Conceptual HL-LHC Circuit Drawings & Nomenclature (Circuits + Power Converters)

Samer Yammine on behalf of the

HL-Magnet Circuit Forum + WP6B

01 November 2016

Input from Markus Zerlauth, Riccardo De Maria, Felix Rodriguez Mateos, Jean-Paul Burnet, Michele Martino, Hugues Thiesen, Yves Thurel, Julien Chanois, Vicente Raul Herrero Gonzalez

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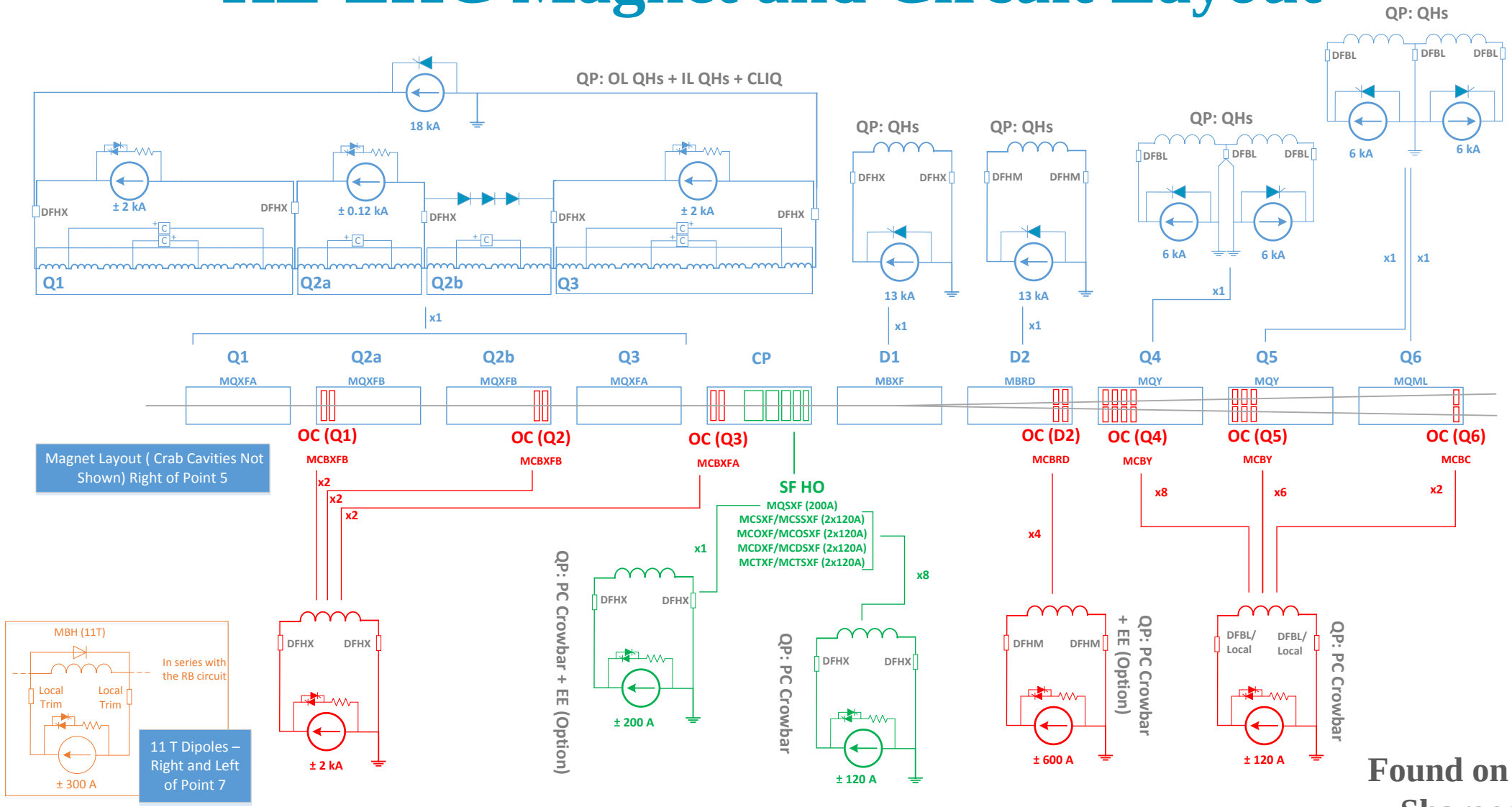
HL-LHC Circuits

