Civil Engineering Aspects of the Forward Physics Facility

6th Forward Physics Facility Meeting, 8-9 June 2023

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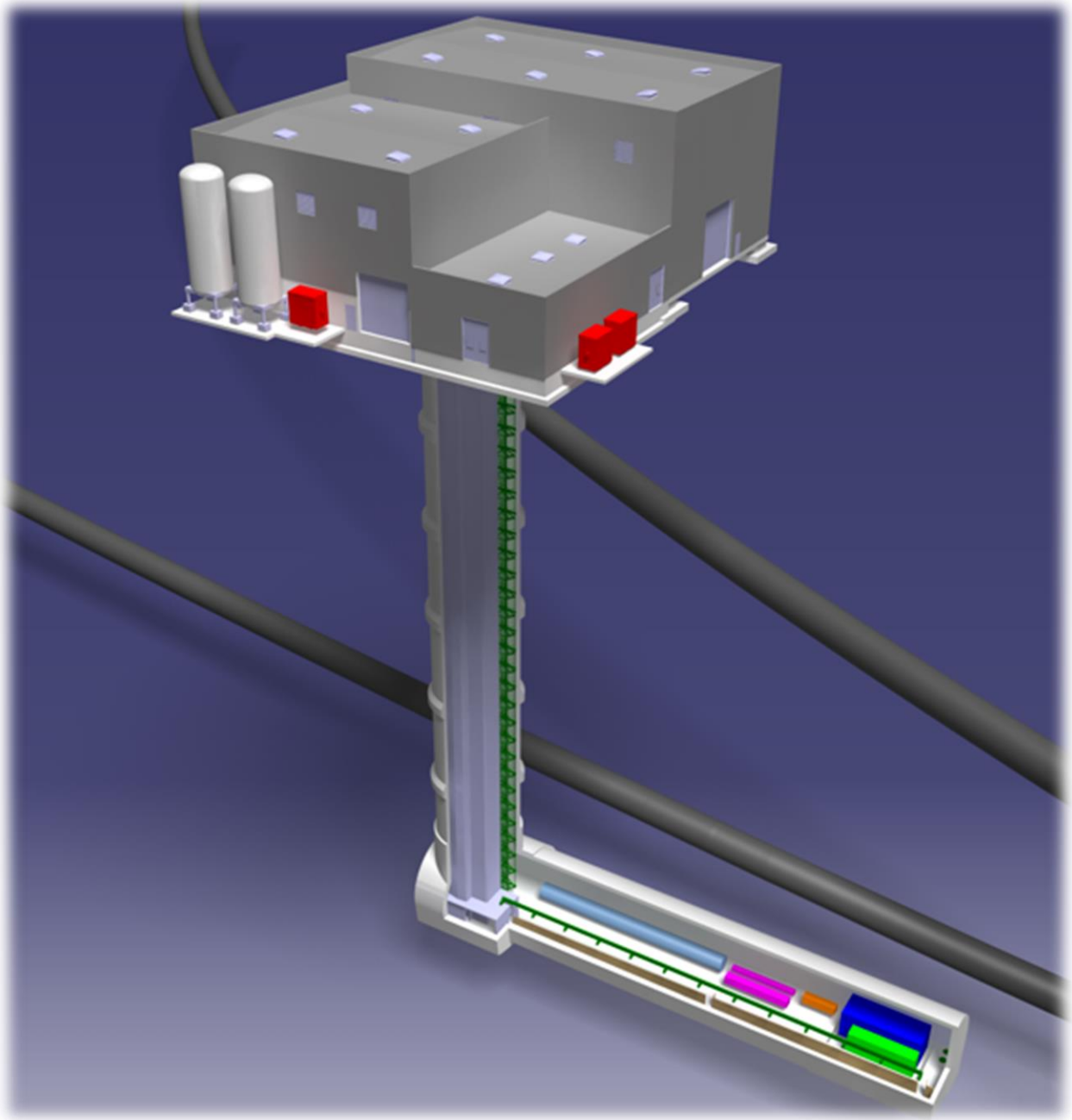
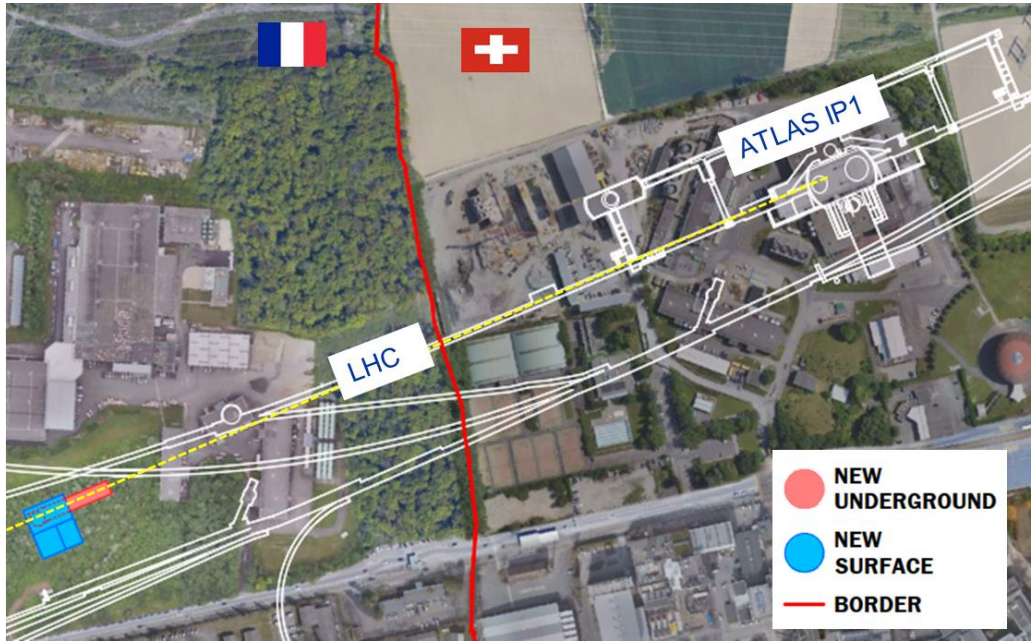
Outline

