Target complex futur development

HI-ECN3 BDF target & target complex initial review

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Acknowledgement: J. M. Martin Ruiz, C. Ahdida, M. Calviani, R. F. Ximenes , M. Fraser, R. Jacobsson, L. Krzempek, G. Mazzola, C. Mucher

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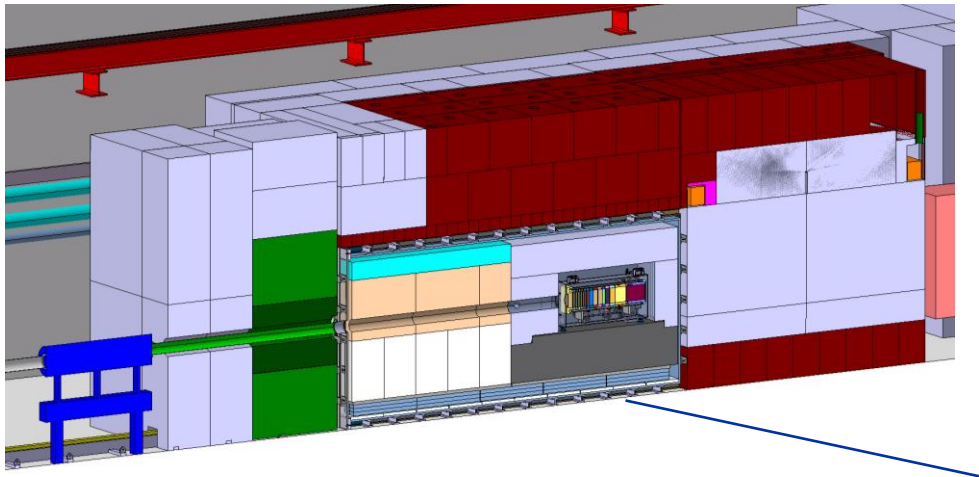
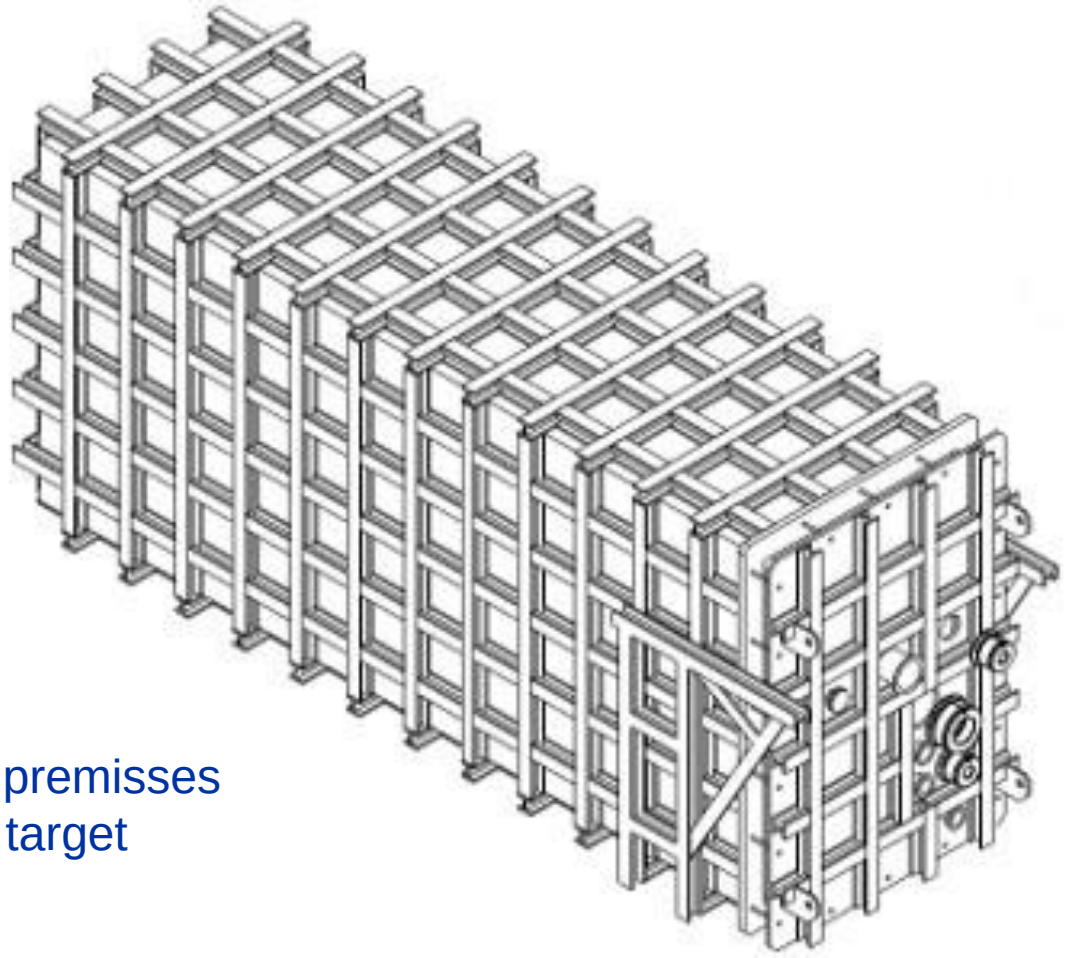
Agenda

- Target station vacuum confinement
- Target handling
- Target shielding extraction
- Target Complex handling
- Target utilities – cooling
- Target positioning,
- Systems failure scenarios

Target station vacuum confinement

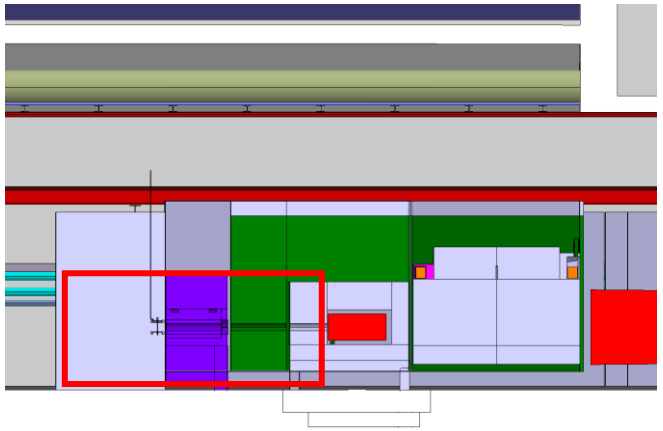


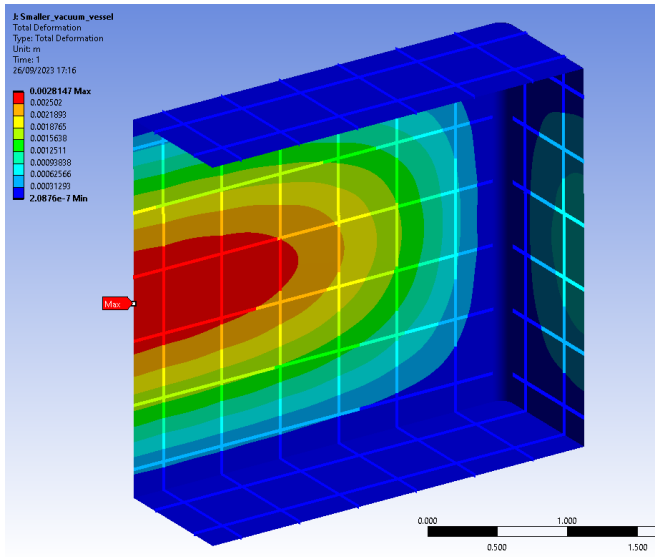


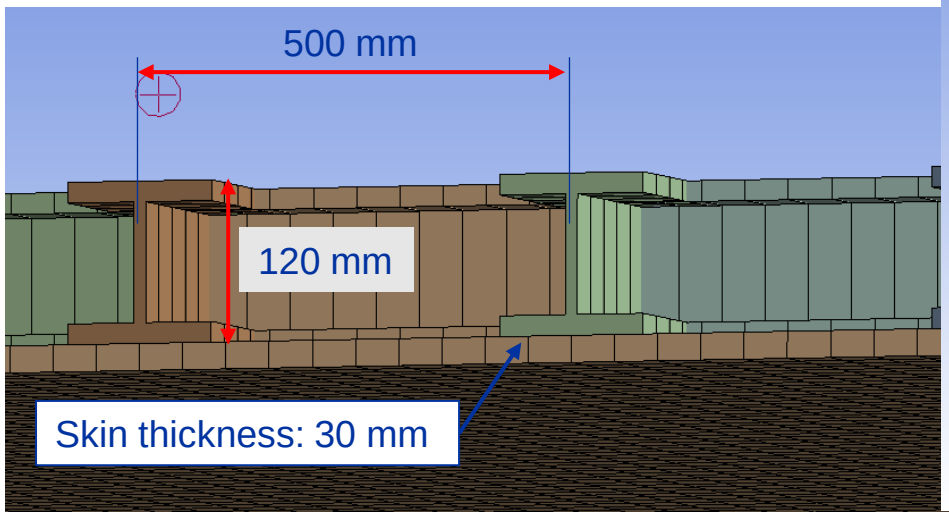
- Overall dimensions: ~6.36 x 2.05 x 2.95 m
- Can be fully fabricated and tested at a contractor premisses
- Primary vacuum to optimize air activation around target
- Water containment (in case of water leak)

