Super FRS Hot Cell
Layout & remote handling in the Super FRS Hot Cell

- Super FRS hot cell Overview
- Remote handling components
- Remote handling Processes

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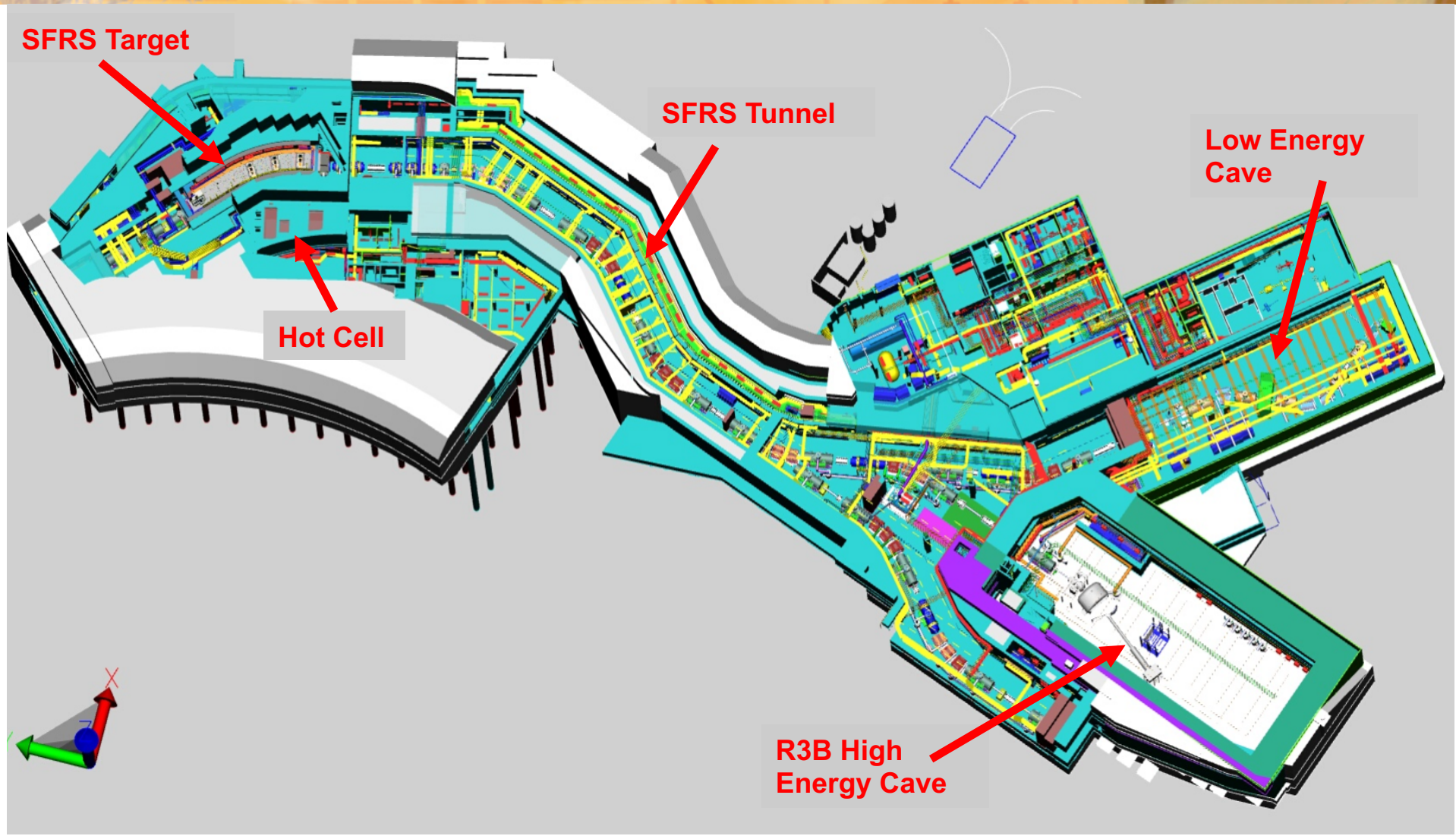
GSI Darmstadt, 02.02.2021

The super FRS facility



Activation of the super FRS target components

Operation foreseen for the Super FRS facility:

- 90 days run

- 120 days break

Isotope	Aktivität (A) Bq	Freigrenze (F) Bq	A / F ---	Halbwertszeit d
^{54}Mn	1,65E+13	1,00E+06	1,65E+07	312,27
^{51}Cr	1,40E+13	1,00E+07	1,40E+06	27,7
^{55}Fe	1,30E+13	1,00E+06	1, 30E+07	996,41
^{52}Mn	6,14E+12	1,00E+05	6,14E+07	5,59
^{48}V	5,06E+12	1,00E+05	5,06E+07	15,97

Table shows the activation of the main isotpes which are responsible for the activation of the components