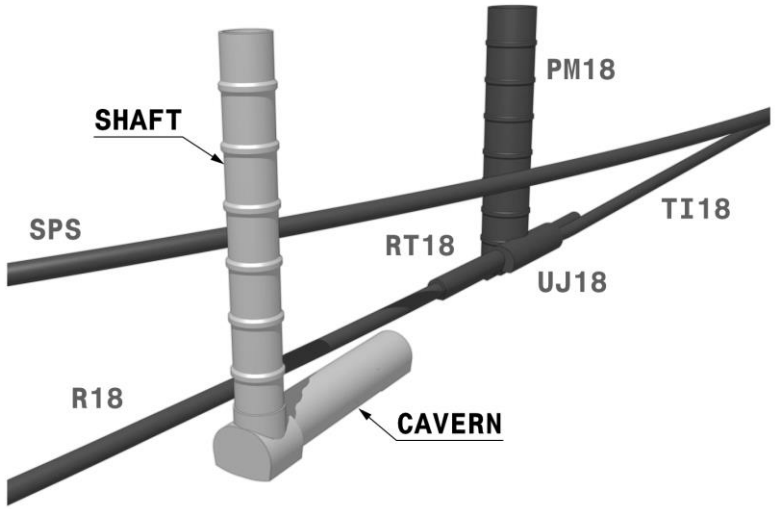
- Proposed Design
- Site Investigation Works
- Next steps



Proposed Design

- **Baseline design:** Purpose built facility
  - Designed around needs of experiments
  - Size/ length not constrained
- **Proposed location:** 617m from ATLAS IP1 on the French side of CERN land, 10m away from the LHC tunnel