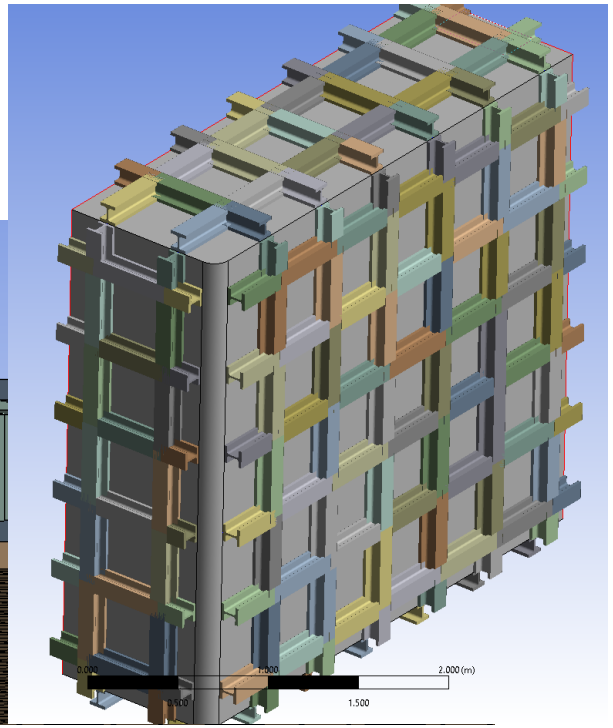
Target station vacuum confinement

- Grid of HE 100 M beams (each 120 mm tall) crossing each other at 90º, 500 mm separation
- Skin thickness: 30 mm
- Boundary condition: floor beams fixed to the floor in the vertical direction.
- Max displacement 3 mm
- Max VM stress in the sheet: ~200 MPa local peak, lower elsewhere
- Max utilization factor of the beams:0.49
- Buckling factor: 0.82
- Simplified analysis using 1-d beams and 2-d shell elements
- More detail vessel design



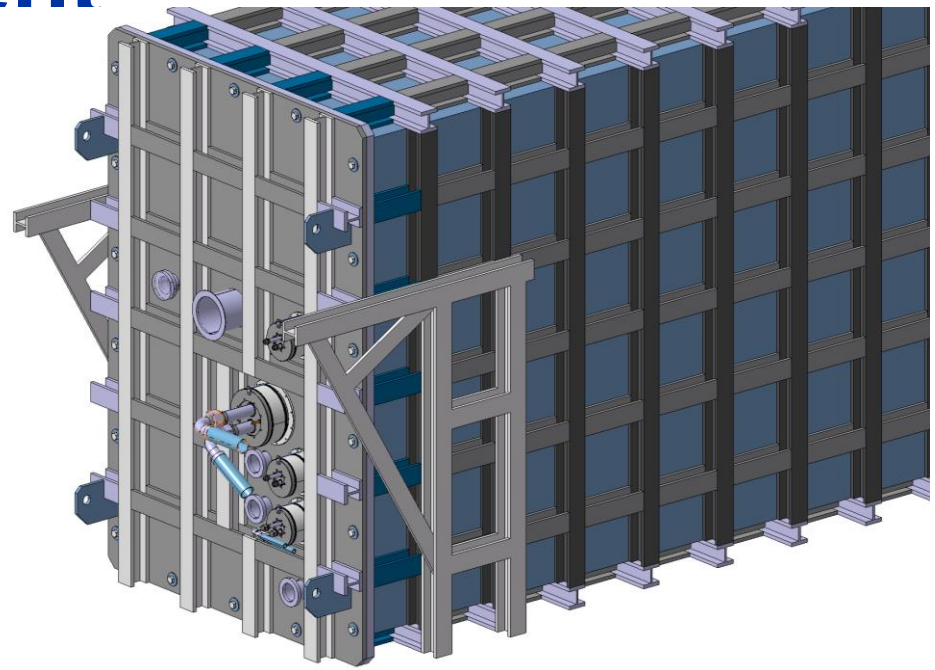


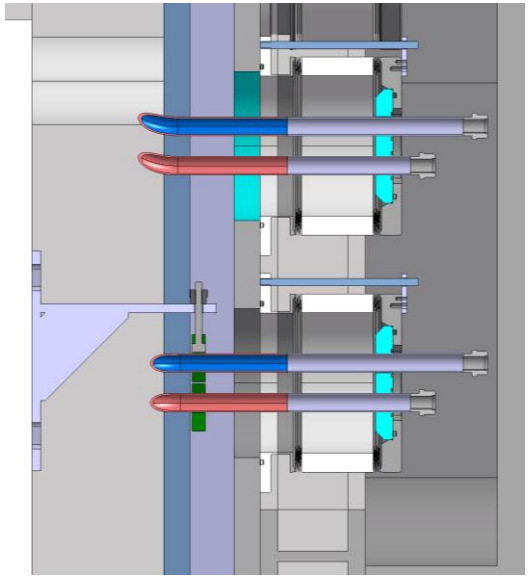


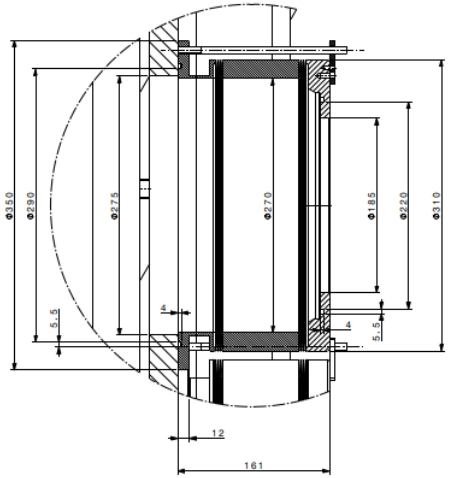


Target station vacuum confinement

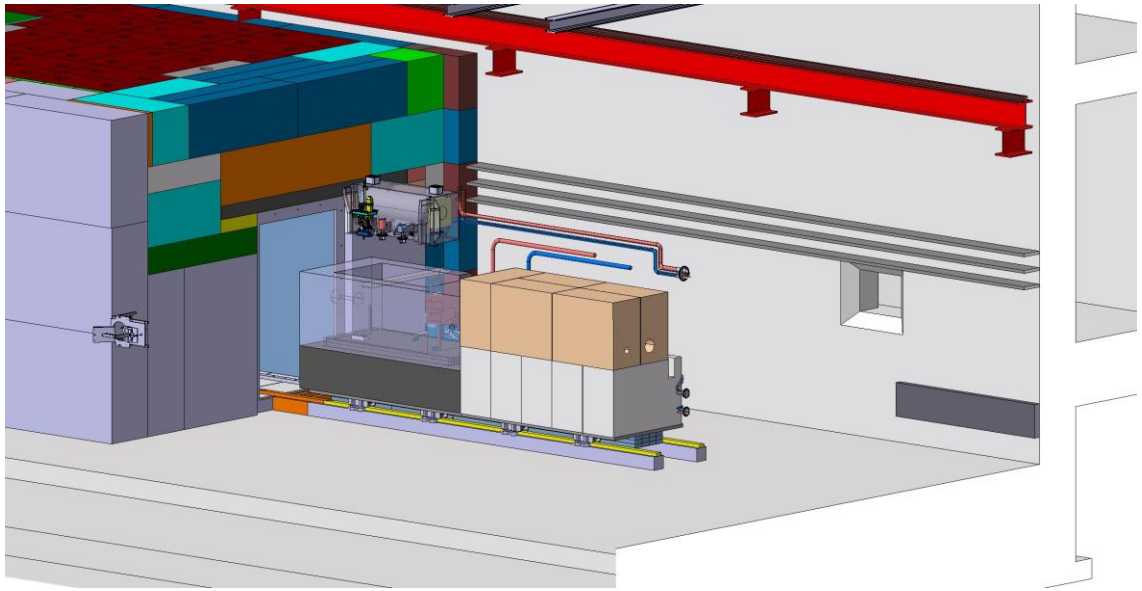
- Utilities feedthroughs
- Mechanical design ready to build a prototype
- Design of radiation tolerant gaskets
- Decommissioning plan

