Half-Cylinder Thermal Cycling & Testing at Liverpool

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Frascati OEC Integration Workshop

31/01/24

Outline

- Use of Integration Cradles at Liverpool
  - Assembly area layout
  - Movements of Integration Cradles
- Integration Cradle Modifications
  - Limitations in length and width
  - Transition into Cold Room
- Half-cylinder Test Enclosure
  - General Requirements
  - Installation of Integration Cradle
  - Type-1 Services connections & Routing
  - Thermal cycling system (-55C)

Use of Integration Cradles at Liverpool

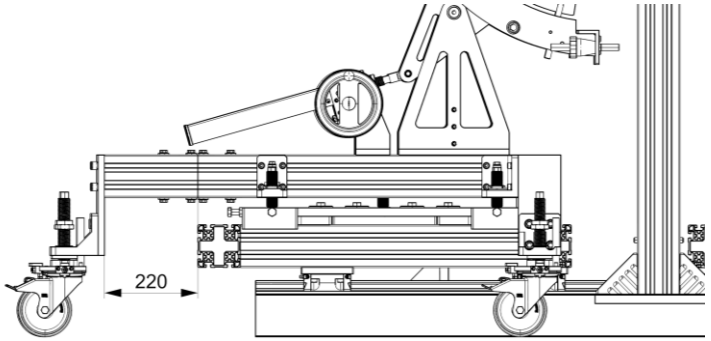
- Intention is to use tooling system designed by Frascati

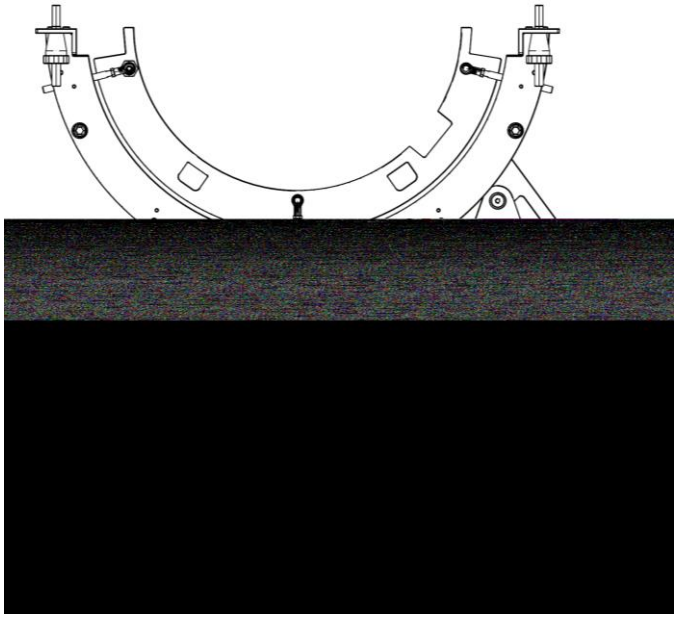
- We have procured materials for TWO cradles and have plates being manufactured
  - We do need to understand the specification of a few components – particularly relating to the rotation mechanism
  - We also need to understand the precise details of how the system is intended to work and, eventually, to learn from experience at Frascati

- We have not done anything relating to the central support and slider mechanisms for the half-cylinder mating
  - We have a slight concern that the base, as designed, may not fulfil all the requirements we might have coming from space and access restrictions

Integration Cradle Modifications

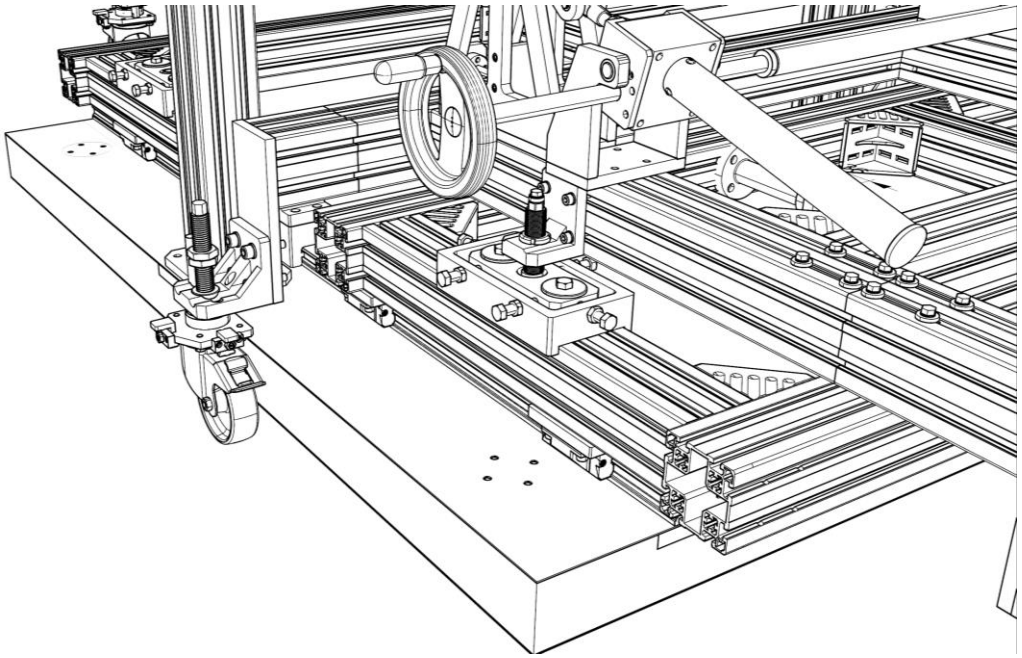
- Sketch shows cradle located on sliders in ‘open’ position (136mm)
  - Shorten depth by (up to) 220mm to ease movement around cleanroom
  - Would have to REMOVE wheels before moving sliders to ‘closed’ position
  - What about the other orientation ?
    - Maybe OK at 100 reduction but not much more – every little helps!





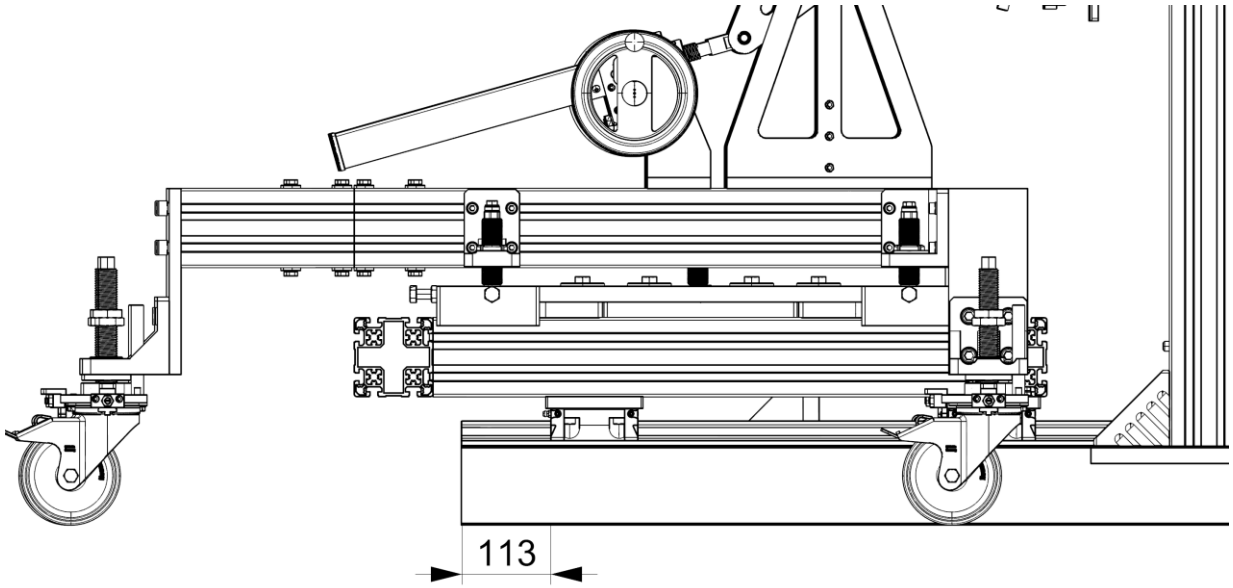
Integration Cradle Modifications

- Beam supporting front wheels extended to avoid clashing with base
  - Extension of 125mm shown

