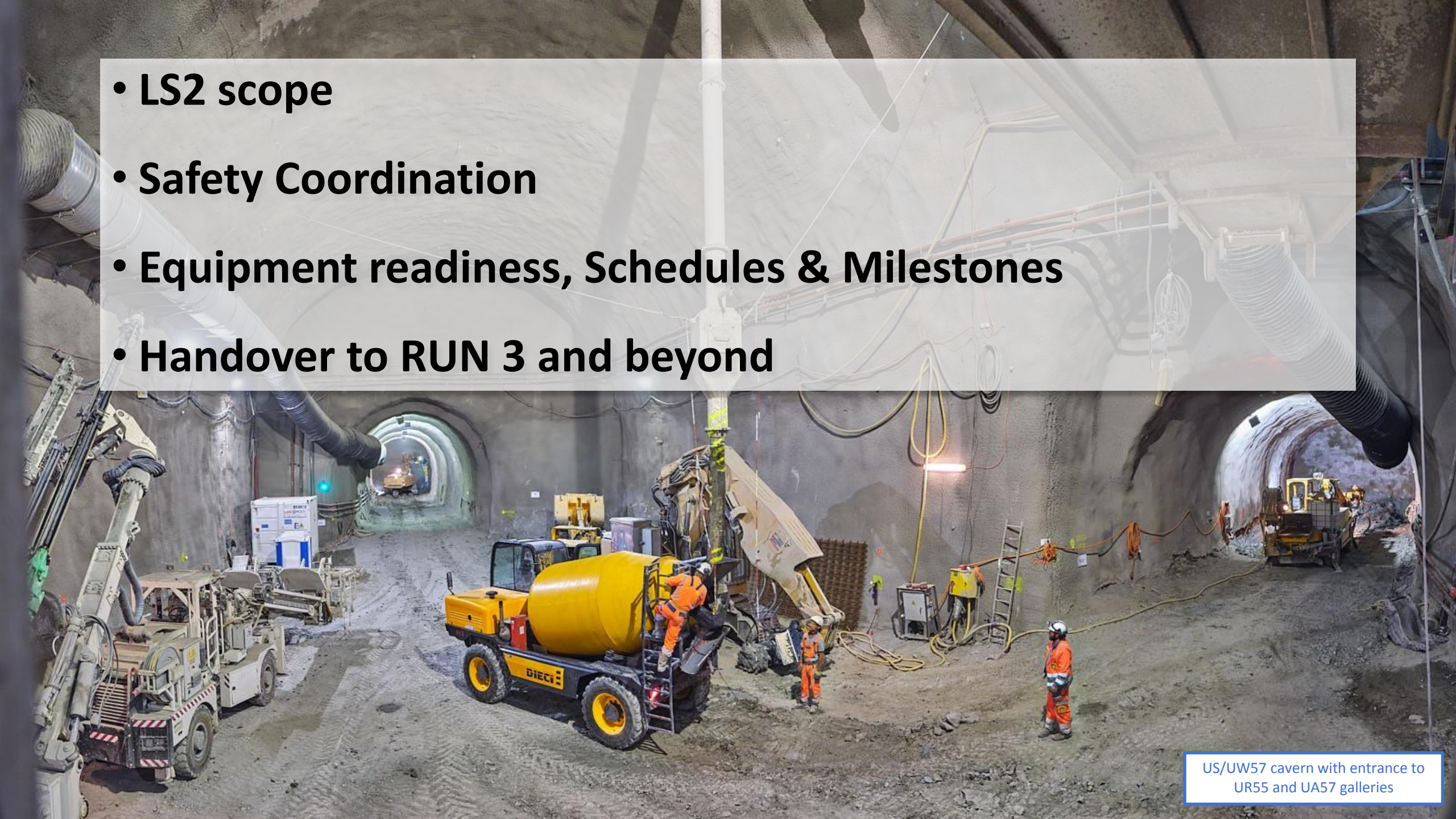

CERN
LS2
ATTENTION
TENSION
DANGER
COUPURE D'URGENCE
INJECTION KICKERS MKI
EMERGENCY SWITCHING
Helium Release Point
Point de rejet d'hélium

- LS2 scope
- Safety Coordination
- Equipment readiness, Schedules & Milestones
- Handover to RUN 3 and beyond



US/UW57 cavern with entrance to UR55 and UA57 galleries

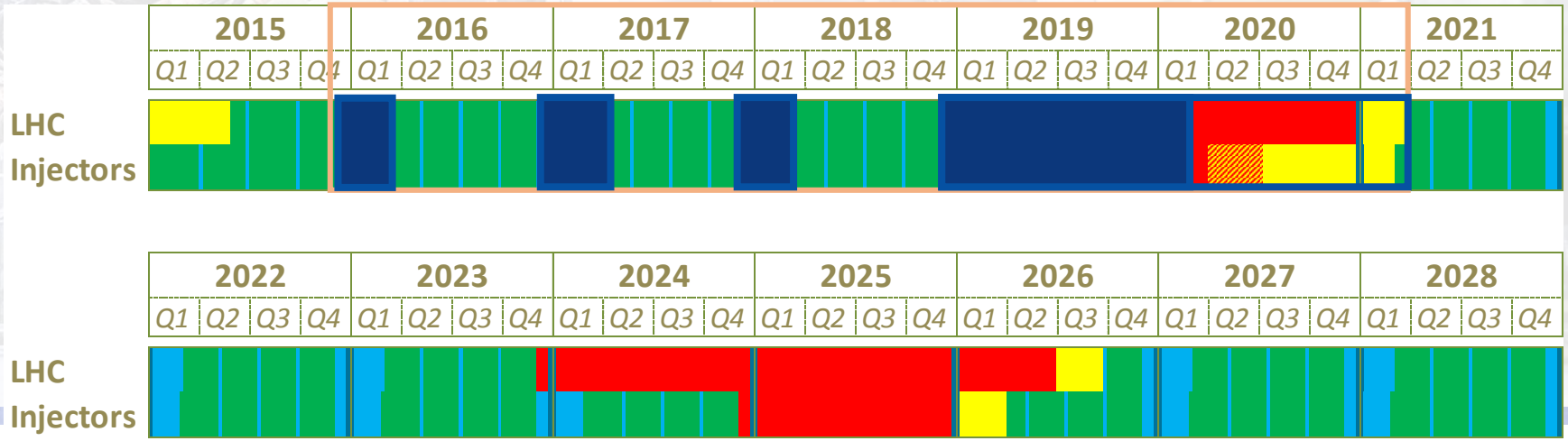
LS2 Scope – Mandate

Definition of **main works** over the LS2 for the **whole** CERN **accelerator facilities** and of **potential arbitrations** based on priorities given to activities.

Definition of a CERN-wide "**resource-loaded planning**", ensuring compatibility of resources and planning across **Injectors**, **LHC Machine, LHC and Non-LHC Experiments**.

Preparation, coordination and follow-up till completion of all activities.

Flexibility to **use the end-of-year technical stops** before and after the LS2 to decrease the load of the LS2.



LS2 Scope – Main objectives

Increase **Intensity** & **Brightness** in the injectors to match HL-LHC requirements

☞ **LIU Project**

Increase injector **Reliability** and **Availability** to cover HL-LHC run

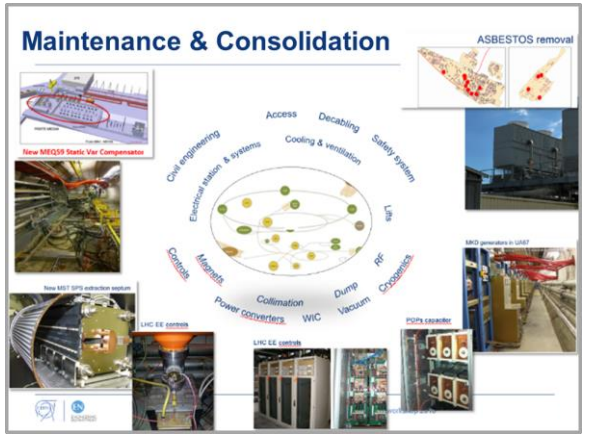
☞ **Consolidation Project**

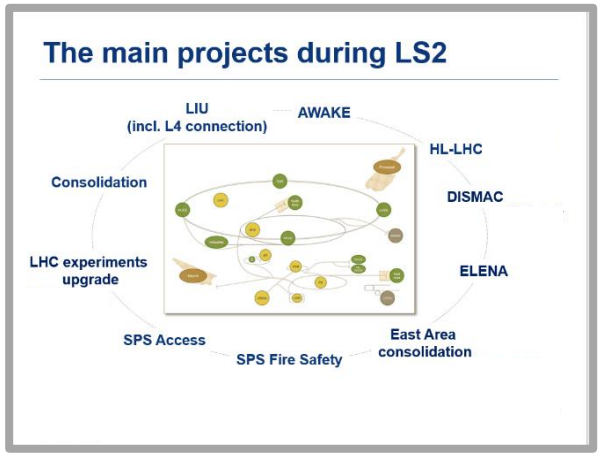
Anticipate **Civil Engineering** works and **beam equipment**

☞ **HL-LHC Project**

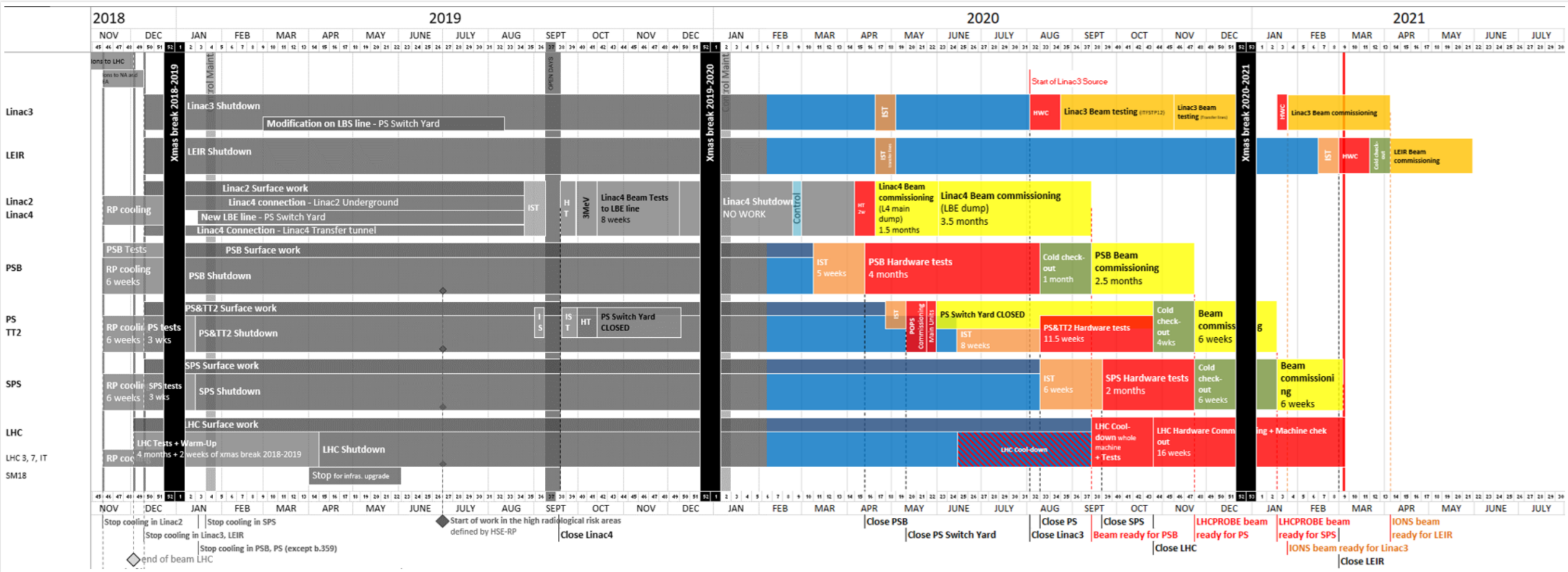
Perform major **Maintenance** & **Infrastructure** Consolidations

☞ **M&O activities**





LS2 Master Schedule (EDMS 1687788 – rev. 2.4)



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Safety Coordination


Barriers @ SPS-BA3

Access restriction @ SPS-BA2

Flashing lights & signs to warn during tests @ PS Switch Yard


Electrical lock-out @ PS Booster

Safety – LS2 Accidents

Facility	Total	Minor	With days of absence	Total days
PS	5	2	3	36
SPS	17	8	9	227
LHC inc. LEX	22	17	5	56
Surface	21	9	12	153
Total	65	36	29	472

Category	Total	Minor	With days of absence	Total days	Frequency Rate	Severity Rate
MPE	15	9	6	59	7.6	0.08
MPA	5	3	2	79	4.0	0.16
ENTC	45	24	21	334	13.3	0.20
Total	65	36	29	472	10.0	0.16

LS1 Accidents

Facility	Total	Minor	With days of absence	Total days**
PS	2	1	1	6
SPS	7	6	1	3
LHC	30	20	10	93
Surface	50	34	16	151
Experiments*	6	3	3	20
Total	95	64	31	273

- 3.7 Million Hours worked
- 64 minor accidents (no absence)
- 31 accidents with total 273 days absence

Frequency rate : 8.4
Severity rate : 0.07

Frequency Rate = Number Accidents (with absence) per Million Hours worked
Severity Rate = Number of days Absence per 1,000 Hours worked

LHC Long Shutdown 1 (LS1) Status and Outlook
F. Bordry
12th December 2014

HL-LHC and LIU Cost and Schedule Review November'19

Frequency Rate:
Accidents with absence per million hours worked
Severity Rate:
Days of absence per thousand hours worked

