INFN magnet test stand @ University of Salerno
(NApoli FAcility for Superconducting Systems)

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Superconducting magnet test stand, CERN, June 13, 2016

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Outline

- Why we are in this business
- Aims of the infrastructure
- ID card and features of the test stand
- First commissioning of the components
- Conclusion

Past and future

DISCORAP project

Manufacture and test of the first s/c dipole for SIS300 ring (wide aperture 100 mm, 4.5 T, ramp rate 1T/s, bended). The dipole is at GSI, Darmstadt

Magnet test stand

UNIONE EUROPEA
Fondo europeo di sviluppo regionale
PON Ricerca e Competitività 2007-2013
Ministero dell'Istruzione, dell'Università e della Ricerca
Ministero dello Sviluppo Economico
investiamo nel vostro futuro

Special PON funding were delivered on 2012 for setting up a new test facility of s/c power devices at 4.5 K.

Twofold aim of the new laboratory

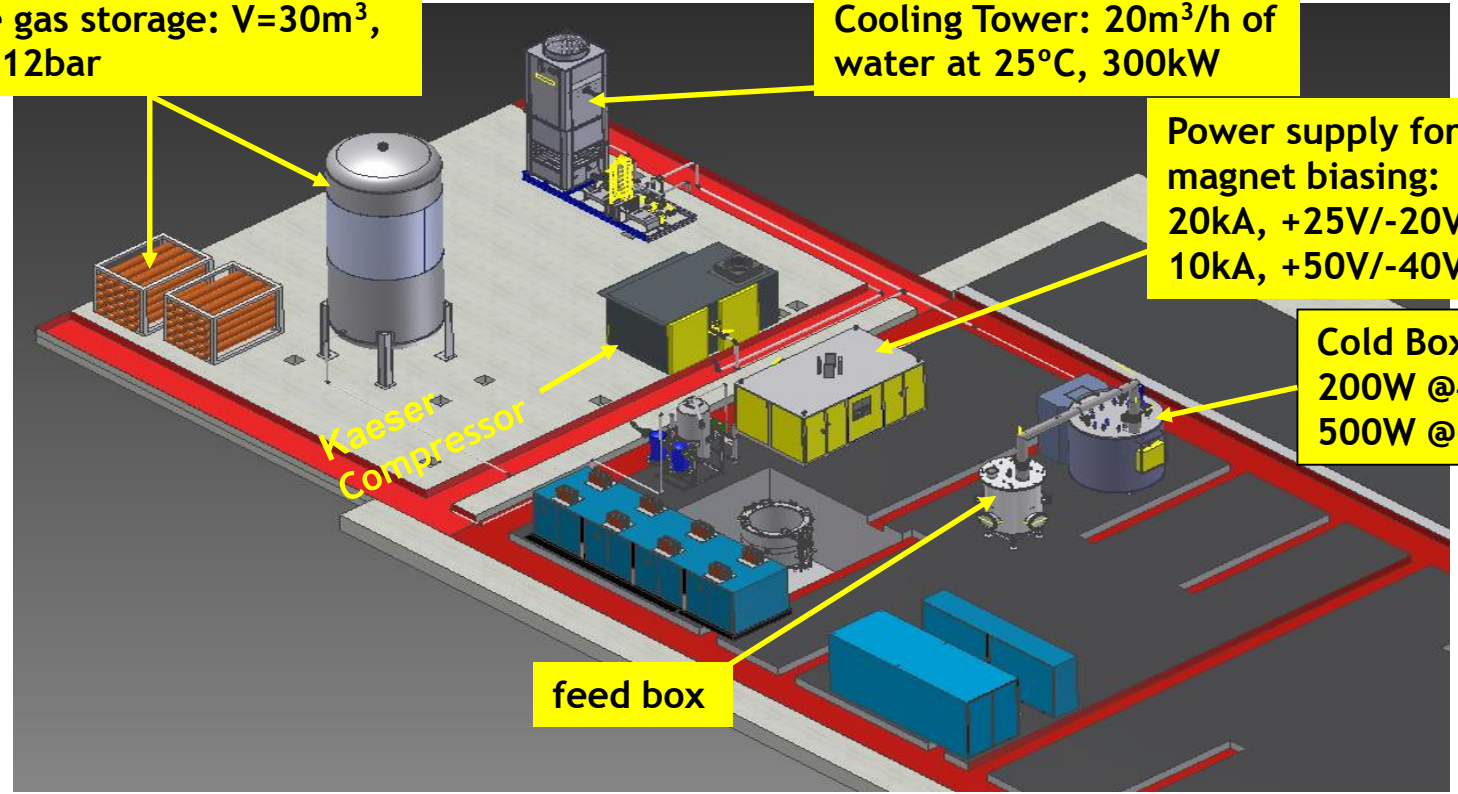
Our project aimed to set up a dedicated facility for applied superconductivity programs, one in the accelerators area and the other one in the fusion area. It will include:

