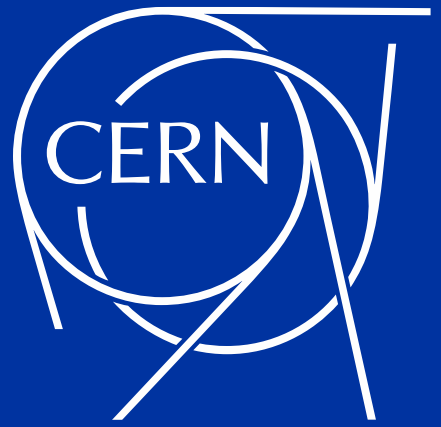


The ET pilot sector at CERN

CERN

ET project Work Package 10 (Jan Hansen)

Workshop 28-03-2023

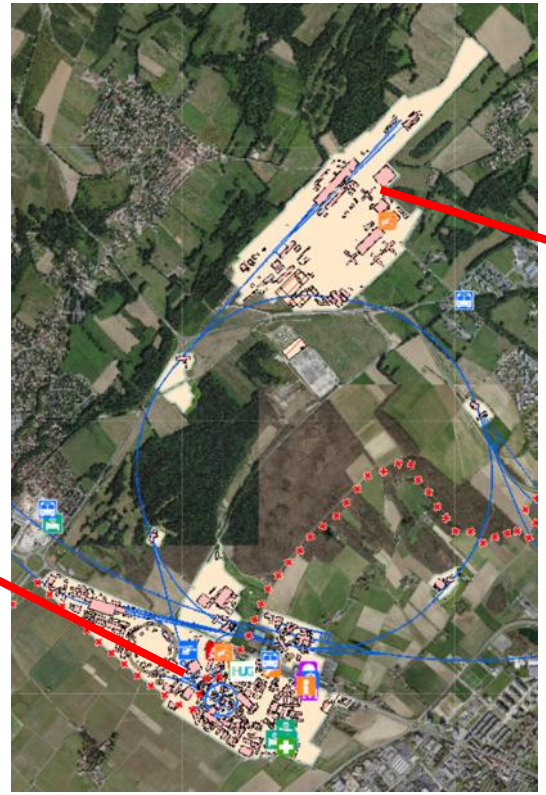
Content

- **Location for the ET pilot sector installation: requirements vs. reality.**
- **Supports and tube, in-situ assembly, and commissioning.**
- **Bakeout: means and methods.**
- **Time line.**
- **Required and possible measurements.**

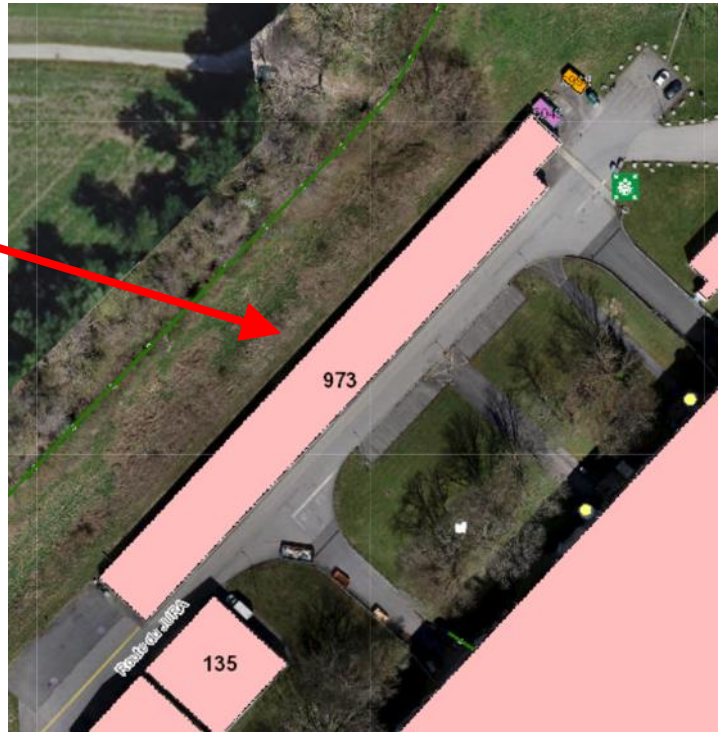
Identification of area for pilot test sector

- **Two areas were** identified **for installation of the pilot** as potential locations.

TT1 tunnel



Bulding 973



Potential locations analysis for pilot sector

	Advantages	Disadvantages	Summary
TT1 tunnel	✓ Tunnel like environment ✓ Stable temperature and humidity	✗ Difficult transport with max lenght to ~ 7m -> cannot test the full process (cleaning, bakeout, etc,) on an ET-like tube. ✗ **Not possible double tube setup** ✗ Availability to start civil works **not before Q4 2024** ✗ Co-activity with the survey testing campaigns ✗ Cost for Civil Engineering (cutting pillars) and electrical distribution depending on tunnel area ✗ Special supports depending on tunnel area (inclination)	Deal breaker?
B973	✓ Available from Q1/Q2 2024. ✓ Easy access/installation. ✓ Sufficient space for double tube setup.	✗ Potential cost to have a constant humidity and a temperature within +/-3 degrees during the measuring campaign (to be verified with data taking period/profiles) ✗ Potential cost of renting a storage tent.	Easy fit! 

