

# **Status of High Luminosity LHC Civil Engineering Works**

**John Osborne CERN**

Thanks to Pieter Mattelaer and the WP17.1 team from  
Site Management & Buildings Department, CERN

30 October 2019 – LCWS19 Sendai, Japan



# Agenda

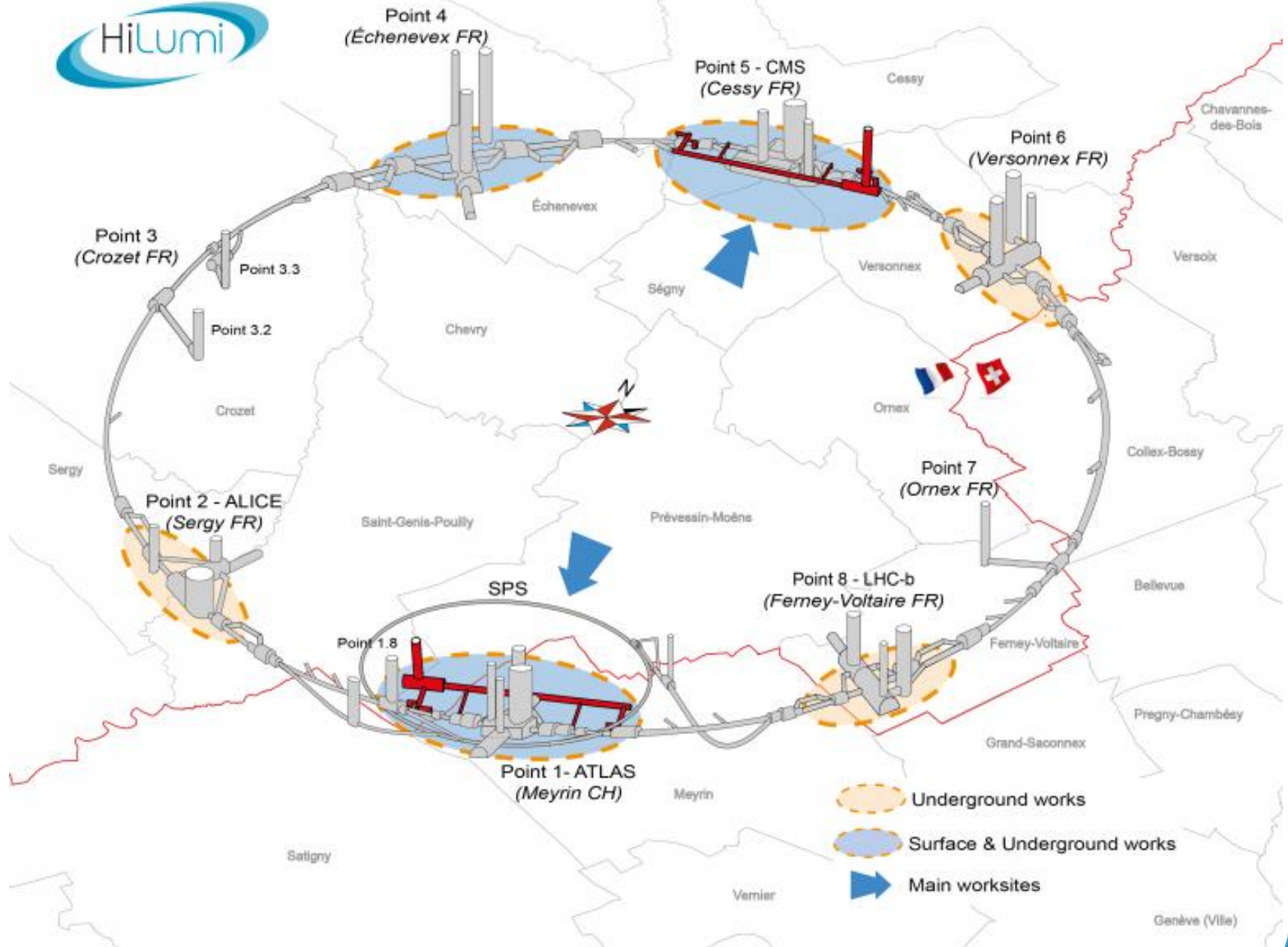
- HL-LHC Civil Works;
- Progress to date;
- Works ongoing at Point 1 & Point 5;
- Conclusions.

## Acknowledgement of WP17.1 team (SMB-SE)

Pieter Mattelaer, Luz Lopez, Pierre Cardon, Martin Manfredi, Pavlos Vardoulakis, Charly Gasnier, Milton Morais, Zacharie Arenas, Ludovic Barthelemy, Angel Navascues, Stephanie Richard, with ad-hoc support from Michael Poehler

