



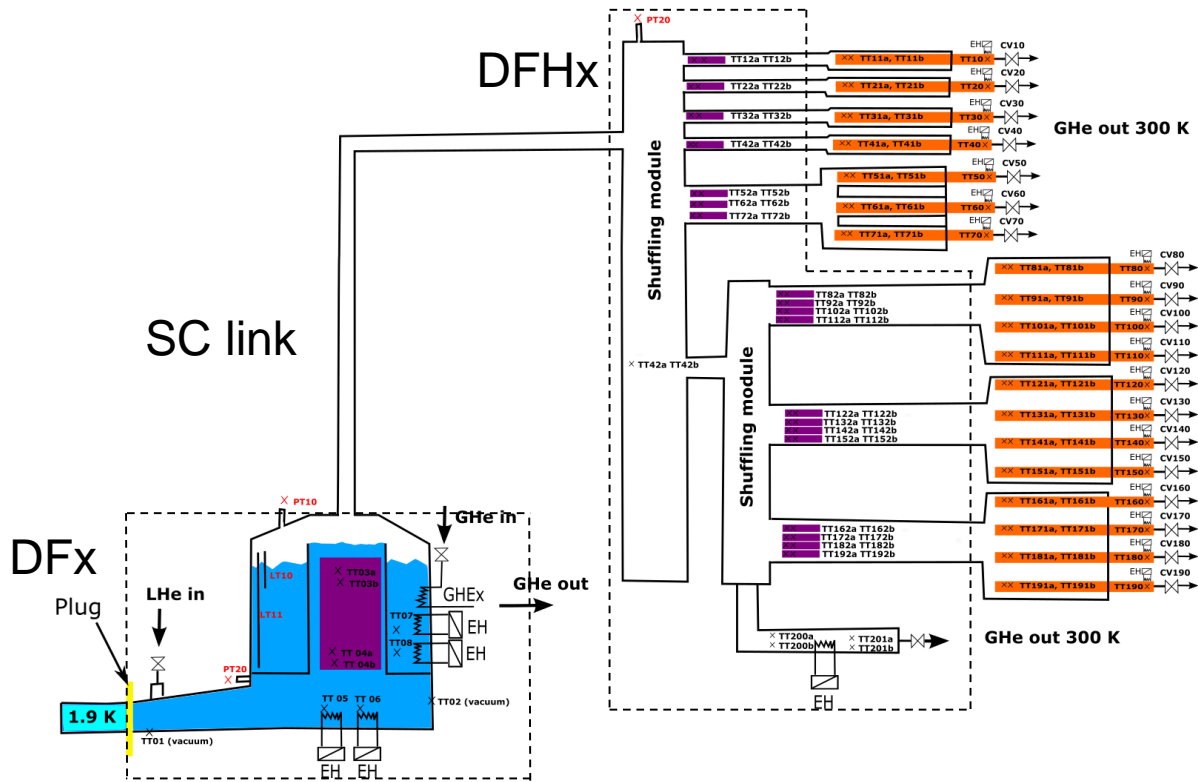
Instrumentation cryogenic Requirements for WP6a

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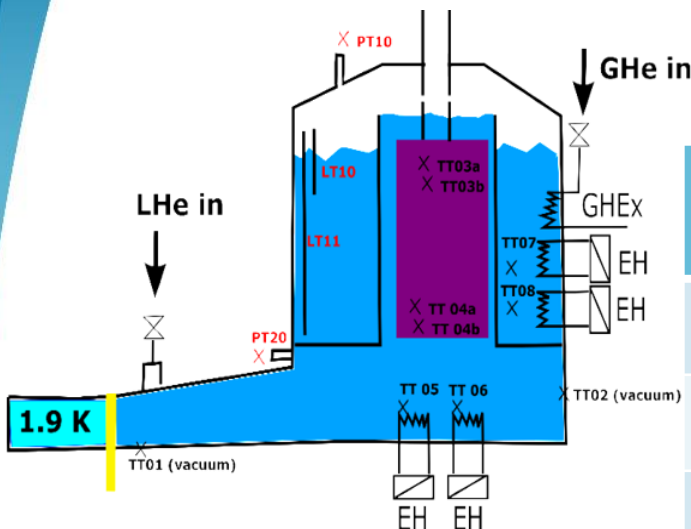
Cryogenic instrumentation of DFX/DFH



From DFHx Conceptual Design Review
Instrumentation J Fleiter

Zoom on DFX

Located in the tunnel in a zone with radiation up to 625 kGy (based on QXL data)



