

CRP interfaces and Module0 preparation

D. Duchesneau / S. Tufanli

- List of deliverables and interfaces
- Status of CRP activities for Module-0
- Safety and engineering notes
- Validation and QC before installation

DUNE Collaboration meeting
Jan 19th 2023

List of deliverables and interfaces

- ❑ 2 Top CRPs
- ❑ 2 Bottom CRPs
- ❑ 2 support metallic frames to:
 - ❑ attach the 2 top CRPs
 - ❑ support the TADs and the dyneema cables for the cathodes
- ❑ 8 support feet and adapter plates for the 2 bottom CRPs to position on the membrane floor
- ❑ 188 signal Cables for the two top CRPs
- ❑ 6 HV cables to connect the top CRP bias lines from the feedthrough to the cold filter box
- ❑ 8 Level meters with temperature probes for the top CRPs
- ❑ 16 Cables for the level meters and 8 cables for temperature probes
- ❑ Tooling for insertion in cryostat

Top CRPs

CRP3: built in July 2023

-tested in coldbox in October 2022

-Inserted in NP02 cryostat on January 17th 2023



CRP2: built in June 2023

-tested in coldbox in July and November 2022

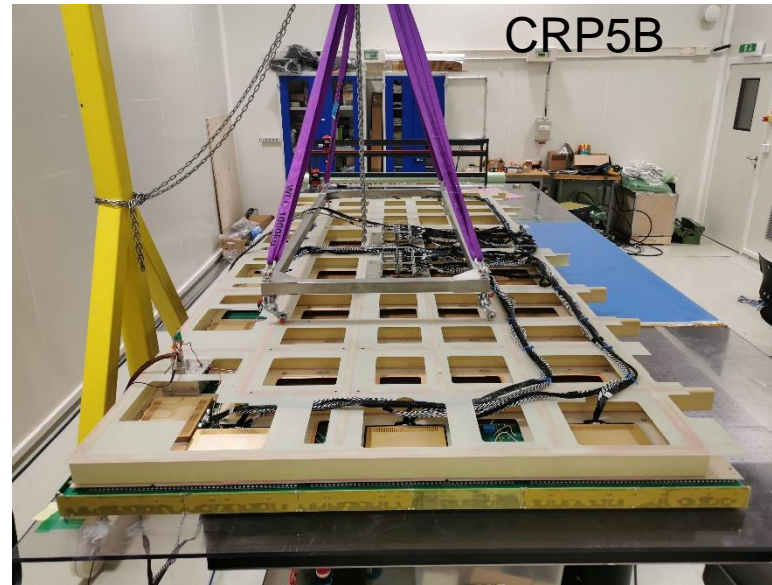
-Insertion in NP02 cryostat beginning of February 2023



Bottom CRPs

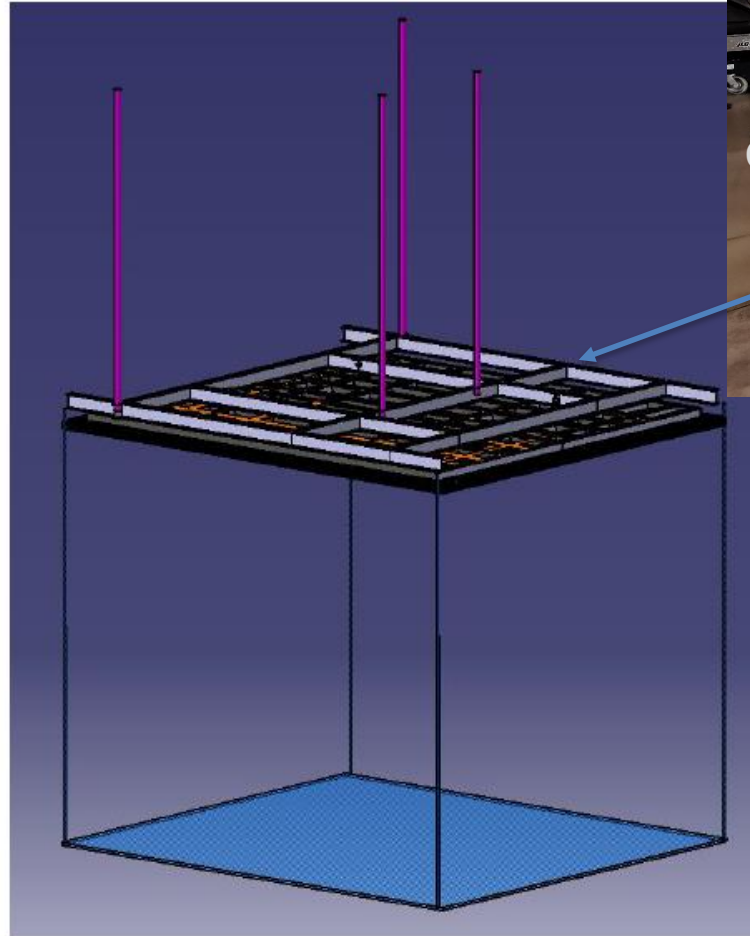
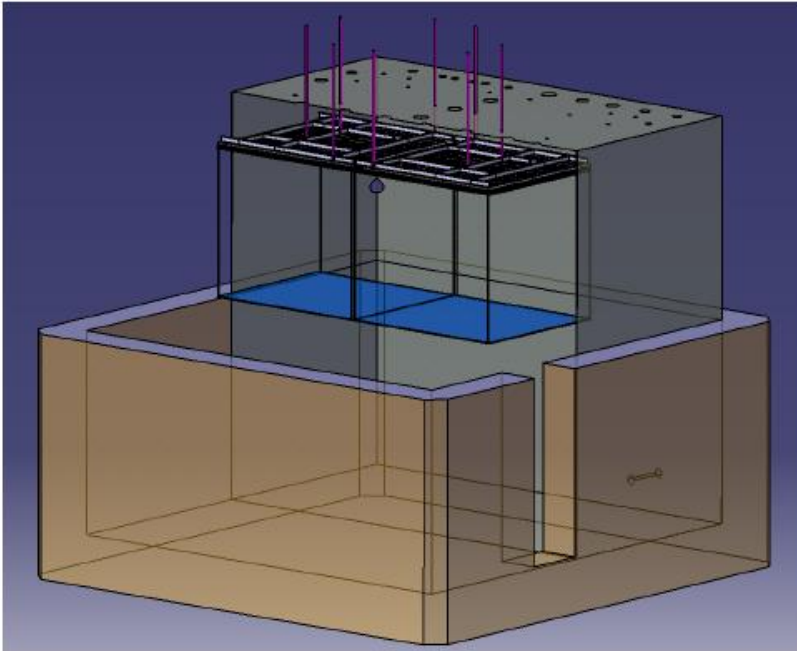
CRP5: built in September 2023 and December 2023
CRP5a tested in coldbox at BNL in December 2022
CRP5 will be assembled on January 20th and tested in coldbox at CERN in February

CRP4: built in Dec. 2022 and Jan. 2023
-tested in coldbox at Yale in January 2022
- To be sent to CERN second week of Feb. 2023
- Possible cold-box test for CRP-4 in March
- Insertion in NP02 cryostat late March 2023



Top CRP assemblies

- 2 independent assemblies including each :
 - 1 stainless steel frame
 - 1 CRP
 - 1 cathode (+ 4 dyneema ropes)
- 4 suspension cables are used for each assembly

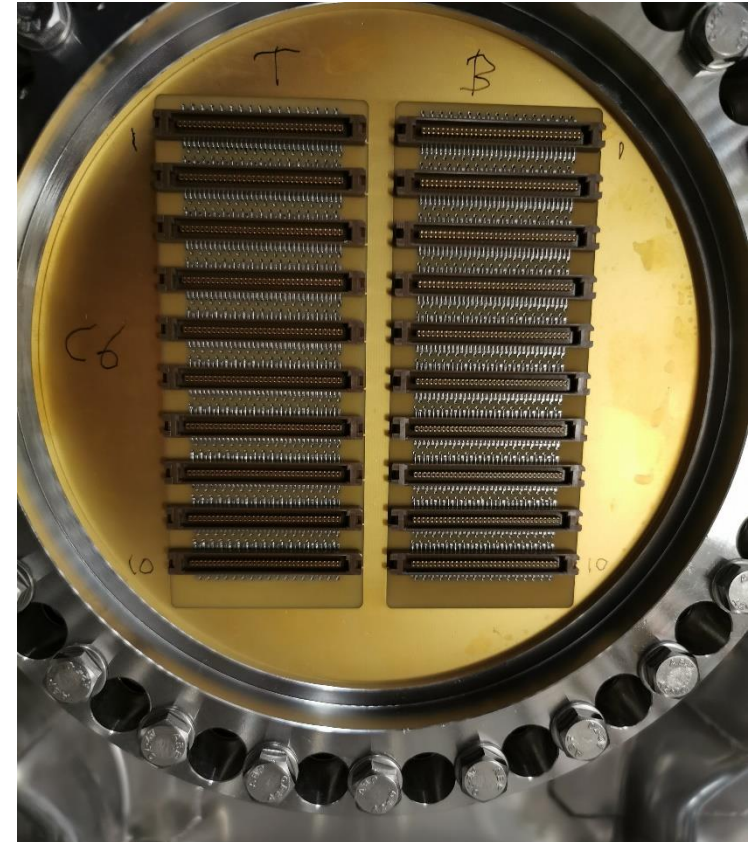


The 2 metallic frames

- inserted in cryostat on Jan 13 2023
- Surveyed by CERN metrology team on Jan 16th 2023

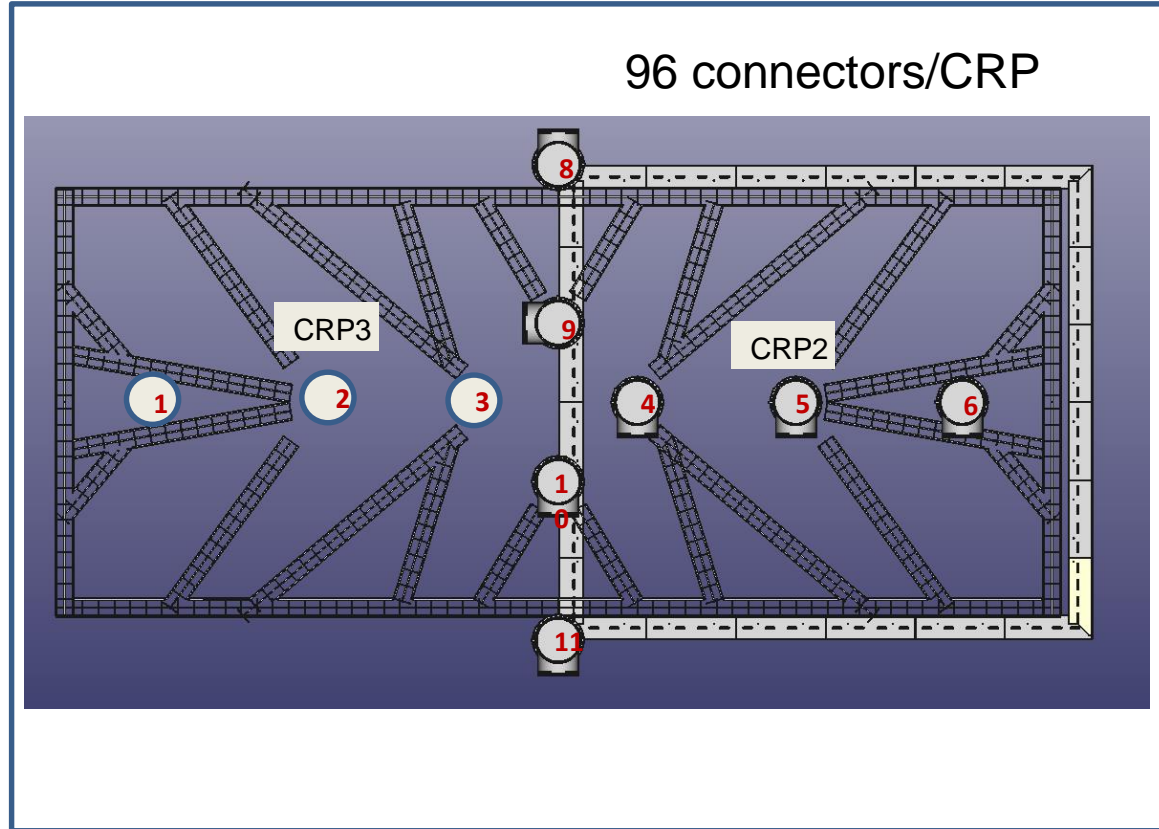
Top CRP signal cabling

CRP-TDE interface



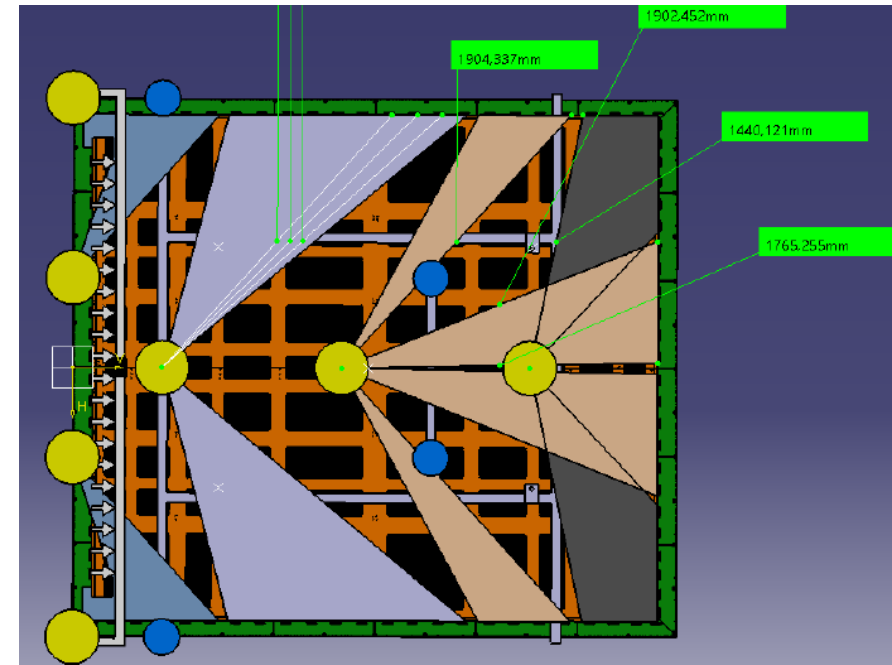
Cold flange:
20 connectors to connect on the CRP
10 chimneys are used for the 2 CRPs

