

Status report on the accelerator complex

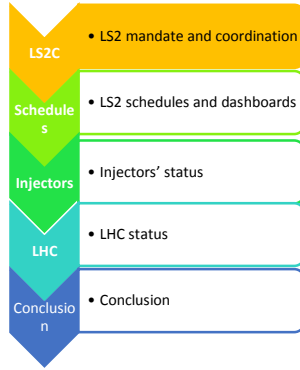
LS2 activities



The LS2 Committee & Coordination meetings

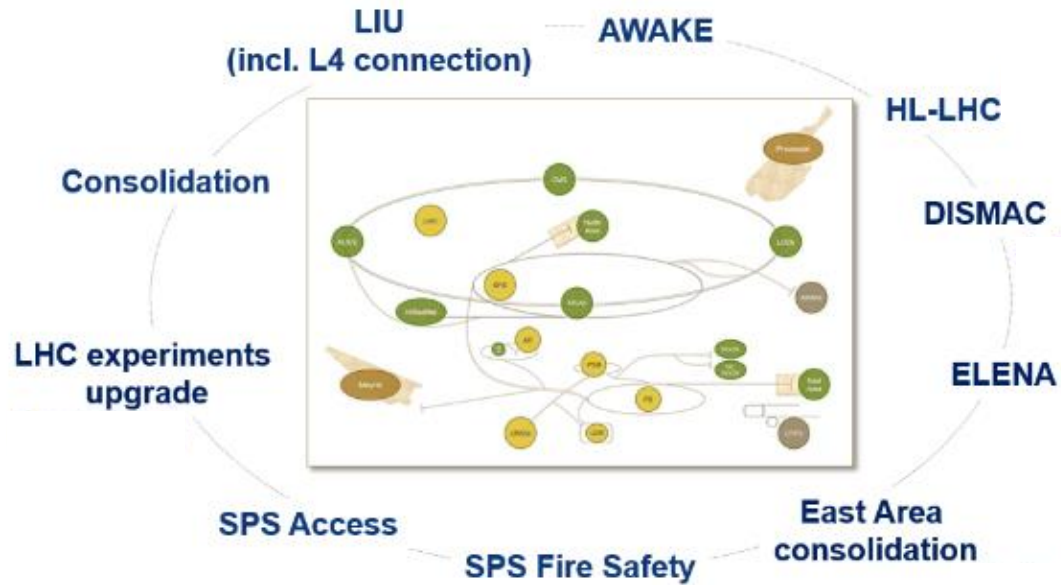
Is the **Executive Committee** covering all **activities** and **resources** over the **whole CERN***

- Which reviews & approves the **Master Schedules** optimising **efficiency** and **Safety** by managing **coactivities** and follows-up the **Quality**
- Which deals with all **technical and organisational aspects**
- The place to **present** and **assess any new activity/work/Project**
- Is the **information channel** towards all Departments, Groups, Projects and Experiments
- The forum to **handles the unexpected**



The main activities

The main projects during LS2



Consolidation & upgrades

ASBESTOS removal

New MEQ59 Static Var Compensator

New MST SPS extraction septum

LHC EE controls

LHC EE controls

POPs capacitor

Workshop 2010

MKD generators in UA87

Civil engineering

Electrical station & systems

Access

Decabling

Cooling & ventilation

Safety system

Lifts

RF

Cryogenics

Dump

Vacuum

WIC

Collimation

Power converters

Controls

Magnets

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**



Safety

Quality

Schedule

The Space Management @ Flex Bld

Space Management
 Storage (including radioactive)
 Living quarters (Base de Chantier)
 Logistics
 Workshops



Zone 10



Zone 9



Zone 2



Zone 3



Zone 11



Zone 1



Zone 12



Zone 13



Zone 7



Zone 8



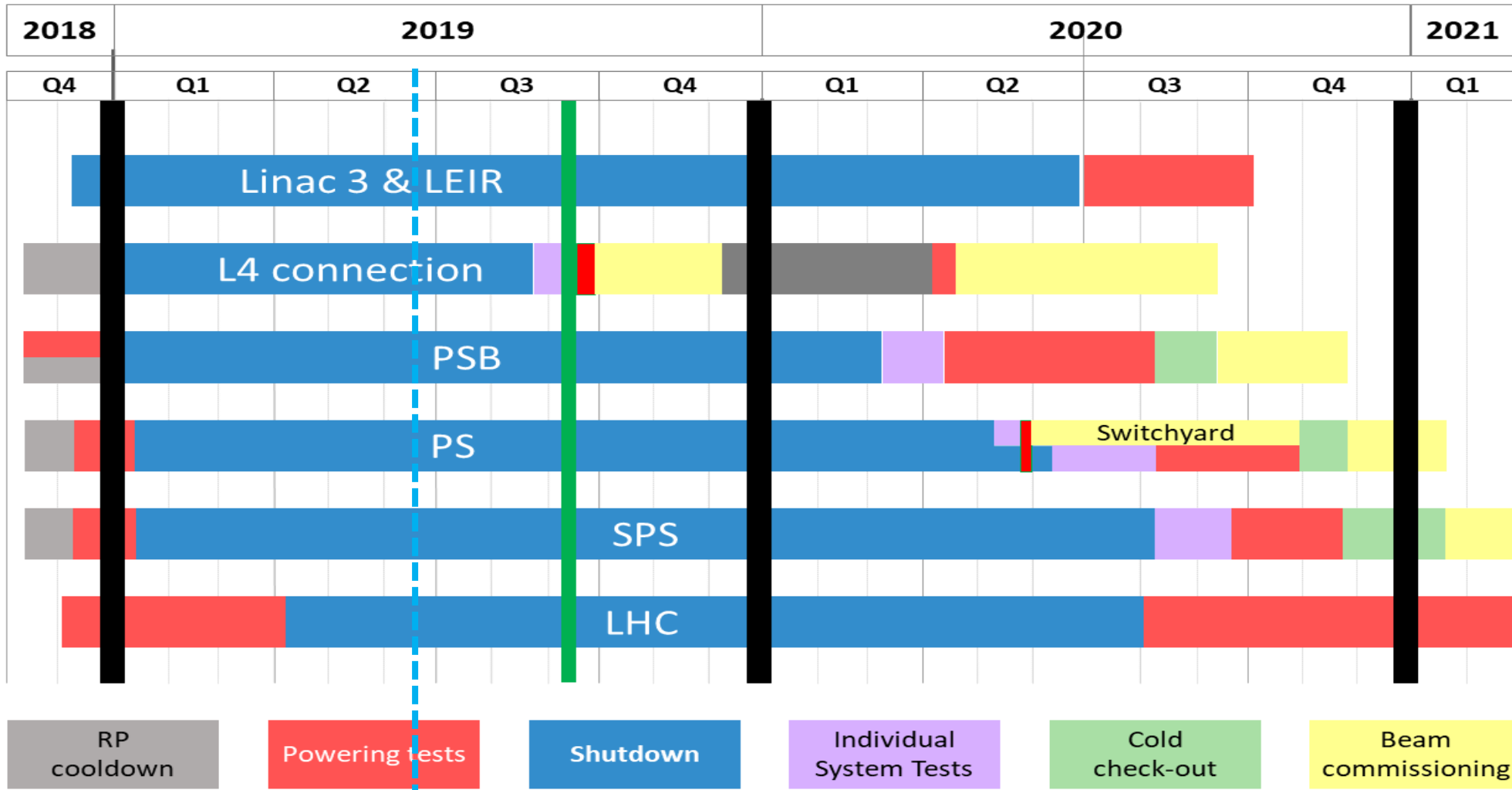
Zone 5



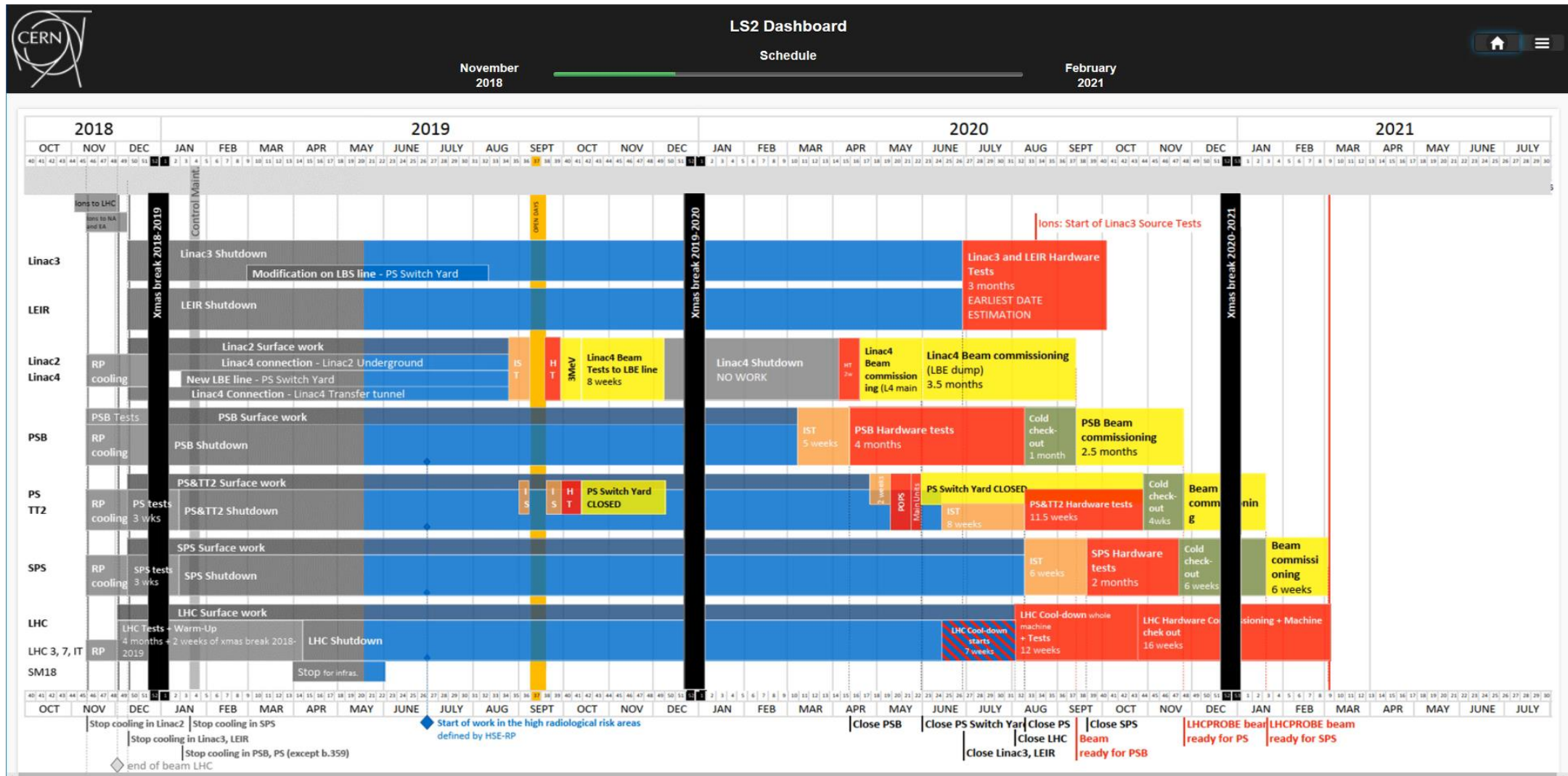
Zone 4

The LS2 schedules and dashboards

- LS2C
 - LS2 mandate and coordination
- Schedules
 - LS2 schedules and dashboards
- Injectors
 - Injectors' status
- LHC
 - LHC status
- Conclusion
 - Conclusion



