INTEGRATION EQUIPMENT NOTE

INTEGRATION OF QUENCH HEATER DISCHARGE POWER SUPPLIES (DQHDS), POINT 1 AND POINT 5

Abstract

The new magnets for HL-LHC will require more Heater Discharge Power Supplies as part of the machine protection equipment. In this document we present a proposal for its integration in both Point 1 and Point 5.

Table 1: Summary of the proposal

Point	**MAGNETS**			
	Q1, Q2, Q3, CP and D1		**D2, Q4, Q5 and Q6**	
	Location of DQHDS	≈Max length [m]	Location of DQHDS	≈Max length [m]
1R	UL16	50	RR17	120
1L	UL14	50	RR13	120
5R	UL557	120/75	RR57	120
5L	USC55	72	RR53	120

Link to presentation for Point 1:
https://edms.cern.ch/document/1561909
Link to presentation for Point 5:
https://edms.cern.ch/document/1561911

TRACEABILITY

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Distribution: Hi-Lumi-WP15-CERN	

Rev. No.	***Date***	***Description of Changes*** *(major changes only, minor changes in EDMS)*

1 DESCRIPTION OF THE EQUIPMENT

1.1 DQHDS

110 Heater Discharge Power Supplies (DQHDS) are to be installed for each IP. They will be distributed as follows:

Table 2: Number of DQHDS per magnet

	Circuits for HiLumi	Magnet Type	Number DQHDS per IP side	Total number DQHDS for P1 and P5
Inner Triplet	Triplet Q1	MQXFA	12	48
	Triplet Q2a	MQFXB	12	48
	Triplet Q2b	MQFXB	12	48
	Triplet Q3	MQXFA	12	48
	Trim Q1		-	-
	Trim Q2		-	-
	Trim Q3		-	-
	Orbit correctors Q2a/b - vertical	MCBXFBV	8	32
	Orbit correctors Q2a/b - horizontal	MCBXFBH	8	32
	Orbit correctors CP - vertical	MCBXFAV	4	16
	Orbit correctors CP - horizontal	MCBXFAH	4	16
	Superferric, order 2	MQSXF	-	-
	Superferric, order 3, normal and skew	MCSXF / MCSSXF	-	-
	Superferric, order 4, normal and skew	MCOXF / MCOSXF	-	-
	Superferric, order 5, normal and skew	MCDXF / MCDSXF	-	-
	Superferric, order 6	MCTXF	-	-
	Superferric, order 6, skew	MCTSXF	-	-
D1	Separation dipole D1; MBXF	MBXF	4	16
D2	Separation dipole D2;MBRD	MBRD	4	16
	Orbit correctors D2	MCBRD	-	-
Q4	Large aperture 2-in1 Quad; Q4	MQY	4	16
	Orbit correctors Q4	MCBY	-	-
Q5	Present LHC Q4 magnet	MQY	4	16
	Orbit correctors present Q4	MCBY	-	-
Q6	Insertion Quad, 2-in1 aperture; Q6	MQML	2	8
	Orbit correctors Q6	MCBC	-	-
11T	11T dipole, MBH	11T dipole, MBH	16	64
	Trim circuit		-	-

The dimensions in mm of one power supply are sketched in the following image:

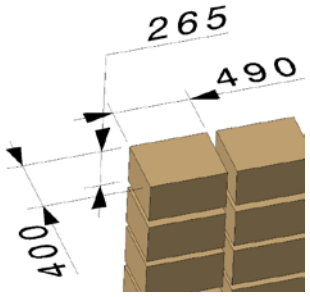

Figure 1: Dimensions of a DQHDS

For every 6 HDS a current transformer is required. It takes the same place as a HDS (490x265x400mm). So for the 90 DQHDS, a total of 15 transformers are required. In terms of space, this means that 105 modules of 490x265x400mm should be foreseen per IP side. Considering that they will be inserted in racks that hold 7 of this units, this gives us a total of **16 racks per IP side** considering that not all the racks will be full. A 3D representation of the racks can be seen in Figures 1 and 2. Please note that this representation shows the racks if they were all placed together, which will not be the case.