Top CRP signal cabling

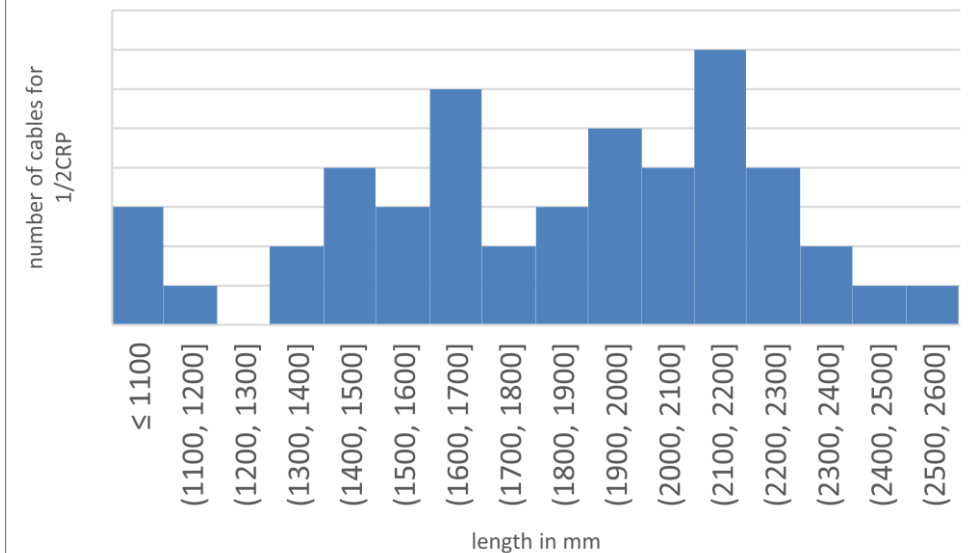


Cable length have been optimised to minimise their length with the existing chimney configuration

Cable trays are attached to the DSS and the orientation is optimised to minimise the path

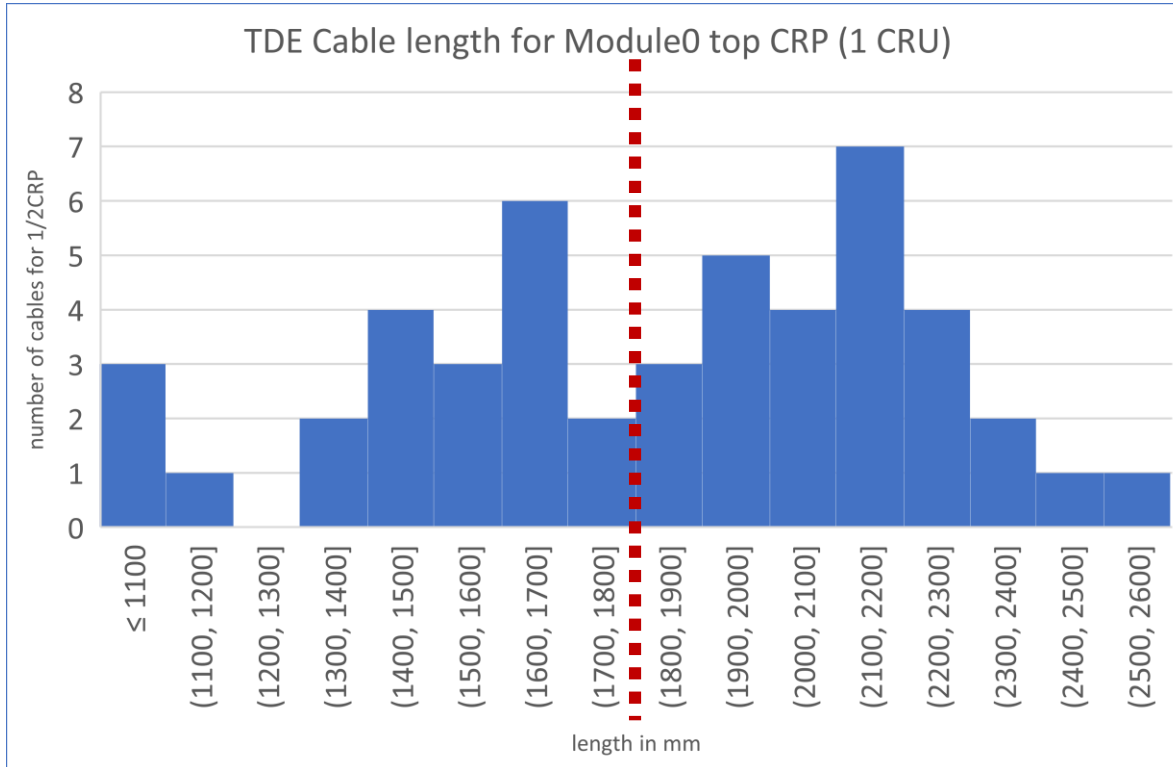


TDE Cable length for Module0 top CRP (1 CRU)



Top CRP signal cabling

Cable length distribution for CRP of Module-0



16 cables are taken from Dual-Phase
176 cables have been done at CERN the week before
christmas

All cables have been tested for continuity and shorts

1 CRP (96 cables):

8 Cables of <1.2m (NP02)

34 cables < 1.8m (28x 1.8m
+ 6x 2.1m)

6 cables of 1.9m
10 cables of 2.0m
8 cables of 2.1m } 24x 2.1m

14 cables of 2.2m
8 cables of 2.3 m } 22x 2.36m

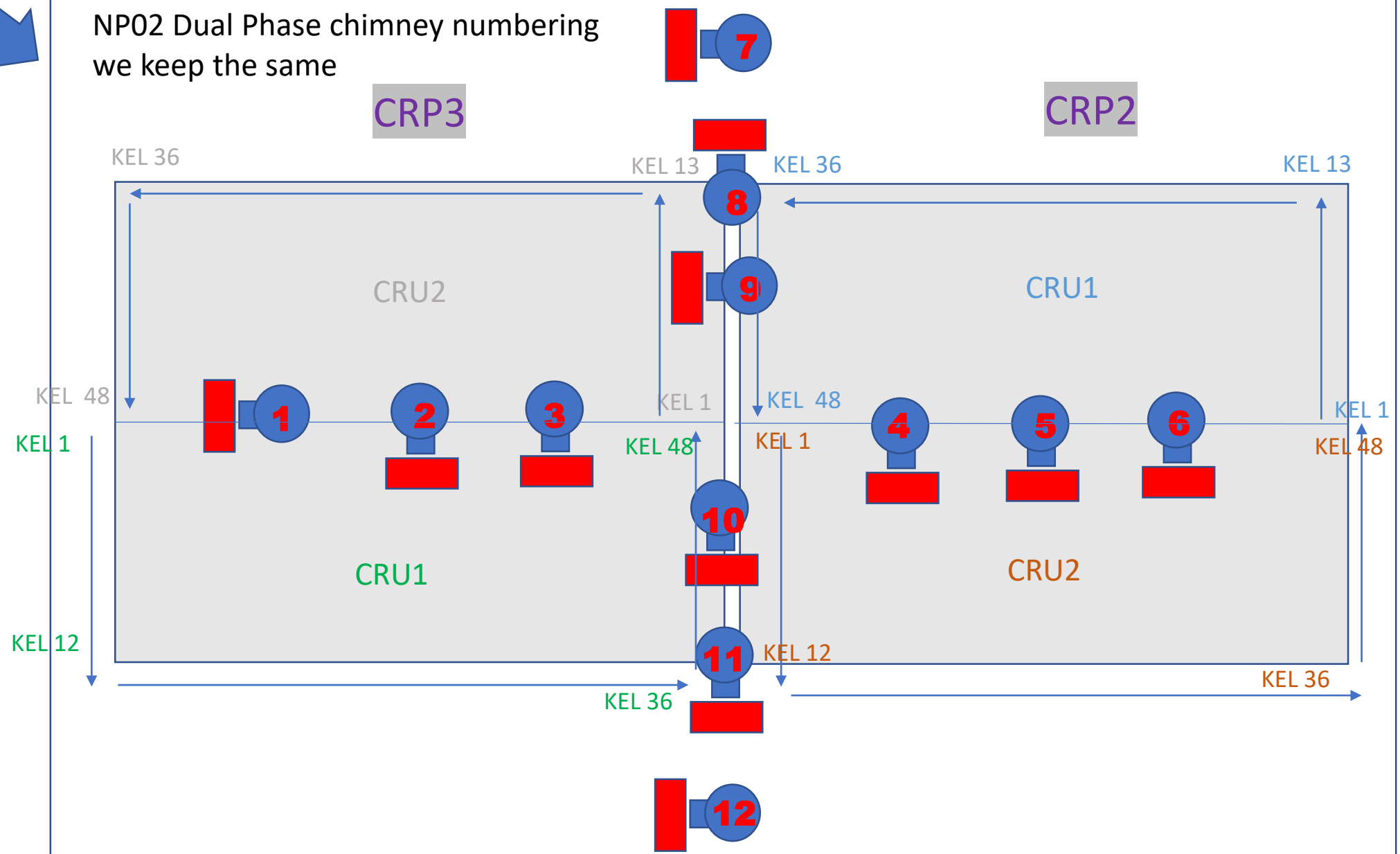
4 cables of 2.4m
2 cables of 2.5m
2 cables of 2.6m } 8x 2.6m