The LS2 schedules and dashboards – Dashboards



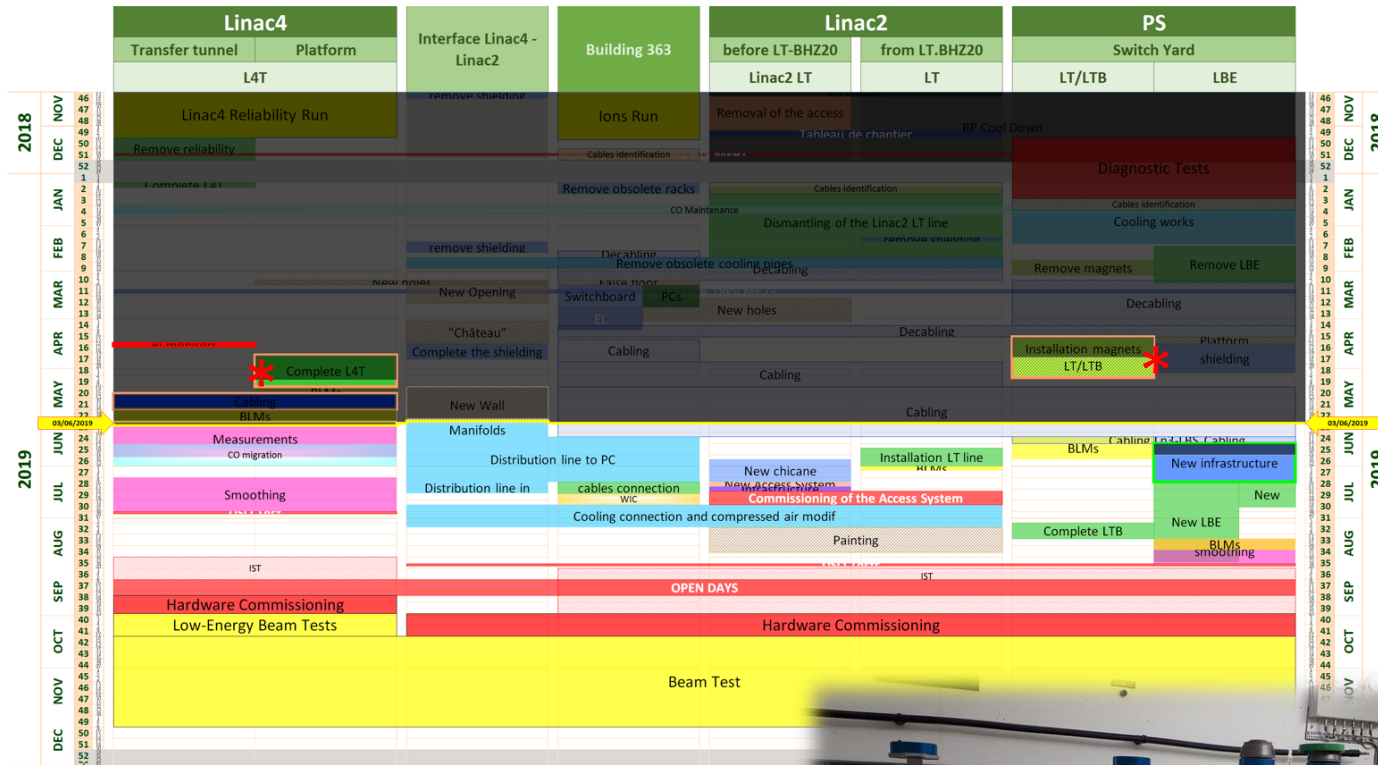
Direct access

<https://lhcdashboard.web.cern.ch/lhcdashboard/ls2>

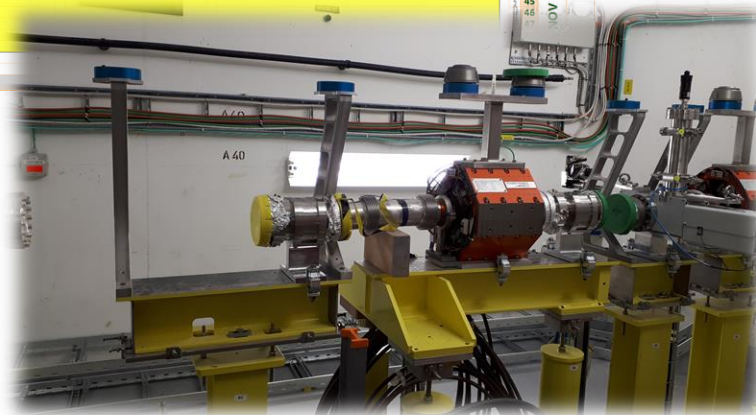
From LS2C web pages

<https://mgt-ls2-committee.web.cern.ch/content/upcoming-meeting> following *dashboard*

LS2 - The LINAC 4 connection



*: review of activity sequence
 – no impact on schedule



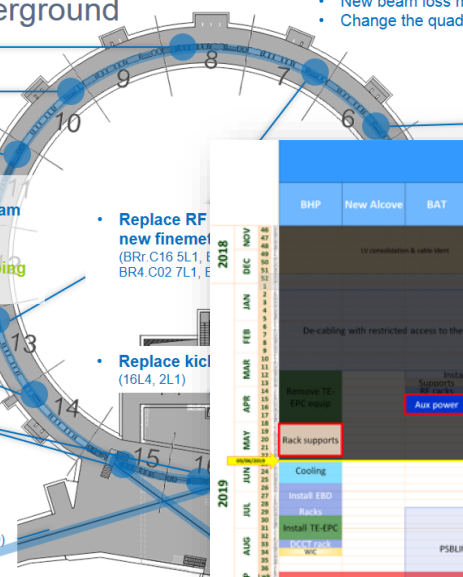
- LS2C
 - LS2 mandate and coordination
- Schedules
 - LS2 schedules and dashboards
- Injectors
 - Injectors' status
- LHC
 - LHC status
- Conclusion
 - Conclusion

LS2 - PSB status

LS2 activities

PS Booster - underground

- New Absorber/Scrapper (BL4)
- Remove RF cavities (BR1.C02 10L1 & BR3.C02 10L1)
- New Wire Scanner x4 (11L1)
- Refurbishment of the painting?
- Warm interlock control (WIC) and beam interlock system (BIS) deployment
- Consolidation of the B-train
- Replacement of ion pumps and pumping groups
- Replace extraction kicker (BER KFA14L1)
- Replace bending magnets (INJ BHZ162, EXT BHZ151)
- Change the bending magnets (BT.BHZ10, BTM.BHZ10)
- Change the beam stopper (BTP.STP10)
- Upgrade magnets (quadrupoles) and add new corrector magnets

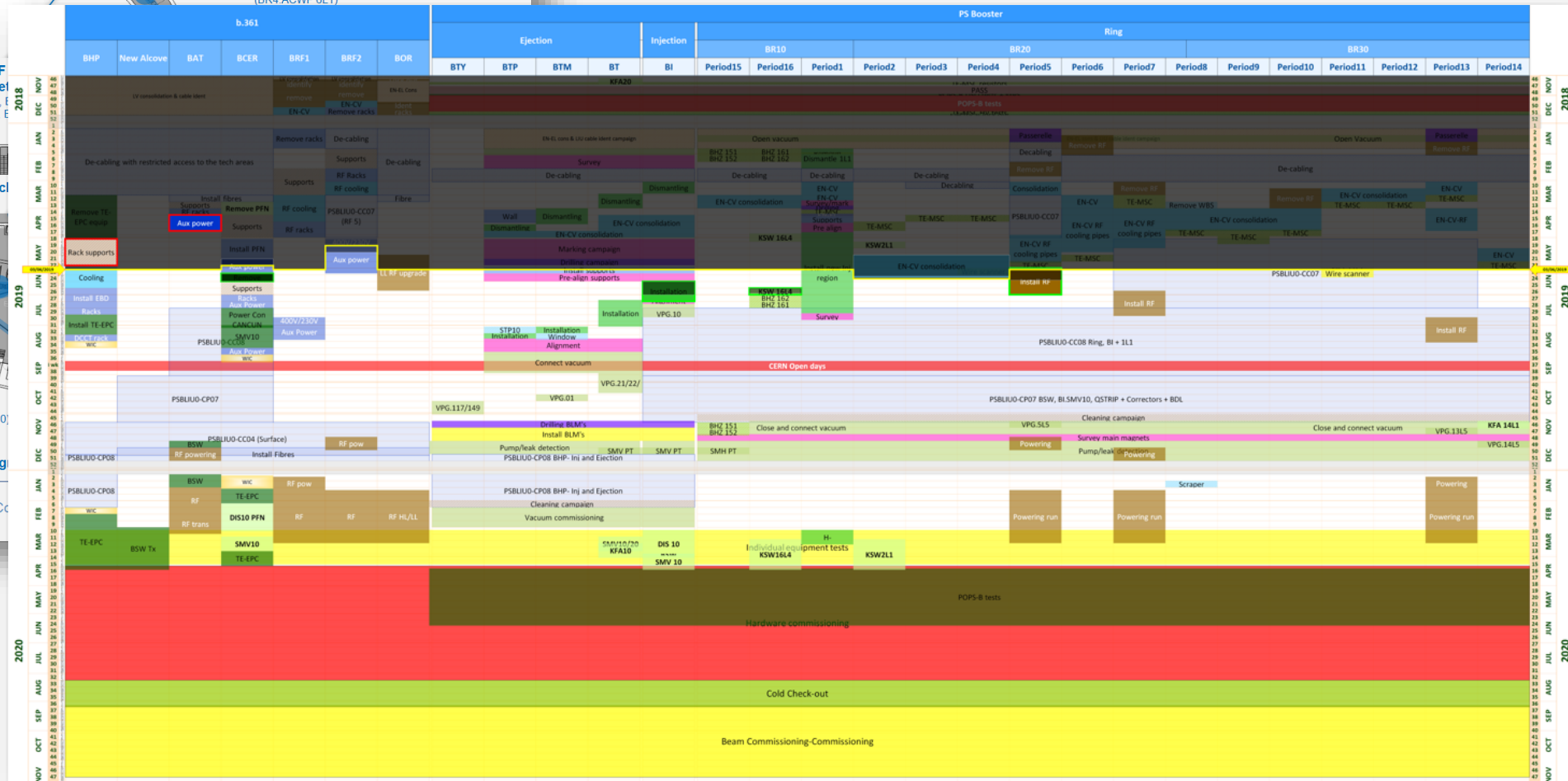


Extraction line BTP: (see PS&TT2 coordination)

- Modification of the beam instrumentations
- New beam position monitor
- New beam loss monitors
- Change the quadrupoles

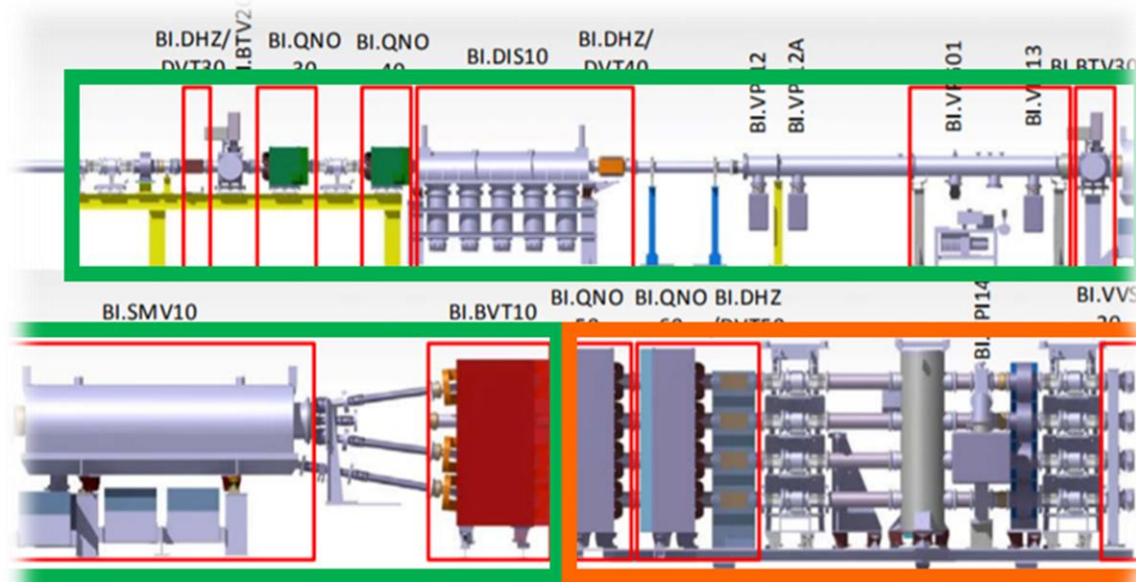
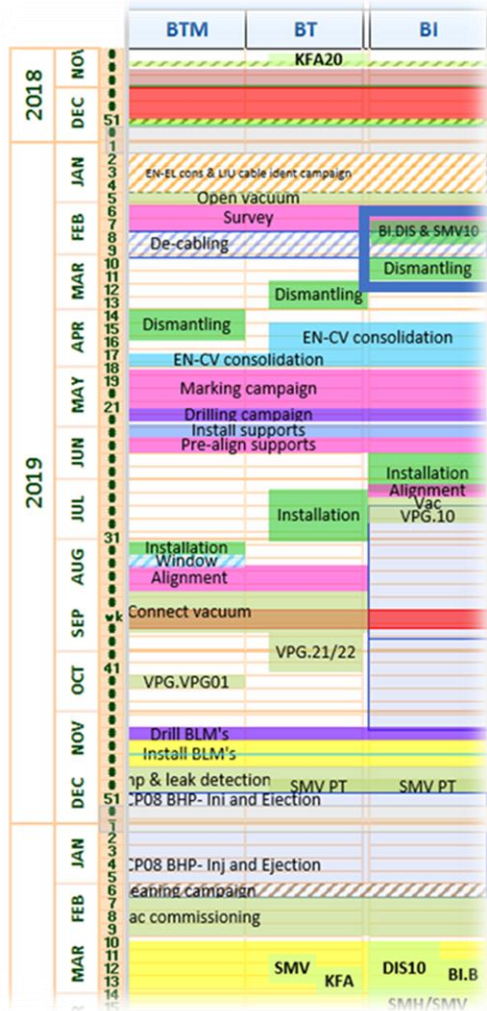
LIU Project
HL-LHC Project
Fire Safety Project
New PPS Project
Consolidations
Maintenance
Upgrade

- Remove prototype finemet cavities (BR4.ACWF 6L1)



EN-ACE - J.C.

