SM18 TEST FACILITY shaping for HL-LHC and beyond in the last 10 years

M. Bajko TE-M SC-TF

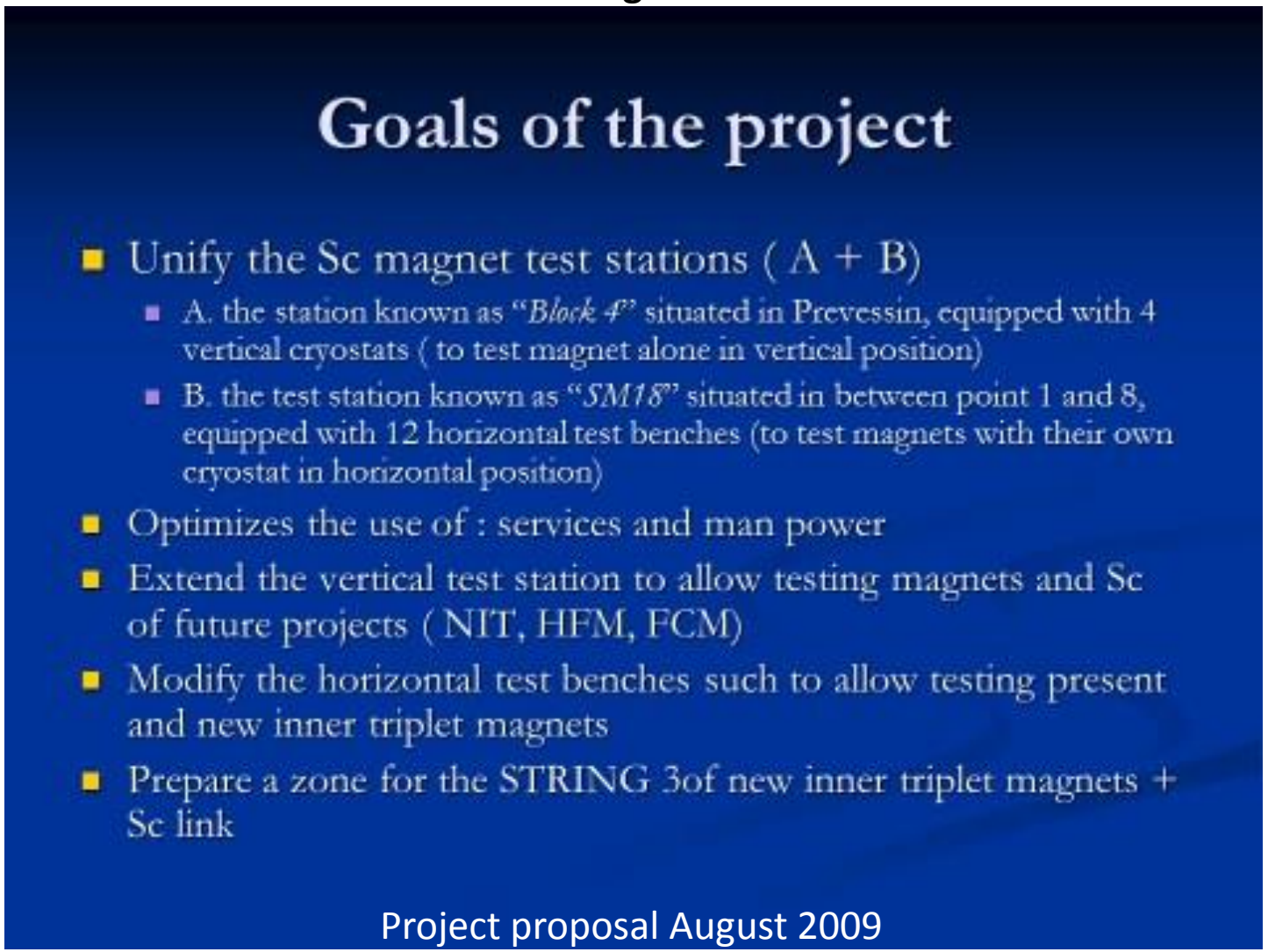
1st of December 2020 for TE-MSC Seminar

Abstarct

- In this presentation I will show the strategy that was set up in 2009 for the modifications of the SM18 hall to fulfil the HL-LHC needs.
- I will recall the main goals I proposed myself, in agreement with my line- and HL-LHC project-management, as a section leader of the magnet test stands.
- I will show than the summary of the past 11 years accomplishments and give the status of the test facility today.
- Before giving my own words on this great adventure that was the challenge of the SM18 test bench construction and the building of a great team of experts for its operation, I will tell you about the importance I payed for the communication in general, the exchange with experts at CERN and within the international community of people in the field.
- I will finish my talk showing you my next challenge : the HL-LHC IT STRING that I am proposing to bring to success with a small, but very motivated team in the next coming (only few) years ? …once again in the SM18 ? shaping it even more!

2009

TE-MSC-TF is created with one of the main task of moving Block 4 from Prevessin to SM18



Project proposal August 2009

The TE-MSC-TF mandate as I translated

- Unify, Extend, Modify, Prepare = CONSTRUCTION
- Optimize = OPITIMIZATION

(where cost, time and performance considerations are of equal level)

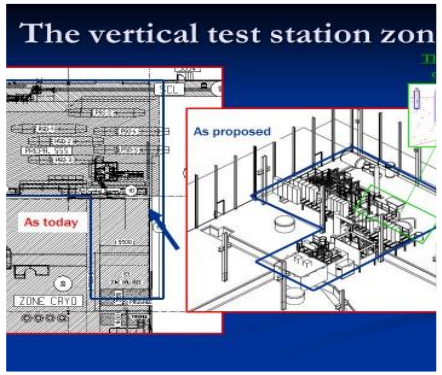
- Service = to allow *TESTING* and *OPEN SM18 to USERS*
- Man Power = *TEAM BUILDING*

THE *TF SECTION* OBJECTIVES

- giving the best possible service
  - making test with good, performing and smart equipment and obviously also in time
  - Assuring the **safety** of the personnel and the equipment
  - giving **reliable feed back** (raw data, analyzed data , reports, planning ect) to the projects
- work within international collaboration and become a **reference** in our field.

FROM BLOCK4 to CLUSTER G

2009

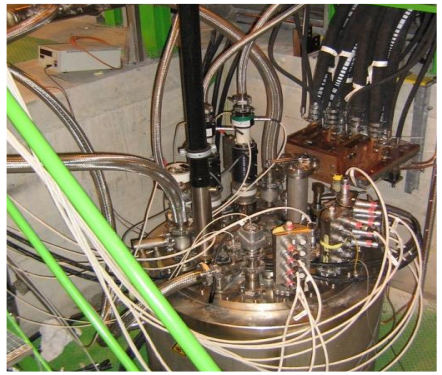


TE-MSC-TF is created with one of the main task of moving Block 4 from Prevessin to SM18

2010

Start of civil engineering in the SM18 – Cluster G

2011



•The new vertical test stand called Cluster G with the “LONG CRYOSTAT” is operational.

2012

SM18 Superconducting magnet Test Facility Infrastructure upgrade

From: Marta Bajko TE-MSC/TF
To the attention of: Luca Bottura, Laurent Tavian, Frederick Bordry, Dorothe Duret, Davide Tommasini, Lucio Rossi

Introduction

The SM18 test hall is dedicated to the cold test of the superconducting magnets and radio frequency (RF) cavities. It is separated in 3 main test areas: one for the test of RF and two for the test of magnets and superconducting material based LHC components. The 3 areas are served by the common **cryogenic infrastructure** designed, operated and maintained by **TE-CRG**, allowing to test at 4.2 K, 1.9 K and at supercritical He temperature (varying between 4.5 K for a fast cycled magnets and up to around 50 K for the HTS LHC type current leads and the Mg_2B based SClink in development for the HL-LHC project). The **powering** is de-centralised: each zone is equipped with its own power converter or power converters under the responsibility of **TE-EPC**, while the **cooling** of the powering cables is assured once again with a unique centralised system designed operated and maintained by **EN-CV**.The RF area is under the responsibility of the group BE-RF while the area dedicated to the magnet and components test is under the responsibility of the group TE-MSC.

The common, centralised services as the cryogenic liquid (LHe) and the water for the cooling of powering cables and power converters needs a ranking of priorities. They cannot serve the 3 areas in parallel and not even the same area with several installations in parallel at the same time. The powering of one of the magnet test areas and the available infrastructure (cryostats and inserts) are further limitations of the test facility, in view of the requirements coming from our magnet program for the next 3-5 years. This memo summarise the requests as a first input, the limitations in the installations and finally gives a proposal to overcome the problems by an extension of the installations.

Cold powering test today and requests for the near future

The inputs of this chapter are coming from the group TE MSC responsible to build, based on superconducting technology, magnets and LHC powering components. There are two main groups of request: one coming from the direct needs of the present configuration of the LHC (such as spare parts) and a second one from the upgrade programs of the LHC

2nd cryostat and the feed box are operational.

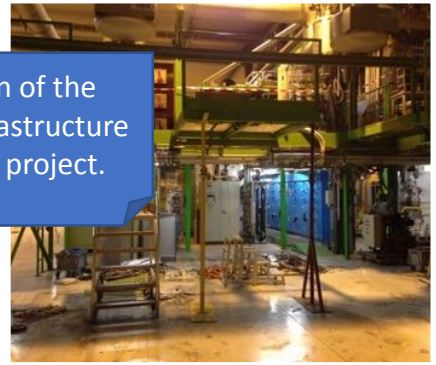
Start of optimisations: new insert for “Long Cryostat” and a new one for FReSCa2: HFM test stand idea is born.

A ***memorandum*** is written to ask for extension of the test stand to fulfil HL-LHC magnet test requirements on the ***cluster D and the SM18 Infrastructure Uprgade***

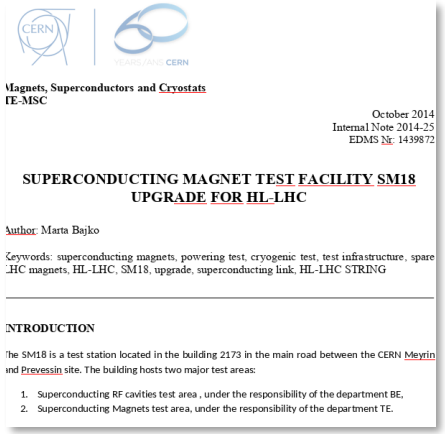
CLUSTER G extension with CLUSTER D

2014

Creation of the SM18 Infrastructure upgrade project.



In July Cluster D is dismounted, while the 3rd cryostat is operational in the cluster G.



Magnets, Superconductors and Cryostats
TE-MSC

October 2014
Internal Note 2014-25
EDMS Nr: 1439872

SUPERCONDUCTING MAGNET TEST FACILITY SM18 UPGRADE FOR HL-LHC

Author: Marta Bajko

Keywords: superconducting magnets, powering test, cryogenic test, test infrastructure, spare LHC magnets, HL-LHC, SM18, upgrade, superconducting link, HL-LHC STRING

INTRODUCTION

The SM18 is a test station located in the building 2173 in the main road between the CERN Meyrin and Prevessin site. The building hosts two major test areas:

1. Superconducting RF cavities test area , under the responsibility of the department BE,
2. Superconducting Magnets test area, under the responsibility of the department TE.

2015

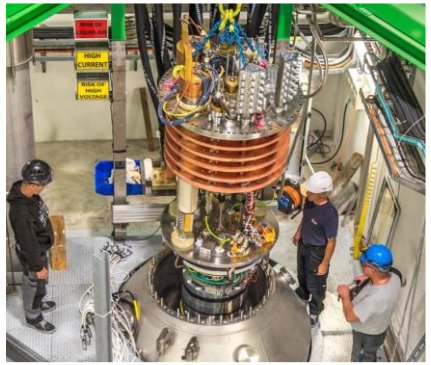
Start of civil engineering Cluster D, while we proved that Cluster A high current circuit can go up to 20 kA

2016

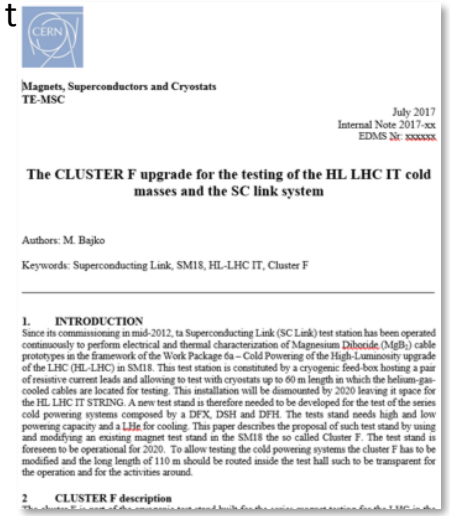
•HFM cryostat ready for HL-LHC model magnets ; New demineralised water station, the new overhead crane became operational; new control room installed in August

[Upgrade of the CERN Superconducting Magnet Test Facility](#)
#28 Marta Bajko(CERN) et al. (Dec 2, 2016) Published in:
IEEE Trans.Appl.Supercond. 27 (2017) 4, 9500307
Contribution to: ASC 2016

2017



Cluster D (but also G and A) is operational; ready for HL LHC magnet t



Magnets, Superconductors and Cryostats
TE-MSC

July 2017
Internal Note 2017-xx
EDMS Nr: xxxxxx

The CLUSTER F upgrade for the testing of the HL LHC IT cold masses and the SC link system

Authors: M. Bajko

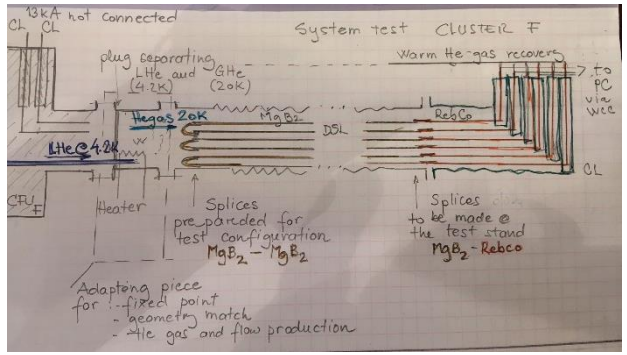
Keywords: Superconducting Link, SM18, HL-LHC IT, Cluster F

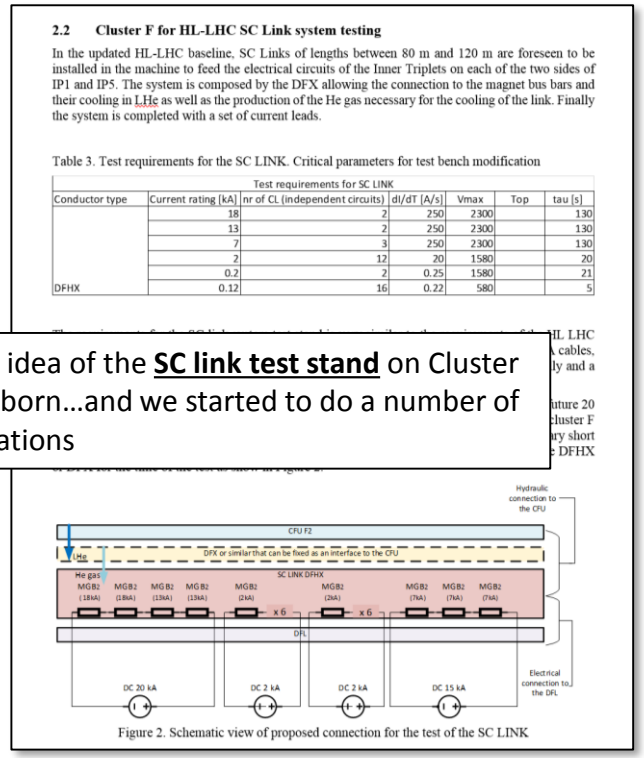
1. INTRODUCTION

Since its commissioning in mid-2012, ta Superconducting Link (SC Link) test station has been operated continuously to perform electrical and thermal characterization of Magnesium Diboride (MgB_2) cable prototypes in the framework of the Work Package 6a – Cold Powering of the High-Luminosity upgrade of the LHC (HL-LHC) in SM18. This test station is constituted by a cryogenic feed-box hosting a pair of resistive current leads and allowing to test with cryostats up to 60 m length in which the helium-gas-cooled cables are located for testing. This installation will be dismounted by 2020 leaving it space for the HL LHC IT STRING. A new test stand is therefore needed to be developed for the test of the series cold powering systems composed by a DFX, DSH and DFH. The tests stand needs high and low powering capacity and a LHe for cooling. This paper describes the proposal of such test stand by using and modifying an existing magnet test stand in the SM18 the so called Cluster F. The test stand is foreseen to be operational for 2020. To allow testing the cold powering systems the cluster F has to be modified and the long length of 110 m should be routed inside the test hall such to be transparent for the operation and for the activities around.

2 CLUSTER F description

CLUSTER F: extension of magnet stand for Sc link





2.2 Cluster F for HL-LHC SC Link system testing

In the updated HL-LHC baseline, SC Links of lengths between 80 m and 120 m are foreseen to be installed in the machine to feed the electrical circuits of the Inner Triplets on each of the two sides of IP1 and IP5. The system is composed by the DFX allowing the connection to the magnet bus bars and their cooling in LHe as well as the production of the He gas necessary for the cooling of the link. Finally the system is completed with a set of current leads.

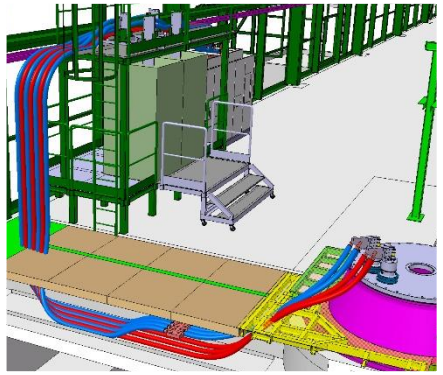
Table 3. Test requirements for the SC LINK. Critical parameters for test bench modification

Test requirements for SC LINK						
Conductor type	Current rating [kA]	nr of CL (independent circuits)	dI/dT [A/s]	Vmax	Top	tau [s]
	18	2	250	2300		130
	13	2	250	2300		130
	7	3	250	2300		130
	2	12	20	1580		20
	0.2	2	0.25	1580		21
DFHX	0.12	16	0.22	580		5

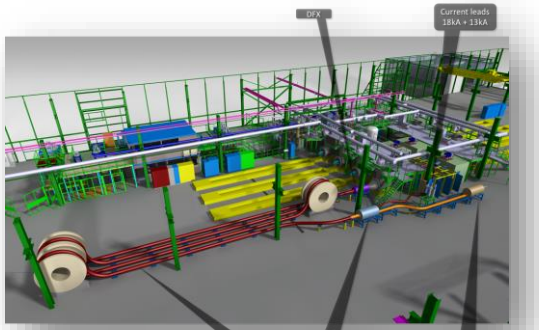
Figure 2. Schematic view of proposed connection for the test of the SC LINK

The idea of the **SC link test stand** on Cluster F is born…and we started to do a number of iterations

2018

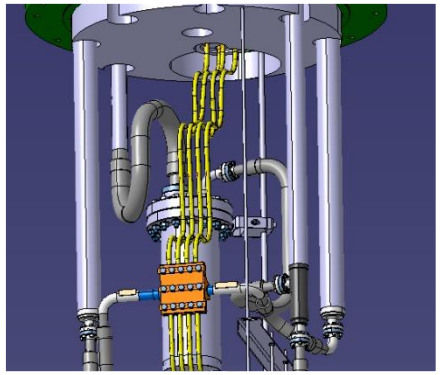


Secondary circuit of of HFM test stand with EE (IGBT) installation done



(Mars 2018)

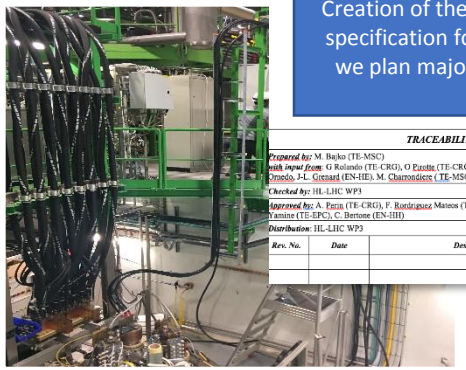
2019

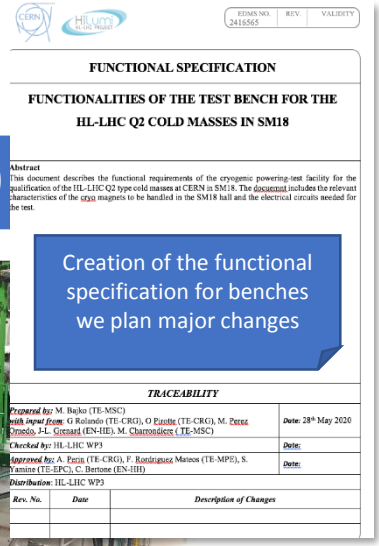


Diode cryostat modification for TRIM lead testing, reviewed interlock of Cluster G with 2 circuits

(Mars 2019)

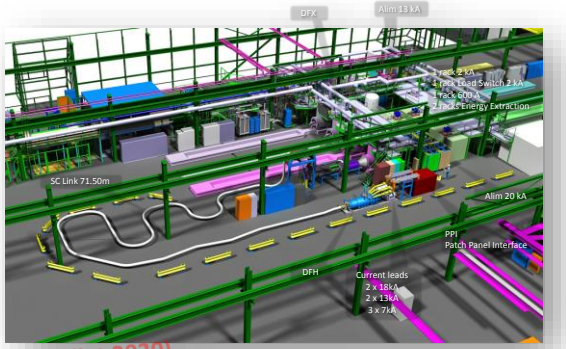
2020





Creation of the functional specification for benches we plan major changes

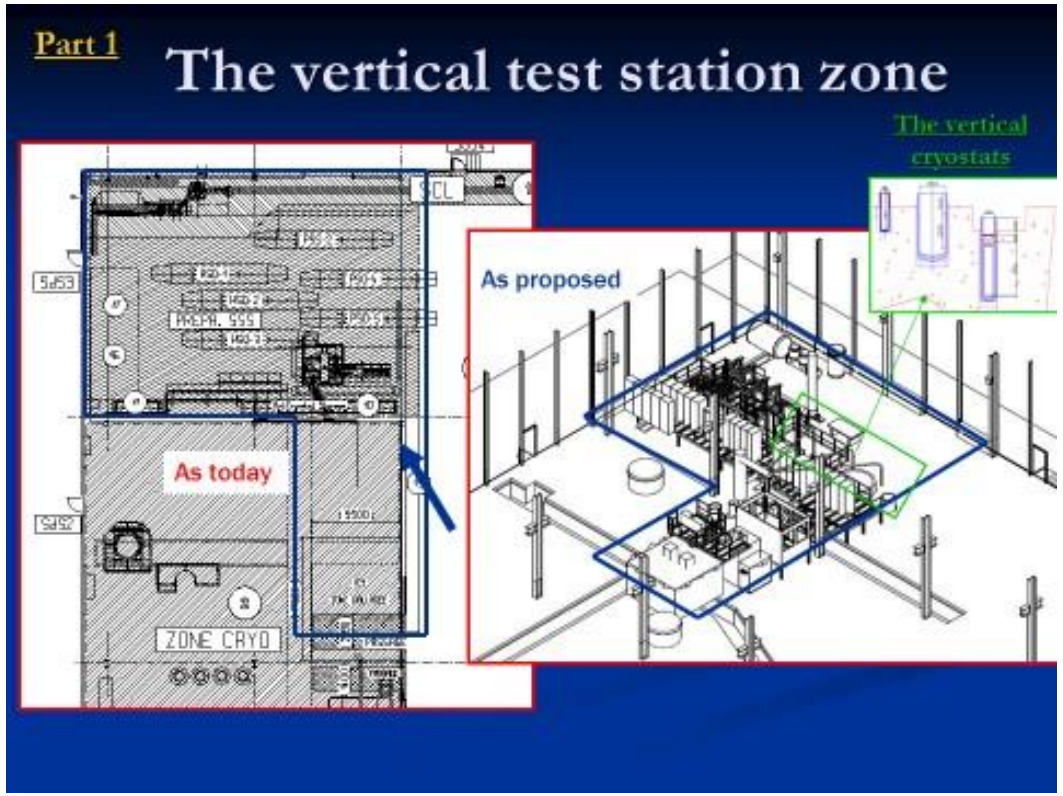
•Secondary circuit of Cluster D, participation to Demo2 installation



(Juillet 2020)

2009

- **TE-MSC-TF is created with one of the main task of moving Block 4 from Prevessin to SM18**



Goals of the project

- Unify the Sc magnet test stations (A + B)
  - A. the station known as "*Block 4*" situated in Prevessin, equipped with 4 vertical cryostats (to test magnet alone in vertical position)
  - B. the test station known as "*SM18*" situated in between point 1 and 8, equipped with 12 horizontal test benches (to test magnets with their own cryostat in horizontal position)
- Optimizes the use of : services and man power
- Extend the vertical test station to allow testing magnets and Sc of future projects (NIT, HFM, FCM)
- Modify the horizontal test benches such to allow testing present and new inner triplet magnets
- Prepare a zone for the STRING 3of new inner triplet magnets + Sc link

