Status report on the accelerator complex
LS2 activities

Content

- Objectives, Baseline
- Injectors status
- LHC status
  - General status
  - DISMAC
  - HL-LHC
  - Others
- Conclusions

The 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**

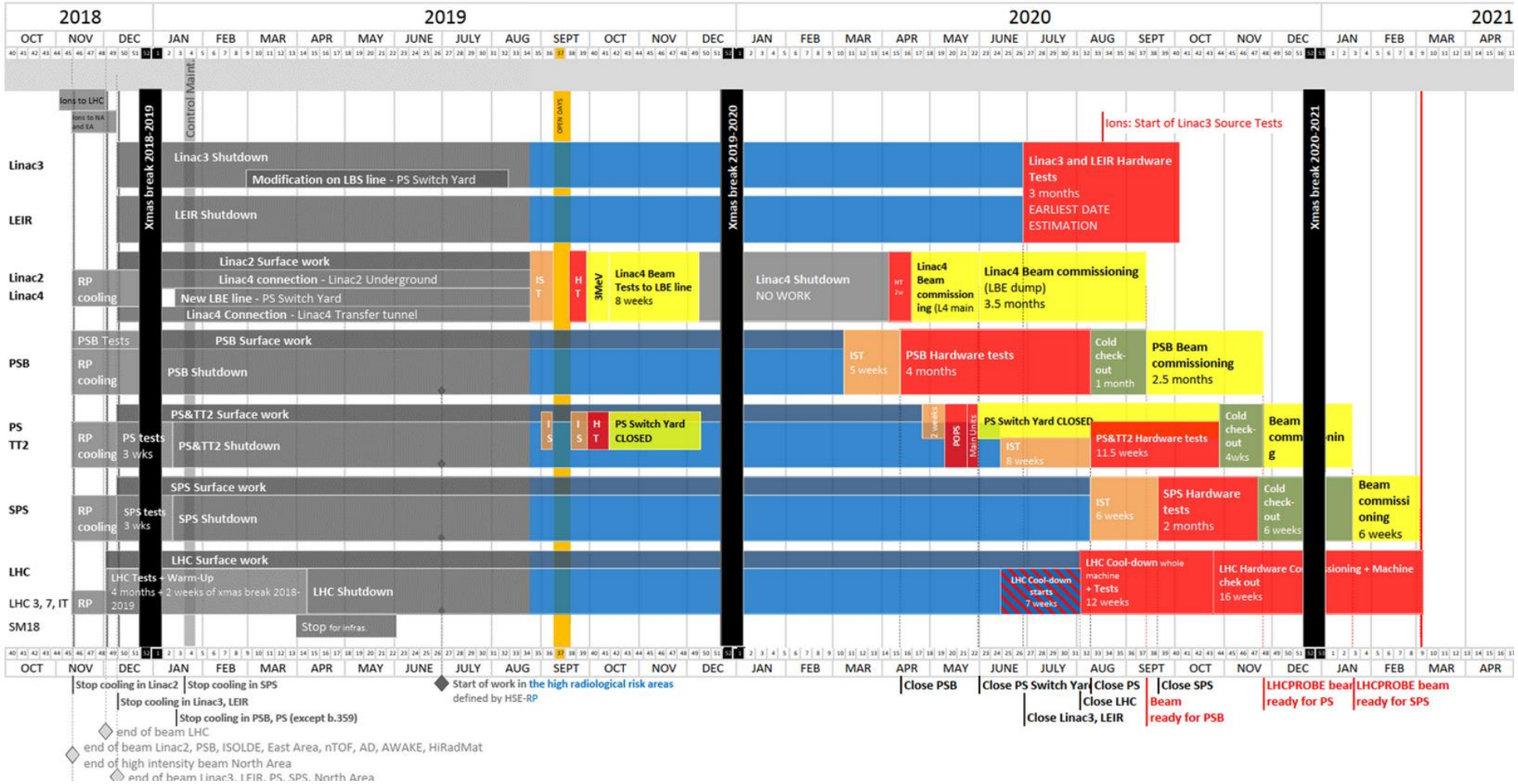
Anticipate **Civil Engineering** works and **beam equipment**

☞ **HL-LHC Project**

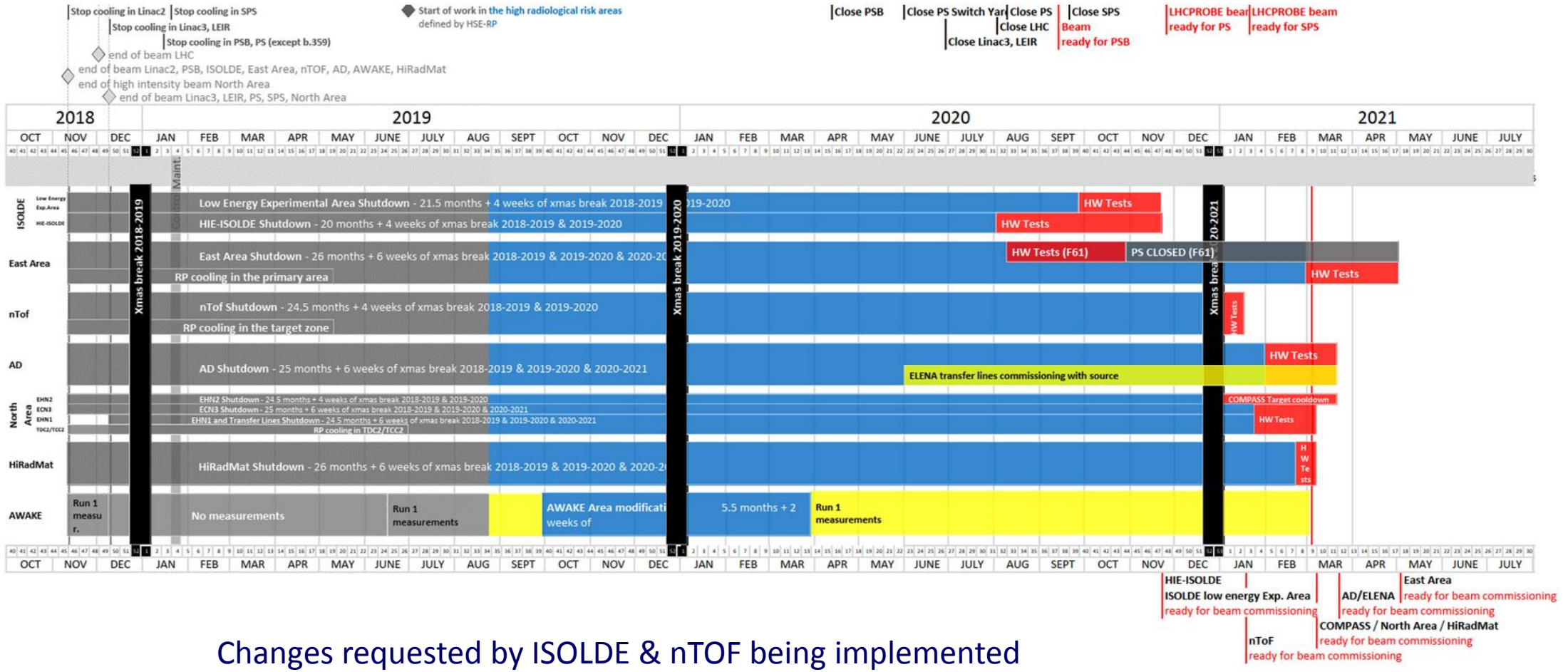
Perform major **Maintenance** & **Infrastructure** Consolidations

☞ **M&O activities**

Baseline


2018
2019
2020
2021
OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR APR
Ions to LHC
Ions to NA and EA
Control Maint.
Xmas break 2018-2019
OPEN DAYS
Xmas break 2019-2020
Xmas break 2020-2021
Ions: Start of Linac3 Source Tests
Linac3
Linac3 Shutdown
Modification on LBS line - PS Switch Yard
Linac3 and LEIR Hardware Tests 3 months EARLIEST DATE ESTIMATION
LEIR
LEIR Shutdown
Linac2
Linac4
RP cooling
Linac2 Surface work
Linac4 connection - Linac2 Underground
New LBE line - PS Switch Yard
Linac4 Connection - Linac4 Transfer tunnel
IST
HT
3MeV
Linac4 Beam Tests to LBE line 8 weeks
Linac4 Shutdown NO WORK
HT 2w
Linac4 Beam commissioning (L4 main
Linac4 Beam commissioning (LBE dump) 3.5 months
PSB
PSB Tests
RP cooling
PSB Surface work
PSB Shutdown
IST 5 weeks
PSB Hardware tests 4 months
Cold check-out 1 month
PSB Beam commissioning 2.5 months
PS
TT2
RP cooling
PS tests 3 wks
PS&TT2 Surface work
PS&TT2 Shutdown
IS
HT
PS Switch Yard CLOSED
2 weeks
POPS
Main Units
PS Switch Yard CLOSED
IST 8 weeks
PS&TT2 Hardware tests 11.5 weeks
Cold check-out 4wks
Beam comm g
nin
SPS
RP cooling
SPS tests 3 wks
SPS Surface work
SPS Shutdown
IST 6 weeks
SPS Hardware tests 2 months
Cold check-out 6 weeks
Beam commissioning 6 weeks
LHC
LHC 3, 7, IT
RP
SM18
LHC Surface work
LHC Tests + Warm-Up 4 months + 2 weeks of xmas break 2018-2019
LHC Shutdown
Stop for infras.
LHC Cool-down starts 7 weeks
LHC Cool-down whole machine + Tests 12 weeks
LHC Hardware Co chek out 16 weeks
sioning + Machine
Stop cooling in Linac2
Stop cooling in SPS
Stop cooling in Linac3, LEIR
Stop cooling in PSB, PS (except b.359)
Start of work in the high radiological risk areas defined by HSE-RP
end of beam LHC
end of beam Linac2, PSB, ISOLDE, East Area, nTOF, AD, AWAKE, HiRadMat
end of high intensity beam North Area
end of beam Linac3, LEIR, PS, SPS, North Area
Close PSB
Close PS Switch Yar
Close PS
Close LHC
Close Linac3, LEIR
Close SPS
Beam ready for PSB
LHCPROBE bear ready for PS
LHCPROBE beam ready for SPS