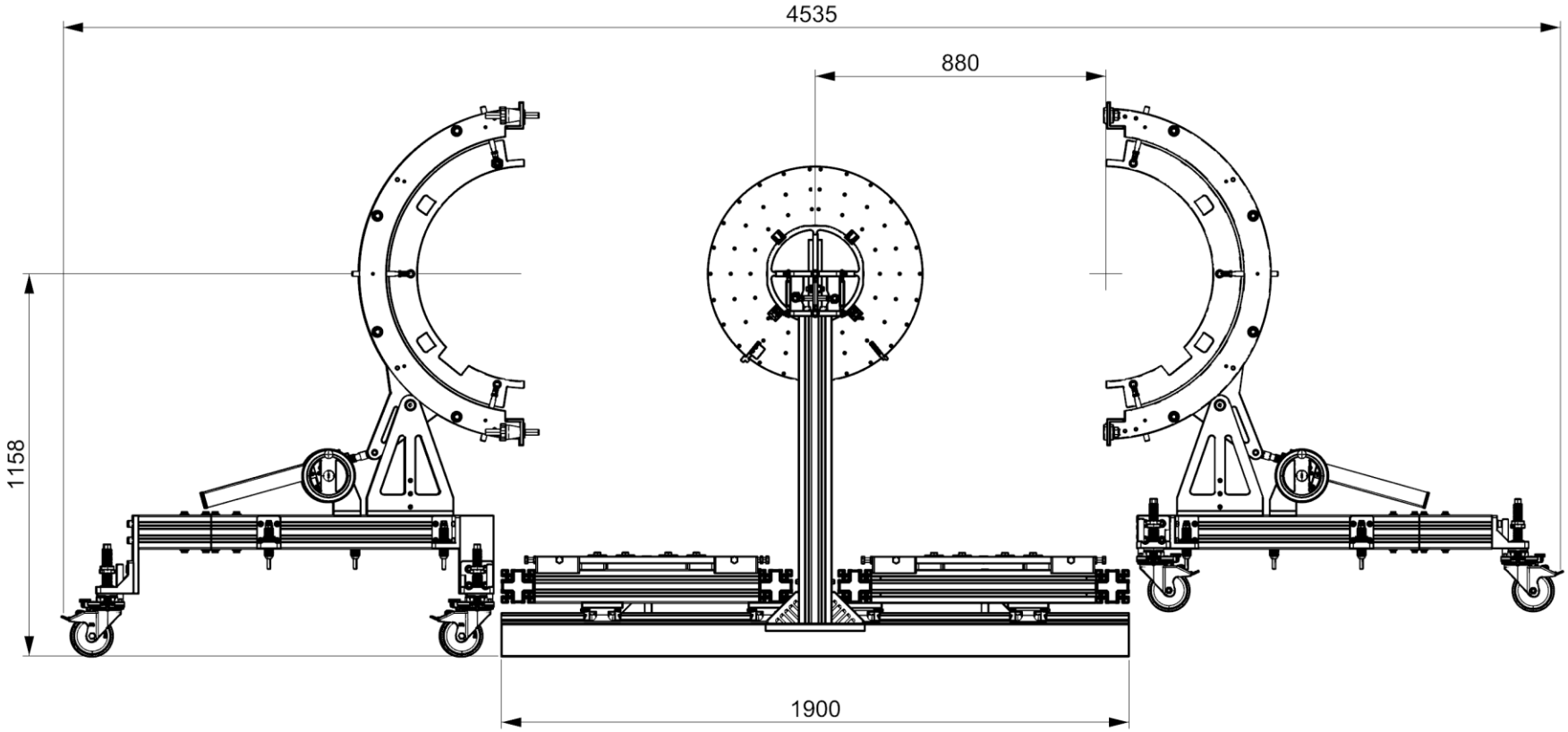


Integration Cradle Modifications

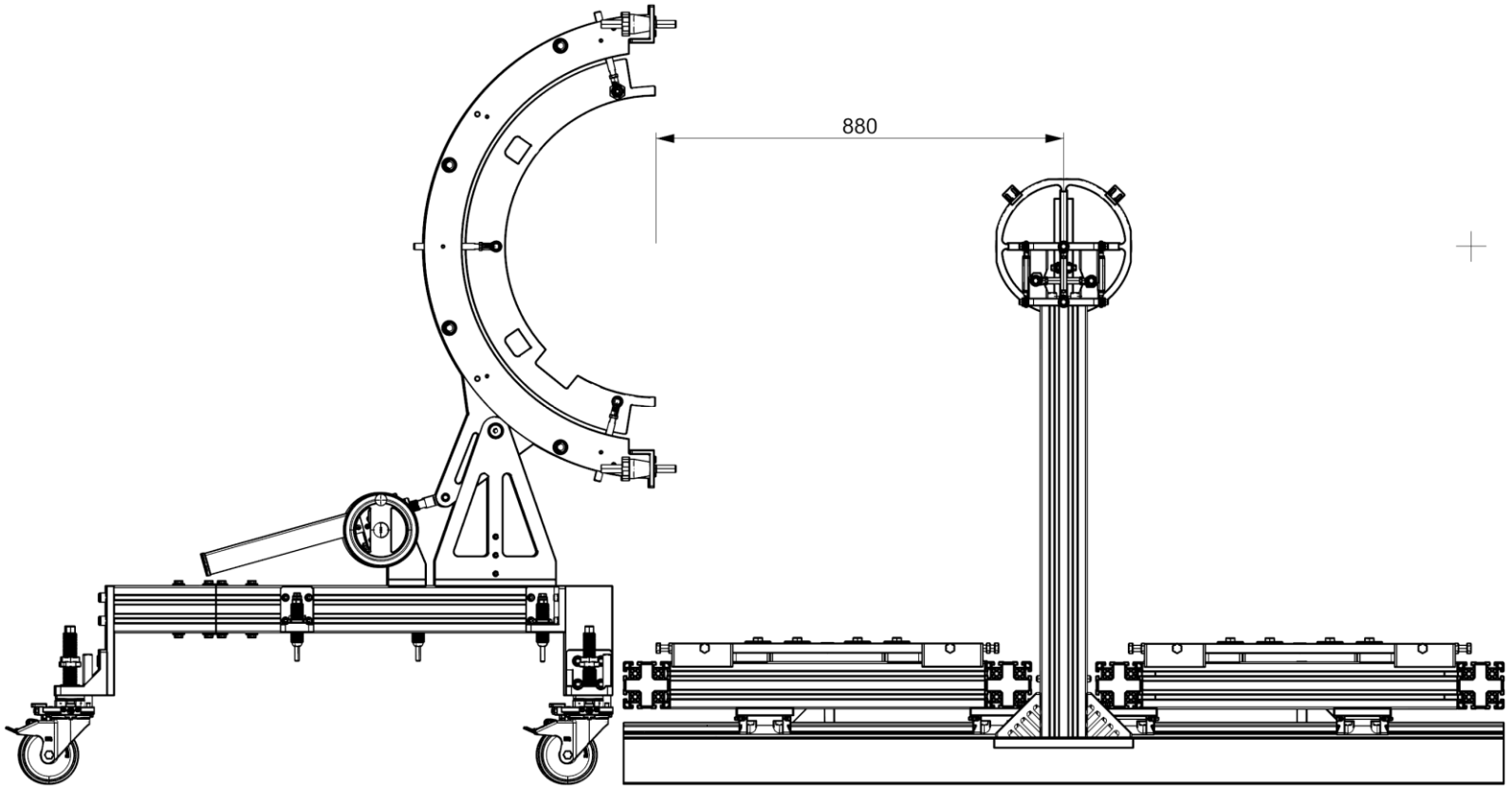
- When the sliders are in their ‘open’ position – displaced by 136mm there is still 113mm of rail ‘free’
  - Could the base be reduced by 2 x 100 mm making it 1700 wide ?



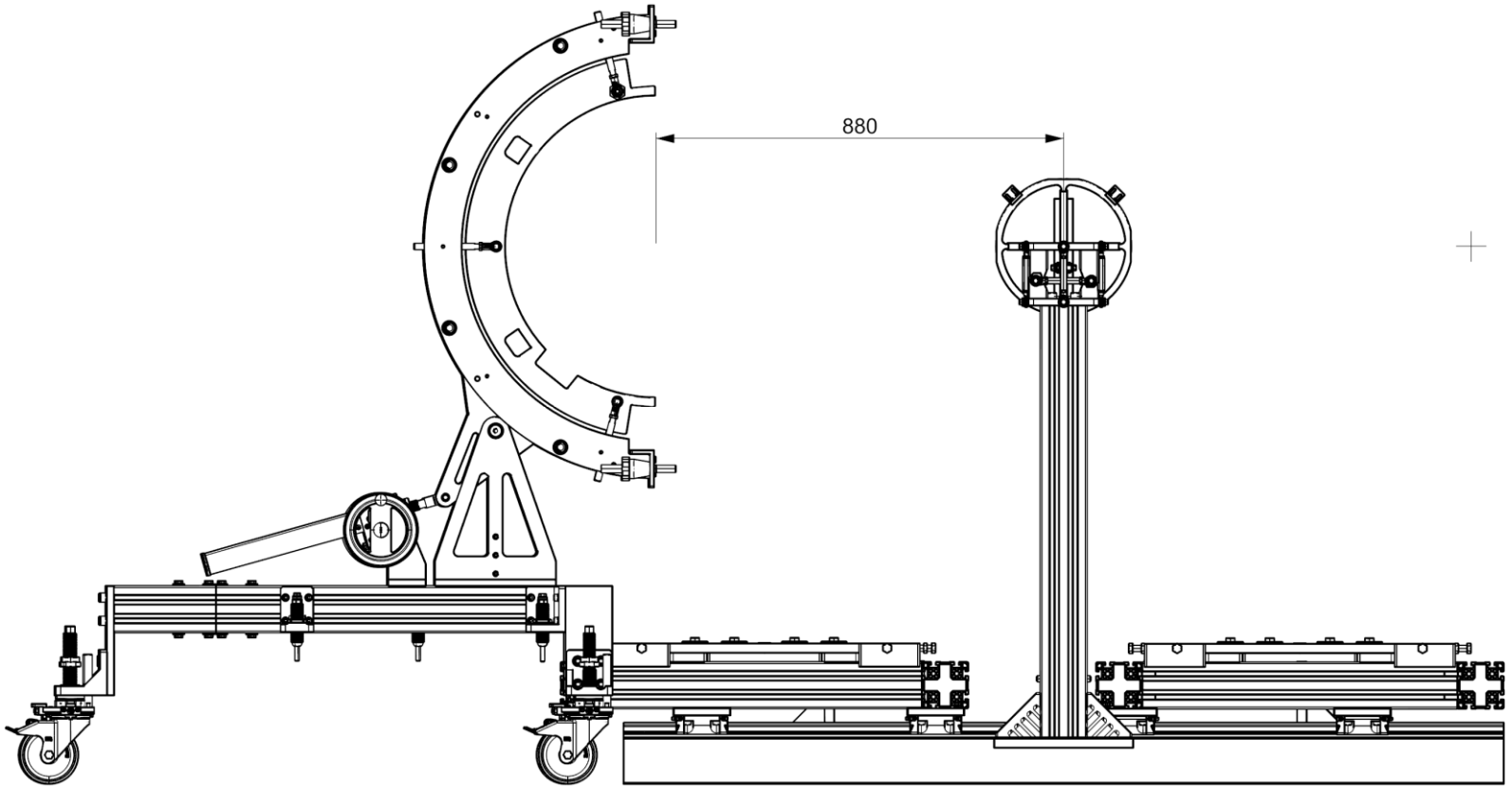
Critical Dimensions – Endcap Integration



