



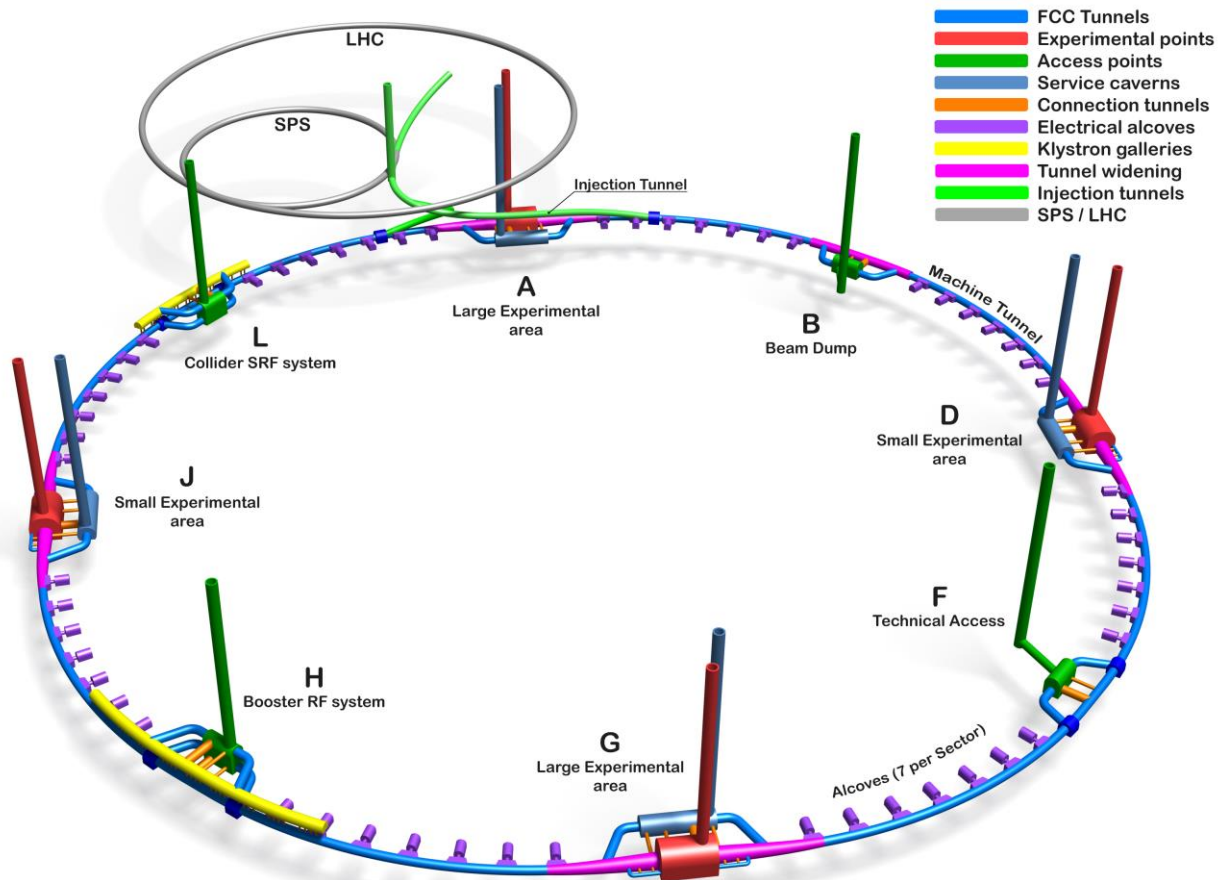
FUTURE
CIRCULAR
COLLIDER

FCC WEEK – UK INDUSTRY SESSION

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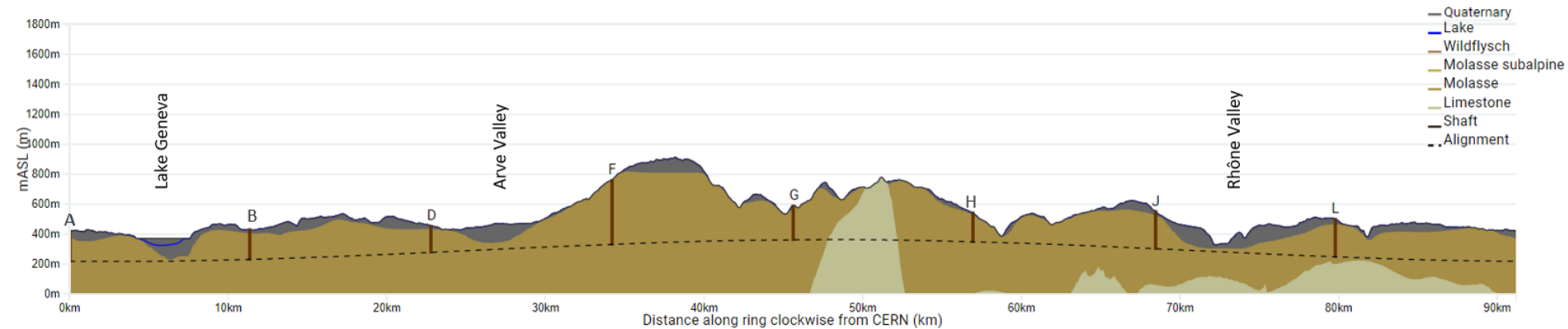