LS2 – PSB status ... zoom on BI line



LS2 – PSB...Example of activities



De-cabling, Cabling & Consolidation

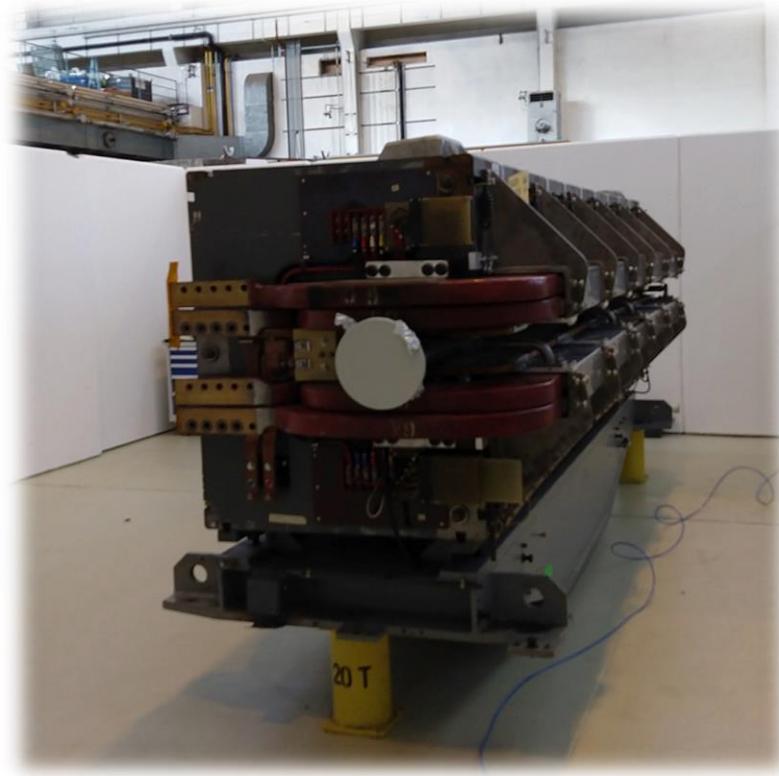


Maintenance & Consolidation
of magnets



Renovation of the PSB cooling system

LS2 – PS ...Example of activities



Main Units



Most of the high radioactive elements have been removed from the machine

LS2 – PS ...Example of activities



Cooling & ventilation
consolidation



LS2 – PS ... surface

B.355



B.365



B.362



B.269



LS2 – SPS status

LS2 activities

SPS

- New UA9 cristal and goniometer pair

- Change all the electrostatic septum ZS (LSS2)

- Add a vacuum valve (sector 210)

Reconfiguration of LSS1 (LSS1, BA1)

- New beam loss monitors
- New upgraded scraper
- Replace one injection kicker MKP
- Reconfiguration of the enlarged quadrupoles (11610, 11710, 11810)

- New beam loss monitors

TT10

TT61

LHC

TIC

TI2

TT70

Reconfiguration of LSS5 (ECA5, ECG5, LSS5)

- New Beam Dump
- New beam loss monitors
- Replace beam gas ionisation profile monitor
- Replace the synchrotron radiation monitor
- New kicker magnet with vertical deflection for dumping MKDV (and generator)
- New BGI
- Move BSRT
- Reconfiguration of the enlarged quadrupoles (51610, 51810)

- Replacement of the irradiation detectors (LSS 2, TDC2, TCC2)

- aC coating (OF SSS, MBB 5+)
- New flanges for the impactors

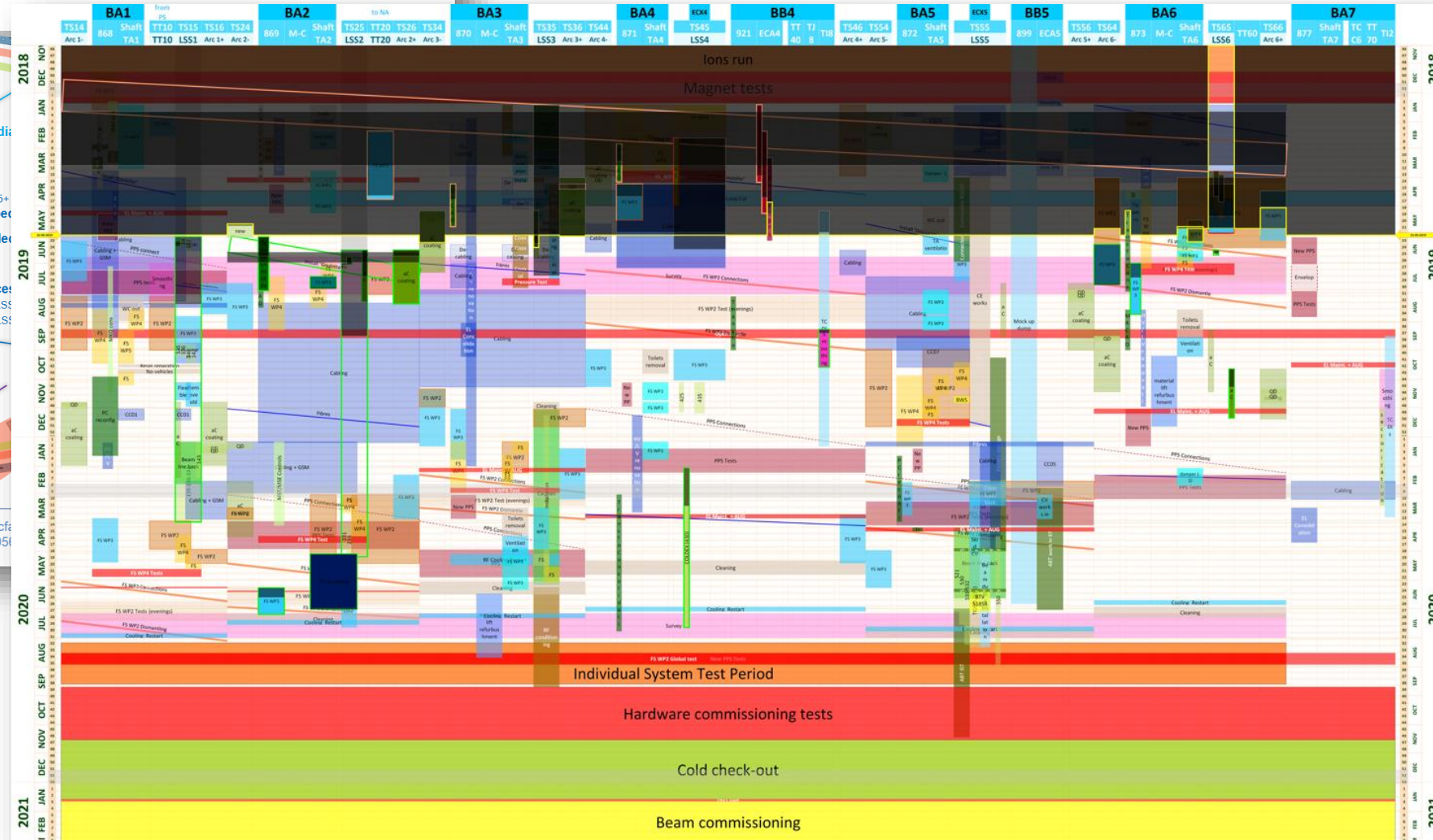
Extraction protection devices

- Replacement of TPSC4 (LSS2)
- Replacement of TPSC6 (LSS2)

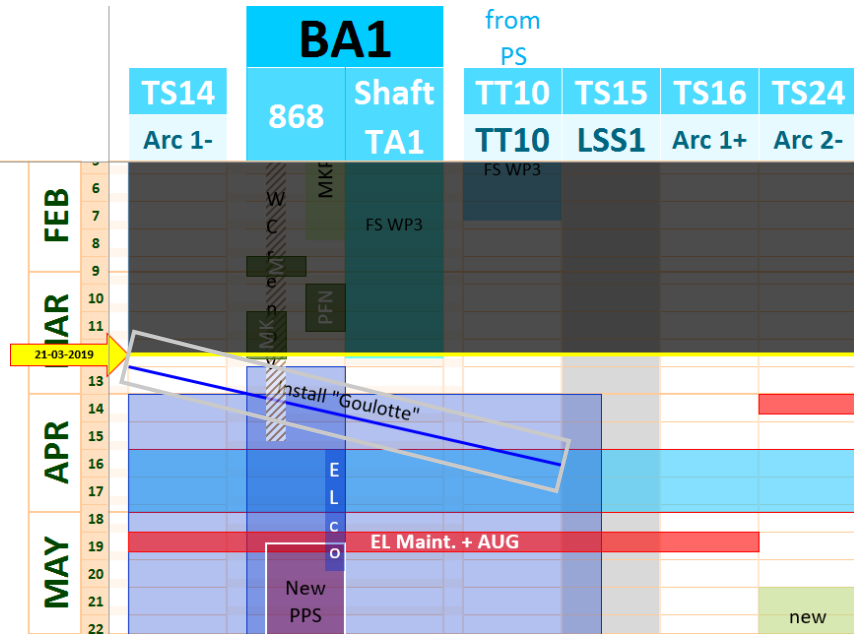
LHC injection lines TI2 and TI8 (see LHC coordination)

- New collimators TCDIs
- New beam loss monitors
- New vacuum valves

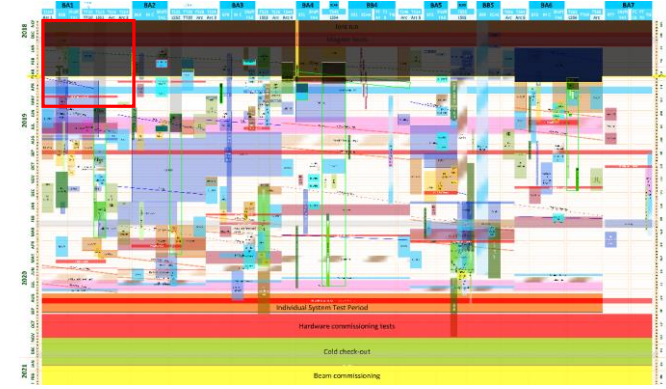
- LIU Project
- HL-LHC Project
- Fire Safety Project
- New PPS Project
- Consolidations
- Maintenance
- Upgrade



