

“HL and LS3 Installation Plans”

(what is planned? what is going on?)

by:

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Content

- Context
- Installation Planning for new surface buildings
- Installation Planning for new underground galleries
- Installation Planning for LS3 : LHC Tunnel
- Status analysis, open points and main issues
- Conclusion

Context

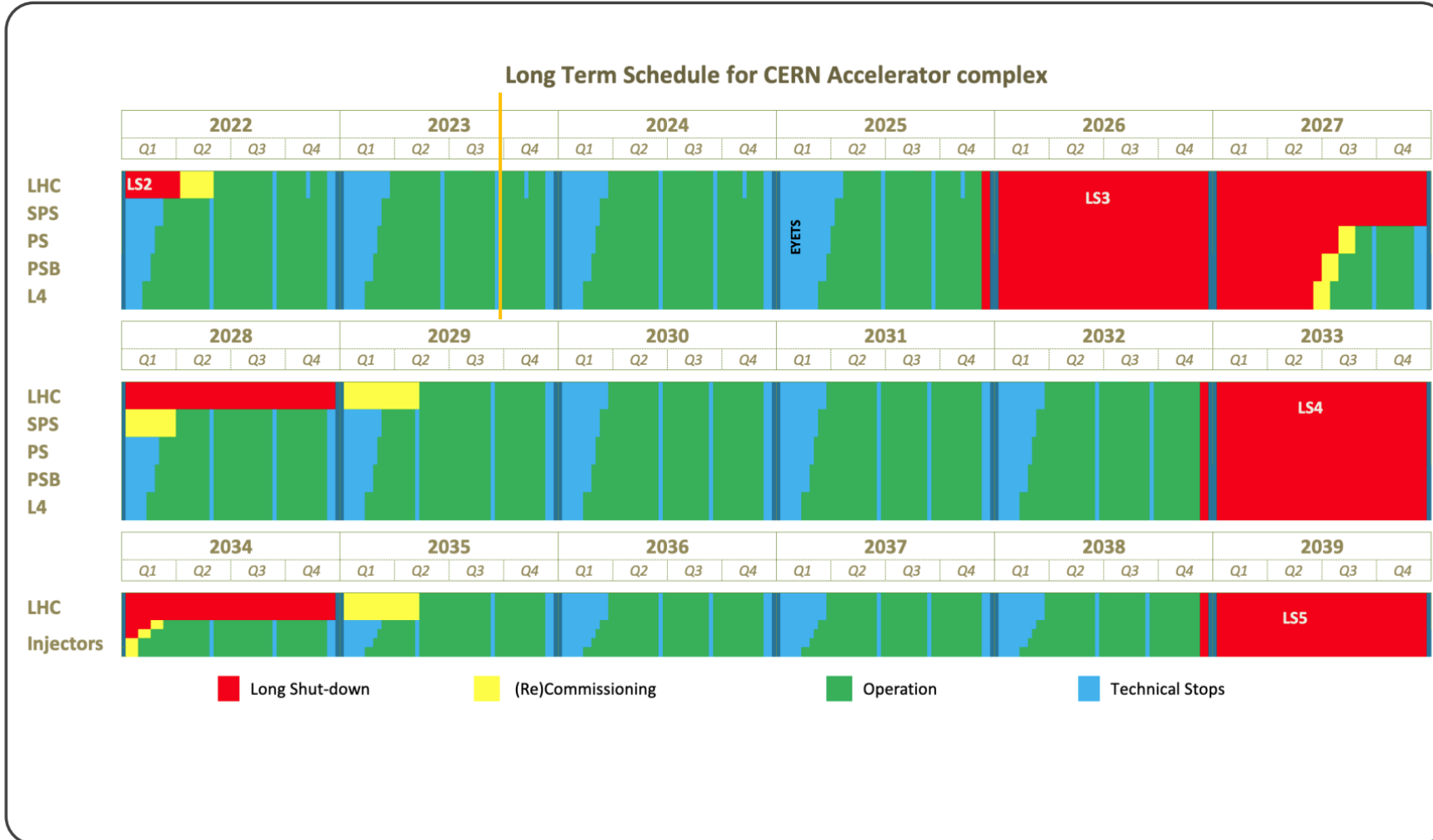
- Following the completion of new HL buildings & galleries construction, the HL Installation phase has started!
 - **New buildings:** Installation advancing at IP1 and IP5 as planned: → *general services installation, (HL equipment will follow); installation expected to be completed before LS3*
 - **New underground galleries installation:** swapped order of priority of IP1 and IP5 due to a CE issue (*lift cage*): → *general services installation started; HL equipment installation will follow without interruption through RUN3-EYETS-LS3*
 - **LHC Tunnel installation schedule (LS3):** several iterations with all main Teams & WPs in order to endorse a LS3 Planning Vers-2 in Oct. 2023 (Note: HL Cost & Schedule Reviews are our natural milestones to approve new planning baselines; **Ver-2** will be presented to CSR23 in November).
- Major milestones to come:
 - Completion of general services installation (*Jan2025 for the new bldgs.; mid2025 for the underground*)
 - Cryogenic installation (*compressors, cold boxes, lines, QXL installation in SHM-PM-US-UR,...*): will be the first main HL equipment to be routed along the “new HL bldgs. & galleries path”
 - EYETS 23/24 and 24/25: prepare (*and advance if/what possible*) the installation in the LHC Tunnel and galleries (*tagging for de-cabling, T12/UJ22 modification, cores pre-excavation(?), etc.*)
 - LS3 START: End of LHC RUN3 expected in November 2025; **TO BE READY! very intense and packed sequence of activities!** ... (*so: planning, resources smoothing, alternative scenario (were possible) are critical and must be analysed and tackled!*)