Project proposal August 2009

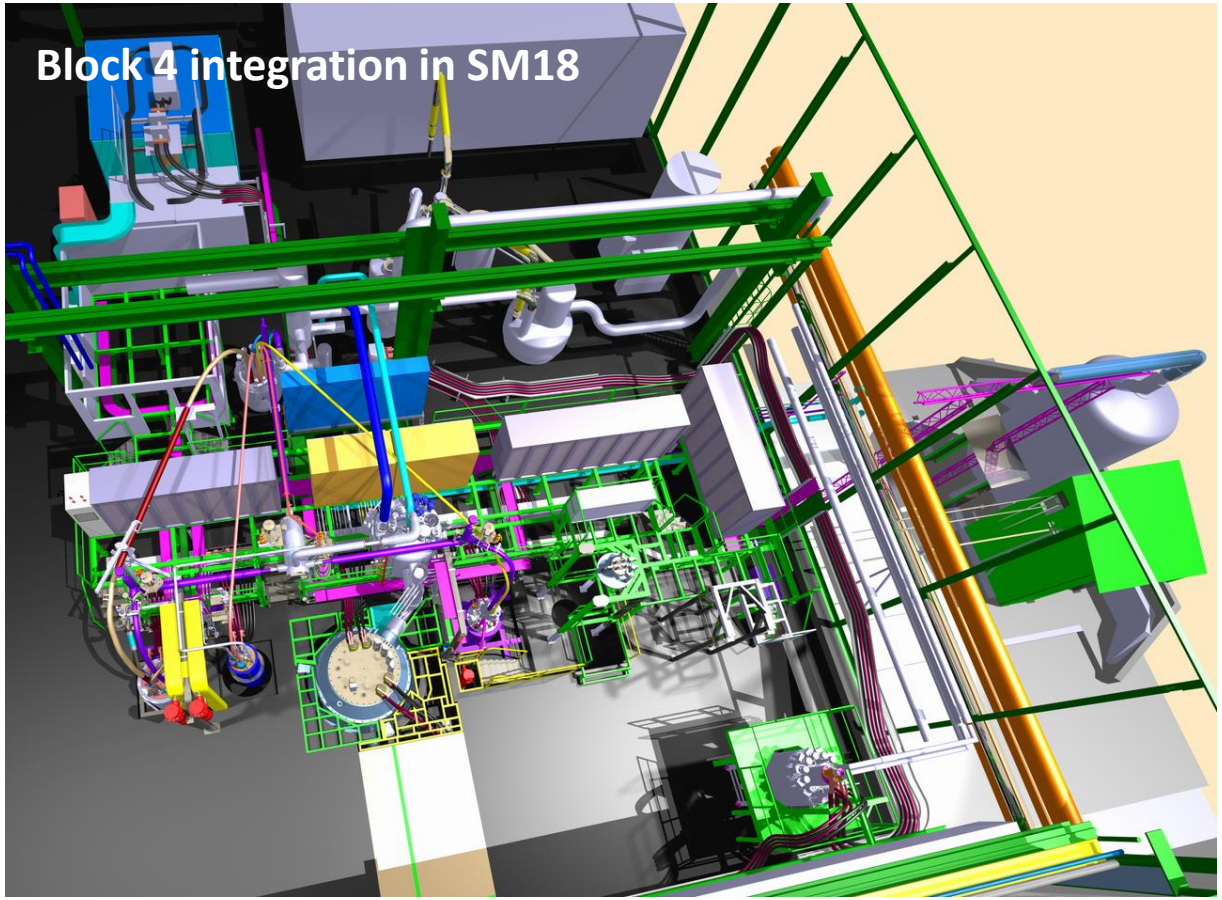
2010

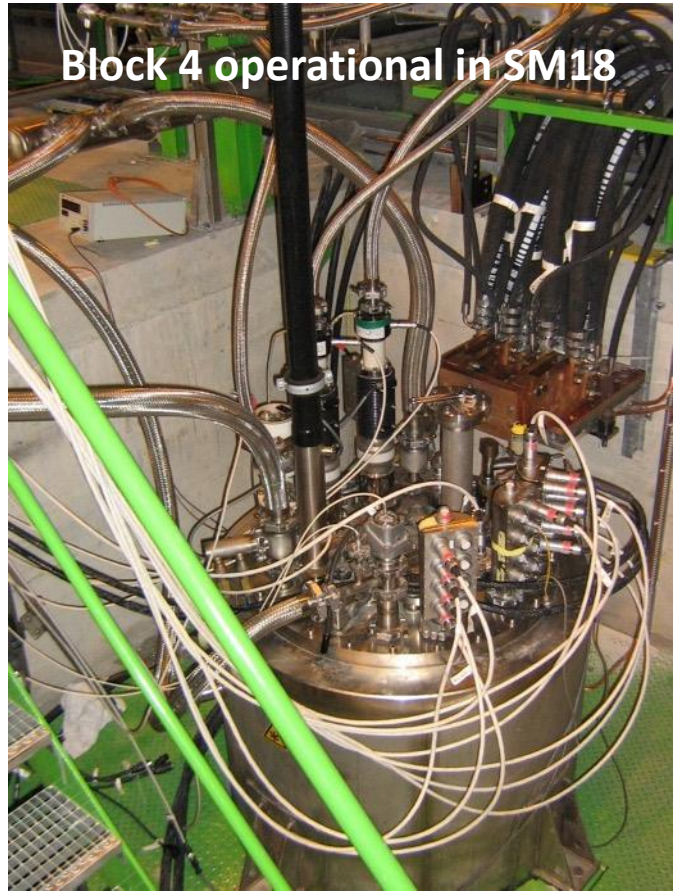
Civil engineering started in the SM18 Cluster G

Mars 2010 Avril 2010 May 2010 June 2010 July 2010

2011

The Cluster G with 1 cryostat fully operational





2012

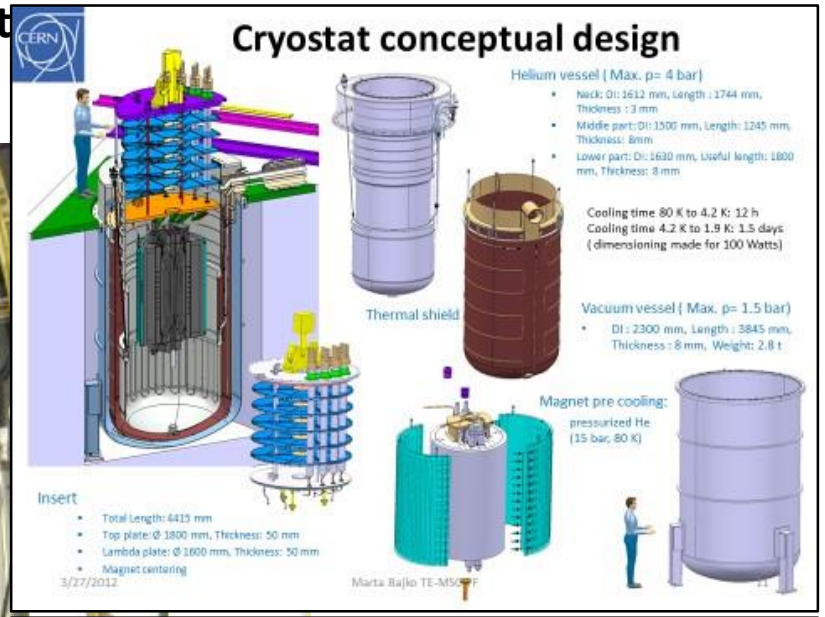
2nd cryostat and the feed box are operational

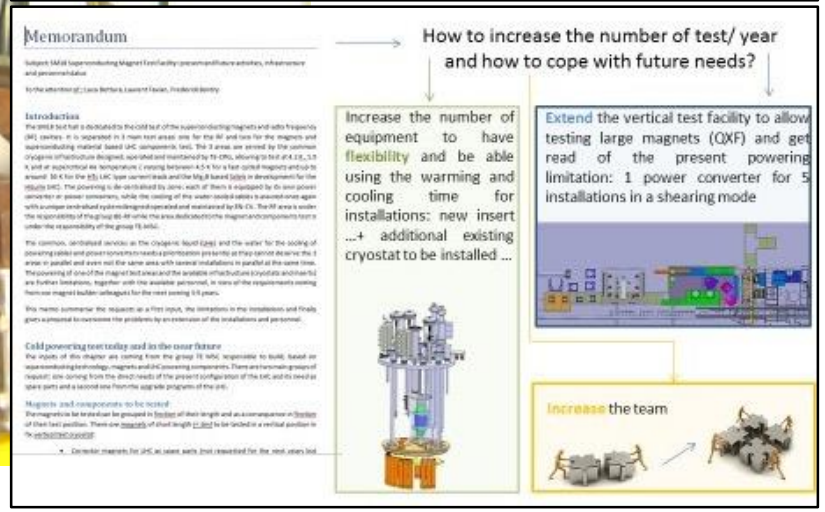
Start of optimisations: new insert for Long Cryostat and a new one for FReSCa2: HFM .

A memorandum is written to ask for extension of the test stand of HL-LHC magnet

Diode cryostat ready for test

Feed Box ready for FCM testing





2013

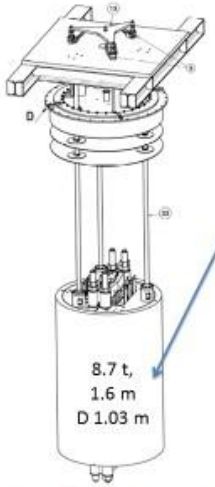
Construction of the LN_2 cryostat.

LN_2 test station : goals and constrains

GOAL

Before summer 2013 the **study, of the thermo mechanical behaviour** of the structure at different pre-stress is, required.

The LHe test station IS NOT AVAILABLE yet, therefore it was decided to set up a dedicated test station at LN_2.



CONSTRAINS

Huge mass and **large dimension** of the magnet requires optimized cooling scenario.

Due to differential thermal shrinkage of Al and steel, the maximum temperature difference between two points of the structure was limited to max. **100 K**.

See presentation of Paolo, Jorge and Juan Carlos

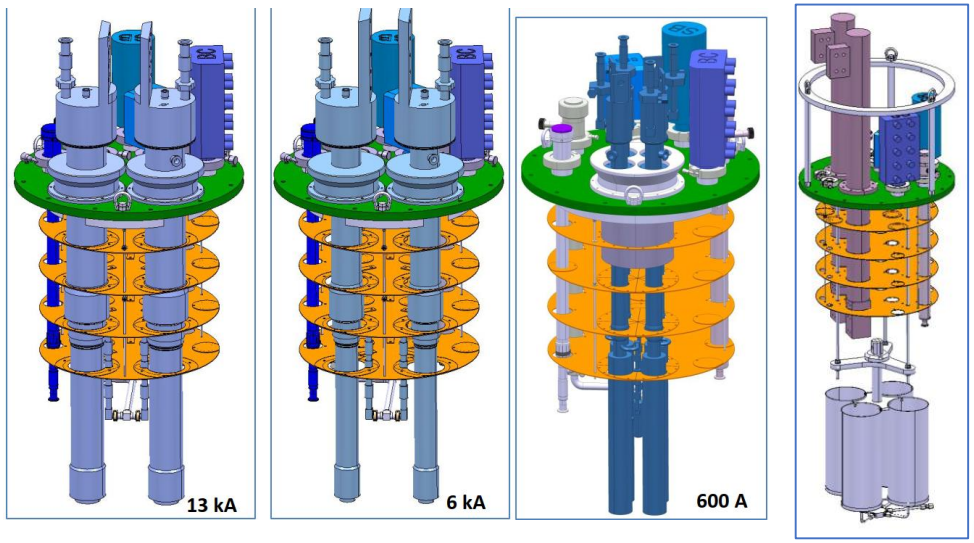
Special thanks to Hugo, Juan, Jorge, Maryline

OPEN DAYS… we have external help: I can count on my daughter.. she is now 4, and with **Tonio** even under the rain is transporting magnets

We got our new offices

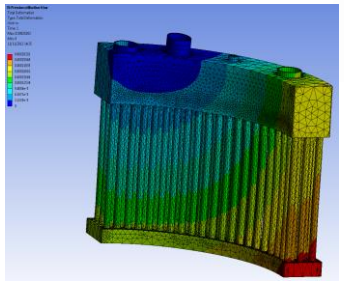
2013-2014

Construction of the new Inserts for the old cryostats

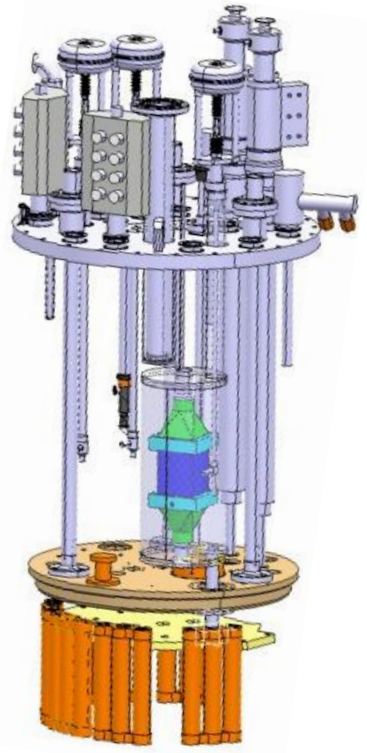


Work of G. Villiger + V. Benda

While we kept the old Block 4 cryostats, we re-built the inserts. Ex. Diodes and LHC lead cryostats with an external satellite allowing us today to used a mixed gas to cool HTs coils at variable He gas temperature



With an original idea of P. Viret
Design and produced by EN-MME design office and Main workshop
Integrated with CRG in the SM18 cooling system



New additional insert for the existing LONG cryostat with IMPROVED performance.

SAFETY a continues work on a constantly growing installations

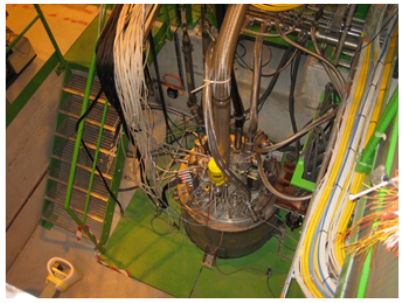
ORGANISATION EUROPÉENNE POUR LA RECHERCHE NUCLÉAIRE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Laboratoire Européen pour la Physique des Particules
European Laboratory for Particle Physics

Rapport d'évaluation de la sécurité des bancs de test verticaux SM18

Référence EDMS	VERS. DRAFT
Département/Groupe	TE/MSC
Localisation	Bâtiment SM18
DSO (Divisional Safety Officer)	Thomas Otto
TSO (Territorial Safety Officer)	Patrick Viret

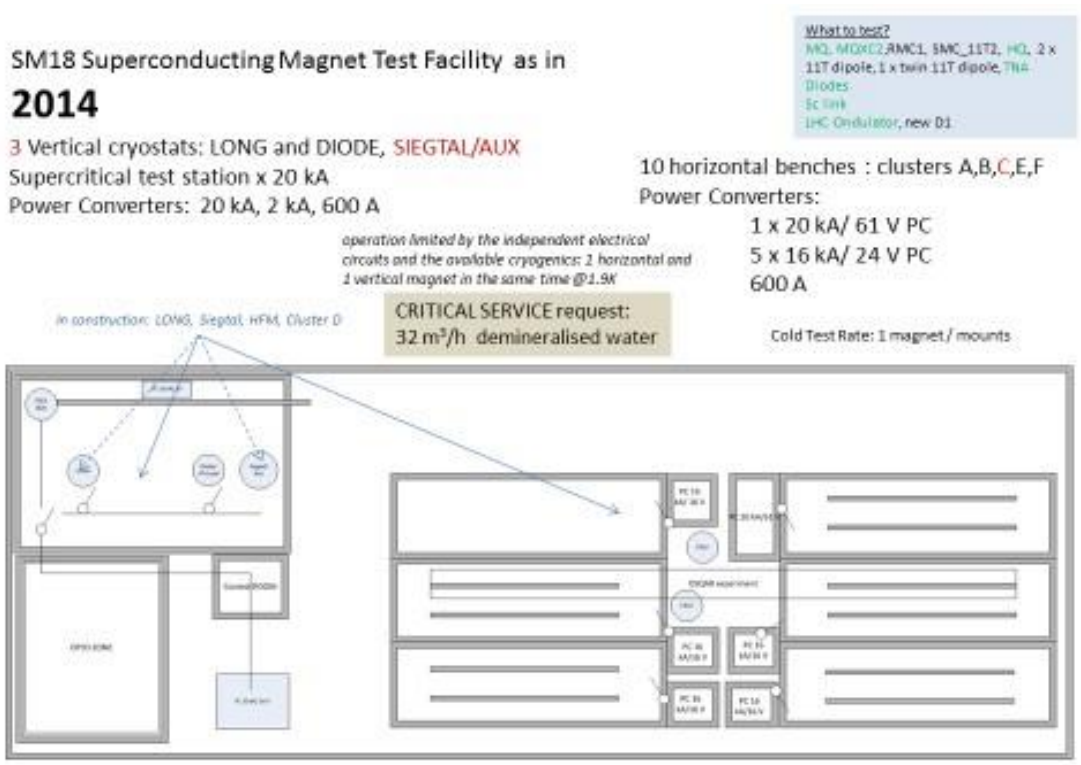
Nom de l'équipement	Bancs de tests verticaux
Fabricant	CERN
Catégorie de la machine	Standard
Description de la machine	L'examen concerne les stations de tests verticaux qui permettent de tester n'importe quel aimant nu (c'est-à-dire sans dispositif de refroidissement et sans cryostat individuel).
Date de mise en service	2001 à 2013



Work with E. Bigot + T. Otto + P. Viret

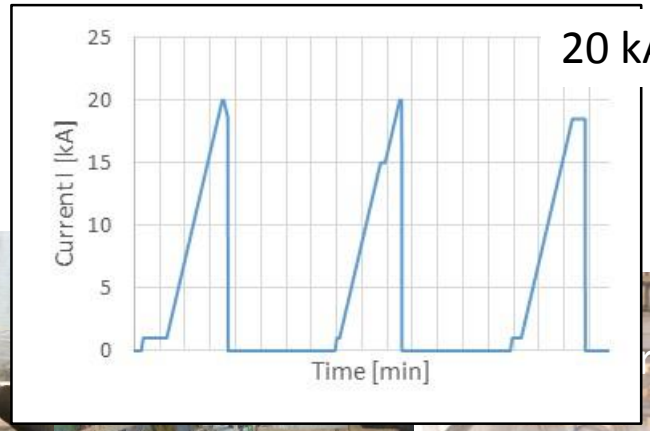
2014

- **In July Cluster D is dismounted. Creation of the SM18 Infrastructure UPG project. 3rd Cryostat is operational in the vertical test facility.**



2015

while work is ongoing for the civil engineering of Cluster D, we start testing Cluster A at high current

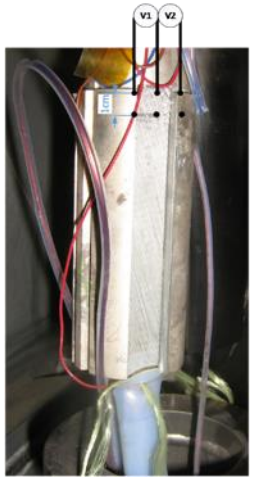


20 kA kept for 30 s in Cluster A. ….so is feasible ….

2016

HFM cryostat ready. Infrastructure improved

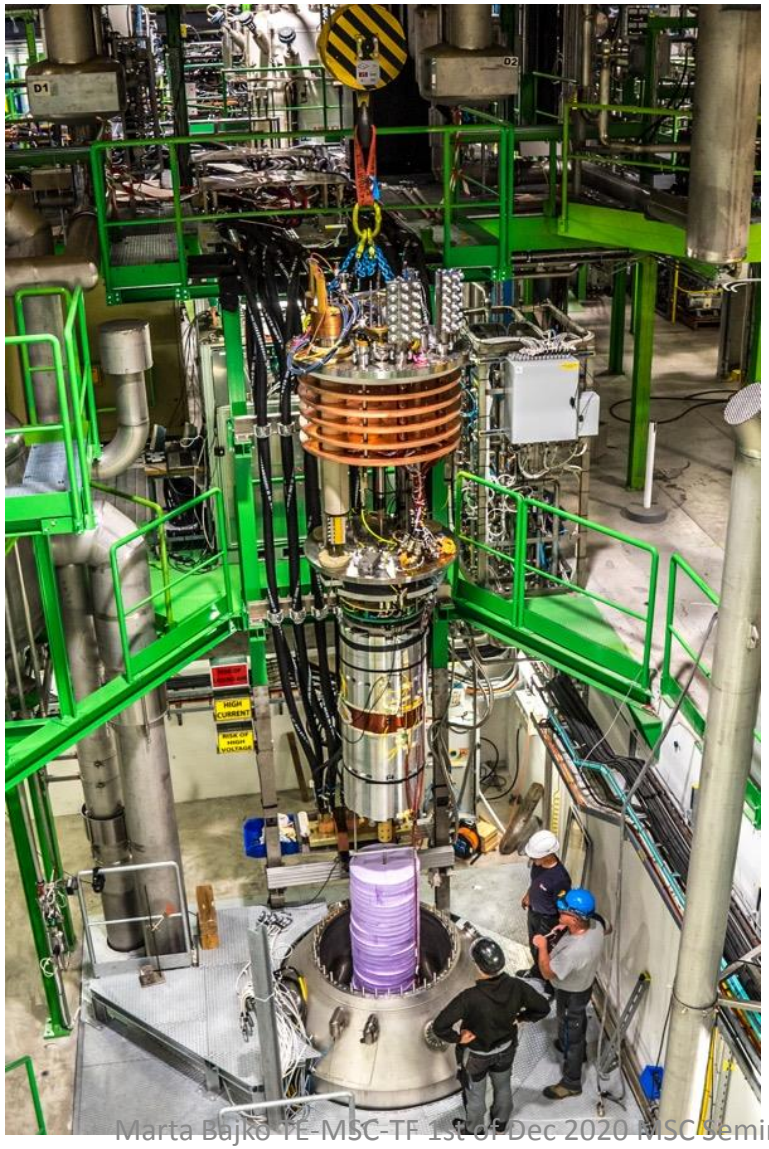
New demineralised water station, Operational in April



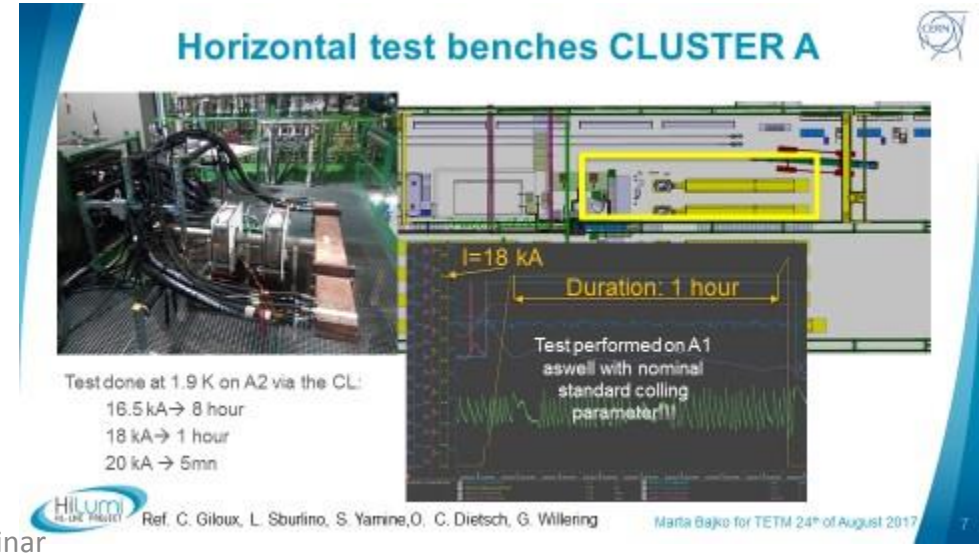
Cluster A CL consolidation

2017

Cluster G , D and A operational



And we enjoy EUCAS 2017 in SM18



SM18 INFRASTRUCTURE UPGRADE

The upgrade was driven by the recommendation to be able to carry out the full test programme withouth constraints

- ❑ DEMINERALISED WATER PRODUCTION: **+ 150 m³/h** — Operational from April 2016

NEEDED FOR DEMINERALISED WATER ENTIRELY COMING FROM MAGNET OPERATION

- ❑ HANDLING: **25 T and longer rope** — Operational from February 2016

NEEDED FOR OVERHEAD CRANE CHANGE ENTIRELY COMING FROM MAGNET OPERATION

- ❑ nCONTROL ROOM — Operational from 2017

NEEDED TO EXTEND THE TOO SMALL CONTROL ROOM OF THE VERTICAL TEST FACILITY TO BE USED ALSO FOR HORIZONTAL BENCHES AND SC LINK

- ❑ PRIMARY WATER COOLING CAPACITY: **+736 m³/h**

NEEDED FOR MAGNETS, CRYO AND RF

- ❑ POWERING FROM THE NETWORK: **3 MVA** — Operational from 2019

NEEDED FOR NEW OR MODIFIED PCs FOR MAGNETS AND IR STRING

- ❑ CRYOGENIC COOLING PRODUCTION: **+ 35 g/s LHe** — Is under final commissioning 2020

NEEDED ESSENTIALLY FOR THE RUNNING OF THE HL LHC IR STRING IN PARALLEL WITH MAGNET TESTING

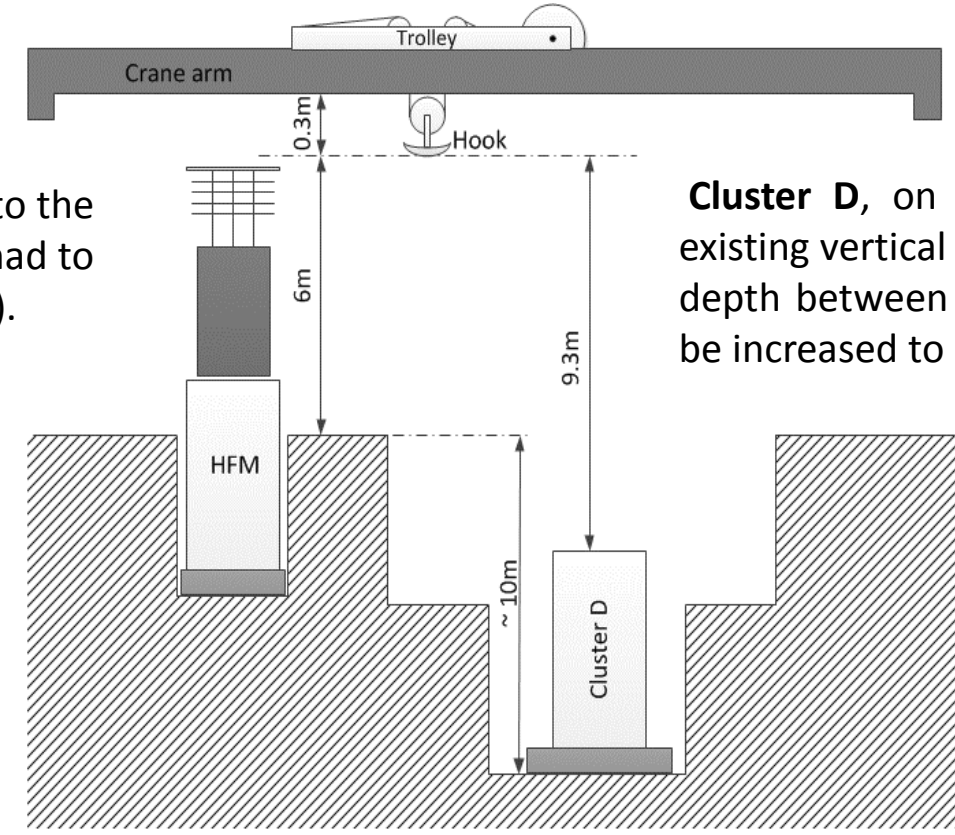
SM18 handling infrastructure upgrade

- HANDLING: **25 t and longer rope**

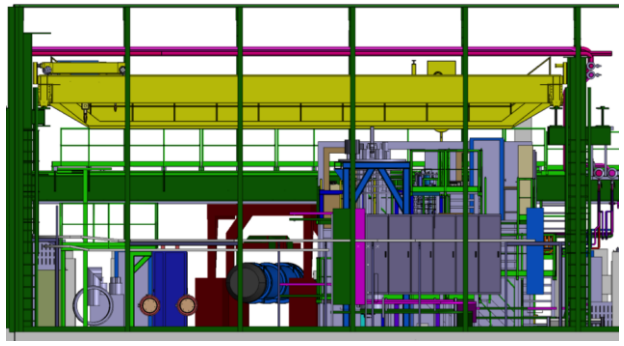
NEEDS FOR OVERHEAD CRANE CHANGE ENTIRELLY COMING FROM MAGNET OPERATION

Special thanks to Roberto R.