Schematic of the Underground Civil Engineering

[Not to scale]

Tunnel Long Profile



Shaft depths:

A: 201 m

B: 201 m

D: 181 m

F: 400 m

G: 226 m

H: 235 m

J: 253 m

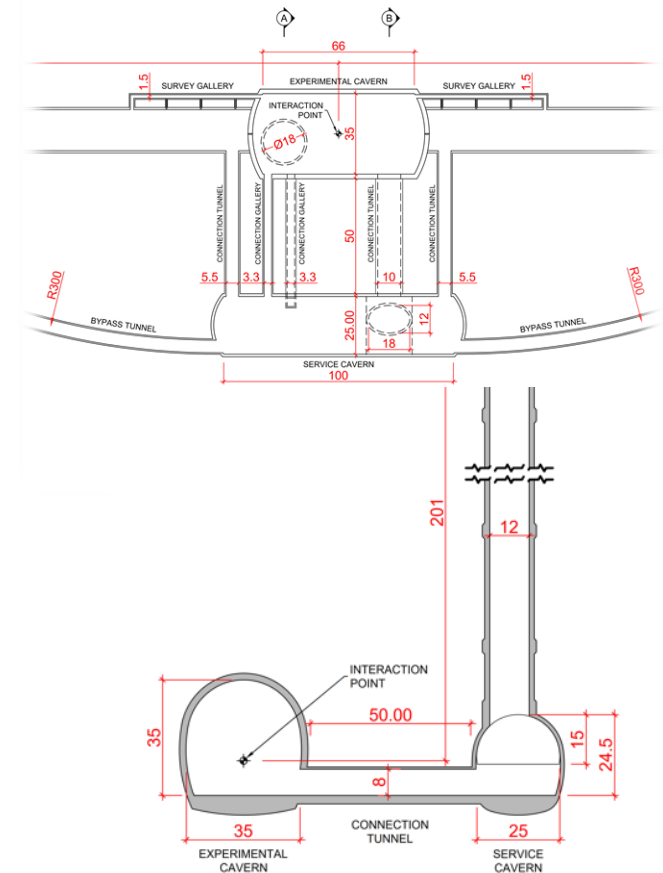
L: 250 m

FCC Study/Project

- The FCC is currently in a “Study” Phase meaning that it is not an official “Project”. The Concept Study started in 2012 and was completed in 2018. We are now in a Feasibility Study Phase which should be completed by end 2025.
- For Civil engineering this means we are undertaking the necessary tasks to determine the technical feasibility of a future project as well as preparing cost estimates and schedules to support the technical feasibility.
- Although in-house design work to ascertain how CERN requirements could be met is normally done “ in-house” CERN generally tends to contract out most civil engineering activities relating to design and construction.
- For FCC, external consultants have participated to conceptual designs and associated costs estimates and defining a site investigation campaign.
- At the present time CERN has one Austrian consultant specializing in underground works, one French consultant for the ongoing site investigation and one UK/French/Swiss consultant for preparing cost estimates for surface works. The US DOE Laboratory Fermilab are collaborating on some surface building preliminary designs and CERN is collaborating with the University of Geneva on geological modelling.