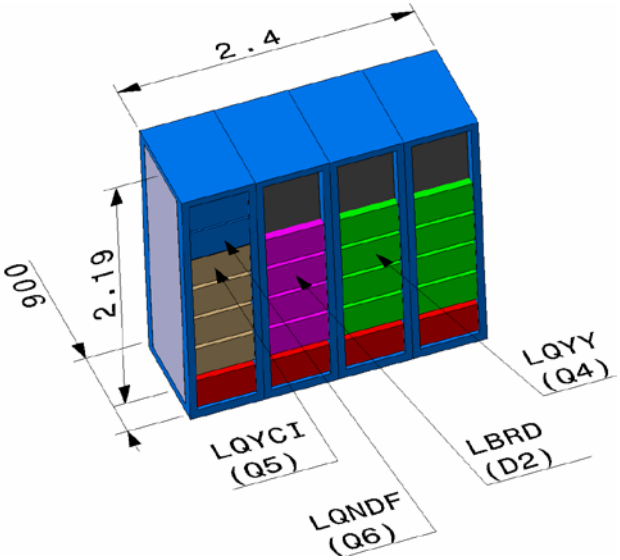

Figure 1: Preliminary footprint of all DQHPS for D2, Q4, Q5 and Q6

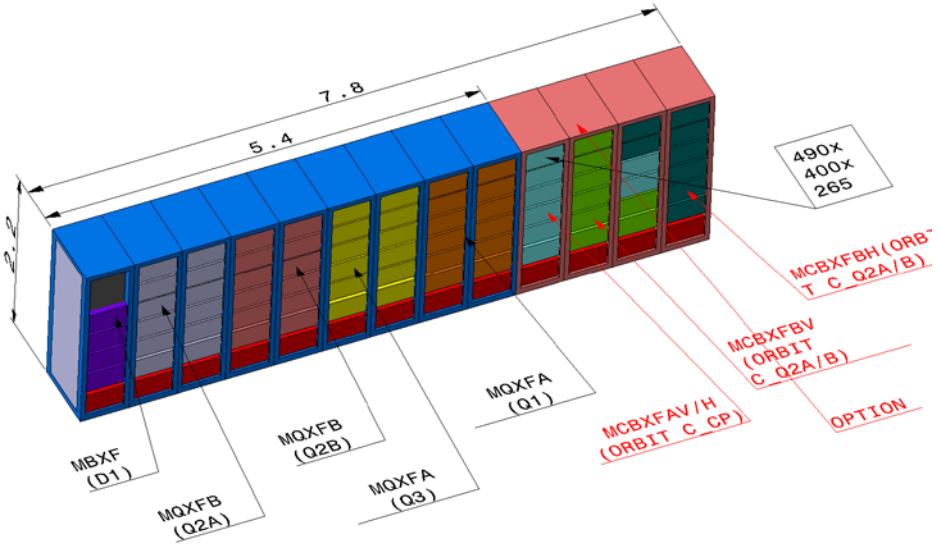

Figure 2: Preliminary footprint of all DQHPS for Q1,Q2, Q3, CP and D1

2 INTEGRATION OF THE EQUIPMENT

2.1 Point 1

It should be stated that for the left side the solution would be symmetric to the presented here. To simplify, the DQHDS will be divided in two groups, one group which supplies the Q1, Q2, Q3, CP and D1 and other group which supplies D2, Q4, Q5 and Q6. They will be placed respectively inside the UL16 and RR17 (P1R) and UL14 and RR13 (P1L):

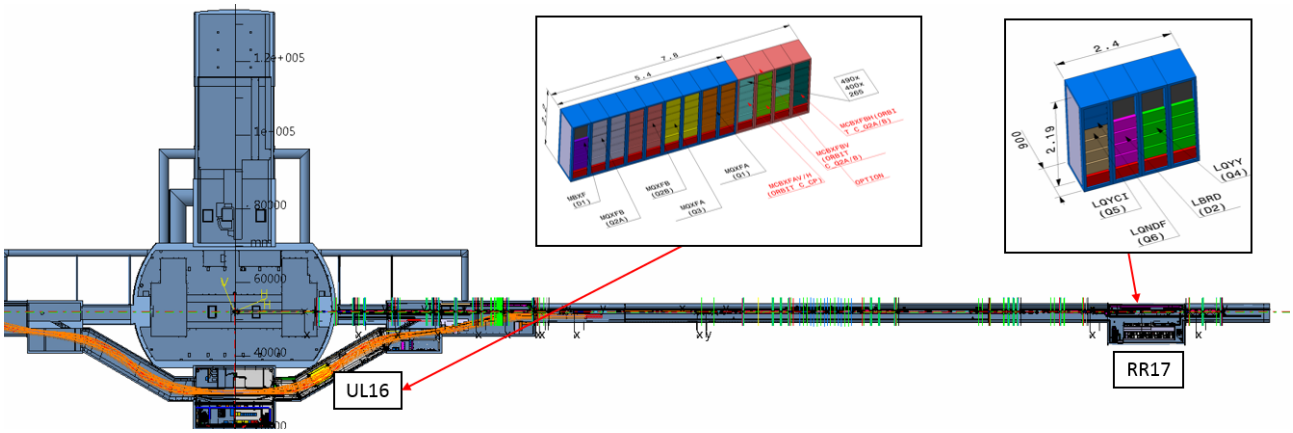

Figure 3: Overview of the integration (P1R) (ST0722100_01)

2.1.1 Q1, Q2, Q3, CP and D1: UL16

In the UL16, the power supplies will be installed close to the side of the tunnel, as shown in the following figure. The maximum cable length for this case would be of 50m for the Q1 and D1:

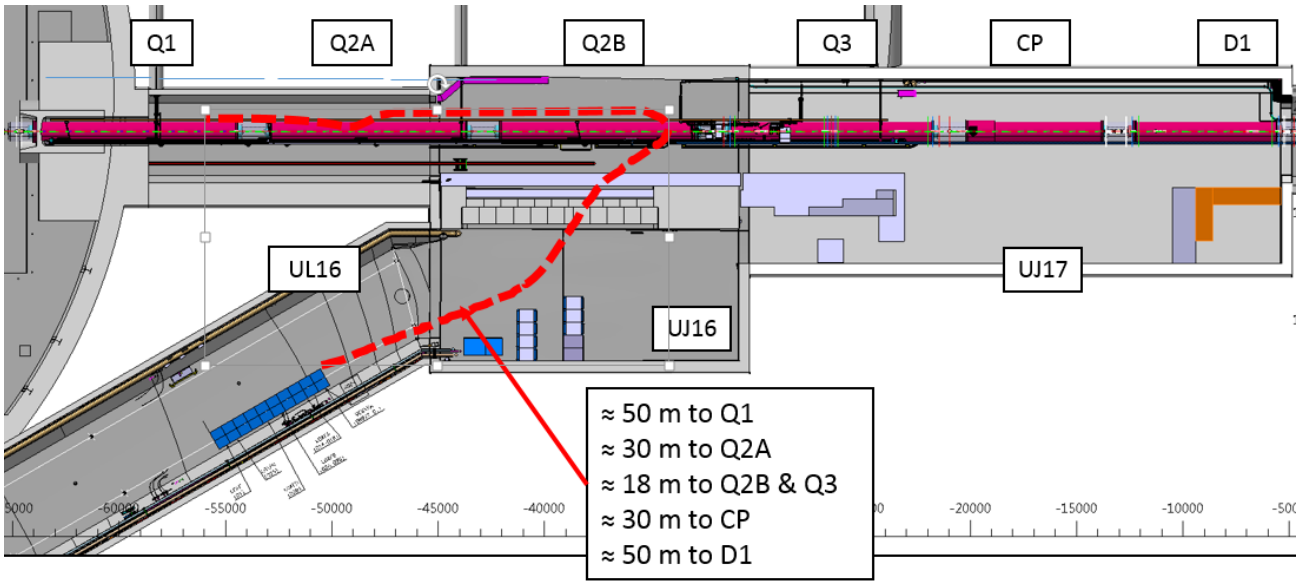

Figure 4: Position of the equipment and draft of the cabling (ST…)

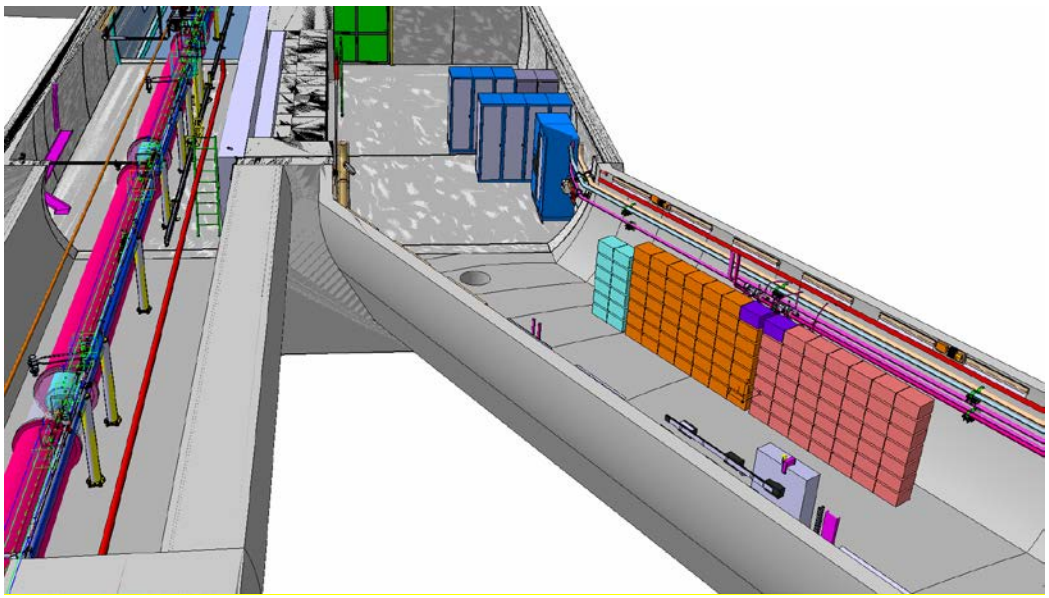

Figure 5: 3D view of the integration in UL16, UJ16 and LHC tunnel) (ST…)

2.1.2 D2, Q4, Q5 and Q6

Magnets D2, Q4, Q5 and Q6 are powered from the RR17 (P1R) and RR13 (P1L). Therefore the three racks in the first floor (DYPG01, DYPG02 and DYPG03) used for LHC will be reused for HL-LHC. However, due to the increase of 4 DQHDS for HL-LHC with respect to LHC, one more rack is needed. One of the racks that is currently not assigned has to be assigned to the QPS. This rack will be assigned for the protection of D2.