HL-LHC Magnet and Circuit Layout

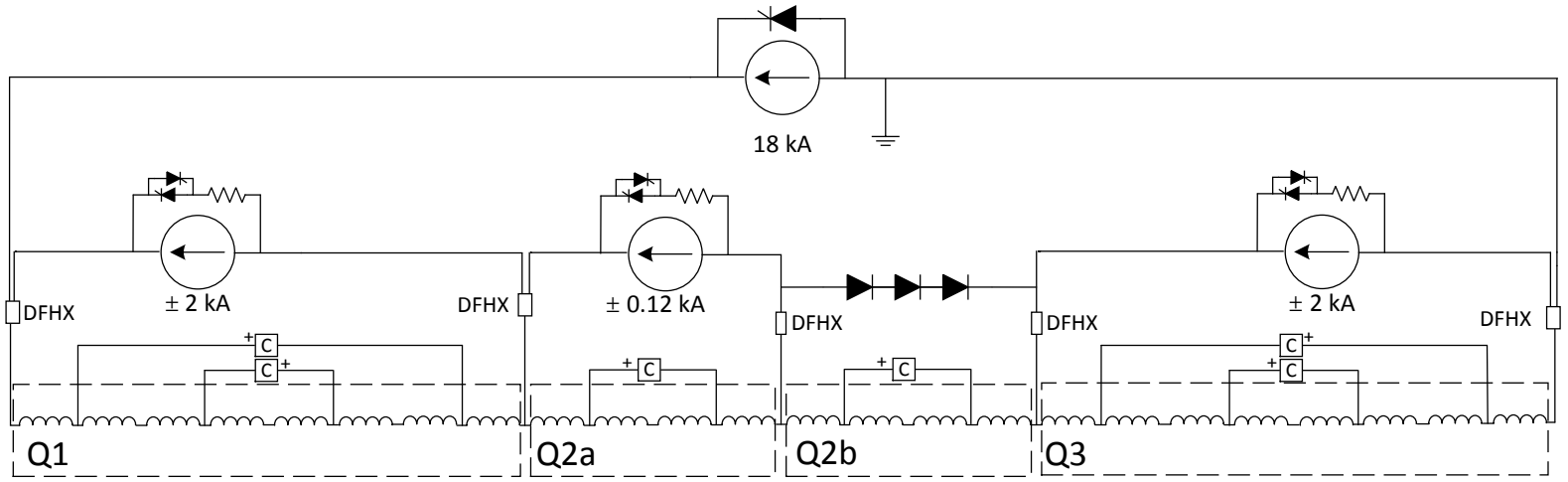


Found on MCF Sharepoint

https://espace.cern.ch/project-HL-LHC-Technical-coordination/MCF

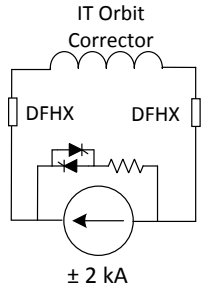
Inner Triplet and Correctors

- 1 Circuit per IP side
- Power Converters:
  - 1 x18 kA 2Q
  - 2 x 2 kA 4Q
  - 1 x 0.12 kA 4Q
  - Location: UR
- Cold Powering:
  - Feedbox: DFHX @ UR
- Quench Protection:
  - Outer layer quench heaters
  - CLIQ
  - Inner layer quench heaters



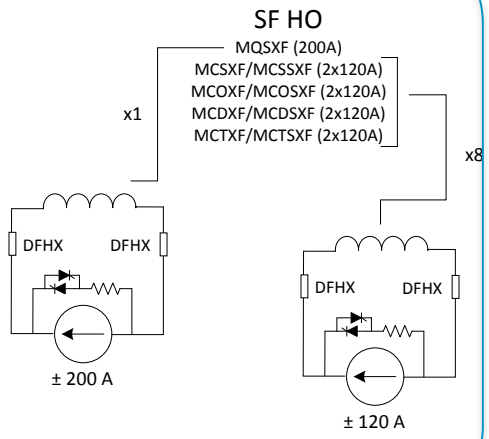
IT Orbit Correctors

- 6 Circuits per IP side
- Power Converters:
  - 6 x 2 kA 4Q
  - Location: UR
- Cold Powering:
  - Feedbox: DFHX @ UR
- Quench Protection:
  - Quench heaters (baseline)
  - Energy extraction (Possibility)



Superferric High Order Correctors

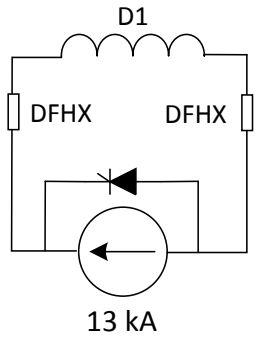
- 9 Circuits per IP side
- Power Converters:
  - 1 x 0.2 kA 4Q
  - 8 x 0.12 kA 4Q
  - Location: UR
- Cold Powering:
  - Feedbox: DFHX @ UR
- Quench Protection:
  - PC crowbar



D1, D2 and Correctors; 11 Tesla Dipole

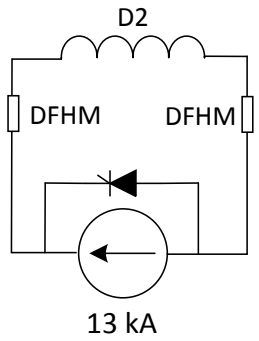
D1

- 1 Circuit per IP side
- Power Converters:
  - 1 x 13 kA 1Q
  - Location: UR
- Cold Powering:
  - Feedbox: DFHX @ UR
- Quench Protection:
  - Quench heaters



