



# Civil engineering wrap up and status on technical infrastructure

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on behalf of the WP17 sub-work-package leaders

14th HL-LHC Collaboration Meeting, Genoa, Italy 7-10 October 2024

HIGH LUMINOSITY LHC



# HL-LHC COLLABORATION MEETING GENOA, ITALY, 7-10 October 2024

Jointly organised by **INFN** and **CERN**, the 14<sup>th</sup> **HL-LHC Collaboration Meeting** will take place in person in **Genoa, Italy** from **7<sup>th</sup> to 10<sup>th</sup> October 2024**. This edition will provide the occasion to showcase the successful production and validation of the first series D2 magnets, produced by ASG in Genoa as an in-kind contribution by INFN (Italy), as well as the completion of production of the MgB<sub>2</sub> wires for the superconducting link by ASG.

Based on the traditional programme with plenary and work package parallel sessions, this meeting will serve as a technical update forum for the 8<sup>th</sup> Cost and Schedule Review, scheduled for 11<sup>th</sup> to 14<sup>th</sup> November 2024. The main objectives will be to update all HiLumi collaborators on the advancement of the series production of components for the project, to showcase the status of the IT String test stand installation at CERN, and to update all collaborators on the latest schedule changes.



- | CERN – Organizing Committee   | INFN – Local Organizing Committee                                |
|---|--|
| <b>Oliver Brüning</b> <i>Project Leader</i>                         | <b>Andrea Bersani</b> - <i>Communication Officer</i>             |
| <b>Markus Zerlauth</b> <i>Deputy Project Leader</i>                 | <b>Barbara Caiffi</b> - <i>MBRD Deputy Technical Coordinator</i> |
| <b>Cécile Noels</b> <i>Project Office &amp; Communications</i>      | <b>Mirko Corosu</b> - <i>IT Manager</i>                          |
| <b>Florence Thompson</b> <i>Project Office &amp; Communications</i> | <b>Stefania Farinon</b> - <i>MBRD Technical Coordinator</i>      |
|   | <b>Filippo Levi</b> - <i>Deputy Conference Coordinator</i>       |
|   | <b>Alessandra Pampaloni</b> - <i>Conference Coordinator</i>      |
|   | <b>Marco Statera</b> - <i>HD Corrector Technical Coordinator</i> |

For more details and registration : [HL-LHC.Secretariat@cern.ch](mailto:HL-LHC.Secretariat@cern.ch) / [hilumilhc.web.cern.ch](http://hilumilhc.web.cern.ch)

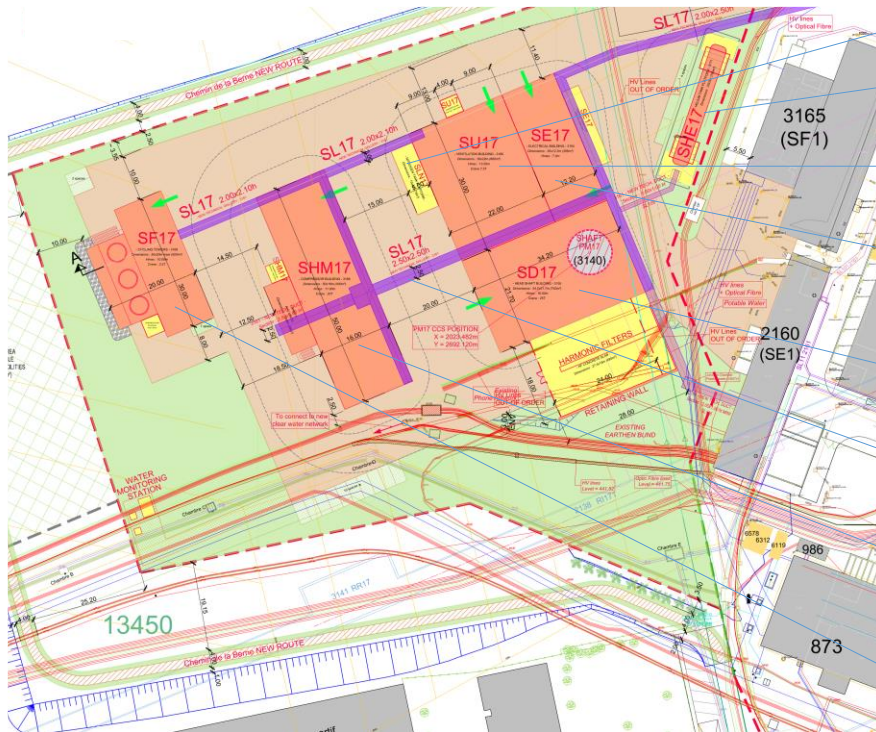
# Content

- Civil engineering wrap-up
- Status on technical infrastructures
  - Electrical distribution
  - Cooling and ventilation
  - Access and alarm
  - Technical monitoring and common control
  - Transport
  - Logistics and storage
  - Operational safety
- Conclusions

# Civil engineering wrap-up

- The scope:
  - Construction of 5 buildings, technical galleries and concrete slabs at the surface of P1 and P5.

