HFM

High Field Magnets

Updates from WP5.1: Test infrastructure

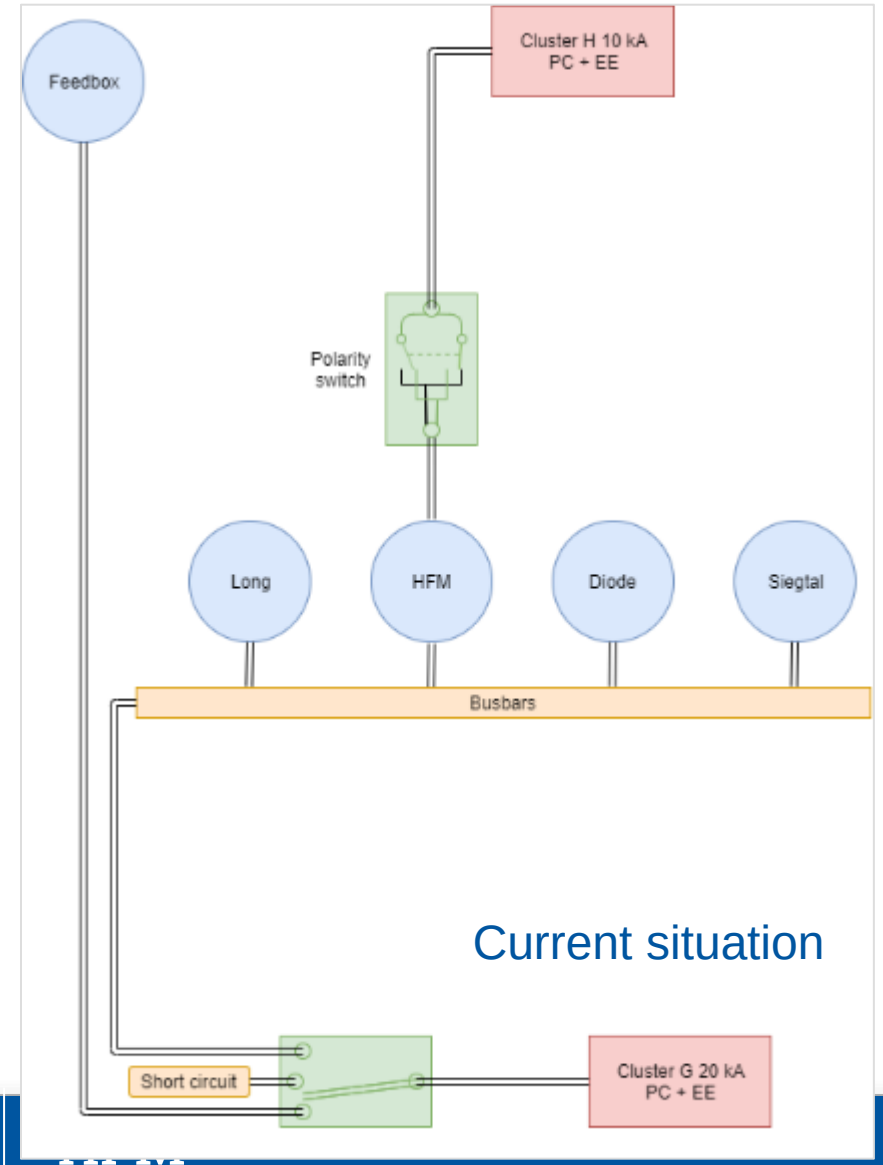
F. J. Mangiarotti

TE-HFM workshop – 2024.09.19

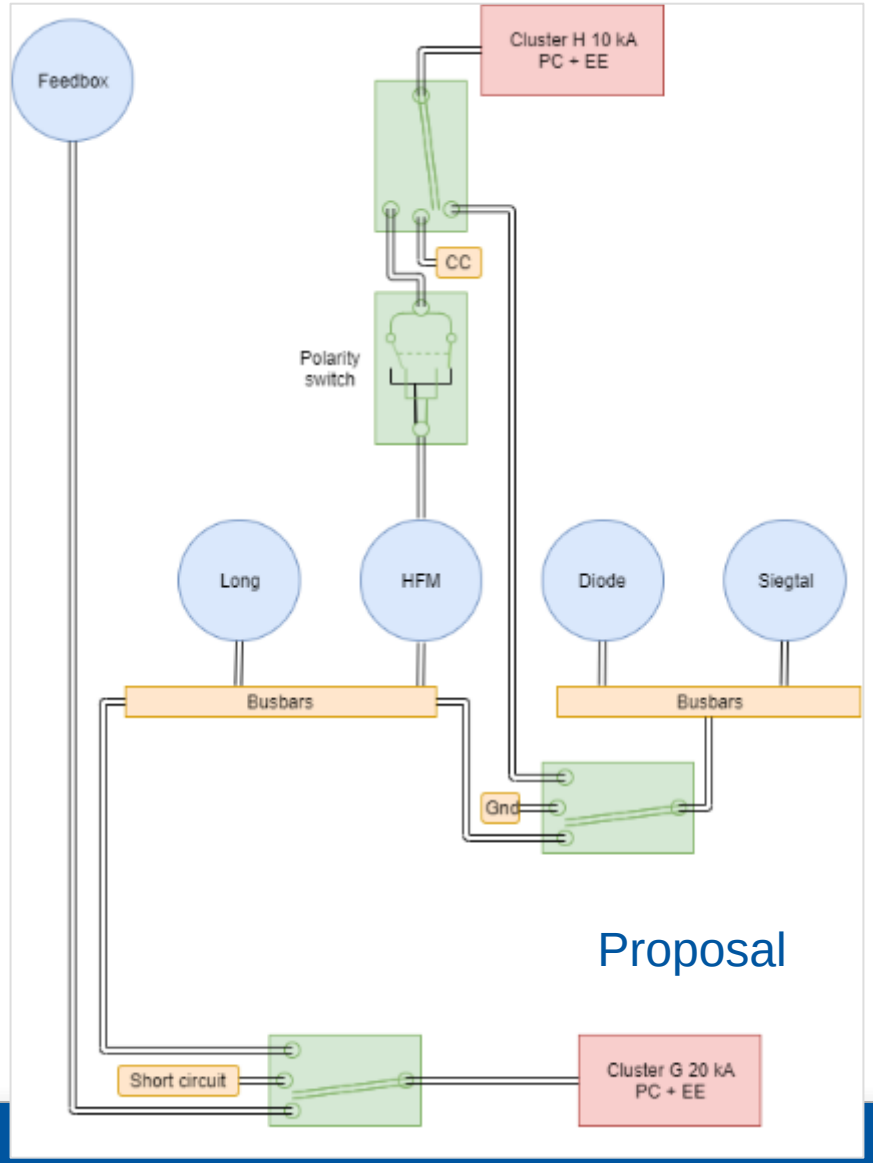
Main tasks of WP5.1

- Cluster G upgrade
- New insert for Cluster D
- D1 as a test bed for HTS coils
- Horizontal cryostat
- Conduction and gas cooled magnet tooling
  - Including synergy with other projects/programs

Cluster G upgrade



Current situation

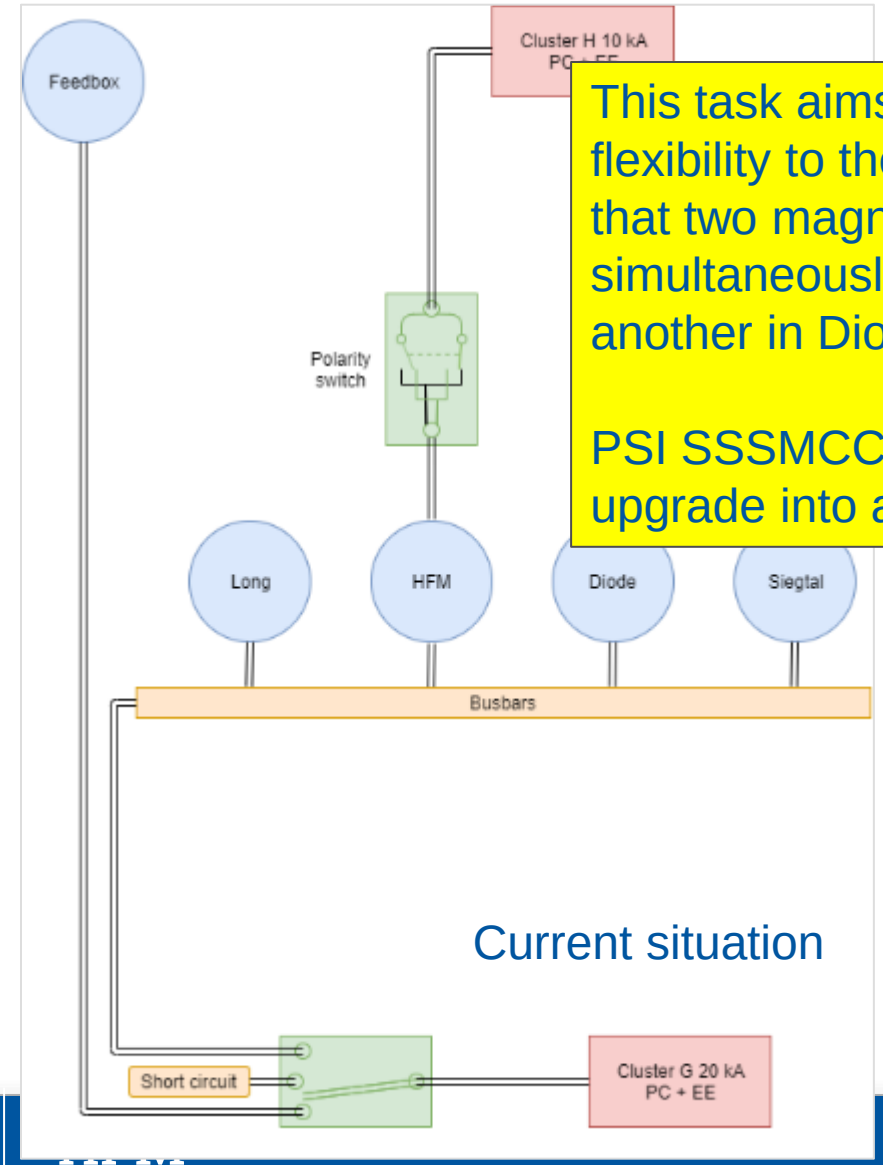


Proposal

Cluster G upgrade

This task aims to provide greater flexibility to the vertical station, such that two magnets can be tested simultaneously, one in Long/HFM and another in Diode/Siegtal.

