Overview and Baseline Changes of the HL-LHC Circuits

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on behalf of the HL-LHC Magnet Circuit Forum

12th HL-LHC Collaboration Meeting, 2022-09-21

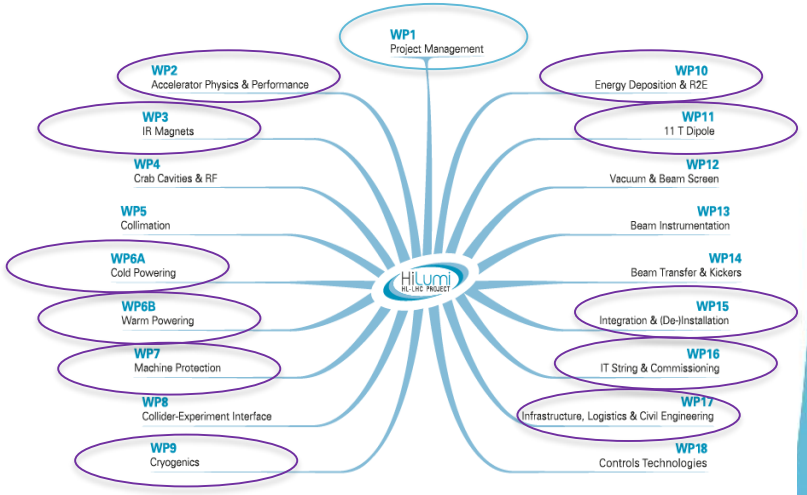
Contents

Updates from the HL-LHC Magnet Circuit Forum

Magnet Circuit Forum

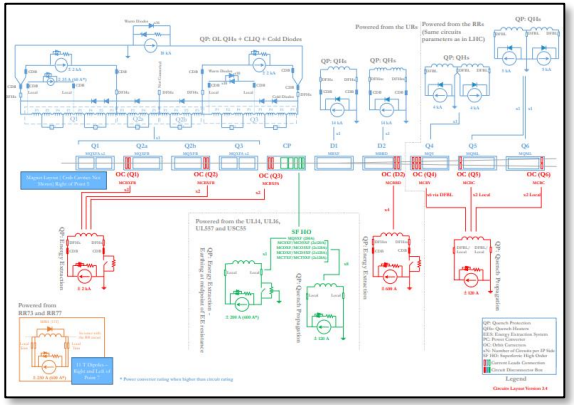
Mandate of the MCF includes:

- *MCF is the meeting where all aspects related to powering and protection of the HL-LHC magnet circuits are discussed.*
- *MCF is mandated to follow the instrumentation and quench detection scheme of the superconducting components of HL-LHC circuits.*
- *MCF, also, is mandated to validate the polarities of the HL-LHC circuits in collaboration with Polarity Controller (M. Pojer).*



- MCF has the responsibility to keep up to date the circuit configurations and parameters
- This is done through updates of the Circuit Table and the Electrical Layout (see MCF Sharepoint)
- So far 108 meetings (since June 2016), documented with minutes, follow-up of actions, etc.
- MCF is also organizing topical meetings with reduced attendance, 46 meetings have taken place so far
- MCF took responsibilities for the preparation of Engineering Change Requests and other documents related to circuit aspects
- About 50 members are regularly invited with an average participation of 25 members

Magnet Circuit Forum



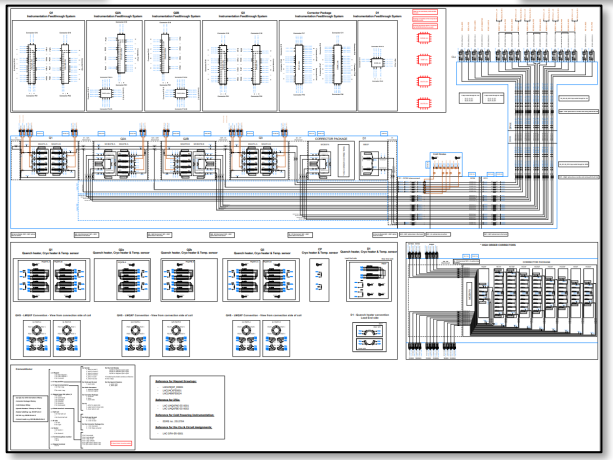
Circuits Layout V3.4

MCF Meetings

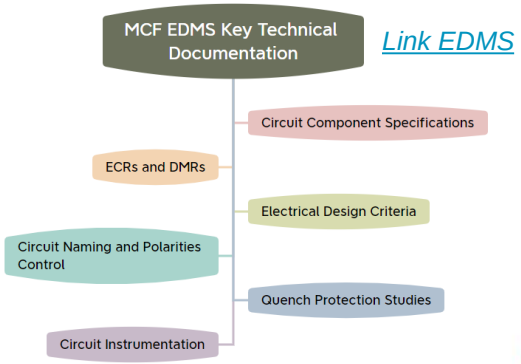
	Circuits for HiLumi	Magnet Type	Number of circuits per IP side	Total number of circuits	I_nominal (7 TeV) [kA]	I_ultimate [kA]	L per circuit at nominal current [mH]	R per circuit [mΩ]	Collaborations	References
Inner Triplet	Triplet Q1, Q2a, Q2b, Q3	MQXFA / MQXFB	1	4 (IR1/5)	16.23	17.5	255.4	0.15	US-HiLumi	EDMS no. 2114564
	Trim Q1	-	1	4 (IR1/5)	2	2	69	1.35	-	
	Trim Q1a	-	1	4 (IR1/5)	0.035	0.035	34.5	227.08	-	
	Trim Q3	-	1	4 (IR1/5)	2	2	69	1.2		
	Orbit correctors Q1/2 - Horizontal/Inner	MCBXFB	2	8 (IR1/5)	1.58	1.69	58.4	2.38	Ciemat	
	Orbit correctors Q1/2 - Vertical/Outer	MCBXFB	2	8 (IR1/5)	1.43	1.53	124.6	2.42	Ciemat	
	Orbit correctors Q3 - Horizontal/Inner	MCBXFA	1	4 (IR1/5)	1.584	1.702	107.1	1.99	Ciemat	
	Orbit correctors Q3 - Vertical/Outer	MCBXFA	1	4 (IR1/5)	1.402	1.502	232.3	1.98	Ciemat	
	Superferric, order 2	MQSXF	1	4 (IR1/5)	0.174	0.197	1530	14.31	INFN	
	Superferric, order 3, normal and skew	MCSXF / MCSSXF	2	8 (IR1/5)	0.099	0.112	213	54	INFN	
	Superferric, order 4, normal and skew	MCOXF / MCOSXF	2	8 (IR1/5)	0.102	0.115	220	54	INFN	
	Superferric, order 5, normal and skew	MCDXF / MCDSXF	2	8 (IR1/5)	0.092	0.106	120	54	INFN	
	Superferric, order 6	MCTXF	1	4 (IR1/5)	0.085	0.097	805	54	INFN	
	Superferric, order 6, skew	MCTSXF	1	4 (IR1/5)	0.084	0.094	177	54	INFN	
D1	Separation dipole D1	MBXF	1	4 (IR1/5)	12.11	13.231	24.84	0.41	KEK	
D2	Recombination dipole D2	MBRD	1	4 (IR1/5)	12.33	13.343	27.46	0.18	INFN	
	Orbit correctors D2	MCBRD	4	16 (IR1/5)	0.394	0.422	920	1.36	CERN	
Q4	Individually powered quad Q4 (4.5k)	MQY	Same Circuit Paramters for Q4, Q5, Q6 and Correctors in IR1/5 as in the LHC							ECR EDMS no. 2083813
	Orbit correctors Q4 (4.5k)	MCBY								
Q5	Individually powered quad Q5 (4.5k)	MQML								
	Orbit correctors Q5 (4.5k)	MCBC								
Q6	Individually powered quad Q6 (4.5k)	MQML								
	Orbit correctors Q6 (4.5k)	MCBC								
Q10	Individually powered quad Q10 (1.9k)	MQML	Deferral of Installation of Lattice Sextupole in Q10 in Points 1 and 5 to L54							ECR EDMS no. 2636486
	Orbit correctors Q10 (1.9k)	MCB								
	Lattice Sextupole (1.9k)	MS								
Q5	Individually powered quad Q5 (4.5k)	MQY	2	4 (IR6)	3.61	3.9	74	0.4	CERN	
	Orbit correctors Q5 (4.5k)	MCBY	2	4 (IR6)	0.088	0.1	5270	34.4	CERN	

Circuit Parameters Table V9.5

Documentation and updates are regularly **communicated** in the MCF meetings and **validated** by stakeholders.



HL-LHC General Instrumentation Drawings & General Quench Detection Signal Representation