3 days		120 days	
Bq	mSv/h	Bq	mSv/h
1,40E+11	9,00E-01	4,87E+10	1,96E-01

graphite target wheel

3 days		120 days	
Bq	mSv/h	Bq	mSv/h
1,35E+11	9,93E+00	5,10E+10	1,89E+00

target plug shielding

3 days		120 days	
Bq	mSv/h	Bq	mSv/h
2,54E+13	2,52E+03	1,17E+13	5,64E+02

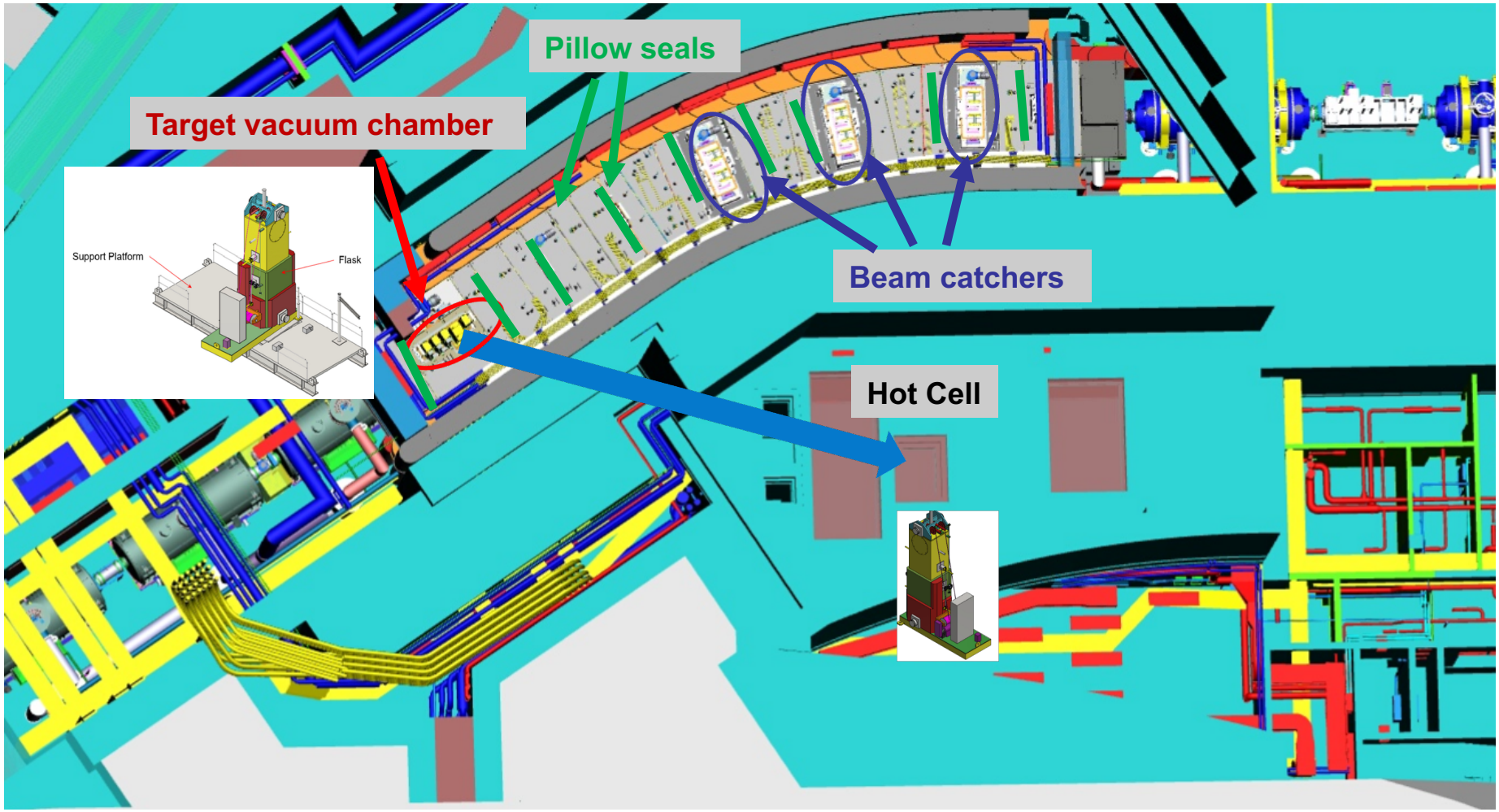
Graphite absorber

3 days		120 days	
Bq	mSv/h	Bq	mSv/h
4,44E+12	3,69E+02	2,67E+12	1,24E+02

Cu-absorber

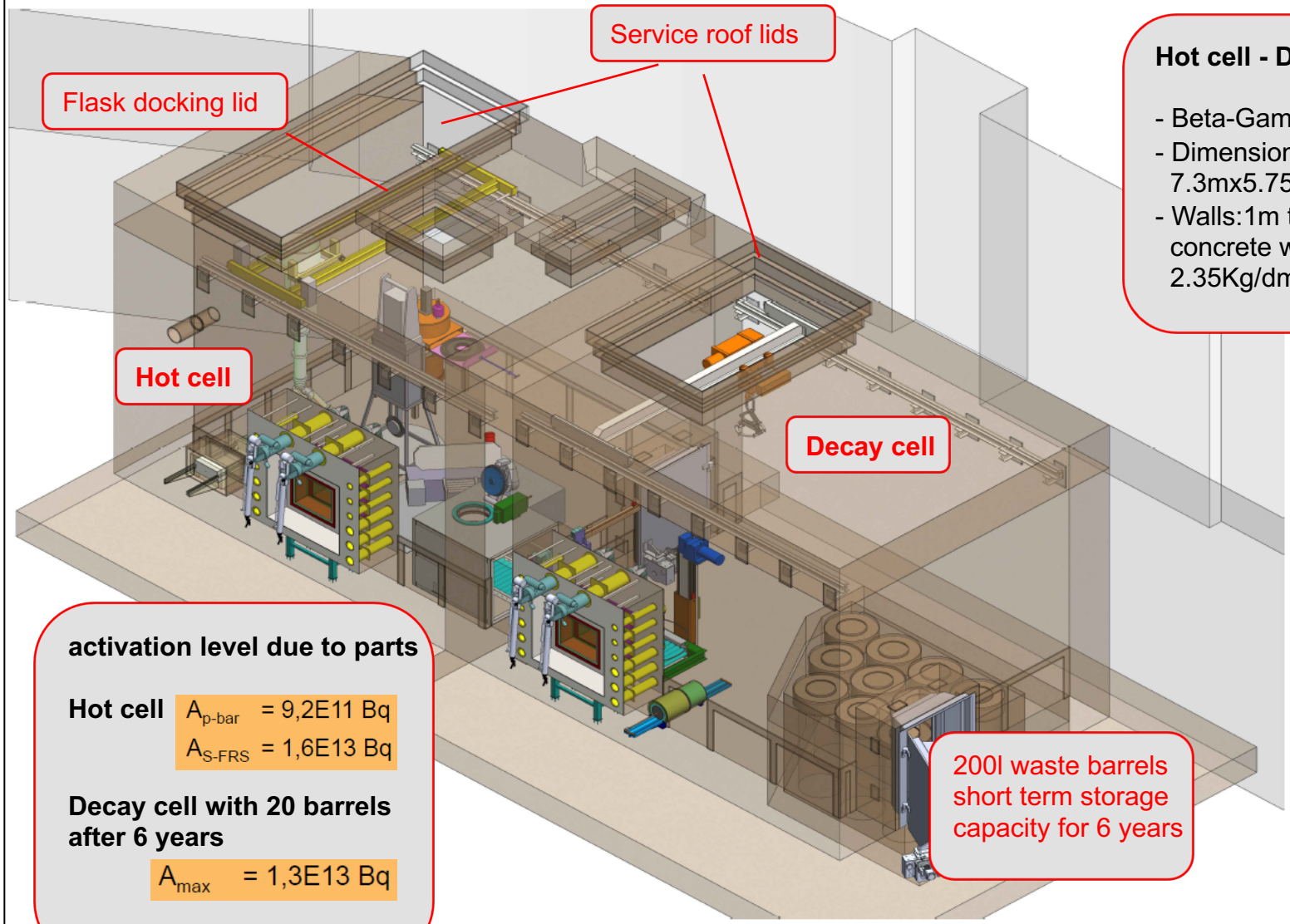
List of the components after a worst case scenario of 180 days beam time with U-238 and intensity of 1E+12 Ions/s and energy of 1,5GeV/u and then 120 days break. The table shows the activation of the parts after 3 and 120 days of decay. These parts are stored in 200l barrels in the floor of the decay cell.

Super FRS target area overview



The components will be moved in the shielding flask from the beam line to the hot cell and be indserted through the double lid slider of roof

The hot cell lay out



Hot cell - Decay cell

- Beta-Gamma cells
- Dimensions (WxDxH): 7.3mx5.75mx5.9m
- Walls:1m thickness of concrete with density of 2.35Kg/dm³

