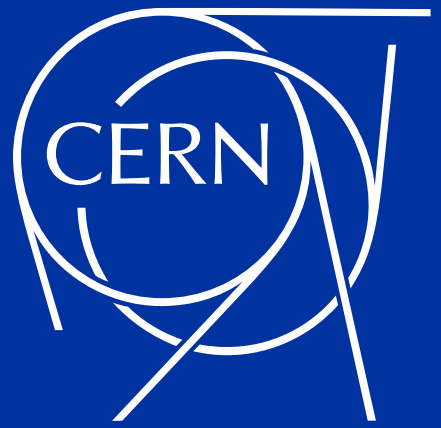


Target Station Configuration & Vacuum Vessel Design Study

30.01.2025

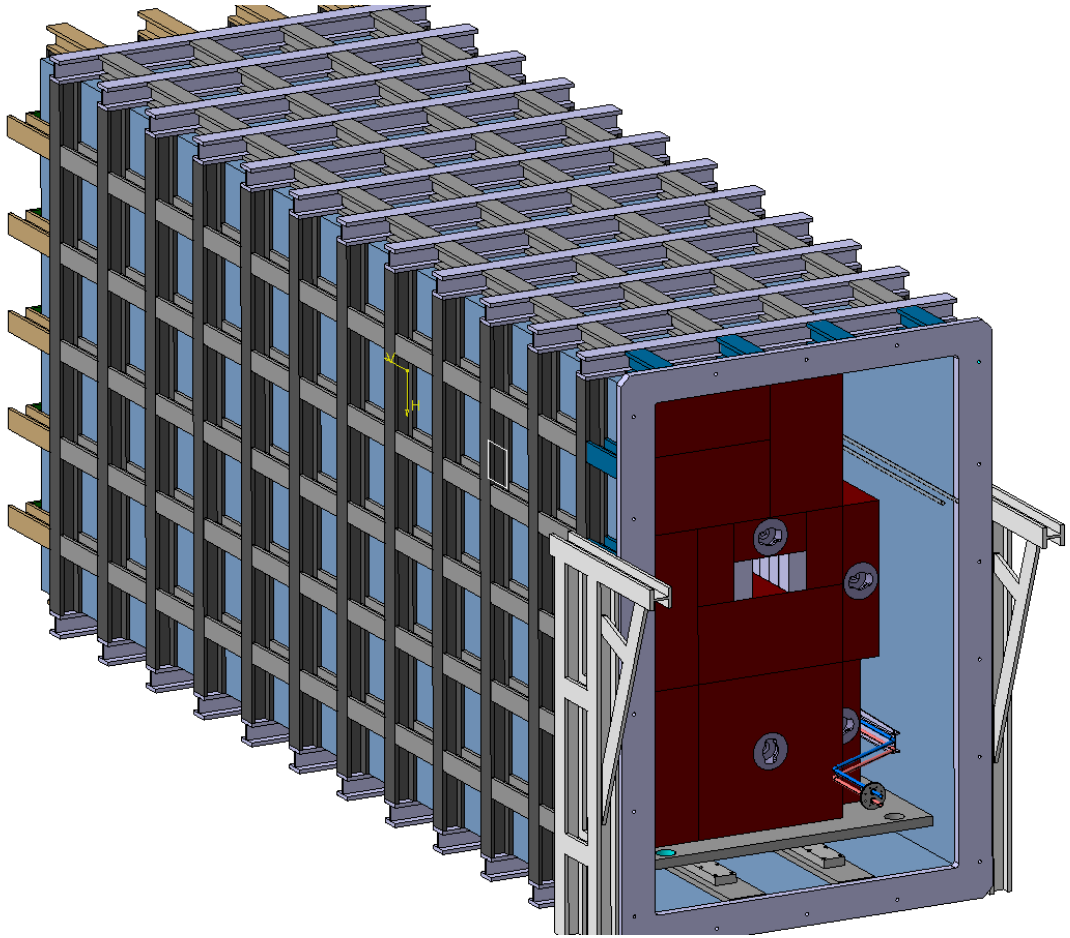
Introduction

- Vacuum Vessel Design Parameters
- Vessel Material and Structure
- Vacuum Vessel Technical Specification
- Prototype Tests
- Technetics
- Inputs Required