HL-LHC Magnet Circuit Layout

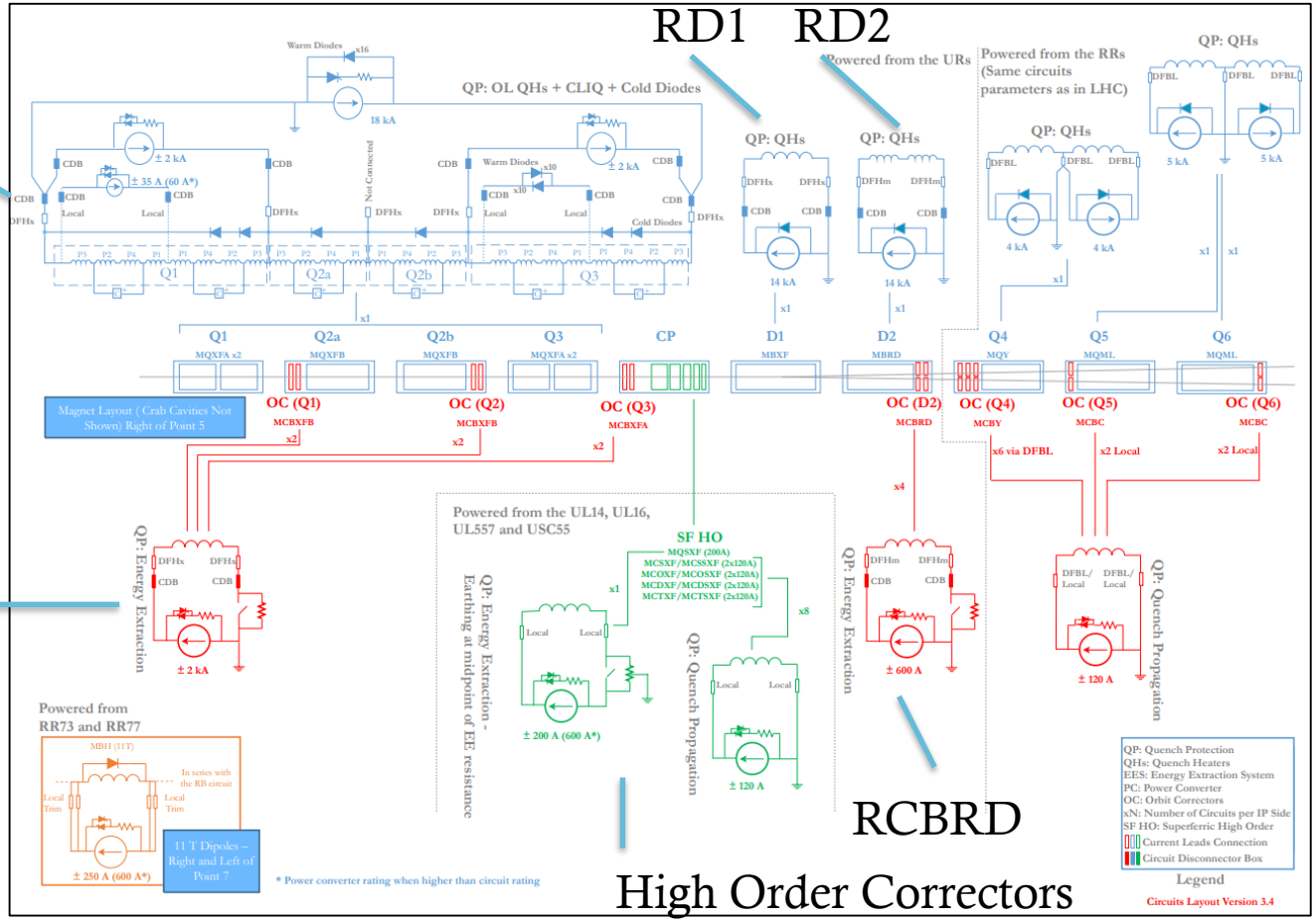
RQX

RCBX

RD1 RD2

RCBRD

High Order Correctors

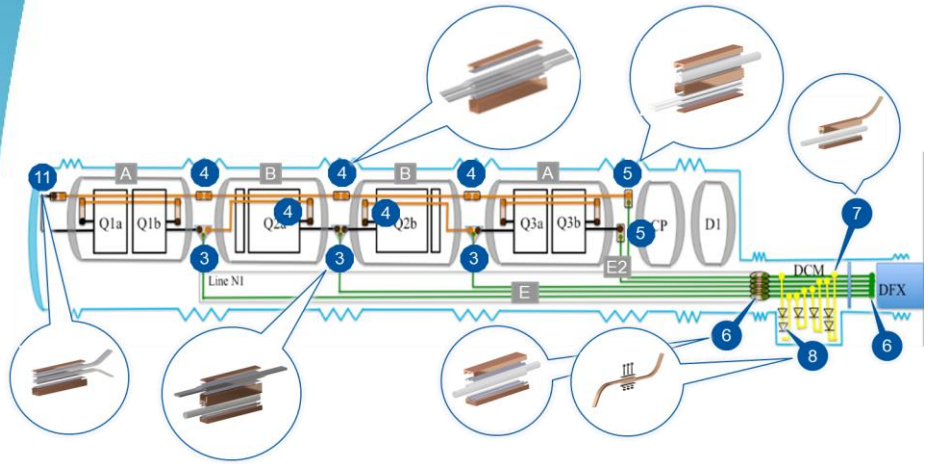


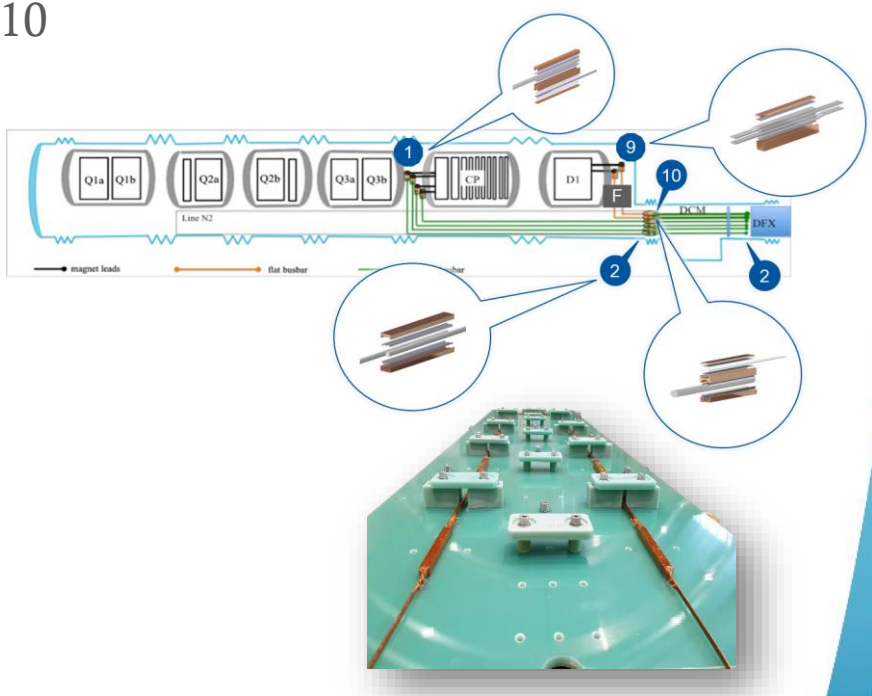
Discussed Topics in the MCF

Updates on the Design of HL-LHC Circuit-related Equipment from last Collaboration Meeting

Splices for WP3 Superconducting Busbars

- WP3 splice catalogue EDMS no. 2492410



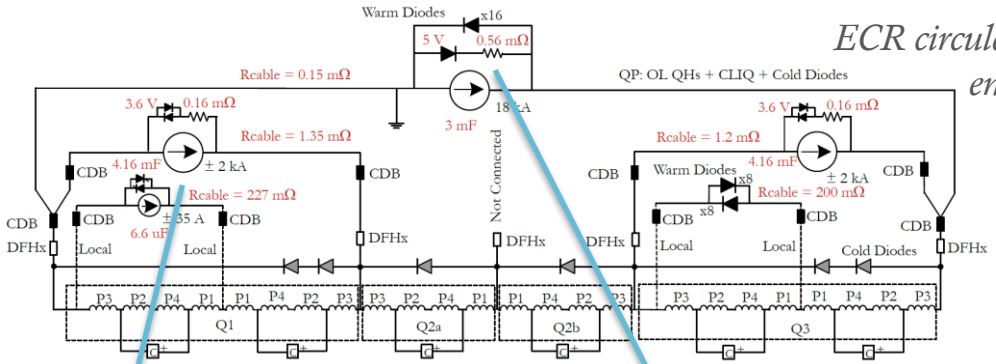


Courtesy of R. Principe – MCF no. 108

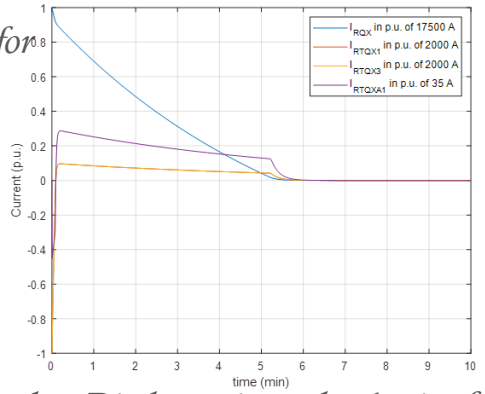
Tests include resistance measurements at RT, mechanical tests and tests at LT in SM18 @ CERN

More info in R. Principe's Talk on THU AM

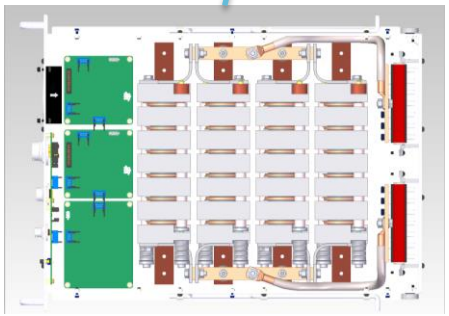
Inner Triplet Circuit Crowbars



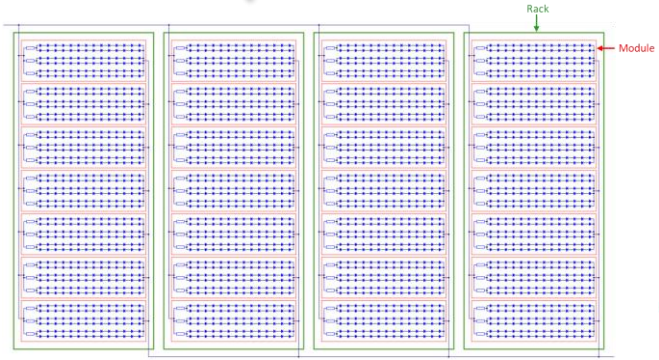
ECR circulation planned for end 2022



Crowbar Discharge in under 6 mins from Ultimate Current



2 kA Trim Power Converter Crowbar

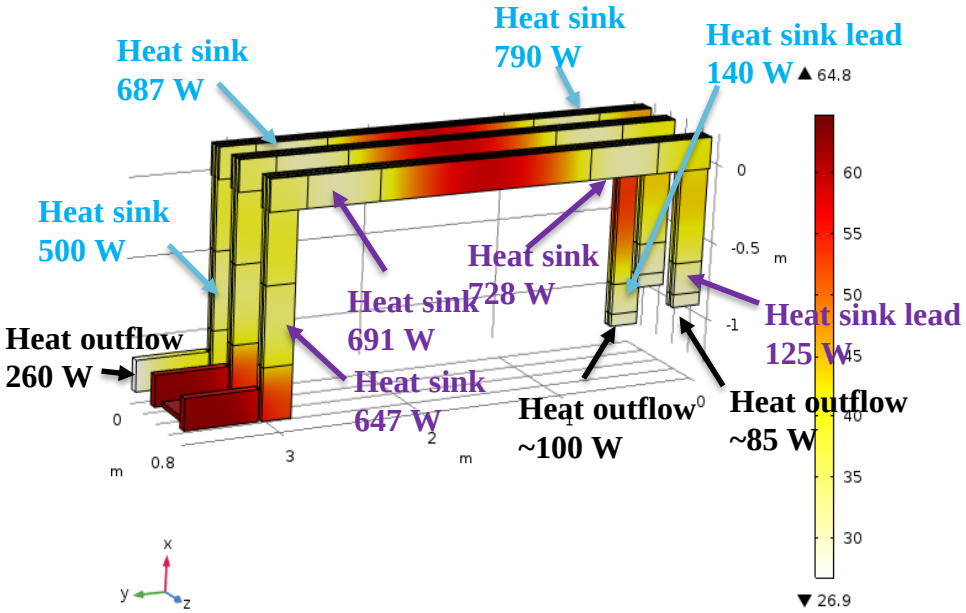


18 kA Main Power Converter Crowbar with ~ 2400 Schottky Diodes in 168 parallel branches in 4 racks – could be discharged with electrical blackout and without water-cooling