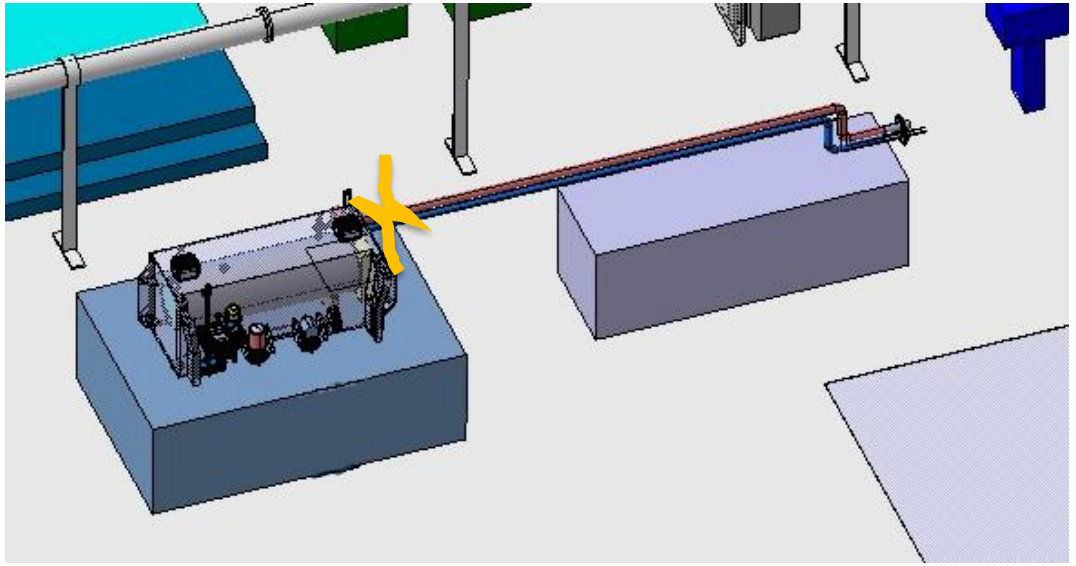






Target handling

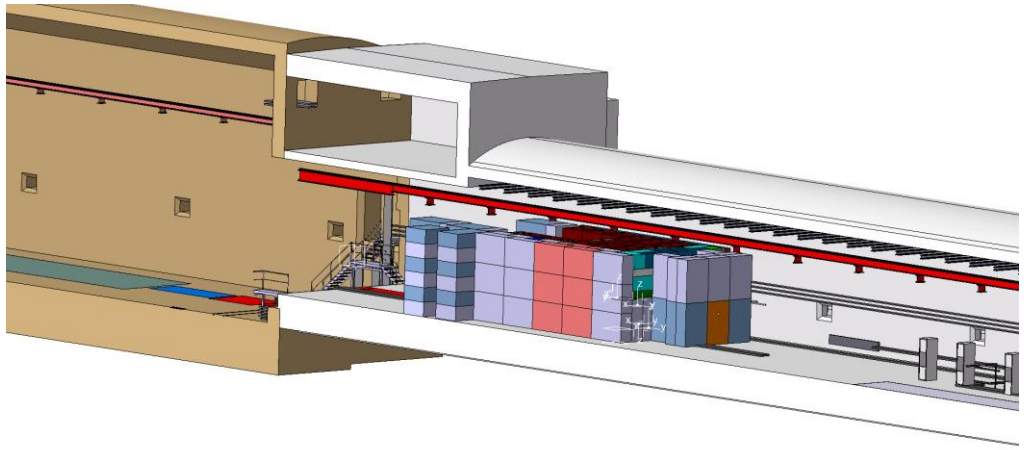


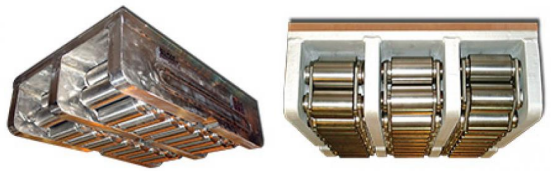


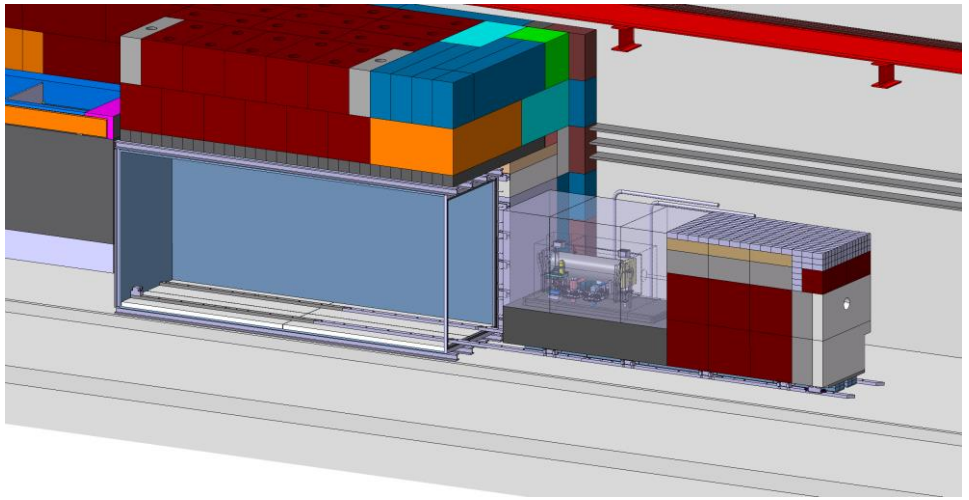
Target utilities removed to fit cask

Target shielding extraction

- Extraction on a trolley mounted on chain action rollers
- ~200t to move
- Mainly developed around ‘’standard’’ cast iron blocks
- In view of reuse of existing blocks from old facilities