## Point 1



- LN<sub>2</sub> storage (SLN17)
- He storage (SHE17)
- Cooling & ventilation building (SU17)
- Electrical-distribution building (SE17)
- Shaft-head building (SD17)
- Technical galleries (SL17)
- Cryogenic-compressor building (SHM17)
- Cooling-tower building (SF17)

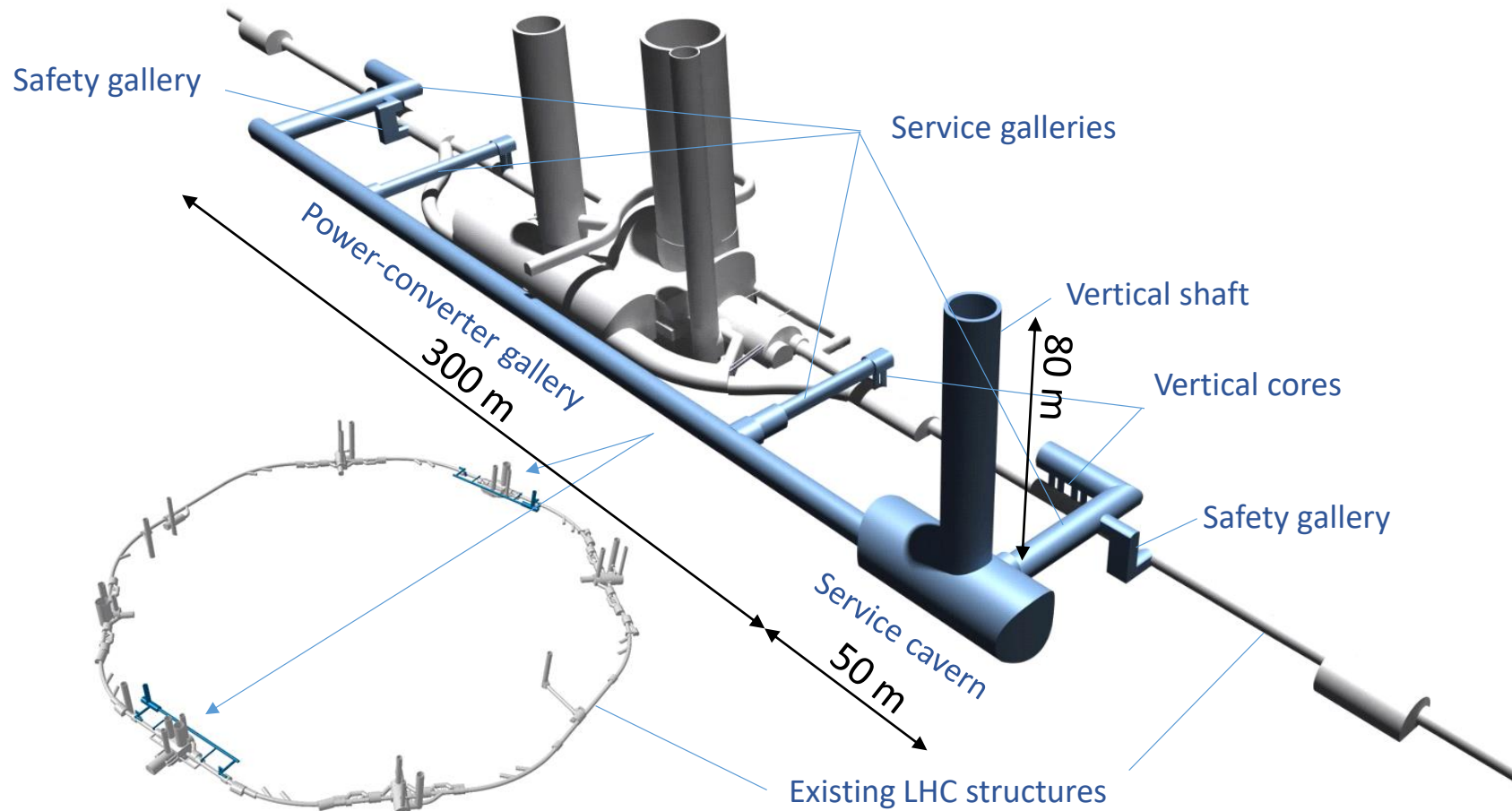
## Point 5



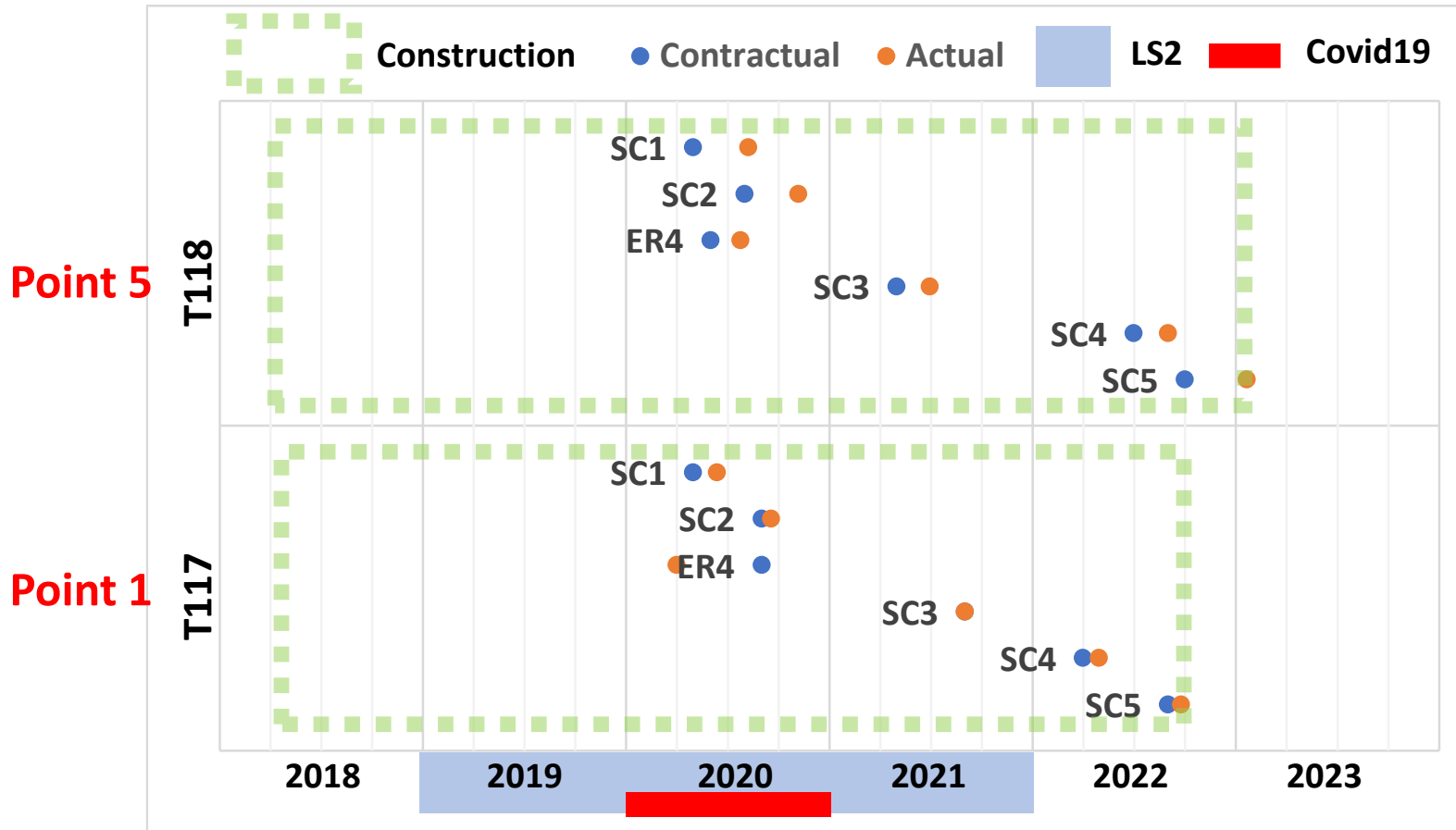
- Cooling & ventilation building (SU57)
- Electrical-distribution building (SE57)
- Shaft-head building (SD57)
- LN<sub>2</sub> storage (SLN57)
- Cooling-tower building (SF57)
- Technical galleries (SL57)
- He storage (SHE57)
- Cryogenic-compressor building (SHM57)