Top CRP signal cabling

BEAM

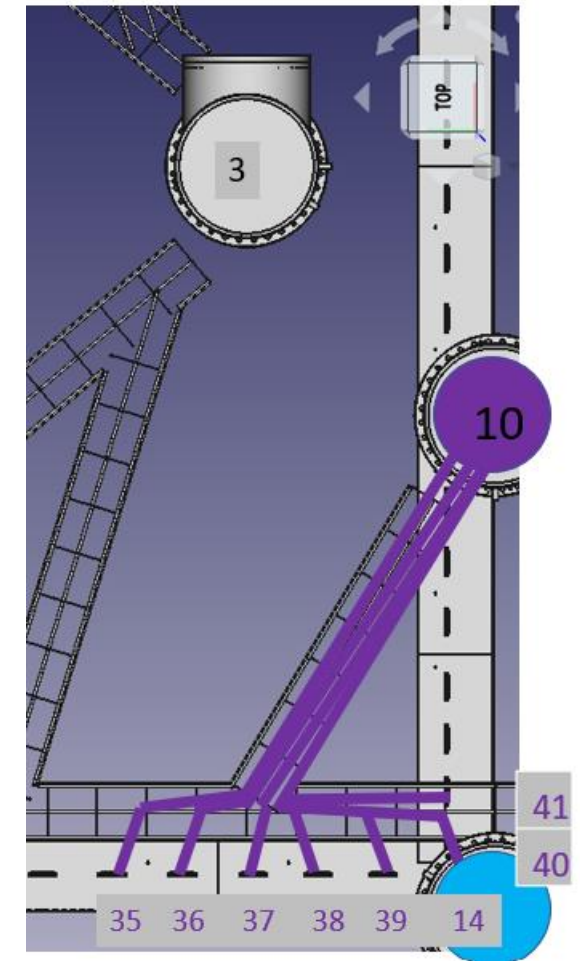
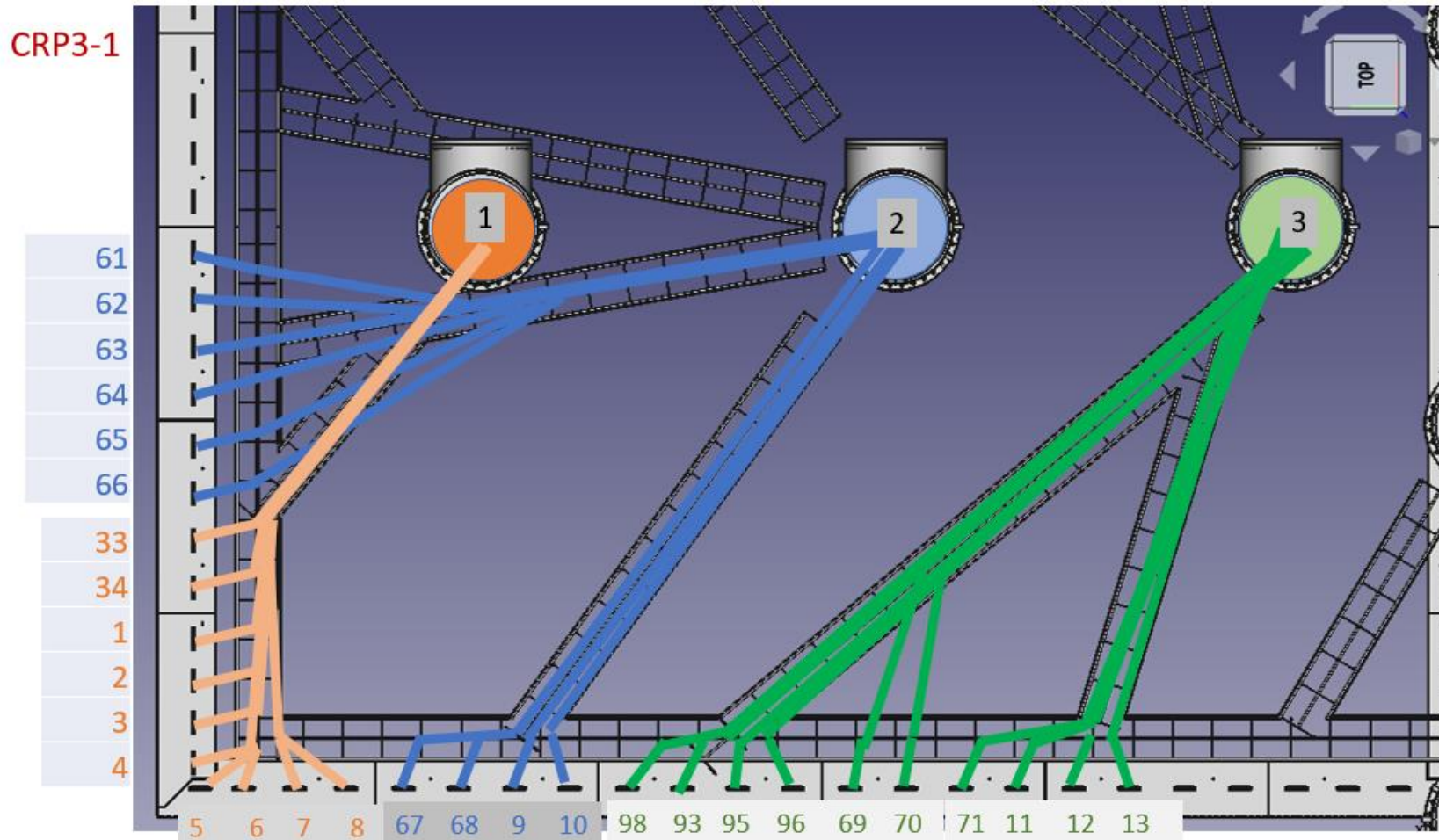


NP02 Dual Phase chimney numbering we keep the same



Top CRP signal cabling

Example of the cable routing and identification for 1 half-CRP in Module-0



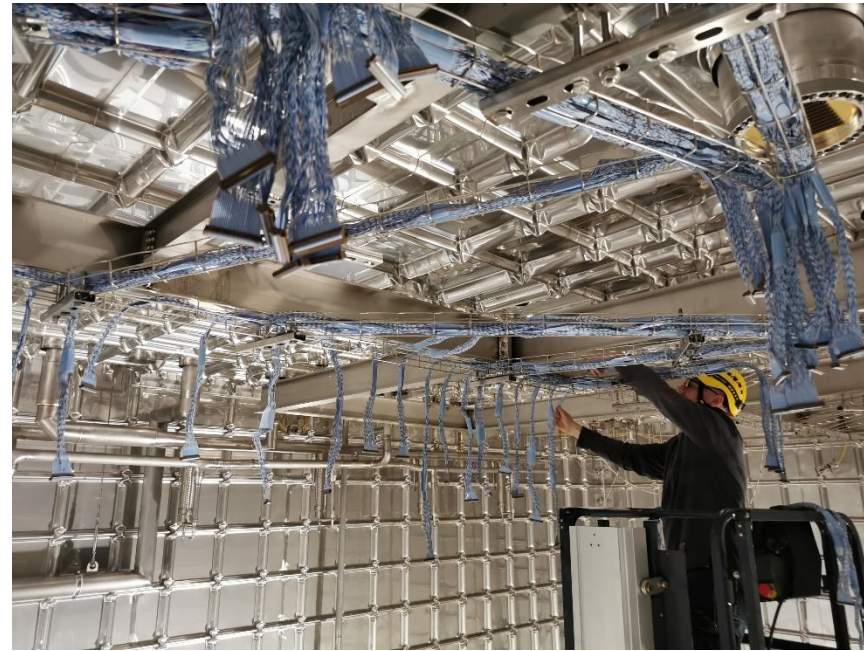
Cabling to the CRP connectors will be done when the CRP is raised to its final position except for the side of the CRP in the middle where the cables are first connected to the CRP.

The connection to the chimney 8 and 11 for this side will be done when the CRP is raised up



B. Aimard
G. Deleglise
N. Geffroy
F. Peltier
A. Parchet

Installation of top CRP cables in NP02 cryostat

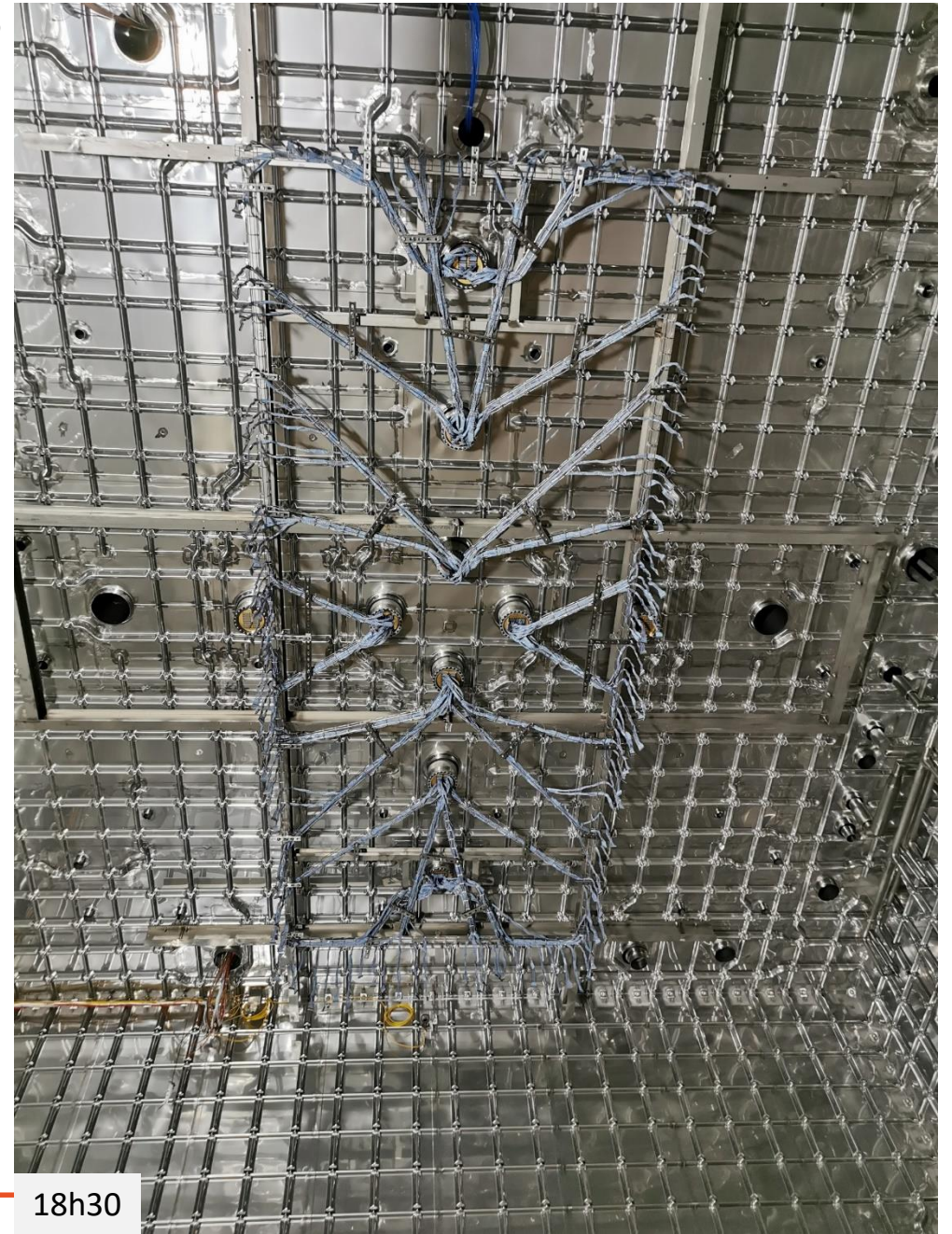
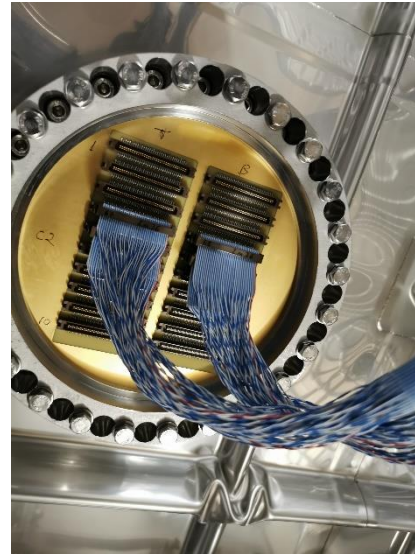
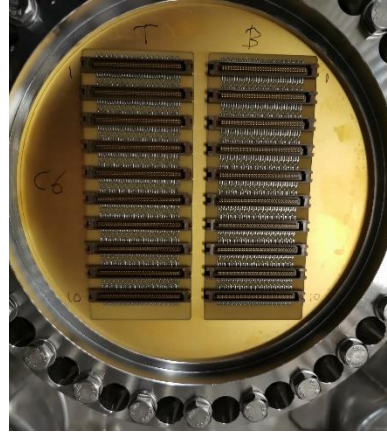