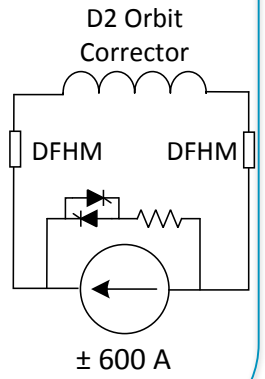
D2

- 1 Circuit per IP side
- Power Converters:
  - 1 x 13 kA 1Q
  - Location: UR
- Cold Powering:
  - Feedbox: DFHM @ UR
- Quench Protection:
  - Quench heaters



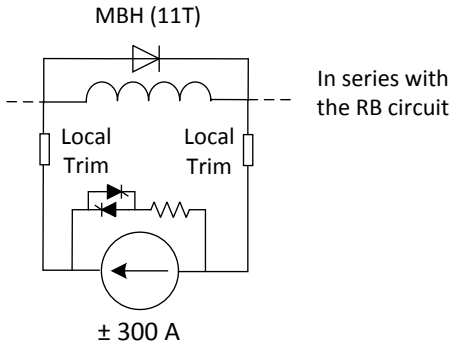
D2 Orbit Correctors

- 4 Circuit per IP side
- Power Converters:
  - 4 x 0.6 kA 4Q
  - Location: UR
- Cold Powering:
  - Feedbox: DFHM @ UR
- Quench Protection:
  - PC Crowbar



11 Tesla Dipole

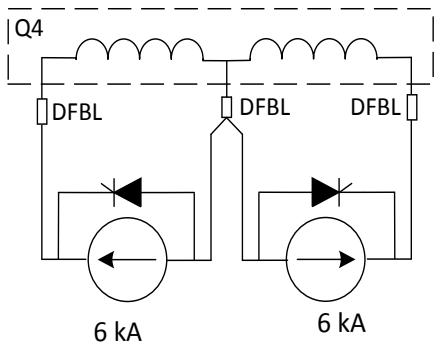
- Power Converters:
  - One power converter per circuit rated at ± 300 A
- Cold Powering:
  - Copper cables will be placed between the power converters placed in the TZ76 or RR and the local current leads of 11T trim.
- Quench Protection:
  - Quench heaters
  - Existing RB EE



Quadrupoles Q4, Q5 and Q6 and Correctors

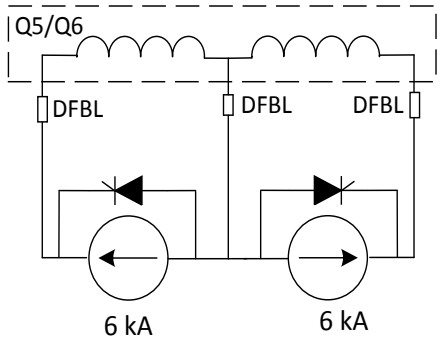
Q4

- 2 Circuit per IP side
- Power Converters:
  - 2 x 6 kA 1Q
  - Location: RR
- Cold Powering:
  - Feedbox: DFBL @ RR
- Quench Protection:
  - Quench heaters



Q5/Q6

- 2 Circuit per IP side
- Power Converters:
  - 2 x 6 kA 1Q
  - Location: RR
- Cold Powering:
  - Feedbox: DFBL @ RR
- Quench Protection:
  - Quench heaters



Q4 orbit corrector

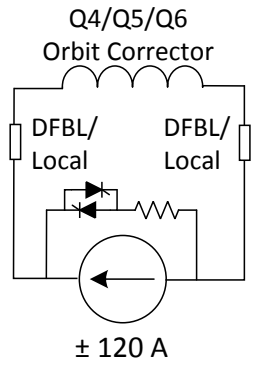
- 8 Circuit per IP side
- Power Converters:
  - 8 x 0.12 kA 4Q
  - Location: RR
- Cold Powering:
  - Feedbox: DFBL @ RR
  - Local powering (tbc)
- Quench Protection:
  - PC Crowbar

Q5 orbit corrector

- 6 Circuit per IP side
- Power Converters:
  - 6 x 0.12 kA 4Q
  - Location: RR
- Cold Powering:
  - Feedbox: DFBL @ RR
  - Local powering (tbc)
- Quench Protection:
  - PC Crowbar

Q6 orbit corrector

- 2 Circuit per IP side
- Power Converters:
  - 2 x 0.12 kA 4Q
  - Location: RR
- Cold Powering:
  - 4 x 0.12 kA leads
  - Local Powering
- Quench Protection:
  - PC Crowbar



