

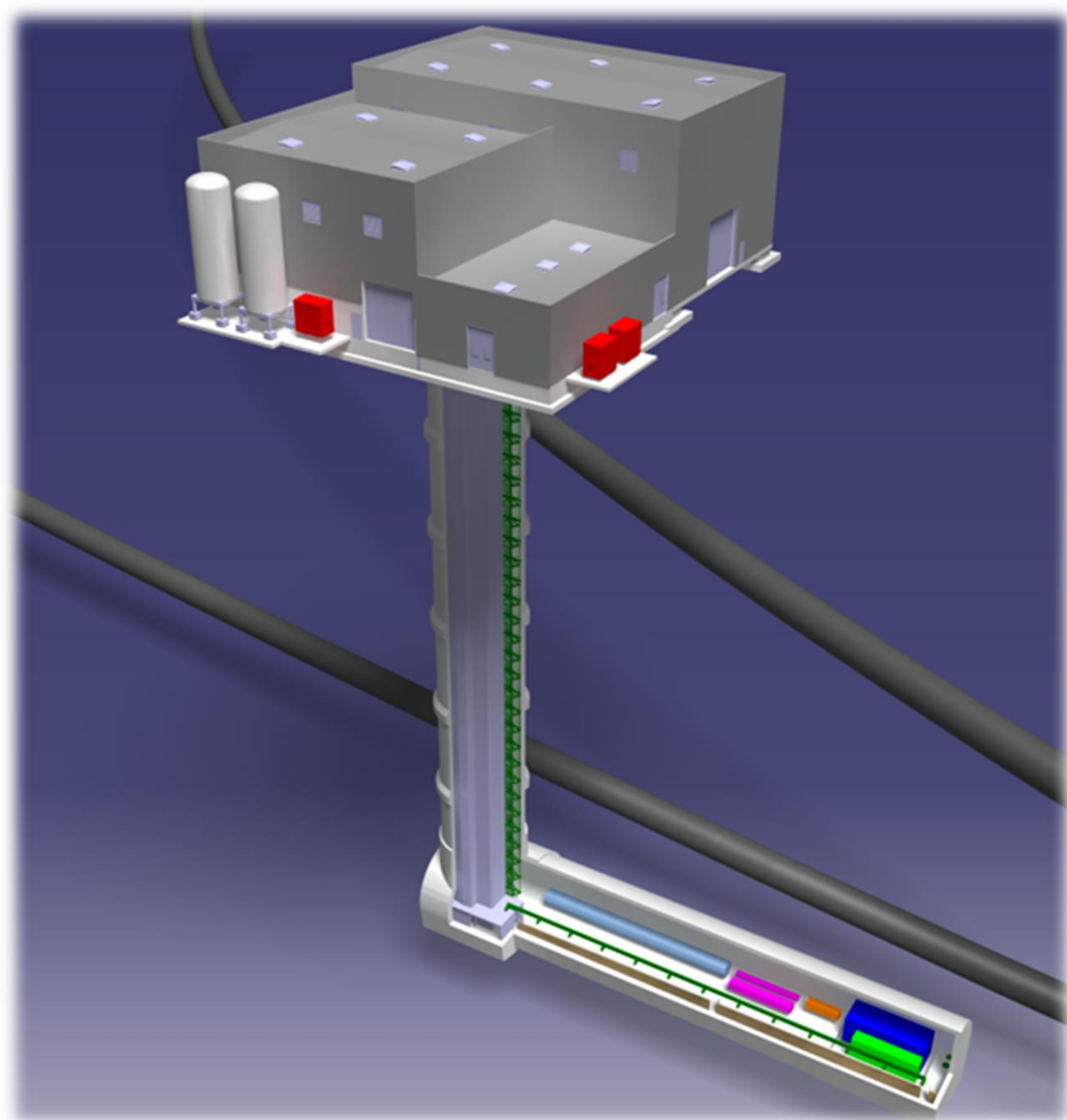
Overview of the Forward Physics Facility Design

5th Forward Physics Facility Meeting, 15-16 November 2022

Kincső Pál (Balázs), John Osborne –SCE- DOD-FS
Drawings: A. Navascues Cornago- SCE-SAM-TG

Outline

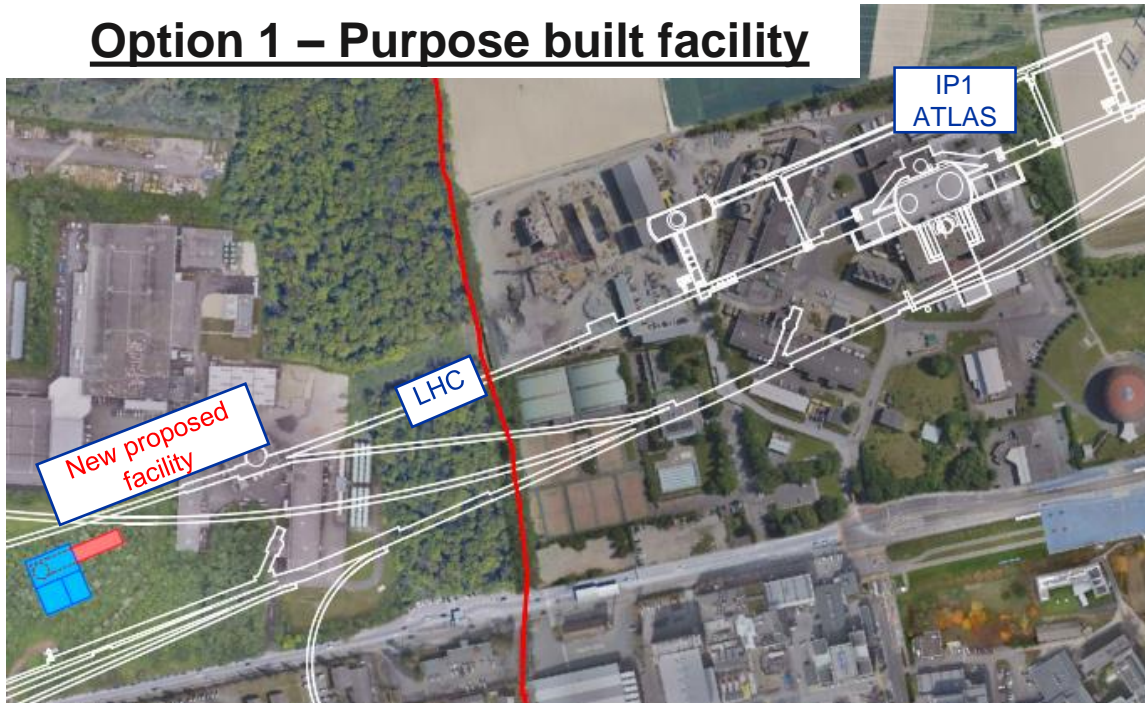
- Proposed Locations
- FPF Design (Baseline option)
- Site Investigation Works
- CE Works Cost and Planning
- Vibration study
- Cooling and Ventilation study