Baseline



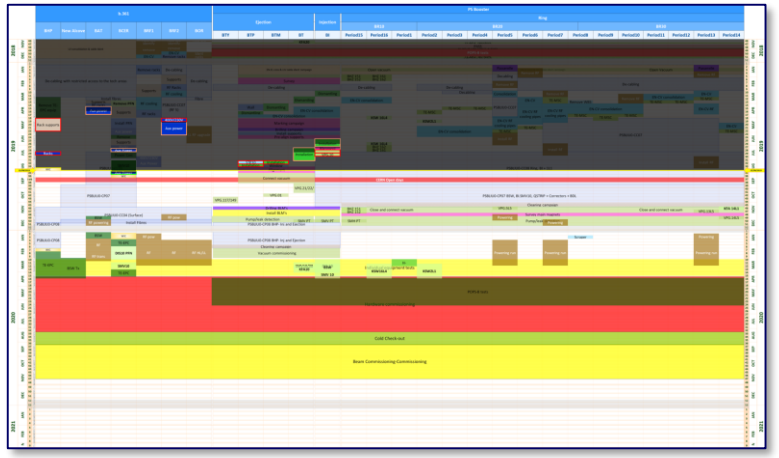
Changes requested by ISOLDE & nTOF being implemented

Injector status

Linac4

- Connection is completed
- Individual System tests and Hardware commissioning started
- Survey smoothing: 3 weeks in September
- Low Energy Beam tests planned in October, followed by beam test until end of 2019


L4 connection completed



PS Booster

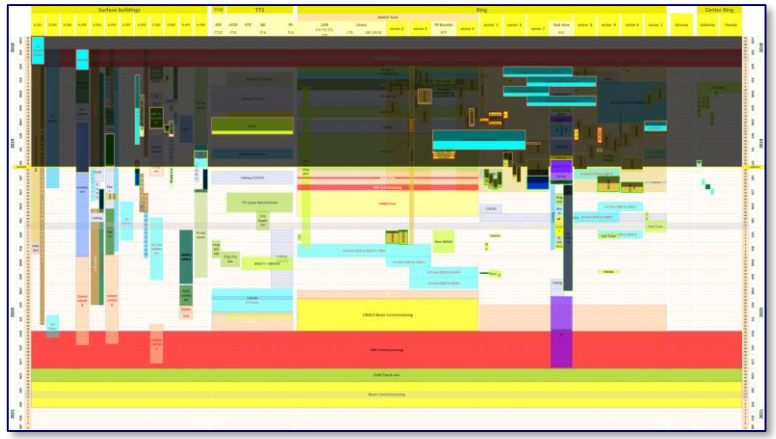
- New injection region installed
- New finemet cavities installed
- Transfer lines installation in progress
- Infrastructure consolidation and upgrade in progress


New injection region


New Finemet cavities


BTV10

Injector status

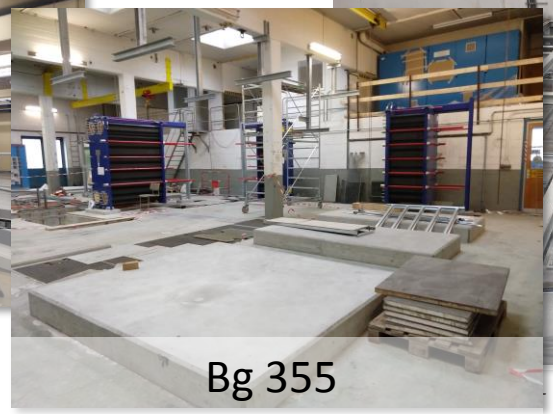


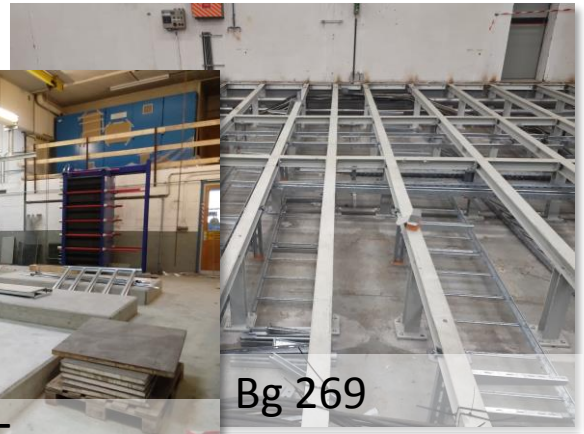
PS

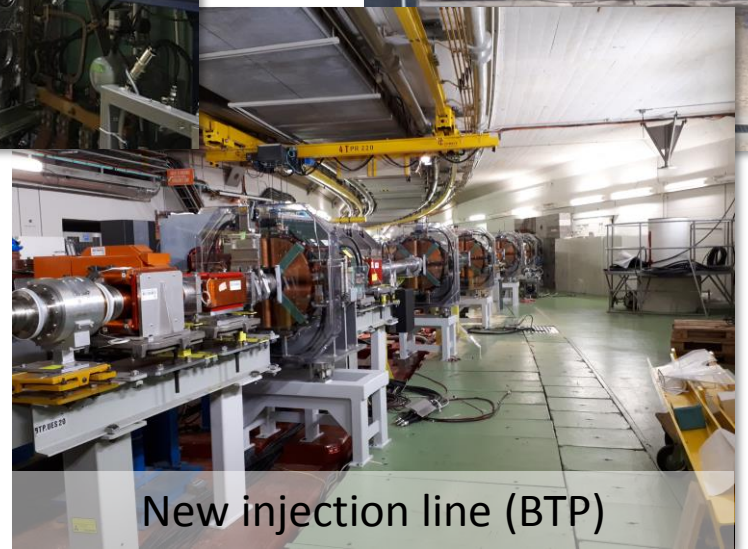
- Infrastructure consolidation and upgrade in progress
- Main units consolidation well advanced (34/43)
- Most of the straight sections have been re-installed
- New injection line installed and successfully leak tested

Surface works (all CPS)

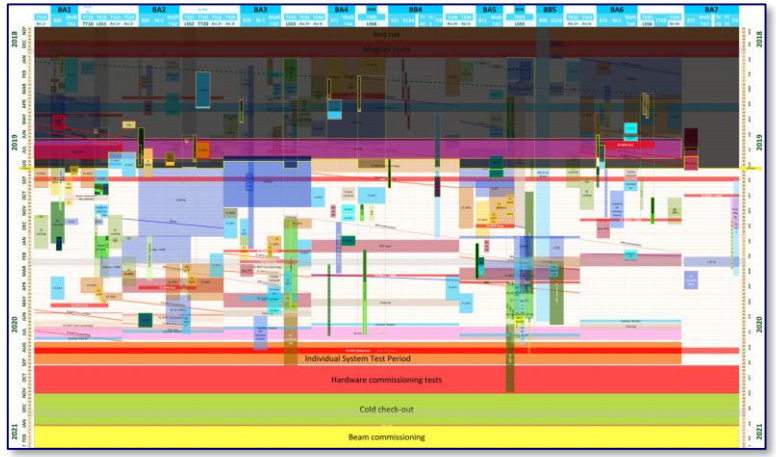
Refurbishments of surface buildings to host new power converters and RF systems … Hard work… very good progress