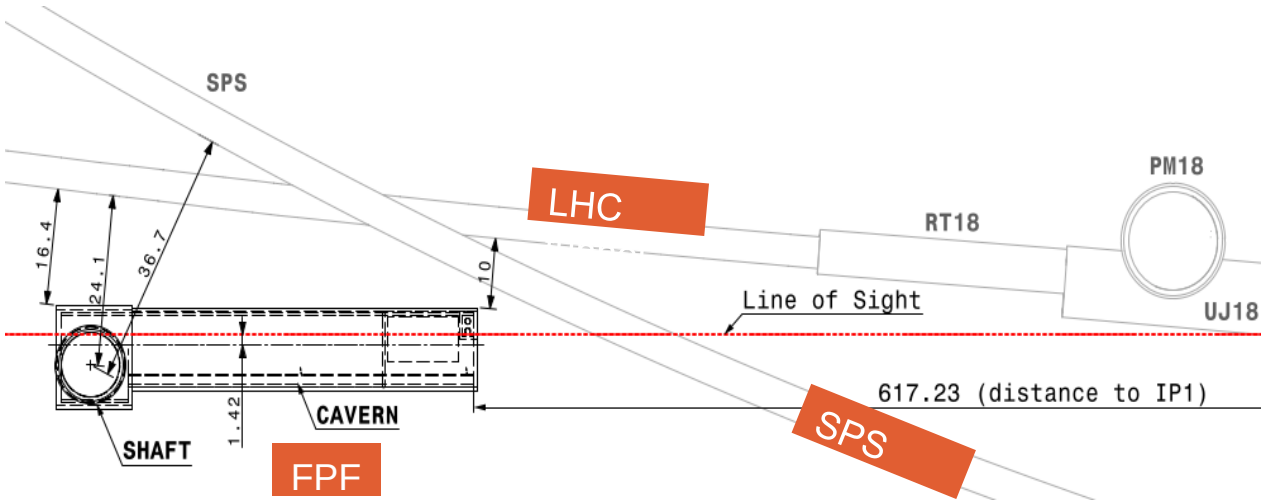




Proposed Design
Purpose built facility

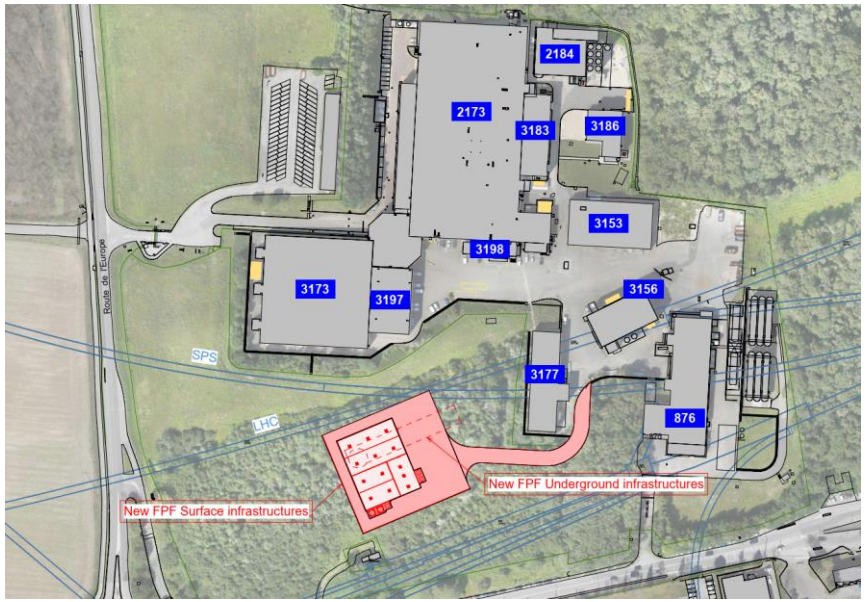
Underground:

- A 65m long experimental cavern
- An 88m deep access shaft
- Safety corridor inside the cavern



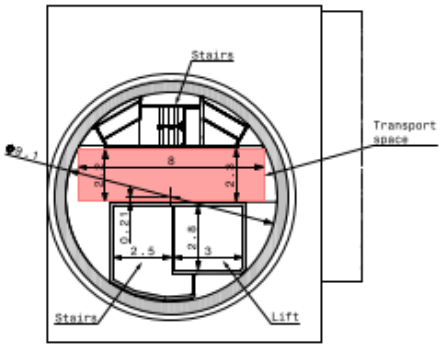
Above ground:

- Access building
- Electrical building
- Cooling & Ventilation building

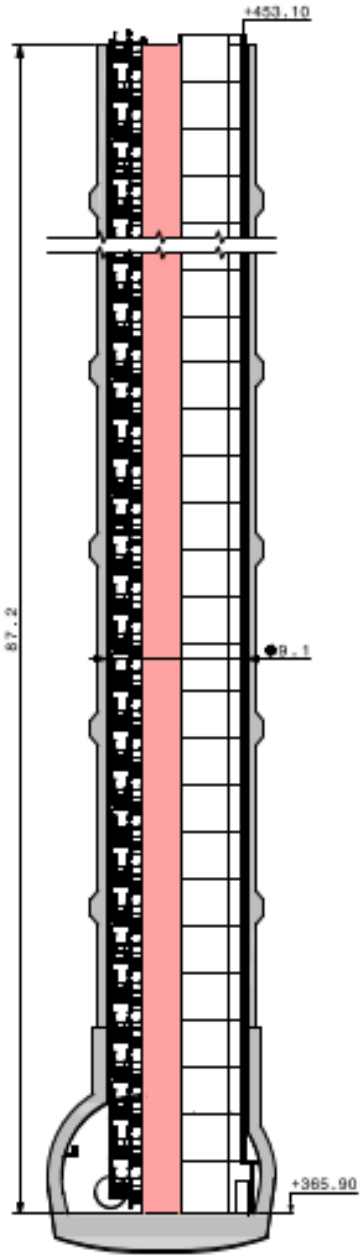


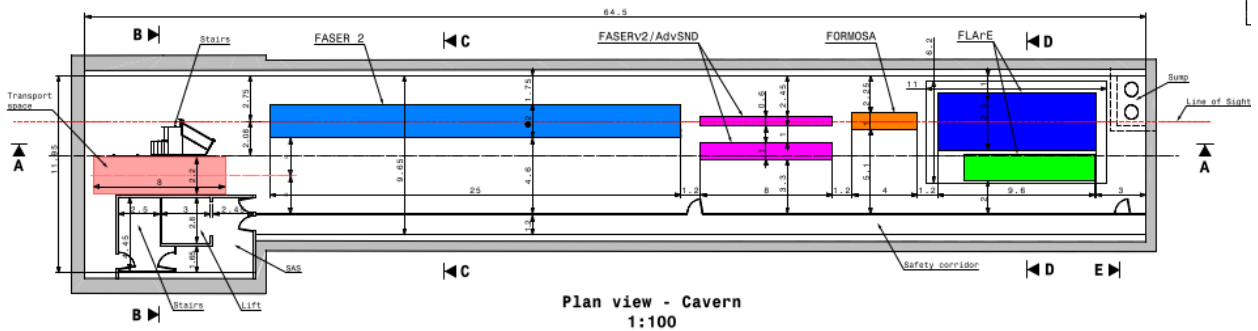
Proposed design
Underground

- A 65m long and 9.65m wide experimental cavern
  - Experiments centralized on the line of sight, 1.5m above the floor
  - Floor is parallel to LoS, 1.25% fall
  - Trench under the LAr detector to catch any escaped cold gas
  - Safety corridor used as an emergency escape route, reduces any risk to the LHC tunnel, and also increases the flexibility of when the facility could be implemented.
- An 88m deep access shaft with a 9.1m internal diameter