All cables have been prepared for each chimney with the recorded identifier

G. Deleglise, N. Geffroy, F. Peltier,
D. Duchesneau, O. Lantwin

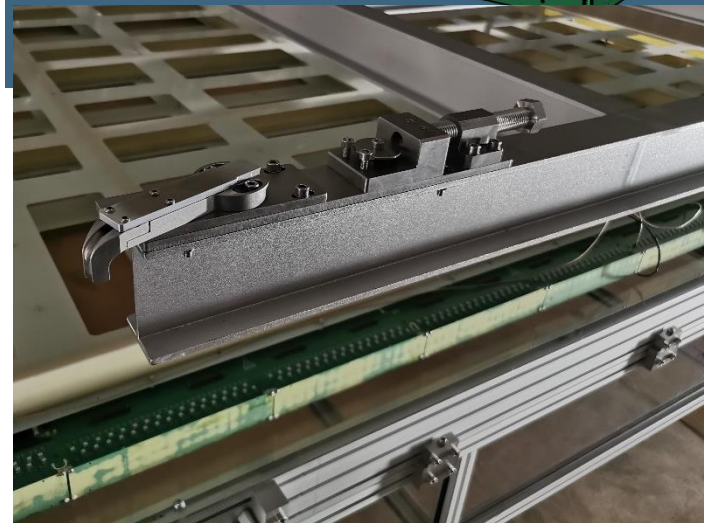
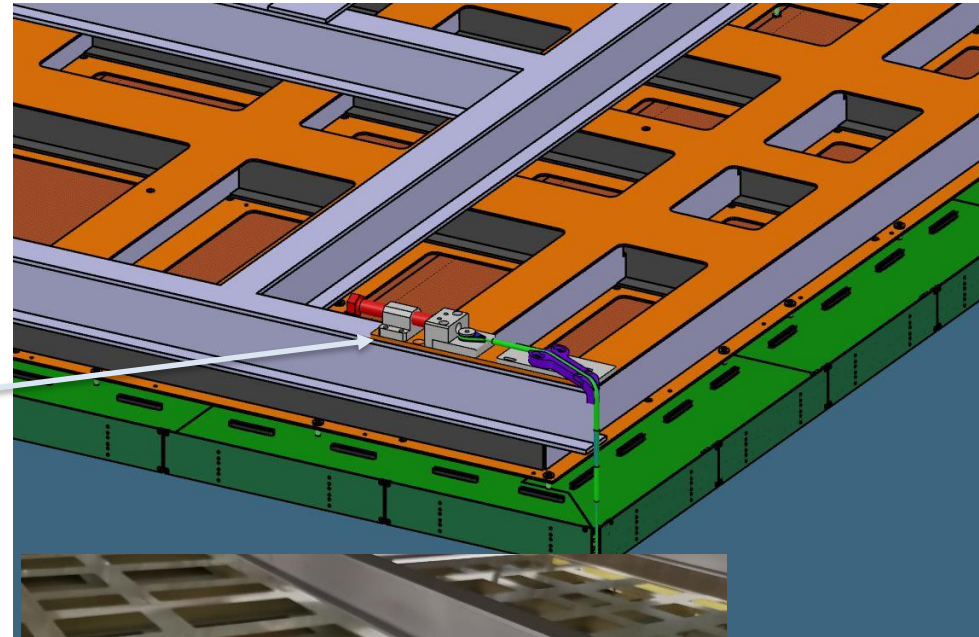
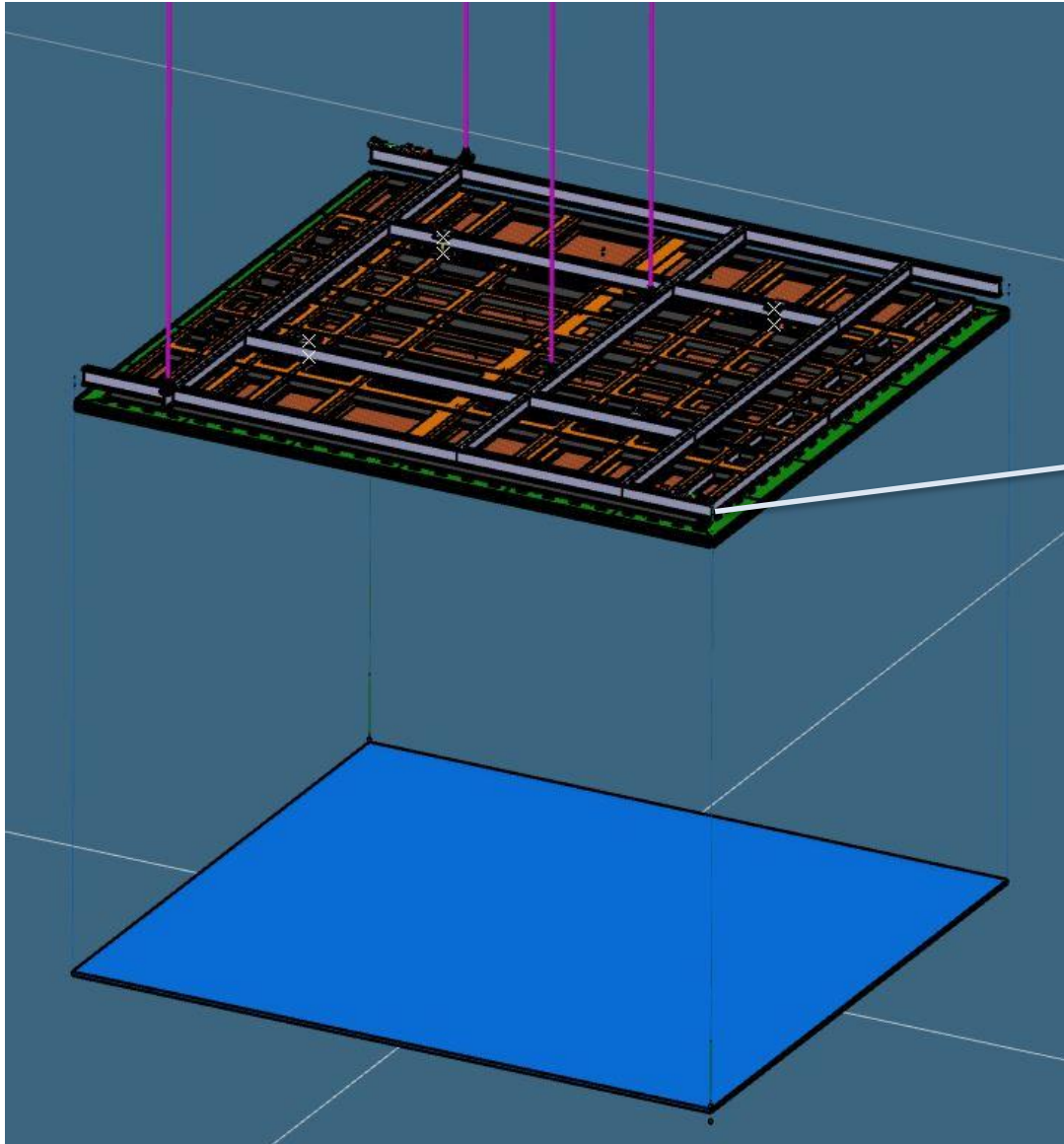
Installation of top CRP cables in NP02 cryostat

January 12th 2023



CRP and Cathode interface

Top CRP and cathode integration work with IJClab, LAPP and CERN



The 8 TAD pieces have been installed on the frames yesterday

CRP and Cathode interface

Scenario to raise the cathode up to now:

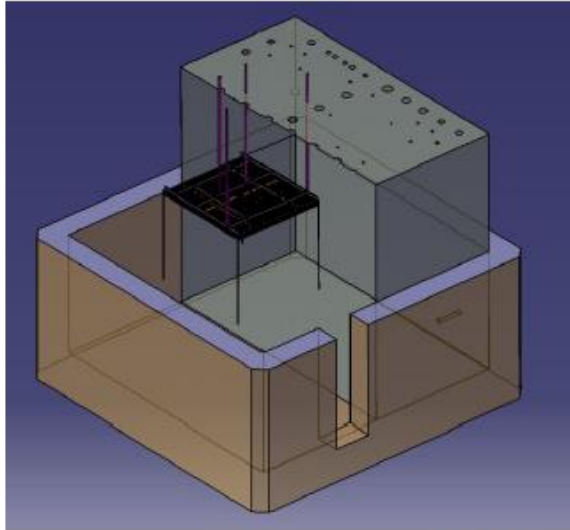
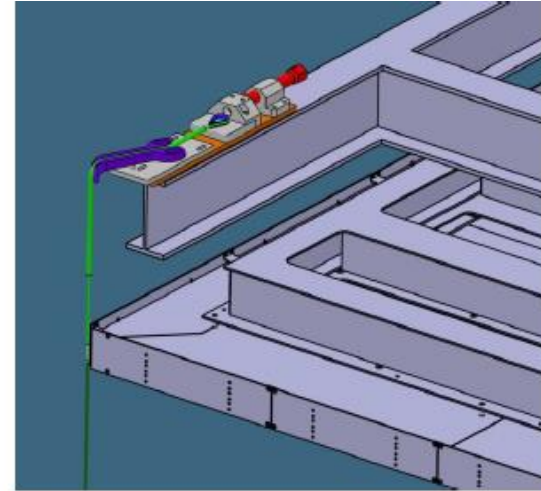
15. Fix the TAD and the 4 cathode dyneema ropes
(courtesy of IJCLab)

~~16. Lift the whole assembly at mid-height (winches)~~

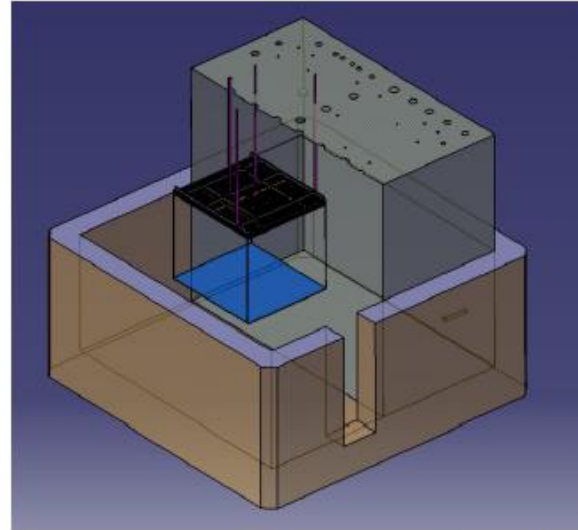
~~17. Fix the cathode~~

~~18. Lift at cabling height / final height~~

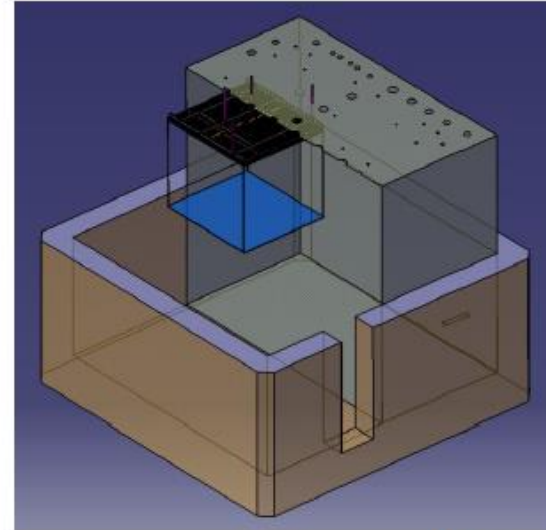
Simple scenario
has been ruled out



Step 16



Step 17

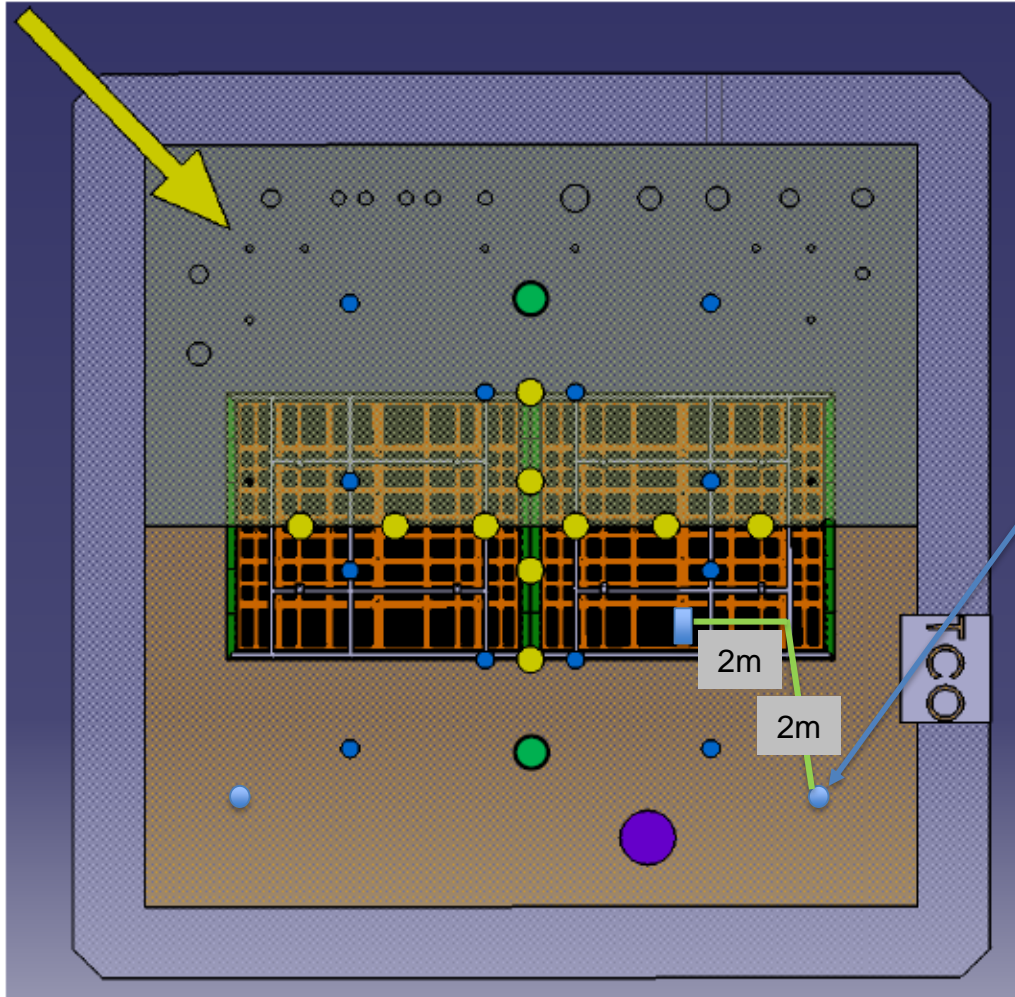


Step 18

The installation scenario
is being changed since
yesterday

It should be discussed
technically and confirmed
before going on

Top CRP bias cold cables and feedthroughs



6 cables (6m long) with SHV

Flange and feedthrough:

Option 1:

1 flange with 6 HV connections is used on the colbox and can be installed on 1 penetration (Dual Phase CRP3 instrumentation)

Option 2:

Use the old HV cables from DP PMTs



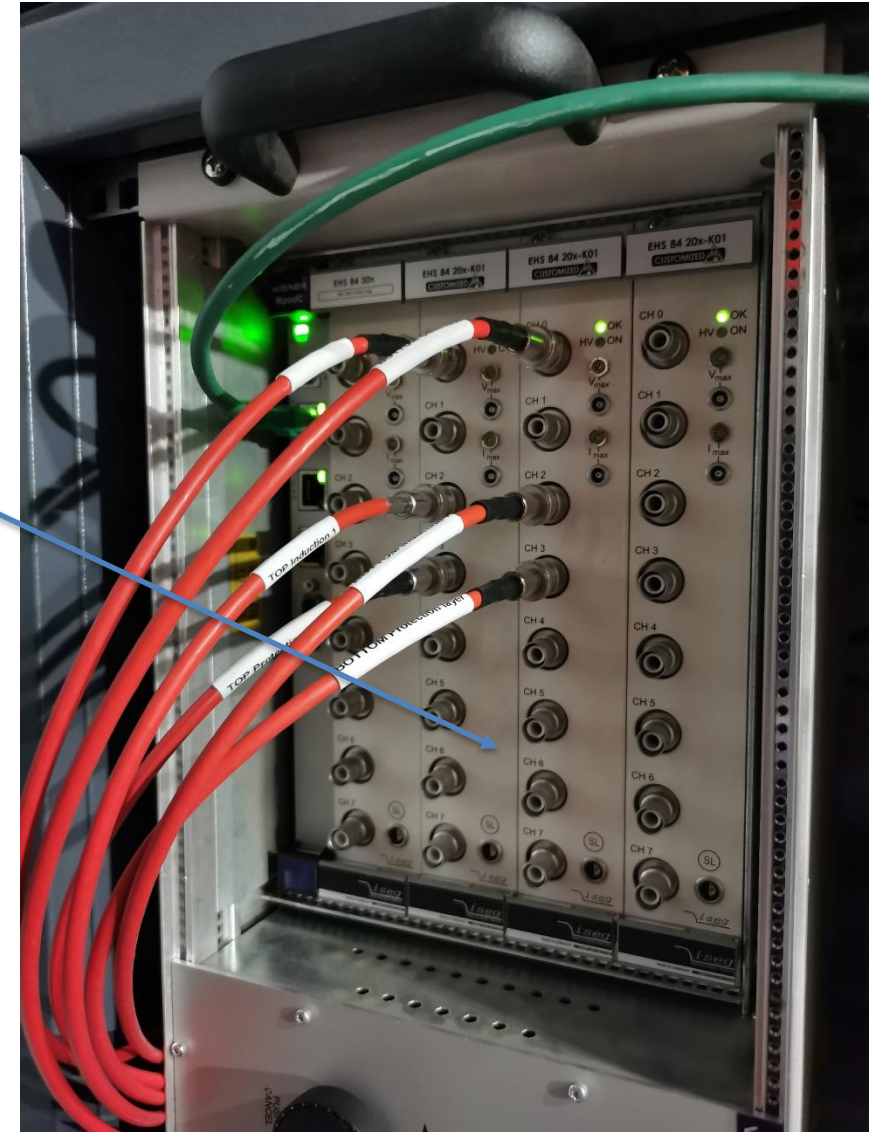
6 Top CRP cold cables to provide if we don't use the option 2
Should be installed and connected to the cold filter boxes when CRP are raised to their final position (mid February?)

Bottom CRP cold cables are coming from the BDE group

CRP power supply and warm HV cables

Warm bias cables: needs 12 for the 4 CRPs => can be reused from large number used for the DP detector (need to check the connectors on the power supply side).

HV bias supply: The Wiener unit used for the cold-box has enough channels to be used for the Module-0

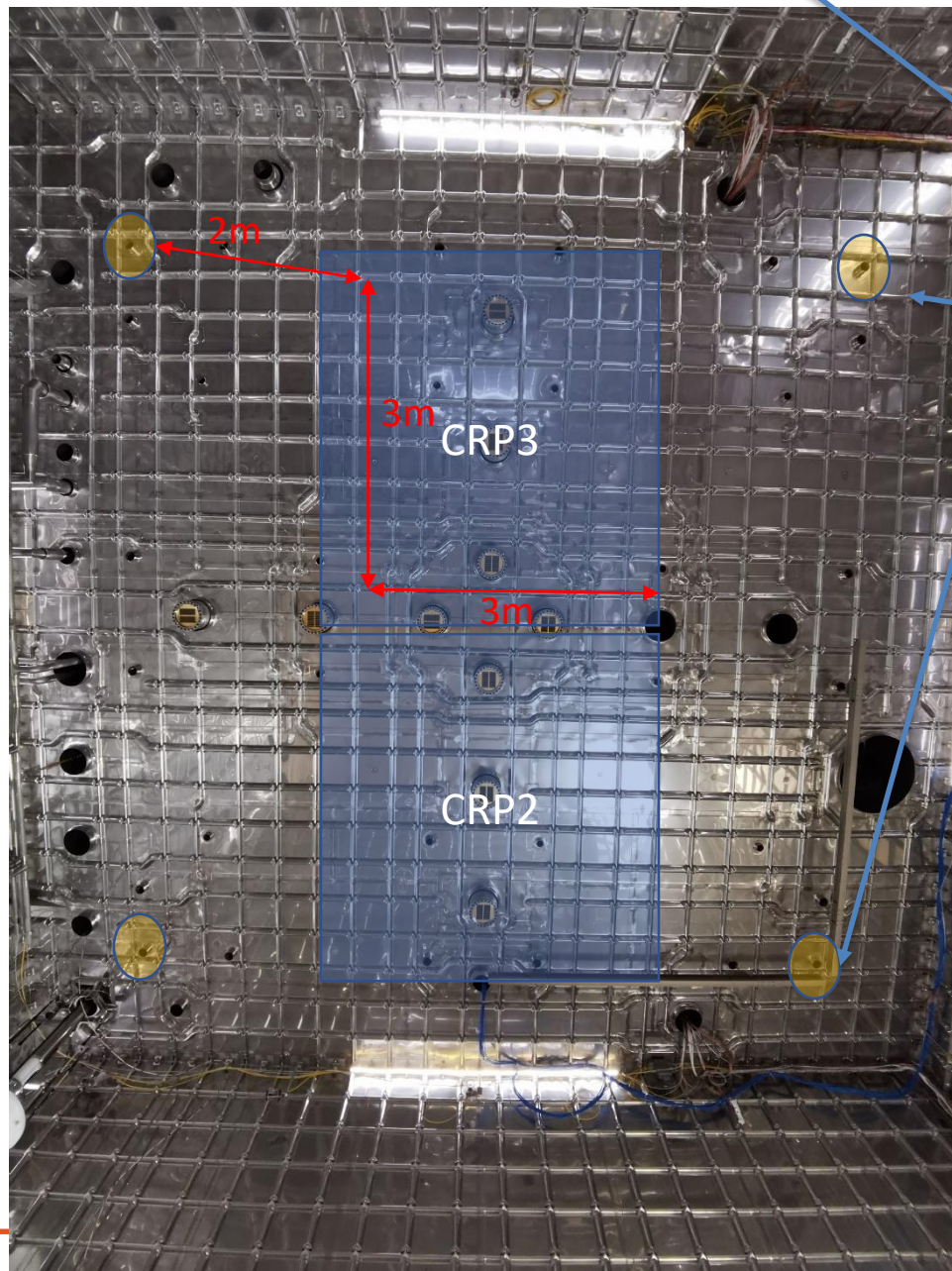


Flange and connection for Level meter and CRP temperature probes: Use of CRP1 and CRP2 DP CRP flange

Longest path to reach the level meter opposite to the instrumentation chimney: 8 m + 2m (through the roof) = 10 m

System under preparation provided by Grenoble

- ❑ 8 Level meters with temperature probes for the top CRPs
- ❑ 16 Cables for the level meters and 8 cables for temperature probes



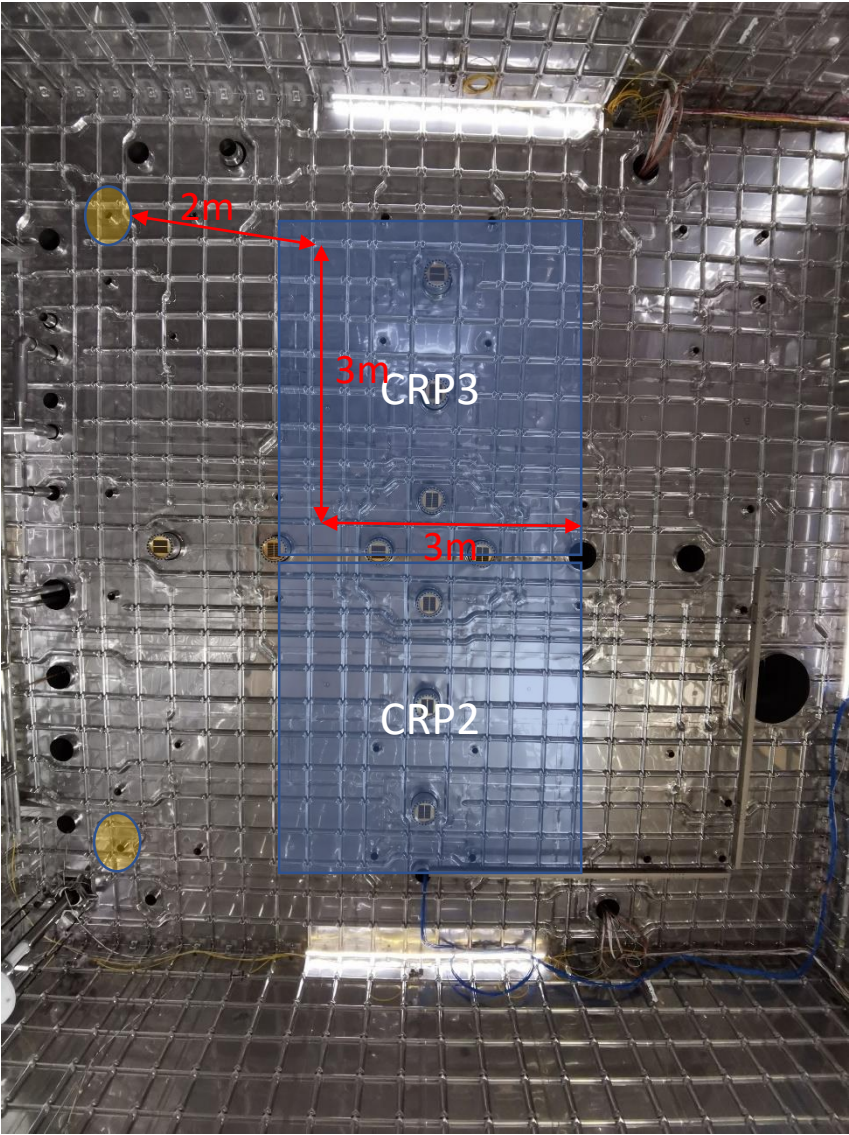
On CRP3 and CRP4 DP feedthroughs

Level meters will be available next week => attach to CRP3 and then to CRP2 when it is inserted in the cryostat

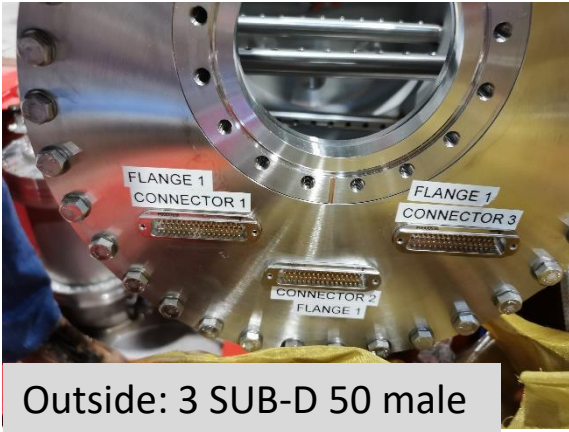
Cables will be available first week of February

Flange and connection for Level meter and CRP temperature probes: Use of CRP1 and CRP2 DP CRP flange