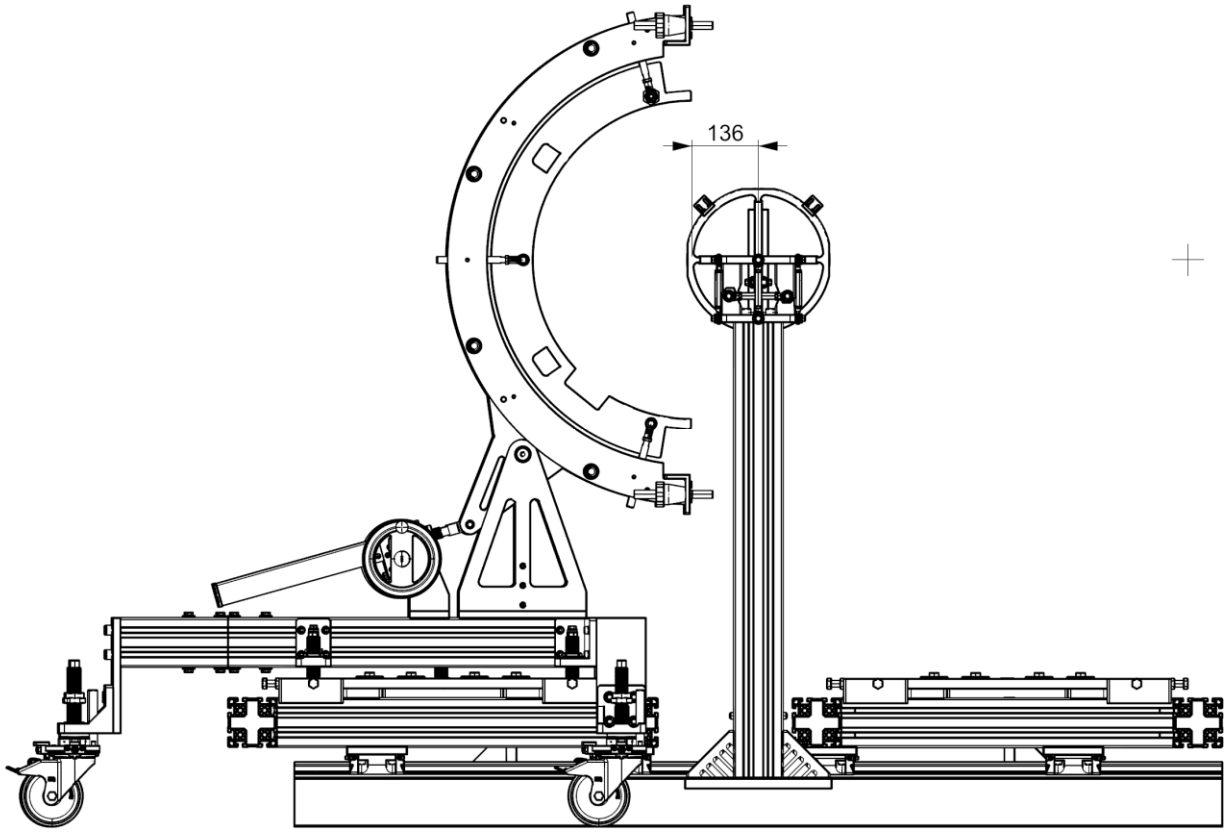
Opening & Closing: HC at 880, Sliders at 0 (closed)



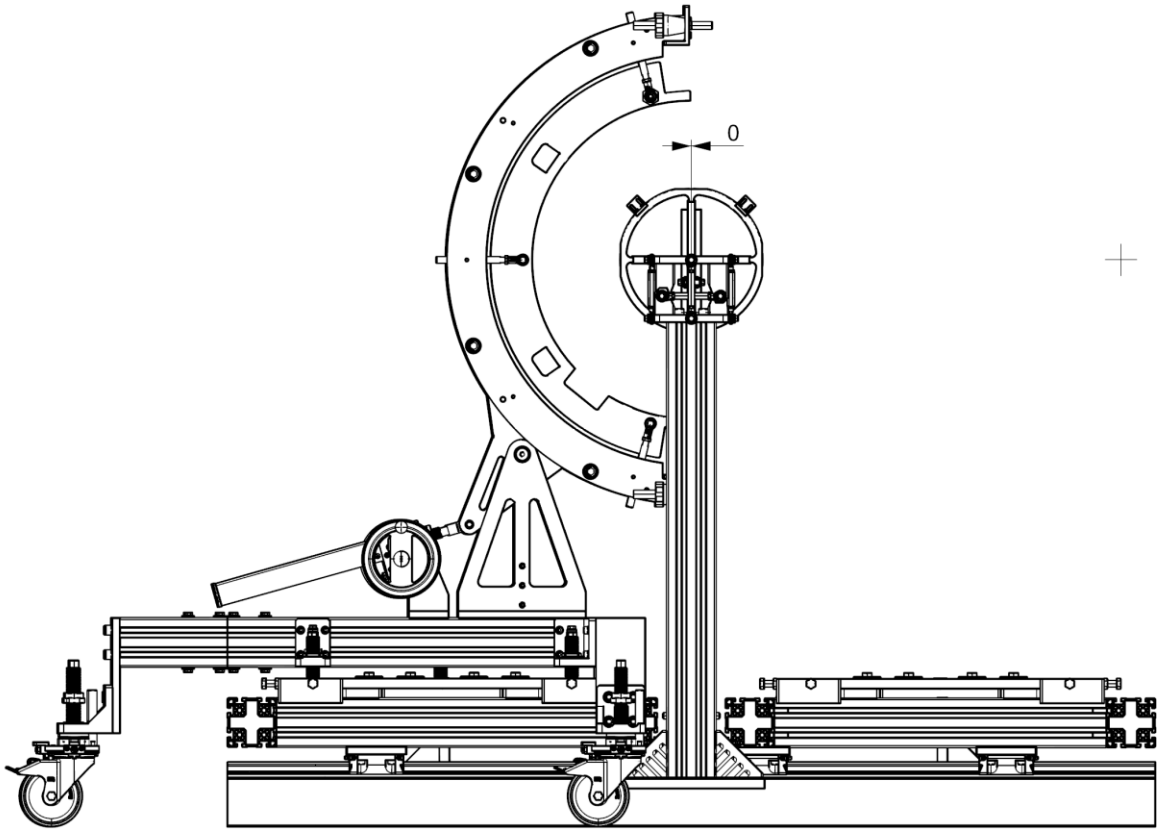
Opening & Closing: HC at 880, Sliders at 136



