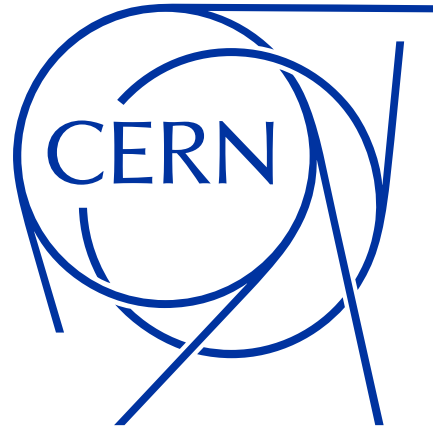


HI ← ECN3.



HI-ECN3 Target complex

13th NBI Workshop - 7-10 October 2024

AYA'S Laboratory, Tokai, Japan

Jean-Louis GRENARD - CERN - on behalf of HI-ECN3 WP4 Target complex

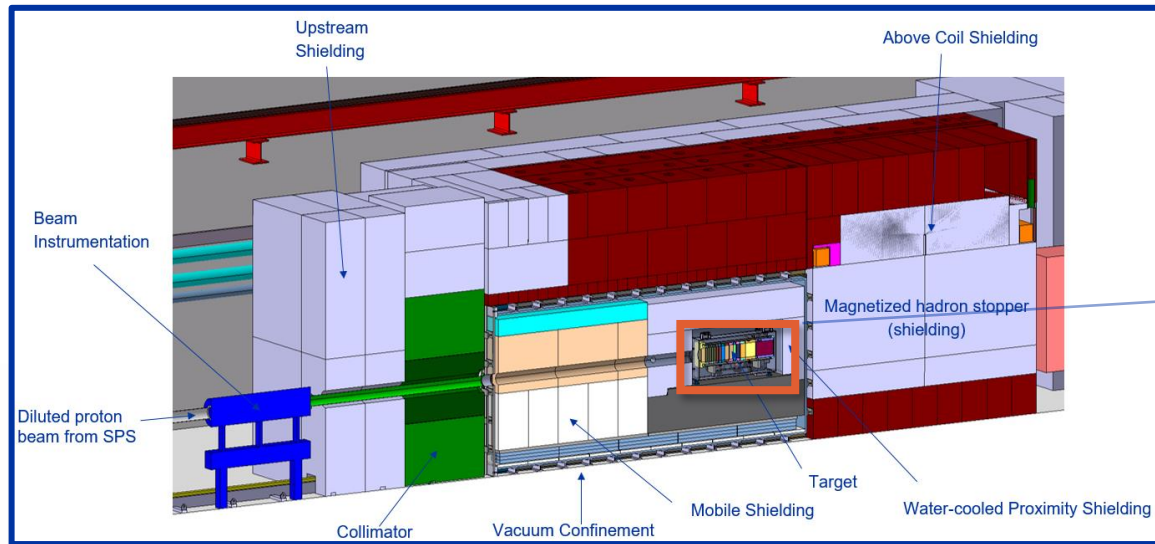


HI-ECN3.

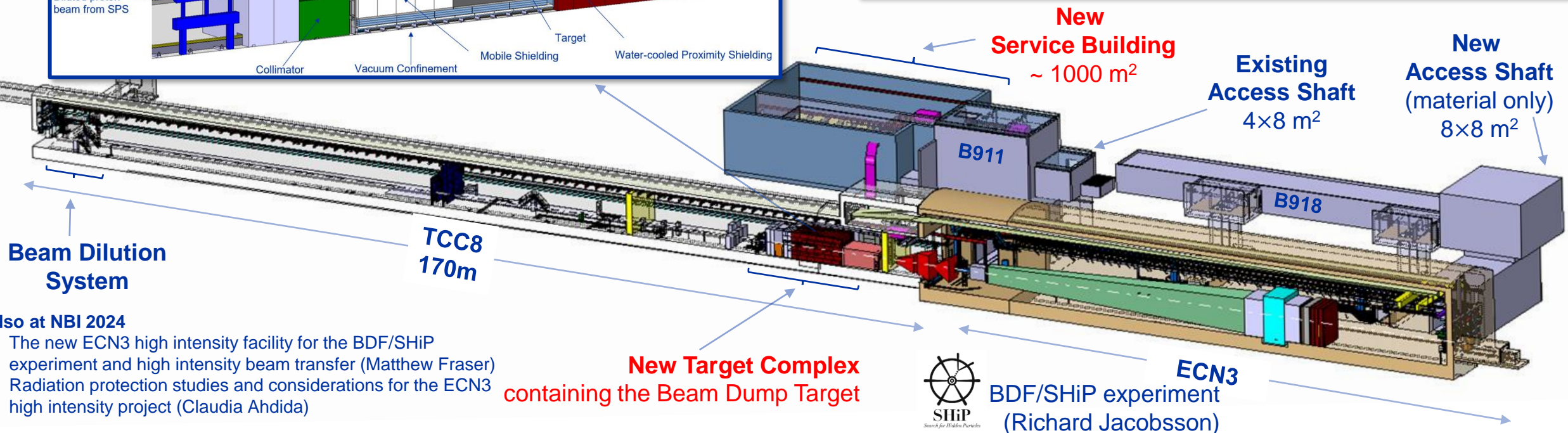
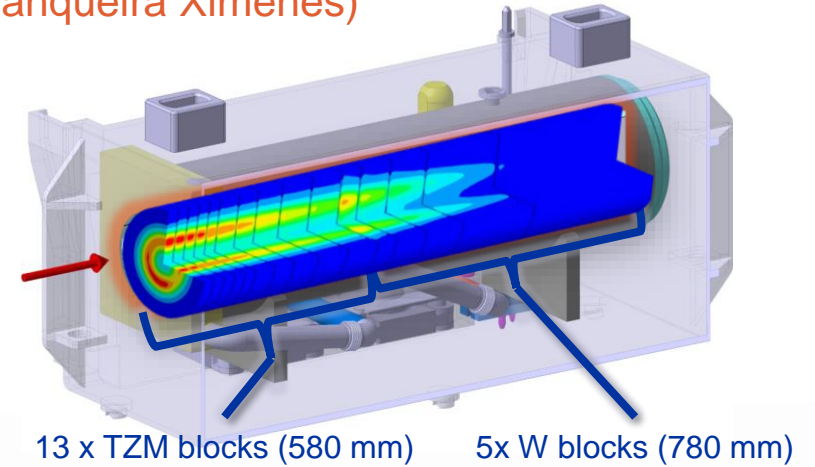
Content

- BDF Target complex
- Target exchange principle
- Service building integration
- Service cell
- Summary

BDF/SHiP Target



Baseline Design → Improvement during TDR
(Rui Franqueira Ximenes)



Also at NBI 2024

- The new ECN3 high intensity facility for the BDF/SHiP experiment and high intensity beam transfer (Matthew Fraser)
- Radiation protection studies and considerations for the ECN3 high intensity project (Claudia Ahdida)