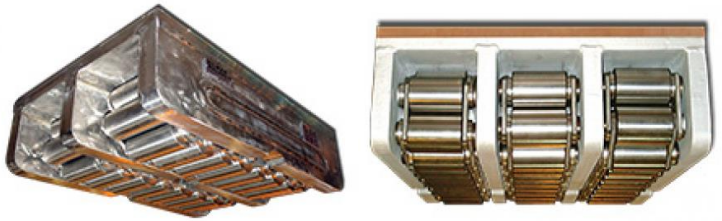


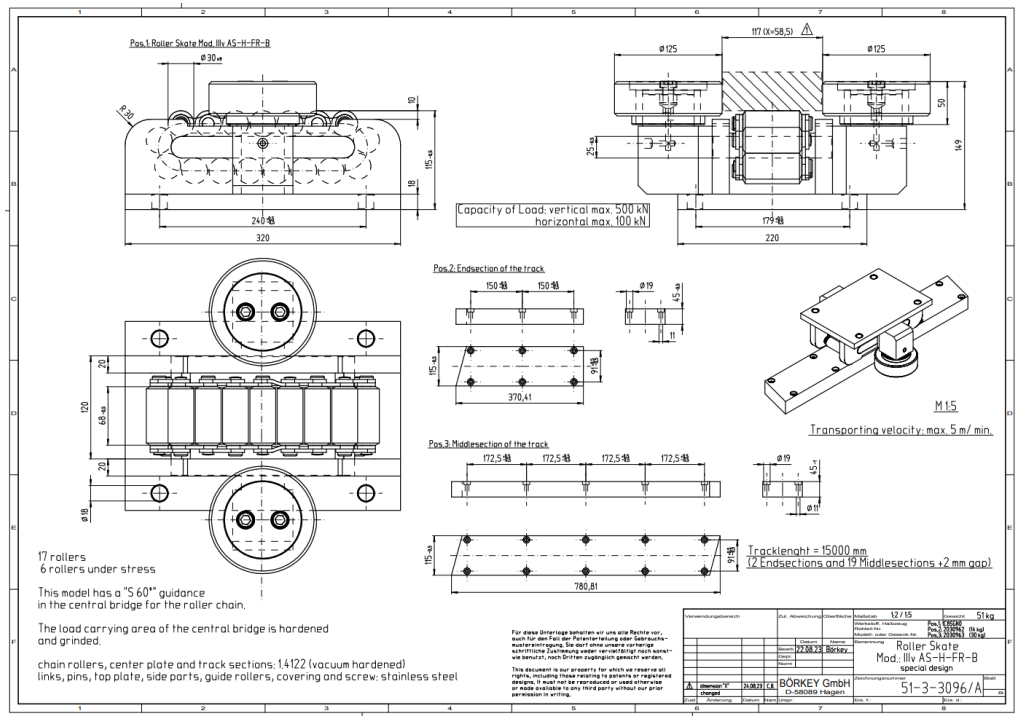




Target shielding wheels

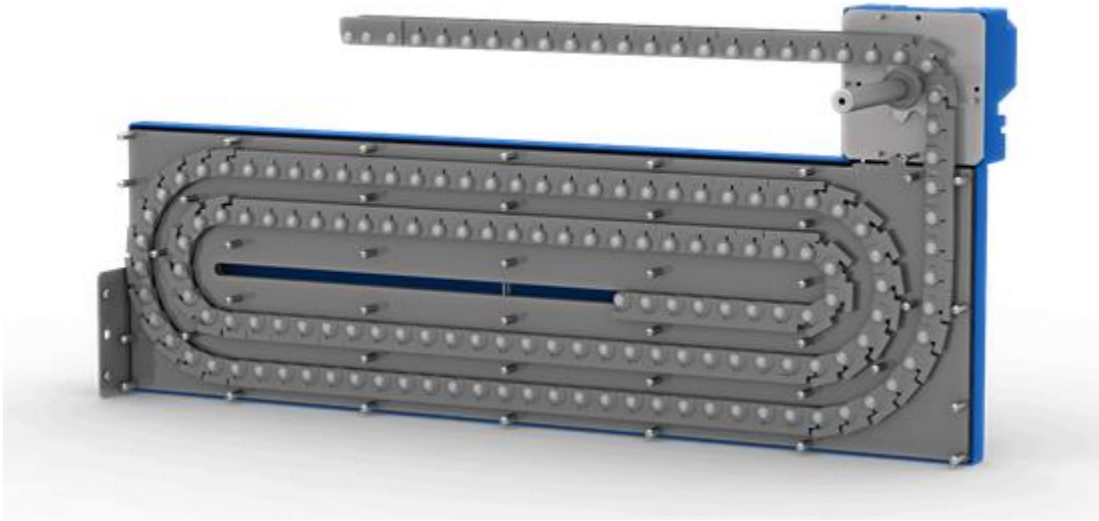
- Investigation for full stainless steel chain action rollers
- Designed by specialized company:
  - Type of stainless steel
  - Number of rollers and configuration (8 rollers foreseen)
  - Prototypes stainless steel rollers already at CERN ready for a test campaign (material selection assessment, test, ageing under harsh environment)





Target extraction mechanism

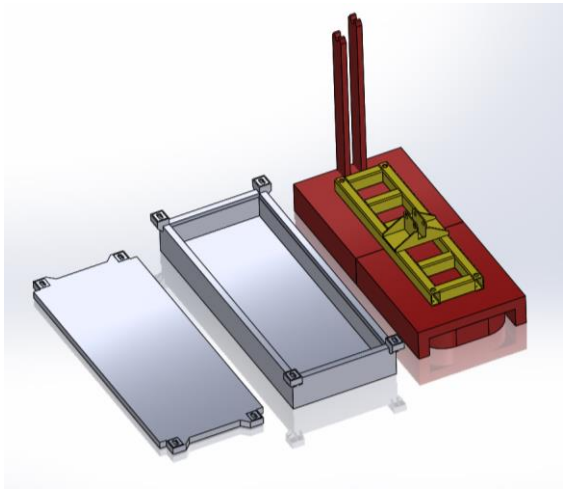
- **Installed on purpose prior to target trolley extraction**
- **Possible mechanisms**
  - Serapid chain (push/pull rigid chain)
  - Hydraulic jacks

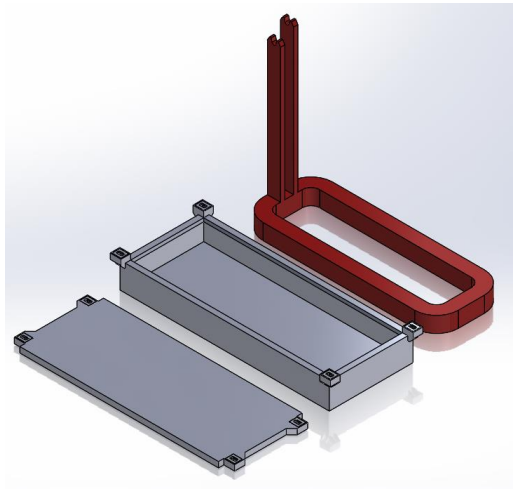


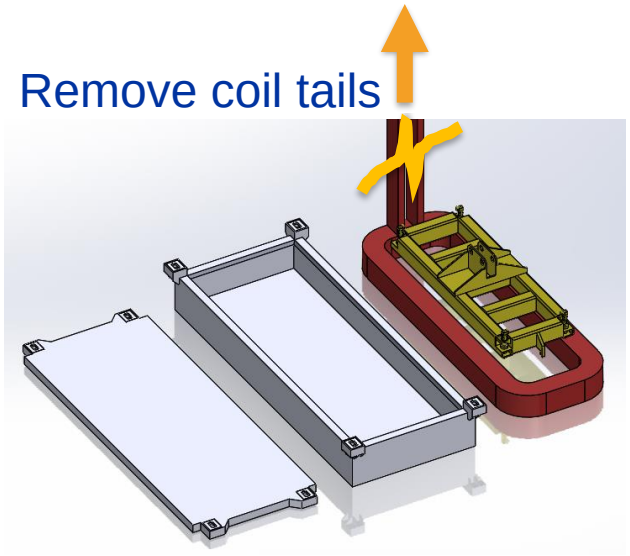
Target Complex handling - coil

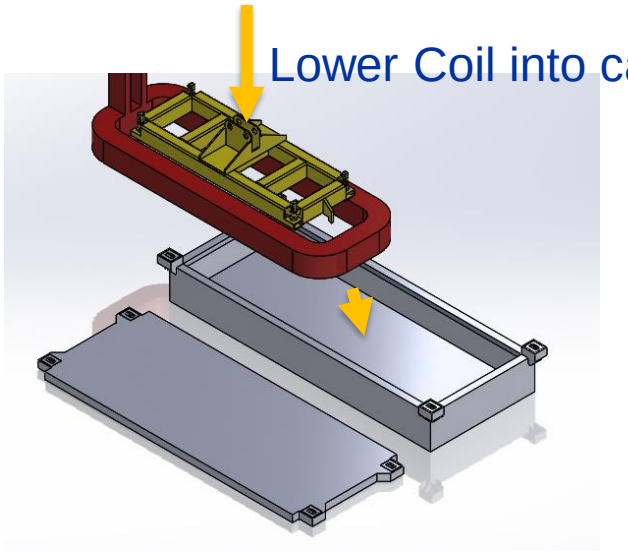
Coil utilities:

- Power feeding
- Support plugin system
- Remotely compatible Lifting
- Active cooling?