Safety – Operational Dosimetry

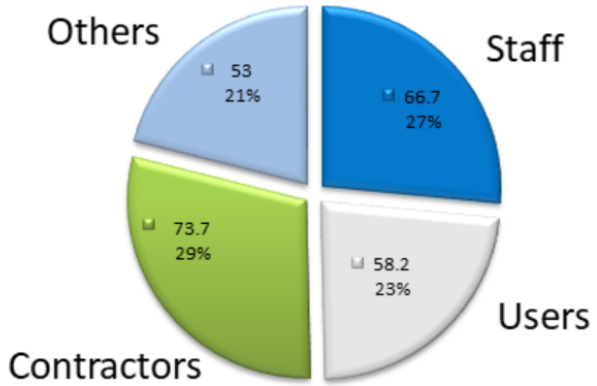
Personal Dosimetry

1st of January 2019 – 30st of November 2019

Collective personal dose: **251.6 person · mSv**
Maximum individual dose: **1.3 mSv (4 pers.)**

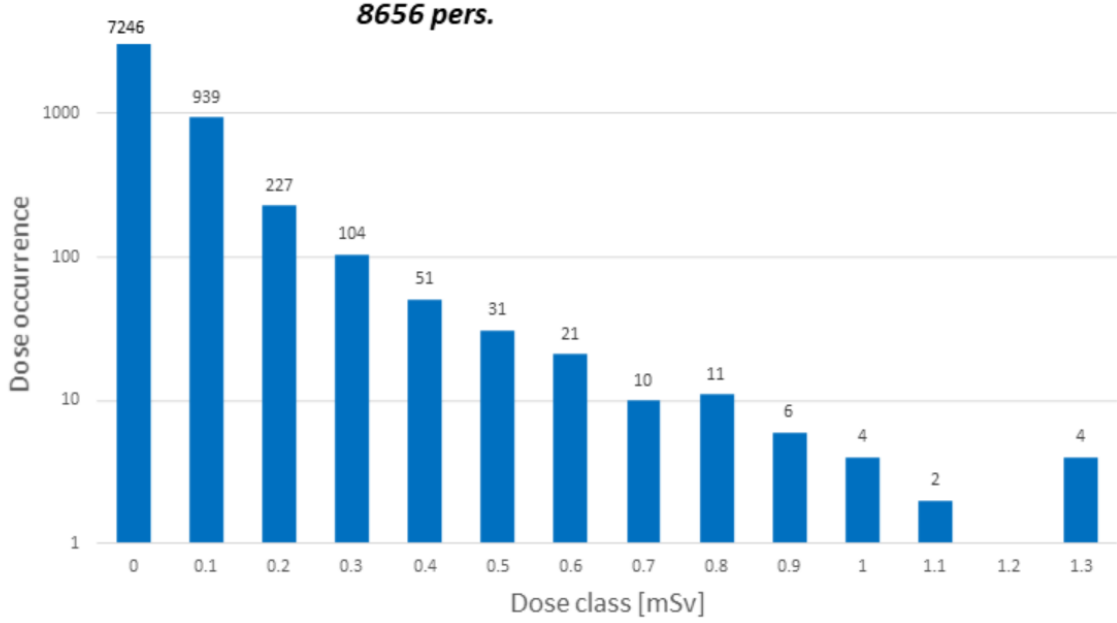
Dose distribution per category of personnel

Values in person · mSv



Others: VISC,TRNE,TEMC,TECH,SASS, RETR, RETP, PJAS, PART, GPRO, FELL, EXTN, EXMP, DOCT, COS,CASS,APPR,ADMI

Dose occurrence per dose class
LS2 1st of January to 30th of November 2019
8656 pers.

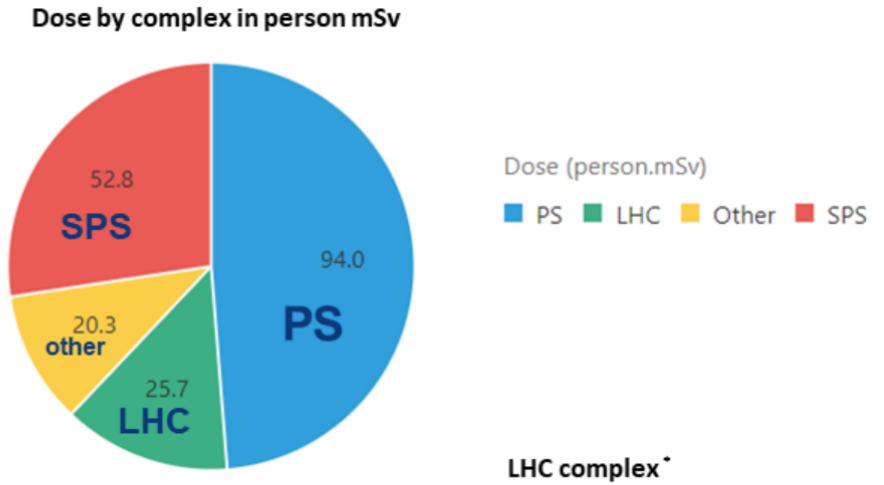


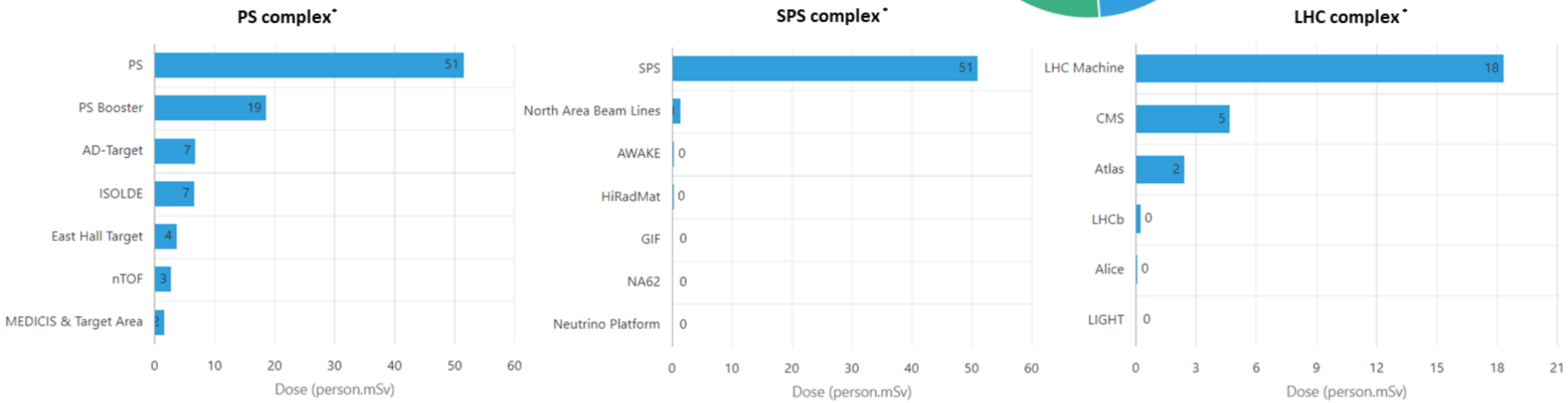
Safety – Operational Dosimetry

Operational Dosimetry

1st of January 2019 – 31st of January 2020

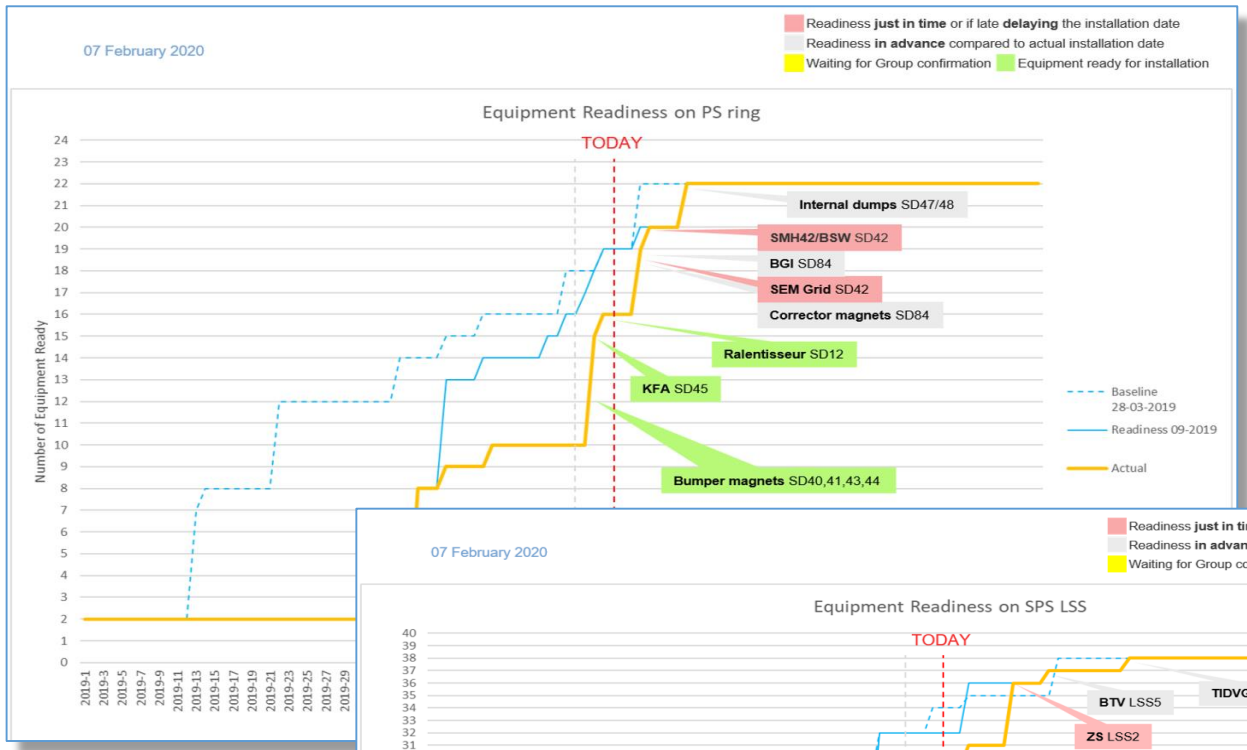
Collective operational dose: 192.8 person · mSv