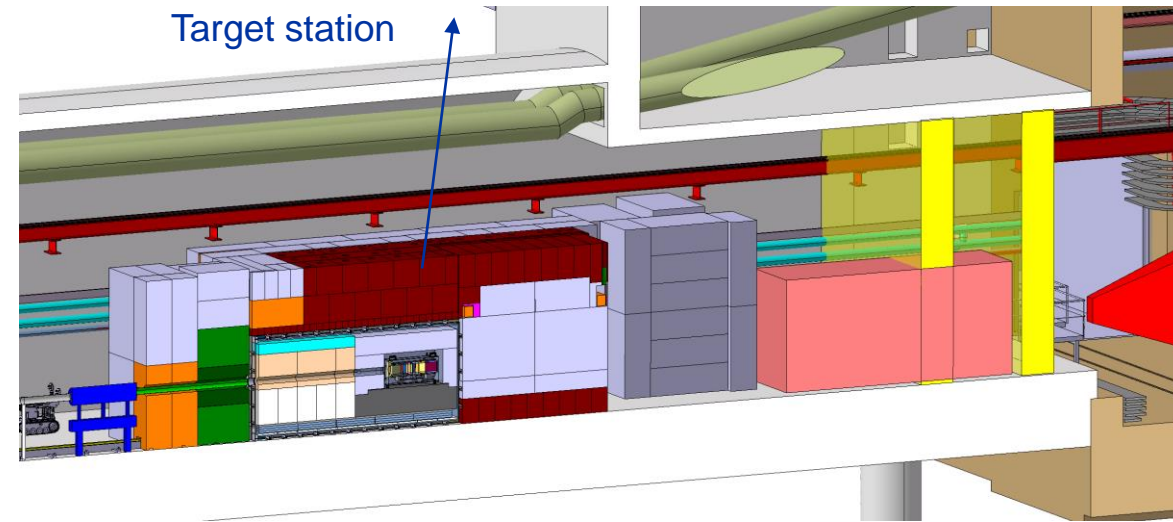
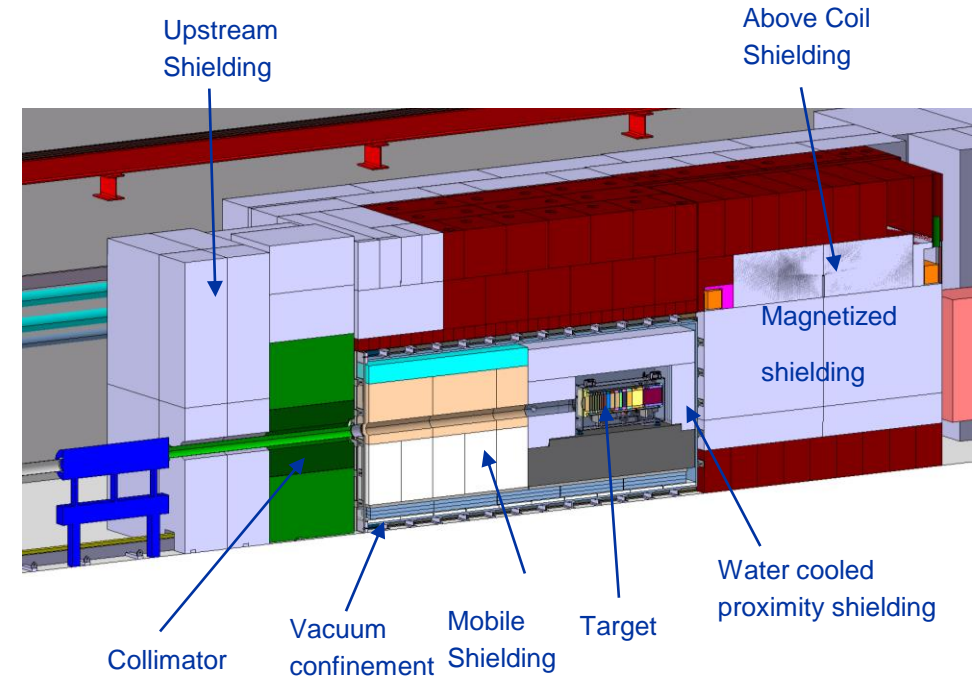
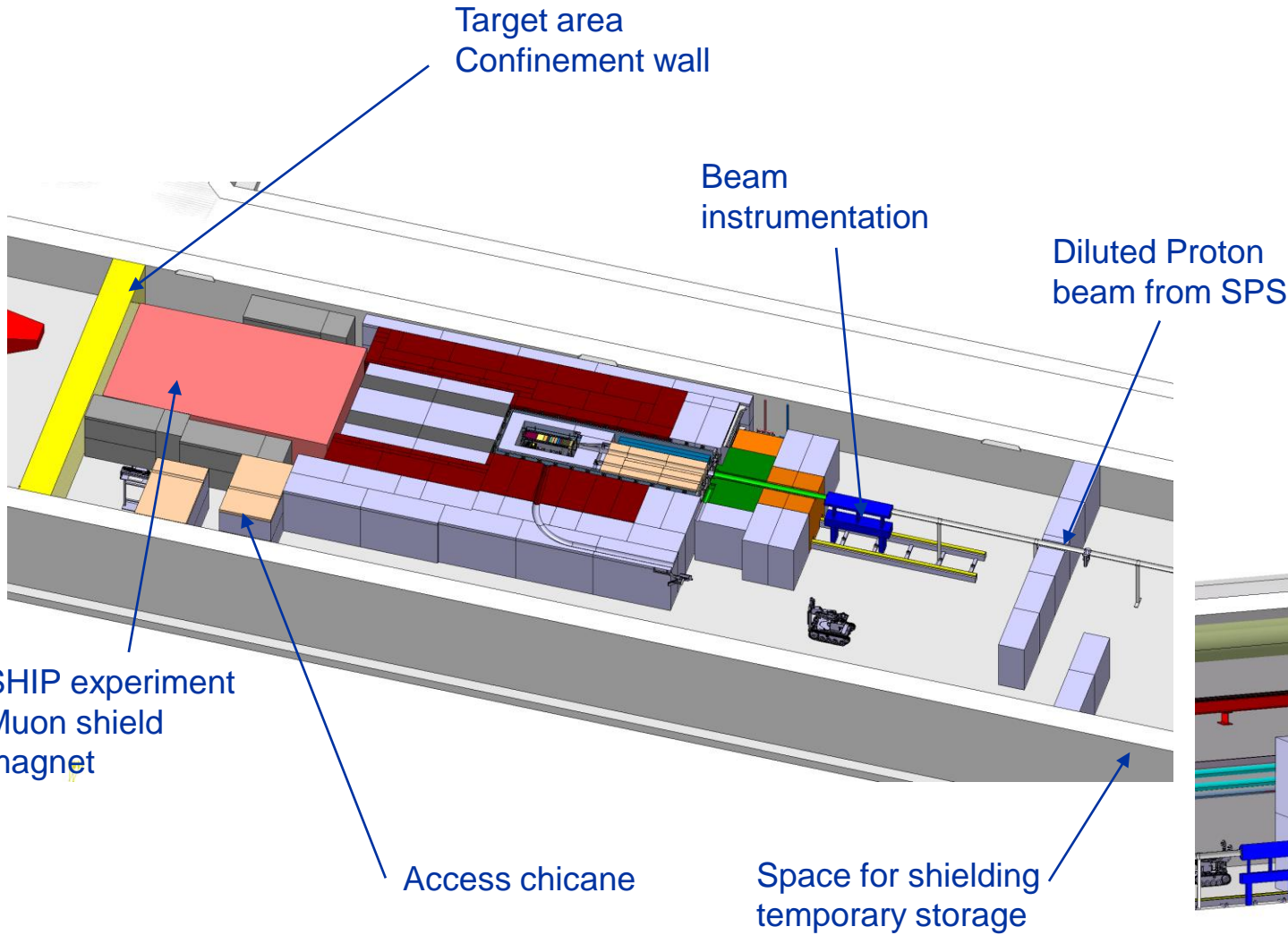