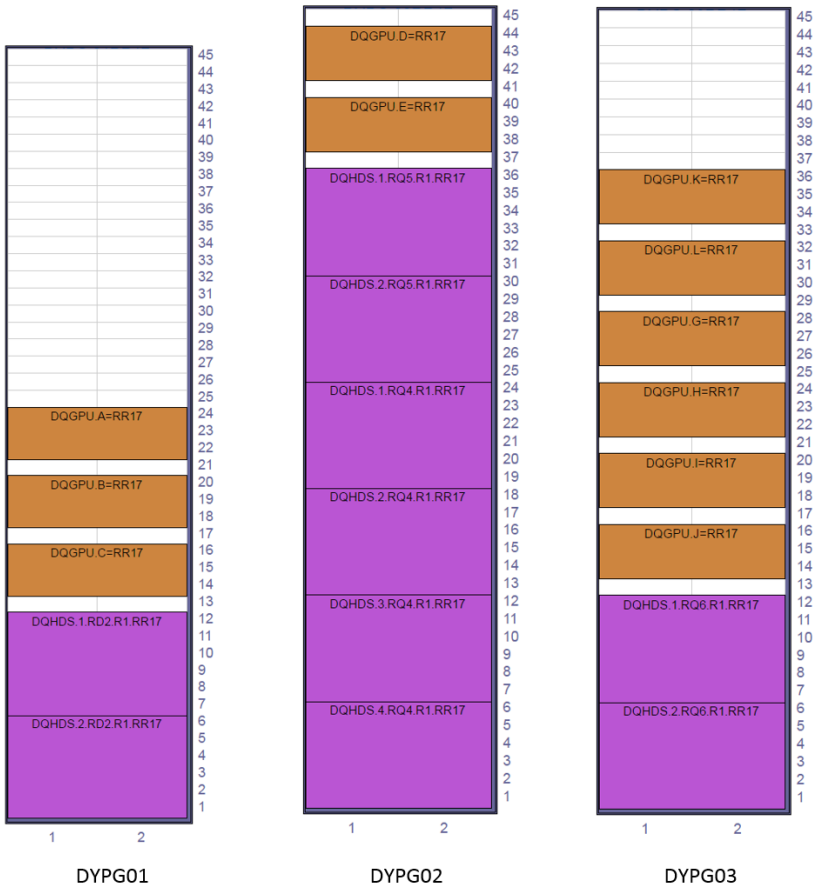

Figure 6: LHC QPS racks for DQHDS in RR17

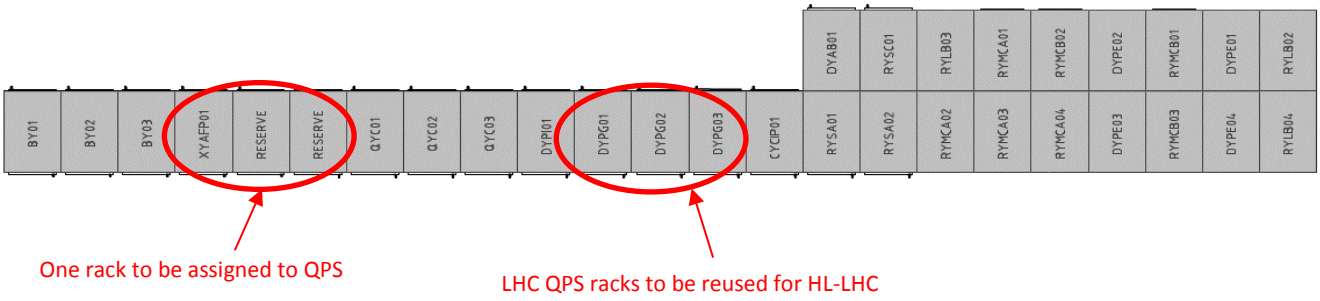

Figure 7: LHC QPS racks for DQHDS in RR17

2.2 Point 5

Due to the existing assimetry of the infrastructures in P5 we have two different solutions for integrating the DQHDS of the inner triplets, D1 and CP in P5L and P5R.

2.2.1 P5R

Similarly to Point 1, the DQHDS would be integrated in two different places: UL557 and RR57

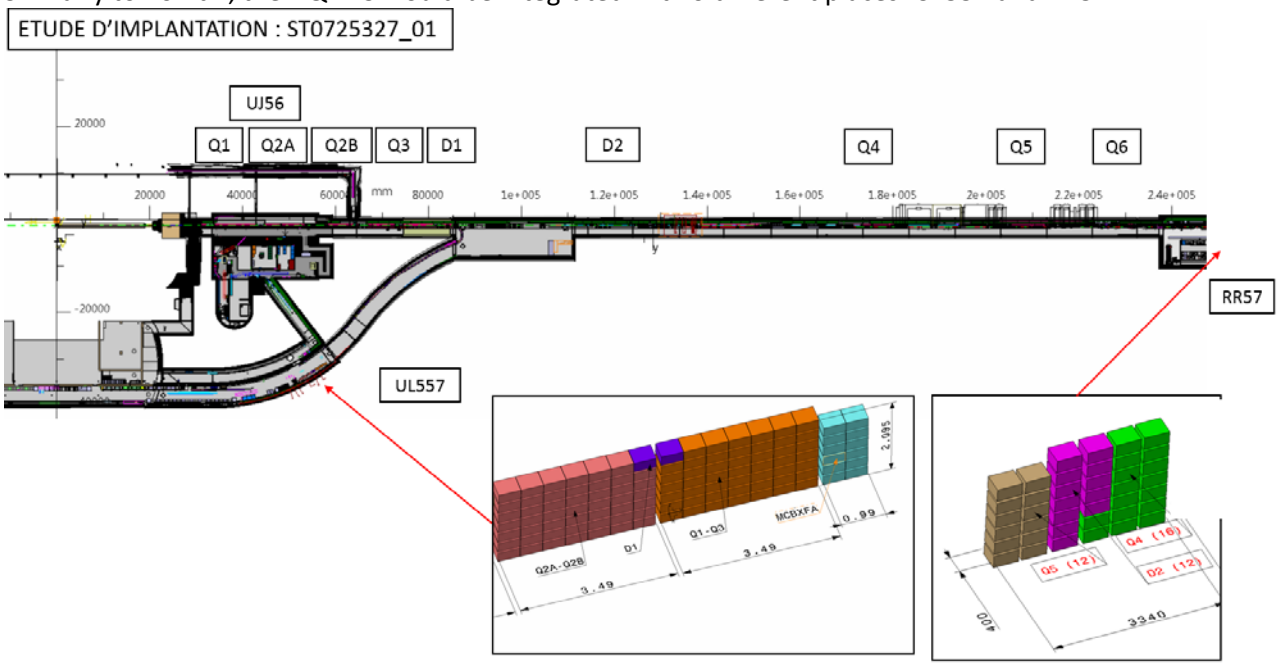

Figure 7: Overview of the integration (from ST0725327_01)

2.2.2 Q1, Q2, Q3, CP and D1: UL557

In the following picture, the main cabling draft is coloured with the red line with a maximum lengh of approximately 120m, but a shorter alternative (orange dashed line) with a maximum length of 75 m goingh through existing cores parallel to TU56 has also been studied.