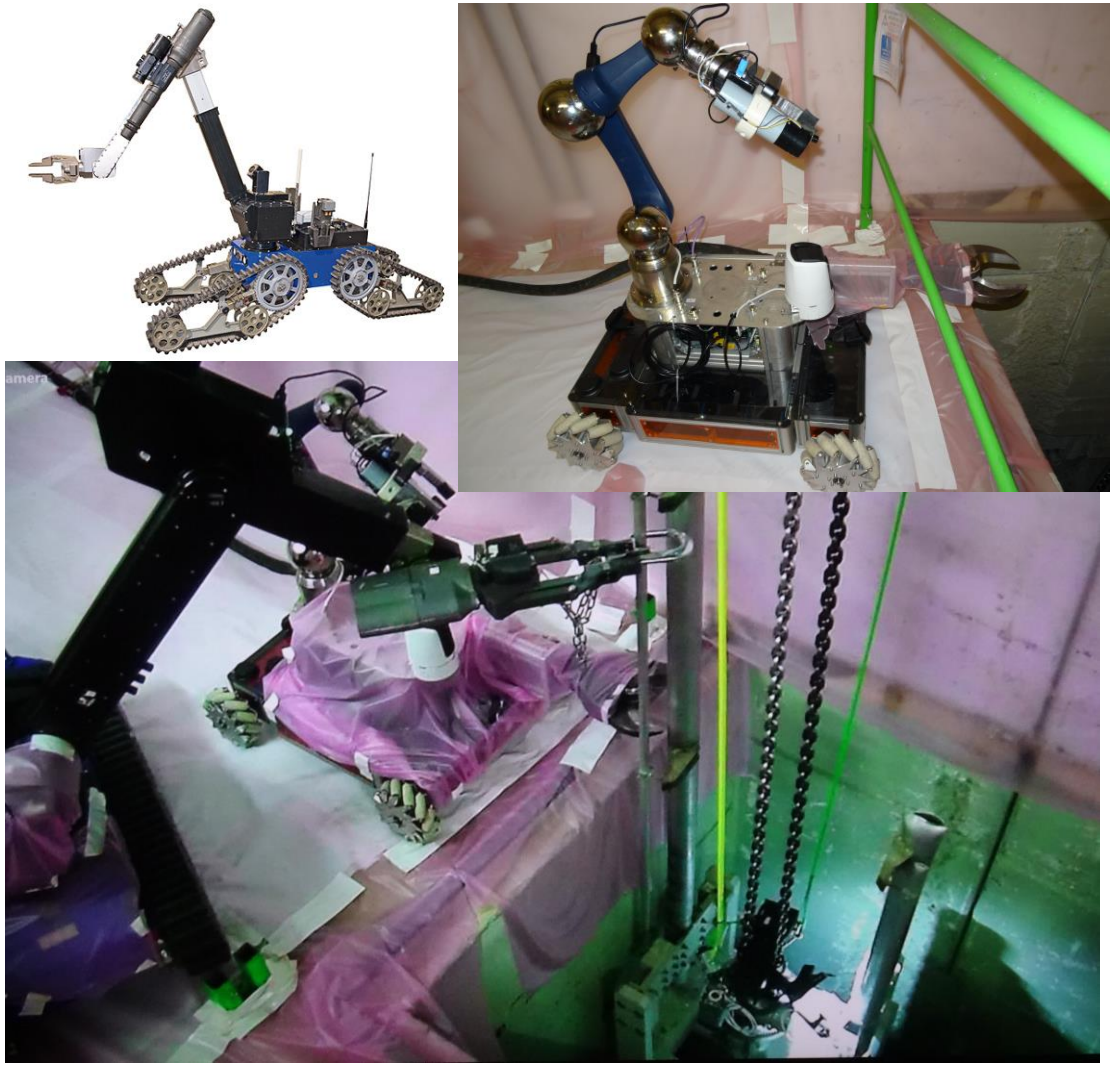






Maintenance of the target complex - few ideas

- **Target exchange**
  - Connections of utilities located in ‘’human’’ accessible environment
  - Remote handling features for the connections
  - Support of remotely controlled crane and ROVs
  - Size reduction for final disposal by shearing
  - Transfer from the underground to surface in shielded casks



n-TOF target#2 pipes reduction with ROVs

Target Complex handling

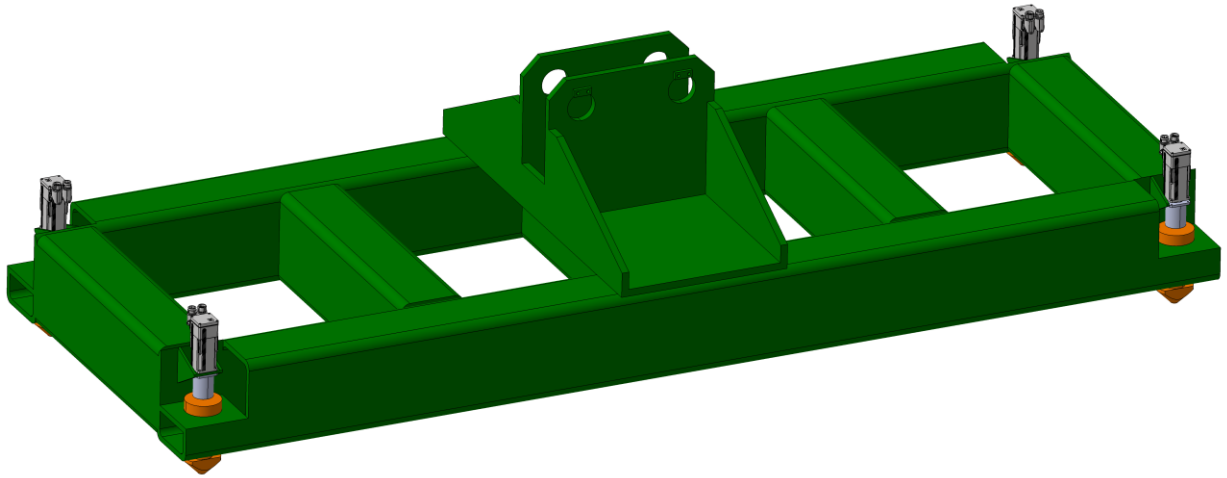
- Existing overhead travelling crane 30t capacity replaced

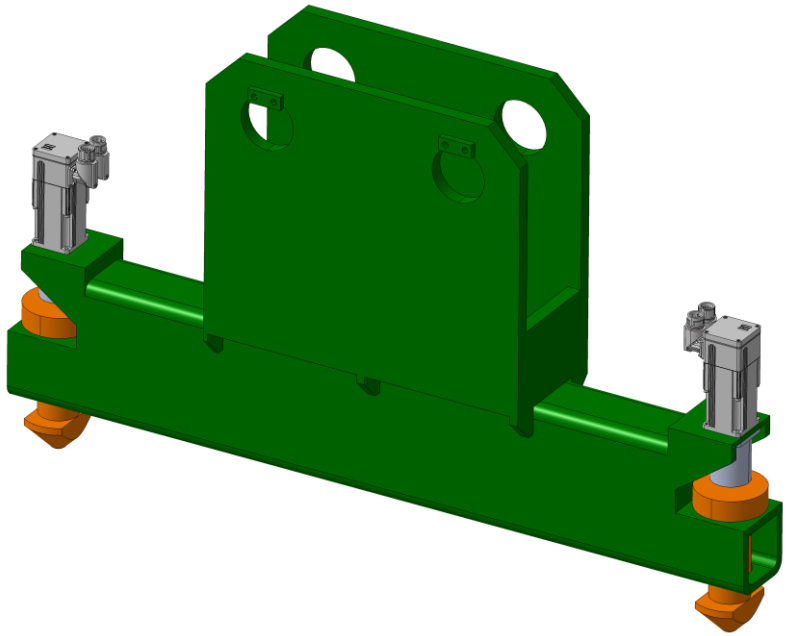
  - Redundancy on the 3 movements of the crane
  - Integration of a video system
  - Integration of a positioning system for the 3 movements
  - Off-board control cubicles
  - Cable festoon routing
  - Remote tools connection on the hook
  - Auxiliary hoist
  - Investigation on possibility to optimize crane size

  Ongoing specification

Target Complex handling

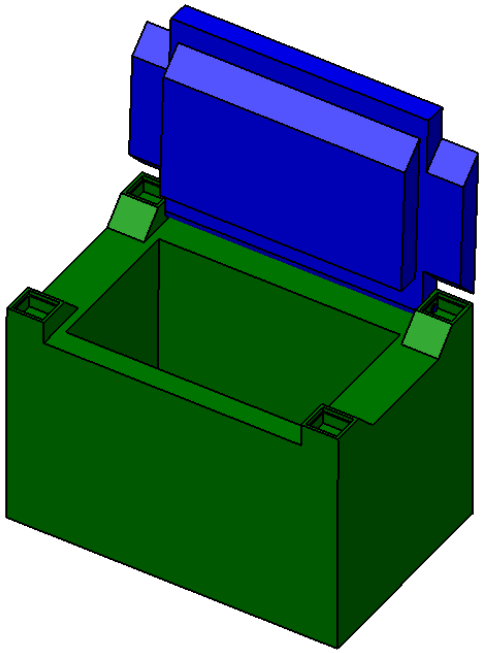
- **Lifting spreaders developments**
  - Target
  - Shielding blocks
  - Coil
  - Casks