PSI SSSMCC designed taking this upgrade into account (Imax < 10 kA)



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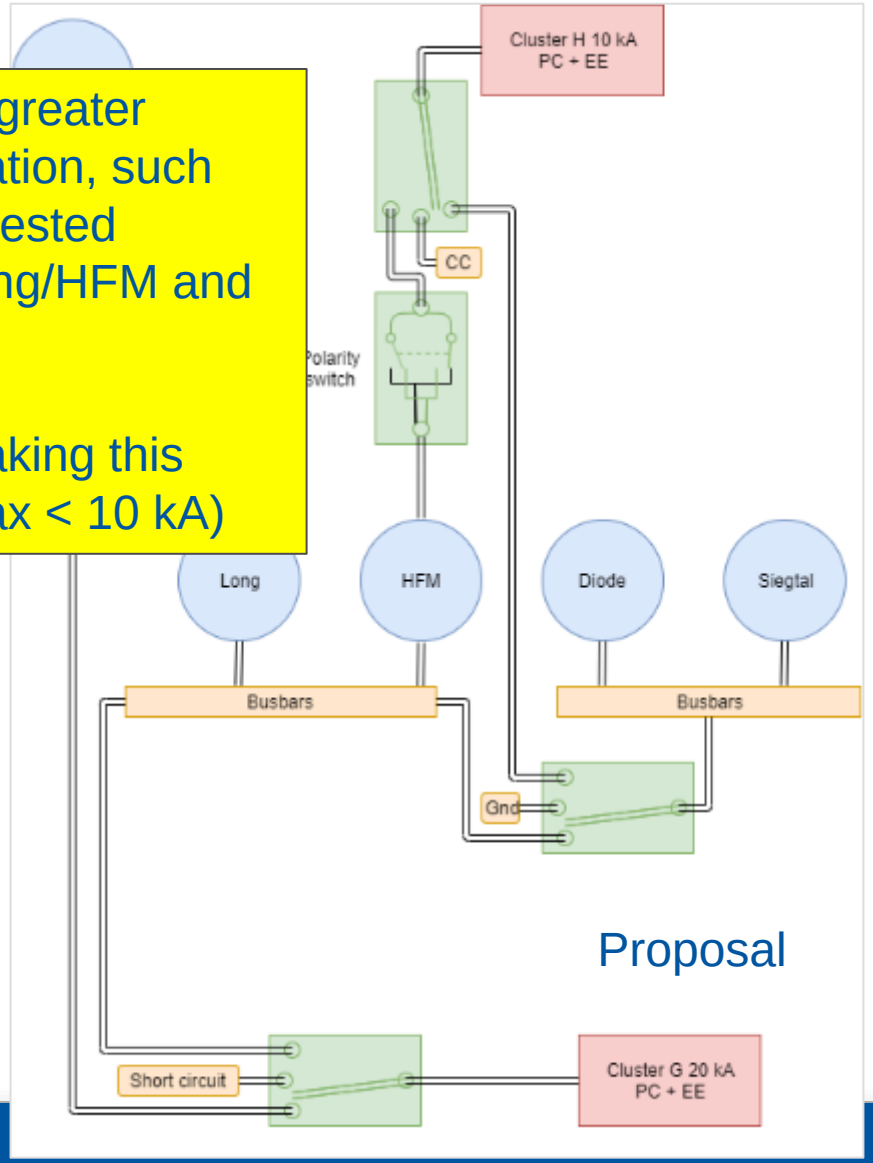
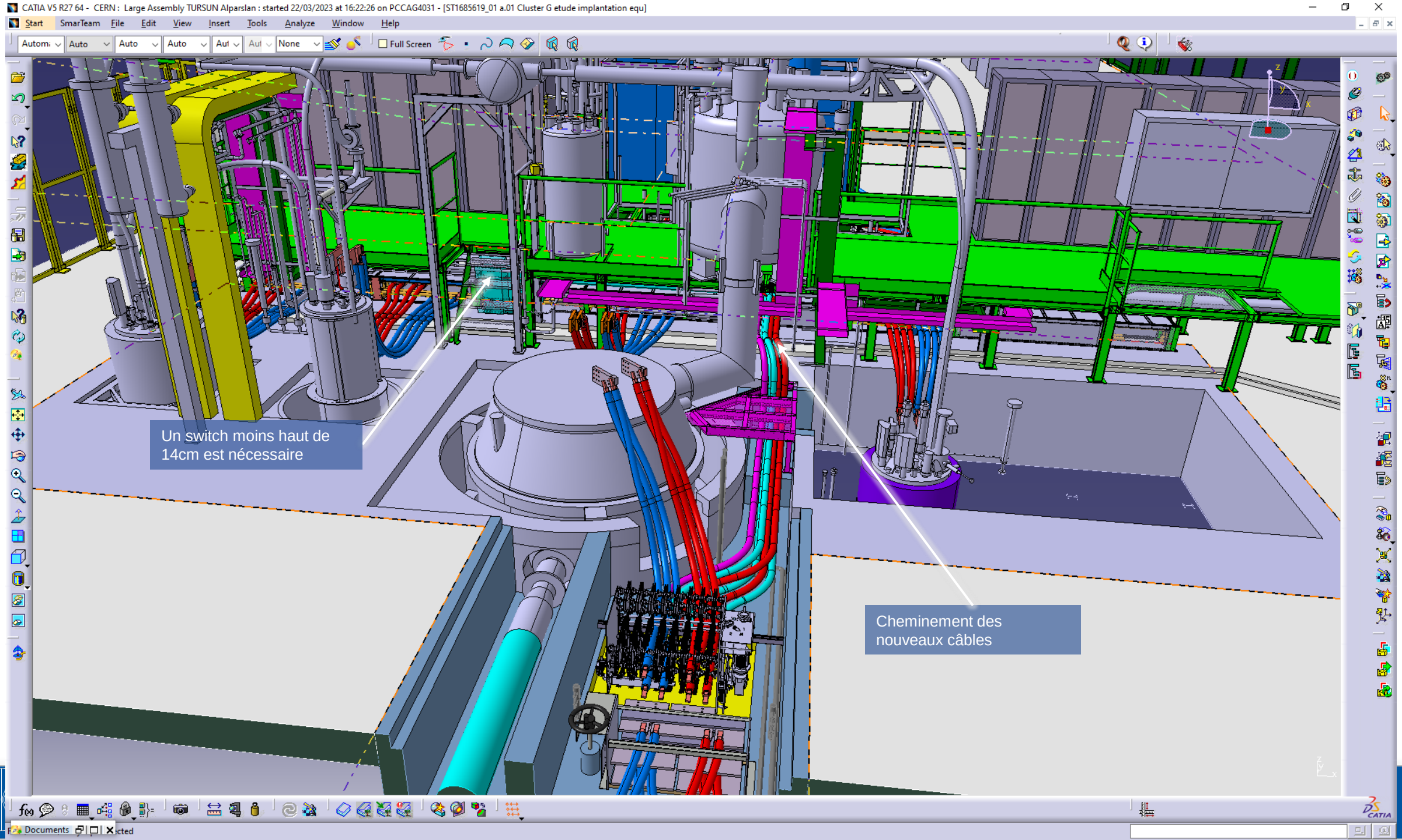
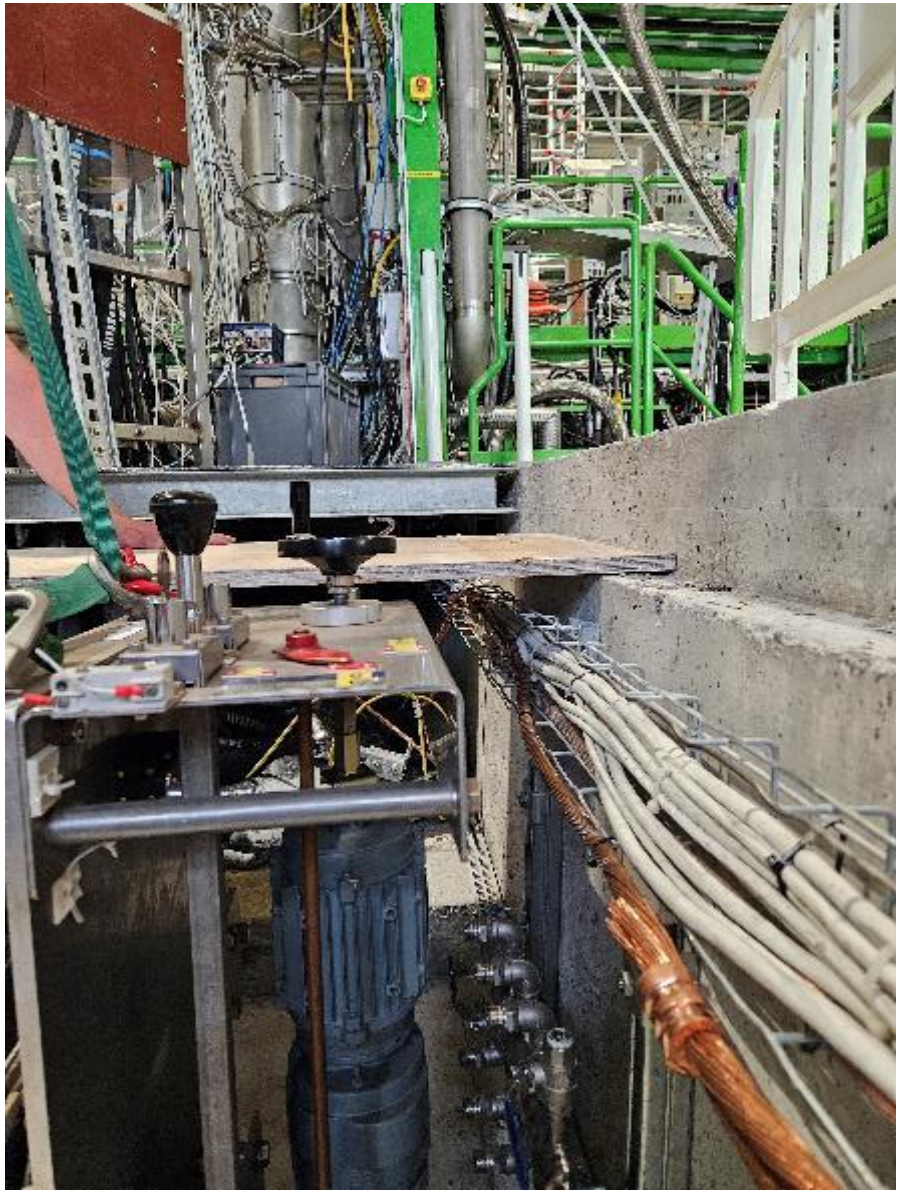


Proposal


CATIA V5 R27 64 - CERN : Large Assembly TURSUN Alparslan : started 22/03/2023 at 16:22:26 on PCCAG4031 - [ST1685619_01 a.01 Cluster G etude implantation equ]
Start
SmarTeam
File
Edit
View
Insert
Tools
Analyze
Window
Help
Full Screen
Un switch moins haut de 14cm est nécessaire
Cheminement des nouveaux câbles
Documents