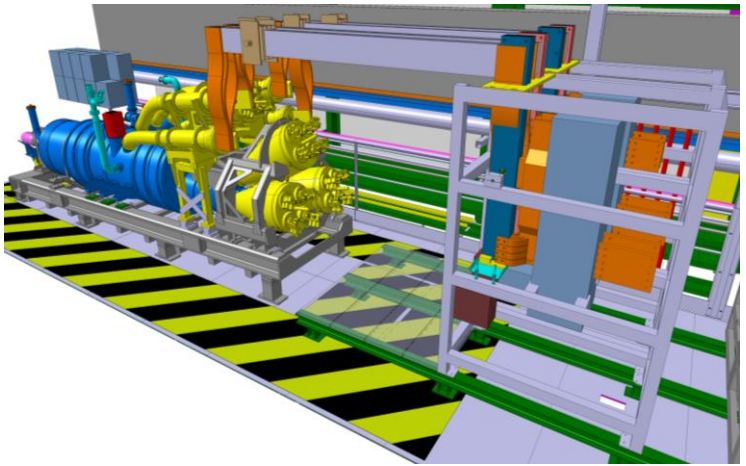
Courtesy of L. De Mallac – MCF no. 107

More info on Quench Simulations E. Ravaioli's Talk

Design of Room Temperature High Current Busbars



Strong Collaboration between WP6a and WP6b – Simulations courtesy of J. Fleiter

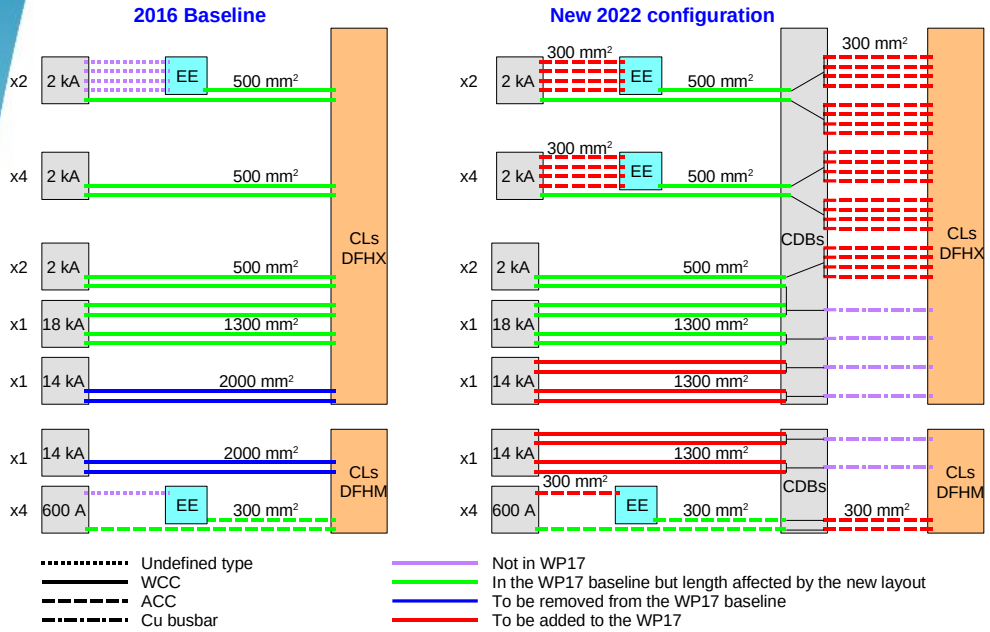


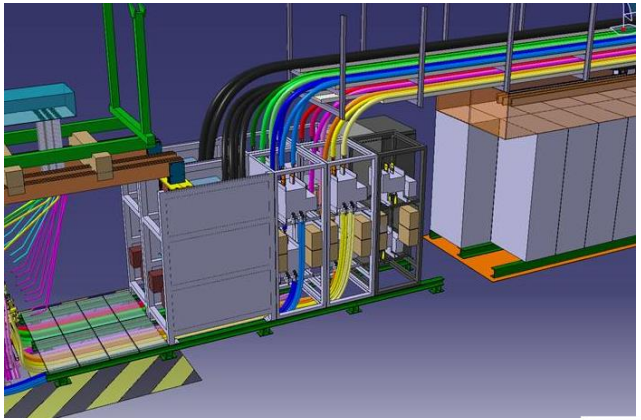
Design of the High Current Busbars has advanced with a first validation in test bench F2 at SM18 and a pre-series design in the HL-LHC IT String

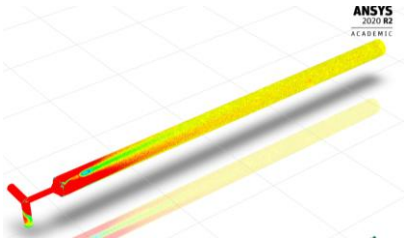
Scope and responsibilities have been defined in the ECR on EDMS no. 2453935

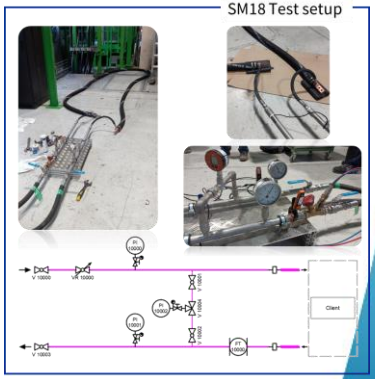
More information in S. Seshadri's presentation

Water-Cooled Cables Configuration









Optimisation of the WCC configuration with WP6b and WP17 – MCF no. 99
Courtesy of L. Tavian – ECR on EDMS no. 2386350

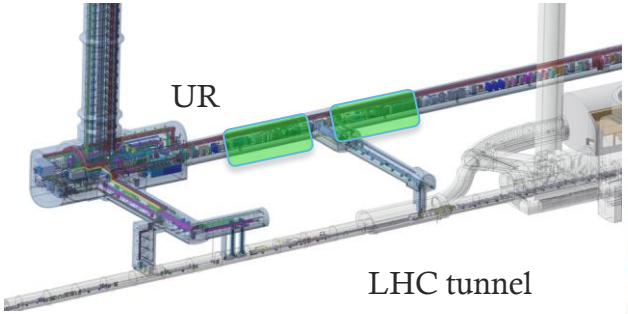
More information in S. Bertolasi's presentation

Simulations and testing to define the cooling configuration of the WCCs

Powering System – UR side (WP6a/b)

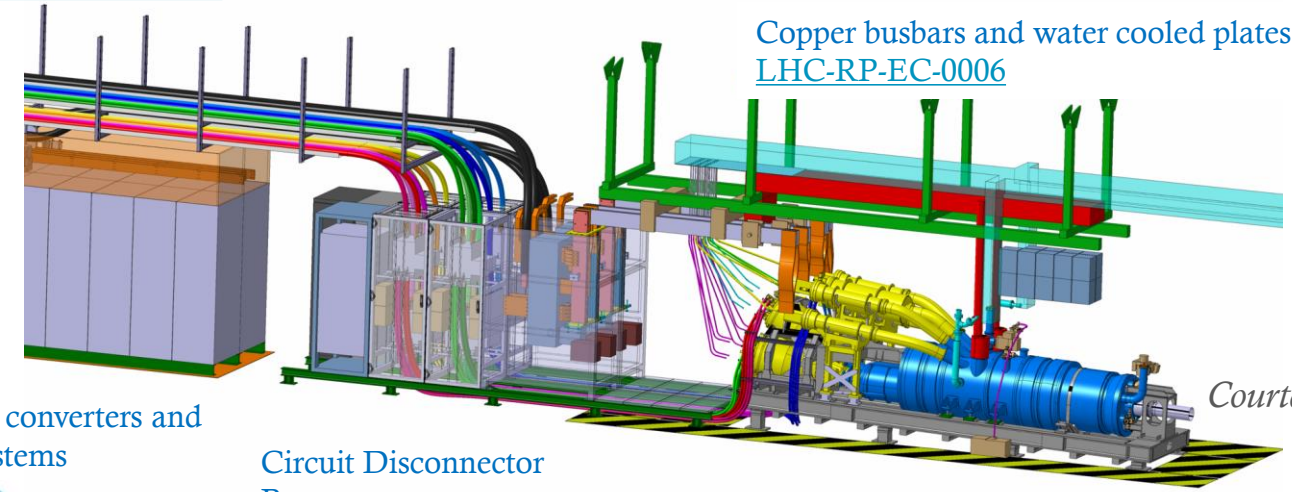
Warm Powering system and interface to DFHX/M now fully defined, incl

- Adaption to latest UR layout and DFHX/M design
- Optimisation and standardisation of DC cables and ventilation needs
- Definition of high current DC copper busbars, their cooling system and interfaces with DFHX/M



New UR layout: impact on DC cables and ventilation
LHC-DFH-EC-0006

Copper busbars and water cooled plates
LHC-RP-EC-0006



Courtesy of M. Zerlauth

Power converters and EE systems

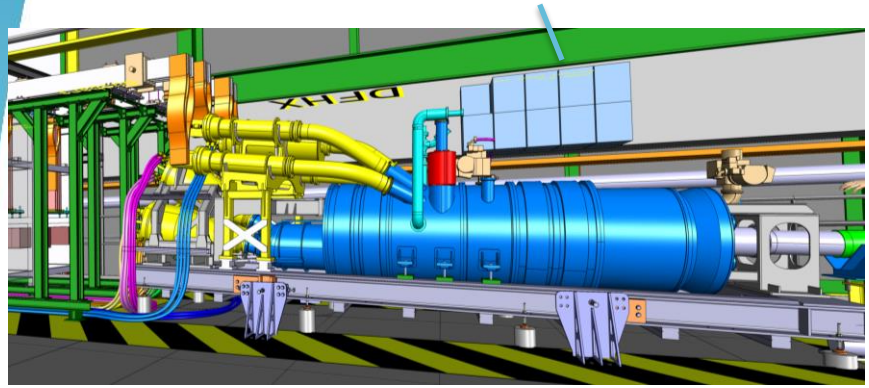
Circuit Disconnector Boxes
LHC-RP-EC-0005