List of Elements for Naming

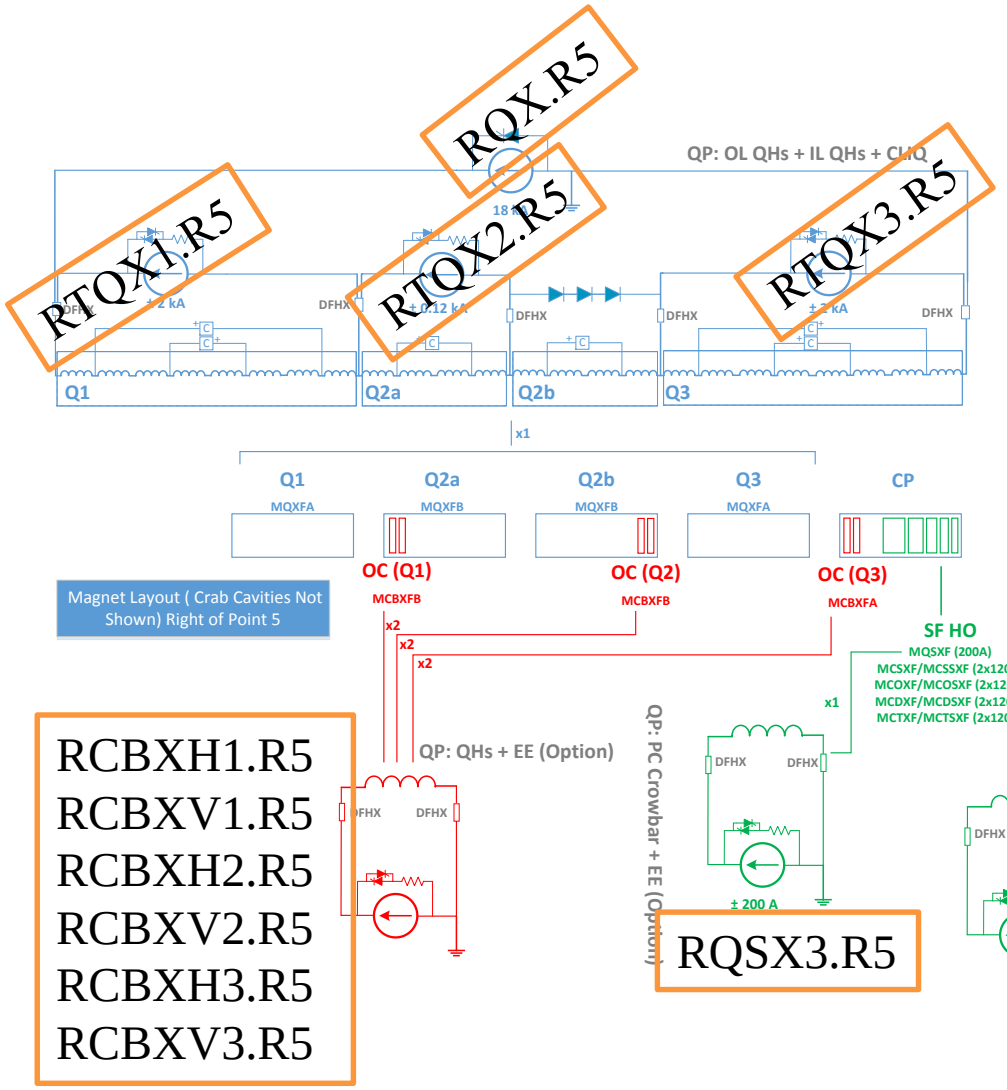
1. Circuit Names
2. Power Converters
3. Cold Powering: DFLH, DFH, DSH, DF
4. Protection: QHPS, EE (if applicable), CLIQ

02

HL-LHC Circuits Nomenclature

Circuit Names

- R + Optical Function + . + Machine Position + Beam Number (if applicable)



Inner Triplet Circuit + Orbit & HO Correctors

Circuit Names

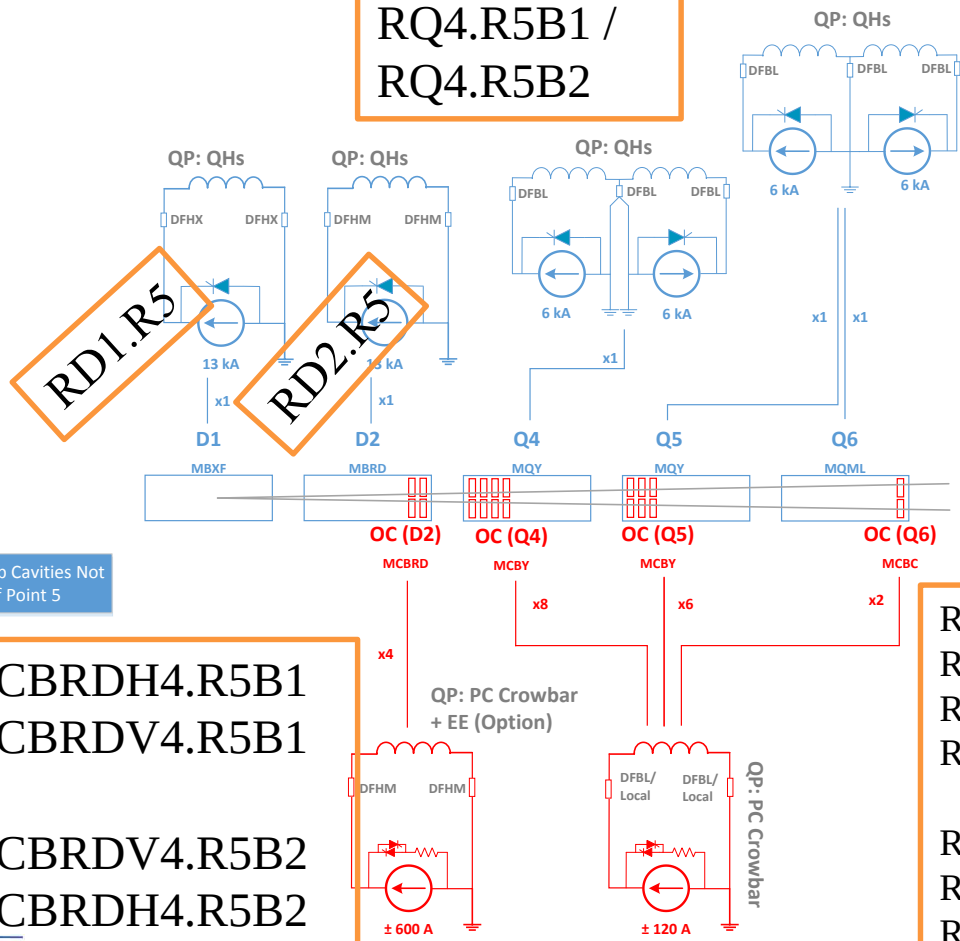
- R + Optical Function + . + Machine Position + Beam Number (if applicable)

