Overview of LS2 period for LHC, SPS, PS&TT2, PSB

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EN-ACE-OSS team
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- Major changes

LS2 for LHC, SPS, PS&TT2, PSB
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- Activities on the critical path
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Conclusions
The LS2 PERIOD includes:
- Extended Year End Technical Stop (EYETS) 2016-2017
- Year End Technical Stop (YETS) 2017-2018
- Long Shutdown 2 (LS2)
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EYETS 2016-2017

LHC

In addition to the baseline fixed for the YETS, there was a request from CMS to anticipate works of LS2, to prepare the Experiment to cope with the $2 \times 10^{34}$ cm$^{-2}$s$^{-1}$ luminosities. These works imply the full opening of the Endcaps and impact the duration of the YETS, which become an Extended YETS

→ From 12th Dec. 2016, to 23rd April 2017 (including HWC & Machine checkout)

→ 19 wks (including Xstmas Break)

INJECTORS

For the SPS, PS and the PSB, the duration is aligned to the LHC

The Injectors benefit from the Extended YETS of the LHC to maximize the activities related to the de-cabling project in the PSB and the SPS, and to anticipate activities related to LIU project

The starting date of the EYETS does not change for Injectors → From Monday 12th December

The additional week is allocated to working time
Overview of the EYETS 2016-17


EDMS 1470895

<table>
<thead>
<tr>
<th>Machines</th>
<th>Opening of the machine (weeks) not including the Xmas break</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linac2</td>
<td>9.5</td>
</tr>
<tr>
<td>PSB</td>
<td>11.5</td>
</tr>
<tr>
<td>PS</td>
<td>13.5</td>
</tr>
<tr>
<td>SPS</td>
<td>11.5 (BA1,BA2) – 12.5</td>
</tr>
<tr>
<td>LHC</td>
<td>17</td>
</tr>
</tbody>
</table>

**EYETS 2016-2017**

<table>
<thead>
<tr>
<th>Accelerators</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linac2</td>
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<td></td>
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<td>Linac3</td>
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<td>LEB</td>
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<tr>
<td>PSB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LHC</td>
<td></td>
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</tr>
</tbody>
</table>

**Experimental Areas**

- PSB ISOSE
- PS East Area
- PS nTOF
- PS AC
- SPS AWAKE
- SPS H Rück
- SPS North Area

**Opening of the machine**

- Linac2: 9.5 weeks (not including Xmas break)
- PSB: 11.5 weeks
- PS: 13.5 weeks
- SPS: 11.5 weeks (BA1,BA2) – 12.5 weeks
- LHC: 17 weeks

**Timeline**

- 7th November 2016 - Marzia Bernardini
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Overview of the YETS 2017-18

- 13 weeks beam to beam stop for the LHC
- Xenon physics for the North Area
- 3 weeks for commissioning (hardware tests + cold check-out + beam commissioning) in the injectors before beam ready for the LHC

<table>
<thead>
<tr>
<th>Machines</th>
<th>Opening of the machine (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linac2</td>
<td>7</td>
</tr>
<tr>
<td>PSB</td>
<td>7.5</td>
</tr>
<tr>
<td>PS</td>
<td>7.5</td>
</tr>
<tr>
<td>SPS</td>
<td>7 (BA1, BA2) – 7.5</td>
</tr>
<tr>
<td>LHC</td>
<td>9</td>
</tr>
</tbody>
</table>

Machines Opening of the machine (weeks) not including the xmas break of 2 weeks

YETS 2017-2018
Open questions for the LHC-YETS 2017-18

- Following the YETS 2015-2016 the management requested to empty all the LHC sectors from Liquid Helium (20 K) → new!
- To do so, minimum 10 days are needed BEFORE the Xmas closure → new!
- Cryogenics & CV maintenance needs 10 full weeks during the YETS
- UPS tests and a complete ELQA campaign on 13kA and DSLC is added to the baseline → new!
- The duration of powering tests and machine checkout has been extended from 1wks to 2wks

The duration of the YETS 2017-2018 for LHC should be reviewed to include the new requests → proposed discussion/decision in Chamonix 2017
LHC-YETS duration: the frame

- CV maintenance in the LHC and its Experiments
- Safety tests (mainly during Christmas Break)
- Regular maintenance on cryogenic equipment and rotating machines
- LHC Recommissioning

Regular maintenance activities on other equipment are performed in the shadow of the activities listed above.