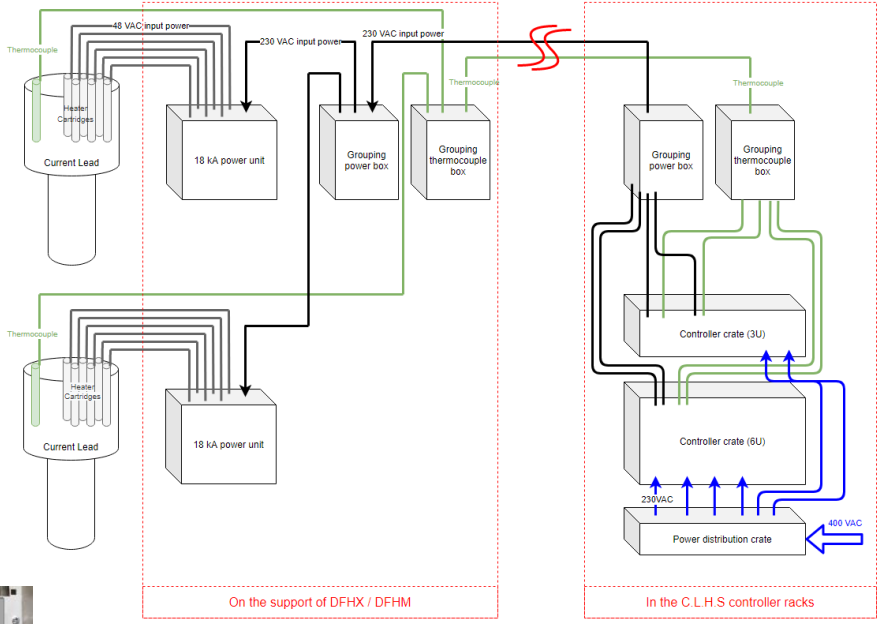
Change of Conceptual design of DFHX/M
LHC-DFH-EC-0006

Current Lead Heating System for HL-LHC

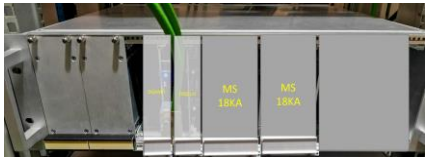
- ECR ongoing and expected end of 2022

Power Units over the DFHX





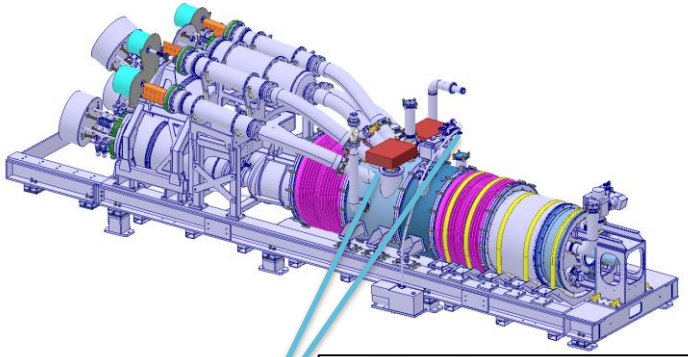
Proposal by WP7 on the CLHS scheme and cabling

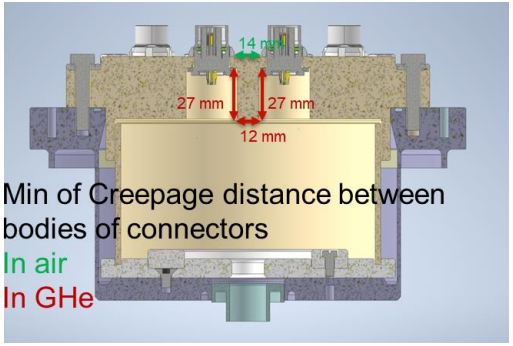


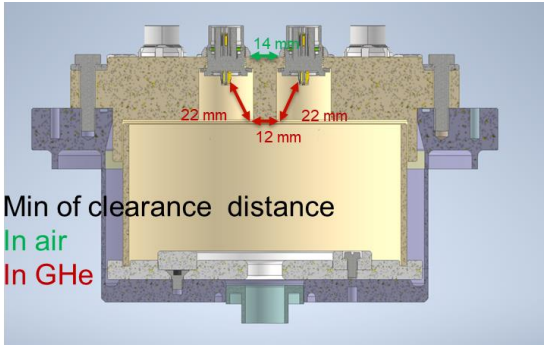
Controller Crates

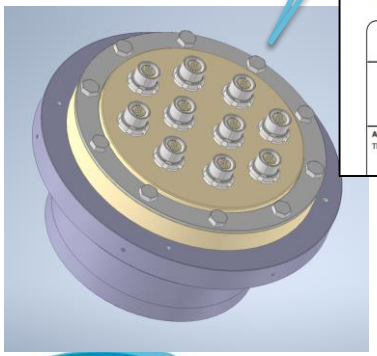
More information in G. D'Angelo's presentation on THU PM

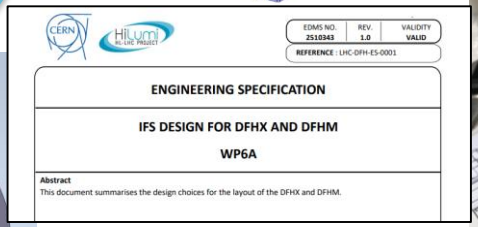
DFH Instrumentation Flanges and Proximity Equipment











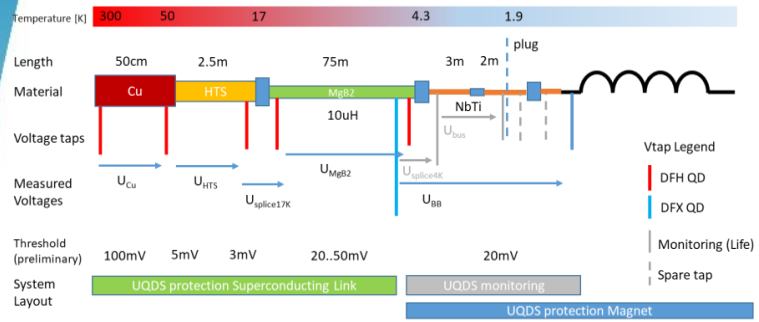
Y. Leclercq – EDMS no. 2510343

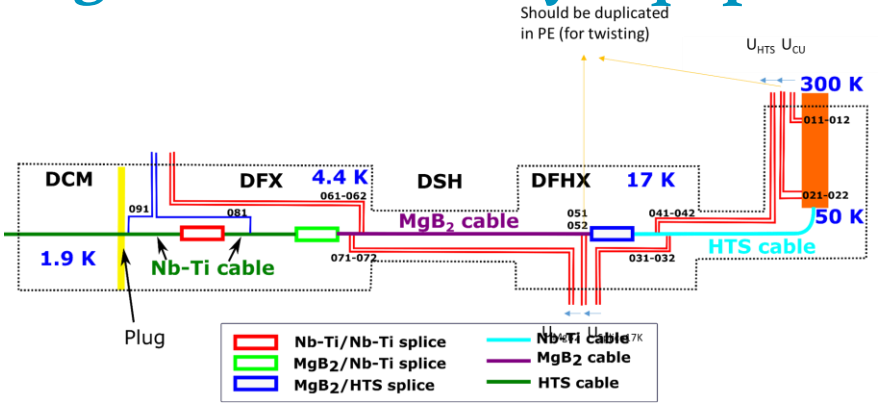
Prototypes at CERN under tests and validation

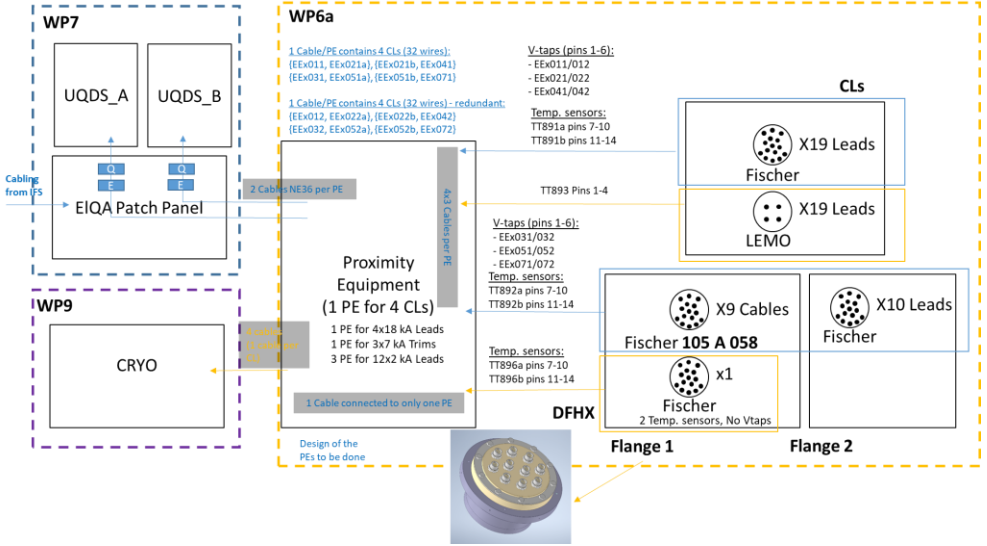
More information in J. Fleiter's presentation on THU PM

