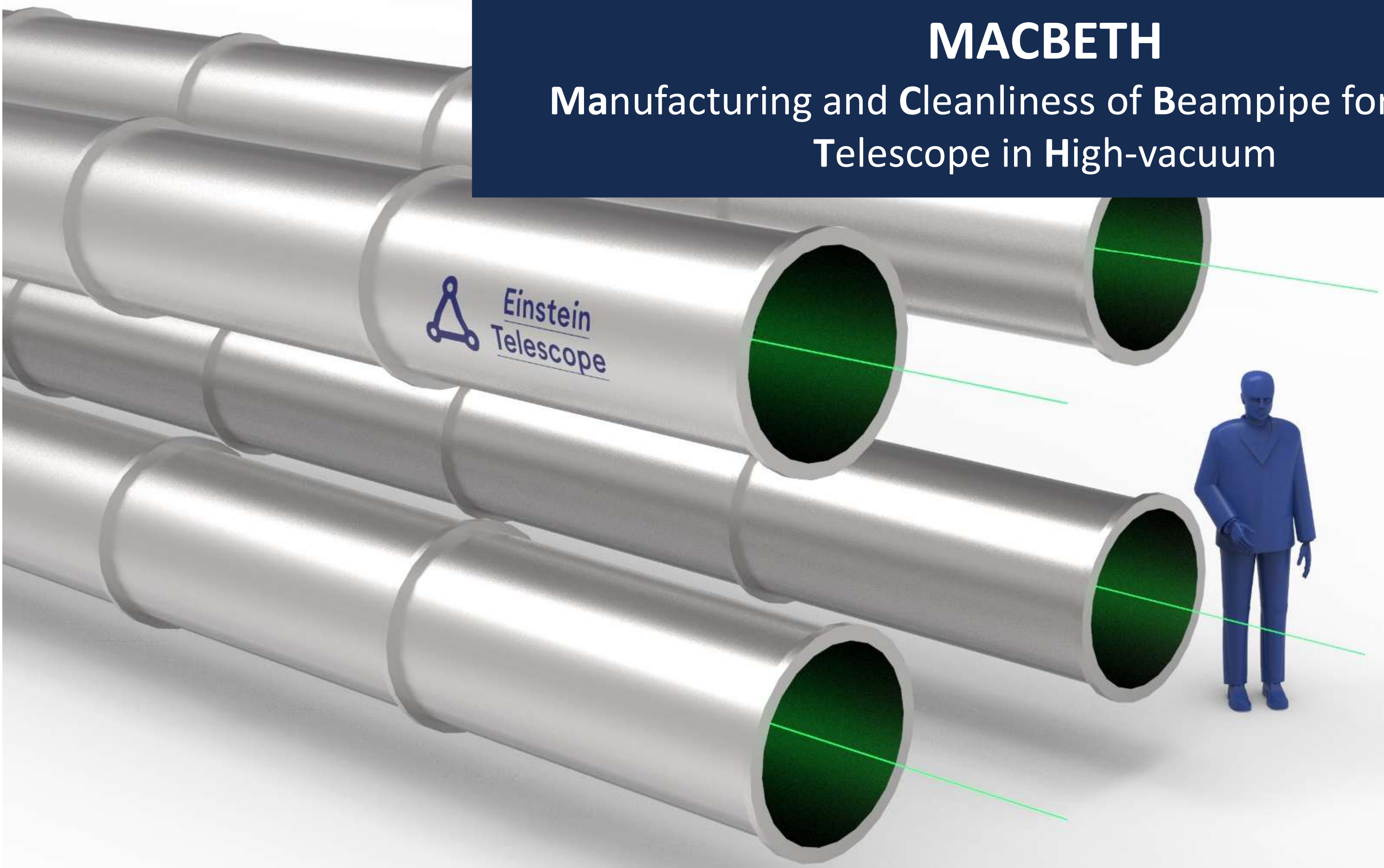
MACBETH

Manufacturing and **C**leanliness of **B**eampipe for **E**instein **T**elescope in **H**igh-vacuum



Collaboration with:

Content

Goal MACBETH

- **Industrialization** of the (arm) vacuum system and in particular a **cost-efficient** design of the **production facility** and the **installation scenario**.
- This should ultimately allow for the realisation of 120km of UHV vacuum tubes for the ET arms, which meet all requirements.