# Civil engineering wrap-up

- The scope:
  - Construction underground structures (shaft, cavern, galleries) at P1 and P5.



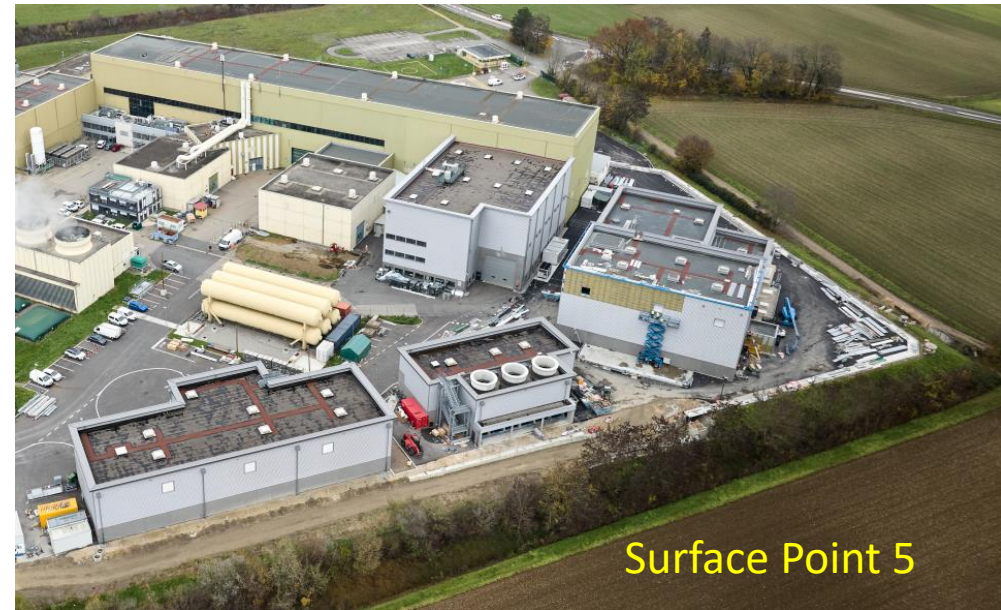
# Civil engineering wrap-up



- Construction started in Apr'18
- About 5 years of construction
- Important to have SC1, SC2 (Safety-gallery deliveries) and ER4 (end of excavation works - Vibrations) before end 2020 → Done despite Covid19 perturbances
- Completion about on time and on budget

Main milestones		T117 Contract			T118 Contract		
		Contract	Actual	Delays [months]	Contract	Actual	Delays [months]
SC1	UPRx7 delivery	30/04/2020	12/06/2020	1.4	30/04/2020	07/08/2020	3.3
SC2	UPRx3 delivery	31/08/2020	17/09/2020	0.6	31/07/2020	05/11/2020	3.2
ER4	Completion of excavation works	31/08/2020	31/03/2020	-5.1	31/05/2020	24/07/2020	1.8
SC3	Delivery of SHMx7 and SFx7 buildings	31/08/2021	31/08/2021	0.0	30/04/2021	29/06/2021	2.0
SC4	Delivery of SUx7 building	31/03/2022	29/04/2022	1.0	30/06/2022	31/08/2022	2.1
SC5	Completion of the works	31/08/2022	23/09/2022	0.8	30/09/2022	19/01/2023	3.7