HL-LHC & consolidation projects will profit from the YETS
WP4 - Accelerating cavities and RF systems

- Install Cryo Module DQW in SPS for testing before installation @ LHC

WP14 - Beam Transfer & Kickers

- Install MKI prototype @ P2 or P8
SPS-YETS duration: the frame

- Hardware tests (mainly magnet tests) before and after the shutdown → 2 wks
- CV maintenance for SPS (not including North Area) → 6 wk
- Activities related to Recommissioning by BE-OP → 3 wk can be considered as a baseline (this duration can evolve)
- The safety tests by BE-ICS and EN-EL

Regular maintenance activities on other equipment are performed in the shadow of the activities listed above

Consolidation & LIU will implement modifications during this period

→ In conclusion, the minimum length (beam to beam) of the YETS for the SPS is 13 wk* (including the Christmas Break)
* The RP cool down period is not included
SPS-YETS: major changes

### Project Details

<table>
<thead>
<tr>
<th>Title</th>
<th>PLAN</th>
<th>Facility</th>
<th>Location</th>
<th>Group</th>
<th>Contact</th>
<th>SRR</th>
<th>SRR status</th>
<th>ECR</th>
<th>ECR status</th>
<th>Installation period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decabling</td>
<td>Partial decabling in SPS 5</td>
<td>11181</td>
<td>SPS</td>
<td>LSS5</td>
<td>EN-ACE</td>
<td>Gerard Cumer</td>
<td>N/A</td>
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<td>N/A</td>
<td>YETS 2017-2018</td>
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<tr>
<td>HL-LHC</td>
<td>Installation of a crab-cavity cryomodule and related infrastructure in LSS6</td>
<td>10843</td>
<td>SPS</td>
<td>LSS6</td>
<td>BE-RF</td>
<td>Giovanna Vandoni</td>
<td>SPS-LJ-EC-0004</td>
<td>RELEASED</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>LIU</td>
<td>New RF power feeder line in SPS point 3 shaft</td>
<td>10836</td>
<td>SPS</td>
<td>BA3</td>
<td>BE-RF</td>
<td>Eric Montesinos</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>SPS-LJ-EC-0005</td>
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<tr>
<td>LIU</td>
<td>aC coating and flange impedance reduction</td>
<td>0</td>
<td>SPS</td>
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<td></td>
<td></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

For LIU activities refer to Simon’s talk
PS&TT2 and PSB-YETS duration: the frame

- Hardware tests (mainly magnet tests) before and after the shutdown → 1wk
- CV maintenance for PSB, PS, Linac2 and Linac4 (not including Isolde, AD, East Area, CTF3 and n-TOF) → 5wks
- Activities related to Recommissioning by BE-OP → 3wks can be considered as a baseline, but this duration can evolve
- The safety tests by BE-ICS and EN-EL

Regular maintenance activities on other equipment are performed in the shadow of the activities listed above

Consolidation & LIU will implement modifications during this period

→ In conclusion, the minimum length (beam to beam) of the YETS for the PS and the PSB is **11 wk** (including the Christmas Break)