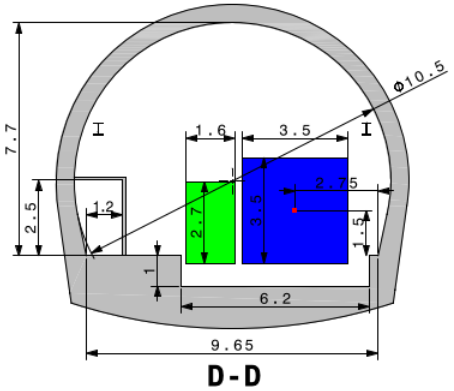


Plan view - Shaft





Plan view - Cavern
1:100



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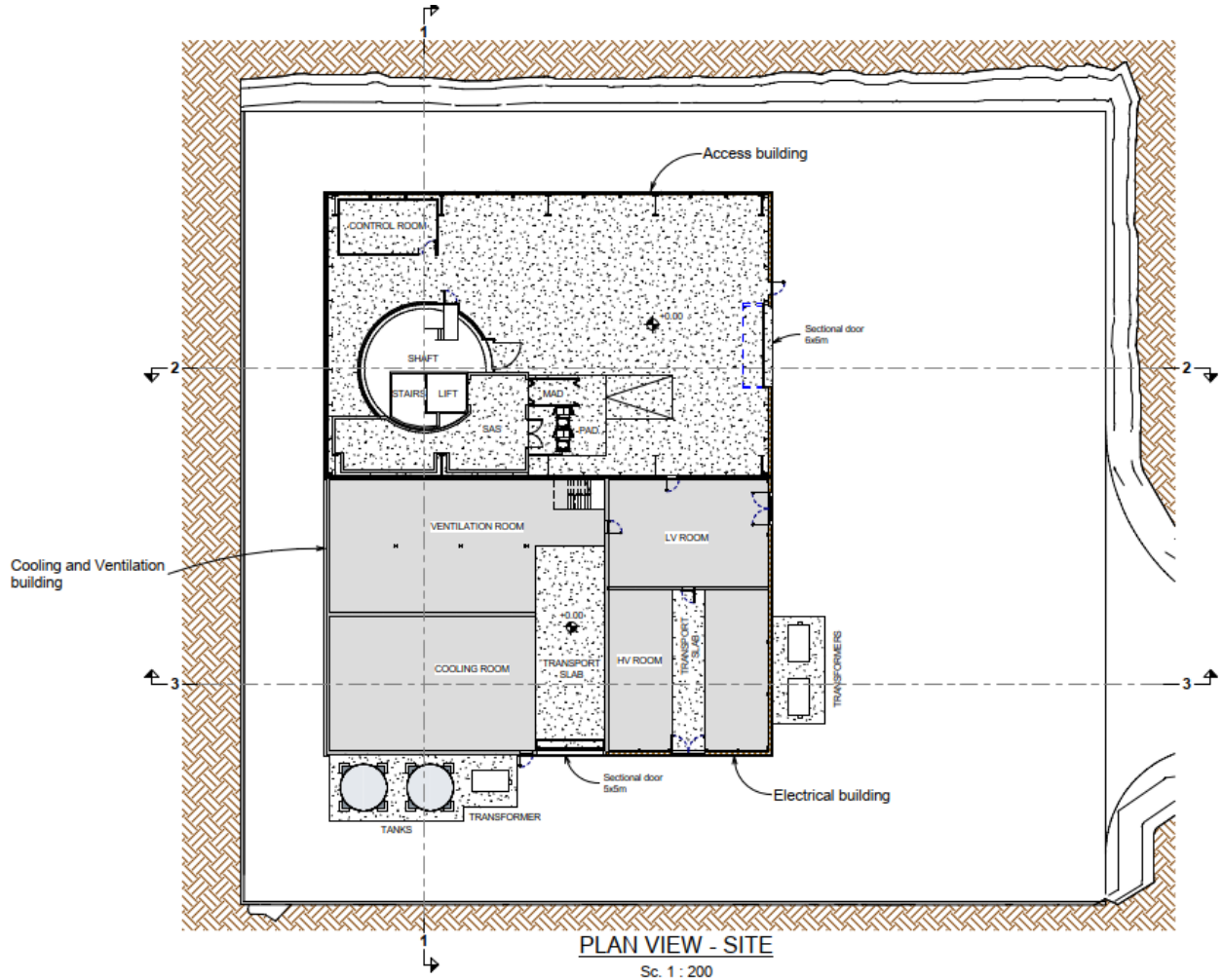
Proposed Design
Surface buildings