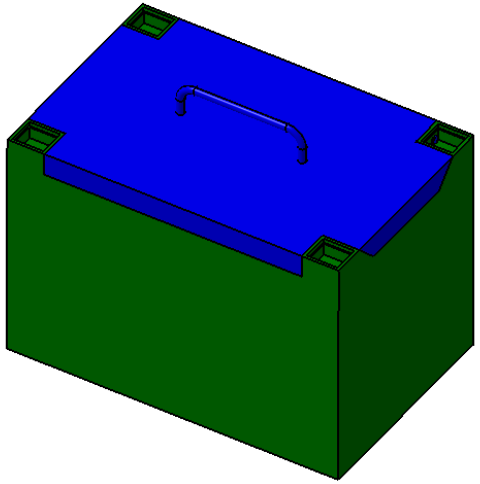




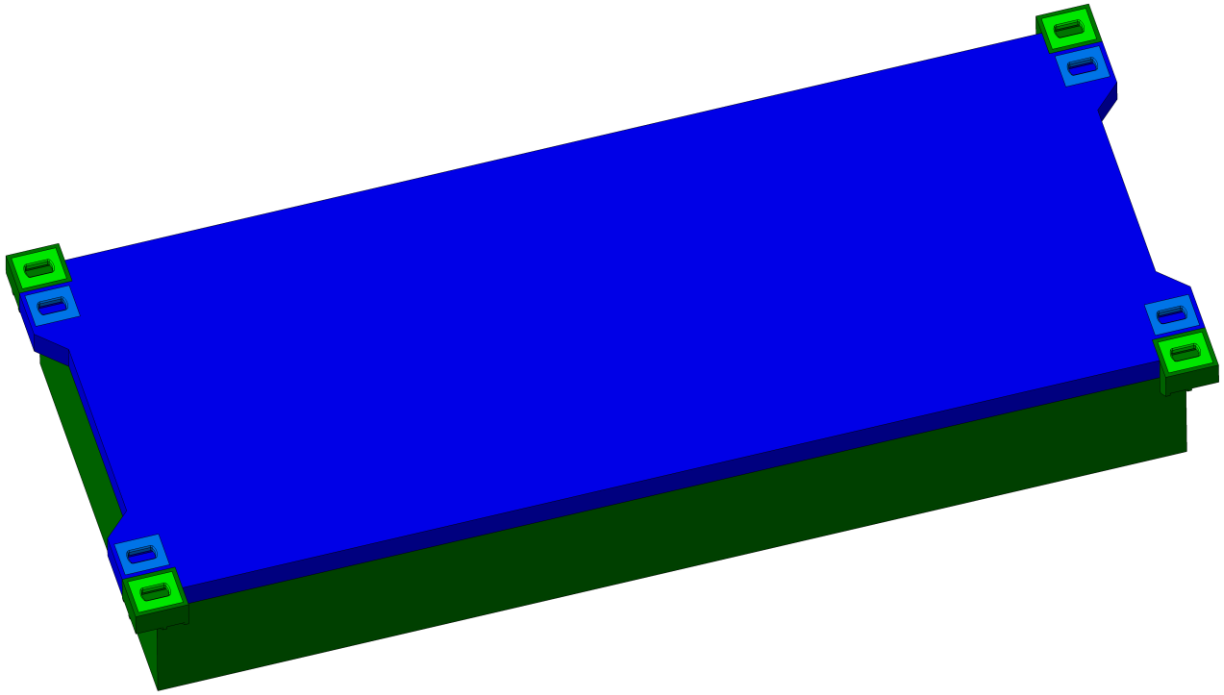
Target Complex handling

- **Casks**





Target cask



Coil cask

One major limitation -> 30t object to handled + cask

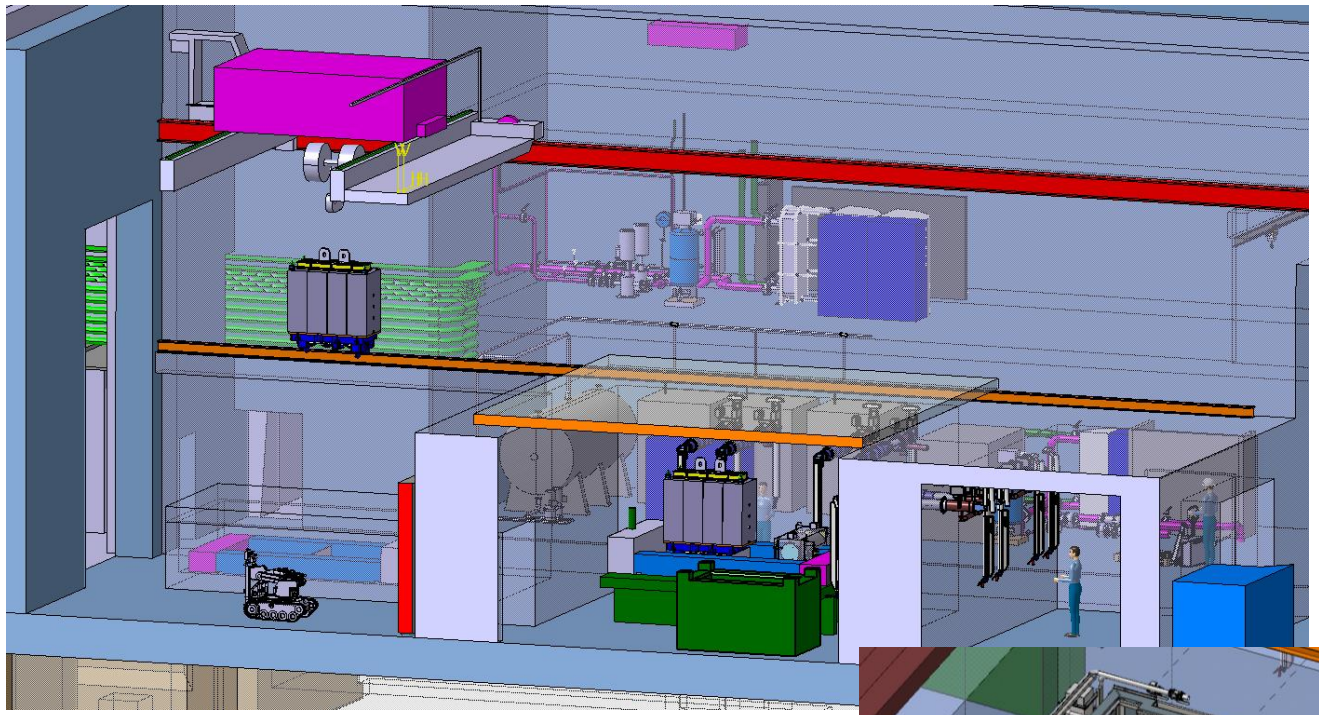
Service building – Service cell - Hotcell

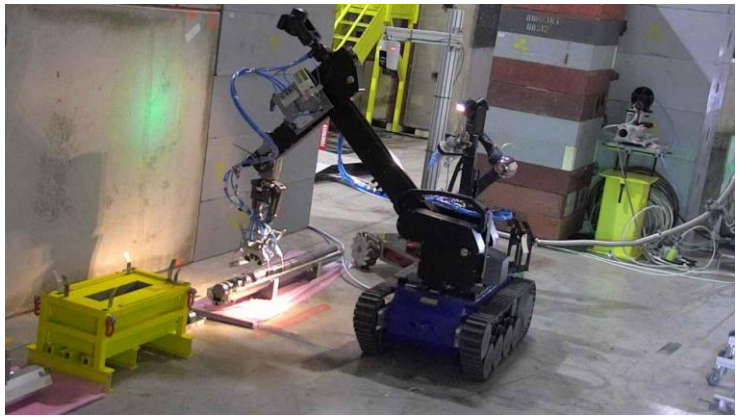
Purpose

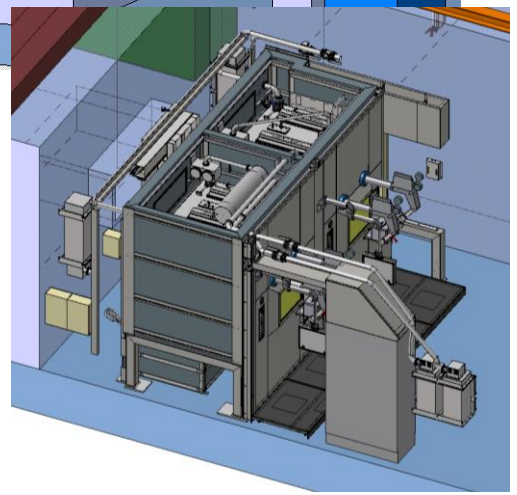
- Repair of activated components
- Size reduction and material separation for final disposal to optimize cost using different elimination path
- Post Irradiation Examination