From presentation L.Scibile, J.Hansen

Identification of area for pilot test sector

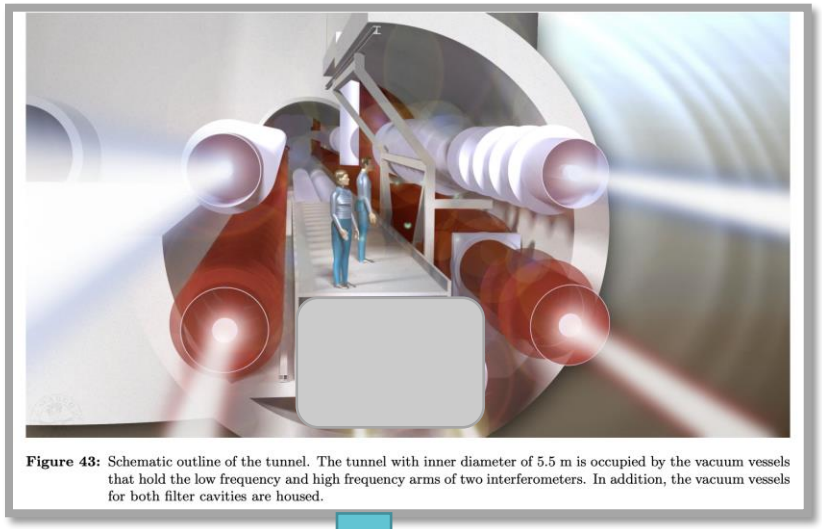
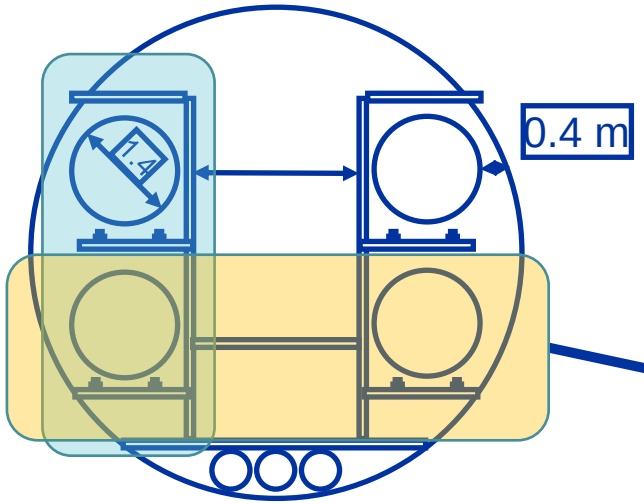
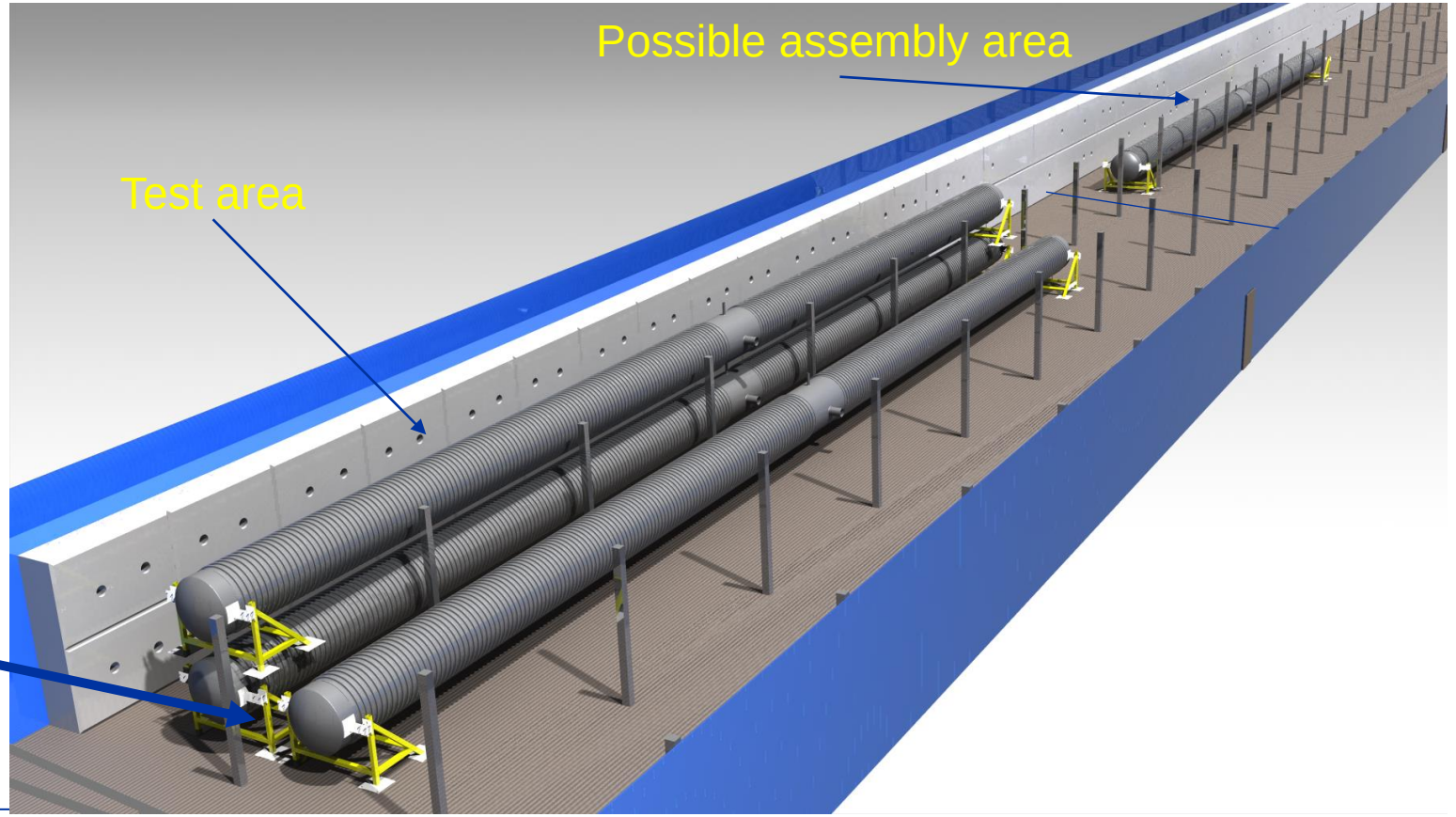