Underground Civil Engineering – Main Features

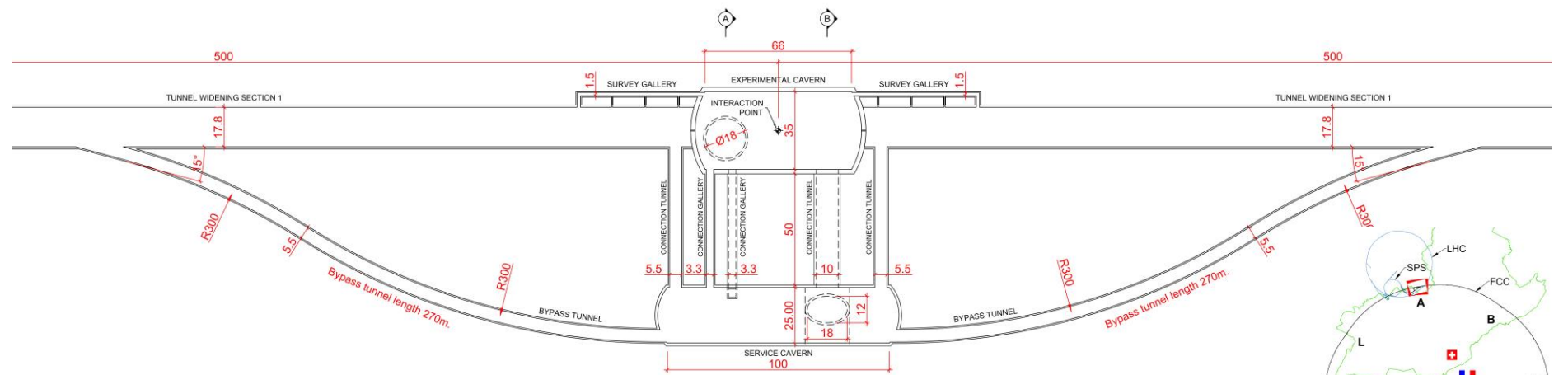
- Two “large” Experiment Areas, each with two shafts for access and two large caverns. Experiment cavern dimensions are 35m x 35m x 66m
- Two “small” Experiment Areas each with two shafts and two caverns. Experiment cavern dimensions are 25m x 25m x 66m
- Large experiment caverns are slightly larger than the ATLAS cavern and the small experiment cavern is similar in size to CMS cavern.
- Deepest experiment cavern is 253m to beamline with shallowest having 181m depth to beam line.