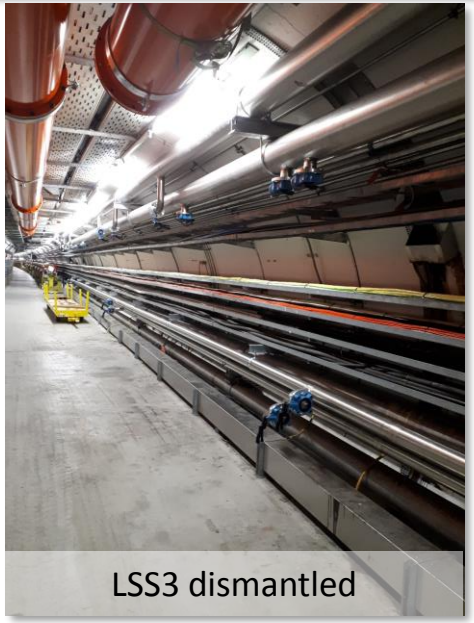
Injector status




SPS fire project

SPS

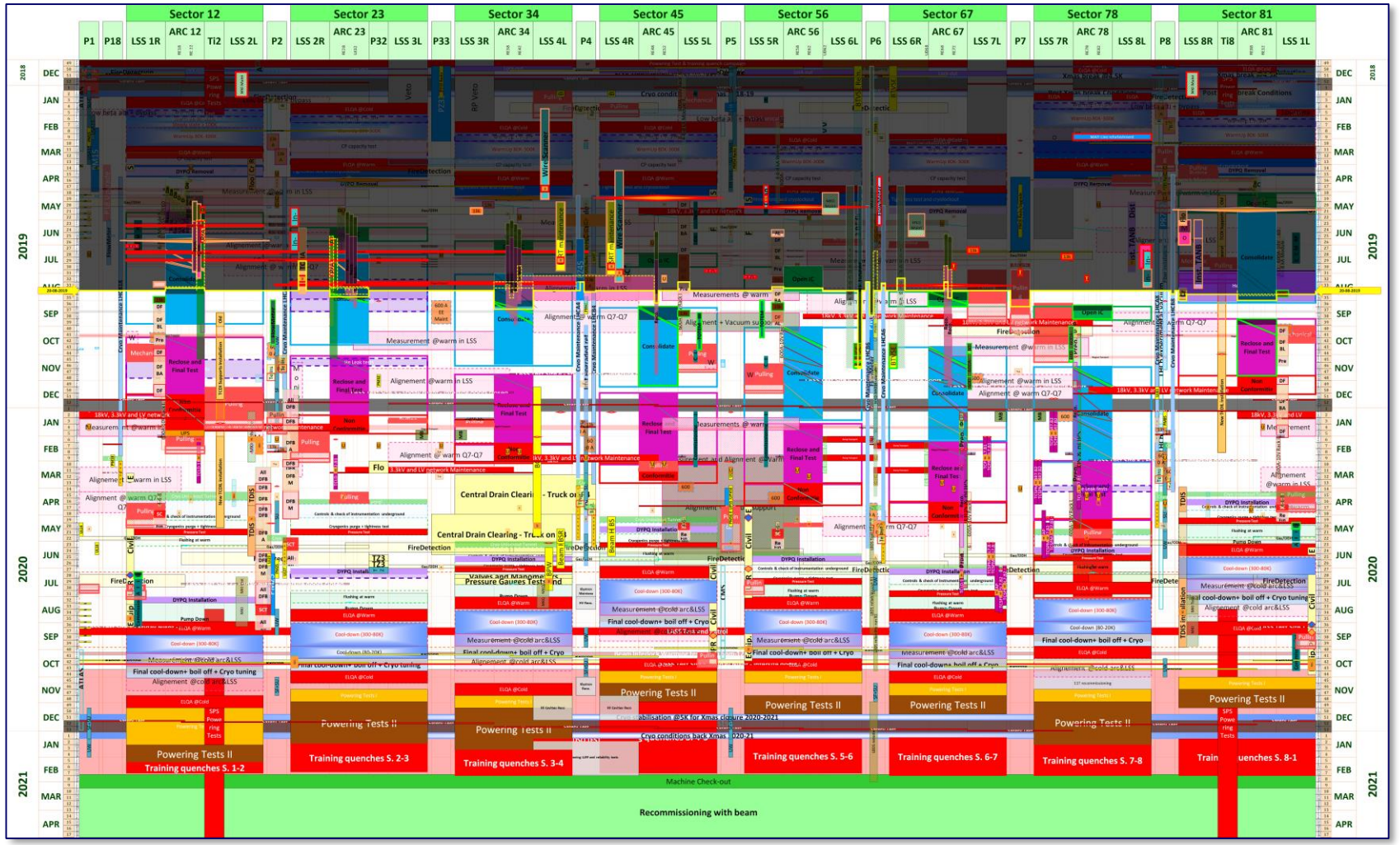
- Infrastructure consolidation and upgrade in progress
- LSS1 (ex dump region) dismantled
- LSS3: all RF systems dismantled
- LSS5 (new dump region):
  - Civil engineering work in progress
  - New beam dump installation being tested on surface on a mock-up
- Fire Safety & new access system in progress


LSS3 dismantled

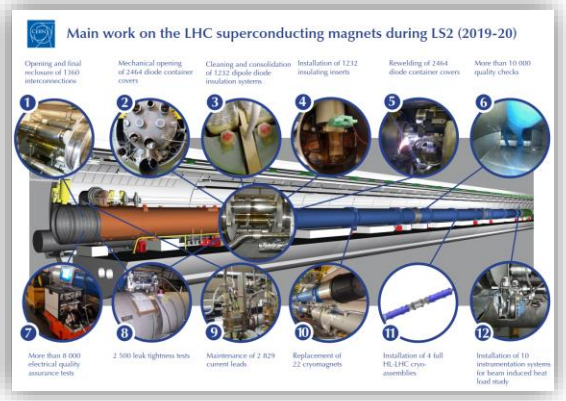

New dump shielding mock-up assembly in BB5


Cutting of the vault in ECX5

LHC status

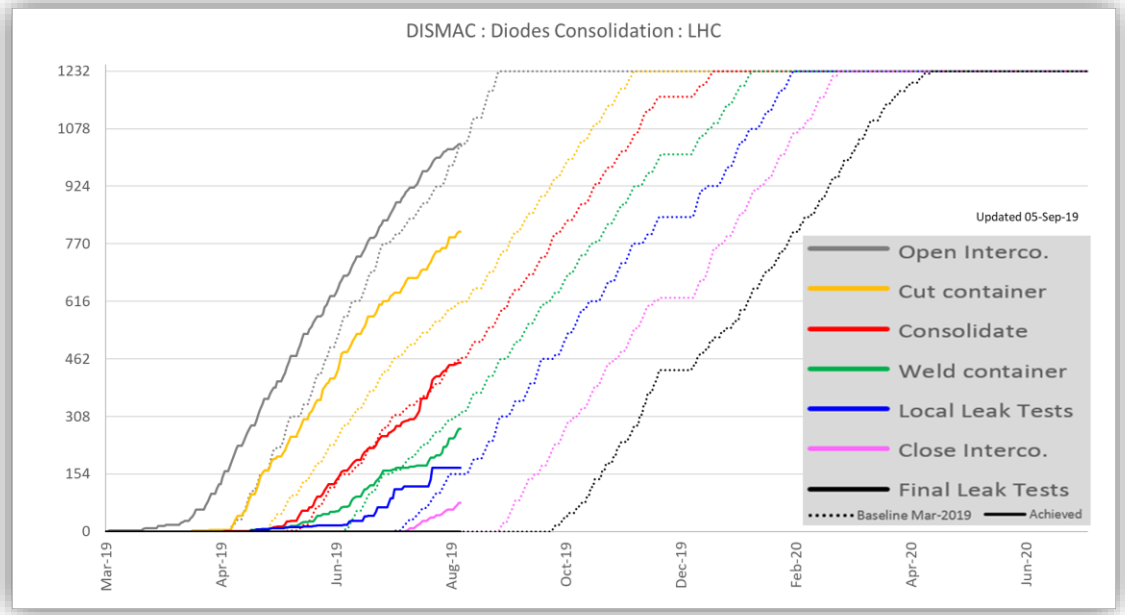

Sector 12
Sector 23
Sector 34
Sector 45
Sector 56
Sector 67
Sector 78
Sector 81
P1
P18
LSS 1R
ARC 12
TI2
LSS 2L
P2
LSS 2R
ARC 23
P32
LSS 3L
P33
LSS 3R
ARC 34
LSS 4L
P4
LSS 4R
ARC 45
LSS 5L
P5
LSS 5R
ARC 56
LSS 6L
P6
LSS 6R
ARC 67
LSS 7L
P7
LSS 7R
ARC 78
LSS 8L
P8
LSS 8R
TI8
ARC 81
LSS 1L
2018
2019
2020
2021
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
Powering Tests II
Training quenches S. 1-2
Training quenches S. 2-3
Training quenches S. 3-4
Training quenches S. 5-6
Training quenches S. 6-7
Training quenches S. 7-8
Machine Check-out
Recommissioning with beam