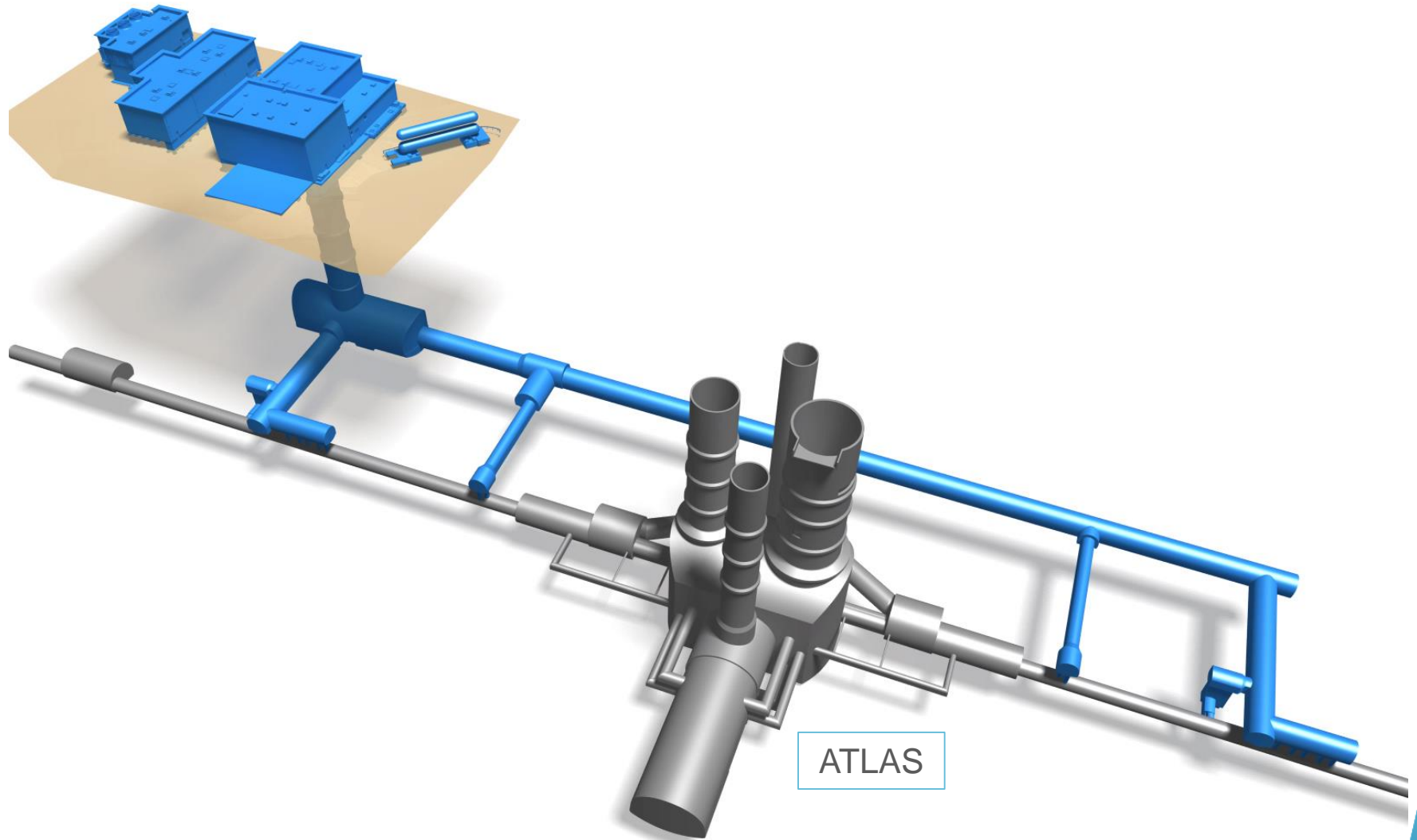


## Civil Engineering HL-LHC Works



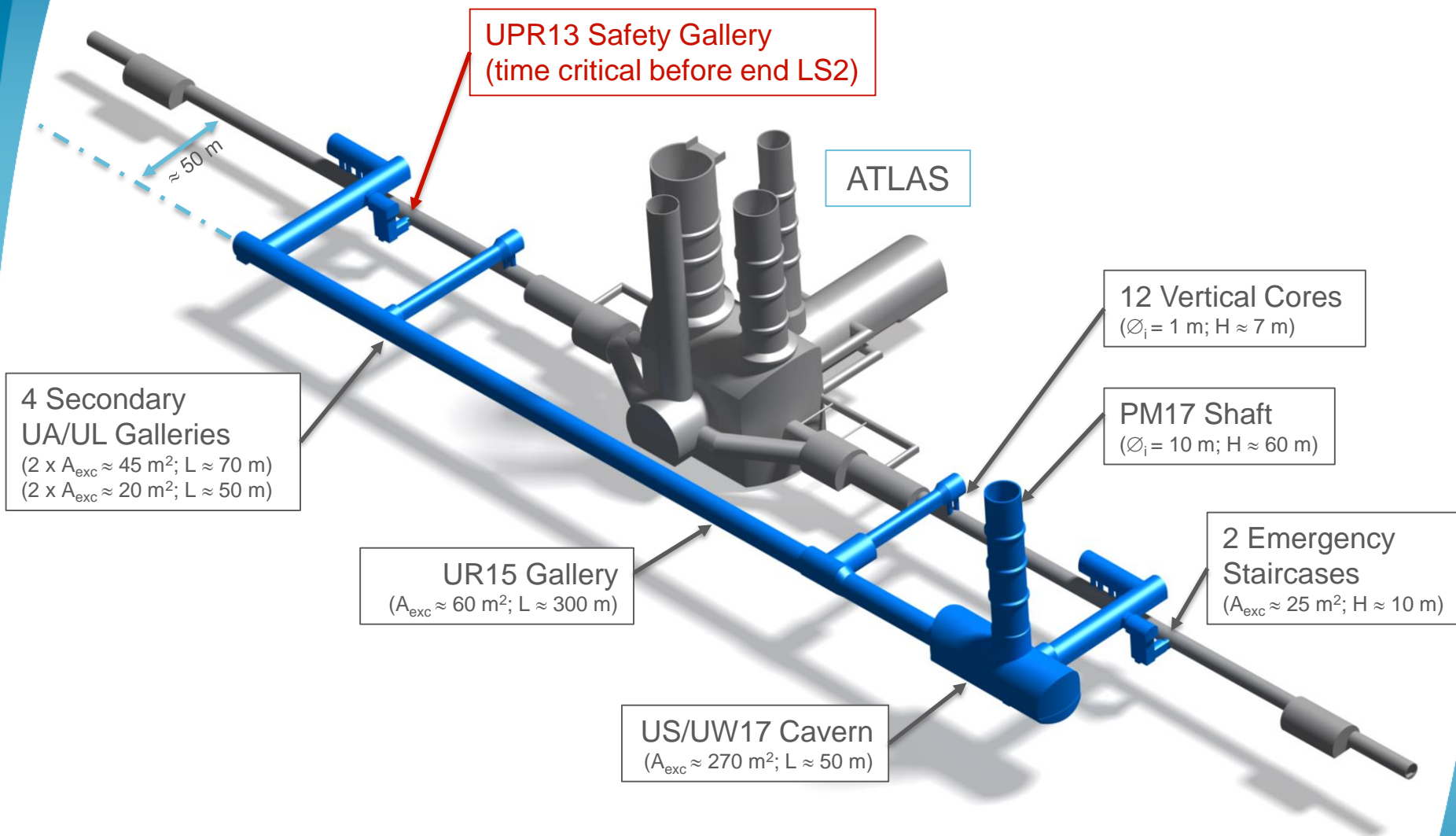


# Civil Works at Point 1

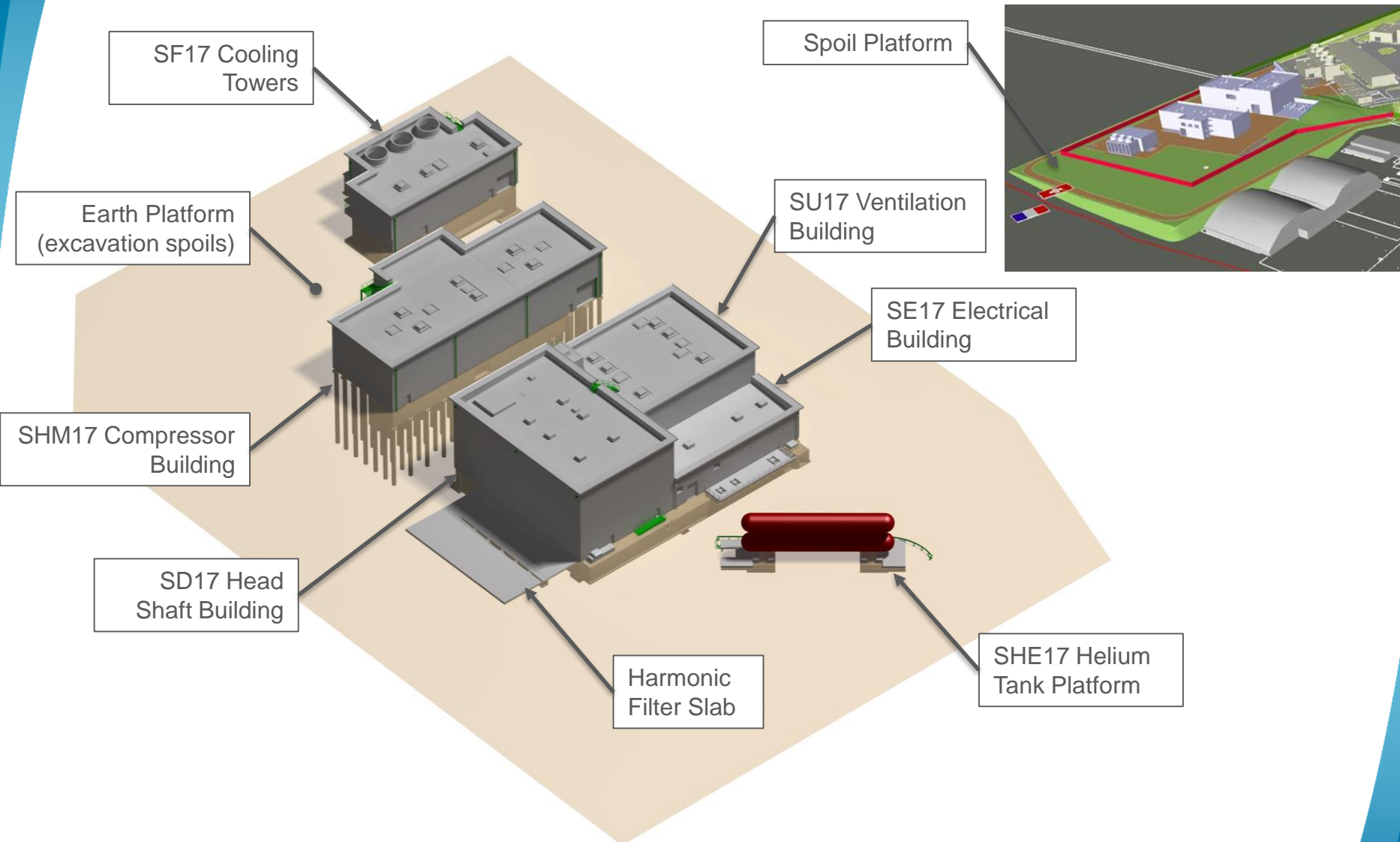


ATLAS

# Underground Works at Point 1

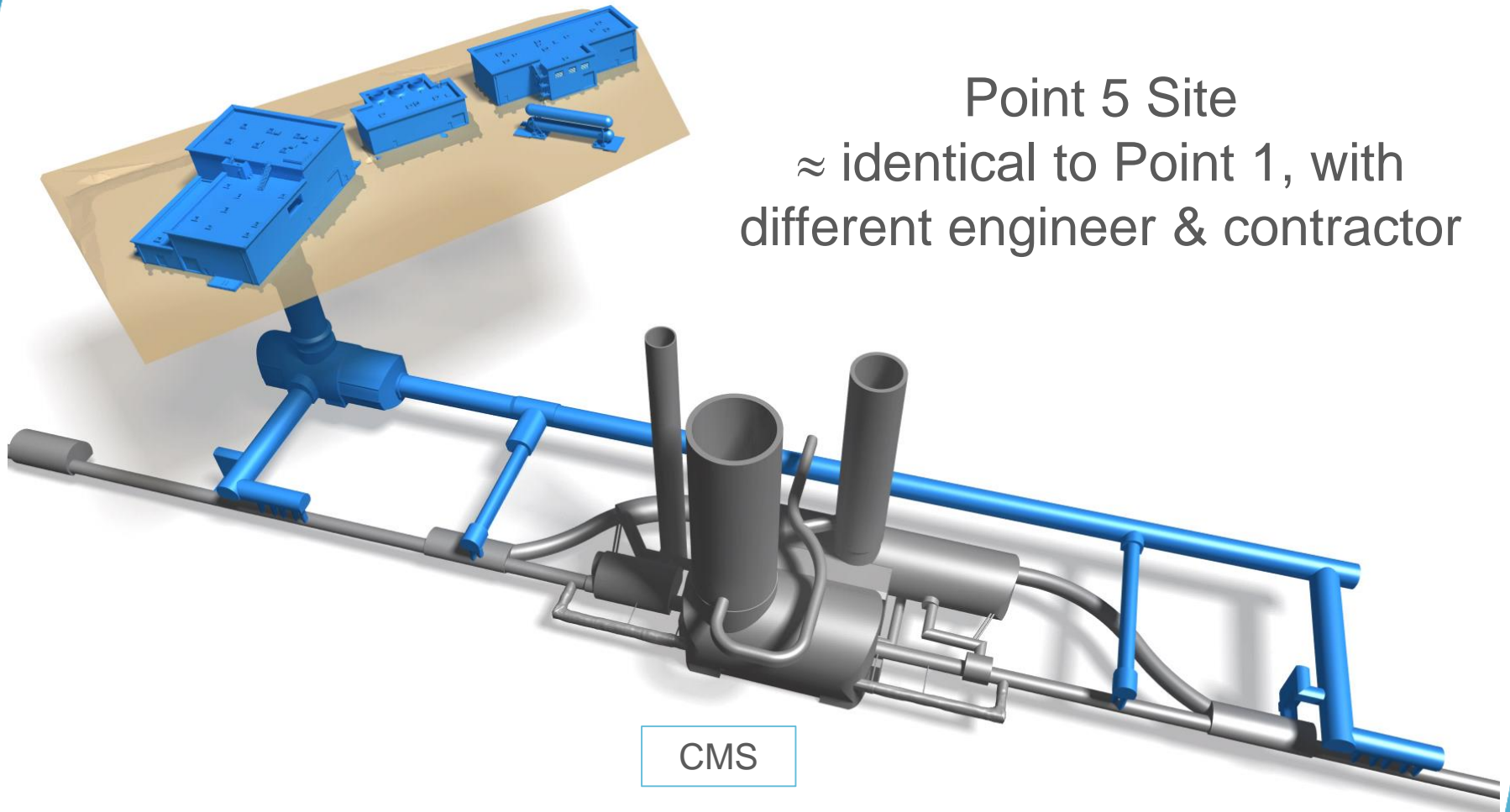


# Surface Works at Point 1



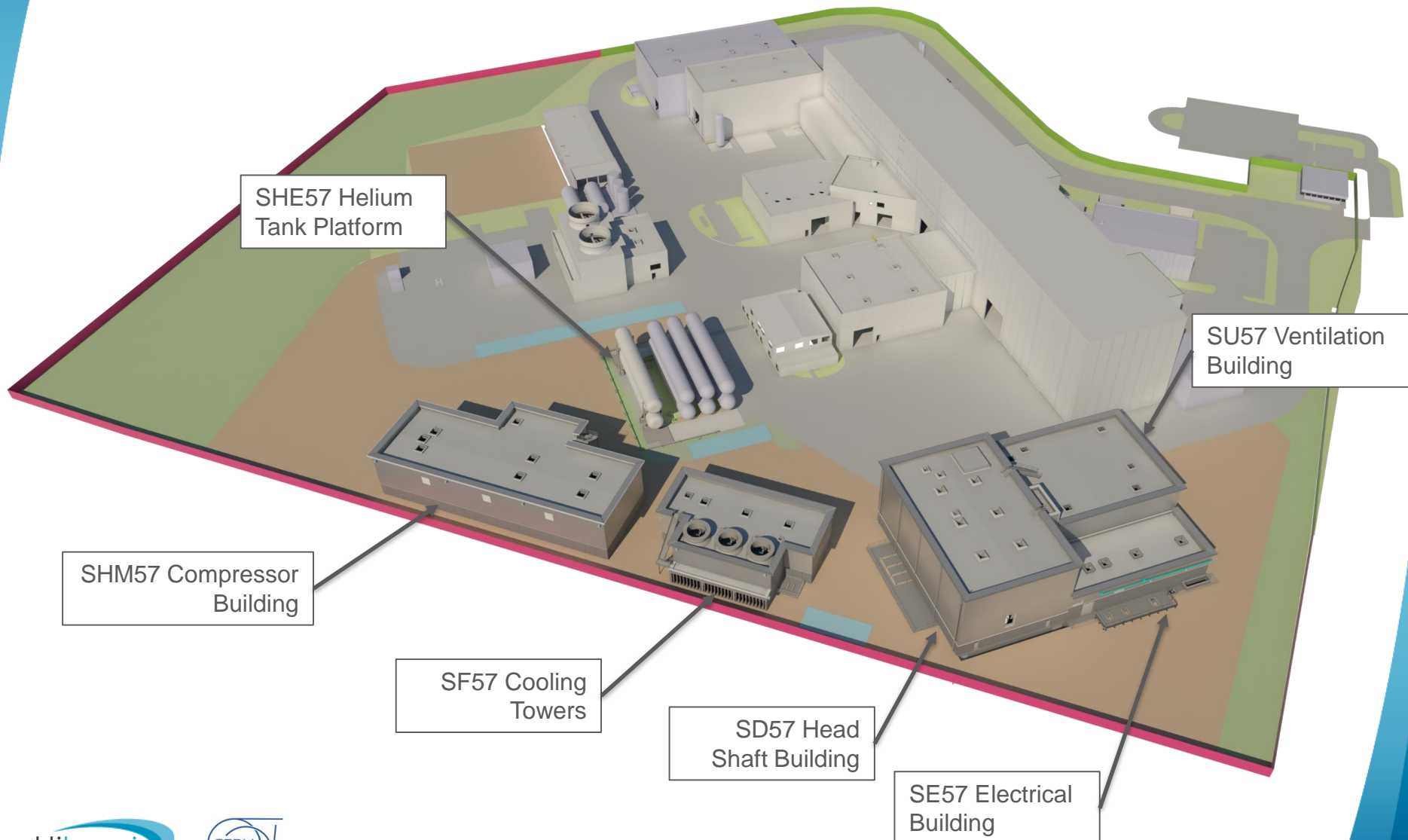
# Civil Works at Point 5

Point 5 Site  
≈ identical to Point 1, with  
different engineer & contractor



CMS