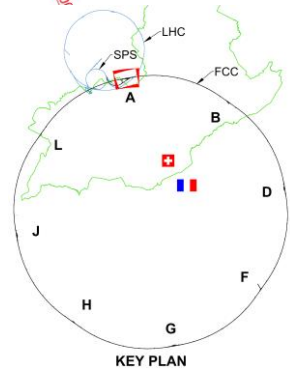
Point A



PLAN VIEW
1:3000

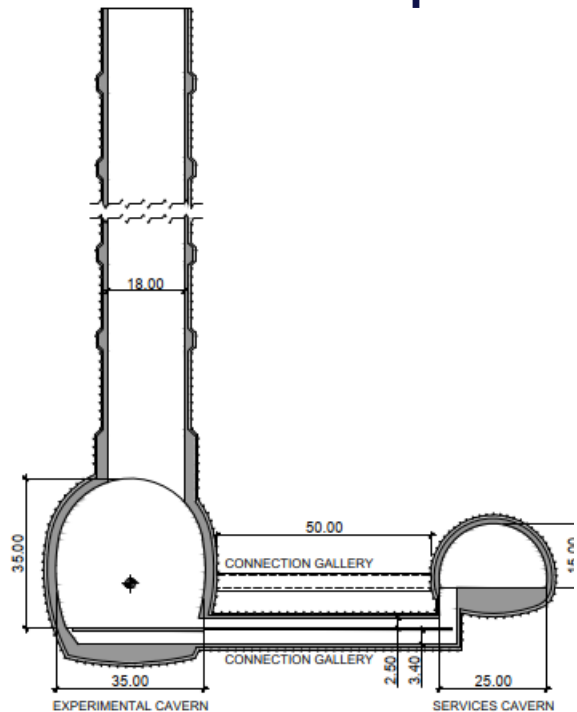


PLAN VIEW
1:1000

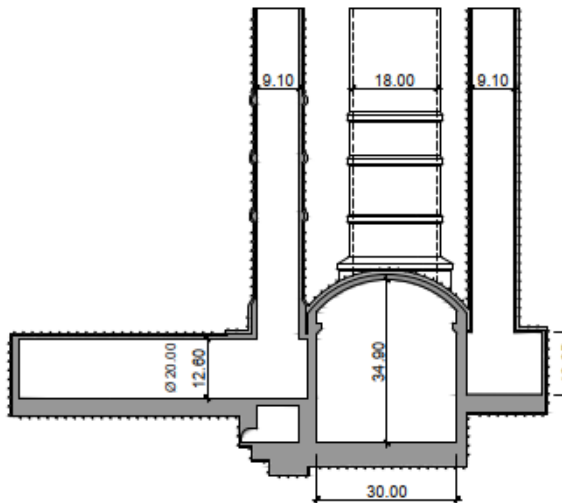


KEY PLAN

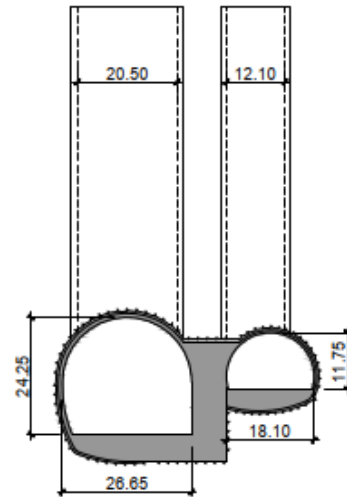
Comparison FCC to ATLAS and CMS Cavern Complexes



FCC

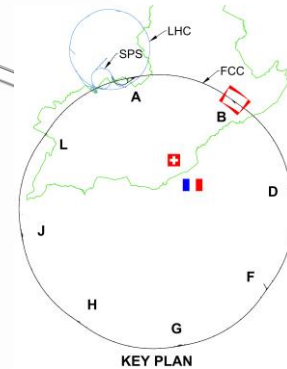
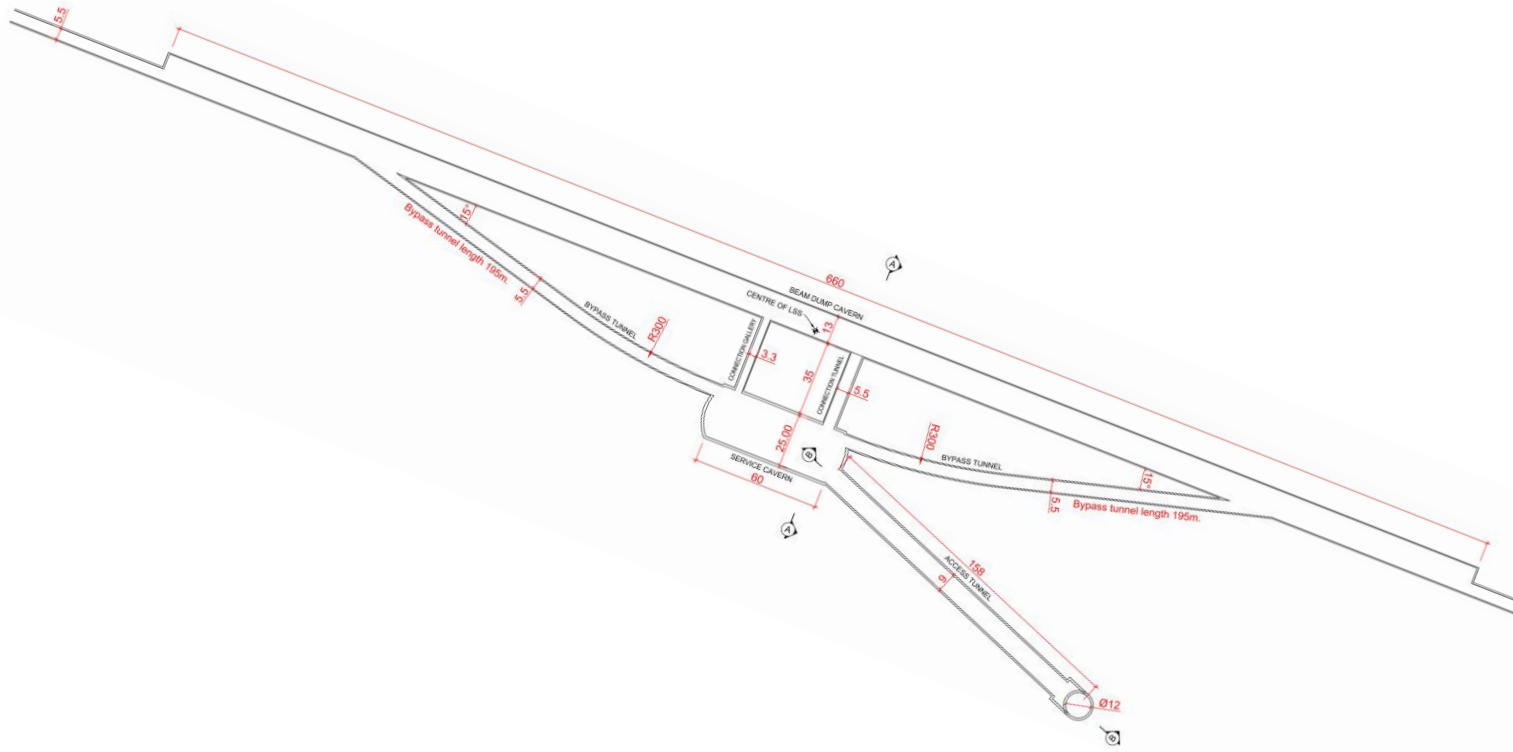