- a large bore superconducting solenoid, called ENFASI, 7 T at 20 kA bias (ENEA, UniSA);
- the INFN cryogenic system, having a cooling power up to 200W at 4.6K up to 7 bar (+500W 60-80K, + 1.5g/s for feed through);
- 2x10 kA +25V/-20V Power Converter to feed magnets (INFN), and 50 kA 10V power supply for critical current tests on CIC cables (ENEA);
- A feed box provided with 20 kA HTS cryogenic feed through (INFN).
- The building and utilities (UniSA)

TEST STAND *ID* CARD

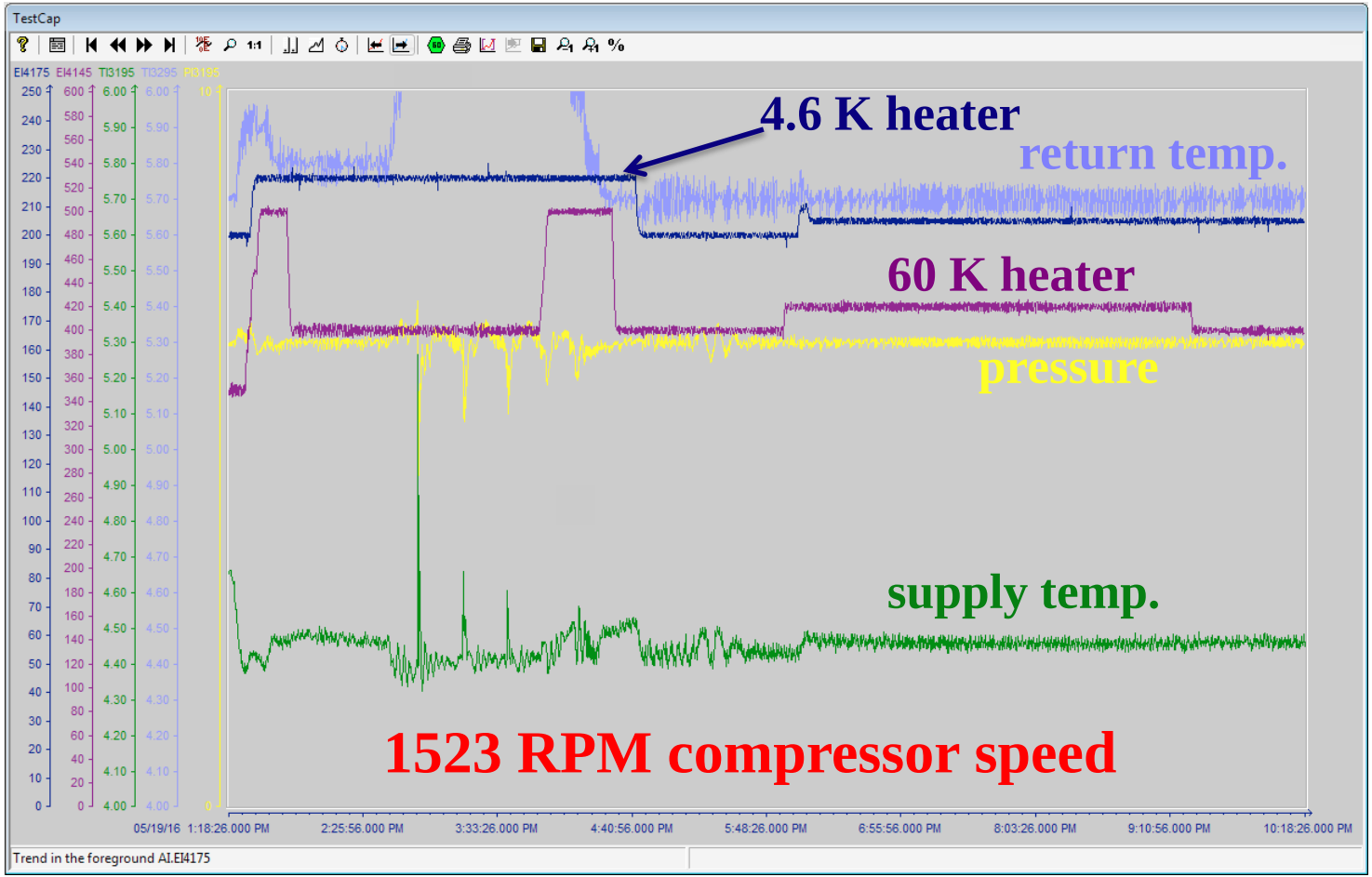
Location: *INFN-Salerno, University of Salerno (Fisciano, I)*
surface of the test laboratory: *approx. 450 m^2*
operating temperature and cooling phases: 4.5K He at 3-7 bar, two phase LHe
Cooling capacity: 120 l/h LHe production (w/o LN2 precooling) , 16 g/s 7 bar 4.5 K, 1.5 g/s 4.5K for leads, 17 g/s 80 K
Operating and max. Current, max Voltage: 2 x 10 kA +25/-20 V power converter (series/parallel operation)
One feed box with HTS 20 kA current leads
Handling tools: *20 tons overhead crane*
Interlock safety: *yes with each subsystem giving its own interlock signal*
DAQ cards and used soft: NI PXI, LabView
Quality control tools: to be implemented
Magnetic measurement capability: only basics