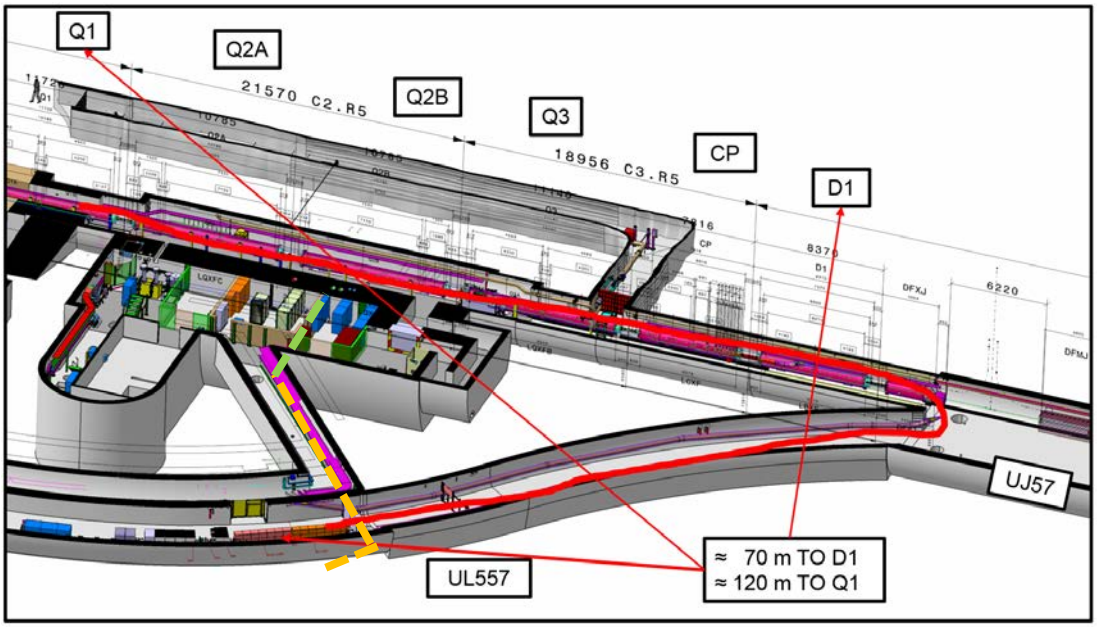

Figure 8: Position of the equipment and draft of the cabling, option 1

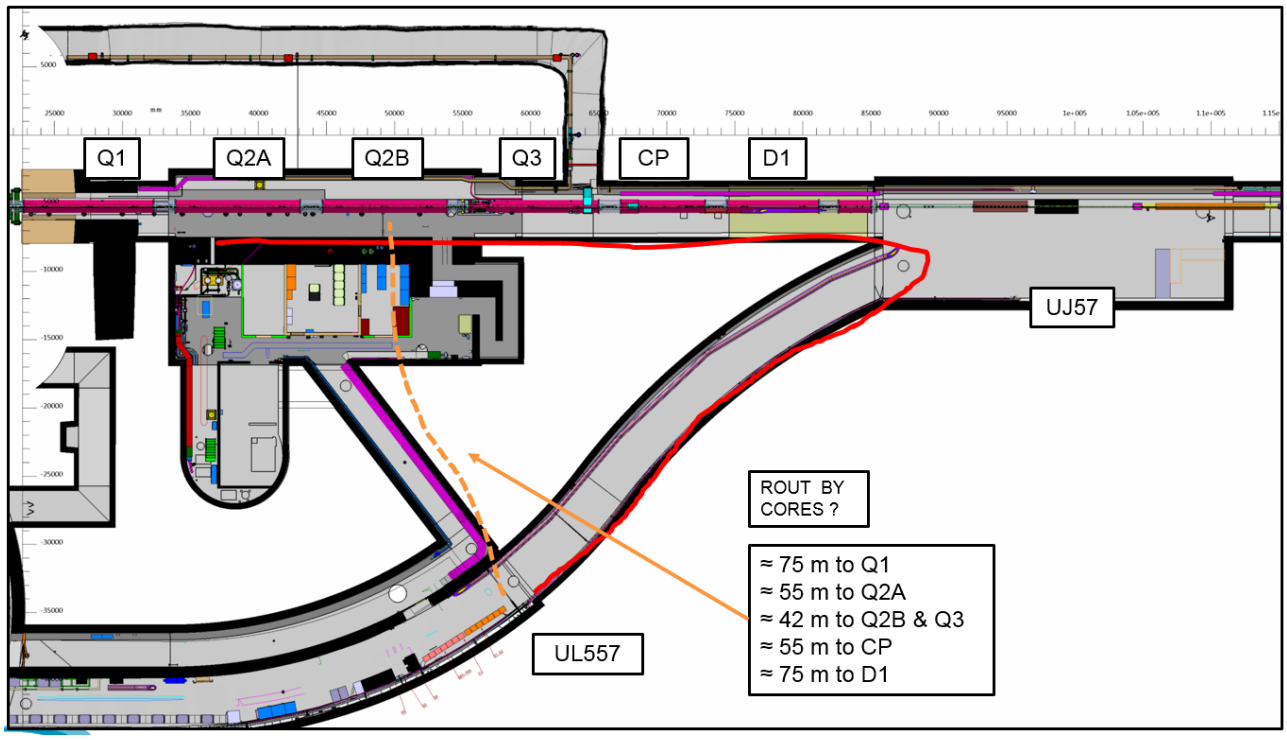

Figure 10: Position of the equipment and draft of the cabling if layout is through cores, option 2

