Cold Powering Installation @ IT String:

- focus on DFX Assembly (& welding)

31/08/2022

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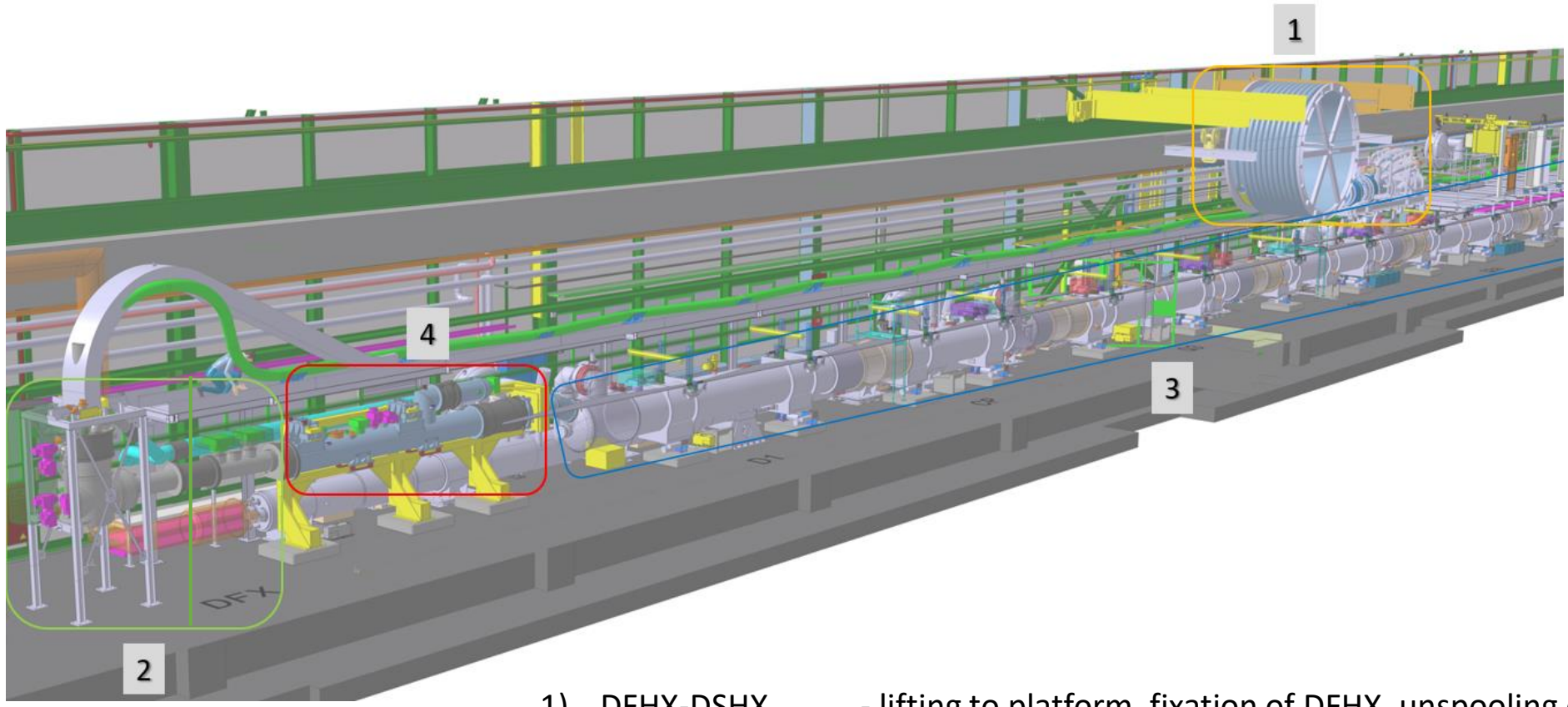
Stefanos Christos Spathopoulos

Overview of Cold Powering Installation Sequence

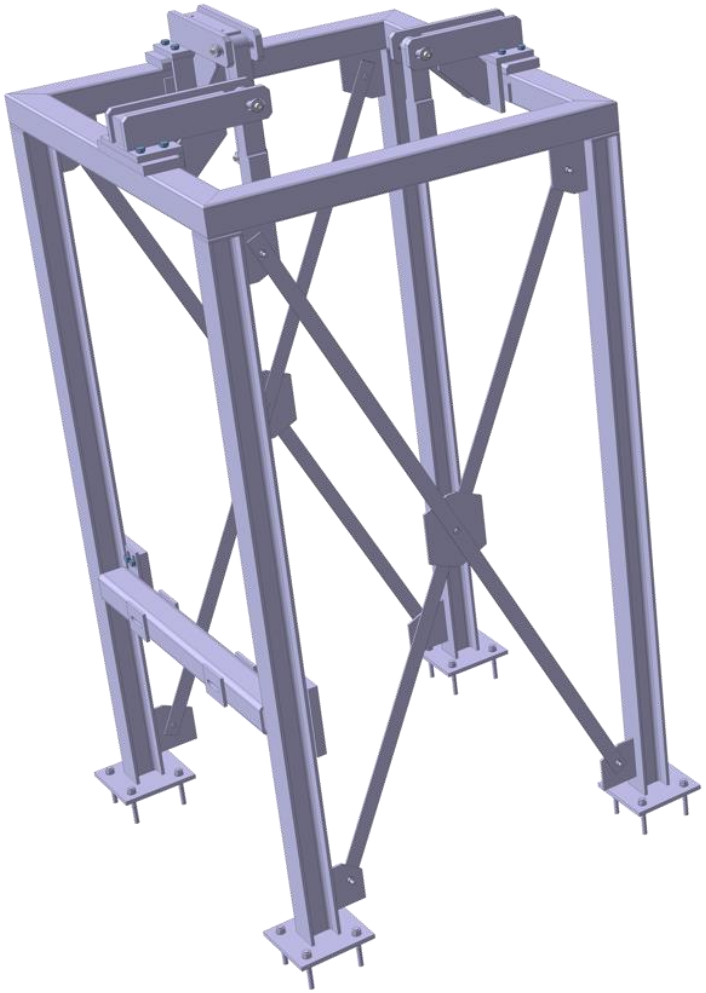


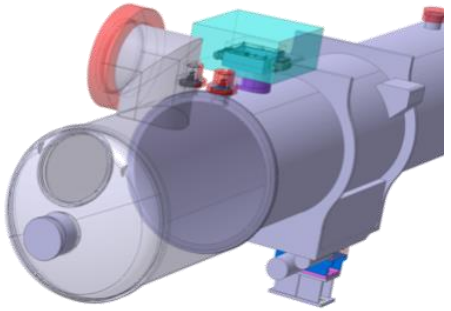
<u>WP6a welding needs:</u>
DFX assembly (4 lip)
DFX NbTi interconnect (2 lip)
DFX-SQXL transfer line (8)
DFHX-GMS transfer line (4)

⇨ Lip welds qualified by MME

			Share of WP6a installation activities:
1)	DFHX-DSHX	- lifting to platform, fixation of DFHX, unspooling of Sc link	~ 10%
2)	DFX	- Sc link insertion, DFX assembly (up to Nb-Ti/Nb-Ti interconnect)	~ 60%
3)	Triplets	- magnet installation including busbar insertion into line N	
4)	DCM	- installation	
2')	DFX	- NbTi/NbTi connection, closure of DFX interconnect	~ 30%

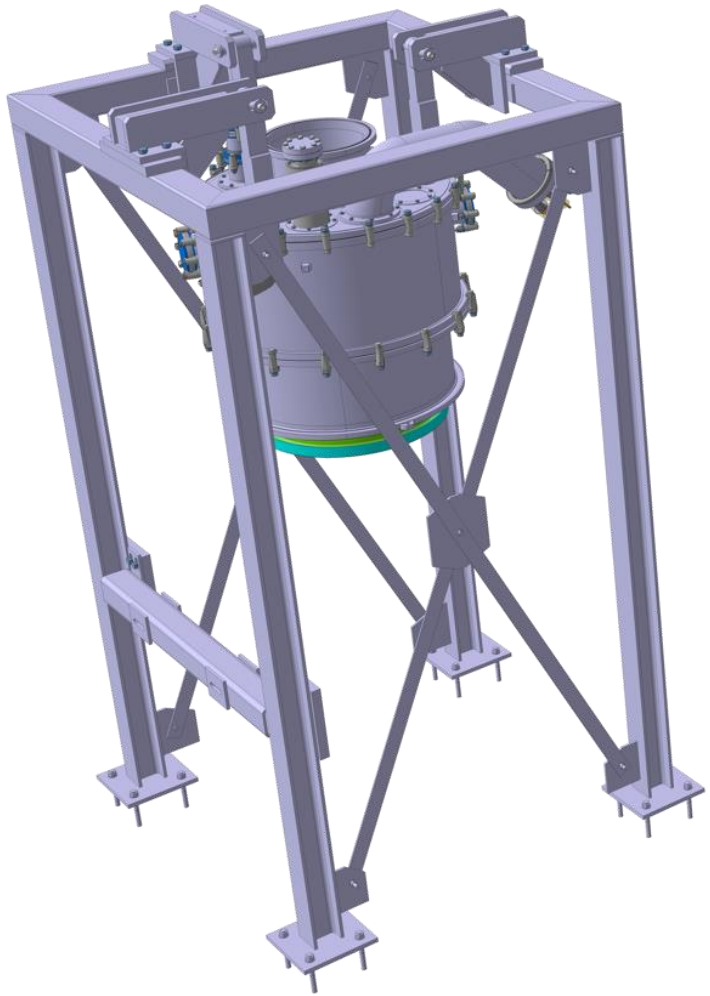
1. Installation of DFX-V

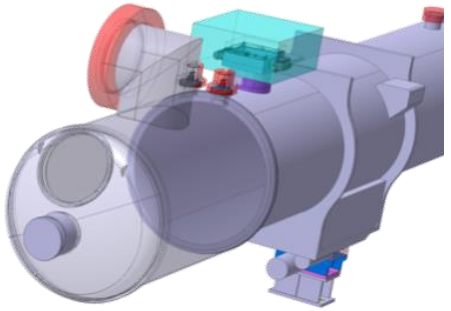




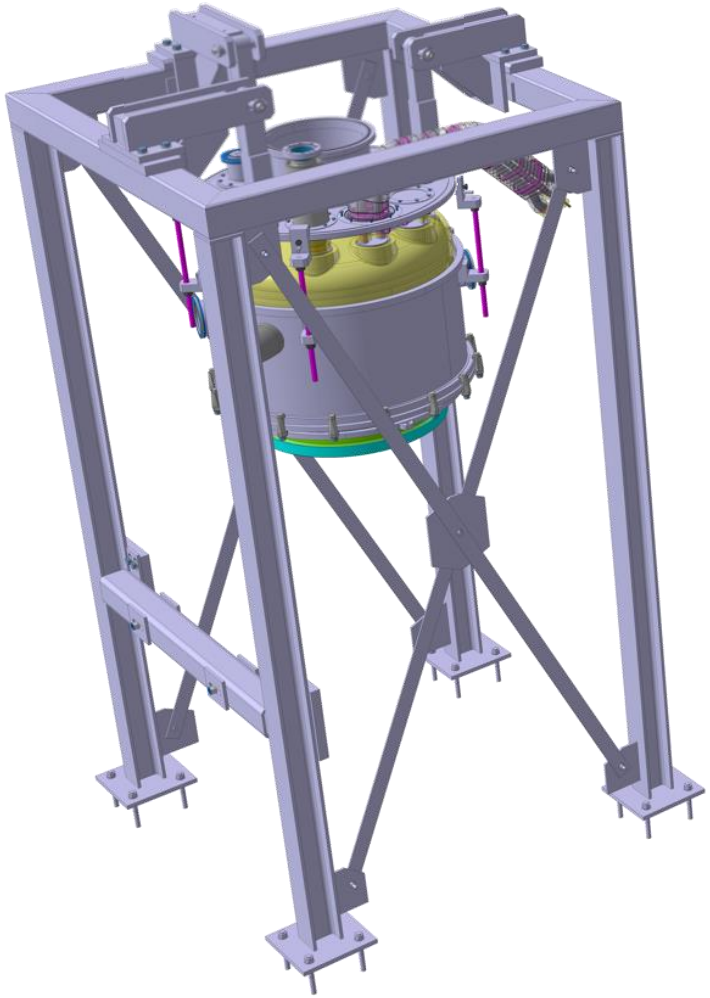
Currently Cluster F frame is depicted.
String frame will follow the same principle with some small modifications. To be produced at the close future.

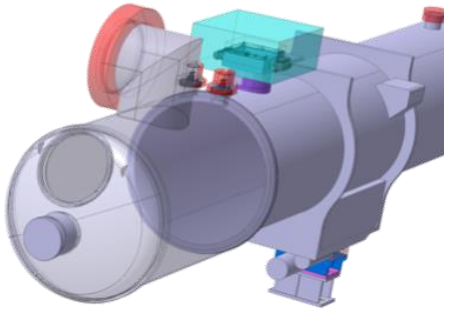
1.1 Mount the DFX-V pre tested subassembly at the support hooks



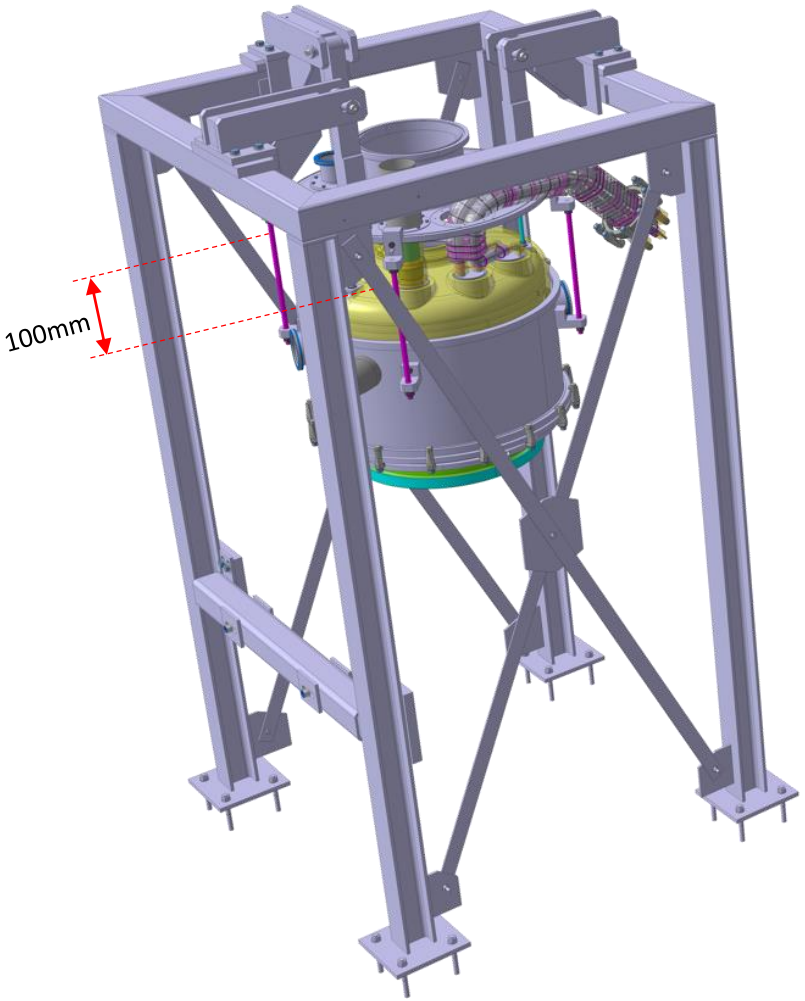


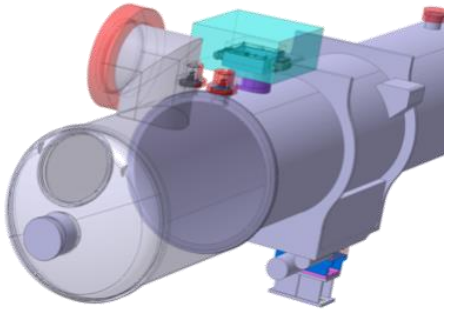
2. Insertion of SC Link



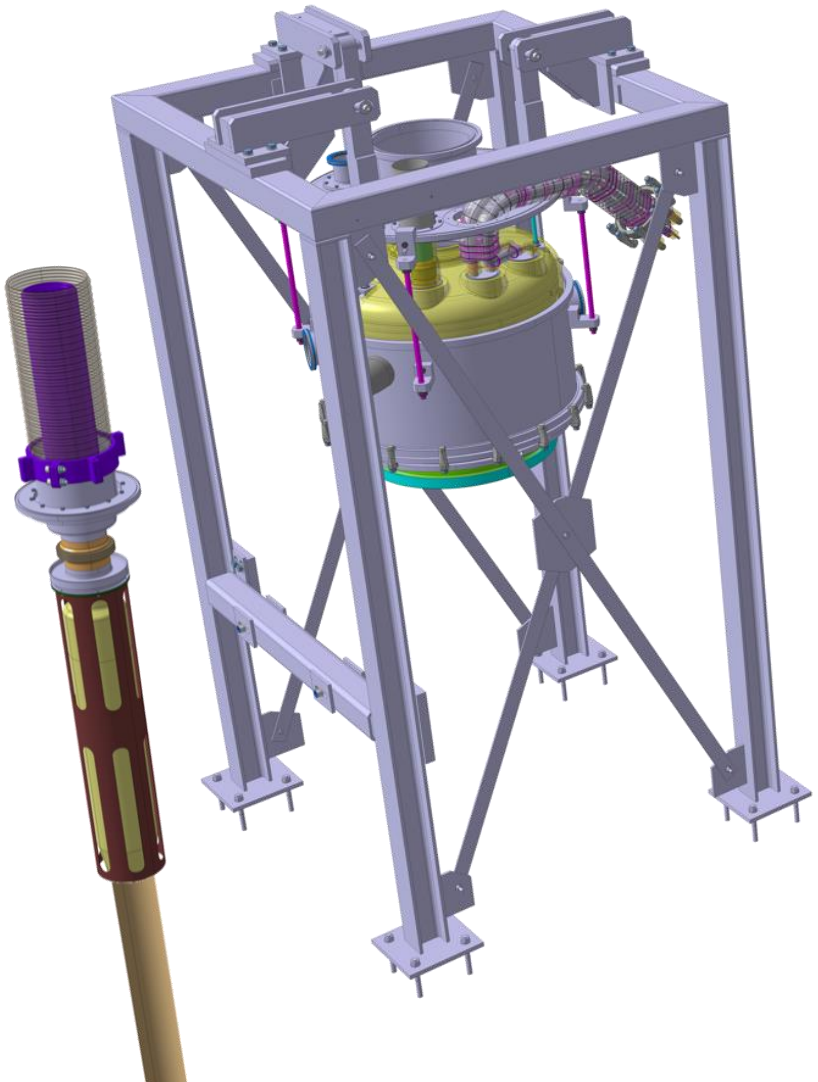


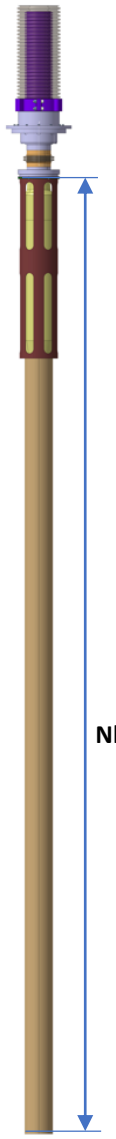
2.1 Adjust the lifting tooling in parallel with the vacuum jacket tool and lower the dome for 100mm.



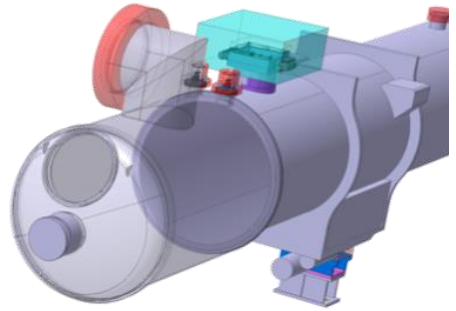


2.2 Remove the protection around SC-Link

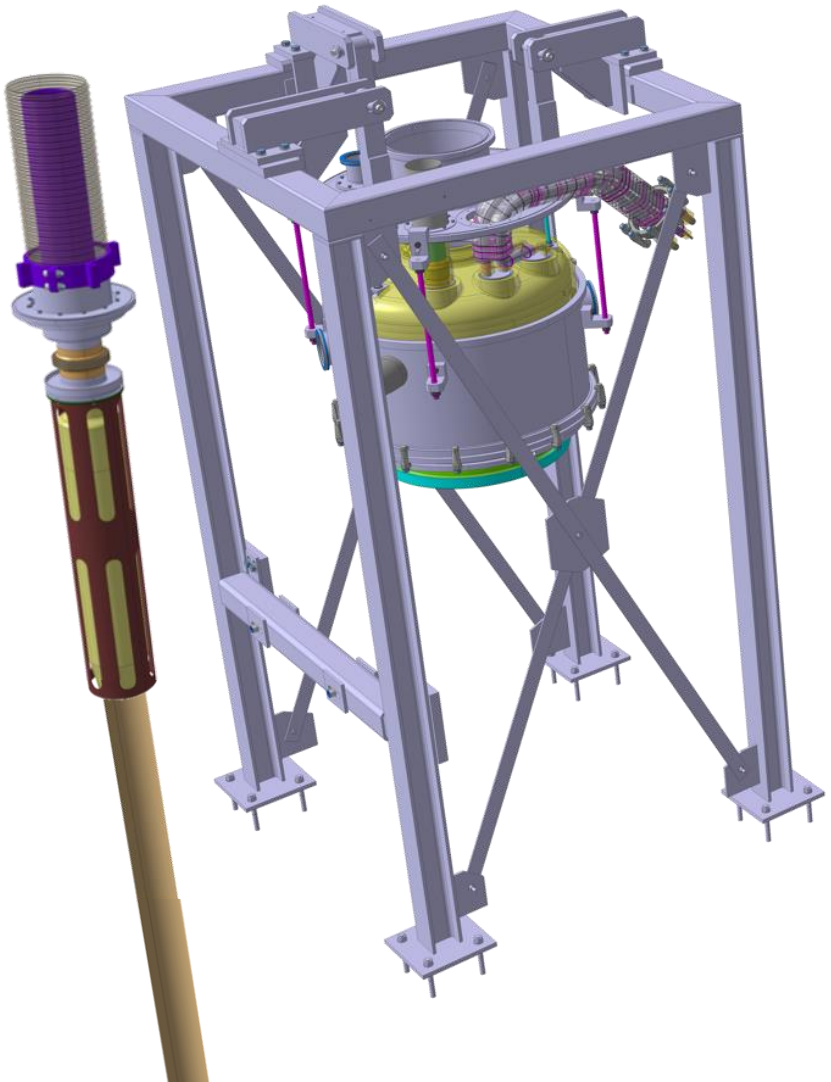


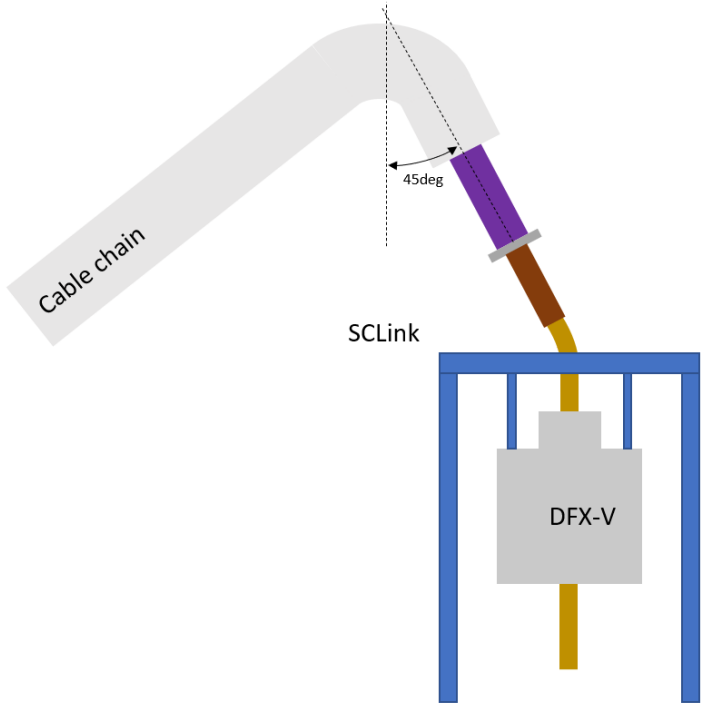


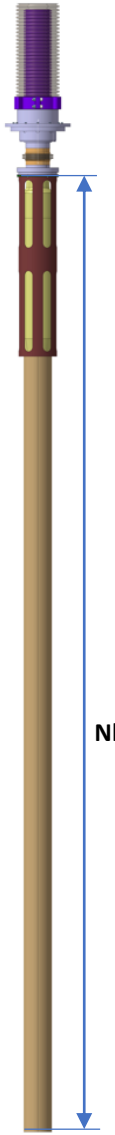
NbTi cable length: 3.3m



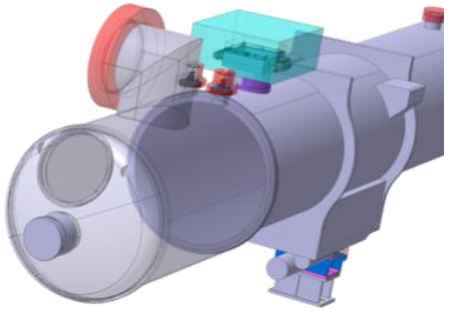
2.3 Insert SC-Link into the dome through the VV Hat