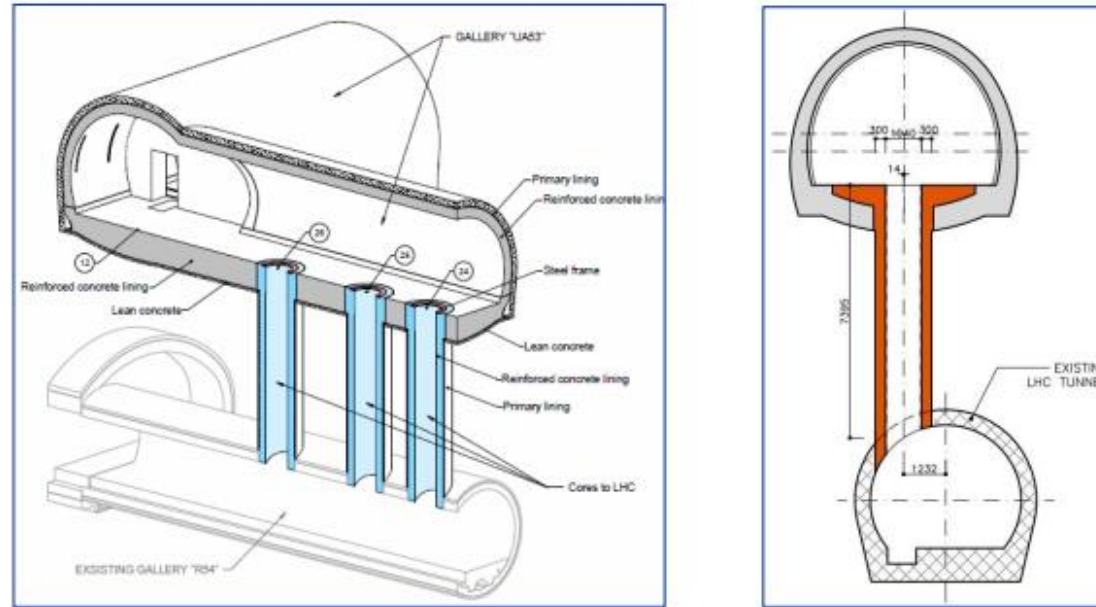
# Civil engineering wrap-up



# Civil engineering post-handover issues

- Following the handover of the structures, the following problems have to be solved:
  - Concrete spalling in the lift cage at P1
    - Consolidation by installing metallic plate on the concrete-module joints.
    - Schedule impact on the lift availability(i.e. underground access): 9 months of delays at P1 and 4 months at P5
  - Water infiltrations in the P1 lift pit
    - Consolidation by resin injection and by “cuvelage”
  - Water leaks in the SF17 basin of the cooling towers
    - Consolidation by redoing the resin layers (still in progress).

# Remaining civil-engineering work: the vertical cores



- Invitation to tenders in two runs
  - The first IT was not successful but was useful to identified obstacles in the proposed technical specifications.
  - A second IT (retendering) will be issued in Dec'24 with less constraining specifications → the main consequences is that the work will impact the LS3 critical path (+ up to 4 months of work on the LS3 critical path)
  - Contract adjudication is foreseen in Jun'25.