HI-ECN3

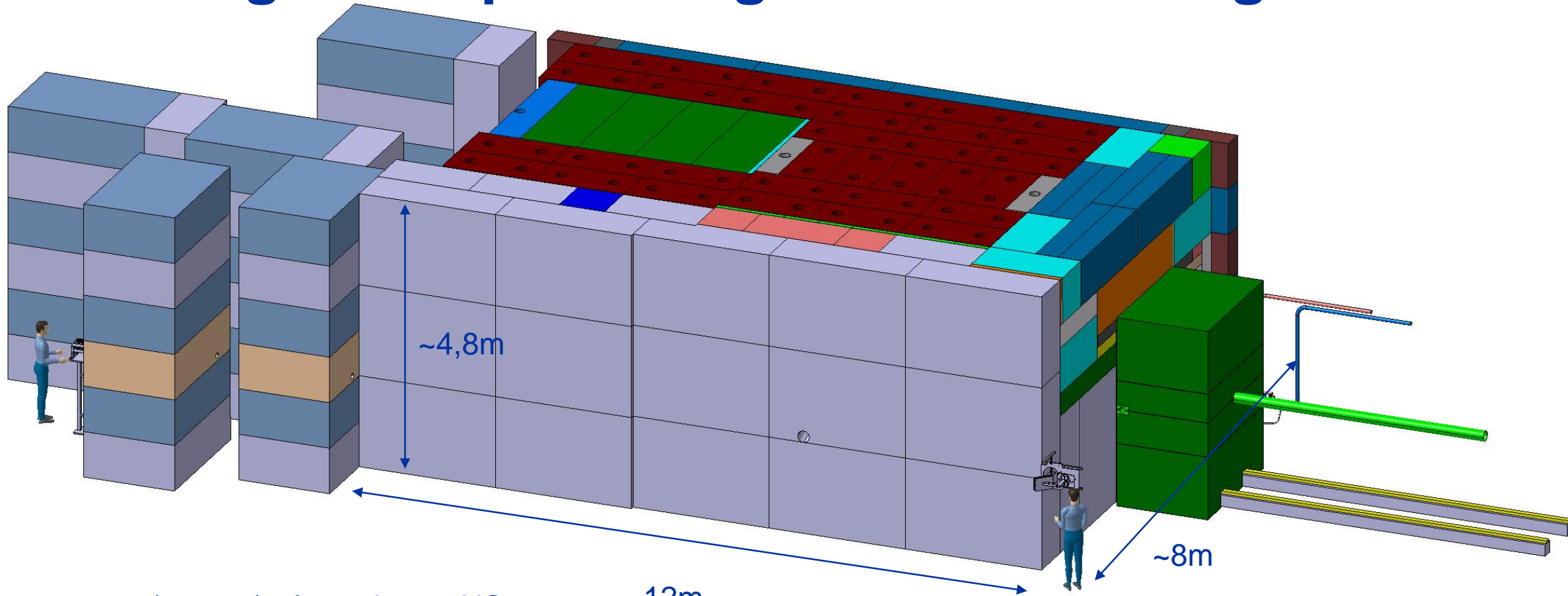


BDF/SHiP experiment
(Richard Jacobsson)

BDF Target complex integration



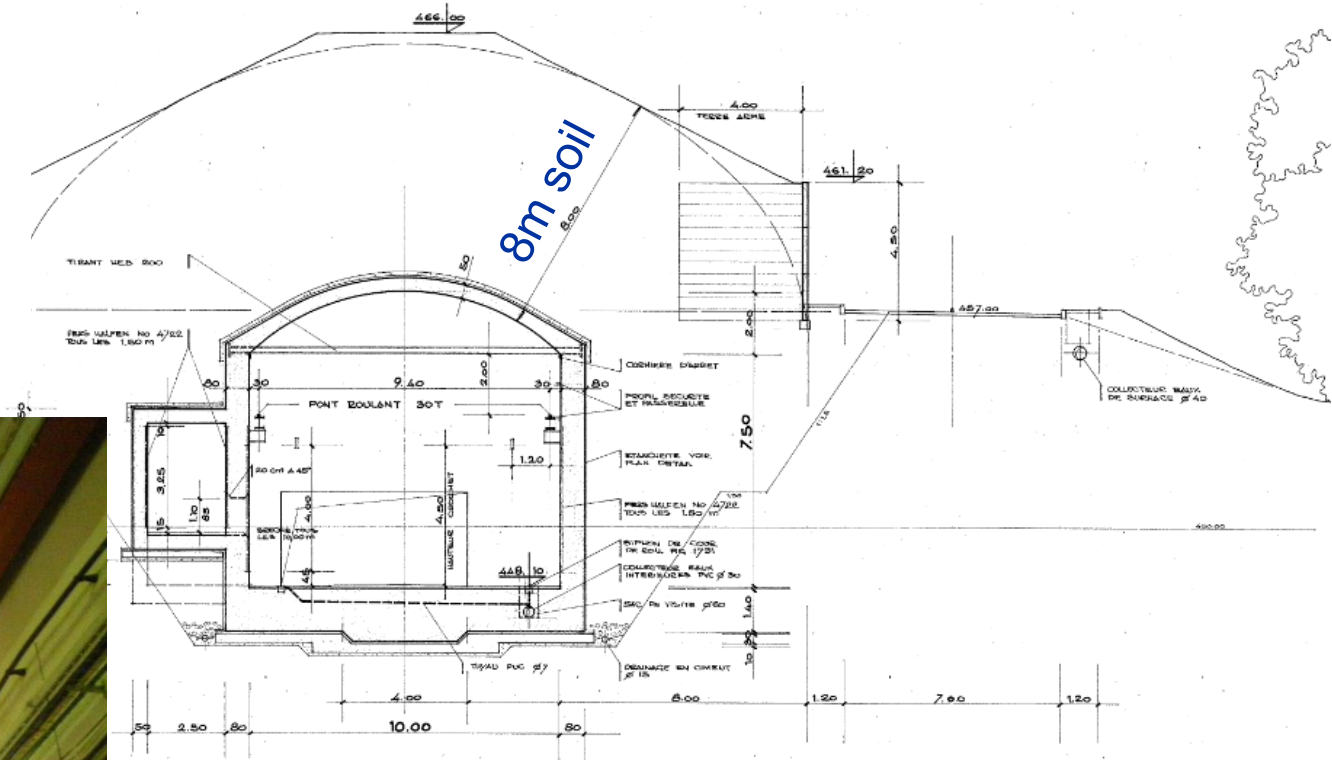
BDF Target complex integration - shielding



- ~ 180 m³ (~1400t) of cast iron + US1010 ~12m
- ~ 360 m³ (~800t) of concrete / marble
- Now establishing a bill of material to cross check what we will recover from other CERN facilities