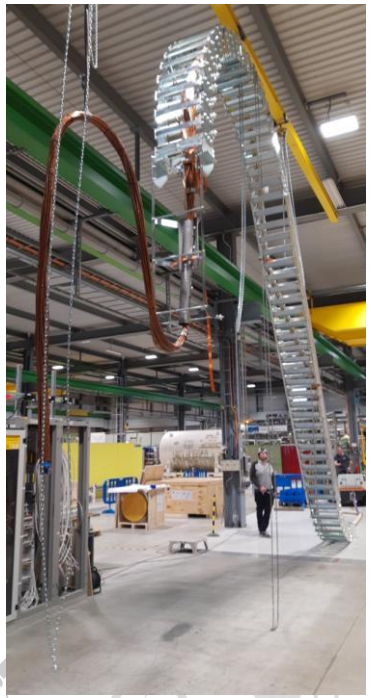




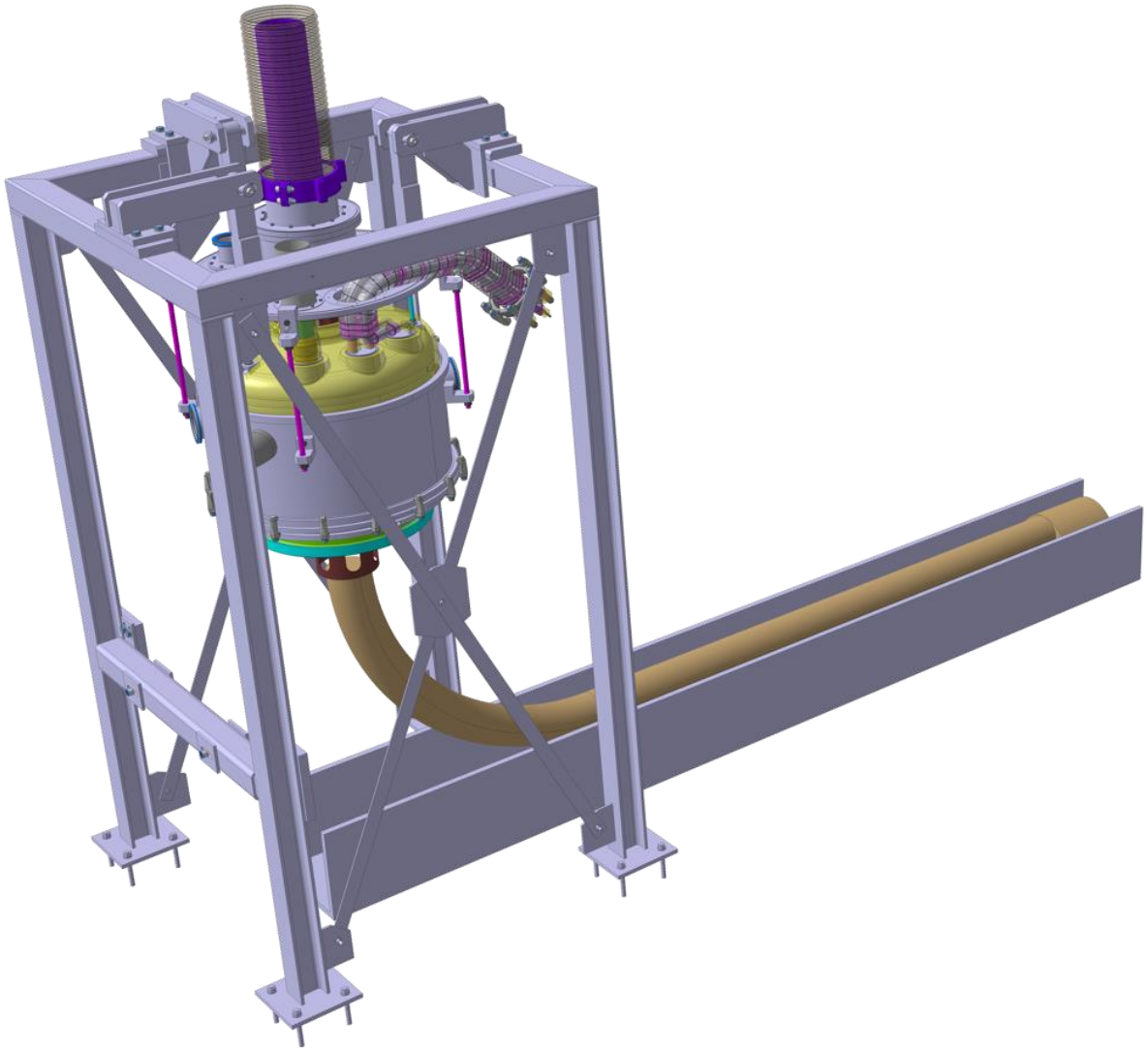


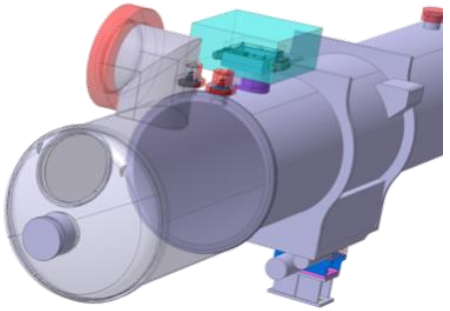
NbTi cable length: 3.3m



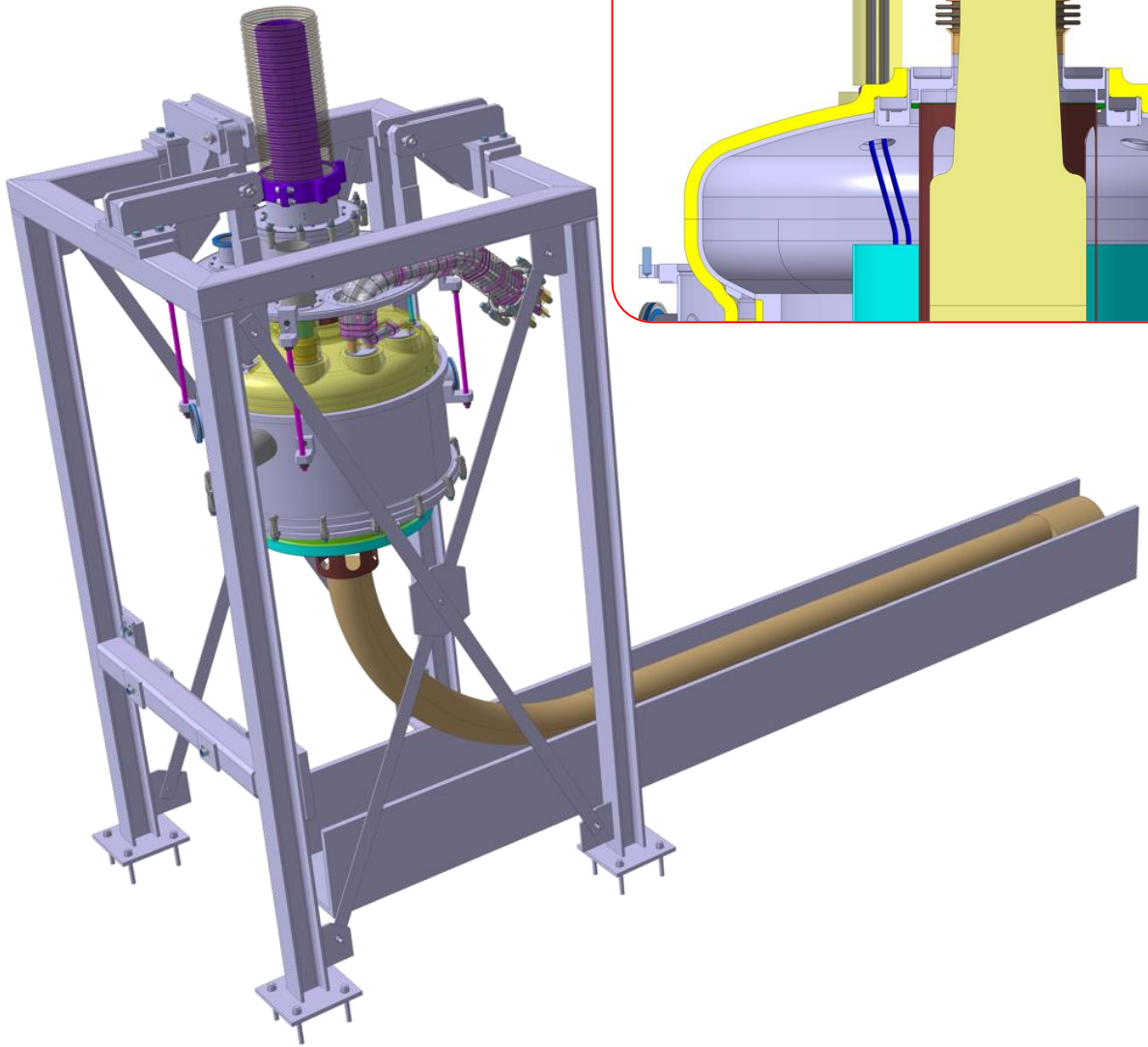


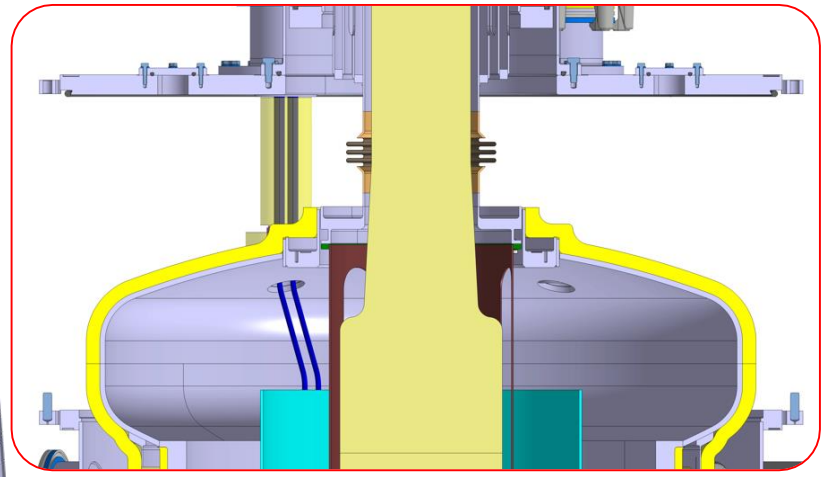
2.4 Position a channel at the bottom of the structure to protect the NbTi cable of SCLink
2.5 Insert SC-Link into the dome through the VV Hat

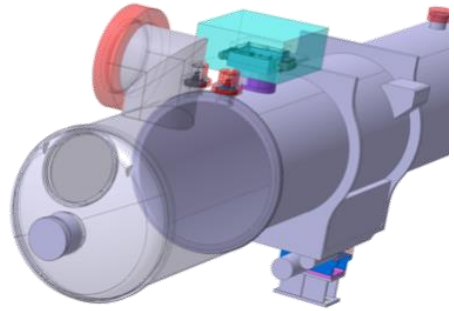




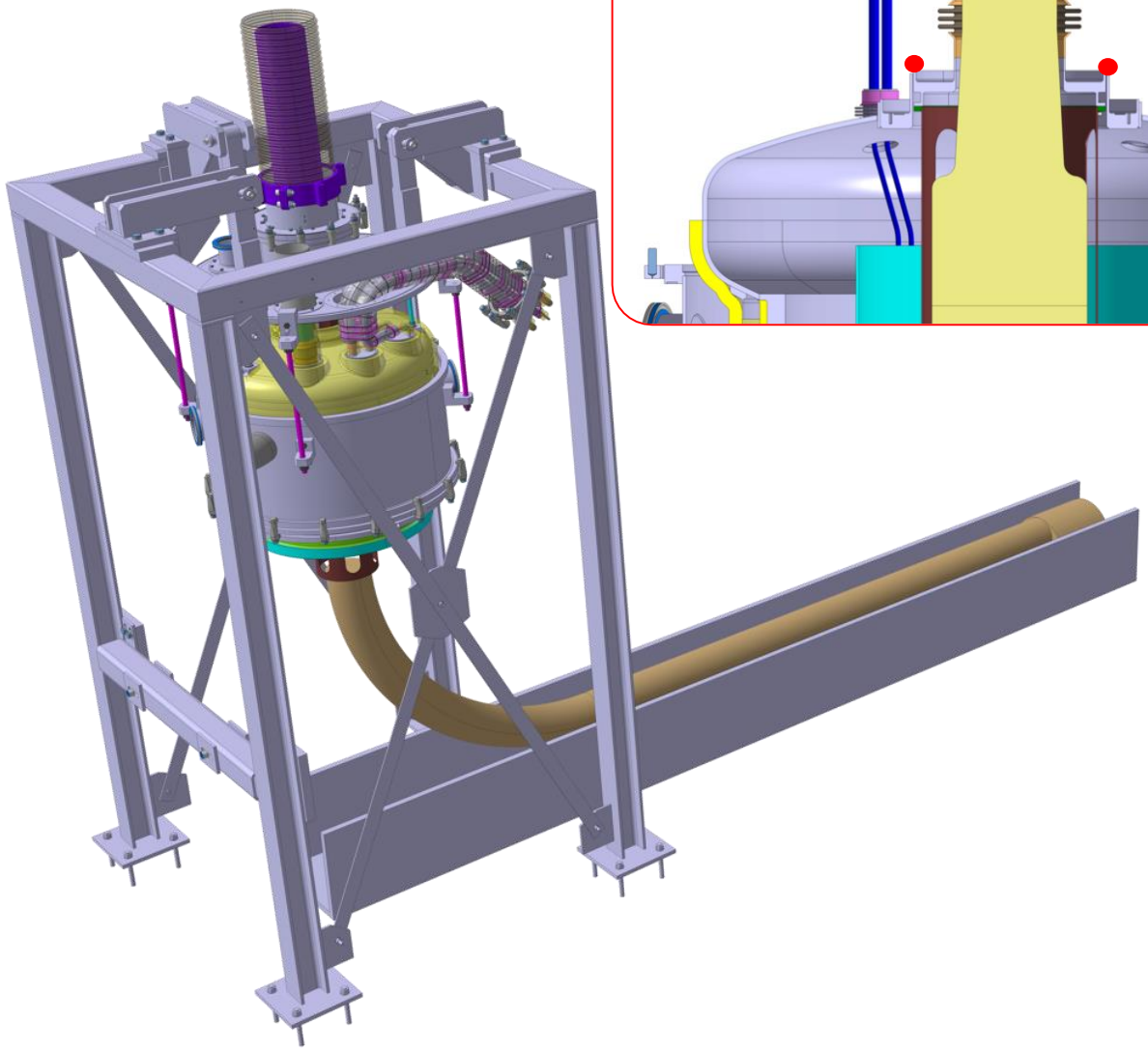
2.8 Remove the MLI protection

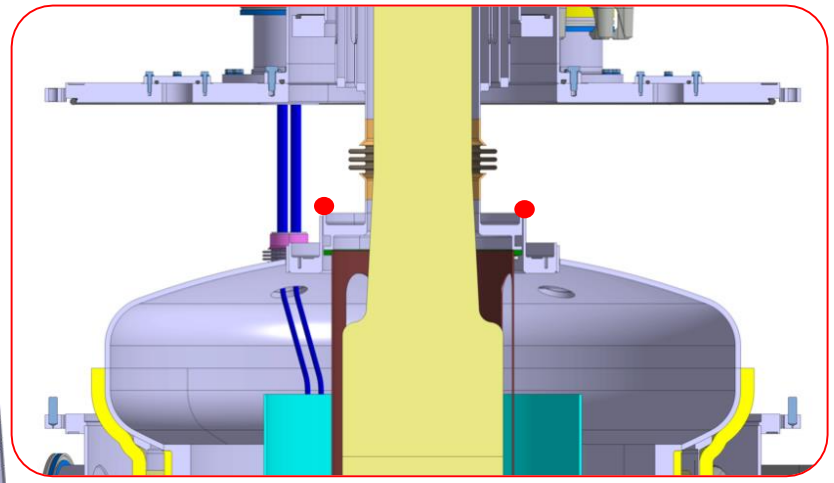


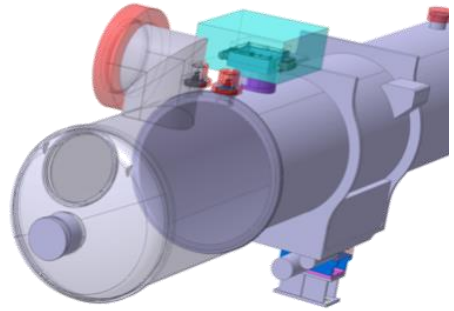




2.9 Lip Weld

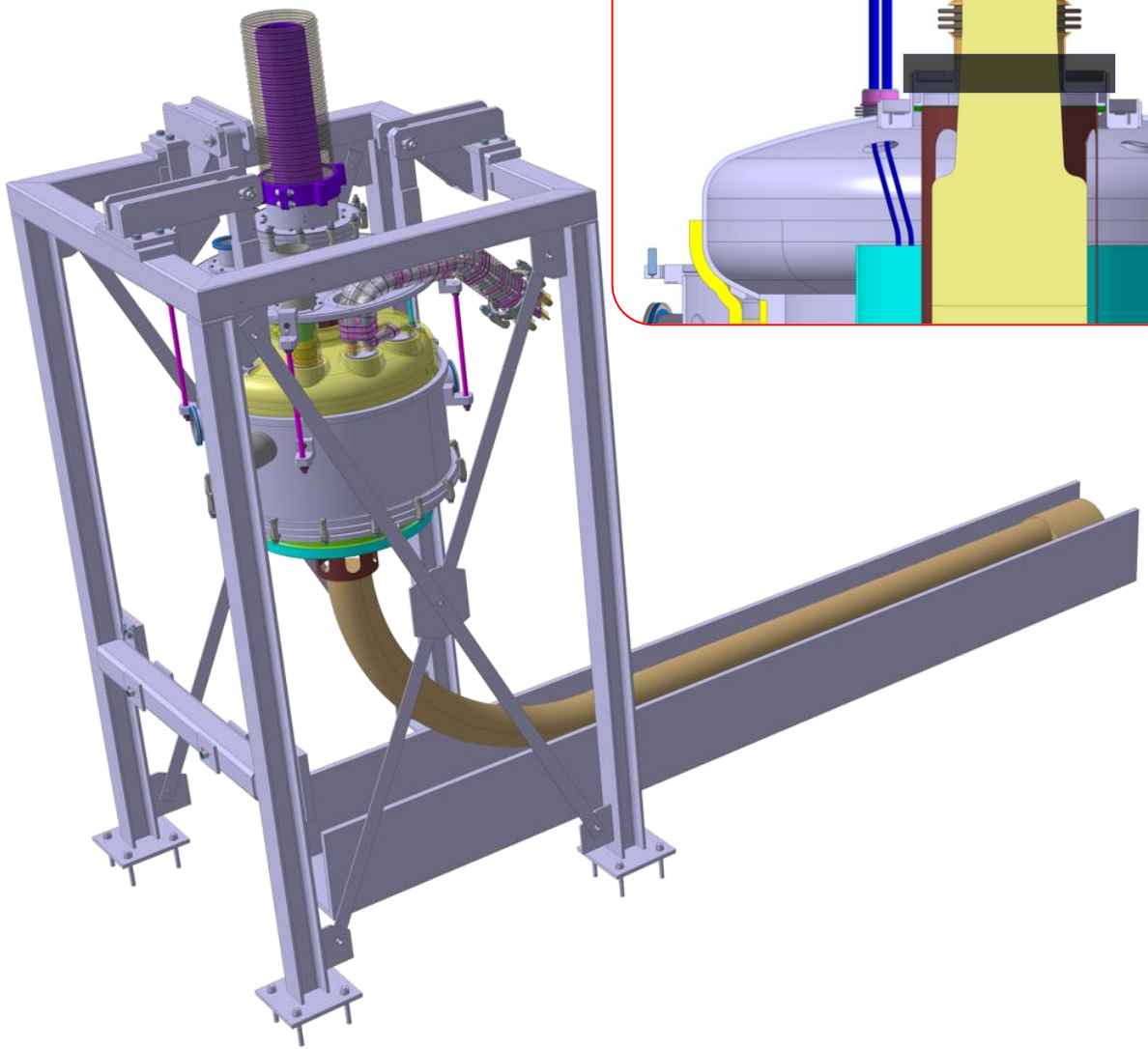


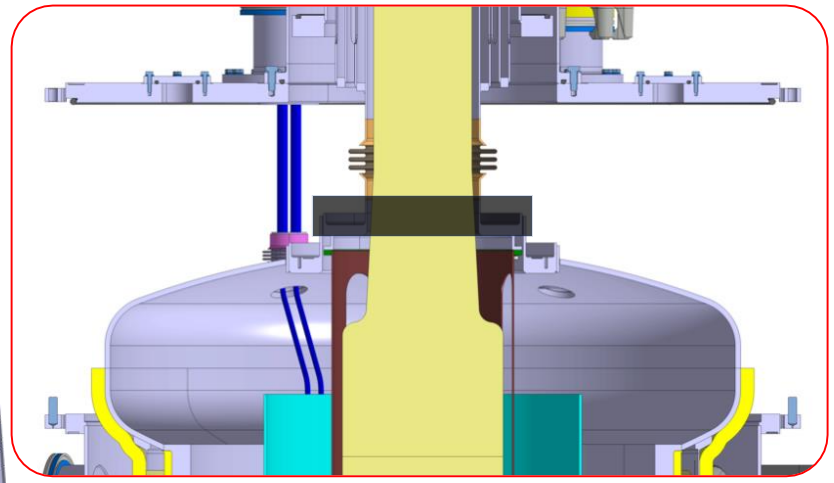


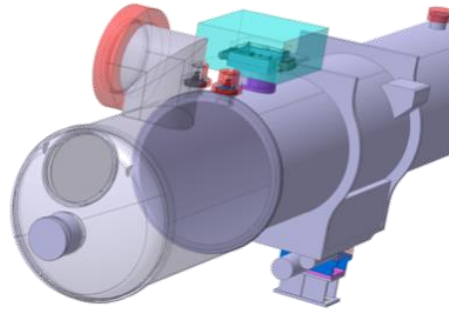


"EN-MME"
or
"TE-MSC" ?