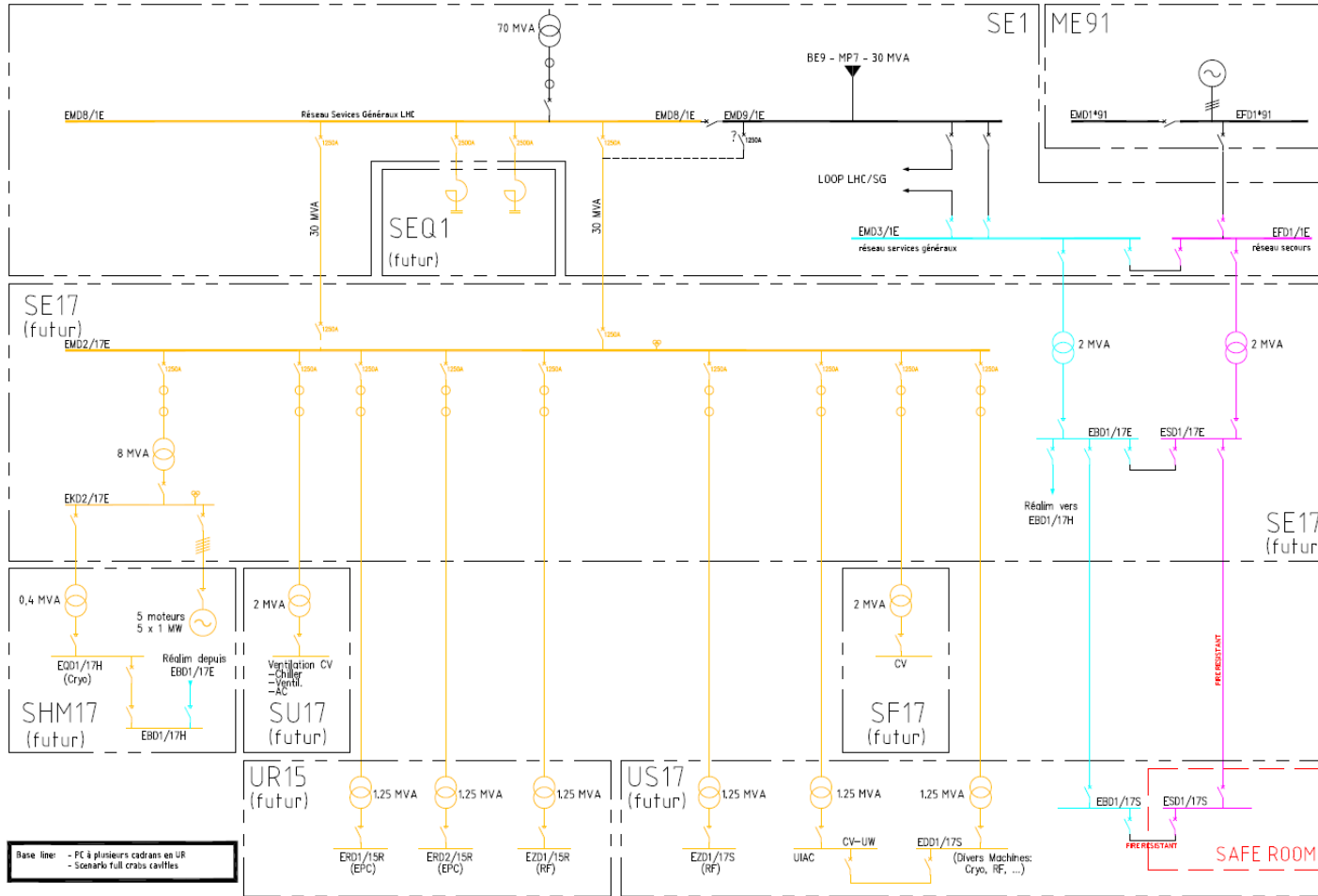


# Status of Technical Infrastructures

	Technical infrastructures (w/o CE)	Progress
sWP17.2	Electrical distribution	37 %
sWP17.3	Cooling and ventilation	60 %
sWP17.4	Access and alarm	36 %
sWP17.5	Technical monitoring and common controls	32 %
sWP17.7	Transport	83 %
sWP17.9	Logistics and storage	58 %
sWP17.10	Operational safety	33 %
	Total (w/o CE)	48 %

we are about half-way

# Electrical Distribution Scope



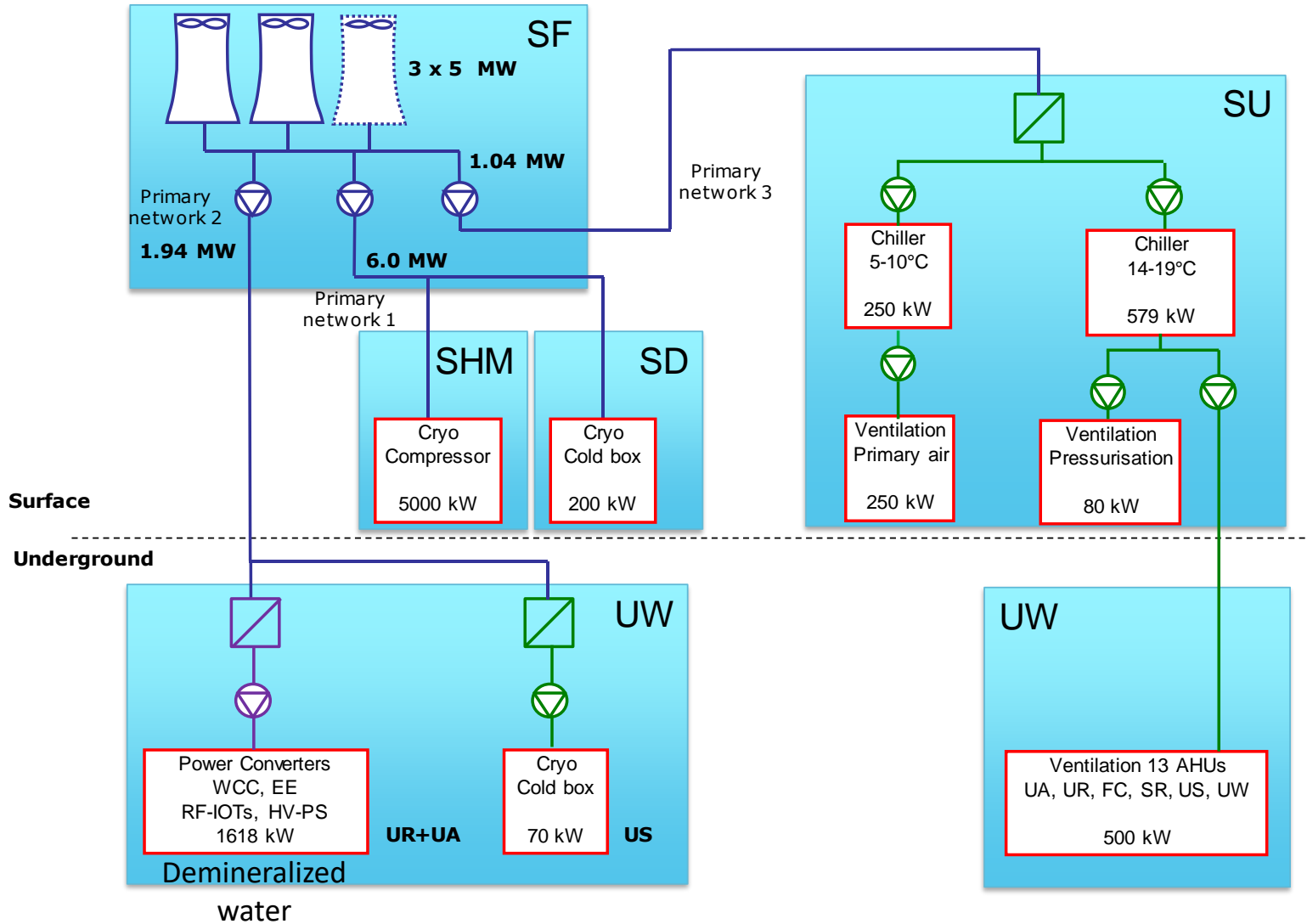
~ 12 MVA to be distributed per Point

- + DC water-cooled cables
- + DC air-cooled cables
- + new 66/18 kV electrical sub-station at Point 5

