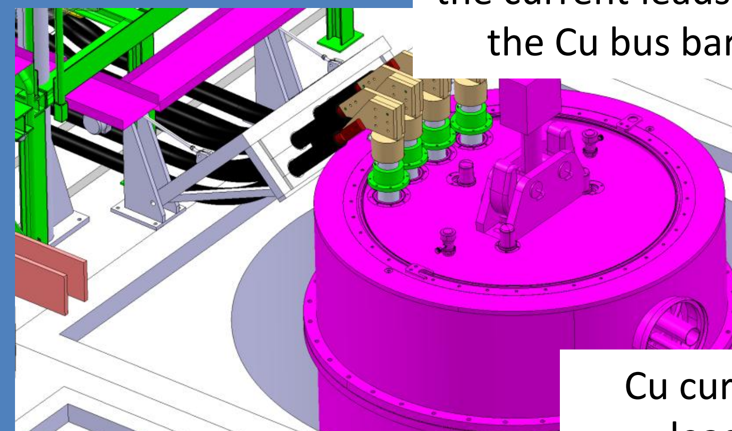
Pre cooling line

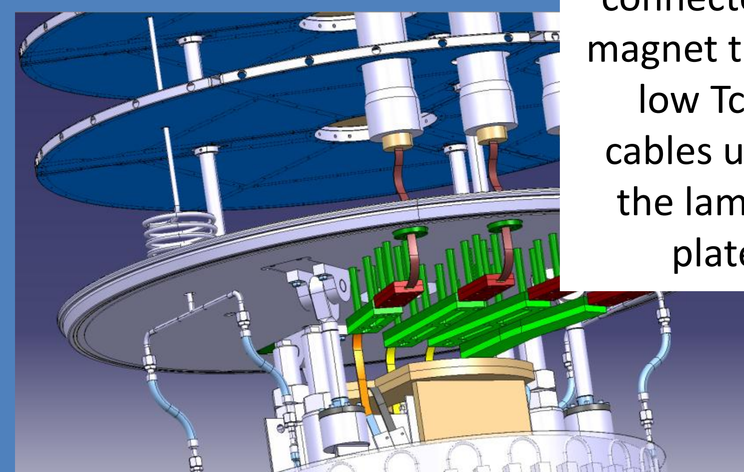


Valve box

Electrical connection

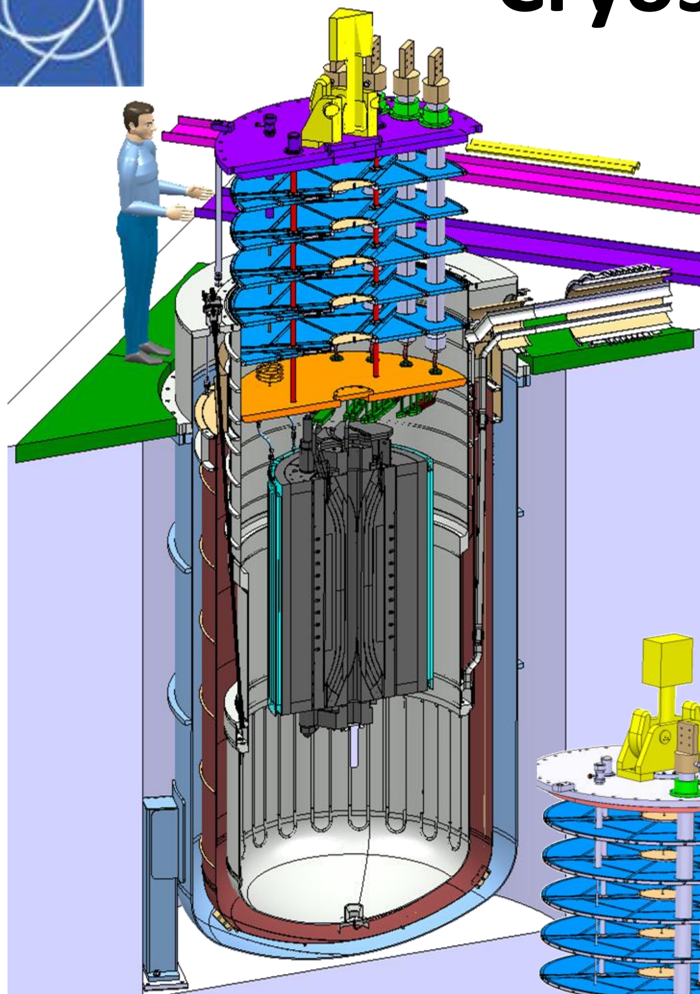
20 kA water cool cable connected to the current leads and the Cu bus bars