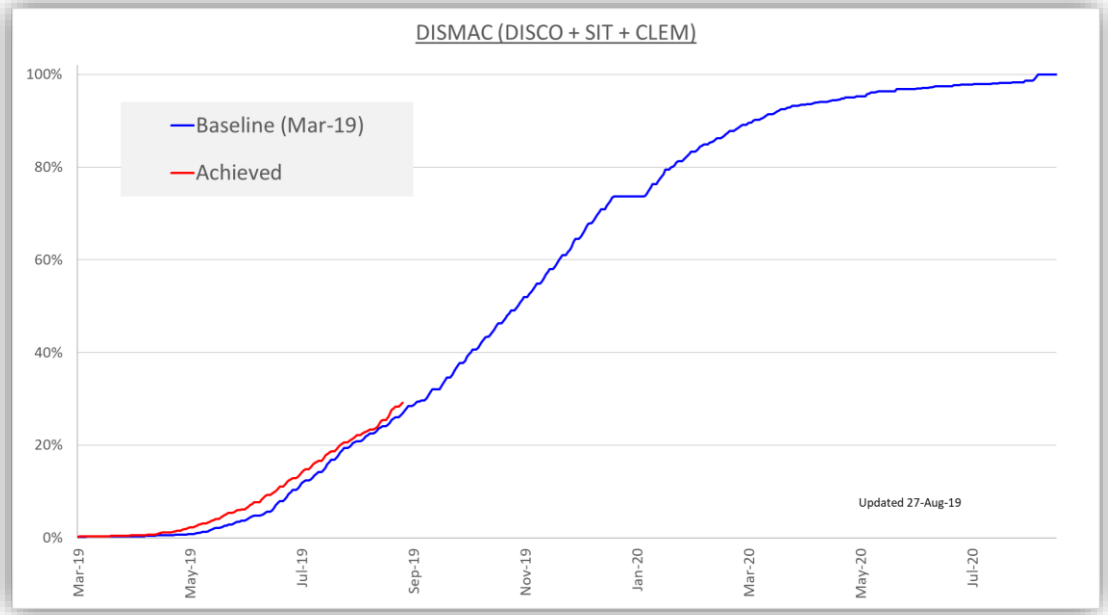
DISMAC general status



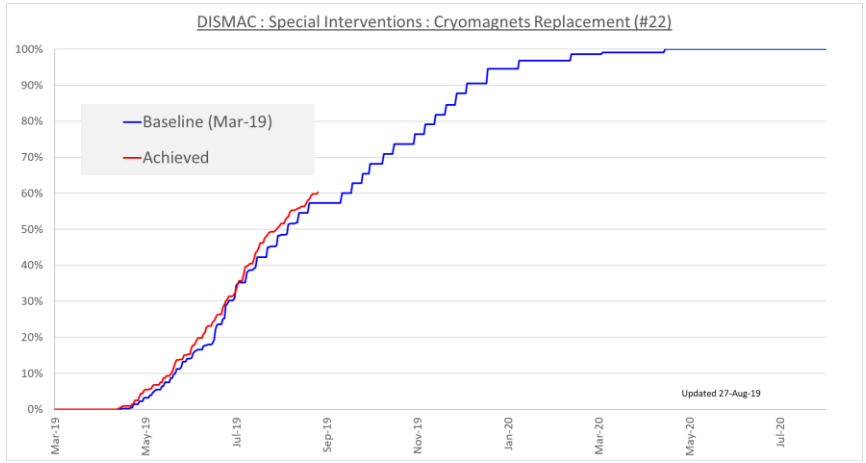
Global progress

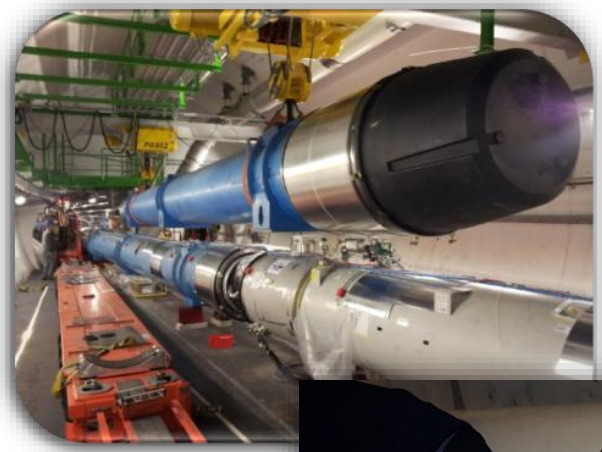
- 30% achieved vs 29% planned
  - 1000th IC has been opened on 23.08.2019
- 1 week ahead of schedule

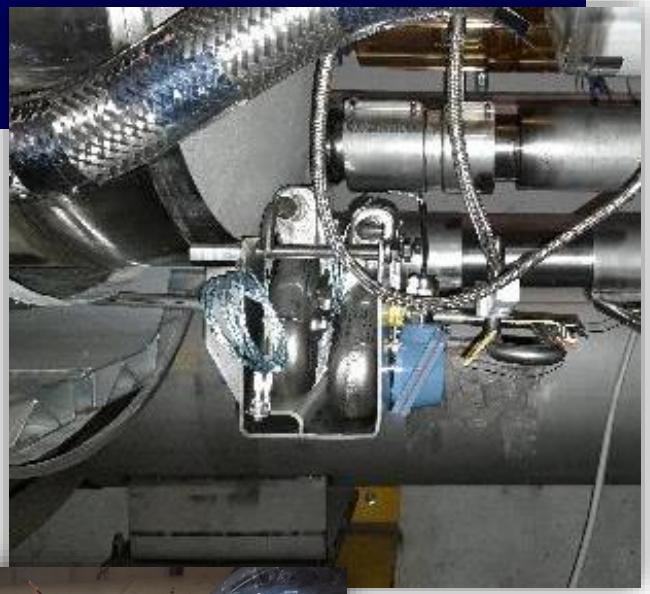


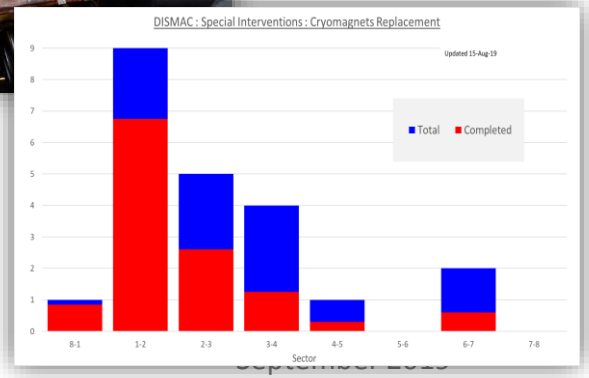


Cryomagnets replacement







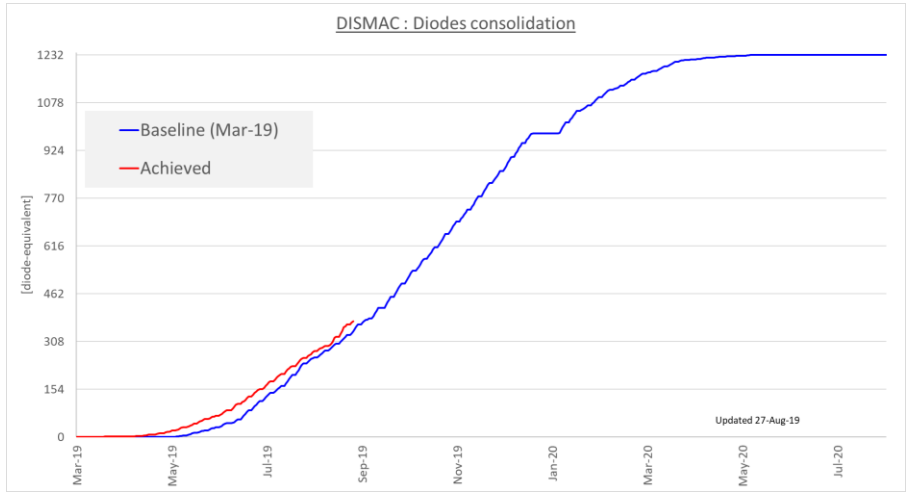


19 cryodipoles & 3 SSS

- All cryomagnets (not including HL WP11 assemblies nor 16L2) have been disconnected, removed and reinstalled;
- The reconnection of the first cryodipole in S81 (A26R8) is completed except the leak tests that are being performed. The others magnets reinstalled are being reconnected.

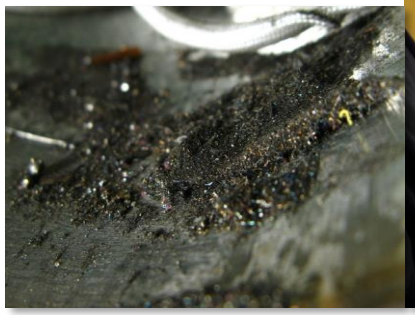
16L2, CC@P2: will be transported after the open days

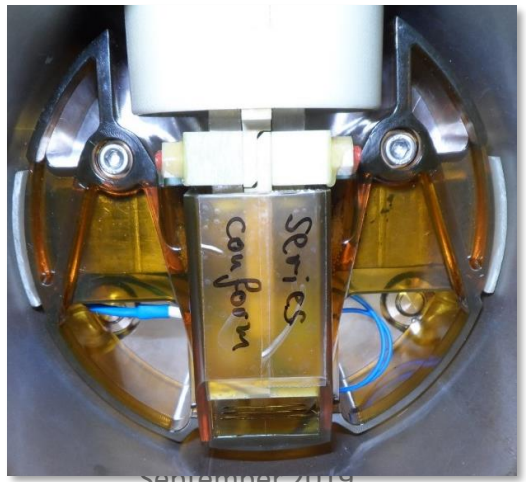
Diodes consolidation



- 1st diode consolidated on 3.05.2019 (about 1 month ahead of schedule)

- Cleaning is complete in ~4 sectors
- The insulation plates and the inserts are installed in 3 sectors





Diodes consolidation & DISMAC QA review

REVIEWS : MANDATE OF THIS REVIEW

Quality Assurance Review

- To assess if the encountered situation corresponds to the expectations and assumptions used during the preparation of the project
- To assess if the implementation corresponds to the plan, especially in terms of Safety, Quality and Schedule
- To review the applied strategies and assess their possible update for the continuation of the project, especially for the following topics:
  - Existing non-conforming welds on the diode containers
  - Thresholds applied during the ElQA tests
  - Local leak test strategy
  - Any additional finding of initial consolidation and inspection that may have relevance to scope, QA and schedule

DISMAC QA Review
Introduction
ck (TE-MSC)
5/21

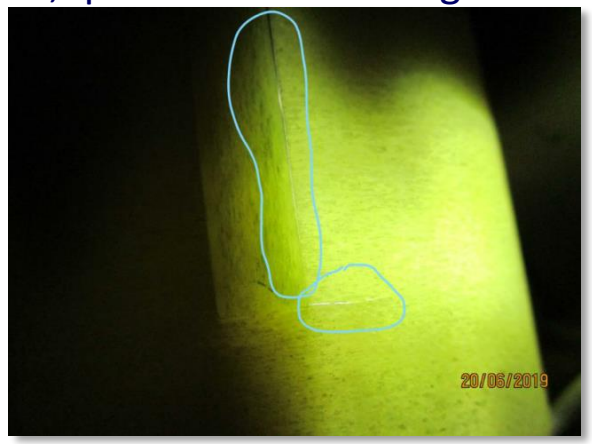
- The tube was repaired with Araldite 2012 epoxy which was applied in the areas shown in the picture.
- Kapton tape was used to secure the parts during curing of the epoxy and removed after curing.
- The repaired pieces where subjected to several thermal cycles in liquid nitrogen.
- After the thermal cycles no visual degradation could be seen on the repaired insulation tube.