activation level due to parts

Hot cell

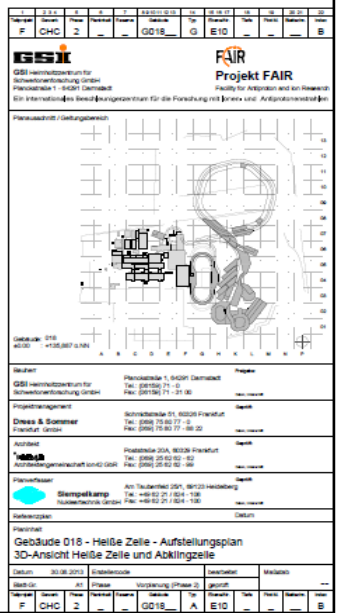
$A_{p\text{-}bar}$ = 9,2E11 Bq

$A_{S\text{-}FRS}$ = 1,6E13 Bq

Decay cell with 20 barrels after 6 years

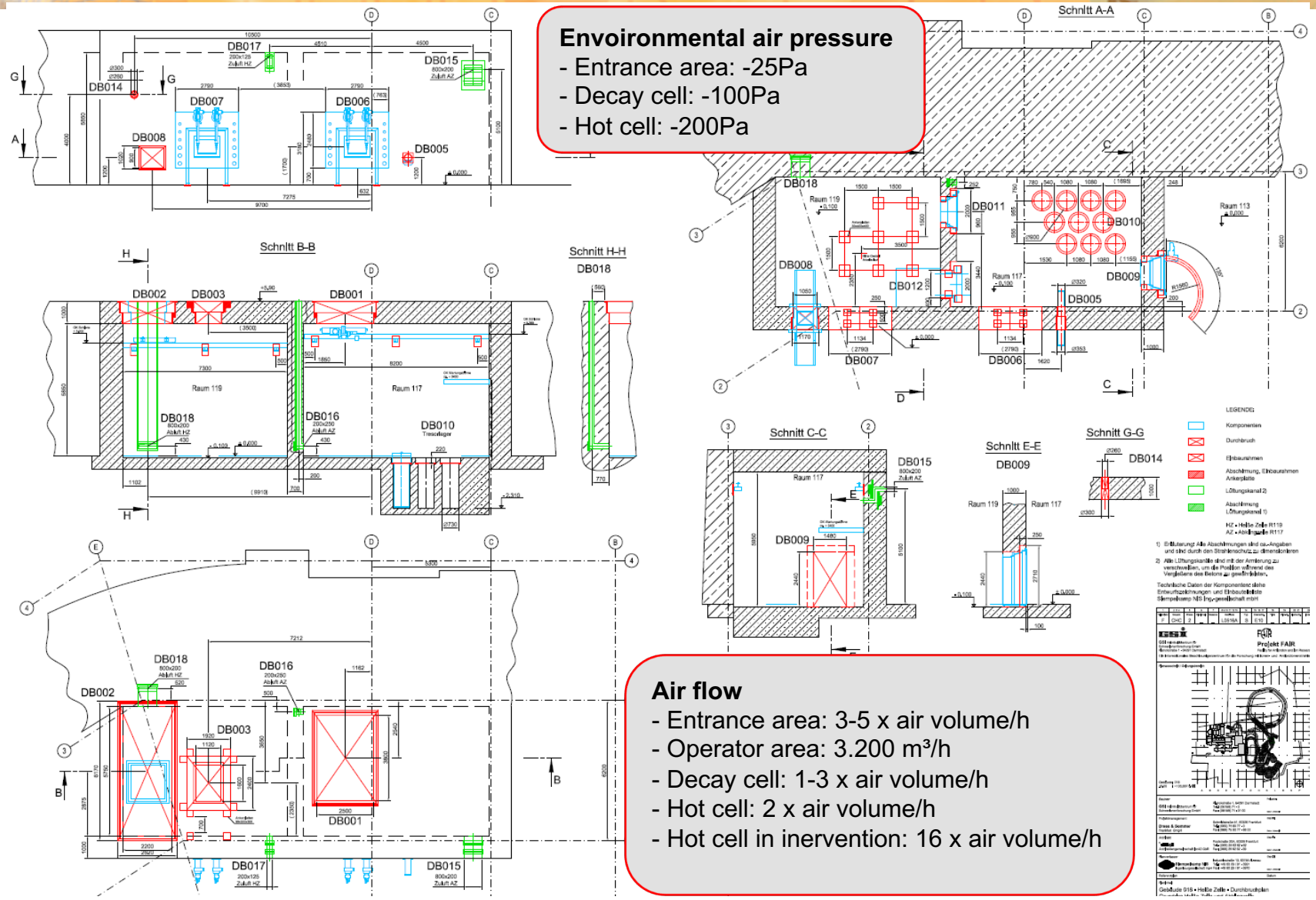
A_{max} = 1,3E13 Bq

200l waste barrels short term storage capacity for 6 years



The hot cell utilities

Envoironmental air pressure
- Entrance area: -25Pa
- Decay cell: -100Pa
- Hot cell: -200Pa

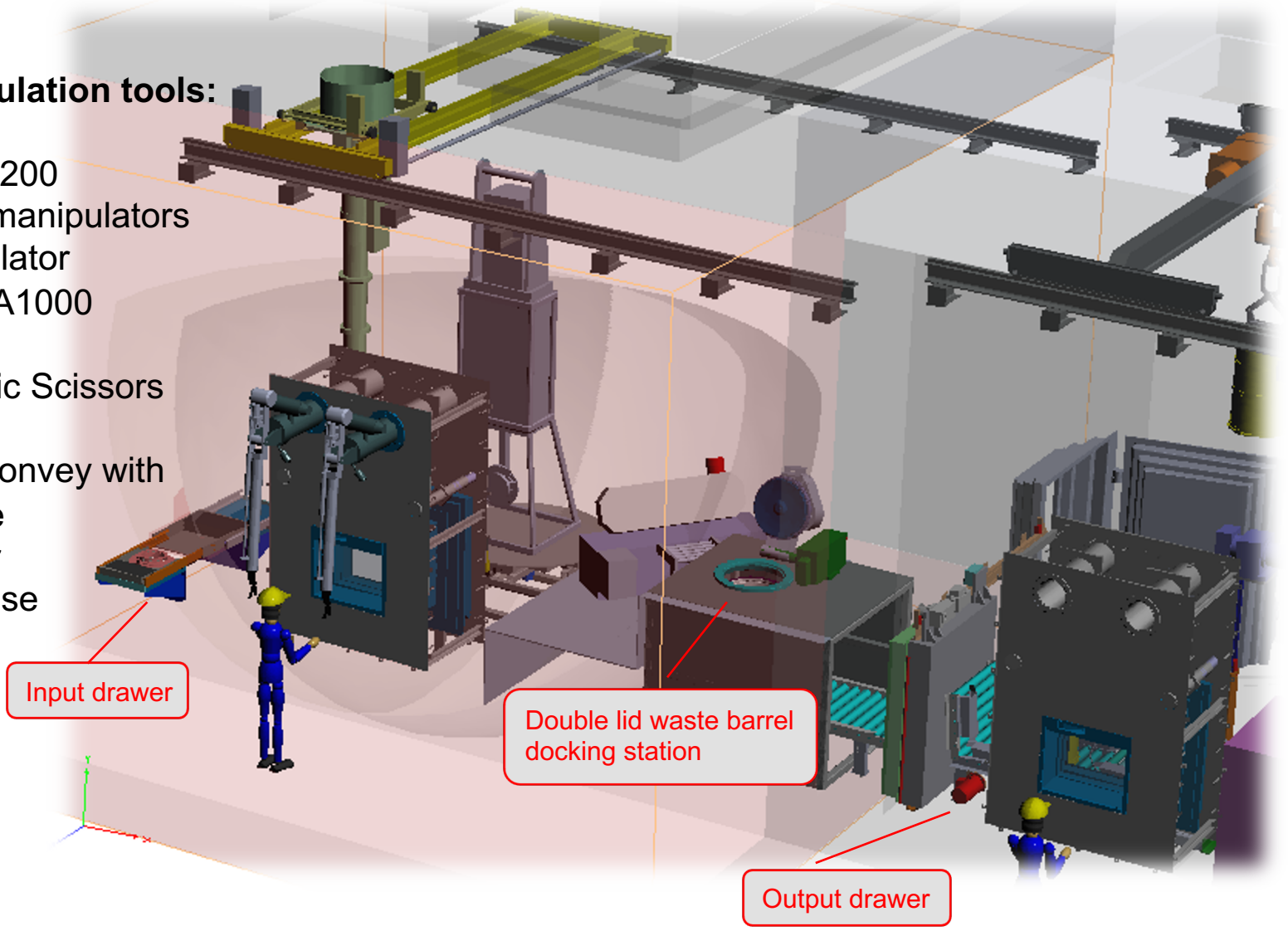


Air flow
- Entrance area: 3-5 x air volume/h
- Operator area: 3.200 m³/h
- Decay cell: 1-3 x air volume/h
- Hot cell: 2 x air volume/h
- Hot cell in inervention: 16 x air volume/h

The equipment of the HC

The main manipulation tools:

- 2 Gettinge MT200 Master-slave manipulators
- Power manipulator Wälischmiller A1000
- Plug turntable
- Saw / Hydraulic Scissors
- Lifter
- Waste barell convey with
- double lid gate
- Funnel drawer
- General purpose small tools