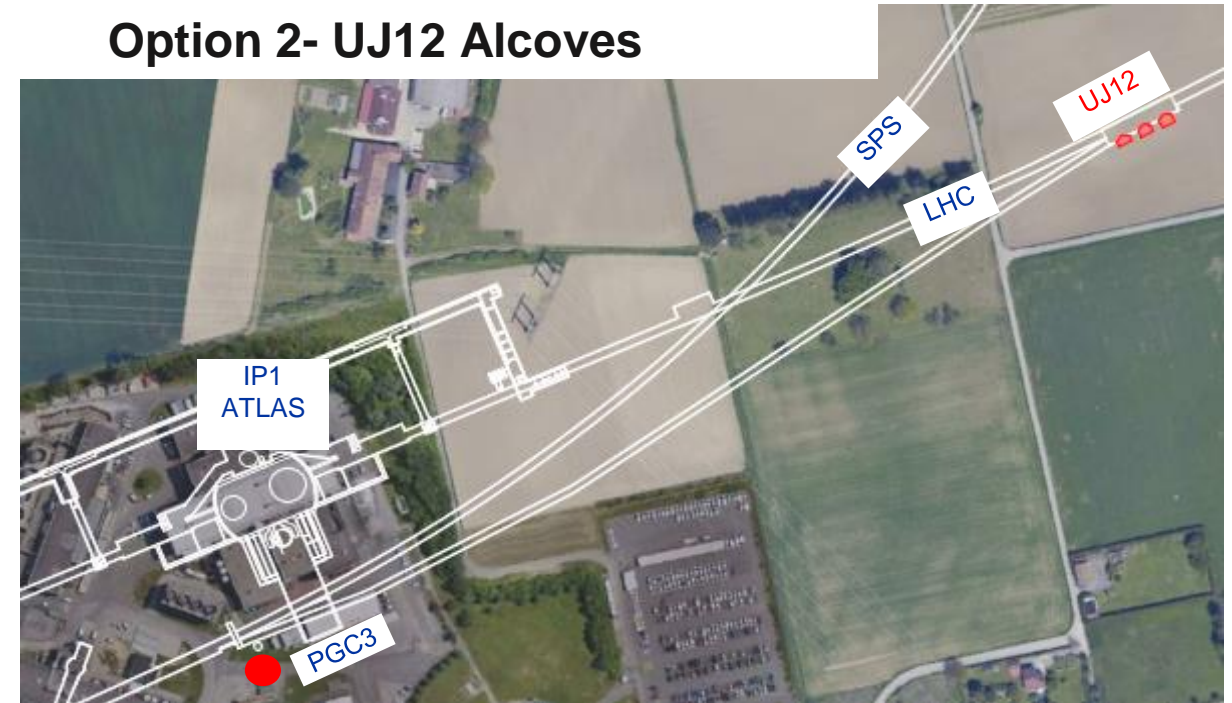
Proposed Locations

- **Requirement:** to have an experimental area approx. 500-600 m away from LHC P1 or P5 on the Line of sight (LoS)
- Two options considered for further study

Option 1 – Purpose built facility



Option 2- UJ12 Alcoves



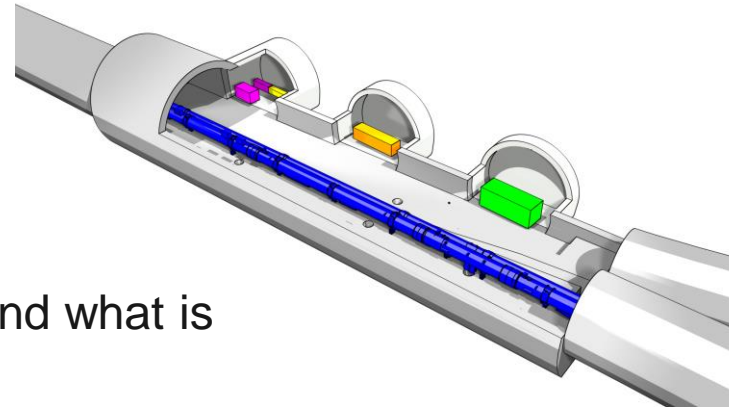
Alcoves in UJ12

➤ Advantages

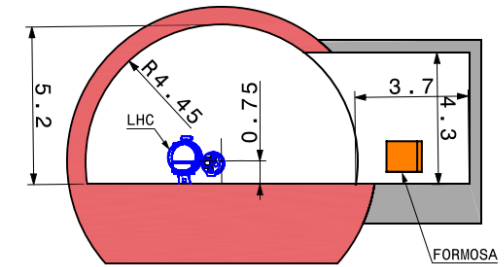
- Lowest cost and disruption

➤ Disadvantages

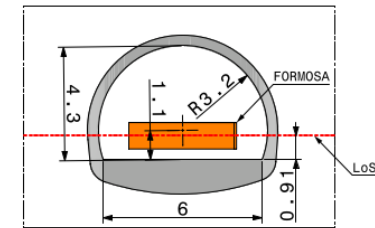
- Experiments need to be designed around what is possible
- Likely only 2-3 alcoves possible around 3mØ
- Stability of existing cavern
- All existing services in UJ12 need to be removed