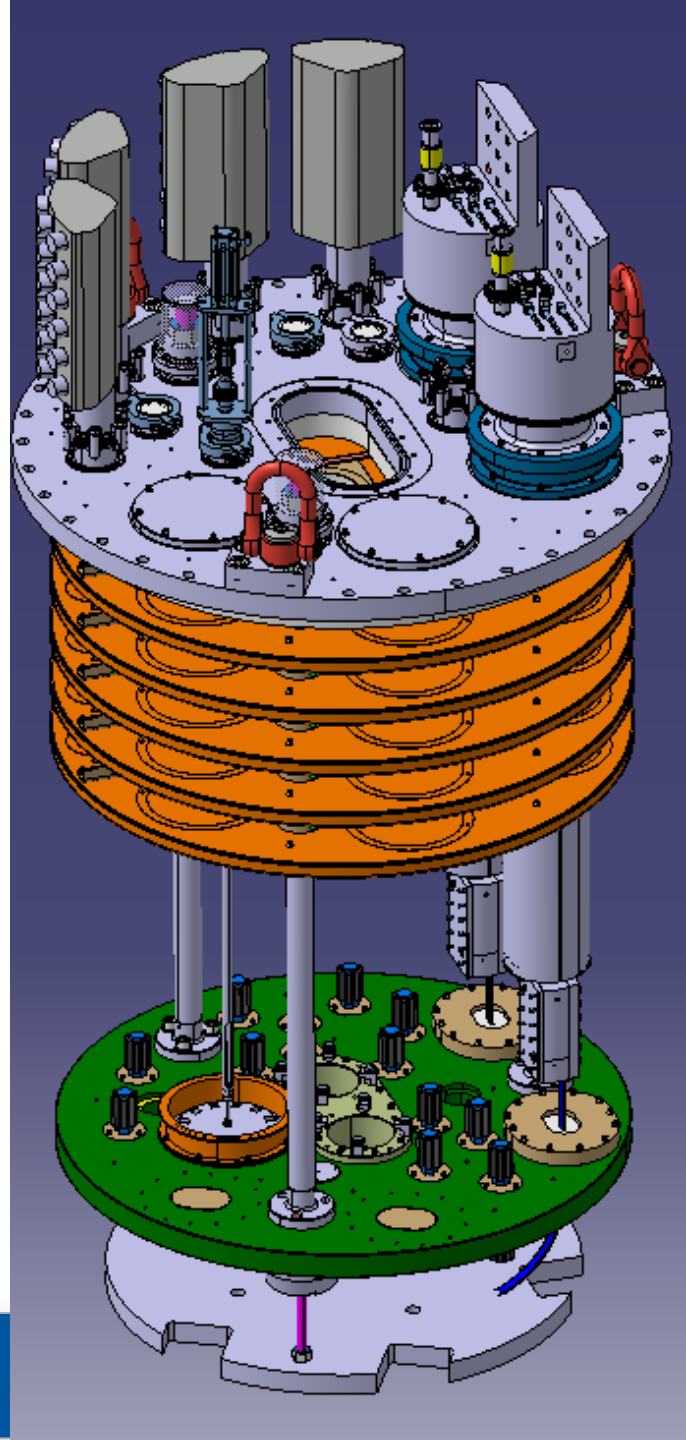


Cluster G upgrade -- status

- Integration studies: done last year-early this year
- Civil engineering: done this summer
- Load switches: one already in SM18, the other one purchased
- Water cooled cables: to be procured in 2025
- Cryogenic piping re-routing: under study

New insert for Cluster D

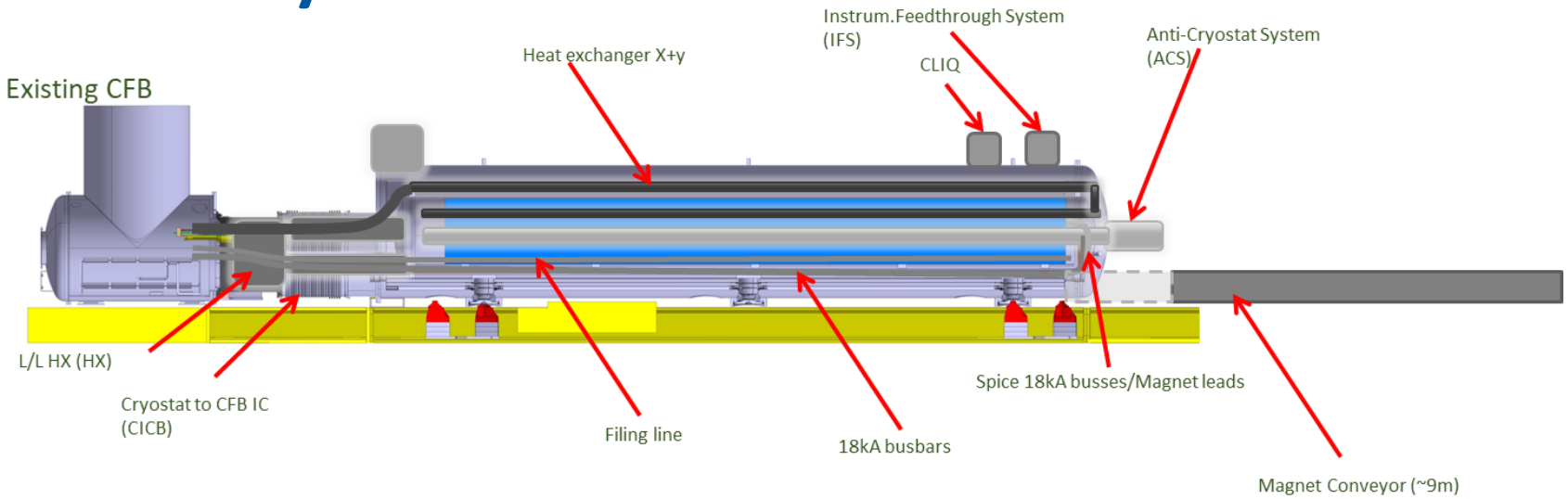
- This new insert is intimately related to WP5.6 (vertical anticryostats, Uppsala Univ)
- Status:
  - 3D drawings: done
  - 2D drawings: done, under approval: EDMS 3030205
  - Manufacturing: expected to be launched this year
  - Assembly: expected next year
  - Connectors: purchased
  - Current leads: strategy under discussion

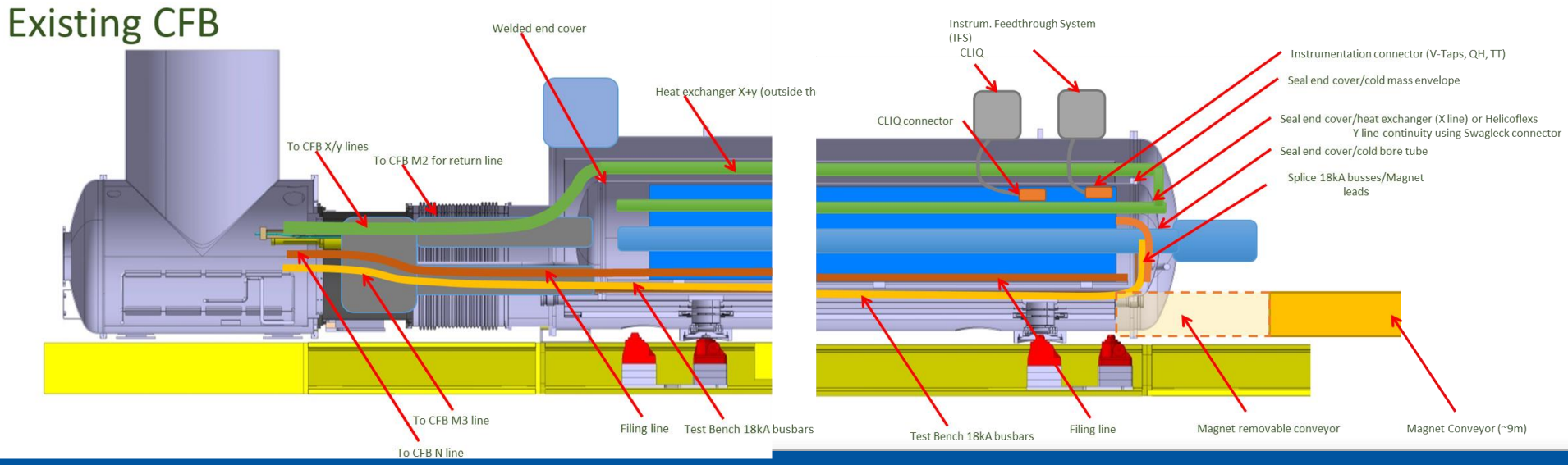


D1 as a test bed for HTS coils

- KEK loaned us a 2 m HL-LHC D1 short model:
  - ~6 T dipole field
  - ~150 mm aperture
- The goal is to use it to test HTS coils in a background field
- Status:
  - Conceptual design: Q1 2025
  - Detailed design and manufacturing: to be adapted to the HTS needs

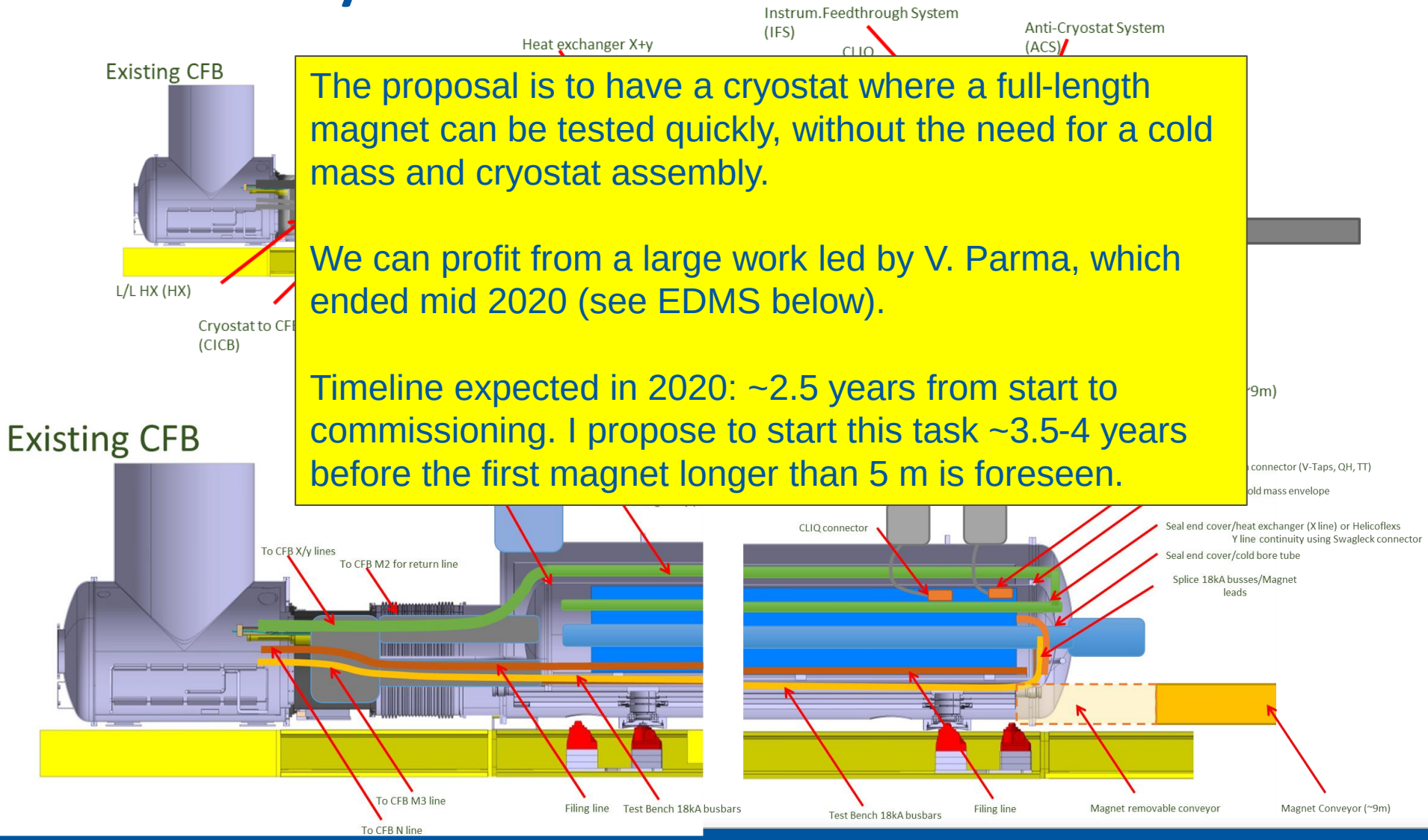
Horizontal cryostat





From https://edms.cern.ch/document/2426281

Horizontal cryostat



The proposal is to have a cryostat where a full-length magnet can be tested quickly, without the need for a cold mass and cryostat assembly.

