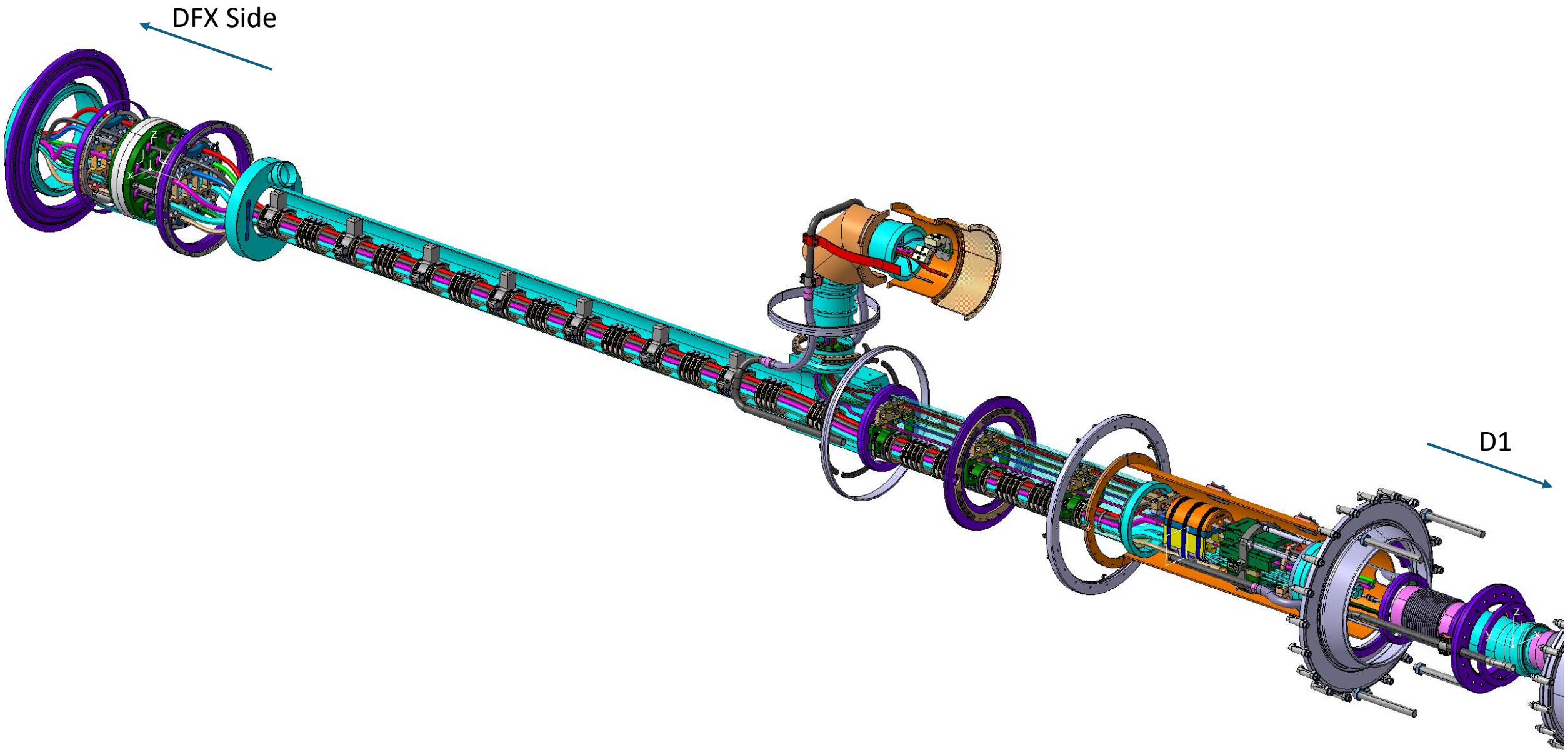
HL-LHC Nonconformity Report

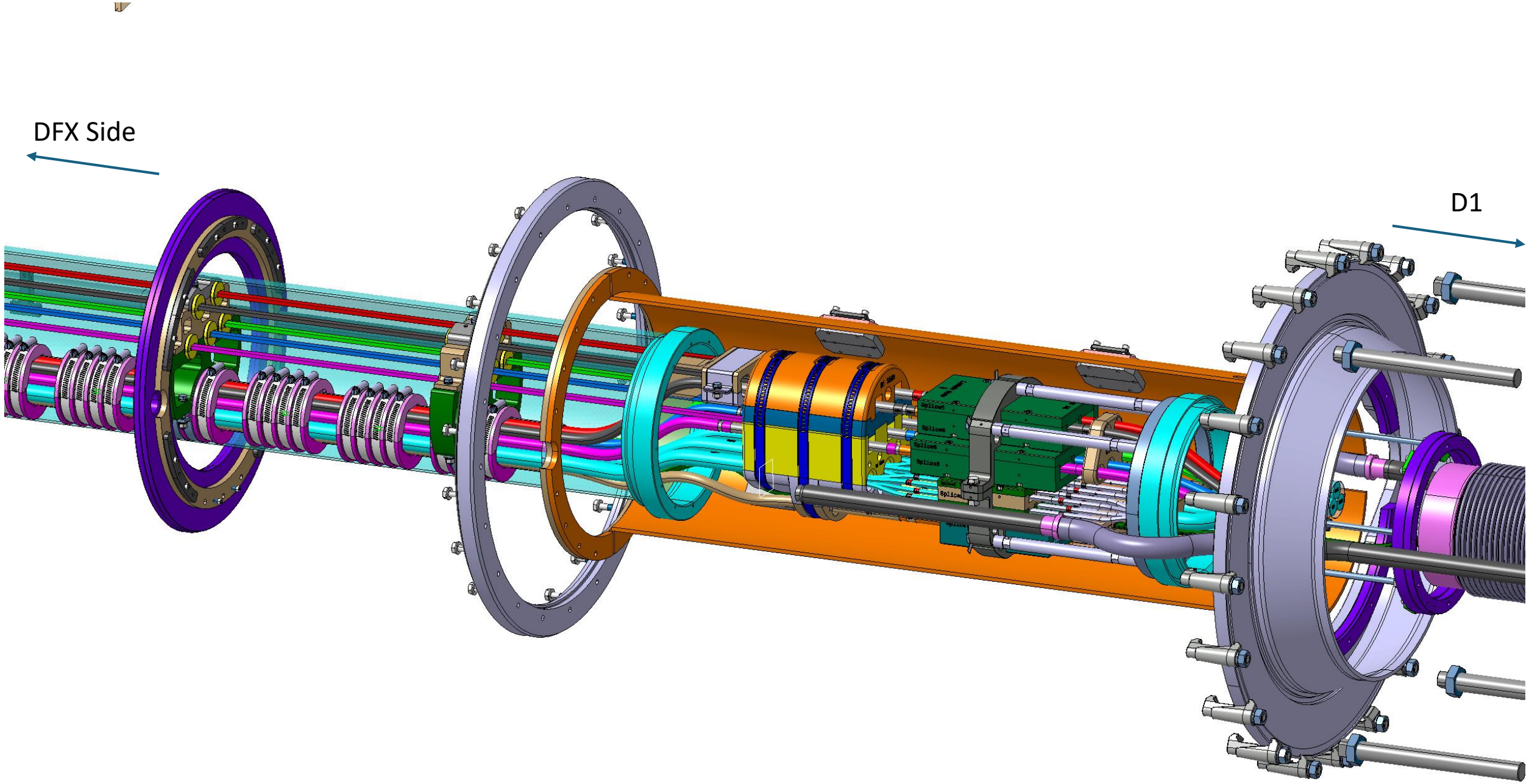
NCR-HCLDQD_366-CR000001-busbars cut too short