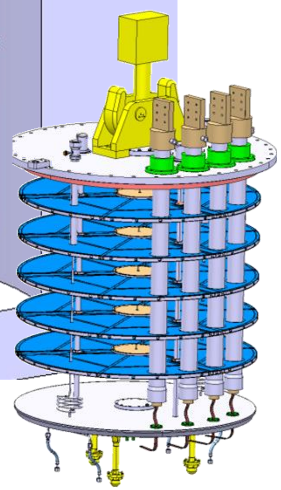




Cu current leads connected to magnet trough low Tc Sc cables under the lambda plate

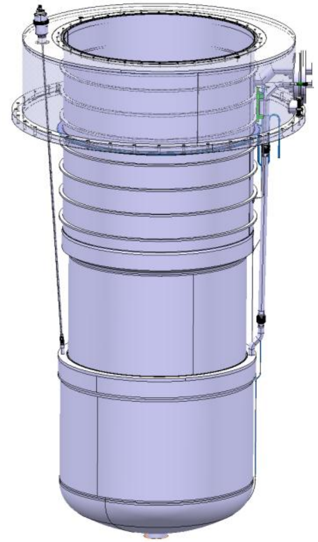
Cryostat conceptual design





Insert

- Total Length: 4415 mm
- Top plate: Ø 1800 mm, Thickness: 50 mm
- Lambda plate: Ø 1600 mm, Thickness: 50 mm
- Magnet centering

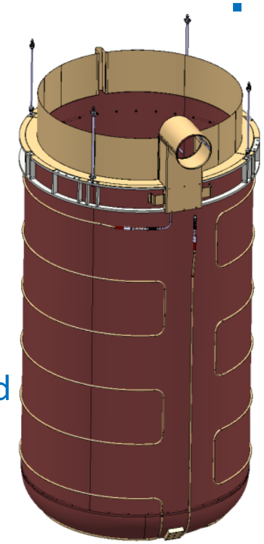


Helium vessel (Max. p= 4 bar)

- Neck: DI: 1612 mm, Length : 1744 mm, Thickness : 3 mm
- Middle part: DI: 1500 mm, Length: 1245 mm, Thickness: 8mm
- Lower part: DI: 1630 mm, Useful length: 1800 mm, Thickness: 8 mm

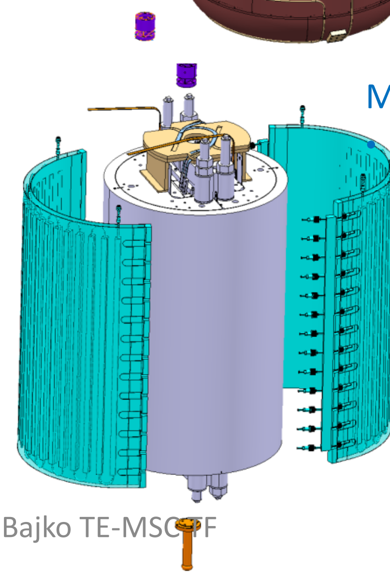
Cooling time 80 K to 4.2 K: 12 h
Cooling time 4.2 K to 1.9 K: 1.5 days
(dimensioning made for 100 Watts)

Thermal shield



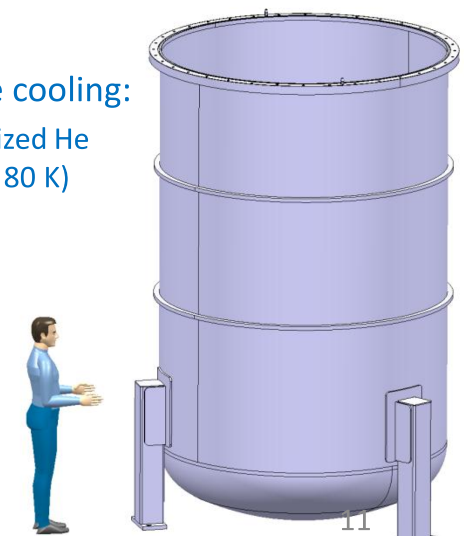
Vacuum vessel (Max. p= 1.5 bar)