DFH Instrumentation Flanges and Proximity Equipment

WP6a QDS Overview



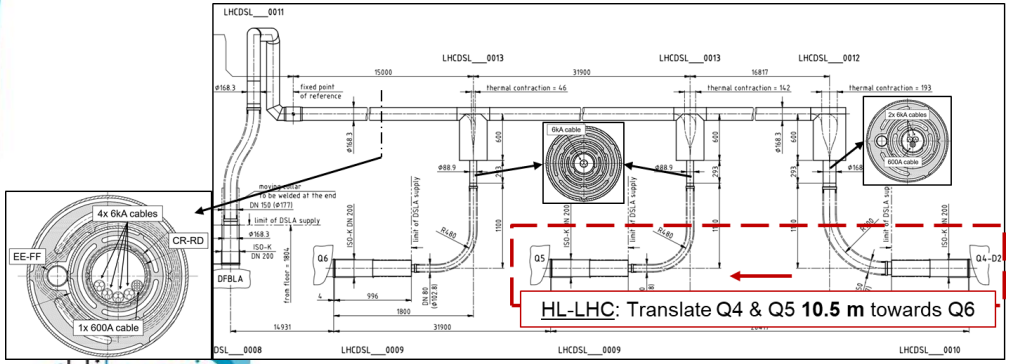


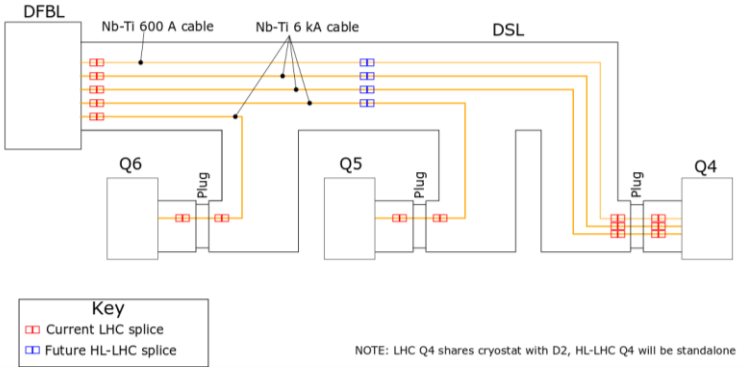


More information in J. Fleiter's presentation on THU PM

DSL Refurbishment for the HL-LHC

- Cut DSL at 2 locations:
  - Sleeves connections, ≈12.3 m apart
  - ≈7.6 m before the Q5 branch
- Installation of new connection box:
  - New splices with the expertise from TE-MSC team
- Analysis on the protection deemed the non-necessity of new V-taps and IFS for the refurbishment

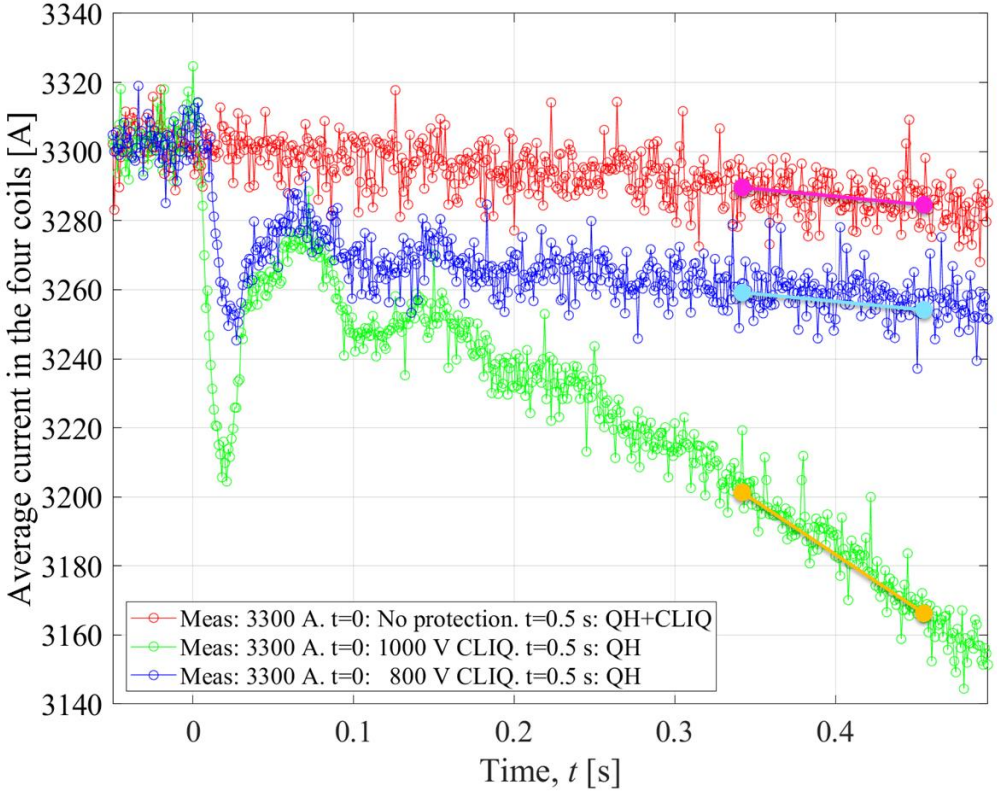




Courtesy of A. Lees, G. Casula – MCF no. 98

Updates on HL-LHC Circuit Protection

CLIQ Efficiency Tests at Low Current in the MQXF



Average current in the four coils

Metric used in the analysis:
dI/dt in the time window 0.35-0.45 s

Tests done on the MQXFP2

Courtesy of E. Ravaioli, F. Mangiarotti – MCF no. 94

CLIQ Efficiency Tests at Low Current in the MQXF

Current [A]	dI/dt in the time window 0.35 s<t<0.45 s [A/s]							
	No protection		800 V CLIQ only			1000 V CLIQ only		
	Measured	Simulated	Measured	Simulated $f_{rho,eff}$=0.75	Simulated $f_{rho,eff}$=1.5	Measured	Simulated $f_{rho,eff}$=0.75	Simulated $f_{rho,eff}$=1.5
3300	-36	-41	-39	-41	-161	-321	-192	-331
2500	-30	-32	-38	-32	-60	-122	-87	-160
2000	-34	-27	-39	-27	-27	-46	-43	-98
1647	-3	-23	-22	-23	-23	-15	-23	-63
1000	-23	-17	-12	-17	-17	-19	-17	-25

OK [used to determine warm circuit params]

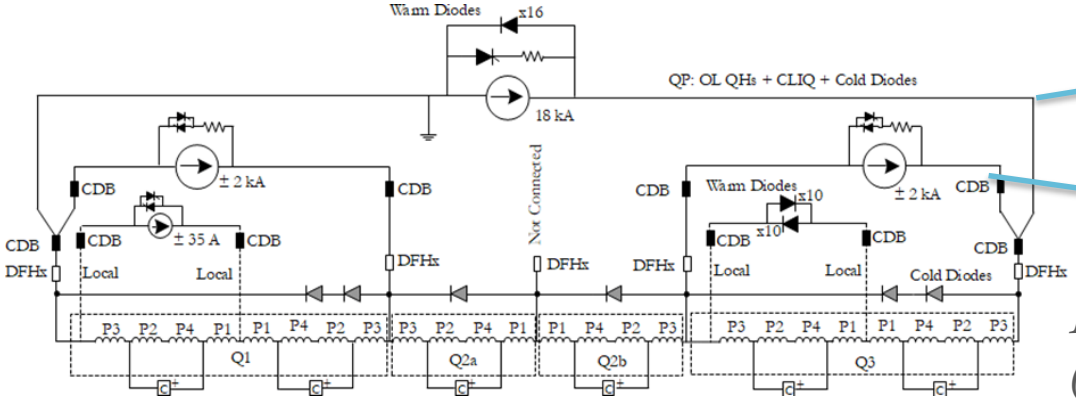
$f_{rho,eff}$=0.75 fits better than 1.5

$f_{rho,eff}$=0.75 fits better than 1.5 for I≤2 kA, and vice versa

- Effective transverse resistivity ($f_{rho,eff}$) influences coupling loss and is a key parameter for CLIQ at low current
- All simulations performed with STEAM-LEDET using $f_{rho,eff}$ as the only fitting parameter
- Before the tests, $f_{rho,eff}$=1.5 was assumed, which resulted in overestimating CLIQ performance for I≤2.5 kA

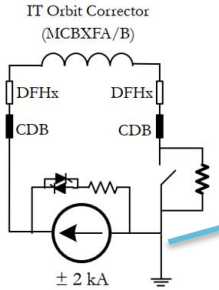
Current Measurement Solutions for the QDS

- Current measurement schemes have been defined for QDS (i.e. symmetric quenches and current-dependant thresholds)

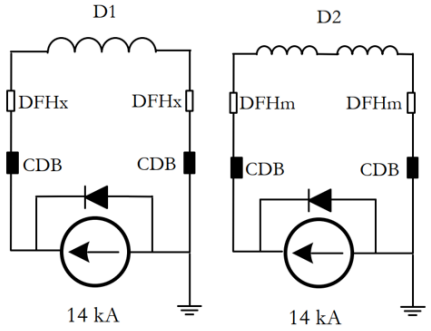


LEM HAZ6000 (open loop Hall)

GMW CPCO 12kA (coreless Hall)



LEM Ultrastab IT 700 (DCCT)

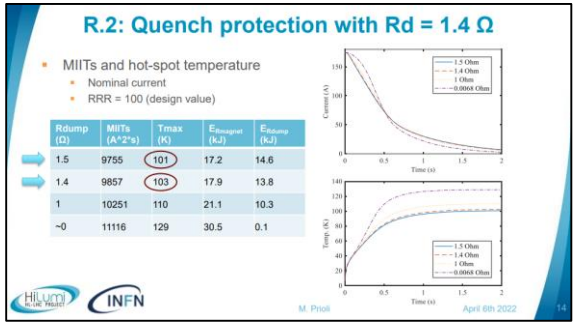


More info in J. Steckert's Talk

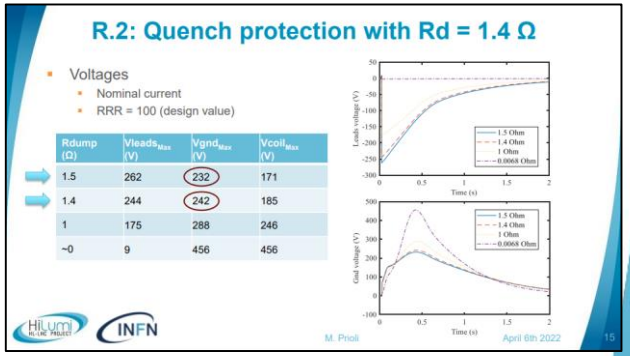
Energy Extraction of the MQSXF

- Align the EES discharge resistances of the HL-LHC RQSX3 with the HL-LHC RCDRB circuits (1.4 Ω) in the aim to reduce the variants of the HL-LHC resistances.