Rough Design Parameters for Vacuum Vessel

Parameter	Value
Beam Height	1700mm from ground, 1694mm from vessel base
Volumes (internal & external)	Internal = 28.96m^3, External = 38.96m^3
External Dimensions (without guide rails)	6410 x 2050 x 2965mm
Internal Dimensions	6210 x 1750 x 2665mm
Empty Weight	~25000kg
Foreseen Internal Load	~142000kg
Foreseen Kinematics Within Vessel	Internal trolley mounted on rails for extraction of target and shielding

Vessel Guide Rails

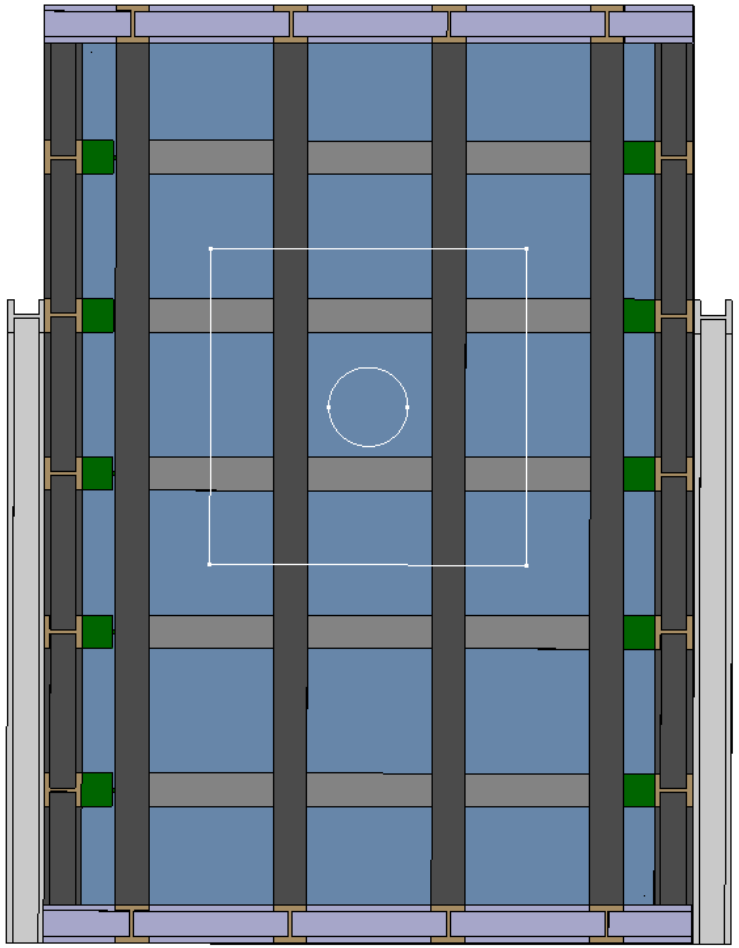


- **Dimension without guide rails:**
  6410 x 2050 x 2965mm
- **Dimension with guide rails:**
  6940 x 2290 x 2965mm
- **Guide rail dimensions:**
  1050 x 120 x 2035.5mm
  (of the 1050mm, only 530mm is protruding from the vessel)
- **The vessel will be installed without guide rails attached.**

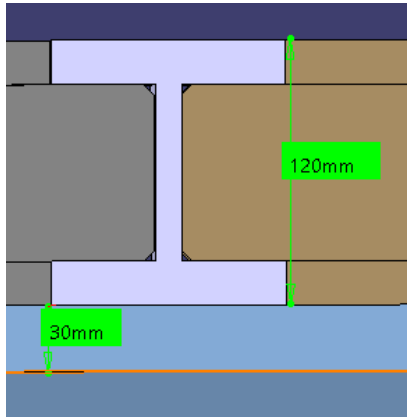
Vacuum Vessel Material

- **Vessel skin – most likely stainless steel**
- **Vessel structure – currently undecided however a few requirements:**
  - From an RP perspective:
    - No materials with a cobalt content that has a weight percentage of >0.1% - need to bear in mind if choosing a stainless steel.
    - Aluminium may be challenging to dispose of as radioactive waste (equally challenging from a construction point of view)
  - From SHiP perspective:
    - No material which is magnetic.

Vessel Structure



- Current structure utilises I-Beams 120mm tall paired with 30mm thick skin based upon structural steel for I-Beams
- Could change due to new material requirements.



- 250mm diameter target.
- 33.5mm clearance from target to lower I beam.
- SHiP confirmed Beams behind target doesn't affect results.