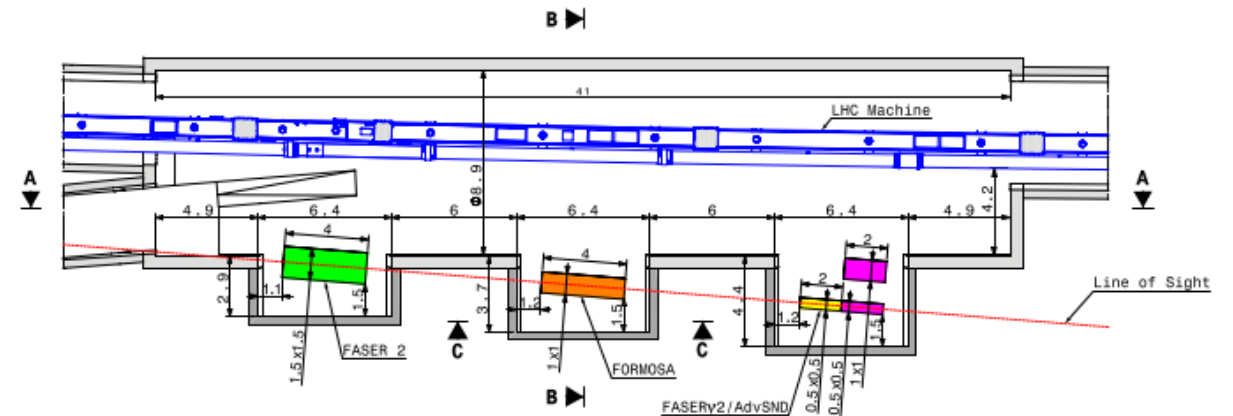
3D view



Alcove Cross Section at B-B



Typical Alcove Cross Section C-C



Plan view showing widening and alcoves

Purpose built facility

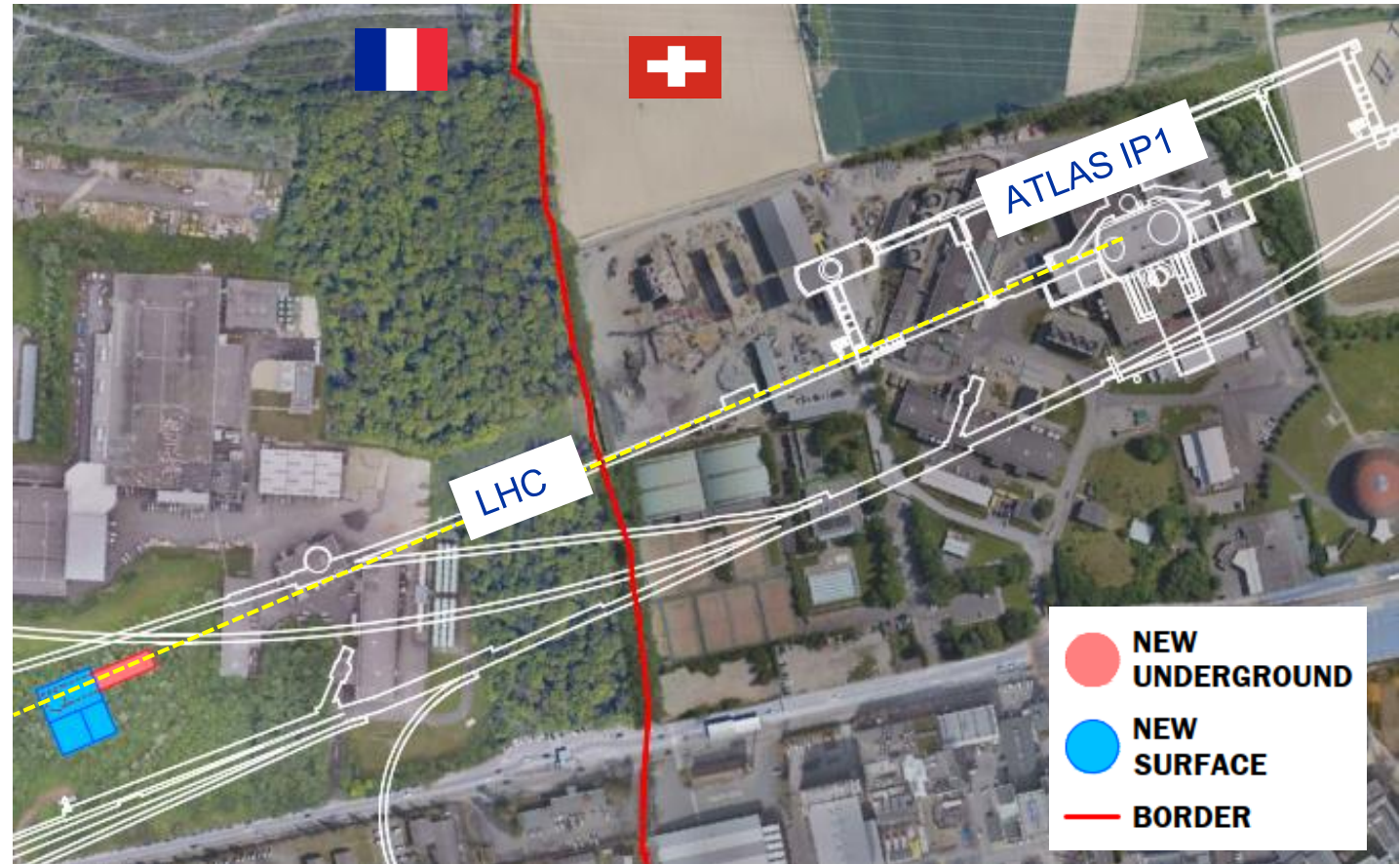
Baseline option

➤ Advantages

- Designed around needs of experiments
- Size/ length not constrained
- Construction access far easier

➤ Disadvantages

- More expensive

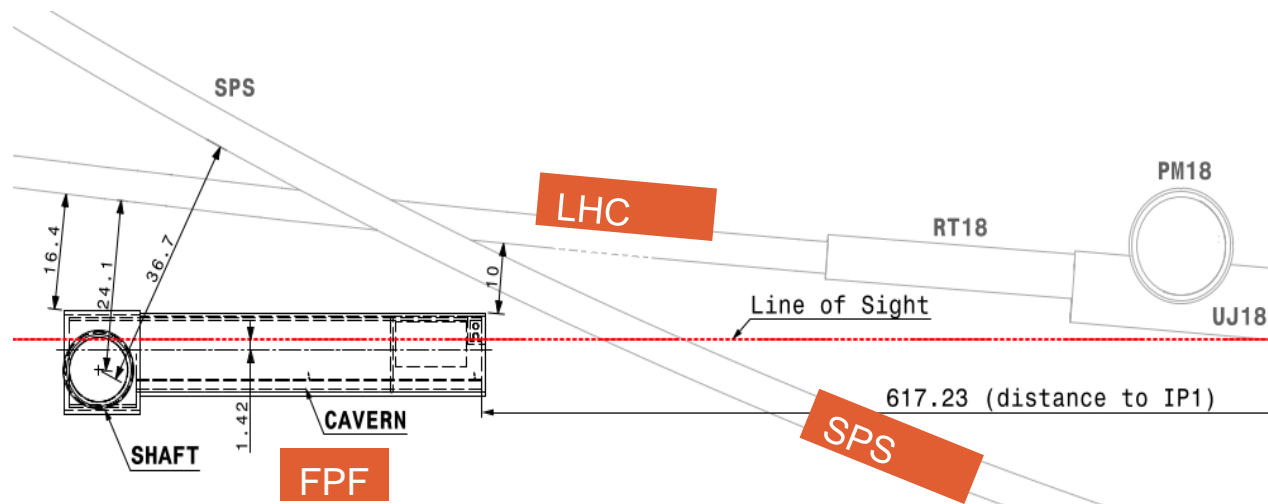


Forward Physics Facility

Proposed Design

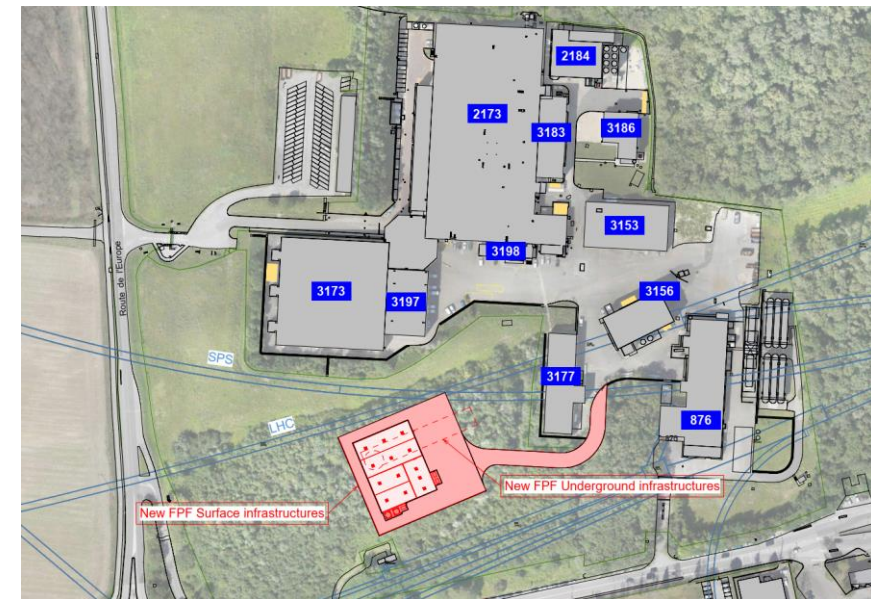
Underground:

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



Above ground:

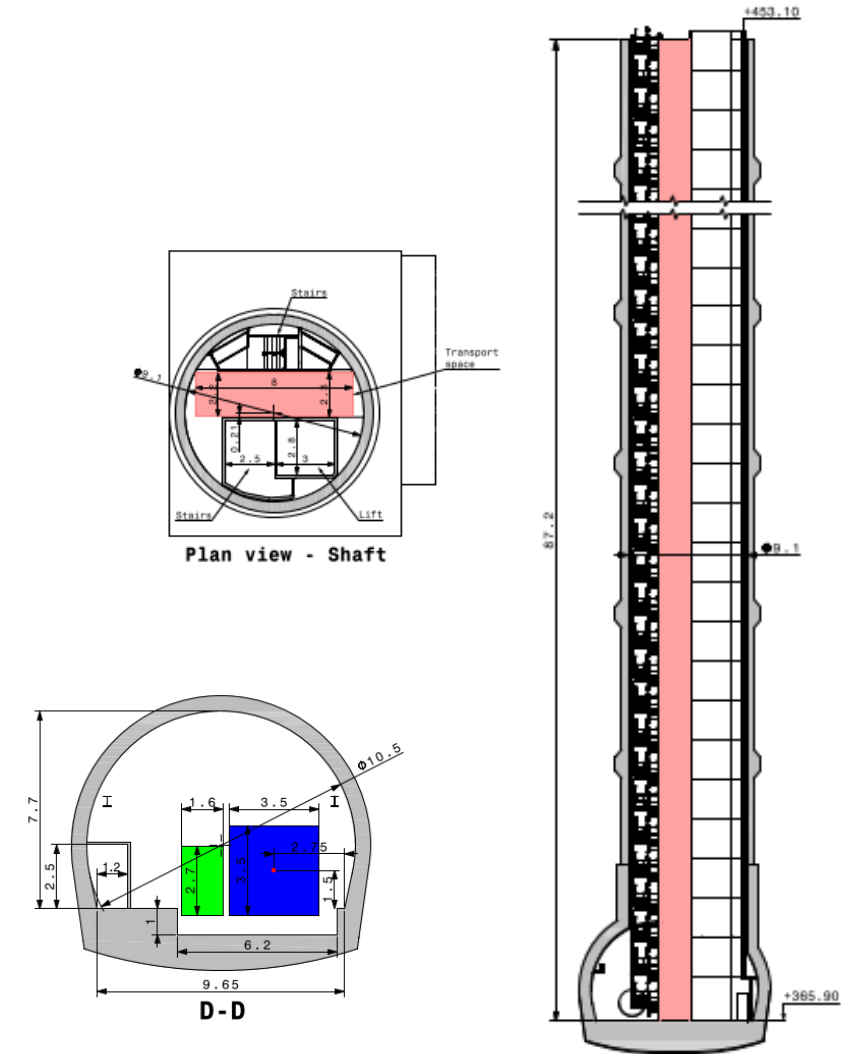
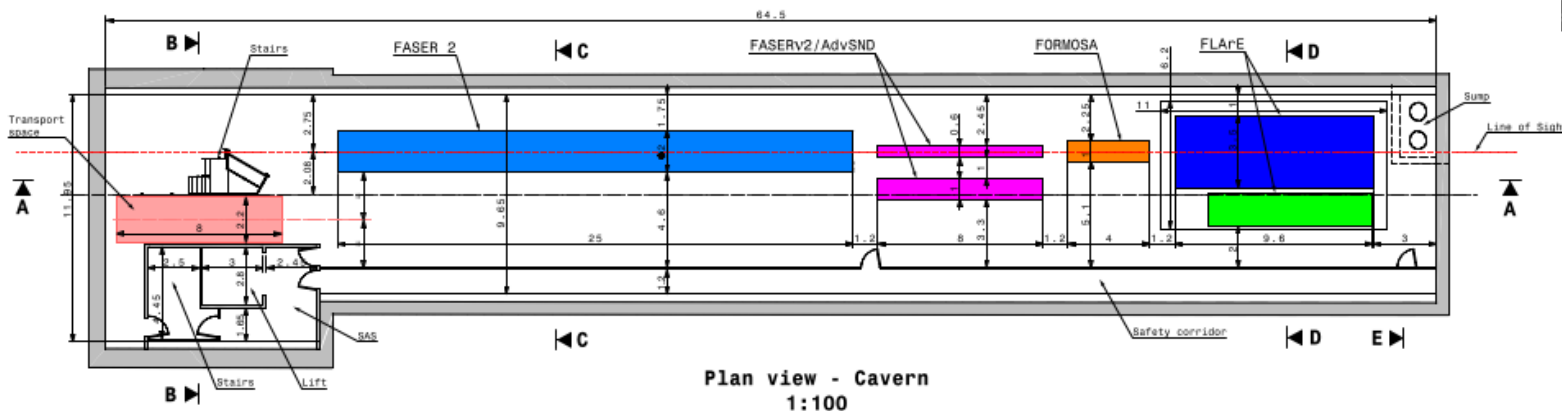
- Access building
- Electrical building
- Cooling & Ventilation building



Forward Physics Facility

Underground design

- 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
- An 88m deep access shaft with a 9.1m internal diameter



Forward Physics Facility

Aboveground Design

➤ Access building :

- Steel portal frame structure, walls on the south and southwest part-formed from a retaining wall
- 33m long, 21m wide with an internal height of 15m
- Equipped with a 25t overhead crane