We can profit from a large work led by V. Parma, which ended mid 2020 (see EDMS below).

Timeline expected in 2020: ~2.5 years from start to commissioning. I propose to start this task ~3.5-4 years before the first magnet longer than 5 m is foreseen.

From https://edms.cern.ch/document/2426281

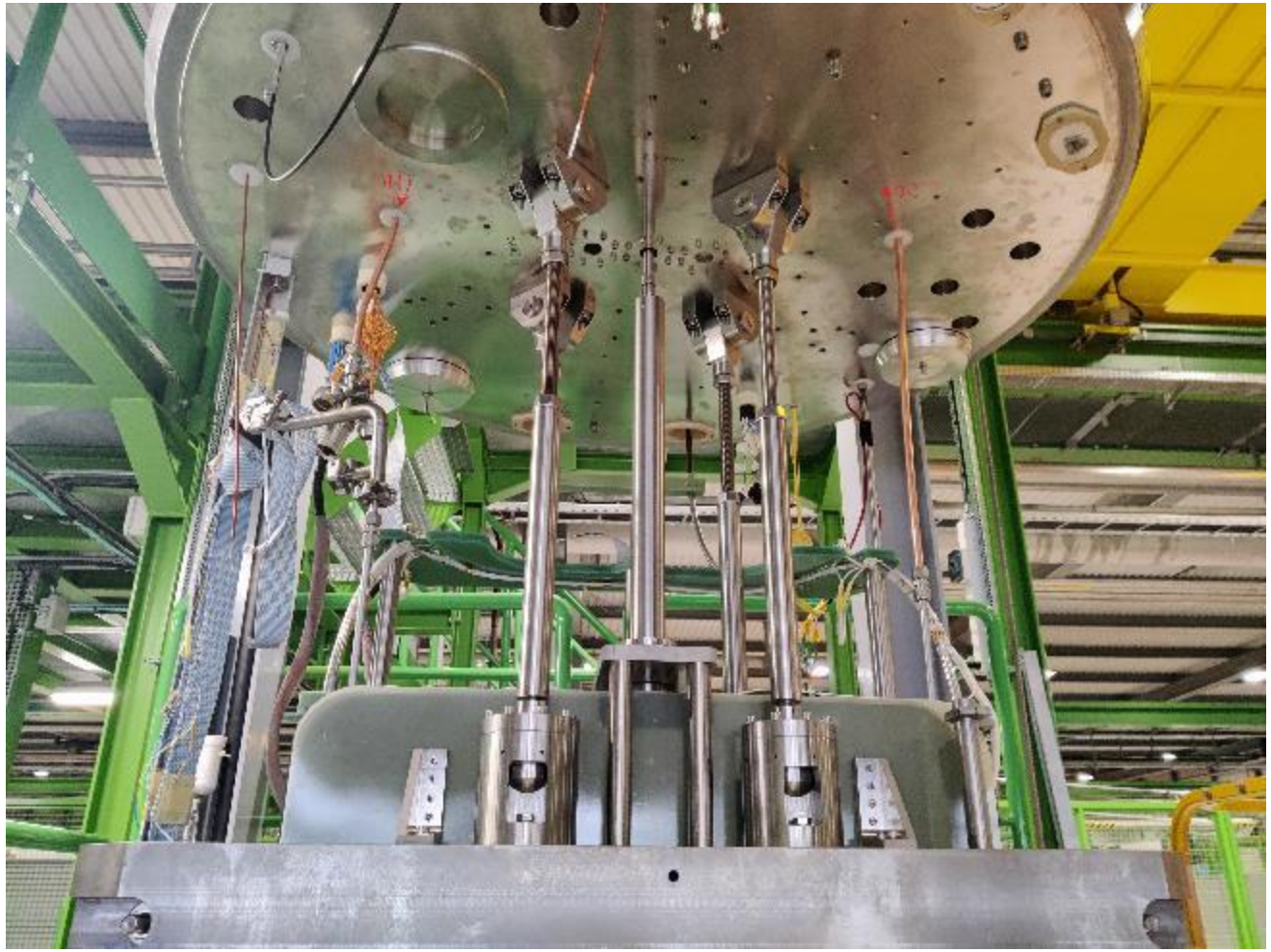
Conduction and gas cooled magnet tooling

This task proposes upgrades without a clear “client” for the moment, however the new functionalities may open the magnet design space.

- HTS current leads for HFM cryostat: to allow the cryostat to operate fully in gaseous helium
- Cold head for conduction-cooled magnets: to test magnets in vacuum, cooling only by conduction

These are being studied in synergy with other projects/programs. Procurement expected in 2025-2026.

Synergies with other projects/programs



EESD: we upgraded the HFM cryostat to allow testing magnets in gaseous helium (with leads cooled by liquid helium).

CHIC: a conduction-cooled magnet, we are looking at test station improvements to test this magnet that would allow us to also test HFM magnets in the same way.

Synergies with [illegible]rojects/programs

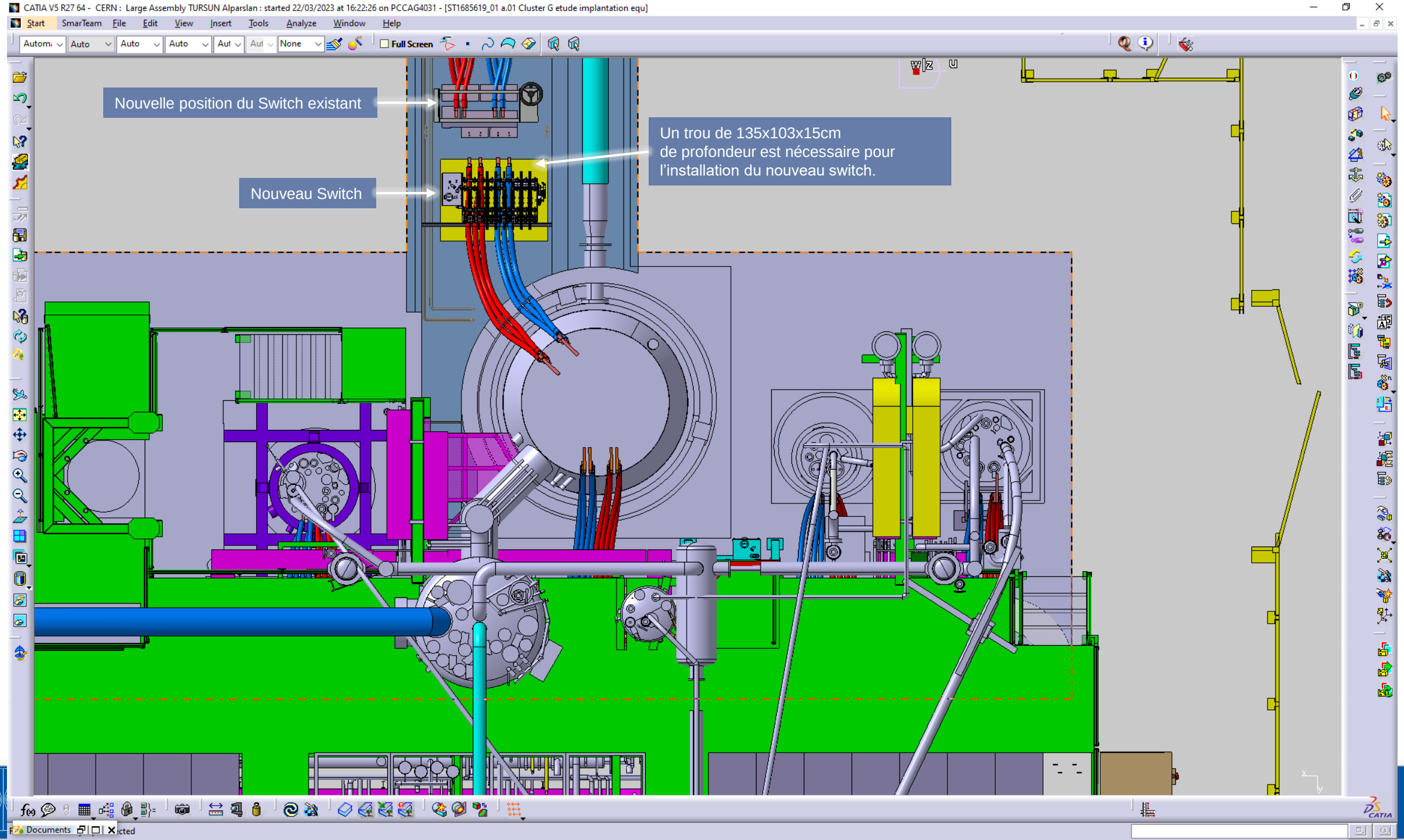
EESD: we upgraded the HFM cryostat to allow testing magnets in gaseous helium (with leads cooled by liquid helium).