Vacuum Vessel Technical Specification

Deliverables Expected from Design Study:

- Design report
- Prototype recommendations
- 3D models
- 2D drawings with detailed explanation
- Detailed calculations including structural loads
- Assembly and installation recommendations
- Factory Acceptance Test recommendations
- Cleaning methods required
- Inspection procedure requirements

Rough Timeline:

	Event	Time to Complete
Prototype	Definition of Requirements	2 Months
	*Preliminary Design	4 Months
	*Preliminary Calculations	2 Months
	Prototype Production	6 Months
	Prototype Testing	2 Months
Full Vacuum Vessel	Technical Specification of Final Vessel	3 Months
	Contact Contractor	2 Months
	Detailed Design and Analysis	6 months
	Review of Design	1 Month
	Vessel Production	6 Months
	Factory Acceptance Tests	1 Month
	Delivery of FAT report and CERN acceptance	1 Month
	Authorisation to deliver vessel	2 Weeks
	Delivery of vessel	3 Weeks
	Installation of vessel	2 Weeks
	Conduct testing	3 Months
	Analyse Results	1 Month

* Run in parallel
~3.5 years total

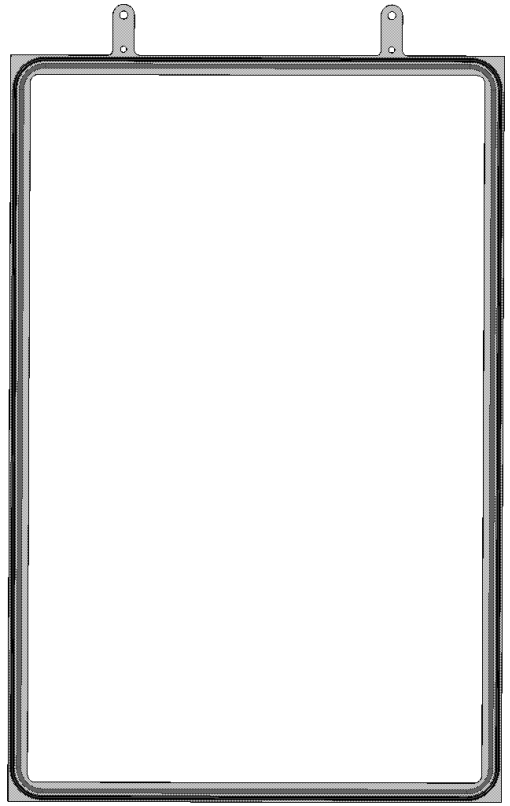
Prototype Tests

Part of the prototype will be required to conduct bellows testing, foreseen tests to be:

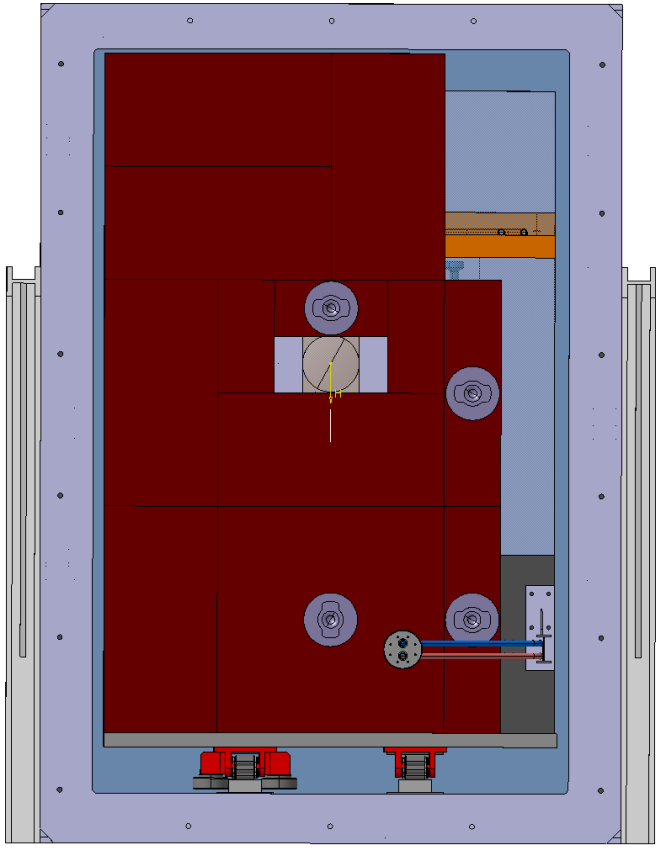
- Installation of the bellows to the vessel door
- Flexibility of the bellows integrating with the connecting coolant pipes
- Radiation exposure
- Installation and removal of bellow if the event of a radiation leak within the vessel