Long Term Schedule for the CERN Accelerator Complex

ACC-PM-MS-0004 V.2.0



EDMS No. 2311633	REV. 2.0	VALIDITY RELEASED
REFERENCE ACC-PM-MS-004		

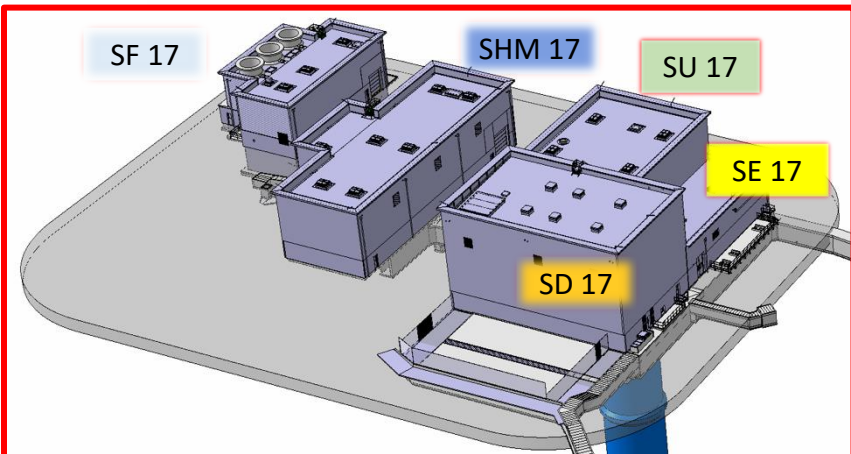
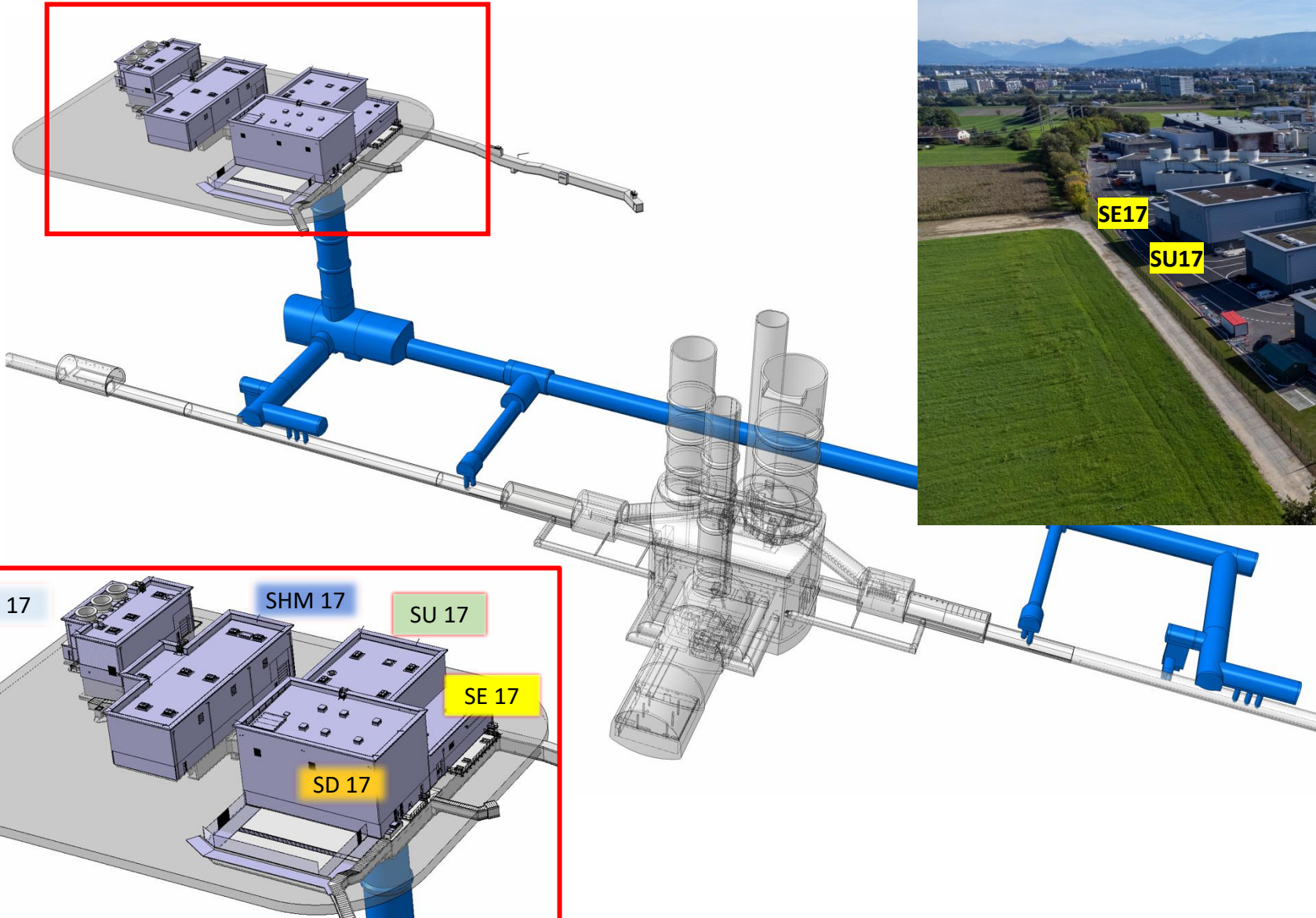


*Long Shutdown 3
starting on
17th November 2025*

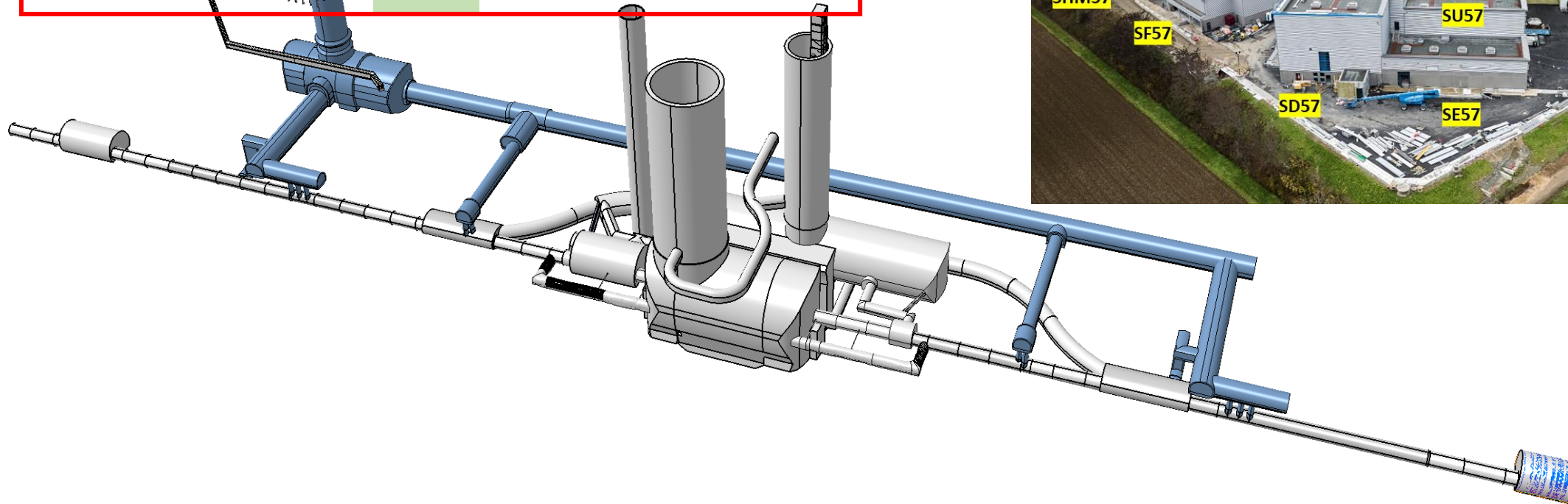
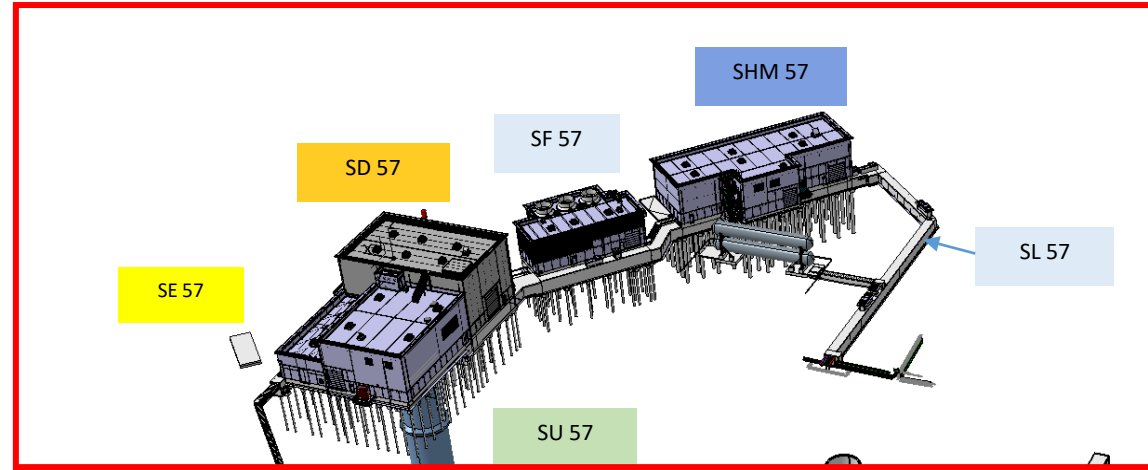
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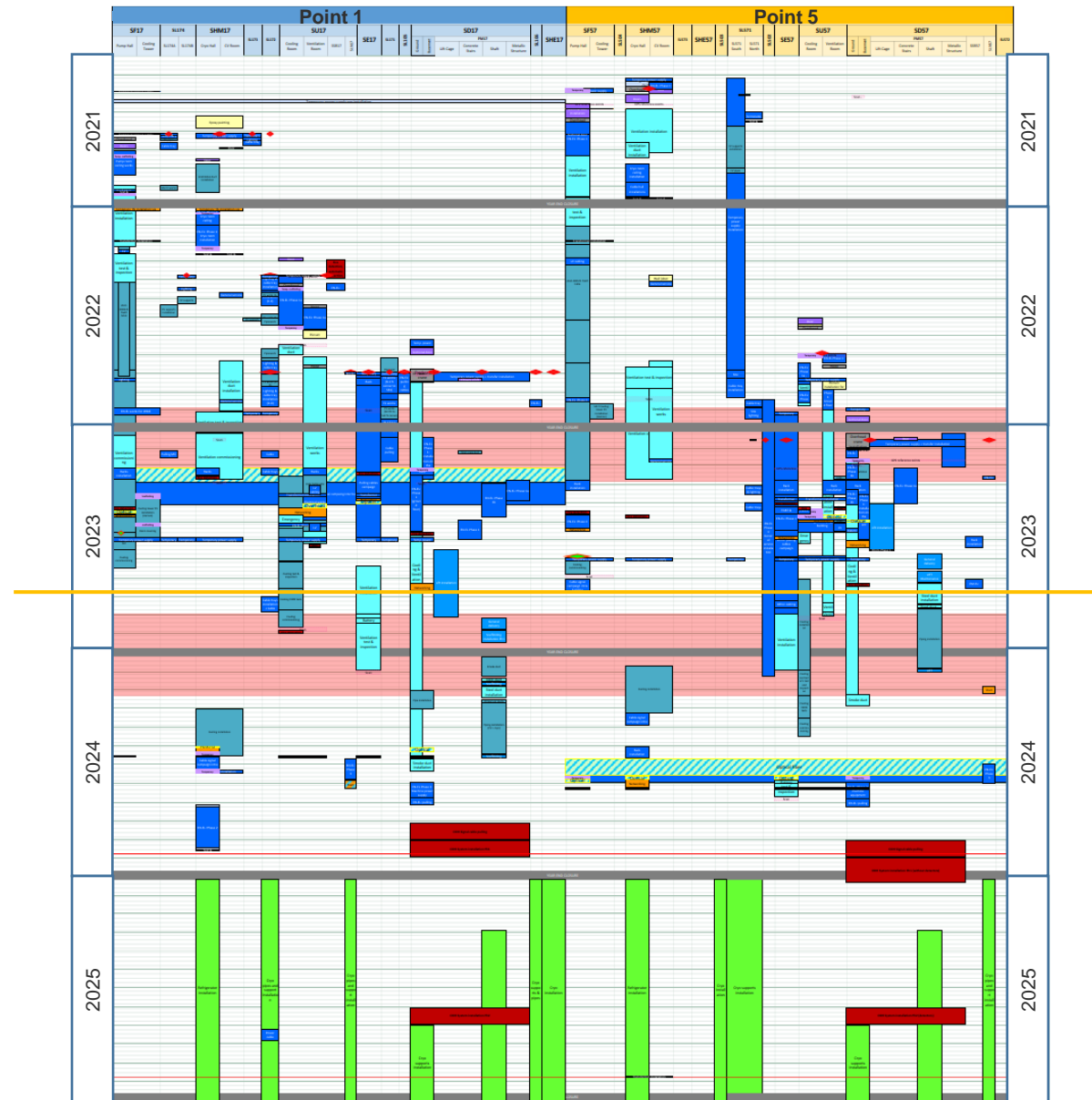
Installation Planning for new surface bldgs. IP1