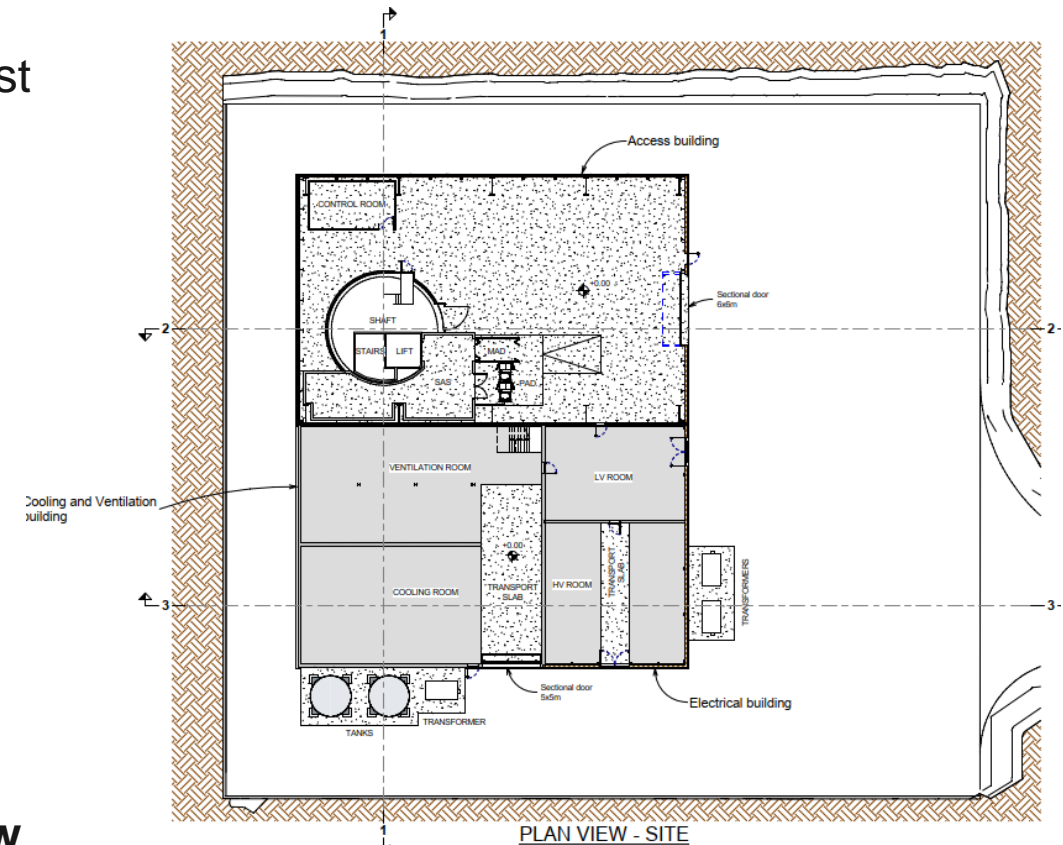
➤ Electrical building:

- Steel portal frame structure
- 20.5m long, 12m wide with an internal height of 5.5m

➤ Cooling & Ventilation building:

- Concrete building
- 20.5m long, 12m wide with an internal height of 13.5m

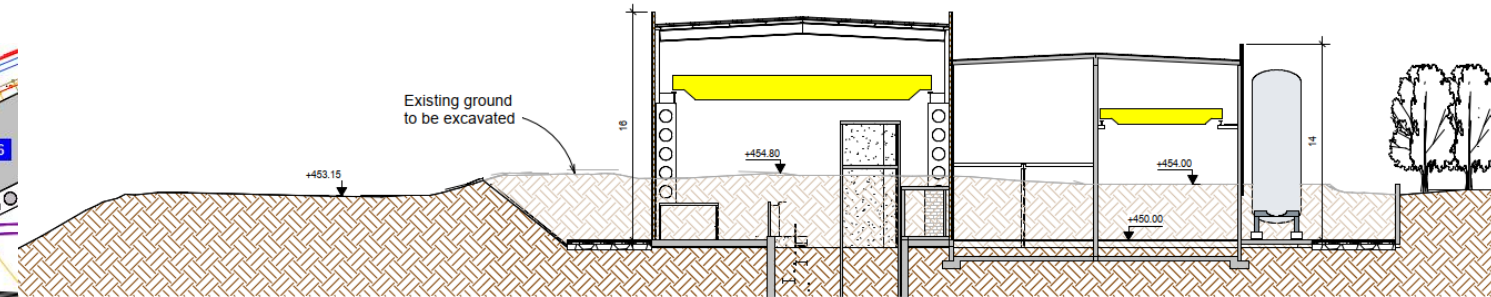
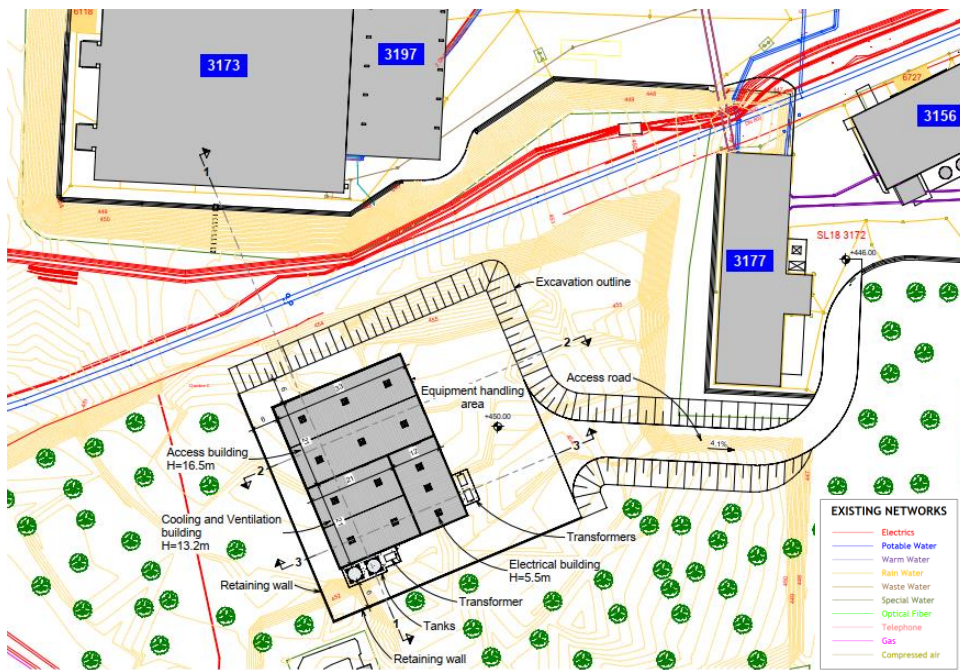
Both service buildings have a 1.2 m deep false floor to allow the services to be distributed into the shaft



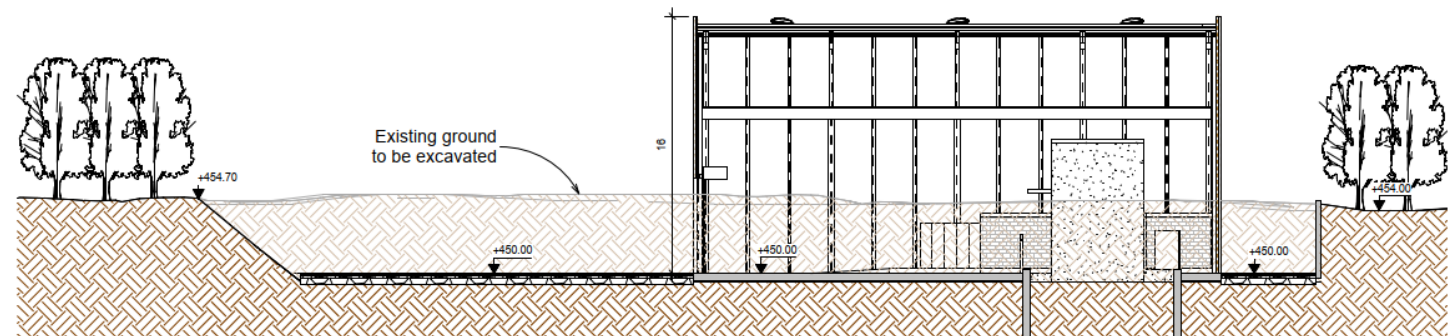
Forward Physics Facility

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 are planned for early next year
 - New core will be drilled the full depth of the proposed shaft
- Proposed location in a wooded area, making the access difficult for survey and for the drilling equipment
 - 30m long and 4m wide access path created
- Tender process currently ongoing