To enable insertion of test objects into the **HFM cryostat** the operating height, had to be increased to **6 m** (presently 5.3 m).



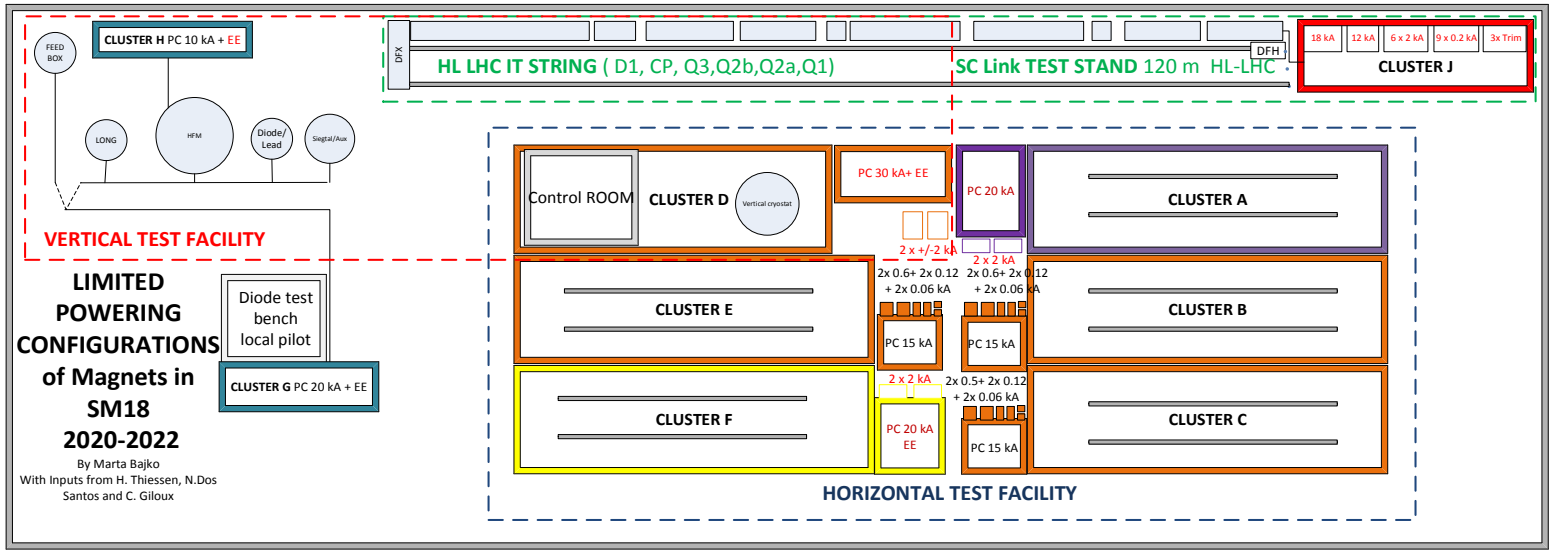
Cluster D, on the other hand, will be deeper than the existing vertical facilities. To handle the inserts the operation depth between the hook and the top of the cryostat must be increased to **9.3 m**.

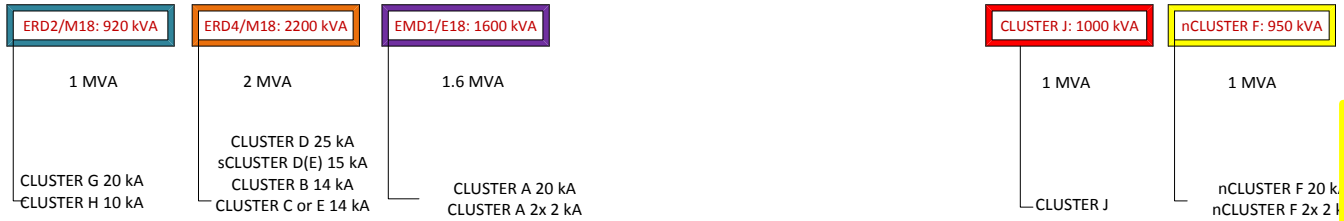


Operational from February 2016

25 T HANDELING CAPACITY

SM18 electrical distribution infrastructure upgrade





To allow some flexibility and margin with new requests that are not formulated yet, the proposal is to **INSTALL a TRANSFORMER OF 3 MVA CAPACITY**

Special thanks to Nuno D. S.

TEST STAND	CLUSTER	Connected to	Individual consumption [MVA]	Consumption by connection [MVA]	Capacity by connection [MVA]
	A	EMT103	1.6	1.6	2
	B		0.48		
	C		0.48		
	D		0.82		
	E	ERD4	0.48	2.26	2
Horizontal	F		0.7		
IT STRING	J	Tobe defined	1	1.7	3
	G		0.8		
Vertical	H	ERD2	0.1	0.9	2

The new transformer will feed HL LHC IT STRING (Cluster J) and the new Cluster F with the 20 kA power converter.

See document: https://edms.cern.ch/document/1604702.

New Control Room

- nCONTROL ROOM

NEEDED TO EXTEND THE TOO SMALL CONTROL ROOM OF THE VERTICAL TEST FACILITY TO BE USED ALSO FOR HORIZONTAL BENCHES AND Sc link

OLD CONTROL ROOM WITH REDUCED SPACE

NEW LARGER CONTROL ROOM AT THE PROXIMITY OF THE CRYOSTATS

NEW CONTROL ROOM: THE GROUND FLOOR

Last adjustments before testing MQXFS5

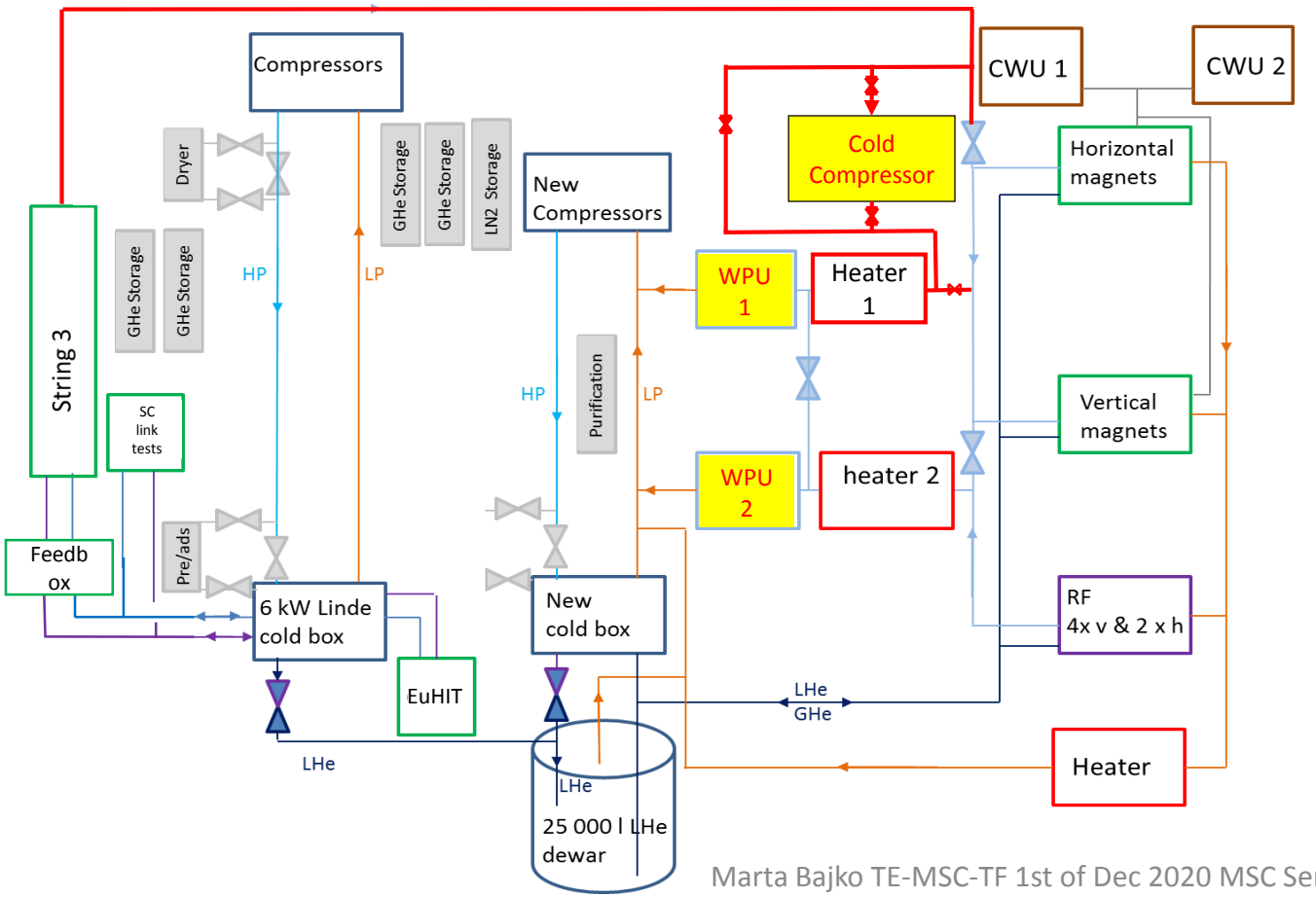
Special thanks to Maryline Ch.

SM18 CRIOGENIC infrastructure upgrade

"SM18 Cryogenics Infrastructure Upgrade Proposal": EDMS 1571317

- CRYOGENIC COOLING PRODUCTION: **+ 35 g/s LHe**

NEEDED FOR RUNNING IN PARALLEL MAGNET AND RF CAVITY WITH THE HL LHC IR STRING TESTING



Special thanks to Antonio P.

An additional **35 g/s liquefing capacity**

Should be operational from January 2021

The existing total pumping capacity in SM18 at **1.8 K is 12 g/s** today that was obtained by **combining** the capacity of **WPU1 and 2.**
This 12 g/s is to be shared between magnet and cavity testing

Operational from April 2016

SM18 water cooling infrastructure upgrade

- DEMINERALISED WATER PRODUCTION: **+ 150 m³/h**

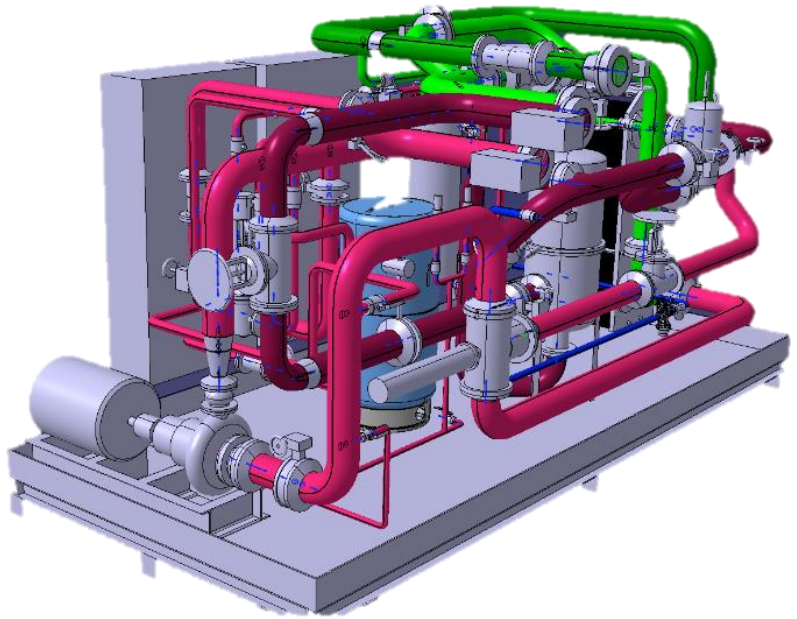
NEEDED FOR DEMINERALISED WATER ENTIRELY COMING FROM MAGNET operation

- PRIMARY WATER COOLING CAPACITY: **+736 m³/h**

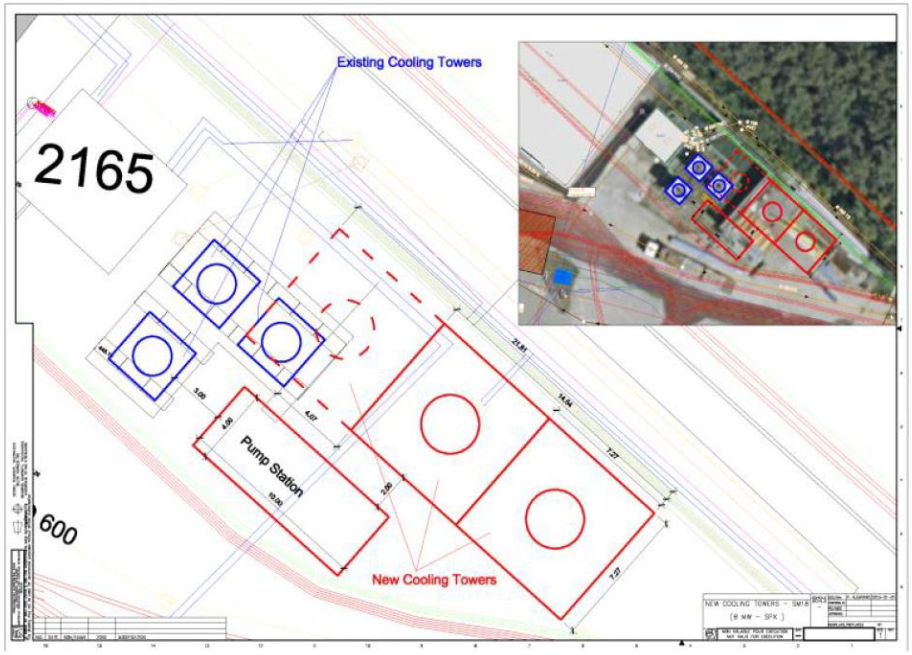
NEEDSED FOR MAGNETS, CRYO AND RF

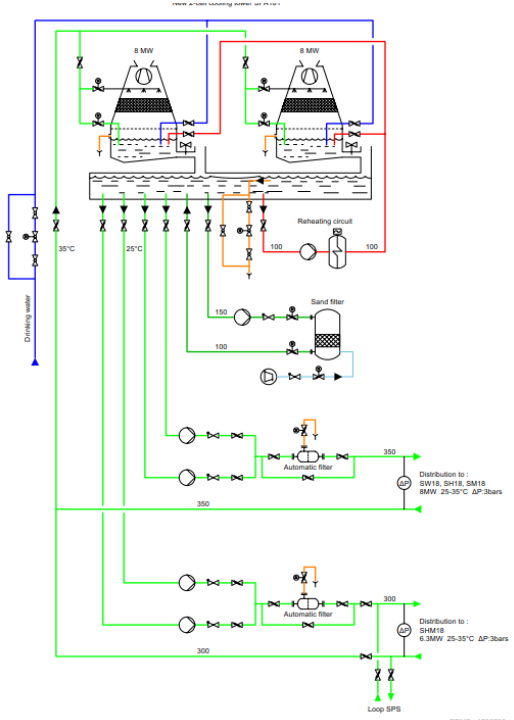
Special thanks to Alexander J. B and Gerard C.

- Upgrade of primary water from 3-cells tower (6 MW) to 2-cells tower (16 MW)
- Construction of new 2-cells tower in 2018.
- Installation of the equipment in the plant room and buried distribution pipes end 2018 and 2019



SFA18

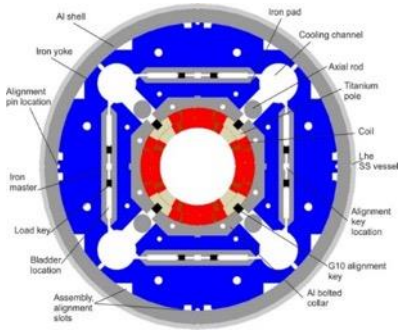


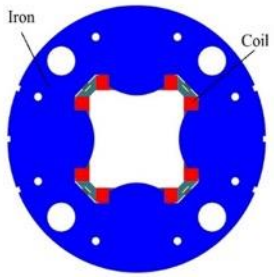


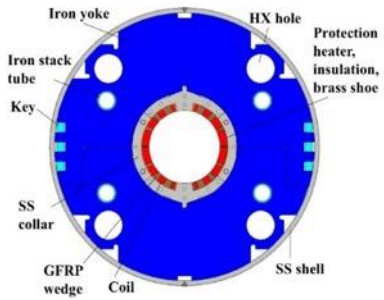
Operational from 2019

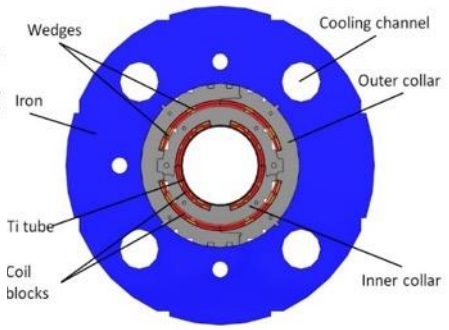
See presentations of G. Cumer , A. J. Broche :https://indico.cern.ch/category/7651/

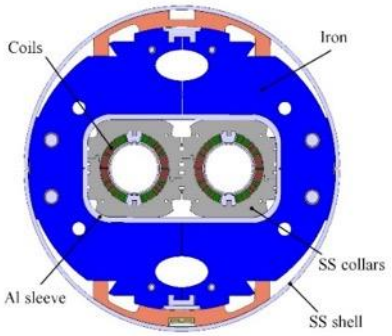
Test stand for magnets (in vertical cryostats)

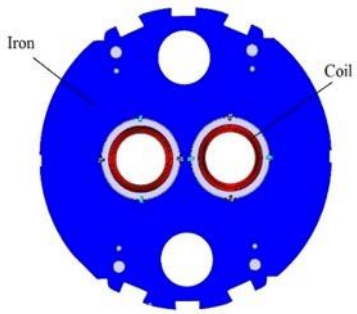


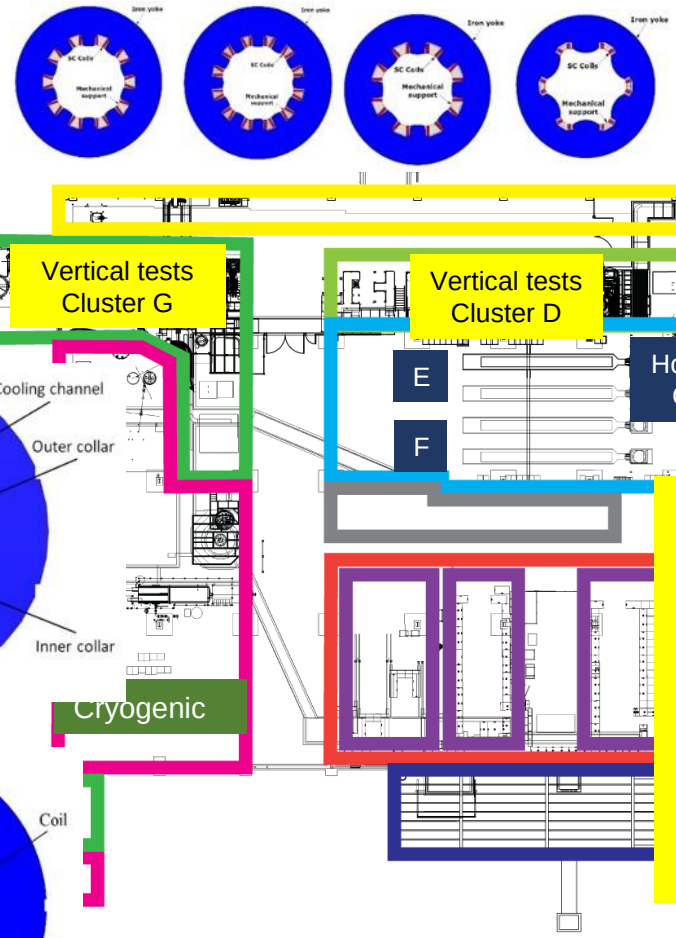










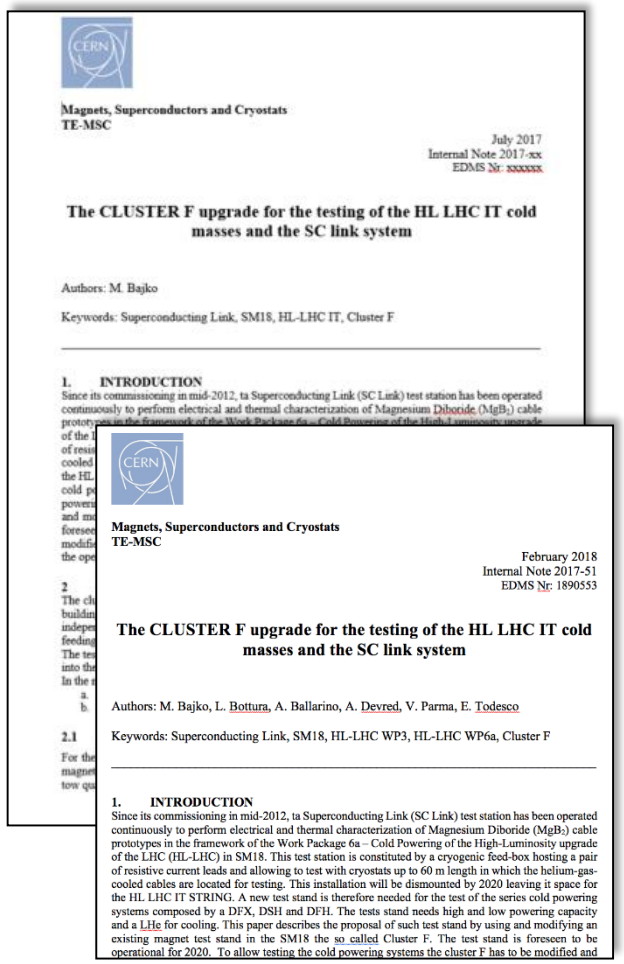


NO modification of the test stand is required. The cryostats are all operational; all ancillary equipment are present and adaptable to needs.
We can test 2 independent circuits both at high and low current.
We have 2 x 2 kA 4 Q PC on D with EE.
Cliq and symmetric quench detection operational.