Opening & Closing: HC rolled over Sliders at 136



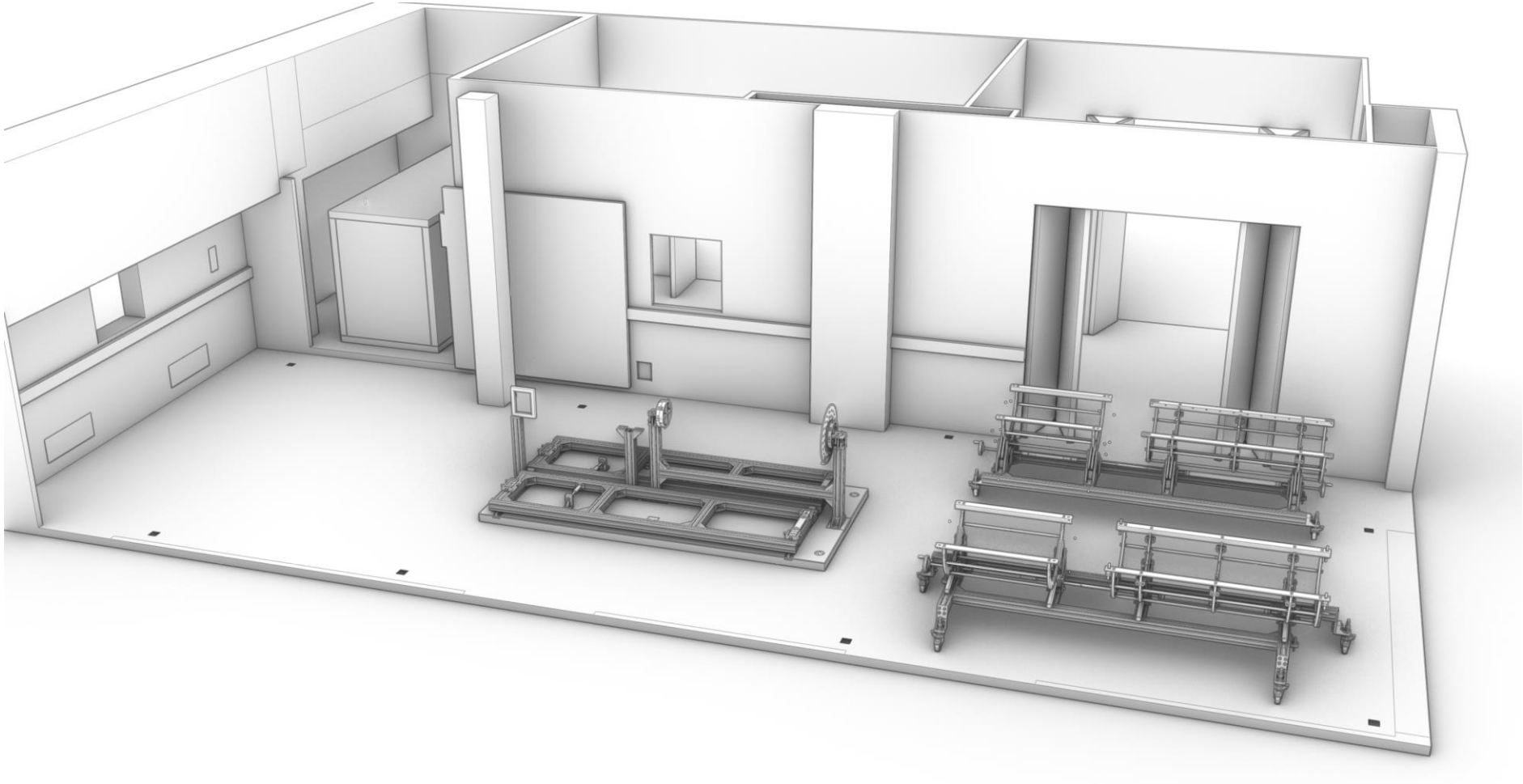
Opening & Closing: HC at Zero



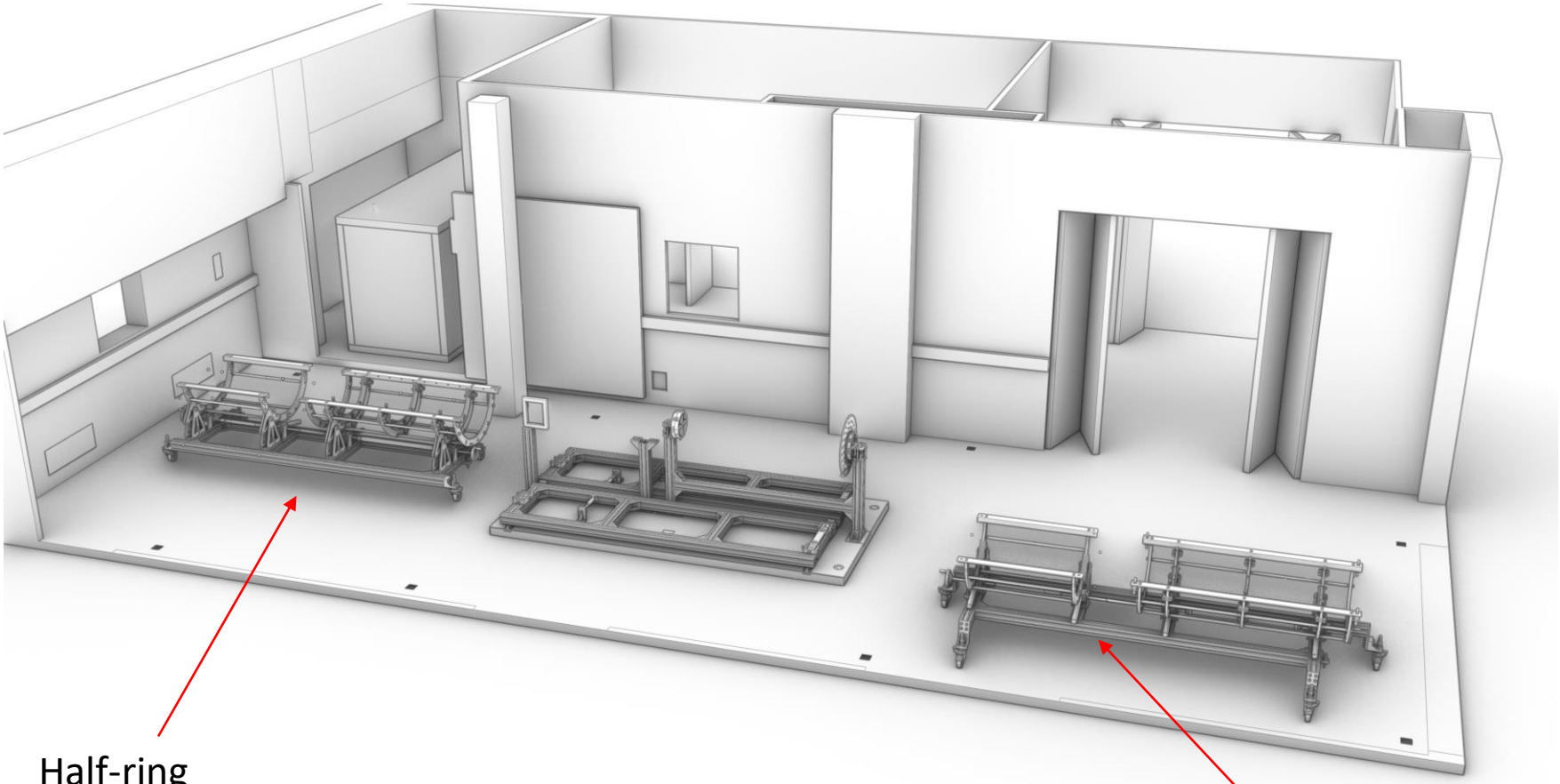
Assembly of UK Endcap

- In the following I show …
  - L2 half-cylinders being populated with Type-1 services & test
  - First L2 half-cylinder being populated with half-rings & connectivity checks. Second half-cylinder being populated with Type-1 services & test
  - First complete L2 half-cylinder being fully tested with CO_2. Second L2 half-cylinder being populated with half-rings & connectivity checks. L3 half-cylinders being populated with electrical services & test

L2: Services Loading



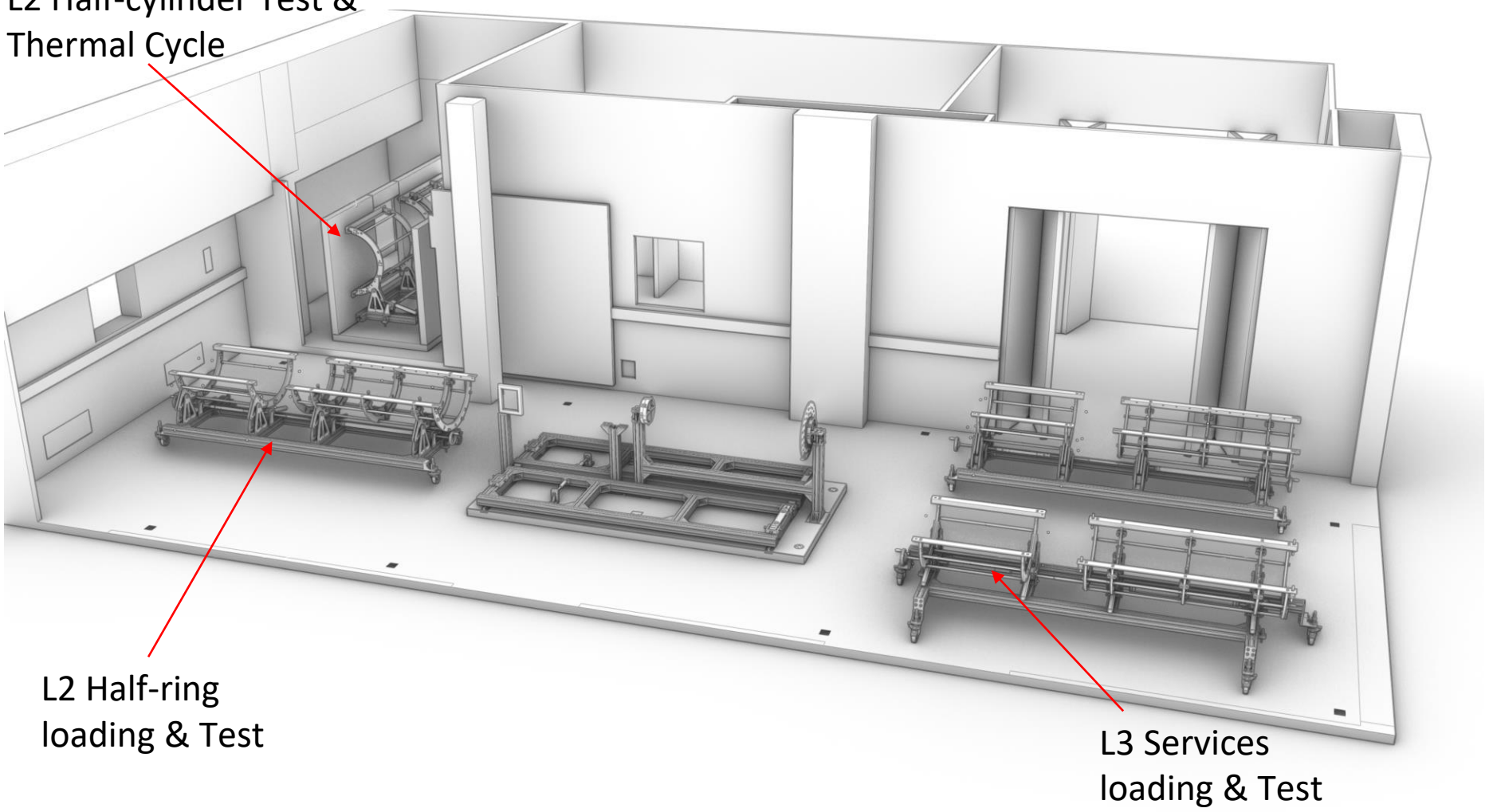
L2: Half-ring loading & Services Loading