RQ4.R5B1 /
RQ4.R5B2

RQ5.R5B1 /
RQ5.R5B2

RQ6.R5B1 /
RQ6.R5B2

D1 + Matching Section & Correctors



Magnet Layout (Crab Cavities Not Shown) Right of Point 5

RCBRDH4.R5B1
RCBRDV4.R5B1

RCBRDV4.R5B2
RCBRDH4.R5B2

RCBYV4.R5B1
RCBYH4.R5B1
RCBYVS4.R5B1
RCBYHS4.R5B1

RCBYH4.R5B2
RCBYV4.R5B2
RCBYHS4.R5B2
RCBYVS4.R5B2

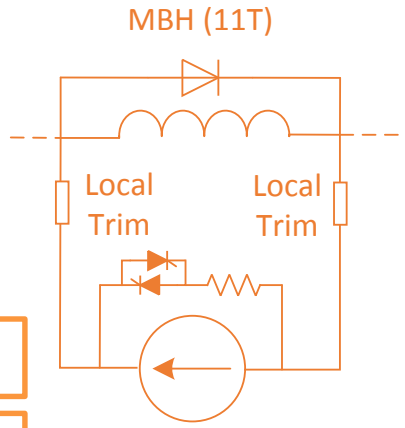
RCBYHS5.R5B1
RCBYVS5.R5B1
RCBYH5.R5B1

RCBYVS5.R5B2
RCBYHS5.R5B2
RCBYV5.R5B2

RCBCV6.R5B1
RCBCH6.R5B2

Circuit Names

- R + Optical Function + . + Machine Position + Beam Number (if applicable)

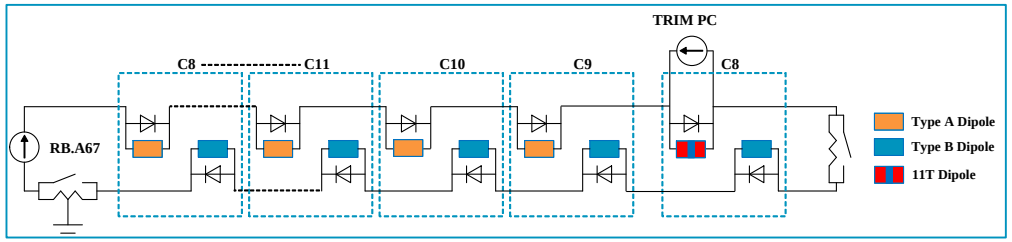


In series with the RB circuit

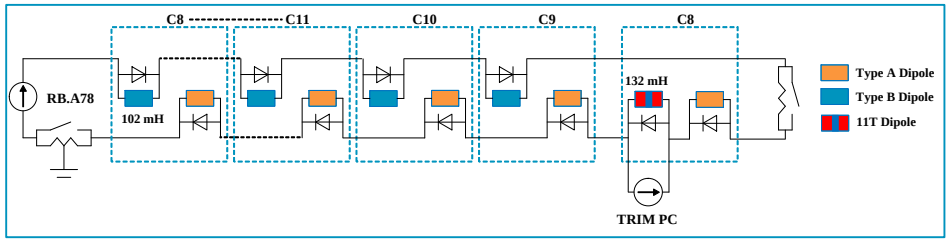
RTB8.R7

RTB8.L7

11 T Dipoles – Right and Left of Point 7



Circuit RB.A67 : MBA-B8L7 replaced



Circuit RB.A78 : MBB-B8R7 replaced (Transfer to Line A)

Circuit Names

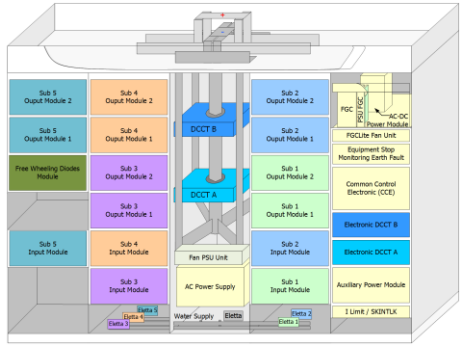
- R + Optical Function + . + Machine Position + Beam Number (if applicable)
- A concern was raised by EN/EL in the MCF on the duality of the circuit names between operation (LHC) and development (HL-LHC) in the databases (Layout Database, Planothèque, Cablothèque, etc.)