EDMS 3172552

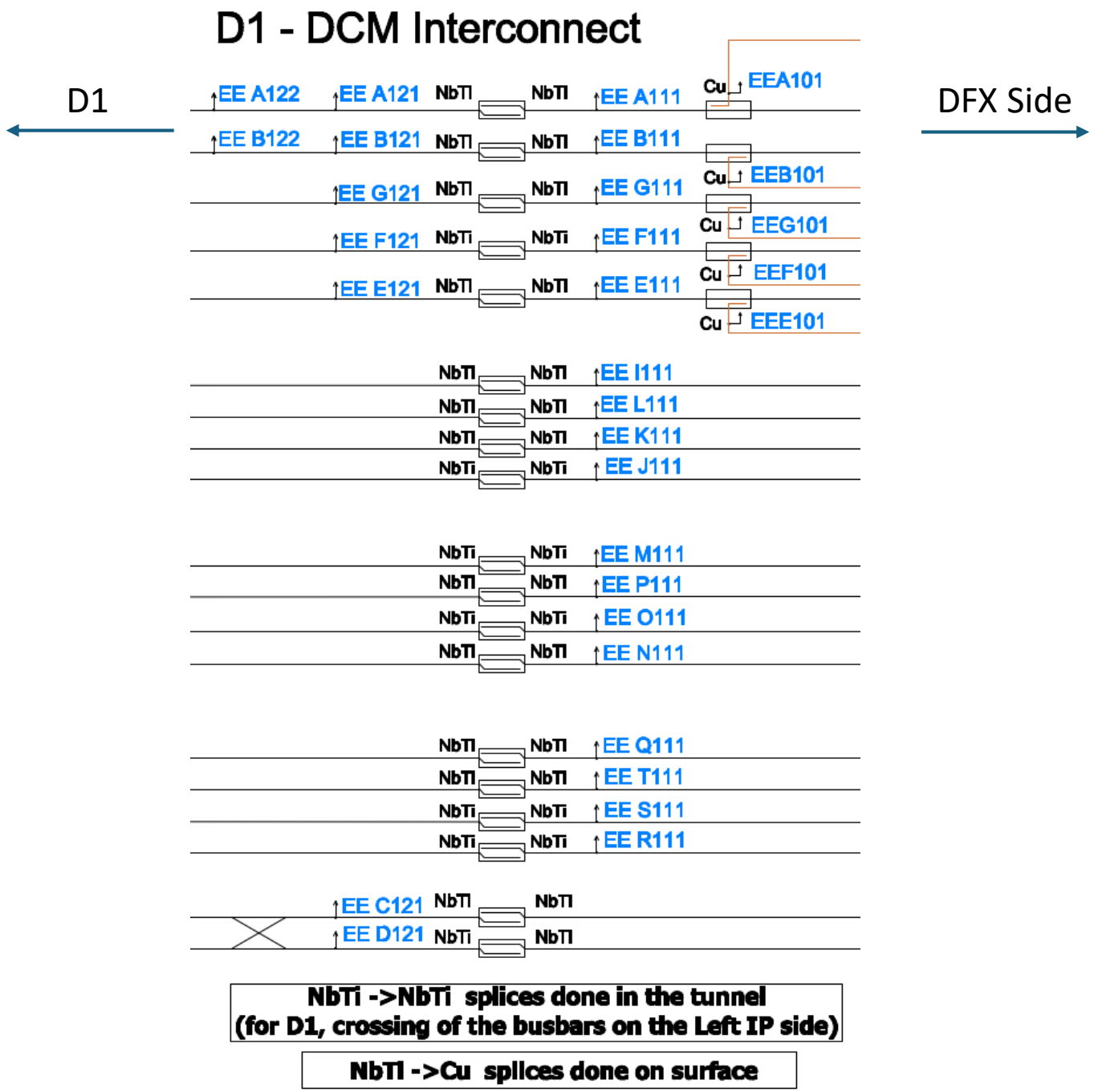
23 October 2024

- Technical discussion on dispositions after NC
- Redaction of the NCR

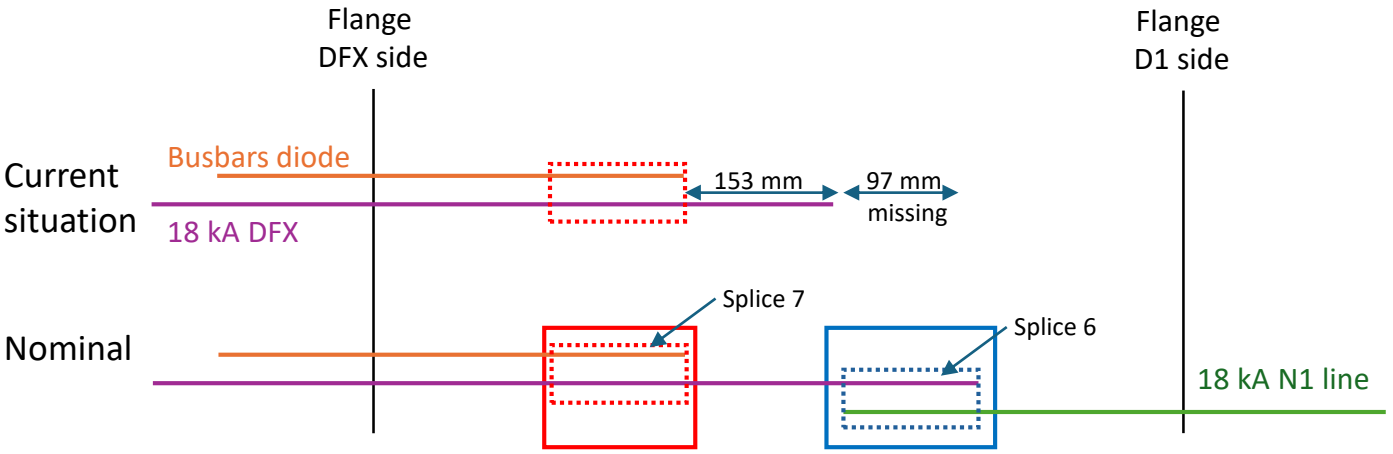

DFX Side
D1


DFX Side
D1

LHCLSDIX0001
LHCLSDIX General Instrumentation
Layout for the Inner Triplet