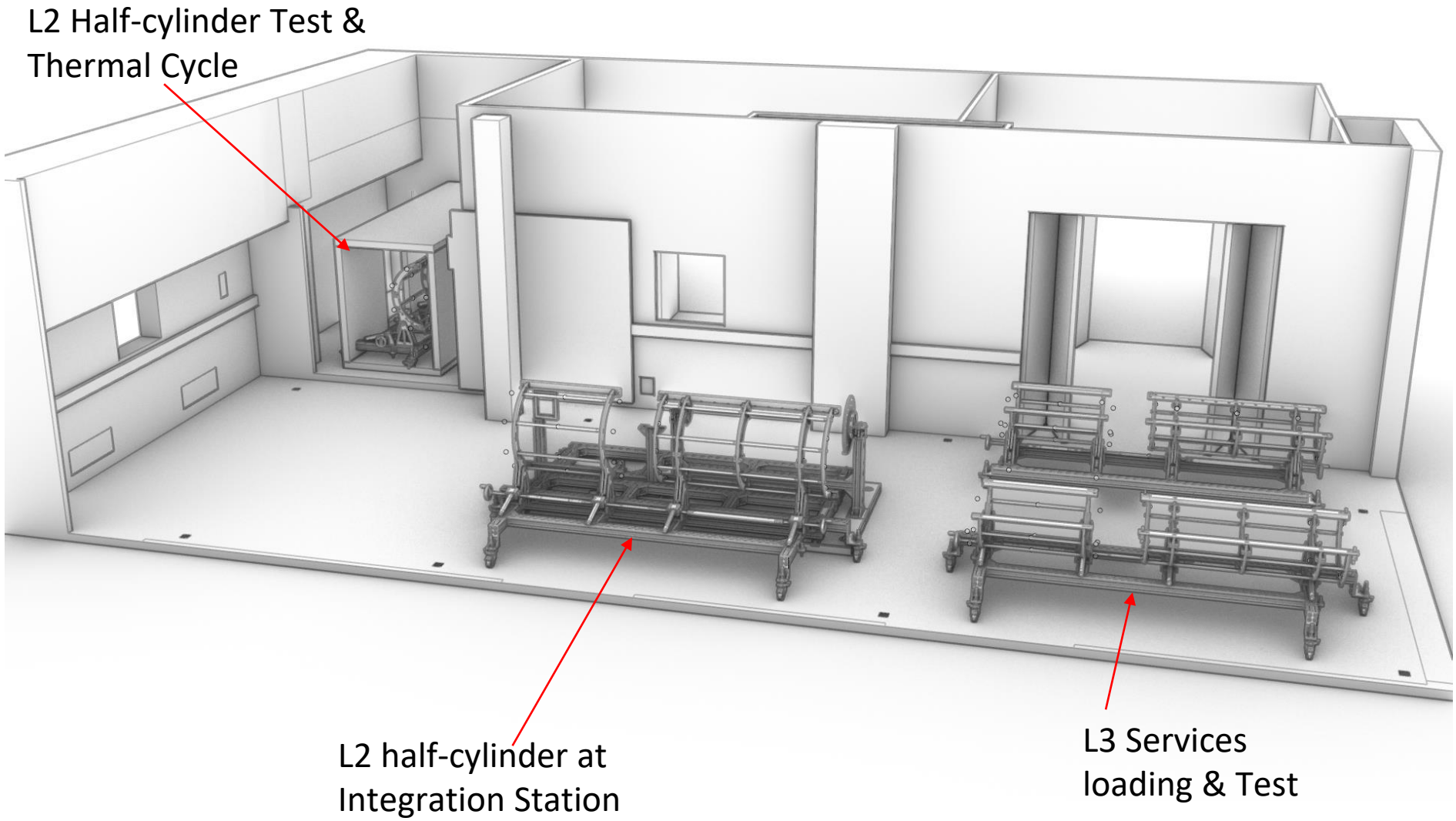
Half-ring
loading & Test

Services
loading & Test

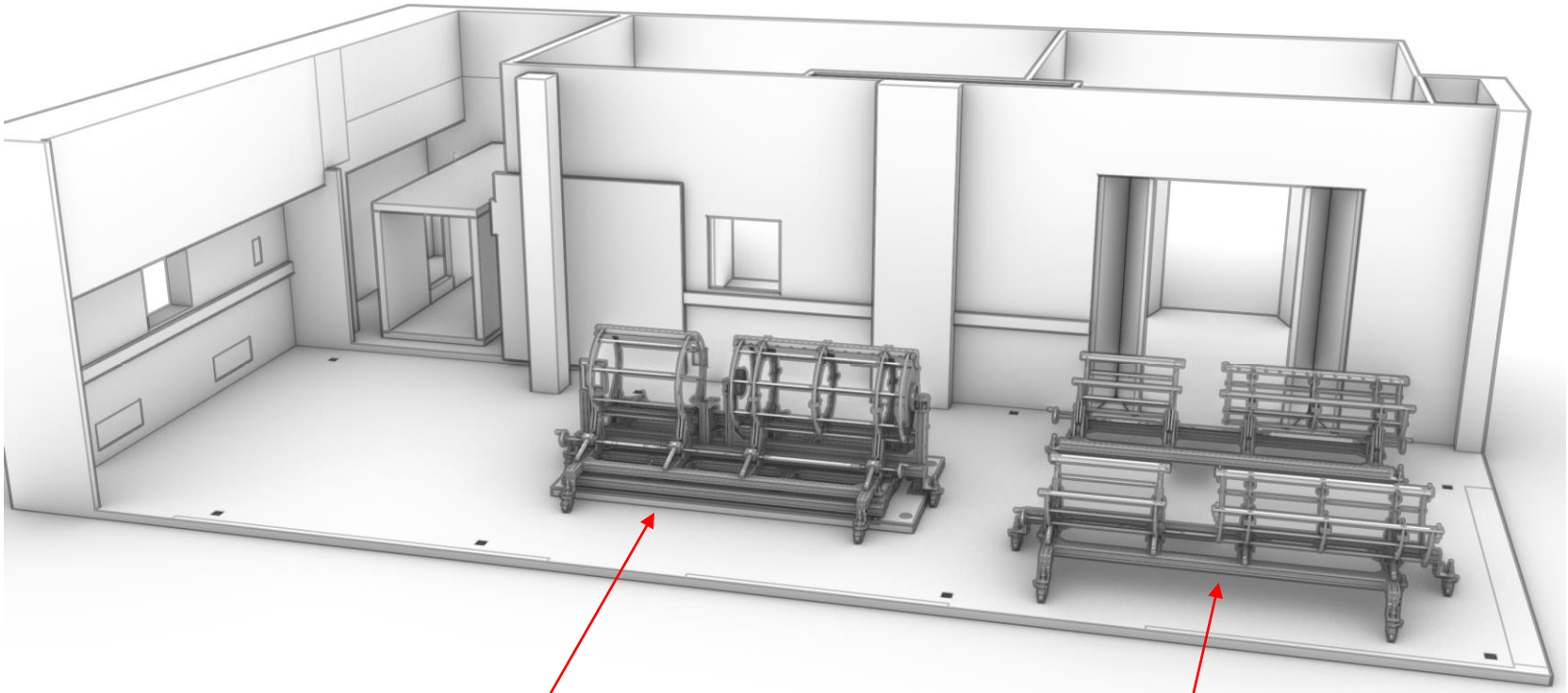
L2 Half-Cylinder Test & L2 Half-ring Loading
L3 Services Installation



L2 Half-cylinder to Integration, 2nd L2 to Half-cylinder Testing, L3 Services Installation & test