Installation Planning for new surface bldgs. IP5



Installation Planning for new surface bldgs. [LHC-PM-MS-0020 v.3.0](#)



Legend:

- EN-EL: electrical infrastructure & cabling
- EN-CV Ventilation
- EN-CV Cooling
- Cryo
- ODH

Installation Planning for new surface bldgs.

- General services installation started as soon as bldgs. were made available. Installation advancing as planned.
- WP15 put in place follow-up meetings (weekly) and documentation to monitor advancement, NC resolution (many!) and validation:



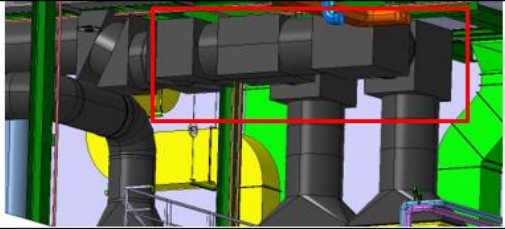

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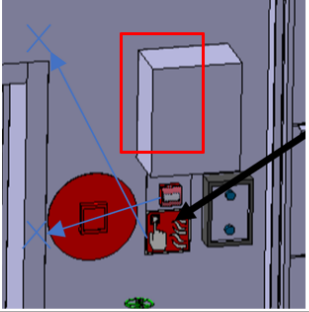

REPORT

HL-LHC SHM17 PHASE 1 REVIEW OF INTE INSTALLATION

Abstract

This report aims to summarize and describe the collection of interferences and during Stage 1 of the Review for Installation of building SHM17.

DISCREPANCY ID*	DATE OF DETECTION*	TEAM/S AFFECTED	ACTION
DISC_SU17_02	2022-04-10	WP17.3 (EN-CV)	WP17.3
LOCATION Description: SU17 FIRST FLOOR			
DISCREPANCY DESCRIPTION AND IMPACT EVALUATION Description: shape of the model and pipes do not coincide.			
SEVERITY* MINOR		PRIORITY* LOW	
RELEVANT IMAGES <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>ST1120220_01 A03</p>  </div> <div style="text-align: center;"> <p>ONSITE</p>  </div> </div>			
SOLUTION PROPOSED* MODIFICATION OF 3D MODEL WILL COME WITH FURTHER UPDATES. UPDATED (05/12/2022)			
ACTIONS			
TEAM*	DESCRIPTION*	EXECUTED (Y/I/W/N)*	DATE OF EXECUTION*

DISCREPANCY ID*	DATE OF DETECTION*	TEAM/S AFFECTED	ACTION TEAM/S*
DISC_SU17_05	2022-11-14	EN-AA-AS WP17.2 (EN-EL)	WP17.2 (EN-EL)
LOCATION Description: SU17 GROUND FLOOR next to sectional door			
DISCREPANCY DESCRIPTION AND IMPACT EVALUATION Description: Near the sectional door one switch is taking the place foreseen for the glass breakage emergency button			
SEVERITY* MINOR		PRIORITY* LOW	
RELEVANT IMAGES <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>ST1120220_01 A03</p>  </div> <div style="text-align: center;"> <p>ONSITE</p>  </div> </div>			
SOLUTION PROPOSED* EN-EL WILL MOVE THE SWITCH. SOLUTION ACCEPTED (P. Durand): - Install the push button in line with the AUG on the door jamb - Install the panel above the door			
ACTIONS			
TEAM*	DESCRIPTION*	EXECUTED (Y/I/W/N)*	DATE OF EXECUTION*
		Y	2022-12-05

Installation phase will be completed with the release of a 3D-Model "AS BUILT"!