Target Complex in an existing facility

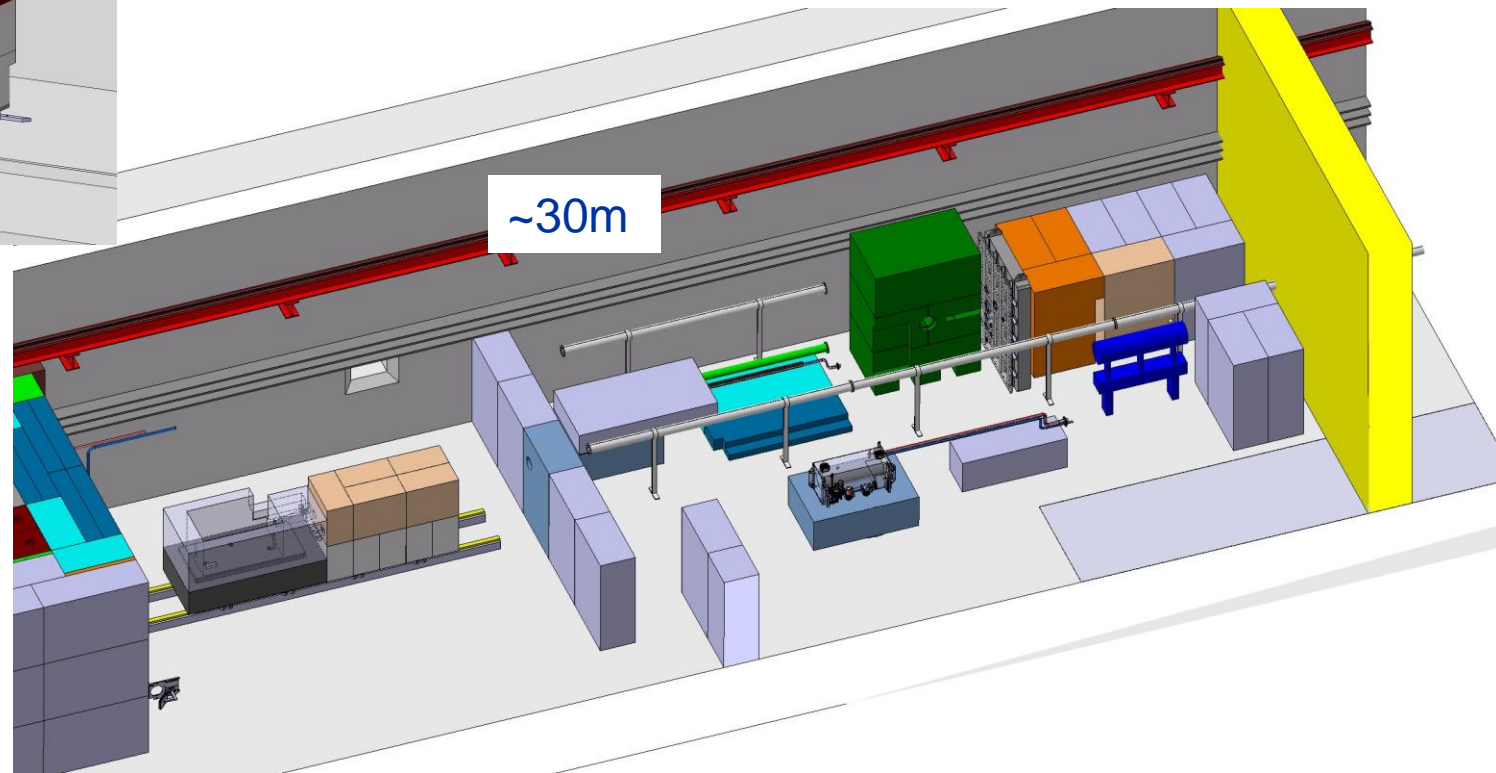
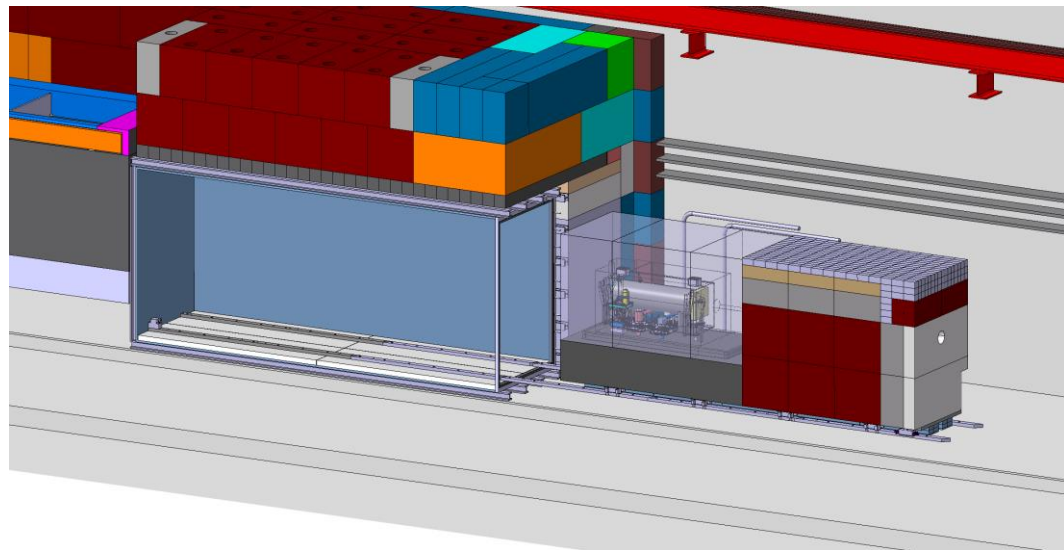
- Benefit of being below ground level and having soil on top of the cavern
- Existing overhead travelling crane 30t capacity



TCC8 cross section (length 170m)

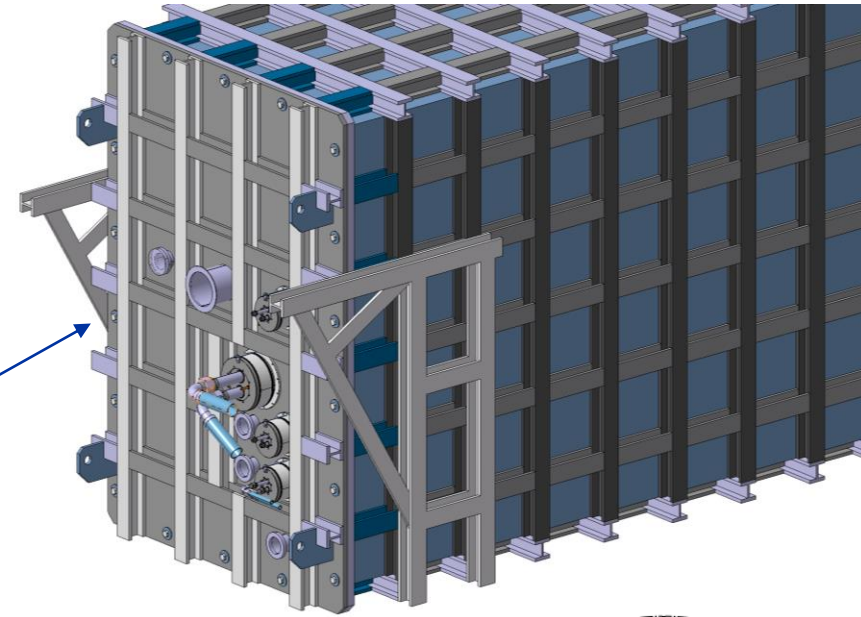
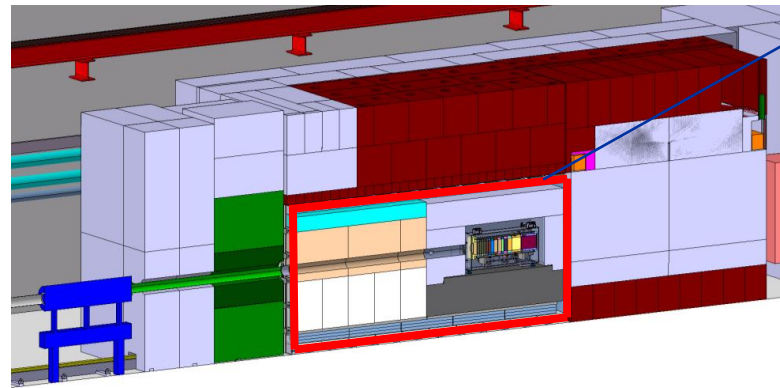
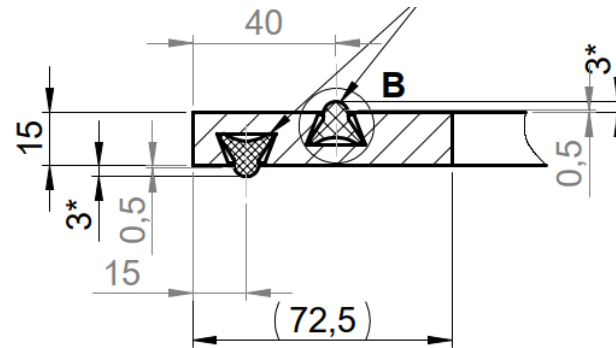