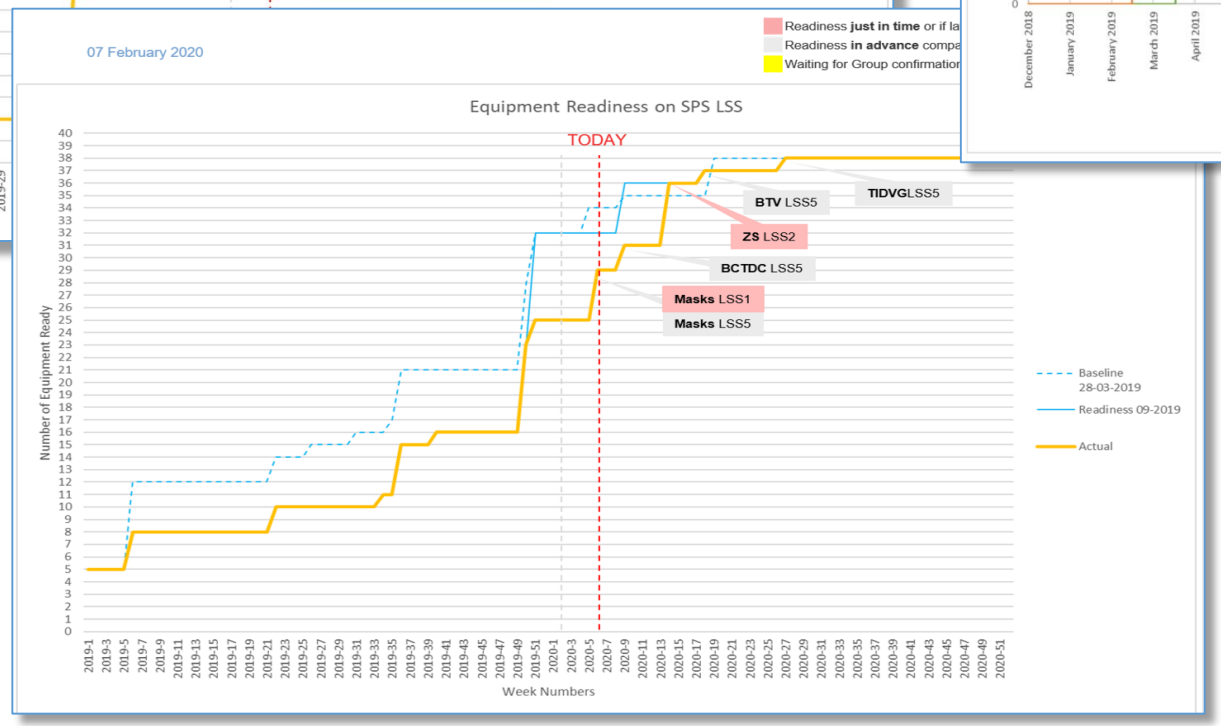


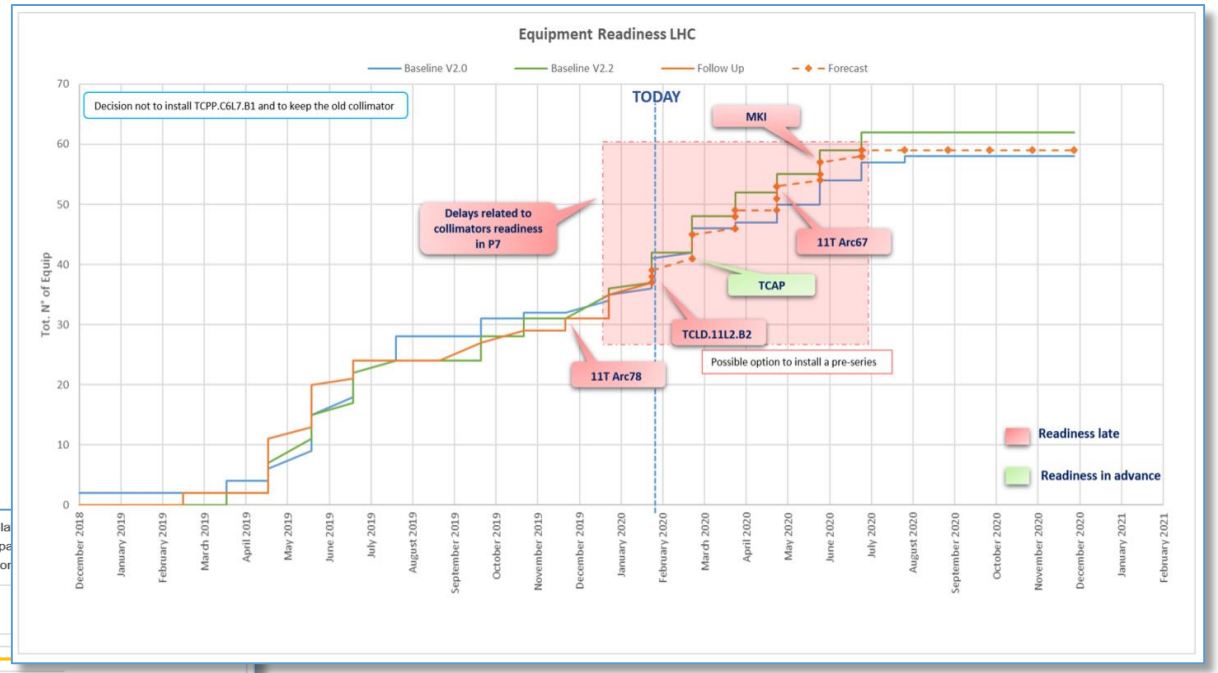


* Top 7 contributors

Equipment readiness, Schedules & Milestones





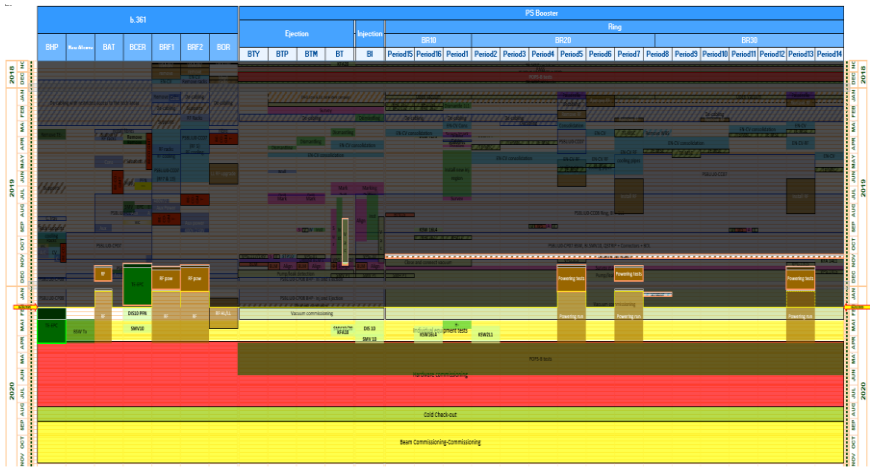


LS2 Dashboard

https://acc-dashboard.web.cern.ch/ls2

(CERN Single Sign On required)

PSB Update



Broken Line

Ring beam lines

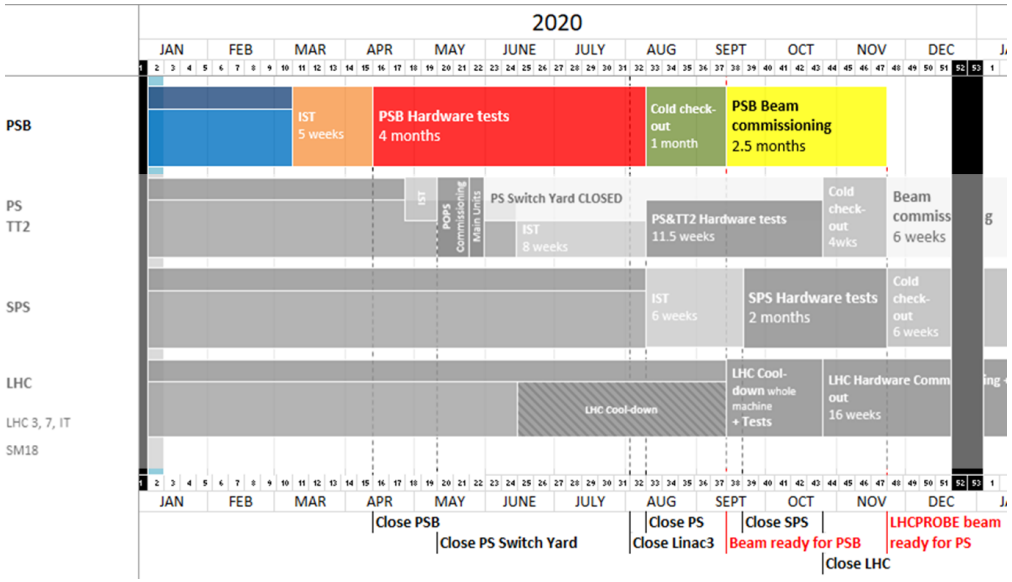
- New RF Finemet Cavities
  - *The whole systems are installed and operational. Individual system tests started*
- New Injection Region (H-)
  - *Ready for individual system tests*
- New Beam Instrumentations
  - *Detectors being vacuum tested before installation*
- New Absorbers
  - *Final equipment to be installed in March*

Transfer lines

- Injection (BI line)
  - *Final smoothing/alignment this week of the line before starting the individual systems tests*
- Ejection to PS (BT line)
  - *Final smoothing/alignment next week of the line before starting the individual systems tests*
- Ejection to ISOLDE (BTM line)
  - *Final smoothing/alignment in two weeks of the line before starting the individual systems tests*

General Services

- Cabling completed
- Cooling system being tested



PSB Update

New Wire Scanners

New RF Finemet Cavities

New extraction line bending magnets

New PS Booster injection system

- Most of the LS2 activities are on track or in advance
- Individual Systems Tests (ISTs) already started in some specific locations
- Most of ISTs will start with the availability of the water cooling the 3rd of March 2020

Surface building and TT2

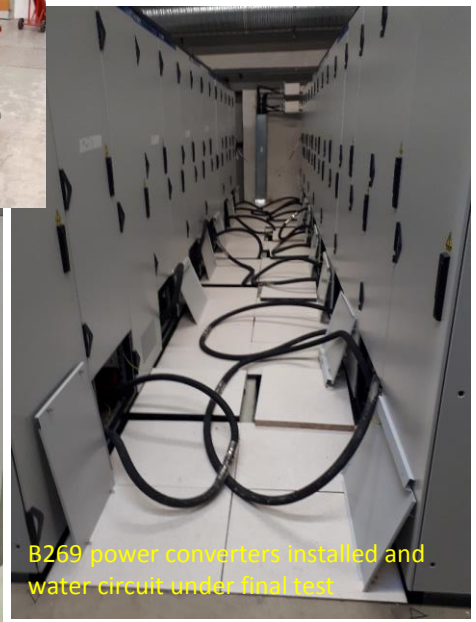

New refurbished bending magnets

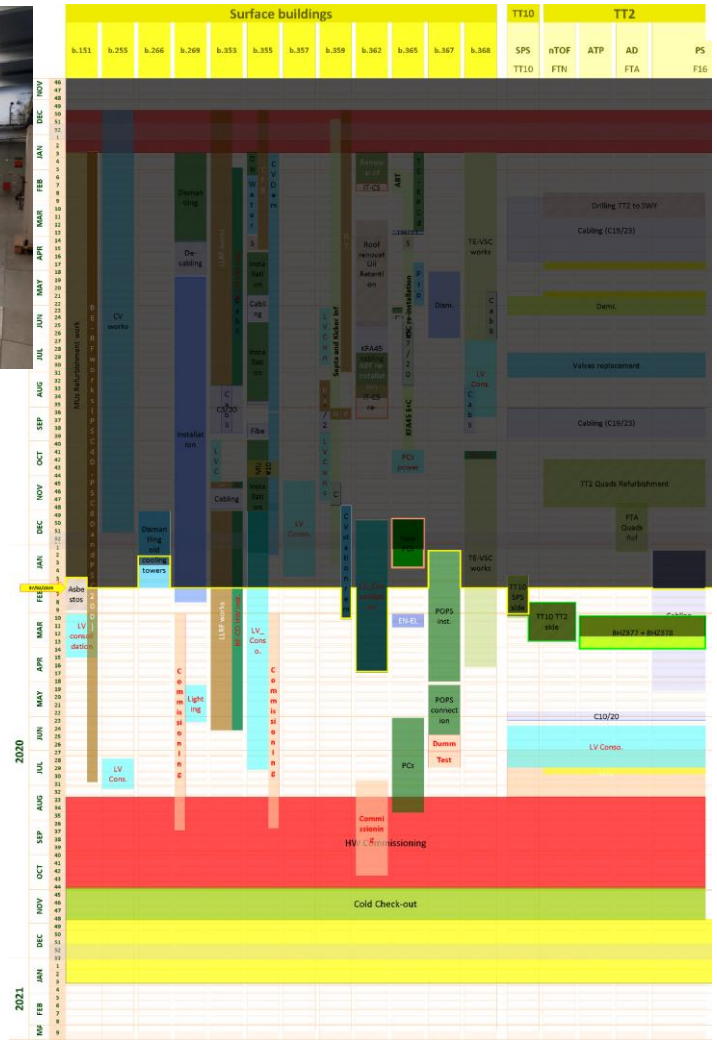

B365 power converters


Dummy loads



New RF transverse feedback system under installation


B269 power converters installed and water circuit under final test



CERN LS2 2015-2020 Coordination

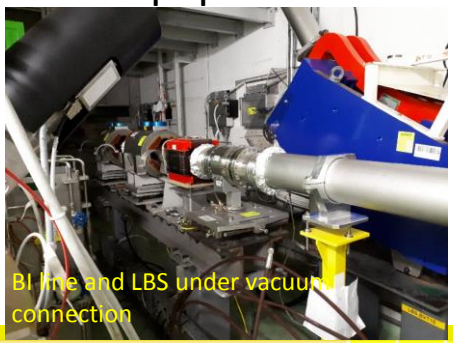
- Most of the LS2 activities are on track or in advance
- Galleries cleaning completed
- Individual Systems tests (ISTs) will start soon for some specific equipment in the ring