All model magnets of (HL-)LHC and others can be tested in Cluster G or D

Test stand for HL-LHC : ongoing constructions

https://indico.cern.ch/event/647714/timetable/#20171114.detailed



Magnets, Superconductors and Cryostats
TE-MSC

July 2017
Internal Note 2017-xx
EDMS Nr: xxxxxx

The CLUSTER F upgrade for the testing of the HL LHC IT cold masses and the SC link system

Authors: M. Bajko

Keywords: Superconducting Link, SM18, HL-LHC IT, Cluster F

1. INTRODUCTION

Since its commissioning in mid-2012, ta Superconducting Link (SC Link) test station has been operated continuously to perform electrical and thermal characterization of Magnesium Diboride (MgB_2) cable prototypes in the framework of the Work Package 6a – Cold Powering of the High-Luminosity upgrade of the LHC (HL-LHC) in SM18. This test station is constituted by a cryogenic feed-box hosting a pair of resistive current leads and allowing to test with cryostats up to 60 m length in which the helium-gas-cooled cables are located for testing. This installation will be dismounted by 2020 leaving it space for the HL LHC IT STRING. A new test stand is therefore needed for the test of the series cold powering systems composed by a DFX, DSH and DFH. The tests stand needs high and low powering capacity and a LHe for cooling. This paper describes the proposal of such test stand by using and modifying an existing magnet test stand in the SM18 the so called Cluster F. The test stand is foreseen to be operational for 2020. To allow testing the cold powering systems the cluster F has to be modified and

Magnets, Superconductors and Cryostats
TE-MSC

February 2018
Internal Note 2017-51
EDMS Nr: 1890553

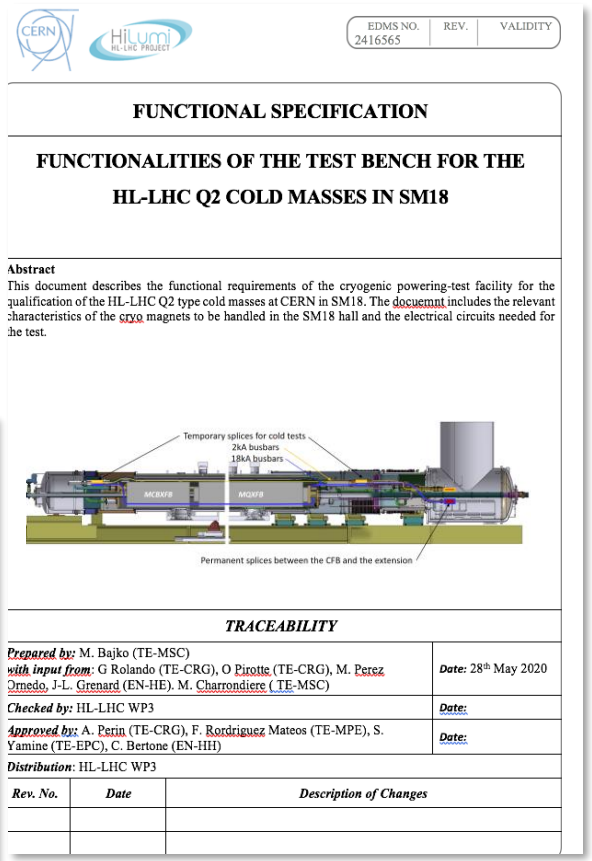
The CLUSTER F upgrade for the testing of the HL LHC IT cold masses and the SC link system

Authors: M. Bajko, L. Bottura, A. Ballarino, A. Devred, V. Parma, E. Todesco

Keywords: Superconducting Link, SM18, HL-LHC WP3, HL-LHC WP6a, Cluster F

1. INTRODUCTION

Since its commissioning in mid-2012, ta Superconducting Link (SC Link) test station has been operated continuously to perform electrical and thermal characterization of Magnesium Diboride (MgB_2) cable prototypes in the framework of the Work Package 6a – Cold Powering of the High-Luminosity upgrade of the LHC (HL-LHC) in SM18. This test station is constituted by a cryogenic feed-box hosting a pair of resistive current leads and allowing to test with cryostats up to 60 m length in which the helium-gas-cooled cables are located for testing. This installation will be dismounted by 2020 leaving it space for the HL LHC IT STRING. A new test stand is therefore needed for the test of the series cold powering systems composed by a DFX, DSH and DFH. The tests stand needs high and low powering capacity and a LHe for cooling. This paper describes the proposal of such test stand by using and modifying an existing magnet test stand in the SM18 the so called Cluster F. The test stand is foreseen to be operational for 2020. To allow testing the cold powering systems the cluster F has to be modified and



EDMS NO. 2416565 | REV. | VALIDITY

FUNCTIONAL SPECIFICATION

FUNCTIONALITIES OF THE TEST BENCH FOR THE HL-LHC Q2 COLD MASSES IN SM18

Abstract
This document describes the functional requirements of the cryogenic powering-test facility for the qualification of the HL-LHC Q2 type cold masses at CERN in SM18. The documemt includes the relevant characteristics of the cryo magnets to be handled in the SM18 hall and the electrical circuits needed for the test.

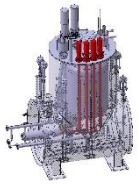
Temporary splices for cold tests
2kA busbars
18kA busbars
MCBXFB
MQXFB
Permanent splices between the CFB and the extension

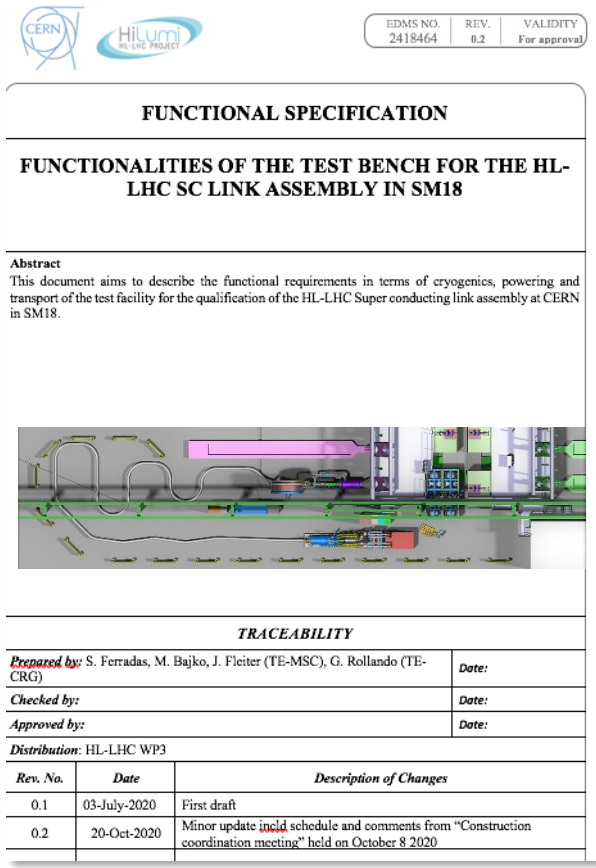
TRACEABILITY

Prepared by: M. Bajko (TE-MSC) ***with input from:*** G Rolando (TE-CRG), O Pirotte (TE-CRG), M. Perez Ornedo, J-L. Grenard (EN-HE). M. Charrondiere (TE-MSC)	***Date:*** 28th May 2020
Checked by: HL-LHC WP3	***Date:***
Approved by: A. Perin (TE-CRG), F. Rordriguez Mateos (TE-MPE), S. Yamine (TE-EPC), C. Bertone (EN-HH)	***Date:***
Distribution: HL-LHC WP3	

Rev. No.	*Date*	*Description of Changes*

Interface the CFU with a new phase separator to allow 4.2 K testing conditions of the triplets and also D2.





EDMS NO. 2418464 | REV. 0.2 | VALIDITY For approval

FUNCTIONAL SPECIFICATION

FUNCTIONALITIES OF THE TEST BENCH FOR THE HL-LHC SC LINK ASSEMBLY IN SM18

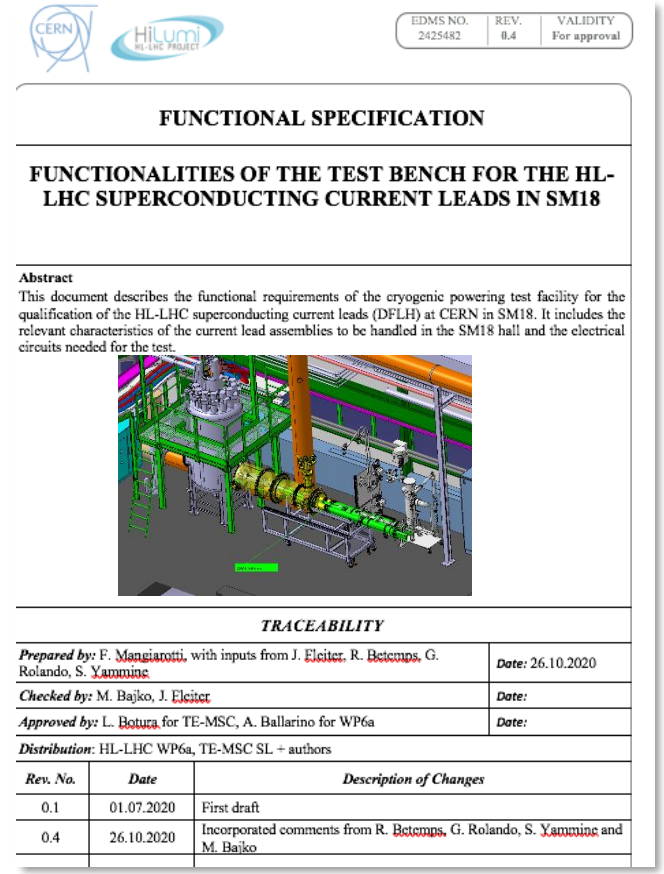
Abstract
This document aims to describe the functional requirements in terms of cryogenics, powering and transport of the test facility for the qualification of the HL-LHC Super conducting link assembly at CERN in SM18.

TRACEABILITY

Prepared by: S. Ferradas, M. Bajko, J. Fleiter (TE-MSC), G. Rollando (TE-CRG)	***Date:***
Checked by:	***Date:***
Approved by:	***Date:***
Distribution: HL-LHC WP3	

Rev. No.	*Date*	*Description of Changes*
0.1	03-July-2020	First draft
0.2	20-Oct-2020	Minor update incld schedule and comments from "Construction coordination meeting" held on October 8 2020

Interface the the warm powering cables with the CL (replace the DCB with an adequate PP). Place order for WCC in time.



EDMS NO. 2425482 | REV. 0.4 | VALIDITY For approval

FUNCTIONAL SPECIFICATION

FUNCTIONALITIES OF THE TEST BENCH FOR THE HL-LHC SUPERCONDUCTING CURRENT LEADS IN SM18

Abstract
This document describes the functional requirements of the cryogenic powering test facility for the qualification of the HL-LHC superconducting current leads (DFLH) at CERN in SM18. It includes the relevant characteristics of the current lead assemblies to be handled in the SM18 hall and the electrical circuits needed for the test.

TRACEABILITY

Prepared by: F. Mangiarotti, with inputs from J. Fleiter, R. Betemps, G. Rolando, S. Yammine	***Date:*** 26.10.2020
Checked by: M. Bajko, J. Fleiter	***Date:***
Approved by: L. Bottura for TE-MSC, A. Ballarino for WP6a	***Date:***
Distribution: HL-LHC WP6a, TE-MSC SL + authors	

Rev. No.	*Date*	*Description of Changes*
0.1	01.07.2020	First draft
0.4	26.10.2020	Incorporated comments from R. Betemps, G. Rolando, S. Yammine and M. Bajko

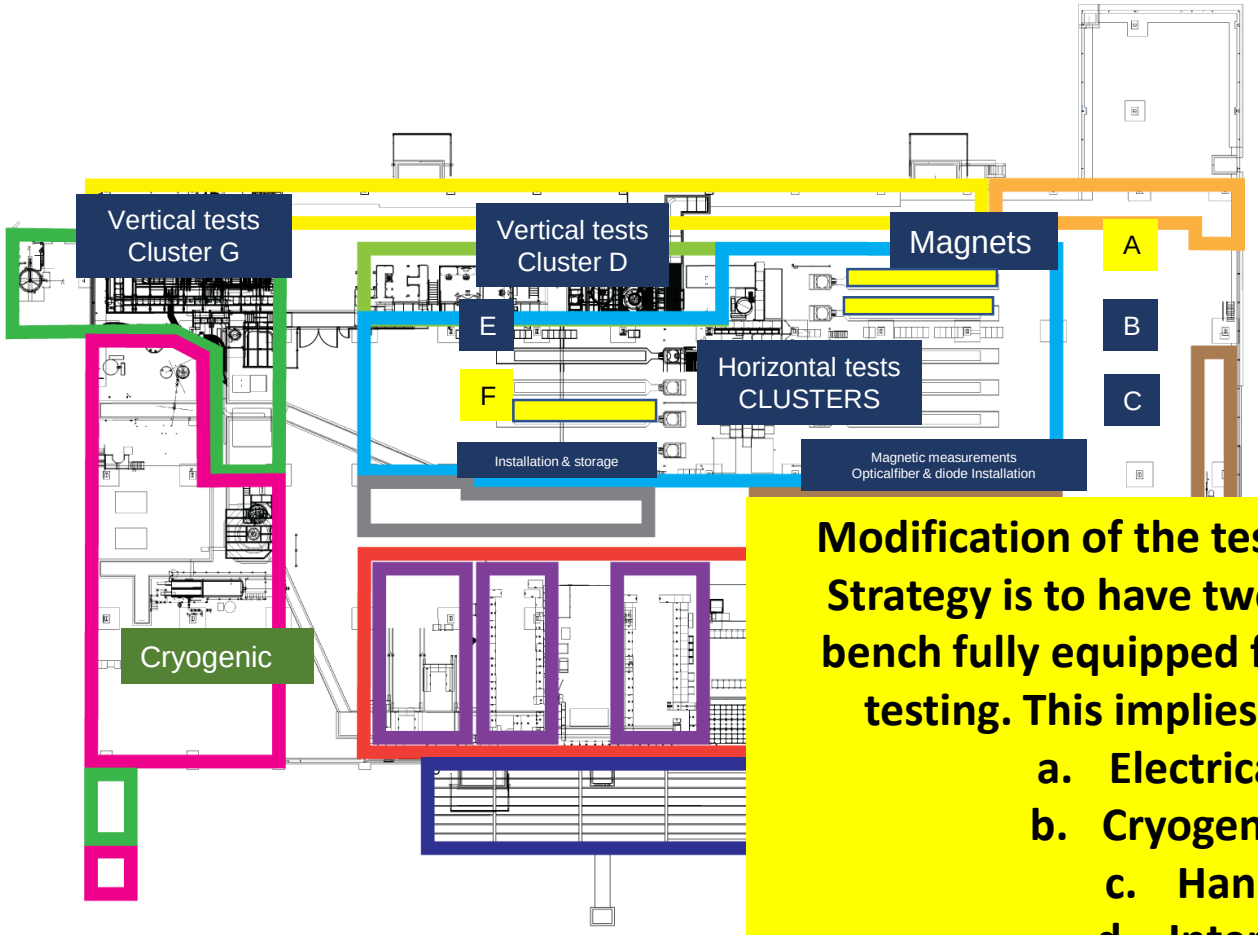
Interface the cryo infrastructure

Installations for WP3 cryo magnets: Q2a/b, (Q1,Q3)

HORINZONTAL test	
apertures	single
condutor technology	Nb3Sn
nominal/max current	16 /20 kA
energy extraction	not possible
QH and CLIQ	possible
Energy	10 MJ
handling	**Modified** Rocla
compatible CFU (LHC)	**NO**

Target : June 2021

The 2nd prototype will be tested on the cluster A with a modification on the cold mass instrumentation to insure the magnet testing at 4.2 K (difficult for the 1st prototype). This will be done using the test cryostat.

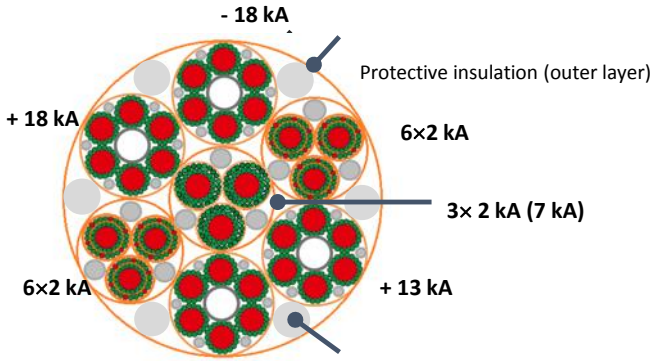


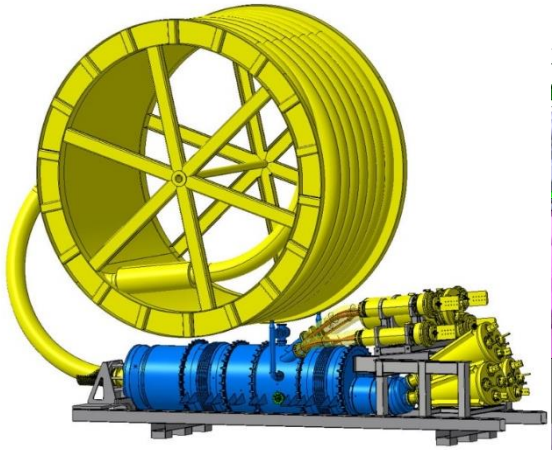
Modification of the test stand is required. Strategy is to have two independent test bench fully equipped for Q2 type magnet testing. This implies modification of :

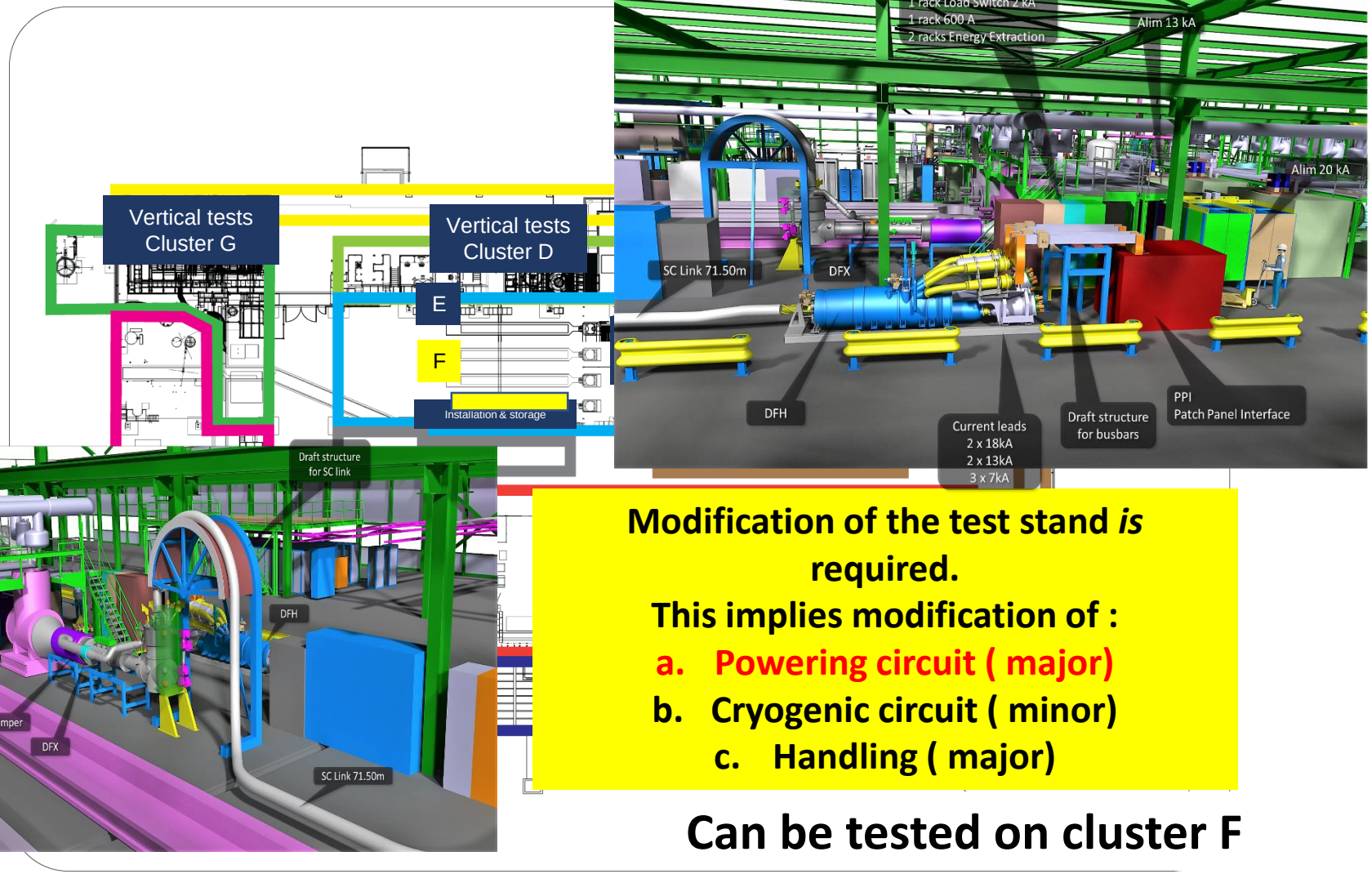
a. **Electrical circuit**
b. **Cryogenic circuit**
c. **Handling**
d. **Interlocks**

Can be tested on cluster A and F

Testing WP6A: Sc Link system







Modification of the test stand *is* required.

This implies modification of :