ATLAS

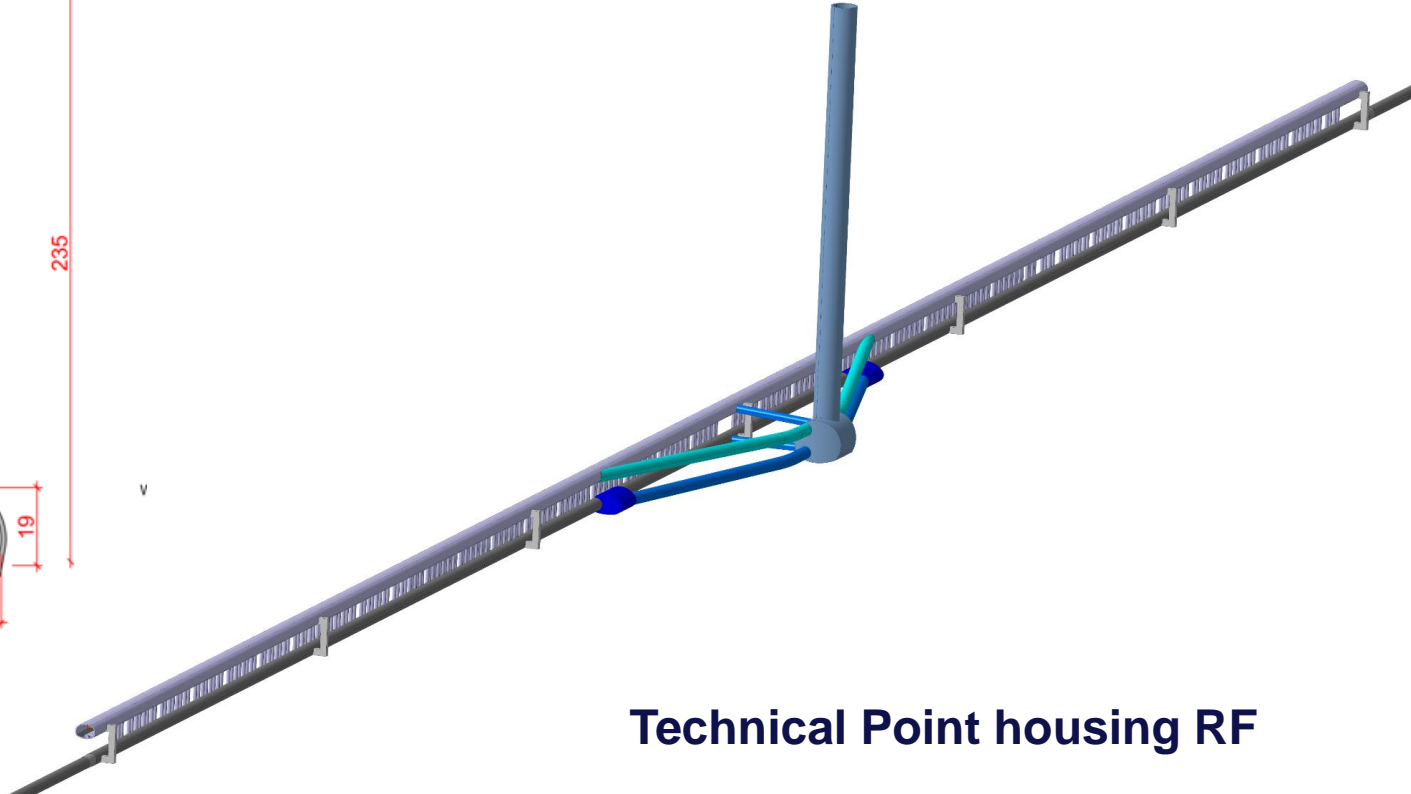
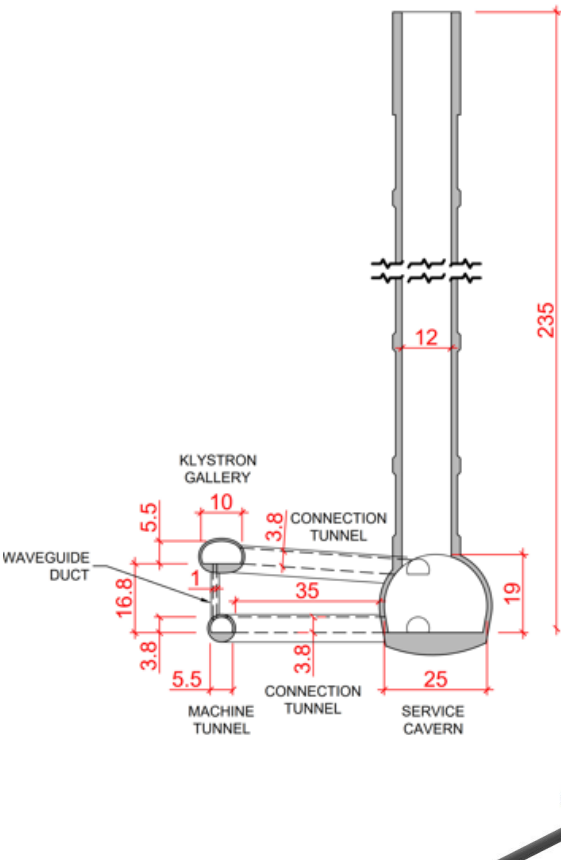