HL-LHC Circuits (IP 1 and 5)	RQSX3
Number of circuits for HL-LHC	4
Magnets per circuit	1x MQSXF
Magnetic length [m]	0.401
I_{nom} [A]	174
L at I_{nom} [mH]	1530
E_{stored} at I_{nom} [kJ]	30.8
Previous Protection baseline	**1.5 Ω EES**
Present Protection baseline	**1.4 Ω EES**



Courtesy of M. Prioli – WP3 Meeting - link



1% larger quench load
2 K higher hot spot temperature but still within the 250 K target
10 V higher voltage to ground

HL-LHC Electrical Design Criteria for the High Order Corrector Magnets has been accordingly updated on EDMS no. 2060633 – link

Signal Interfaces between HL-LHC Circuit Equipment

Powering Failure	Quench	Discharge	Cryo	UPS	AUG	GPM	Operator
SPA	FPA	FPA	SPA	FPA	FPA	FPA	SPA FPA

Index	CIRCUIT NAME	SYSTEM	Interface Type
1	RQX	18kA	B1
2	RTQX1	2kA	N/A
3	RTQXA1	60A	B1
4	RTQX3	2kA	N/A
5	RCBXH1	2kA	B1
6	RCBXV1	2kA	B1
7	RCBXH2	2kA	B1
8	RCBXV2	2kA	B1
9	RCBXH3	2kA	B1
10	RCBXV3	2kA	B1
11	RD1	14kA	B1
12	RQSX3	0.6kA	B1
13	RCSX3	120A	C
14	RCSSX3	120A	
15	RCOX3	120A	
16	RCOSX3	120A	
17	RCDX3	120A	C
18	RCDSX3	120A	
19	RCTX3	120A	
20	RCTSX3	120A	

HL-LHC change

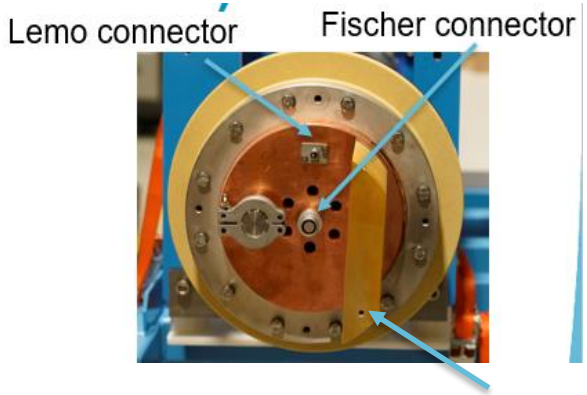
PIC Interfaces for HL-LHC defined – based on LHC EDMS no. 1001985

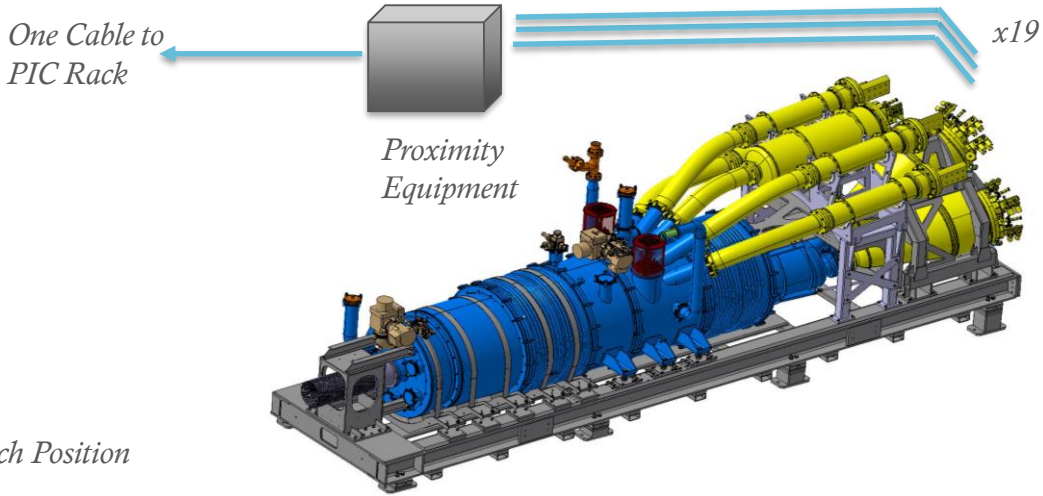
Courtesy of A. Antoine – MCF no. 90

Signal Interfaces between HL-LHC Circuit Equipment

- In contrast to LHC, the CL TS is routed to the PIC (vs. to the PC in the LHC)

Powering Failure	Quench	Discharge	Cryo	UPS	AUG	GPM	Operator	CL TS
SPA	FPA	FPA	SPA	FPA	FPA	FPA	SPA FPA	SPA

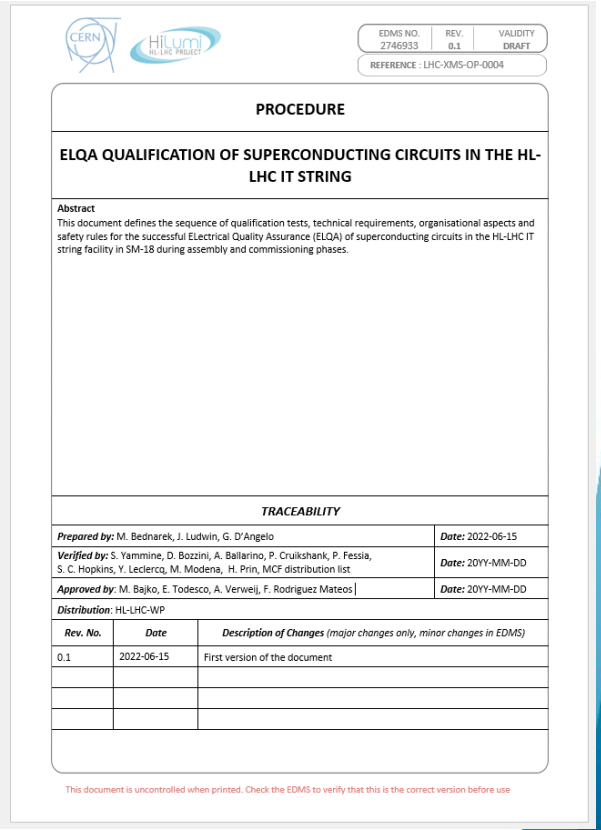




Courtesy of A. Antoine and J. Fleiter – MCF no. 101

ElQA Program for the HL-LHC IT String Circuits

- Validate circuits during assembly.
- Validate the circuits for cool-down and powering.
- Acquire working experience on HL-LHC circuits.
- Acquire reference values for complete HL-LHC circuits.
- Validate ElQA test procedures and ELQA test equipment and ensure that the qualification is as tight as possible.
- ➢ ElQA in the IT String will be as similar to the final ELQA in the tunnel as possible.



EDMS NO. 2746933 | REV. 0.1 | VALIDITY DRAFT

REFERENCE : LHC-XMS-OP-0004

PROCEDURE

ELQA QUALIFICATION OF SUPERCONDUCTING CIRCUITS IN THE HL-LHC IT STRING

Abstract

This document defines the sequence of qualification tests, technical requirements, organisational aspects and safety rules for the successful Electrical Quality Assurance (ELQA) of superconducting circuits in the HL-LHC IT string facility in SM-18 during assembly and commissioning phases.

TRACEABILITY

Prepared by: M. Bednarek, J. Ludwin, G. D'Angelo	***Date:*** 2022-06-15
Verified by: S. Yammine, D. Bozzini, A. Ballarino, P. Cruikshank, P. Fessia, S. C. Hopkins, Y. Leclercq, M. Modena, H. Prin, MCF distribution list	***Date:*** 20YY-MM-DD
Approved by: M. Bajko, E. Todesco, A. Verweij, F. Rodriguez Mateos	***Date:*** 20YY-MM-DD
Distribution: HL-LHC-WP	

Rev. No.	*Date*	*Description of Changes (major changes only, minor changes in EDMS)*
0.1	2022-06-15	First version of the document

This document is uncontrolled when printed. Check the EDMS to verify that this is the correct version before use

ElQA Procedure on EDMS no. 2746933

Courtesy of M. Bednarek, G. D'Angelo and J. Ludwin, MCF no. 104

ElQA Program for the HL-LHC IT String Circuits

	SLC	MIC-W	IT-PAQ	ITIV	ITIC
HVQ	✓	✓	✓	✓	✓
TFM	✓	✓		✓	
IRC	✓	✓		✓	
ICC	✓	✓	✓	✓	
TDR	✓	✓			✓
COC	✓			✓	✓
QHR		✓			
DVC		✓			
TSQ	✓	✓			

ELQA tests during assembly

SLC – Superconducting Link Check
MIC-W – Magnet Instrumentation Check
IT-PAQ – Inner Triplet Partial Assembly Qualification
ITIV – Inner Triplet Interconnection Verification
ITIC – Inner Triplet Instrumentation Check

HVQ – High Voltage Qualification
TFM – Transfer Function Measurement
IRC – Instrumentation Resistance Check
ICC – Instrumentation Configuration Check
TDR – Time Domain Reflectometry
COC – Continuity of Conductor check
QHR – Quench Heater Resistance measurement
DVC – Diode opening Voltage Check
TSQ – Temperature Sensor Qualification

TP4-A – Test Procedure 4 type A
MIC-W – Magnet Instrumentation Check at warm
TP4-B – Test Procedure 4 type B
TP4-C – Test Procedure 4 type C
TP4-D – Test Procedure 4 type D
MIC-D – Magnet Instrumentation Check at 80 K
MIC-C – Magnet Instrumentation Check at cold
TP4-E – Test Procedure 4 type E

	TP4-A	MIC-W	TP4-B	TP4-C	TP4-D +MIC-D	MIC-C	TP4-E
	At warm	At warm	After flushing	During cool-down/ warm-up	At 80 K	At cold	At cold
HVQ		✓	✓	✓	optional	✓	✓
TFM	✓	✓			optional	✓	✓
IRC	✓	✓			optional	✓	✓
ICC	✓	✓			optional	✓	✓
TDR		✓			optional	✓	
QHR		✓			optional	✓	
DVC		✓				✓	
TSQ	✓	✓			optional	✓	✓