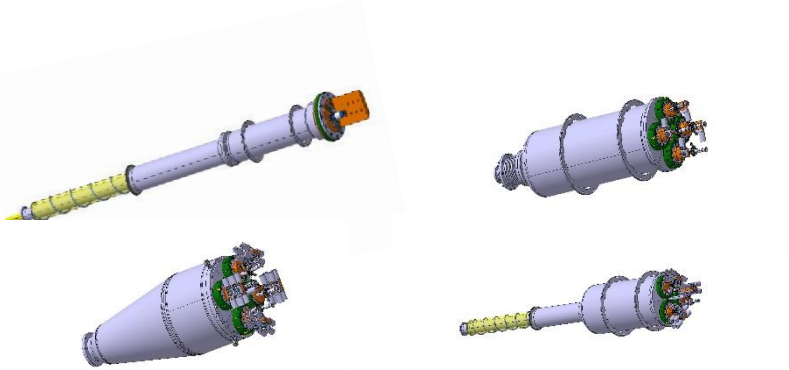
a. **Powering circuit (major)**

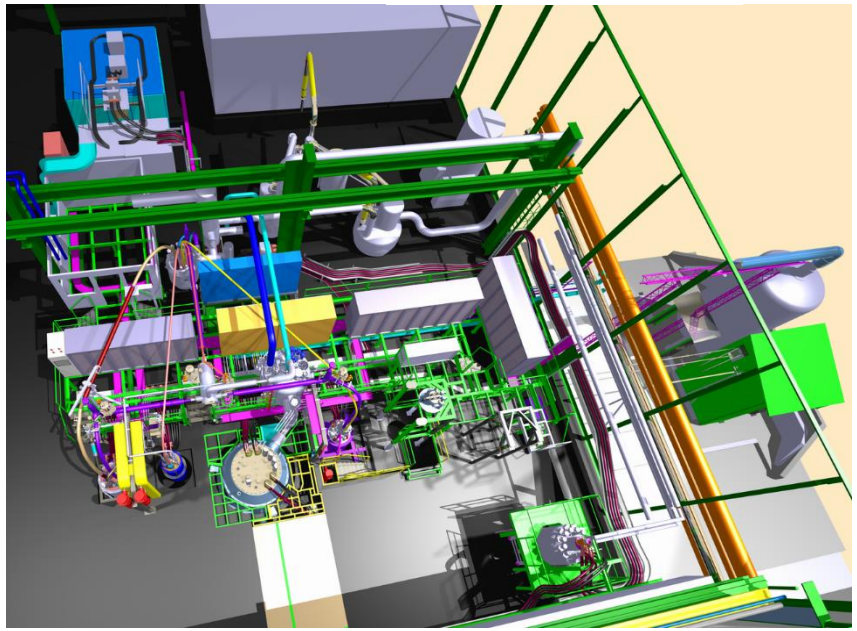
b. **Cryogenic circuit (minor)**

c. **Handling (major)**

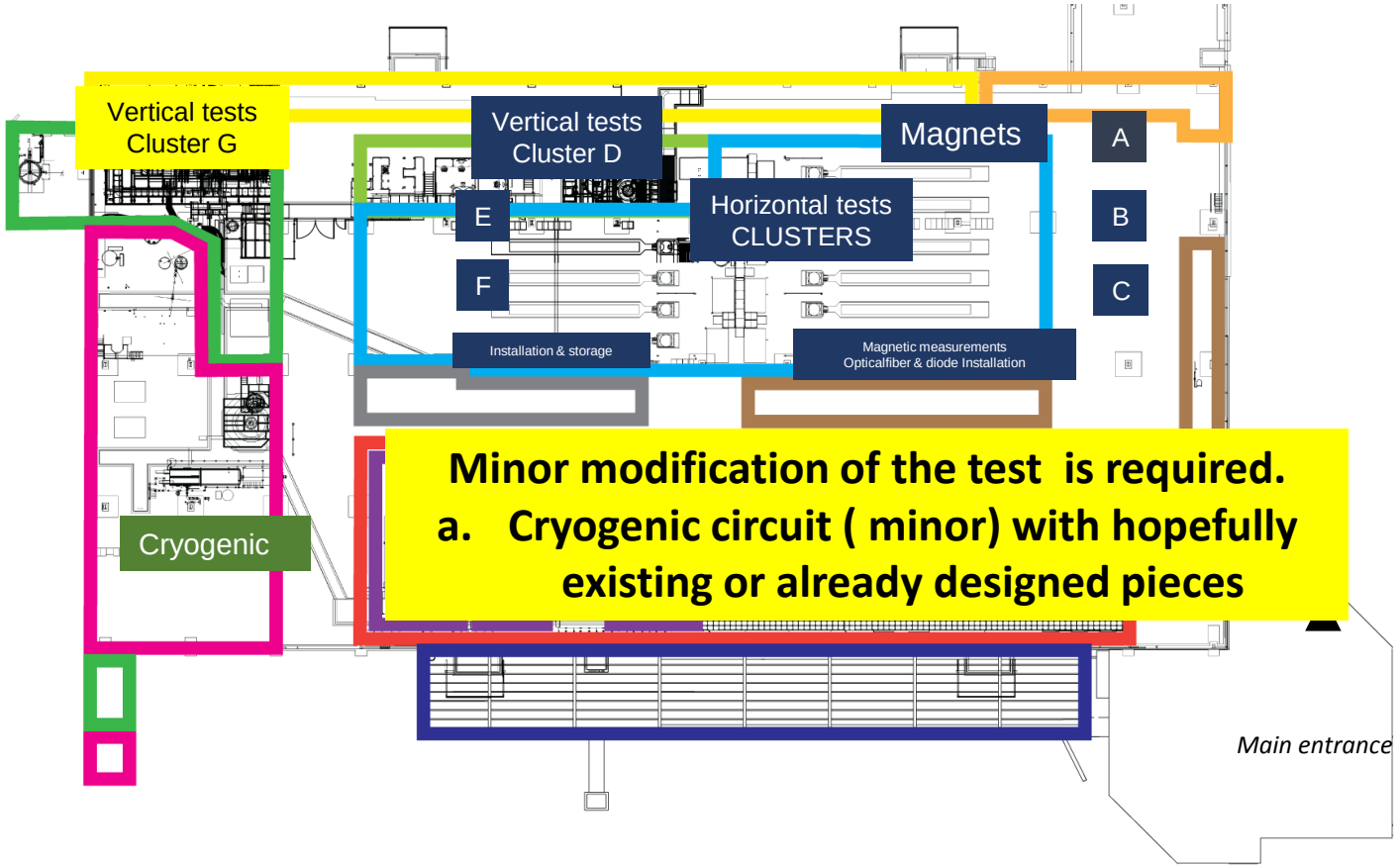
Can be tested on cluster F

Testing WP6a: Type test for CL

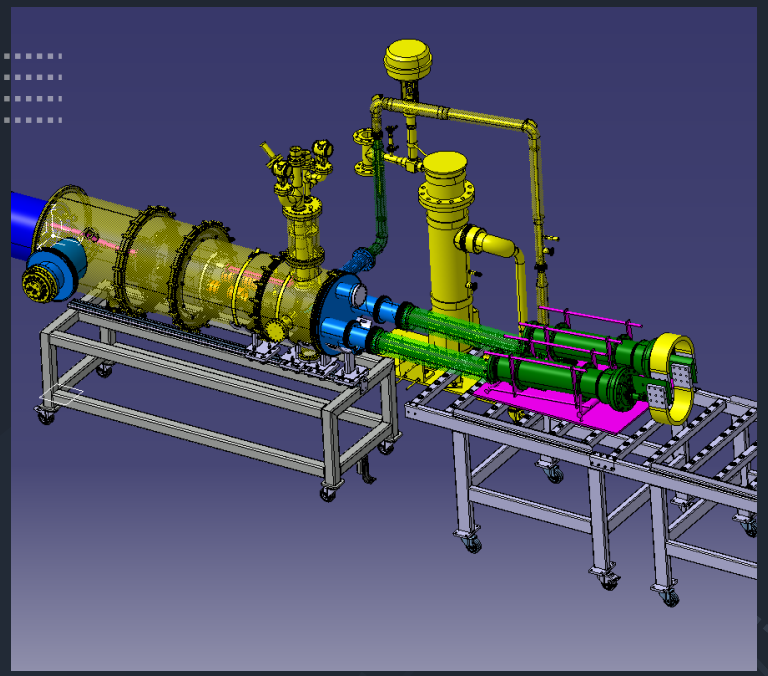


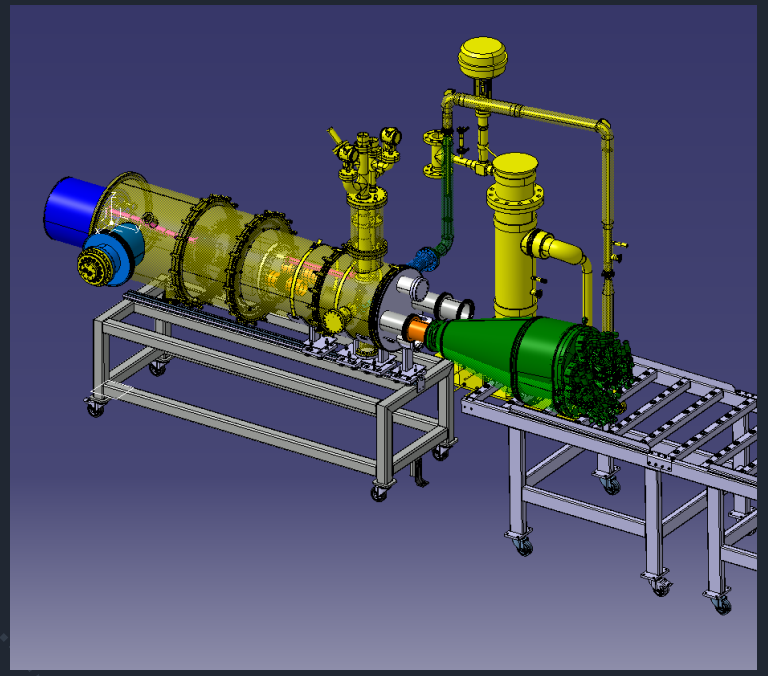


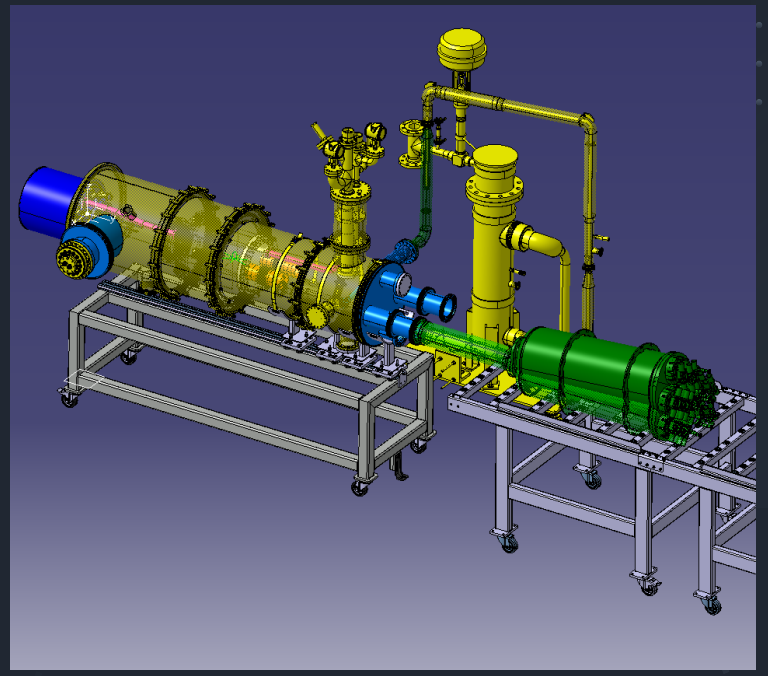
It is a test stand for type test , not implying extra charge for operation.
Prototypes will be not tested here so it is not on the critical path.



“The Feed Box” would be used for the high current lead test



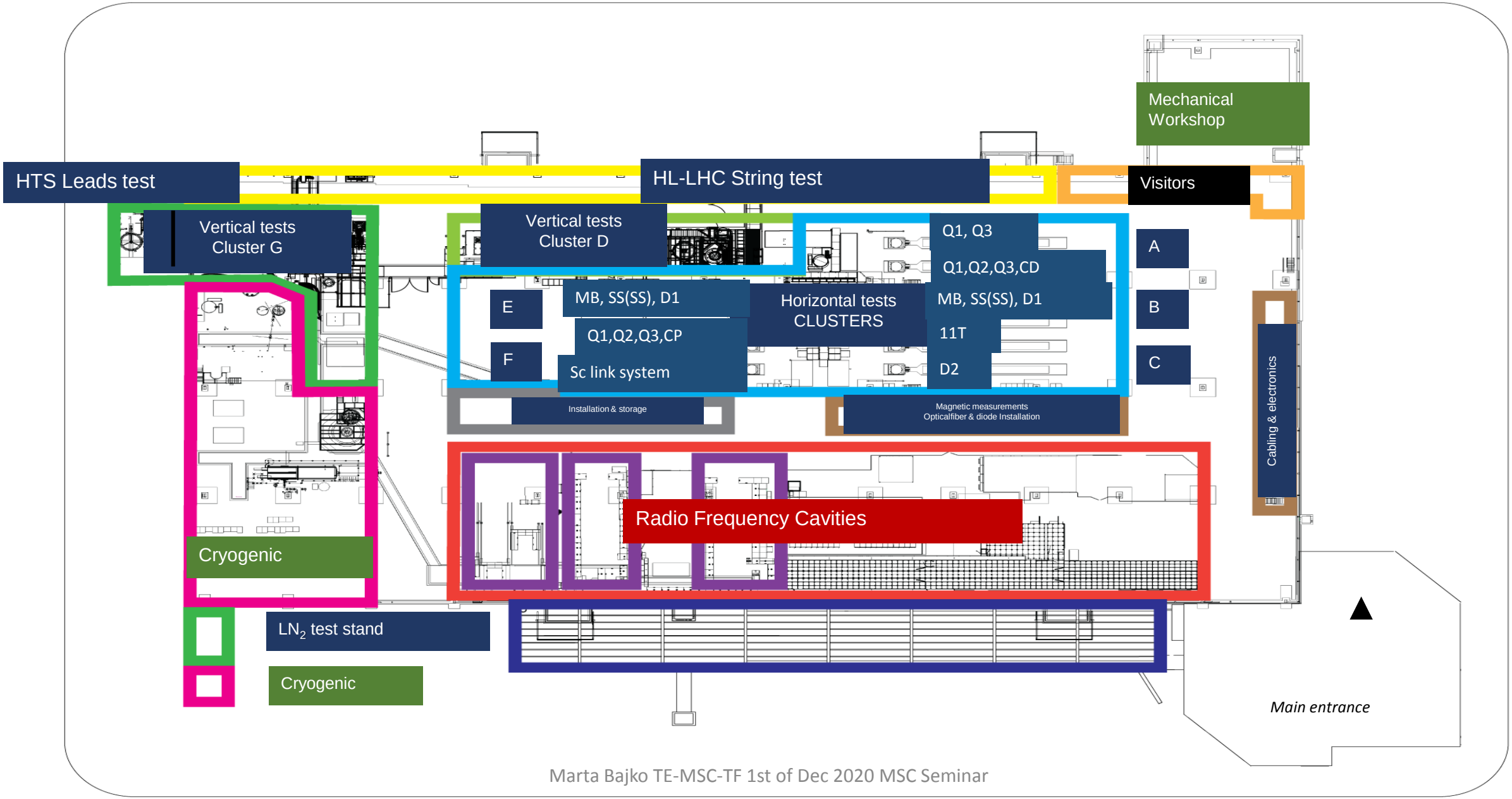




Testing WP6a: Type test for CL

- Hopefully existing or already designed pieces:
- a. in yellow all existing
- b. in green CL
- c. other to be designed

The new distribution of test benches of SM18

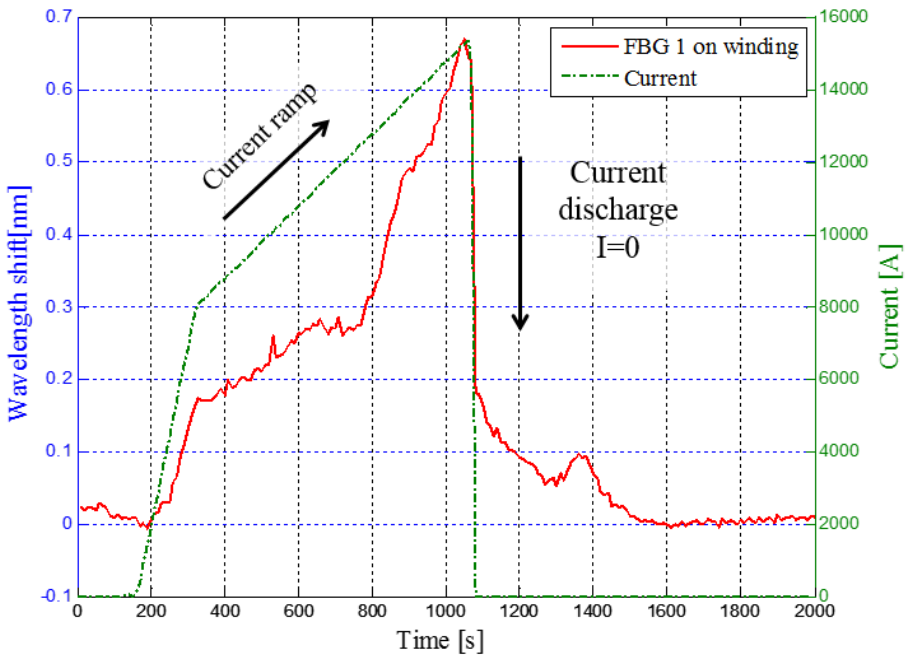


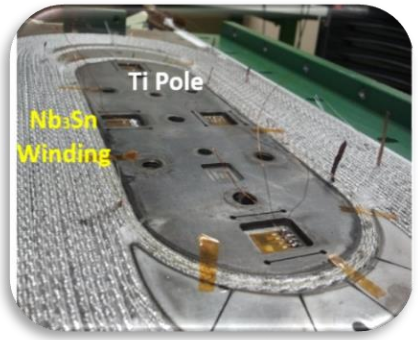
The TF R&D. Optical fiber based sensing at Low Temperature

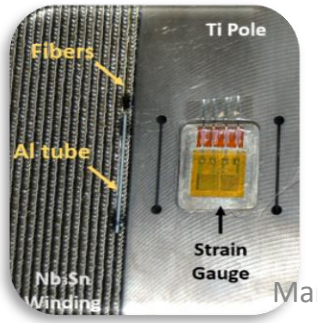
Strain monitoring inside the coil

Magnet powering to 15 kA @ 1.9 K

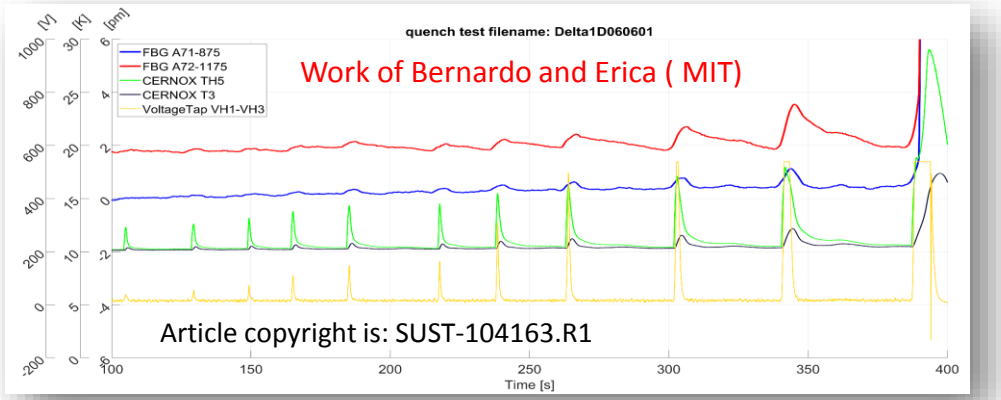
Work of Antonella and Juan Carlos



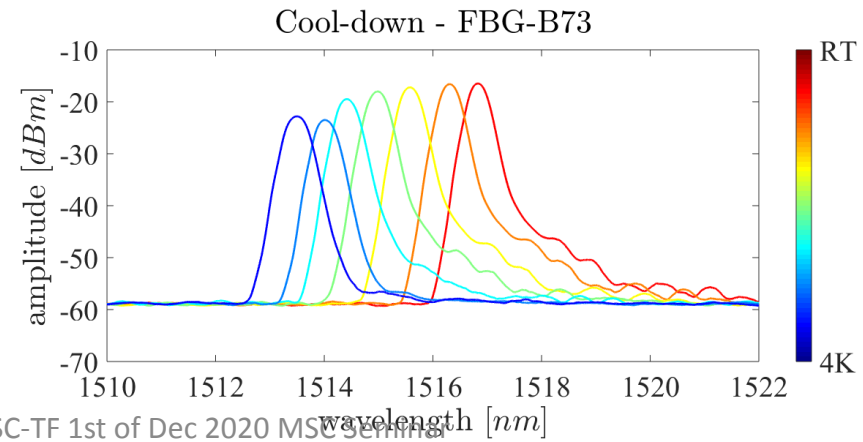


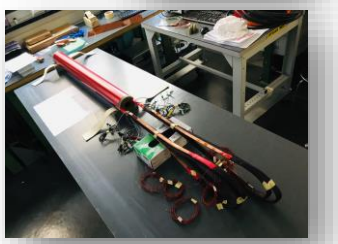


Quench detection in HTs sample in SULTAN



Minimum Quench Energy test on an HTS sample carried out in SULTAN test facility in Paul Scherrer Institut in the framework of CERN-MIT collaboration

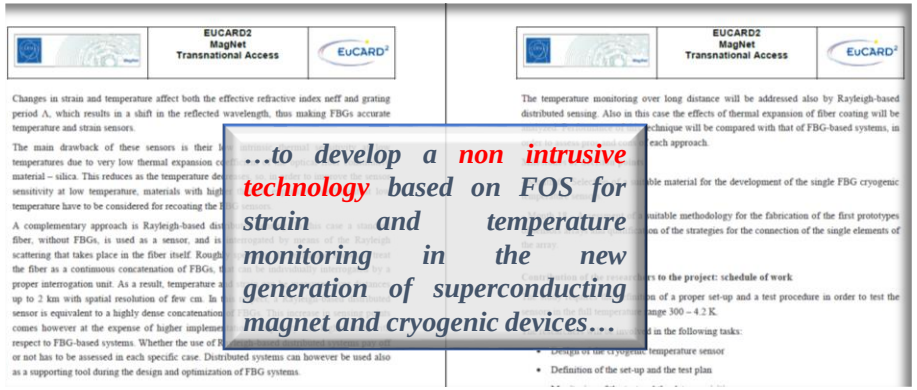




Collaborations. Eucard² and ARIES Trans National Access

EUCARD²

The objectives foreseen for **MagNet WP9** were to deliver at least **1,920** access units (hours) to an estimated number of **64 users** from **8 projects**.


EUCARD2 MagNet Transnational Access

Changes in strain and temperature affect both the effective refractive index neff and grating period Λ, which results in a shift in the reflected wavelength, thus making FBGs accurate temperature and strain sensors.

The main drawback of these sensors is their l… temperatures due to very low thermal expansion c… material – silica. This reduces as the temperature de… sensitivity at low temperature, materials with high… temperature have to be considered for recoating the F… sensors.

A complementary approach is Rayleigh-based dist… fiber, without FBGs, is used as a sensor, and i… scattering that takes place in the fiber itself. Rough… the fiber as a continuous concatenation of FBGs, t… proper interrogation unit. As a result, temperature … up to 2 km with spatial resolution of few cm. In … sensor is equivalent to a highly dense concatenation… comes however at the expense of higher implemen… respect to FBG-based systems. Whether the use of … or not has to be assessed in each specific case. Distributed systems can however be used also as a supporting tool during the design and optimization of FBG systems.

EUCARD2 MagNet Transnational Access

The temperature monitoring over long distance will be addressed also by Rayleigh-based distributed sensing. Also in this case the effects of thermal expansion of fiber coating will be … technique will be compared with that of FBG-based systems, in … each approach.

… suitable material for the development of the single FBG cryogenic …

… suitable methodology for the fabrication of the first prototypes … tion of the strategies for the connection of the single elements of …

… to the project: schedule of work

… tion of a proper set-up and a test procedure in order to test the … range 300 – 4.2 K.

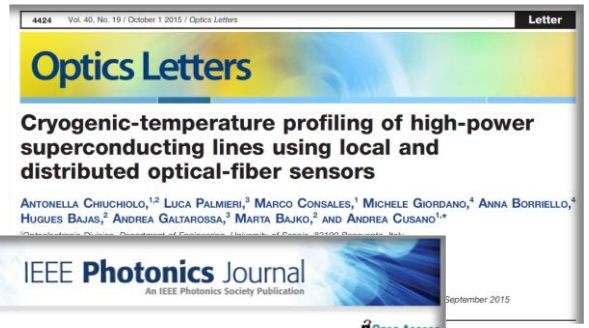
… ed in the following tasks:

- Design of the cryogenic temperature sensor
- Definition of the set-up and the test plan

…to develop a non intrusive technology based on FOS for strain and temperature monitoring in the new generation of superconducting magnet and cryogenic devices…

1st access granted 20th of November 2013

- University of Sannio (IT)
- University of Napoli, Federico II (IT)
- University of Padova (IT)
- University of Debrecen (HU)
- Institute of Polymers, Composites and Biomedical materials (IT)


4424 Vol. 40, No. 19 / October 1 2015 / Optics Letters Letter

Optics Letters

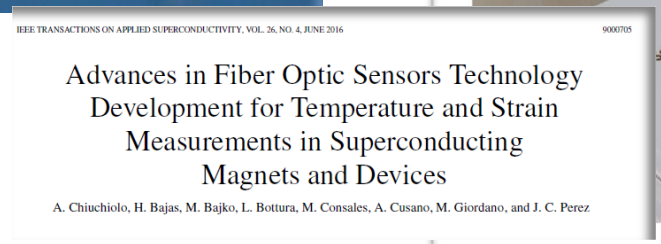
Cryogenic-temperature profiling of high-power superconducting lines using local and distributed optical-fiber sensors

Antonella Chiuchiolo,[1,2] Luca Palmieri,[3] Marco Consales,[1] Michele Giordano,[4] Anna Borriello,[4] Hugues Bajas,[2] Andrea Galtarossa,[3] Marta Bajko,[2] and Andrea Cusano[1,*]


IEEE Photonics Journal
An IEEE Photonics Society Publication
Open Access

Fiber Bragg Grating Cryosensors for Superconducting Accelerator Magnets

Volume 6, Number 6, December 2014


IEEE TRANSACTIONS ON APPLIED SUPERCONDUCTIVITY, VOL. 26, NO. 4, JUNE 2016 9000705

Advances in Fiber Optic Sensors Technology Development for Temperature and Strain Measurements in Superconducting Magnets and Devices

A. Chiuchiolo, H. Bajas, M. Bajko, L. Bottura, M. Consales, A. Cusano, M. Giordano, and J. C. Perez


Enhanced European Coordination for Accelerator Research & Development

Fact Sheet | Results in Brief | Reporting | Results

Final Report Summary - EUCARD-2 (Enhanced European Coordination for Accelerator Research & Development)

Executive Summary:

Particle accelerators are contributing to the advancement of physics and, through accelerator-based X-ray and neutron sources, to the progress of medicine, biology and material science. With more than 30,000 accelerators worldwide in the industrial and health sectors their use is rapidly spreading outside of the scientific environment, to address societal challenges and to generate economic growth. To deal with the increasing demands from basic science and to enhance the diffusion of accelerator technologies towards applied science and societal applications, future particle accelerators need to be more powerful but at the same time have smaller footprint, better energy efficiency, and higher reliability. A common development strategy to face these challenges was the subject of the EuCARD-2 (Enhanced European Coordination for Accelerator Research and Development) Integrating Activity Project. It brought together a consortium of 40 European universities, accelerator laboratories and technological institutes on a programme that, over 4 years, has mobilised a community of more than 350 researchers, organising more than 100 workshops and events and producing 62 high-level deliverable reports, 282 publications and dissemination activities and 4 applications for patents.

The EuCARD-2 Networks have generated a large amount of studies, initiatives and new ideas in a wide range of fields related to accelerator technologies. Activities were centred on future circular particle colliders, storage rings for intense beams, superconducting hadron linacs, and polarization challenges. Novel ideas included sequences of large circular colliders, new schemes for the production of cold muon beams, future acceleration concepts based on

Project Information

EUCARD-2

Grant agreement ID: 312453

Status: Closed project

Start date: 1 May 2013 — End date: 30 April 2017

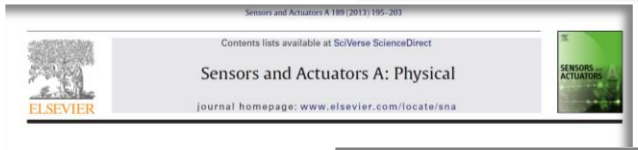
Funded under: FP7-INFRASTRUCTURES

Overall budget: € 23 400 922,32

EU contribution: € 8 000 000

Coordinated by: EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH, Switzerland

The **MagNet TNA** at CERN **provided access** to 34 users from 15 different institutes, for a total of **2,660 access** units of 9 projects, **exceeding** the initial requirement of 1,920 units.