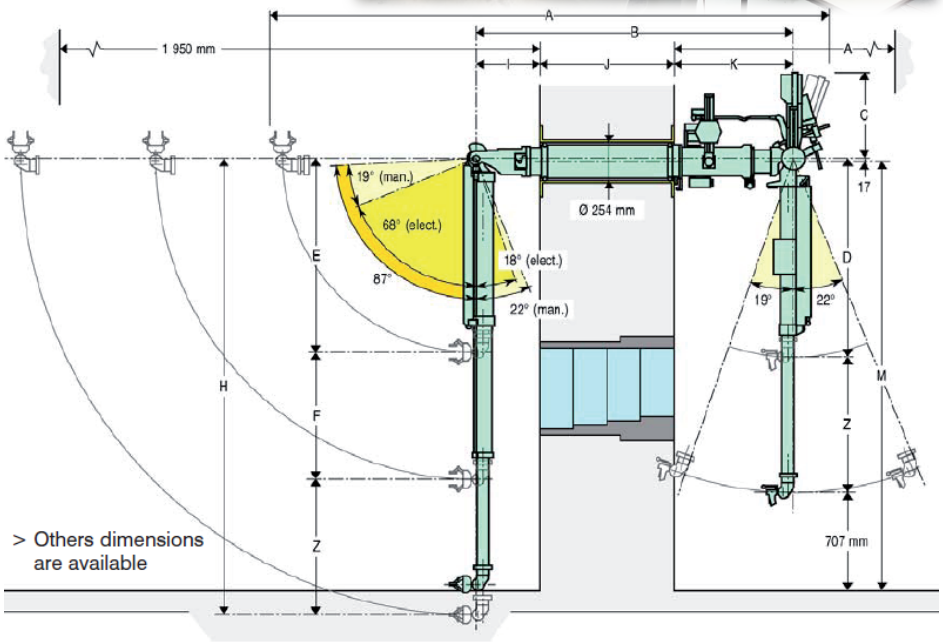


Master slave and power manipulators

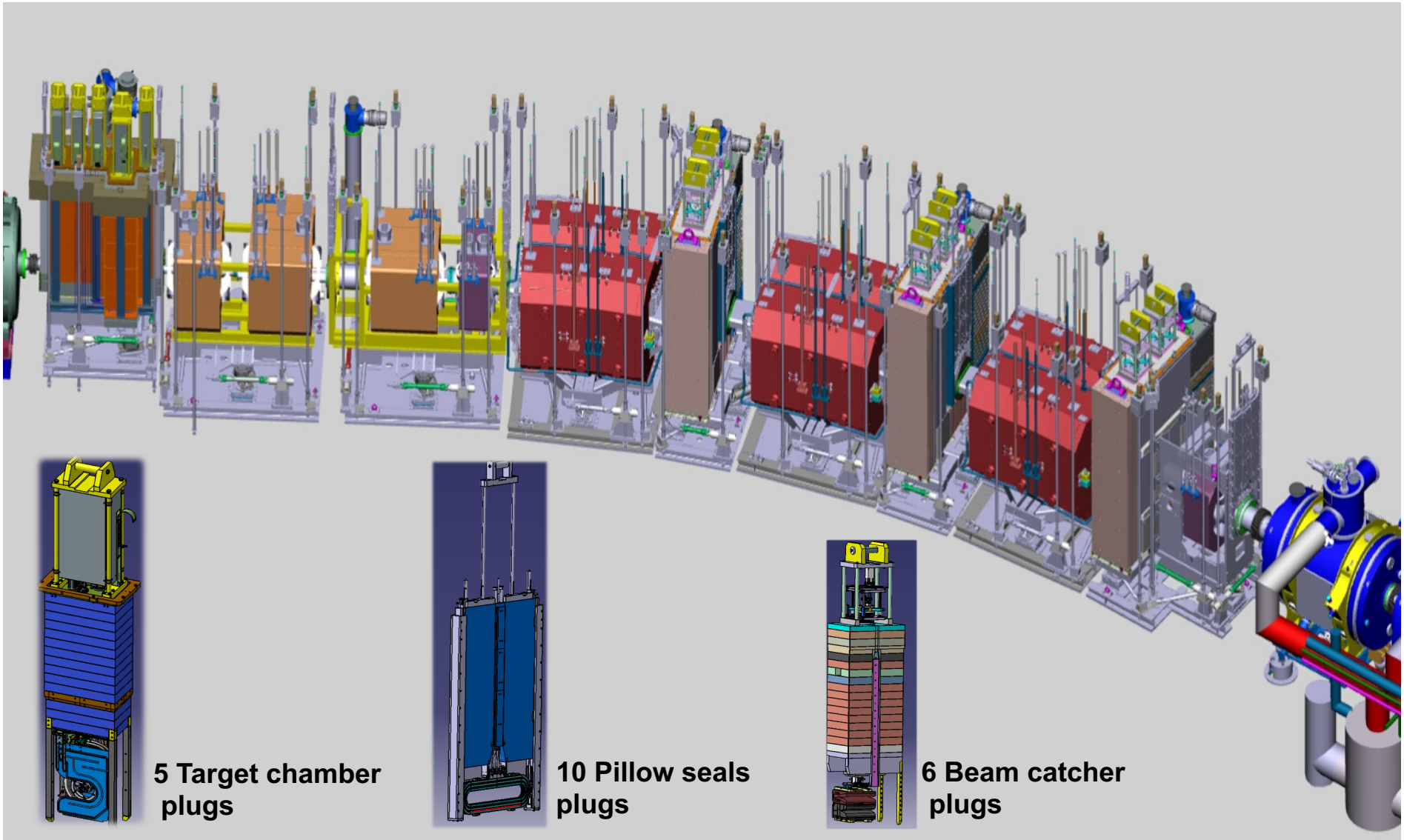
Gettinge MT200 Technical Specs
- Max load capacity: 20daN
- Max tongs force: 22daN
- Max tongs opening: 90mm
- Total length extracted: E+F+Z: 3270mm
- Detachable gripper and tongs
- Booting on slave side

Photo: Wällischmiller

Wällischmiller A1000 Technical Specs
- Max load capacity: 200 daN
- Max crane load capacity: 2 Tonnes
- Force feedback
- 6 axis movement
- Radiation resistance: 1MGy