ELQA tests during commissioning

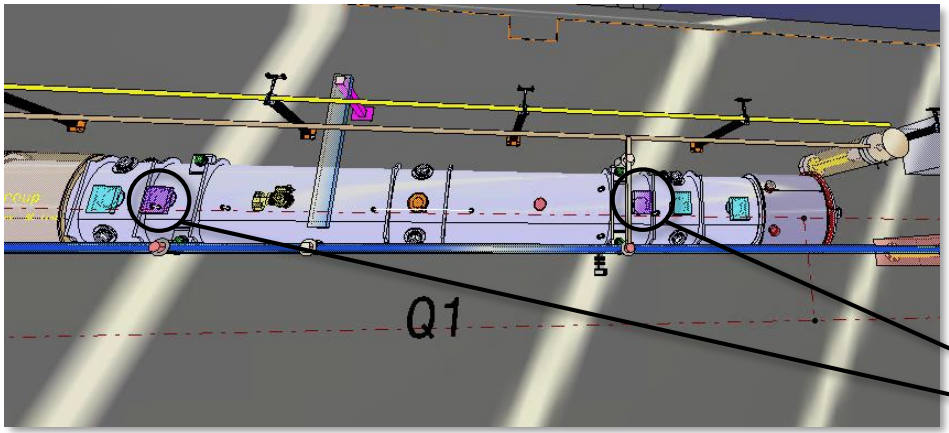
ELQA tests during commissioning & operation

Qualification set	At warm	At warm after flushing	Cool-down 300 K to 80 K	At 80 K	Cool-down 80 K to 1.9 (4.5) K	At cold	At cold after powering	Warm-up	At warm	Cool-down	At cold	At cold after powering	Warm-up	At 80 K	Warm-up 80 K to 300 K	At warm
TP4-A	✓								✓							✓
MIC-W		✓							✓							✓
TP4-B		✓							✓							✓
TP4-C			✓		✓			✓		✓			✓		✓	
TP4-D				✓										✓		
MIC-D				✓										✓		
MIC-C						✓	✓				✓	✓				
TP4-E						✓	✓				✓	✓				

More info in M. Bednarek's Talk THU AM

Documentation

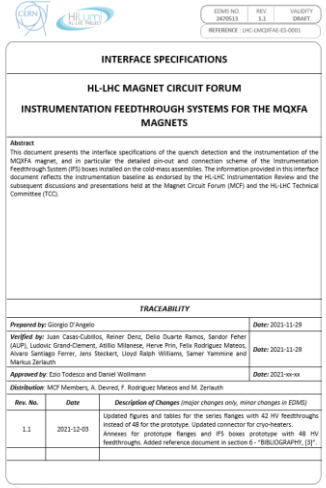
Instrumentation Feedthrough Systems (IFSs)



Interface Specification Documents:

- *LHC-LMQXFAE-ES-0001*
- *LHC-LMQXFBE-ES-0002*

Ongoing work for CP, D1 and D2



INTERFACE SPECIFICATIONS

HL-LHC MAGNET CIRCUIT FORUM

INSTRUMENTATION FEEDTHROUGH SYSTEMS FOR THE MQXFA MAGNETS

Abstract

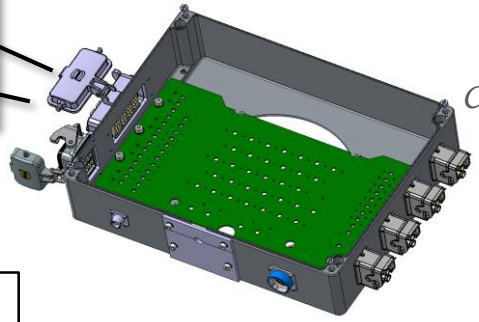
This document presents the interface specifications of the quench detection and the instrumentation of the MQXFA magnet, and in particular the detailed pin-out and connection scheme of the Instrumentation Feedthrough System (IFS) boxes installed on the cold-mass assemblies. The information provided in this interface document reflects the instrumentation baseline as endorsed by the HL-LHC Instrumentation Review and the subsequent discussions and presentations held at the Magnet Circuit Forum (MCF) and the HL-LHC Technical Committee (TCC).

TRACEABILITY

Prepared by: Giorgio D'Angelo	**Date:** 2021-11-29
Verified by: Juan Casas-Cubillos, Reiner Denz, Delio Duarte Ramos, Sandor Feher (AUP), Ludovic Grand-Clement, Attilio Milanese, Herve Prin, Felix Rodriguez Mateos, Alvaro Santiago Ferrer, Jens Steckert, Lloyd Ralph Williams, Samer Yammine and Markus Zerlauth	**Date:** 2021-11-29
Approved by: Ezio Todesco and Daniel Wollmann	**Date:** 2021-xx-xx
Distribution: MCF Members, A. Devred, F. Rodriguez Mateos and M. Zerlauth	

Rev. No.	Date	Description of Changes (major changes only, minor changes in EDMS)
1.1	2021-12-03	Updated figures and tables for the series flanges with 42 HV feedthroughs instead of 48 for the prototype. Updated connector for cryo-heaters. Annexes for prototype flanges and IFS boxes prototype with 48 HV feedthroughs. Added reference document in section 6 - "BIBLIOGRAPHY_[3]".

Courtesy of Giorgio D'Angelo



Example of the Instrumentation Feedthrough System (IFS) for the MQXFA Magnets

*Routing of the Instrumentation through the **IFS boxes***

More info in G. D'Angelo's Talk TUE PM

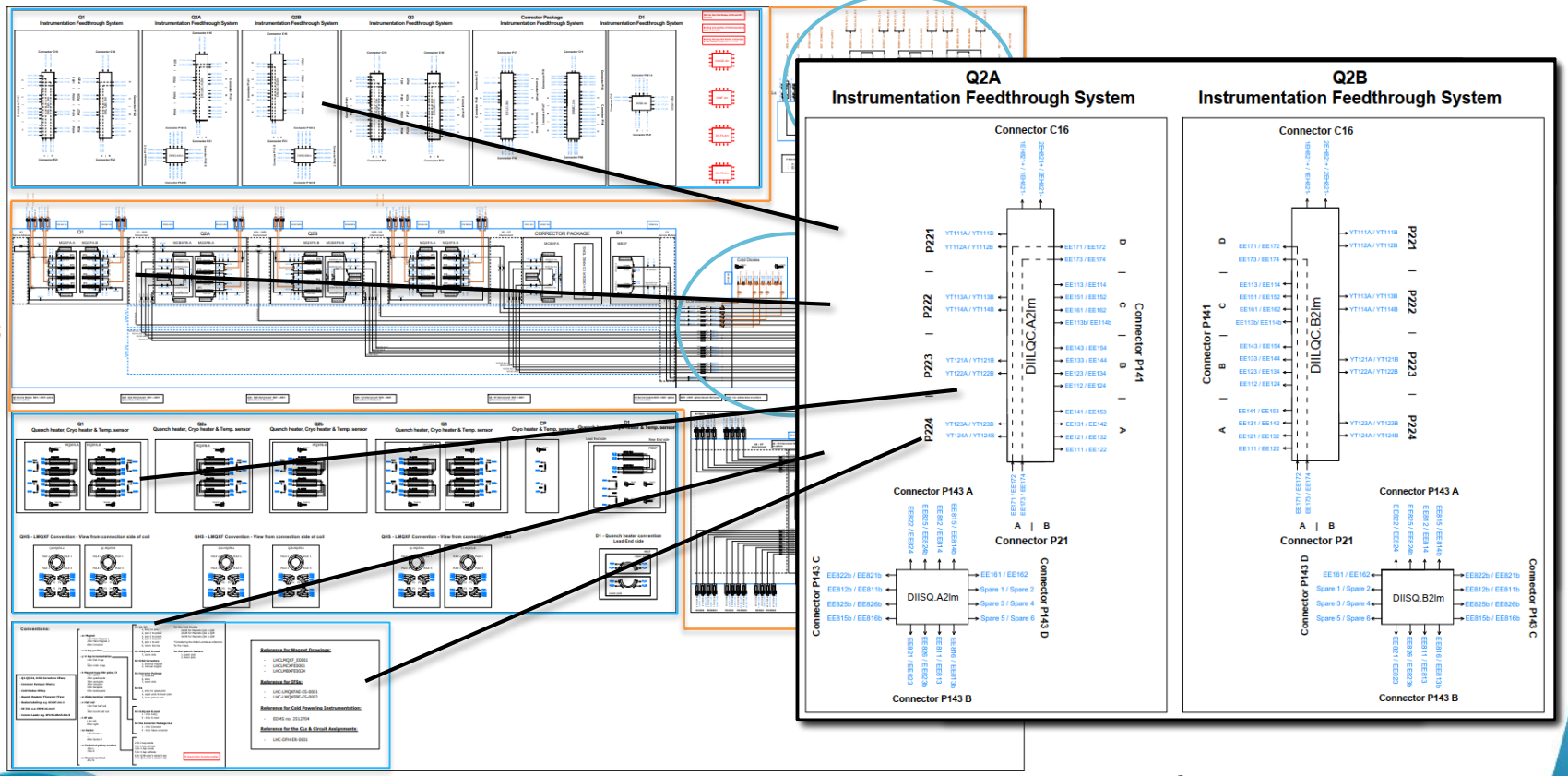
HL-LHC General Instrumentation Drawings

IFSs

Magnets
+
Cold Powering

QHs
Cryo Heaters
Temp.Sensors

Conventions
References



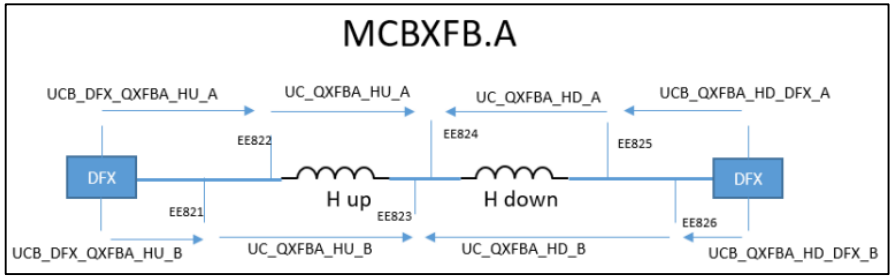
HL-LHC Inner Triplet GID

Courtesy of A. Santiago Ferrer

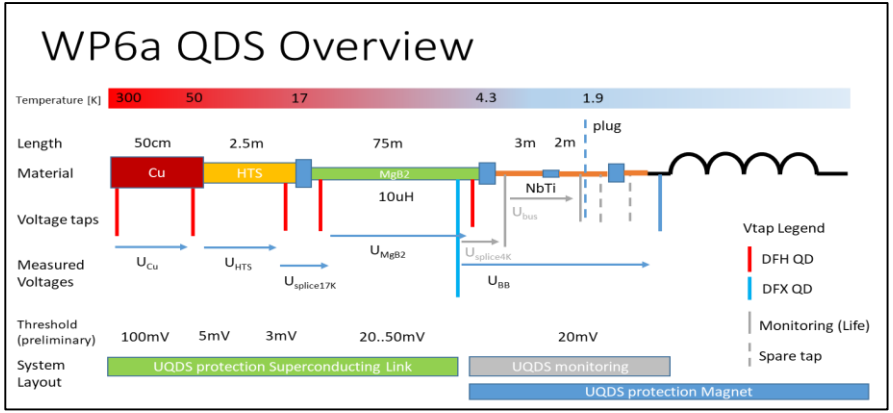
HL-LHC General Instrumentation Drawings – MCF Sharepoint