Sensors and Actuators A 189 (2013) 195–203

Contents lists available at SciVerse ScienceDirect

Sensors and Actuators A: Physical

journal homepage: www.elsevier.com/locate/sna

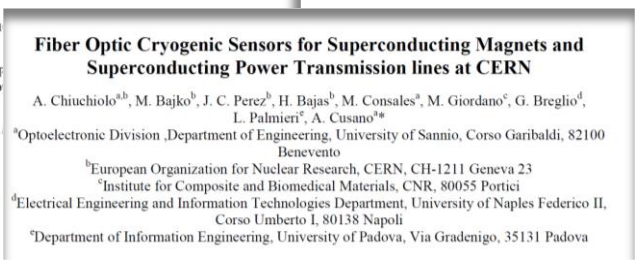
ELSEVIER

SENSORS AND ACTUATORS

Fiber Bragg Grating sensors to measure th… polymers at cryogenic temperatures

Marco Esposito[a,b], Salvatore Buontempo[a,f], Angelo F… Andrea Saccomanno[c], Zoltan Szillasi[d,f], Alajos Mako… Marta Bajko[b,f], Michele Giordano[b,f,*]

[a] INFN – National Institute of Nuclear Physics, Sez.NA, Italy
[b] CNR-IMCB – Institute for Composites and Biomedical Materials, National Research Council, …
[c] DIBET – University of Napoli Federico II, Italy
[d] ATOMKI – Institute of Nuclear Research of the Hungarian Academy of Science, Hungary
[e] University of Debrecen, Hungary
[f] CERN – European Organization for Nuclear Research, Switzerland
[g] Engineering Department – University of Sannio-Benevento, Italy
[h] DSF – Physical Sciences Department, University of Naples Federico II, Italy


Fiber Optic Cryogenic Sensors for Superconducting Magnets and Superconducting Power Transmission lines at CERN

A. Chiuchiolo[a,b], M. Bajko[b], J. C. Perez[b], H. Bajas[b], M. Consales[a], M. Giordano[c], G. Breglio[d], L. Palmieri[e], A. Cusano[a,*]

[a]Optoelectronic Division ,Department of Engineering, University of Sannio, Corso Garibaldi, 82100 Benevento

[b]European Organization for Nuclear Research, CERN, CH-1211 Geneva 23

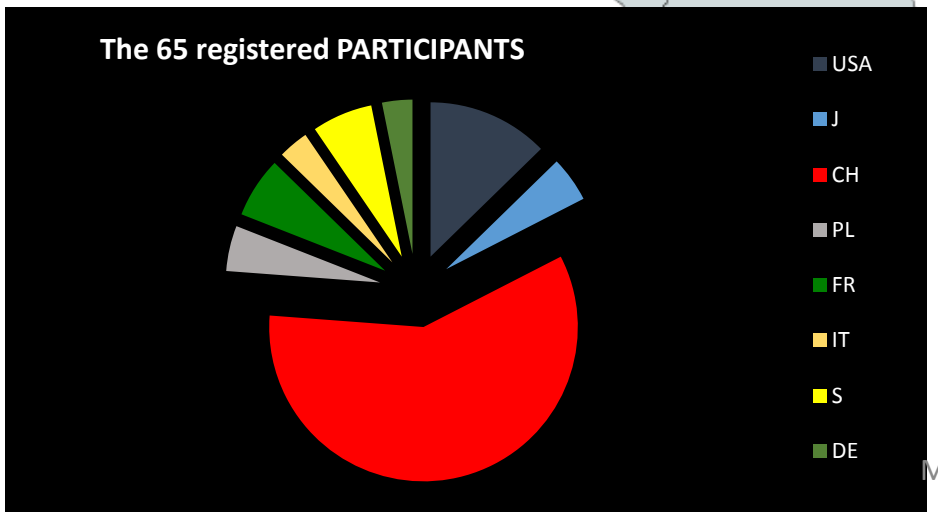
[c]Institute for Composite and Biomedical Materials, CNR, 80055 Portici

[d]Electrical Engineering and Information Technologies Department, University of Naples Federico II, Corso Umberto I, 80138 Napoli

[e]Department of Information Engineering, University of Padova, Via Gradenigo, 35131 Padova

Collaborations

International Workshops on Superconducting Magnet Test Facilities

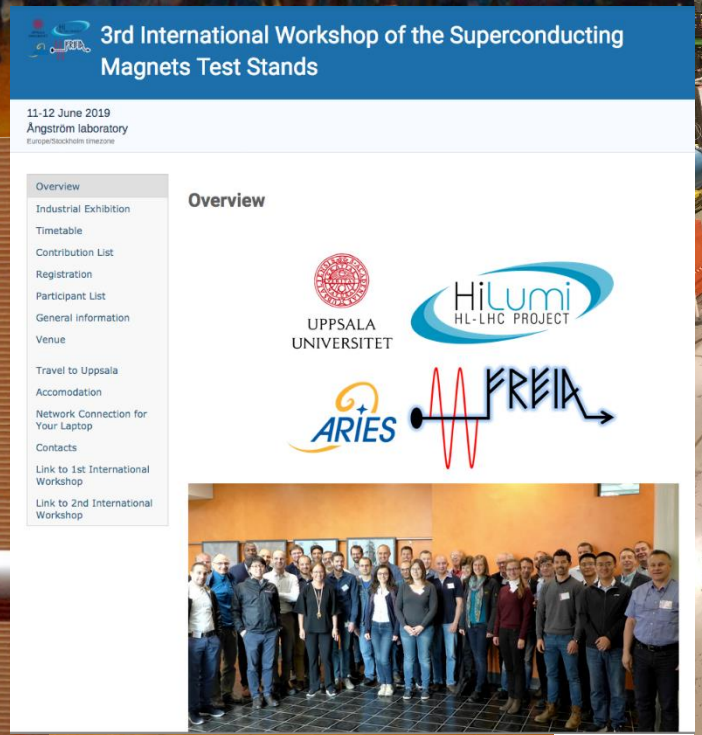


*Most of **these participants has** a valuable long **experience and expertise** in superconducting magnet testing*

Created with mapchart.net ©

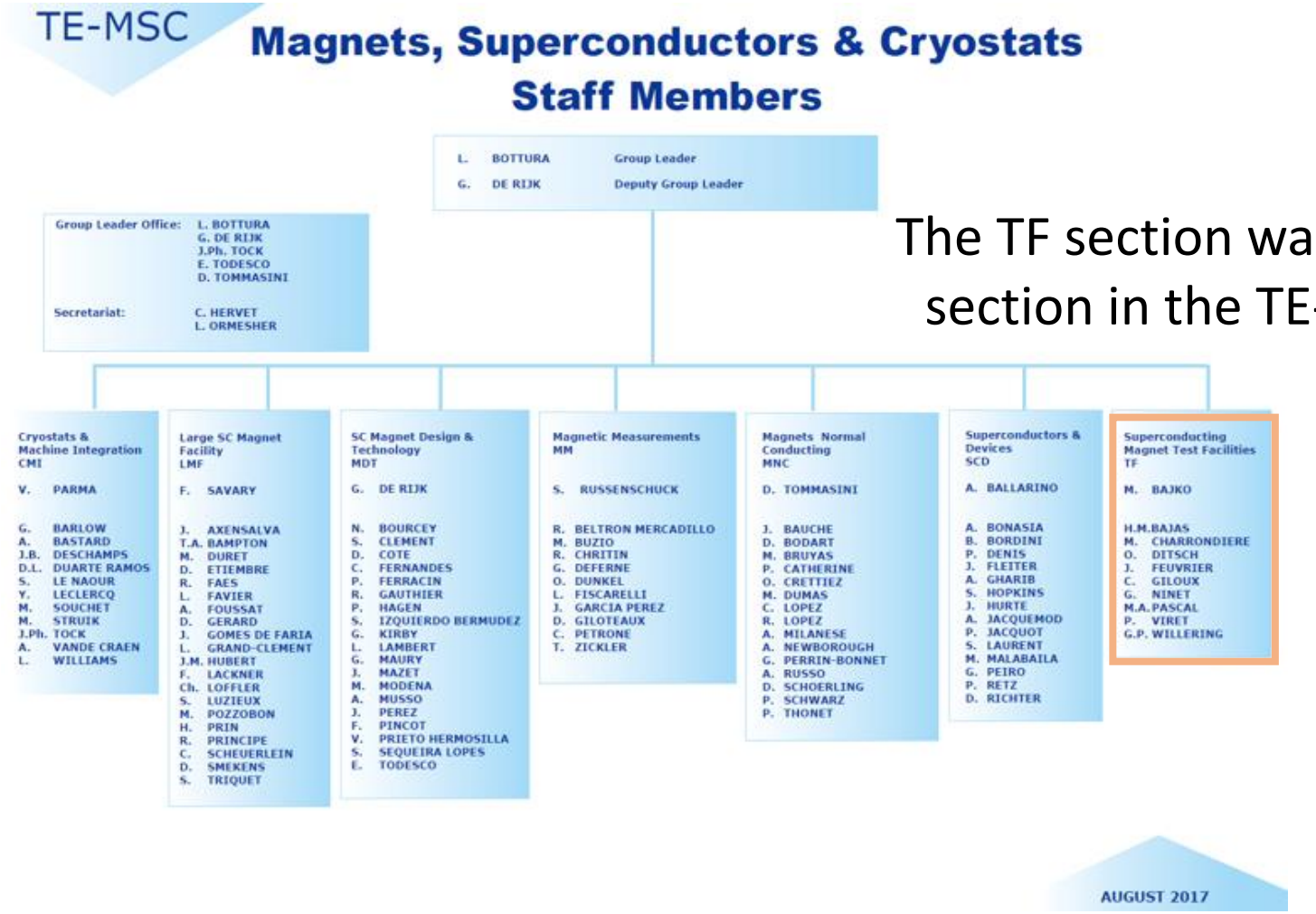
https://aries.web.cern.ch/content/application-and-follow-procedures

There is a large international community that I "bridged" through (till now) these workshops



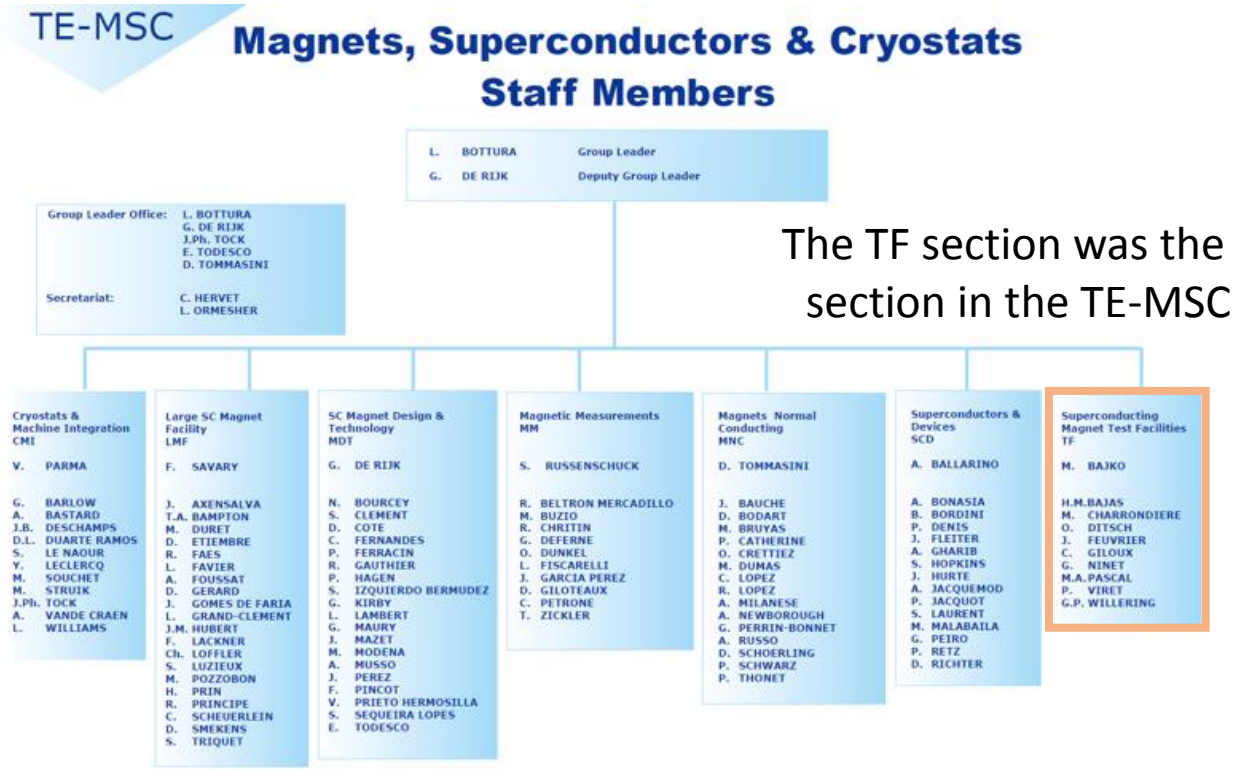
Thanks Virginia, Joe and Kevin for the help in organization

Man Power = TEAM BUILDING



The TF section was the smallest section in the TE-MSC group!

Man Power = TEAM BUILDING



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But we had a "**non mandated extension**" of the section!!!

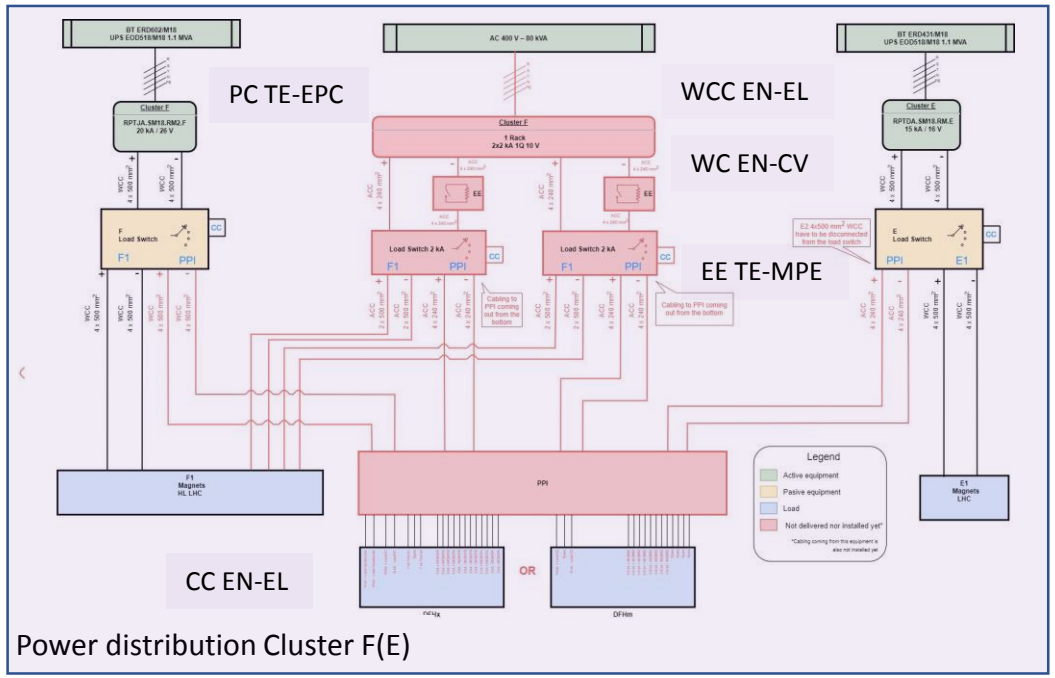
They played a key role in the construction and/or the operation of the test stands.

Many thanks to them for their valuable help, flexibility and availability!

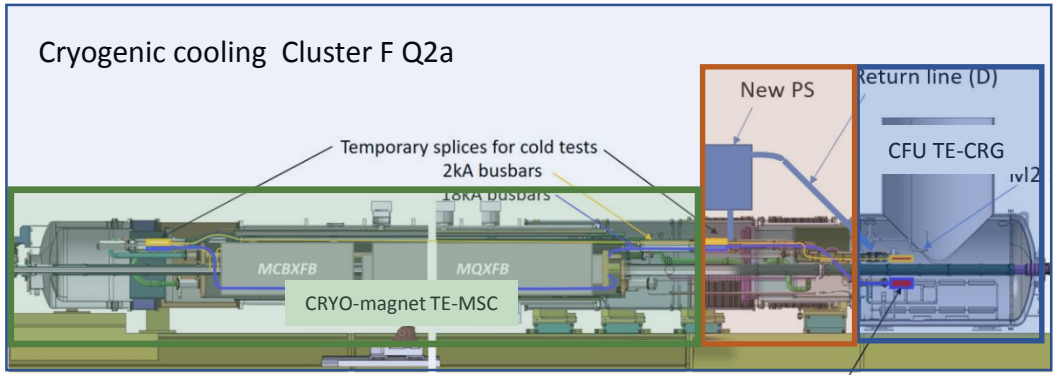
The ACTORS of the bench construction

The main actors

- Integration/Planning
  - EN-ACE
- Satefy and Interlock
  - TE-MSC
  - BE-ICS
- Powering circuits
  - TE-EPC
  - TE-MPE
  - EN-EL
  - EN-CV
- Cryo Cooling
  - TE-MSC
  - TE-CRG
  - EN-MME
- Handling
  - TE-MSC
  - EN-HH
- Daq and Software
  - EN-SMM
  - TE-MSC
- Measuring systems
  - TE-MSC
  - EN-MME



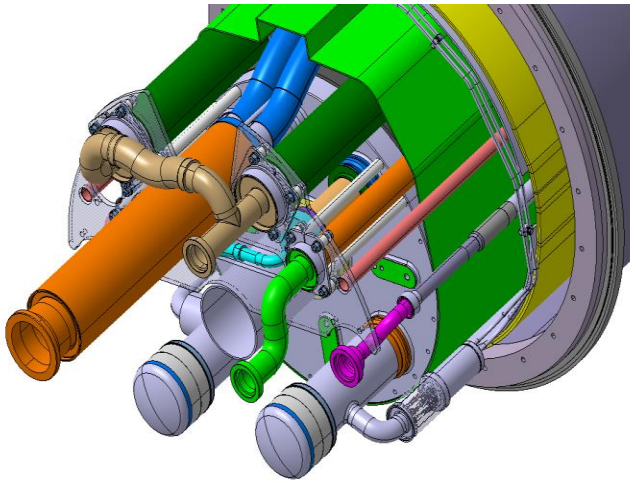
Power distribution Cluster F(E)



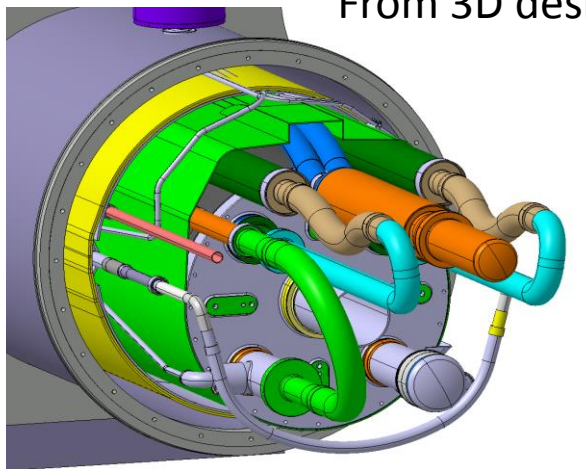
EN-MME with TE-MSC and TE-CRG

Robin, Philippe Herve, Gaelle Gabriella, Olivier

Design Office and Main Workshop EN-MME



From 3D design



Plans archivés CDD | Plans non archivés CDD | Pièces en stock SM18? | Plans non faits

Pièces restant sur bancs

Pièces montées sur bancs avant présentation cryo-Assemblages

Pièces montées sur cryo-assemblages au SMA18

Pièces écrans thermiques mises en place avec zone connexion ouverte

Banc	REDUCTION SCREEN CFB LHCMMQD_0225	HALF SCREEN LHCMQD_0233	CARRIAGE ENHANCE LHCMMQQX0022	STABILIZER SPACER LHCMMQQX0021	CARRIAGE SOCKET EXTENSION ASS. LHCMMQD_0241	SOCKET EXTENTION ASSY L=1060 LHCMMQQXF0017	BELLOWS ASSEMBLY LG 840 MM LHCQQ8_A0011	ECCENTRIC FLANGE H =-26 LHCMMQBRS0005	RAISE 160 LHCMMQQX0155	EQUIPPED COLUMN EXTENSION LHCMMQQX0001	CARRIAGE SOCKET EXTENSION ASS. - Ø1025 LHCMMQQXFS0024	CRYOSTAT EXTENSION L =143 MM LHCMMQBR0020	THERMAL SCREEN Q HL-LHC - L = 535 LHCMMQQXFS0012	THERMAL SCREEN D2 LHCMMQBRS0006	ECCENTRIC THERMAL SCREEN TRANSITION CFB SIDE LHCMMQQXFS0010	
A1	1	2	2	2	1	1	1	1	2	2	1		1		1	A, E
F1	1	2	2	2	1	1	1	1	2	2	1		1		1	A, B
C2	1	2	2	2	1	1	1	1	2	2		1		1		A, B, C, D
Besoin	3	6	6	6	3	3	3	3	6	6	2	1	2	1	2	
Stock	4	8	2	2	4	1	1		2	2		1				
A commander			4	4		2	2	3	4	4	2		2	1	2	

A — Ecan bombé CFB et écran MRB. Modification pour A.C. Ø136.7

B — Ecran plat CFB tourné de 180° avec ligne E, voir plan CRG. Lancement fabrication de 2 ensembles. As discussed, we can provide the drawings but the procurement of the new flange and any other

C — Percages pour colonnes et contre-poids, plan à modifier

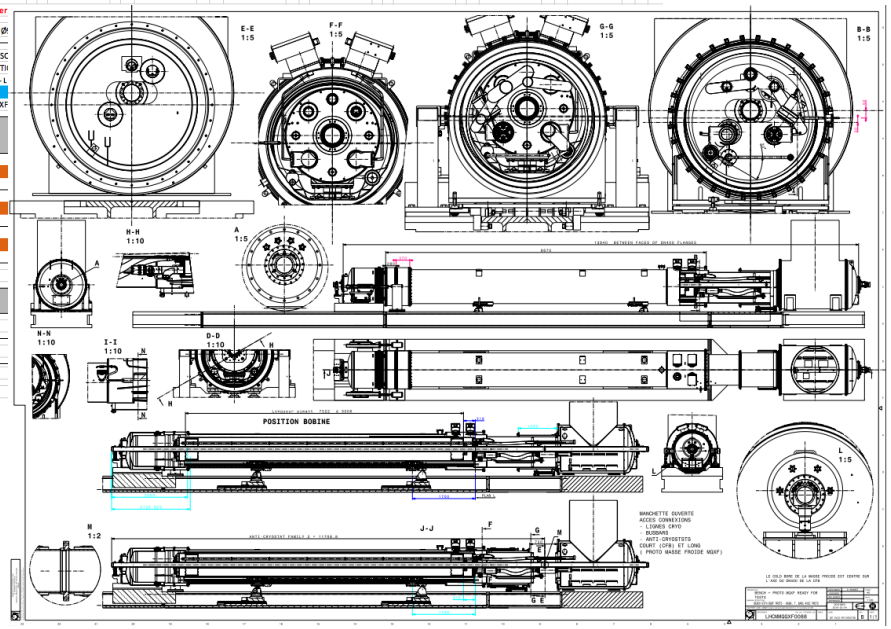
E — Ecran plat CFB tourné de 180° avec ligne E existe déjà

D — Ecran bombé CFB et écran MRB. Modification pour A.C. Ø

cryo-assemblage	ECCENTRIC THERMAL SCREEN TRANSITION D2 LHCMMQBRS0007	HALF SCREEN D2 LHCMMQBRS0009	THERMAL SCREEN TRANSITION - MRB SIDE D2 LHCMMQBRS0009	SCREEN TRANSITION Q2b LHCMMQQXFS0023	THERMAL SCREEN TRANSITION Q1/3 LHCMMQQXFS0018	CRYOSTAT EXTENSION L=970 LHCMMQQXFS0011	CRYOSTAT EXTENSION L=946 LHCMMQQXFS0015	SCREEN FOR MRB SIDE L=820 LHCMMQQXFS0016	THERMAL SC TRANSITI MRB SIDE - L LHCMMQQXF
D2	1	2	1						
Q1/3					1	1	1	1	1
Q2a						1	1	1	1
Q2b				1		1		1	1
Besoin mini*	1	2	1	1	1	3	2	3	3
Stock									
Spares									
A commander	1	1	1	1	3	2	3	3	1