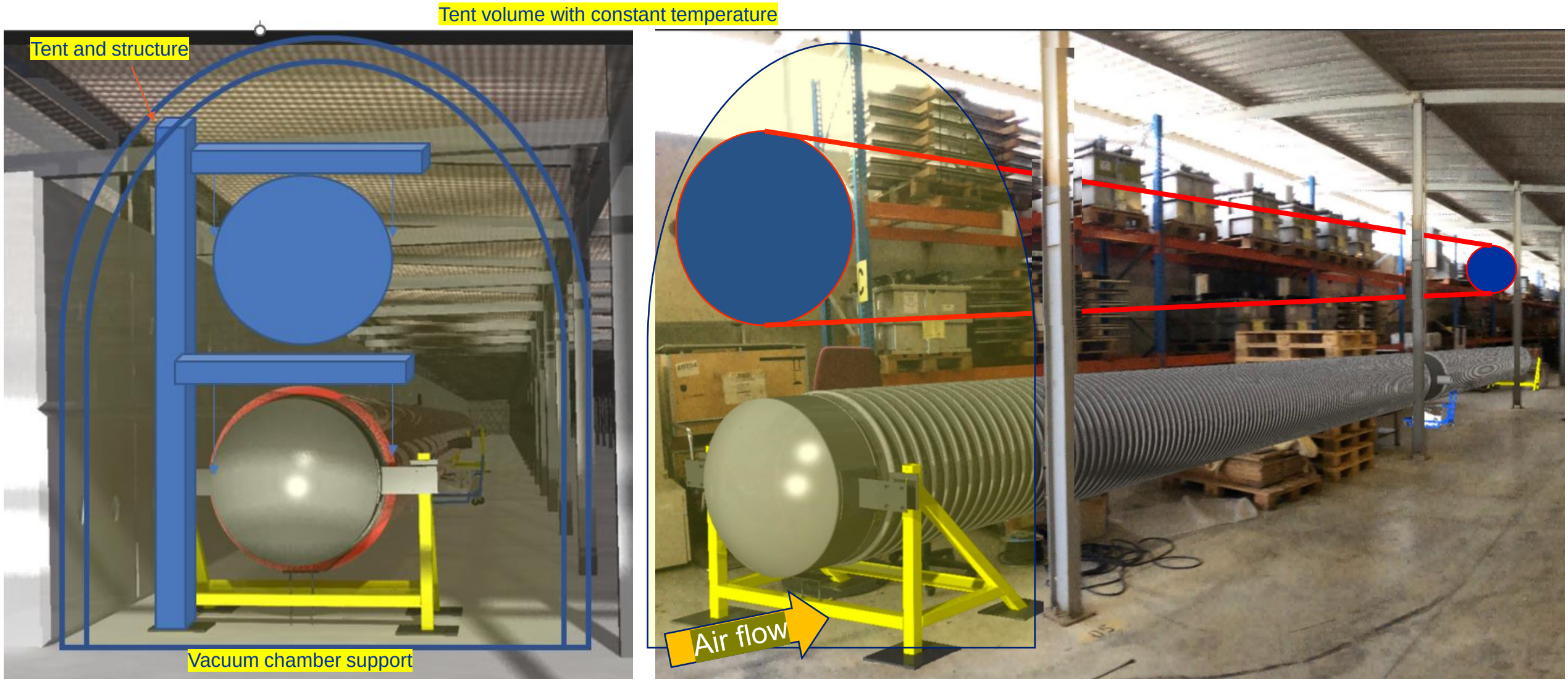
Figure 43: Schematic outline of the tunnel. The tunnel with inner diameter of 5.5 m is occupied by the vacuum vessels that hold the low frequency and high frequency arms of two interferometers. In addition, the vacuum vessels for both filter cavities are housed.



- Double tube installation:
  - Side by side or Stacked tubes,
- Possible infrastructure.
  - Tube assembly area and test area

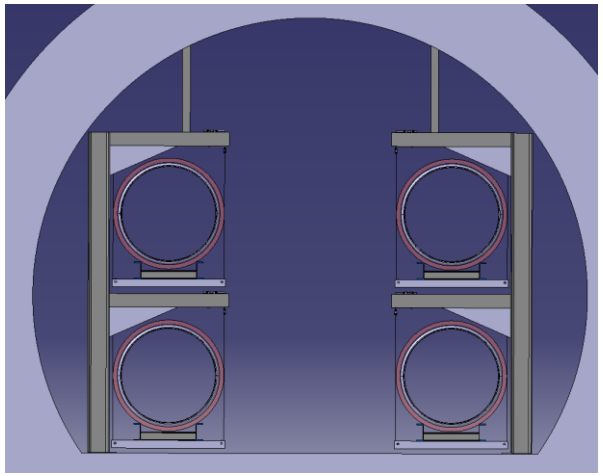


Conceptual model integrated in the B973



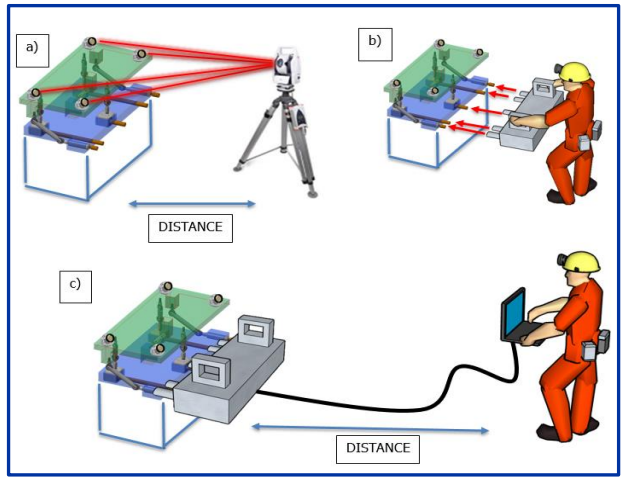
Supports & tube, in-situ assembly, and commissioning

Supports & tube, in-situ assembly, and commissioning.

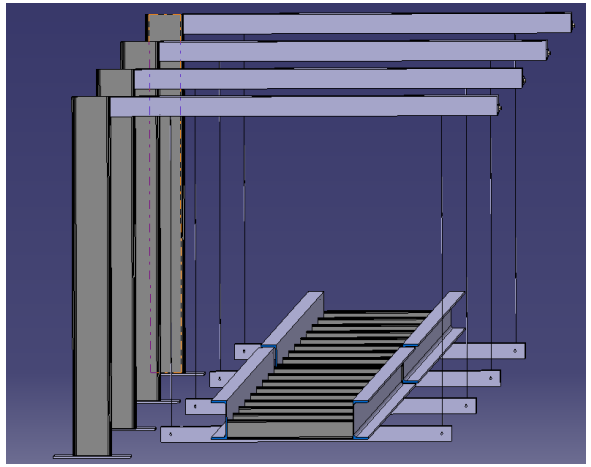


Support and tube concept

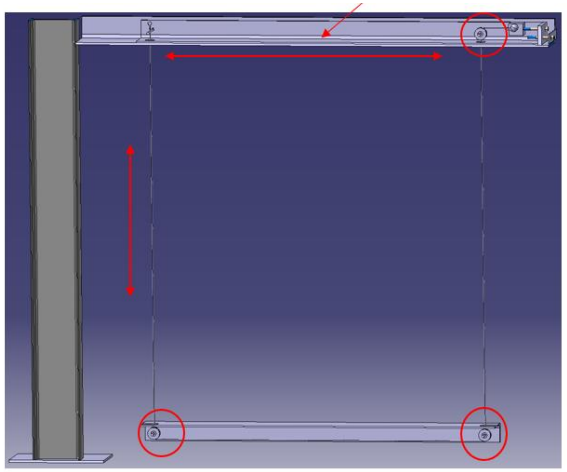
- Validate support & tube concept
- Stability measurements.
- Validate position of alignment features and adjustments concept used for the alignment