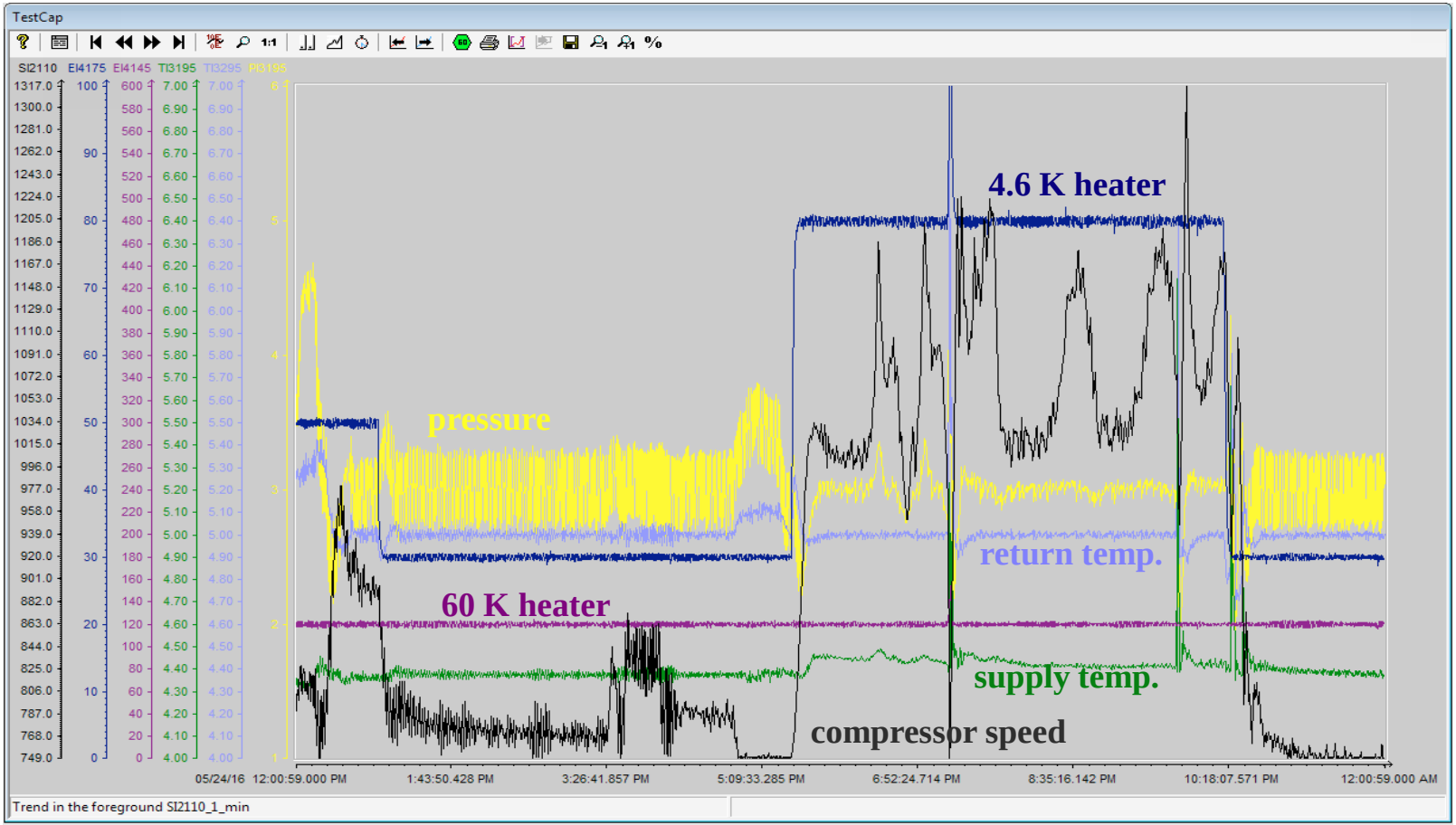
Test area layout



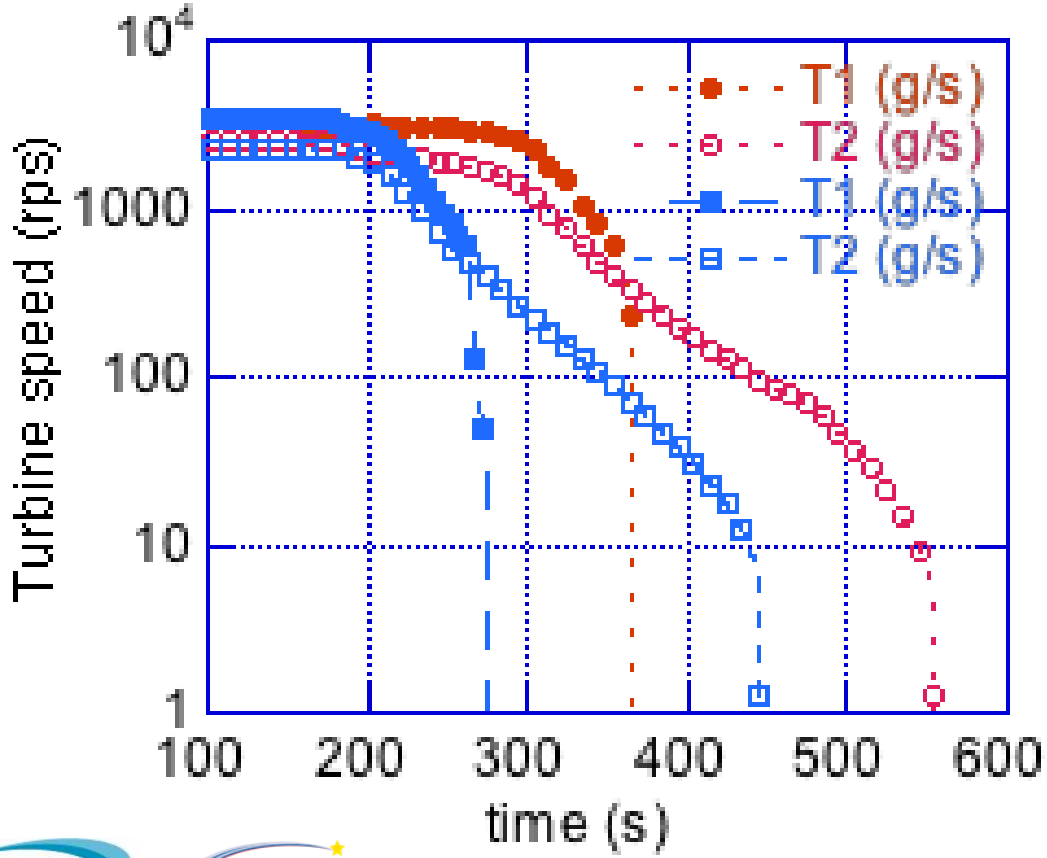
Our choice was a Linde LR280 with a 196 kW screw compressor. The procurement included the SFC for the compressor, a J-T liquid port, internal purifier, internal 80 K adsorber, He subcooler for single phase stream at 4.6 K up to 7 bar. Max 4.6 K flow is about 18 g/s.