* The RP cool down period is not included
# PS&TT2 and PSB-YETS: major changes

## PS&TT2

<table>
<thead>
<tr>
<th>Project</th>
<th>Title</th>
<th>PLAN</th>
<th>Facility</th>
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<th>Group</th>
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<th>Integration</th>
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<th>ECR</th>
<th>ECR status</th>
<th>Installation period</th>
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<tbody>
<tr>
<td>Consolidation</td>
<td>3 Material Double-Doors Entrance to SWY and PS Ring</td>
<td>0</td>
<td>PS</td>
<td>EN-ACE</td>
<td>Simon Mataguaz</td>
<td>In progress</td>
<td>N/A</td>
<td>YETS 2017-2018</td>
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<tr>
<td>Consolidation</td>
<td>Installation of New Power Converters for the PS 40 and 80 MHz RF Cavities (4 racks)</td>
<td>11135</td>
<td>PS</td>
<td>355</td>
<td>TE-EPC</td>
<td>Serge Pittet</td>
<td>Completed</td>
<td>N/A</td>
<td>PS-R-EC-0001</td>
<td>UNDER APPROVAL</td>
<td>YETS 2017-2018</td>
</tr>
<tr>
<td>LIU</td>
<td>New Fast BWS prototype in SS54 10434</td>
<td>PS</td>
<td>SS54</td>
<td>BE-BI</td>
<td>Ana Guerrero</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LIU</td>
<td>Installation of vertical Beam Gas Ionization (BGI) Beam Profile Monitor for the PS Ring (New BGI, 2 new magnets)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
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## PSB

<table>
<thead>
<tr>
<th>Project</th>
<th>Title</th>
<th>PLAN</th>
<th>Facility</th>
<th>Location</th>
<th>Group</th>
<th>Contact</th>
<th>SRR</th>
<th>SRR status</th>
<th>ECR</th>
<th>ECR status</th>
<th>Installation period</th>
</tr>
</thead>
</table>
| LIU | - Booster Injection Qstrip converters  
- Booster Injection Corrector Powering  
- Booster Injection Quadrupole Powering  
- MidiDiscap | 10304 10307 10308 10314 | PSB | 361 BCER | TE-EPC | Serge Pittet | N/A | N/A | Draft | IN WORK | YETS 2017-2018 and LS2 (be ready YETS 2016-2017) |
| LIU | New SEMGrid in sector 4 | 10071 | PSB | period 4 L1 ring 3 | BE-BI | Christophe Violet | PSB-UN-EC-0004 | RELEASED | | | YETS 2017-2018 |

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**CERN Days**  
7th November 2016 - Marzia Bernardini
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Master schedule of LS2
EDMS ACC-PM-MS-0002 v.1.0
LHC-LS2 the frame

During the LS2, three main categories of activities will be implemented

- Projects: HL-LHC
- Consolidation & Other activities: this could concern all equipment of the LHC machine

The frame

- Warm up at ambient Temperature of the Machine, and related tests (Powering tests, ELQA, vacuum, …)
- Cool down & related tests (Powering tests, ELQA, vacuum, …)
- CSCM
- LSS3 and LSS7 → according RP cool down
LHC-LS2 the frame
HL-LHC during LS2

WP4 - Accelerating cavities and RF systems
- Dismantling Cryo Module DQW in SPS
- Install Cryo Module RFD in SPS for test

WP5 – Collimation
- Install 8 units of TCSPM @P7
- Install 4 units of TCLD @P2 & P7

WP7 - Machine Protections
- Install Quench Detection System [QDS] for the 11T @P7

WP8 - Collider Experiment interface
- Dismantling old TAXN and install new TAXN at both sides @ LHCb
- Install radiation Shielding @ATLAS and CMS (Option to advance the activity from LS3)

WP9 – Cryogenics
- Install new Cryo Station @P4

WP11 - 11T DS dipole
- Install 4 units of 11T dipole and 2 units of LEN bypass cryostat @P7
- Install 2 units of LEN bypass cryostat and 4 units LEP connection @P2

W12 - Beam Vacuum
- In-situ a-Coating @P2 & P8

WP13 - Beam Diagnostics
- Install BPW prototype and BGV prototype

WP14 - Beam Transfer & Kickers
- Install 6 TDIS
- Install 2 TCDD @ P2 & P8
- Coated installation in all MKIs

WP17.1 - Civil Engineering
- Build underground structures @P1 & P5
- Build surface structures @P1 & P5
LHC-LS2 main changes

Presently NO Space Reservations and no ECR are issued or validated for LS2 for LHC 😞

- The only approved ECR is related to lifts replacement EDMS 1529672

- The replacement of TCDI and BLM is part of LIU project, but will be implemented in LHC side