Insulation tube broken and tube separated from inner wall.

Insulation tube after curing of epoxy.

New issues not expected during the preparation:

- Quality of existing welds
  - Perform further detailed analysis only in case of major NCs or if NCs are different from what has been analysed so far
  - Perform pressure test with higher Safety factor on 2 diode containers with similar major NCs
- Cracks / break of some half-moon electrical insulation tubes.
  - Confirmation of use of two materials for these insulation tubes
  - Cracks have been seen at the opening, but no tube was so far found broken at opening of the diodes containers
  - On-going actions:
    - Extensive inventory of all the accessible cases
    - The repair solution has been studied, qualified and is being applied
    - Systematic reinforcement of all low-Q ones (in-situ method)
- **No Impact on global schedule**

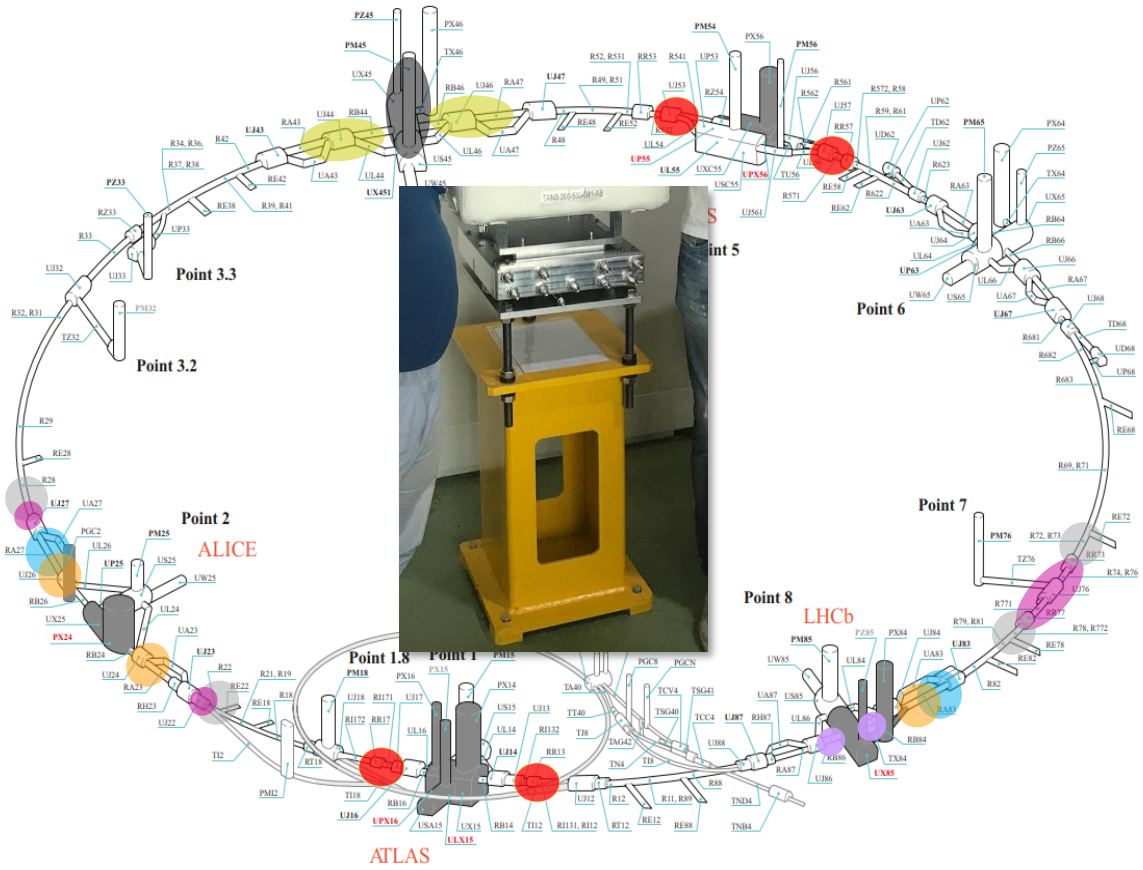


DISMAC…next steps

- DISMAC status
  - ☺ No (major) personel accident so far
  - ☺ Globally, about one week ahead of schedule
  - 😐 Many non-conformities are encountered, mainly pre-existing ones ; their management is efficient and implies frequent procedures optimisations, definition of new procedures and interventions by experts
  - ☺ Some activities are ahead of schedule [Opening, cutting,…]
  - 😐 The critical activity is the diode insulation consolidation
  - ☺ Confident that the global schedule can be respected
  - 😐 Impact of the insulation tubes reinforcement will be small thanks to a sound solution developed swiftly

- Next milestones
  - End -2019 : All cryoassemblies (but Q16/C16L2 and WP11 cryoassemblies) will be reconnected for December 2019
1st sector completed
  - May 2020 : Last standard interconnection reclosed
First pressure test (sector 81)
  - Q3-2020 : Last NC solved
  - End 2020 : Formal end of the project
End of collaboration contracts, budget closure

HL-LHC



1st HL-LHC instrument in ! ☺

WP5 - Collimation
- 8 Target Secondary Collimators TCSPM in LSS7
- 2 Dispersion Suppressor Collimators TCLD in LSS7 (11T)
- 2 Dispersion Suppressor Collimators TCLD LSS2 (CC)

WP8 - Collider & Experiment Interface :TANB both sides LSS8

WP9 - Cryogenics
- Cryogenics upgrade of refrigerator
- Installation of general infrastructure for the mobile refrigerator & compressor at P4

WP11 – 11T DS Dipole
- 11T in A9R7 & A9L7
- CC in C11R2 & C11L2

WP12 – Beam Vacuum: In-situ aC-coating Q5-Q6 at P2 & P8

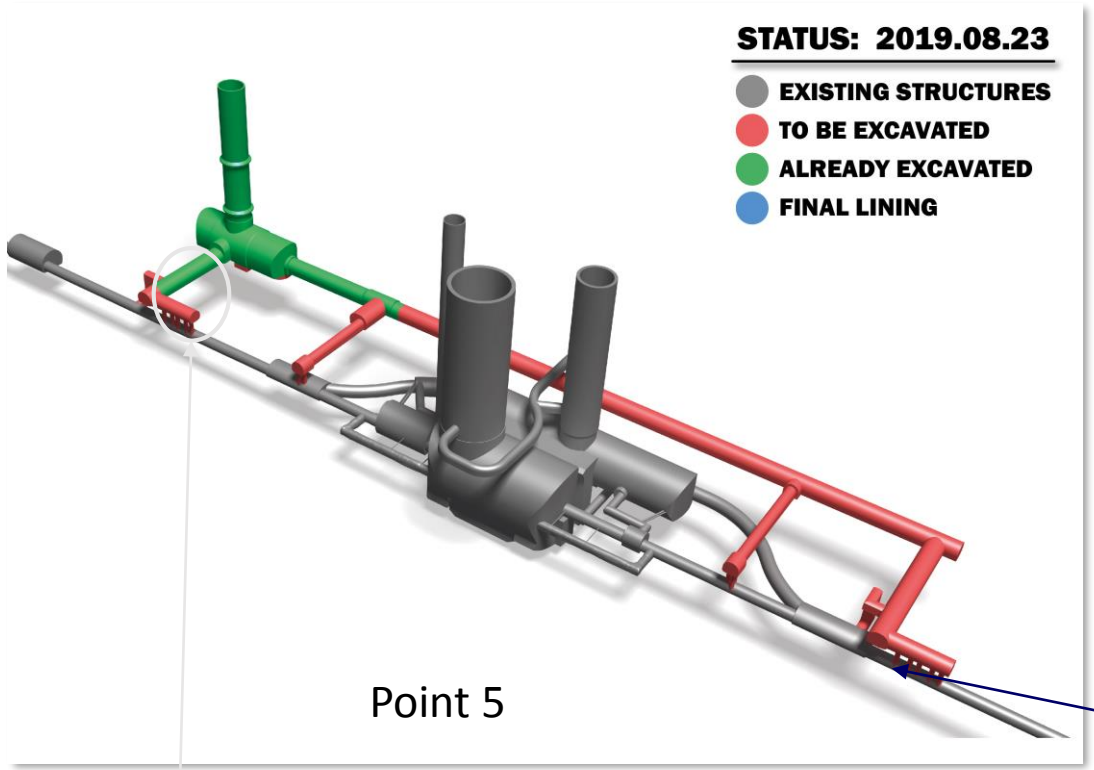
WP13 – Beam Diagnostics
- New Wide-Band transverse pick-up BPW prototype at LSS4L
- Beam Gas Curtain BGC prototype at LSS4L
- BSRT (adding halo cleaning) at LSS4L/R

WP14 – Beam Transfer & Kickers
- Injection Dump TDIS at P2L & P8R
- Cooled MKI at P2
- Displacement of TCLIA in LSS2R (C4R2)