PS Ring and PS SwitchYard


New rigid RF 40&80 MHz lines


New WIC system

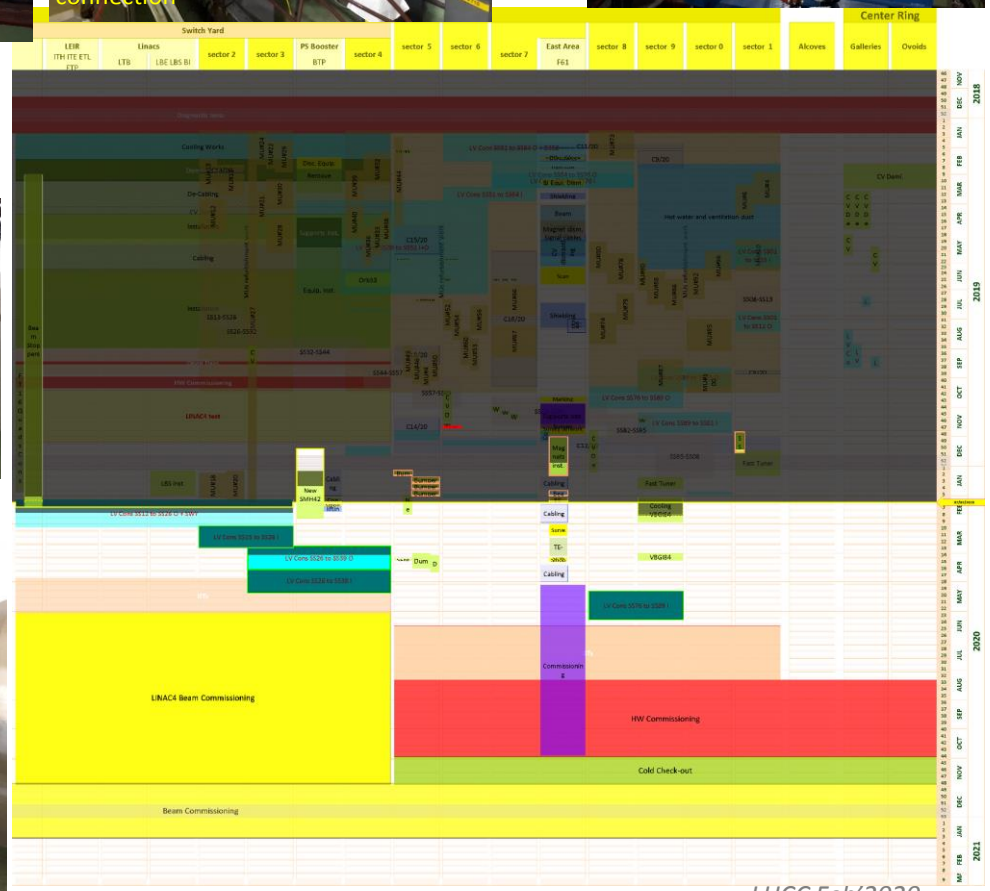

SMH16 back to the machine


BI line and LBS under vacuum, connection

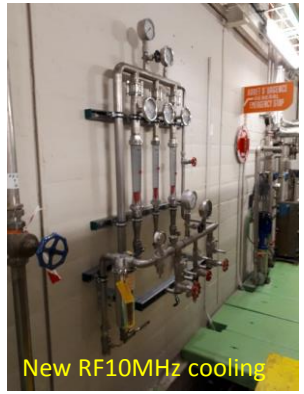

New Bumpers


BTP line connected, aligned and under vacuum


Last MU back to the machine




New BusBars

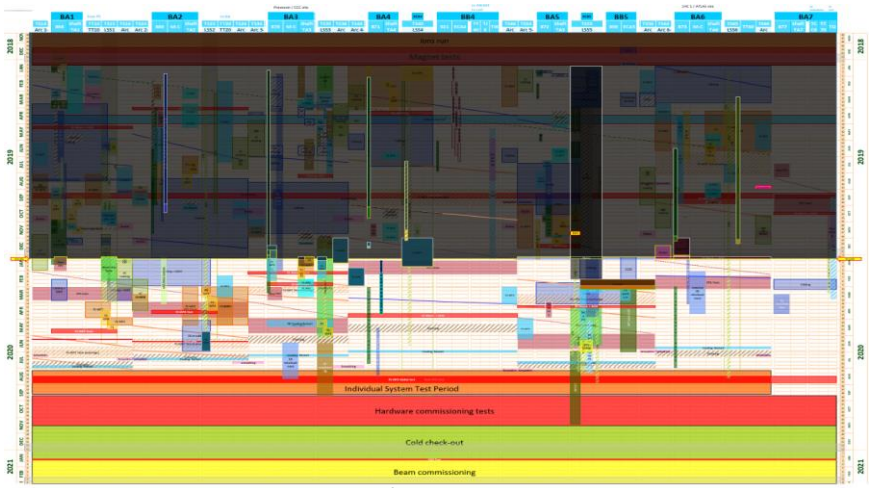

New RF10MHz cooling


New WireScanners


New F16 Beam Stoppers

LHCC Feb'2020

SPS Update

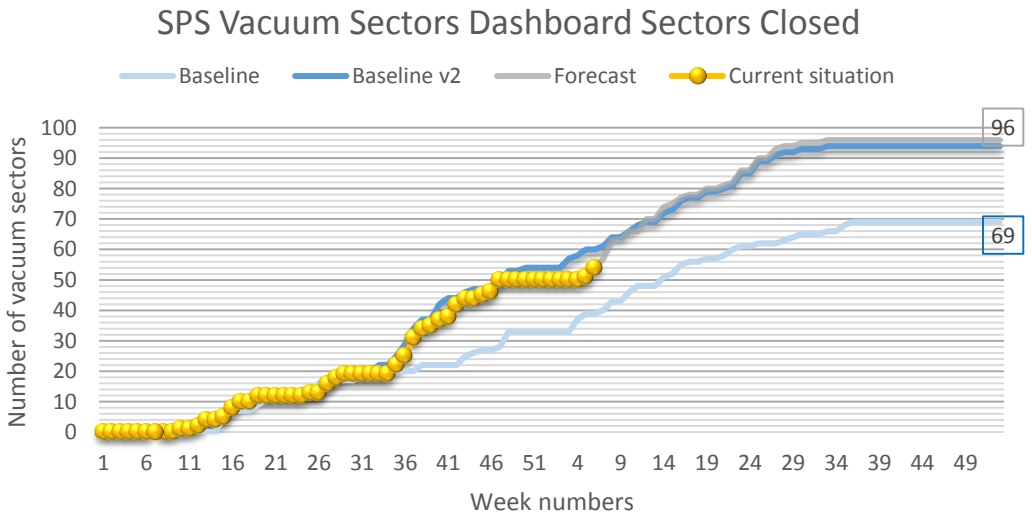


Broken Line

- CE works in **ECX5** completed on Schedule.
  - *Installation of Auxiliary systems in ECX5 is ongoing.*
- De-Cabling/Cabling & Installation of Auxiliary systems in LSS3 are completed.
  - *Re-installation of RF cavities in LSS3 is ongoing.*
- Re-installation of Beamline in LSS1 has started.
- PPS Project:
  - *10 of 12 new access systems installed.*
- aC Coating project:
  - *11 of 12 sectors are completed.*

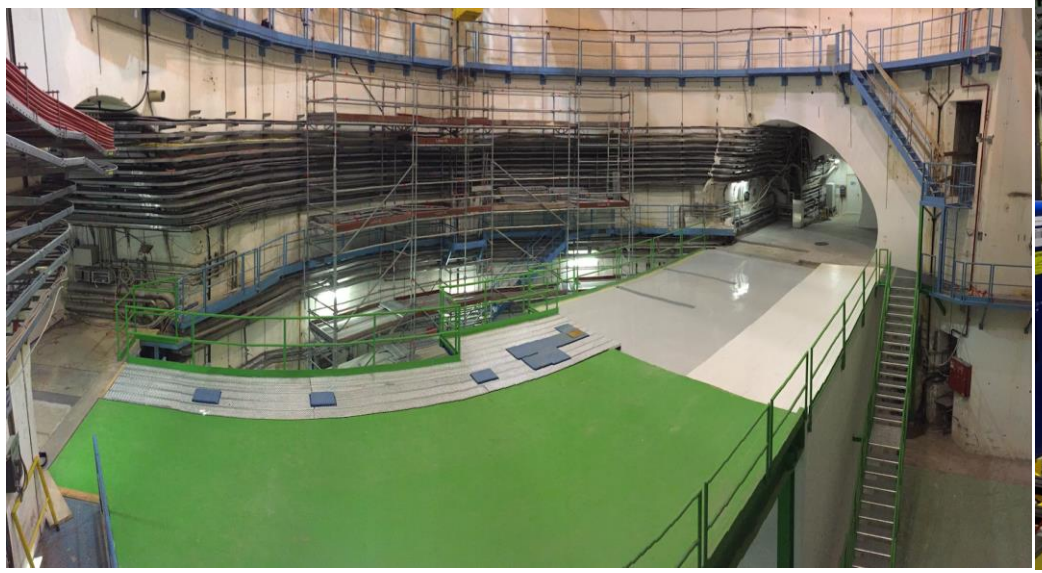
Fire Safety Project:

- WP1: Fire Doors
  - *11 of 21 doors installed.*
- WP2: Fire Detection
  - *75% installed. (2 of 6 zones fully operational)*
- WP3: Dry Risers
  - *80% completed. (Only BA3 shaft,TT20, Arc 4+, Arc 5- to complete)*
- WP4: Sprinklers
  - *70% Completed. (6 of 11 circuits fully operational)*

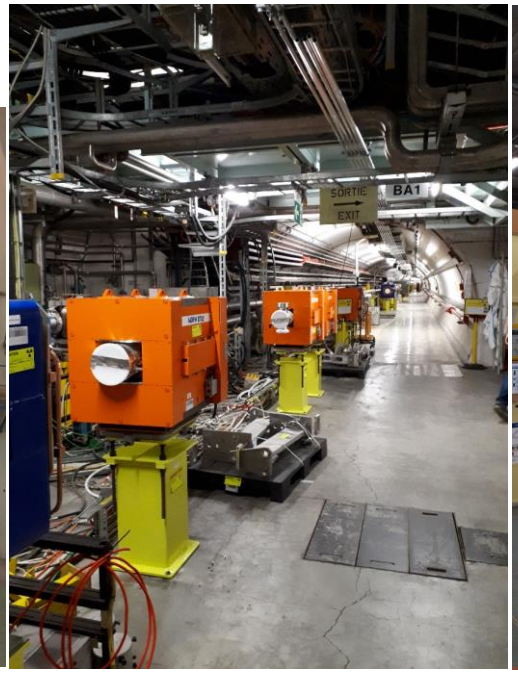


Overall delay of 6 sectors (will be caught up in March)

SPS Update

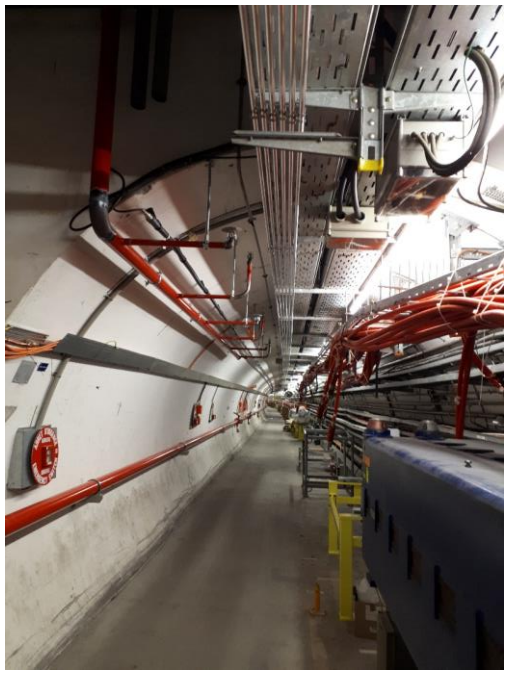


CE works in ECX5 complete on time.



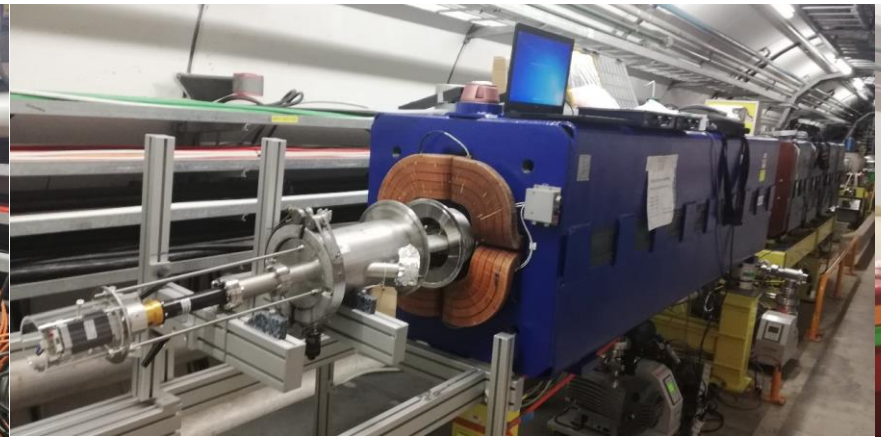
LSS1 Re-installation

New PPS BA1



WP2, 3 & 4 installed in LSS5

Re-installation of magnets and RF cavities in LSS3



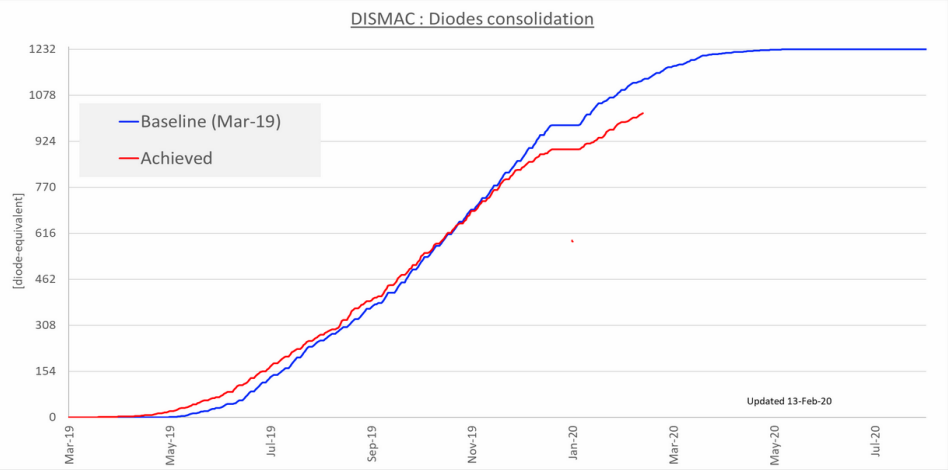
aC coating about to start its final sector