# Surface Works at Point 5





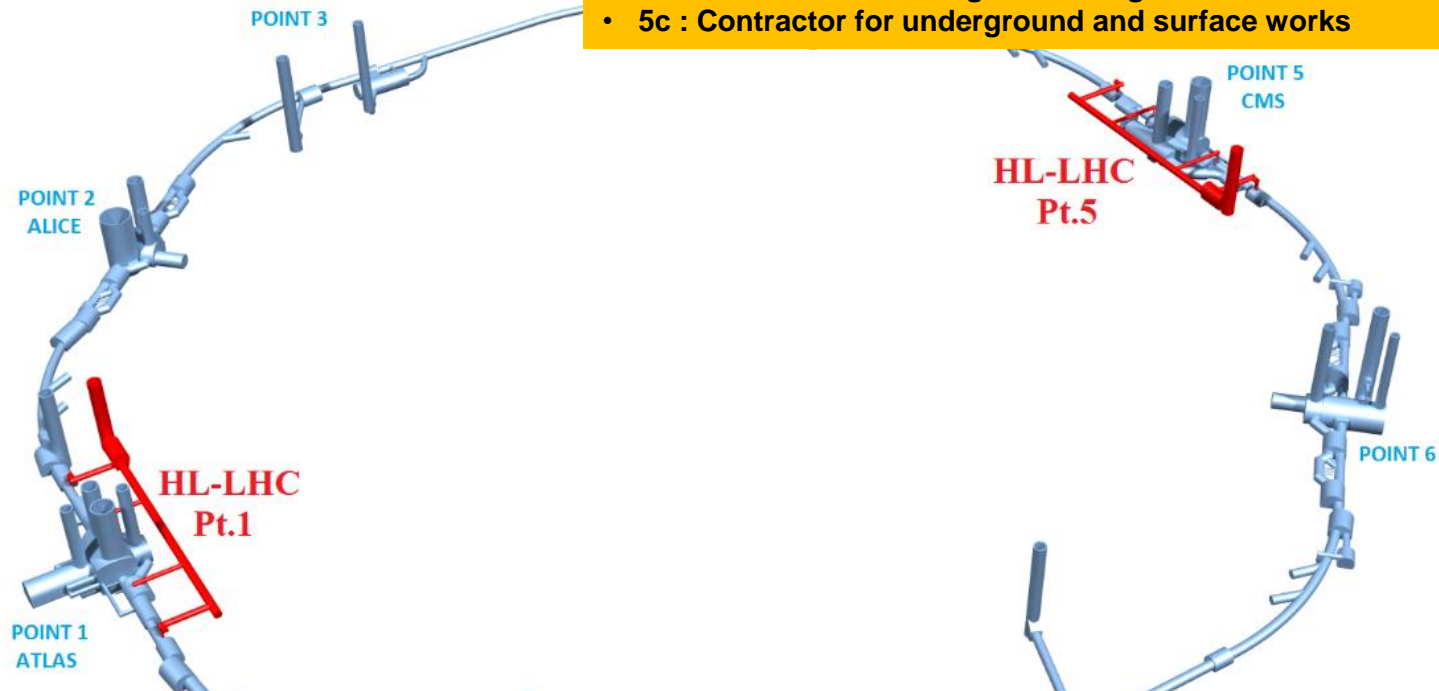


## Civil Engineering Progress to date

# Civil Engineering Contract Strategy

## Point 5 - CMS:

- 5a : Architect for building permit submission (F)
- 5b : Consultant for design of underground and surface works
- 5c : Contractor for underground and surface works



## Point 1 - ATLAS:

- 1a : Architect for building permit submission (CH)
- 1b : Consultant for design of underground and surface works
