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

June'19
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
The Space Management @ Flex Bld

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

Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Zone 8
Zone 9
Zone 10
Zone 11
Zone 12
Zone 13
The LS2 schedules and dashboards

<table>
<thead>
<tr>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
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<tr>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
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<td>Linac 3 &amp; LEIR</td>
<td>L4 connection</td>
<td>PSB</td>
<td>PS</td>
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<tr>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td>SPS</td>
<td>LHC</td>
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</table>

- **LS2 mandate and coordination**
- **Schedules**
- **Injectors**
- **LHC status**
- **Conclusion**

Today
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
LS2 activities
PS Booster - underground

- New Absorber/Scrapers (LS8)
- Remove RF cavities (B1V: C12 10.1 & B20: C12 10.1)
- New Wire Scanner x4 (110,1)
- 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 (B5, F1, A1, K1)
- Replace bending magnets (B20: H2, E2, B1N: H2)

Injection line B1:
- New Injection bending (B1N: H2)
- New Distributor (B1N: H2)
- New Septa (B1N: H10)
- Retractable beam instrumentation (B1: B1Y)
- Change of the magnets (B1H1, B1H2)
- New BPMs
- New beam loss monitors
- New RF bypass

- Change the bending magnets (B1, B1T, B1M: B1N: H2)
- Change the beam stopper (BTP: STP: 19.1)
- Upgrade magnets (upgraded) and add new corrector magnets

LS2 activities
PS Booster - underground

- New Absorber/Scrapers (LS8)
- Remove RF cavities (B1V: C12 10.1 & B20: C12 10.1)
- New Wire Scanner x4 (110,1)
- Refurbishment of the painting?
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- Consolidation of the B-train
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LS2 - PSB status
LS2 – PSB status … zoom on BI line
LS2 – PSB status ... zoom on BTM line
LS2 – PSB...Example of activities

De-cabling, Cabling & Consolidation

Renovation of the PSB cooling system

Maintenance & Consolidation of magnets
LS2 – PS status

LS2 activities
PS&TT2 - underground

- New injection septum + bumper SMH42:
  - New SEMOGrid (SM41)
  - New bumper (SM40)
- Replace injection extra kicker (SM413)
- New injection bumpers (40, 41, 43, 44)
- New low-beta injectors (SM41, SM42)
- New beam loss monitors (TT2, TT3, TT12)
- Consolidation of the beam stoppers (SM47, SM48, SM49, SM50)
- New rafelknebs
- Replace 2 magnets in extraction line to SPS (TT2)
- New internal beam dumps (SM47 and SM48)
- Warm interlock control (VIC) deployment
- Consolidation of the B-brain
- Consolidation of the RF systems
- New beam wire scanners (SM44, SM45, SM46, SM47)

LIU Project
ILC-LHC Project
Fire Safety Project
New PPS Project
Consolidations
Maintenance
Upgrade
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
LS2 – SPS status

**LS2 activities**

**SPS**
- New UA9 crystal and goniometer pair
- Change all the electrostatic septum ZS (LS7)
- Add a vacuum valve
- Reconfiguration of LS81 (5.5.5.1, 9.1)
  - New beam loss monitors
  - New upgraded scraper
  - Replace one injection kicker MKP
  - Reconfiguration of the enlarged quadrupoles (1110, 11170, 11180)
- New beam loss monitors

**Extraction protection device**
- Replacement of TPSC4 (LS3)
- Replacement of TPSC6 (LS3)

**Reconfiguration of LS15 (5.4.5.8, 5.6.5.8)**
- New Beam Dump
- New beam loss monitors
- Replace beam gas ionization profile monitors
- Replace the synchrotron radiation monitors
- New kicker magnet with vertical deflecting dumping MKDIV (and generator)
- New BO
- Move BSRT
- Reconfiguration of the enlarged quadrupoles (5.1.6, 5.1.8)

**LHC injection lines T2 and T8** (new LHC commissioned)
- New collimators TC0s
- New beam loss monitors
- New vacuum valves

- **LIU Project**
  - HL-LHC Project
  - Fire Safety Project
  - New PPS Project
  - Consolidations
  - Maintenance Upgrade
**LS2 – SPS @ BA1**

<table>
<thead>
<tr>
<th>BA1</th>
<th>BA1</th>
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<tbody>
<tr>
<td>TS14</td>
<td>Arc 1-</td>
</tr>
<tr>
<td>TS15</td>
<td>TT10</td>
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<tr>
<td>TT10</td>
<td>TT10</td>
</tr>
<tr>
<td>LSS1</td>
<td>Arc 1+</td>
</tr>
<tr>
<td>Arc 2-</td>
<td></td>
</tr>
</tbody>
</table>

**From:**
- PS

**In:**
- Shaft TA1

**To:**
- Shaft SB1
- Shaft SC1

**Install “Goulotte”**
- EL
- ELC

**New:**
- PPS
- EL Maint. + AUG

**Toilet renovation in BA1**

**Dry riser in Shaft 1**

**“Goulotte”, dry riser and new fire extinguishers in TT10**
LS2 – SPS @ BA3

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

<table>
<thead>
<tr>
<th></th>
<th>Provisional quantity [km]</th>
<th>Provisional quantity of cables</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPS point 3</td>
<td>321</td>
<td>4171</td>
</tr>
</tbody>
</table>