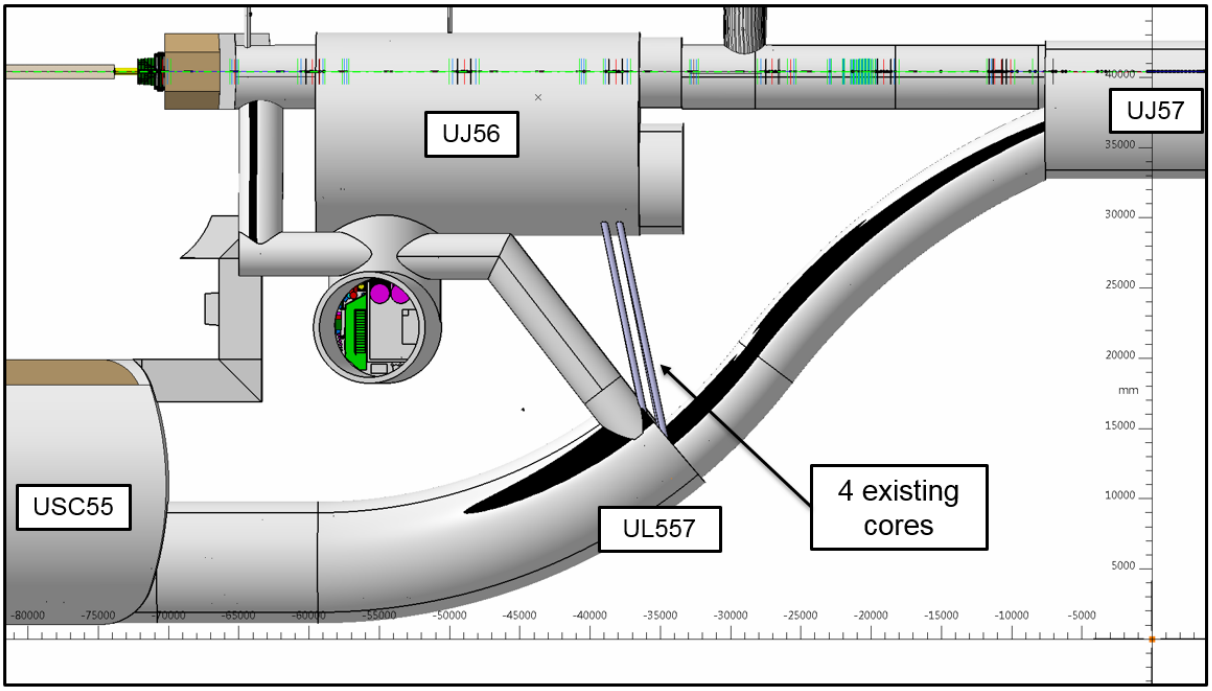

Figure 11: Existing cores for option 2

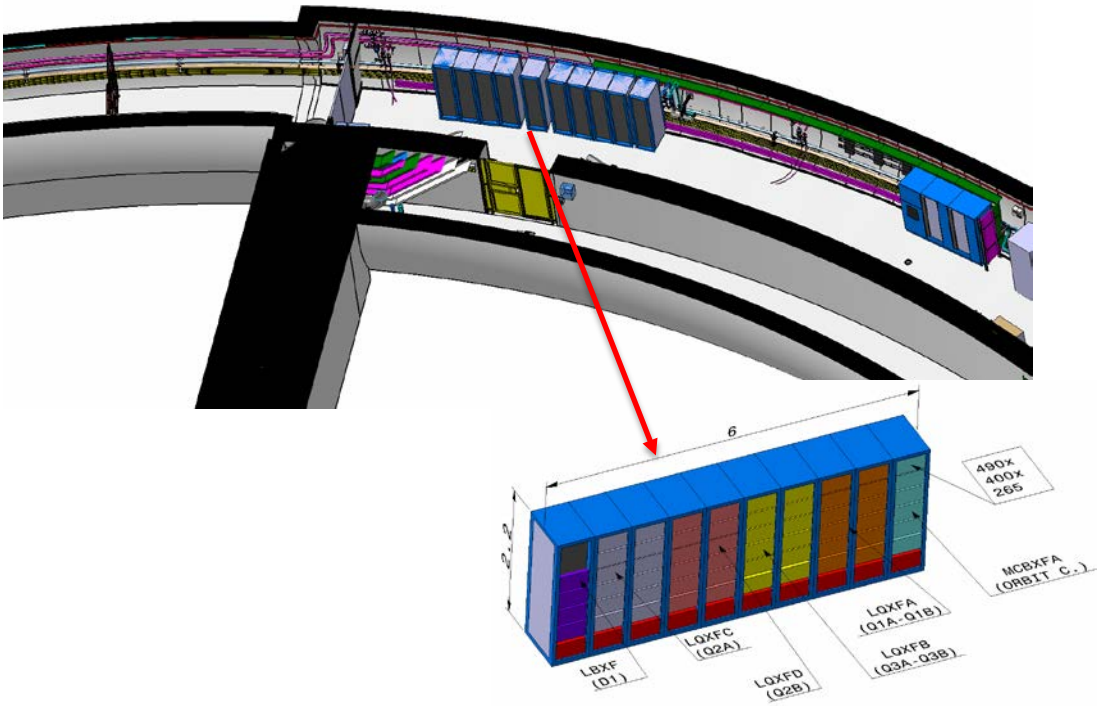

Figure 11: 3D view of the integration of the racks

2.2.3 D2, Q4, Q5 and Q6: RR57

Magnets D2, Q4, Q5 and Q6 are powered from the RR57 (P1R) and RR53 (P1L). Therefore the three racks in the first floor (DYPG01, DYPG02 and DYPG03) used for LHC will be reused for HL-LHC. However, due to the increase of 4 DQHDS for HL-LHC with respect to LHC, one more rack is needed. One of the racks that is currently not assigned has to be assigned to QPS. This rack will be assigned for the protection of D2.