- 1c : Contractor for underground and surface works

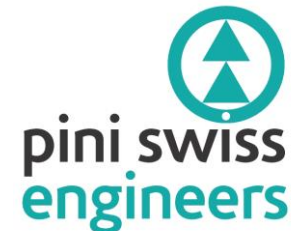
**Form of Contract based FIDIC Emerald Book – Re-measurement based with panel of adjudicators**

# Engineering Contracts

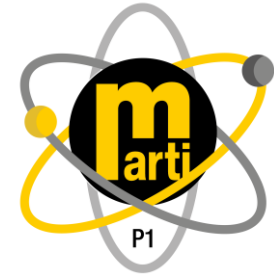
- Scope: Design & Construction Management; from 2016-2022; (vertical cores in 2024);
- Point 1 (CH): JV ORIGIN



- Point 5 (FR): JV LAP



# Construction Contracts



## ■ Point 1 Contractor:

- Joint Venture Marti Meyrin (JVMM);
- Accepted Contract Amount  $\approx$  67 million CHF;  
contract duration of 53 months (until 31.08.2022)
- Country of origin: Switzerland, Austria, Germany;



## ■ Point 5 Contractor:

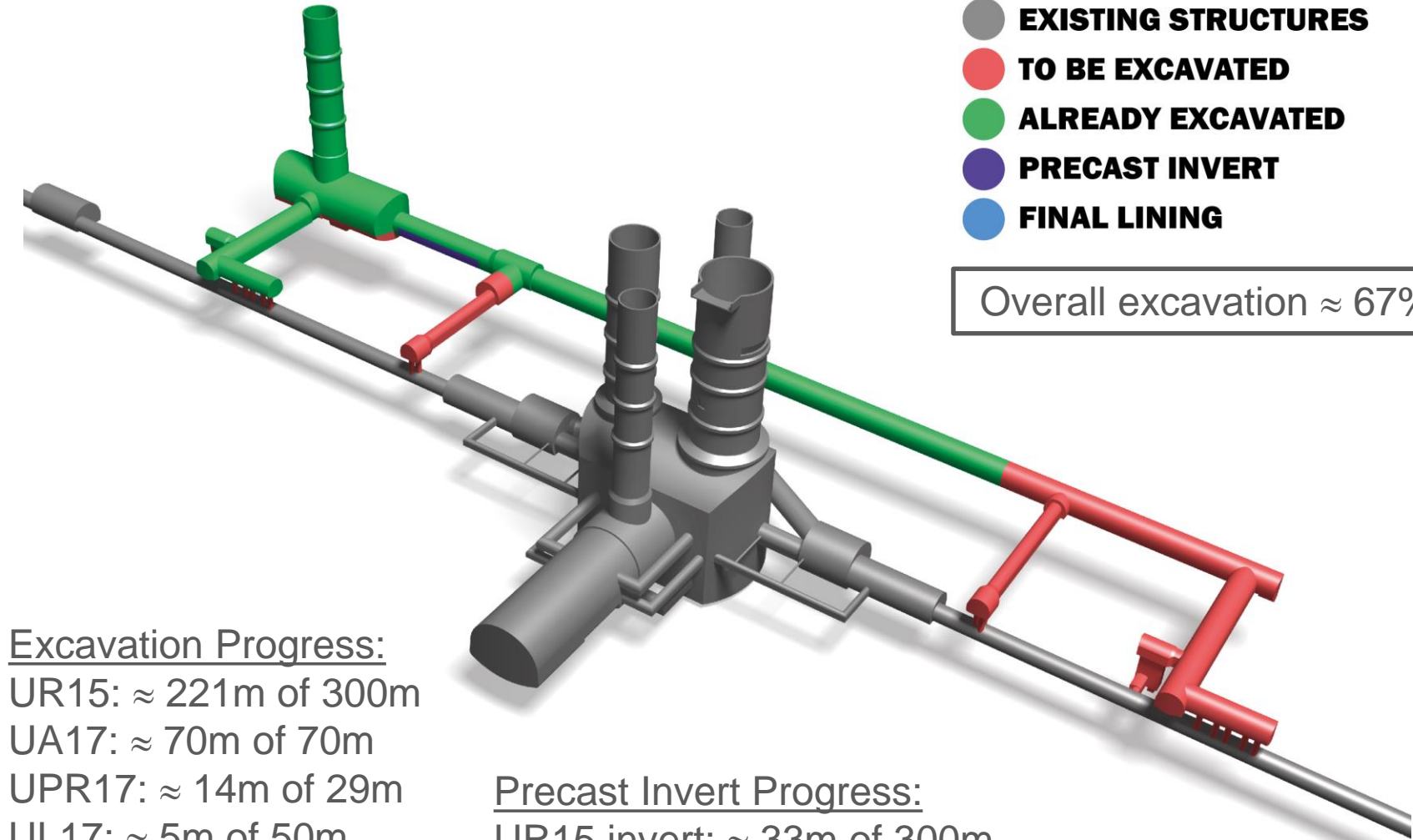
- Consortium Implenia Baresel (CIB);
- Accepted Contract Amount  $\approx$  58 million EUR;  
contract duration of 54 months (until 30.09.2022)
- Country of origin: Switzerland, Germany, France;