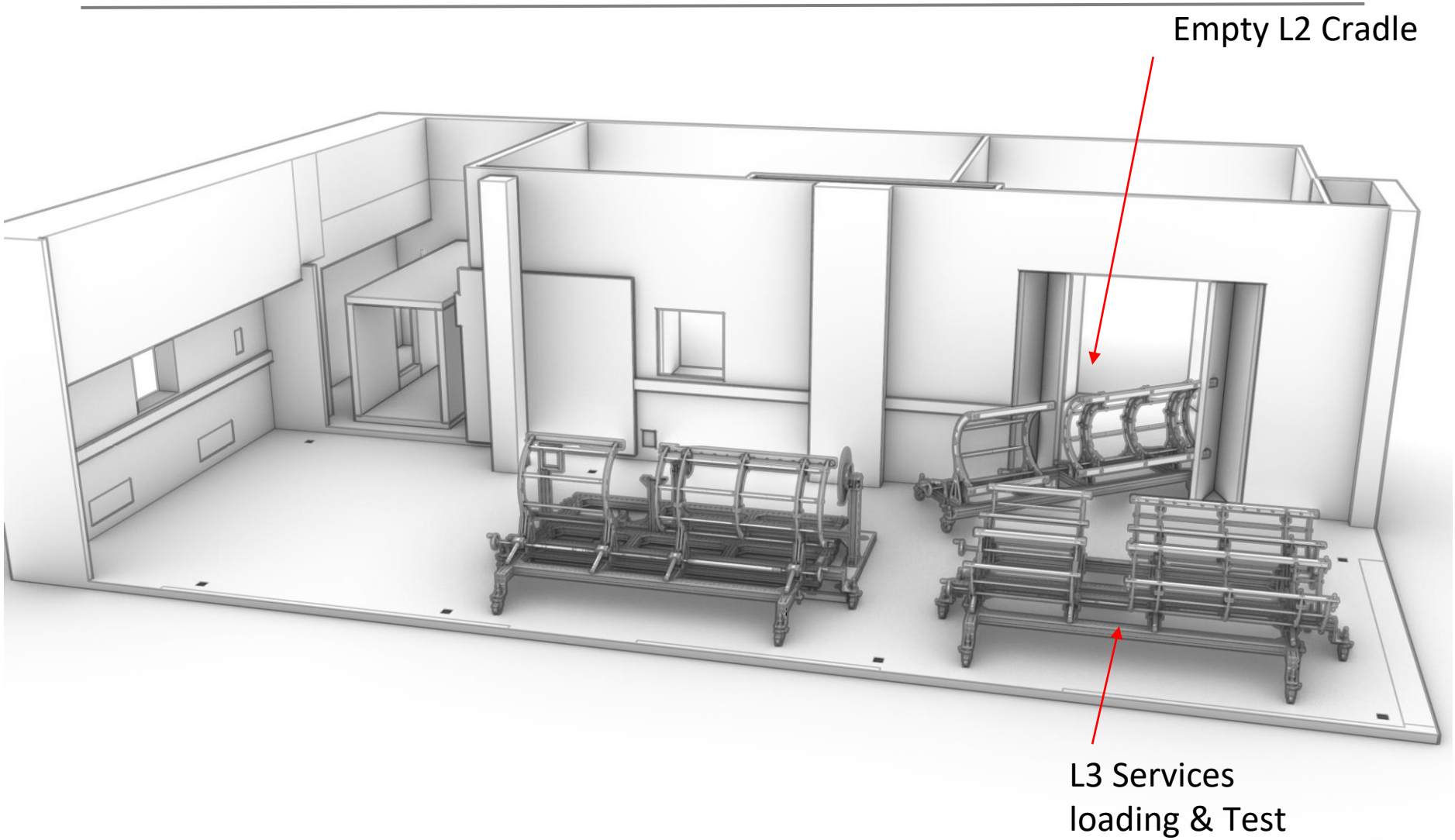
L2 Joining



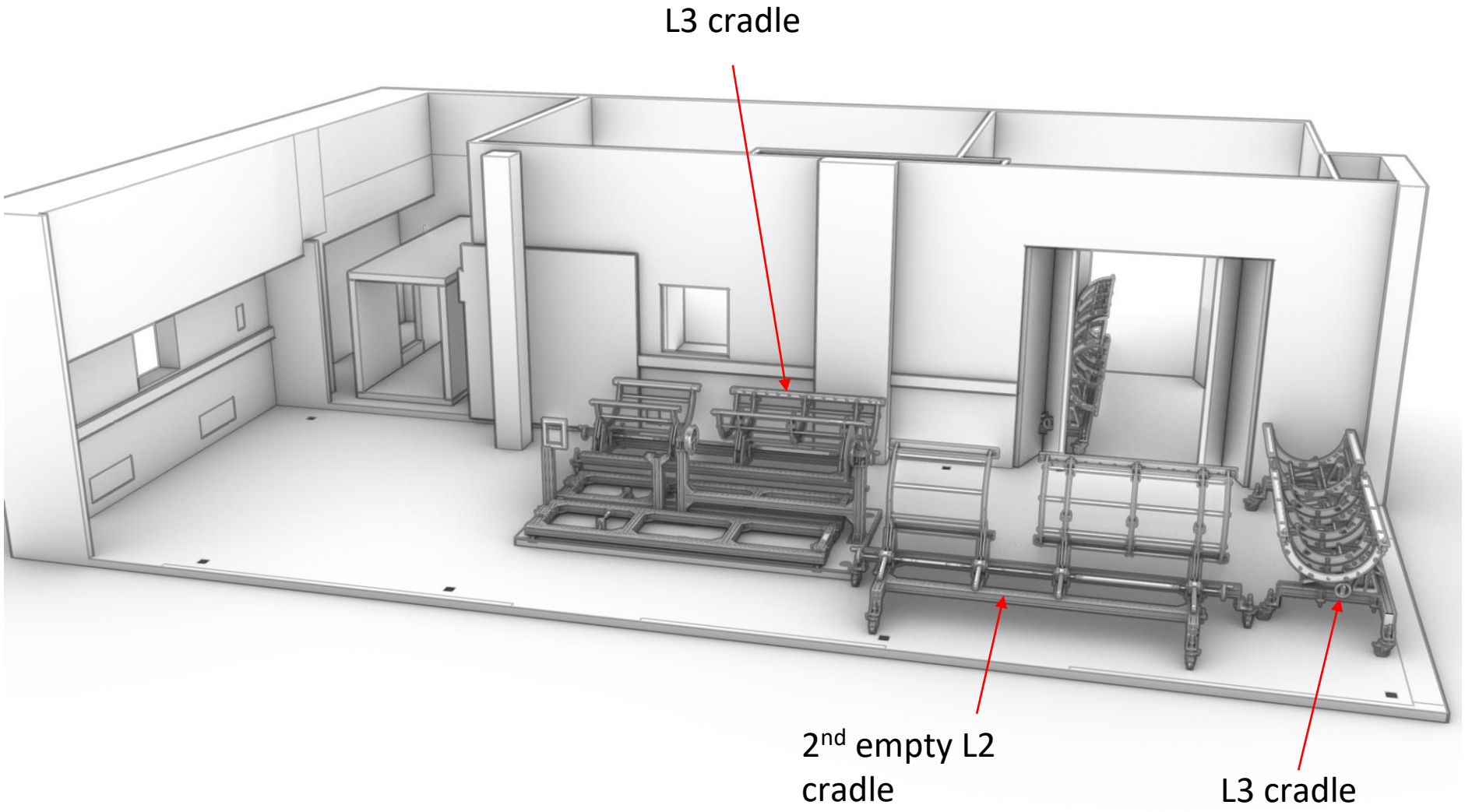
Both L2 half-cylinders at Integration Station