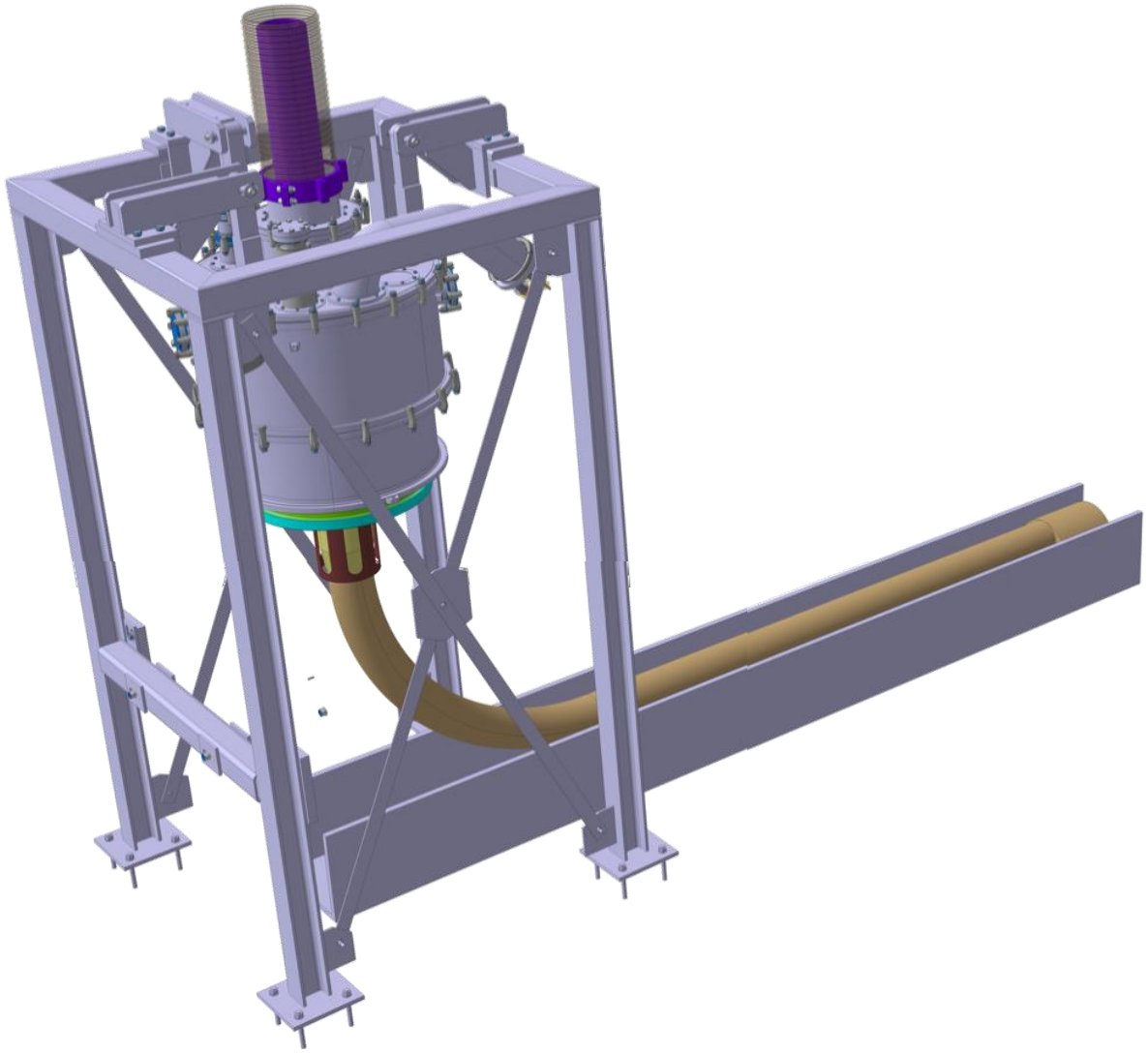
2.10 Clam shell leak test

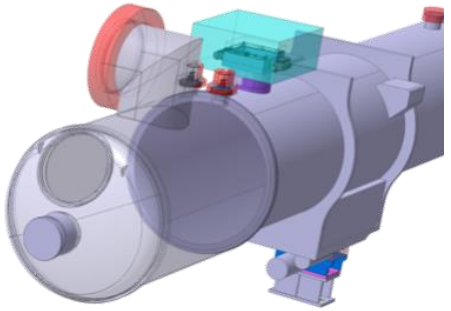




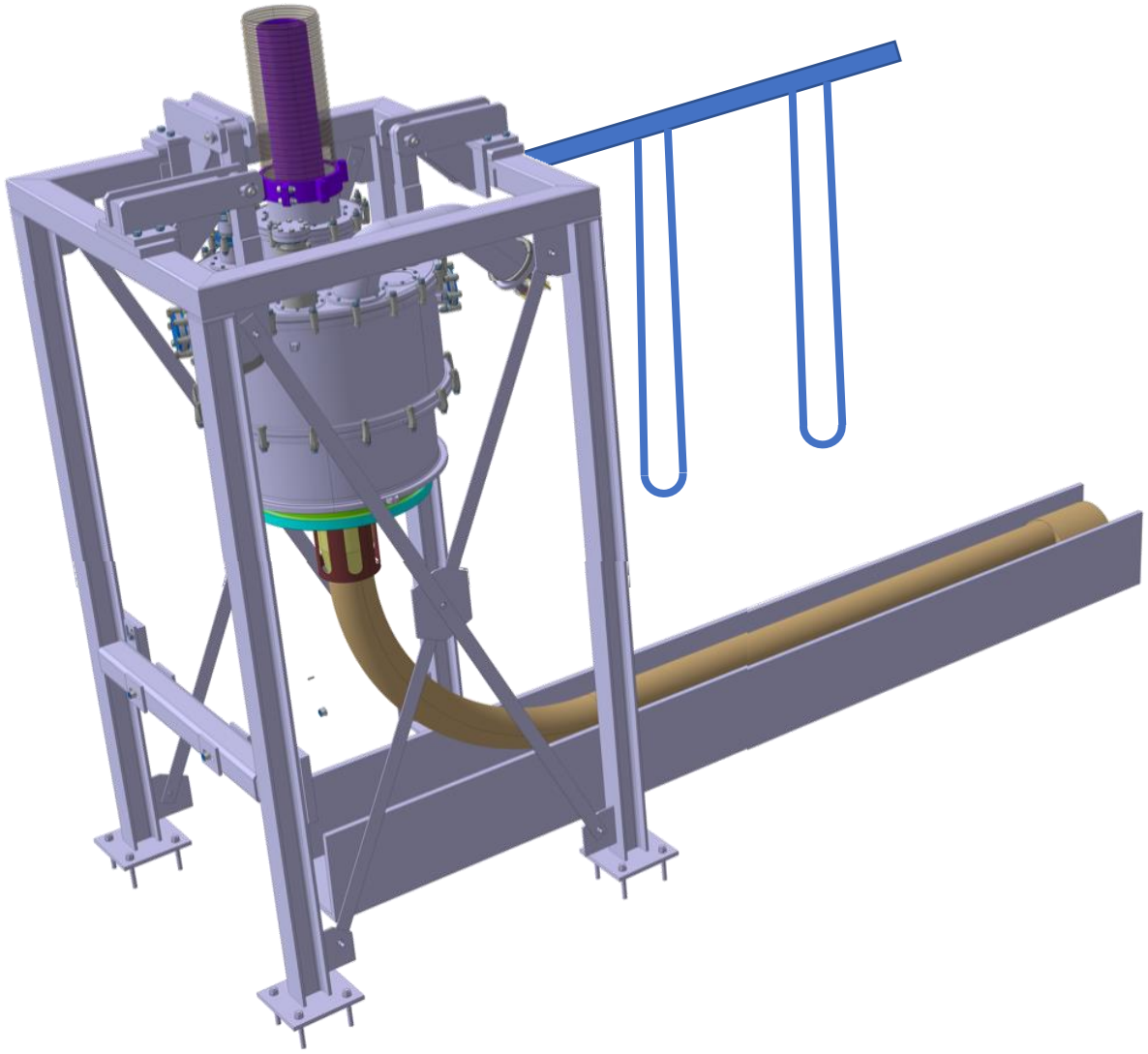


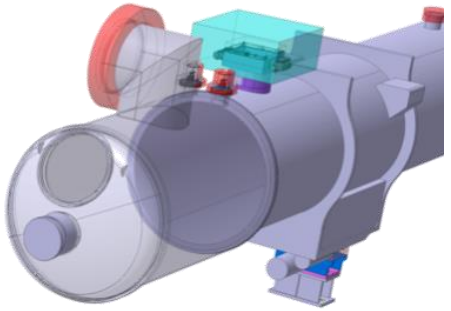
4. Bending of NbTi extensions





4.1 Install the SCLink supporting configuration to hold the NbTi cable in position



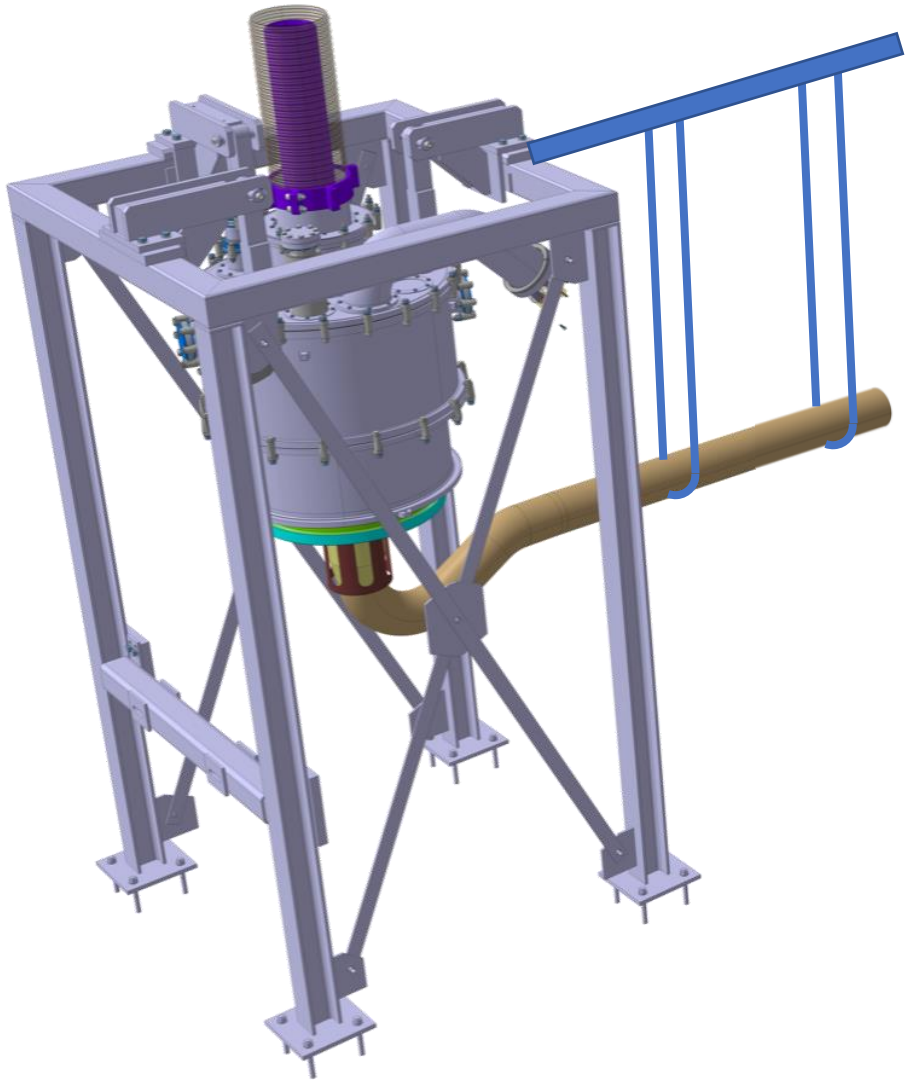


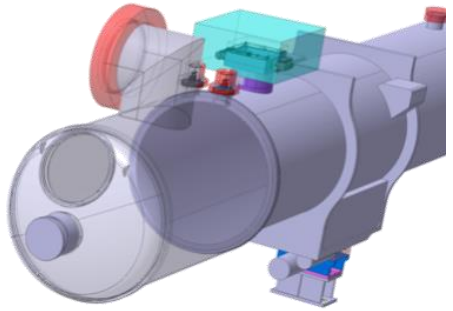
<u>NbTi cable support configuration</u>

-Maintain the vertical position as well as the initial bending radius of the SCLink

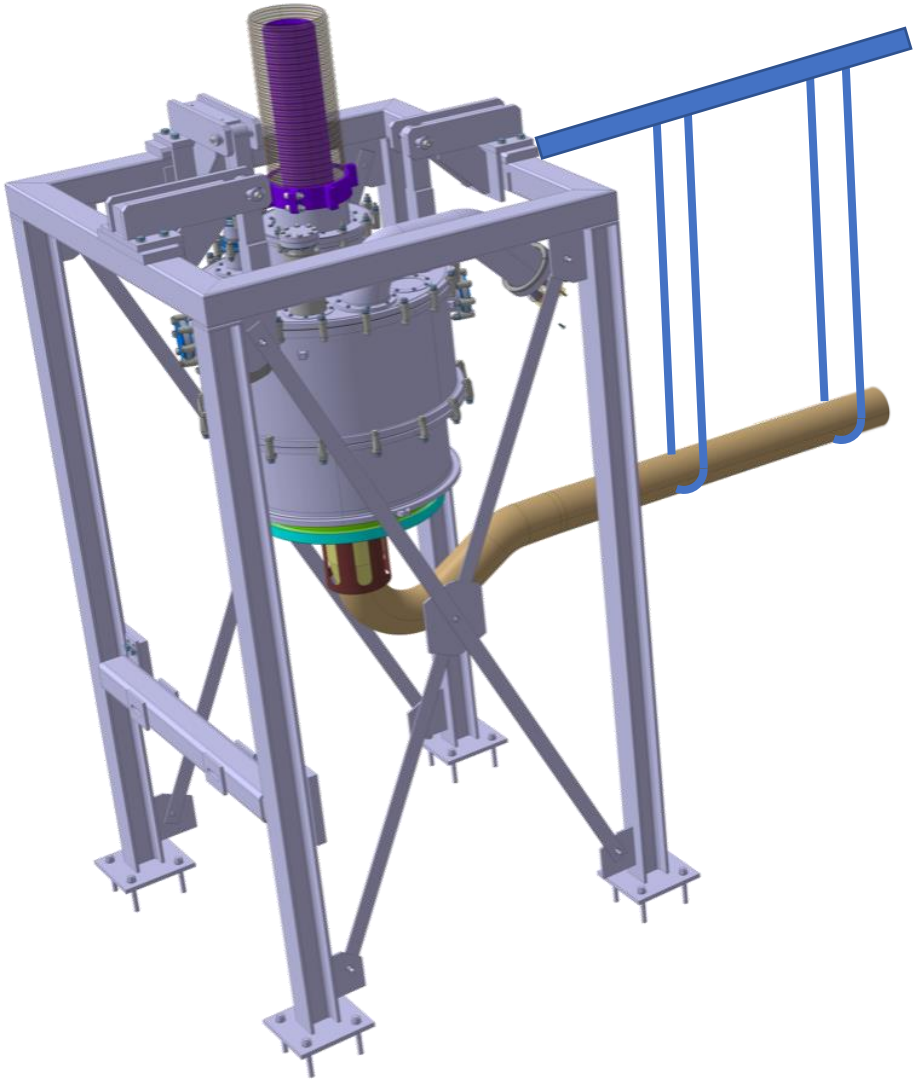
-Just an illustrative sketch. Tooling configuration to be studied in more detail.

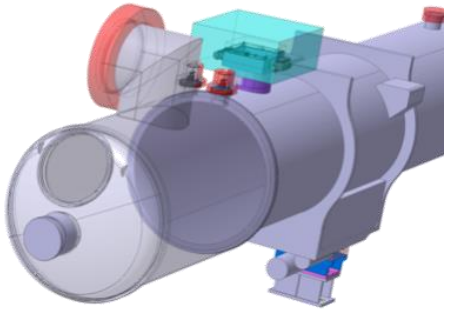
4.2 Bend the NbTi cable to reach the nominal shape



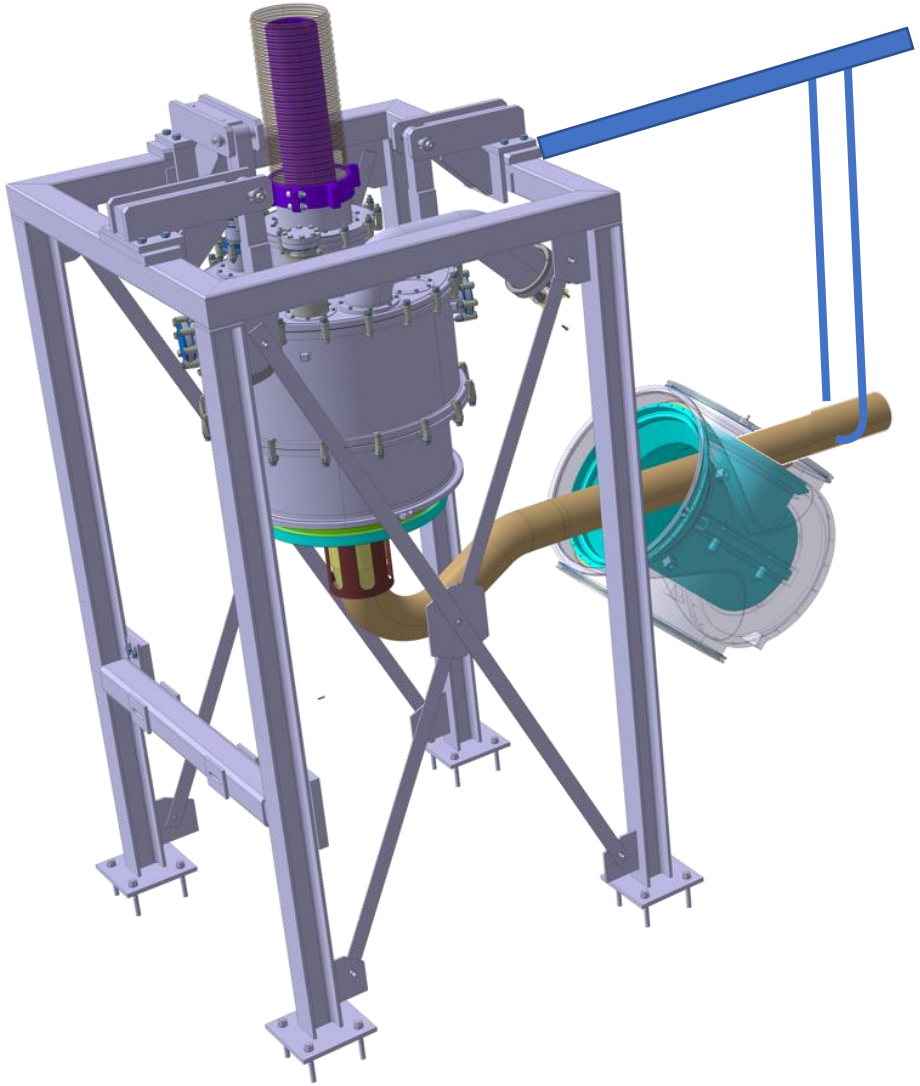


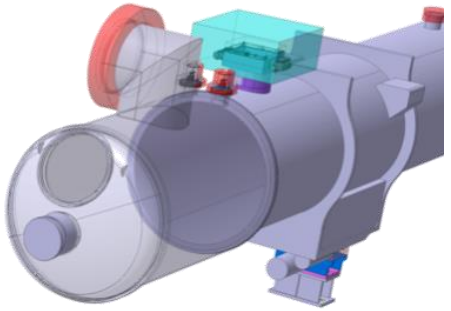
5. Insertion of DFX-V|Low



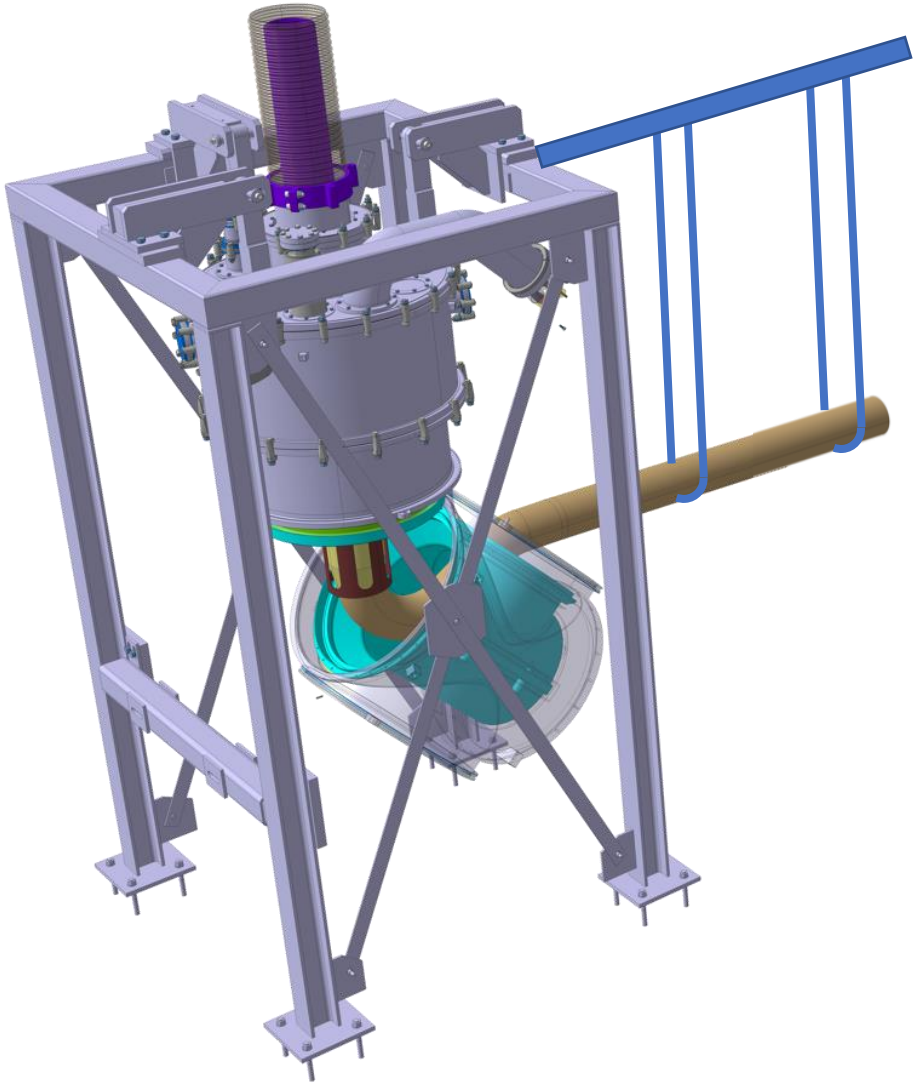


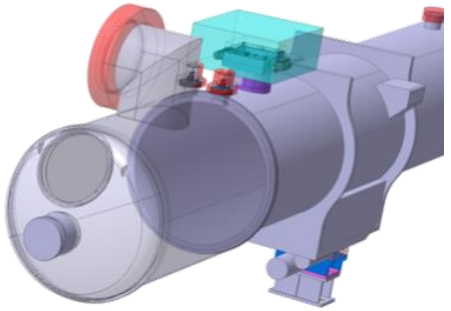
5.1 Lift and position the DFX-V|Low subassembly
5.2 Insert carefully without damaging the SC-Link.



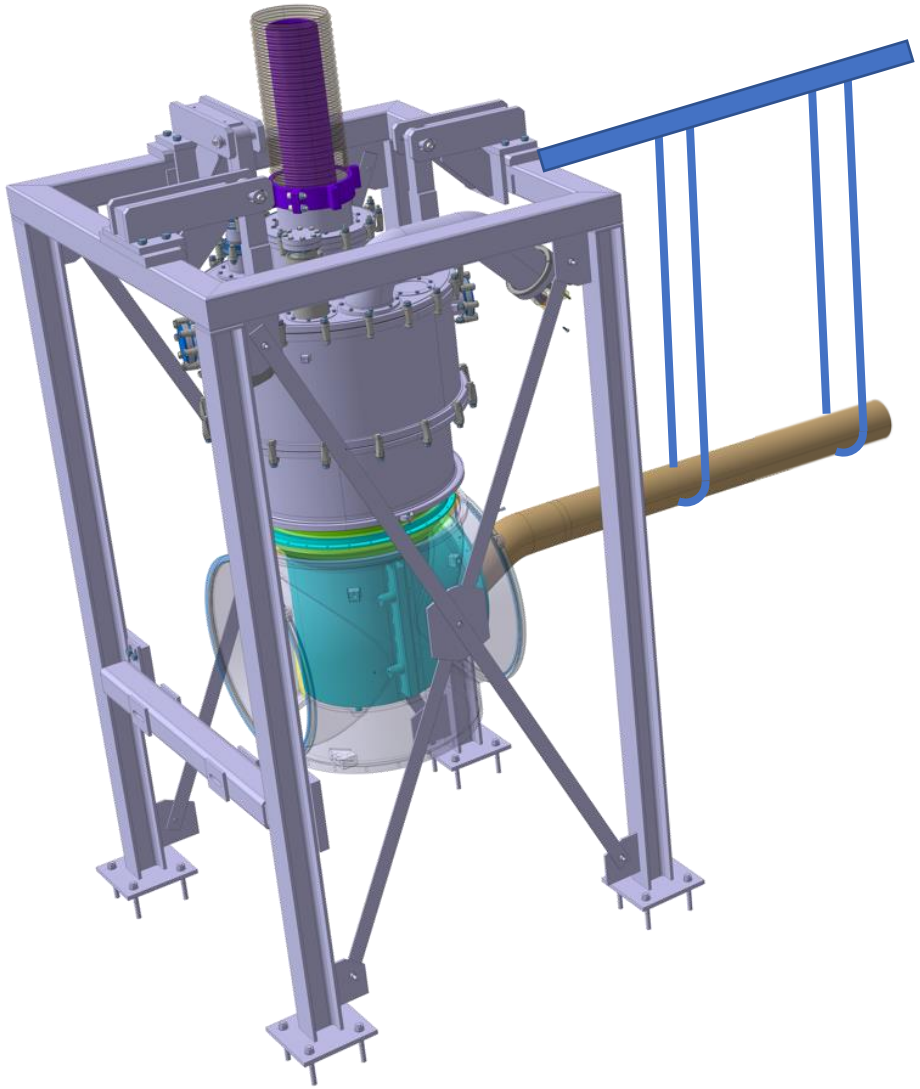


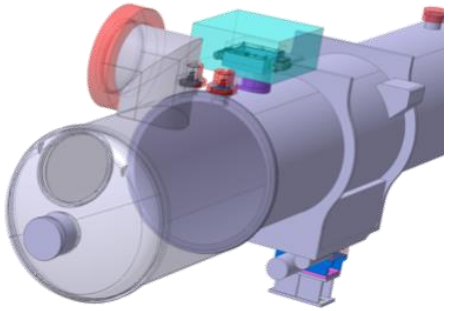
5.1 Lift and position the DFX-V|Low subassembly
5.2 Insert carefully without damaging the SC-Link.