BDF Target complex integration - extraction

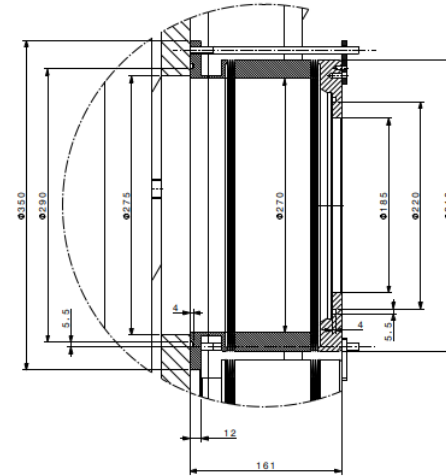
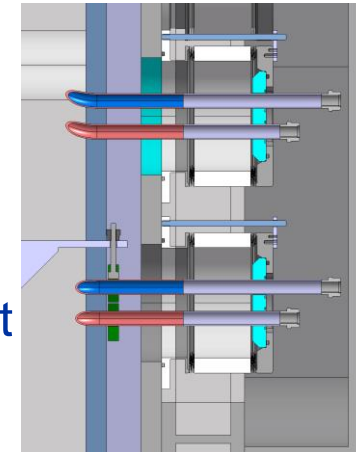


Target station vacuum confinement

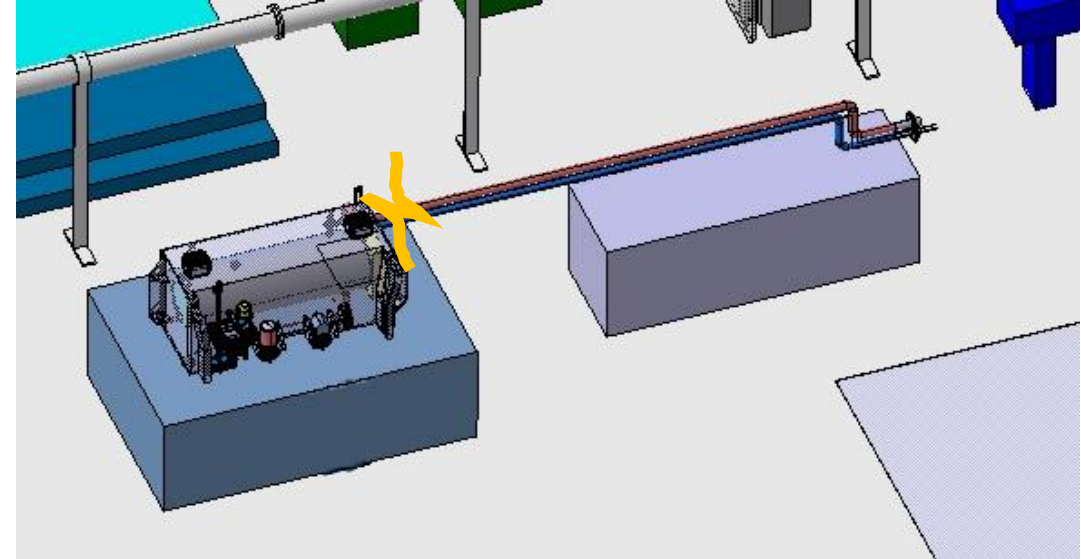
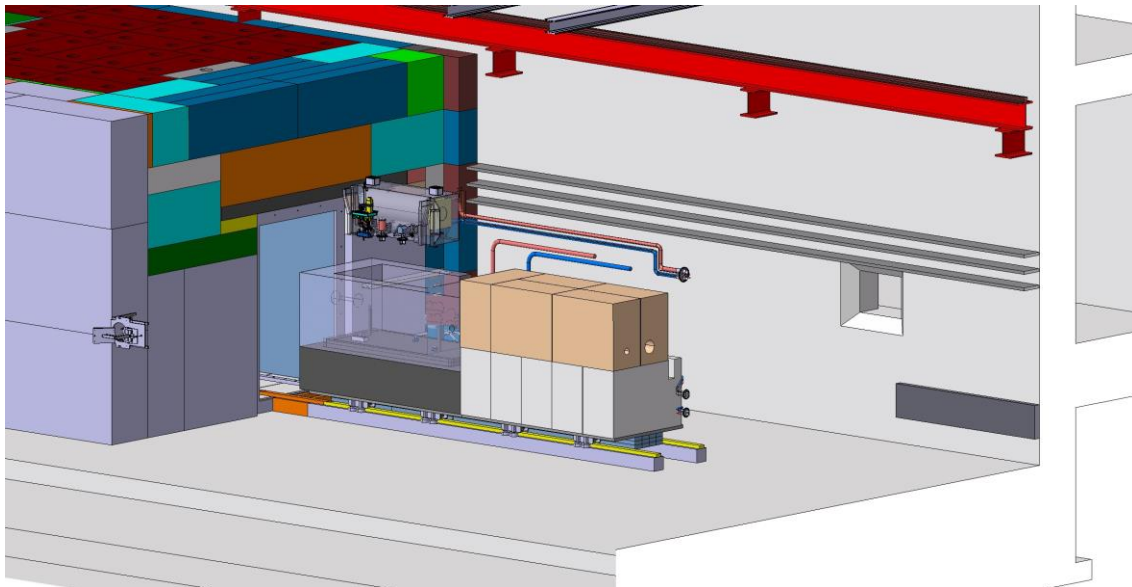
- Utilities feedthroughs
- Mechanical design ready to build a prototype
- Design of radiation tolerant gaskets
- Decommissioning plan



- Overall dimensions: ~6.36 x 2.05 x 2.95 m
- Can be fully fabricated and tested at a contractor premisses
- Primary vacuum ($10^{-3} mbar$) to optimize air activation around target
- (Water containment in case of water leak)



Target handling



Target utilities removed to fit cask

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



The target service building

Nuclear ventilation system of the target complex

- Air handling units, filters, dehumidifiers (outside)

Target cooling systems

- Pumps, Filters, Heat exchanger, Cooling instrumentation, He circulation system
- Target controls systems
- Target monitoring (sensors), Target control valves, vacuum vessel confinement