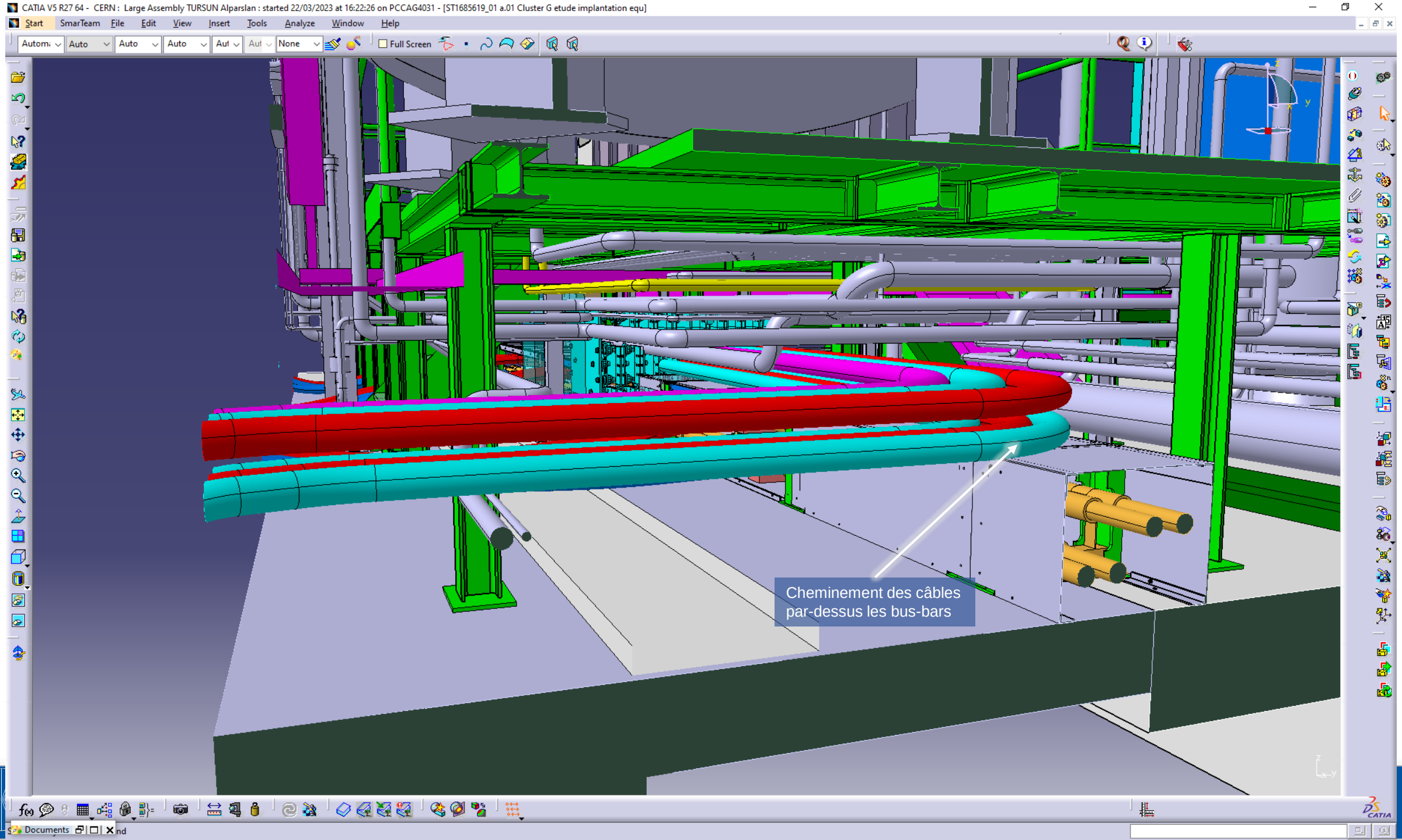
CHIC: a conduction-cooled magnet, we are looking at test station improvements to test this magnet that would allow us to also test HFM magnets in the same way.

Outlook

- Cluster G upgrade expected to significantly advance in 2025, but probably it will finish in 2026.
- Cluster D new insert expected to be assembled in 2025, with only a new pair of current leads missing for it to be completed.
- D1 as a test bed for HTS timeline heavily depends on HTS coils timeline, could be done in 2025 if needed.
- Horizontal cryostat: a flagship task, probably to be started in 2026+
- Conduction and gas cooled magnet tooling: to be greatly advanced in 2025, mainly pushed by other projects.

Extra slides


Nouvelle position du Switch existant
Nouveau Switch
Un trou de 135x103x15cm
de profondeur est nécessaire pour
l'installation du nouveau switch.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Start
SmarTeam
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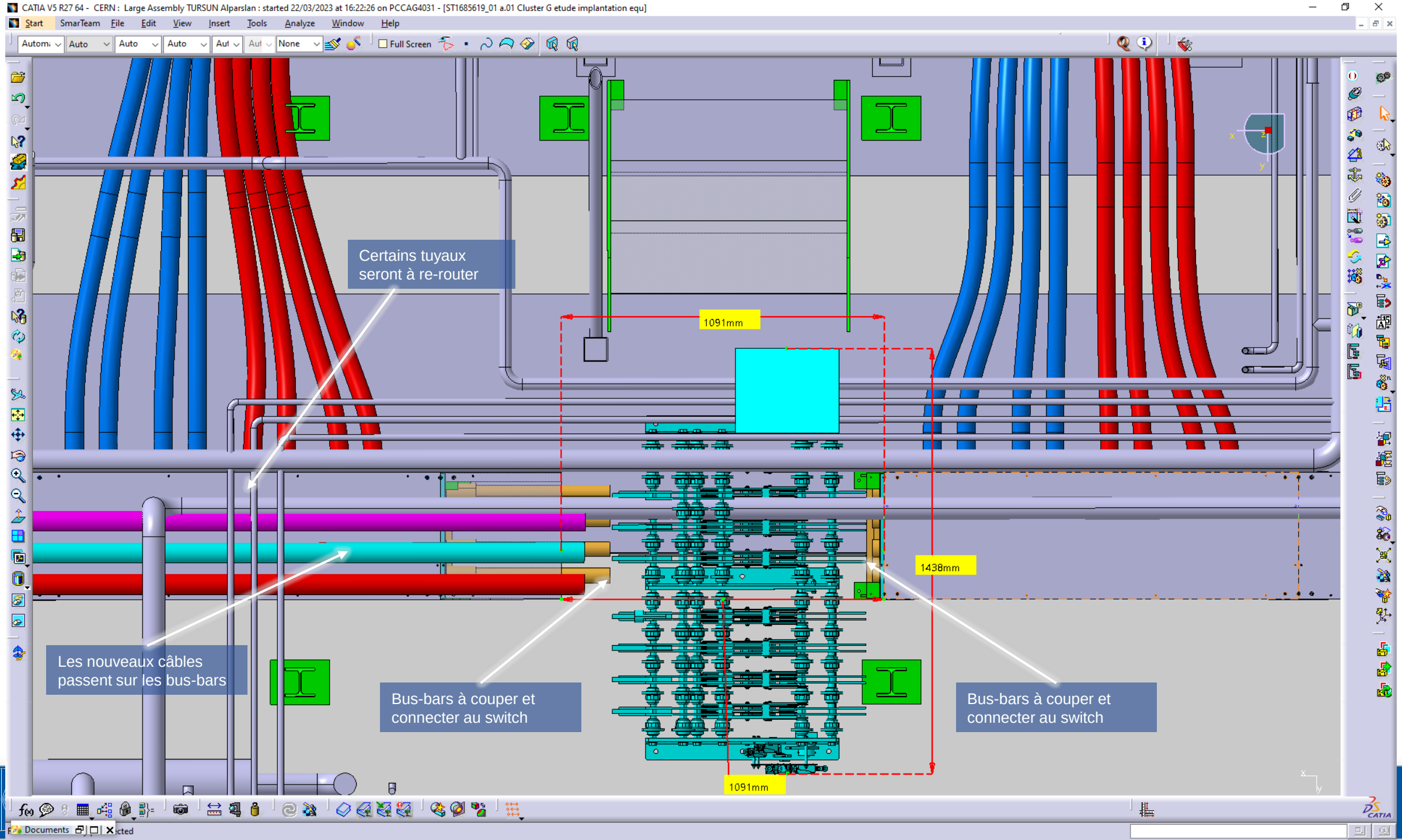
Cheminement des câbles
par-dessus les bus-bars
Documents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Start
SmarTeam
File
Edit
View
Insert
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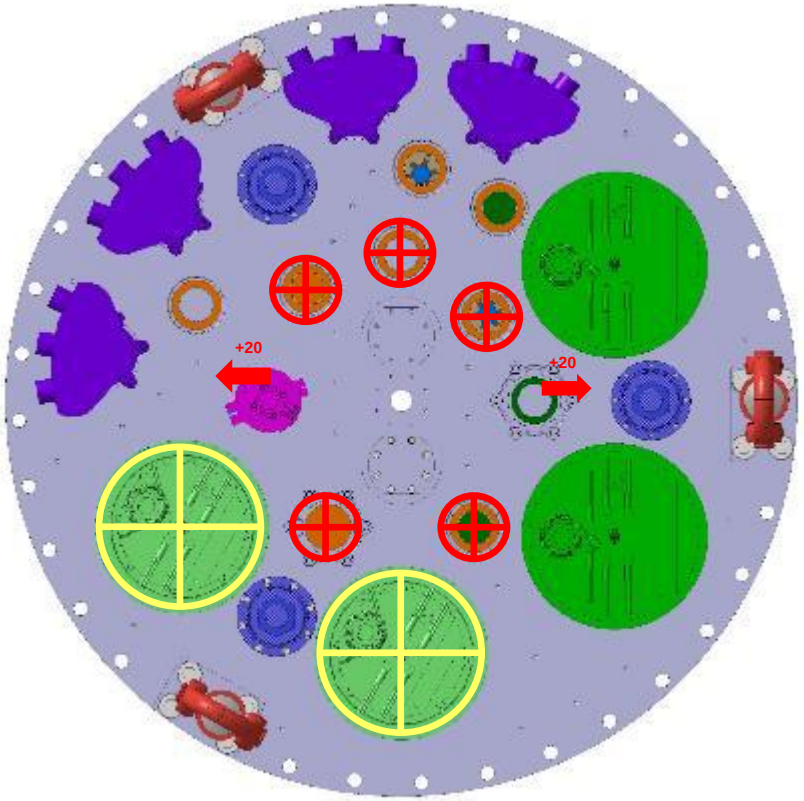
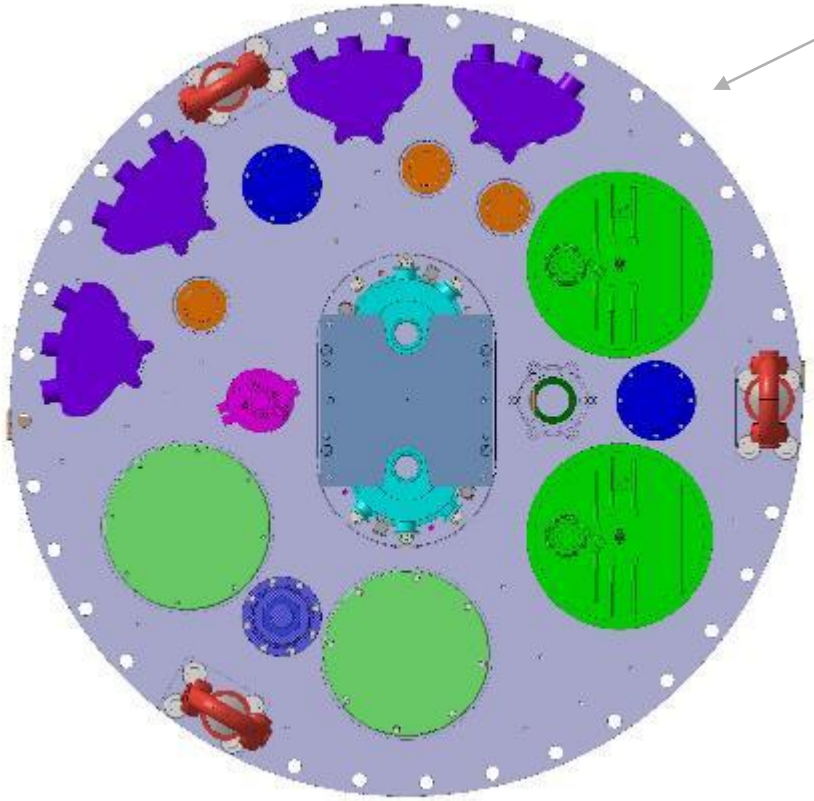
Analyze
Window
Help
Full Screen
Certains tuyaux seront à re-router
1091mm
1438mm
1091mm
Les nouveaux câbles passent sur les bus-bars
Bus-bars à couper et connecter au switch
Bus-bars à couper et connecter au switch
Documents

