Electrical requirements of DFX components: specification and tests

A. Ballarino

DFX Detailed Design Review, CERN, 20/06/2019

Electrical components in DFX- Electrical Insulation

Electrical components:

Nb-Ti bus-bar from SC Link

Nb-Ti bus-bar from the λ-plate

Instrumentation signals (see next presentation)

Instrumentation connectors

System includes electrical splices (Nb-Ti to Nb-Ti done in the tunnel)

EDMS 1821907

Validated by MCF

DFX

Rating (kA)	Worst case voltage to ground during operation (V)	Acceptance tests of components to ground (V)		Insulation test voltage of system to ground (V)		Leakage current per component (μA)	Test duration (s)
		RT	NOC	RT	NOC		
18	900	4600	2300	460	1080	≤10	30
7	900	4600	2300	460	1080	≤10	30
2	540	3160	1580	316	648	≤10	30
0.2	540	3160	1580	316	648	≤10	30
0.12	40	1160	580	220	360	≤10	30
0.035	900	4600	2300	460	1080	≤10	30

RT → Room Temperature

NOC → He gas @ RT, 1 bar

Electrical components in DFX
Electrical Transients

EDMS 1821907

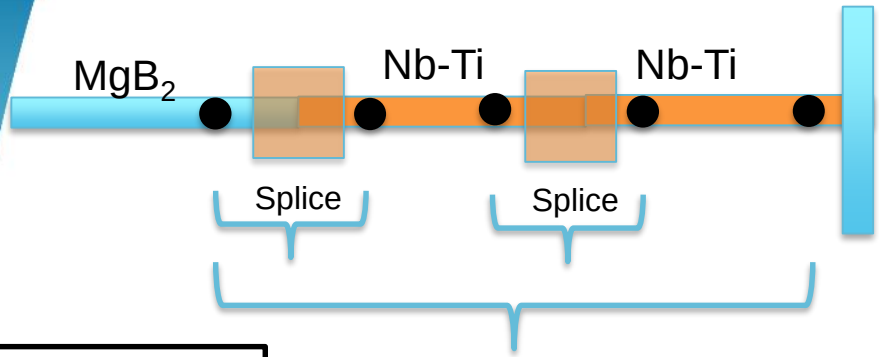
DFX

Rating (kA)	MIITs ($MA^2 \cdot s$)	dI/dt (kA/s)	τ_n (no quench of magnets) (s)	τ_Q (quench of magnets) (s)	Equivalent time (s)
18 (*)	32	250	130	0.2	0.1
7	5	250	130	0.2	0.12
2 (**)	1	20	20	0.5	-
0.2 (***)	0.02	0.25	21	0.8	-
0.12	0.02	0.22	5	0.8	-

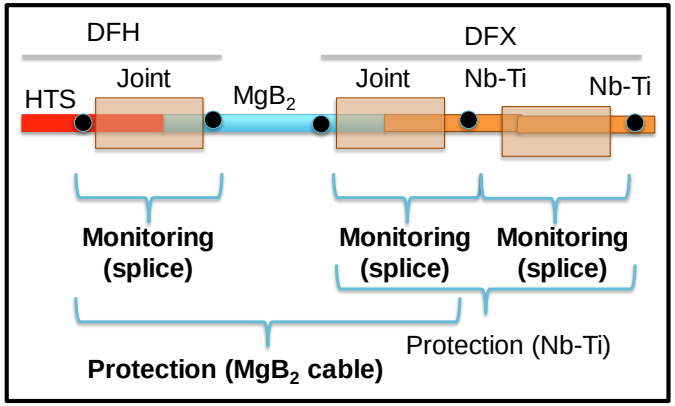
- Nb-Ti superconducting cables **AC losses** will be measured at Univ. of Twente on short (few meters long) cables with final design (contract being placed).
- **Full system** validation, including Nb-Ti cables, with **prototype system test in the SM-18** (Oct 2020)

Protection

https://indico.cern.ch/event/643197/timetable/#20170703



EDMS 1951502



International Review Cold Powering, July 2017

Monitoring of splices
Protection of bus-bar

EDMS 1951503

- Monitoring of individual splices requested
  - MgB_2 → HTS and MgB_2 → NbTi
  - Interlocking capability can be added on request

Cu stabilizer in Nb-Ti bus-bar limiting Tmax to < 100 K during transients

Redundancy of all signals

Instrumentation connectors

- Definition of connectors being discussed within MCF as part of a global strategy for HL-LHC

For the DFX:

- Large amount of signals to be extracted from the DFX
- Each connector grouping voltage taps from the same circuit
- Insulation of pins to ground according to table in slide 1
- Insulation between pins < 500 V in NOC

Thanks for your attention !