Service cell / hot cell

Buffer area

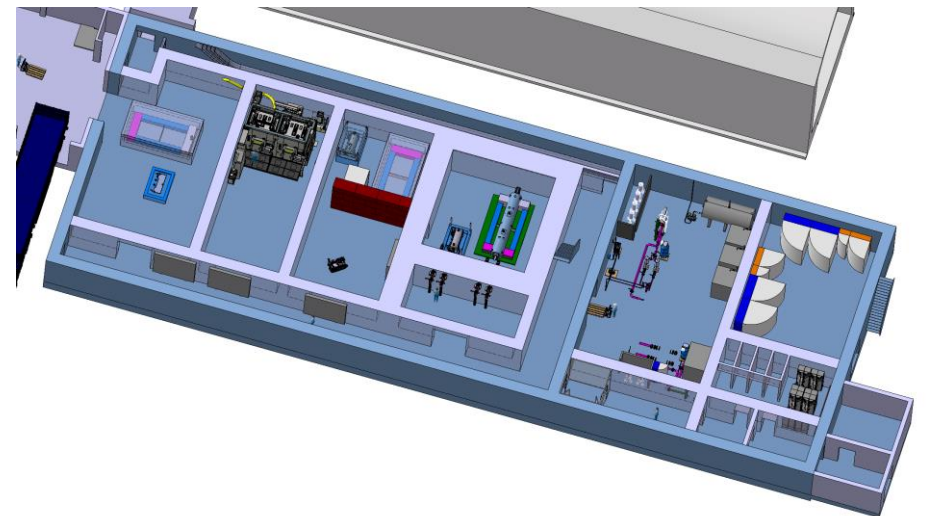
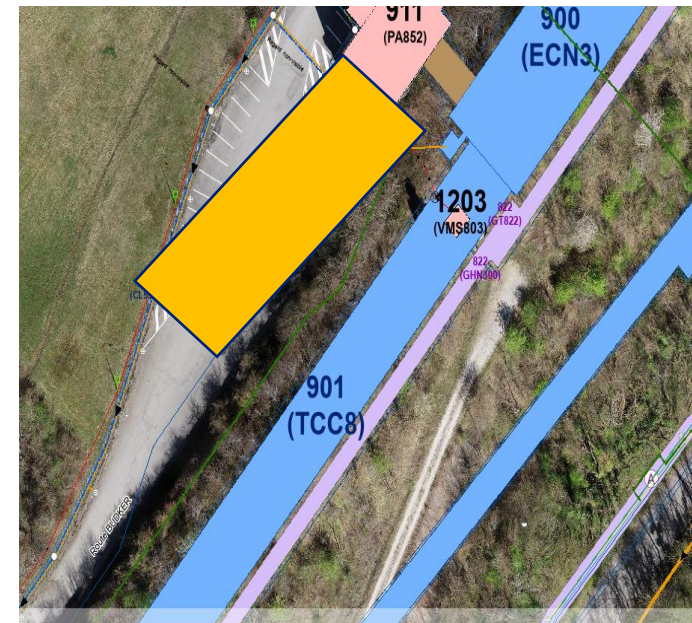
Safety systems

Electrical distribution system

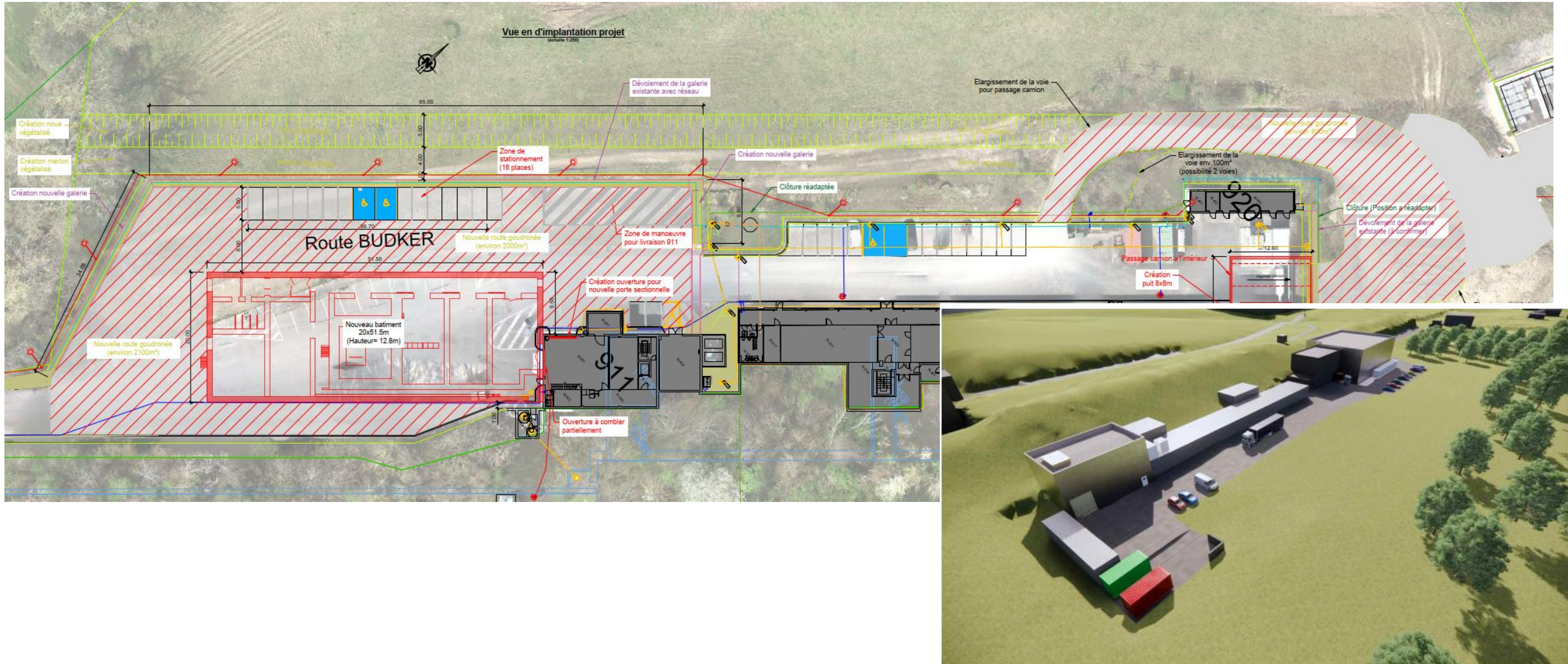
Control and safety systems

(Evaporator)