Position marked by CERN survey team



Civil Engineer Works

Preliminary Cost Estimate

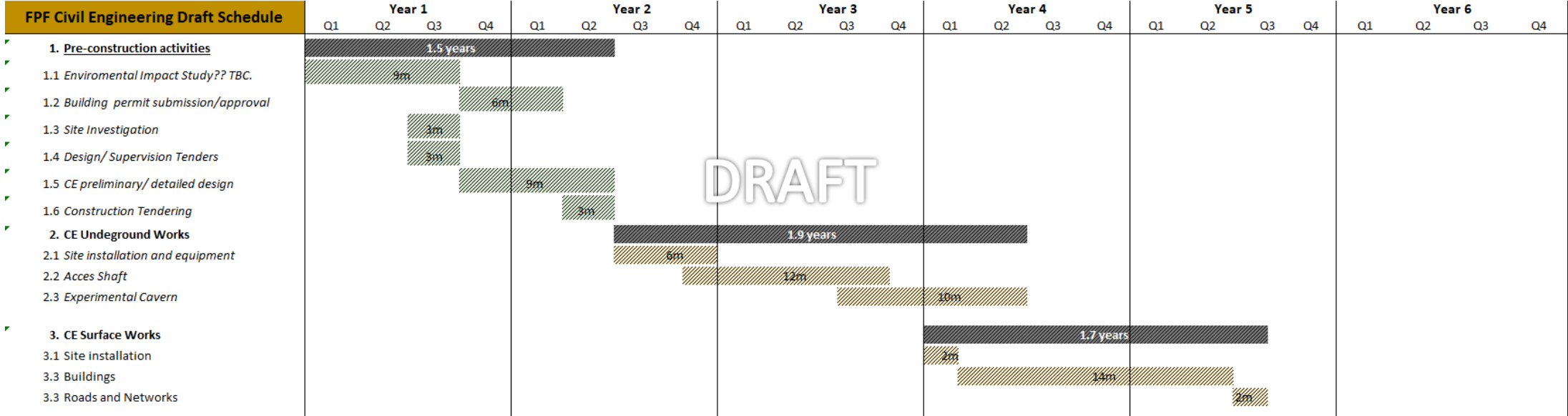
- Very preliminary cost estimate prepared in 2021
 - HL-LHC Point 1 as reference project
- Cost estimate Class 4 – total could be 50% higher and 30% lower than the given estimate
- New / updated cost estimate will be prepared
 - Changes in the design
 - Escalation of prices (Ukrainian War)
 - Soil Investigation findings

Order placed with an external consultant for CE cost study



Civil Engineer Works

Preliminary Schedule

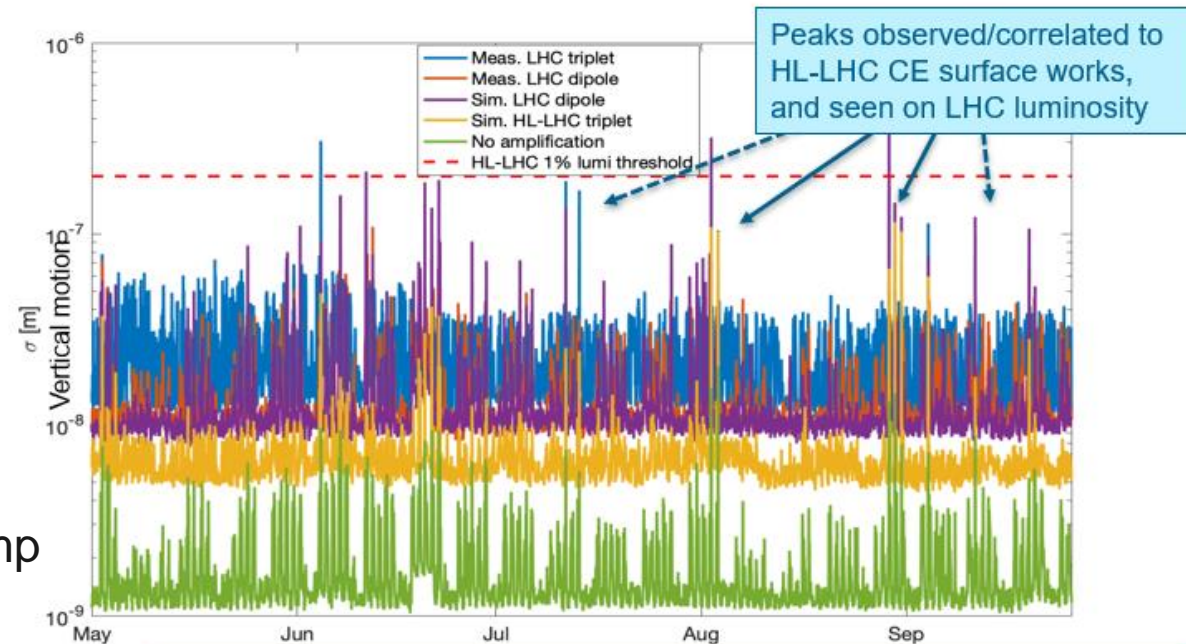


- Access shaft approx. 12 months
- Experimental cavern approx. 10 months

Vibration study

Beam Operation

- Ongoing study on the effect of CE works on LHC/SPS operation
- Existing data from HL-LHC underground works at IP1/5
 - Facility 10m from the LHC tunnel and 36m from SPS
 - FPF is much further from the interaction point, but closer to the LHC
 - Net effect expect similar or smaller effect on beam operations from vibrations, very low risk of beam dump from ground motion
- Compaction of the road and surface area is one of the most problematic operation
 - Surface works need to be coordinated with the LHC run