~37% of progress

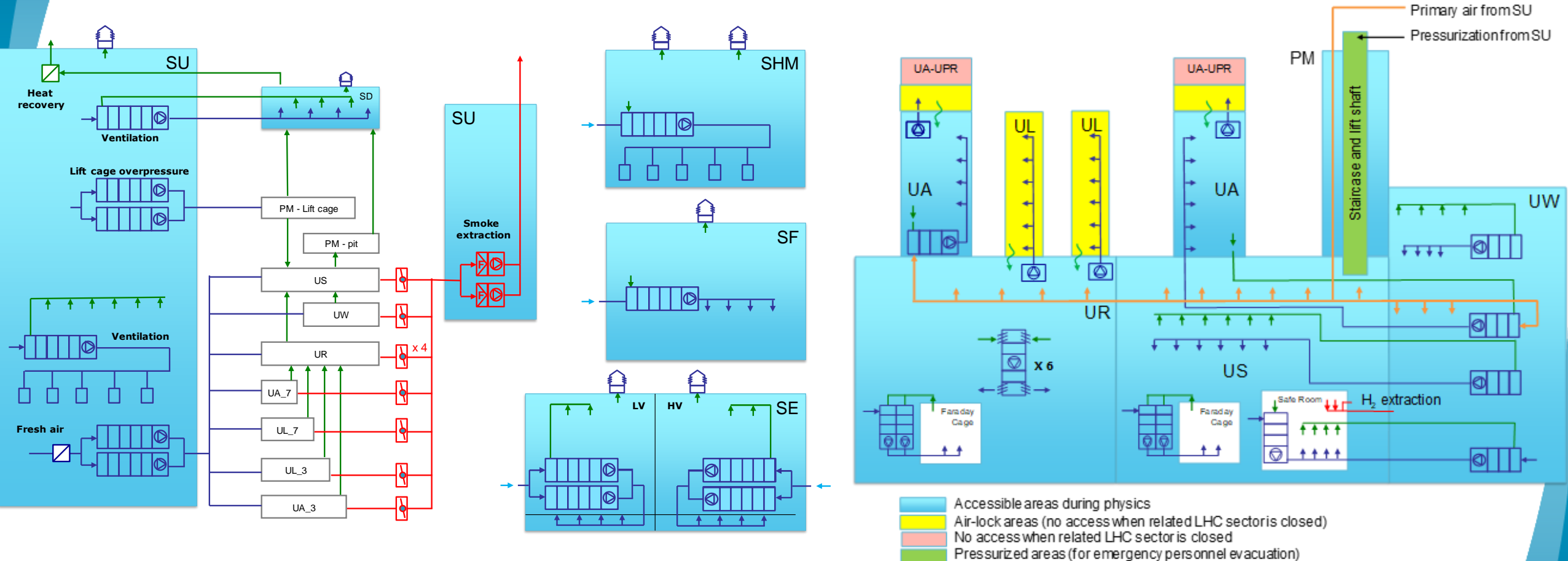
Base line: - PC à plusieurs cadrans en UR  
- Scenario full crans cavités

# Cooling Scope (TDR)



*~60% of progress*

# Ventilation scope (TDR)



Surface  
(12 ventilation units per Point)

~60% of progress

Underground  
(23 ventilation units per Point)

# Scope of Access and Alarm (TDR)

Equipment	System	Q
Interlocked end-of-zone door (grating) in the UL	LASS	4
Interlocked end-of-zone/ventilation door (solid) in the UA	LASS	4
Interlocked sector door (grating) in UPR	LASS	4
Interlocked ventilation/overpressure door in the UPR	LASS	4
Interlocked ventilation door in the UL	LASS	4
Monitored ventilation door in the UA	LASS	4
Key-operated switch box for arming patrol in a sector	LASS	12
Equipment rack for cabling, relays, PLC I/O modules	LASS	4
RF EIS : Elements acting on RF powering	LASS	4
Personnel Access Device (PAD) including iris scanner	LACS	2
Material Access Device (MAD) including video surveillance	LACS	2
Equipment rack including badge readers, interphonie, panel-PC	LACS	2
Access point video surveillance camera	LACS	4
Non-interlocked door at top of pit	LACS	2
Fire detector	Fire Detection	220
Fire central concentrating several detectors	Fire Detection	4
Red telephones (direct line to the fire brigade with alarm)	Emergency Comm	50
Secure communication equipment (TETRA)	Emergency Comm	2
CSAM rack : Secure delivery of level 3 alarms to the fire brigade	CSAM	2
ODH detector and warning	ODH Detection	74
ODH central	ODH Detection	6
Evacuation siren in underground areas	Evacuation	40
Evacuation central	Evacuation	2
CROME monitoring station for detection of ambient radioactivity	Radiation Monitoring	8
Ionization chamber for detection of ambient radioactivity	Radiation Monitoring	8
Simple access controlled door	SUSI	24
Non-access controlled but supervised door (emergency exit)	SUSI	12
Video surveillance camera of the buildings and sites	SUSI	30

*~36 % of progress*

# Transport scope

## Lifts

Location	Capacity (kg)	Travel Height (m)	Door width (m)	Door height (m)	Speed (m/s)	Cabin dimensions (m)		
						Length	Width	Height
PM17/57	3000	72.5	1.9	2.7	1.6	2.7	1.9	2.7

 Done

## Electric overhead travelling cranes

Location	Capacity (t)	Height Hook (m)	Lifting Height (m)	Hopper (m)		Speed (m/min)	
				Rail length	Span	Max	Min
SHM17 / 57	20	6	6	50	15	5	0.25
SD17 / 57	25	10	100	28.4	16.1	20 (without load) 10 (with load)	0.5
SF17 / 57	3.2	9	9	23	10	5	0.25
SU17 / 57	7.5	8	8	16	14	5	0.25
US17 / 57	5	7.5	7.5	26	12	5	0.25
UW17 / 57 (top)	3.2	3.2	3.2	15	6	5	0.25
UW17 / 57 (floor)	3.2	3.2	3.2	15	6	5	0.25

## Manual overhead travelling cranes

Location	User	Capacity [t]	Length [m]	Width [m]
UA13 / 17 / 53 / 57	RF	1	26	5

+ Hoists, drawbridges, mobile shielding (UA) and fixed shielding (UL), handling tooling