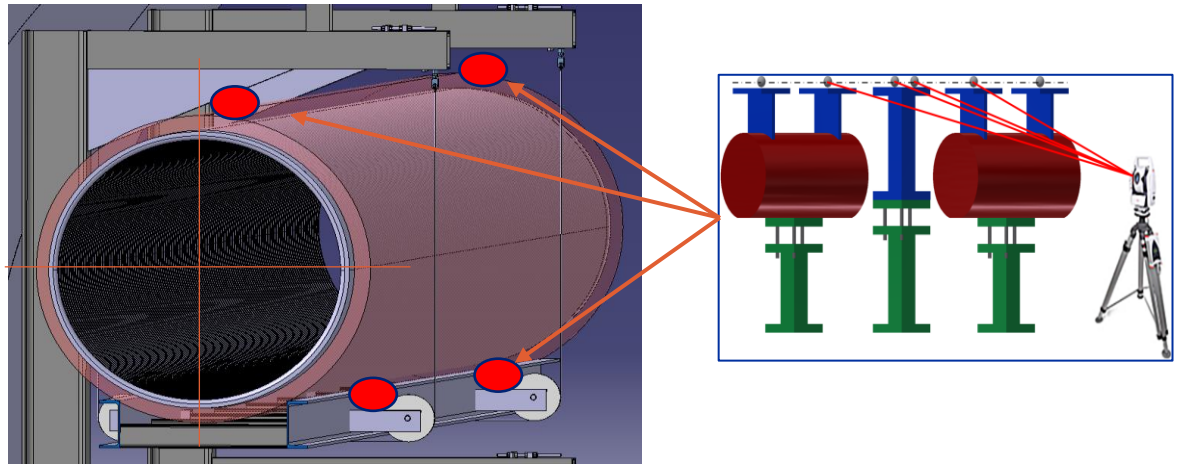
Manual or semi-auto alignment



Stability measurements

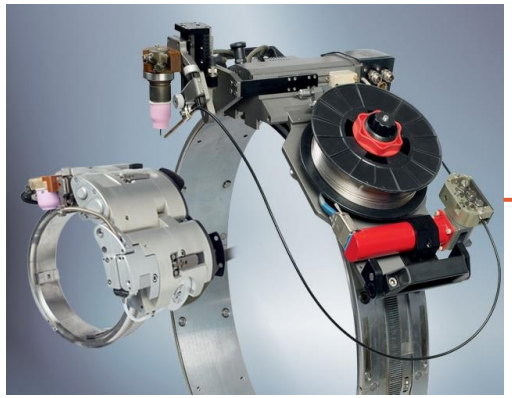


Adjustments for alignment

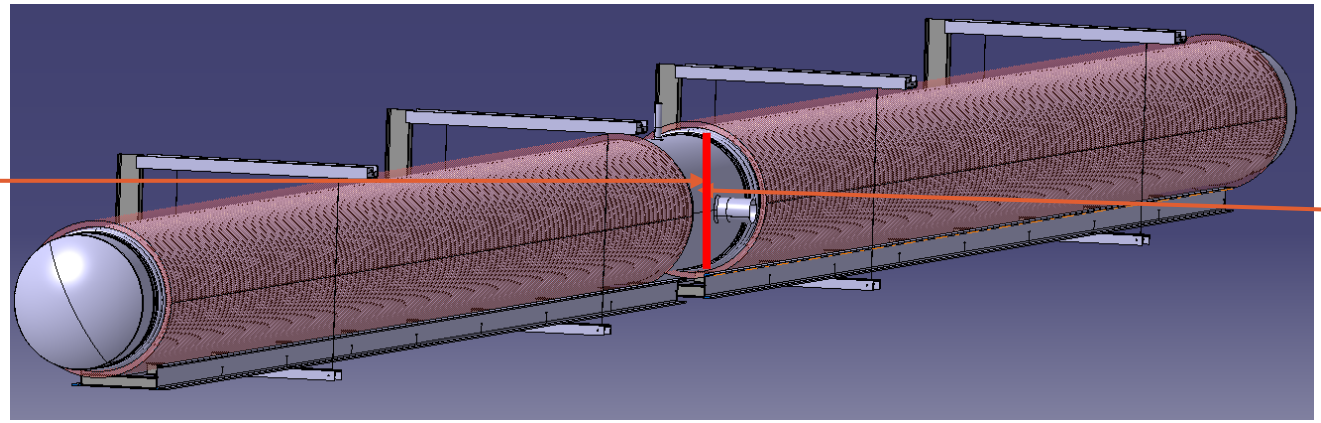


Alignment mires

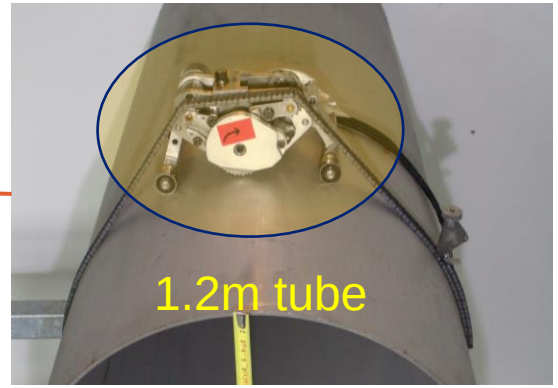
Supports & tube, in-situ assembly, and commissioning.