TRACEABILITY

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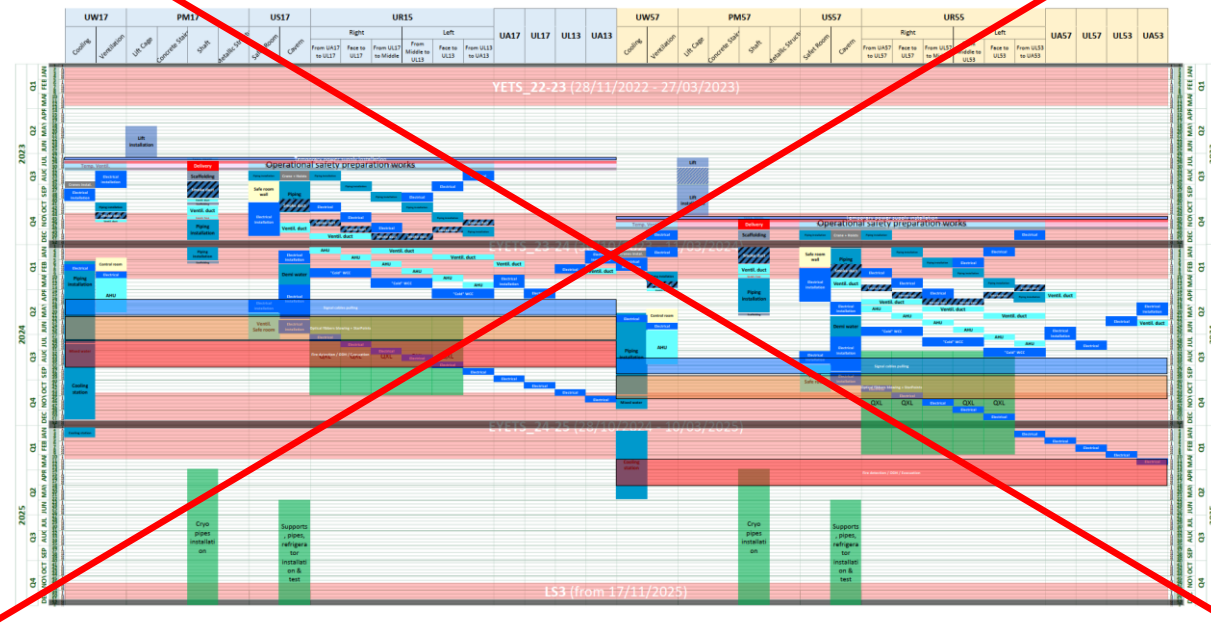
Installation Planning for new underground galleries

- A first version “in work” for the new underground galleries planning (1st phase) was presented by WP17 at 181st TCC (20/7/23)
- Formally, the supervision of the installation will pass from WP17 to WP15 as soon as installation of general services is completed.
- A 1st finalized version will be circulated (*TCC etc.*) in October 2023
- As for the surface buildings, installation phase will be completed with the release of a 3D-Model “AS BUILT”!

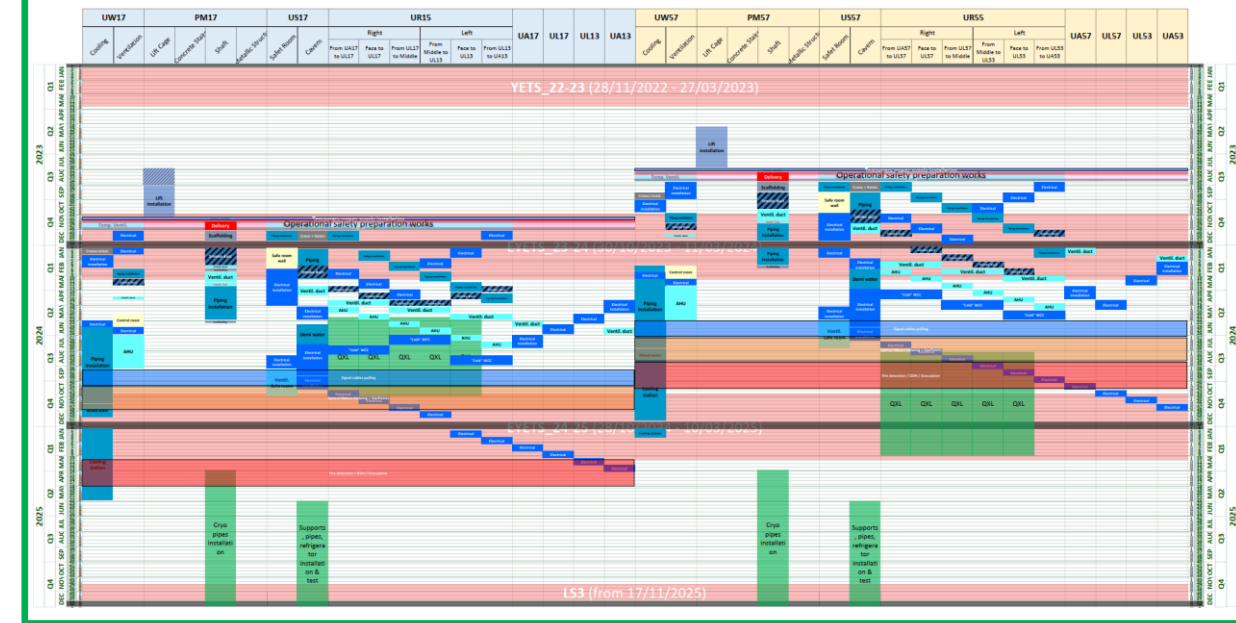
WP17 Underground installation planning

- New strategy adopted
 - It was decided to permute lift installation from Point 1 to Point 5 (Plan B)
 - Lift installation in PM57 started 8th of May 2023, and commissioning 21st of July 2023
 - Lift installation in PM17 restarted 17th of July 2023, and commissioning 3rd of November 2023

Plan A: Point 1 then Point 5

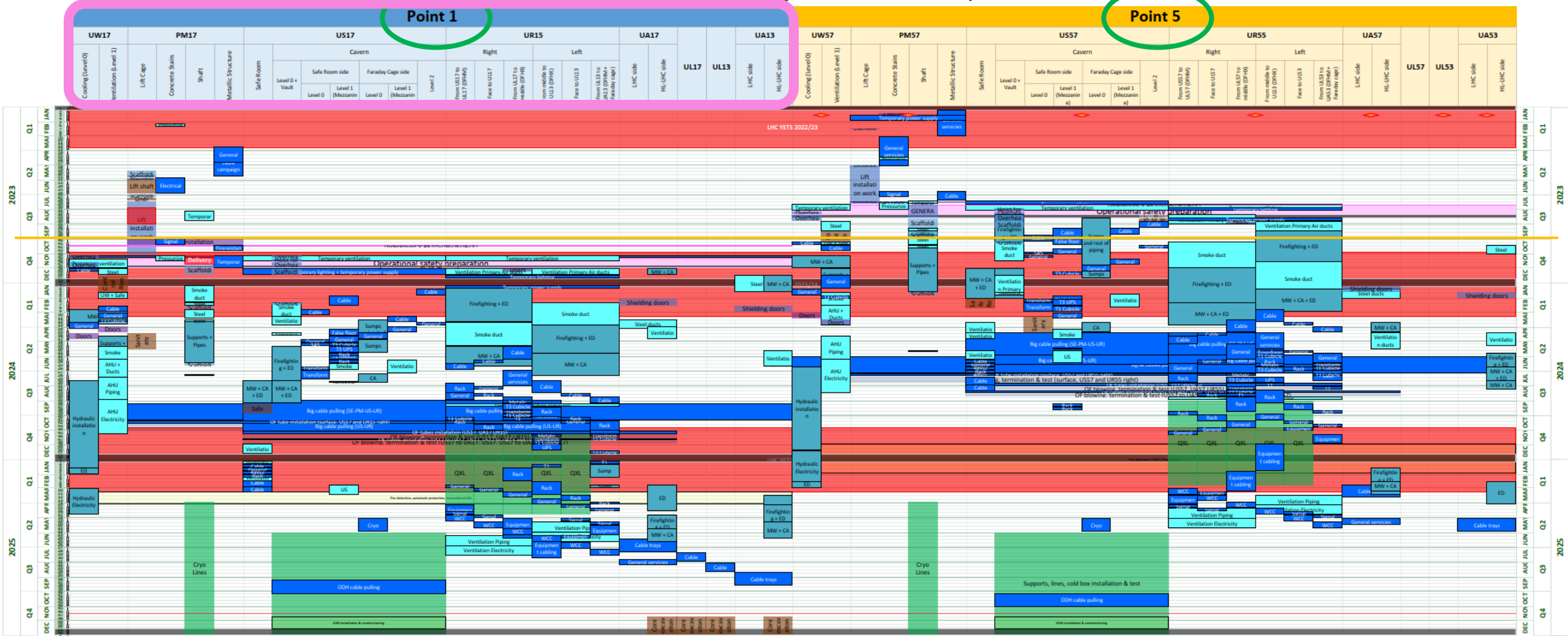


Plan B: Point 5 then Point 1



WP17 Underground installation planning [LHC-PM-MS-0020 v.3.0](#)