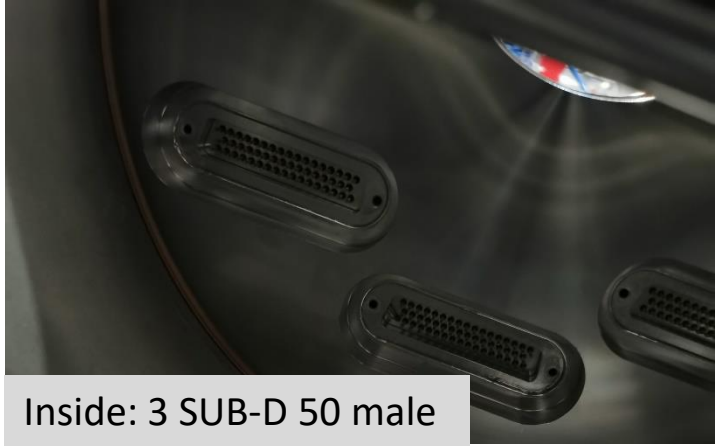
Longest path to reach the level meter opposite to the instrumentation chimney: 8 m + 2m (through the roof) = 10 m



Solution 1:

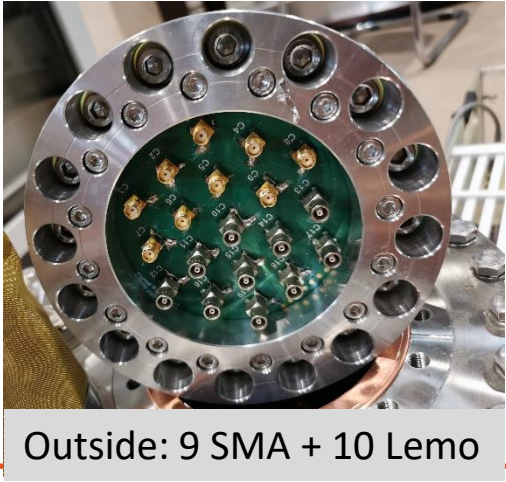


Outside: 3 SUB-D 50 male

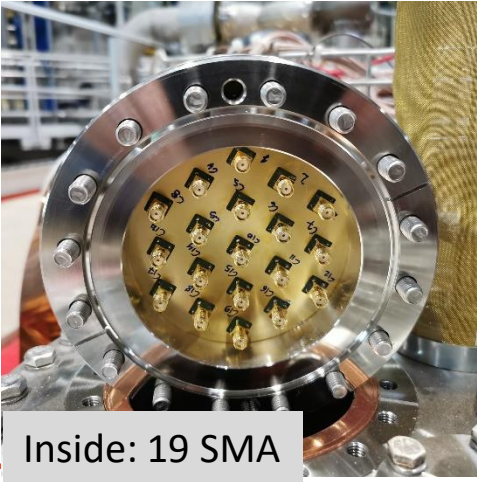


Inside: 3 SUB-D 50 male

Solution 2:



Outside: 9 SMA + 10 Lemo



Inside: 19 SMA



Bottom CRP support feet and adapter plates



The insertion and installation procedure of the Bottom need to be developed and detailed

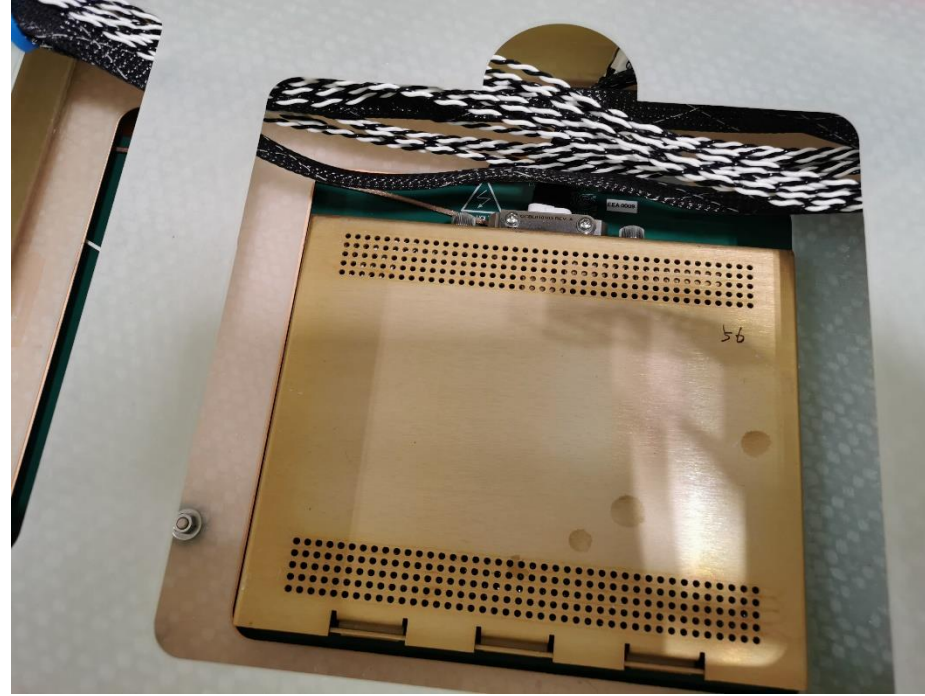
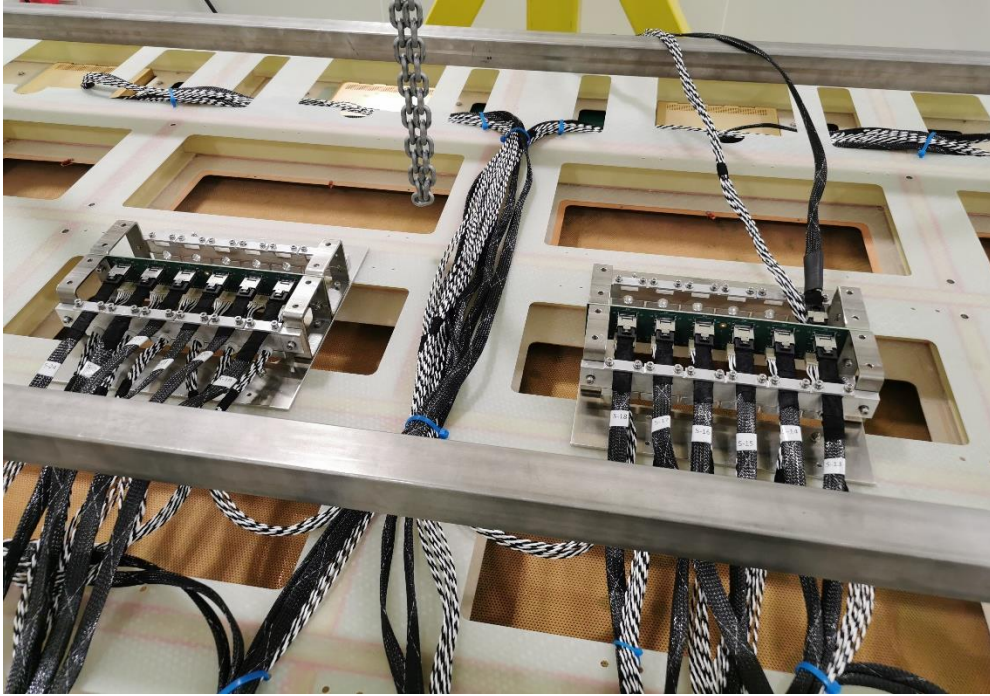
Steps to be defined

The adapter plates and feet will be installed when the CRP are inside the cryostat?

The manipulation tooling inside the cryostat has to be provided

More details will be discussed next week with Wisconsin group

Bottom CRP patch panels and FEMBs installation

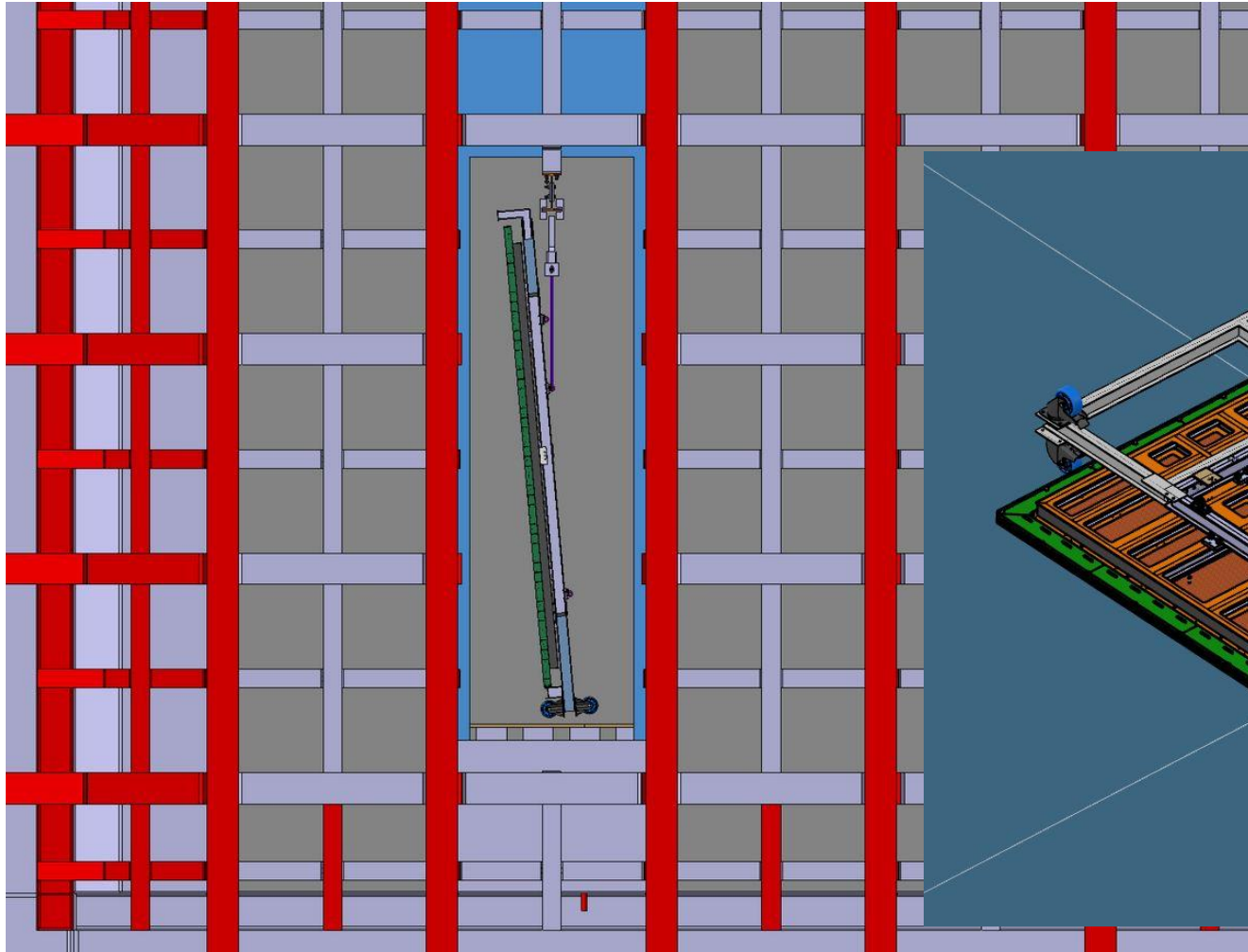


- ❑ Electronics have been integrated and tested : cold and warm for CRP5A and warm for CRP5B
- ❑ Electrical connectivity have been tested with capacitance measurement for CRP4 before FEMB integration
- ❑ Next week CRP5 will come to EHN1 to be tested at warm in the Faraday cage. It will go to the coldbox beginning of February