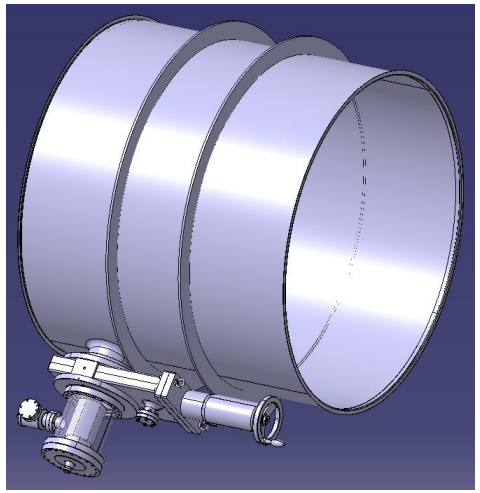
Mobile circular welding machine fixed to a guide ring installed around the tube



Assembly of tube with measuring and pumping ports

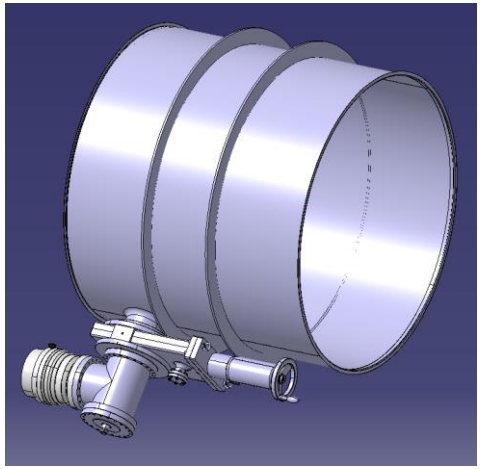


Mobile circular cutting machine fixed to a guide ring installed around the tube



Install valves & UHV pumps

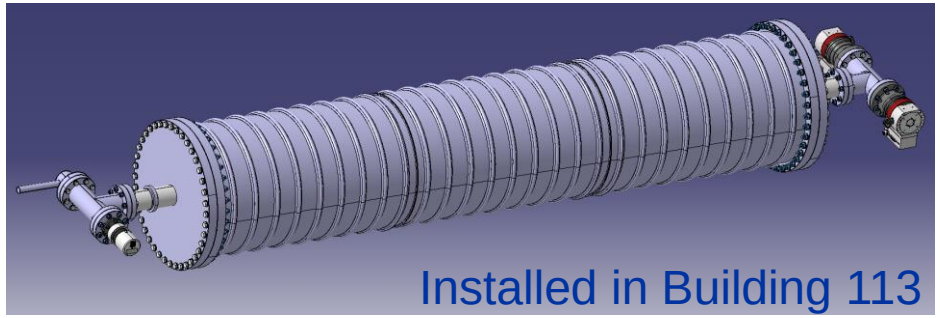
- Assembly, welding and cutting.
- Installation of pumps and gauges
- Recheck alignment.



Install gauges & HV pumps

Supports& tube, in-situ assembly, and commissioning

Pre-Pilot sectors



- *Ø 400 mm x 2000 mm*
- *Plate thickness < 2 mm*
- *Corrugated solution*
- *Weld qualification (WQ) according to CERN requirements for vacuum components*

Austenitic stainless steel — AISI 304L

Manufacturing	WQ
Longitudinal welding	NDT
Forming/corrugation	Metallurgy
Cleaning	Tensile testing
Thermal treatment	Erichsen test
Circular welding	…
Flanges welding	

Ferritic stainless steel — AISI 430

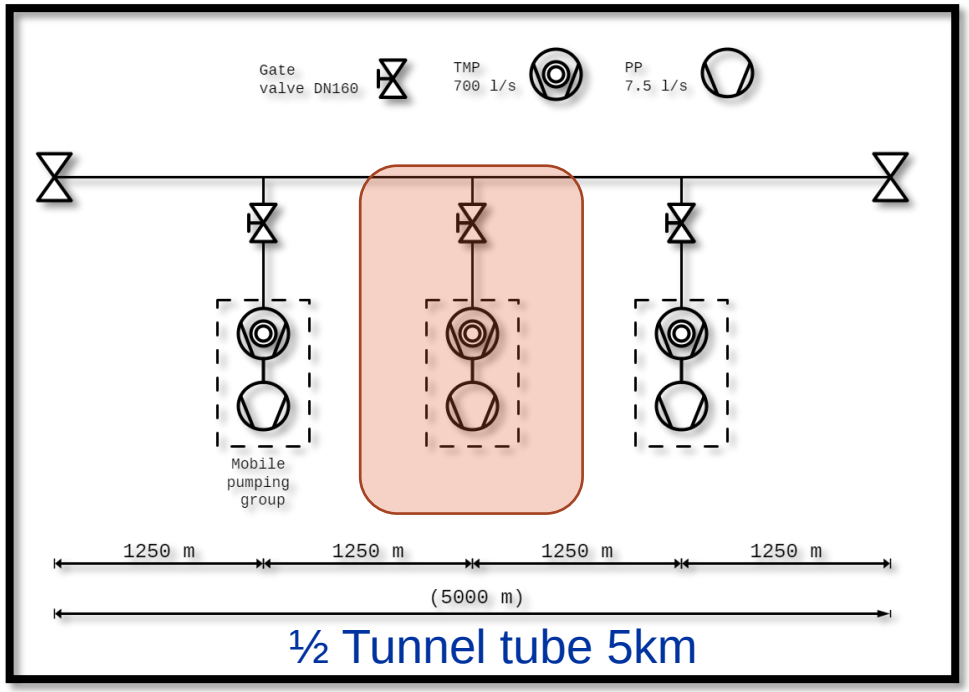
Manufacturing	WQ
Longitudinal welding	Metallurgy
Forming/corrugation	Tensile testing
Cleaning	NDT
Circular welding	Erichsen test
	…