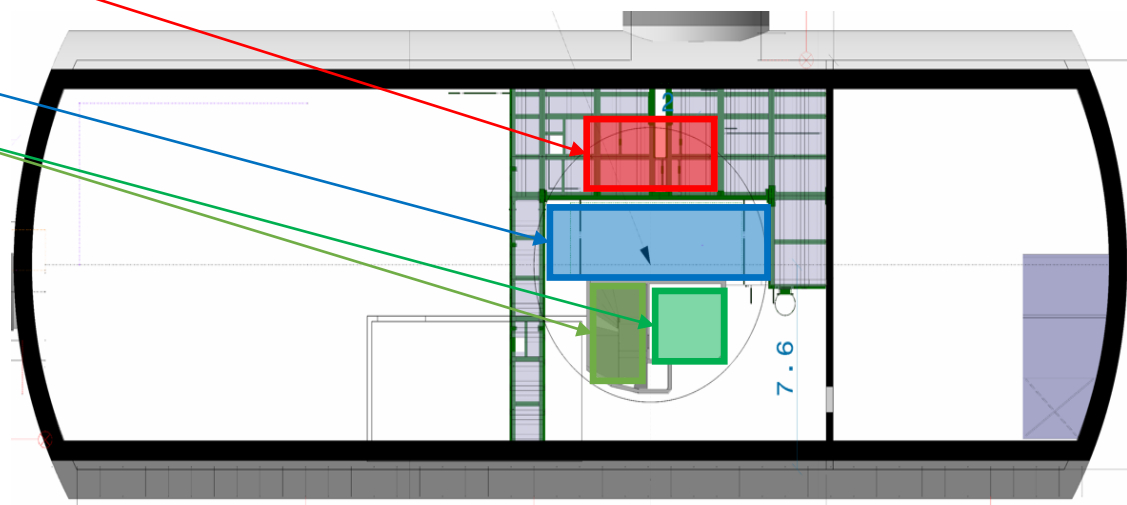
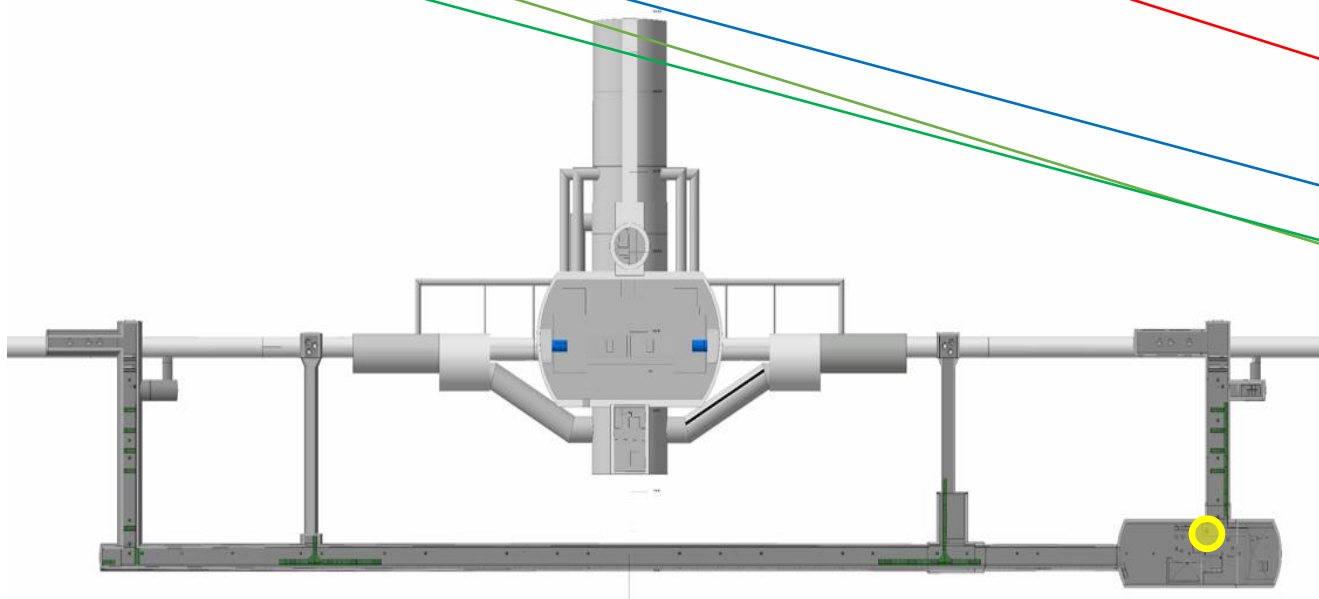
Updated the installation scenario (swapped Points)



Installation Planning for new underground galleries

Point 1

UW17		PM17				US17				UR15				UA17		UA13								
Cooling (Level 0)	Ventilation (Level 1)	Lift Cage	Concrete Stairs	Shaft	Metallic Structure	Safe Room	Cavern				Right		Left		LHC side	HL-LHC side	UL17	UL13	LHC side	HL-LHC side				
							Level 0 + Vault	Safe Room side		Faraday Cage side		Level 2	From US17 to UL17 (DFHM)	Face to UL17							From UL17 to middle (DFHX)	From middle to UL13 (DFHX)	Face to UL13	From UL13 to UA13 (DFHM + Faraday cage)
								Level 0	Level 1 (Mezzanine)	Level 0	Level 1 (Mezzanine)													



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LS3 Installation planning: status & evolution

- We are today at **Version-2.0** (EDMS 2400939) to be endorsed with WPs, Groups and mgmt. as new “**In-work Baseline**” (EDMS doc. will remain “IN WORK”). Pure installation duration estimated in **~3y plus ~6m** for commissioning (not including the training quench phase of the last sector)
- This Vers-2.0 is the consolidation of **Vers-1.3** presented at this 178th TCC (8 June 2023)
- (NOTE : in Nov 2022: **Vers-1.2** presented at 166th TCC and sent out “for revision”. Received comments analysed and discussed with teams through more than 15 dedicated meetings/discussions)
- (NOTE: on Feb 2021: started conjoint studies with EN/ACE-OSS*)
- **Vers-1.0** was released in Nov 2020 (CSR2020): duration of **~3y** (34.5 months) (validated with all Groups → “success oriented” approach)
- **Vers-0** was released Nov 2019 (CSR2019): HL Schedule : **~4y** duration, (“initial estimations” discussed with WPs/Groups)
- (NOTE: at the start of the Project, duration of HL-LHC installation was fixed “a priori” to **2.5y**)

LS3 planning will continuously evolve, mainly due to the inclusion of all other activities and projects planned for LS3 (*Injectors upgrades, standard LHC maintenance, exceptional LHC maintenance (e.g. Beam Screen treatments), resource smoothing with NACONS, etc...*)

- *ACE-OSS in charge of coordinating and scheduling of consolidation, upgrade, installation, maintenance and repair activities for the LHC and its injectors during programmed stops (long shutdowns and technical stops), as well as for providing planning support for projects.