LS2 – SPS @ BA1



Toilet renovation in BA1



"Goulotte", dry riser and new fire extinguishers in TT10



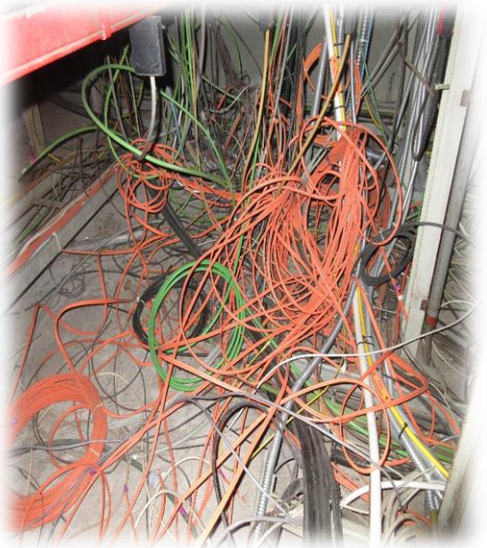
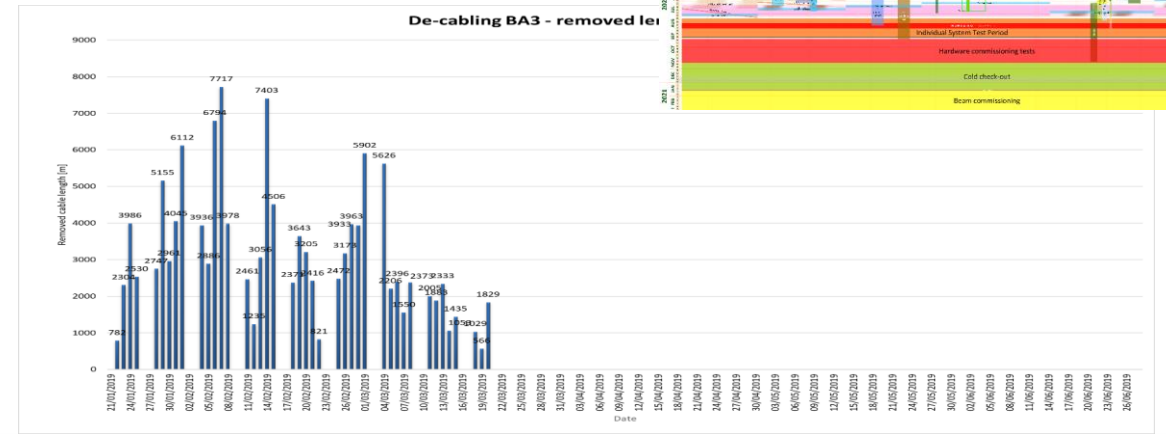
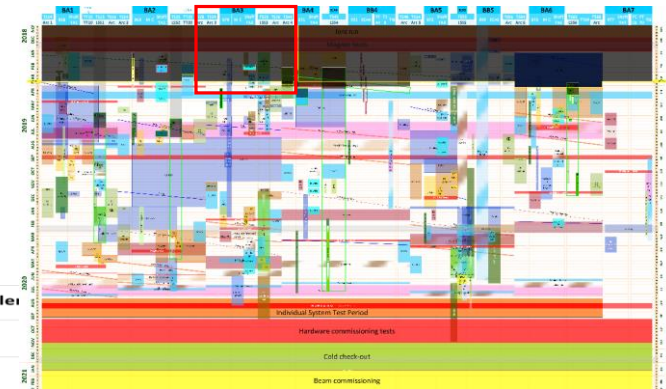
Dry riser in Shaft 1

LS2 – SPS @ BA3

- Start date: 21/01/2019
- End date: 28/06/2019

	Provisional quantity [km]	Provisional quantity of cables
SPS point 3	321	4171

The works are ongoing according to planning



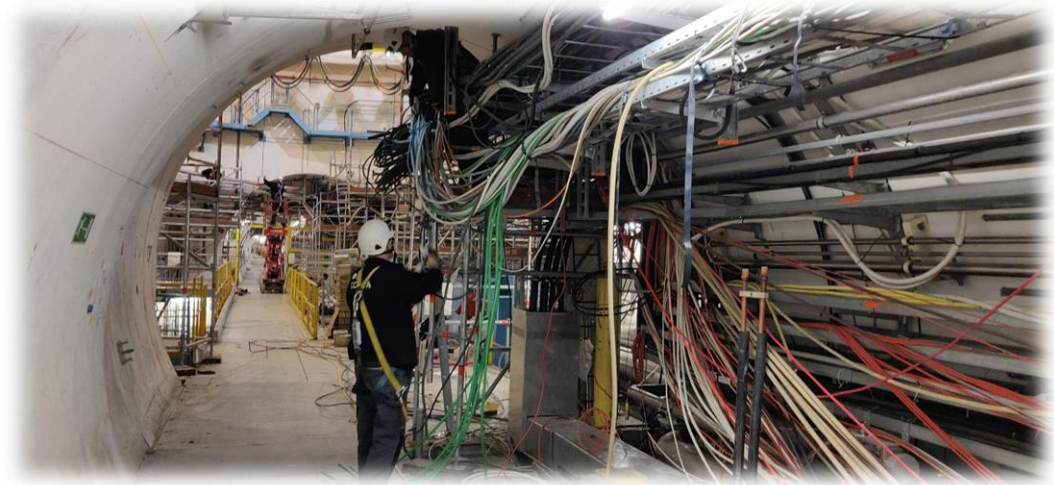
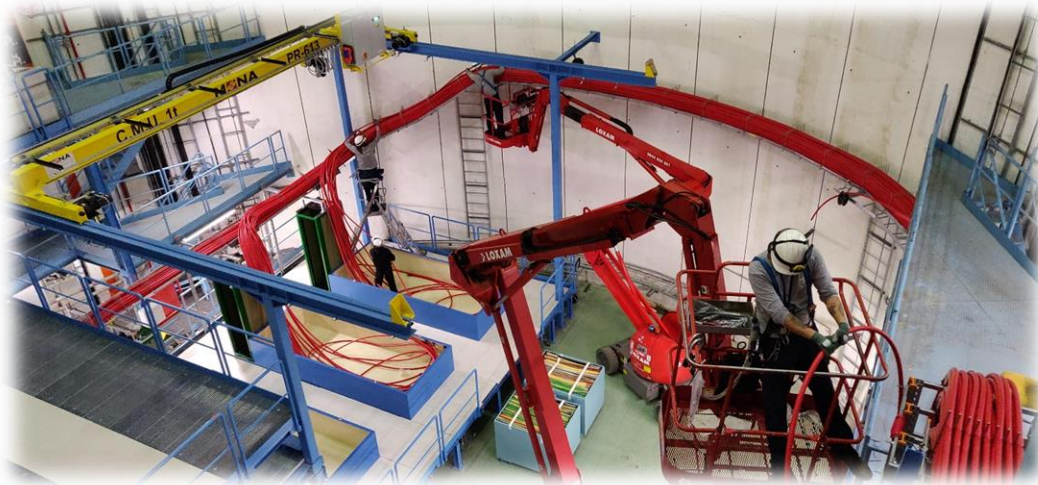
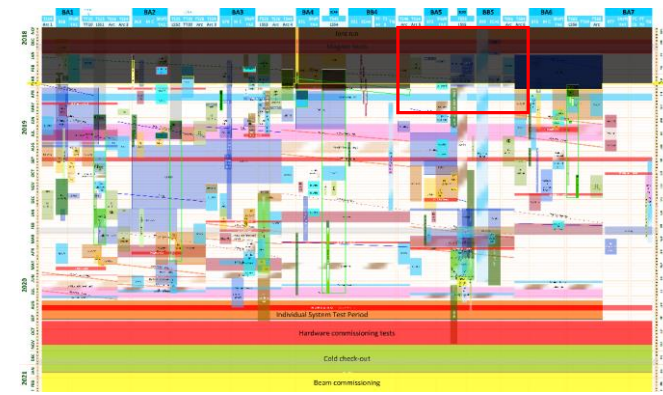
LS2 – SPS @ BA5 ... decabbling

❑ On-going activity

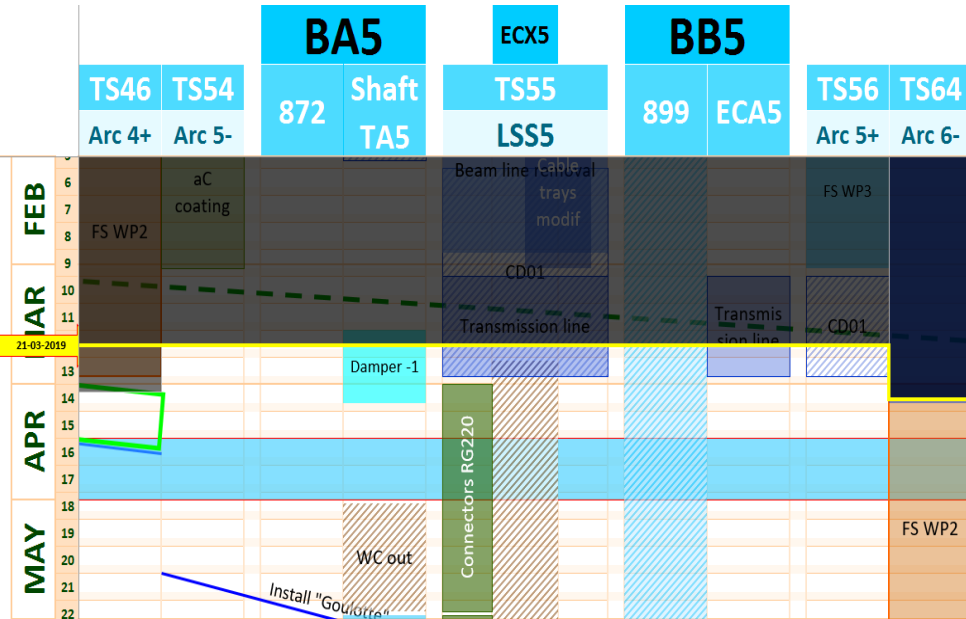
❑ Kicker transmission lines installation (**81 cables** of 93 installed)

❑ De-cabbling BA5

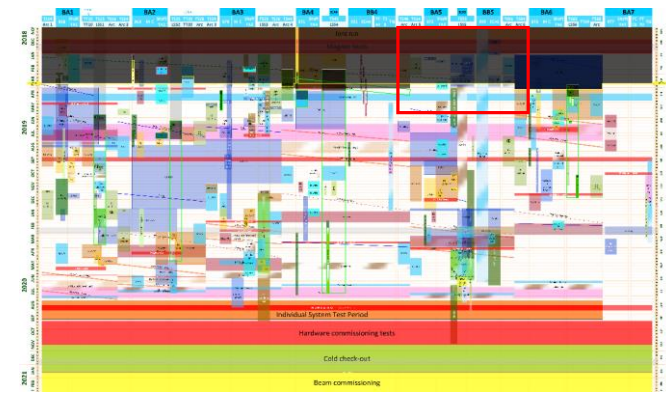
- Removed so far **135 km, 1675 cables** (**83.3 km, 902 cables** initially estimated)
- **56 m³** of conventional waste and **33.8 m³** of radioactive waste
- Removal of cables on going in the shaft towards BA5 surface



LS2 – SPS @ BA5



Tunnel eye ready for civil engineering (ECX5)



Mock up of the TIDVG5 in BB5

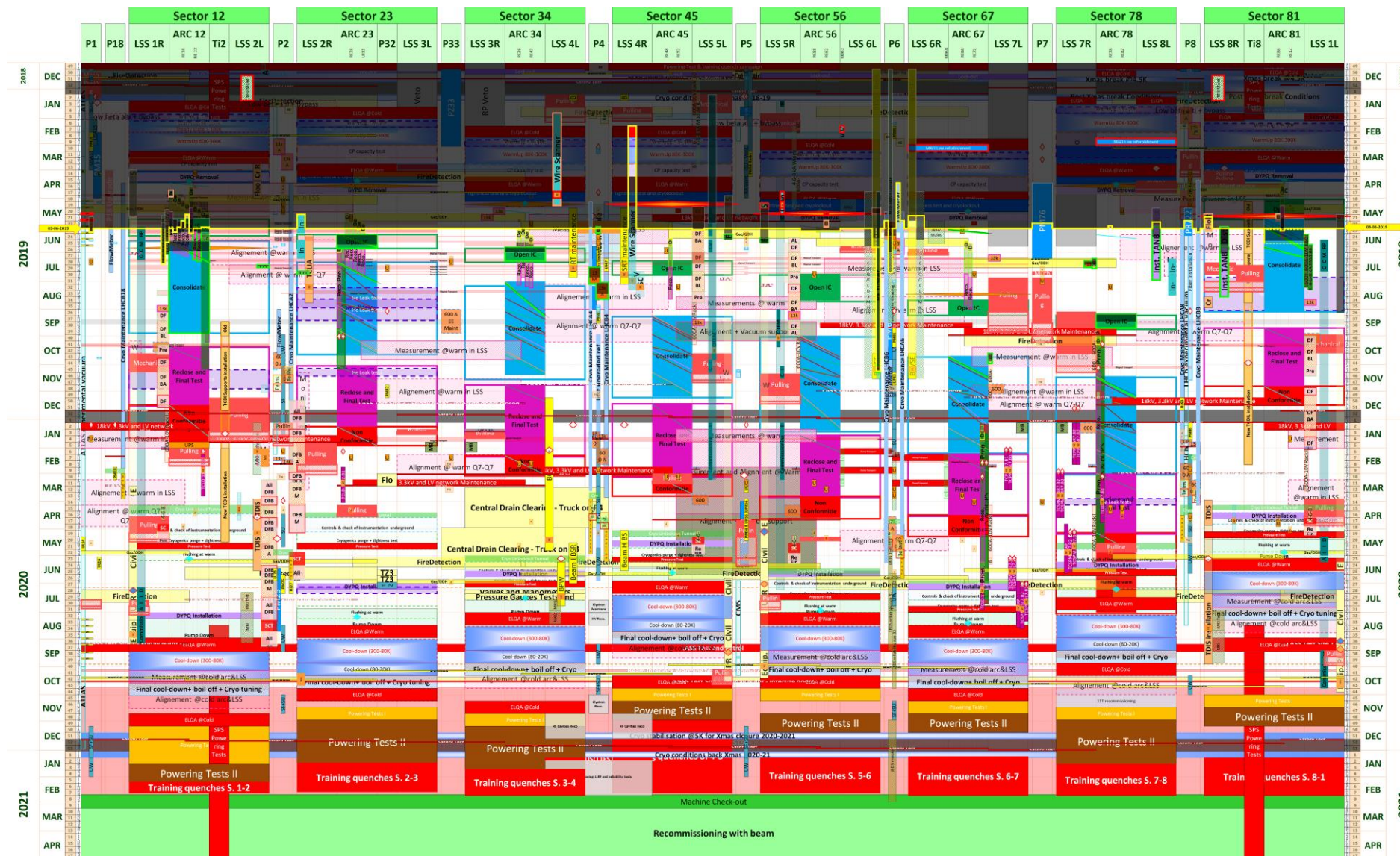


Transmission line installation in ECA5

June'19

LS2 – LHC status

- LS2C • LS2 mandate and coordination
- Schedules • LS2 schedules and dashboards
- Injectors • Injectors' status
- LHC • LHC status
- Conclusion • Conclusion