Super FRS target beam line

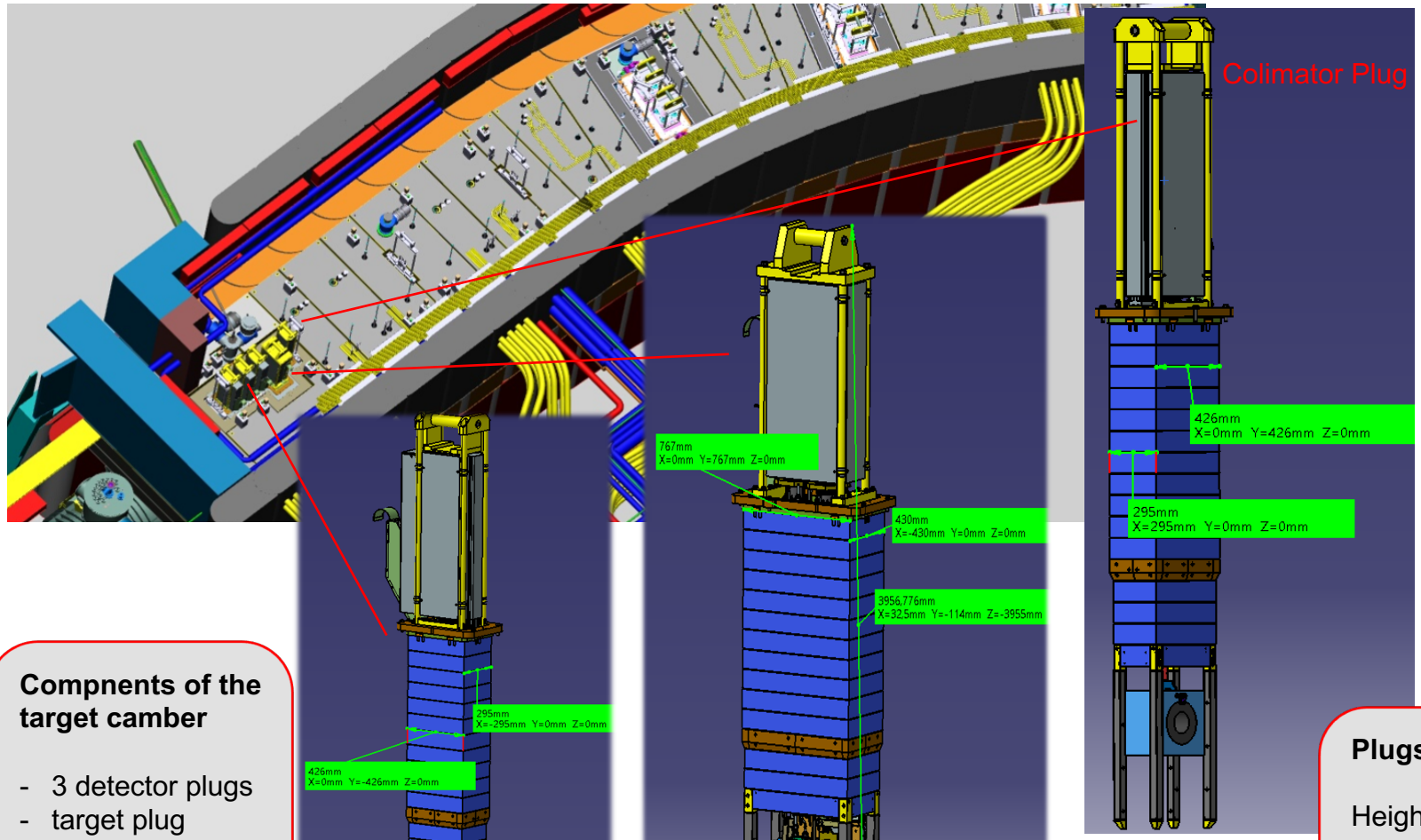


5 Target chamber plugs

10 Pillow seals plugs

6 Beam catcher plugs

The target chamber components



Compnents of the target camber

- 3 detector plugs
- target plug
- colimator plug

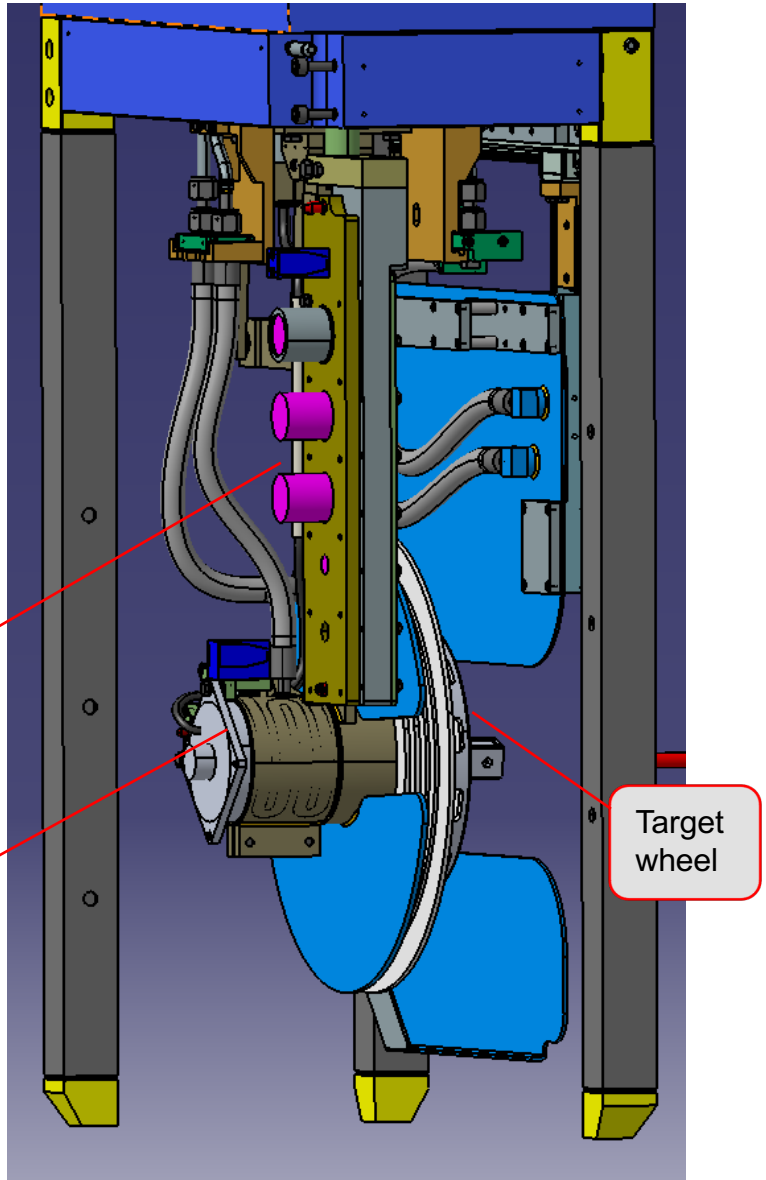
Plugs dimensions

Height: 4m
Width: 420-760mm
Length: 295-430mm
Weight: up to 8 tonnes

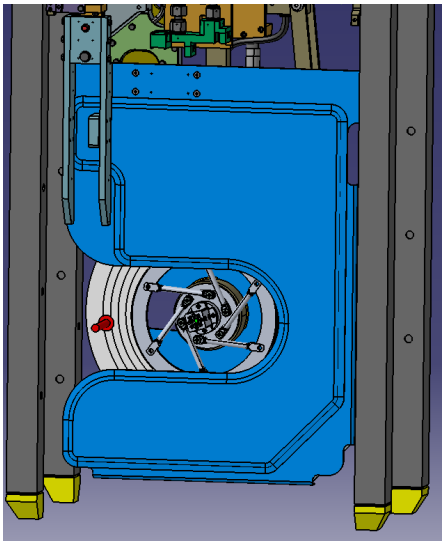
The target plug

Tasks regrding the taret plug in the HC

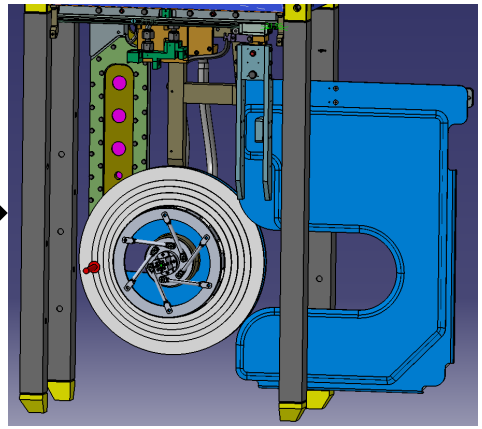
Service yearly	Failure	Optional
Target wheel	Cooling plate	Target ladder
Stepper motor	Linear sleigh	
	Cooling hoses	

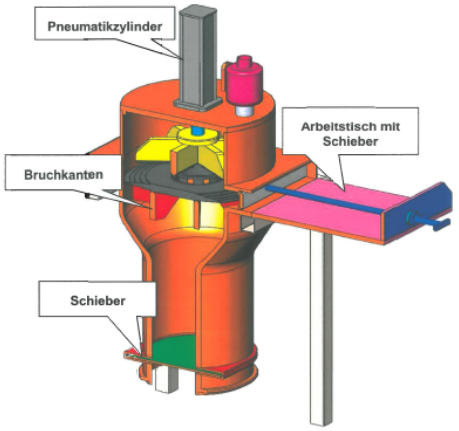


Target plug tasks



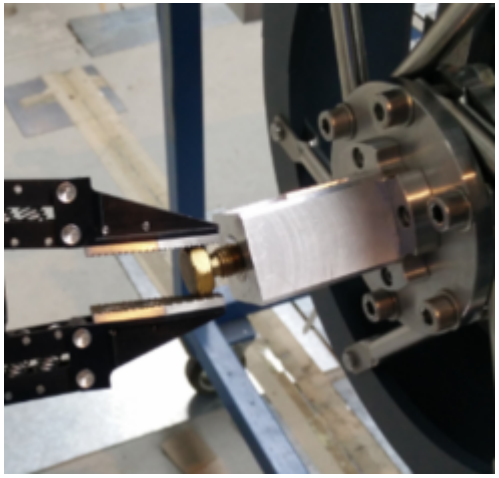
Step 1: cooling plate removal



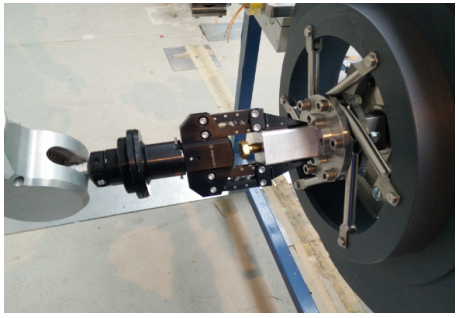


Step 4:
separation of the materials means a crusher above the double lid barrel docking station