Structural mild steel — S315MC

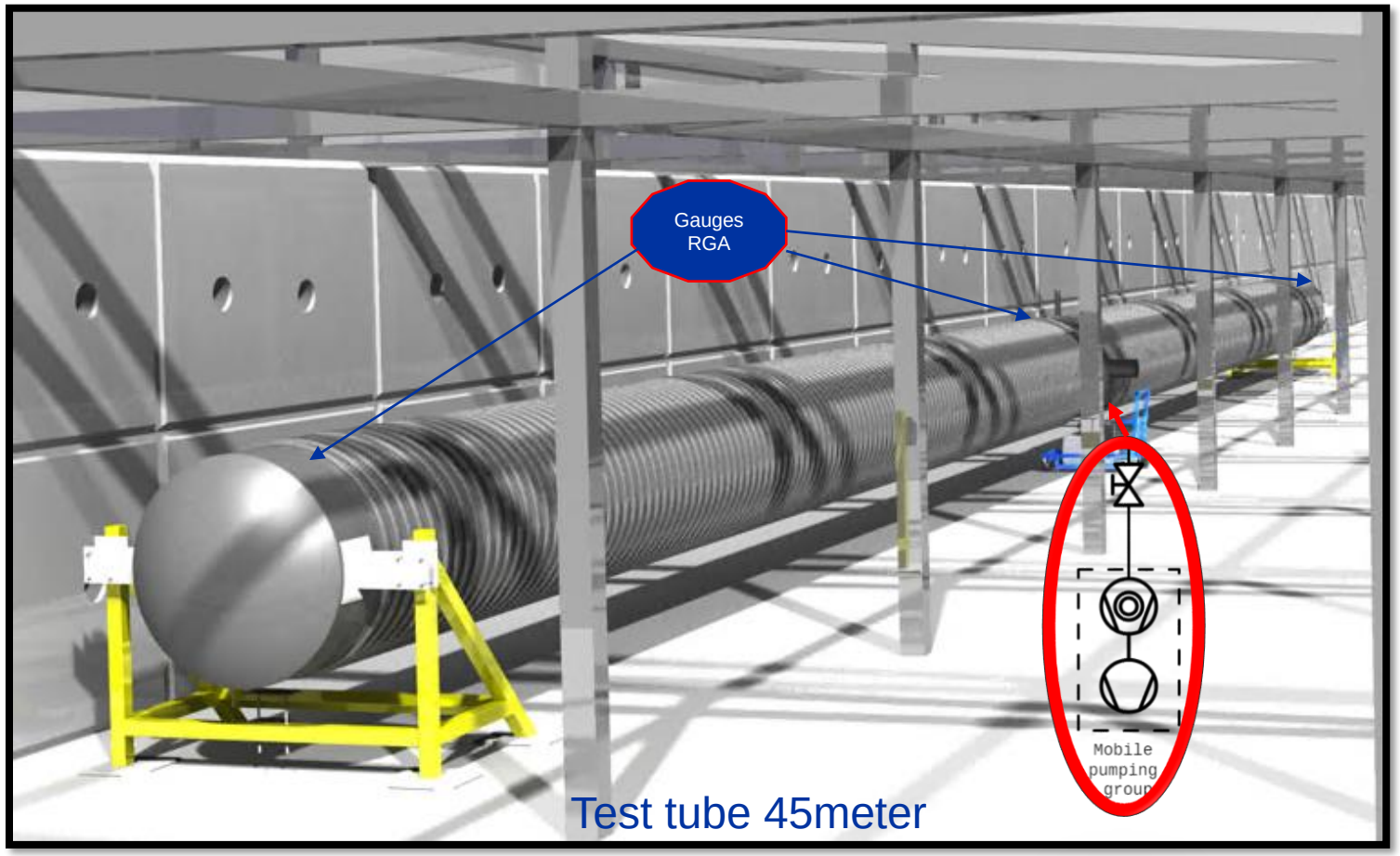
Manufacturing	WQ
Longitudinal welding	Metallurgy
Forming/corrugation	Tensile testing
Cleaning	NDT
Circular welding	Erichsen test
Flanges welding	…

Courtesy WP1

Supports& tube, in-situ assembly, and commissioning



½ Tunnel tube 5km



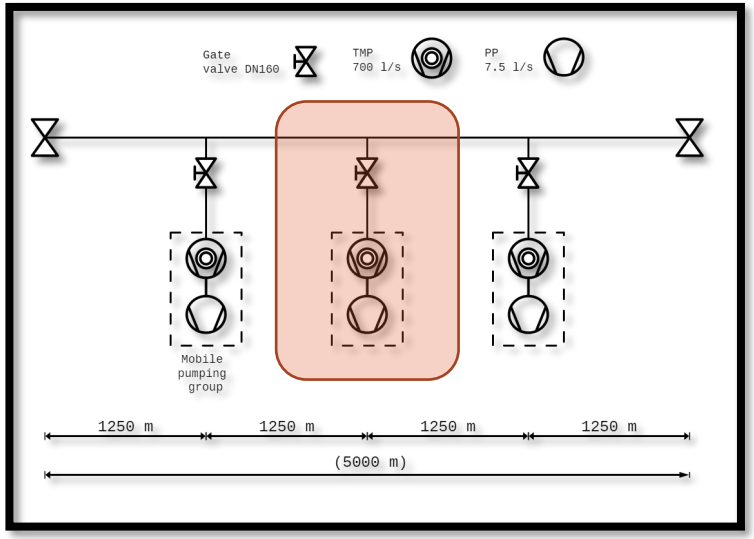
Test tube 45meter

- One turbo molecular pumping systems with fixed conductance to extrapulate from 45 meter to 5 km.
- Three pressure measuring ports: extremities and in the center.
- Final residual gas analysys

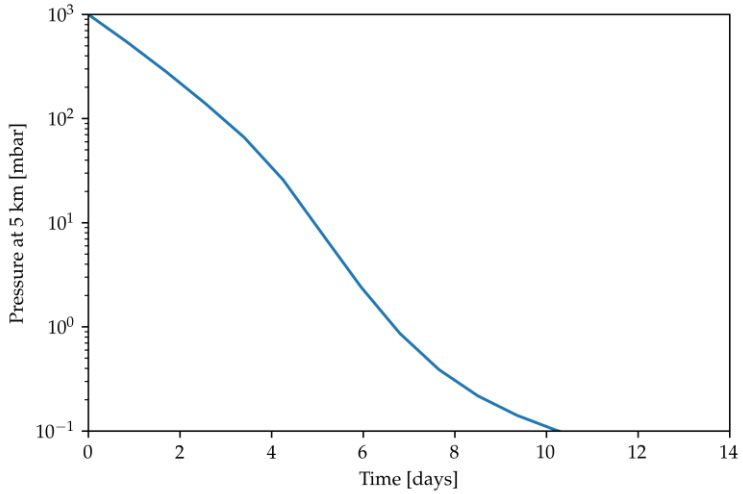
Test: Supports, in-situ assembly, and commissioning.