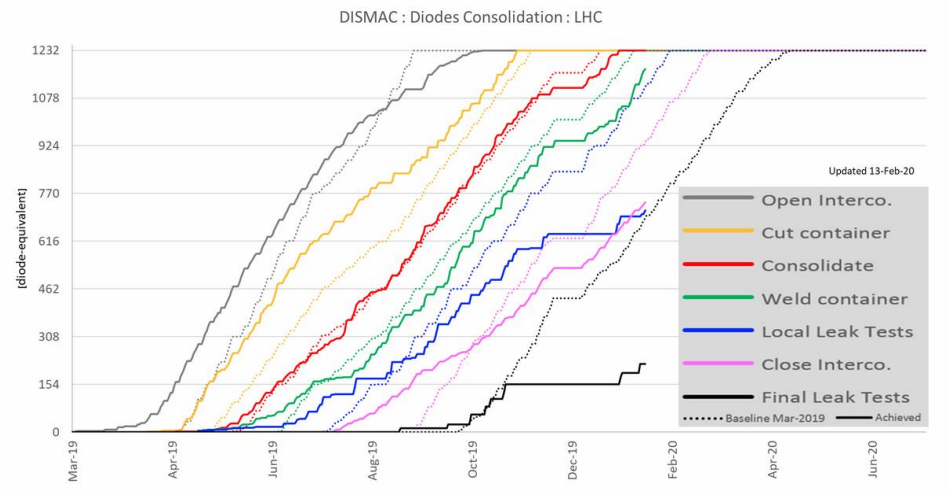
WP1 installed in LSS6+

Status 7th February 2020 wrt baseline 2.4

LS2 2015-2020
Coordination

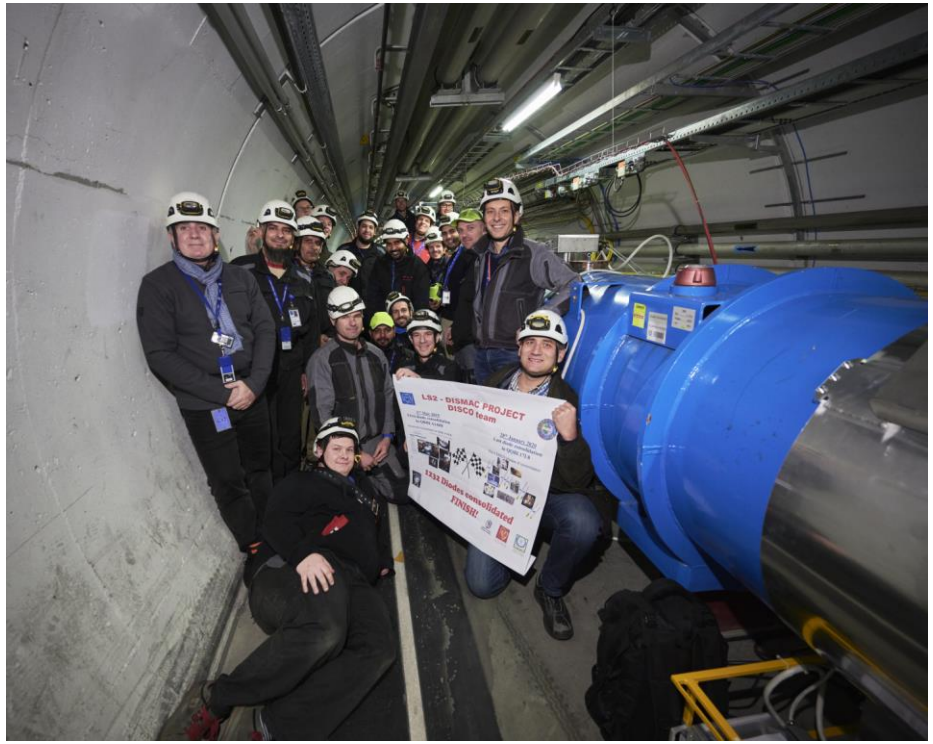
DISMAC





- Sector 8-1 all works done
- Diodes electrical insulation consolidation fully completed
- DISMAC progression shows a small delay according to the baseline

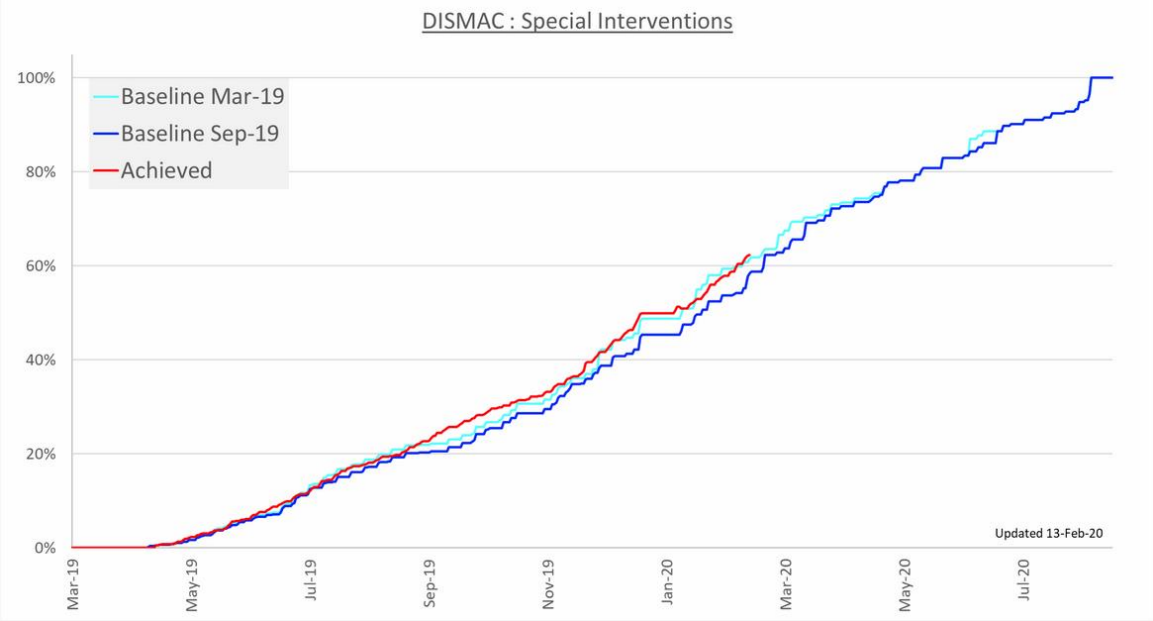
Courtesy J.Ph.Tock + M Pojer

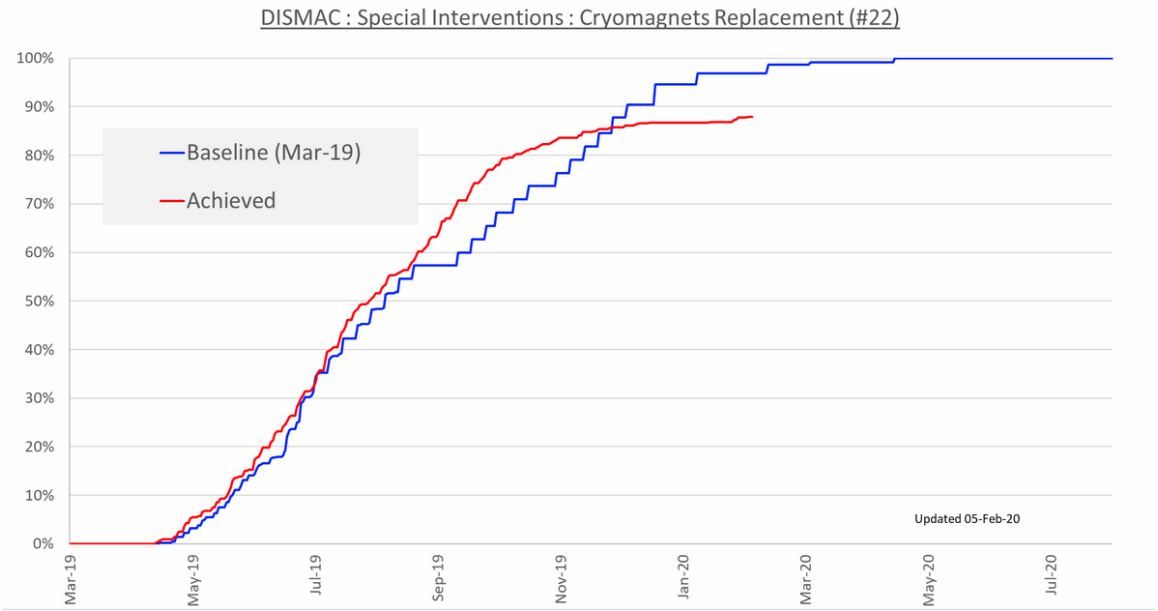


28th January 2020: Last Diode box consolidation

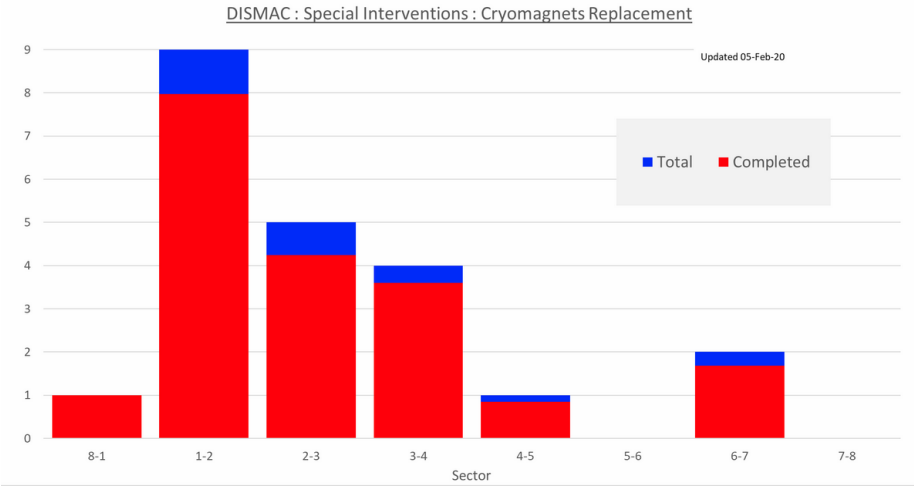
DISMAC

Courtesy J.Ph.Tock





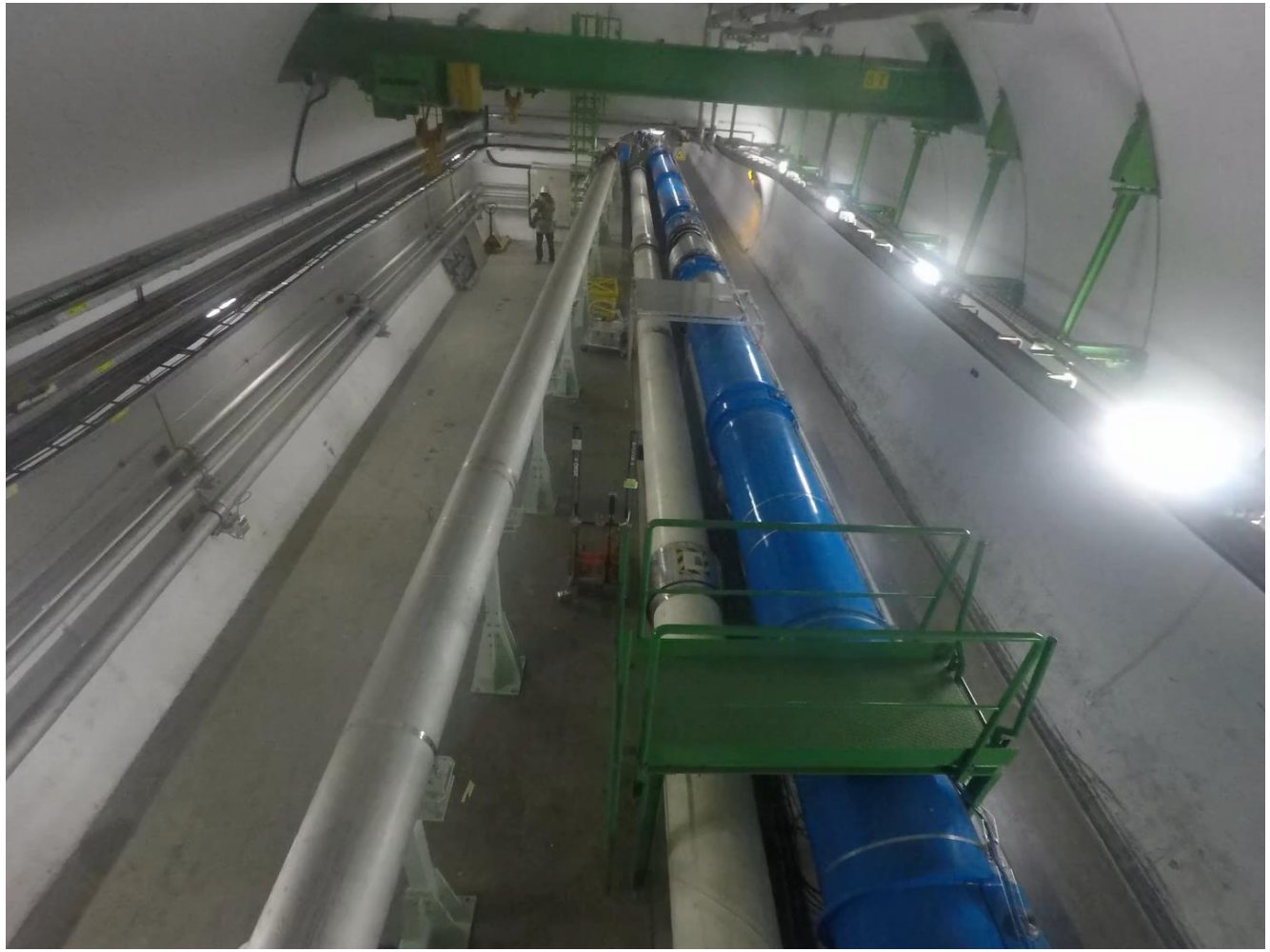
- All cryomagnets (not including HL WP11 – LSS7) have been disconnected, removed and reinstalled; last pressure tests remain to be done
- Reconnection almost completed for the magnets that have been reinstalled.
  - CC-11R2 showed a NC but has been already fixed and currently being connected



LHC external beam dump block (TDE) works during LS2

- At the end of January the two spare dumps have been successfully removed from the UD62/68 to the UX65