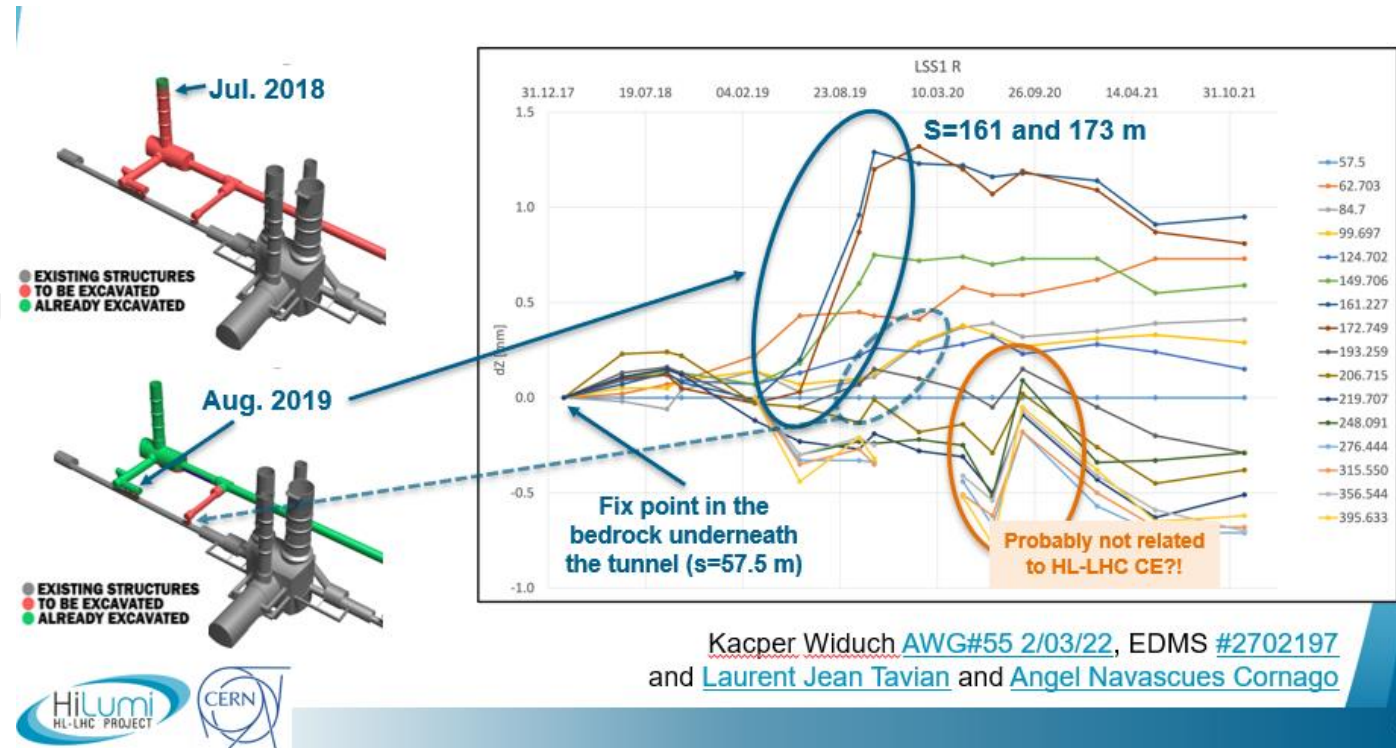


Courtesy of D. Gamba –BE-ABP

Vibration study

Static movement of the tunnels

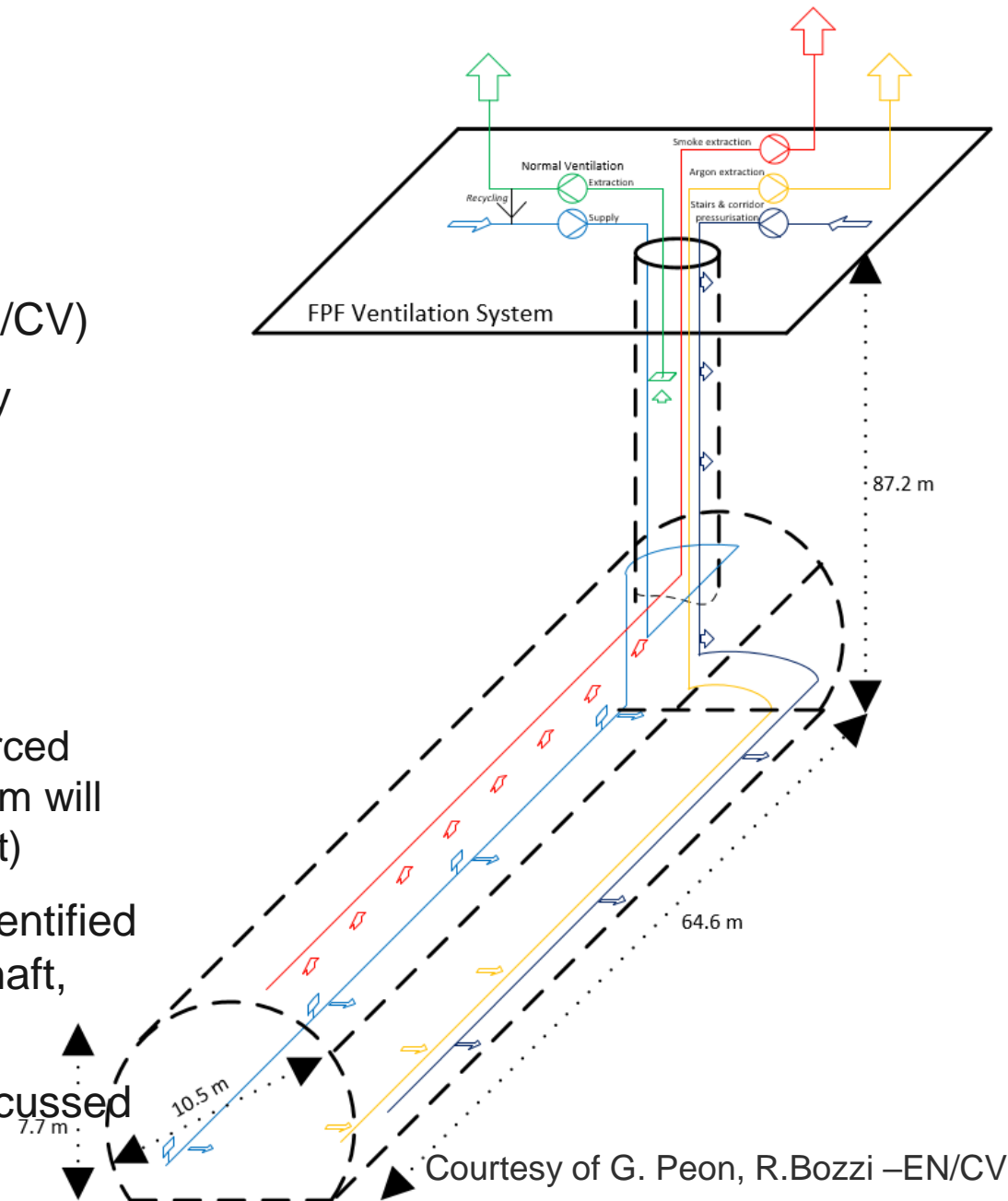
- Study on the vertical displacement of LHC tunnel during CE works
 - Typically, tunnel moves with respect to rock of the order of 0.25 mm/year
 - A ~1 mm “sudden” movement observed during excavation of gallery 5 m above LHC tunnel
 - No visible impact on tunnel positioning from shaft digging
- Study planned on the SPS tunnel movement during HL-LHC CE



Courtesy of D. Gamba –BE-ABP

Cooling and Ventilation study

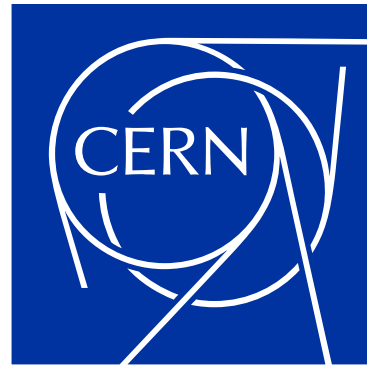
- Study carried out by Guillermo Peon, Roberto Ales Bozzi (EN/CV)
 - Shaft assumed not to be covered (confirmed as very likely possible by RP)
- Proposed System including
 - Supply of fresh air
 - Pressurization – single exit configuration
 - a two-door airlock scheme at the base of the shaft is enforced (Even in case of loss of pressurisation, the two-door system will (mostly) prevent smoke or Argon from entering in the shaft)
 - Smoke extraction with three different fire compartments identified (cavern+ surface building, pressurised stairwell access shaft, safety corridor)
 - LAr evacuation included, but details need to be further discussed with safety



Courtesy of G. Peon, R.Bozzi –EN/CV

Next Steps

- Interpretation of the soil investigation
- Refine the design and cost estimate (ongoing)
- Conceptual Design Report



Thank you!