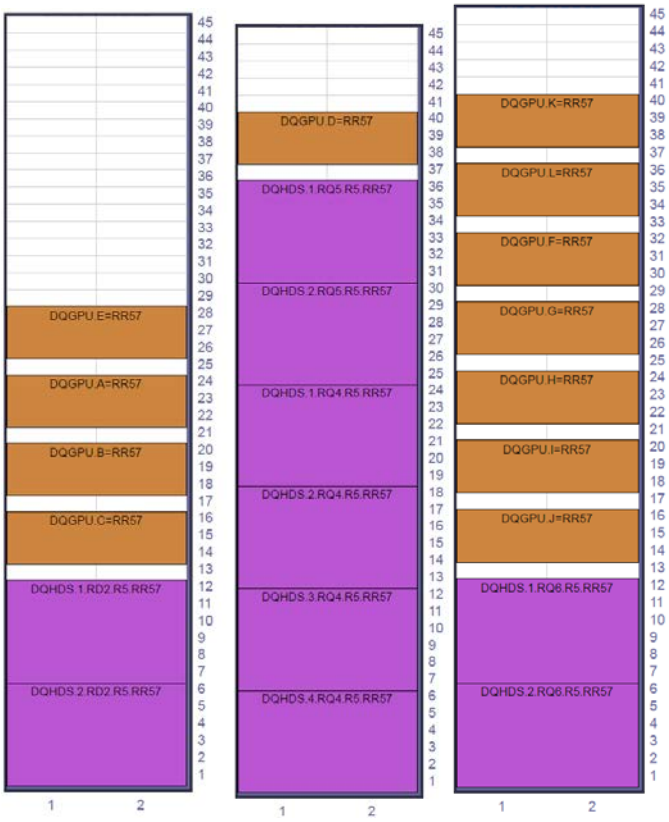

Figure 11: LHC QPS racks for DQHDS in RR57

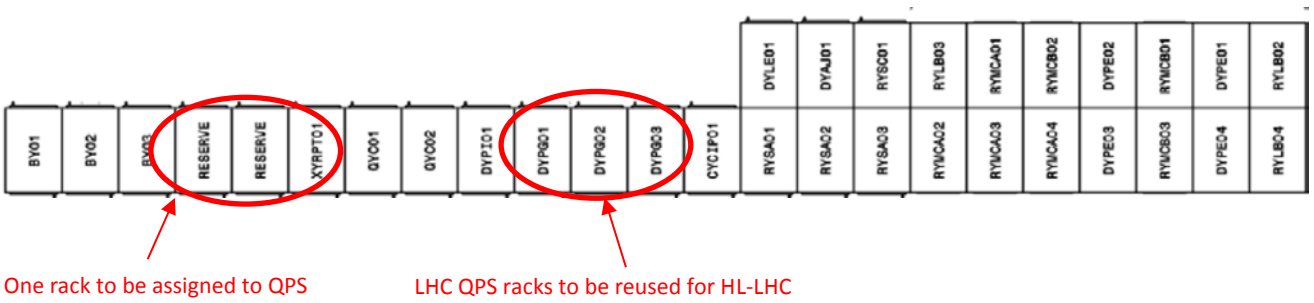

Figure 12: LHC QPS racks for DQHDS in RR57

2.3 Point 5 Left

2.3.1 Q1, Q2, Q3, CP and D1: USC55

In the left side the racks for the innter triplets, the CP and D1 will be placed in the service cavern USC55 and the cabling to the LHC tunnel will pass through existing cores. The space will be available after de-installing the equipment shown in figure 13.