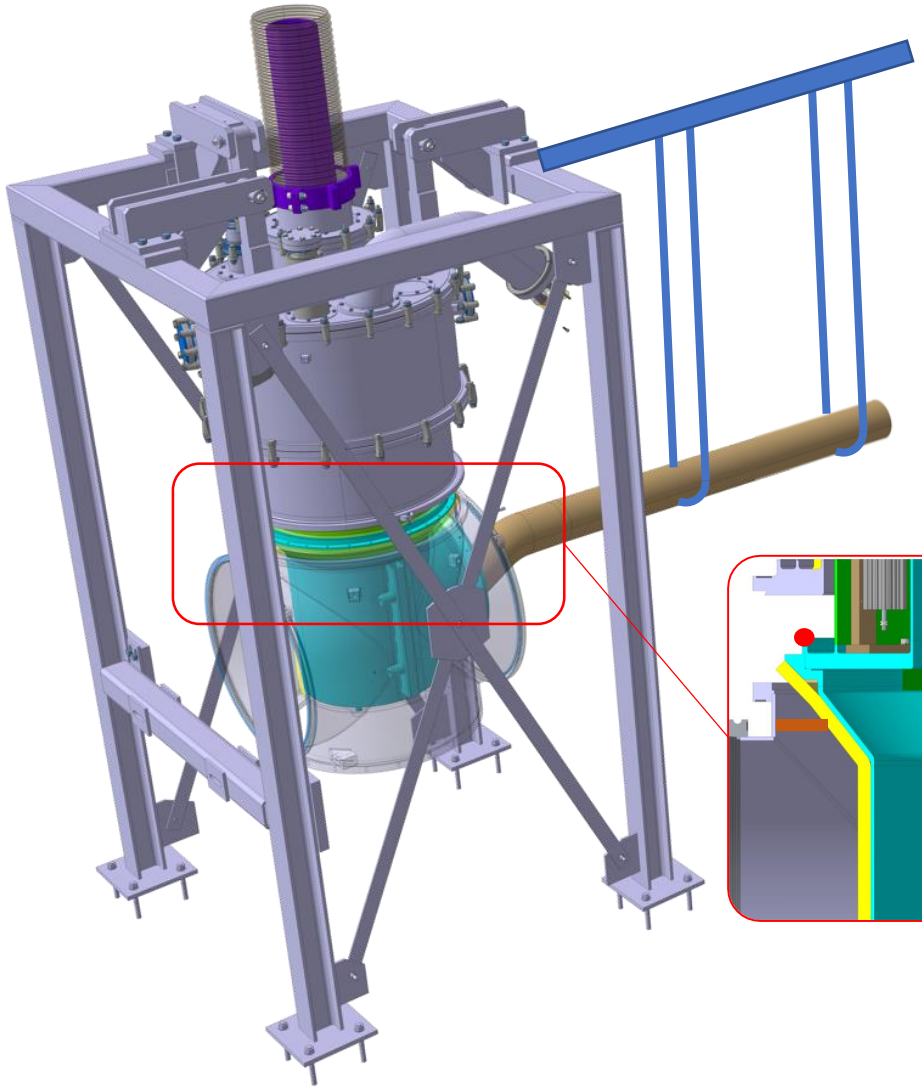


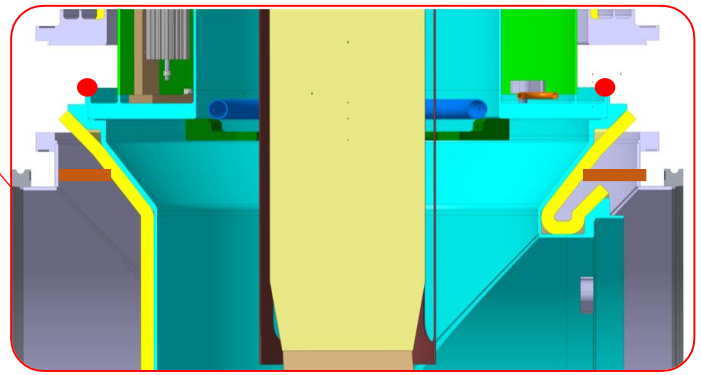
5.1 Lift and position the DFX-V|Low subassembly
5.2 Insert carefully without damaging the SC-Link.

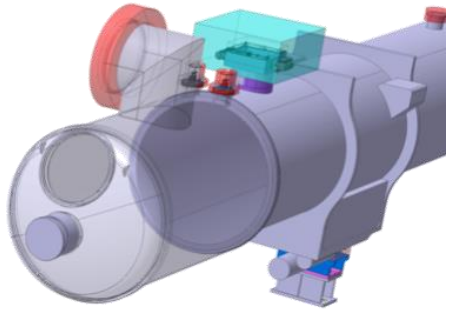




5.6 Lip Weld







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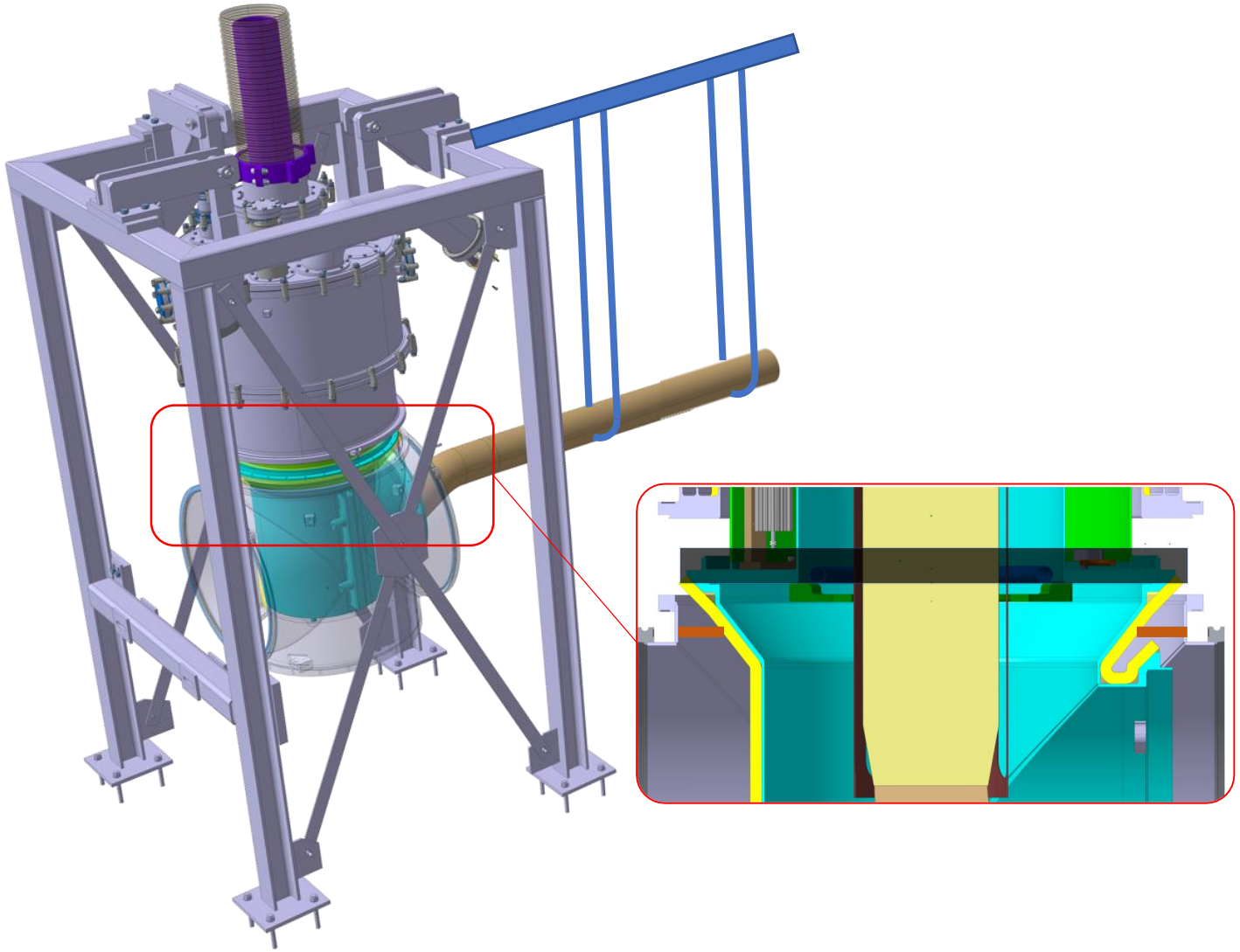
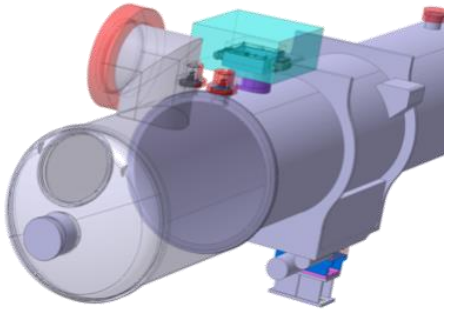
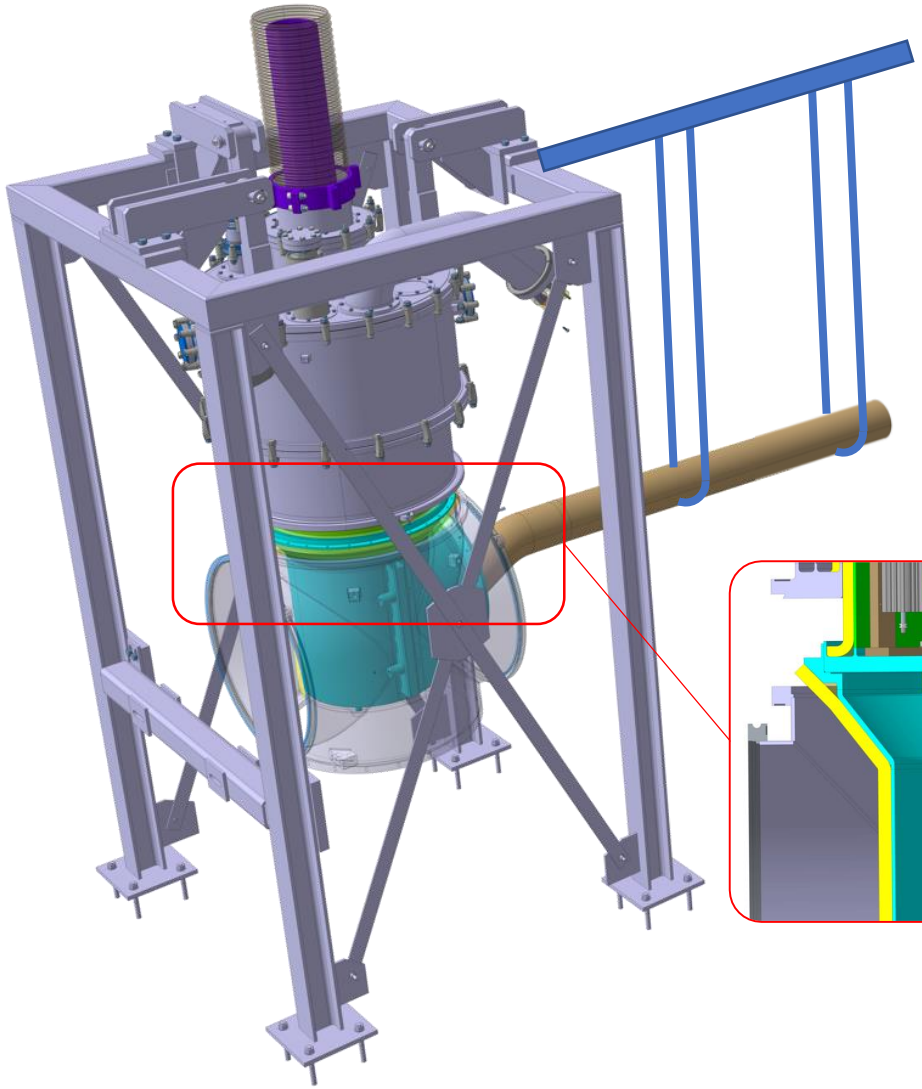
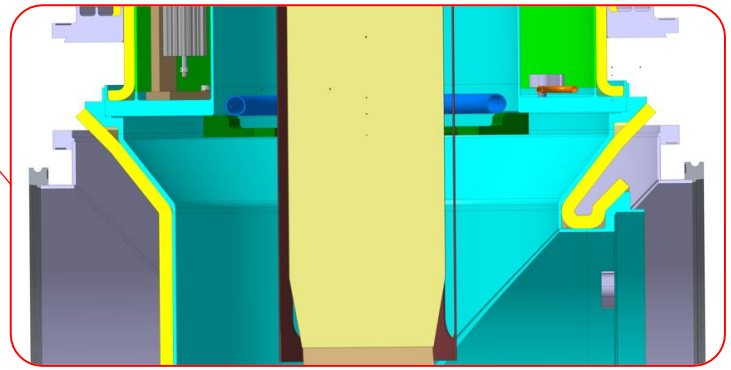
5.7 Clam shell leak test

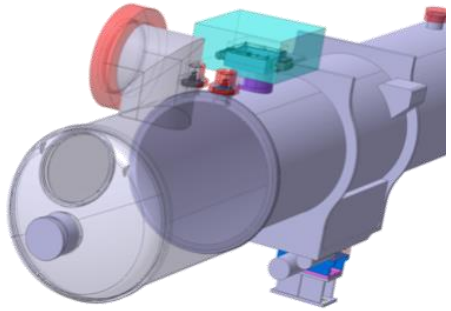




5.9 Remove the shims in between the HV and the VV

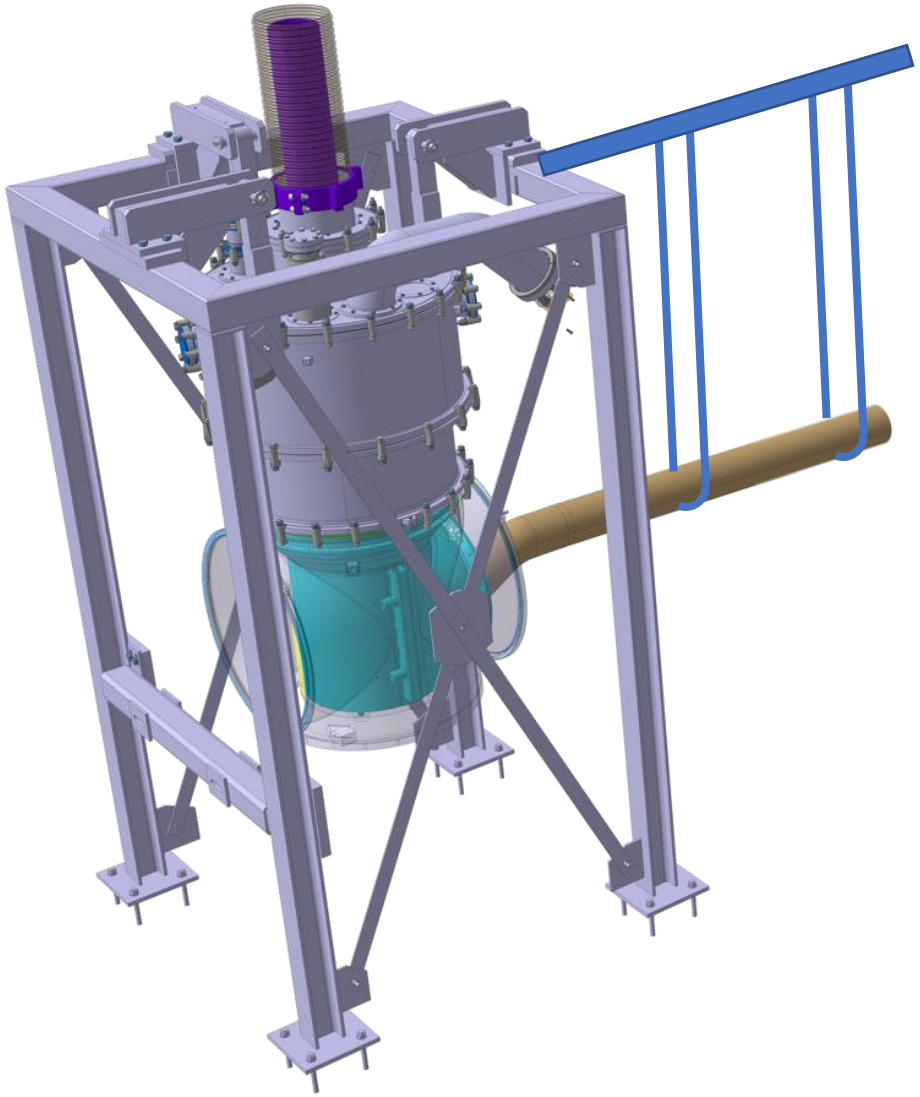


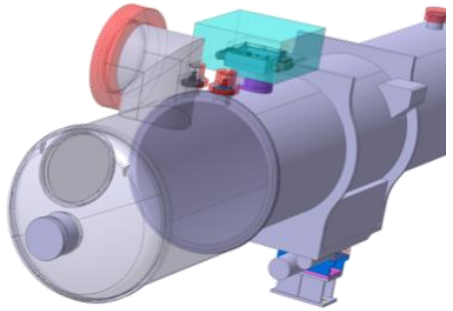




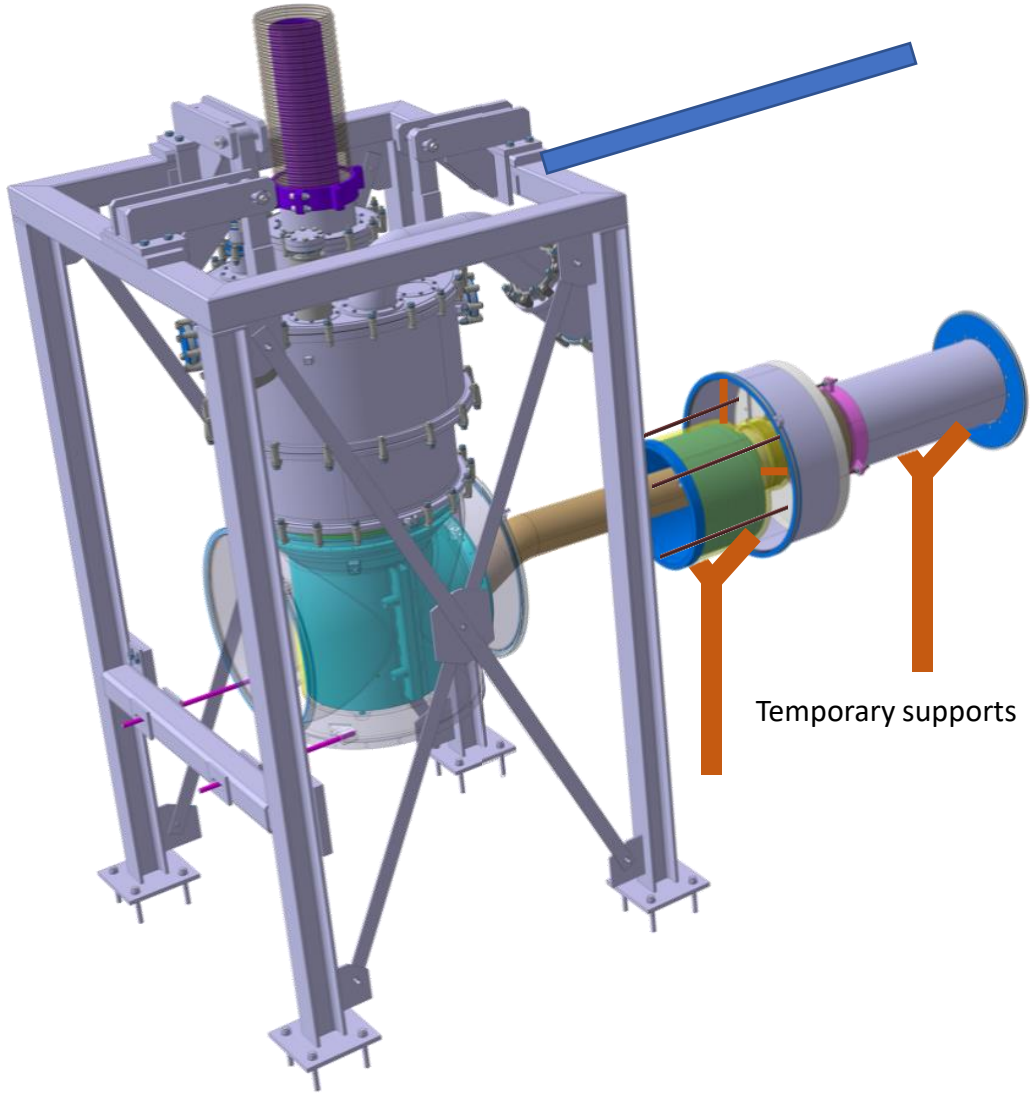
5.10 Lift the VV of the elbow

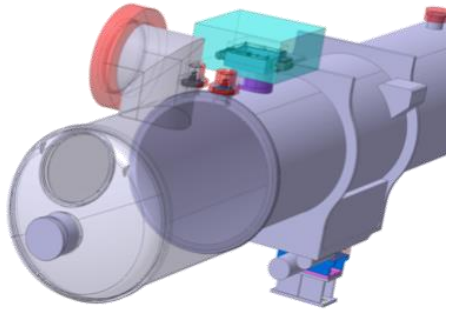
5.11 Clamp it to the DFX-V subassembly



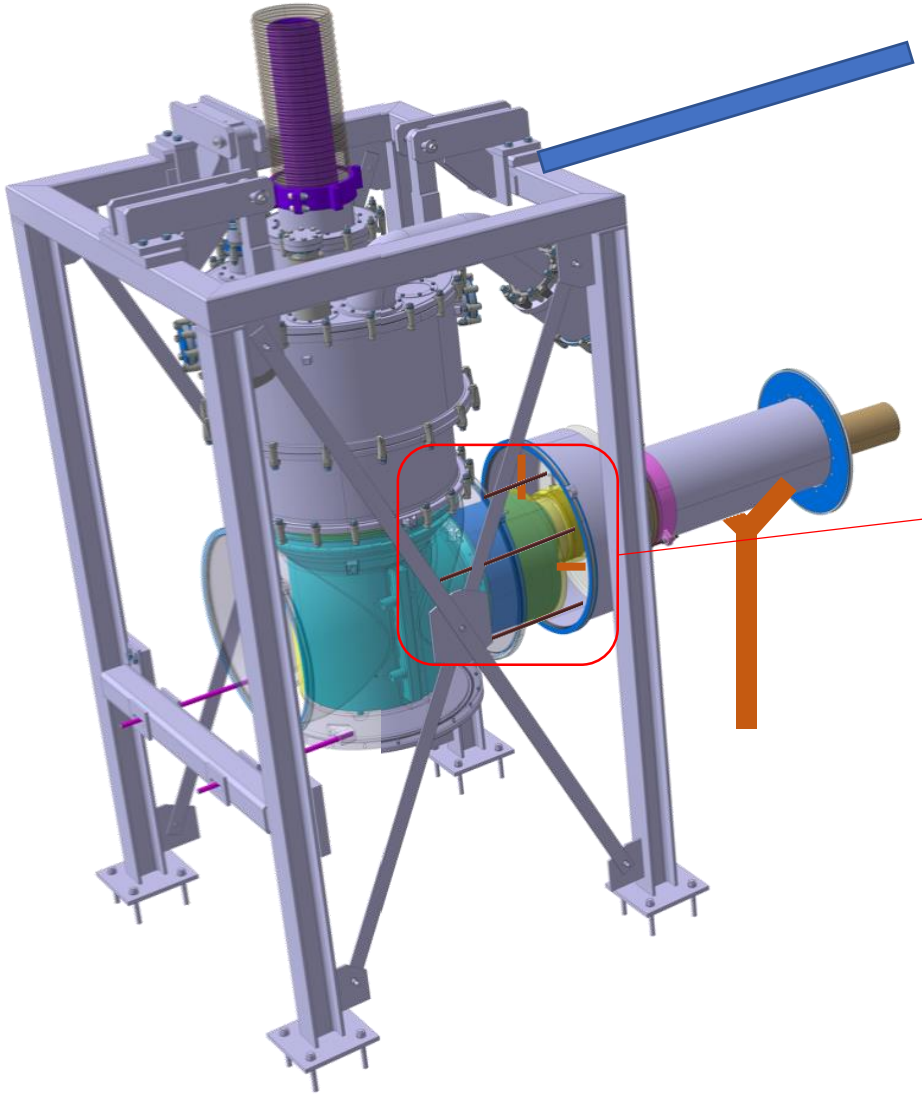


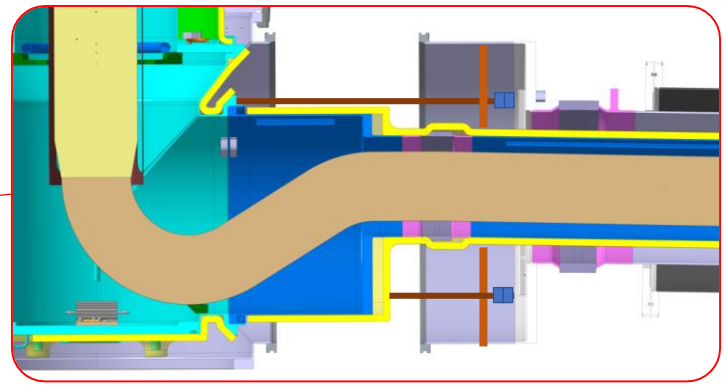
6.1 Position the DFX-h|Link side subassembly by using the supporting trolley
6.2 Insert the SC Link cable inside the DFX-h/Link side subassembly carefully

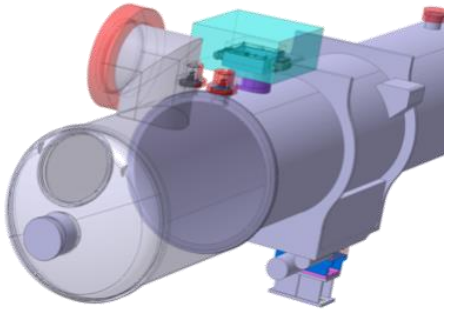




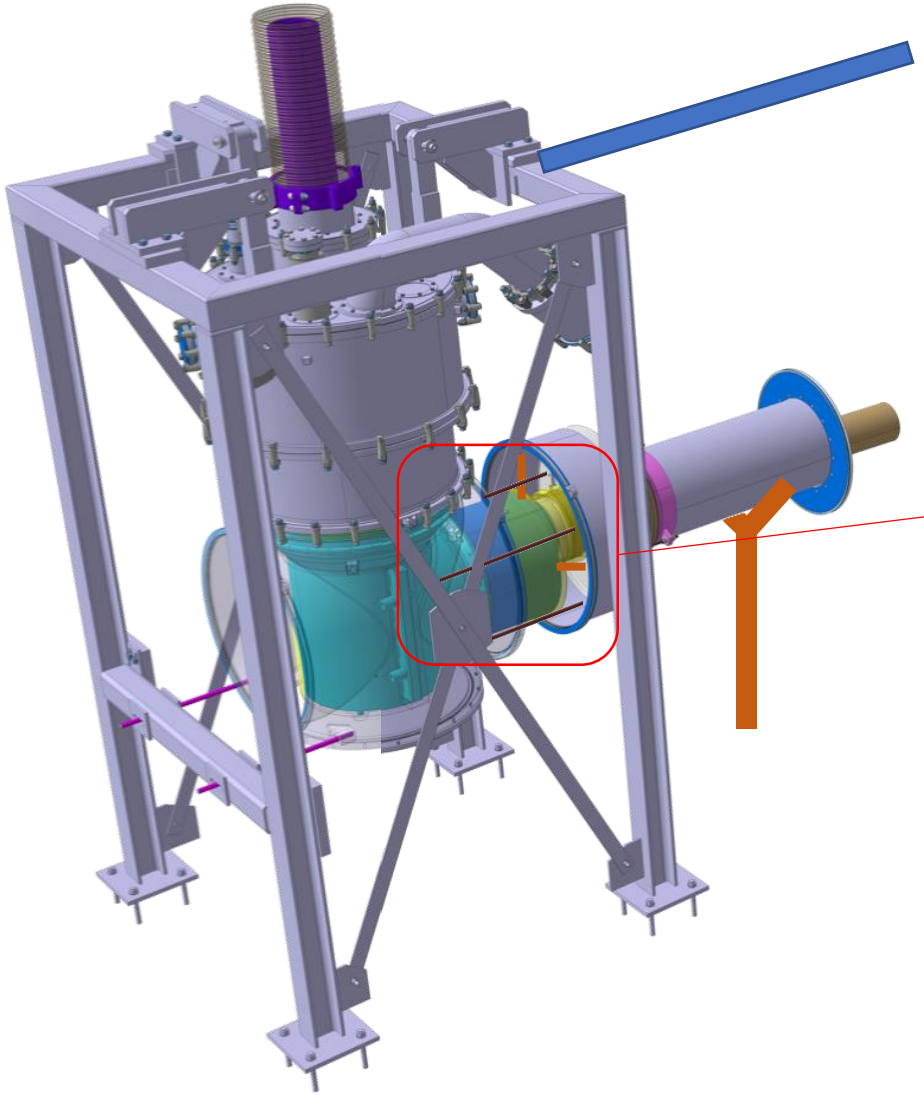
6.3 Center the subassembly based on the HV lip and the positioning pins while having the VV offset.