We installed our self the components.


TestCap
EI4175 EI4145 TI3195 TI3295 PI3195
4.6 K heater
return temp.
60 K heater
pressure
supply temp.
1523 RPM compressor speed
05/19/16 1:18:26.000 PM
2:25:56.000 PM
3:33:26.000 PM
4:40:56.000 PM
5:48:26.000 PM
6:55:56.000 PM
8:03:26.000 PM
9:10:56.000 PM
10:18:26.000 PM
Trend in the foreground AI.EI4175


TestCap
SI2110 EI4175 EI4145 TI3195 TI3295 PI3195
4.6 K heater
pressure
return temp.
60 K heater
supply temp.
compressor speed
05/24/16 12:00:59.000 PM
1:43:50.428 PM
3:26:41.857 PM
5:09:33.285 PM
6:52:24.714 PM
8:35:16.142 PM
10:18:07.571 PM
12:00:59.000 AM
Trend in the foreground SI2110_1_min

Anomalous turbine stop



Turbines were both removed for factory inspection and bench test.

The power converter

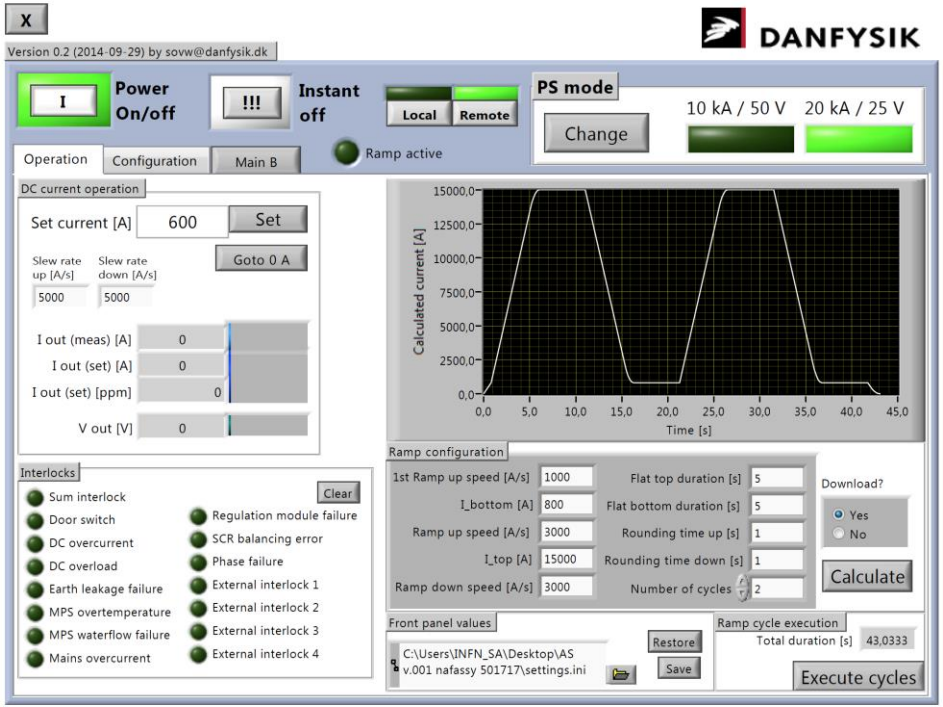
Producer: DANFYSIK A/S
DK-2630 Taastrup, DK

Outputs: 20 kA +25/-20 Volts
10 kA +50/-40 Volts

Main Input is 400 Volts ac 3 Phase
Water cooled

The power converter is made of two 10 kA converters that can be switched in series/parallel to achieve either high voltages (for SIS300 dipoles) or high currents (e.g. for the ENFASI solenoid). The controller is able to provide custom current profiles as well as subsequent cycles of a customized profile for specific applications.