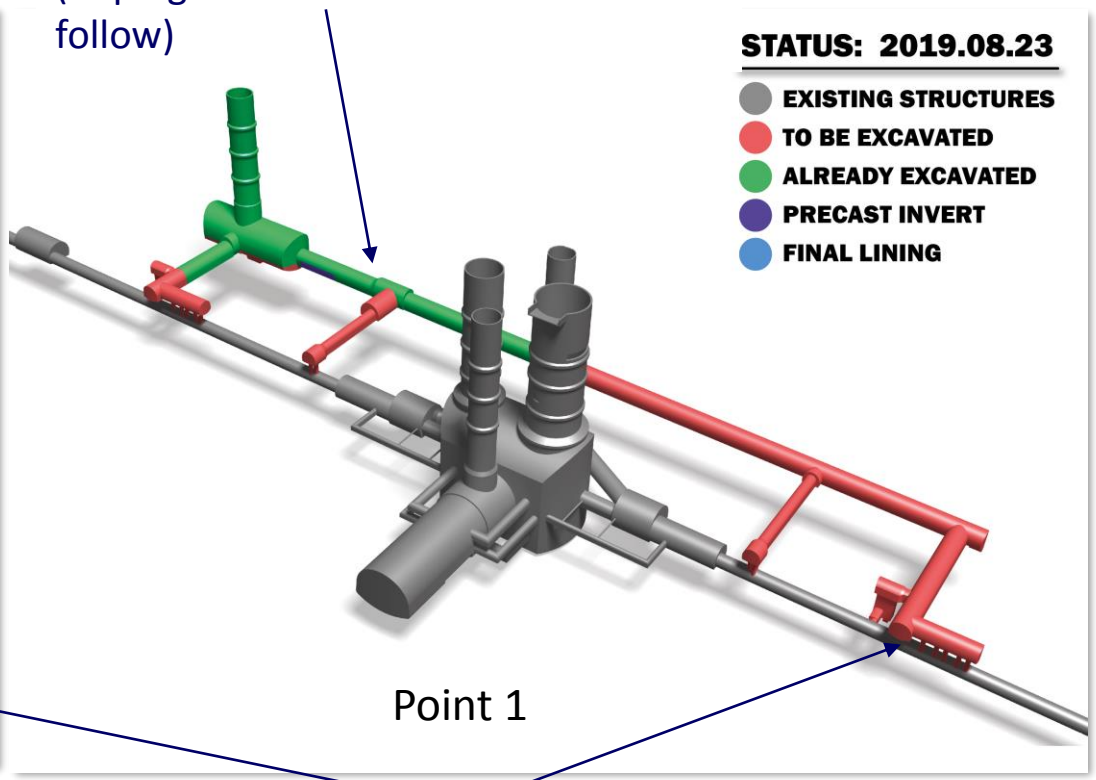
WP17 - Infrastructure Logistics and Civil Engineering
- UPR connections at P1 & P5

HL-LHC: Civil engineering works

UR15 excavation rate lower than expected ⇨ Margin reduction from 80 to 5 days for the delivery of the UPR (hoping than softer molasses will follow)



Point 5

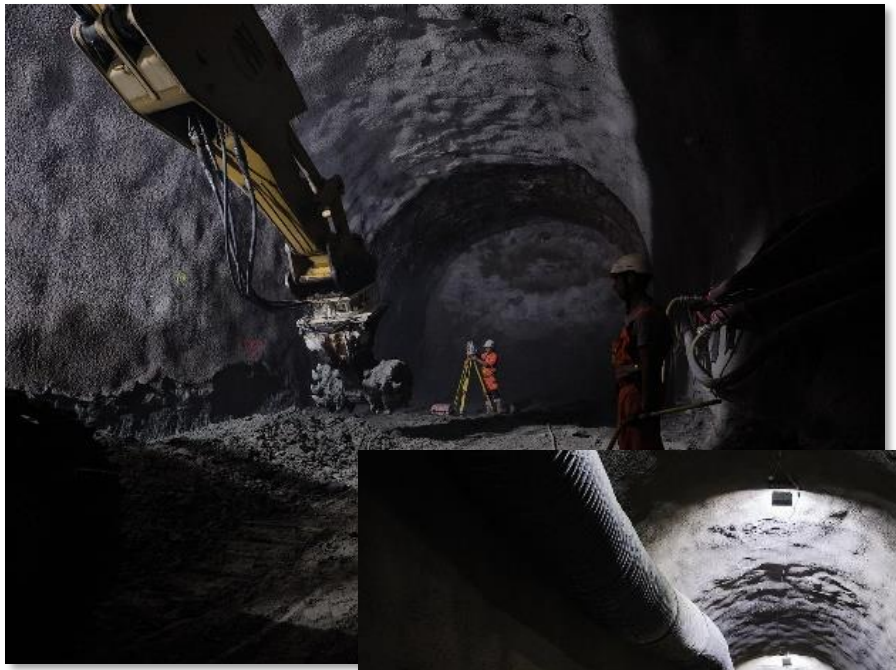


Point 1

Request for early opening of this UPR (discussion on-going with the LS2 coordination)

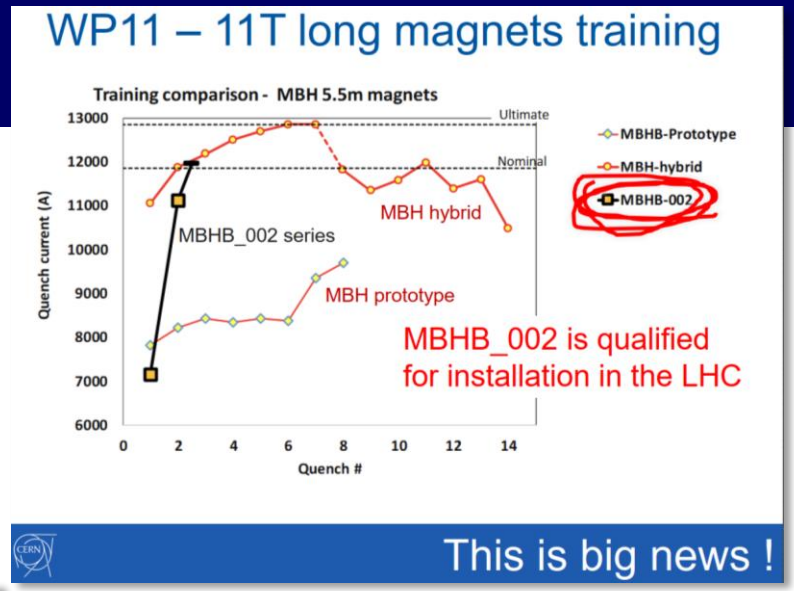
Delivery of the UPRs on the LS2 critical path
(Plan B: missing UPR opening during the YETS'21-22 without impacts on technical infrastructure installation and on the YETS duration)