* Besoin si un cryo-assemblage de chaque type est préparé ou testé en même temps

Checking the existing, the needed



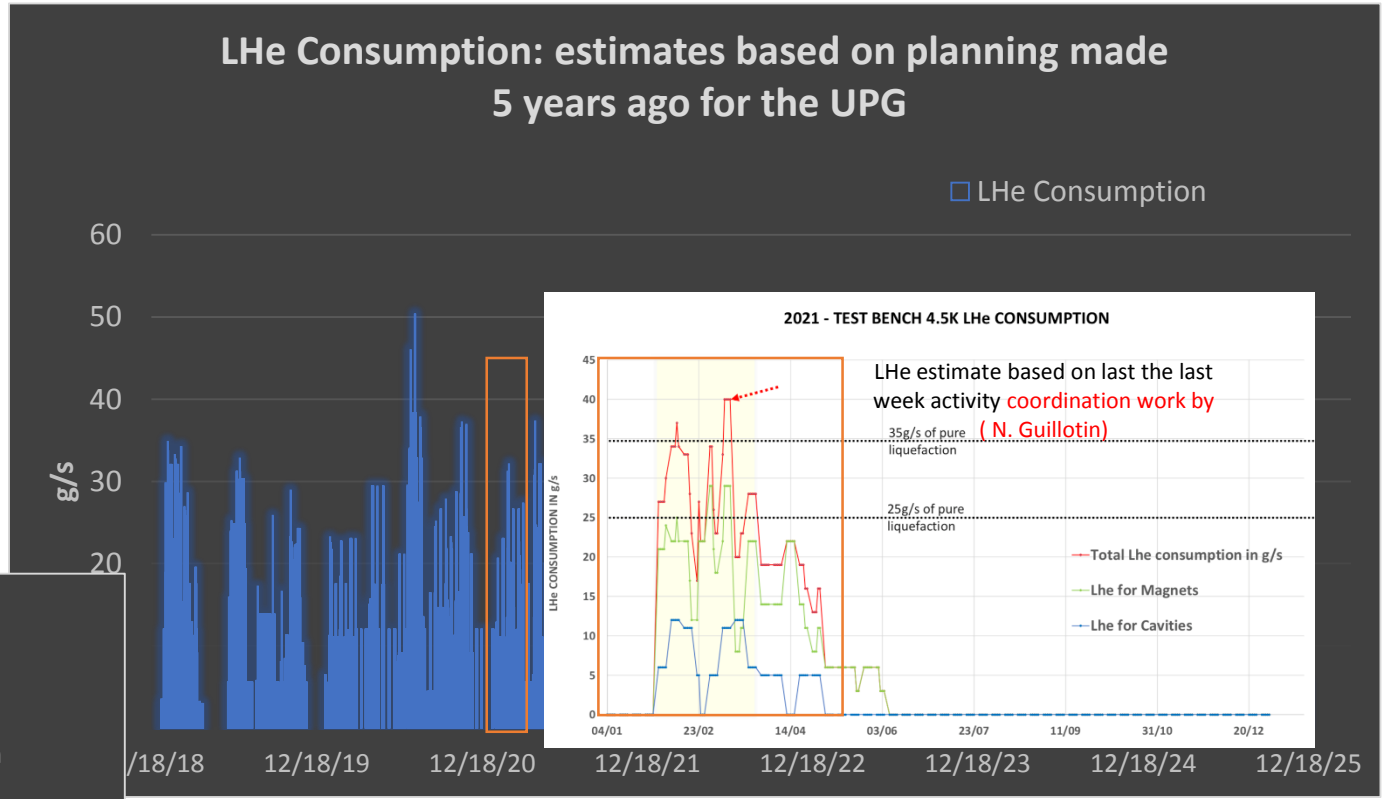
Making fabrication drawings for ordering at main workshop

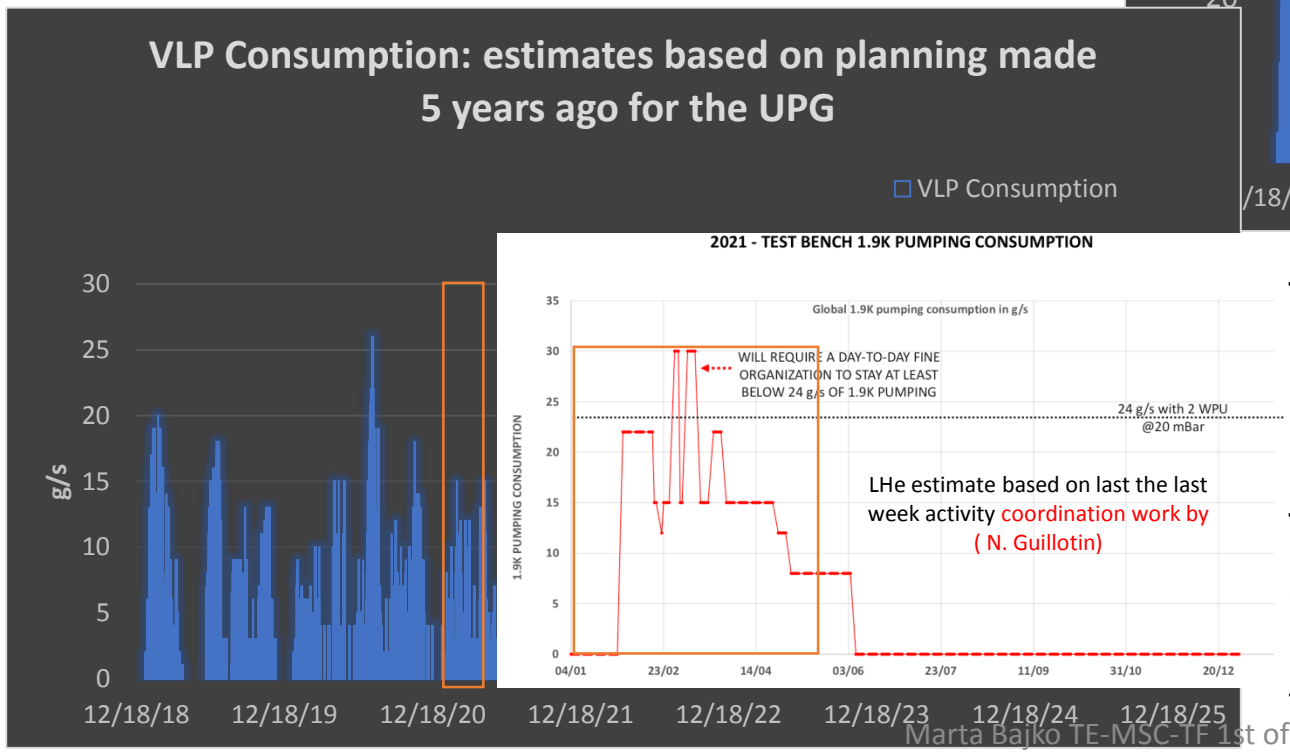
TE-CRG and EN-ACE

Nicolas G. + Estrella V.

I think is no doubt that this group is the major partner of the SM18 magnet test bench construction and operation.

I will therefor give one example relevant for the UPG and operation together but there are examples of the bench modifications in the annex slides aswel.





These estimates are based on a full Ms Project based on HL-LHC Master Plan, but not only: including RF and Magnets and R&D + LHC needs. Test are pre-distributed on benches and benches are characterized by its consumptions estimated together with CRG.

Ex. Cluster D planning

Cluster D for HL-LHC	16106	MQXFS_5	12.06.17	15.09.17
Cluster D for HL-LHC	17044	MQXFS_3c	26.09.17	09.03.18
Cluster D for HL-LHC	16105	MQXFS_4	12.03.18	09.05.18
Cluster D for HL-LHC	23644	MQXFS_3d	11.05.18	19.06.18
Cluster D for HL-LHC	23990	MQXFS_4b	20.06.18	26.07.18
Cluster D for HL-LHC	23650	MQXFS_6	08.01.19	27.02.19
Cluster D for HL-LHC	21880	MCBXFAP1	06.07.20	24.08.20
Cluster D for HL-LHC	21886	MCBXFAS1	25.08.20	20.10.20
Cluster D for HL-LHC	23716	MCBXFAS2	21.10.20	01.12.20
Cluster D for HL-LHC	23740	MCBXFAS3	01.02.21	26.03.21
Cluster D for HL-LHC	21906	MCBXFAS4	29.03.21	11.05.21
Cluster D for HL-LHC	23758	MCBXFA Spare 1	07.07.21	17.08.21
Cluster D for HL-LHC	23770	MCBXFA Spare 2	18.08.21	28.09.21
Cluster D for HL-LHC	17074	D2 Short Model vertical test	28.01.19	22.03.19
Cluster D for HL-LHC	23808	D2 correctors - MCBRD Shor	03.04.17	09.06.17
Cluster D for HL-LHC	23817	D2 correctors - MCBRD Shor	01.10.18	16.11.18
Cluster D for HL-LHC	26125	D2 correctors - MCBRD Shor	10.12.18	15.02.19
	26034	D2 correctors - MCBRD Prot	18.02.19	12.04.19
Cluster D for HL-LHC	23560	D2 correctors - MCBRD Serie	01.04.20	02.06.20
Cluster D for HL-LHC	23576	D2 correctors - MCBRD Serie	02.06.20	27.07.20
HFM for HL-LHC	23584	D2 correctors - MCBRD Serie	02.11.20	07.12.20
HFM for HL-LHC	26119	D2 correctors - MCBRD Serie	01.06.21	06.07.21
Cluster D for HL-LHC	12257	SQXF	01.04.15	28.04.15
Cluster D for HL-LHC	12262	SQXF	01.10.15	28.10.15
Cluster D for HL-LHC	17680	Slot for R&D_1	03.01.22	15.04.22
Cluster D for HL-LHC	17688	Slot for R&D_2	10.07.23	20.10.23
Cluster D for HL-LHC	17696	Slot for R&D_3	08.01.24	19.04.24
Cluster D for HL-LHC	17704	Slot for R&D_4	22.04.24	02.08.24
Cluster D for HL-LHC	17712	Slot for R&D_5	05.08.24	15.11.24
Cluster D for HL-LHC	17720	Slot for R&D_6	18.11.24	11.04.25

TE-EPC

Samer Y

EDMS NO.	REV.	VALIDITY
1758151	8.2	APPROVED

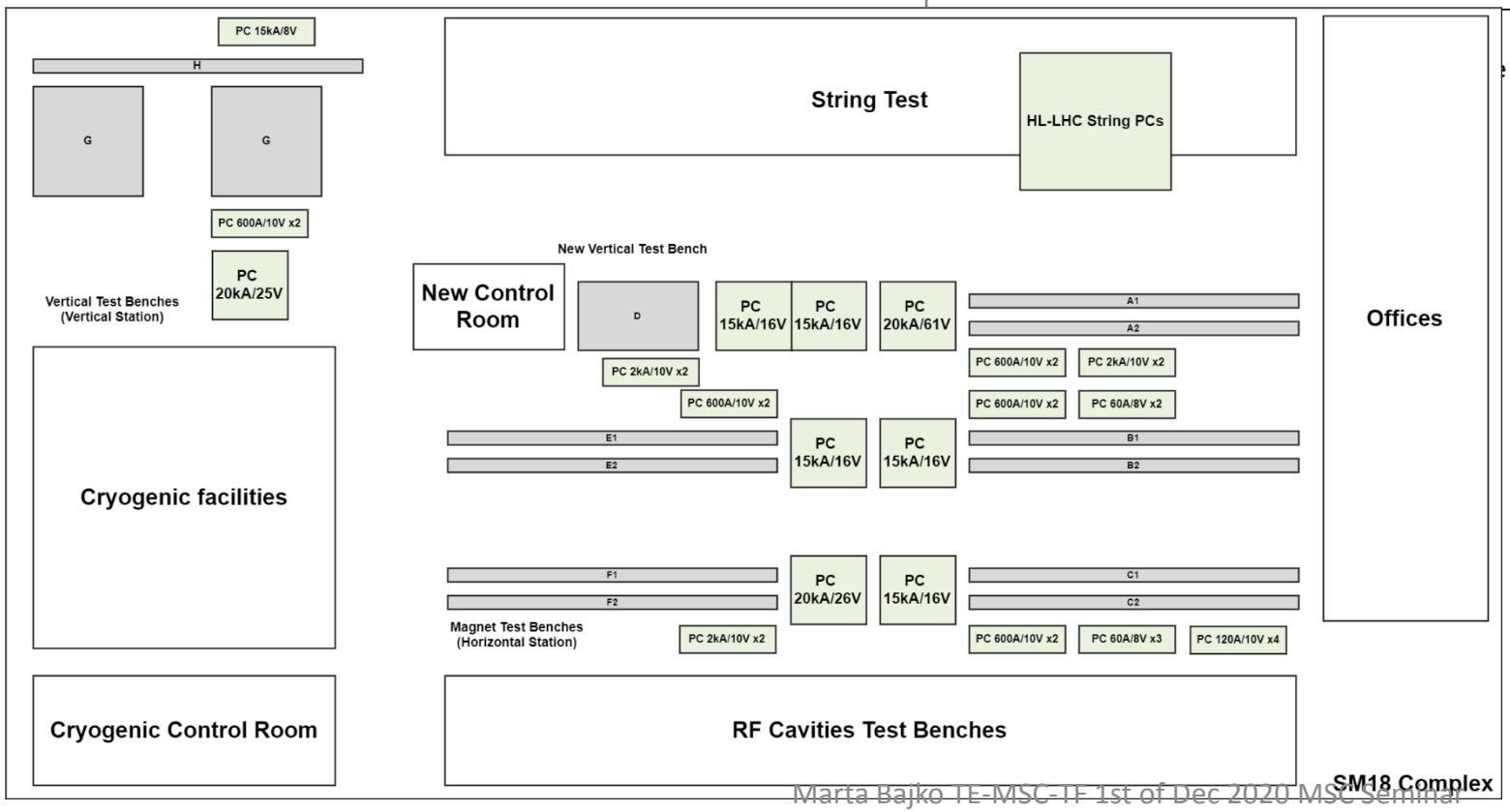
REFERENCE : LHC-EQCOD-ES-XXXXX

An other key partner:

PROJECT OVERVIEW

Upgrade of the Electrical Powering Circuits of SM18 Test Facilities for HL-LHC

e SM18 test facility upgrade for the HL-LHC project from the



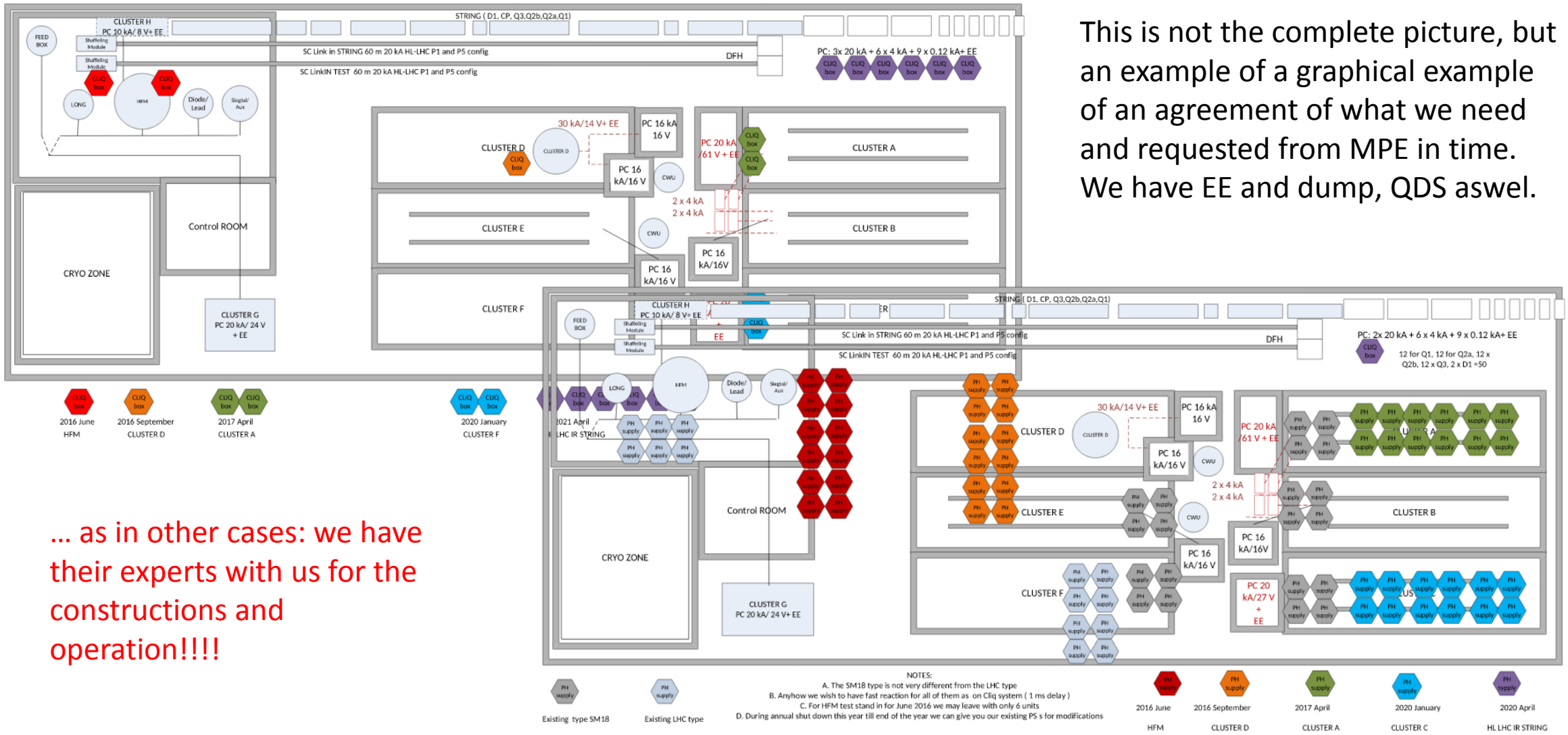
Cluster A PC UPG to 20kA!!! *Saving !!!*

Cluster F 20kA PC already operational! And all PC in SM18…. And even more important: we had an excellent and online (onsite) support of expert!!!!

TE-MPE

Felix + Gert

Magnet Protection and Energy Extraction: plans for needs in SM18



This is not the complete picture, but an example of a graphical example of an agreement of what we need and requested from MPE in time.
We have EE and dump, QDS aswel.

… as in other cases: we have their experts with us for the constructions and operation!!!!

TE-MSC and EN-SMM

Hubert and Maryline

High Luminosity LHC

Functional Specification

HL-LHC MAGNET TEST FACILITY

DAQ & PROTECTION FEATURES

NI PXIe-6358

Simultaneous X Series Data Acquisition

Zoom/Alternate Images

Example of HF system

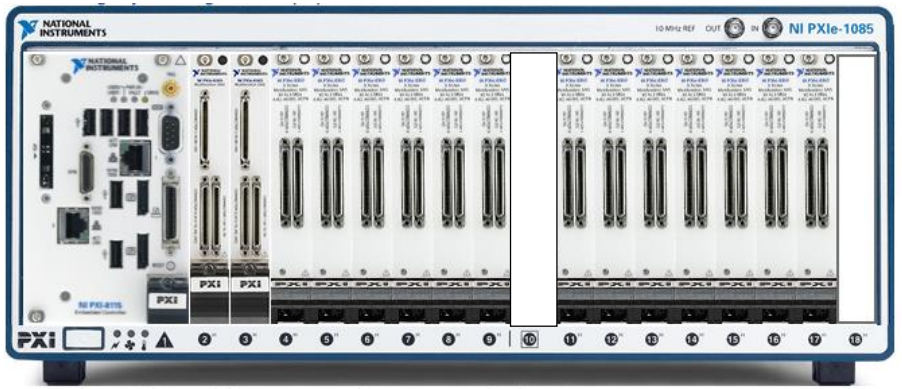
Starting at ~~$ 6,086~~ $ 5,355.68 (view pricing options)

View Data Sheet

- 16 simultaneous analog inputs at 1.25 MS/s/ch with 16-bit resolution; 20 MS/s total AI throughput
- Four analog outputs, 3.33 MS/s, 16-bit resolution, ±10 V
- 48 digital I/O lines (32 hardware-timed up to 10 MHz)
- Four 32-bit counter/timers for PWM, encoder, frequency, event counting, and more
- Analog and digital triggering and advanced timing with NI-STC3 technology
- Support for Windows 7/Vista/XP/2000

DAQ SPECIFIED PARAMETERS

Input channels:		+/- 10 V analog
Nr of HF channels:	200 differential	
HF frequency:	200 kHz	
HF,MF,LF resolution:	16 bit resolution	
HF,MF,LF accuracy:	1mV	
MF frequency:	50 kHz	
Nr of LF channels:	144	
LF frequency:	1kHz	
Timing:		GMT synchronization

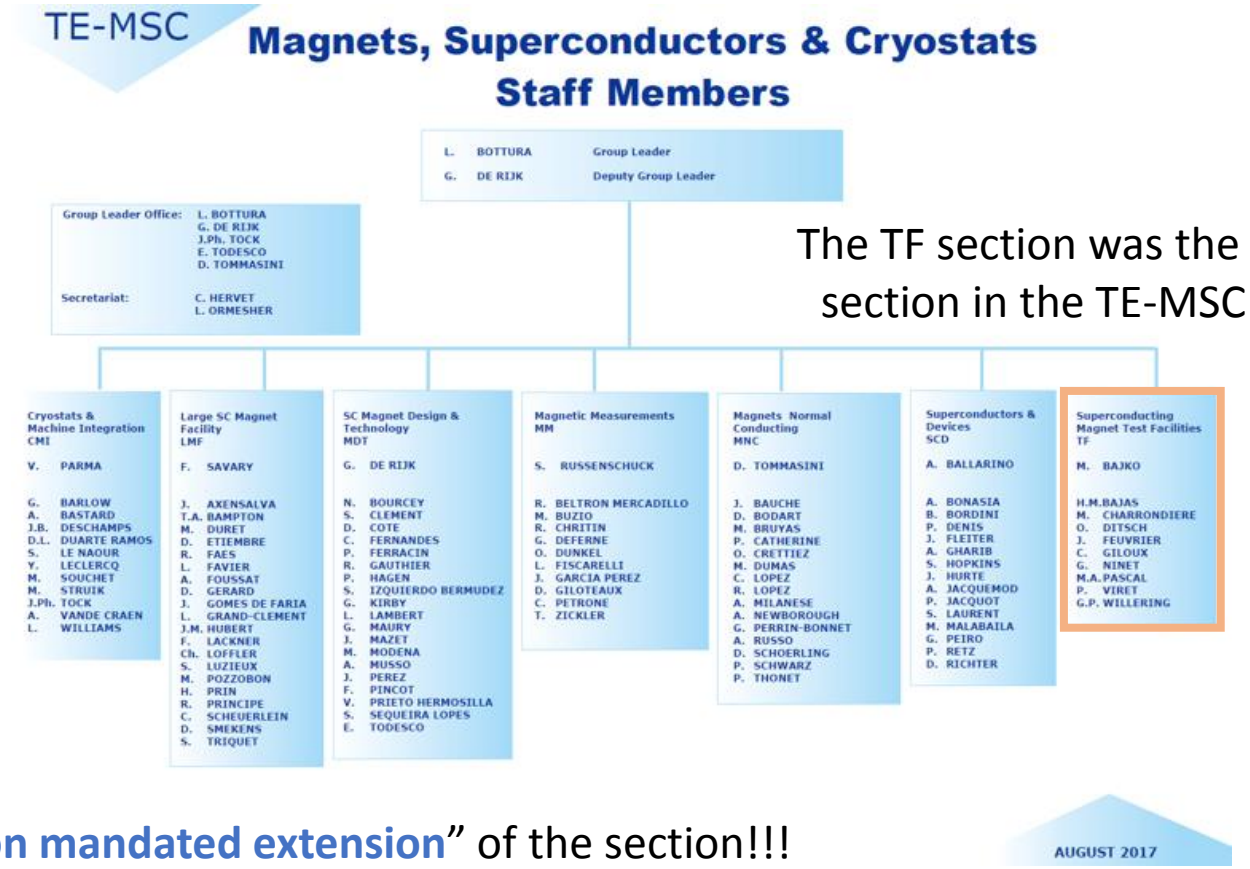


Specification in 2016 for Cluster D

Data Analysis with DIADEM

Man Power = TEAM BUILDING

Many thanks to all our **collaborators** in the different sections, groups, departments;
together we did and we will continue shaping the SM18 hall



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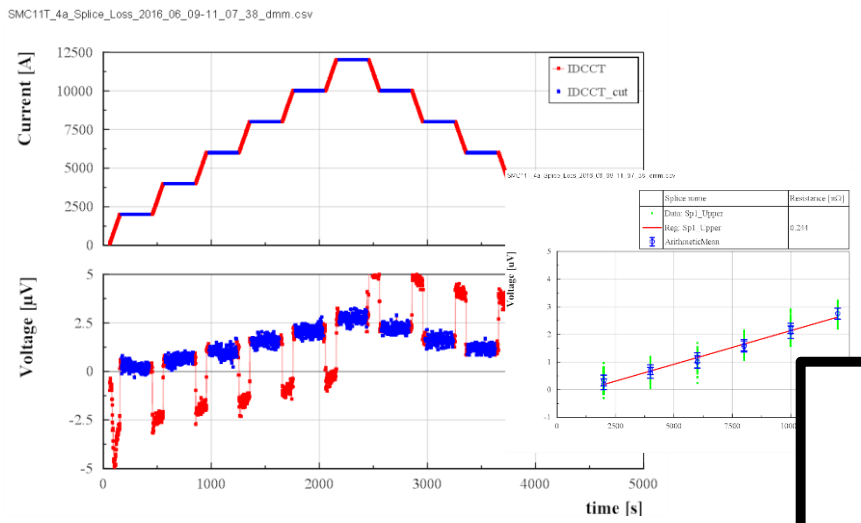
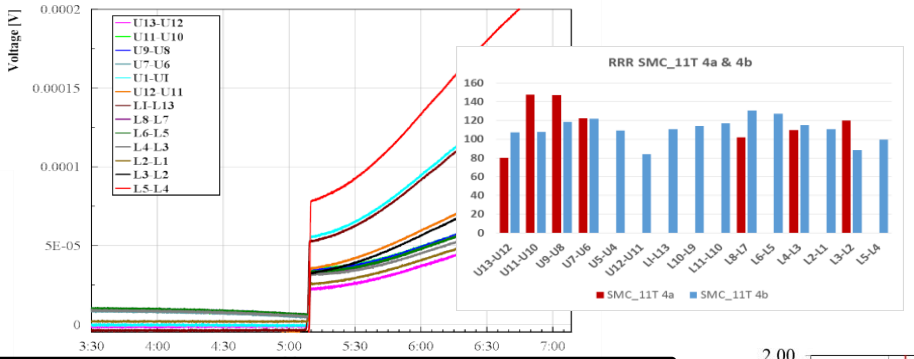
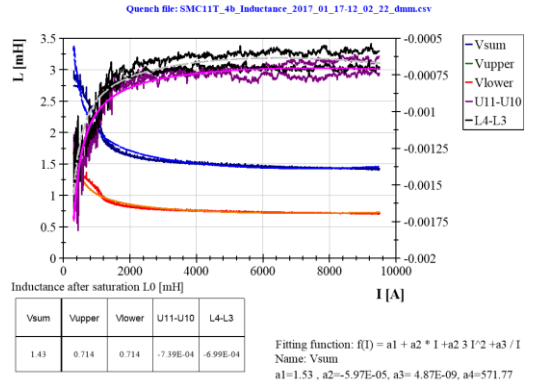
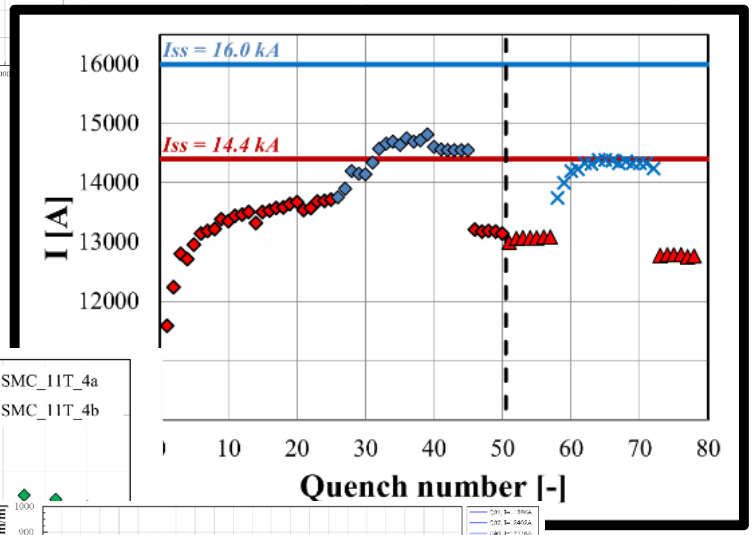
Many thanks to them for their valuable help, flexibility and availability!