L3 Services loading & Test

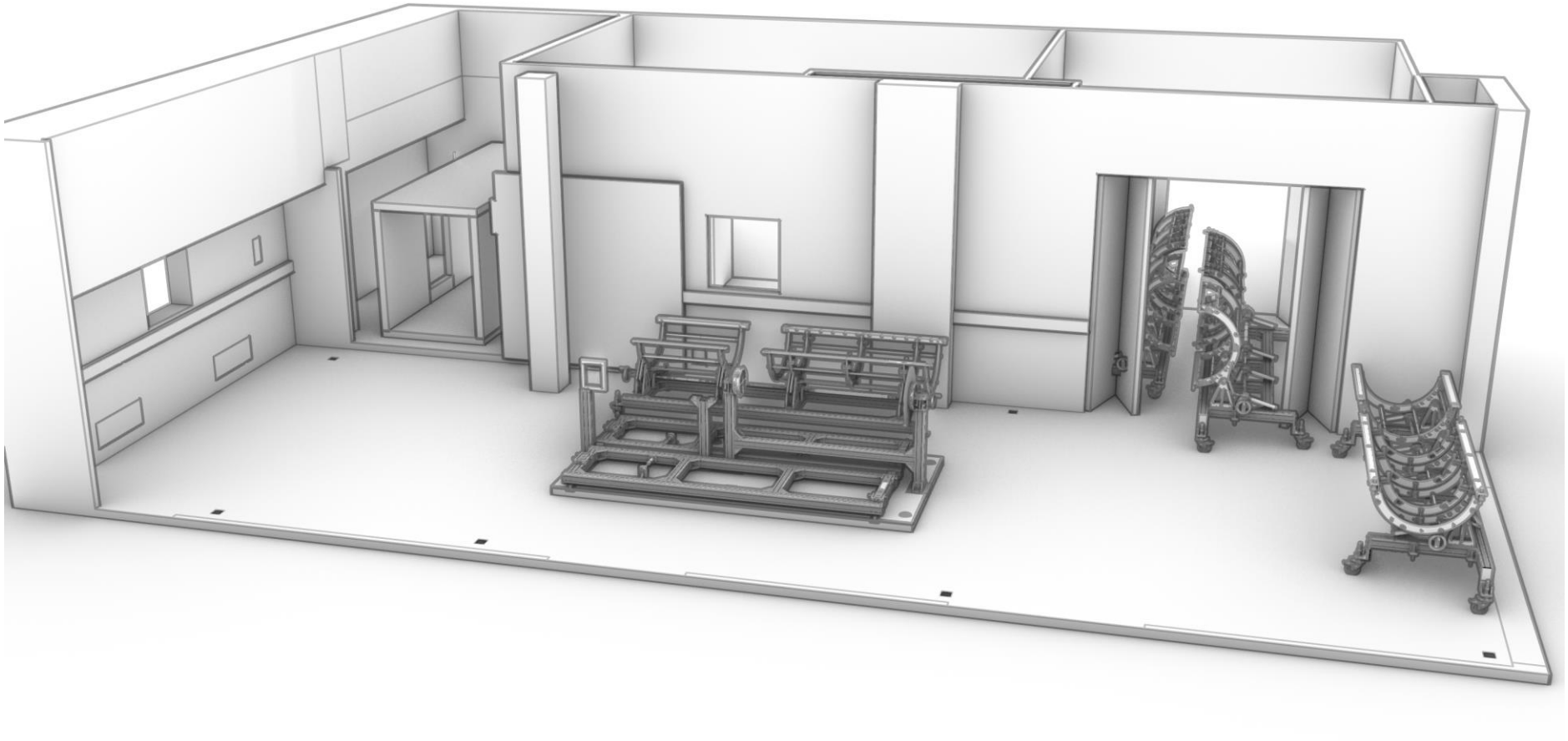
1st L2 Cradles to Loading Bay



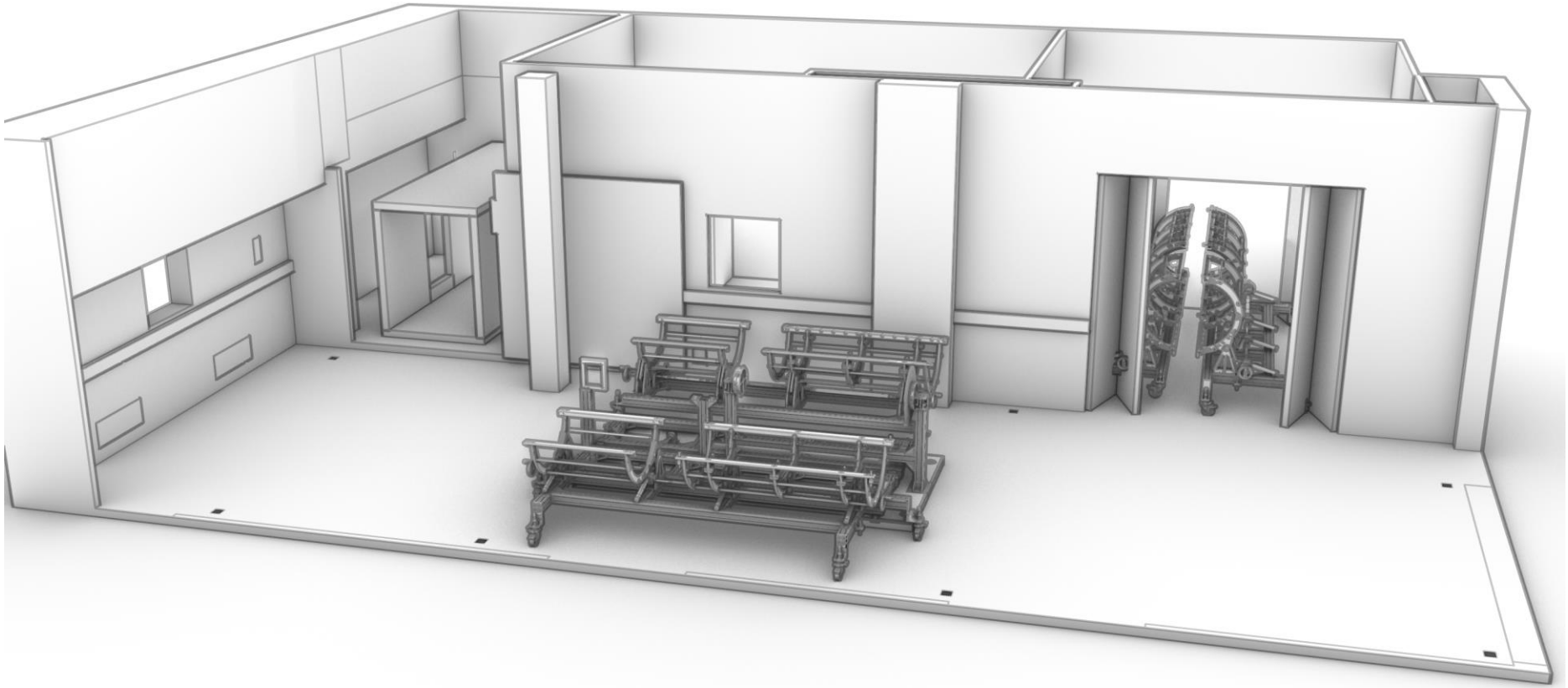
L3 Cradle to Integration Stand-by, 2nd L3 displaced to allow 2nd L2 to transfer to Loading Bay