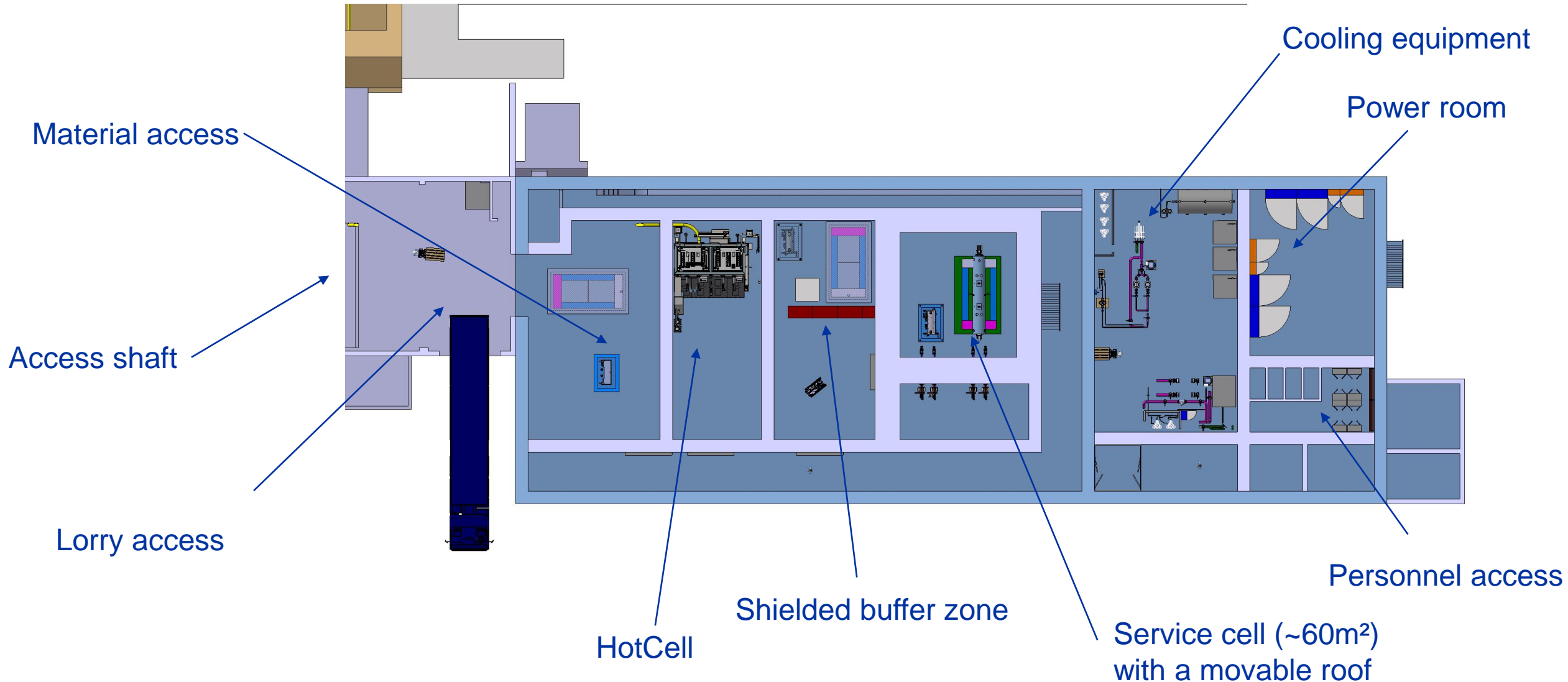
~1000m²



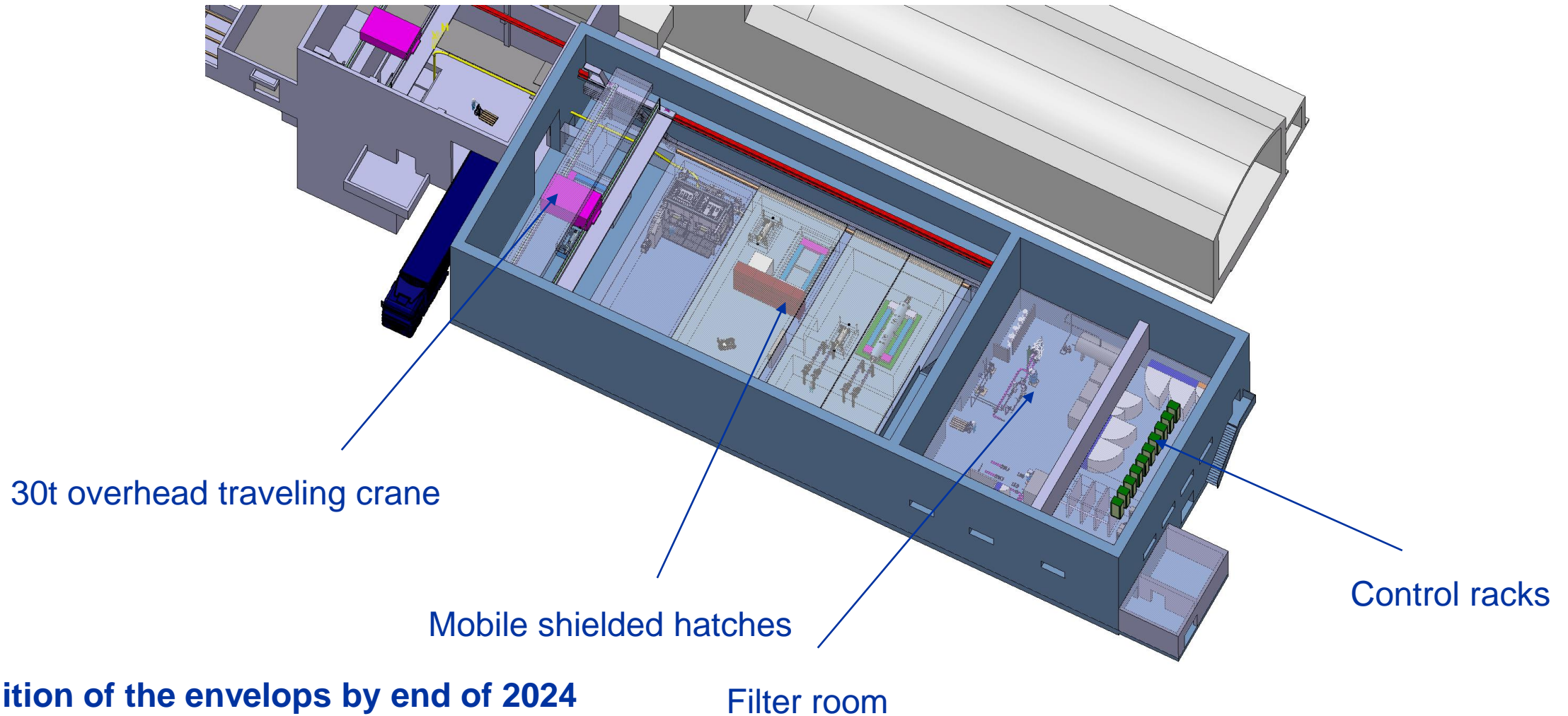
Service building within the BDF/SHiP complex



Service building – ground floor



Service building – 1st level



Definition of the envelops by end of 2024

Filter room

HI-ECN3 service cell - context

HI-ECN3 project need to have a facility to prepare objects for final disposal

- BDF target
- Proximity shielding
- Hadron stopper coil

Why do we need a specific facility to prepare HI-ECN3 object for final disposal (waste packaging)?

- Level of radiation (~few Sv/h after 1year of cool down)
- Characteristics of materials (W)
- Presence of radiological critical spallation products
- Size and weight of the objects doesn't fulfil elimination path requirement towards PSI (container size limitation)
- Understanding of failure modes to improve future designs
- Lessons learnt from waste packaging of highly radioactive objects (ISOLDE target, LHC TDE, n_TOF spallation targets)
- **Currently such facility does not exist at CERN**