I. 377000m2 (53 football fields) sheet metal area

II. 95000m3 vacuum chamber volume

MACBETH project

WP1

- Industrialization for manufacturing and cleaning of the 120km corrugated vacuum beampipe (WP1)

WP2

- Measurement and quality control of the cleanliness (WP2)

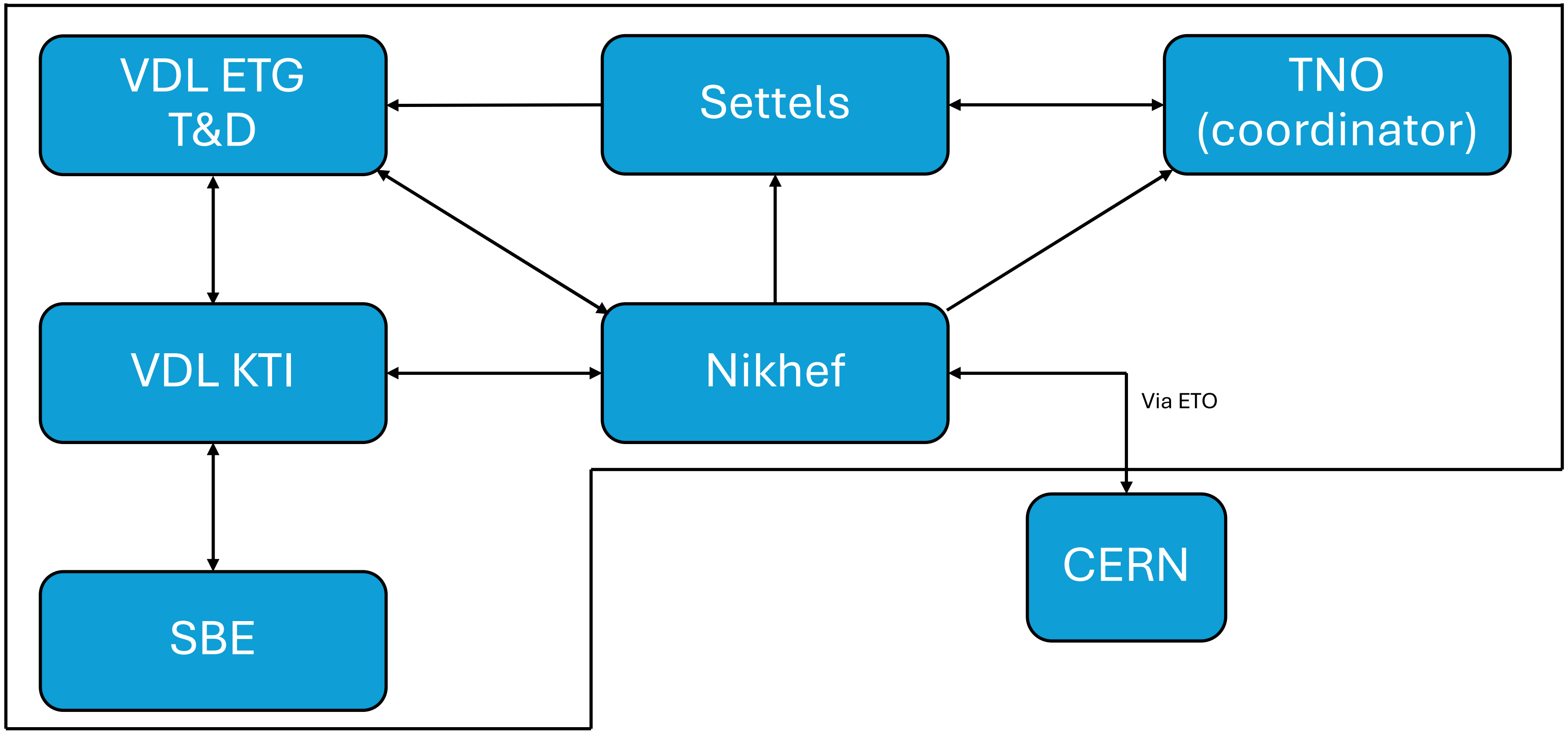
WP3

- Industrialization of the packaging and logistics (production, installation and maintenance) (WP3)