CMS

Underground Civil Engineering – Technical Area



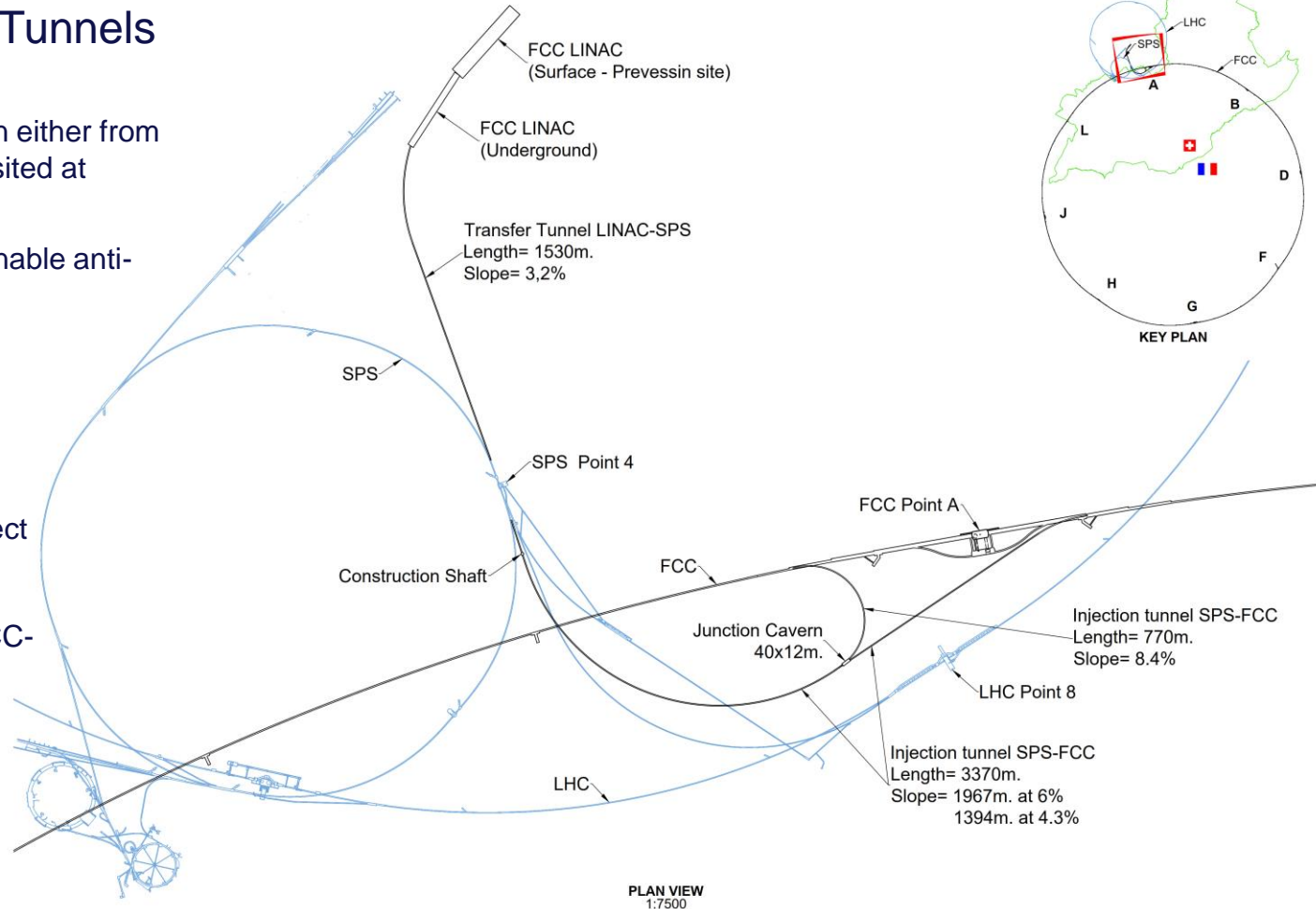
Underground Civil Engineering – Technical Area