- Requirement for P,T measurement in QRL for virtual flow calculation of line C and line E (already provided)
- Requirement for T measurement in QRL for duty calculation of gas heater (to be the nearest of the DFX)

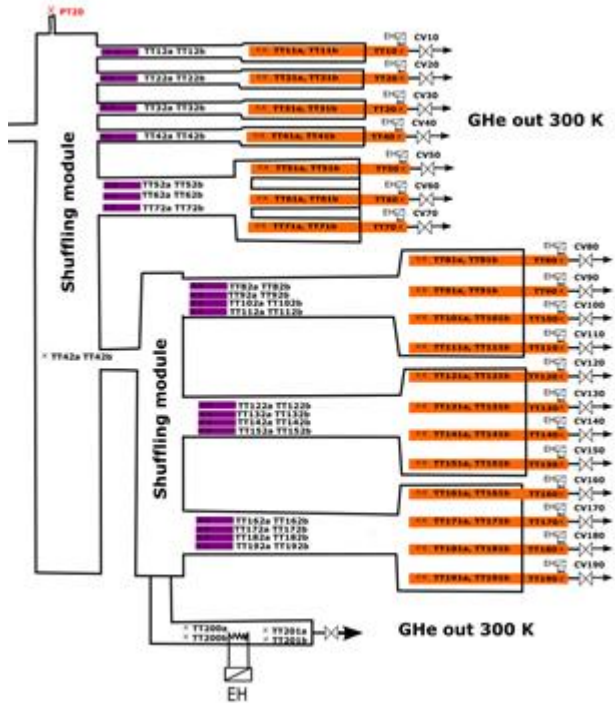
Number	Instrumentation	Normal Operating Range	Range	accuracy
4	Process Temperature transmitter*	4.4-5.5 K	3-325 K	+/- 0.1 K
2	Vacuum Temperature transmitter	4.4-300 K	3-325 K	+/- 0.5-1 K
4	Electric Heater	0-100 W	0-300 W	1 W
2	Flexible Level transmitter	365-515 mm	0-615 mm	10 mm
2	Pressure transmitter	1.05-2 bara	0-4 bar	0.01 bar
1	Pressure switch (line D)	NA	NA	NA
1	Temp switch (SV)	NA	NA	NA

* TT for heater protection not included

Zoom on DFHx

Located in Service Gallery- No radiation expected
Instrumentation to be provided In purple zone

WP6a will provide temperature probes in current leads

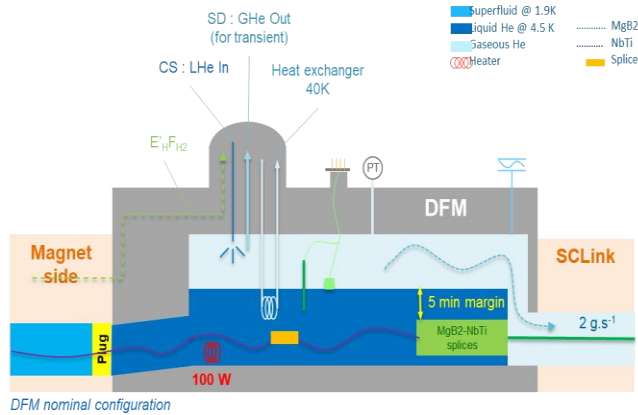


Number	Instrumentation	Normal Operating Range	Range	accuracy
42	Temperature transmitter	10-20 K	3-325 K	+/- 0.5 K (TBC)
1	Electric Heater	0-1500 W	0-15000 W	1 W
2	Temperature transmitter	ambient	3-325 K	+/- 5 K
1	Pressure transmitter	1.05-2 bara	0-4 bar	0.01 bar
1	Differential Pressure transmitter (TBC)	0-100 mbar	0-300 mbar	1 mbar
1	Temp switch (SV)	NA	NA	NA

Zoom on DFm

PRELIMINARY

Located in the tunnel in a zone with radiation over 1000 kGy
(TBC, based on QXL data)



- Requirement for P,T measurement in QRL for virtual flow calculation of line C and line E
- Requirement for T measurement in QRL for duty calculation of gas heater

Number	Instrumentation	Normal Operating Range	Range	accuracy
4*	Process Temperature transmitter	4.4-5.5 K	3-325 K	+/- 0.1 K
2	Vaccum Temperature transmitter	4.4-300 K	3-325 K	+/- 0.5-1 K
2	Electric Heater	0-100 W	0-300 W	1 W
2	Level transmitter	TBC	TBC	10 mm
2	Pressure transmitter	1.05-2 bara	0-10 bar	0.01 bar
1	Temp switch (SV)	NA	NA	NA