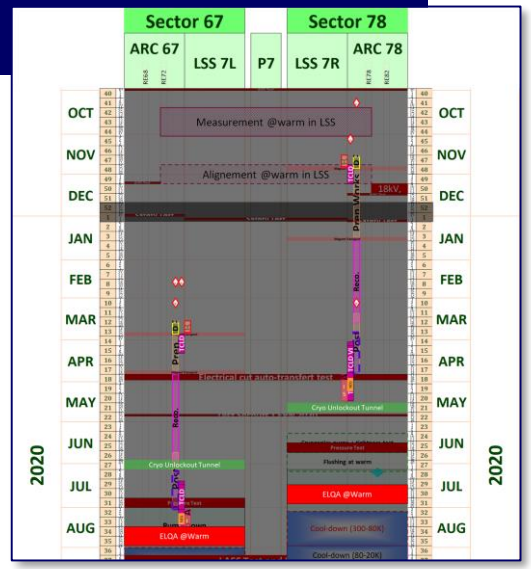
HL-LHC: Civil engineering works



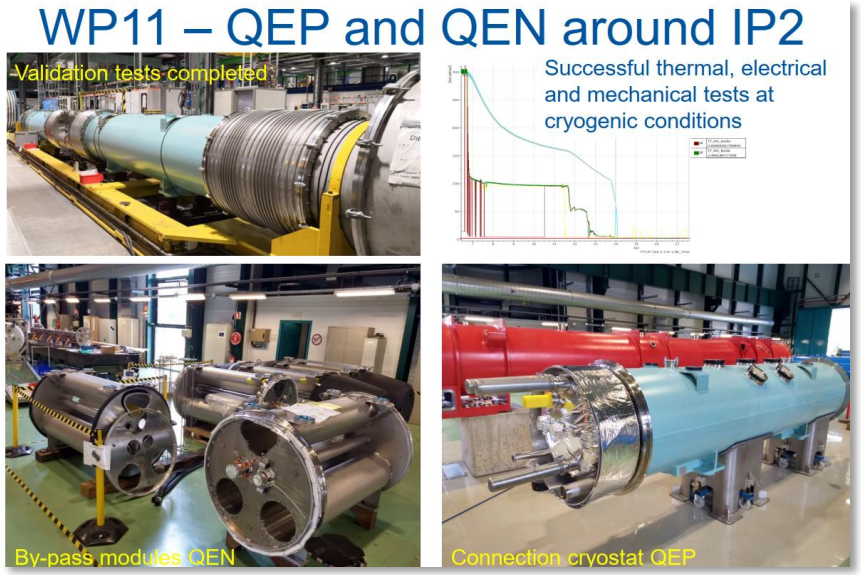
HL-LHC

- 11T tests succesful
  - No impact on end date





- QEP & QEN around IP2



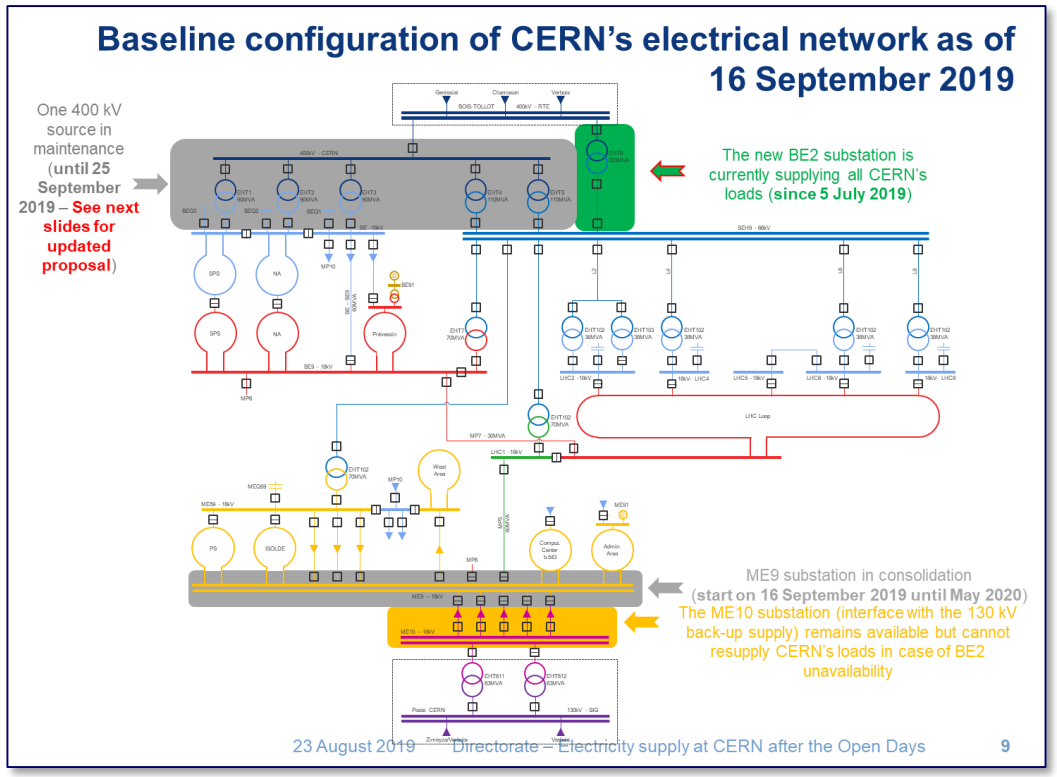
- New TDIS prototype almost ready

EL maintenance

Maintenance NO ACCESS*		AUG NO ACCESS*	
Point	**Day**	**Point**	**Day**
LHC1 + ATLAS	6 -10 January 2020 (W2)	LHC1 + ATLAS	13 January 2020 (W3)
LHC18 + SM18	23-25 April 2019 (W17)	LHC18 + SM18	26 April 2019 (W17) 11 February 2020 (W7)
LHC2 + ALICE	11-14 June 2019 (W24) – Access OK 20-24 January 2020 (W4)	LHC2 + ALICE	27 January 2020 (W5)
LHC3 + PM32	9-12 March 2020 (W11)	LHC3 + PM32	~~30 April 2019 (W18)~~ 13 March 2020 (W11)
LHC4	17-20 June 2019 (W25) – Access OK 24-28 February 2020 (W3)	LHC4	~~7 Oct. 2019 (W41)~~ 2 March 2020 (W10)
LHC5 + CMS	20-24 May 2019 (W21) 24-27 June 2019 (W26) – Access OK	LHC5 + CMS	~~27 May 2019 (W22)~~ **TO BE RESCHEDULED** 5 May 2020 (W19)
LHC6	3-6 June 2019 (W23) TBC – Access OK 17-19 Sept. 2019 (W38)	LHC6	20 Sept. 2019 (W38)
LHC7	23-27 Sept. 2019 (W39)	LHC7	30 Sept. 2019 (W40)
LHC8	15-19 April 2019 (W16) – Access OK 9-13 Dec. 2019 (W50)	LHC8	16 Dec. 2019 (W51)
TEST SECOURS (10min)	All points on 19th December (6am – 6:10am) (W51)	Prevessin	4 April 2020 (W14)
		Meyrin + Adm.	**4th January 2019 (W1)**
400 kV Test → Thu 20 Dec 2018 from 8am to 11am		Auto-transfert	27-29 April 2020
400 kV maintenance → ~~22 July – 27 Sept 2019 (W30-39)~~ → 4 July – 27 Sept 2019 (W27-39) → Under discussion 4 July- 4 October (W27-40)		66 kV maintenance (reduced consumption 15MVA LHC, 90 MVA CERN) → ~~28 Mai – 19 July 2019 (W22-29)~~ → 28 June– 4 July 2019 (W26-27)	

* NO ACCESS in SURFACE and UNDERGROUNG (Guardian at the point entrance)

Electricity supply at CERN after the Open Days



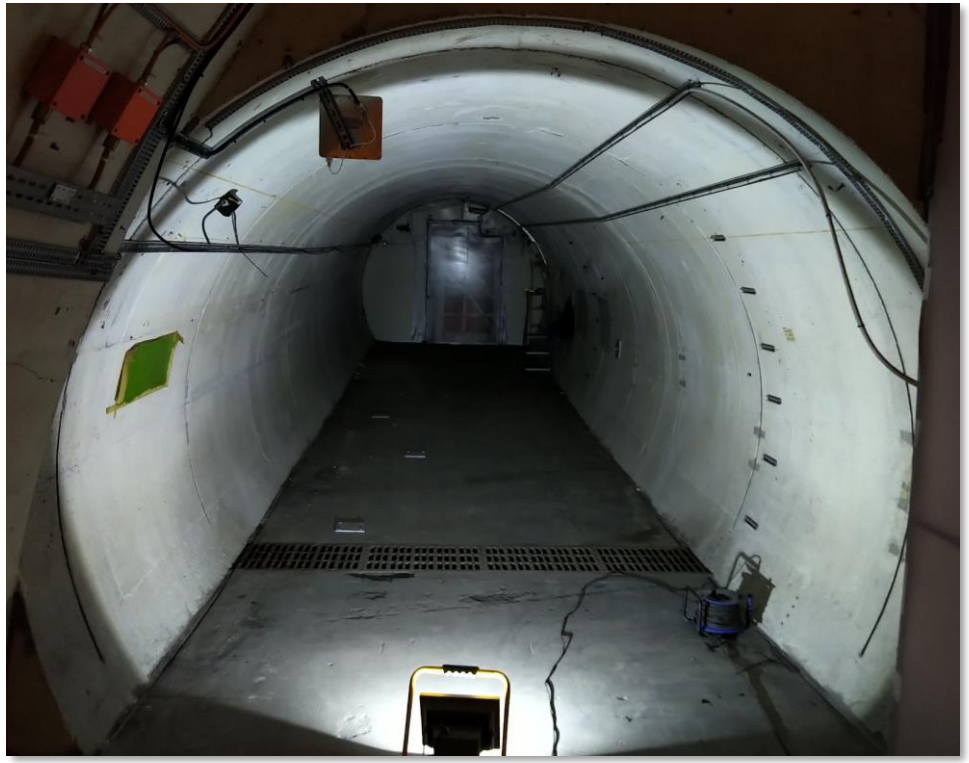
- From **16 September 2019 to May 2020**:
  - **No auto-transfer available** (i.e. automatic reconfiguration of the electrical network in case of a voltage failure on the general services networks) until completion of the ME9 substation consolidation

- Meyrin's administrative loop will be manually re-supplied through a dedicated cable from ME10 in case of long power loss (thus by-passing the ME9 substation)
  - Resupply time: **30 minutes during normal working hours / 2 hours outside normal working hours**

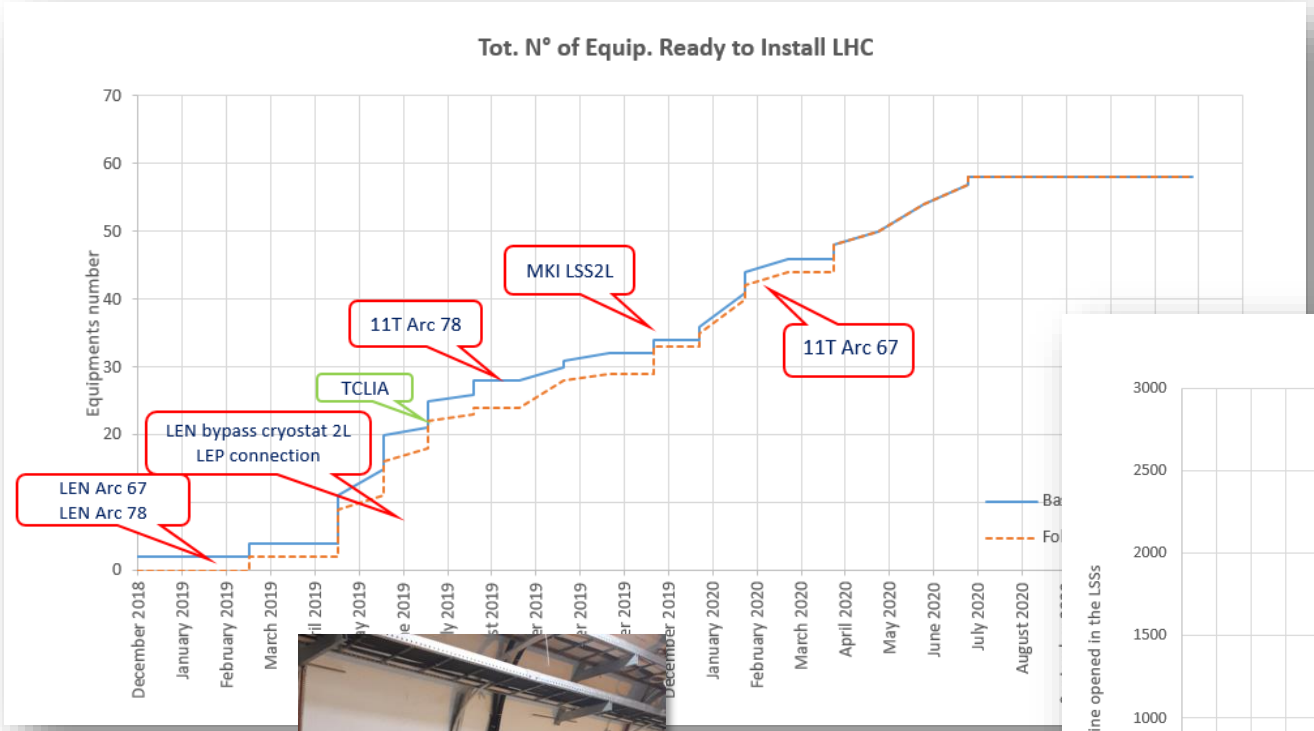
- High voltage specialists (EN-EL and Contractors) will be fully available during the period with a single source to minimize downtime
  - Re-powering the BE2 substation in case of failure expected **within 2 hours in <u>most</u> cases**