Technical Point housing RF

LINAC and Injection Tunnels

- Designed to enable injection either from SPS or from a new LINAC sited at Preveessin
- Single tunnel with spur to enable anti-clockwise injection
- Connection details to SPS and FCC tunnel to be developed.
- Layout could facilitate a direct surface to FCC link
- Design allows re-use for FCC-hh



Surface Civil Engineering

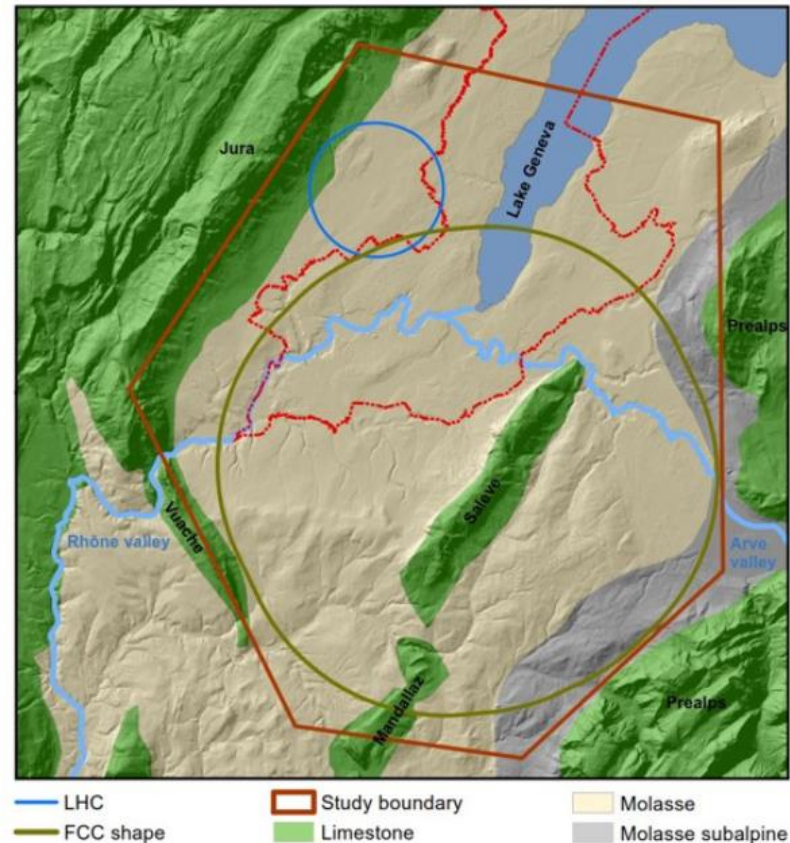
- Preliminary layouts for surface buildings for an Experiment Site and a Technical Site have been developed in conjunction with the Fermilab civil engineering group.
- These layouts along with their associated bills of quantities will be used to prepare cost estimates for surface works.
- For most of the other surface sites, the FCC civil engineering team has been working on options for surface buildings in order to support ongoing discussions with the local communities which will lead to more definitive layouts being prepared after the mid-term review.
- Surface buildings at experimental sites are constrained by the underground caverns and shafts since the experiment access shaft can be located in only one of two positions relative to the Intersection Point.
- For Technical sites there is more flexibility as the access shaft can be located further away from the beam tunnel.