Discussion with Technetics concerning:

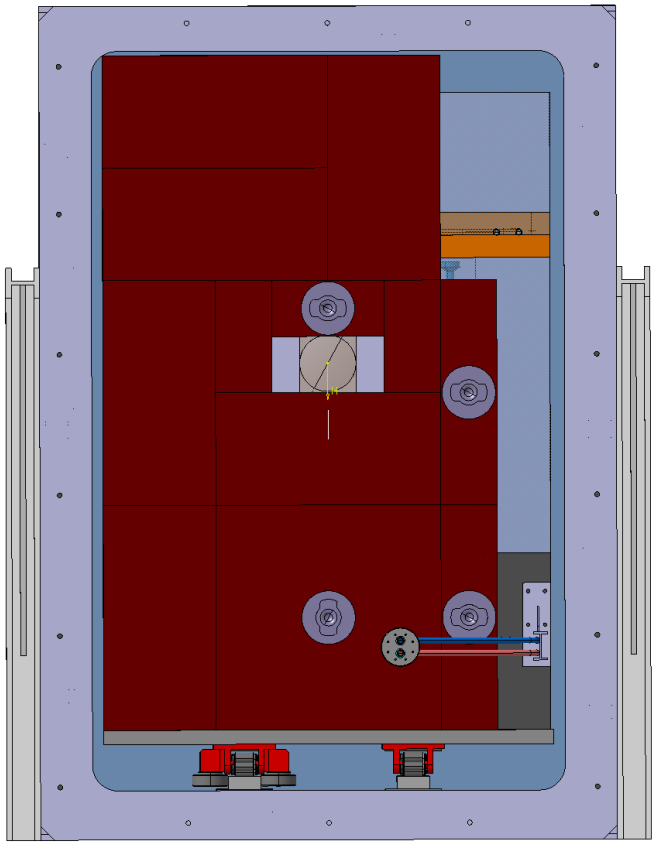
- Seals for bellows within vacuum vessel door
- Seal for connection of door to vessel
- Quick disconnect system onwards from helium pipes leaving the bellows out of the vacuum vessel door
- Possibility to produce and test the prototype for us



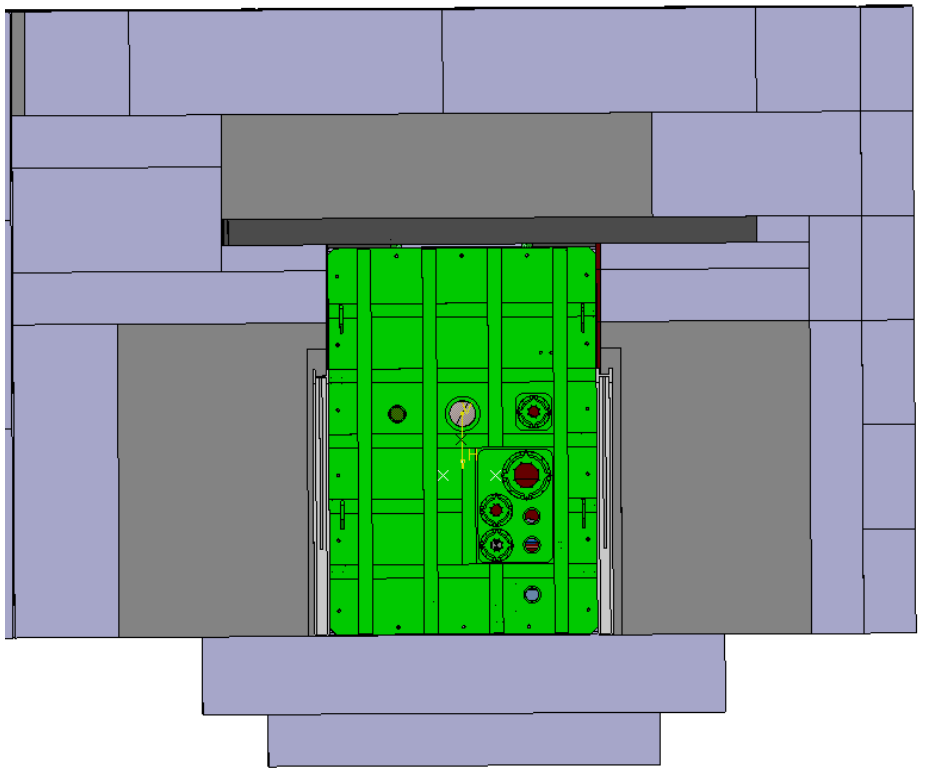
Inputs Required - RP



20mm Radius Edge Fillet



90mm Radius Edge Fillet



Assessment of if a pool needs to be built into the ground beneath vacuum vessel and filled with shielding.