Spare TDEs in the ad-hoc space in UX65

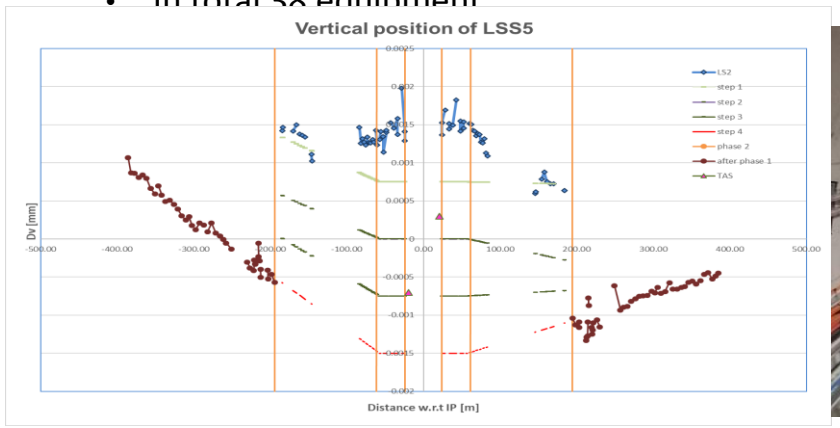


LSS5 Realignment → Planning consolidated

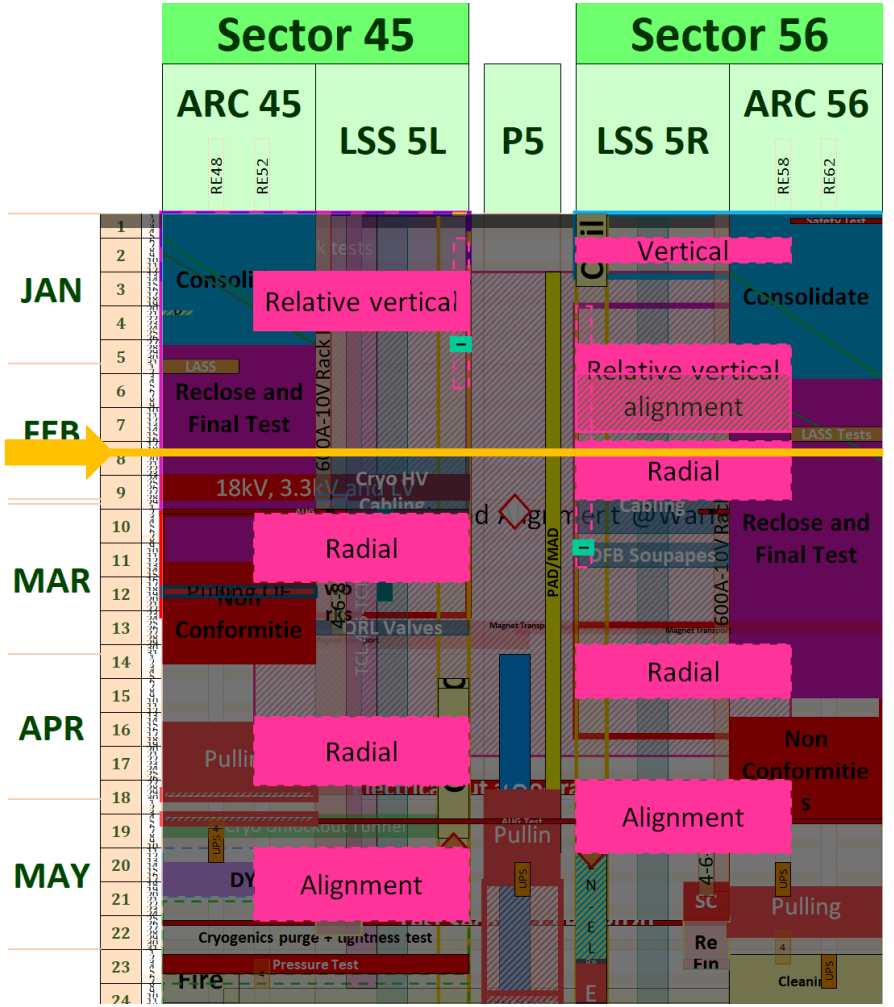
Phase I – Realignment from Q7 to Q5 → 14th Sep to 10th Oct 2019

Phase II – Realignment between Q5 to Q5 → in progress (From January 2020 to May 2020)

- Q5-D1 (6 MBWX, 1 Q4, 1 D2, 1 TAN, 4 pick-ups and 4 Collimators)
- Q1L-Q1R (2 TAS, VAS and 2 BPMWK)
- In total 38 equipment



Phase II – Q5-D1 and Q1L-Q1R before alignment

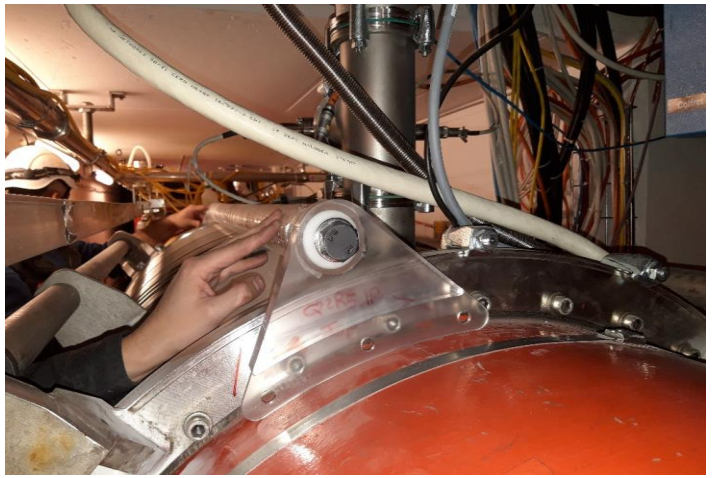


Q1 – DFBX → Alignment on the Inner Triplet area project (V Parma) LSS5L w5, LSS5R w11

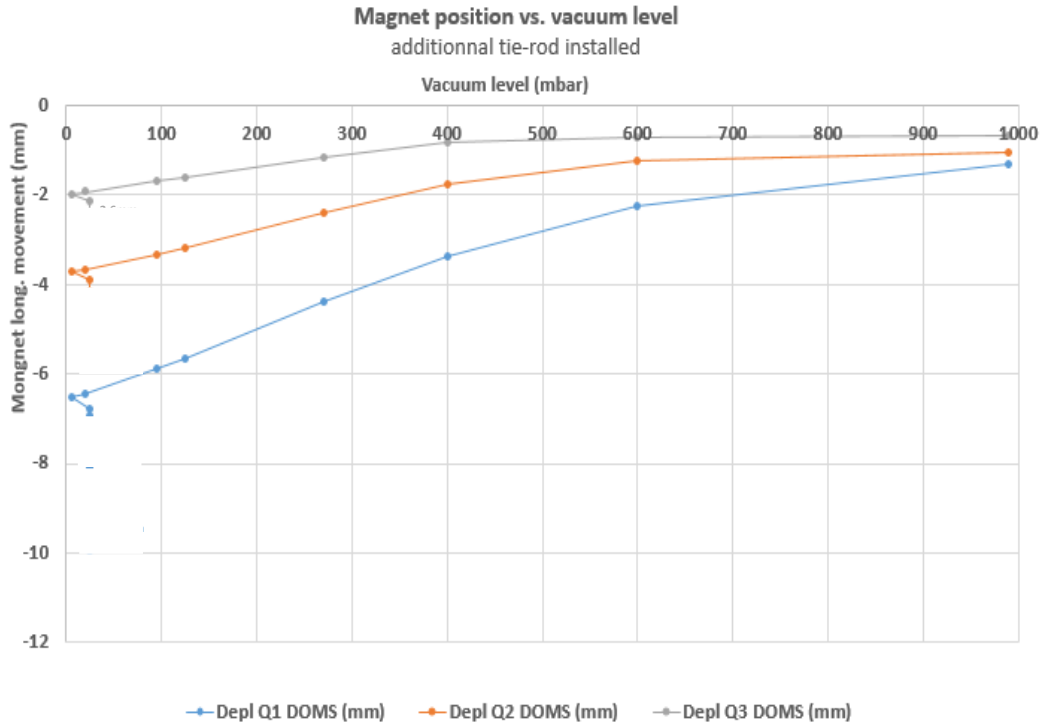
TAS (Right side) (F Sanchez Galan) → w11 in // with the DFBX LSS5R

IT Consolidation

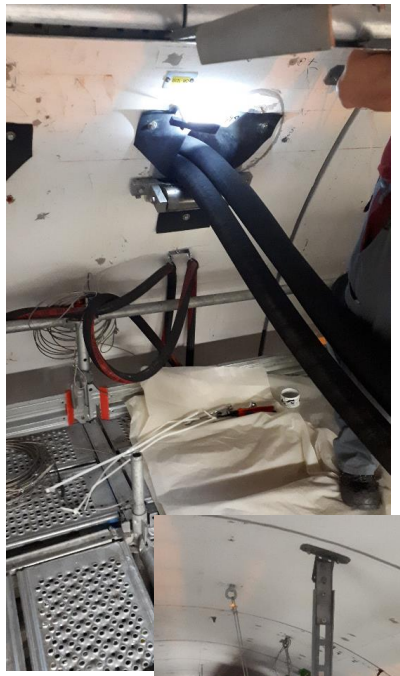
- On all 8 triplets (starting with Pt2 and 8, learning in low radiation areas)
- 1 working day per triplet for a team of 4 (from SIT) + support by Survey team
- March-April



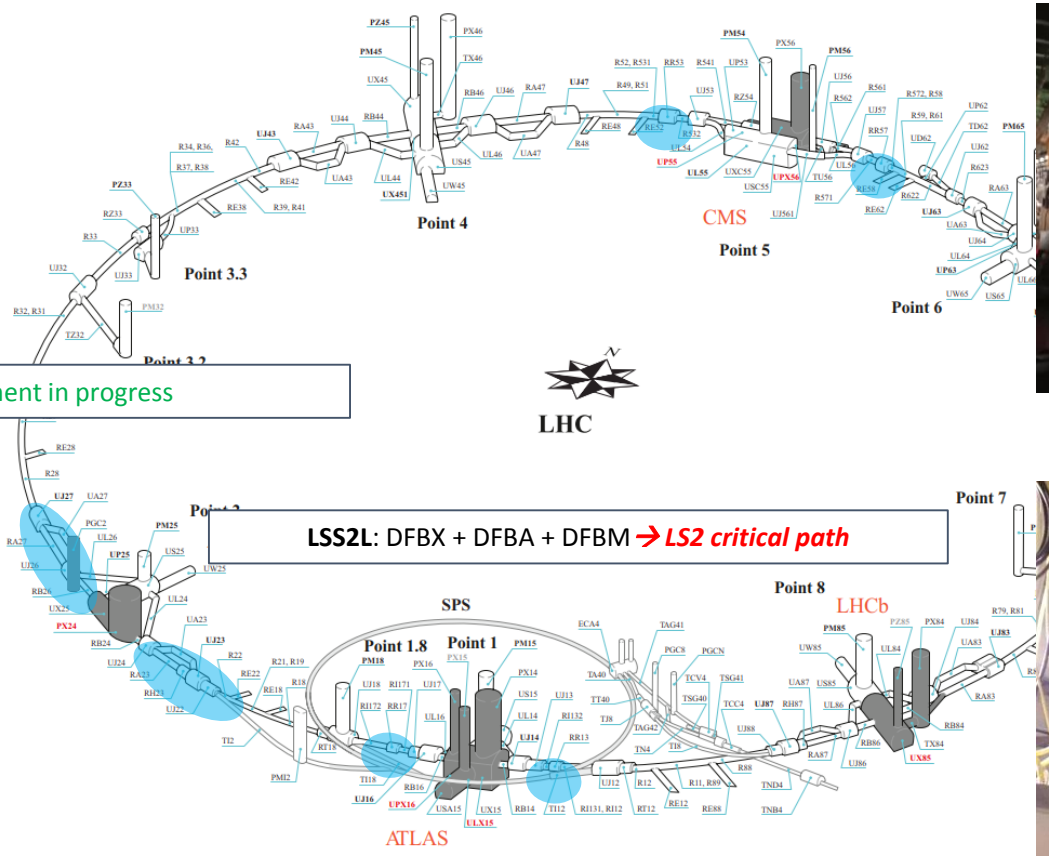
Trial assembly with mock-up tie-rods in Pt.5



WCC Hose exchange



LSS2R: hose replacement in progress



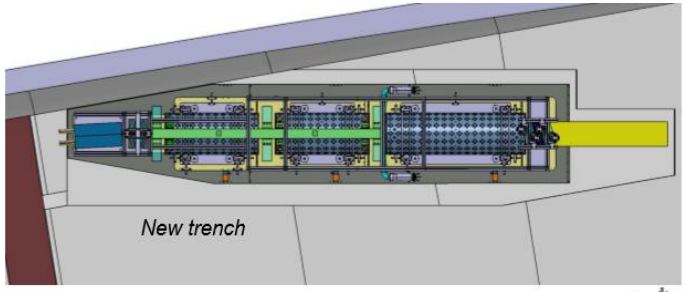
LSS2L: DFBX + DFBA + DFBM → ***LS2 critical path***