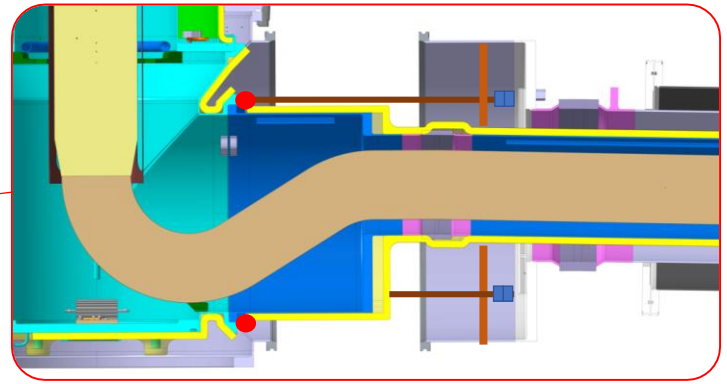


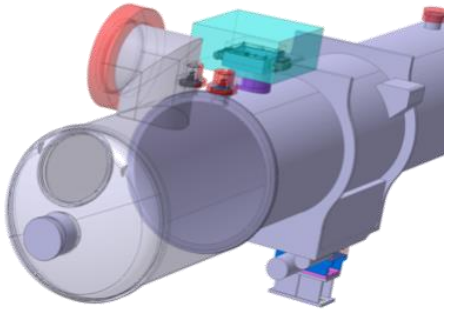




6.4 Lip weld

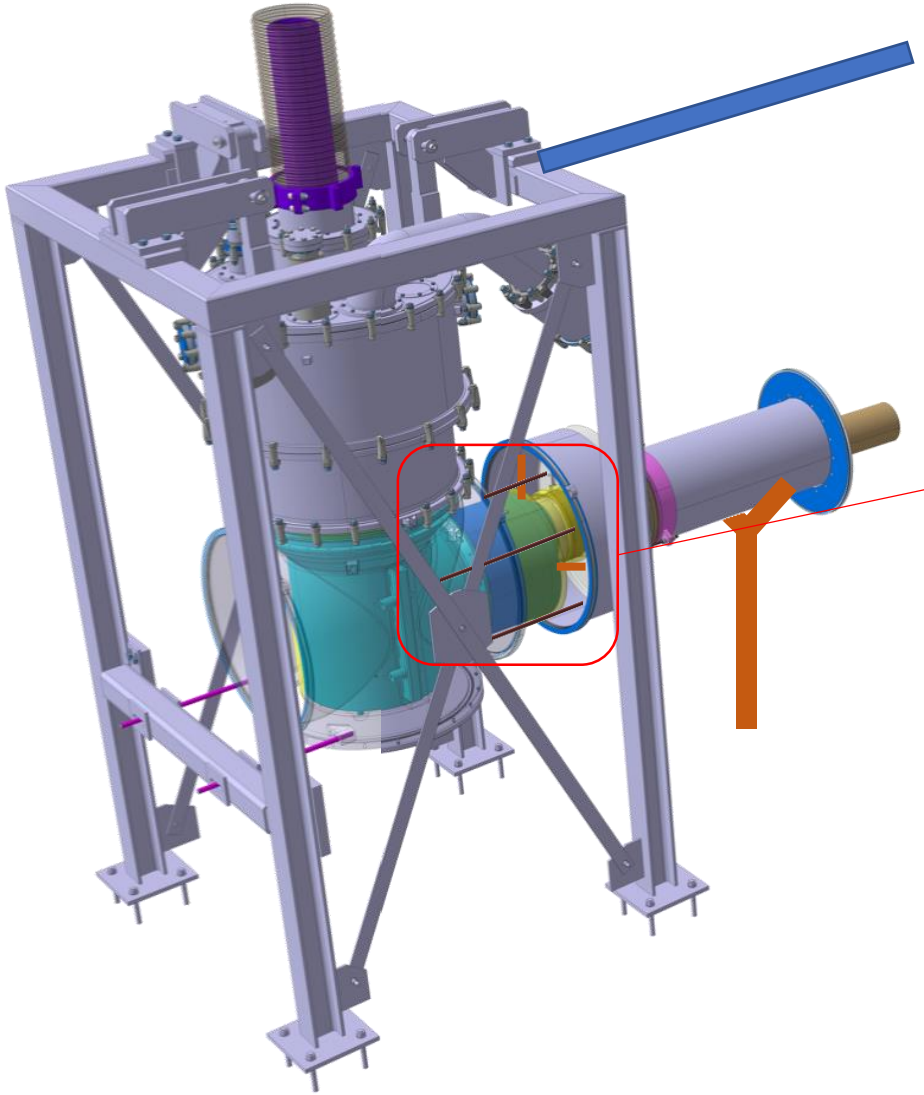


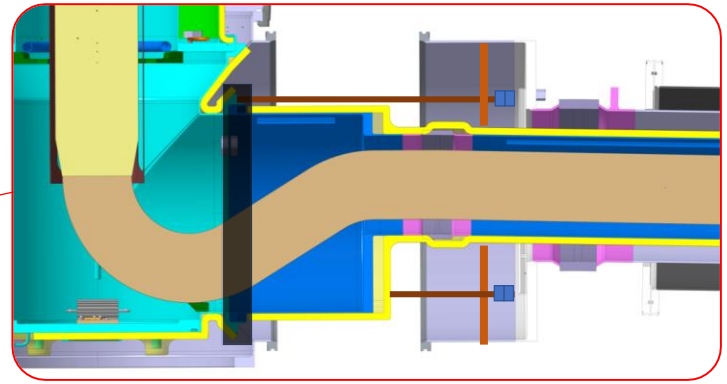


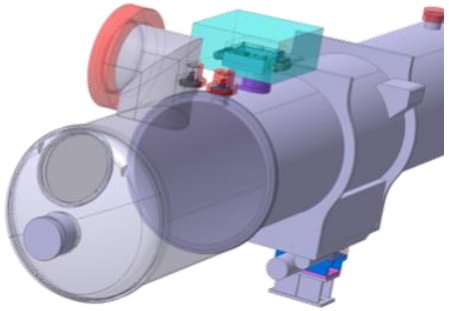


"EN-MME"
or
"TE-MSC" ?

6.5 Clam shell leak test



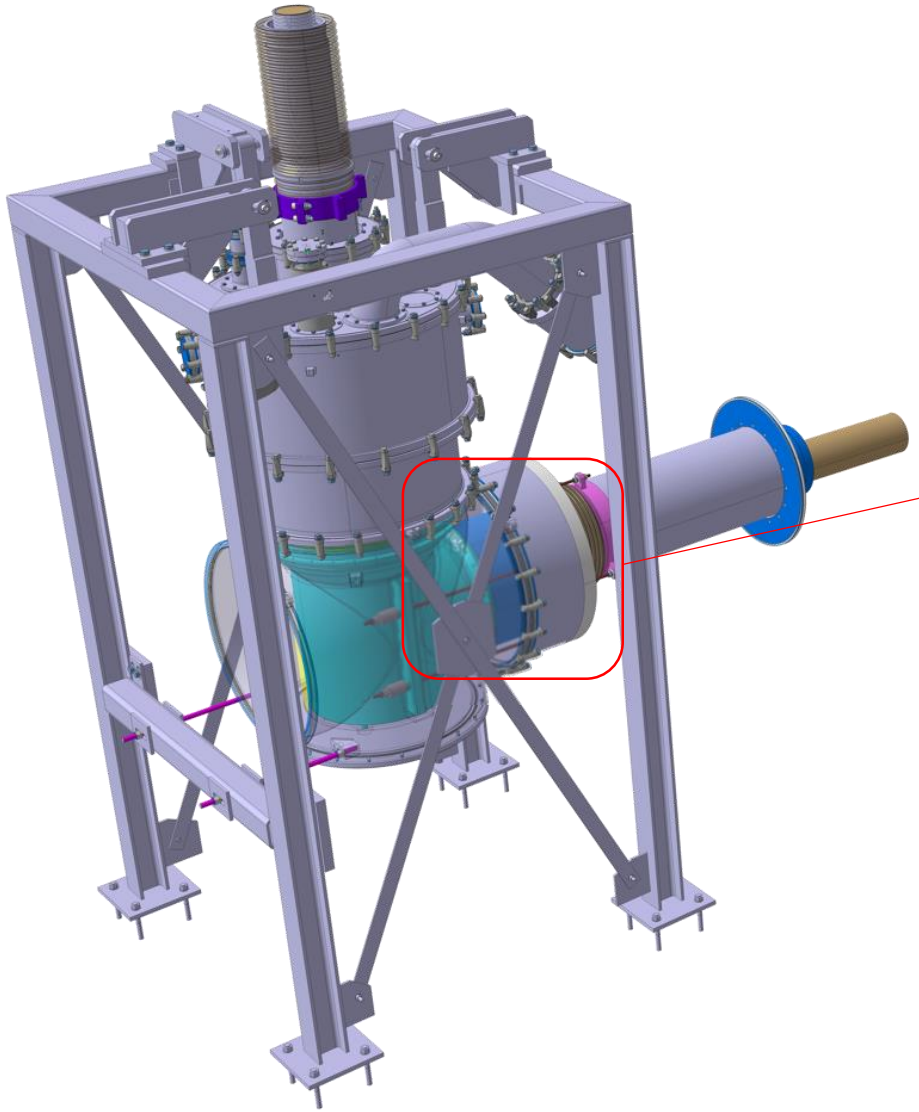


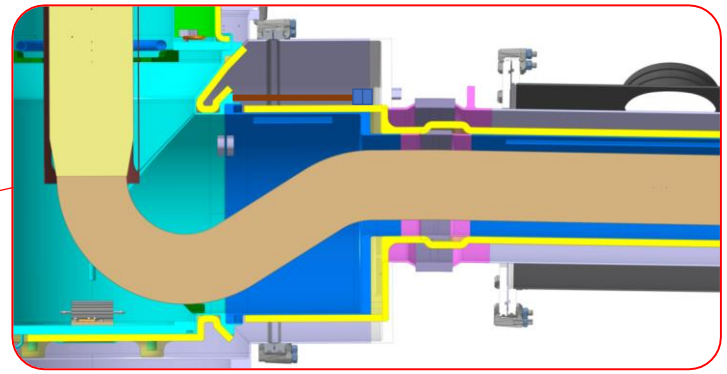


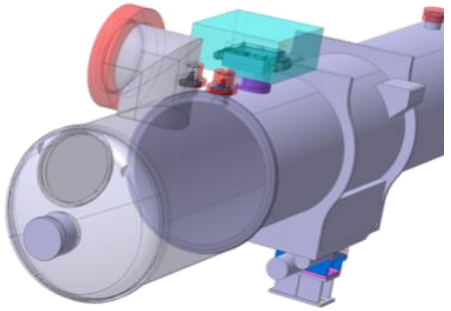
6.6 Remove the shims

6.7 Pass the holding bars through the corresponding slots of the HV Elbow

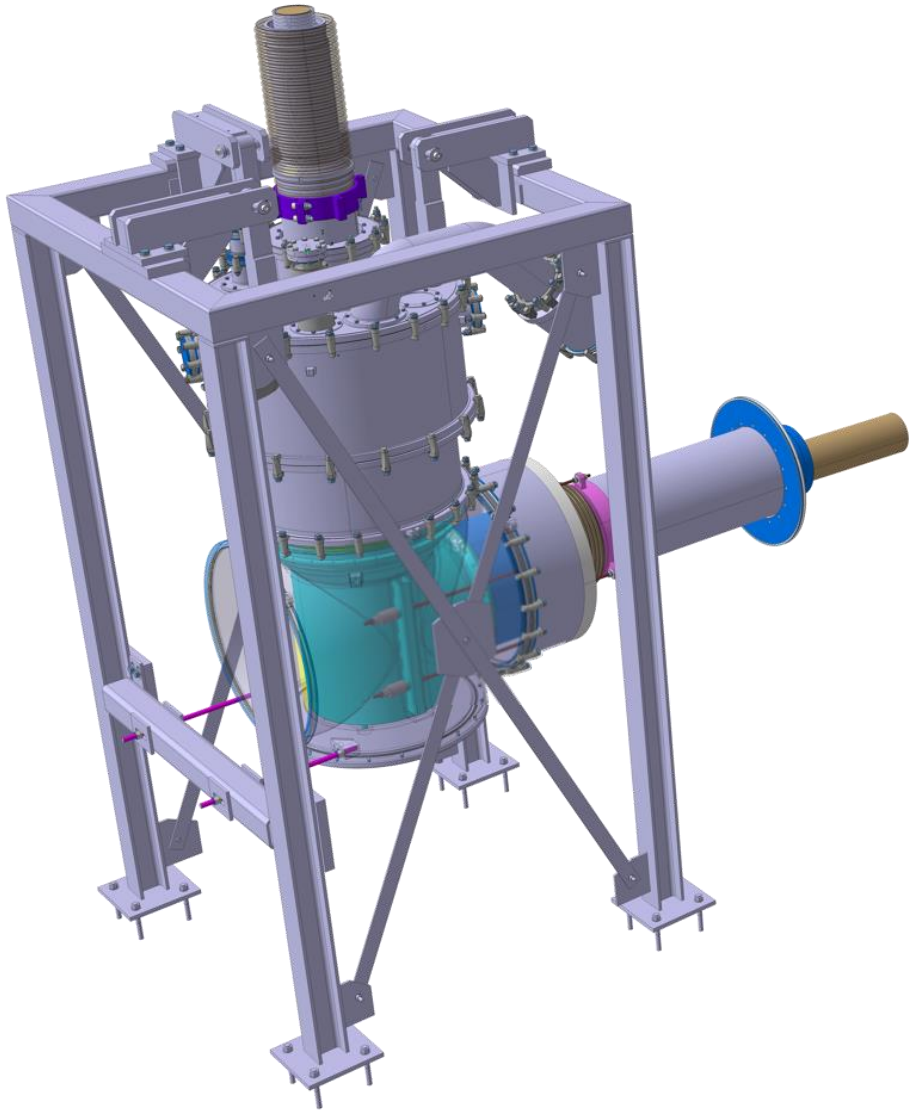
6.8 Slide towards the elbow side close and clamp the VV envelope

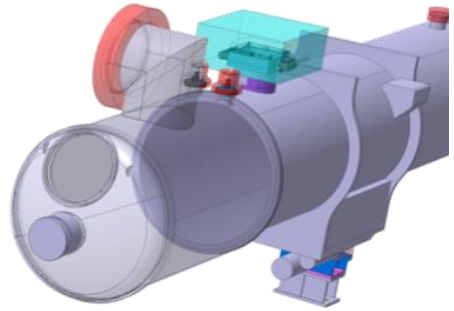


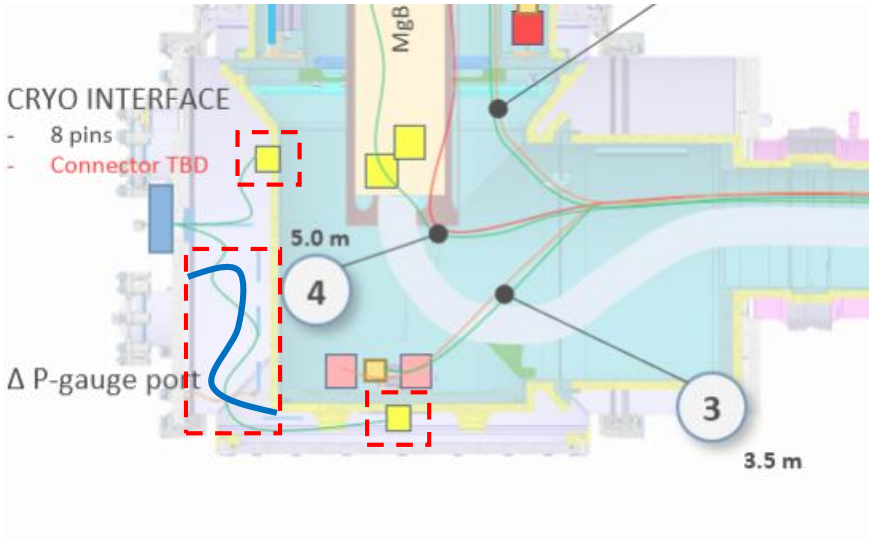




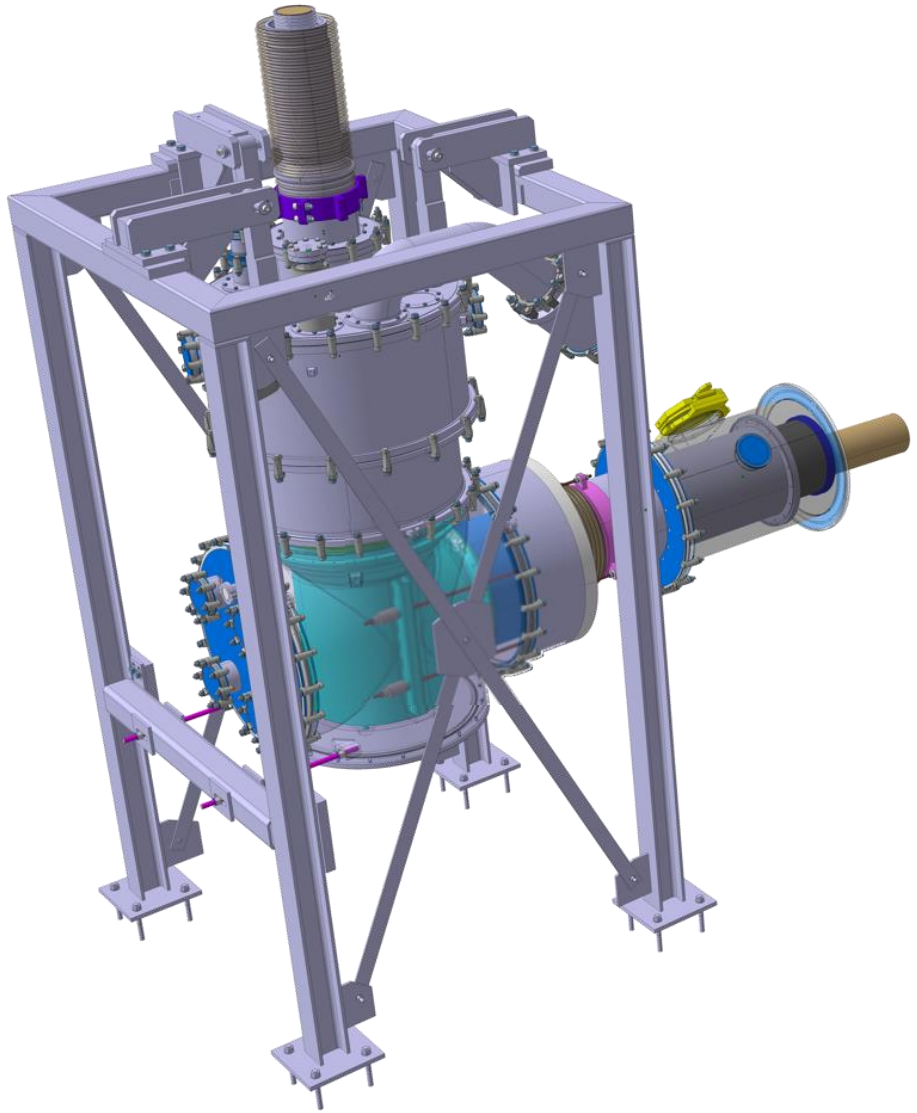
6.10 Install the temperature sensors and the ΔP gauge on the HV elbow

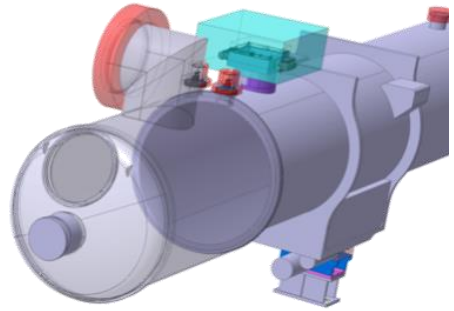






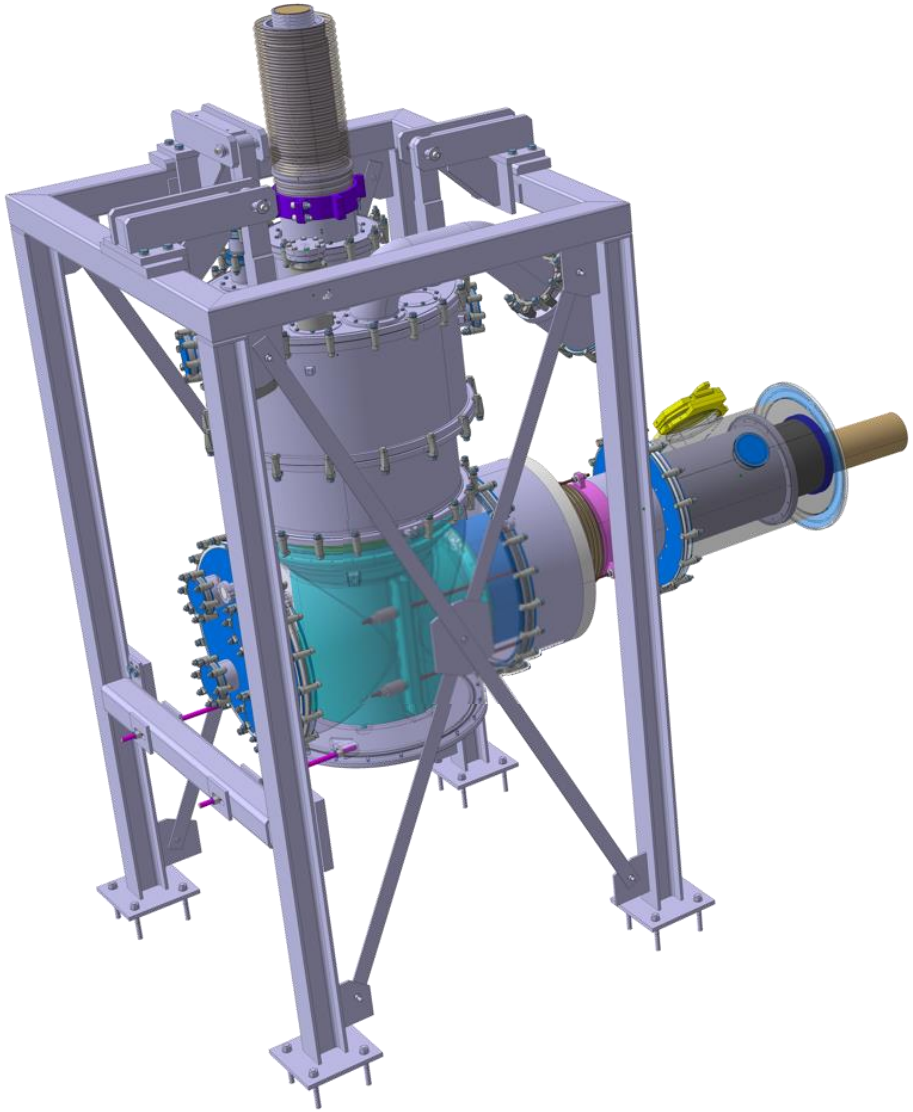
6.15 Position and slide the VV+HV Sleeves towards the DFX-V elbow