General Quench Detection Signal Representation

Magnets

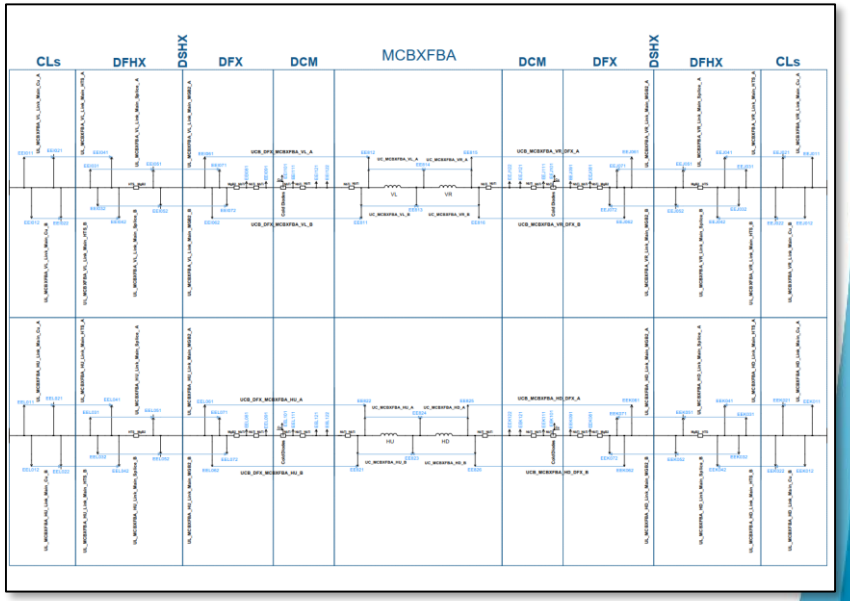


Cold Powering



Courtesy of Jens Steckert and Reiner Denz

MCBXFB.A [General Quench Detection Signal Representation]

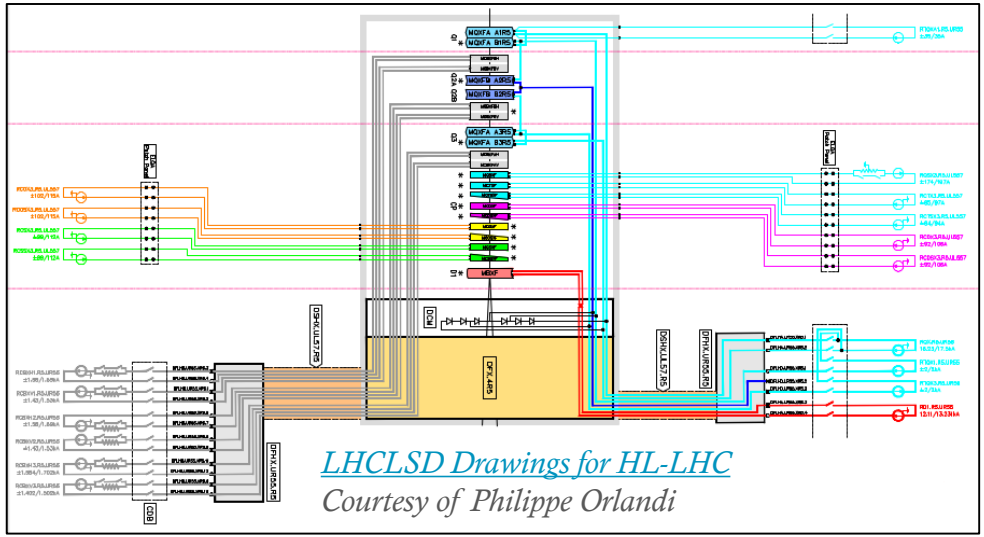


Example for the MCBXFB.A Corrector Circuits

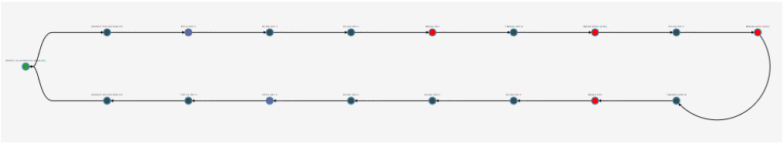
Done for all magnet circuits in close collaboration with WP7

HL-LHC General Quench Detection Signal Representation– MCF Sharepoint

Circuit Description in CERN Databases



LHCLSD Drawings for HL-LHC
Courtesy of Philippe Orlandi



Connection	Connection	Cable name	Cable type	Cable lenght	Source	Source Pole	Target	Target Pole	Circuit nam	Valid from	Expiry day
Powering cl...					RPHFC.UL16.RQX.R1 (RPHFC...	A	DWWCF.01UI16.RQX.R1		RSEG.RQX.R...	17-02-2014	LS3 1.5
Powering cl...					DWWCF.01UI16.RQX.R1		DFLX.83R1 (DFLX.5R1.2)	A	RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					DFLX.83R1 (DFLX.5R1.2)	A	DCXD.5R1.1		RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					DCXD.5R1.1		DCXQ.5R1.1		RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					DCXQ.5R1.1		MQXA.5R1	A	RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					MQXA.5R1	A	T.MQXA.5R1.A		RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					T.MQXA.5R1.A		MQXB.B2R1 (Q2B)	A	RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					MQXB.B2R1 (Q2B)	A	DCVQ.2R1.1		RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					DCVQ.2R1.1		MQXB.A2R1 (Q2A)	B	RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					MQXB.A2R1 (Q2A)	B	T.MQXB.A2R1.B		RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					T.MQXB.A2R1.B		MQXA.1R1	B	RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					MQXA.1R1	B	DCXQ.2R1.1		RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					DCXQ.2R1.1		DCXQ.5R1.2		RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					DCXQ.5R1.2		DCXD.5R1.2		RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					DCXD.5R1.2		DFLX.A5R1 (DFLX.5R1.1)	B	RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					DFLX.A5R1 (DFLX.5R1.1)	B	T.DFLX.5R1.1		RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					T.DFLX.5R1.1		DWWCF.02UI16.RQX.R1		RSEG.RQX.R...	28-01-2013	LS3 1.5
Powering cl...					DWWCF.02UI16.RQX.R1		RPHFC.UL16.RQX.R1 (RPHFC...	B	RSEG.RQX.R...	17-02-2014	LS3 1.5

Circuits for the machine are introduced in CERN Layout DB
Courtesy of Uwe Epting, Pedro Pinheiro, Pascal Le Roux and Markus Zerlauth

Concluding Remarks

Concluding Remarks

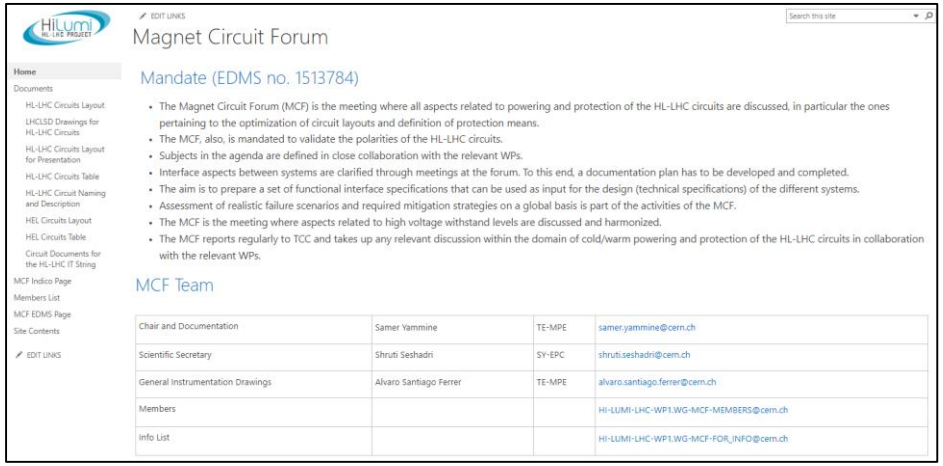
- During the past year, the MCF concentrated increasingly on the detailed design and implementation of magnet circuits powering and protection in line with the preparation of the HL-LHC IT String and the pre-series and series components manufacturing.

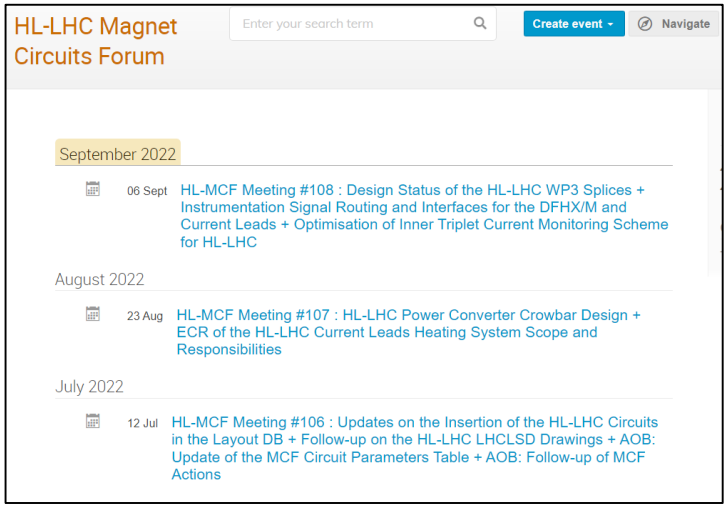
- This detailed approach and studies will continue for the next year, in view of the important validation of the circuit design in the HL-LHC IT String.

- An instrumental work was done on the General Instrumentation Drawings and the General Quench Detection Signal Representation and the introduction of the circuits in the CERN databases.

References

- MCF meetings no. 92-108 (indico page link)
- MCF Sharepoint (link)





Thank you to the participants and collaborators of the MCF for all their efforts

Thank you for your attention