WP4

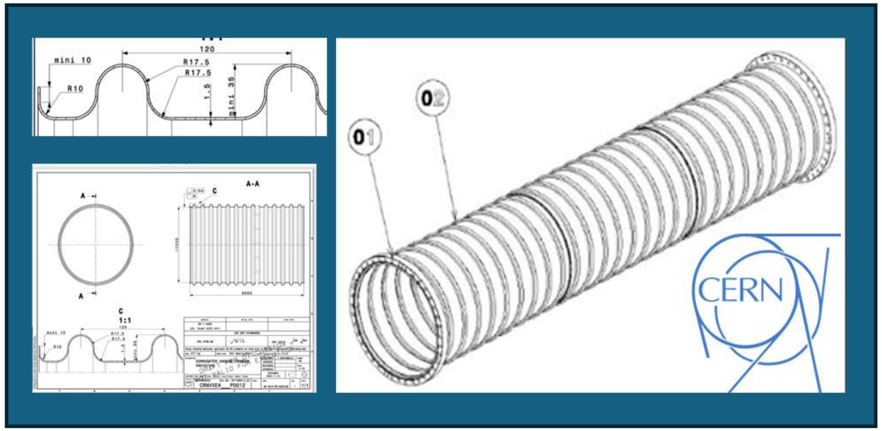
- Plasma assisted bake-out and cleaning (WP4)