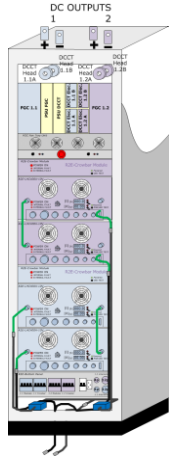
03

HL-LHC Power Converters Nomenclature

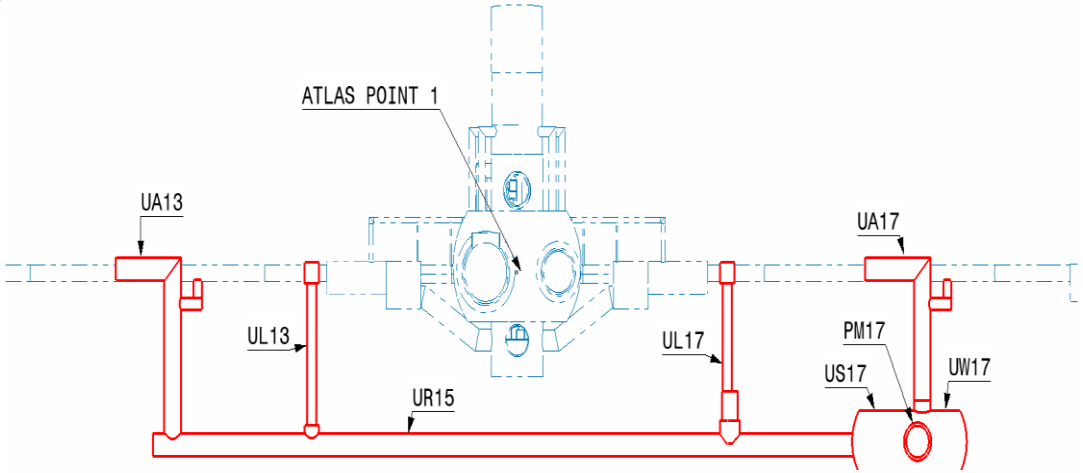
Power Converters for HL-LHC

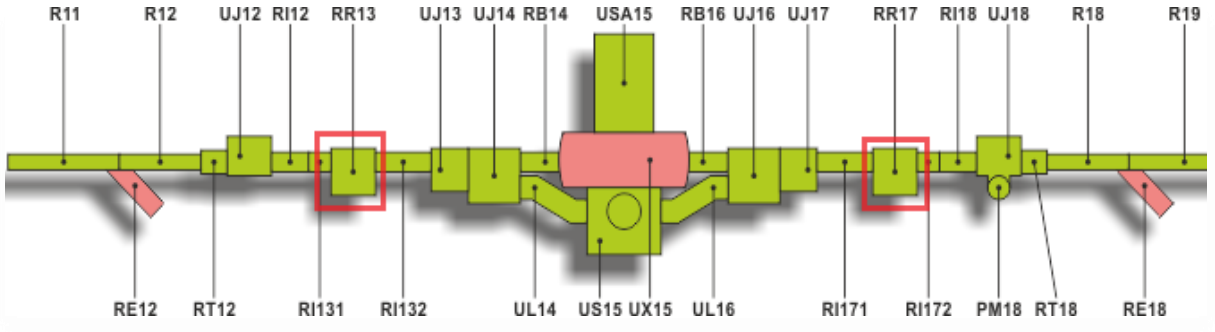
Type No.	Power converter name	Magnet Circuit	Current	Voltage	Quantity per IP side	Integration	PC technology
Type 1	RPAFE	Inner Triplet Mains	18kA	±8V	1	UR	New
Type 2	RPAFF	D1-D2	13kA	8V	2	UR	New
Type 3	RPHSB	Q4-Q5-Q6	6kA	8V	6	RR	Existing (for R2E Project)
Type 4	RPBAA	Inner Triplet Correctors - 2xIT Trims	±2kA	±10V	8	UR	New
Type 5	RPMBD	D2 Correctors	±600A	±10V	4	UR	Existing (for R2E Project)
Type 6	RPBAB	SF 2nd Order	±200A	±10V	1	UR	New
Type 7	RPLB (may be subject to change)	SF High Order - 1xIT Trim - Q4-Q5-Q6 Correctors	±120A	±10V	25	UR and RR	Existing (to be reevaluated)
Type 8	tbd	11 T Trim	±300A	±10V	1	RR73 and RR77	New