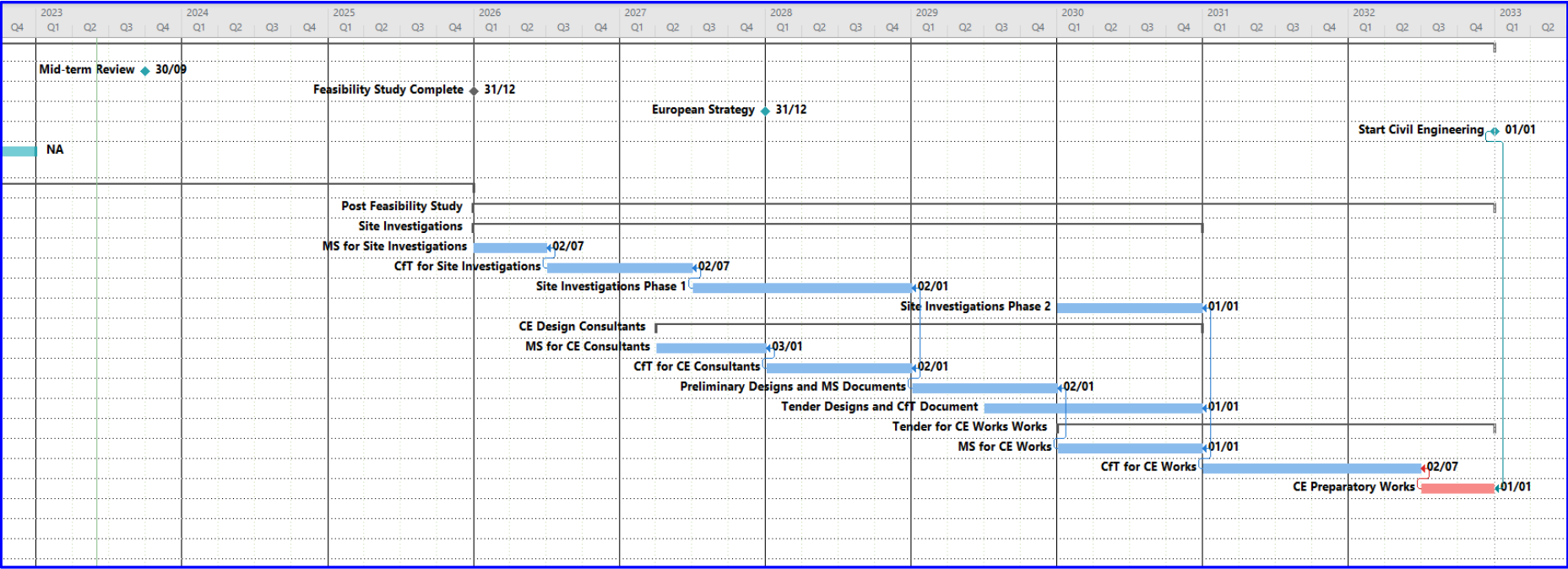


Site Investigation for Areas of Geological Uncertainty

- The works will consist of:
- About 48 cored or non-cored boreholes. These will determine precise locations of the interfaces between the different rock types and testing on samples will provide data for further structural design work for the underground structures.
- Around 80 km of seismic reflection lines which will help determine the location of the interfaces between limestone and molasse rock as well as between the molasse and the superficial overlying sand/gravels/silts
- In some boreholes it is anticipated to install piezometers for measuring water pressure



Post Feasibility Study Best-Case Schedule



Feasibility Phase Work Scope

- Work scope to be assigned externally to contractors is limited but some small value contracts may be issued for the following support:
- Cost estimation (underground and surface works)
- Architectural and landscaping services (limited to visual aspects of the surface sites)
- Possibly scheduling expertise for underground works

Post - Feasibility Phase Work Scope

After feasibility phase ends and prior to start of construction the following external services would certainly be required:

1. Planning and oversight of site investigations
2. Permitting and authorizations in FR and CH for SI activities
3. Engineering services for Tender and Construction designs of underground and surface works as well as Architectural services for surface buildings.
4. Construction oversight (FIDIC Engineer) Services
5. Underground and surface construction contracts
6. Legal support, Adjudication Panel members etc

Previous contributions from UK Civil Engineering Companies

For large Projects (SPS, LEP, LHC, Hi-Lumi) the contributions from UK companies has been:

SPS (1970's) – nothing

LEP (1980's) – nothing

LHC (1998-2006):

- Gibb (now Jacobs) in JV with Austrian and Swiss companies for design and oversight (Engineer role)
- Knight Piesold UK in JV with EDF (now part of AECOM I think)
- Brown and Root UK in partnership with Intecsa
- Taylor Woodrow and Amec in a JV with Spie for one of three large construction contracts
- Norton Rose for legal services

Hi-Lumi

- ARUP (pre-feasibility)

Comments

1. Need to leverage from the CERN procurement rules that favour supplies from poorly balanced countries
2. Need to note that major contracts are always prepared at least in the English Language. LHC civil engineering was executed in English due to the diverse nationalities involved.
3. Need to note that in last 20 years CERN has consistently used FIDIC model for medium and large construction contracts
4. JVs with host state firms can give a good mix of skill sets
5. JVs with companies skilled in recent deep tunnels could be considered
6. Construction very challenging given strong host states capabilities.



Thank you
for your attention.