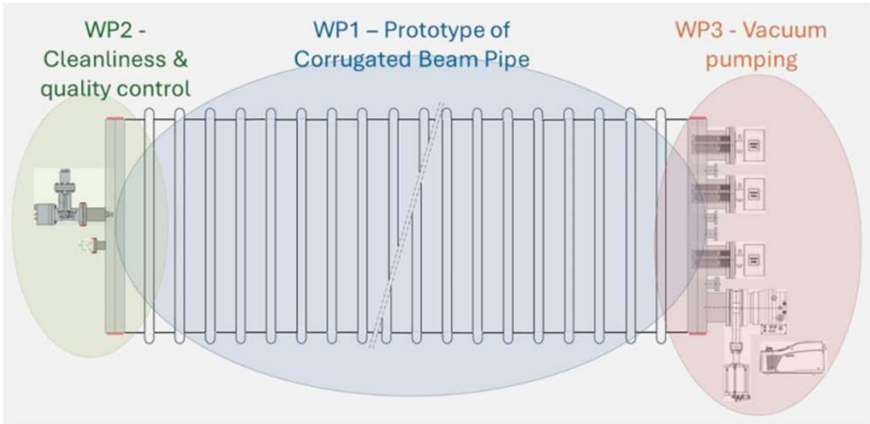
Project partner landscape



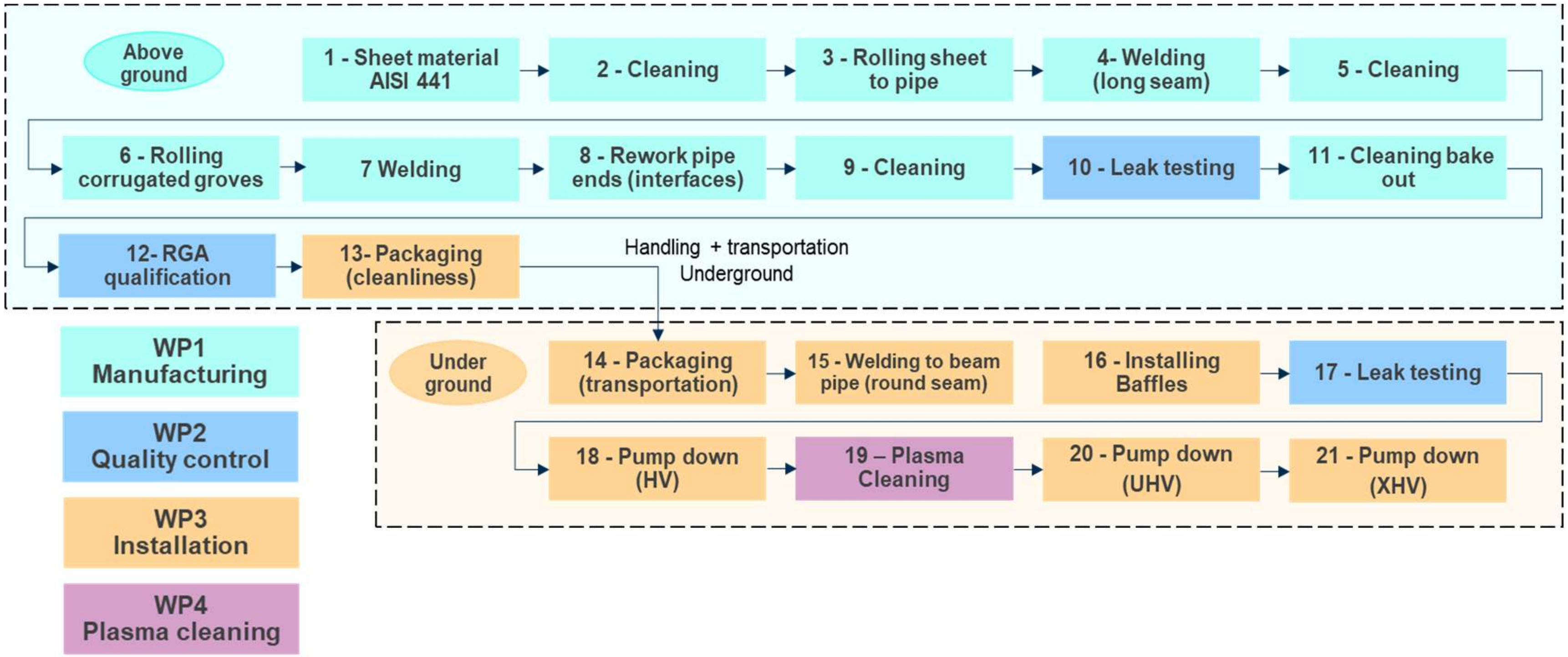
Boundary requirements MACBETH

- A corrugated beampipe of 1.5mm thickness (or similar) will be used
- Instead of AISI 304L (austenitic), AISI 441 (ferritic) will be used
- Beampipe needs to be installed underground instead of above ground