LS3 Planning for LHC Tunnel EDMS 2400939

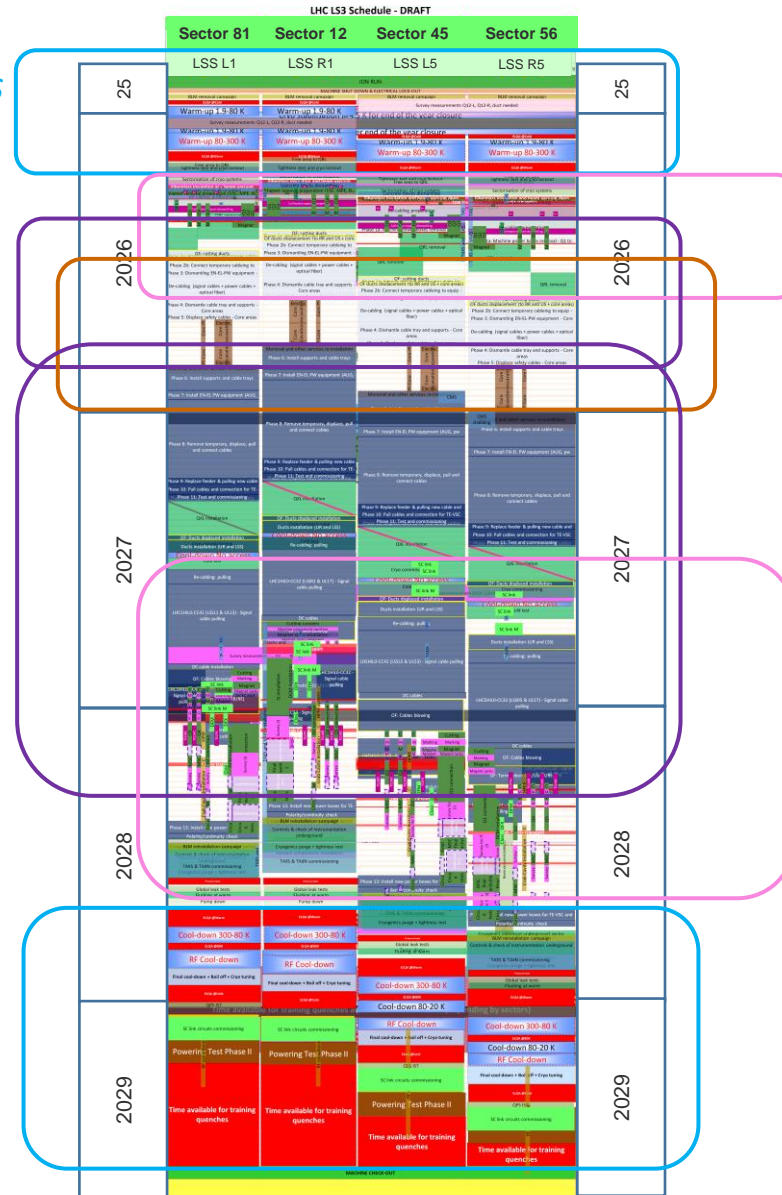
LS3 Schedule – September 2023, Ver.-2.0

Warm-up and related tests
(Nov'25 to Mar'26)

Cabling dismantling
(May'26 to Oct'26)

Cabling installation
(Oct'26 to Feb'28)

Cool-down, related test and HWC
(from Aug'28)



LSS dismantling after cryo lockout
(Mar'26 to Jul'26)

Core excavation (LHC side)
(Aug'26 to Dec'26)

LSS installation (Mar'27 to Sep'28)

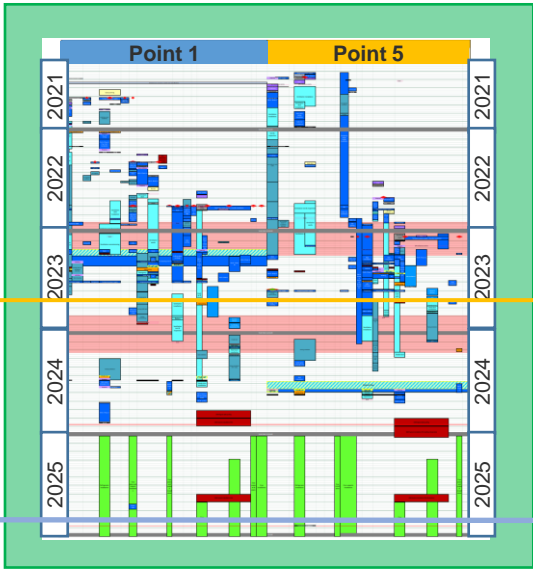
Note: a presentation of the LS3 Planning *Vers-2* is scheduled at the TCC of 5th October!

Content

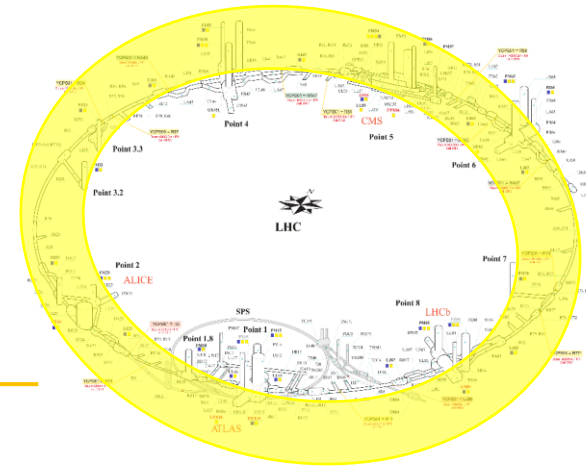
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HL-LHC Run3+LS3 schedule