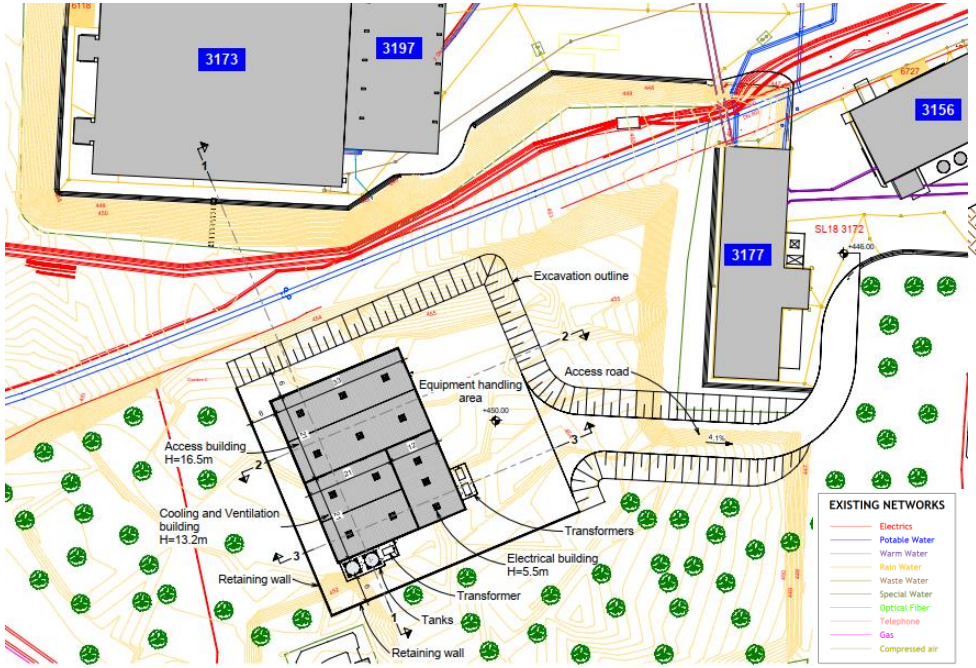
- **Access building :**
  - Steel portal frame structure, walls on the south and southwest part-formed from a retaining wall
  - Equiped with a 25t overhead crane
- **Service Buildings:**
  - Electrical building: steel portal frame structure
  - Cooling & Ventilation building: concrete building

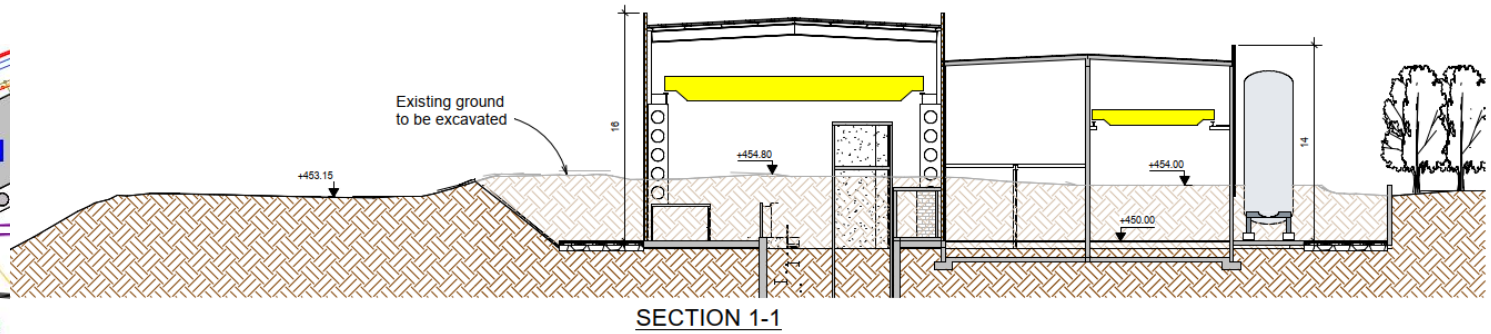
Both service buildings have a 1.2 m deep false floor to allow the services to be distributed into the shaft



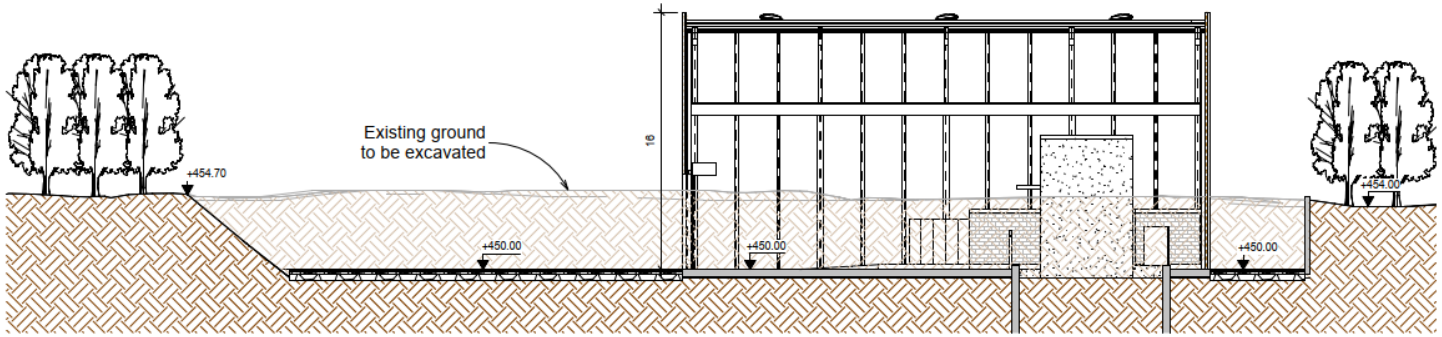
Proposed design
Surface works

- Site used as a spoil disposal area for previous CERN projects
- Ground levels between 453-455m, approx. 7 m above the surrounding area
- Site planning avoiding interference with the existing networks and optimising the volume of the excavation