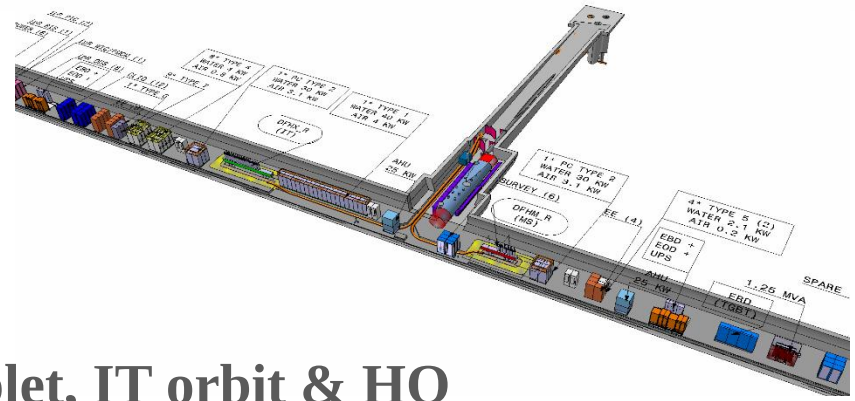




Power Converters for HL-LHC







Inner triplet, IT orbit & HO Correctors, D1, D2 and D2 correctors PCs are placed in the new URs @ points 1 and 5

Q4, Q5, Q6 & correctors PCs stay in the RRs

Power Converter Names

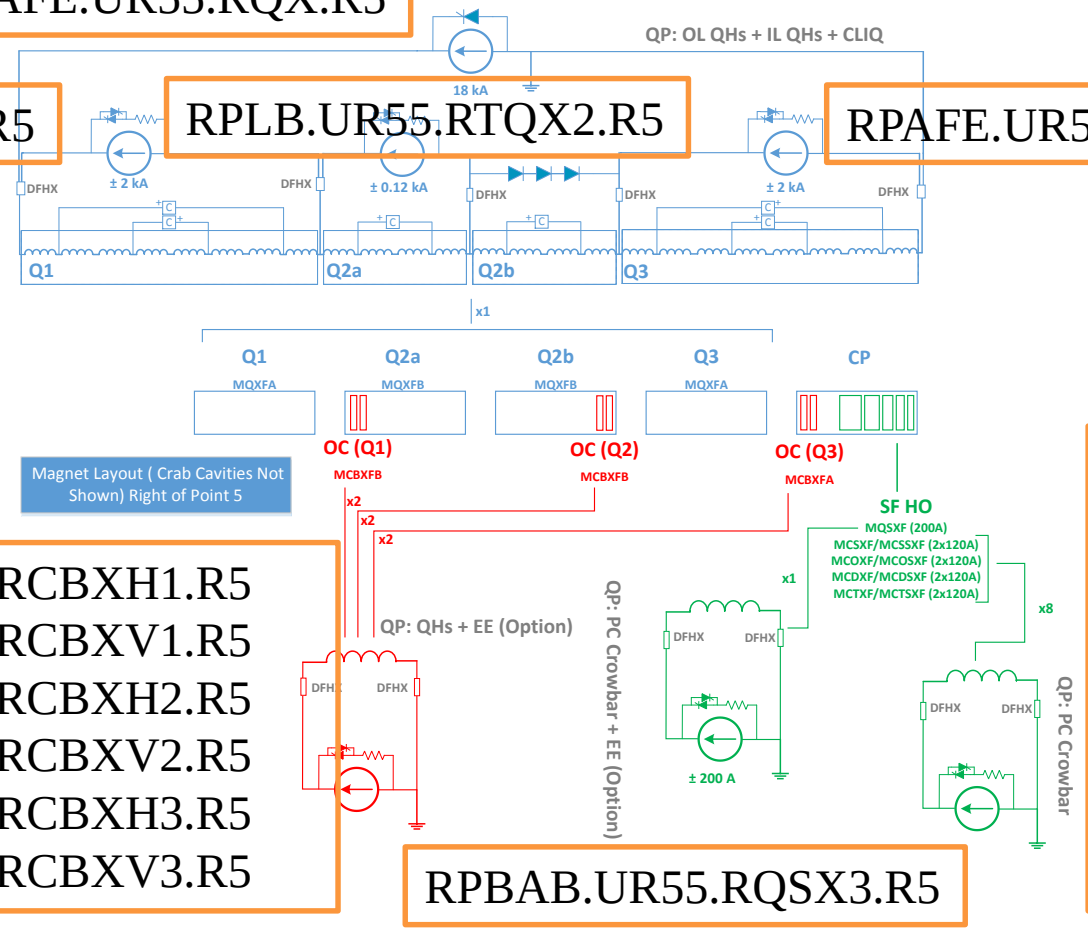
- PC_Family_Name.Machine_Position.Circuit_Name

RPAFE.UR55.RQX.R5

RPAFE.UR55.RTQX1.R5

RPLB.UR55.RTQX2.R5

RPAFE.UR55.RTQX3.R5



RPAFE.UR55.RCBXH1.R5
RPAFE.UR55.RCBXV1.R5
RPAFE.UR55.RCBXH2.R5
RPAFE.UR55.RCBXV2.R5
RPAFE.UR55.RCBXH3.R5
RPAFE.UR55.RCBXV3.R5