NEED to fix a deadline for ECR → proposal Q1-2018
LHC-LS2 activities
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>SPS Shutdown (19.5 months + 2 weeks of Xmas break 2019-2020)</td>
</tr>
<tr>
<td></td>
<td>aC Coating campaign</td>
</tr>
<tr>
<td></td>
<td>Available</td>
</tr>
<tr>
<td></td>
<td>RF Upgrade Work in LSS3 (RF+CV+EL+Magnets+transport+vacuum)</td>
</tr>
<tr>
<td></td>
<td>New Beam Dump Installation (Passage through BA5 completely blocked for the entire LS2)</td>
</tr>
<tr>
<td></td>
<td>Renovation</td>
</tr>
</tbody>
</table>

**Stop cooling & Access granted in SPS**

**End of physics and all beams stopped**

**Close SPS**

**Beam ready for LHCf**
SPS-LS2: major changes

<table>
<thead>
<tr>
<th>Project</th>
<th>Title</th>
<th>PLAN</th>
<th>Facility</th>
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<th>Group</th>
<th>Contact</th>
<th>ECR</th>
<th>ECR status</th>
<th>Installation period</th>
<th>Installation status</th>
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</thead>
<tbody>
<tr>
<td>Consolidation</td>
<td>Renovation of the Access System</td>
<td>10036</td>
<td>SPS</td>
<td></td>
<td>BE-ICS</td>
<td>Tomasz Ladzinski</td>
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<td>LS2</td>
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<td>Consolidation</td>
<td>New fireproof doors</td>
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<td>SPS</td>
<td></td>
<td>BE-OP</td>
<td>James Ridewood</td>
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<tr>
<td>Consolidation</td>
<td>Consolidation of B-Train Systems</td>
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<td>PSB</td>
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<td>BE-RF</td>
<td>Marco Buzio</td>
<td>ACC-MTGBM-EC-0001</td>
<td>UNDER APPROVAL</td>
<td>LS2</td>
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<tr>
<td>Consolidation</td>
<td>Replacement of the irradiated cables in TDC2-TCC2</td>
<td>10322</td>
<td>SPS</td>
<td>TDC2, TCC2</td>
<td>EN-EL</td>
<td>Jean-Claude Guillaume</td>
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<tr>
<td>Consolidation</td>
<td>Replacement of the irradiated cables in TS2+ or TS4+ or TS6-</td>
<td>10366</td>
<td>SPS</td>
<td>TS2+ or TS4+ or TS6-</td>
<td>EN-EL</td>
<td>Jean-Claude Guillaume</td>
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<tr>
<td>Consolidation</td>
<td>Renovation of the &quot;monte-charge&quot;</td>
<td>0</td>
<td>SPS</td>
<td>BA3, BA6</td>
<td>EN-HE</td>
<td>Nicolas Perez</td>
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<td>LS2</td>
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<tr>
<td>Decabling</td>
<td>Final decabling in SPS 5</td>
<td>11181</td>
<td>SPS</td>
<td>LS55</td>
<td>EN-ACE</td>
<td>Gerard Cuman</td>
<td></td>
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<td>LS2</td>
<td></td>
</tr>
</tbody>
</table>

...and **HUGE** number of changes related to LIU

→ refer to Simon’s talk
SPS-LS2: critical path

LSS5
- New Beam Dump reconfiguration

Co-activities potential issues, due to the impressive volume of activities to be performed (access system consolidation, aC coating, …)

The on site follow up must be well prepared
Considering the major changes related to LIU in the PS and PSB, and the connexion of the Linac4, several months are allocated for the re-commissioning of the machines!
PS&TT2-LS2: major changes

...and **HUGE** number of changes related to LIU

⇒ refer to Simon’s talk
PS&TT2-LS2: critical path

The limited space in the PS magnet workshop could be a bottleneck to perform the refurbishment of 44 main units!