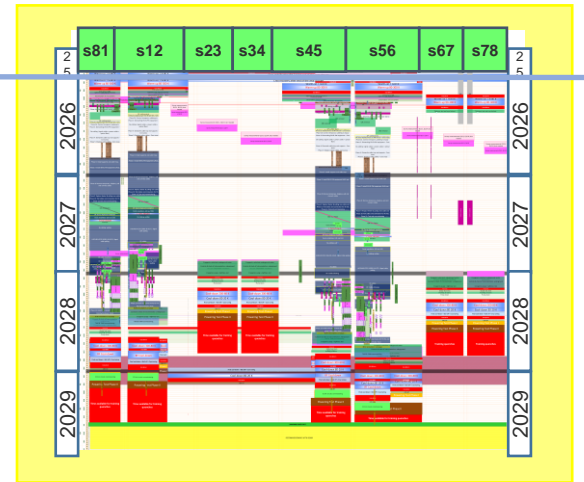
HL-LHC surface facilities



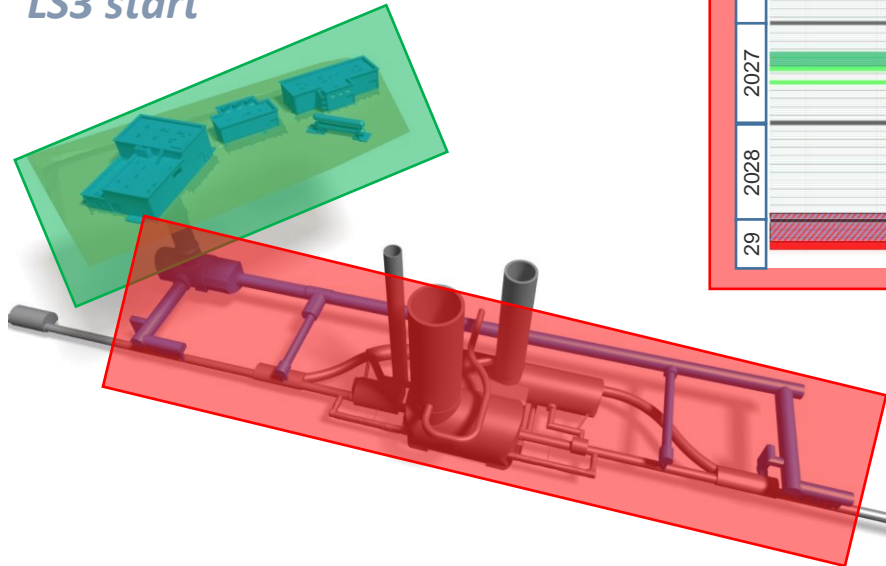
HL-LHC underground galleries



LHC LS3 schedule



LS3 start

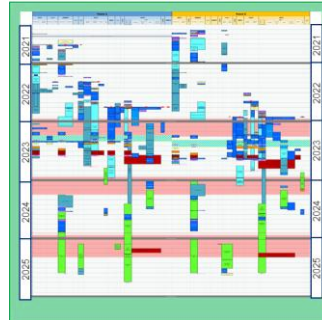


LHC Run3+LS3 preliminary draft schedule

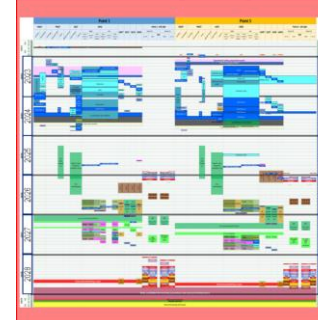
HL-LHC/LHC Master Schedule

Teams will alternate between P1 & P5, to optimise resources and manage co-activities

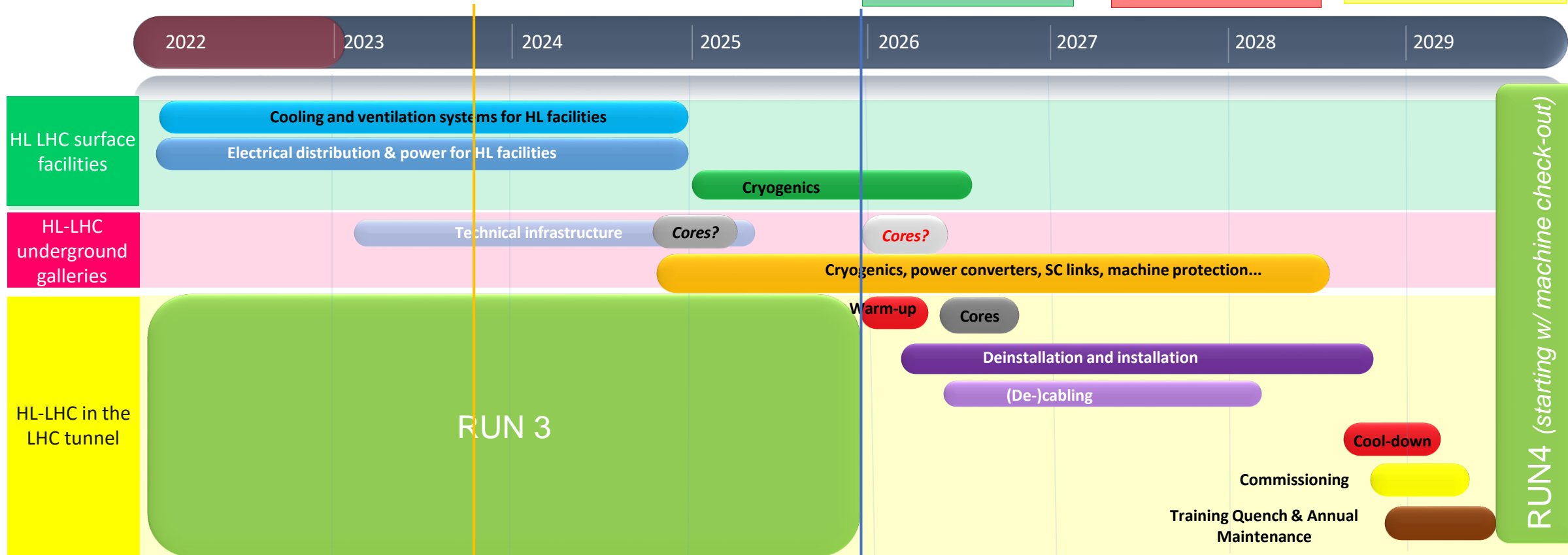
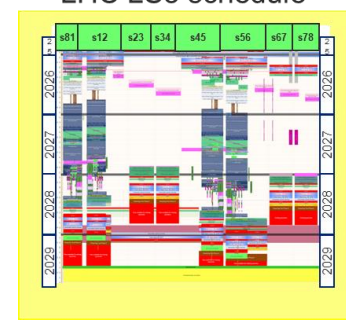
HL-LHC surface facilities



HL-LHC underground galleries



LHC LS3 schedule



LS3 schedule analysis and open points

Some comments on Version 2.0:

- The study advanced further (with >30 meetings hold since Nov2022) in order to explore further optimisations.
To be remarked in particular:
 - **EN-EL:** *considering the global presence on the field during LS3, they are the primary actors:*
 - *De-cabling and cabling (including cables trays, lightening, electrical boards, etc.) is the largest activity in terms of equipment volume treated and areas covered.*
 - *Upon request of the Project, EN-EL has confirmed the possibility to widely utilize double-shift for its activities during LS3*
 - **TE-VSC:** *is intervening everywhere in all HL regions for:*
 - *the (present) beam Vacuum Sectors de-/installation and installation of the new ones,*
 - *plus all the interventions in support of other teams (e.g. insulation vacuum of magnets, CC, DFHX/M, TDE, etc.),*
 - *plus in standard LHC and other projects (e.g. Beam Screen treatments)*
 - *With these 2 Groups we have now a more solid and agreed evaluation of the duration of activities.*
 - *Consolidated as well the magnets/SLinks transport and installation (with TE-MSD and EN-HE). The SLinks installation is the most difficult to be evaluated (→ but we should soon profit from the STRING experience)*
 - *A key point of further improvement: agreement on activities cohabitation (e.g. during the EN-EL installation phases, during the magnets interconnection activities, etc.)*

LS3 schedule analysis and open points

Some comments on Version 2.0:

- **Version-2.0** now includes the mandatory “End-of-LS LHC maintenance” needs:
 - *Maintenance mandatory as for any other standard LHC LS and shut-down (it will cover: CV, CRYO, EL installations – AUG tests - and many other subsystem checks/maintenance)*
 - *End-of-LS3 LHC maintenance has to adapt due to the presence of new HL Plants (with pro&contra)*
 - *The analysis and planning of the “End-of-LS LHC maintenance” phases is in mandate of EN/ACE-OSS.*
 - *HL-LHC will contribute with the analysis of required maintenance for the new HL installations (CRYO, EN-CV, EN-EL)*
 - *The analysis has started and is ongoing! Since this maintenance phase for 4 Sectors is deeply embedded with the installation and (re)commissioning phases, it is essential to optimize these 3 phases together!*
- The impact of the cores excavation is still to be analysed and consolidated, since we are at the moment missing technical information (*MS for cores excavation just completed; IT will be sent out in Oct 2023*)
- The “homework” asked now to WPs and Groups is to perform a resource evaluation & resource-smoothing based on Vers-2.0 and bring to the Project and to the CERN Management which mitigation actions (*and at which cost*) could be studied and put in place on those aspects.
- As mentioned, Version-2.0 shows an overall HL duration slightly longer with respect to previous version and to nominal LS3+commissioning duration → *keep-on pursuing the LS3 phases optimization with all HL-WPs and CERN Groups and Services in order to optimize the duration!*

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CONCLUSION:

- HL Installation has started and is advancing as planned!
 - → *new surface bldgs.* → *new underground galleries ...then* → *LHC Tunnel*
 - This will be a continuous process through RUN3, EYETS and finally LS3
- LS3 Planning studies are on-going with the release of a new **Version-2.0**
 - Consolidating duration estimation of all phases with Groups/WPs
 - Starting to add LHC consolidations, other projects, resource allocation analysis, etc.
 - Still “light” on some technical evaluation/impact (*i.e. cores excavation*)
 - Global duration vs. LS3 expected length is still critical point under analysis: we still miss some important information (e.g. other consolidation projects in LHC and others).
- A key point will now be the resources evaluation & smoothing to be done with/by the WPs and Groups.