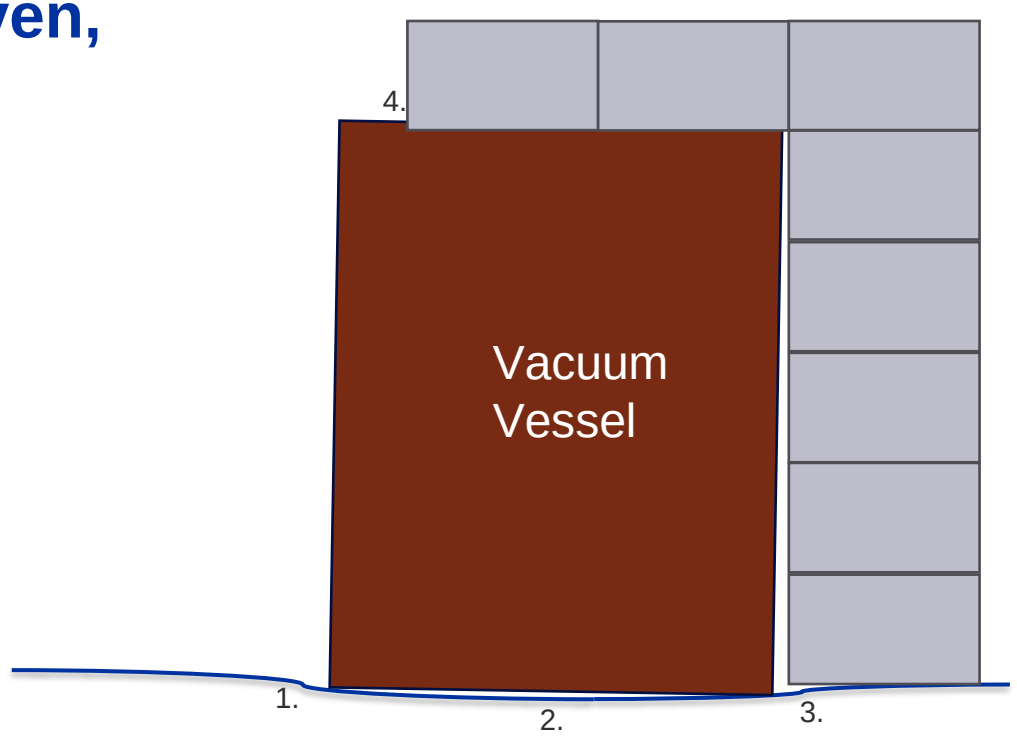
Evaluate what radius/chamfer angle can we have on the vessel door which still allows for enough shielding within the vessel.

Inputs Required – Surveying Team

Potential for ground in TCC8 to be uneven, problems this could cause:

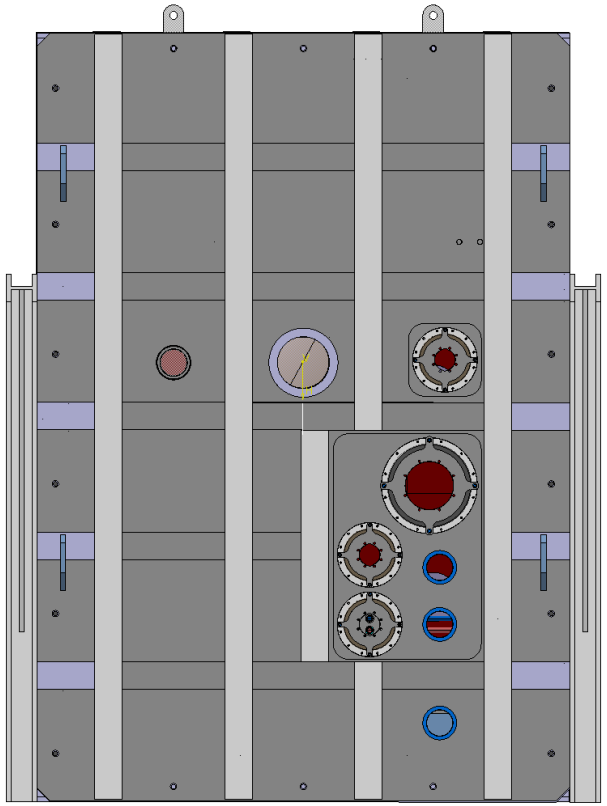
Potential Problems	Potential Mitigation
Target misaligned with beam line.	Installing a pool within the floor could also aid in levelling the floor.
Shielding blocks not fitting correctly around the vessel due to their standard sizes.	Adjust the thickness of the vessel skin and structure to make the top of the vessel compatible with a certain height of shielding blocks.