Tools envisaged

- Master-slave manipulators
- Robots (fixed and mobile)
- Custom built machinery







Traget complex cooling circuit

Table 6.20: Cooling-system requirements for the BDF target complex

Parameter	Units	Target	Proximity shielding	Magnetic coil
Location	–	Trolley area	CV room	CV room
T_{supply}	°C	28.0	28.0	28.0
Flow rate	m^3/h	45	6	15
Thermal load	kW	350	20	150
P_{supply}	bar	22	–	–
ΔP	bar	3.5	–	–
Type	–	Demineralized	Demineralized	Demineralized

Number from CDS

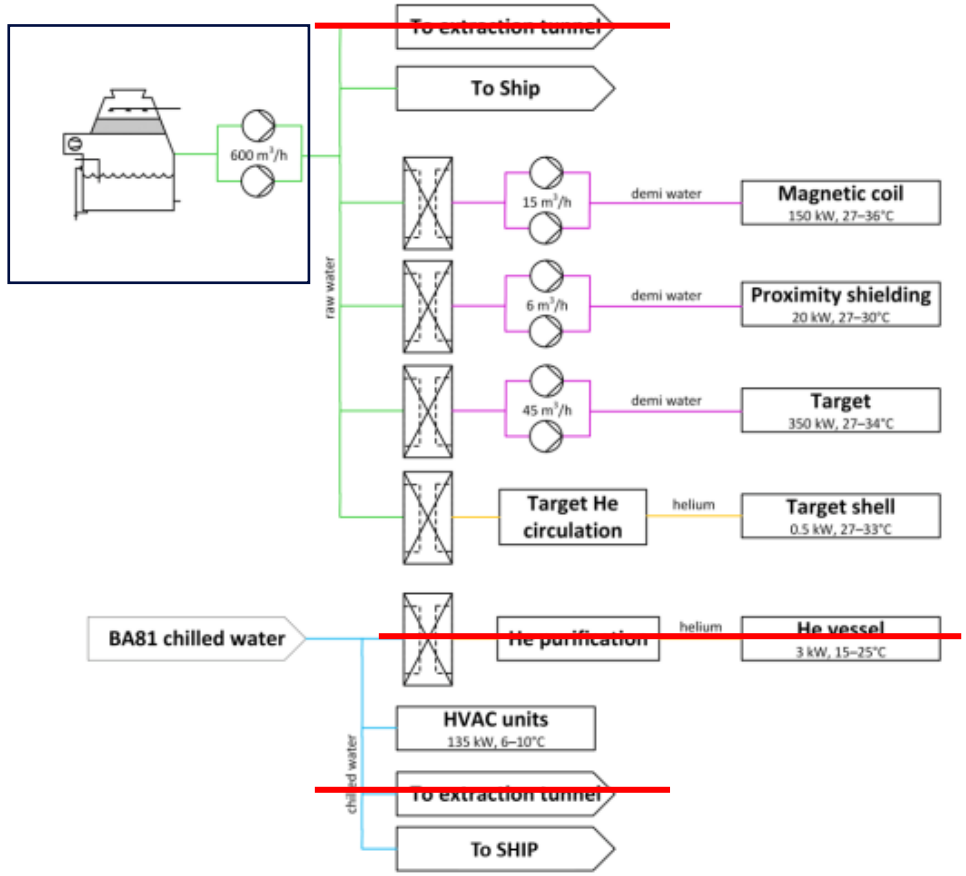


Fig. 6.153: Overview of cooling-system structure for the BDF target complex. The primary (green) and chilled (blue) water circuits are shared with the extraction and experimental areas in the BDF complex.

Target cooling systems

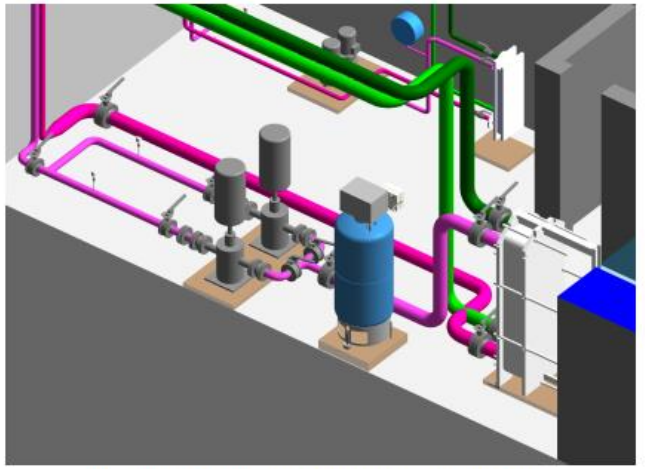


Fig. 6.161: Cooling station for magnetic coil in CV room

~5m²

To be located in a shielded area (was located in the underground area in the CDS)

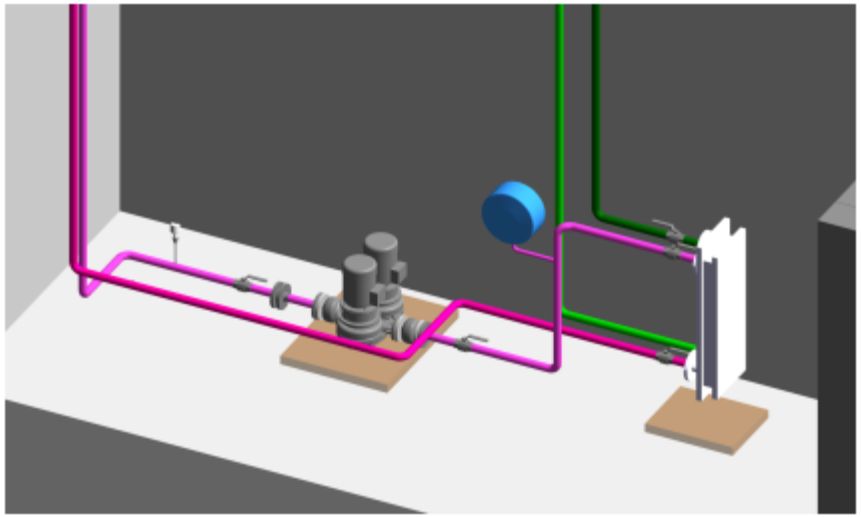


Fig. 6.158: Cooling station for proximity shielding in the CV room

~5m²

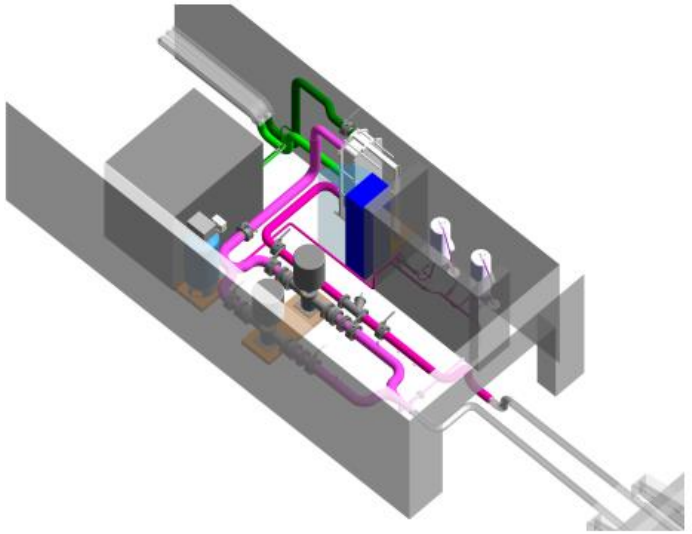


Fig. 6.155: Integration of target cooling system and helium circulation system on trolley. The model also shows the heat exchanger for heat rejection to the primary system.