SECTION 1-1

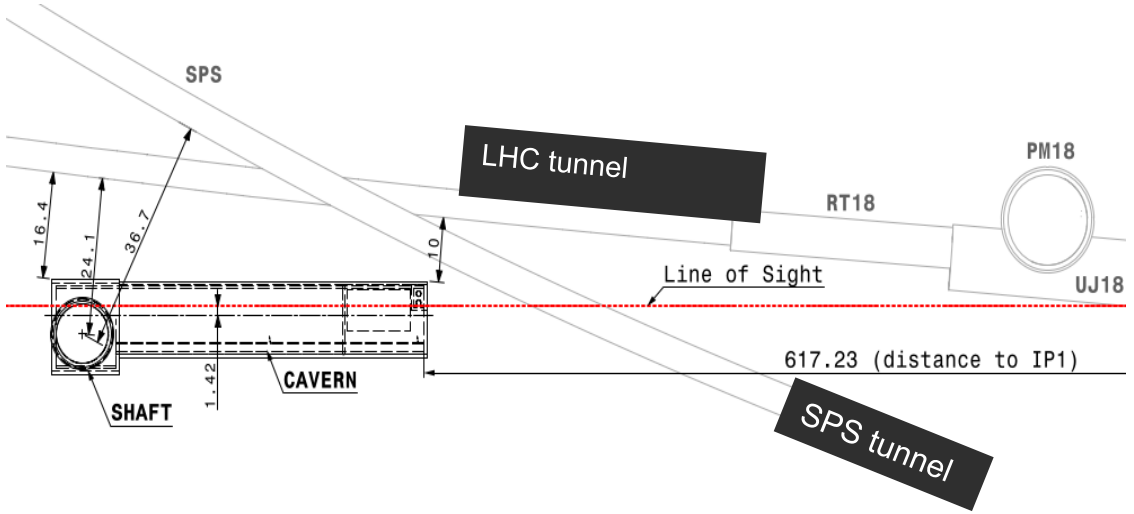


SECTION 2-2

Forward Physics Facility
Site Investigation Works

- Site investigation works carried out in March-mid April
- A single new core was drilled the full depth of the proposed shaft

Position marked by CERN survey team



- Shaft located 24m from LHC and 36.7m from SPS

- Proposed location in a wooded area, a 30m long and 4m wide access path was created for the works