The control panel of the Power Converter, presently set for a water cooled brass resistive load (1.25 mΩ).

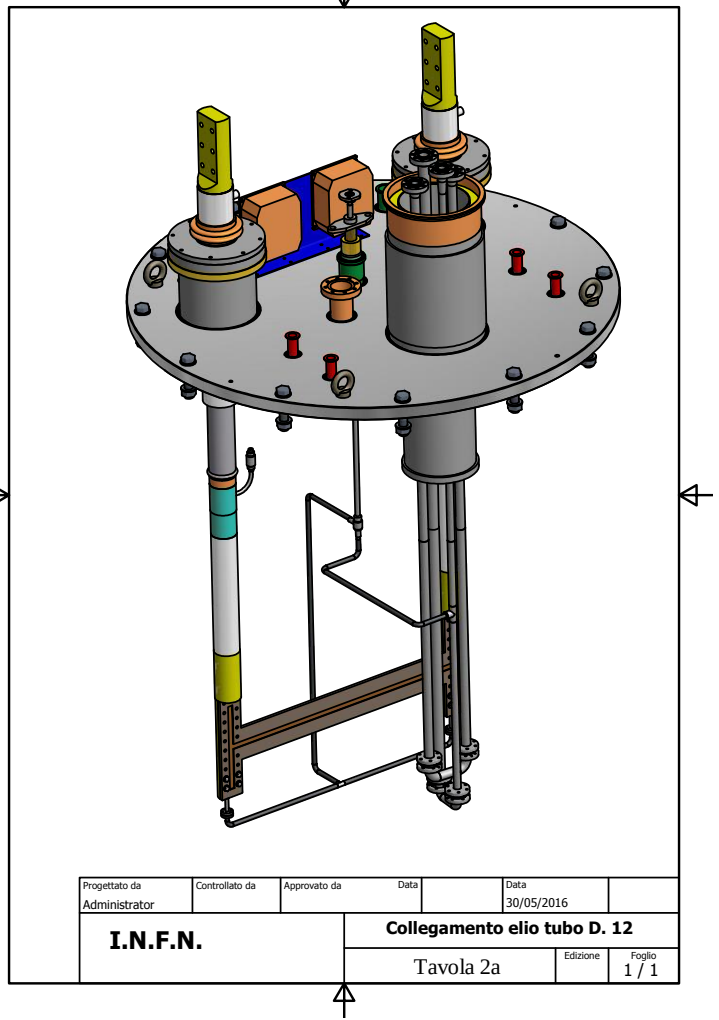


The output of a ramp control test, up to 15 kA, rate 3kA/s, flat top 5 s: white set profile, red measured profile.

The feed box

The feed box is provided with its own vacuum system (500 l/s turbomolecular pump with a 100 mc/h rough rotary pump). The sleeve connection delivers cold flow from the cold box to both current leads and magnets.

A s/c busbar (DISCORAP I rutherford cable) will short the current leads during preliminary tests.




KRYOTECHNIK


KRYOTECHNIK

Conclusion: potentials of the facility

Test of devices: magnets, motors, FCL, SMES, etc.;
Critical current cable test (LTS and HTS);
insertion HTS windings for hybrid magnets
Cryogenic and insulation test

HiLumi HL-LHC PROJECT

Thank you for your kind attention

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EuCARD²

Players of the project

INFN, € **3.472.586,20**
University of Salerno, € **2.375.634,34**; further € 700.000 were assigned for young scientists training courses;
ENEA, € **2.541.903,50**;
*CRdC scarl, € **1.709.875,96***

ENFASI Magnet

The solenoid has been manufactured by CRIOTEC srl, as well as its cryostat.