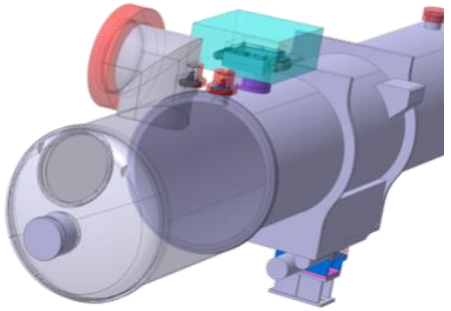




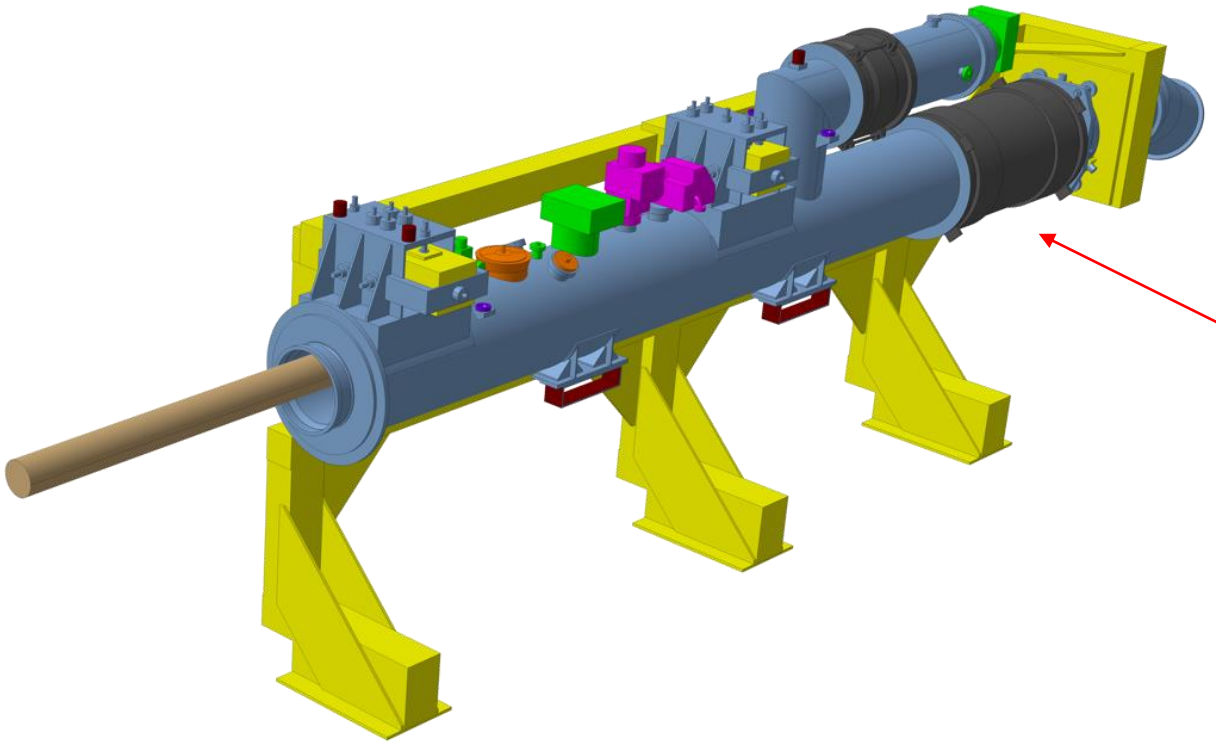
While awaiting installation of DCM, the interconnect will be temporarily closed to protect the cables, helium volume and insulation vacuum volume

7. Installation of DCM / DFX-h|Plug side subassembly



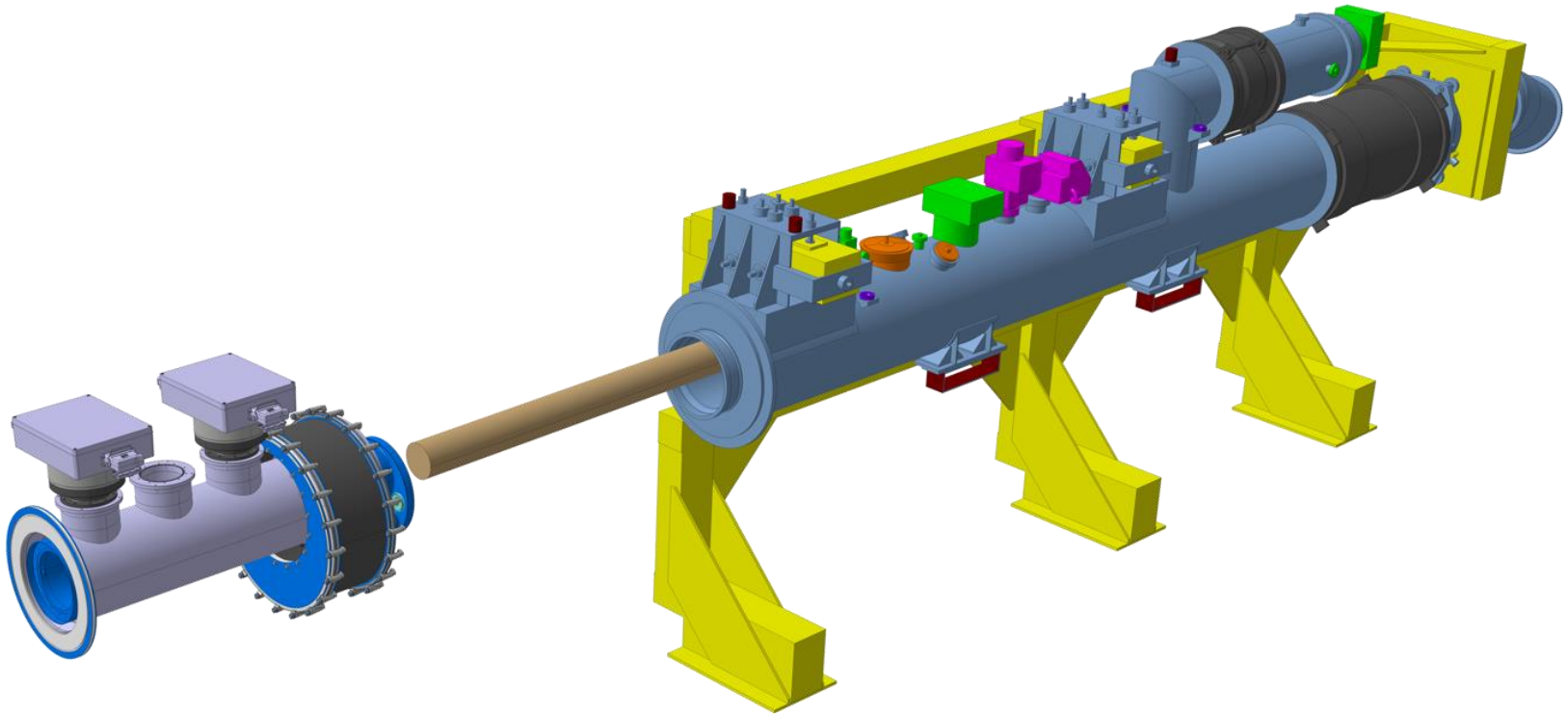


7.1 DCM/ DFX-h|Plug Side joining preparation

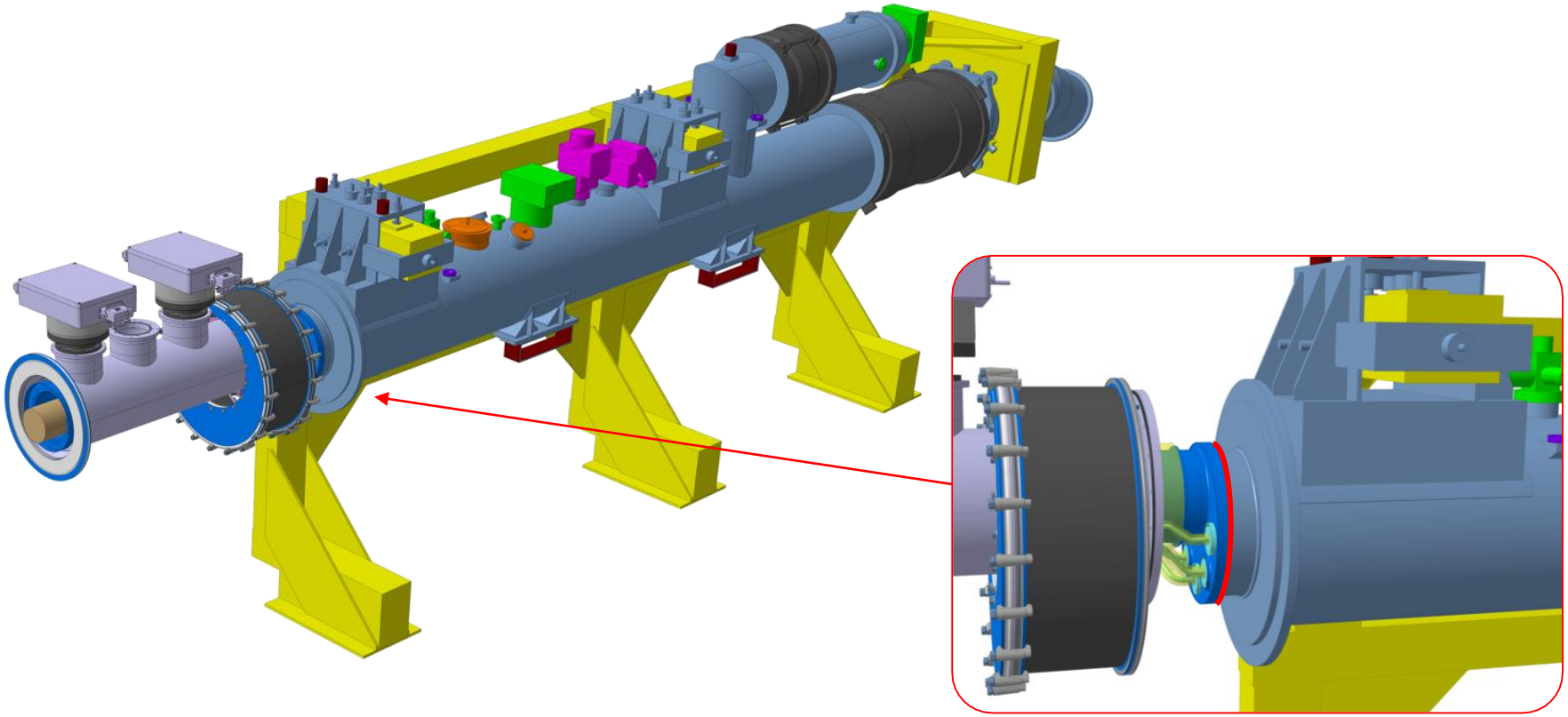


During the DCM installation the DCM-D1 interconnect is obviously open but for illustrative purposes is shown closed for simplicity

7.1 DCM/ DFX-h|Plug Side joining preparation

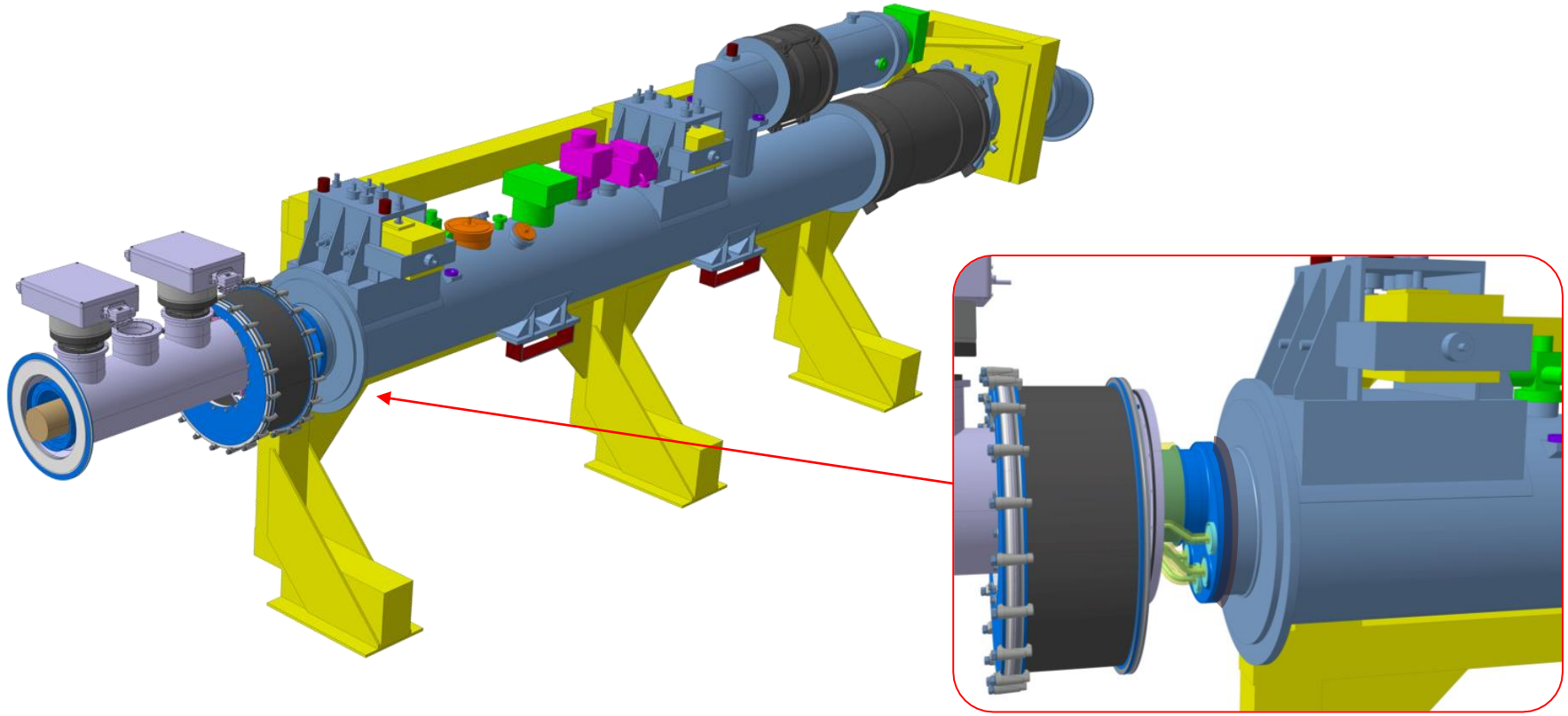


7.2 DCM/DFX-h|Plug Side welding and clam shell leak test

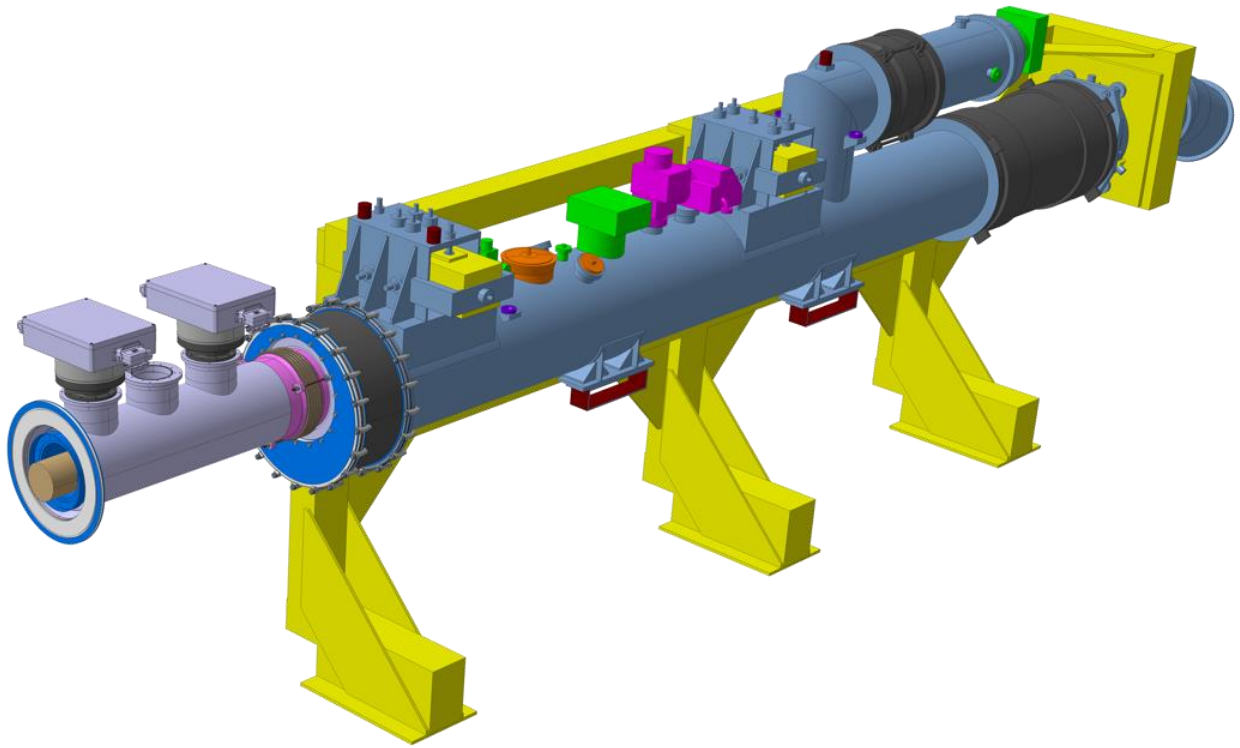


Welding between the two separate interfaces shall be implemented off-line.

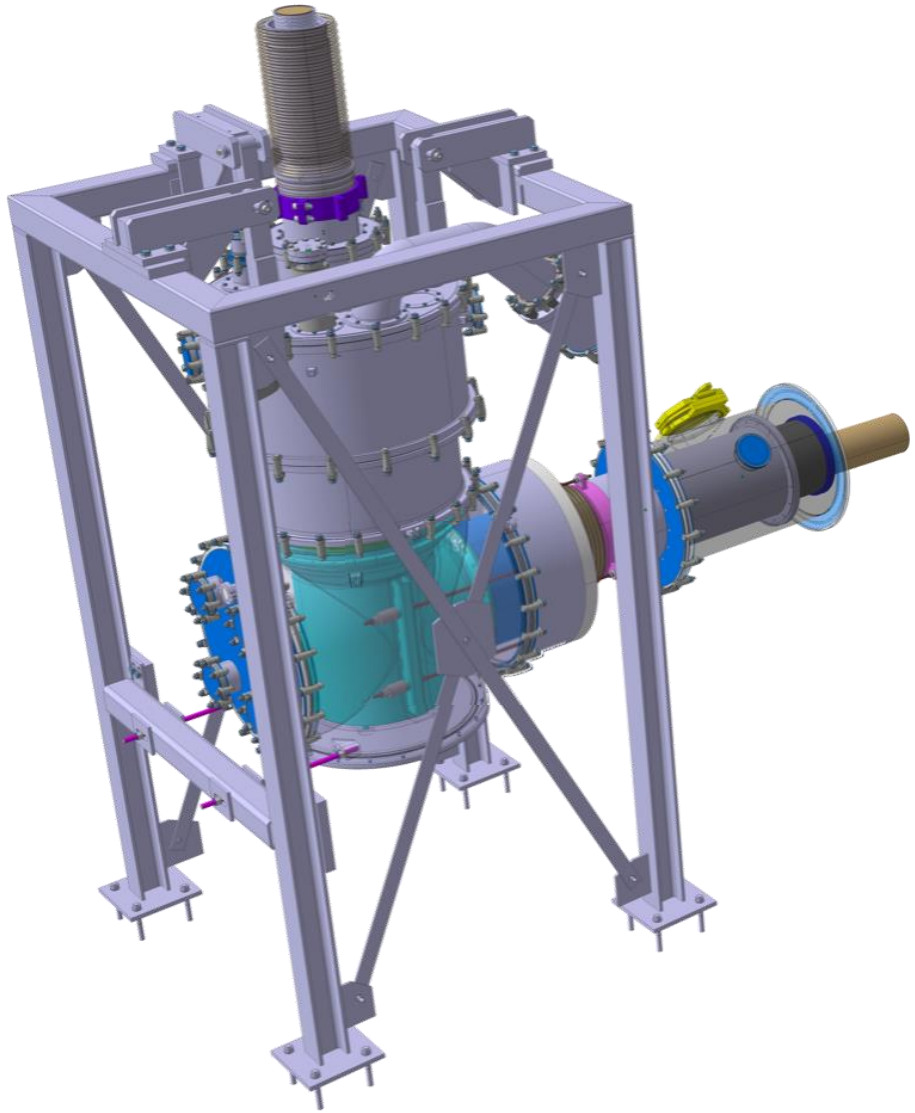
7.2 DCM/DFX-h|Plug Side welding and clam shell leak test