The works are ongoing according to planning.
LS2 – SPS @ BA5 ... decabling

- **On-going activity**
  - Kicker transmission lines installation (**81 cables** of 93 installed)

- **De-cabling 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
LS2 – LHC ... 1\textsuperscript{st} 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.
  ✓ EIQ@cold didn’t show NCs 3 NC @ warm being investigated.
  ✓ DISMAC started as planned as well as magnet replacements.
LS2 – LHC: main project is DISMAC
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

June’19
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

- **S 2-3**: x 5 dipoles exchange, x 1 LECL 11R2 removal for cryo assembly installation
- **S 3-4**: x 1 dipole exchange, x 3 Quadrupoles exchange
- **S 4-5**: x 1 dipole exchange
- **S 6-7**: x 1 dipole removal for 11T installation
- **S 7-8**: x 1 dipole for 11T installation

**Total**
- 19 Dipoles exchange
- 2 Dipoles removal for 2x11T full assembly installation
- 2 CC removal for 2x cryo assembly installation
- 3 Quadrupoles exchange

- **9/26** reinstalled
- **11/26** removed
During removal the polythene broke into 3 parts, 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.)

LS2 Committee (LS2C)
*Fortnightly*
- Recurrent Items on Safety, Integration, Configuration Management, Scheduling and Logistics
- Special topics
  - Issues: delays / technical / organizational
  - General interest: readiness, safety organization or rules, status of a system...
- AOB
  - Short announcements
  - New activities

LS2 executive meeting
*Weekly: LS2 team (+DH)*

LS2 team
Facility coordinators
Projects: LIU, HL-LHC, SPS fire, EA renovation...
Departments Groups
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
The LS2 schedules and dashboards - LHC version 1.4

<table>
<thead>
<tr>
<th>Sector 12</th>
<th>Sector 23</th>
<th>Sector 34</th>
<th>Sector 45</th>
<th>Sector 56</th>
<th>Sector 67</th>
<th>Sector 78</th>
<th>Sector 81</th>
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<tbody>
<tr>
<td>PS1</td>
<td>PS18</td>
<td>PS12</td>
<td>PS2</td>
<td>PS23</td>
<td>PS36</td>
<td>PS46</td>
<td>PS58</td>
</tr>
</tbody>
</table>

**Tests (Powering, Electrical, Leak) and Warm-up**

- Main LHC interventions
  - 10-13 months per sector at room temperature

**Cool-down**

**Powering tests (including training)**

**Beam commissioning**

**Sequencing beginning LS2 (5 months)**
- Powering tests and training quench campaign
- Machine Lockout:
  - Cryogenics preparation for Christmas closure & cryo reconditioning after Christmas
  - EIOA @ cold
  - Warm up at ambient temperature
  - Vacuum leak tests & Inspection (IV and BV)
  - Cryoplant capacity tests
  - EIOA @ warm
  - Tightness tests and cryo lockout

**Sequencing End LS2 (11 months)**
- Pressure tests
- EIOA @ warm
- Vacuum leak tests & BV inspections
- Cool down & vacuum leak tests
- Machine levelling (survey) at cold
- EIOA @ cold
- DSO test (16th Oct. 2020)
- Powering tests and training quench campaigns
  - Machine to 3 shifts BE-OP → W44-2020

**CERN LS2 Coordination**

**June’19**
# The Safety execution - LS2 Accidents

<table>
<thead>
<tr>
<th>Description</th>
<th>All</th>
<th>Minor</th>
<th>With absence</th>
<th>Days of absence</th>
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<tbody>
<tr>
<td>Collision, false movement</td>
<td>2</td>
<td>2</td>
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<td></td>
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<tr>
<td>Electricity</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Fall</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
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<tr>
<td>Handling and Manipulation</td>
<td>7</td>
<td>2</td>
<td>5</td>
<td>114</td>
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<tr>
<td>Hand tools and Power tools</td>
<td>6</td>
<td>6</td>
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<tr>
<td>Machine tools</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>42</td>
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<tr>
<td>Object in Movement</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Vehicles</td>
<td>1</td>
<td>1</td>
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<tr>
<td><strong>Total</strong></td>
<td>26</td>
<td>17</td>
<td>9</td>
<td>171</td>
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</table>
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

<table>
<thead>
<tr>
<th>Workers</th>
<th>1000</th>
<th>~1500</th>
<th>2000</th>
<th>LS1</th>
<th>Industrie**</th>
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<tr>
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<tr>
<td>Frequency</td>
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<td>6.8</td>
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<td>8.4</td>
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<td>0.13</td>
<td>0.10</td>
<td>0.07</td>
<td>0.8</td>
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</table>

* Data until May 2019 included

** France, Caisse nationale d’assurance maladie des travailleurs salaries, 2
The main LHC 2019-2020 consolidations (DISMAC)

- 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

Diodes Insulation and Superconducting MAgnets Consolidation

**Project involving > 150 FTE at peak**
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]

All standard qualification tests passed:
- The fault was successfully eliminated