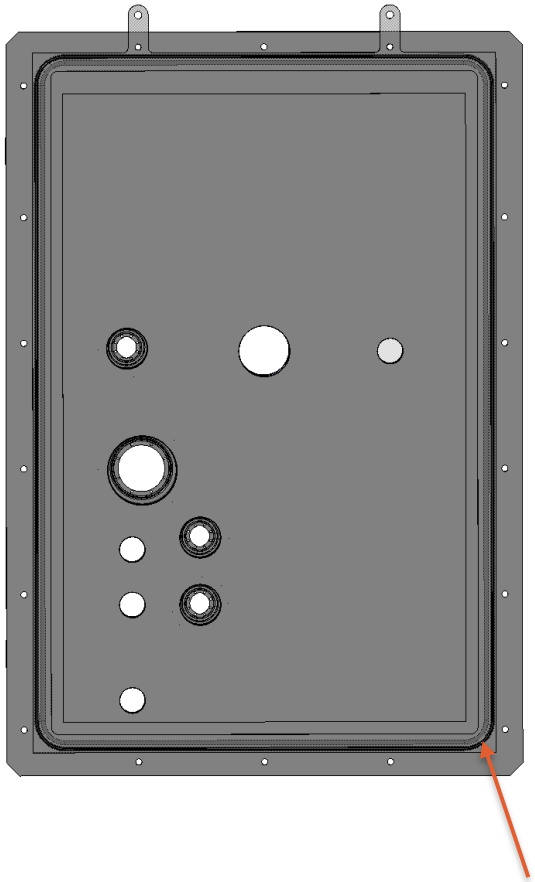
Need to assess the current floor level and if vessel skin thickness would need to be adjusted/floor levelled.

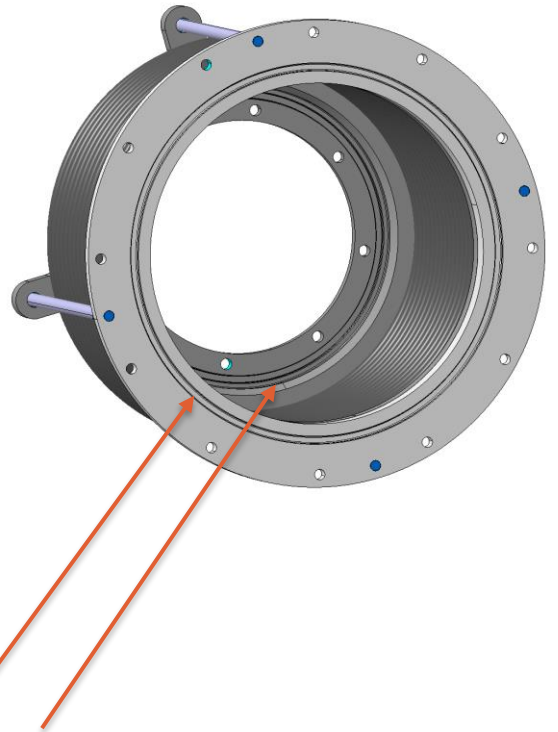


1. Floor is uneven
2. Vessel sits on a slope
3. Shielding installed level
4. Shielding clashes with vessel

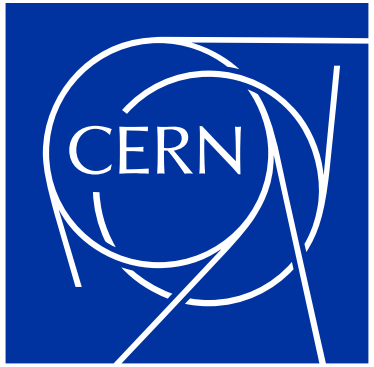
Inputs Required - Robotics







- Best method for installing vessel door onto vessel – if a special screw is needed
- Method for replacing the gaskets in the bellows and in the vessel door if an unexpected leak occurs within the vessel



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