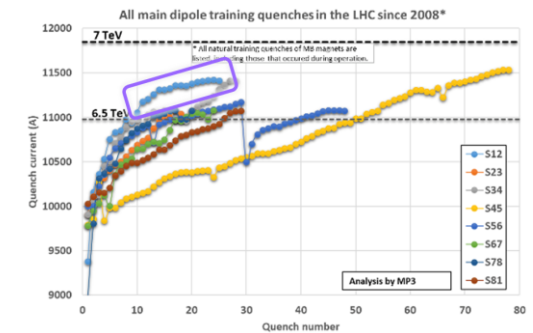
LS2 – LHC ... 1st phase complete

✓ Superconducting magnet powering tests

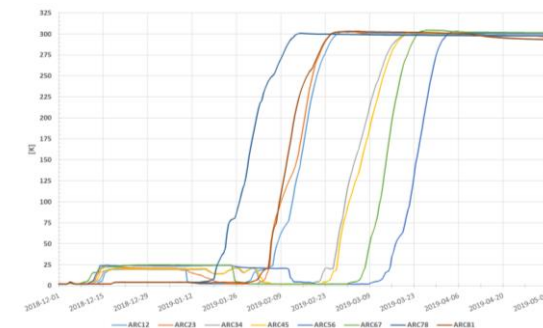
- ✓ were predicting a faster sector training. No limits to 7 TeV, but longer training campaign

✓ LHC behaviour through warming-up was excellent, beyond our expectations:

- ✓ No buckling on QRL bellows one leak being investigated.
- ✓ No new leak or degradations observed so far on Beam vacuum and magnet cryostats.
- ✓ EIQA @cold didn't show NCs 3 NC @ warm being investigated.
- ✓ DISMAC started as planned as well as magnet replacements.



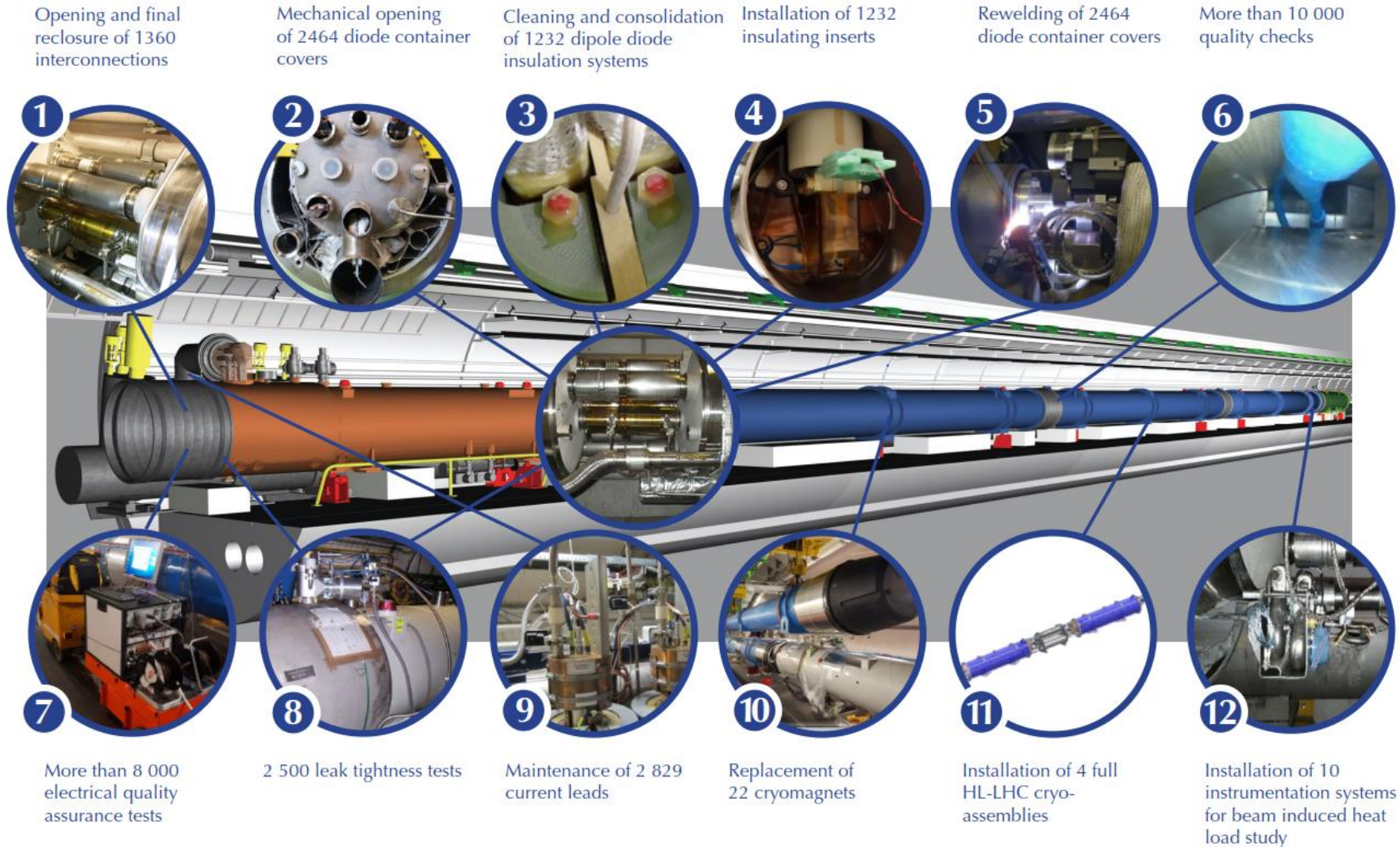
Surprise : Predicting a faster sector training
No limits to 7 TeV, but longer training campaign



LS2 – LHC: main project is DISMAC



Main work on the LHC superconducting magnets during LS2 (2019-20)