*~83 % of progress*

# Operational safety scope

Doors

Type	Location	Total number	opening size L x H [m x m]	CE interface size	resistant category		Comment
					Fire	Pressure	
Ventilation and fire-resistant door	UA airlock system	4	1.3 x 2.4	R 3.2 m	EI 120	n/a	
Ventilation and end-of-zone door	UA airlock system	4	1.3 x 2.4	R 3.2 m	n/a	n/a	
End-of-sector door	UPR LHC side	4	1 x 2.1	1.16 x 2.2	n/a	n/a	Grating
Fire- & pressure-resistant door	UPR LHC side	4	1 x 2.1	1.08 x 2.2	EI 120	60 mbar	
Fire-resistant door	UR	2	2.8 x 2.8	R 2.9 m	EI 90	n/a	
Fire-resistant door	UW	4	3 x 3	3.1 x 3.05	EI 90	n/a	1/3 - 2/3
Fire-resistant door	Safe-room	2	2 x 2.45	2.1 x 2.5	EI 120	n/a	
End-of-zone door	UL	4	1.1 x 2.15	R 1.6 m	n/a	n/a	Grating
Ventilation door	UL	4	1.1 x 2.15	R 1.6 m	n/a	n/a	
Ventilation and fire-resistant door	US lift sas	2	2 x 2.65	2.1 x 2.7	EI 120	n/a	
Sectional door	SD	2	6 x 6	n/a	n/a	n/a	wall mounted
Sectional door	SF	2	4 x 4	n/a	n/a	n/a	wall mounted
Sectional door	SHM	2	5 x 5	n/a	n/a	n/a	wall mounted
Sectional door	SHM (CV room)	2	4 x 5	n/a	n/a	n/a	wall mounted
Sectional door	SU	2	5 x 5	n/a	n/a	n/a	wall mounted
Smoke curtain	UR	6	n/a	R 2.9 m	EI 90	n/a	
Smoke curtain	UA entrance	4	n/a	R 3.2 m	EI 90	n/a	
Smoke curtain	UL entrance	4	n/a	R 1.6 m	EI 90	n/a	
Noise curtain	SHM	2	5 x 5	n/a	n/a	n/a	

Done

Fire extinguishers

Location		Underground	SU	SD	SE	SF	SHM	Total
# of extinguishers per Point	5 kg CO <sub>2</sub>	14	5	3	4	2	4	32
	9 kg CO <sub>2</sub>	2	0	0	0	0	0	2

~33% of progress

+ RP support, safety/installation coordination and safety inspections (manpower: Peak in LS3)

# Technical infrastructure achievement: SE building



Main electrical distribution with cubicles, switchboards and switchgears





# Technical infrastructure achievement: SF building



Ventilation ducts

Cable trays

Crane

Primary-water pumps

# Technical infrastructure achievement: SU building

Ventilation duct

Ventilation unit



Ventilation duct

Ventilation units



Ventilation duct

Chillers



Pumps

# Technical infrastructure achievement: SHM building

Ventilation ducts



Cable trays

Crane

# Technical infrastructure achievement: SD building

Ventilation ducts

Cable trays

Crane (25 t)