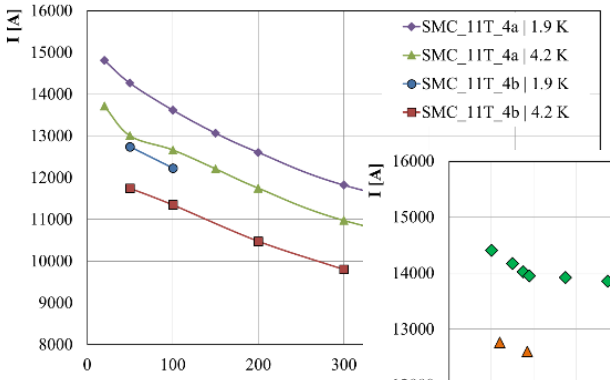
Measurements in the SM18: training?

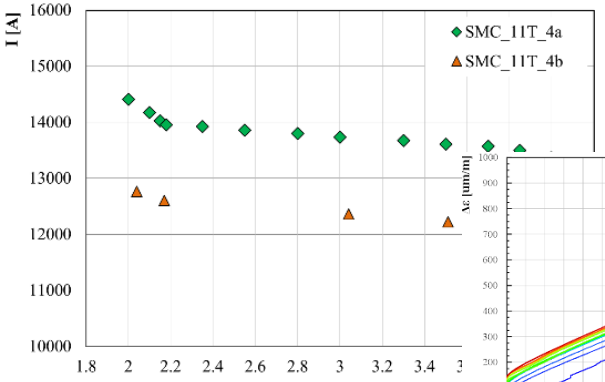


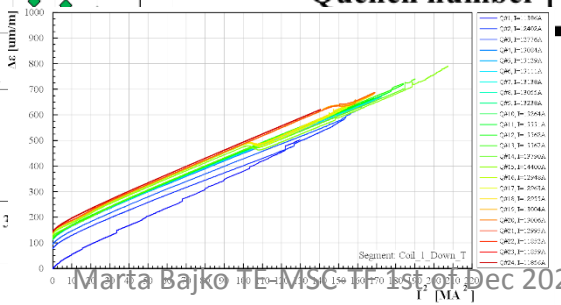


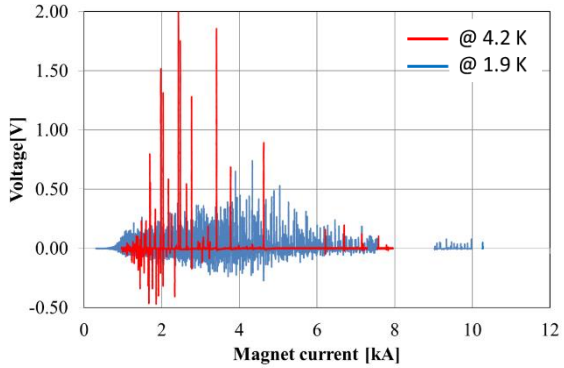


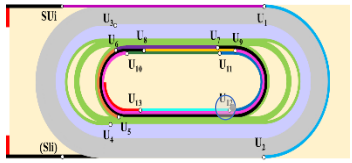


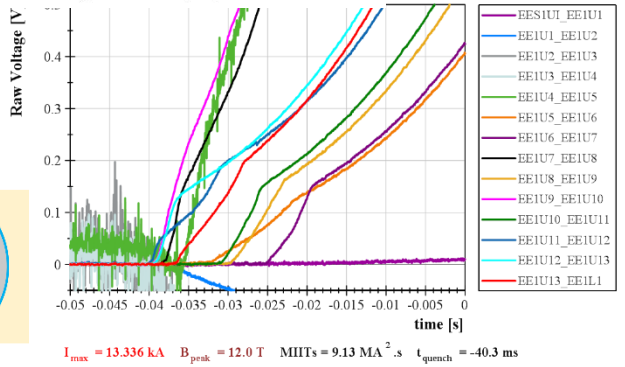




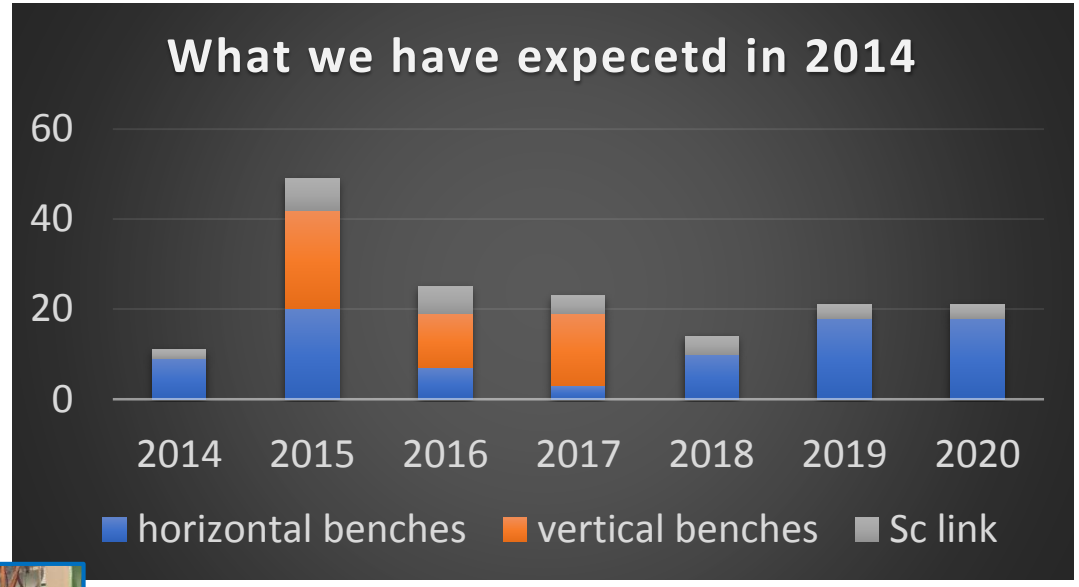


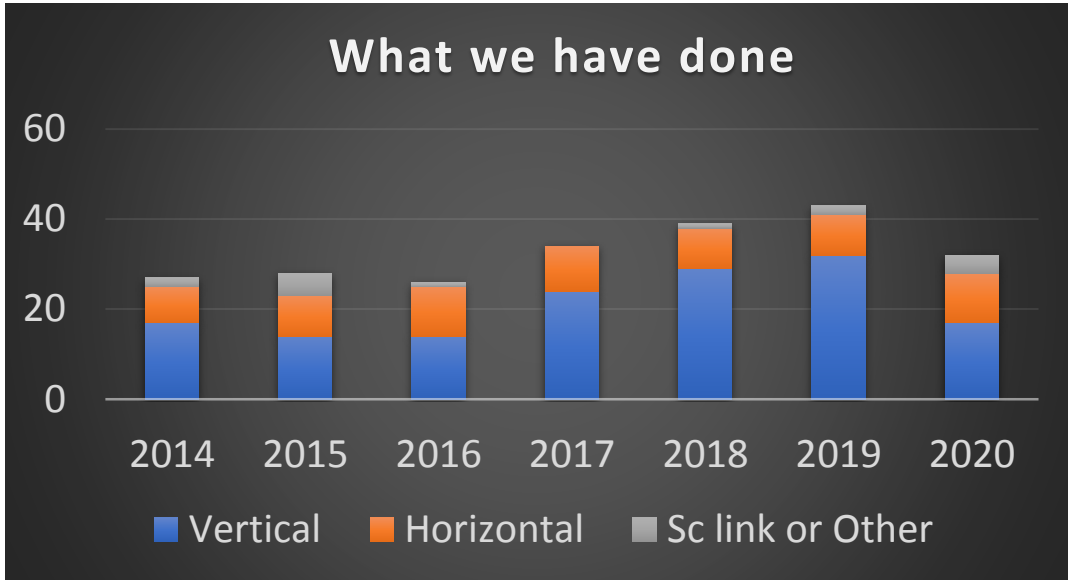






Service = to allow TESTING and OPEN SM18 to USERS





A part of the message that the test stand capacity is larger than expected, here I wish to say that **we** are also producing a lot of **data, measurements, test results, reports and publications**!!!



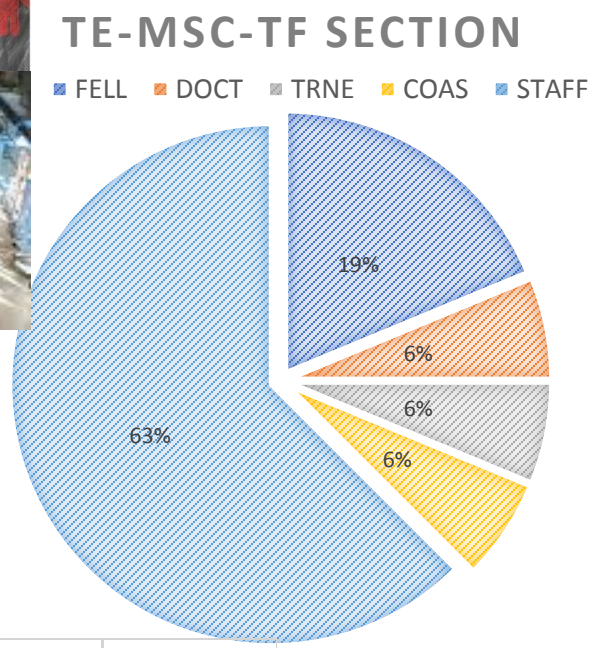




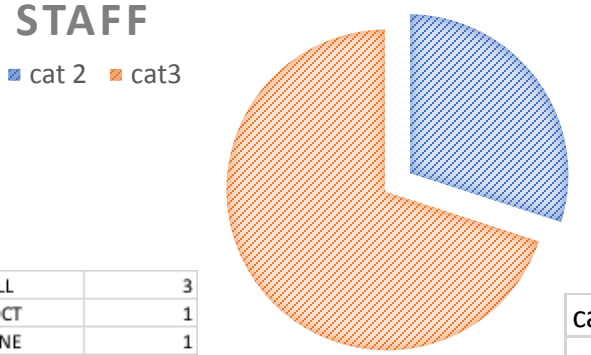


The core of the TE-MSC-TF section

We are today about 25 max 28 including M4P and MPA from which 10 STAFF members.



FELL	3
DOCT	1
TRNE	1
COAS	1
STAFF	10



cat 2	3
cat3	7

*A big thank for the members of the TF section : **Christian**, Hugo, Gerard, Franco, Antonella, Michal S., Vincent R., Patrick, Jerome, Gaelle, Olivier, Mary, Guillaum, Vincent J.D., Bernardo, Jose, Sara, Ioannis, Daniel T., Salvador, Yacine, Fred R, Fred F, Raphael, Abdelhay, Bertrand, Yannick,Ruben, Gyopar, Jean-Luc, Clinton;*

as in 2016

Apart 2 staff members I have participated to hire all Staff, MPA and M4P of the section. We have trained people for FNAL, GSI, PSI (2) and of course for CERN. I thank you for all of YOU being so good COLLEAGUES AND COLLABORATORS.

What is the role of TF ?

Who is the owner of the data? Who should analyse, report , publish ect.

THERE IS NO UNIQUE ANSWARE FOR THIS, but a continues willing to look for a correct attitude and balance between teams.

The data can be used only if is validated.

The data is only produced because we get the magnets done by the others!

The data can only be understood if we can correctly corelate with the magnet design.

You can only make as well as you can measure

By Joseph Withworth,

The data is produced because the others needs them to understand the magnets they designed!

The data we produced to help the understanding the magnets behaviour.

The data is produced thanks to our work!

The data produced is valuable only if is analysed and published!

The analysed data can only be understood if we understand how it was produced.

When finally the data is analyzed, reported, published by the magnet designer, builder and not by you, think that your role was to make it possible to measure their magnet and this was crucial!!!

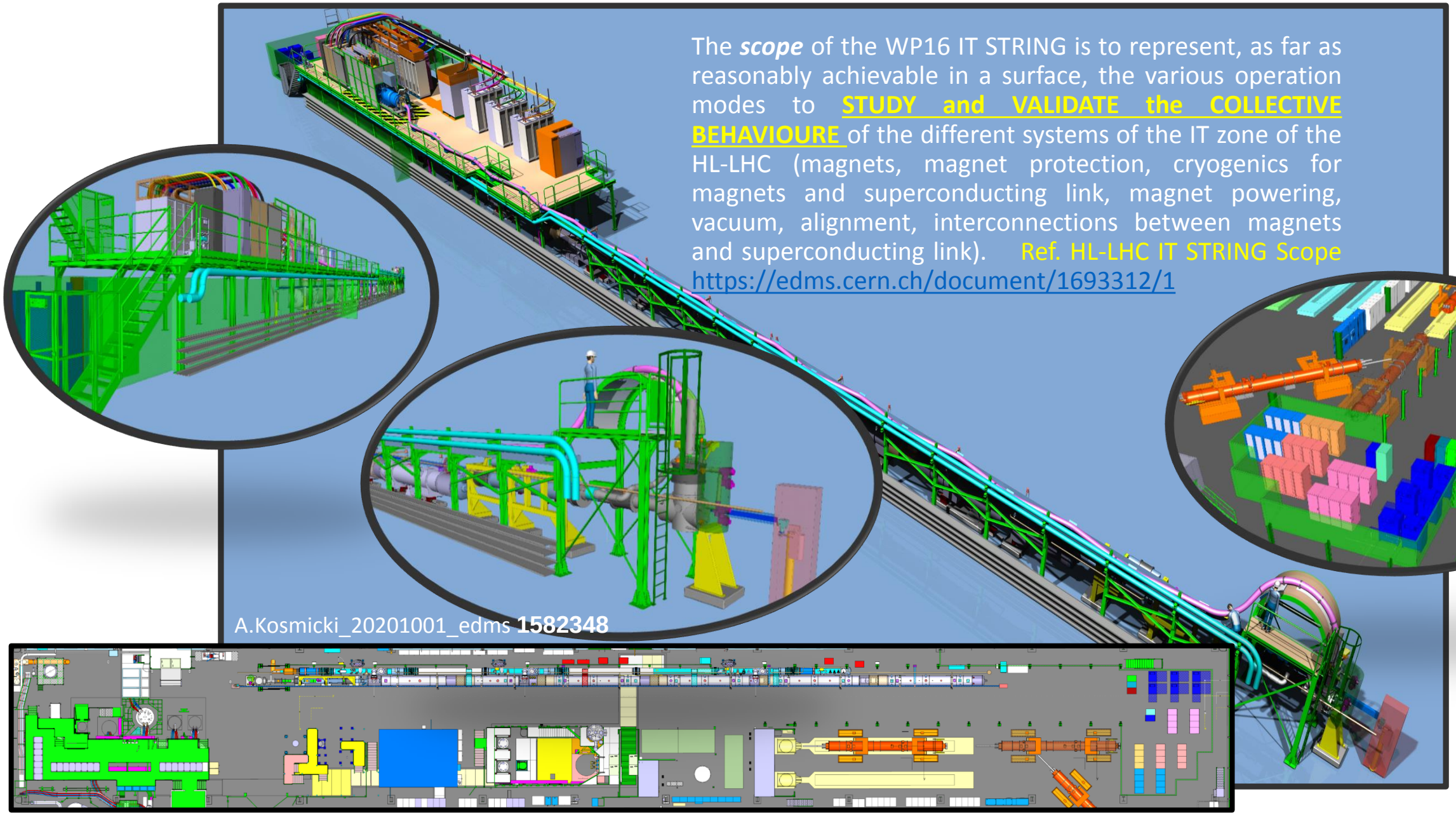
After one year of measuring the 1st Nb_3Sn magnet (the TQ) at CERN, in the old Block 4, and doing the LHC HWC, Lucio and Fredy to give me **the challenge** to merge Block 4 and SM18. If I have to summarise, it was:

- an **honour** to participate to this adventure and **BE ONE OF THE MAJOR ACTORS** of the shaping of the SM18 in these last 10 years.
- a **pleasure** to work with a great team (remember the iceberg slide)
- a **satisfaction** to see how the SM18 hall get transformed for HL-LHC need during theses last years

I thank my line management: Lucio, Luca, Miguel and Volker for giving me this chance to participate to this work and to guide me during these years . Thank Ezio (WP3), Frederic (WP11) and Amalia(WP6a) for their collaboration.

I wish to those stepping behind me success and satisfaction in completing the remaining work for HL-LHC test benches and operation. I hope they will have also the chance to shape further the test benches for new projects and **leave their own footprint in SM18**!

The HL-LHC IT STRING SCOPE



The ***scope*** of the WP16 IT STRING is to represent, as far as reasonably achievable in a surface, the various operation modes to **STUDY and VALIDATE the COLLECTIVE BEHAVIOURE** of the different systems of the IT zone of the HL-LHC (magnets, magnet protection, cryogenics for magnets and superconducting link, magnet powering, vacuum, alignment, interconnections between magnets and superconducting link). Ref. HL-LHC IT STRING Scope https://edms.cern.ch/document/1693312/1

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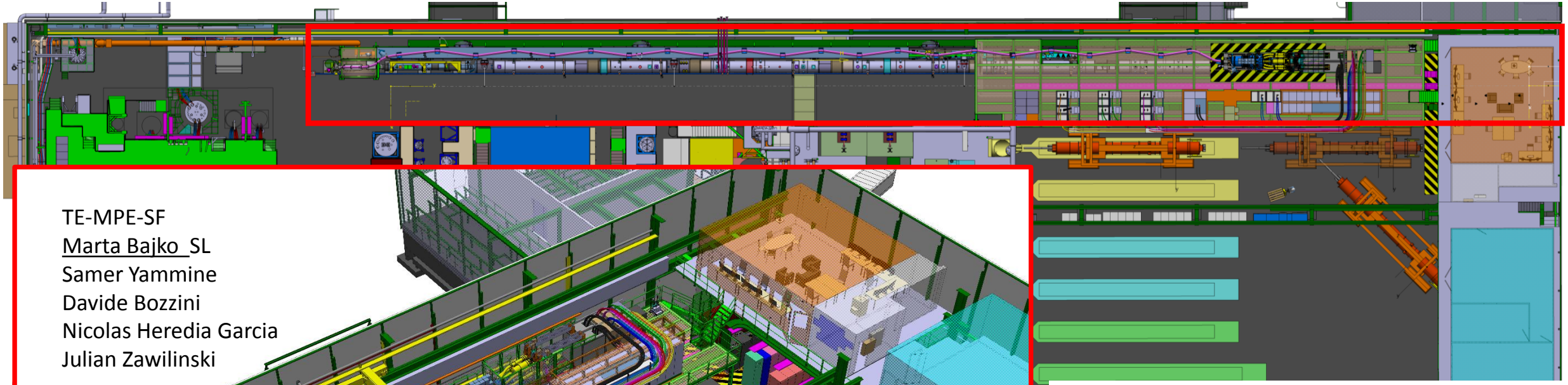
The next steps for me : HL LHC IT STRING



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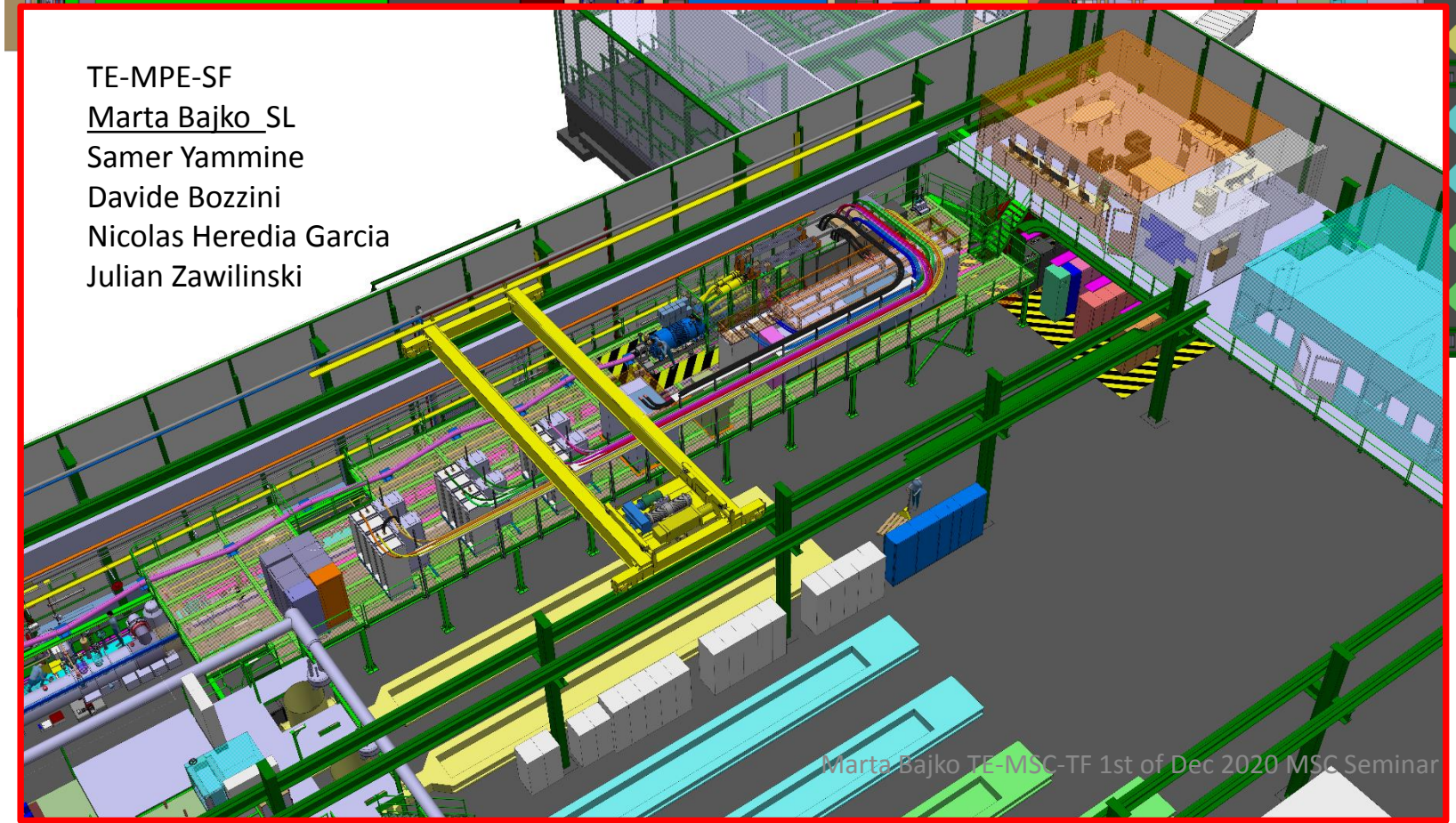
Nicolas Heredia Garcia
Julian Zawilinski



As from **1st of January 2021**, I will dedicate my time fully to the ***HL-LHC IT STRING*** not only as co-**WP16** leader of the HL-LHC project, but also as the section leader of the a new, small, but extremely motivated **TE-MPE-SF** section with the help of many other collogues of different groups and departments and continue shaping SM18!

Thank you for your attention