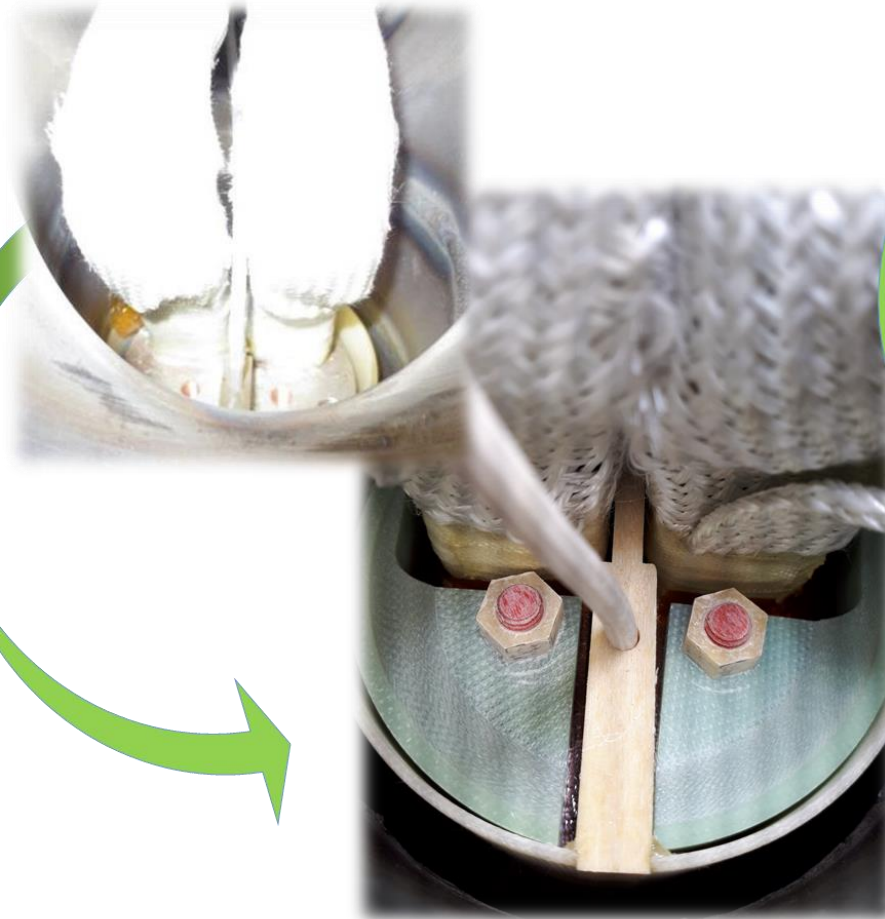
LS2 – LHC - DISMAC consolidation

1 Removal of accessible (metal) debris

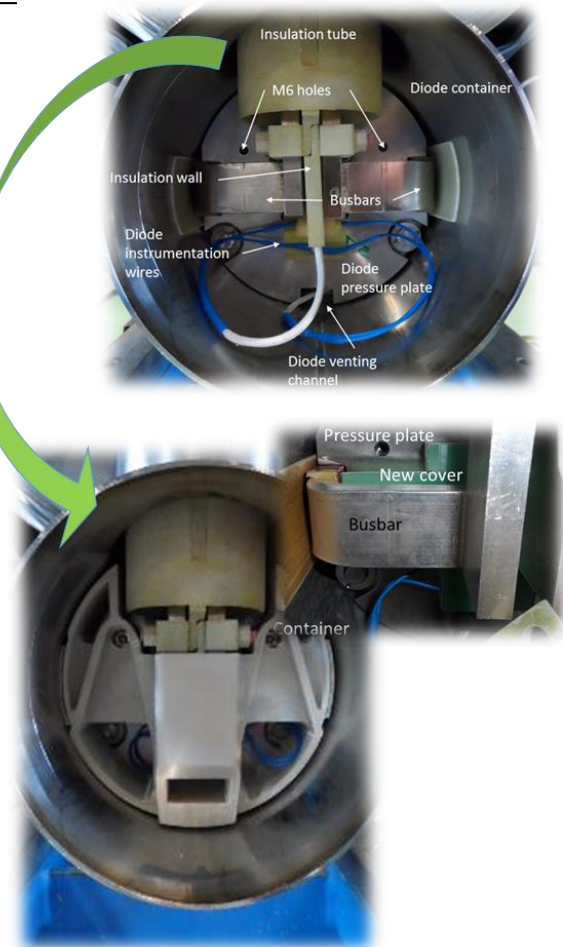


TECHNICAL SOLUTION : 3 main actions

2 Installation of *optimised* half-moon insulation pieces



3 Insulation of diodes bare busbars

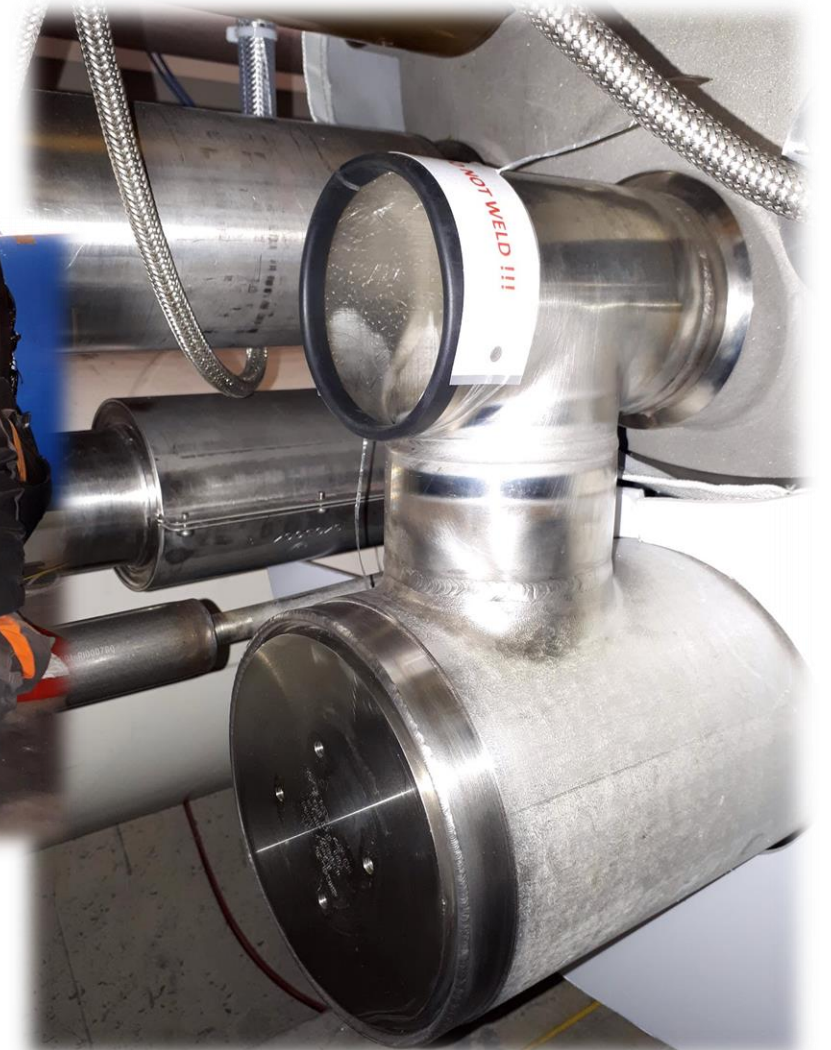


LS2 – LHC: DISMAC...first milestones achieved !

1st March 2019: First Interconnection opening
IC QBBI.A30L8 sector 78
DISMAC project

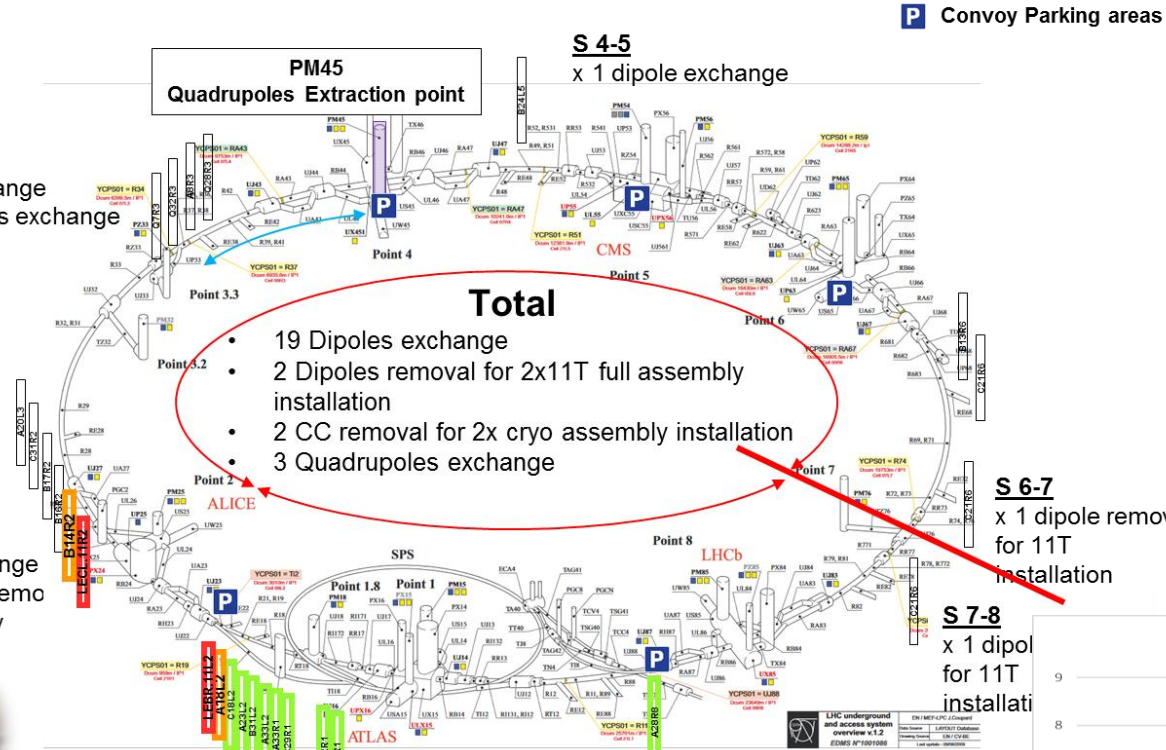


The 1st cover was rewelded
on 17.05.2019



LS2 – LHC: consolidation of magnets

- Reinstalled
- Removed
- Postponed



MAFI Convoy



The MAFI convoy consists of :

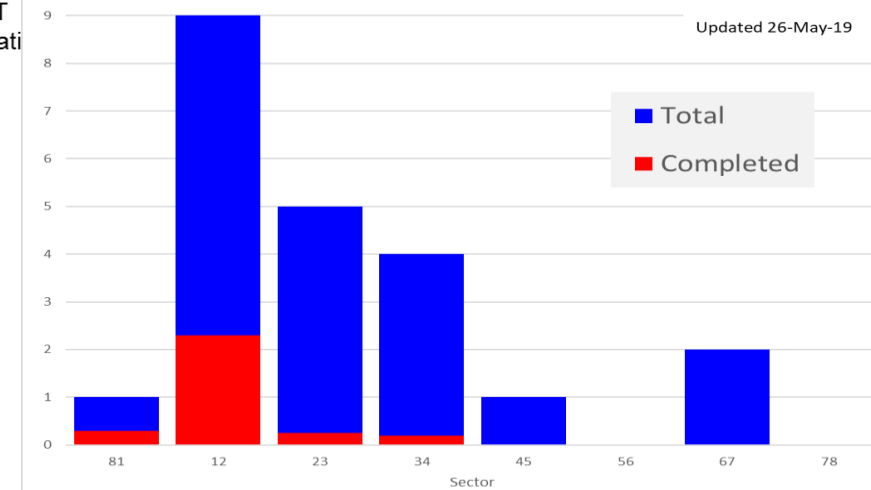
- 1 trailer 35T
- 2 Tractors
- 2 Unloading equipment



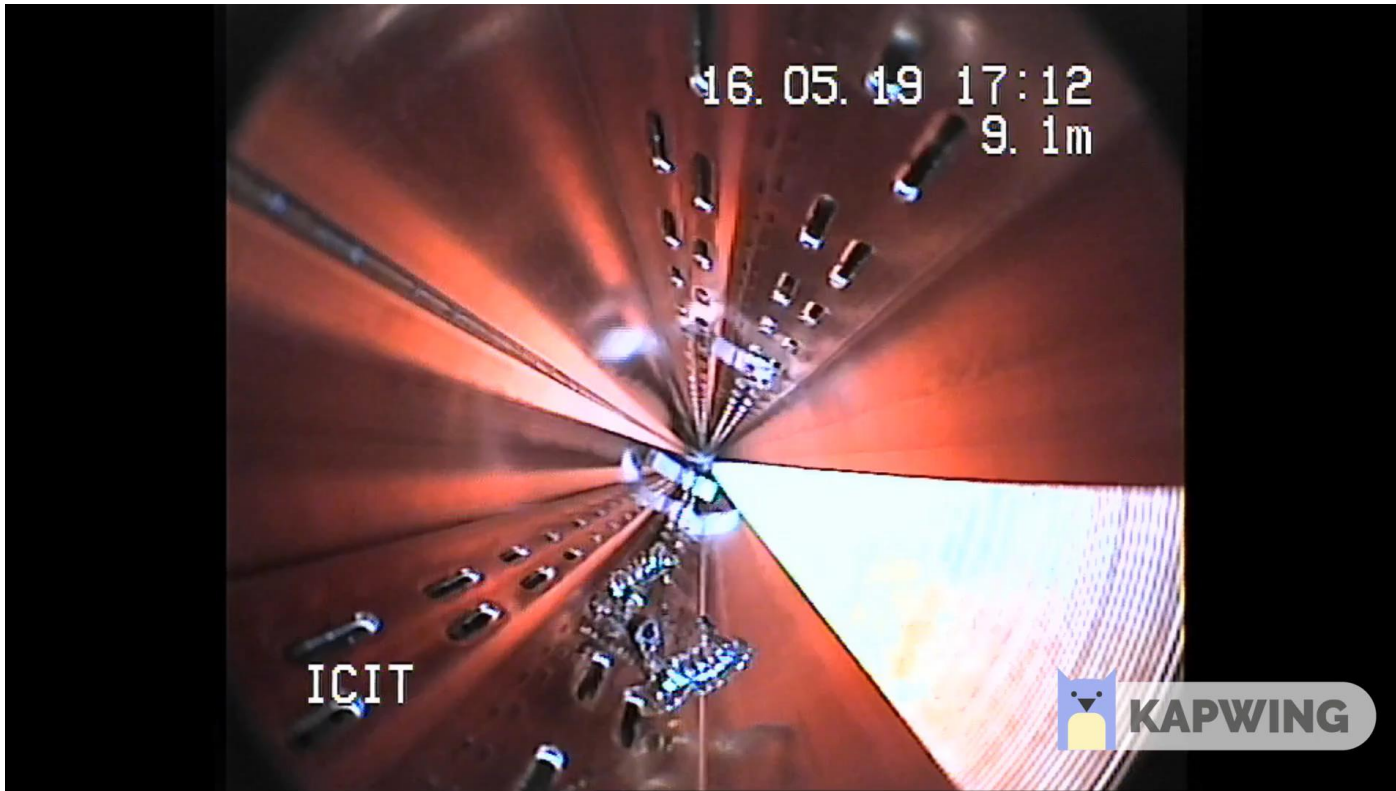
- 9/26 reinstalled
- 11/26 removed

DISMAC/SIT : Cryomagnets Replacement

Updated 26-May-19



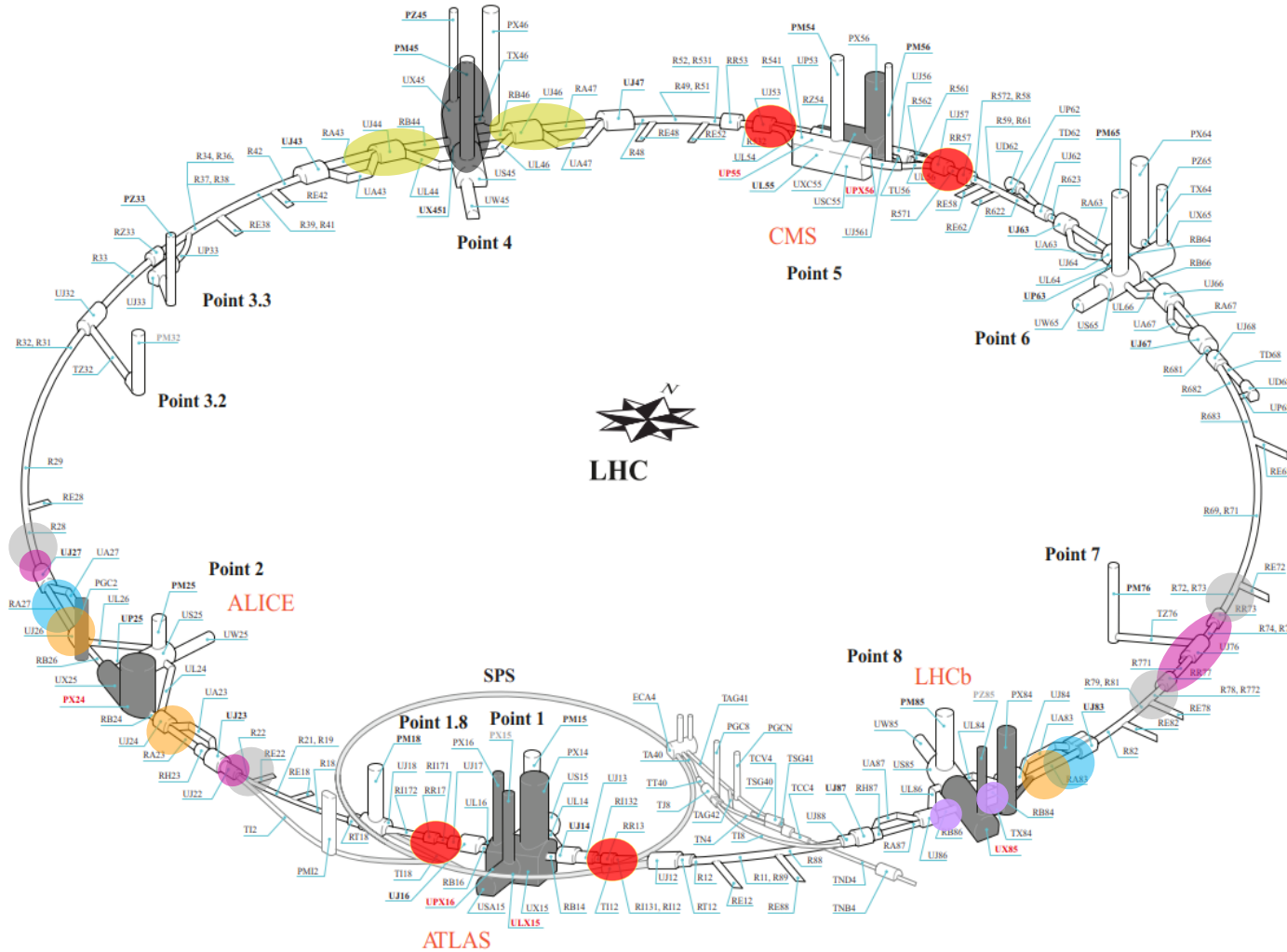
ULO Recovery C15R8 – 16/05/2019



During removal the polythene broke into 3 part, all of which are recovered (small fragment not shown).