- DI : 2300 mm, Length : 3845 mm, Thickness : 8 mm, Weight: 2.8 t



Magnet pre cooling:

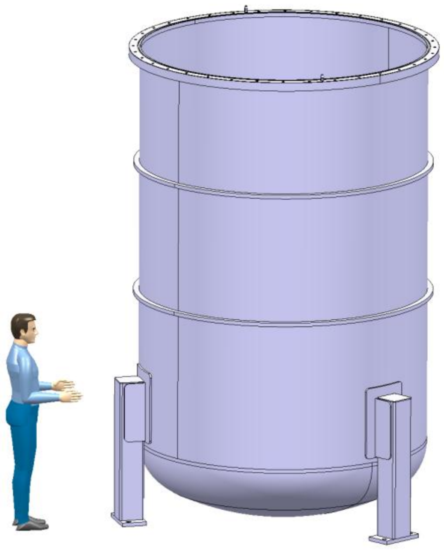
pressurized He
(15 bar, 80 K)



Cooling to LN2 in January 2013??

- @ CERN there is no adequate Dewar for this test
- the FRESCA 2 cryostat vacuum vessel is not equipped with security valves and is not INSULATED

- A LN2 Dewar of the characteristics: 1.2 m diameter and 2 m depth may be found on the market.
- A supporting system should be designed and adapted to such LN2 Dewar



Measurements to do

- Electrical integrity (HiPot, Insulation, Continuity)
- RRR during cool down and warm up
- Splice resistance measurements
- Inductance measurements
- Powering test at 1.9 K and quench localization with V taps (eventually also quench antenna but it represent an important extra work)
- Protection heater study if required (we need to know the time constant or the deposited energy on the heaters to set up the circuits; we have up to 400 V or lower and fixed capacitor benches with units of 14 mF)
- Ramp Rate dependence study
- Mechanical measurements with strain gauges
- Magnetic measurements

When we can test?

Task Name	Duration	Start	Finish
FRESCA2 test station	337 days?	Wed 28/03/12	Fri 12/07/13
Integration design	4 wks	Wed 28/03/12	Tue 24/04/12
CRYOSTAT	286 days	Mon 02/04/12	Mon 06/05/13
20 kA powering circuit	140 days?	Wed 28/03/12	Tue 09/10/12
10 kA powering circuit	4 mons	Wed 28/03/12	Tue 17/07/12
CRYOGENIC circuit	317 days	Wed 28/03/12	Thu 13/06/13
cold buffer	185 days	Wed 28/03/12	Tue 11/12/12
Civil engineering for cold buffer	55 days	Mon 09/04/12	Fri 22/06/12
installation of buffer	2 wks	Wed 12/12/12	Tue 25/12/12
acceptance test of buffer	2 wks	Wed 26/12/12	Tue 08/01/13
valve box	157 days	Wed 11/04/12	Thu 15/11/12
small valve box for pre cooling	182 days	Wed 02/05/12	Thu 10/01/13
cryo rack	252 days	Wed 16/05/12	Thu 02/05/13
cryo lines	267 days	Wed 06/06/12	Thu 13/06/13
MAGNET PROTECTION CIRCUIT	25 days	Mon 01/04/13	Fri 03/05/13
SECURITY PLC	24 days	Sat 01/09/12	Thu 04/10/12
COOLING WATER CIRCUIT	75 days	Fri 01/06/12	Thu 13/09/12
DAQ	51 days?	Wed 28/03/12	Wed 06/06/12
CRYOGENIC CONTROL	70 days	Mon 04/06/12	Fri 07/09/12
Fresca 2 test station hardware commisioning	4 wks	Fri 14/06/13	Thu 11/07/13
FRESCA 2 Magnet test	0 days	Fri 12/07/13	Fri 12/07/13