Main justification

Service building – Service cell

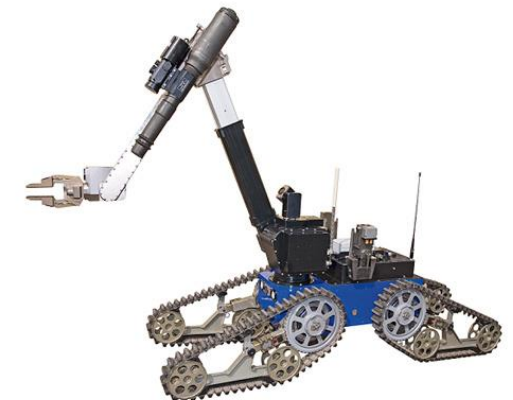
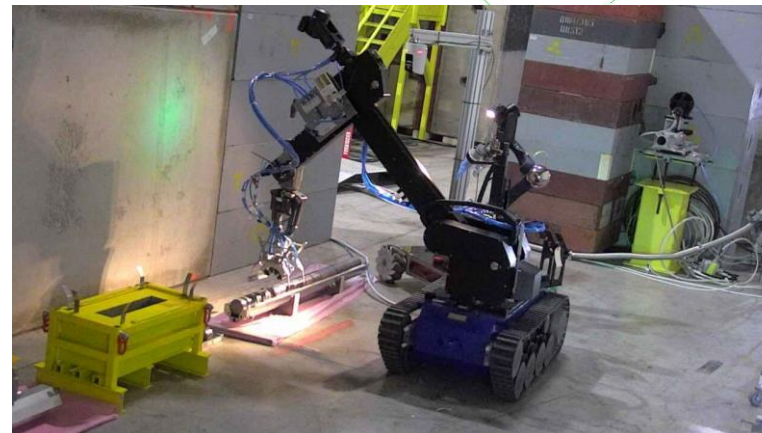
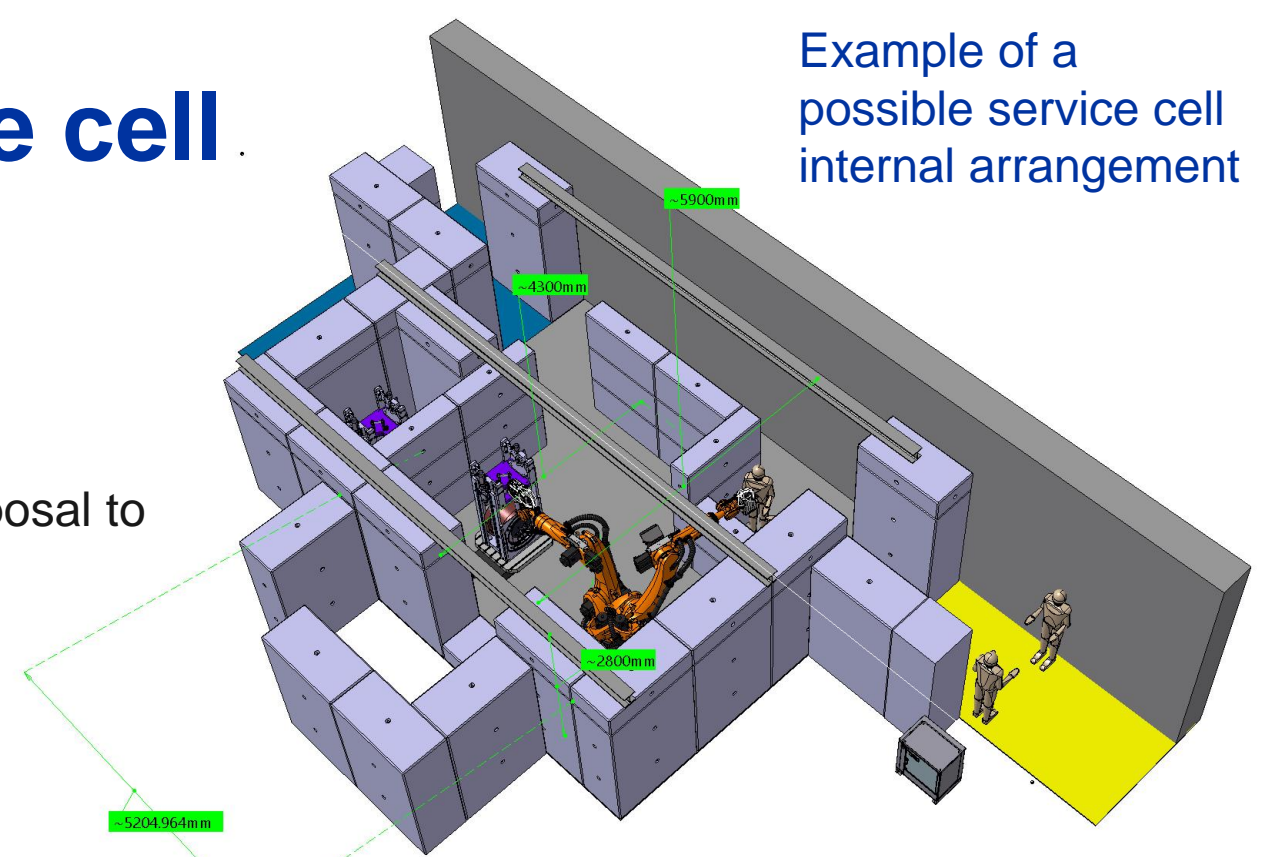
Example of a possible service cell internal arrangement

Purpose

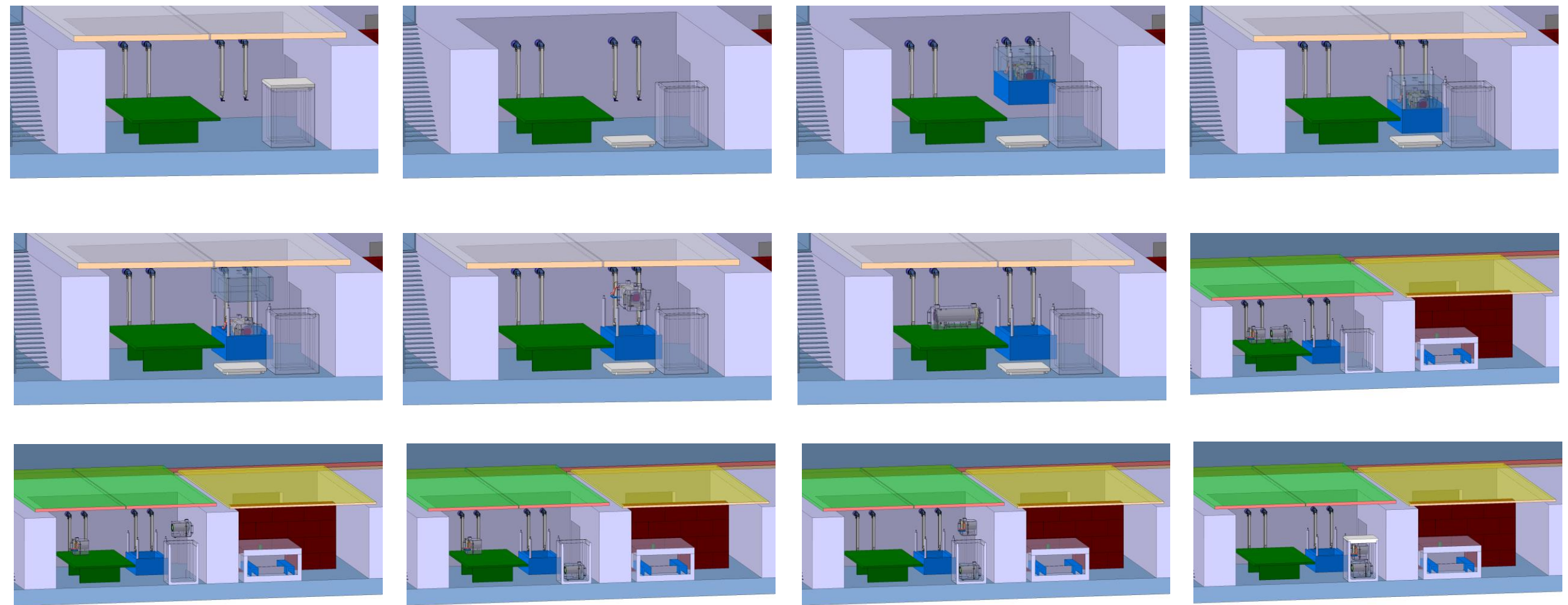
- Repair of activated components
- Size reduction and material separation for final disposal to optimize cost using different elimination path
- Post Irradiation Examination

Tools envisaged

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



Service cell definition – BDF target disposal draft sequence



Summary

- Significant benefit by reusing an existing infrastructure
- Preliminary shielding study have been designed and optimized according to radioprotection requirement
- TDR is in progress to finalize the design now focused on defining the process to define Civil Engineering aspects
- A service building will be implemented to support the target complex
- Part of this building will be dedicated to a service cell for size reduction, waste packaging and to perform PIE
- A wide range of remote handling technics will be used within the HI-ECN3 target complex taking the benefit of all the recent developed made across various projects at CERN



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Thank you



HI-ECN3.