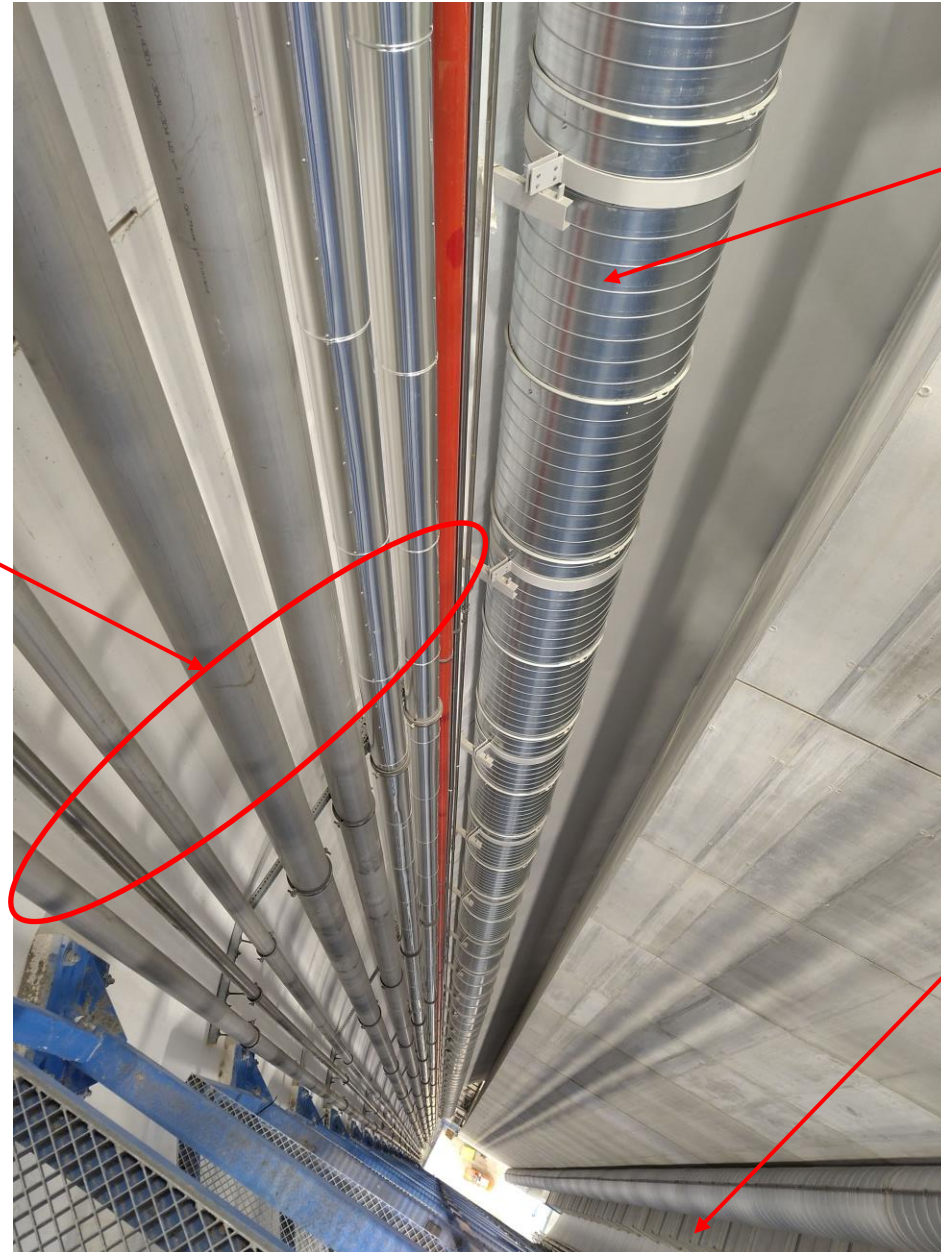
Lift

Stair-case/lift  
pressurized & fire-  
resistant enclosure



# Technical infrastructure achievement: PM shaft

Cooling pipes



Ventilation duct

Smoke extraction duct

Installation required a  
80-m height scaffolding!

# Technical infrastructure achievement: US cavern

Smoke-extraction duct



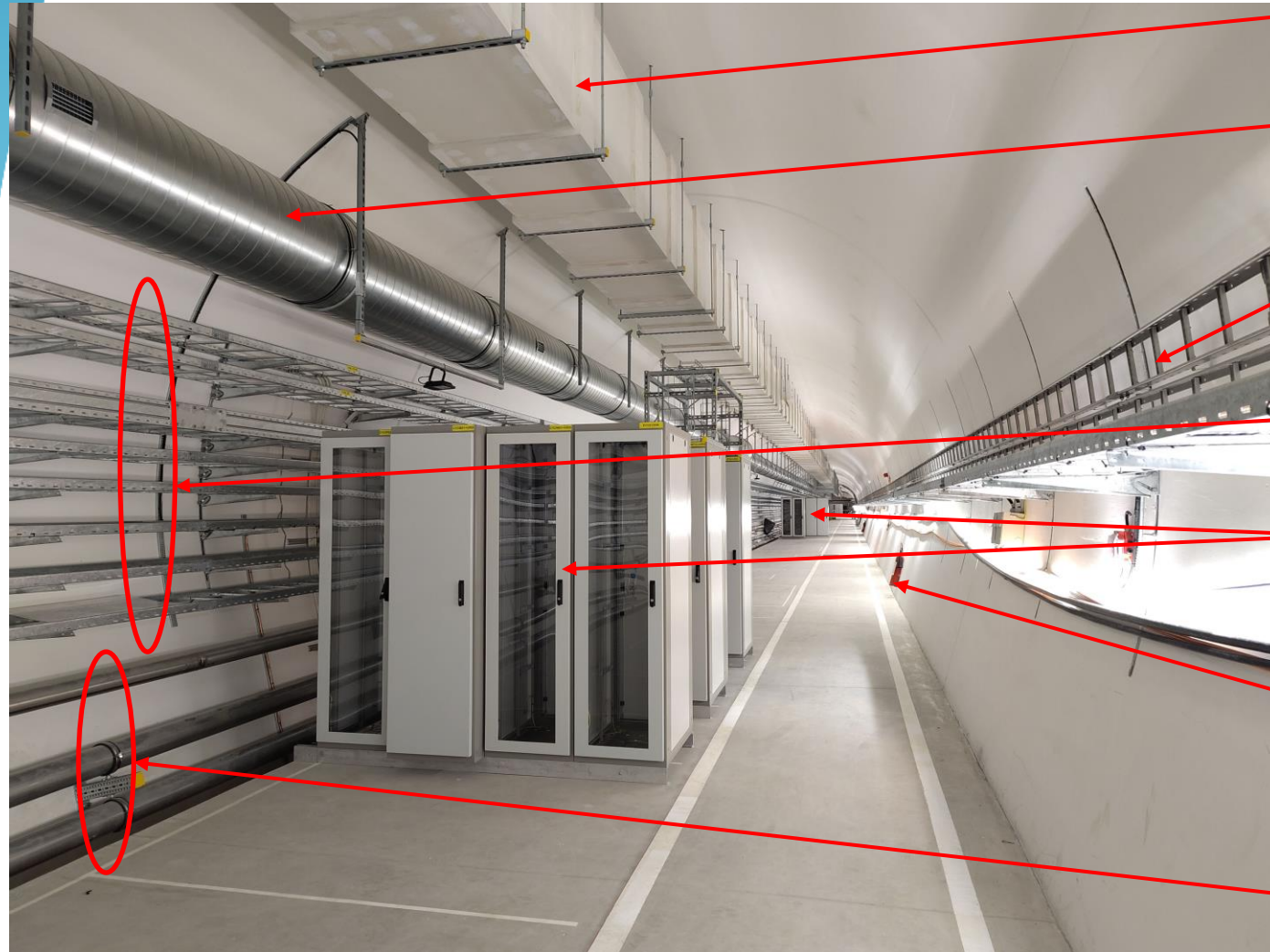
Ventilation ducts

Crane

Electrical cabinets

Electrical transformer

# Technical infrastructure achievement: UR gallery



Smoke extraction duct

Primary air ventilation duct

Fire-resistant cable trays

Cable trays

Electrical racks

Fire extinguisher

Cooling pipes

# Conclusions

- Completion of the main civil engineering work about on time and on budget.
  - Good decision to advance the work by 2.5 years  
→ most of the technical infrastructures are and will be installed during the Run3 outside the LS3 critical path.
  - Remaining work will be the drilling of the vertical cores which will be on the critical path of the LS3 schedule (IT#2 in Dec'24, FC in Jun'25).
- The installation of the technical infrastructures is progressing.
  - Progresses are between 32 % (Technical monitoring) and 83 % (Transport) with a total progress of about 50 % (80 % if we include the civil-engineering works).
  - A new team (Henry and Silvia) is now in place and ready to follow and lead the remaining WP17 activities.