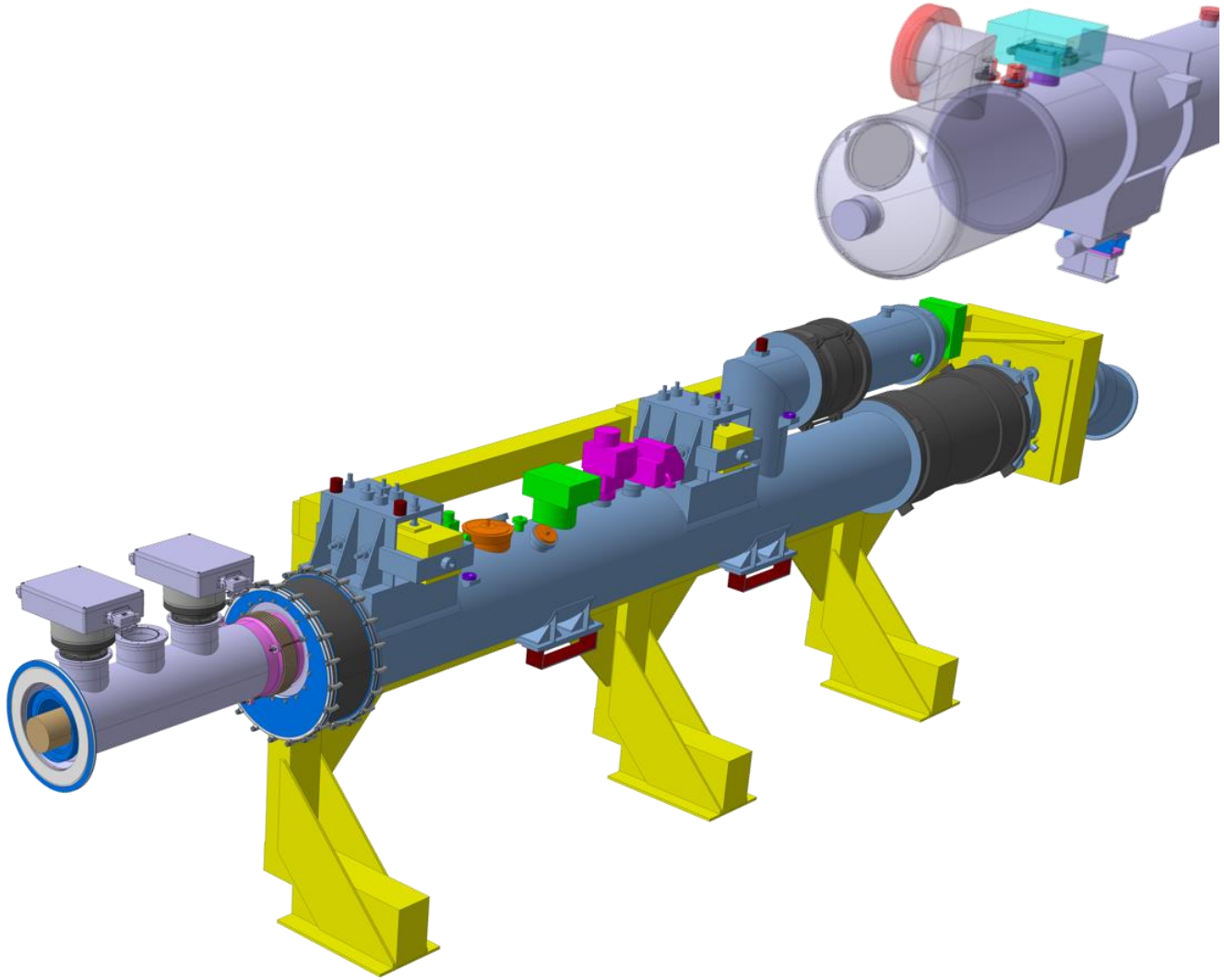


7.3 Slide the VV sleeve of DFX-h|Plug Side and clamp it

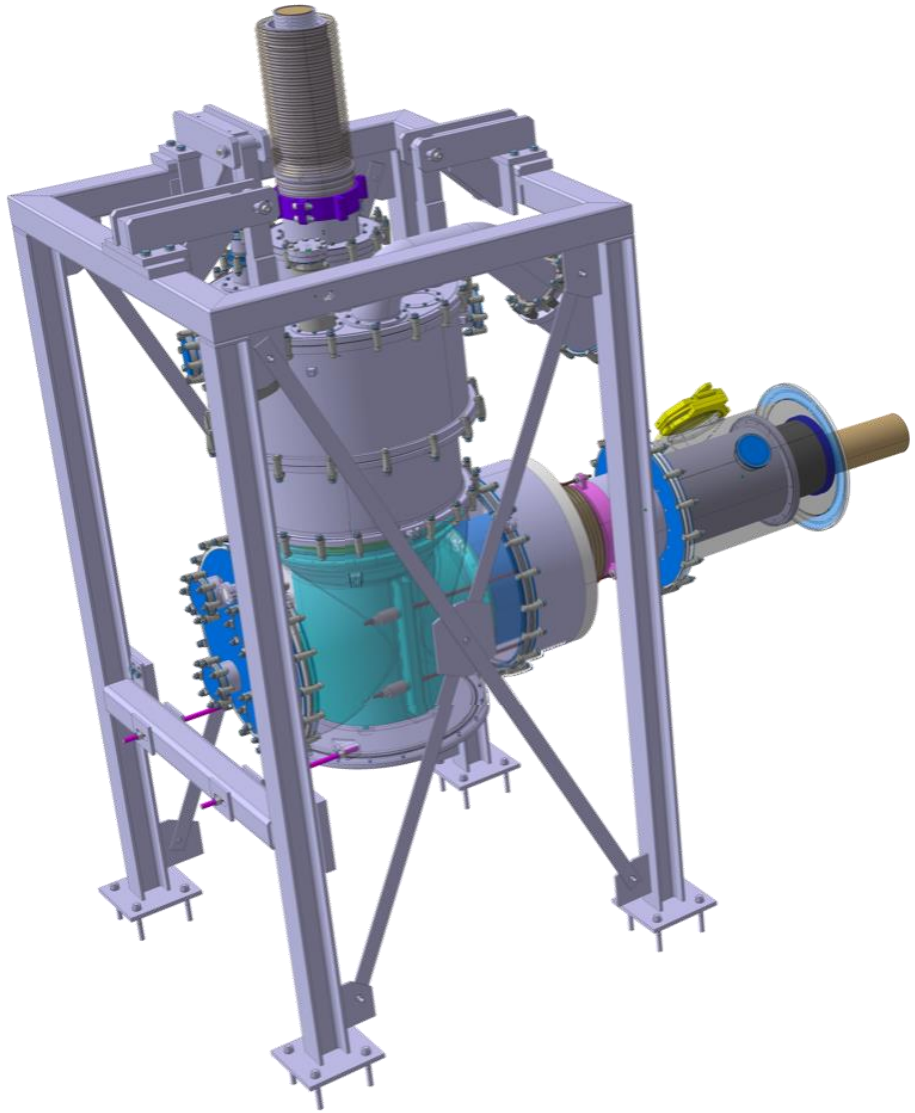


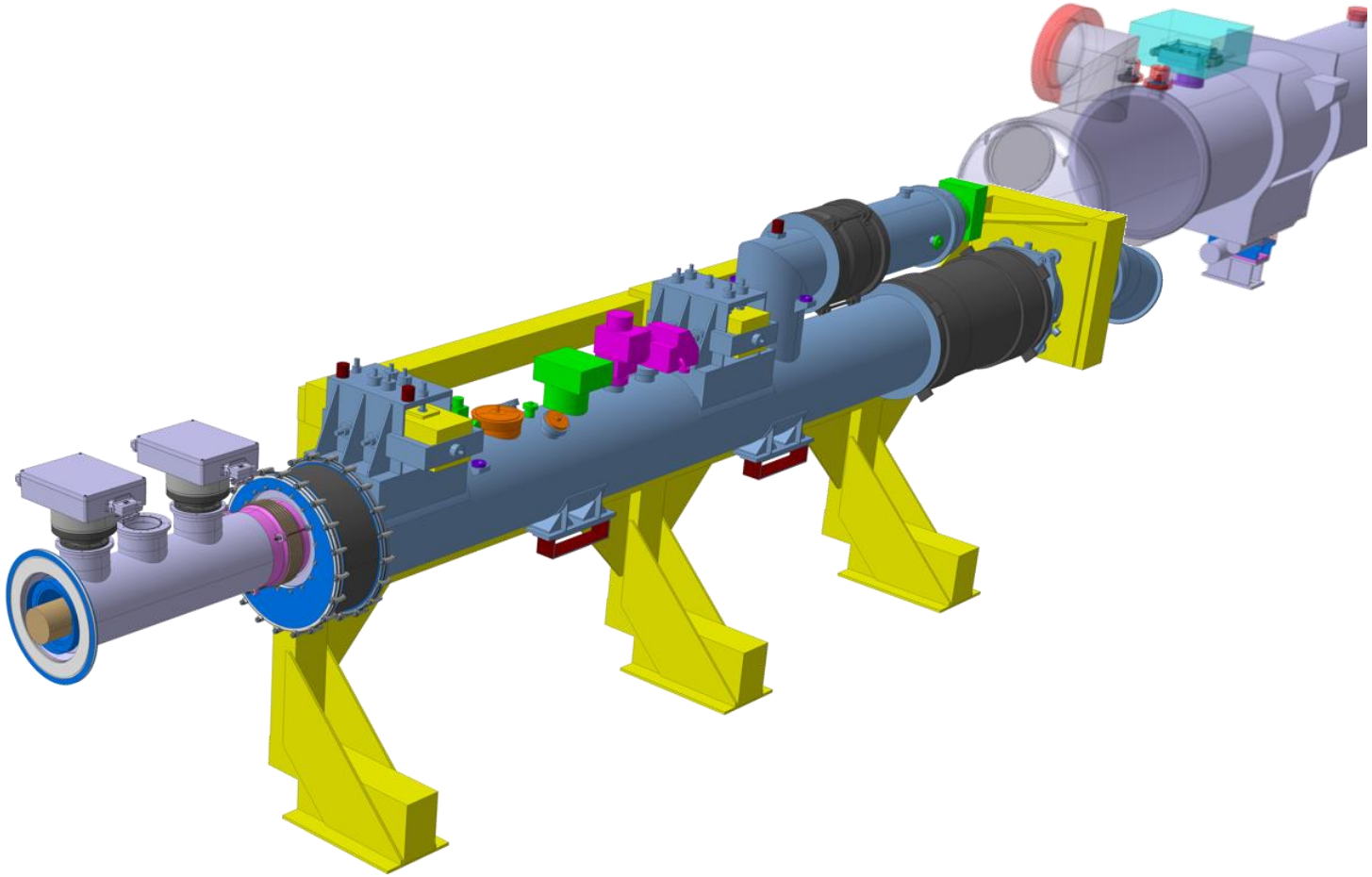
7.4 Position the DCM / DFX-h|Plug Side subassembly at the IT string



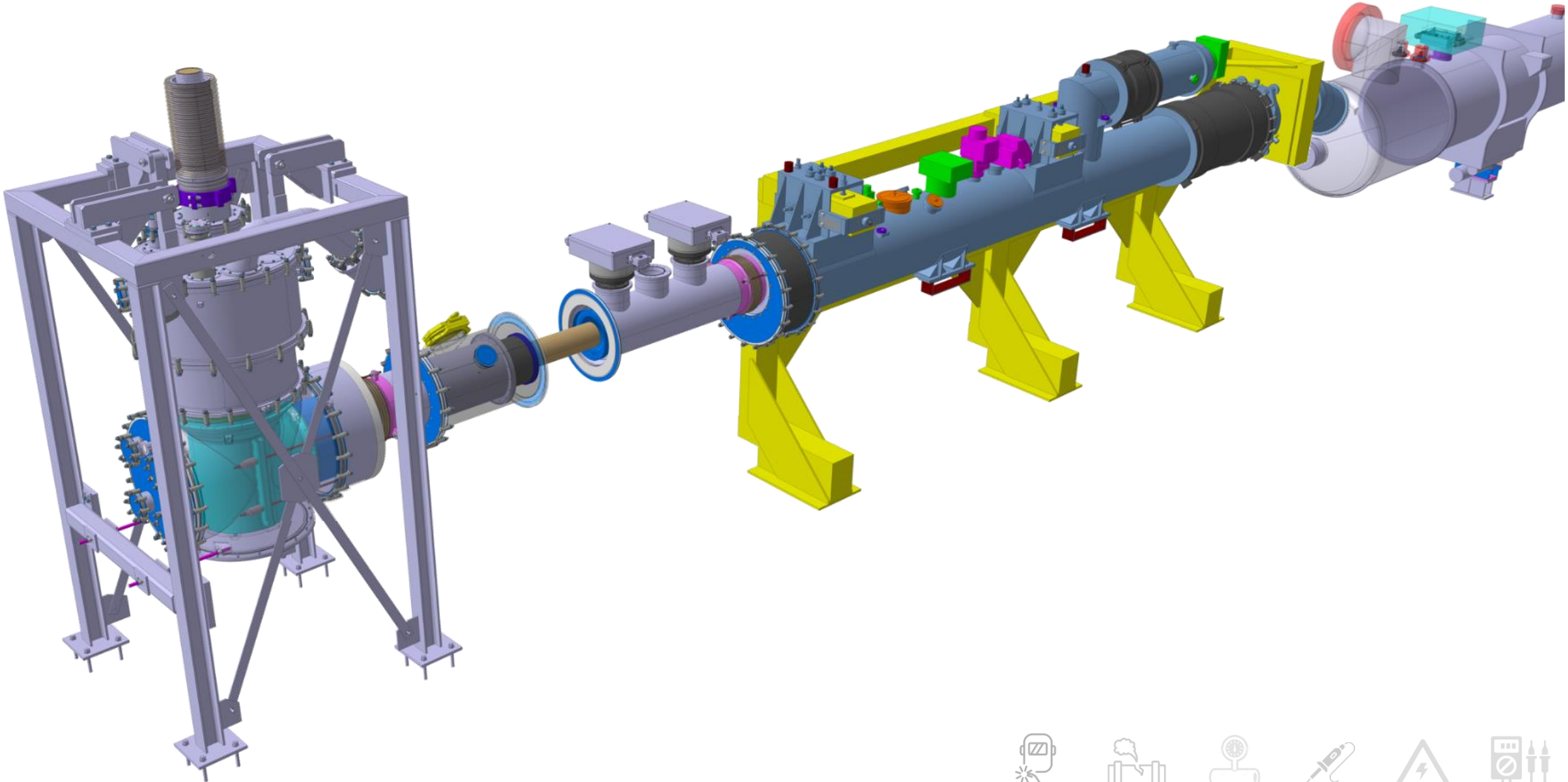


7.4 Position the DCM / DFX-h|Plug Side subassembly at the IT string



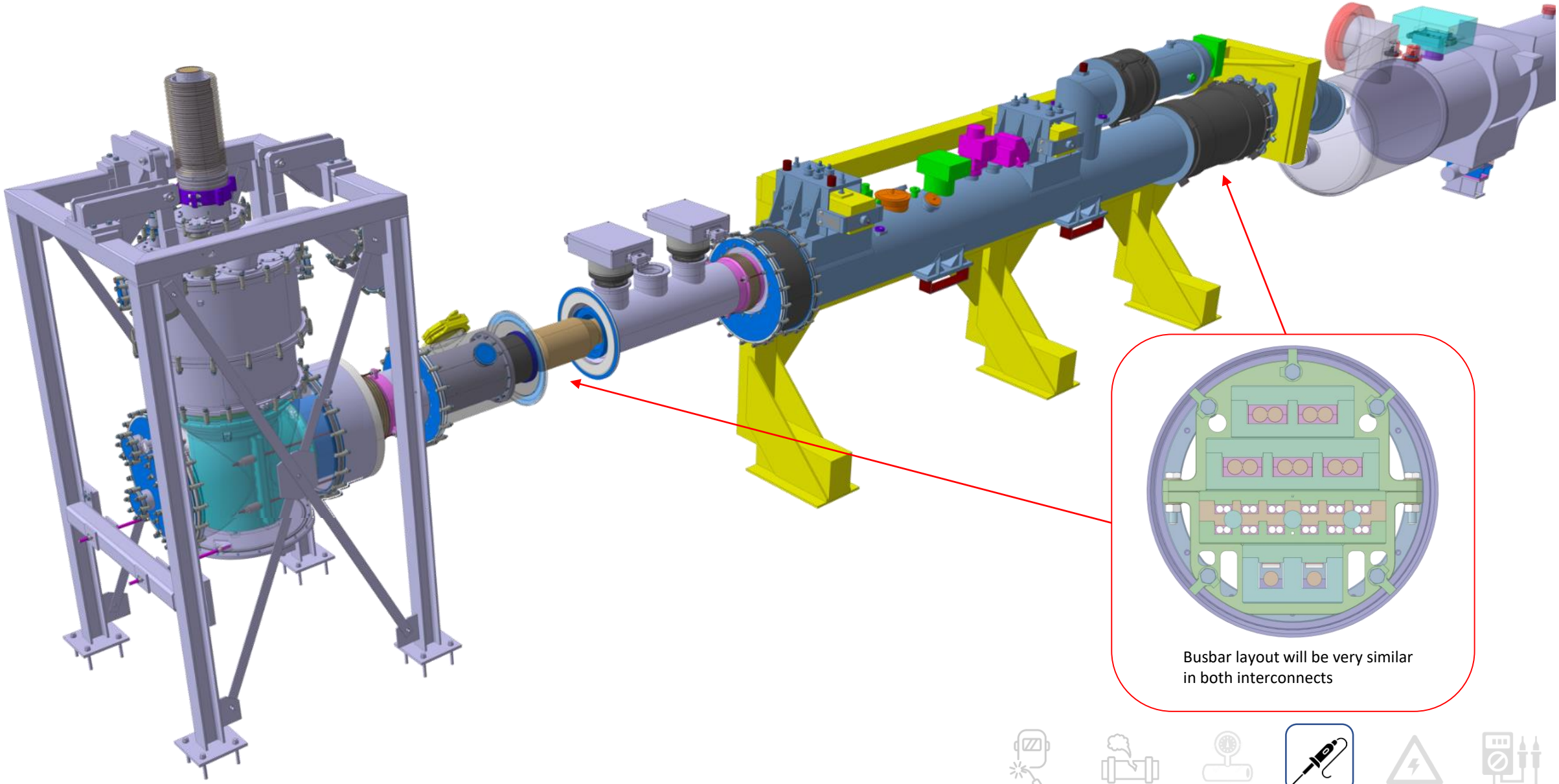


7.4 Position the DCM / DFX-h|Plug Side subassembly at the IT string



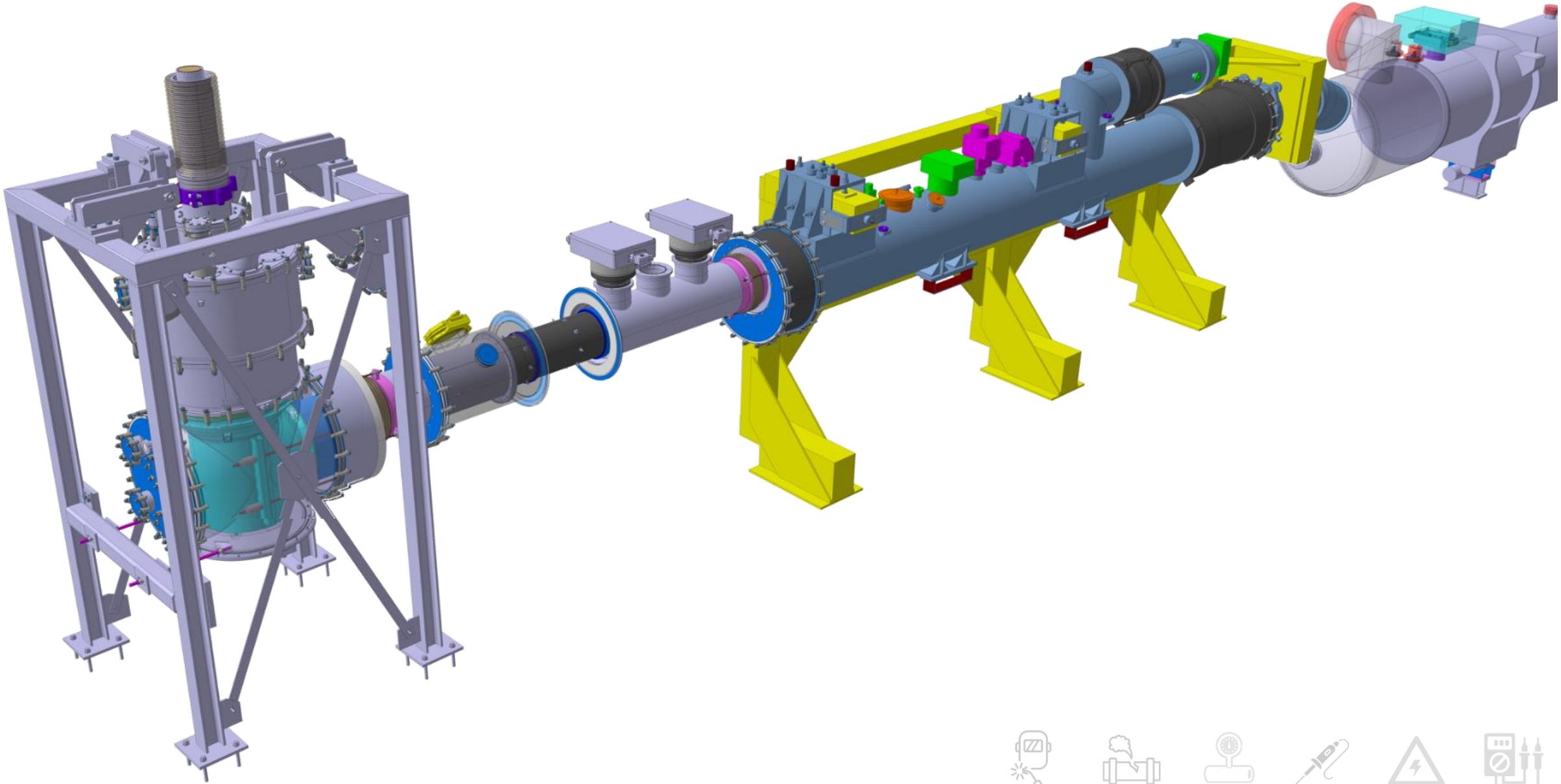
7.5 NbTi-NbTi splices soldering

7.6 SCLink - IFS instrumentation joining

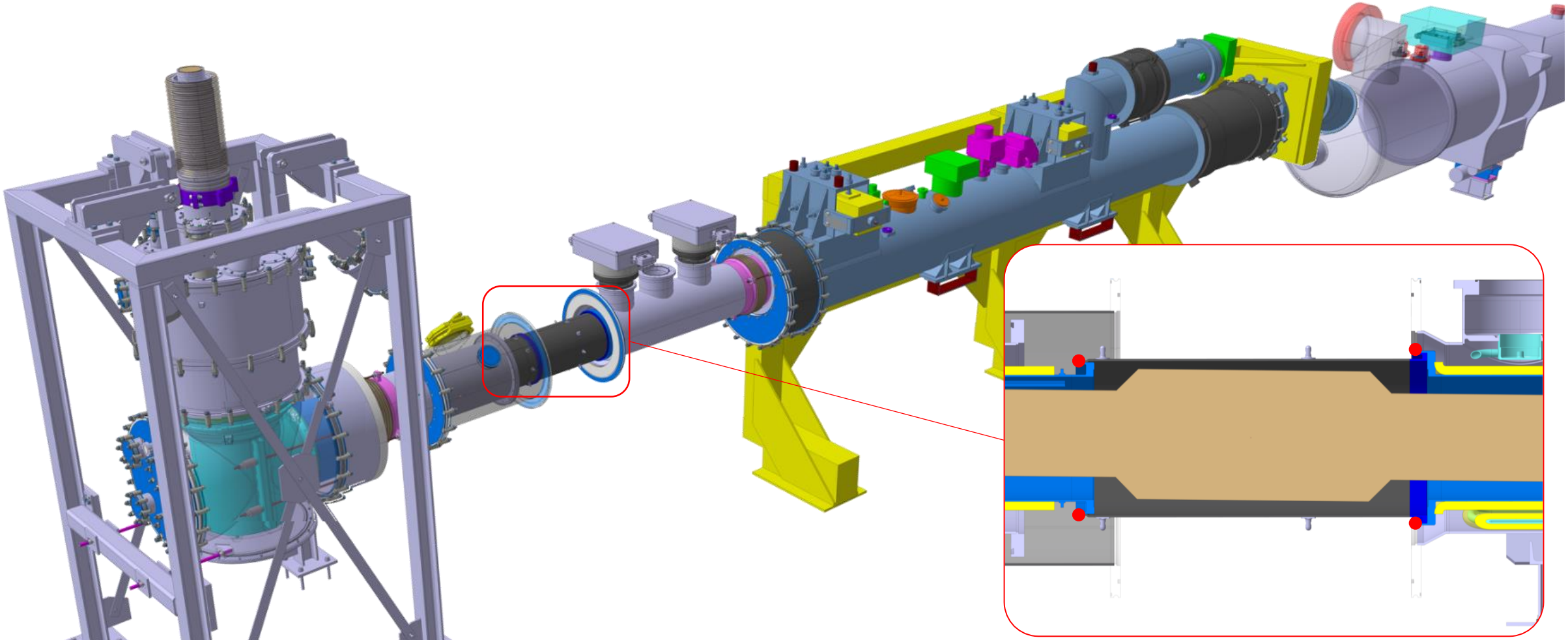


Busbar layout will be very similar
in both interconnects

7.7 Slide the HV sleeve towards the plug side

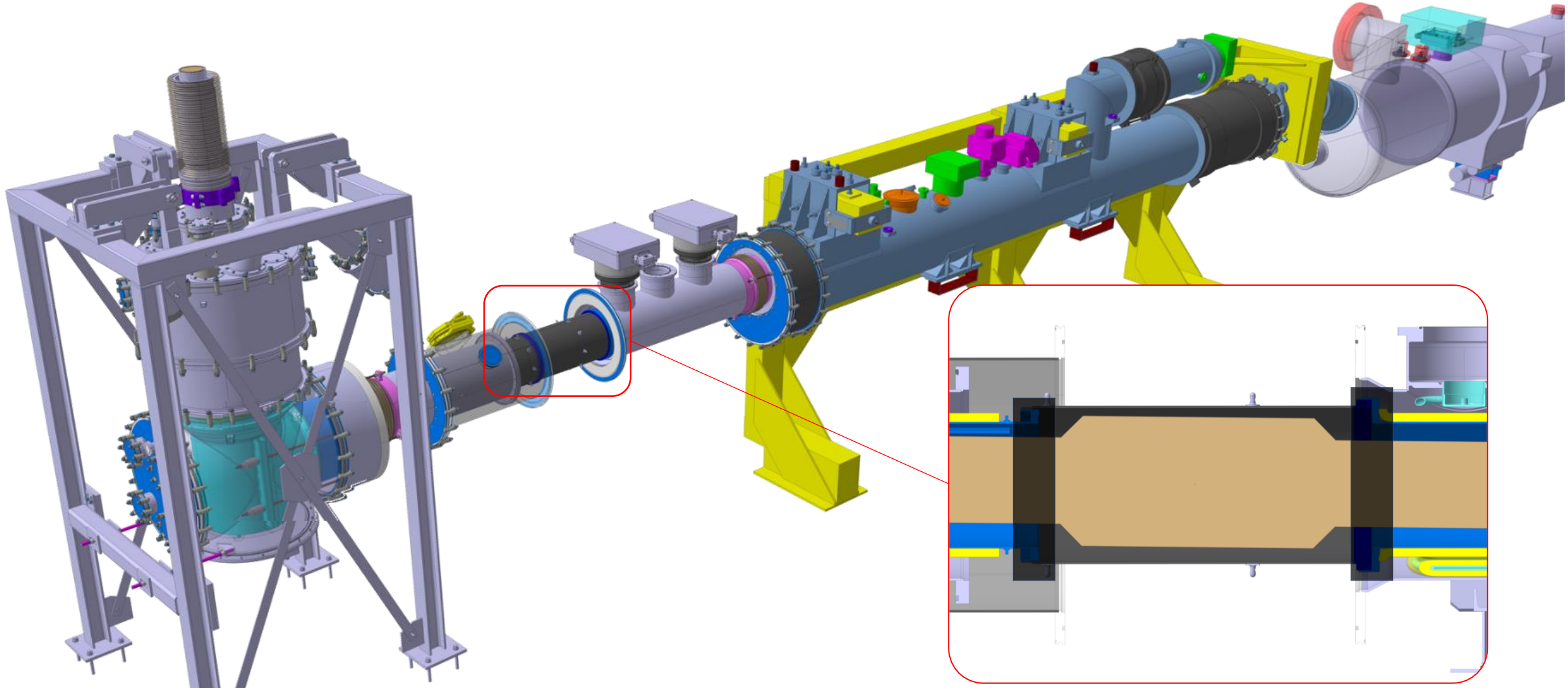


7.8 Lip Weld

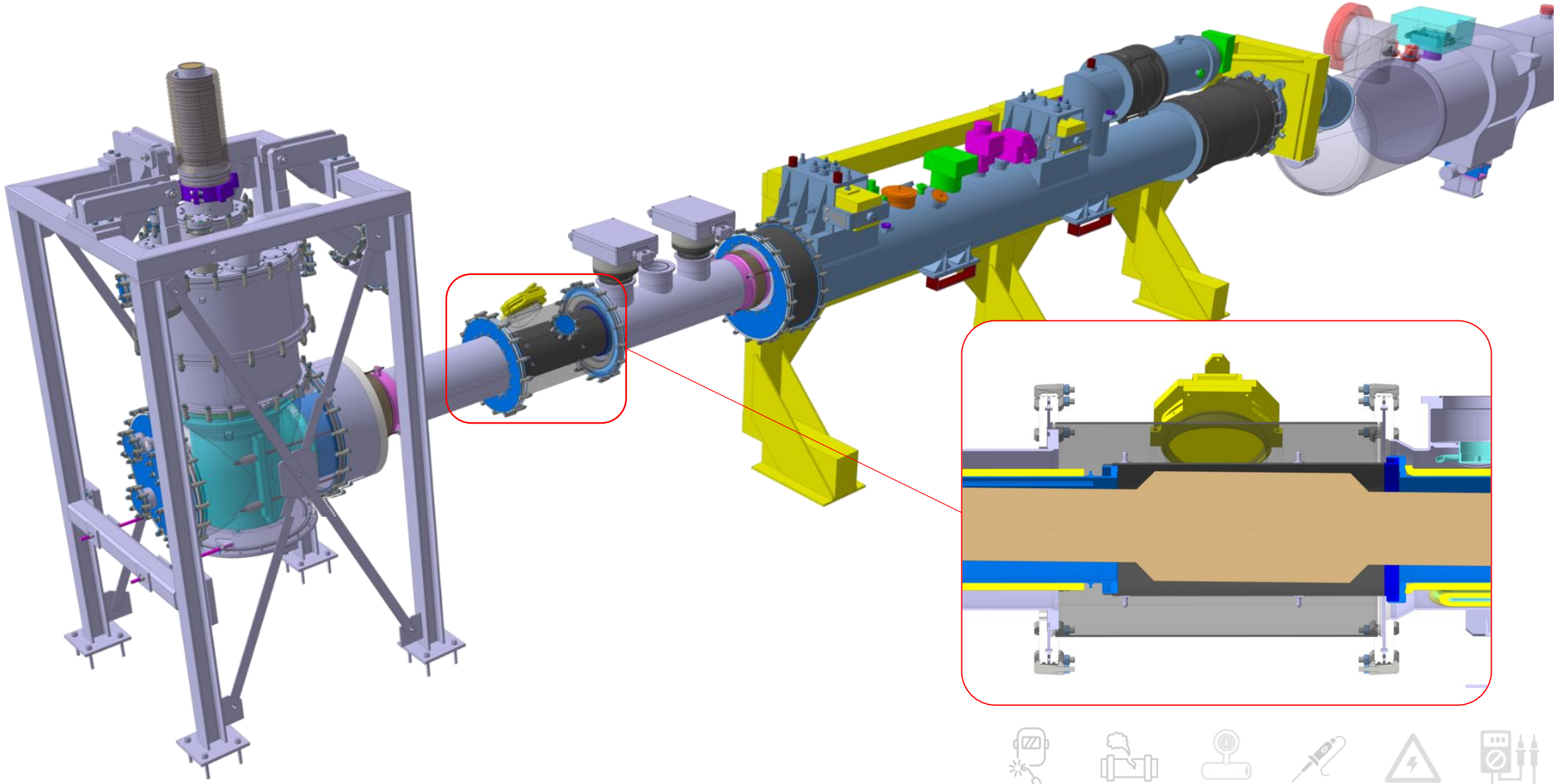


"EN-MME"
or
"TE-MSC" ?