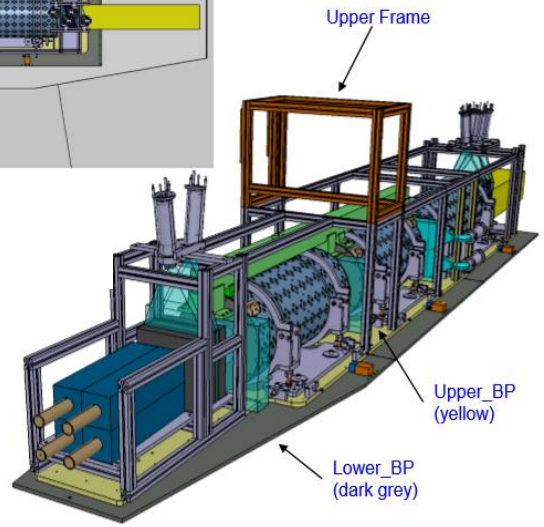
RR13 & RR17 in progress

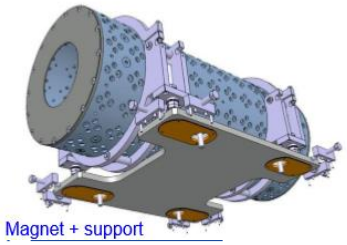
- DFBA And DFBL cables replacement completed, new water hoses installed.
  → Waiting for Dielectric tests

RR53 & RR57 replacement completed
→ waiting Short Circuit Tests

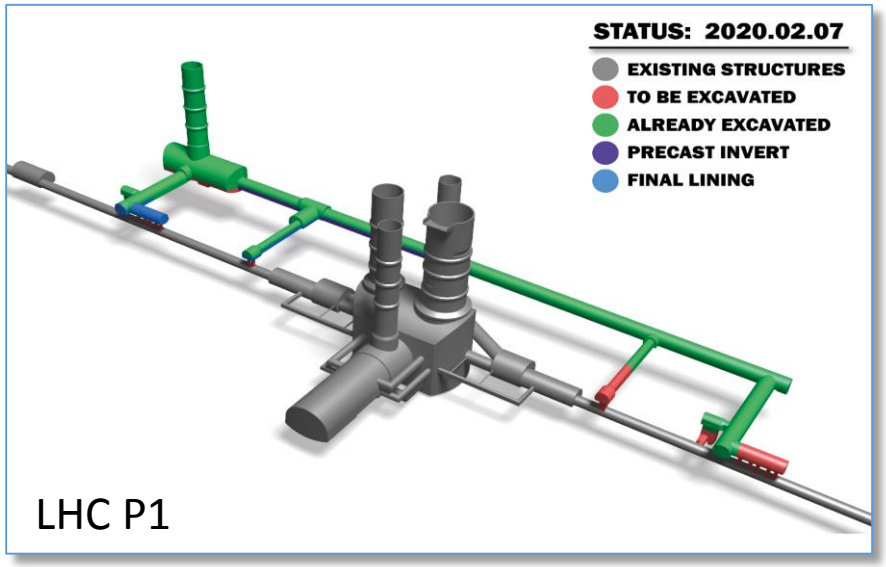
FASER


New trench

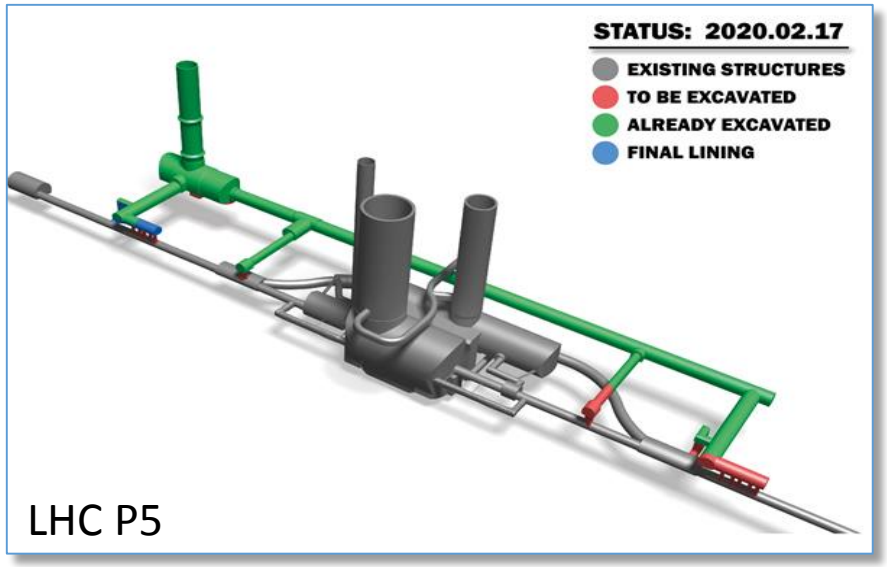

Upper Frame
Upper_BP
(yellow)
Lower_BP
(dark grey)


Magnet + support

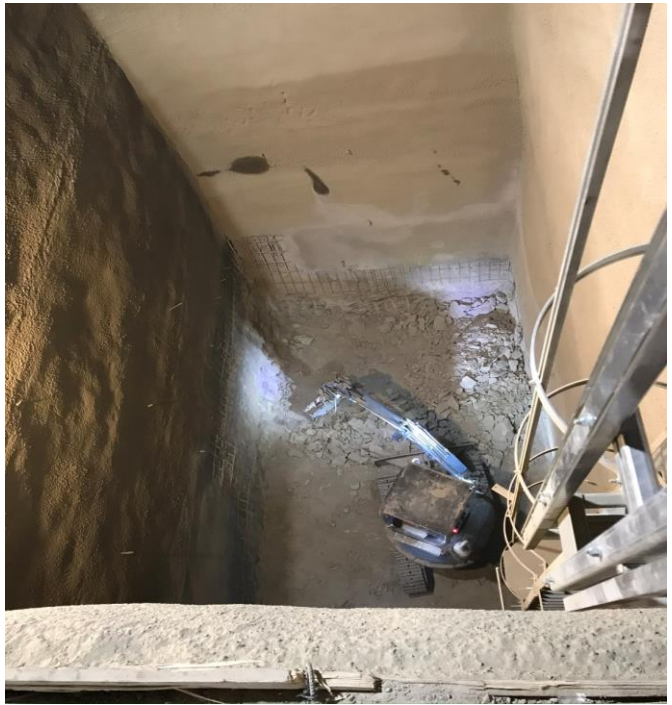
HL-LHC civil engineering



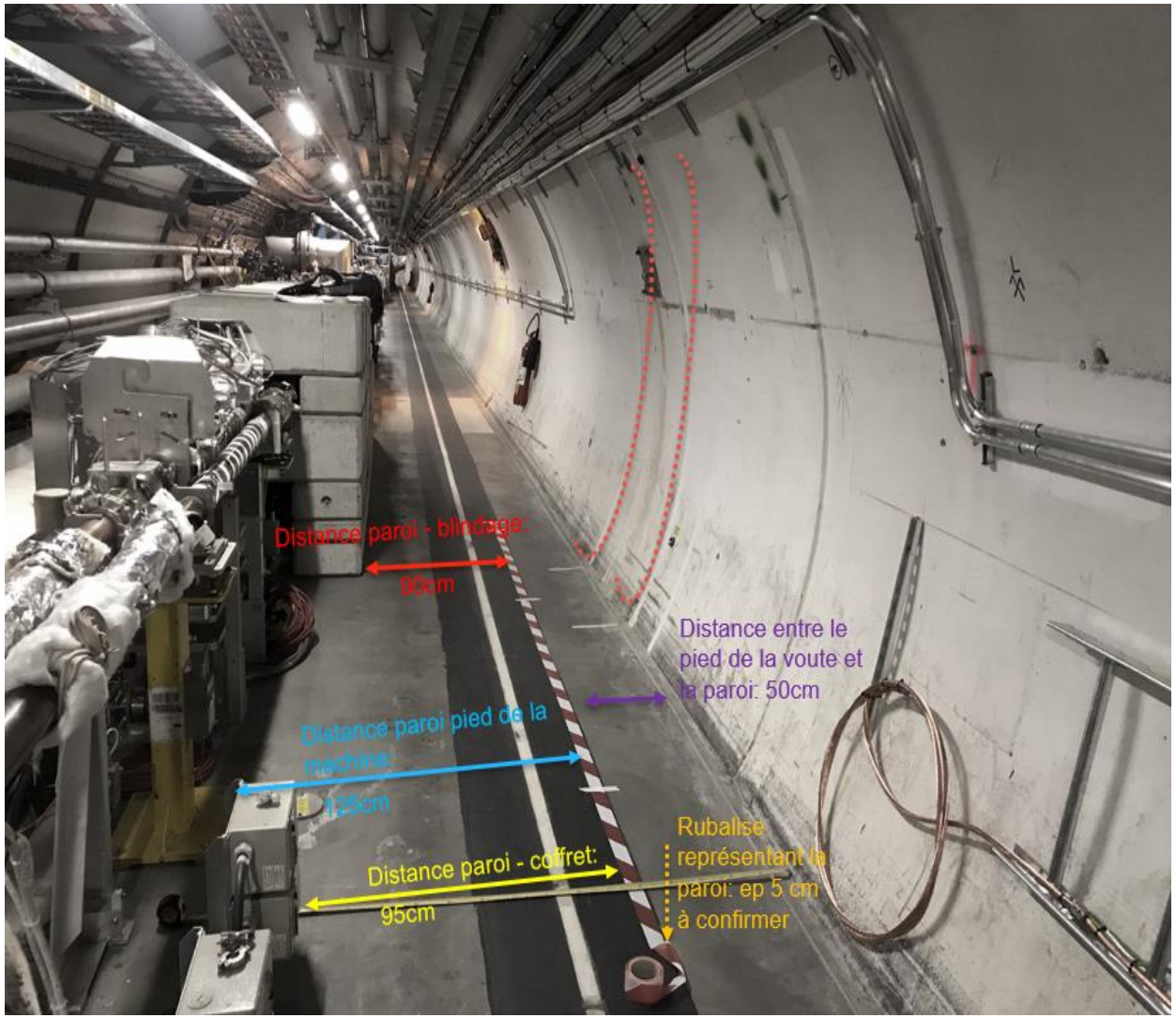
LHC P1



LHC P5

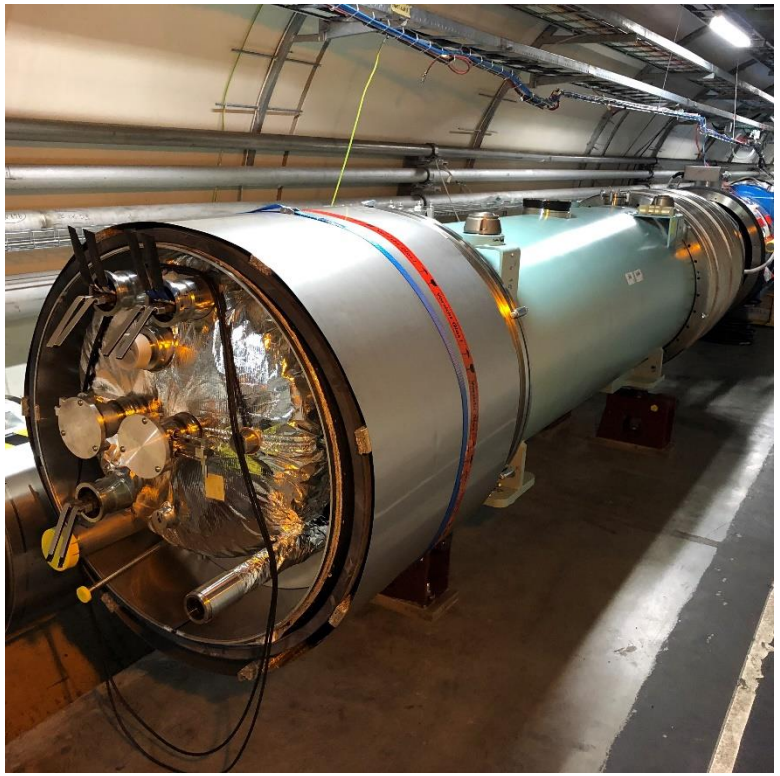


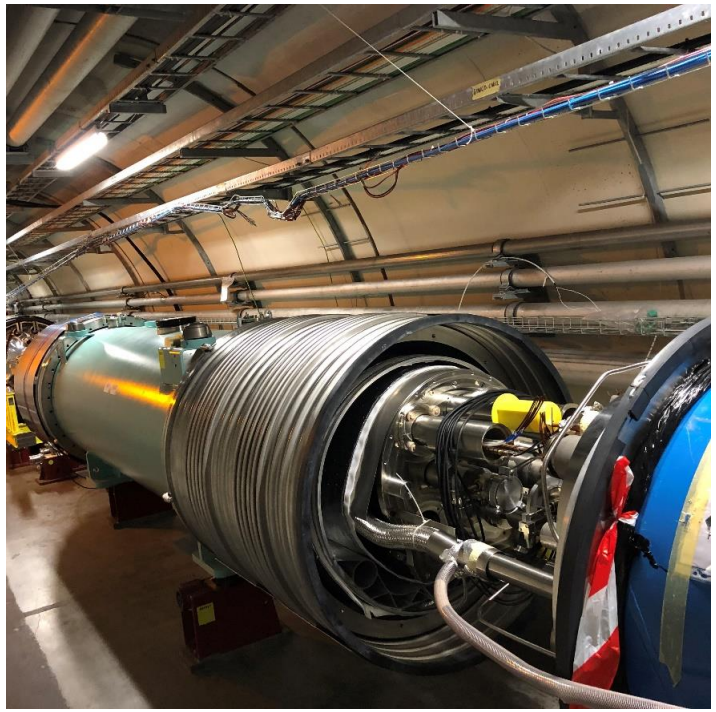
HL-LHC civil engineering

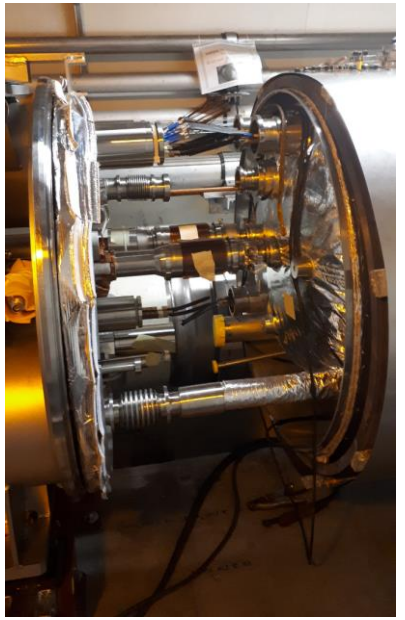


Cryostat Connection HL-WP11 LSS2

Cryostat Connection HL-WP11 LSS2







Installation completed!!!!