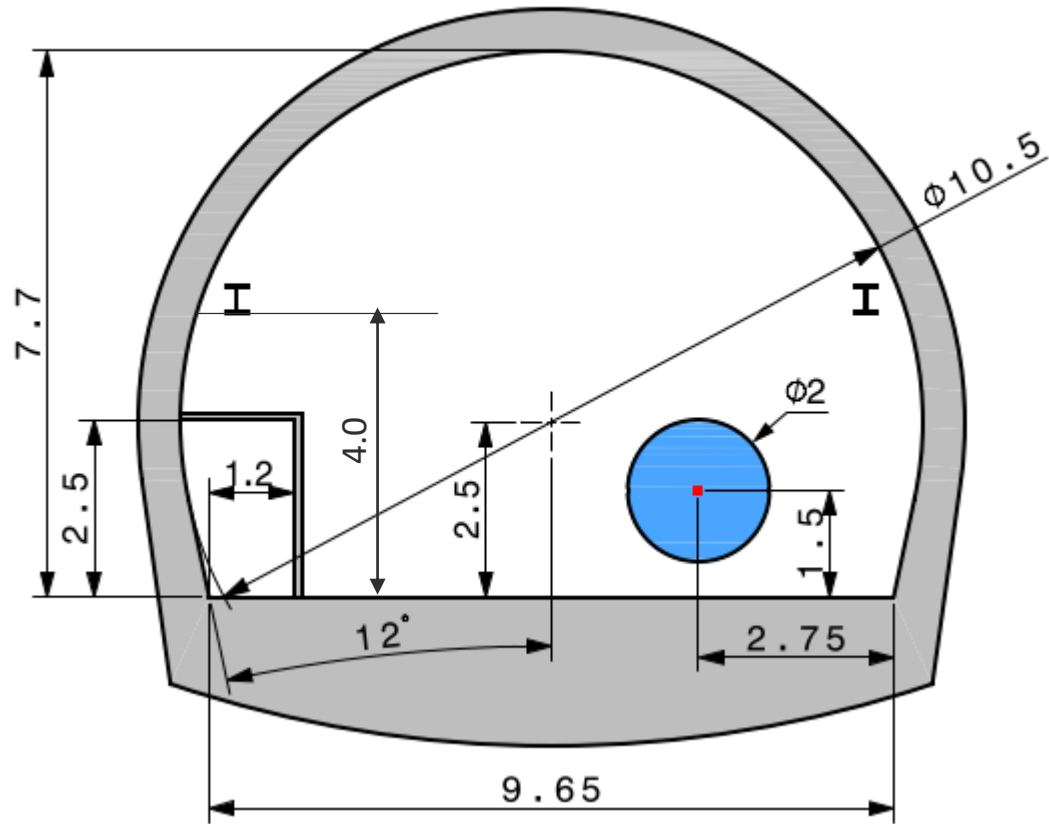
home.cern

Back-up Slides

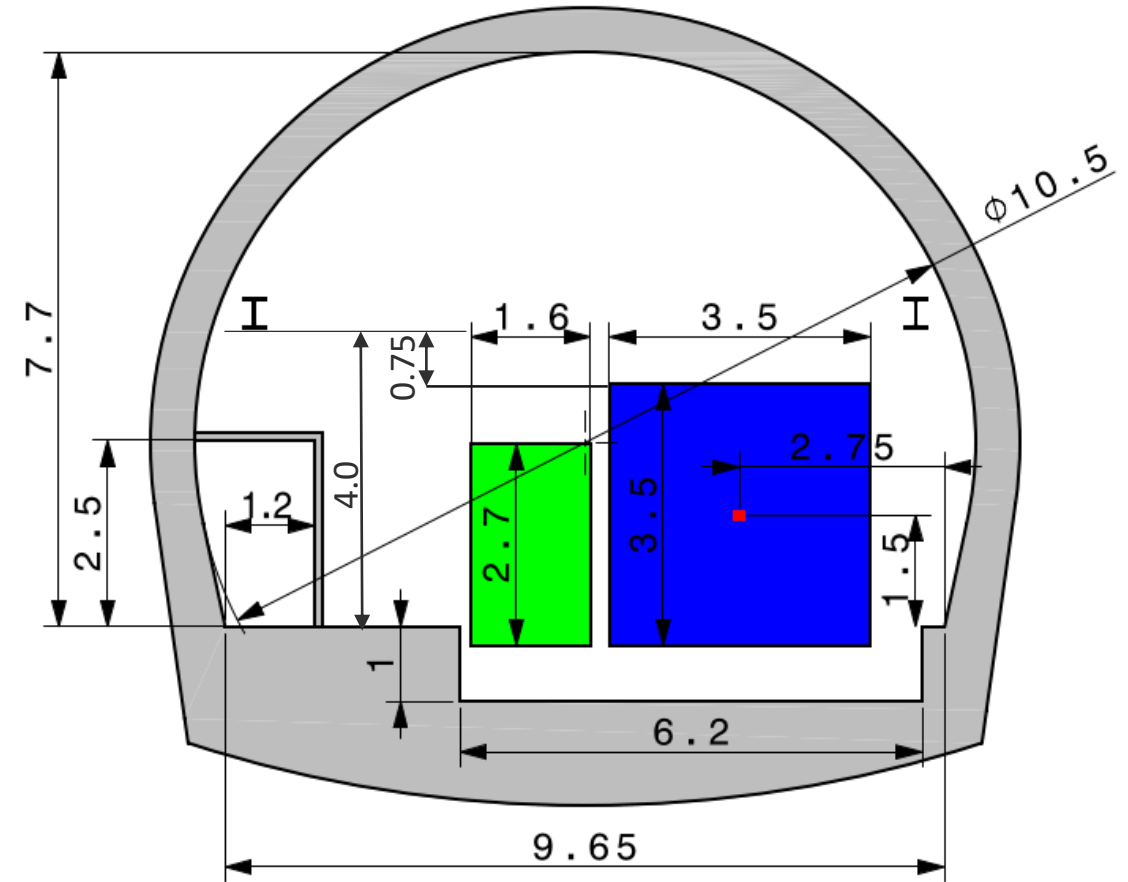
Forward Physics Facility

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 FIARE and teh trench under