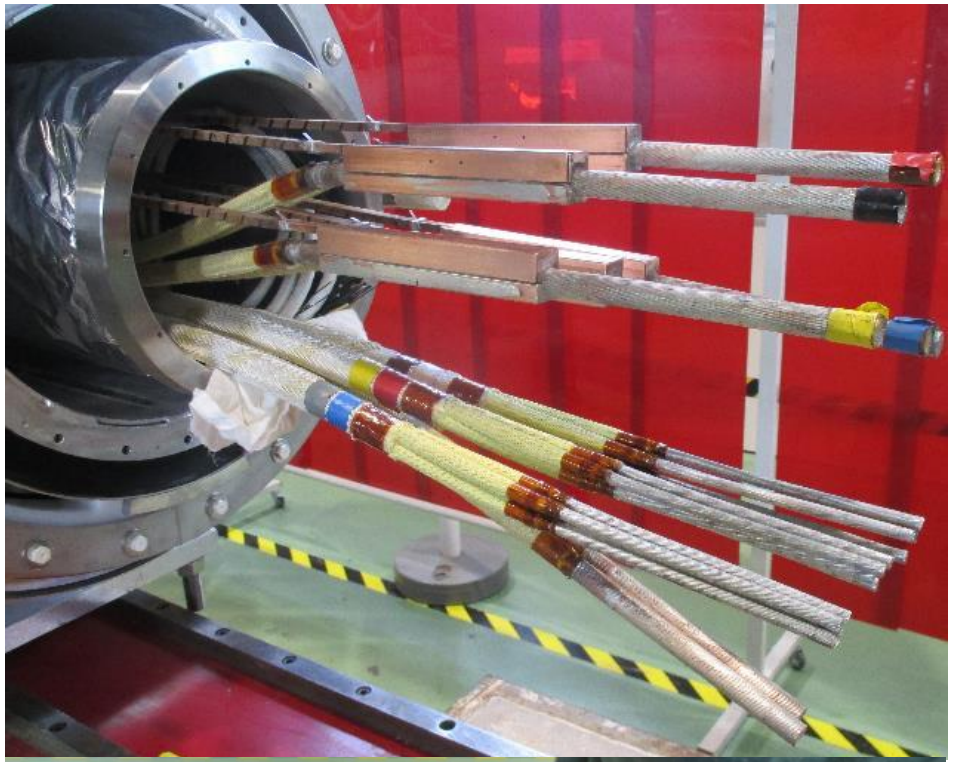


Current situation

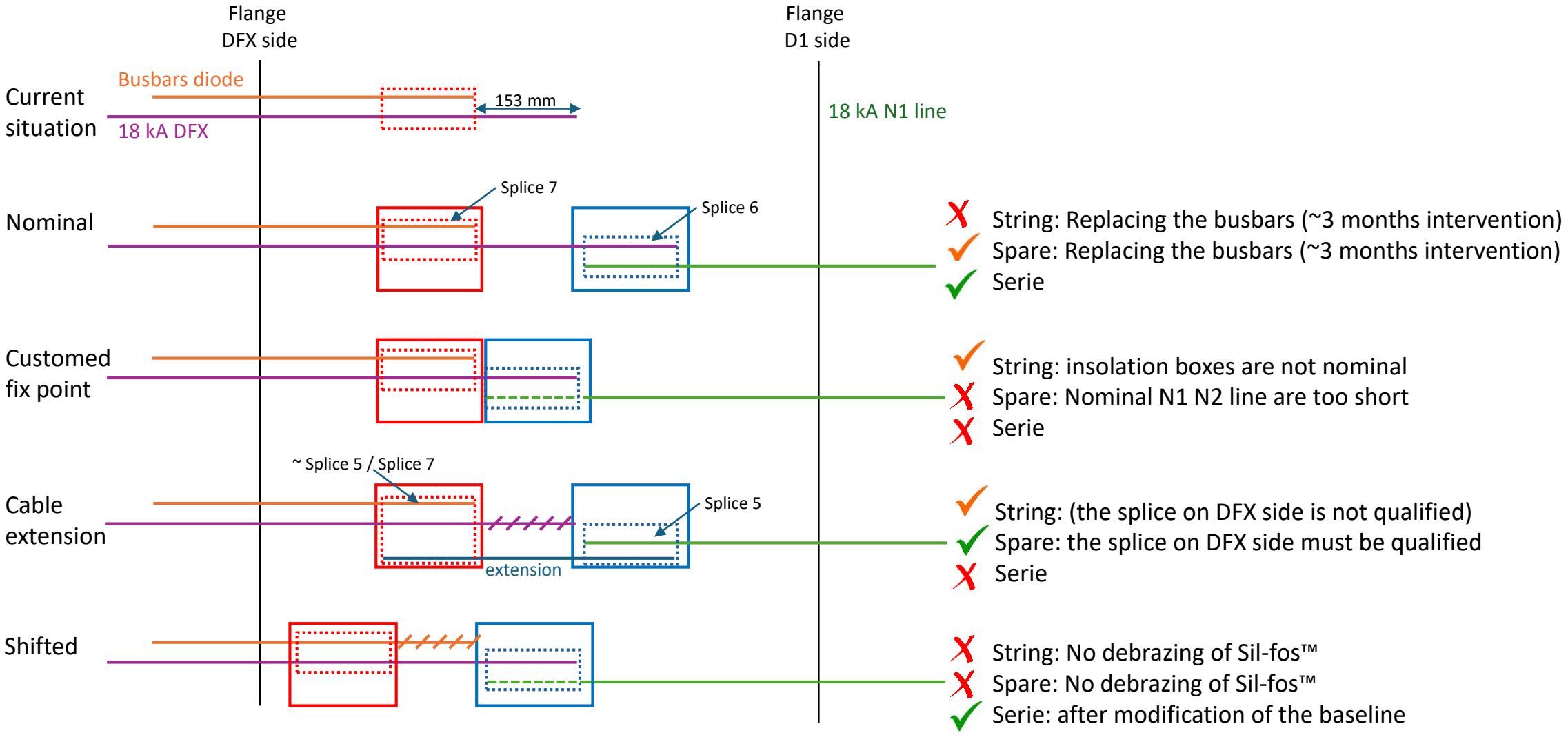


Replacing the busbars (~3 months intervention)
✗ Option discarded for the String

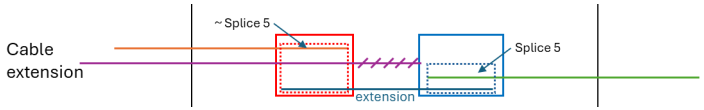
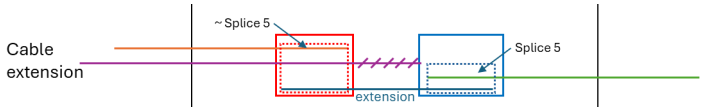
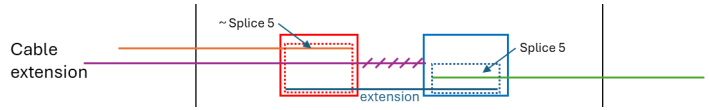
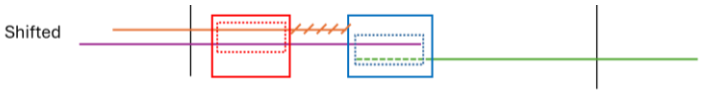
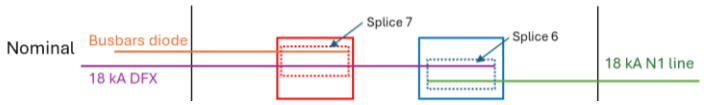
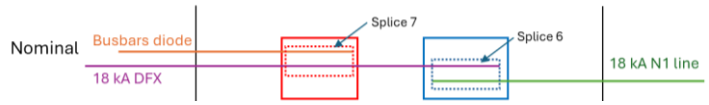
Reducing the length of the splice (150 mm for splice on 18 kA cables):
✗ Option discarded after zoom call with Arjan Verwiej and Sandrine