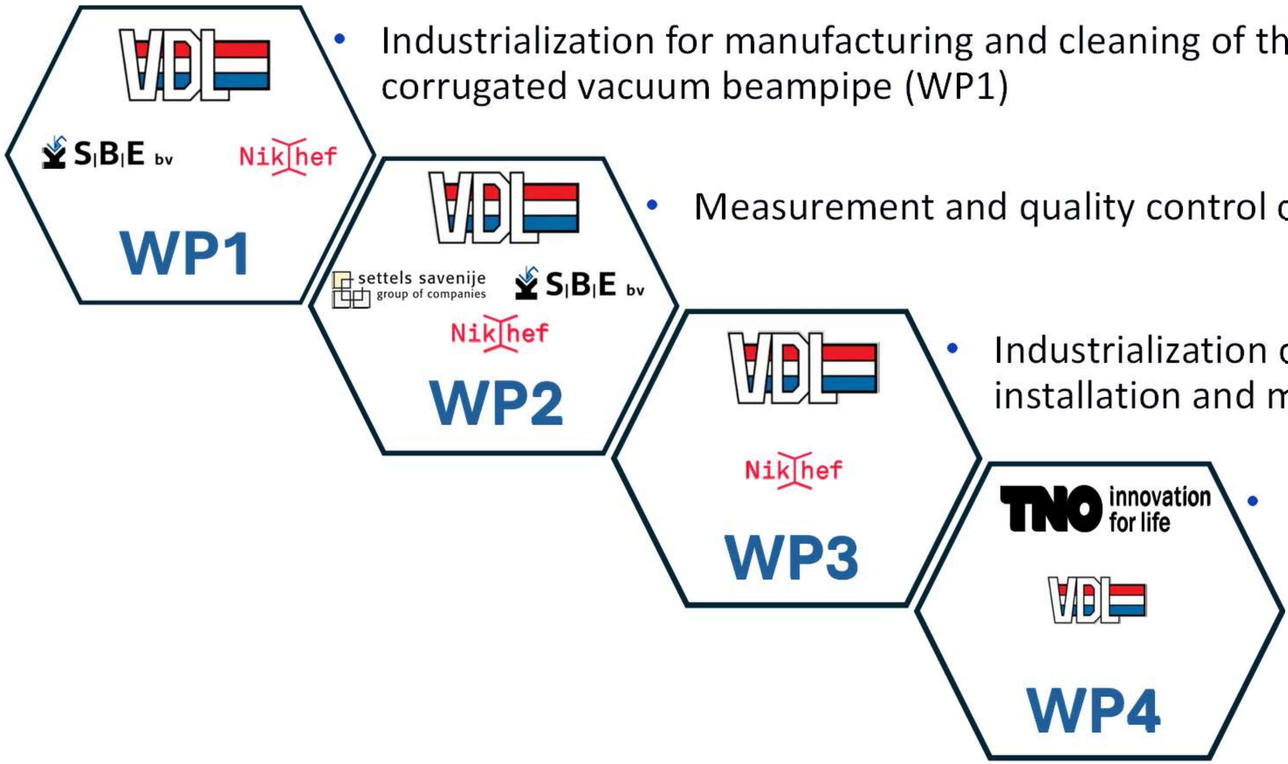




Flow chart of installing the beampipe



MACBETH project



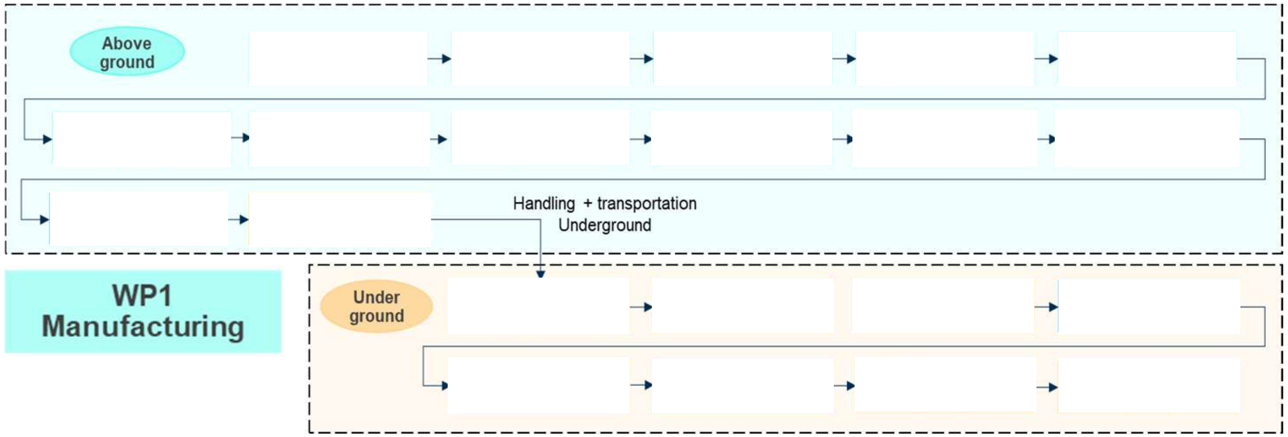
- Industrialization for manufacturing and cleaning of the 120km corrugated vacuum beampipe (WP1)
- Measurement and quality control of the cleanliness (WP2)
- Industrialization of the packaging and logistics (production, installation and maintenance) (WP3)
- Plasma assisted bake-out and cleaning (WP4)

Lead VDL

WP1 Main results

WP1 - Industrialization for manufacturing and cleaning of the 120km corrugated vacuum beampipe

- Prototype beampipe section of min. 3m length above ground, including supply chain study and measurement/validation reports on requirements.
- Building of prototype machines/tooling to produce beampipe sections.



1 - Sheet material AISI 441

2 - Cleaning

3 - Rolling sheet to pipe

4- Welding (long seam)

5 - Cleaning

6 - Rolling corrugated groves

7 Welding

8 - Rework pipe ends (interfaces)

9 - Cleaning

11 - Cleaning bake out

Lead

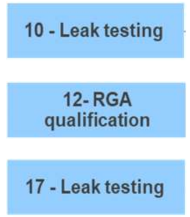
WP1 Main challenges

WP1 - Industrialization for manufacturing and cleaning of the 120km corrugated vacuum beampipe

- How will a long pipe with corrugations be made?
- What welding technique should be used?
- How to keep contamination (during assembly) to a minimum?