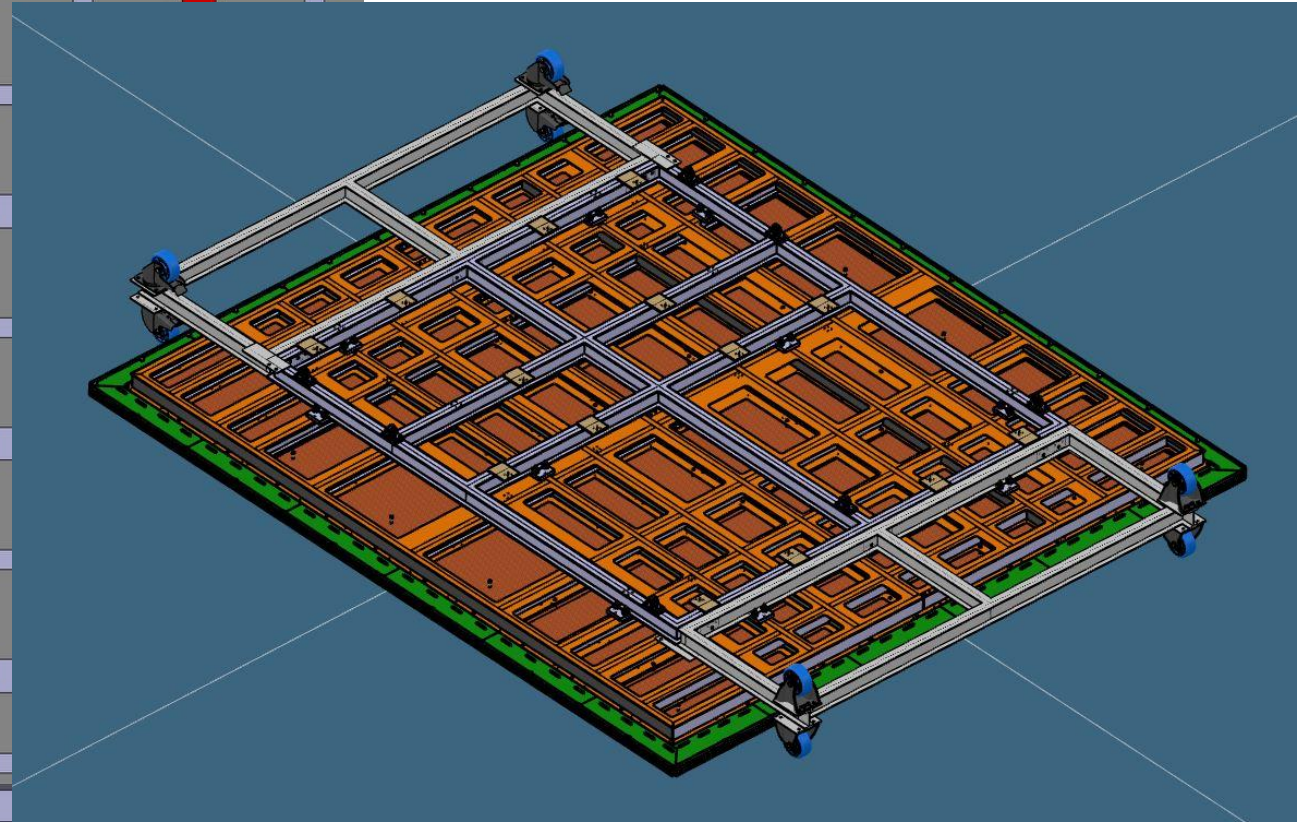
CRP insertion tooling

Developed initially for Top CRP

Insertion tooling in NP02 cryostat



Insertion of full CRP with a lifting structure allowing to enter both top and bottom CRPs

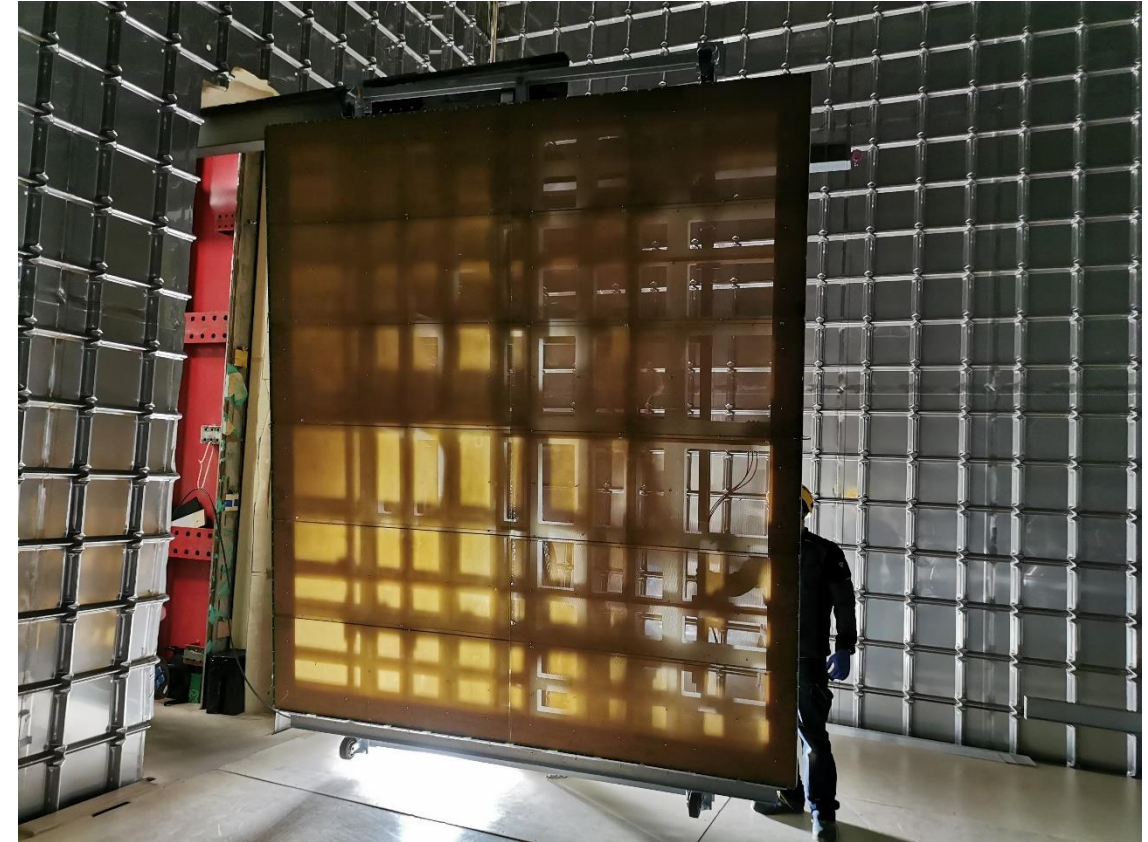
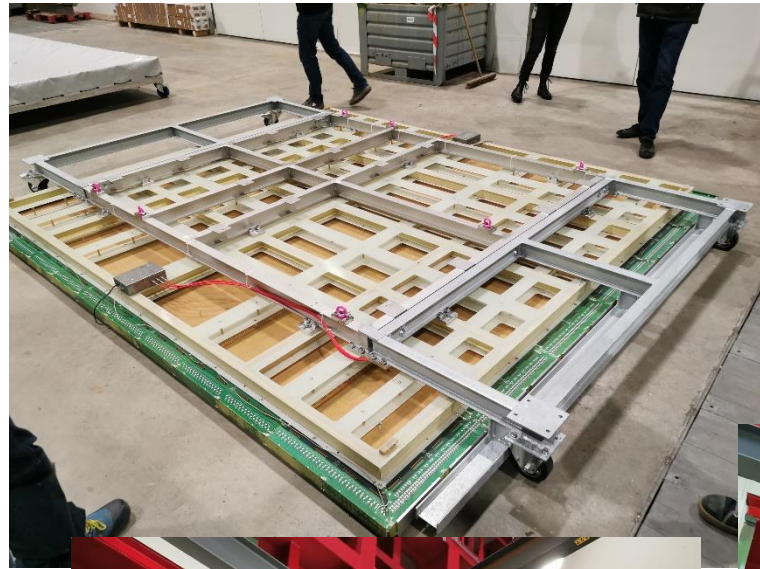


CRP insertion tooling

CRP3 insertion in NP02 cryostat on January 17 2023

Many aspects related to the manipulation/ rotation and clearances were learned

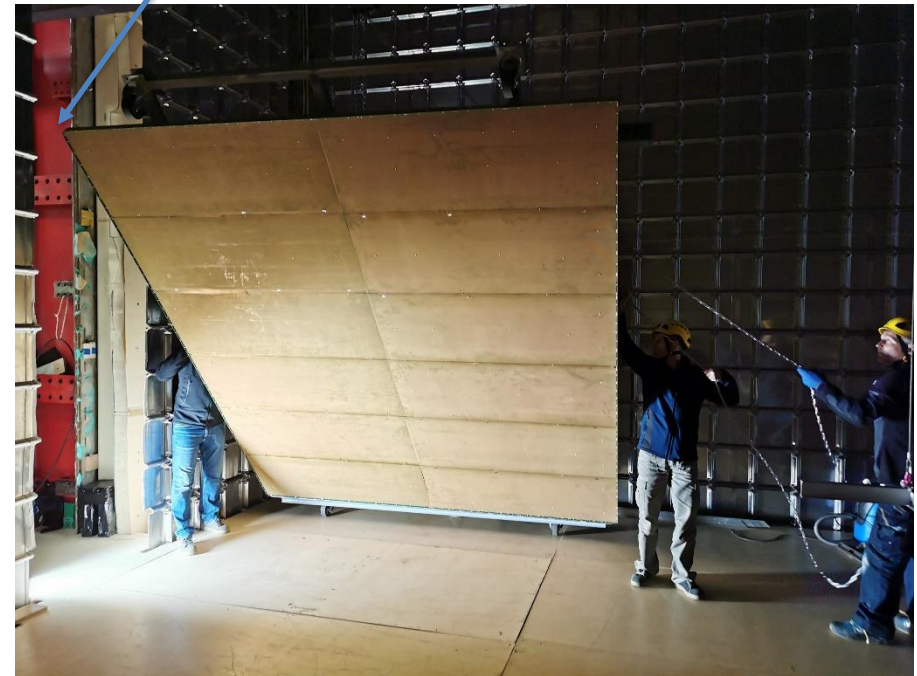
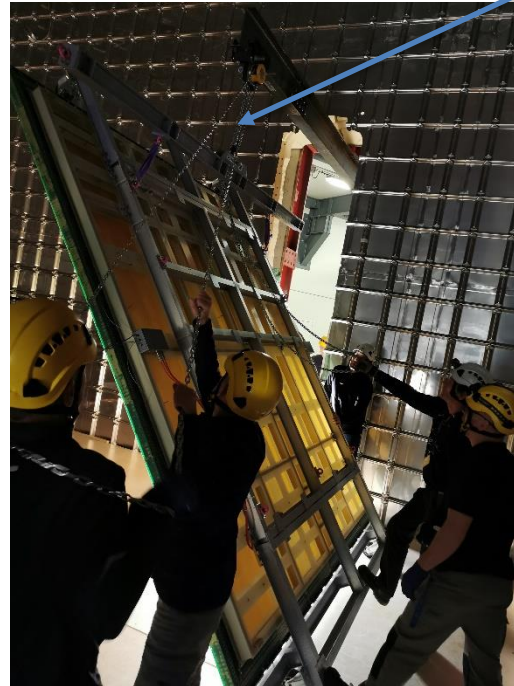
=> The tooling worked for the top CRPs but should be updated for the bottom



Bottom CRP insertion and installation

- ❑ Scenario for positioning and cabling will be discussed next week
- ❑ Full procedure of movements inside the cryostat should be detailed. The use of the insertion beam or other device should be described and the tooling provided
- ❑ The installation of adapter plates, feet to be clarified
- ❑ To note: the rotation and sliding of the CRPs are delicate operation

Beam is really limit to allow easy operation



Bottom CRP insertion and installation

Topics that will be addressed by Ian Jentz at the CRP consortium meeting next Wednesday Jan 25 at 5pm

- Attachment of adapter plates outside of the cryostat
- Moving CRPs into cryostat using the existing lifting frames. Integration with the lifting frame, how the frame is removed from the CRP.
- Attachment of support feet, tine guides, and edge locators after lifting frame is removed.
- Assembly of installation truss on membrane floor. At the spot where CRPs will be installed
- Lifting CRP onto installation truss using tine system.
- Attachment of patch cables and leveling of the CRP.
- Placement of alignment bar on the false floor.
- Lowering the CRP to the floor. Disassembly of the installation truss. Locating the CRP by touching edge locators off the alignment bar.
- Removing the tines from under the CRP.