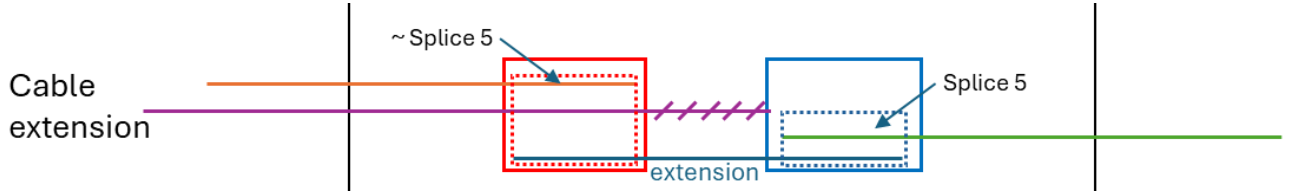
Alternatives

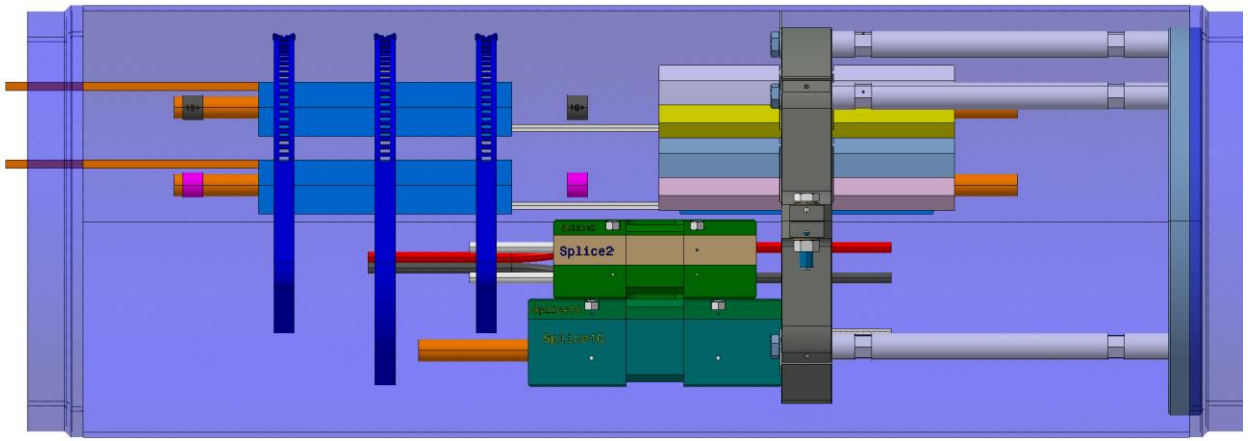


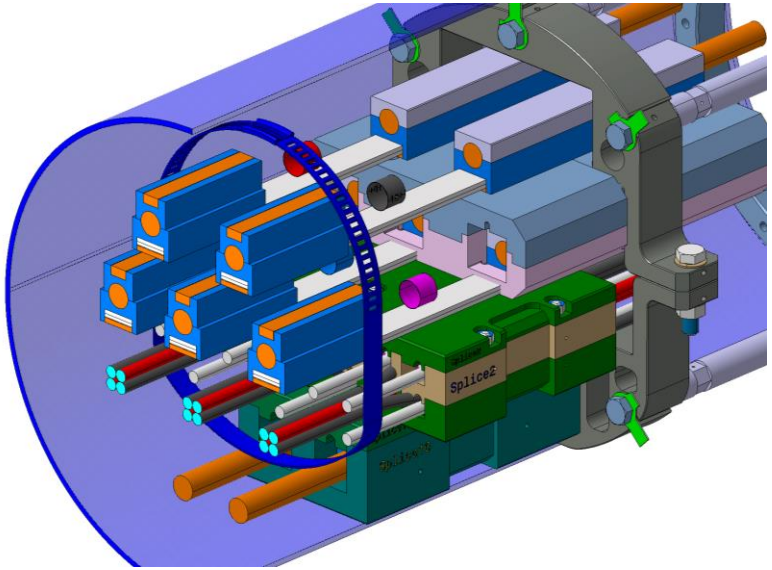
Alternatives for String, Spare and Serie

	Disposition 1	Disposition 2	Disposition 3
String			
Spare			
Serie			

Technical aspects



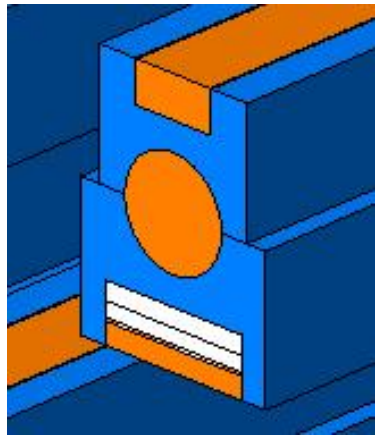




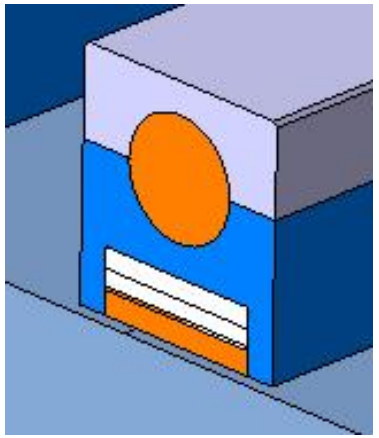
The splice on DCM side is assembled inside an insulation box ensuring several functions:

- ✓ Splice on D1 side (splice 5)
- ✓ Splice on DFX side (hybrid splice 7 /splice 5), not qualified