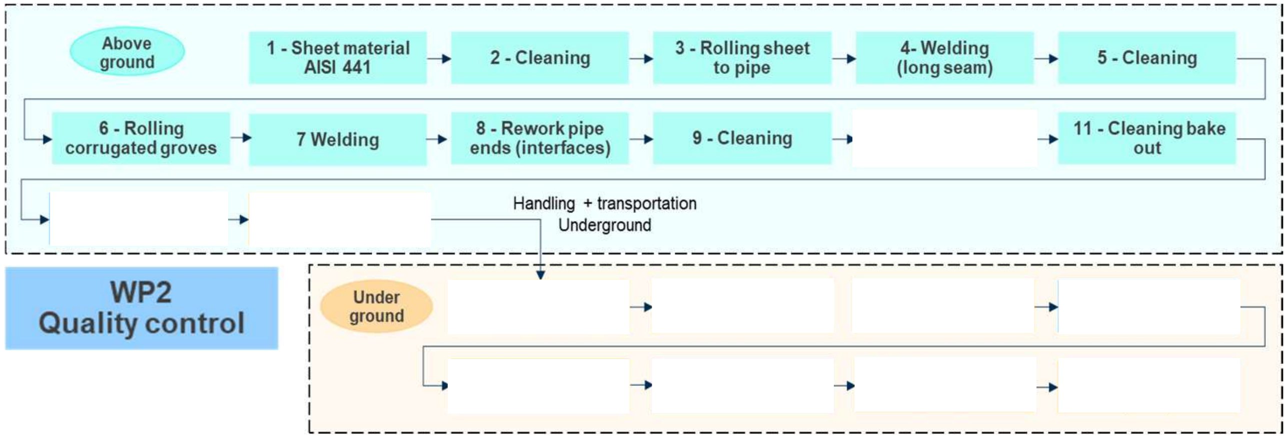
Lead

WP2 Main results



WP2 - Measurement and quality control of the cleanliness

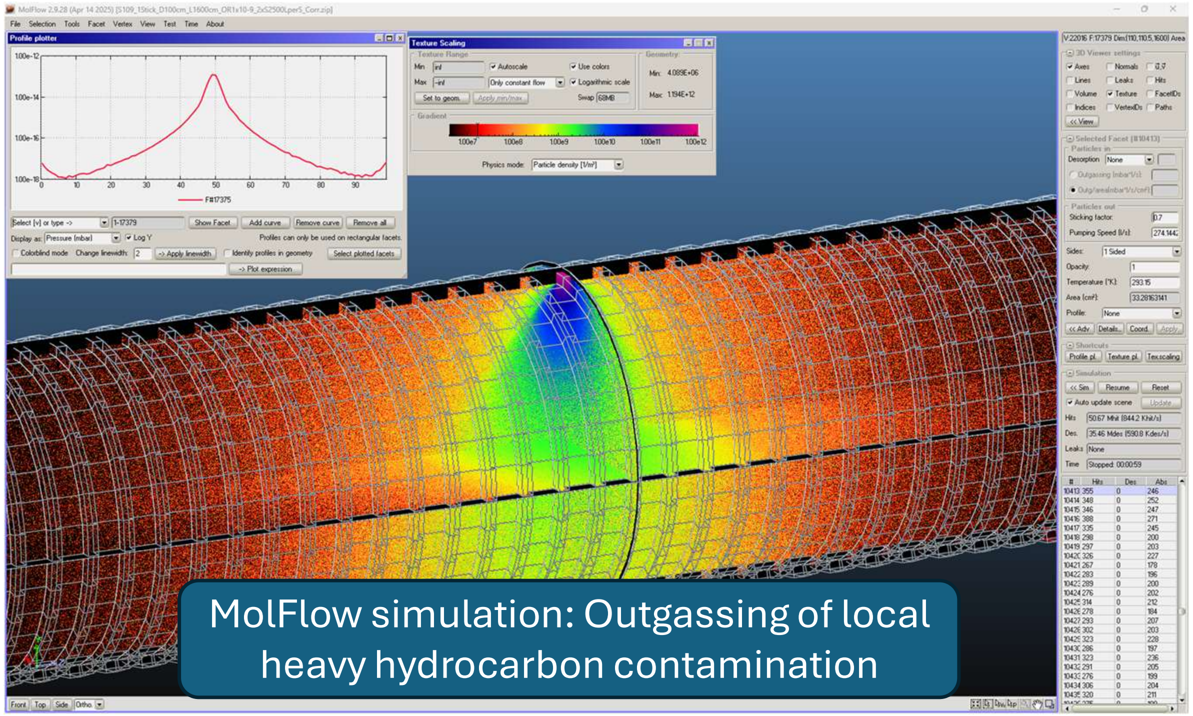
- Developing proof of concept test setup and blind/interface flanges to be tested on WP1 prototype beampipe, including supply chain study for producing beampipes to requirements.
- Proof-of-Concept of vacuum test equipment to qualify beampipe segments (robot crawler).