Forward Physics Facility
Site Investigation Works

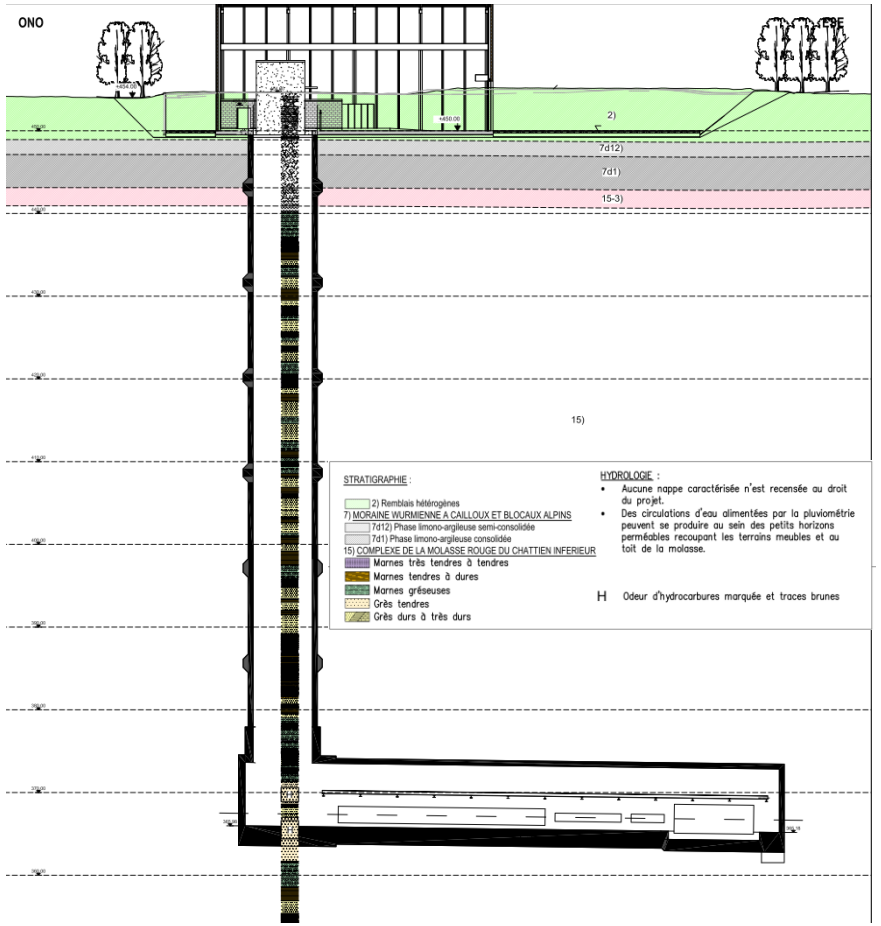
- Drilling machine in place

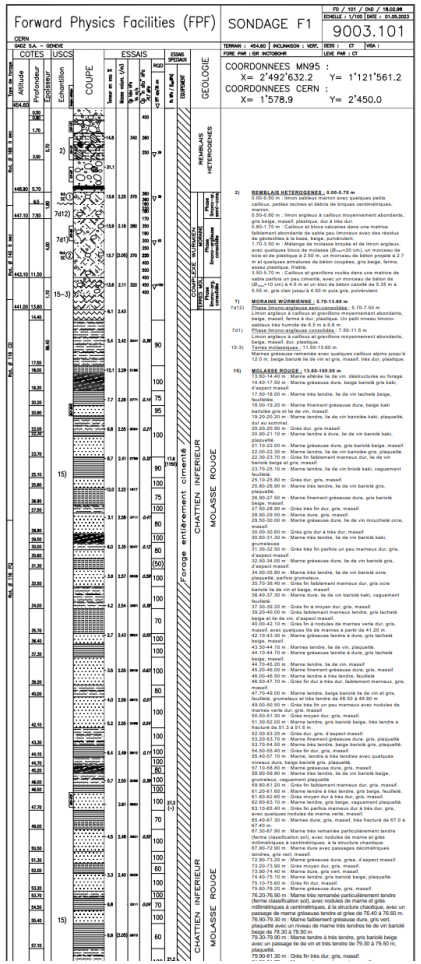
- Works started

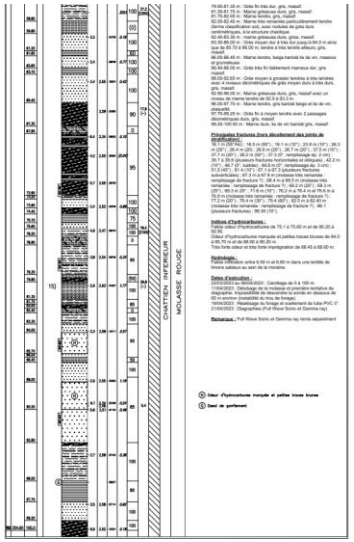
- Core samples

Site Investigation Works

First results







100m deep core:

- **0.0 to 5.7m**: heterogeneous fill comprising gravel, moraine and molasse rock from former excavations, as well as concrete and metal debris.
- **5.7 to 13.6m**: mainly consolidated silty-clay Würmian moraine.
- **From 13.6m**: red molasse, consisting of alternating marl, sandstone and sandy marl.

Site Investigation Works
First results

- At depths of **67.3, 76.20 and 82.0 m**, 40 to 70 cm thick levels of very soft, crushed marl soil like (hard clay and silt with concretions of marls and sandstone) were found

  ⟶ Should be taken into consideration for the design of the shaft and experimental cavern

- Signs of hydrocarbons were found in the soft sandstone at depths between 84m and 90m

  ⟶ The excavated material needs to be disposed in a biocentre or in a non-hazardous waste storage facility

- Foundations of the surface buildings will sit within the moraine.

  ⟶ Additional shallow boreholes are recommended to check the variations in the thickness of the backfill over the entire area

- No water table has been identified. Overall the ground is not very permeable, only low-flow infiltration has been identified in a slightly more permeable zone of the moraine.

Site Investigation Works
Impact on the beam operation

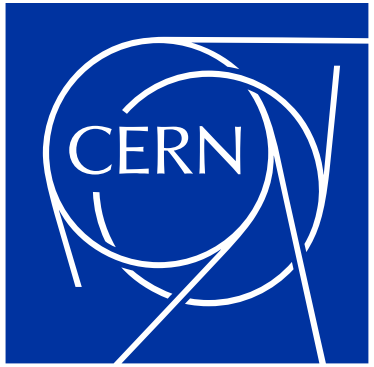
- Similar site investigations conducted in 2015 for HL-LHC (further away from the LHC tunnel but closer to the triplets at that time), no issues reported by the LHC to our knowledge
- Forward Physics Facility is much further from the interaction point, but closer to the LHC
- Site Investigation Works were done prior to LHC physics start but during SPS/ LHC commissioning
- No harmful effect on the beam operation was reported to us

More studies are available on the CE impact from excavation works phase:

- Forward Physics Facility (FPF) Expected vibration impact of CE activities on the LHC / SPS Performance – study by M. Guinchard & D. Gamba EDMS 2808909 v.1

Next Steps

- Final geotechnical report to be issued
- Refine the design and cost estimate (ongoing)
  - External consultant engaged for CE cost study and Soil Investigation Interpretation
  - Findings to be fed in the design
- Conceptual Design Report



Thank you!