~20m²

Ventilation systems

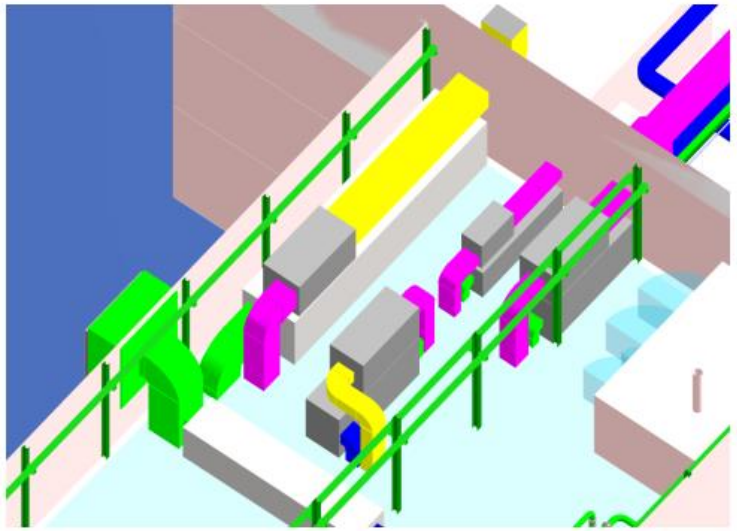


Fig. 6.165: Layout of ventilation units in a dedicated area of the auxiliary building, including all ventilation units for the target complex, the auxiliary building, and the extraction tunnel.

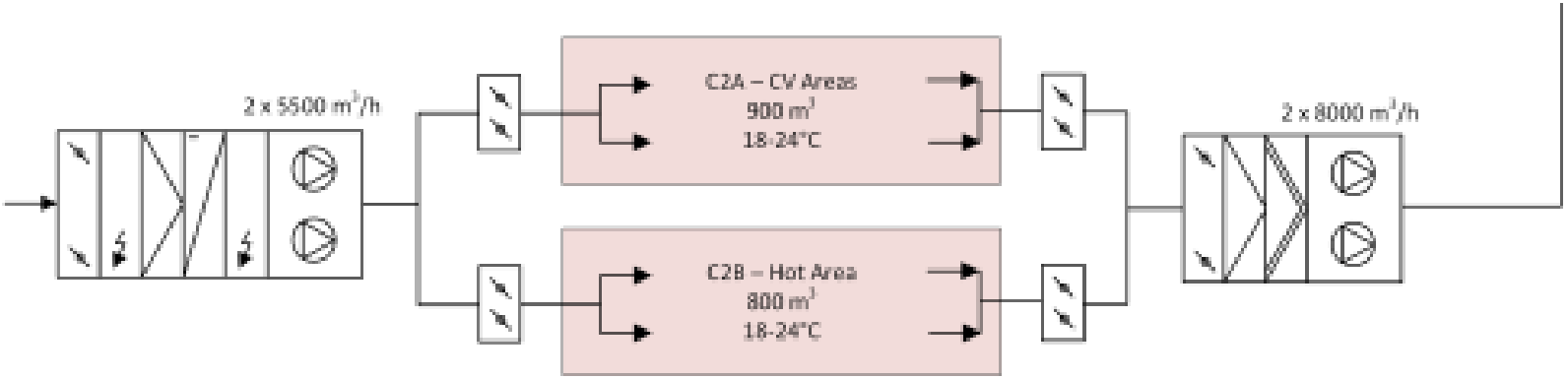
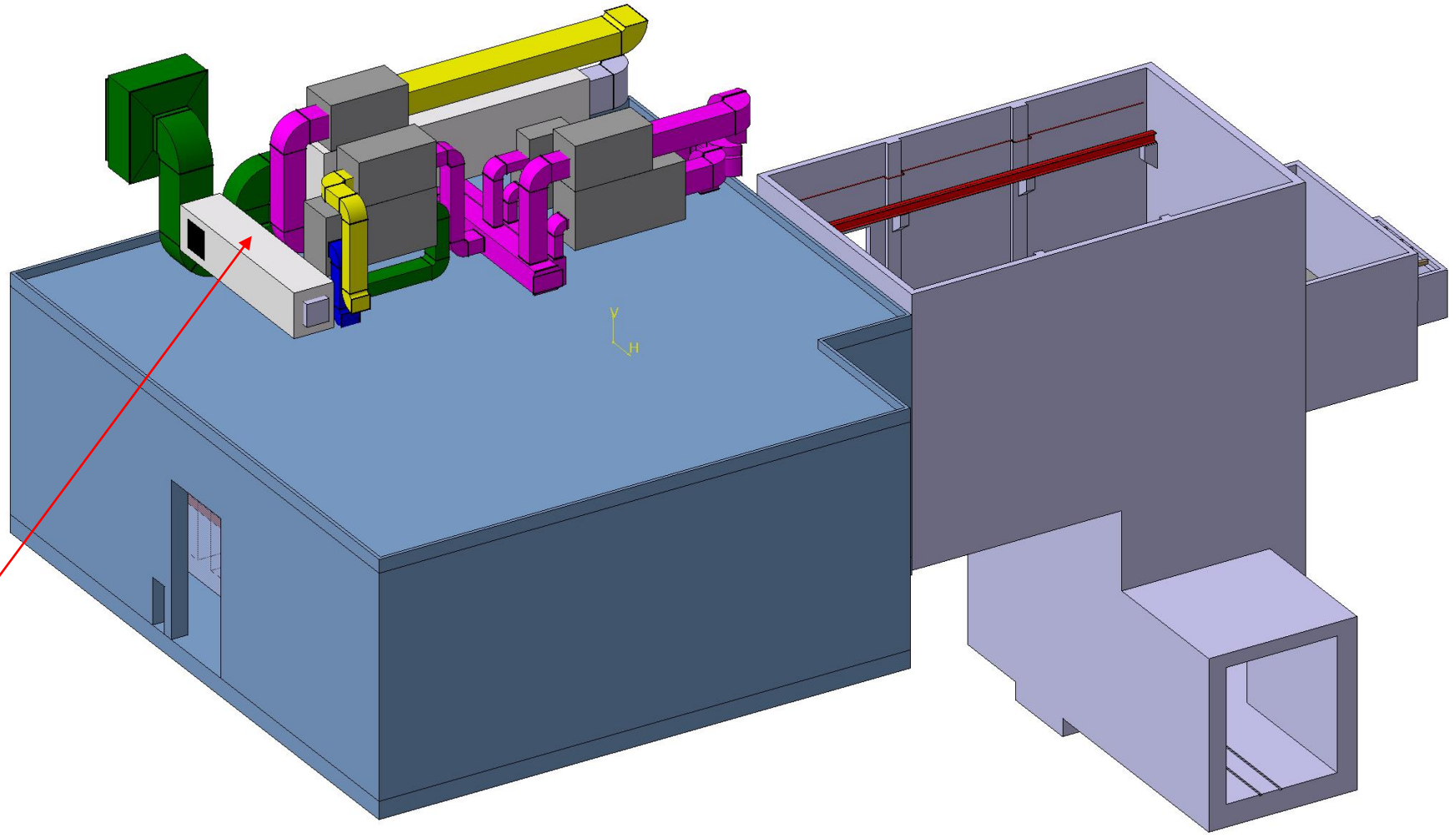


Fig. 6.164: Schematic illustration of ventilation system for the target complex

~150m²

Number from CDS

Ventilation systems



Target station and service building air handling units

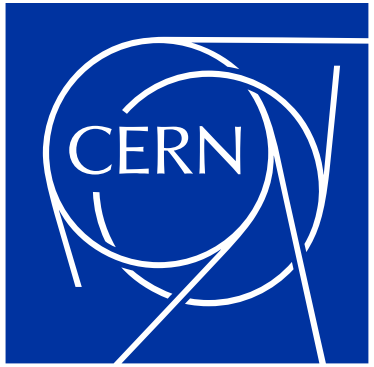
*equipement shown based from ECN4 design

Target positioning

- **Target alignment precision with respect to beam line 1cm! But…**
- **Everything inside the vessel can’t be realigned after 1rst start of operation**
  - Target need to have alignment features on its side
  - Robust plug-in system (should survive several target exchange)
  - Need measurement jigs to measure references every time we replace the target
  - Need of remote technic measurements?
- **Floor and building deformation to take in consideration**

Systems failure scenarios

- **Evaluation required for operation and maintenance scenarios**
  - Water leak
  - Vacuum leak
  - Fire
  - Ventilation
  - Cooling
  - Extraction system
  - Handling tools



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