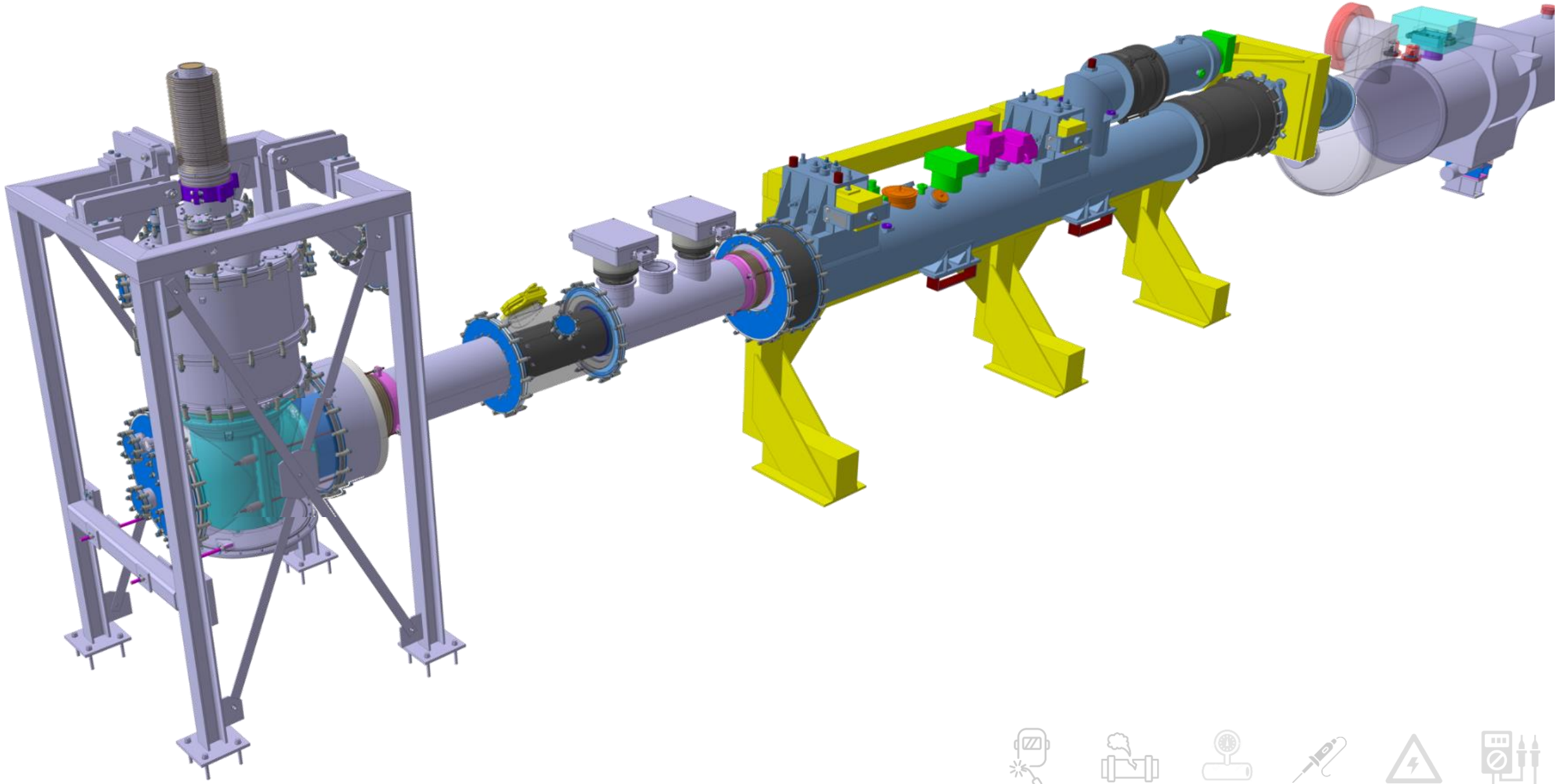
7.9 Clam shell leak test



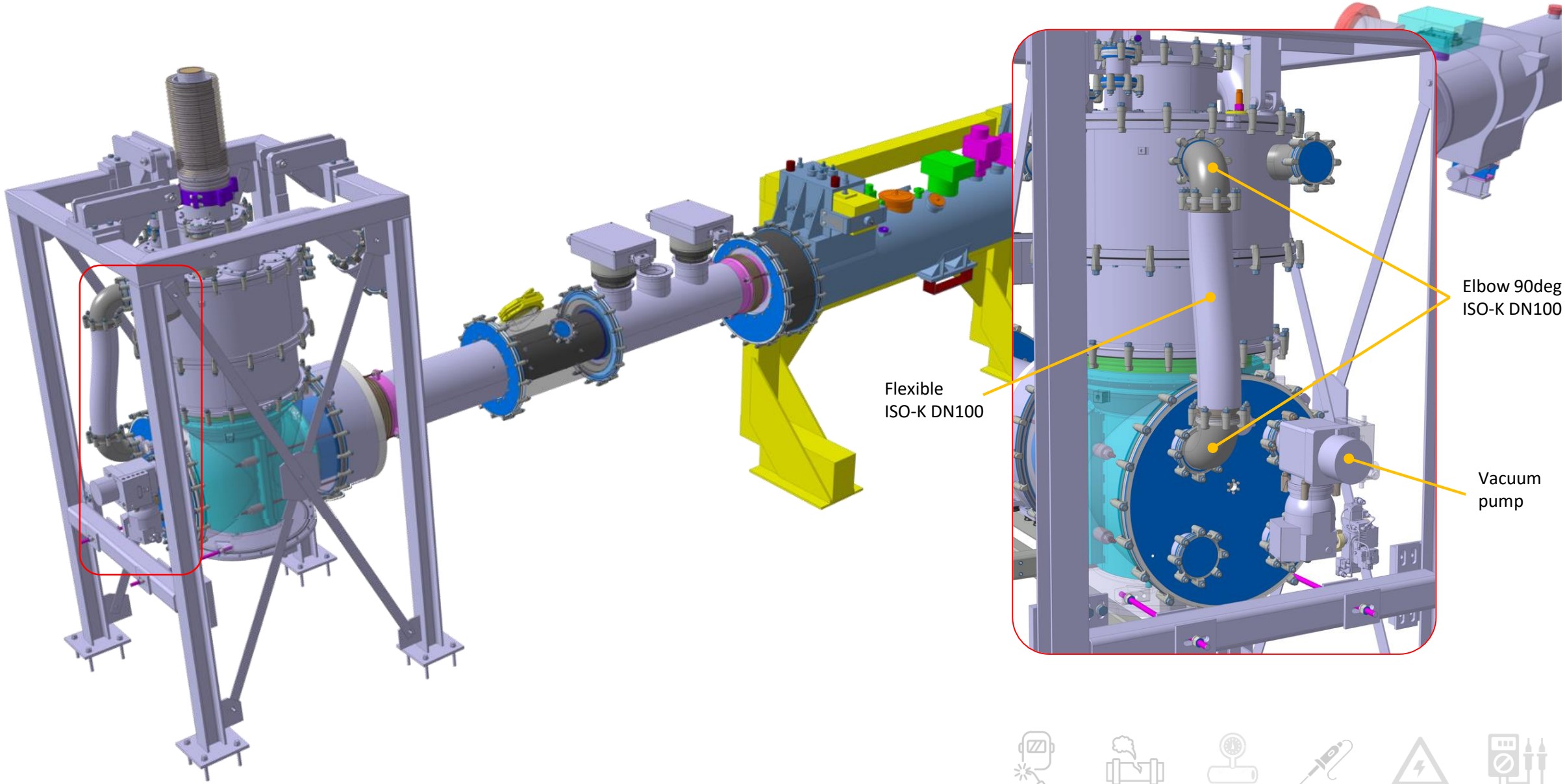
7.10 Slide the VV sleeve towards the plug side and clamp it



8. Installation of services

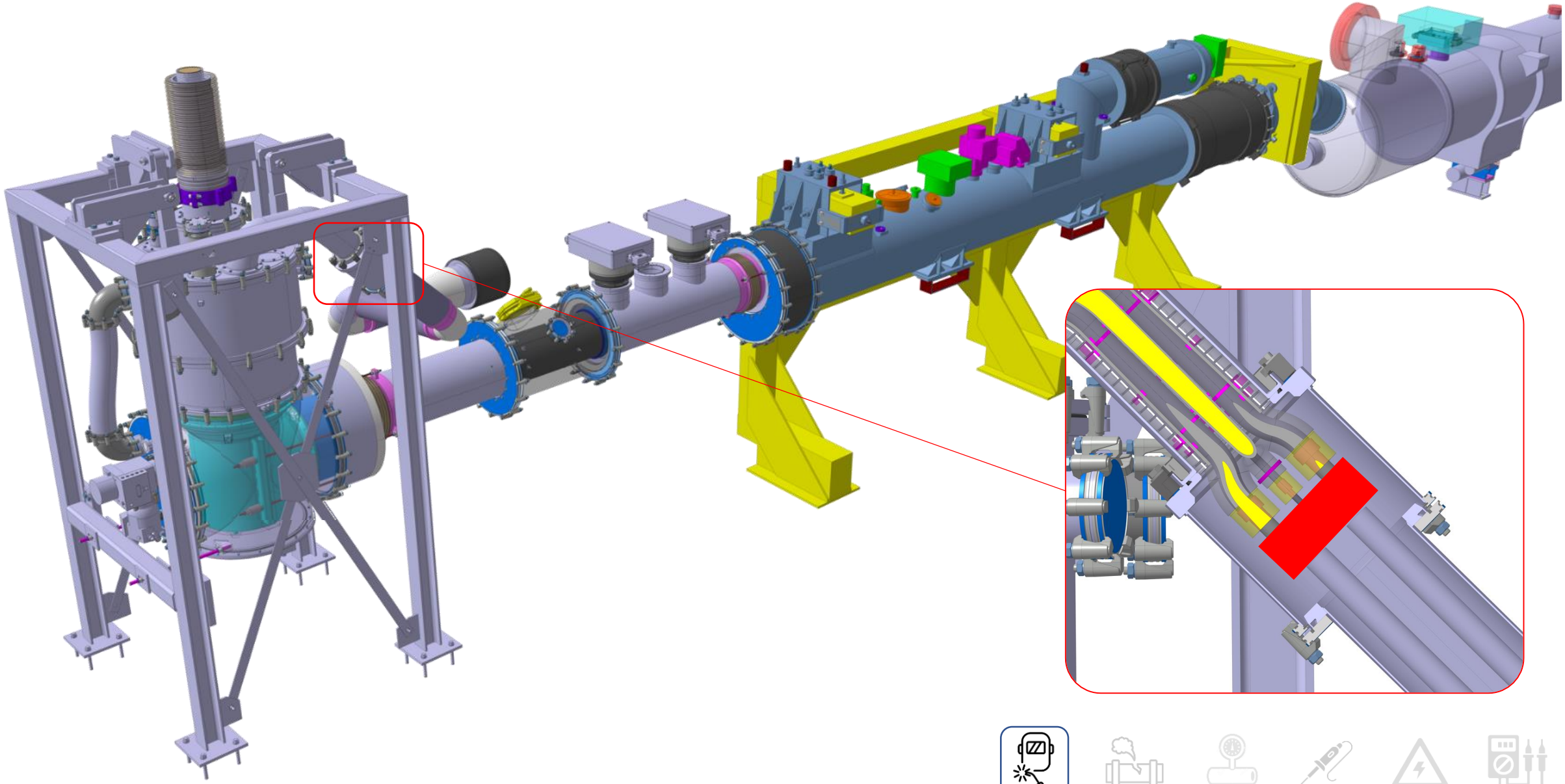


8.1 Install the bypass valves assembly

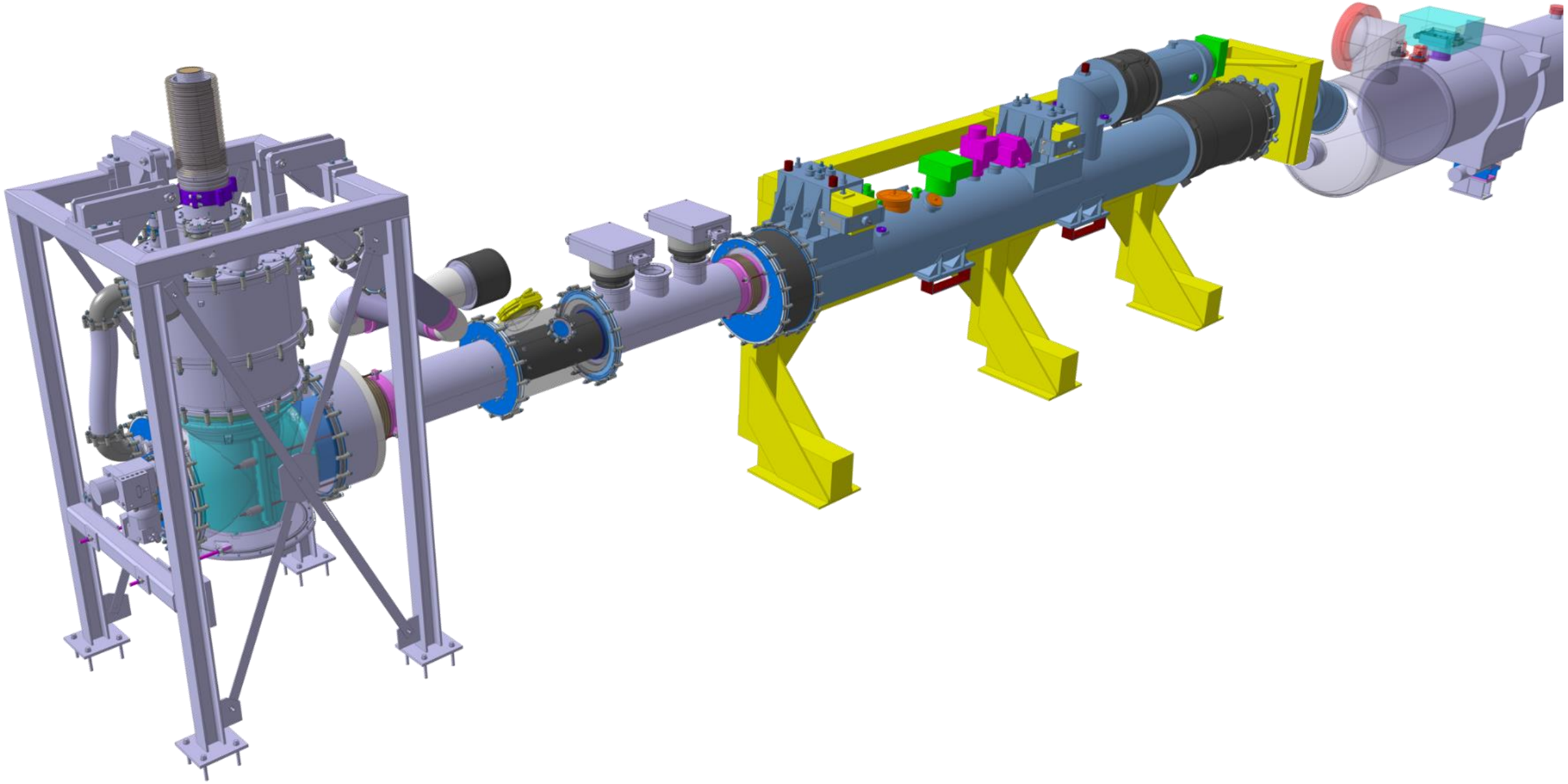


8.2 Weld the cryogenic line at DFX & SQXL interfaces

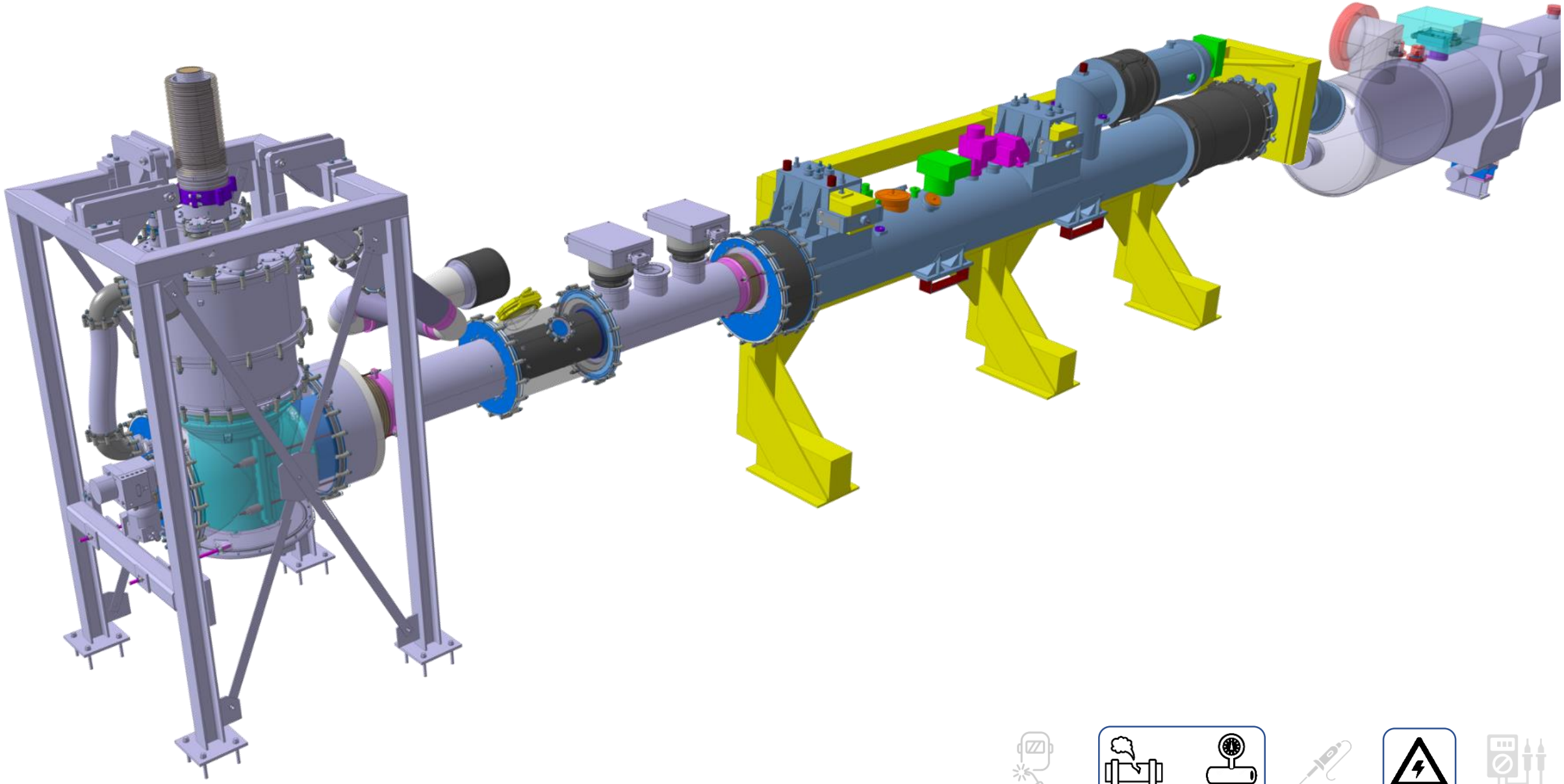
8.3 Clamp and close the DFX Supply tube



9. Qualification



9.1 Pressure Test
9.2 Leak Test
9.3 Electrical Test



Resources for WP6a at IT String (1)

- To determine manpower requirements of the WP6a contribution, the following assumptions are made with respect to support teams:

  - Installation coordination & planning WP16
  - Handling in SM18: EN-HE contribution in SM18 (up to 2 persons)
  - Supports & their installation: WP6a jobs with EN-ACE
  - DFX assembly work: WP6a team contribution.
  - DFX interconnection (NbTi/NbTi): TE-MSC contribution (Sandrine/Rosario team)
  - DFX interconnection welding*: WP6a jobs with EN-MME (alternatively via TE-MSC – tbd)
  - Vac instrumentation & pumping: TE-VSC contribution
  - Interconnect & global leak tests: TE-VSC contribution
  - ELQA & electrical protection: TE-MPE contribution

*overall welding needs are: DFX assembly; DFX interconnect; DFX-SQXL transfer line; DFHX-GMS transfer line

Resources for WP6a at IT String (2)

- Several WP6a documents have been prepared to collate the IT String interfaces, activities & resources
  - Interface Specification of WP6a in IT String – edms 2087862
  - WP6a (TE-MSC) Contribution to WP16 document – edms 2188577
  - DFX assembly sequence @ IT String – https://cernbox.cern.ch/index.php/s/q02aVBvLn6l8Ufp
  - Cold Powering assembly sequence @ IT String – https://cernbox.cern.ch/index.php/s/DzSmU6aVmdzpkQk

- IT String assembly builds upon the experience gained during the cold powering system test at F2

- WP6a resources @ IT String
  - Staff Project Engineer
  - Staff Technician
  - FSU Technician
  - TE-MSC synergies (eg field coordinator/QA/QC)

Table 5: FTE of Staff per year

Group	2021 study	2022 preparation	2023 installation	2024-2025 commissioning & operation	2026 dismantling	Total (FTE·years)
TE-MSC WP6a -Eng	0.05	0.1	0.35	0.2		**1.9**
TE-MSC WP6a - Tech		0.1	0.7	0.4		

Table 6: FTE of M4P per year

Group	2021 study	2022 preparation	2023 installation	2024-2025 commissioning & operation	2026 dismantling	Total (FTE·years)
TE-MSC WP6a - M4P	0	0.1	0.7	0.1		**0.9**

Extract from 'WP6a contribution to IT String' edms 2188577 (in work status)

Thanks for your attention !

Questions ?