# Excavation progress at Point 1

**STATUS: 2019.10.11**

- **EXISTING STRUCTURES**
- **TO BE EXCAVATED**
- **ALREADY EXCAVATED**
- **PRECAST INVERT**
- **FINAL LINING**

Overall excavation  $\approx 67\%$



## Excavation Progress:

UR15:  $\approx 221\text{m}$  of  $300\text{m}$

UA17:  $\approx 70\text{m}$  of  $70\text{m}$

UPR17:  $\approx 14\text{m}$  of  $29\text{m}$

UL17:  $\approx 5\text{m}$  of  $50\text{m}$

## Precast Invert Progress:

UR15 invert:  $\approx 33\text{m}$  of  $300\text{m}$

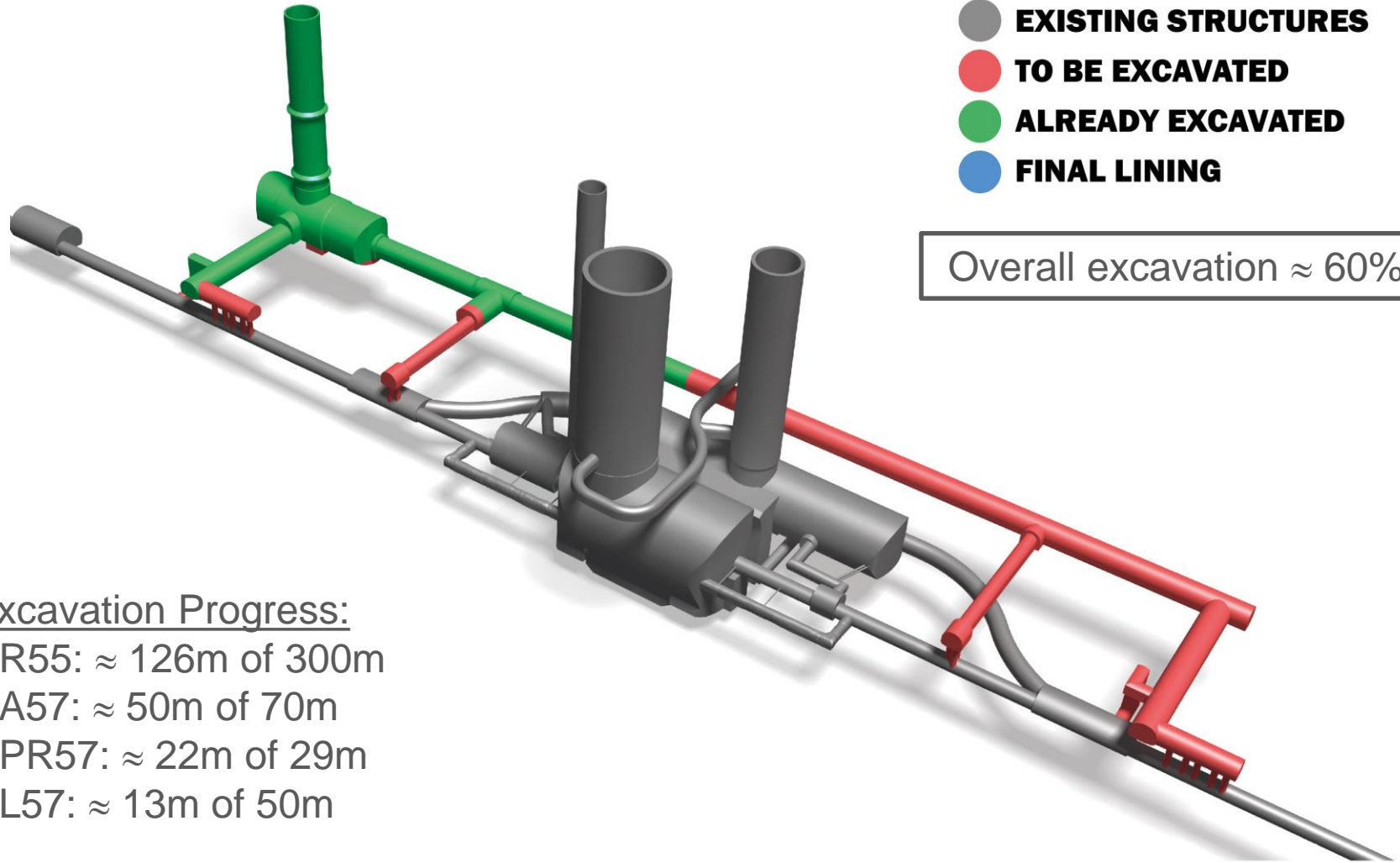


# Excavation progress at Point 5

**STATUS: 2019.10.11**

- **EXISTING STRUCTURES**
- **TO BE EXCAVATED**
- **ALREADY EXCAVATED**
- **FINAL LINING**

Overall excavation  $\approx$  60%



## Excavation Progress:

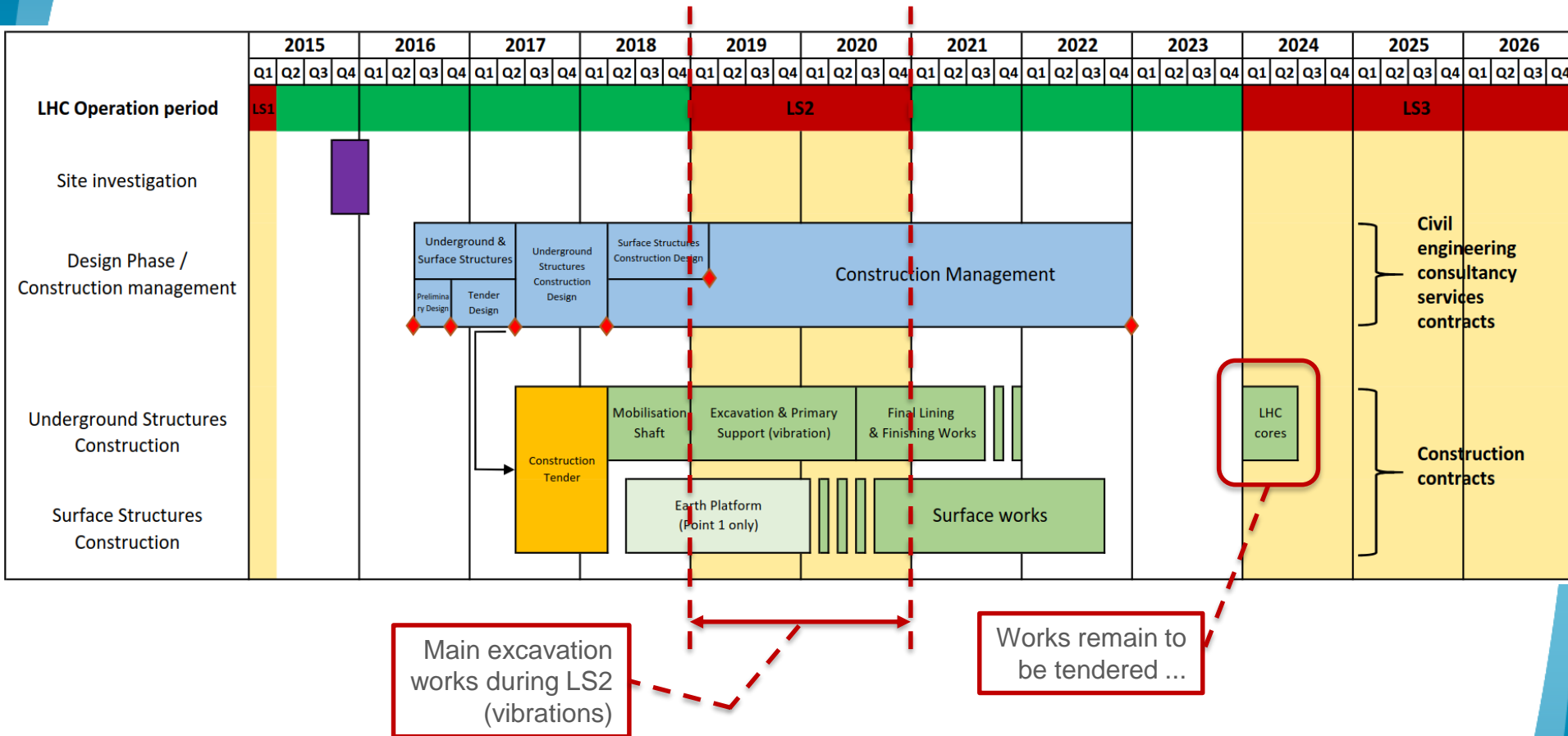
UR55:  $\approx$  126m of 300m

UA57:  $\approx$  50m of 70m

UPR57:  $\approx$  22m of 29m

UL57:  $\approx$  13m of 50m

# WP17.1 Outline Schedule



# Construction Contracts (Key Dates)

Sectional Completion or Employer Requirement	Point 1	Point 5
<b>Completion for the whole of the Works</b>	<b>31/08/2022</b>	<b>30/09/2022</b>
<b>Section 1:</b> UPRX7 and end part of UAX7 up to the connexion with UPRX7	<b>31/03/2020</b>	<b>30/04/2020</b>
<b>Section 2:</b> UPRX3 and end part of UAX3 up to the connexion with UPRX3	<b>31/08/2020</b>	<b>31/07/2020</b>
<b>Section 3:</b> Buildings SFX7, SHMX7, (SHEX7) with associated galleries SLX7, concrete slabs, roadworks and landscaping	<b>31/08/2021</b>	<b>30/04/2021</b>
<b>Section 4:</b> Buildings SUX7 with associated gallery SLX7 towards SHMX7	<b>31/03/2022</b>	<b>30/06/2022</b>
<b>Section 5:</b> Whole of the underground works, including shaft PMX7, and building SDX7, SEX7, (SHEX7) and SLNX7 with associated galleries SLX7, concrete slabs, roadworks and landscaping	<b>31/08/2022</b>	<b>30/09/2022</b>
<b>ER1:</b> Site mobilisation for the Underground Structures	<b>03/04/2018</b>	<b>03/04/2018</b>
<b>ER2:</b> Completion of shaft PMX7 excavation (up to level top of cavern vault)	<b>31/12/2018</b>	<b>31/12/2018</b>
<b>ER4:</b> Completion of excavation works for the Underground Structures	<b>31/08/2020</b>	<b>31/05/2020</b>
<b>ER5:</b> Completion of Underground Structures incl. shaft access arrangement and steel structures in USX7/UWX7 cavern	<b>30/09/2021</b>	<b>31/12/2021</b>

**Diesel powered hydraulic hammer**  
**... the LHC's worst *vibration* nightmare ...**





# Vibration Risk in 2018 (during RUN 2)



Noticeable but negligible ...