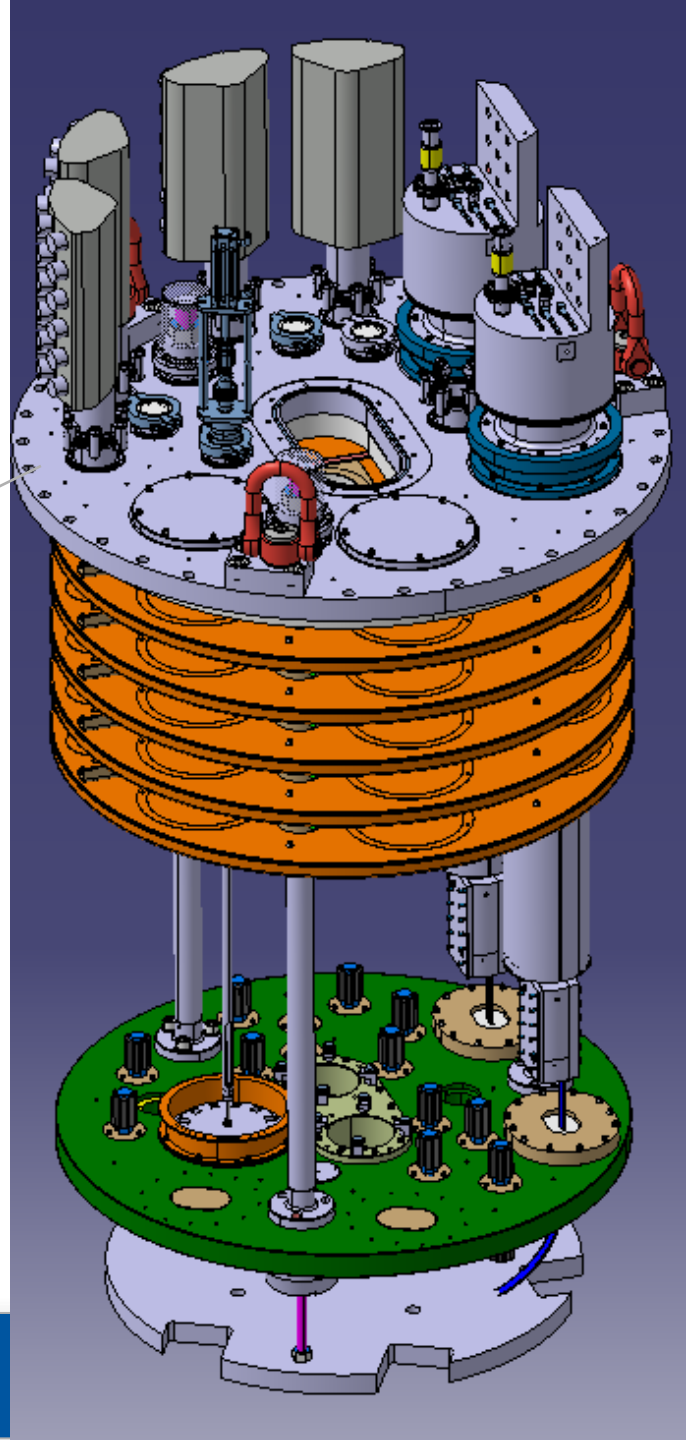
New Cluster D insert
Top plate

Old top plate



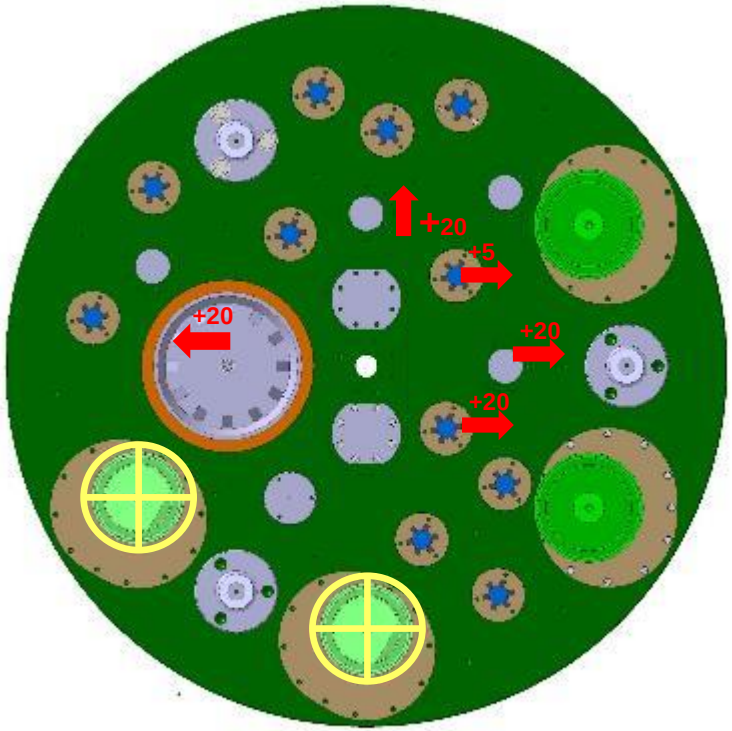
New top plate



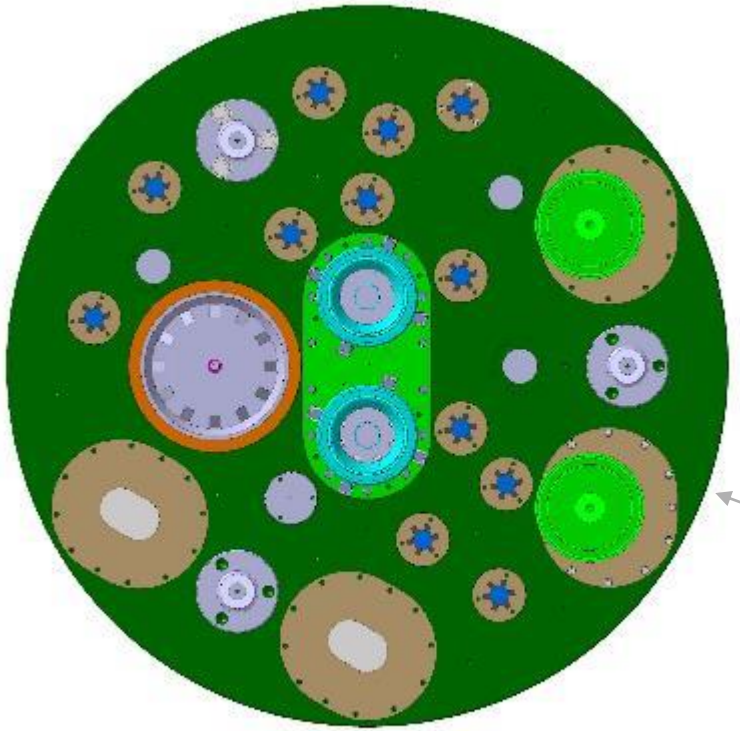


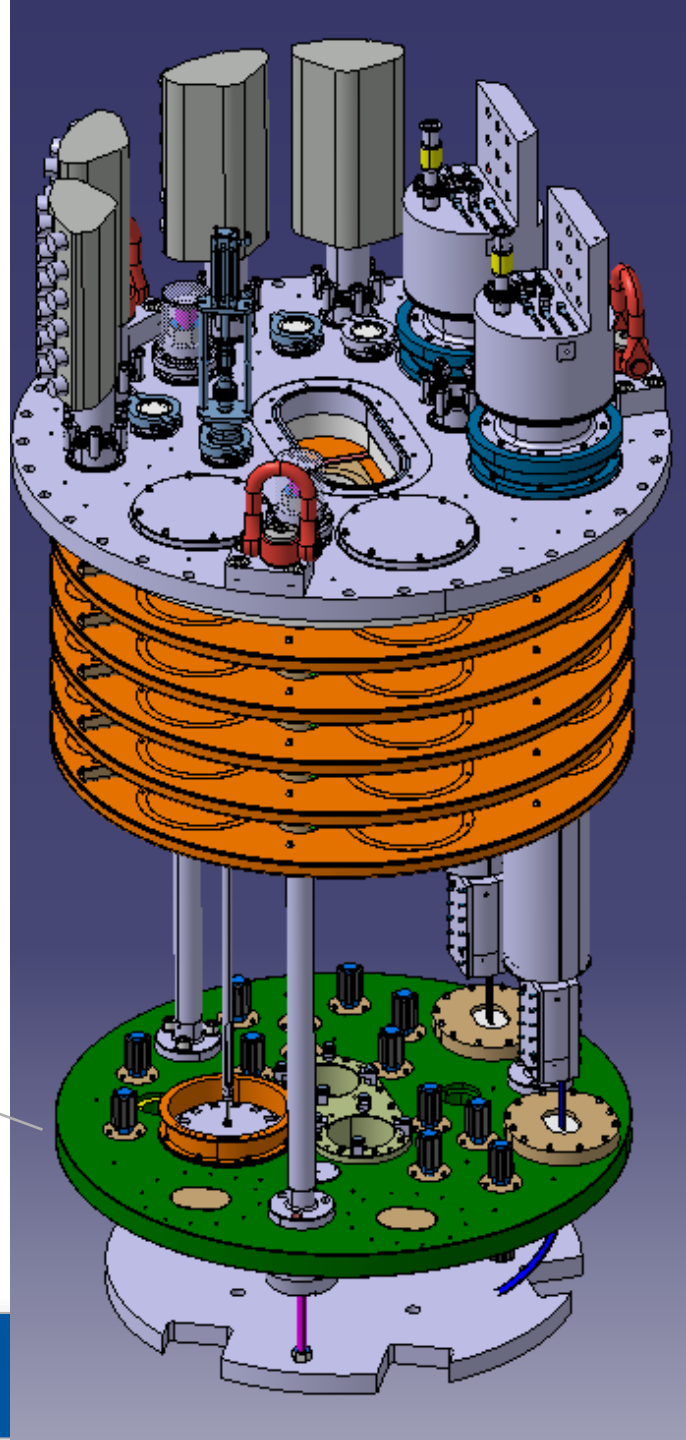
New Cluster D insert
Lambda plate

Old lambda plate

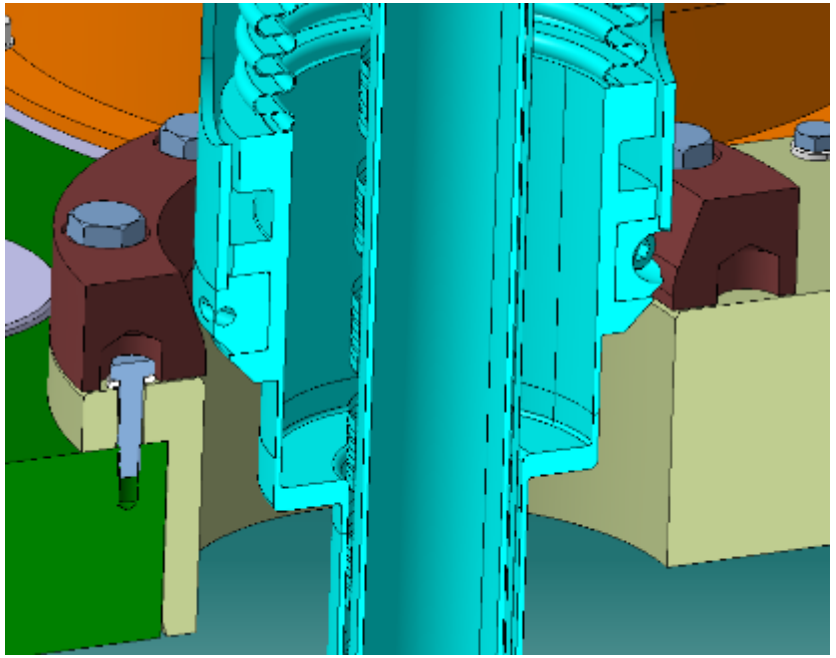


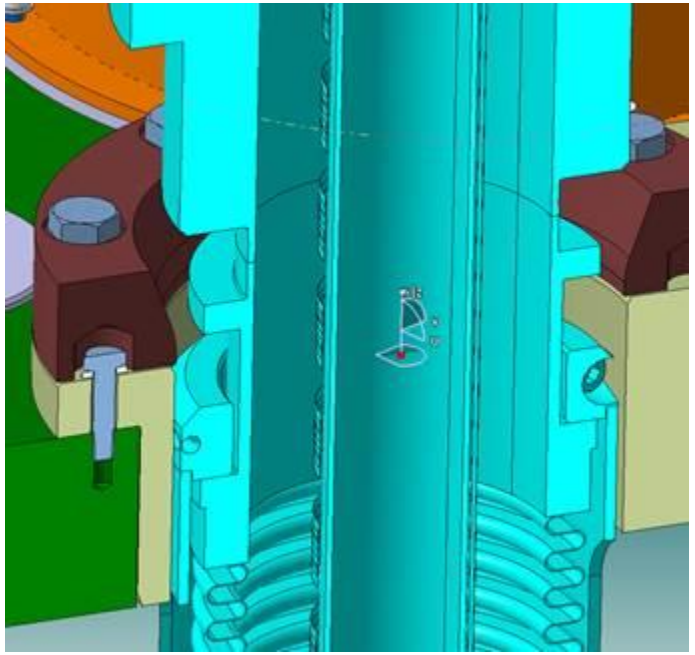