Step 2:
release the quick lock mechanism



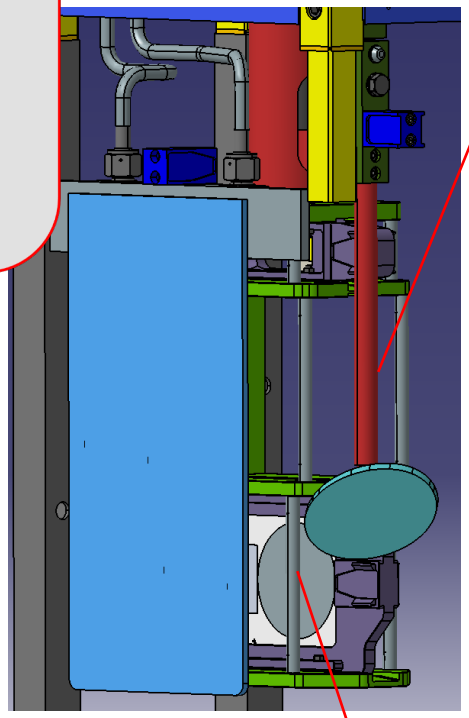
Step 3:
removal of the graphite target

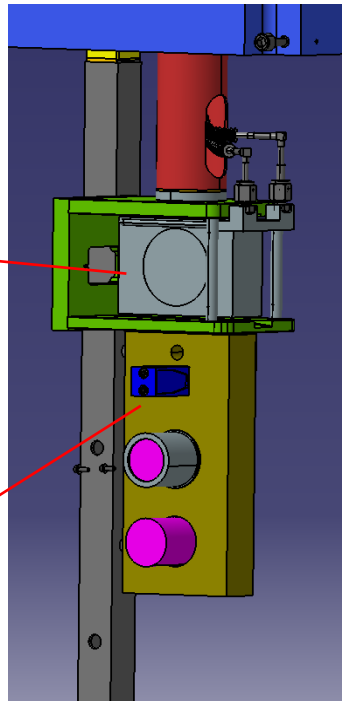


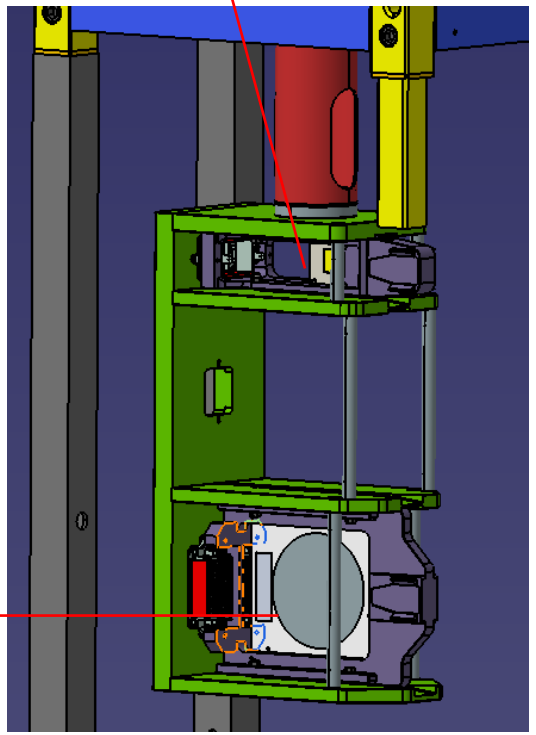
Tasks on the detector plugs

Tasks in the HC concerning the detector plug

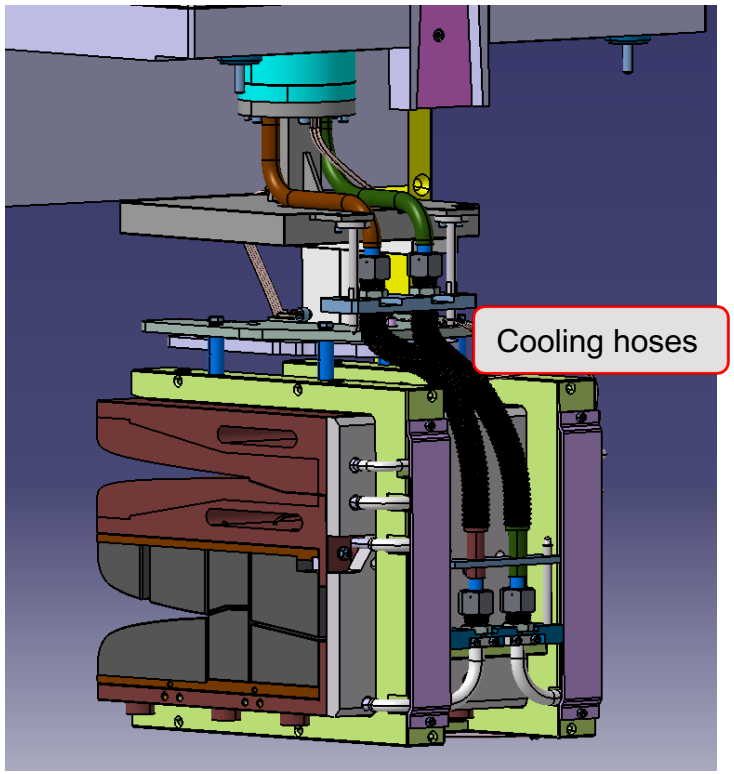
Service	Failure	Optional
	Mirror exchange	Target ladder
	Cooling plate exchange	
	Detector exchange	
	CV DD	
	IC	
	SEM Grid	
	Seetram	

