

07/01/2023 – FCC Week 2023

## FCC Underground Civil Engineering Update

## FCC Feasibility Study

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# FCC Civil Engineering Studies

- Feasibility study of FCC construction at CERN
- Mid-term review 2023
- Geological site investigations 2024
- Feasibility study delivery 2025



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# PA31-3.2 Alignment

90.7 km circumference Swiss molasse basin Lake crossing River (moraine) crossings Mountain topography Geneva metropolitan area









# **Civil Engineering Sub Surface**

- 8 surface sites
- 13 shafts
- 4 experiment caverns
- 8 service caverns
- Beam dump
- **RF** klystron galleries
- SPS injection lines





**Experimental points** Service caverns **Connection tunnels Electrical alcoves Klystron** galleries **Tunnel widening Injection tunnels** 

[Not to scale]



### Main Beam Tunnel



Credit: Fani Valchkova-Georgieva





### Shafts

Shaft depths, 180m to 400m

- 2 x 18.4m elliptical
- 4 x 18m circular
- 7 x 12m circular









Credit: Angel Navascues Cornago











FCC



### ATLAS (LHC)



### CMS (LHC)

Credit: Angel Navascues Cornago

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### **Experimental Area**









# Tunnel Widening

















### Alcoves and Passing Bays

7 Alcoves per sector

Every 1.6km

Passing bays included

Larger alcoves near FCC points for additional EL





Credit: Angel Navascues Cornago









Machine tunnel









# **SPS Injection Lines**

#### **CERN Prevessin LINAC to SPS Point 4**

SPS Point 4 to FCC

Reuse of SPS machine









### Excavation

- Estimate of the quantity of excavated material
- Baseline TBM layout and direction of drives
- Balance of material between France and Switzerland
- Bulk total: 8,100,000 m<sup>3</sup>
- 160,000 to 1,400,000 m<sup>3</sup> per site
- 96% molasse
- 3% limestone
- 1% moraine















#### 2023 – FCC Cost and Schedule study by ILF Consulting Engineers

#### 2018

- 12 Points FCC
- Cost and schedule study by ILF

#### 2023

- 8 Points FCC
- New cost and schedule study by ILF



Schematic: 2023 - 8 Points FCC





# ILF GROUP

# 6,0004 °

**150+** COUNTRIES IN WHICH ILF HAS BEEN SUCCESSFUL

**40**+ OFFICE LOCATIONS ACROSS FIVE CONTINENTS



### 2,400+ EMPLOYEES WORLDWIDE

224 MILLION € REVENUE

### **50+** YEARS OF EXPERIENCE





# **ILF SWITZERLAND AT A GLANCE**



### **YEARS OF EXPERIENCE**



#### **PROJECTS SUCCESSFULLY** EXECUTED

### **BRANCH OPENING IN ZÜRICH**

**BEEN SUCCESSFUL** 



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### **OFFICE LOCATIONS ZÜRICH + BAAR (ZG)**



### **COUNTRIES IN WHICH ILF HAS**

EMPLOYEES





### **ROAD TUNNEL**

### DIGITAL **DESIGN & CONSTRUCTION**





### **RAILWAY INFRASTRUCTURE**

### **SPECIAL PROJECT**

### **TUNNEL VENTILATION SYSTEM**

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### PROJECTMANAGEMENT **CONSULTANT BUILDINGS**



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# **Construction Schedule Study**

- **Tilos** is a linear infrastructure tool
  simplified, visual look at the construction project through a
- powerful linear scheduling view
- Time Chainage & Scenario optimization
- Optimal mass handling

FUTURE CIRCULAR COLLIDER

Cost overview with time











## Longitudinal view



Longitudinal view with specification to: Country, section, Alcoves, Tunnel Widening, Machine Tunnel, Klystron Stairwell





### Construction Schedule Study

Start excavation: January 2033

Sector completion:

- End first sector (A & A-B) : About 6.5 years
- End last sector (F & F-G) : About 8.5 years



Credit: ILF





- Site installation
- Shaft

FUTURE CIRCULAR COLLIDER

- Conventional excavations
- Caverns •
- Main Beam tunnel excavation with **TBM**
- **Cavern** steel construction



Installation around 2 shafts (LHC construction)





### Sequence of the construction schedule

#### **Shaft & conventional excavation**

- Service shaft with diameter = 12m
- Experiment shaft with diameter = 18m
   → excavation takes longer
- Bypass tunnel with conventional excavation



Roadheader

FUTURE CIRCULAR COLLIDER

Shotcrete for breakout protection



Point 5 - PX56 excavation (-43m) - May 18, 2000 - CERN ST-CE





Schedule at Point G





### Sequence of the construction schedule

#### Machine tunnel excavation with TBM

#### Excavated diameter ca. 7 m





TBM from G to H





# Tunnel Boring Machine (TBM)



Precast segments





### Sequence of the construction schedule

#### **Cavern steel construction**



CMS cavern



3 months for the steel structures in the experiment cavern





### Sequence of the construction schedule

#### **Cavern steel construction**



CMS cavern  $\rightarrow$  experiment cavern



CMS cavern





# Thank you for your attention.



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