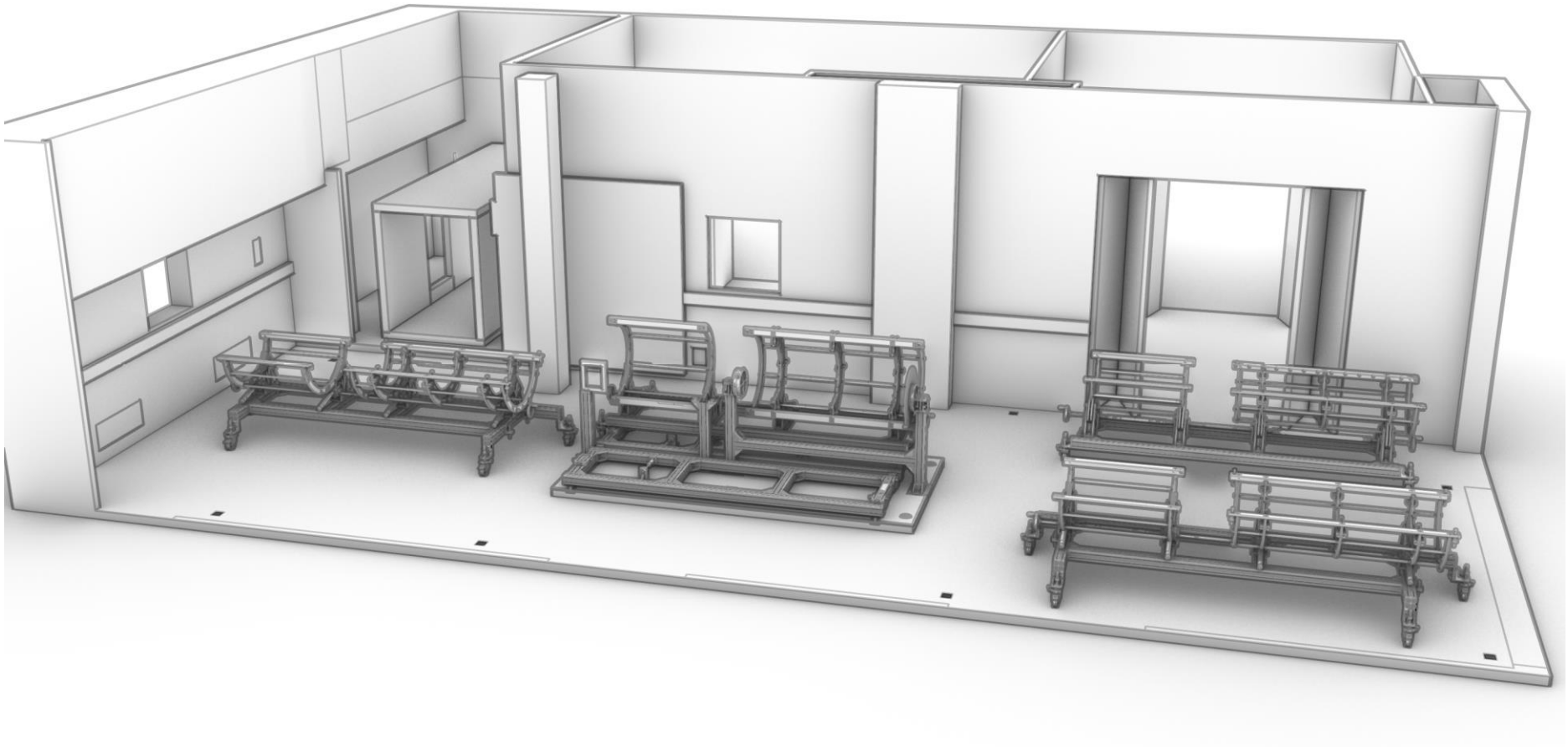
2nd L2 entering loading bay



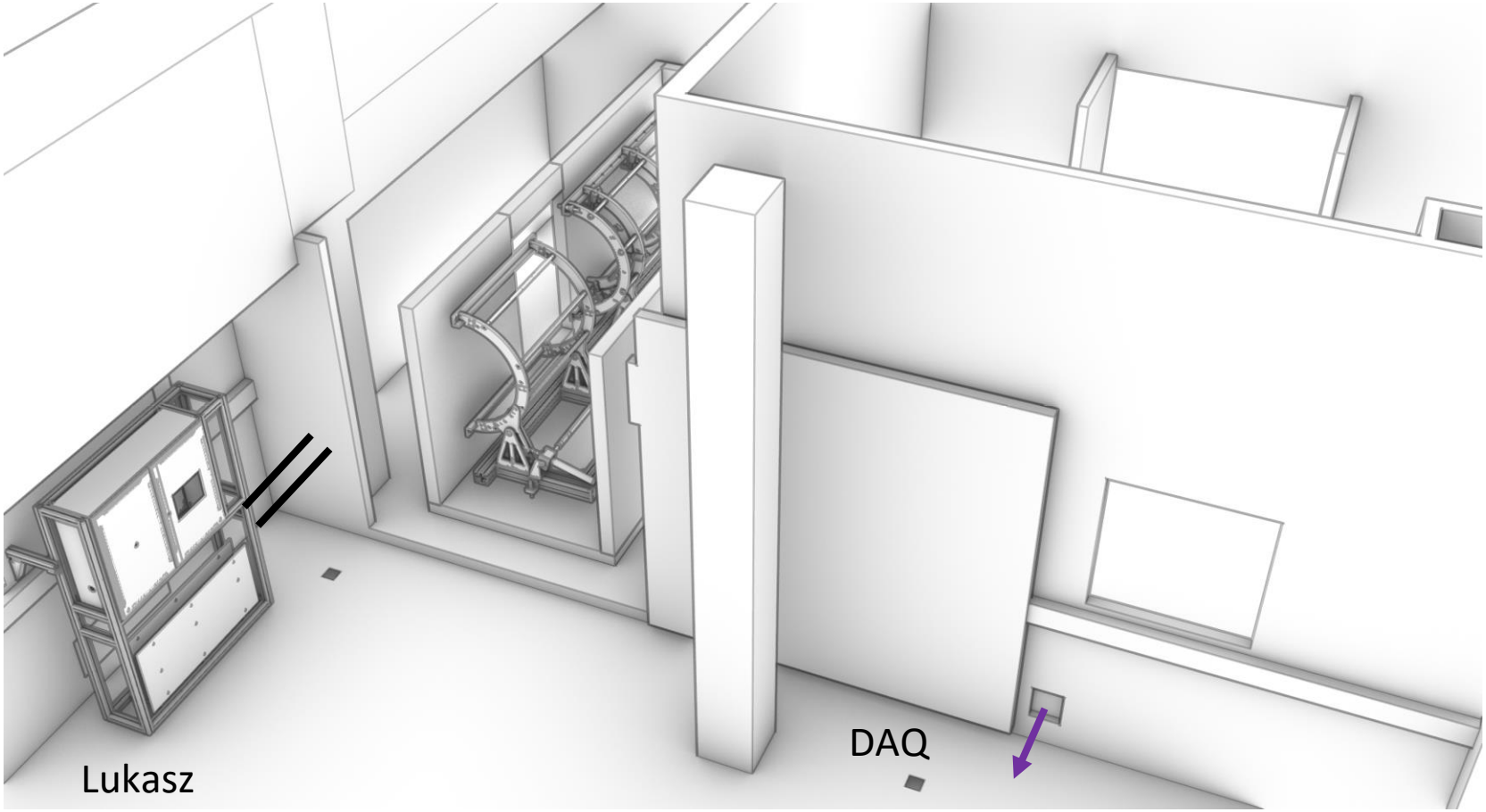
L3 Cradles at Integration / Stand-by



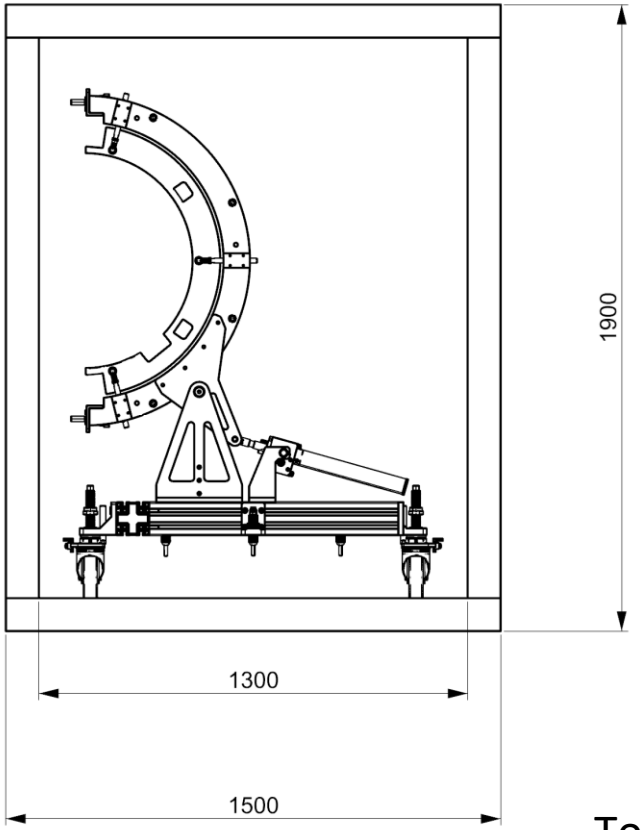
First L3 at Half-ring Mounting & Test, 2nd L3 Parked, L4s - Services assembly & Test

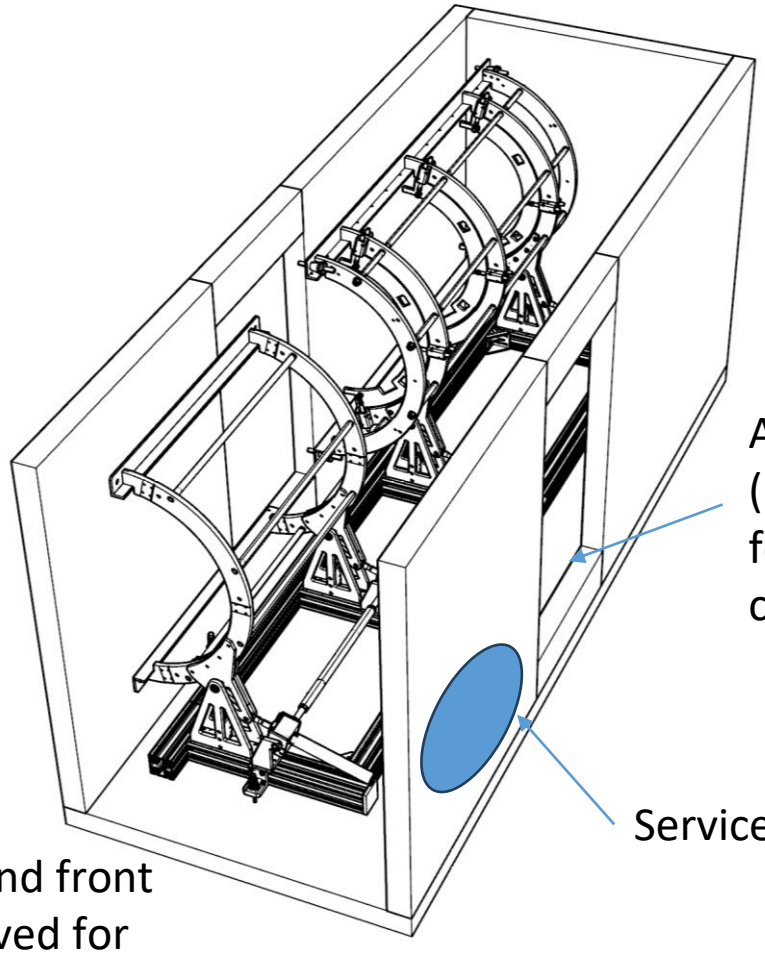


Half-Cylinder Test Enclosure in -20°C Cold Room



Half-Cylinder Test Enclosure



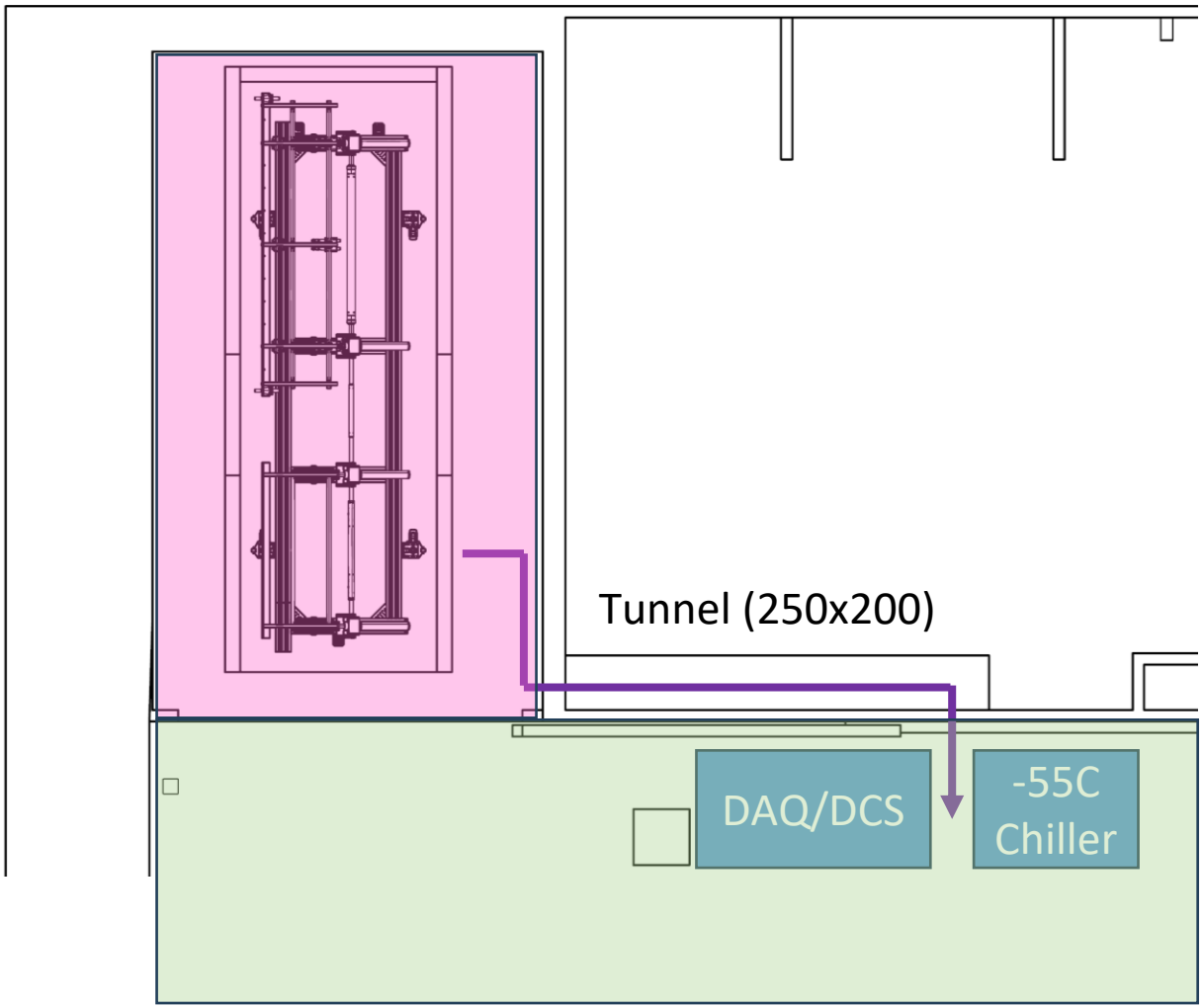


Access hatches (1300 x 800) for services connections

Services feed-thru's

Top and front removed for clarity

Services Routing



-55°C Chiller

- Julabo Presto A70
  - Min temp = -70°C
  - Cooling power > 0.4kW @ -60°C

Cooling capacity 1								Medium: Ethanol
°C	20	0	-20	-40	-50	-60	-70	
kW*	1.12	1.1	0.98	0.9	0.69	0.45	0.23	

Cooling capacity 2								Medium: Ethanol
°C	20	0	-20	-40	-50	-60	-70	
kW*	1	0.91	0.8	0.75	0.55	0.38	0.12	

Cooling capacity 3								Medium: Thermal HL90
°C	20	0	-20	-30	-40	-50	-60	-70
kW*	0.96	0.87	0.8	0.76	0.72	0.61	0.35	0.12

Test Enclosure Mechanics

- Available cooling power sets the specification for the thermal enclosure
  - Need Heat leak < 0.6kW @ -60°C
  - $Q = k.A.\Delta T/t$
    - *Area = 2 x (4x1.7) + 2 x (4x1.5) + 2x(1.5x1.7) = 24sqm*
    - *t = 0.1m*
    - *ΔT = -35 °C*
    - *k=0.05 W/mK*
  - *Q = 420W*

- Modular construction using metal-skinned foam cored sandwich panels would work well
  - Typical quoted k <0.03 W/mK
  - Need to watch for heat-leaks at joints

- Main issue is that what we want is very non-standard but early indications are positive – at a price !