Commissioning of the vacuum system.

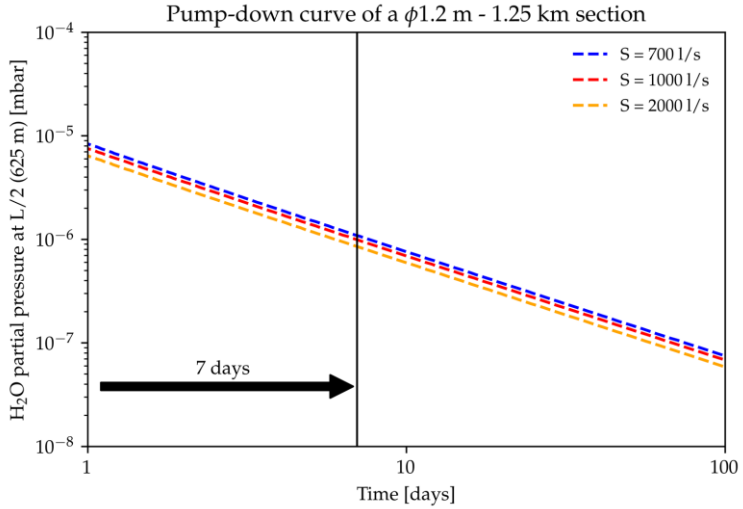
- Rough pumping (from atmospheric pressure to 10^{-1} mbar)
- Intermediate pumping (from HV to UHV range)
- Bake-out
- Steady state pumping (UHV range)



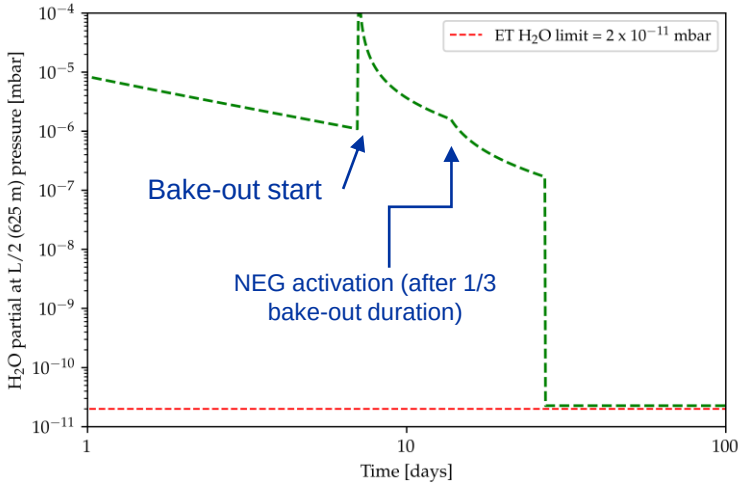
1 – Rough pumping



2 – Intermediate pumping



3 Bakeout & Steady state



From C.Scarcia presentation

Bakeout means and methods.

Bakeout: means and methods.

Mineral wool

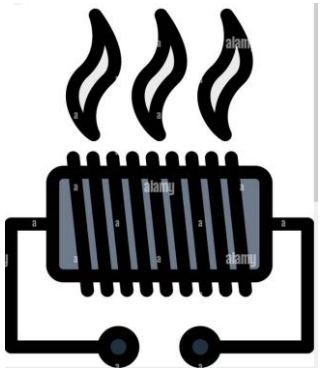
EPDM

Phenolic/ Polyurethane foam

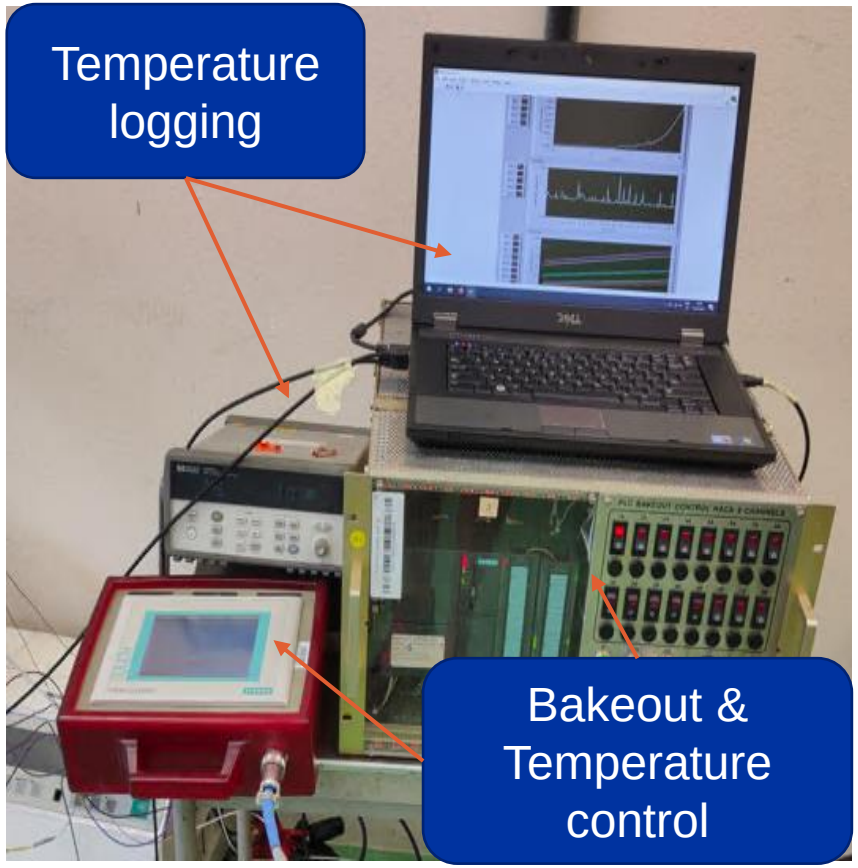
Aerogel

Bakeout insulations

- Insulations
- Installation and bakeout methods.
  - Plan A: Joule effect
  - Plan B: Standard CERN bakeout (heating tape and jackets)
- Controls and logging