RPBAB.UR55.RQSX3.R5

RPLB.UR55.RCSX3.R5
RPLB.UR55.RCSSX3.R5
RPLB.UR55.RCOX3.R5
RPLB.UR55.RCOSX3.R5
RPLB.UR55.RCDX3.R5
RPLB.UR55.RCDSX3.R5
RPLB.UR55.RCTX3.R5
RPLB.UR55.RCTSX3.R5

Power Converter Names

- PC_Family_Name.Machine_Position.Circuit_Name

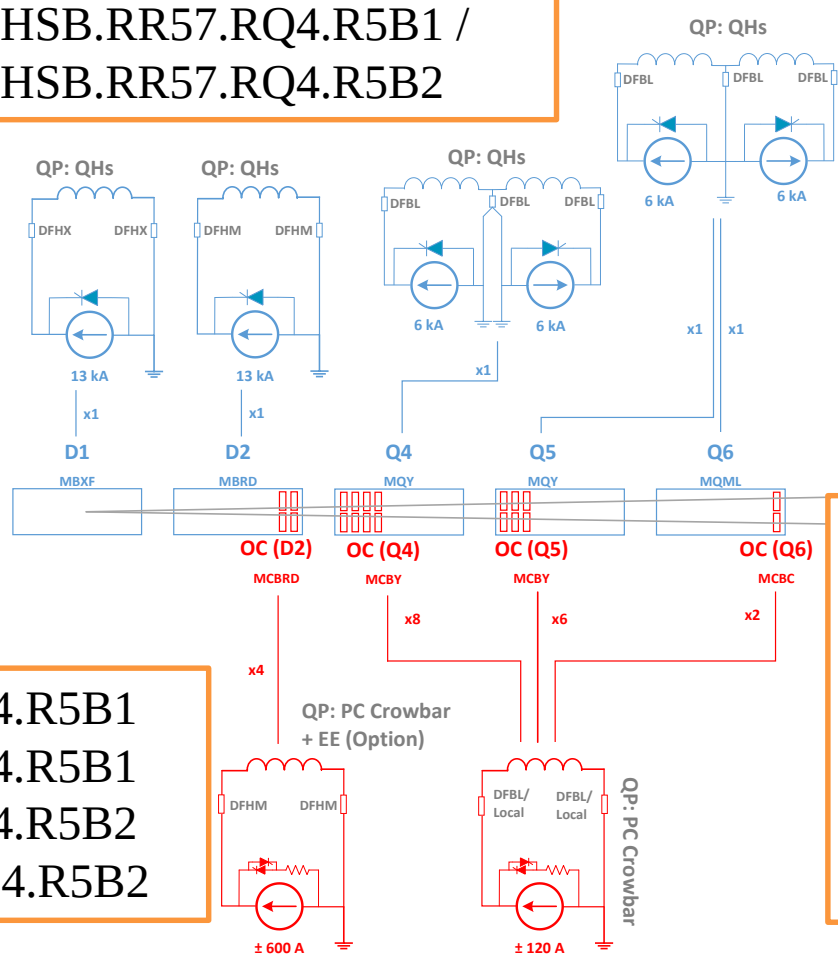
RPHSB.RR57.RQ4.R5B1 /
RPHSB.RR57.RQ4.R5B2

RPHSB.RR57.RQ5.R5B1 /
RPHSB.RR57.RQ5.R5B2

RPHSB.RR57.RQ6.R5B1 /
RPHSB.RR57.RQ6.R5B2

RPAFF.UR55.RD1.R5

RPAFF.UR55.RD2.R5



Magnet Layout (Crab Cavities Not Shown) Right of Point 5

RPMBD.UR55.RCBRDH4.R5B1
RPMBD.UR55.RCBRDV4.R5B1
RPMBD.UR55.RCBRDV4.R5B2
RPMBD.UR55. RCBRDH4.R5B2

RPLB.RR57.RCBYV4.R5B1
RPLB.RR57.RCBYH4.R5B1
RPLB.RR57.RCBYVS4.R5B1
RPLB.RR57.RCBYHS4.R5B1

RPLB.RR57.RCBYH4.R5B2
RPLB.RR57.RCBYV4.R5B2
RPLB.RR57.RCBYHS4.R5B2
RPLB.RR57.RCBYVS4.R5B2

RPLB.RR57.RCBYHS5.R5B1
RPLB.RR57.RCBYVS5.R5B1
RPLB.RR57.RCBYH5.R5B1

RPLB.RR57.RCBYVS5.R5B2
RPLB.RR57.RCBYHS5.R5B2
RPLB.RR57.RCBYV5.R5B2

RPLB.RR57.RCBCV6.R5B1
RPLB.RR57.RCBCH6.R5B2

04

Conclusion

Conclusion

- Conceptual HL-LHC circuit layout presented
- Proposal of circuit names presented
- Power converters names presented (with exception of the 11T)
- Cold powering equipment to be named
- Protection equipment to be named

Thanks for your attention