New lambda plate

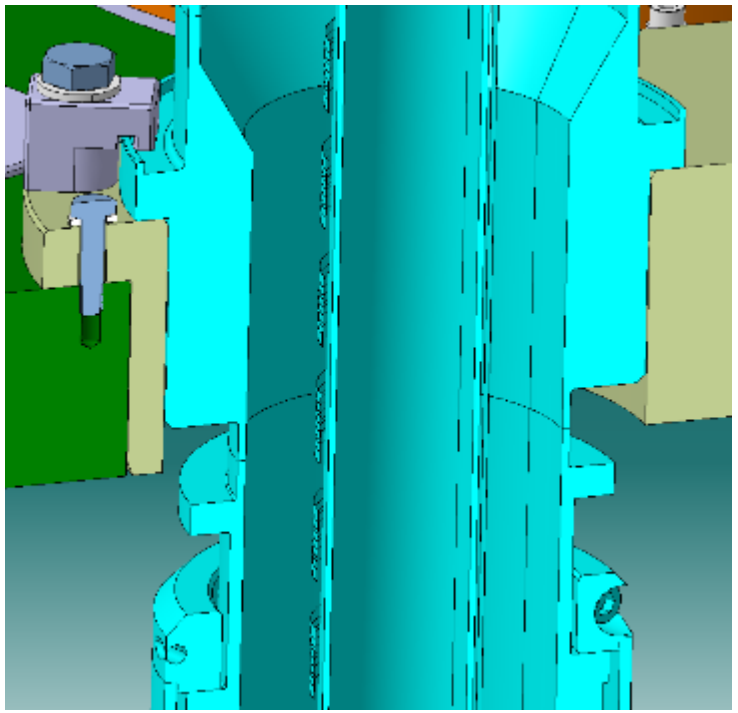




New Cluster D insert
Anticryostat insertion



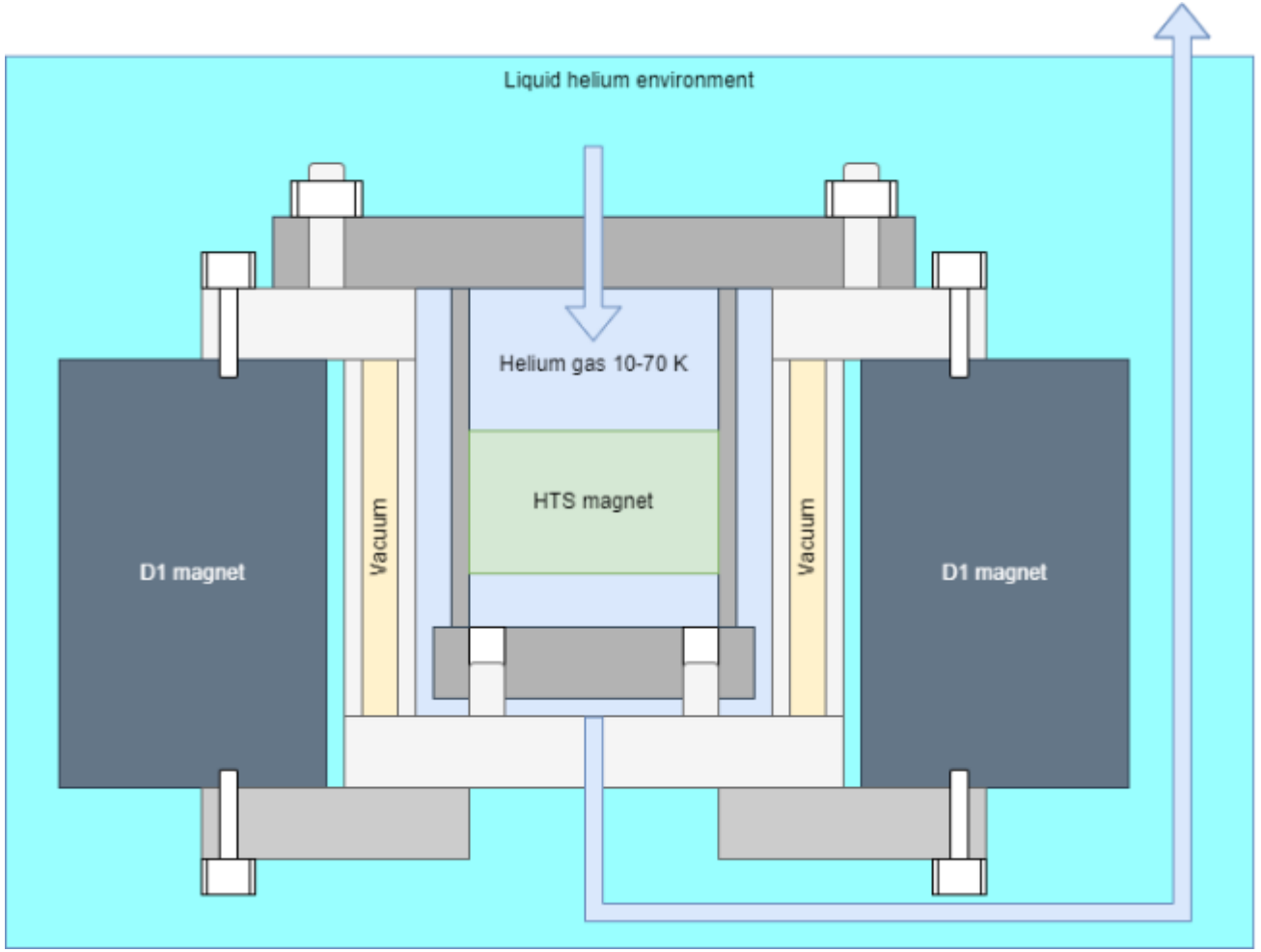




Green: lambda plate
Cyan: anticryostat

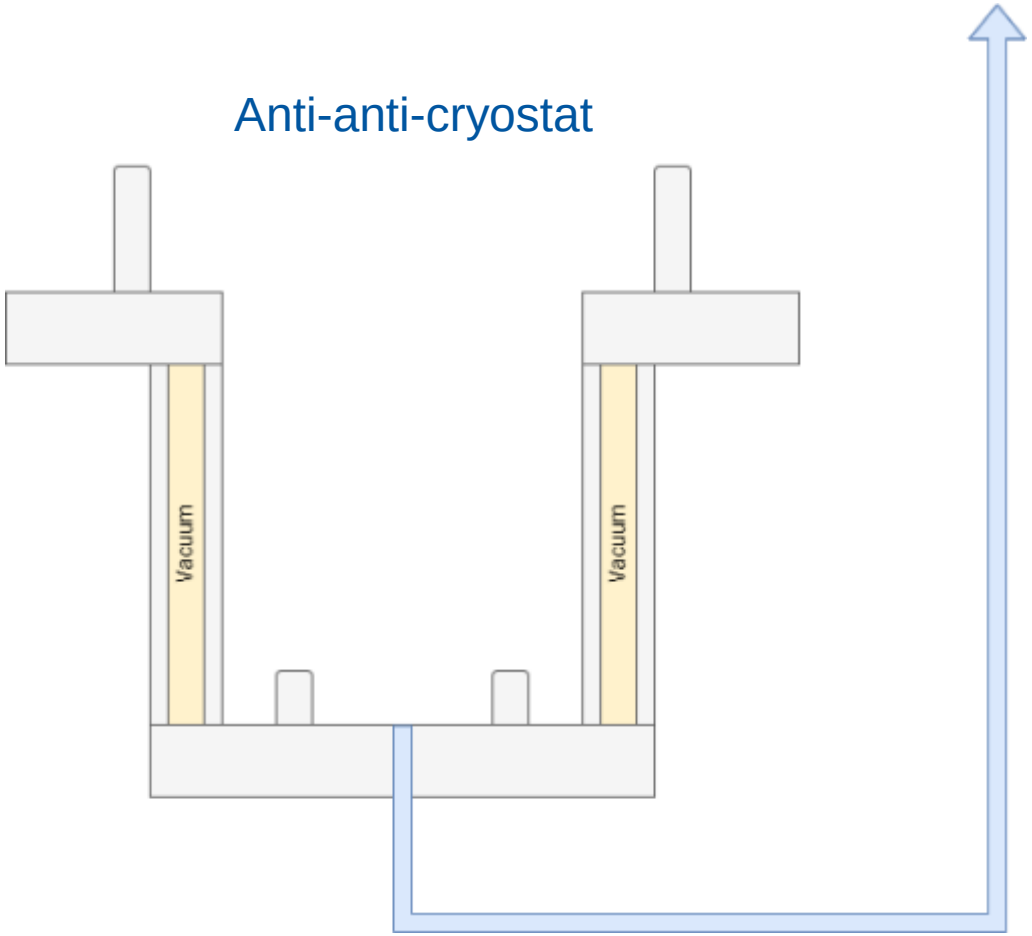
The brown piece helps guide the AC through the lambda plate, and it's removed for final fixation