# (No) Vibration Risk in 2019 (during LS2)



# (No) Vibration Risk in 2019 (during LS2)



Valuable vibration lessons learnt for Linear Collider planning



## **Works Ongoing at Point 1**





HiLumi Point 1 Site



# Point 1 Site Mobilisation



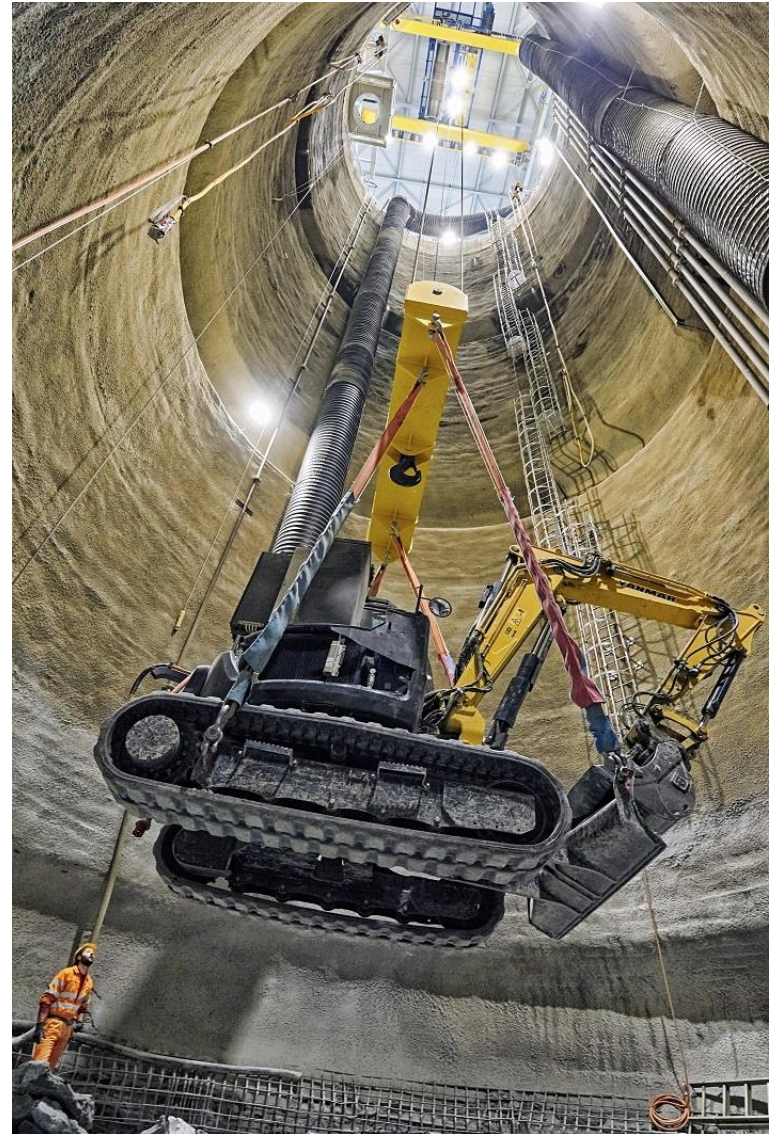




Shaft hall with view of  
PM17 shaft excavation

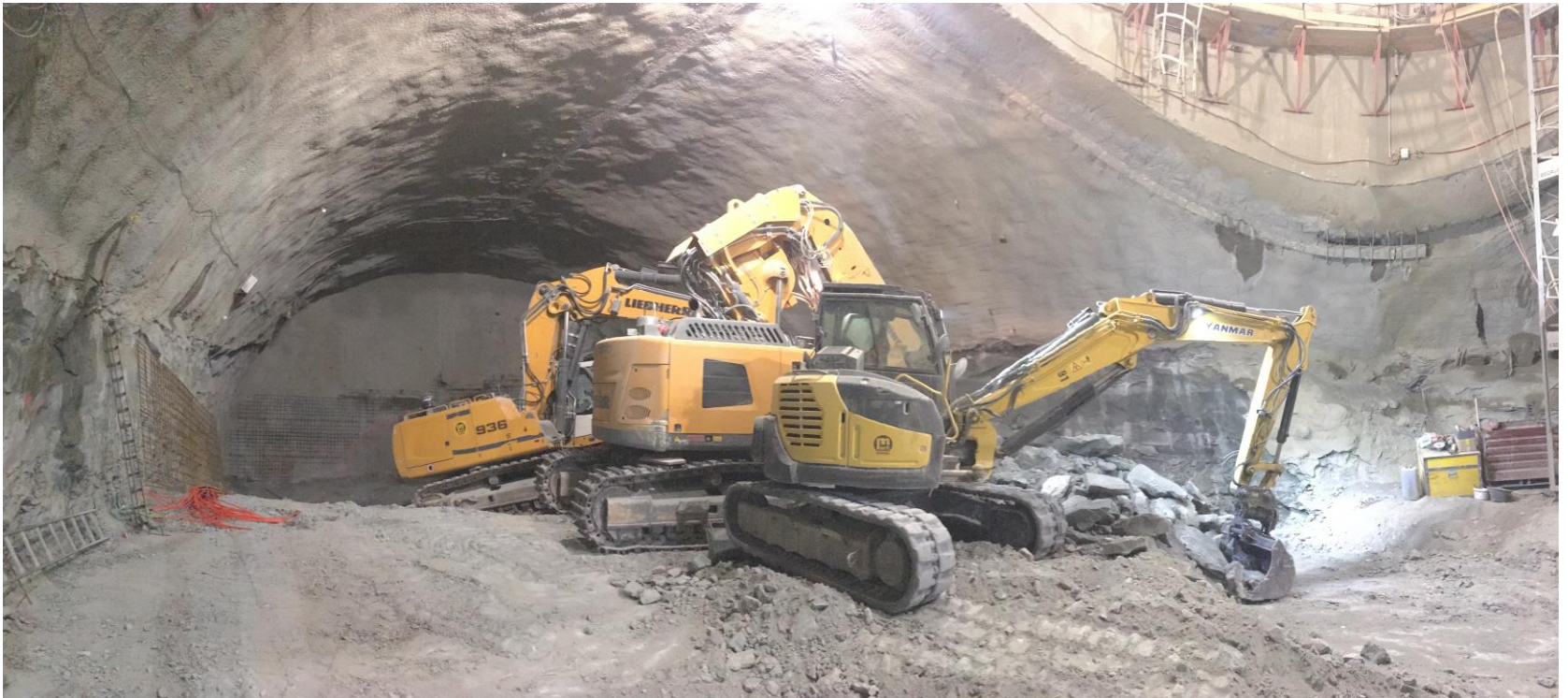


# PM17 Shaft Excavation





# US/UW17 Cavern Excavation







US/UW17 cavern  
(view towards UR15 gallery)





US/UW17 cavern





UR15 gallery excavation





UR15 gallery primary support  
(lattice girders)





UR15 precast invert gantry





UR15 precast invert installation





UA17 gallery excavation





UPR17 safety gallery excavation



# Surface Works – SF17 building (for EN-CV)



SF17 Foundations & Walls



## Works Ongoing at Point 5



# Point 5 Site Mobilisation







Shaft hall with view of  
PM57 shaft excavation





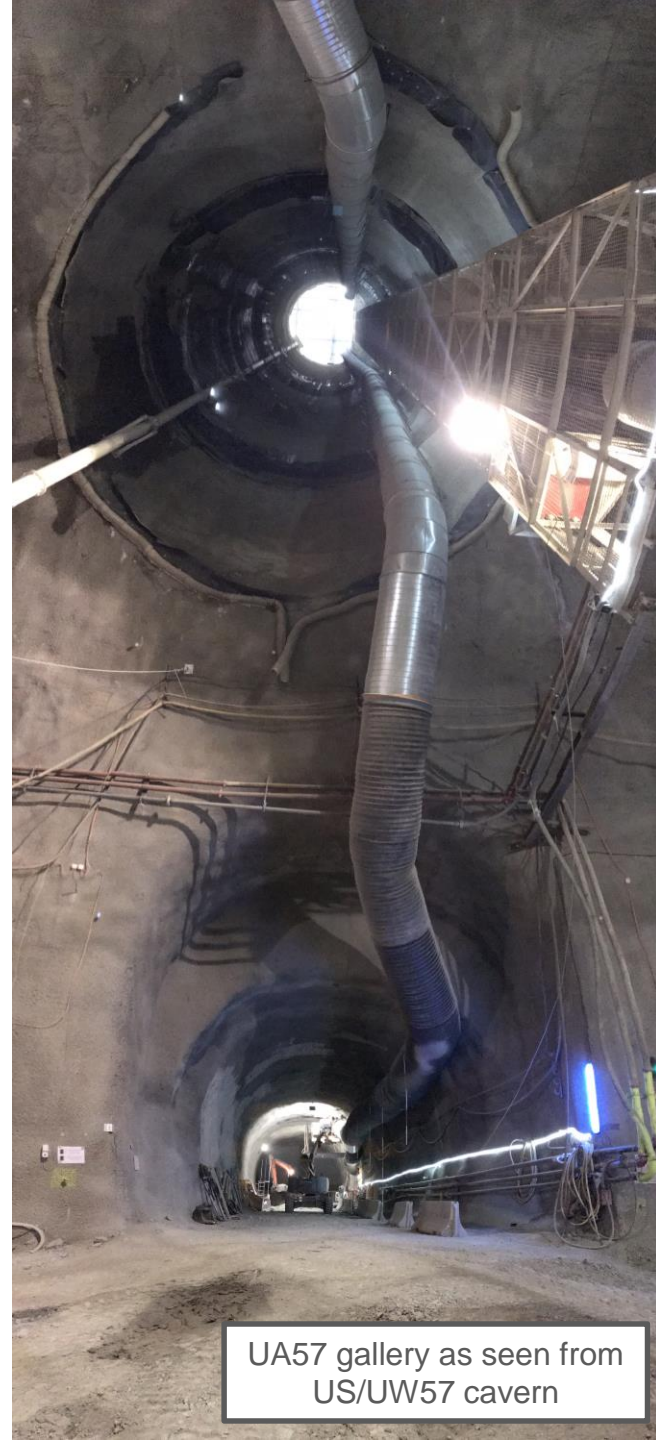
Rock layer polluted with hydrocarbons

US/UW57 cavern excavation





UR55 gallery as seen from  
US/UW57 cavern



UA57 gallery as seen from  
US/UW57 cavern



# (Start of) Excavation of UA57 Gallery







US/UW57 cavern with entrance to  
UR55 and UA57 galleries





View from UR55 gallery into  
US/UW57 cavern





UR55 gallery excavation





UA57 gallery excavation





UPR57 gallery excavation  
(view from UA57 gallery)