This should answer several points and be the starting point to validate the overall procedure as well as the interference with FC installation and cathode connection

Safety and engineering notes

- ❑ Calculation notes need to be produced
Validation by CERN HSE
- ❑ Procedure description to produce in order to get a validation and an IMPACT before doing the work

Example done last week for Top CRP frame installation

For each procedure a description should be done and validated by HSE CERN

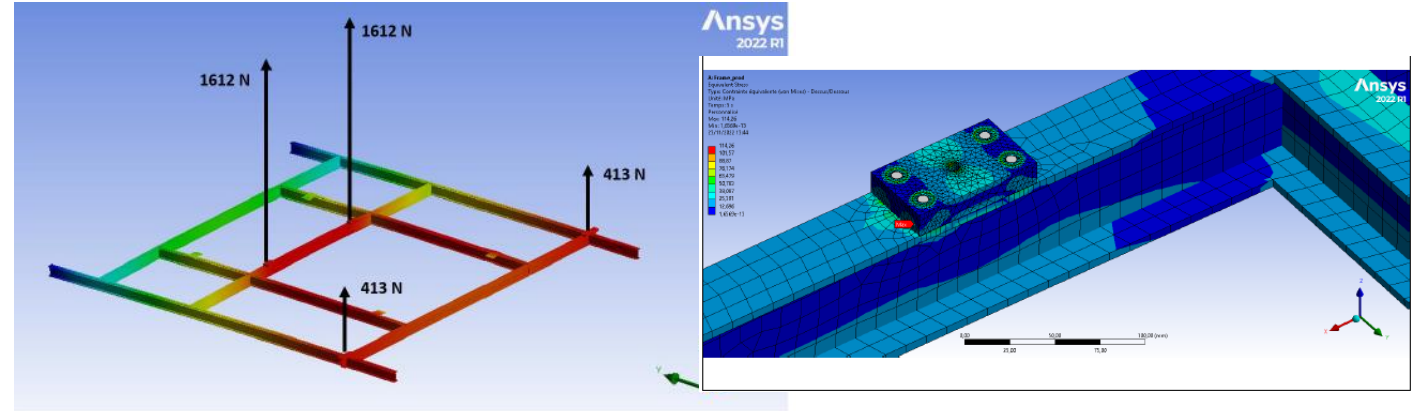
 <p>ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH Laboratoire Européen pour la Physique des Particules European Laboratory for Particle Physics</p> <p>OVERALL SAFETY AND HEALTH PROCEDURE</p> <p>SST installation in NP02 cryostat</p> <p>CERN TEAM: NEUTRINO PLATFORM COLLABORATION Contact names: Dominique Duchesneau, Nicolas Geffroy Tel (mobile): + 33 6.51.70.13.03 Email: dominique.duchesneau@lapp.in2p3.fr, geffroy@lapp.in2p3.fr</p> <p>Starting date of the operation: 11/01/2023</p> <p>PLEASE NOTE THAT A COPY OF THIS DOCUMENT MUST BE KEPT ON SITE</p> <table border="1"><tr><td>Written by: Nicolas Geffroy, Evelyne Laura Rowland Drawn up on: 10/01/2023</td><td>Checked by the EP DSO on 11/01/2023</td></tr></table>	Written by: Nicolas Geffroy , Evelyne Laura Rowland Drawn up on: 10/01/2023	Checked by the EP DSO on 11/01/2023	<p>1- REQUIREMENTS</p> <table border="1"><tr><td>CERN Team Neutrino Platform collaboration.</td></tr><tr><td>Description of the activity Installation of two SST modules (Super Structure) inside the cryostat NP02.</td></tr><tr><td>Period of execution Start Date: 11/01/2023 Completion Date: 17/01/2023</td></tr><tr><td>Required access area EHN1-NP, EHN1-NPT</td></tr></table>	CERN Team Neutrino Platform collaboration.	Description of the activity Installation of two SST modules (Super Structure) inside the cryostat NP02.	Period of execution Start Date: 11/01/2023 Completion Date: 17/01/2023	Required access area EHN1-NP, EHN1-NPT
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Required access area EHN1-NP, EHN1-NPT							

Safety and engineering notes

Top CRP structure and suspension system

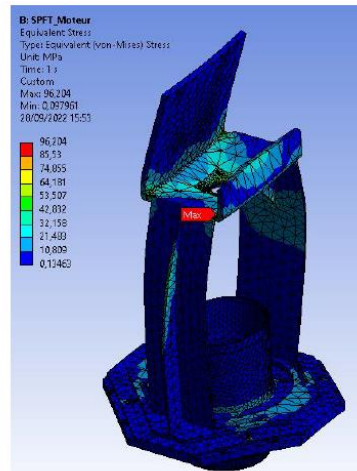
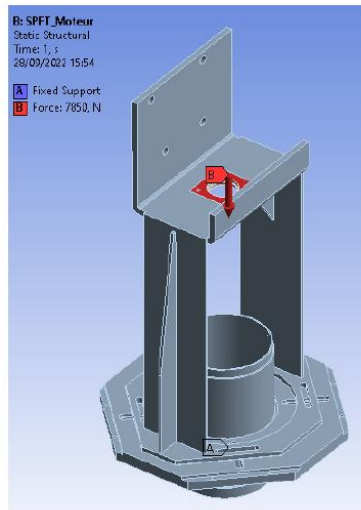
Validation report for the use of Stainless Steel frames to suspend CRP for DUNE-VD Module 0

<https://edms.cern.ch/document/2808866/1>

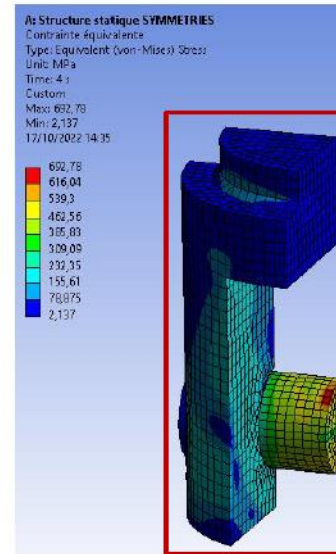


Calculation note on SPFT for Module0 CRP

<https://edms.cern.ch/document/2810555/1>



Maximal stress in the structure is lower than the RP0.2 of the material, safety it then insured.



As Structure statique SYMMETRIES
 Contrainte équivalente
 Type: Equivalent (von-Mises) Stress
 Unit: MPa
 Time: 4 s
 Custom
 Max: 602,78
 Min: 2,137
 17/10/2022 14:35

Material	Dedgation	Volumic mass (kg/m ³)	Young Modulus E (MPa)	Yield strength 0.2% R _p (MPa)	Ultimate strength R _m (MPa)	Thermal Contraction Coefficient (α·10 ⁻⁶ K ⁻¹)
Invar	1.3012	8130	210e ⁹	220	400	1,08
References : Invar Plates Standard Specifications [1]						
NIST : Material Properties, Invar[16]						
SILMS Welders certification : QS 15.17.1 and QS 12.5.1						
Certifloat_invar_Aperem.pdf						
Certifloat_invar_William_Ongor.pdf						
Stainless Steel	304L / 316L	7800	200e ⁹	210	520	16
Duplex Steel	UNS S 2205	7850	200e ⁹	450	650	16
References : Arcelor Mittal - Uninox 2205 [15]						
Certifloat_Swiss_Duplex_Trenco_2011.pdf						

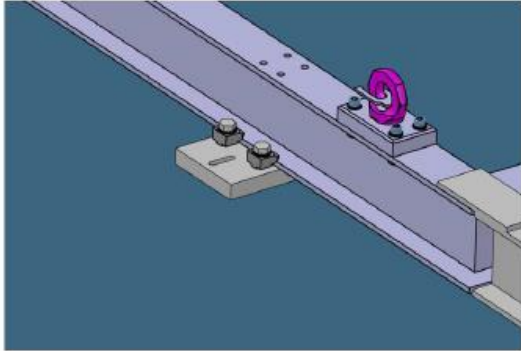
MECHANISCHE EIGENSCHAFTEN						
PROBE	ANZEIGENWERT	BEWEIS	Rm	Rp 0,2%	Rp 1%	A 5
PROBE	PROBENUMMER	PROBENUMMER	MPa	MPa	MPa	mm/mm
P 005			1.045	972	1.001	60
ANFORDERUNGEN			EN 1000	810	630	12
			870	1140		

Safety and engineering notes

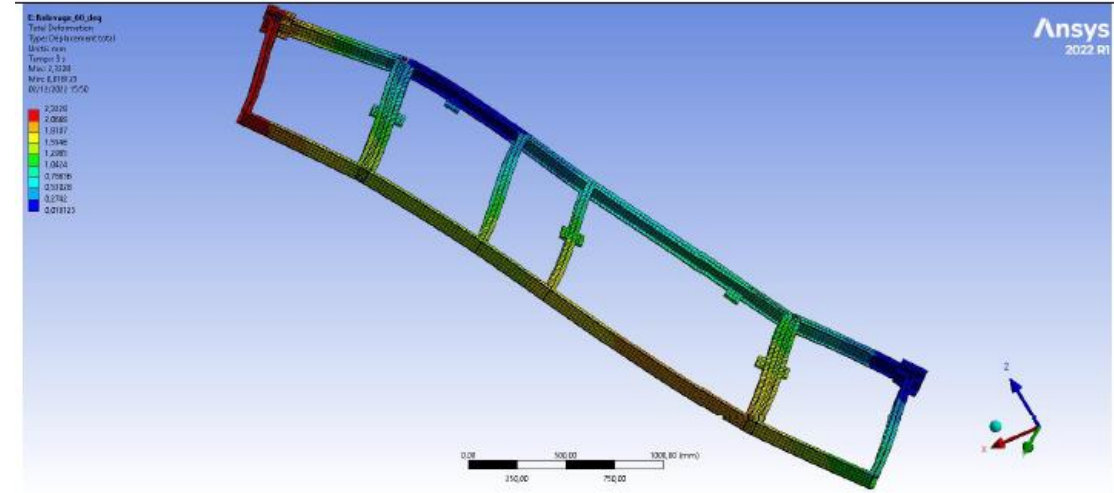
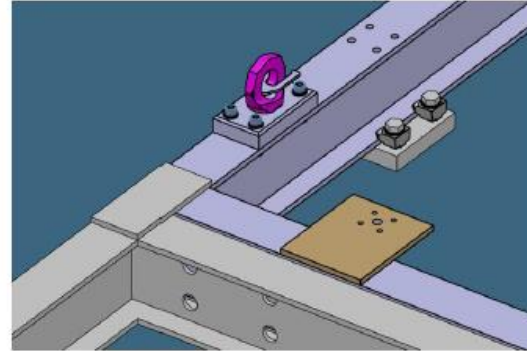
Calculation note on specific tooling to insert CRP in the cryostat for Module 0

<https://edms.cern.ch/document/2808864/1>

Left view on
2 girder clamps



Right view on
2 girder clamps



- Calculation notes need to be produced for Bottom CRP installation
 - Work will start

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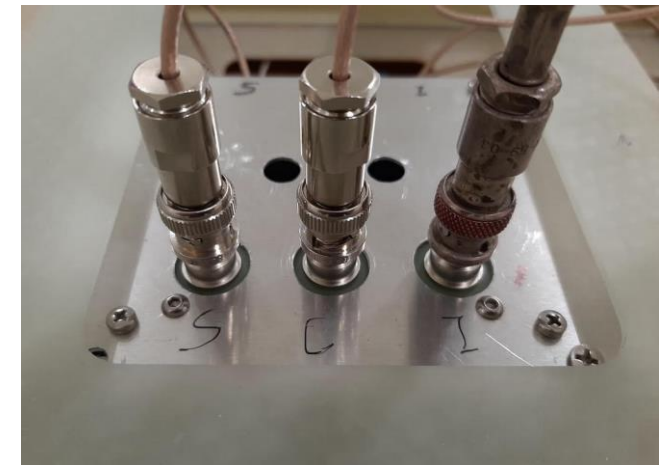
#	Id	Title	File	Status	Creat...	Author	Docu...	Tags
10	2718670	Analysis Plan for DUNE Super Structures and associate...	🔒	In W	2022-03	DOMINI	Spec...	
20	2808864	Calculation note on specific tooling to insert CRP in the ...	🔒	In W	2022-12	DOMINI	Engi...	
30	2808866	Calculation note on CRP metallic frame for Module 0	🔒	Eng	2022-12	DOMINI	Engi...	
40	2810555	Calculation note on SPFT for Module0 CRP	🔒	Eng	2023-01	DOMINI	Engi...	

<https://edms.cern.ch/document/2810555/1>

<https://edms.cern.ch/document/2808866/1>

CRP grounding and shielding

- Grounding scheme of the CRPs follows the one used for the Faraday cage and cold-box tests
- **TOP CRPs:**
 - Metallic frame is connected to the detector ground
 - No shield breaking on the bias cables (HV cable shield is connected to the bias flange)
 - Ground for each adaptor board is provided by the readout cables. Ground of adapter boards are isolated from each other
 - Electrical schematics for the adapter boards(2717223 v.1), edge cards(2785495 v.1) and cold filter board(2765577 v.1) are at edms
- **BOTTOM CRPs:**
 - Metallic feet sitting on the cryostat membrane is electrically isolated from the CRP
 - Shield of the bias cables are broken at the cold-filter box level
 - Ground of the cold-filter box is connected to the copper layer under the composite frame
 - Ground of each adapter board is connected to the copper layer under the composite frame
 - Electrical schematics for the adapter boards(2765576 v.1), edge cards(2785495 v.1) and cold filter board(2765577 v.1) are at edms
- Overall system schematics needs to be created



Validation and QC before installation

- ❑ CRP connectivity before and after installation in cryostat: capacitance measurements for top CRP
- ❑ Signal cable:
 - Complete test of continuity and short after fabrication => each cable has a test recorded in a file (it will be uploaded to EDMS)
 - Cleaning of the cable
 - after cabling => double cross check of routing and position on the cold flange
- ❑ Horizontality control of the metallic frame and survey with laser metrology => define shims to be added to guarantee the planarity of CRP within 0.2mm
- ❑ Cleaning of all frames and material with alcohol before final installation
- ❑ Visual inspection of the CRP after full process of insertion in the cryostat
- ❑ HV bias test of the CRP before installing in final position

Rapport câblage CableEye TEST 1-6-23 10:56 AM
64 Fil Non-blindé Extension directe
Nom Opérateur: "Aucun opérateur" EP-DT-DI

P A S S

HEADF J1				HEADF J2
2	1			1
4	3			3
6	5			5
8	7			7
10	9			9
12	11			11
14	13			13
16	15			15
18	17			17
20	19			19
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24	23			23
26	25			25
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62	61			61
64	63			63