Hybrid Splice 7 / Splice 5

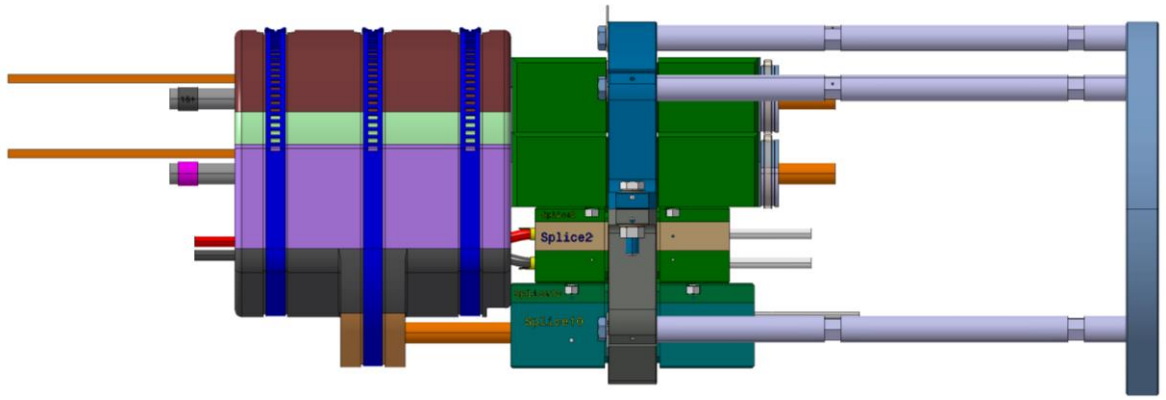


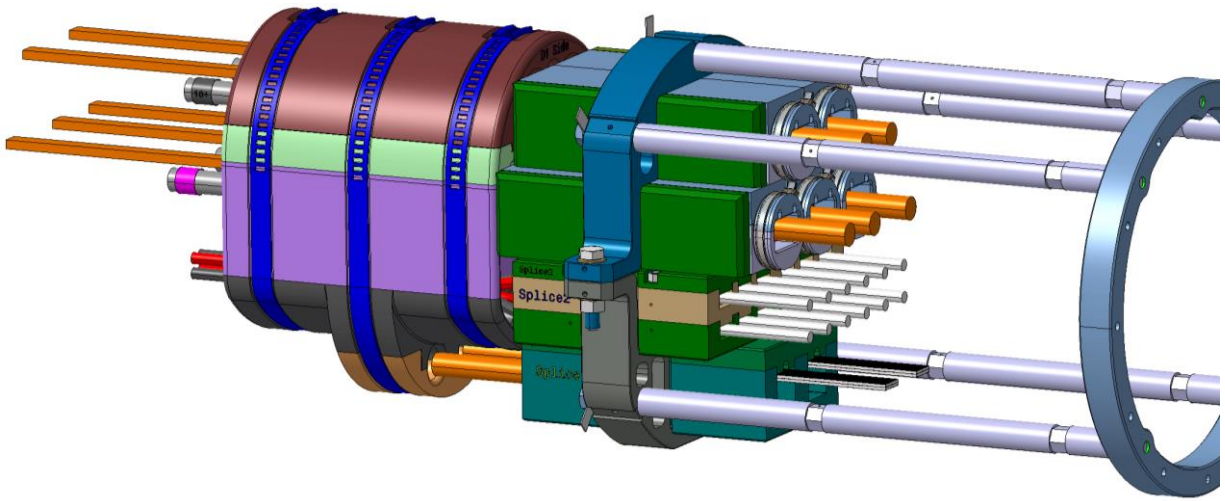
Splice 5



Splice resistance at cold measured at SM18:
Average: 0.592 nΩ
Max: 0.616 nΩ
Specification <1nΩ

Technical aspects



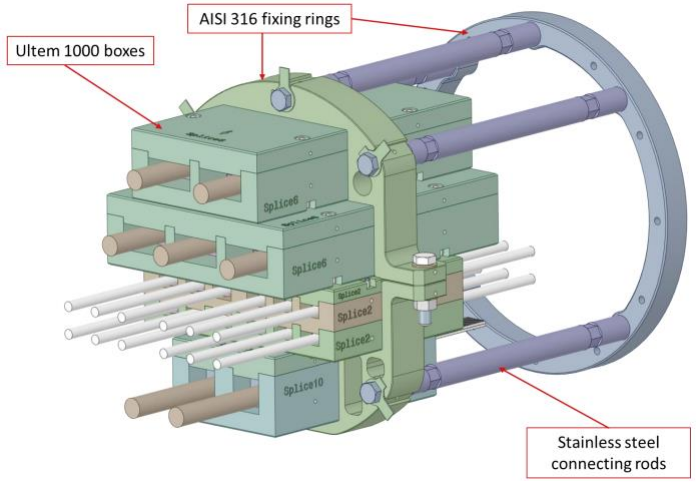


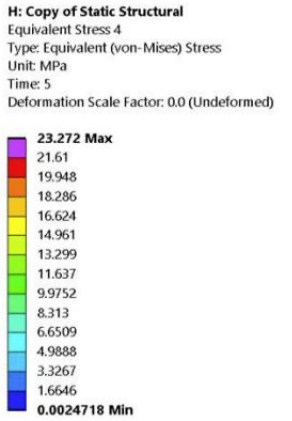
During STRING activities, the following dispositions will be implemented to move the splices on D1 side closer by 90mm towards DCM:

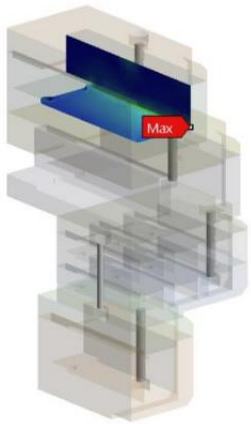
- The design of the insulation box installed around the splice on the D1 side need to be adapted to get it more compact in the longitudinal direction while insuring its functionalities.
- As the fix point as been shift by 90 mm, the mechanical design of the standoffs of the fixed point need to be extended.
- As the position of the splices is shifted, the effective length of the N1, N2 lines and D1 busbars, will be longer than nominal.
  - D1 busbars are already produced. The extra length foreseen during the fabrication is enough to cover this need.
  - N1 and N2 lines have not been produced yet. The nominal length will be increased by 90 mm.

- Precaution during installation:
  - splice 6 without heating up the splice 7 (risk of debrazing)
  - installation and isolation of the V-Taps and routing of the wires (modification of the mammoth)

Technical aspects







LC	MPa
1	17.5
2	15.4
3	18.1
4	19.7
5	23.3
6	18.7
7	22.1
8	16.5

Table 3: ULTEM™ RESIN 1000 strength properties [4].

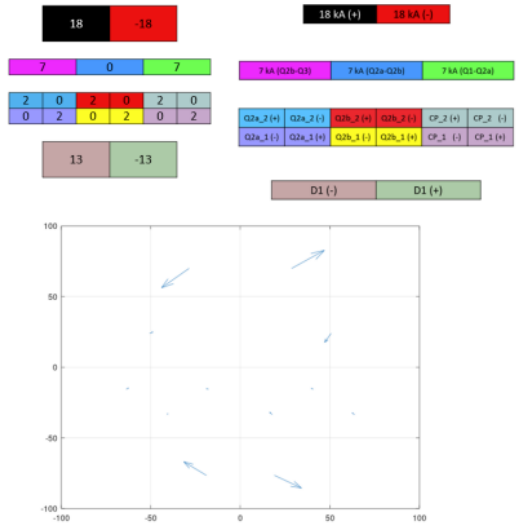
Strength Properties [MPa]	
Tensile Stress, yield, 50 mm/min	110

The splice on DCM side is assembled inside an insulation box ensuring several functions:

- withstand the Lorentz forces, (max 1600 N mostly radial, see EDMS 2773790 for assessment of nominal insolation box).
- fixed point in the longitudinal direction.
- insulations between the splices.

8.5 Currents' configuration #5

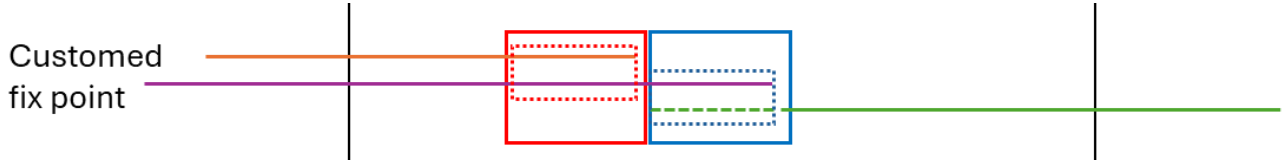
Cable	Current (kA)	F horizontal [N]	F vertical [N]	F resultant [N]
IT+	18	-1107.63	-986.544	1483.276
IT-	-18	1315.82	922.6867	1607.088
Triplets Q2b-Q3	7	130.8115	71.5456	149.0987
Triplets Q2a-Q2b	0	0	0	0
Triplets Q1-Q2a	7	-256.542	-455.478	522.7566
Q2a_2+	2	92.97245	59.56924	110.4191
Q2a_2-	0	0	0	0
Q2b_2+	2	-87.6896	26.75932	91.68166
Q2b_2-	0	0	0	0
CP_2+	2	-85.1835	42.4679	95.18271
CP_2-	0	0	0	0
Q2a_1-	0	0	0	0
Q2a_1+	2	11.744	62.70544	63.79572
Q2b_1-	0	0	0	0
Q2b_1+	2	-101.718	125.2864	161.3794
CP_1-	0	0	0	0
CP_1+	2	-94.9324	84.82225	127.3066
D1-	13	-909.716	694.151	1144.303
D1+	-13	1092.061	-647.972	1269.829



Force scheme: on the two axis we have the spatial positions of the cables
(and the application point of each force); forces' intensity and direction are represented by the arrows

Extracts of EDMS 2773790 Nominal insolation box

Technical aspects



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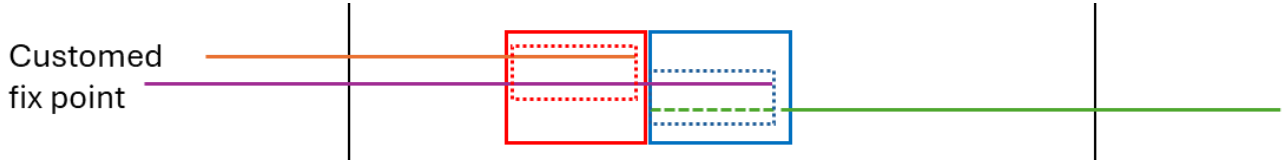
Visuel
clavette