The plastic appears blackened and locally brittle (presently at the RP control bunker)

LS2: HL-LHC activities



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 and compressor at P4 (under definition)

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

LS2 & HL-LHC Civil Engineering – Point 1



LS2 & HL-LHC Civil Engineering – Point 5



Closing remarks

Excellent readiness levels

- ✓ Activities declared in PLAN tool, new demands discussed @ LS2C
- ✓ No further arbitration considered today
- ✓ Equipment readiness evaluated and “flattened”
- ✓ Master resource-loaded schedules completed and available in EDMS
- ✓ Workshops, logistics & storages are operating beyond expectations

QA and documentations just on time

- ✓ Recovered on 3D integrations and differential layout drawings
- ✓ Progressed with ECR approvals – expect completion by end June’19

Daily follow-up towards a successful ramping-up of activities

- ✓ Intensive field coordination and safety follow-up (tunnel and surface)
- ✓ Radioactive transports and storage issues getting solved

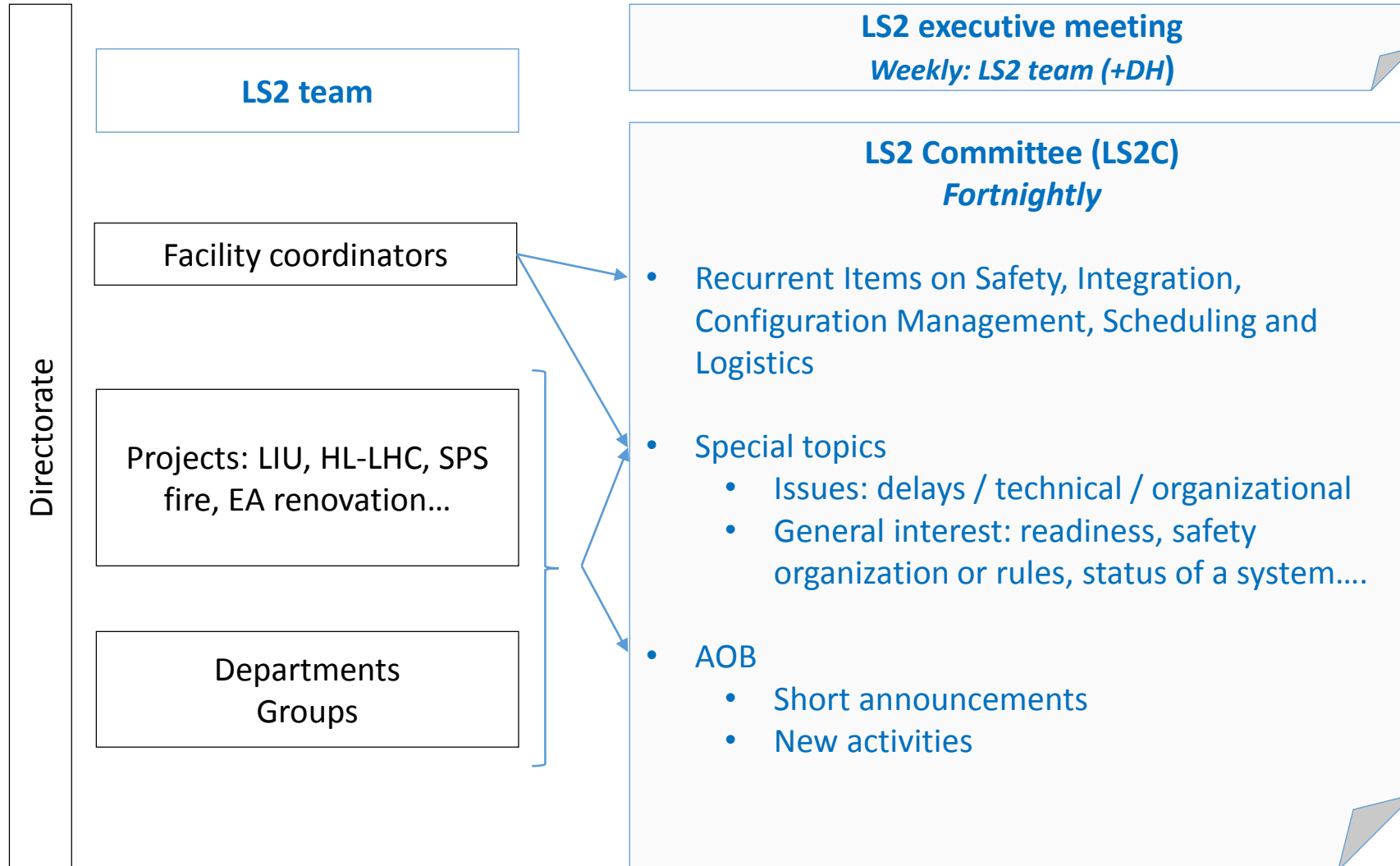
Questions?



Accelerating Science and Innovation



The LS2 Committee & Coordination meetings (cont.)



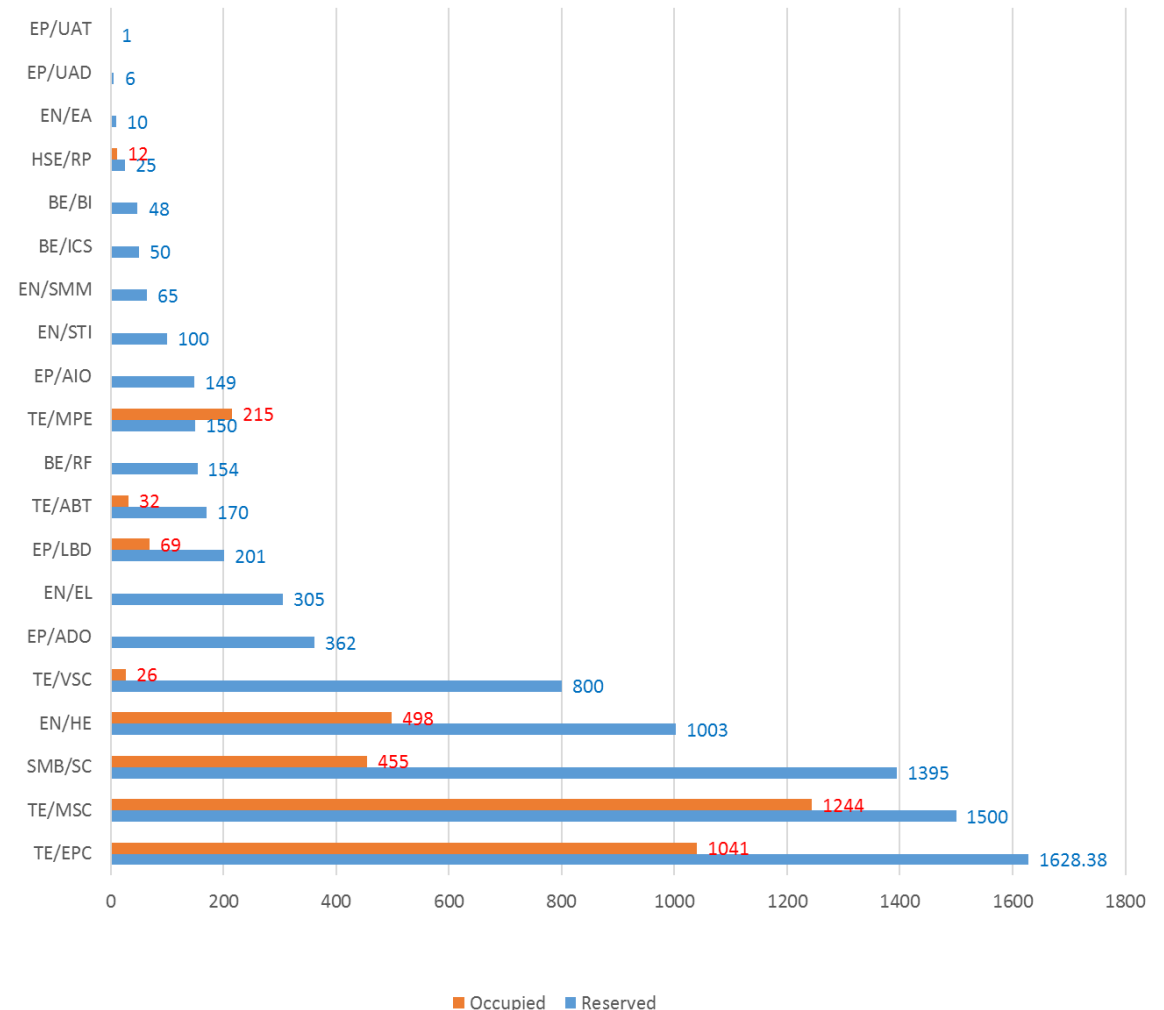
The Space Management @ Flex Bld

Total reserved: 8122 m²
Occupied on 31.05.2019: 3591 m²
(started outspend process – max occupied ~ 3700 m²)

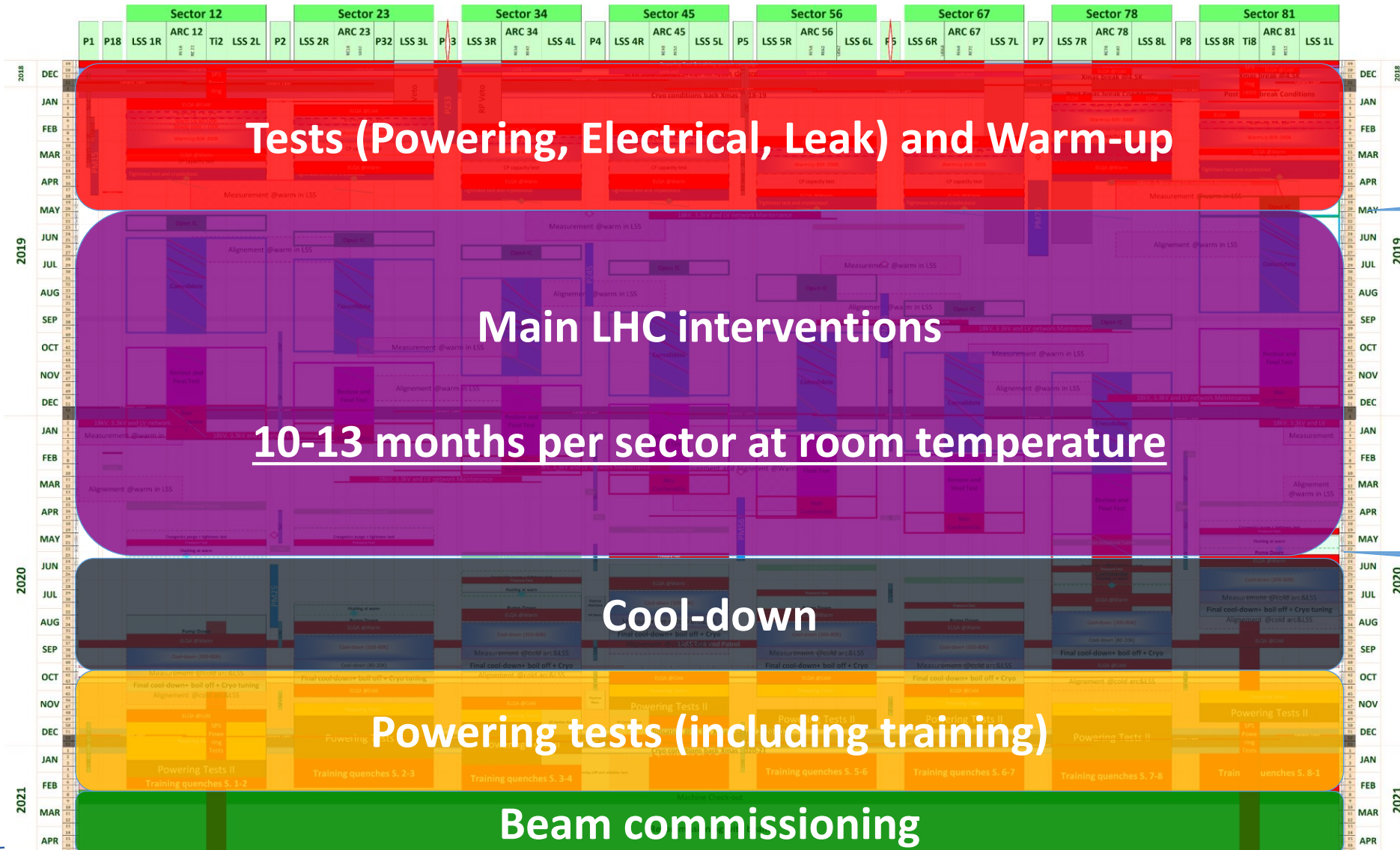
Next deliveries:

- 300 m² from SMB (from B879/954/955)
- 100 m² TE-MSc for new components
- 50 m² TE-EPC for Sirius racks

Storage space by group [m²]



The LS2 schedules and dashboards - LHC version 1.4



Sequencing beginning LS2 (5 months)

- Powering tests and training quench campaign
- Machine Lockout:
- Cryogenics preparation for Christmas closure & cryo reconditioning after Christmas
- EIQA @ cold
- Warm up at ambient temperature
- Vacuum leak tests & Inspection (IV and BV)
- Cryoplant capacity tests
- EIQA @ warm
- Tightness tests and cryo lockout

(12 months)

- **Major cryogenics maintenance**
- **Major Maintenances**
- **DISMAC**
- **All other works (HL, Consolidation, ...)**

Sequencing End LS2 (11 months)

- Pressure tests
- EIQA @ warm
- Vacuum leak tests & BV inspections
- Cool down & vacuum leak tests
- Machine levelling (survey) at cold
- EIQA @ cold
- DSO test (16th Oct. 2020)
- Powering tests and training quench campaigns
→ Machine to 3 shifts BE-OP → W44-2020



The Safety execution - LS2 Accidents

Description	All	Minor	With absence	Days of absence
Collision, false movement	2	2		
Electricity	1	1		
Fall	1		1	1
Handling and Manipulation	7	2	5	114
Hand tools and Power tools	6	6		
Machine tools	3	1	2	42
Object in Movement	5	4	1	14
Vehicles	1	1		
Total	26	17	9	171

The Safety execution - LS2 Accidents*

- Accelerators and Surface Buildings
- Large Experiments
- LS2-related activities in other buildings

- 16 minor accidents (no absence)
- 10 accidents with 171 days of absence

Workers	1000	~1500	2000	LS1	Industrie**	
					Fabrication de machines et équipement	Entreposage, auxiliaire de transport
Frequency	10.2	6.8	5.1	8.4	16.3	32.3
Severity	0.19	0.13	0.10	0.07	0.8	2.3

* Data until May 2019 included

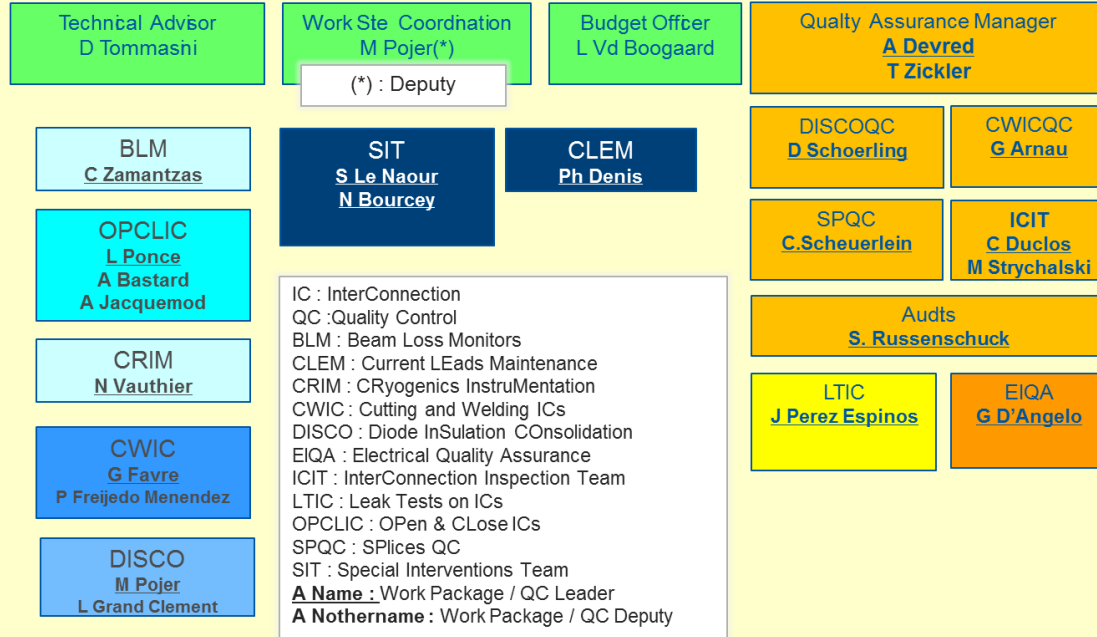
** France, Caisse nationale d'assurance maladie des travailleurs salaries, 2

The main LHC 2019-2020 consolidations (DISMAC)

Diodes Insulation and Super-conducting MAgnets Consolidation

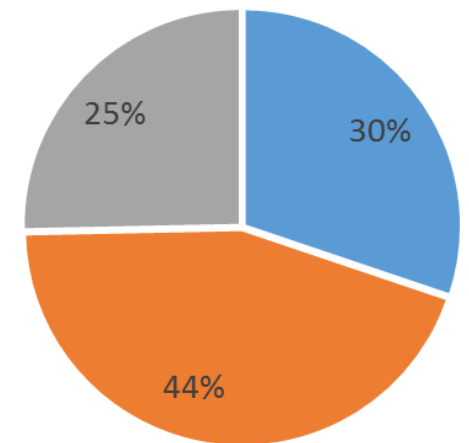
DISMAC: J.Ph. TOCK

Project Office : Logistics, Planning, Safety, Radoprotection
 C Adoriso, M. Bednarek, M Bernardini, R Faes, M Gonzalez Torres, S Le Naour, M Pojer, T Otto, Y Pira,
 L Vd Boogaard, E Vergara

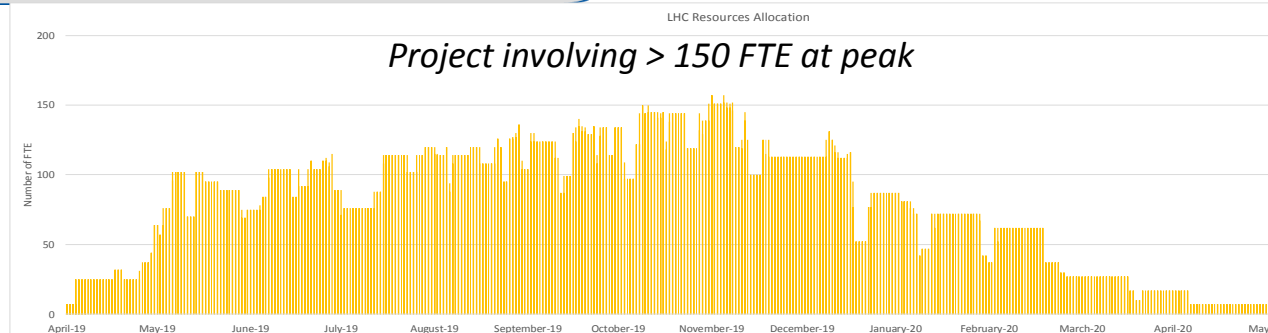


25.02.2019

- ❖ Consolidation of 10 diodes per working day (5/7)
- ❖ 6 efficient working hours per day (LS1 exp)
- ❖ Starting at P8, clockwise (RP @ P7)
- ❖ SIT (Special Interventions Team) to solve NCs to avoid disrupting the main flow of activities



Project involving > 150 FTE at peak



■ Staff ■ Collaborators ■ Contractors

June'19

Long Shutdown 2 : JM. Jimenez

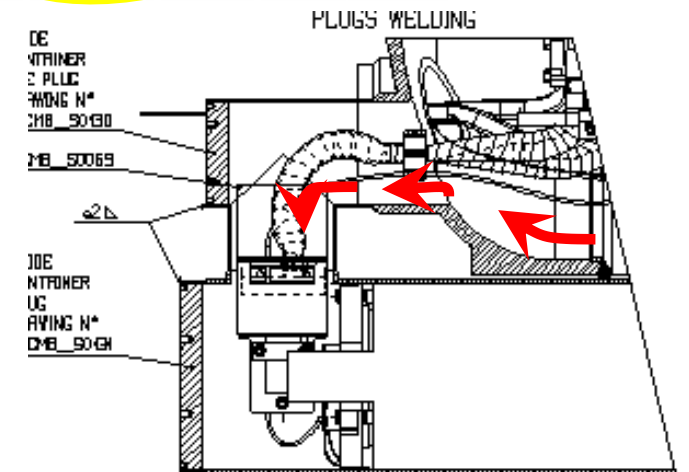
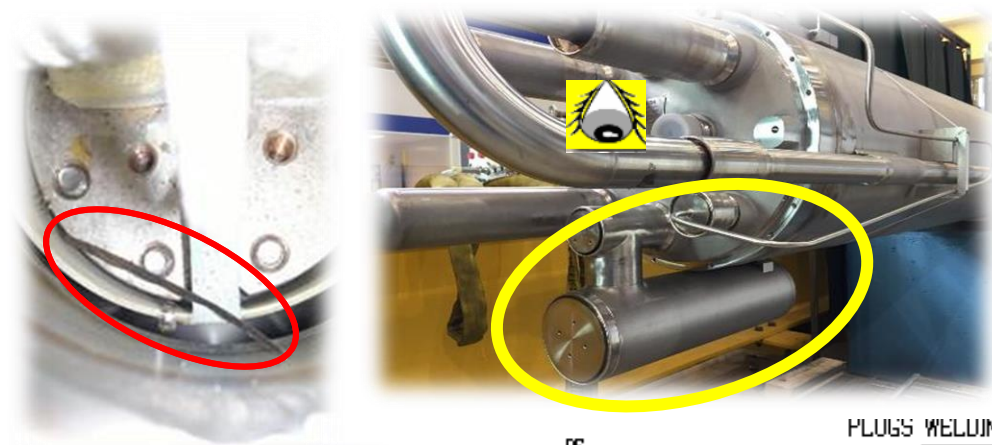
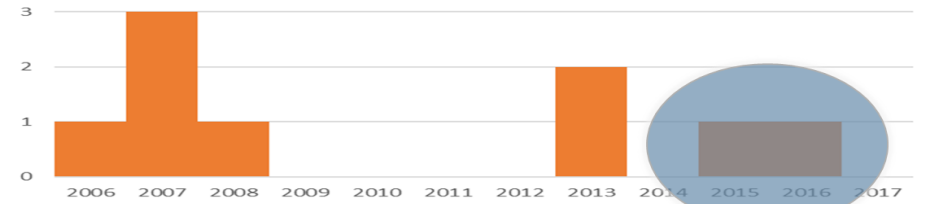
LS2 – The LHC: DISMAC consolidation

- ❖ 9 short circuits to ground localised on the main dipole circuits, localised in the dipole diodes container since 2006
- ❖ 2 last ones in 2015 and 2016 during training (quench) campaigns **so at cold**

➤ Created by metal debris, present in the dipole cold mass, transported by the helium flow (warm-up, cool-down, flushing and quench)

- ❖ The 2 short to ground noticed at cold were removed thanks to the Earth Fault Burner (EFB) [No warm-up necessary]

Yearly Dipole Diodes Shorts



Final X-ray



All standard qualification tests passed:

➤ The fault was successfully eliminated