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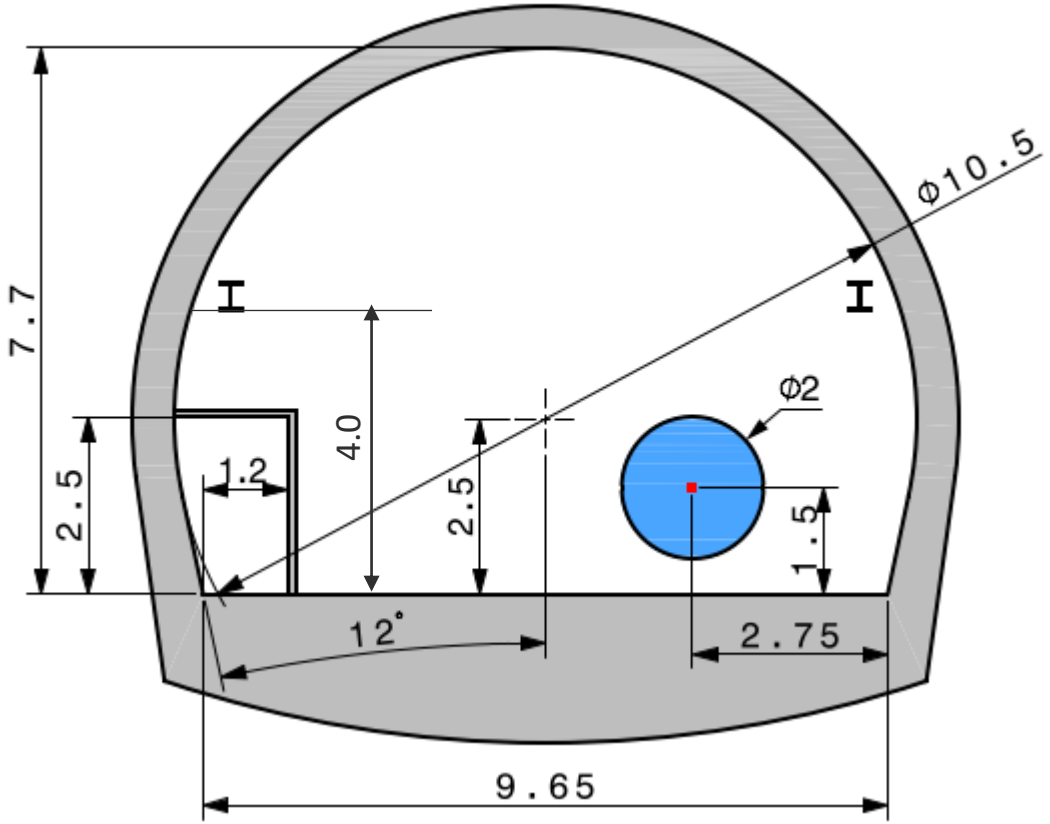
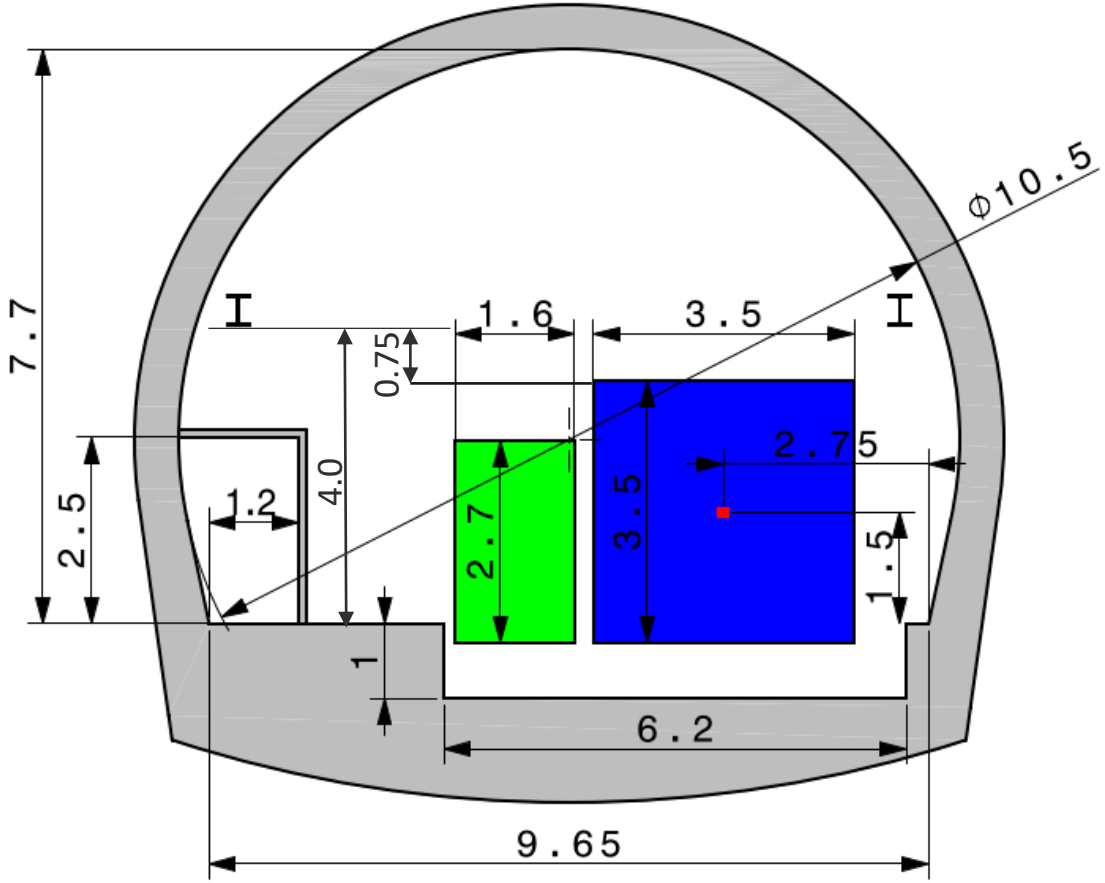
Back-up Slides

Forward Physics Facility
Aboveground Design

- Overhead crane at 4m above the floor



Cross section of the cavern showing the Faser 2



Cross section of the cavern showing the FlArE and teh trench under