Technical aspects



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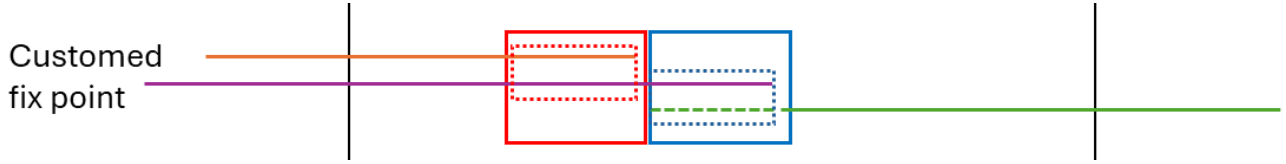

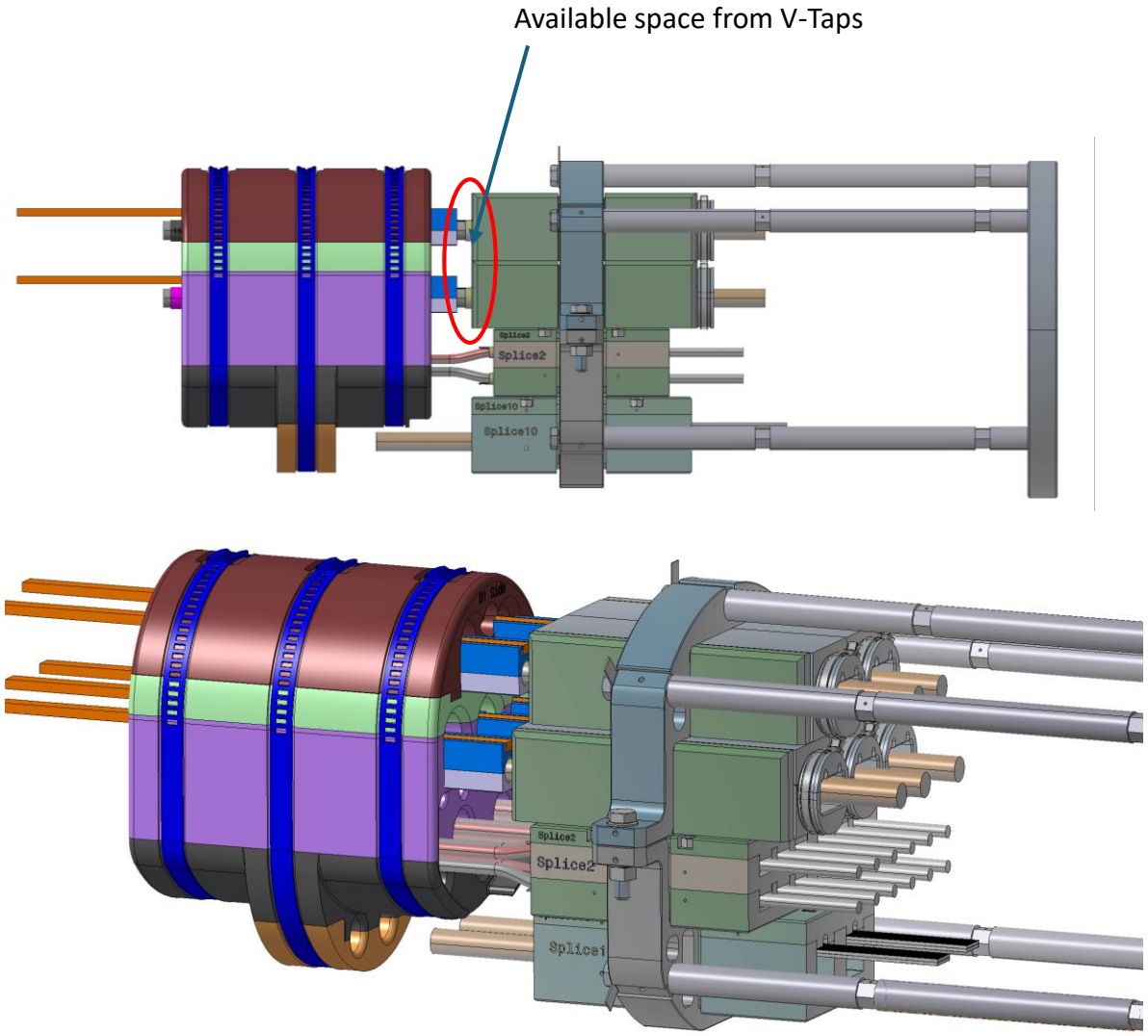

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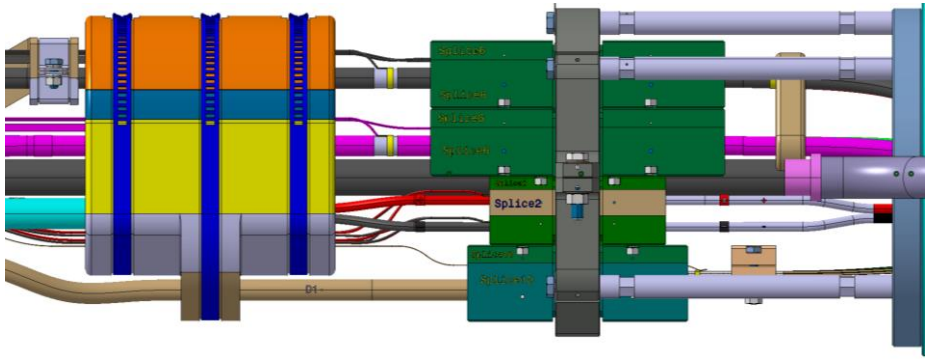
  - ✓ installation and isolation of the V-Taps and routing of the wires (modification of the mammoth)



V-Taps routing in nominal configuration