WP2 Main challenges

WP2 - Measurement and quality control of the cleanliness

- How to measure contamination by heavy HydroCarbons in the center of the beampipe
- Local RGA needed
- RGA sensitivity ~<2D
- How to test / qualify
  the last weld underground
  with 16m pipe segments



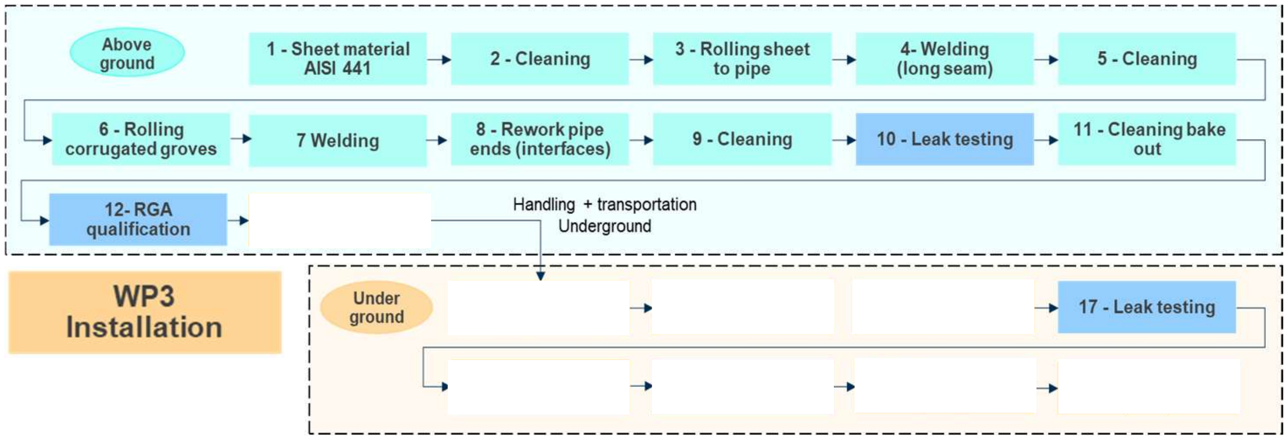
MolFlow simulation: Outgassing of local heavy hydrocarbon contamination

Lead

WP3 Main results

WP3 - Industrialization of the packaging and logistics (production, installation and maintenance)

- Concept and supply-chain study on the handling, packaging, transportation, storage, and installation of qualified Beampipe segments.
- The concept on packaging and transportation will be tested with transportation of the beampipe to the test facilities at CERN for testing.

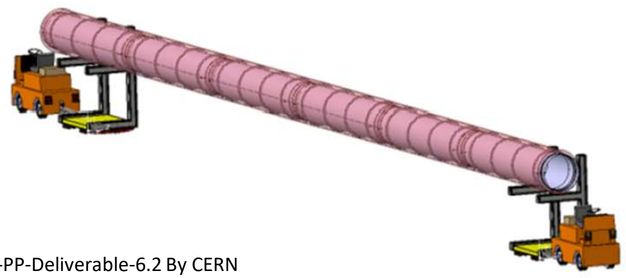


WP3 Main challenges

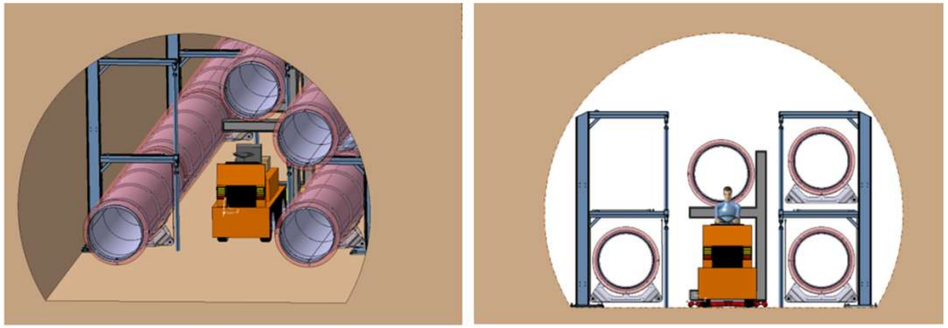
Lead

WP3 - Industrialization of the packaging and logistics (production, installation and maintenance)

- How will the beampipe be maneuvered in the tunnel?
- How will the beampipe need to be supported?
- How will the beampipe sections be aligned with each other?