D1 as a test bed for HTS coils

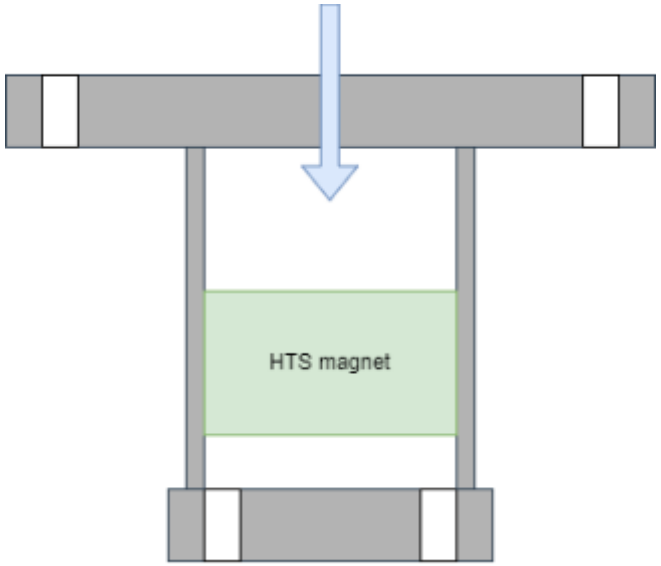


D1 as a test bed for HTS coils

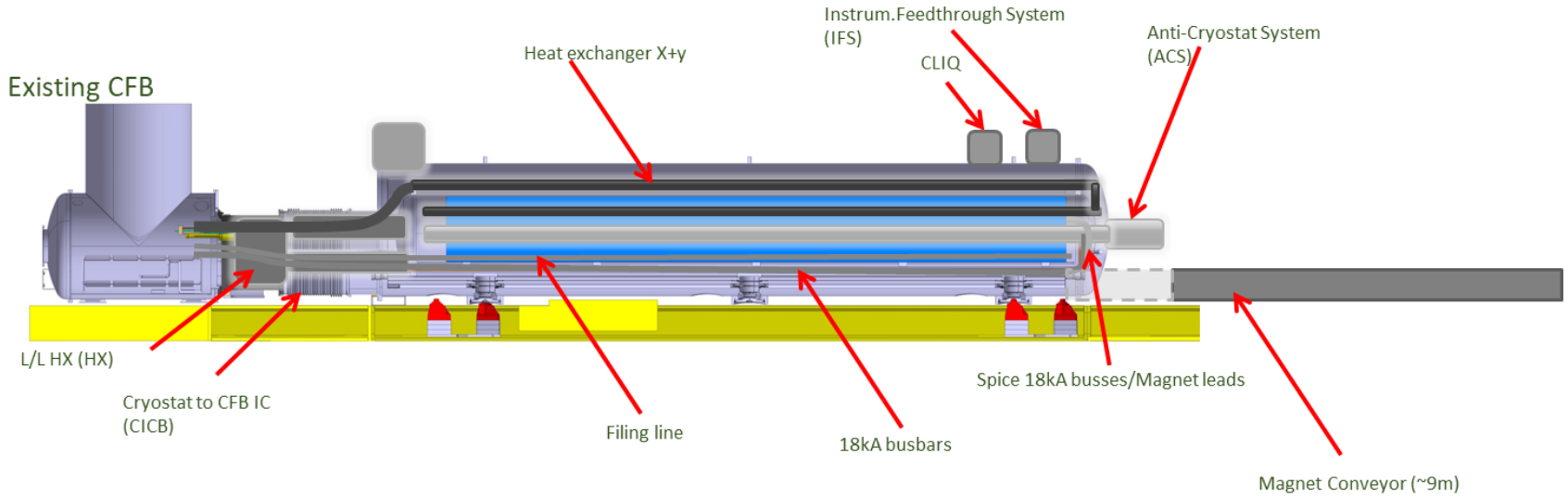
Anti-anti-cryostat

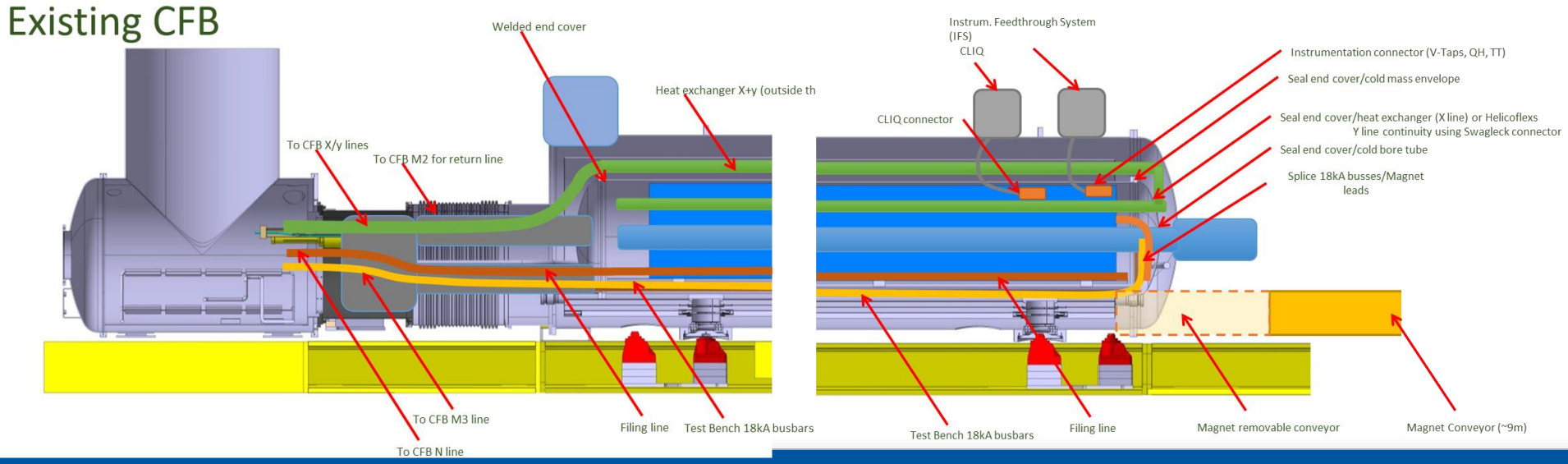


Support structure



HMTS schematic





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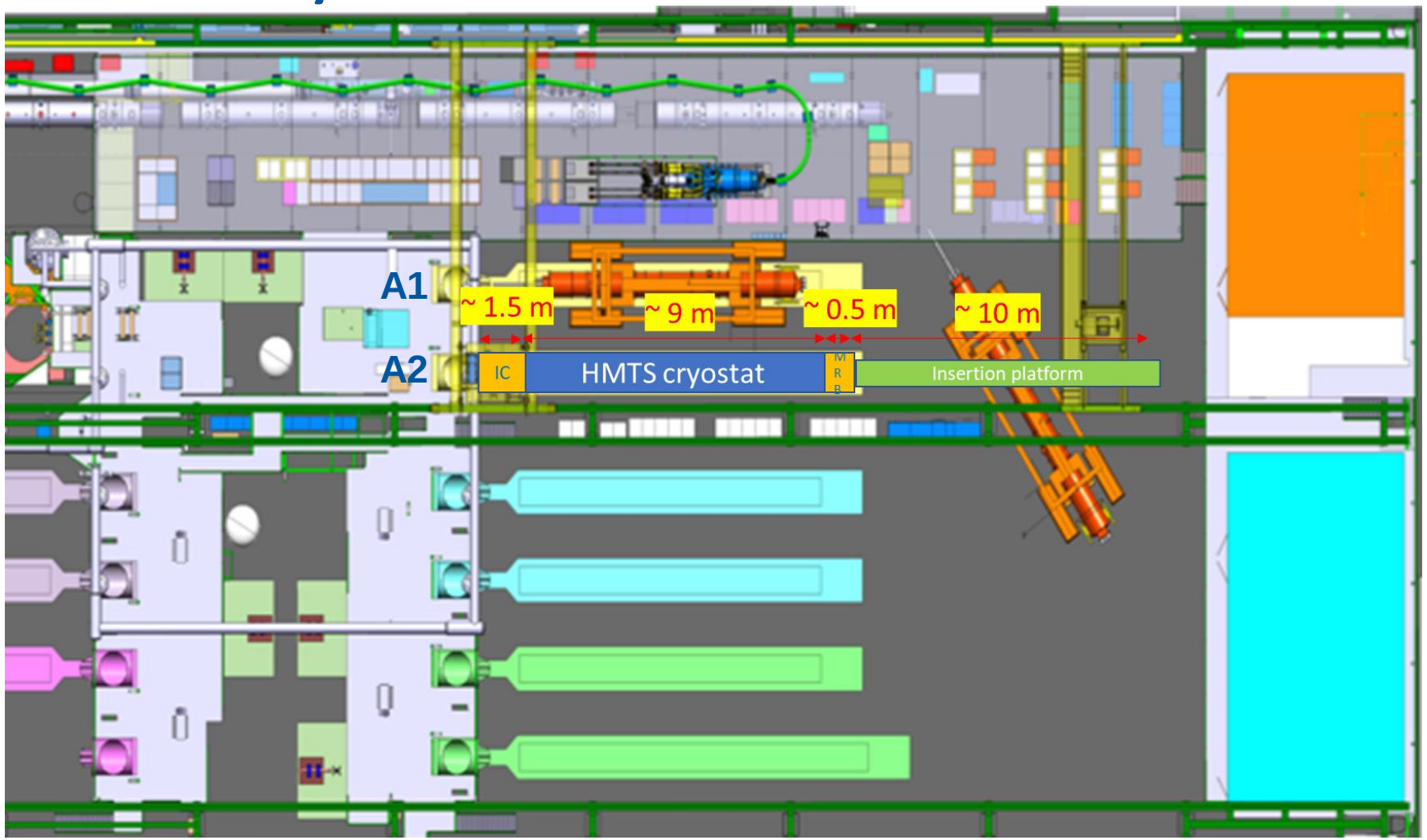
SM18 layout



- Logistics and handling to be studied: A1 preferable wrt A2 ?

From https://edms.cern.ch/document/2426281

Estimate of human resource needs

- First estimates of up to about 7.3 FTE.y, excluding services, and including about 1.2 FTE.y TE-CRG
- Work format could be similar to the one for Fresca 2 (according the EN-MME, timing is ideal with the ramp-down of design effort)
- A FELL has just joined MSC-CMI for engineering work on HMTS

Horizontal test station HMTS - Resources

Version 16/07/2020. Including resources for test bench modifications. Optimistic schedule with project finish mid-2022.

	2020		2021				2022					Notes
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Total FTE*year	
Project manager	0.2	0.5	0.5	1	0.5	0.2	1	1			1.2	
Design engineer		1	1.5	1.5	1						1.3	
Designer		1.3	2.8	2.3	0.8						1.8	
Procurement engineer		0.5	1	1	1	0.5					1.0	
Technician assembly/installation							2.5	2.5			1.3	
Welder							0.2	0.2			0.1	
Technician instrumentation							0.2	0.2			0.1	
QA+QC			0.2	0.4	0.4	0.4	0.5	0.5			0.6	
											7.3	
Support services												
Alignment/survey							x	x				
Handling and transport							x	x				
Leak detection and pressure test								x				
Weld NDT							x	x				
Baseline Schedule												
Concept design and MS												
Detailed Design												
Tender and contract placement												
Fabrication												
Installation + commissioning												
Schedule contingency												

From https://edms.cern.ch/document/2426281