* TT for heater protection not included

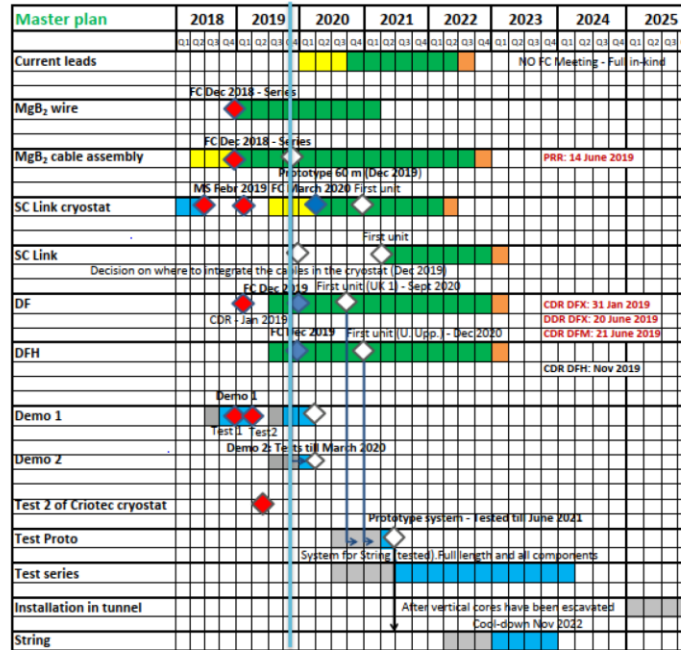
Zoom on DFHm

PRELIMINARY

Located in Service Gallery- No radiation expected
(number of cold TT to be confirmed according to the final number of current leads)

Number	Instrumentation	Normal Operating Range	Range	accuracy
20 (TBC)	Temperature transmitter	10-20 K	3-325 K	+/- 0.5 K (TBC)
1	Electric Heater	0-325 W	0-7500 W	1 W
2	Temperature transmitter	ambient	3-325 K	+/- 0.1 K
1	Pressure transmitter	1.05-2 bara	0- 4 bar	0.01 bar
1	Differential Pressure transmitter	0-100 mbar	0-300 mbar	1 mbar

Planning



Series procurement

MgB₂ full-cable for Triplets. Use in Demo 2

Series procurement

First DFX unit from UK1

First DFH unit

Demo 2

Prototype system

Instrumentation to be available:

- for the test proto in SM18 – Q4 2020
- DFx/m – Q2 2021
- DFHx/m - Q2 2022

Total for installation in the tunnel

Cold powering of Inner Triplets

	Number	Instrumentation	Normal Operating Range	Range	Total (x4)
DFx	4	Process Temperature transmitter	4.4-5.5 K	3-325 K	16
	2	Vacuum Temperature transmitter	4.4-300 K	3-325 K	8
	4	Electric Heater	0-100 W	0-300 W	16
	2	Level transmitter	365-515 mm	0-615 mm	8
	2	Pressure transmitter	1.05-2 bara	0-4 bar	8
DFHx	42	Temperature transmitter	10-20 K	3-325 K	168
	1	Electric Heater	0-1500 W	0-15000 W	4
	2	Temperature transmitter	ambient	3-325 K	8
	1	Pressure transmitter	1.05-2 bara	0-4 bar	4

Total for installation in the tunnel

Cold powering of matching section

	Number	Instrumentation	Normal Operating Range	Range	Total (x4)
DFm	4	Temperature transmitter	4.4-5.5 K	3-325 K	16
	2	Vacuum Temperature transmitter	4.4-300 K	3-325 K	8
	2	Electric Heater	0-100 W	0-300 W	8
	2	Level transmitter	TBC	TBC	8
	2	Pressure transmitter	1.05-2 bara	0-4 bar	8
DFHm	20 (TBC)	Temperature transmitter	10-20 K	3-325 K	80
	1	Electric Heater	0-325 W	0-700 W	4
	2	Temperature transmitter	ambient	3-325 K	8
	1	Pressure transmitter	1.05-2 bara	0-4 bar	4

Grand Total

Instrumentation in tunnel	Grand Total
Temperature transmitter	312
Electric Heater	32
Level transmitter	16
Pressure transmitter	24
Differential Pressure transmitter	8

Instrumentation for prototype	Grand Total
Temperature transmitter	52
Electric Heater	4
Level transmitter	2
Pressure transmitter	4
Differential Pressure transmitter	1

Instrumentation to be available:

- DFx/m – Q2 2021
- DFHx/m - Q2 2022

Instrumentation to be available:

- for the test proto in SM18 – Q4 2020