1. ET-PP-Deliverable-6.2 By CERN



2. ET-PP-Deliverable-6.2 By CERN

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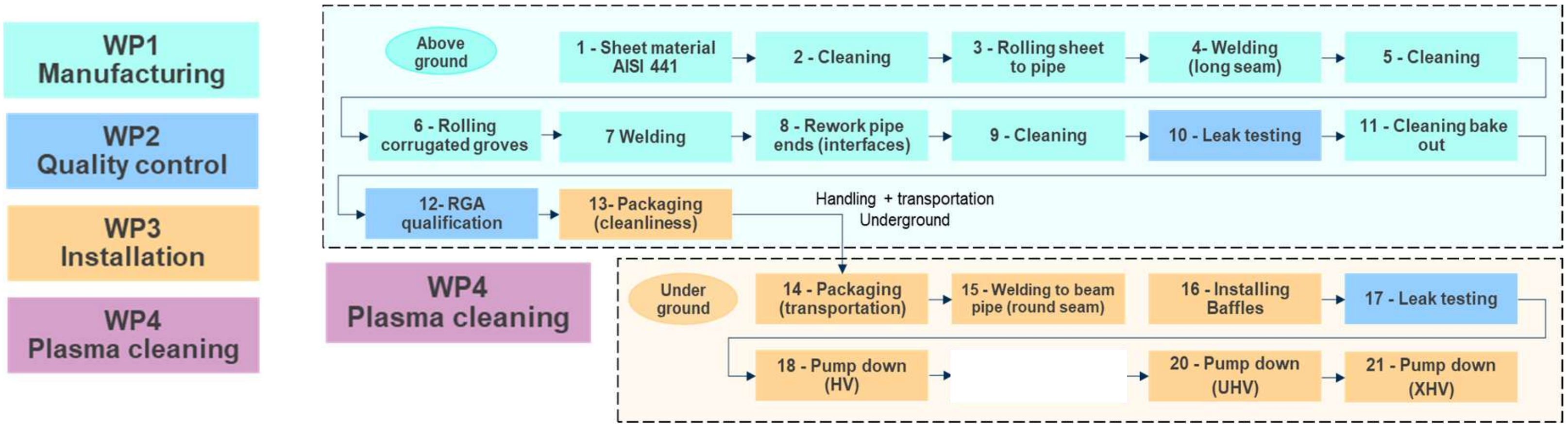
WP4 Main results

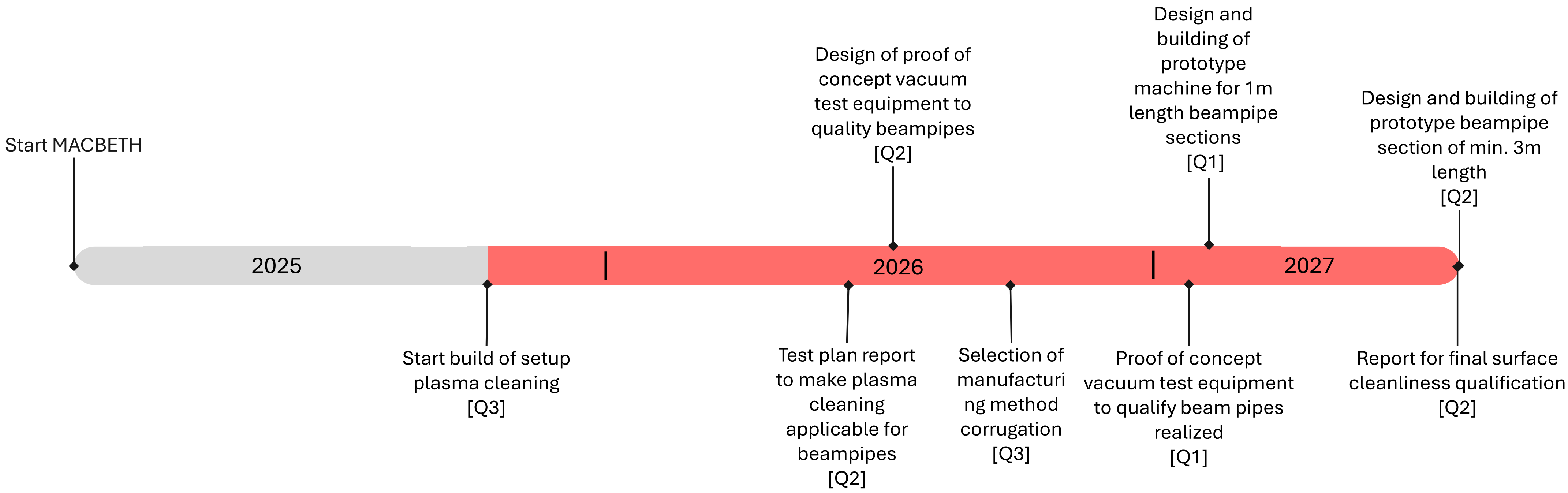
19 – Plasma Cleaning

WP4- Plasma assisted bake-out and cleaning

- Feasibility study of removing contaminations from the inner surface of the beampipe after installation using plasma.
- A proof of concept test set-up to test and validate this.
- Potential of substituting in-situ bakeout.



Timeline important deadlines



Questions?