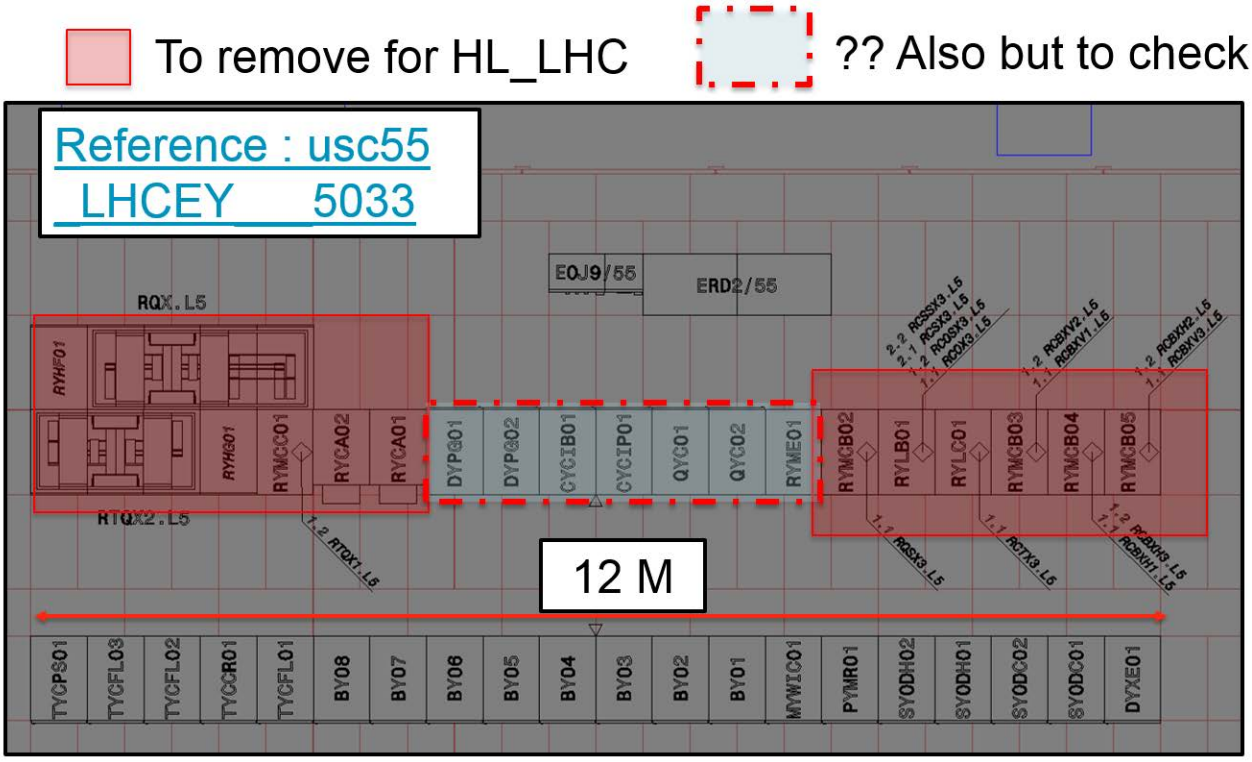

Figure 13: Equipment to be removed in USC55

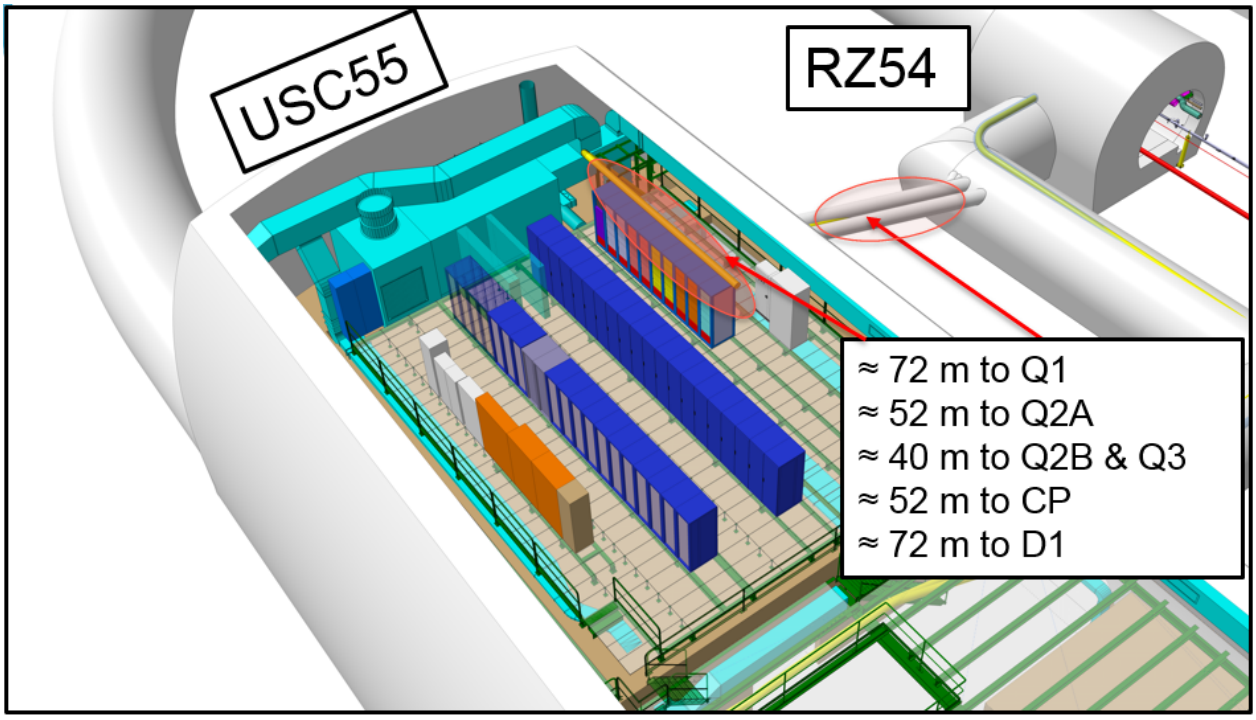

Figure 9: Integration in USC55 and cabling

2.3.2 D2, Q4, Q5 and Q6: RR53

The integration of the DQHDS for D2, Q4, Q5 and Q6 is symmetric to RR57 (see section 2.2.3).

3 PENDING ACTIONS

Table 3: List of pending actions

Location	Magnets	Action
P1, UL16/UL14	Q1, Q2, Q3, CP and D1	Integration of cables
P5R	Q1, Q2, Q3, CP and D1	Further study on options 1 and 2 for cabling layout
P5L	Q1, Q2, Q3, CP and D1	Identify if all the racks can be de-installed