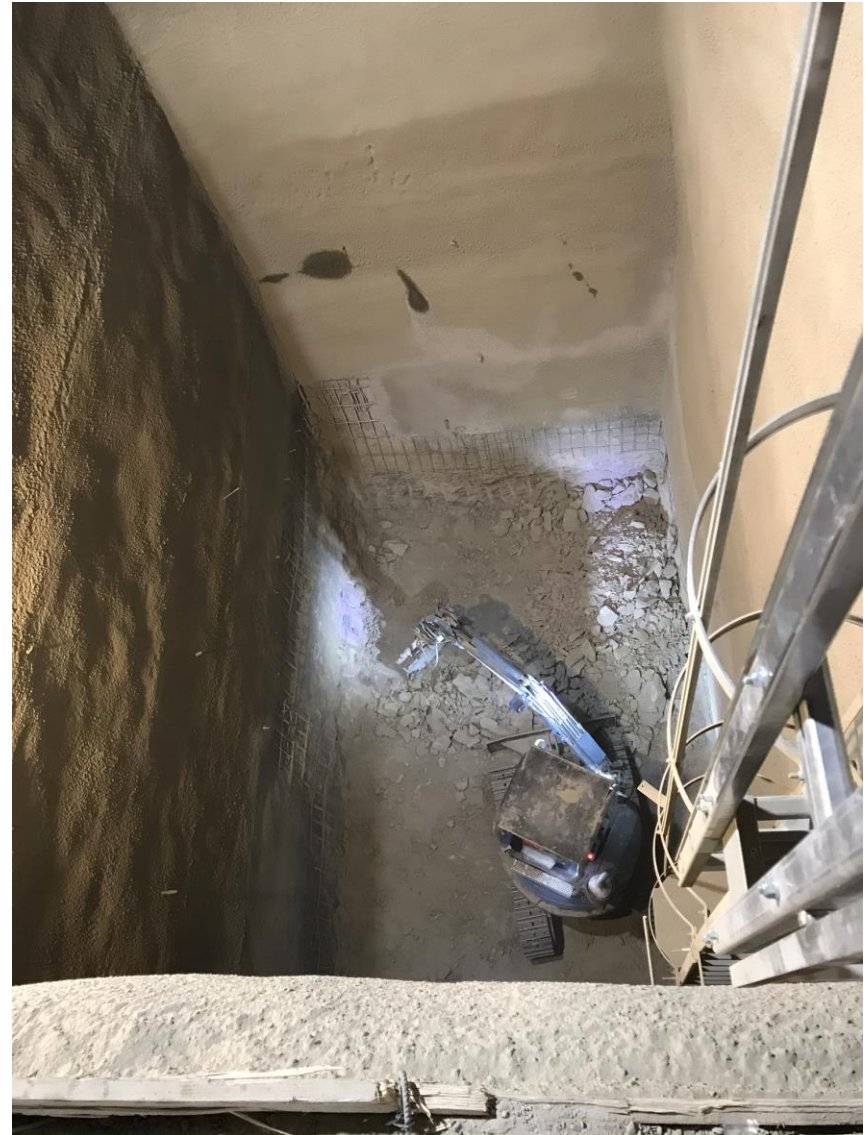




UPR57 gallery excavation  
Staircase down to LHC



# UPR57 Safety Gallery Excavation





Get ready LS2 ...  
because we're coming!

Distance paroi - blindé  
90cm

Distance paroi pied de la machine  
125cm

Distance paroi - coffret:  
95cm

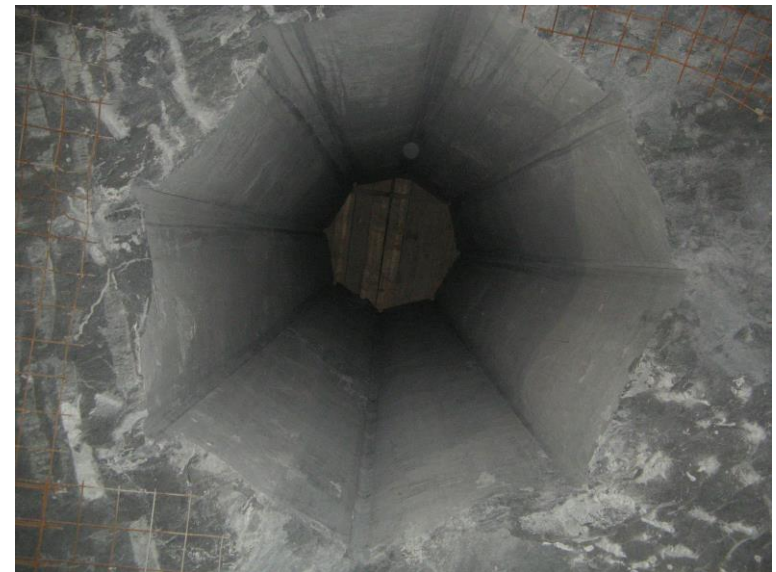
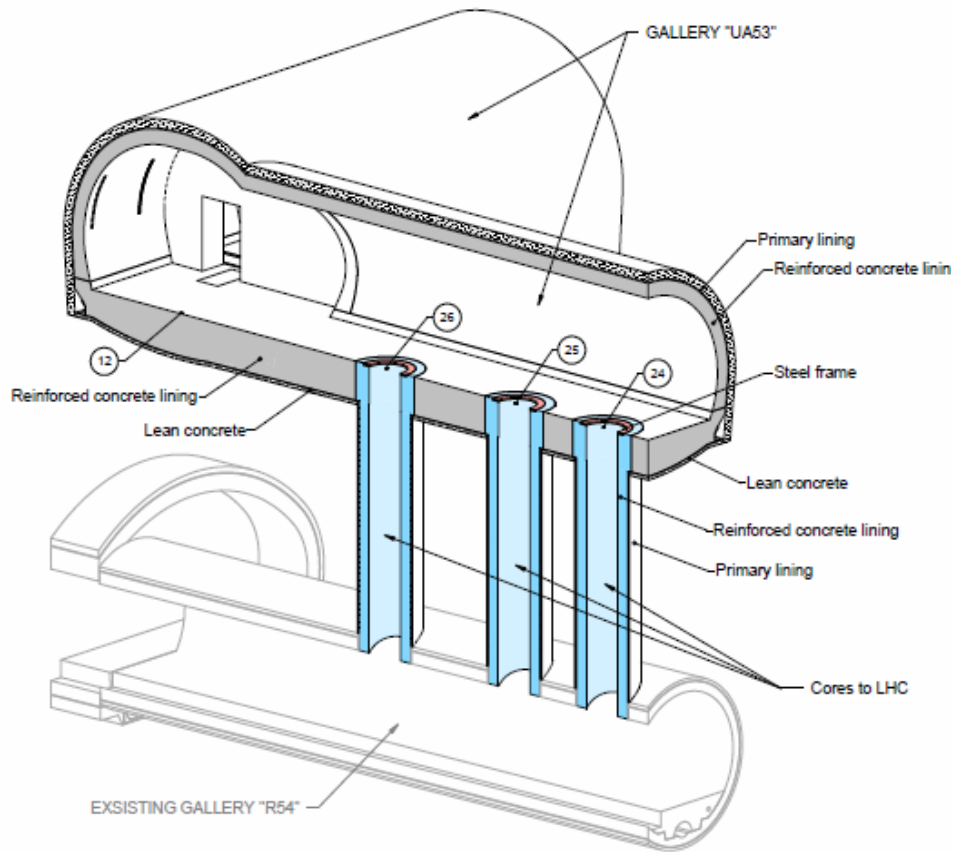
le  
poutre et  
la paroi 10cm

Rubalise  
représentant la  
paroi: ep 5 cm  
à confirmer

Location of future UPR57  
access door into LHC



# Vertical Cores (scheduled in LS3 / 2024)



# Vertical Cores (project in Luzern, CH)



Get ready LHC tunnel ...  
because we may make a mess!







## Civil Engineering Conclusions

# Conclusions

- Progress to date:
  - Design:
    - ❖ Underground:  $\approx$  done, issued for construction;
    - ❖ Surface: still ongoing, final integration review;
  - Construction:
    - ❖ Underground: in full swing, no major problems; polluted spoil;
    - ❖ Surface: just started (early);
  - Programme & cost: on-track
    - ❖ Some minor delays but without impact on milestone dates;
    - ❖ Expenditure in line with cost estimates (2018 C&SR).





***Thank You and Questions?***



John Osborne CERN : 30 October 2019 – LCWS19 Sendai, Japan