THANKS for the ATTENTION!

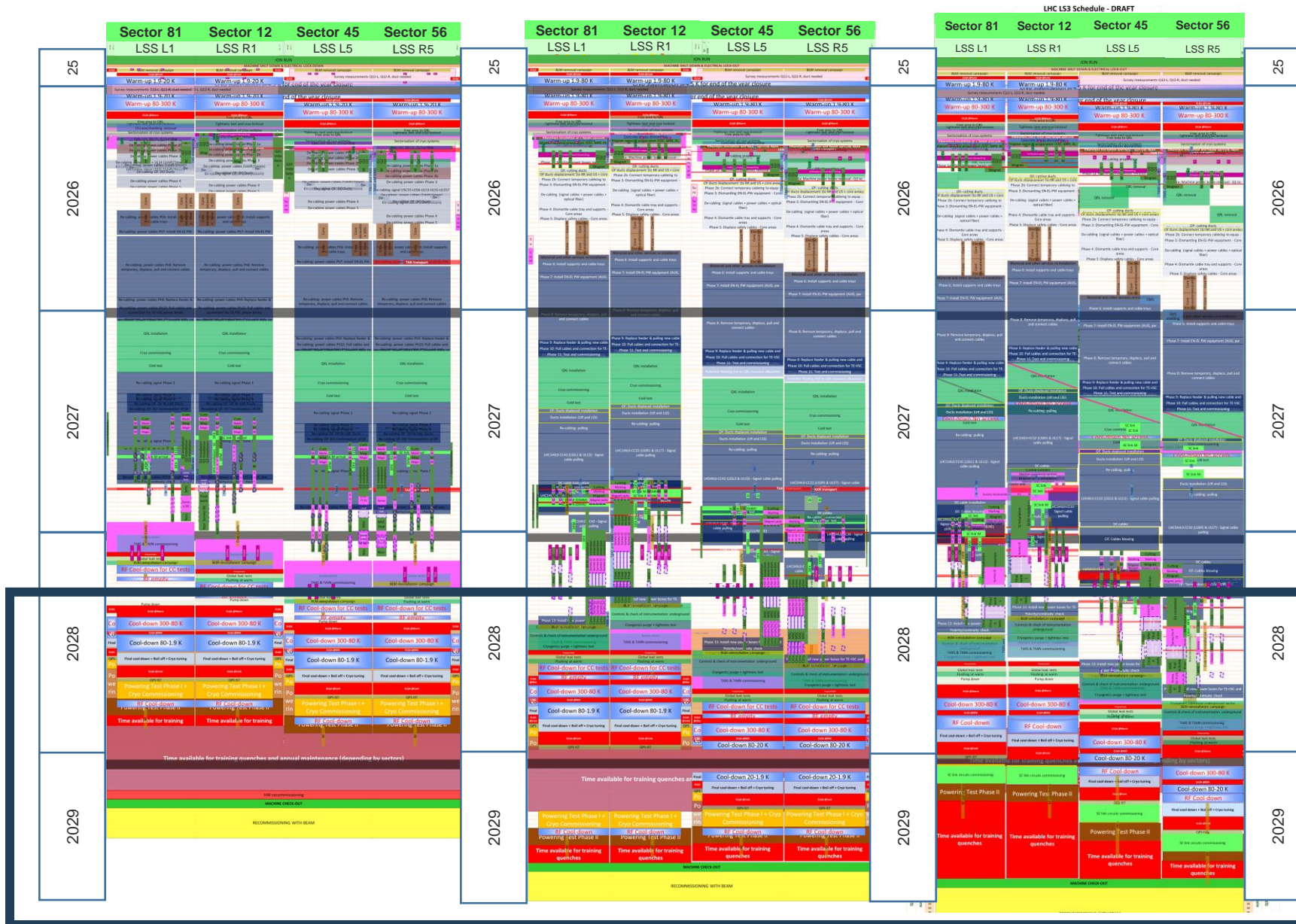
Extra slides

LS3 Planning for LHC Tunnel EVOLUTION EDMS 2400939

LS3 Schedule – TCC Nov 2022, Ver.-1.2

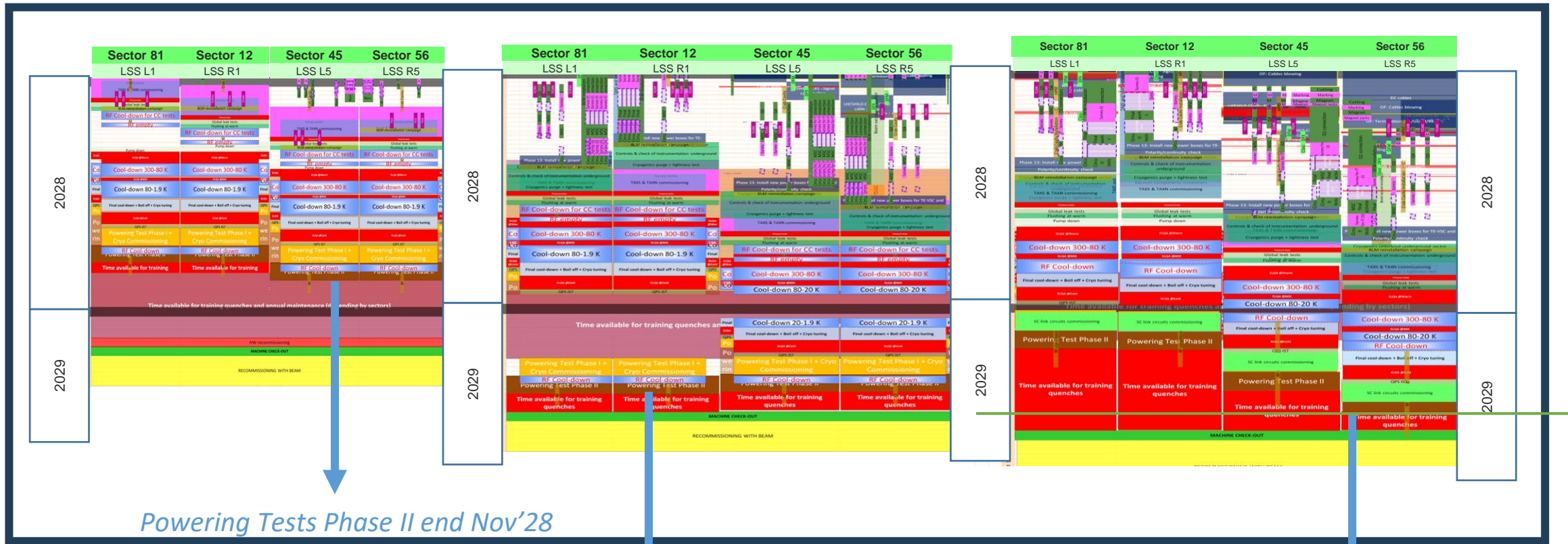
LS3 Schedule – TCC June 2023, Ver.-1.3

LS3 Schedule – September 2023, Ver.-2.0



Note: a presentation of the LS3 Planning *Vers-2* is scheduled at the TCC of 5th October!

LS3 Planning for LHC Tunnel EVOLUTION EDMS 2400939



Powering Tests Phase II end Nov'28

Powering Tests Phase II end May'29

Powering Tests Phase II end in Jun'29

Note: a presentation of the LS3 Planning *Vers-2* is scheduled at the TCC of 5th October!

LHC LS3 Schedule Critical path

- Warm-up & test
- de-cabling
- core excavation
- cabling
- LSS reinstallation
- Cool-down & test & recommissioning