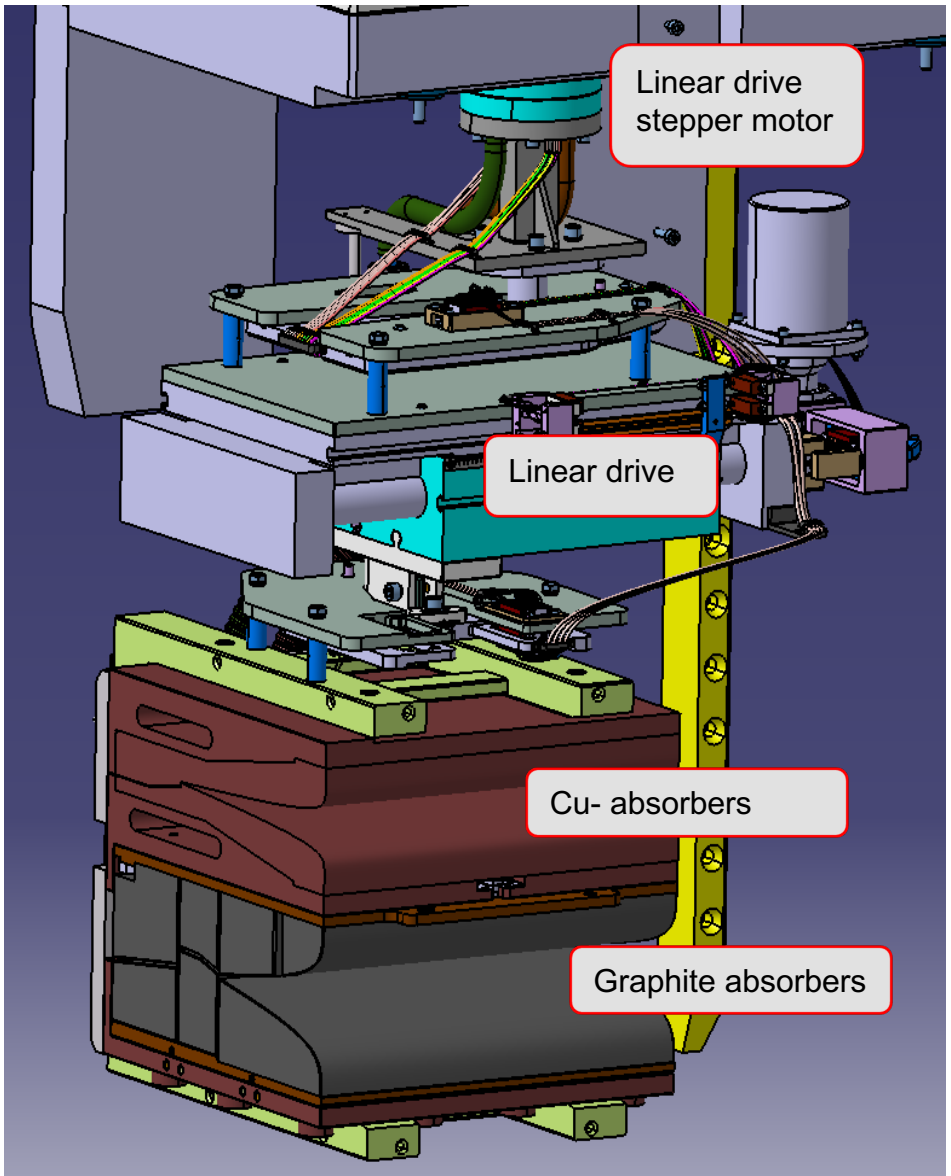






Tasks on the beam catcher plug

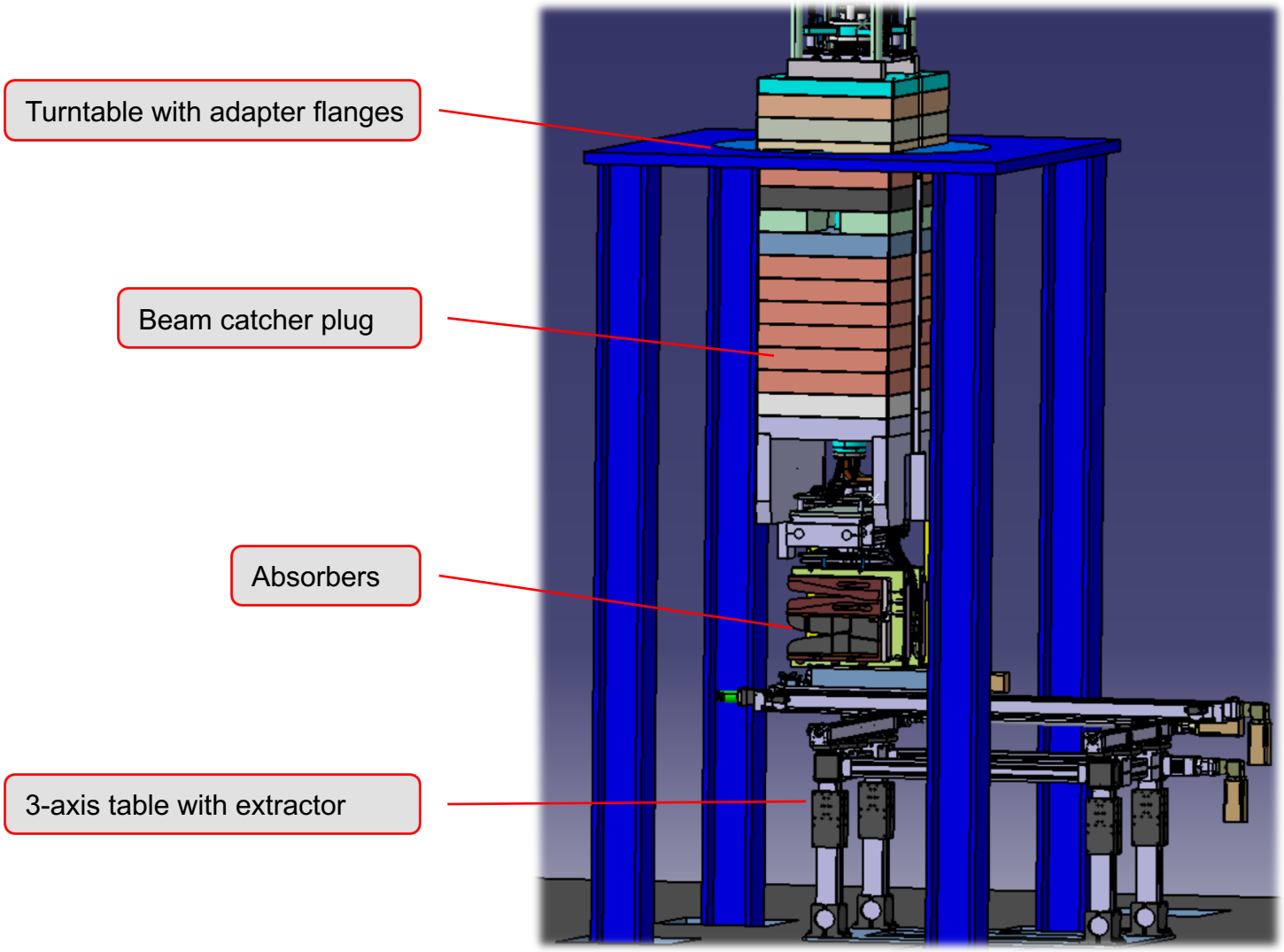




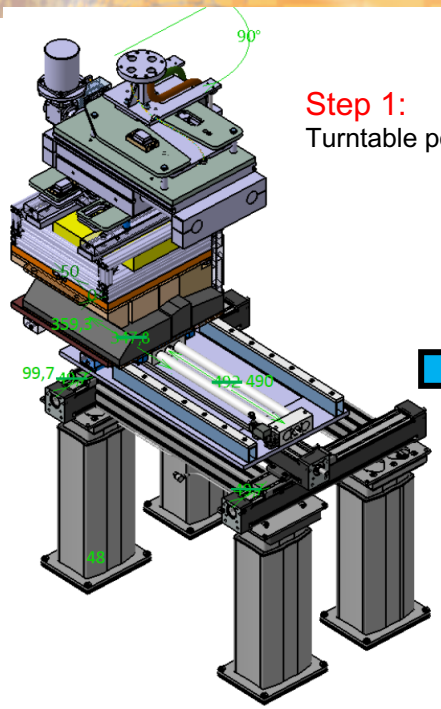
Beam catchers tasks in the HC

Service	Failure	Optional
Lower C-Absorber	Absorber frame	
Upper C-Absorber	Cooling hoses	
	Linear drive	
	Stepper Motor	

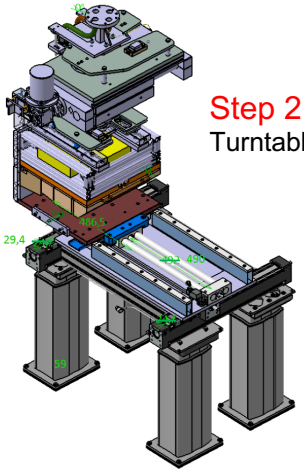
The plugs turntable and the realisation of the BC tasks



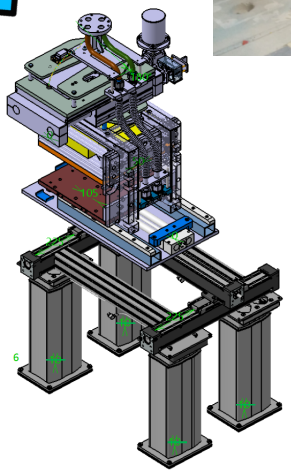
Absorber dis-/mounting



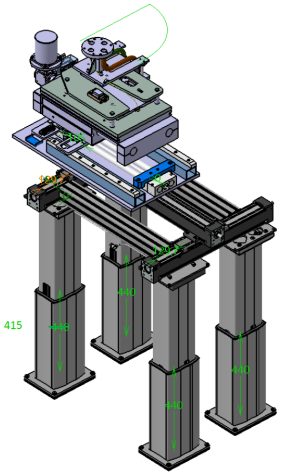
Step 1:
Turntable position 90°



Step 2:
Turntable position 0°

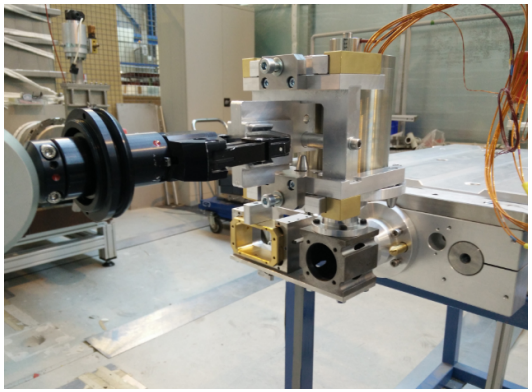


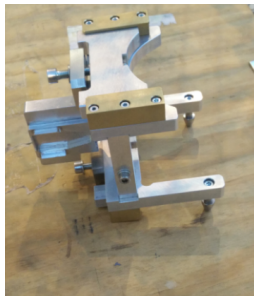
Step 3:
Turntable position 180°



Step 4:
Turntable position 90°

Linear drive‘s steper motor exchange





The four steps to exchange the absorbers:

1. Dismounting of the lower graphite absorber
2. Dismounting of the upper graphite absorber
3. removal of the absorber C-frame
4. Removal of the linear drive