FASER

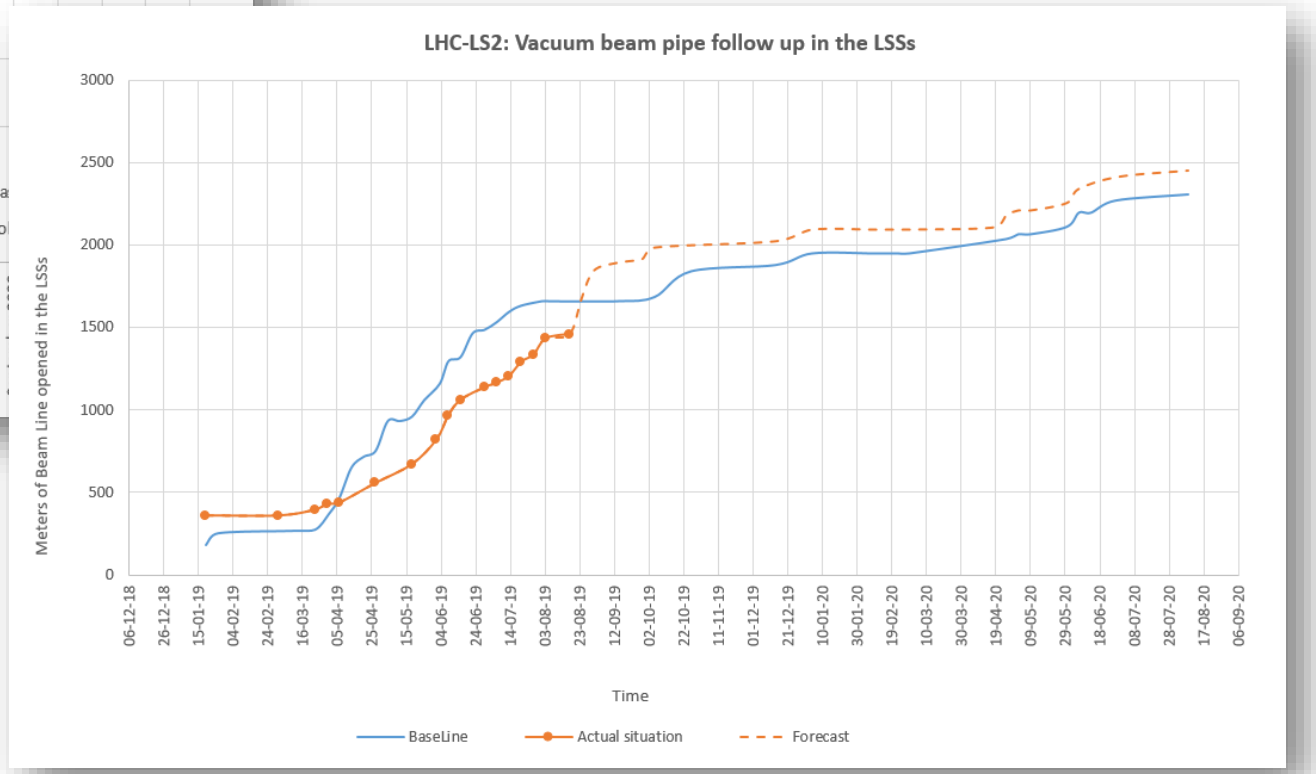
- Cores drilling completed
- Dismantling activities completed
- Crane installation in progress
- Civil engineering Jan.- Feb 2020



Equipment readiness and beam vacuum SS



LSS5: Survey Q12L-Q12R

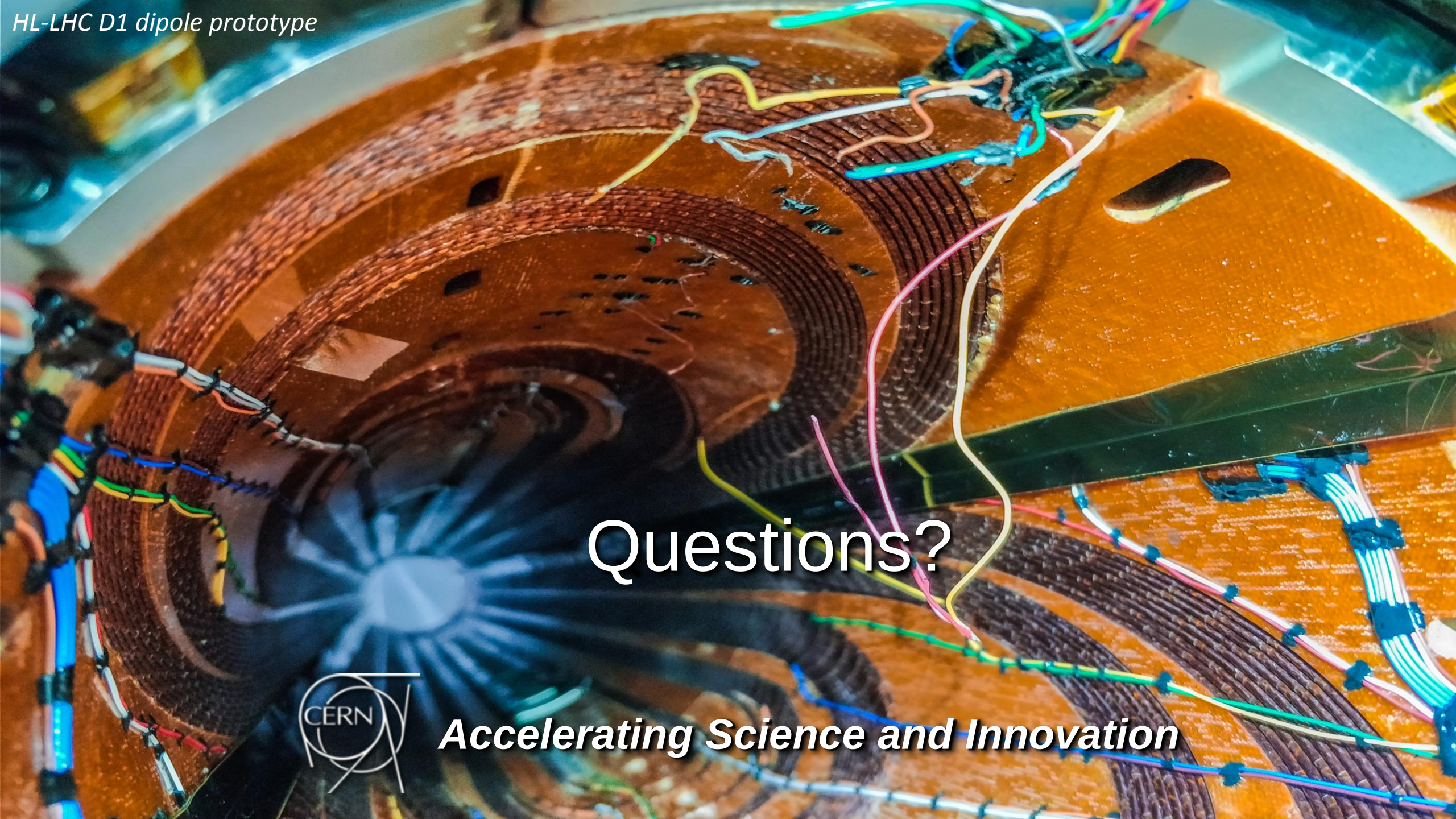


TCLIA installation

Conclusions

- As a general fact, no major blocking point
  - New version of Master Schedule to cope with changes in n-ToF and ISOLDE to be approved by RB 18th September. Others stay **UNCHANGED**!
    - New versions of the Linear schedules to be released simultaneously to show reorganisations of activities
    - New broken lines to be presented on LS2C on 20th September
  - Injectors will be ready for start their commissioning by beginning of next year as scheduled with access restrictions to be expected.
  - LHC follows the master schedule
    - Maintenance activities proceeding smoothly
    - DISMAC on schedule, despite the new non conformities discovered
    - HL-LHC: 1st instrument in, request to anticipate the CE breakthrough of UPR57 (under evaluation)

- **So far, so good ☺**


HL-LHC D1 dipole prototype
Questions?
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