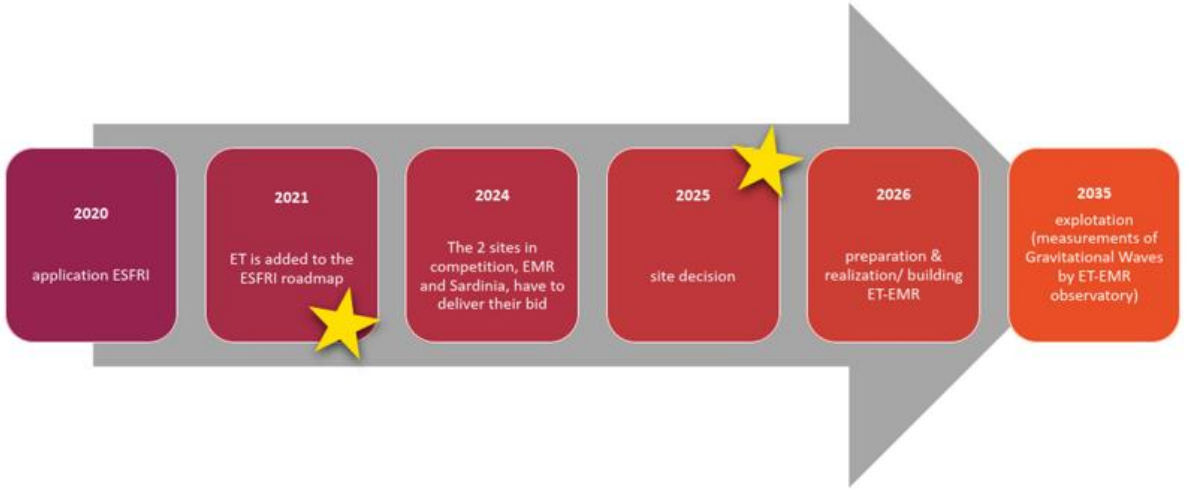
Bakeout installations & methods



Bakeout controls, logging

Time line.

Preliminary schedule Pilot sector



Main deliverable: provide design report by end 2025

	2023				2024				2025				2026			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Design report																
Removal and cleaning of B973																
Finalize required infrastructure (tent)																
Installation of infrastructure																
Design of support, tube, bakeout, controls																
Ordering																
Manufacturing and cleaning																
Assembly																
Test program																

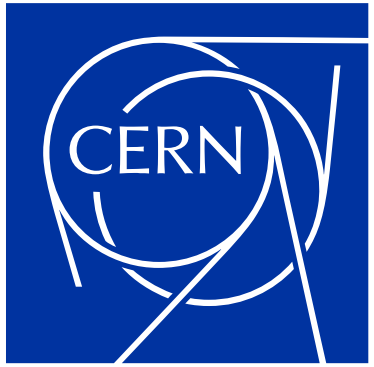
Block choice of bakeout method

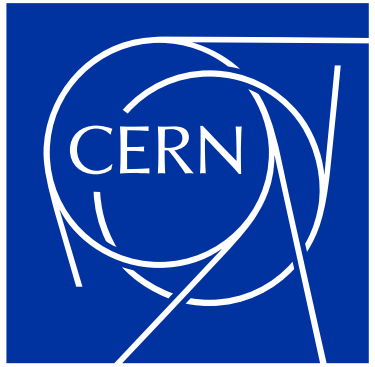
Required and possible measurements.

Resume of measurement program.

- **Foreseen measurements**
  - Installation and Alignment of supports and tubes
  - Welding and assembly
  - Leak detection scenarios: Assembly and Operation
  - Pumping down time and bakeout time scaled from 5km to 45m tube
  - Residual Gas Analyses
  - Temperature during activation and operation (tunnel and vessel)

- **We are open for other experimental measurements.**
  - Dust concentration inside tube and on the baffles ?
  - Dust displacement inside the tube (from vacuum to atmospheric pressure)?
  - Alignment of baffles inside the tube ?
  - Vibration transfer function: Supports, tubes and baffles ?

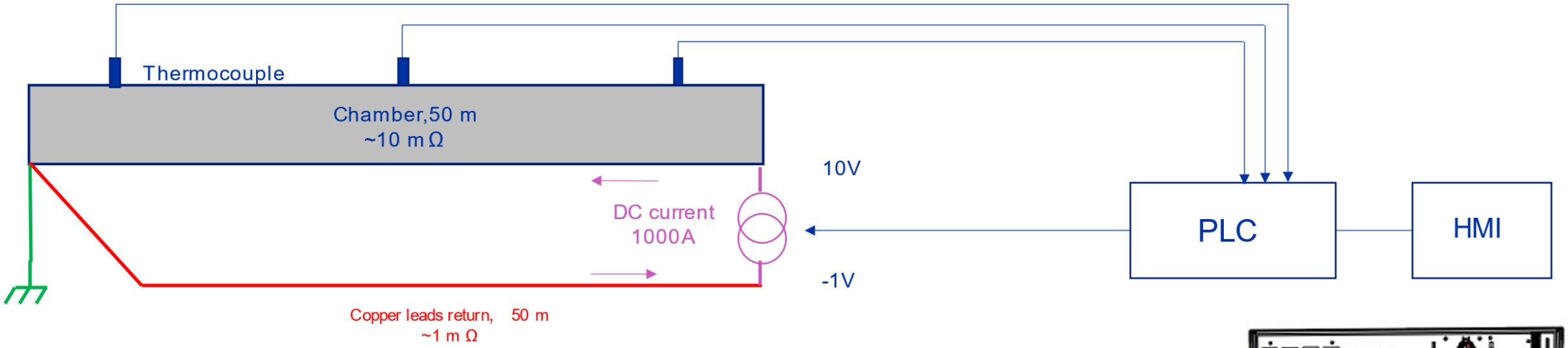




Thanks for your attention

On behalf of
CERN Work package 10
(Jan Hansen)

I^2R Bake-out



- Safety standard: potential of the chamber < 60V
- Resistance: ~1-10 mΩ (resistivity, geometry of the chamber)
- Current: ~100-1000 A (resistance, temperature, insulation)
- Current source: // connection of several PS
- Temperature measurement: thermocouples
- Temperature regulation: PID controller (PLC)
- HMI and logging system
- Example of current source:
  - 4x SM70-CP-450 connected in // (1.8kA, 33V)
  - Main power (max): 4x15kW = 60kW