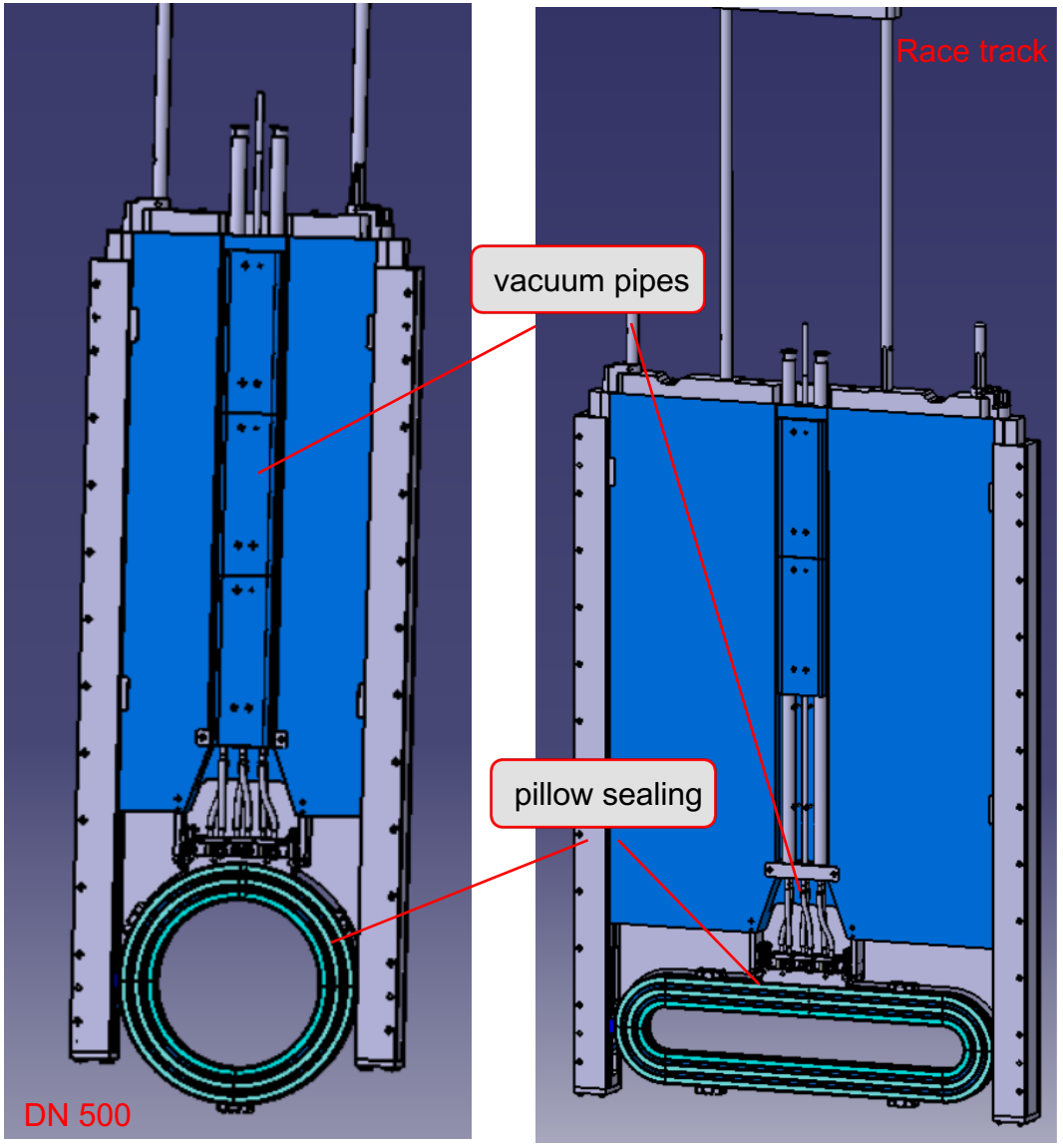
Pillow-seal plugs

Pillow seals Tasks in the HC

Service	Failure
	Pillow seal module
	Vacuum / compressed air pipes module

Plugs dimensions

Total height: 4m
Width: -1760mm
Length: 120mm
Weight: up to 2 tonnes



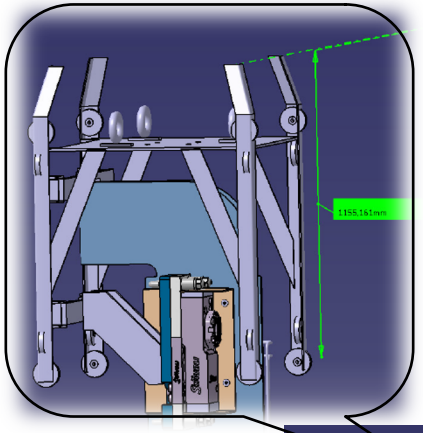
Antiprotons P-bar target & horn

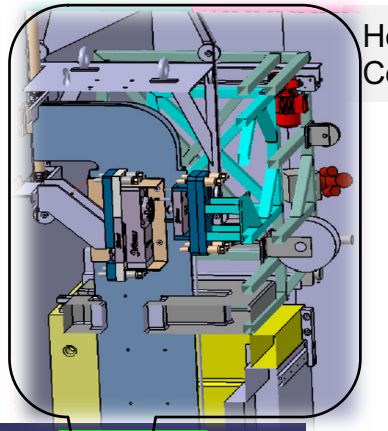
P-bar Tasks in the HC

Service/3 months
Target disposing
Horn disposing

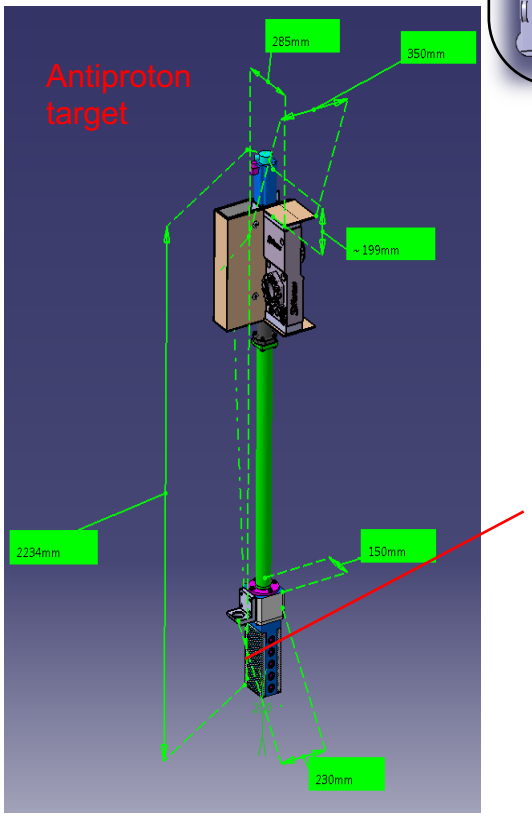
Antiptoton Target and horn are not foreseen to be maintained. After their are inserted in the hot cell they will be cuted by a saw or a hydraulic scissors and will be disposed. They are main waste volume which are in the 200l barrels

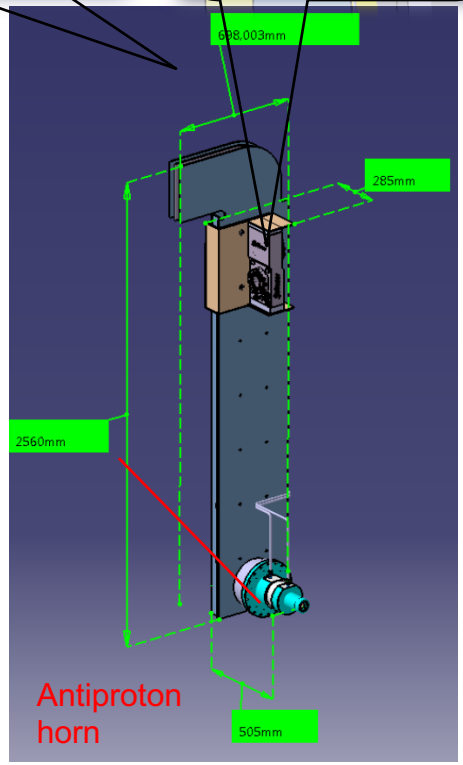
Horn cage mechanical interface of the horn





Horn Connector





Main Remaining tasks

- **Hot cell utilities**

- Layout and later installation of electrical network, monitoring, compressed air, envoironmental sensors

- Design and layout of tools in the hot cell

- **Hot cell DMU model and 3D modeling of the tasks**
- **Turntable detailed design and manufacturing**
- **Design / manufacturing of the double lid shielding flask interface**
- **Design / manufacturing of the waste barrel convey**
- **Activation measurement station of the decay cell**
- **Documentation and approval of the authorities**

Thank you for your attention