Re-Connection in progress

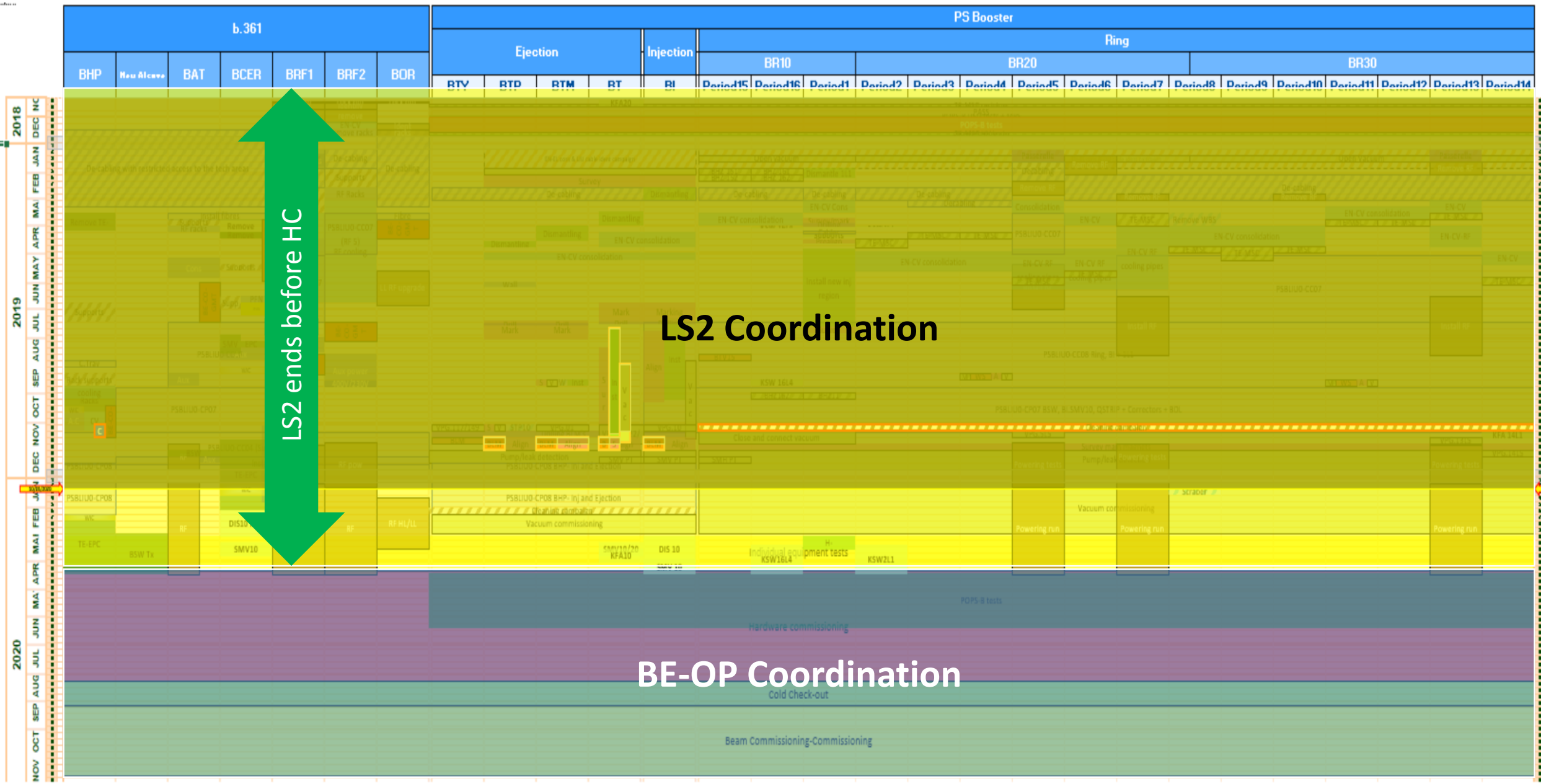
S1 successfully qualified

S2 @ SM18, cooldown, to be tested wk8-9

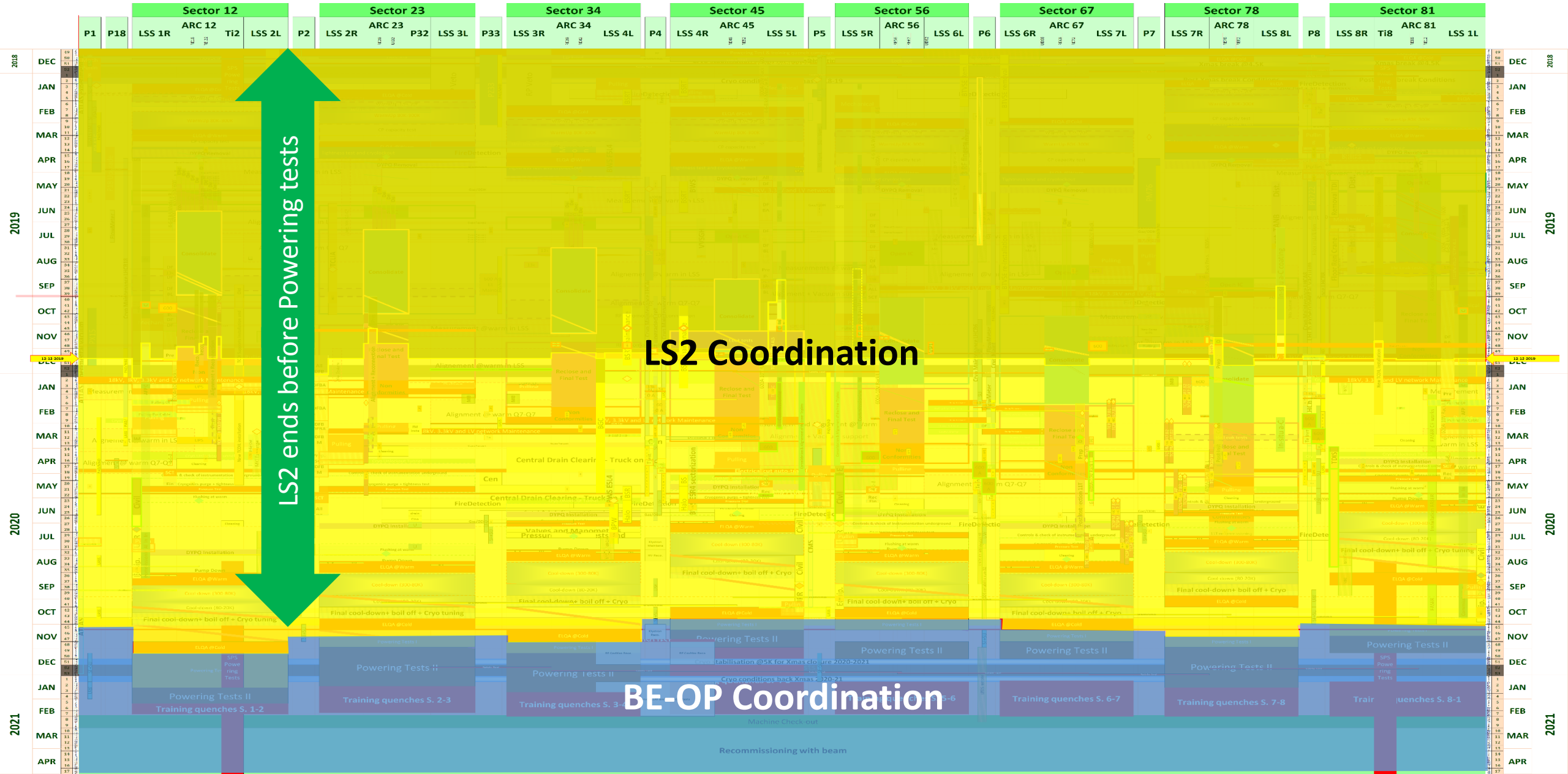
S3 failed the test, back to workshops Bldg.180/SMI2

S4 ready for test in SM18, wk10-11

Handover to RUN 3 and beyond (PSB case)



Handover to RUN 3 and beyond (LHC case)



Closing remarks

Excellent progress and follow-up

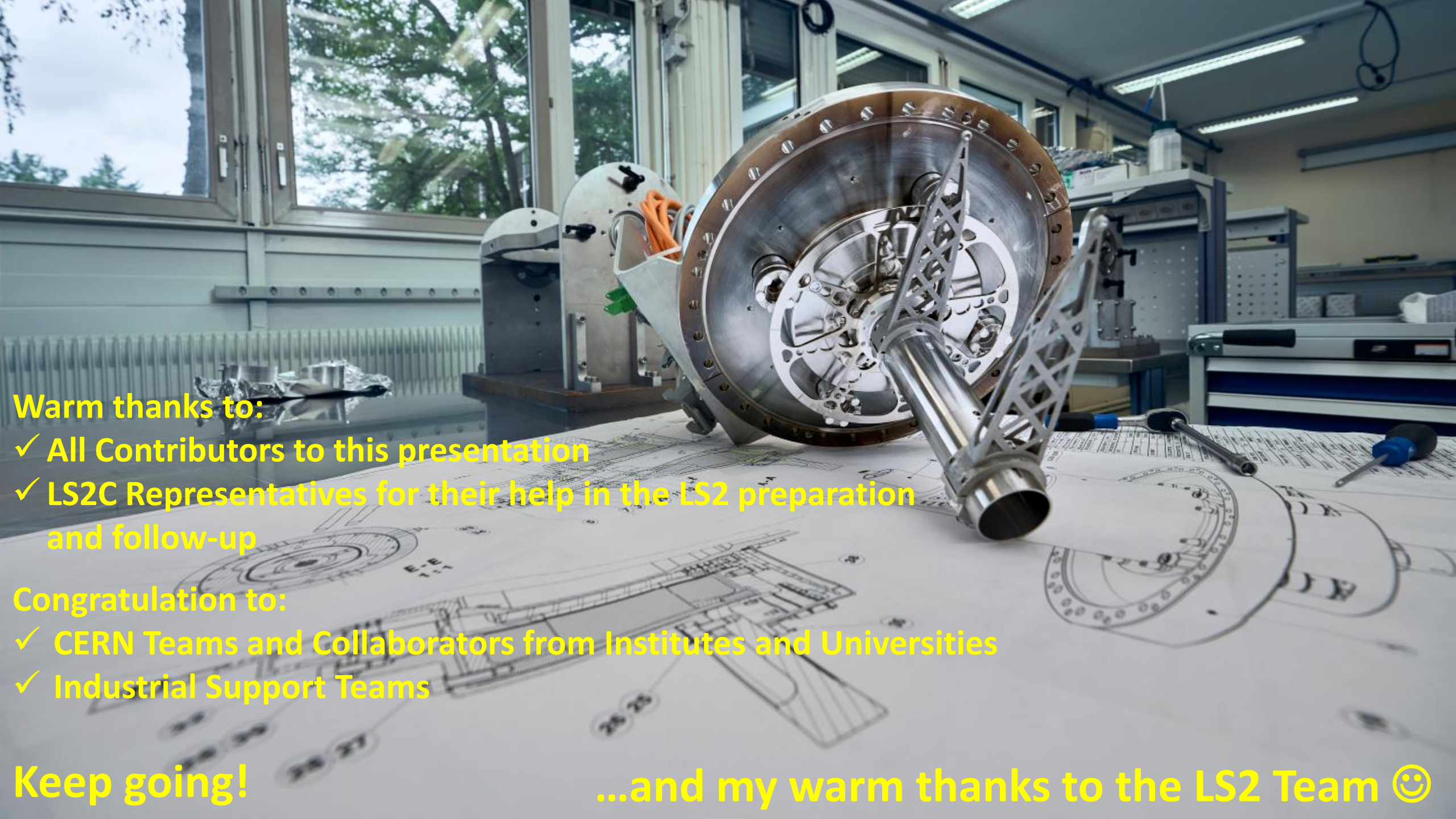
- ✓Changes in linear schedule to cope with minor delays / problems
- ✓Equipment readiness followed closely and so far no strong showstopper identified
- ✓"Safety First" remains LS2 priority and intensification of support / controls
- ✓Master resource-loaded schedules reviewed to version 2.5 by end of February 2020 with no date change for Hardware Commissioning (end of LS2)

QA and documentations just on time

- ✓3D integrations, differential layout drawings and ECRs available on time.

Daily follow-up towards a successful completion of LS2 activities

- ✓Intensive field coordination and safety follow-up (tunnel and surface)
- ✓Radiation dose to personnel perfectly handled, same for radioactive transports



Warm thanks to:

- ✓ All Contributors to this presentation
- ✓ LS2C Representatives for their help in the LS2 preparation and follow-up

Congratulation to:

- ✓ CERN Teams and Collaborators from Institutes and Universities
- ✓ Industrial Support Teams

Keep going!

…and my warm thanks to the LS2 Team ☺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