Half of the PS machine!
## PSB-LS2: major changes

<table>
<thead>
<tr>
<th>Project</th>
<th>Title</th>
<th>Plan</th>
<th>Facility</th>
<th>Location</th>
<th>Group</th>
<th>Contact</th>
<th>ECR</th>
<th>ECR status</th>
<th>Installation period</th>
</tr>
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<tbody>
<tr>
<td>Consolidation</td>
<td>Consolidate the PSB chilled water cooling plant</td>
<td>10427</td>
<td>PSB</td>
<td>EN-CV</td>
<td>Stefano Moccia</td>
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<td>Consolidation</td>
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<td>PSB</td>
<td>EN-CV</td>
<td>Stefano Moccia</td>
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<td>Consolidation</td>
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<td>EN-CV</td>
<td>Stefano Moccia</td>
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<tr>
<td>Consolidation</td>
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<td>PSB</td>
<td>TE-MSC</td>
<td>Marco Buzio</td>
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<td>UNDER APPROVAL</td>
<td>LS2</td>
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<tr>
<td></td>
<td>New BHZ EXT</td>
<td>10936</td>
<td>PSB</td>
<td>TE-MSC</td>
<td>Antony Newborough</td>
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<tr>
<td></td>
<td>Upgrade of the Main Ring Bending and Quadrupole magnets for 2 Gev</td>
<td>10937 (coil shimming and side plates)</td>
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<td>TE-MSC</td>
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<td>N/A</td>
<td>LS2</td>
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<tr>
<td></td>
<td></td>
<td>10942 (new magnets and removal of BTM, BHZ10)</td>
<td>PSB</td>
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<tr>
<td></td>
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<td>11020 (new magnets)</td>
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<td></td>
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<td>N/A</td>
<td>LS2</td>
<td></td>
</tr>
</tbody>
</table>

...and **HUGE** number of changes related to LIU → refer to Simon’s talk
**PSB-LS2: major changes**

*PSB Injection Systems:*
- New Injection bending BHZ INJ
- New Distributor BI.DIS
- New Septa BI.SMV
- Modification of the beam instrumentation BI.BTV30
- Change the magnets

*New PSB Injection Region*
- Remove the current sector 1L1
- New H- charge exchange injection systems

*PSB Extraction and Transfer:*
- New BHZ EXT
- New septum (BT.SMV10 and BT.SMV20)
- Modification of the beam instrumentation (BT.BTV1 and BT.BTV30)
- New kicker (BT.KFA10)
- Change the magnets

*New Absorber/Scraper*

*New finement cavities (BR2&4.C02 7L1 and BR1&3.C02 10L1)*

*New finement cavity (BRr.C04 13L1)*

*New extraction kicker BEr.KFA (14L1)*

*Under studies:*
- Change of the beam stoppers
- New vacuum window before the PSB Dump

- New RF bypasses
- New BHZ jacks
- Laminated side plate on bending BHZ MAIN
- Parallel shunt resistors on quadrupoles QDE, QFO and bending BHZ MAIN magnets

*LIU Project*
Consolidation
Additional activities

**CERN**

**LS2 Days**

7th November 2016 - Marzia Bernardini
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Conclusions
Linac4 & PSB-LS2: connection

1. **Linac4**
   - Complete Linac4 transfer line (L4T)

2. **Linac2**
   - Partial dismantling of Linac2
   - Connection of the Linac4 to BHZ20

3. **PS Switch Yard**
   - New LBE line

4. **PSB**
   - Upgrade of the injection line (BI)
   - Upgrade of the injection period (1, 2, 16)

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7th November 2016 - Marzia Bernardini
The de-cabling campaign of the PSB is scheduled during the EYETS 2016-2017 which means that an early upgrade of the PSB machine for the 160 MeV connection of the Linac4 cannot start before end of March 2017.

6 months are needed to make a 160 MeV connection of the Linac4 to the PSB and 9 months in total are needed for the shutdown, hardware commissioning tests and beam commissioning.
# Decabling Project

**EDMS:** 1686452

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| **SPS**         |          |           |          |            |          |           |          |               |
| Cable identification | PREPARATION | IDENTIFICATION |      |            |          |           |          |               |
| Cable labeling    |          | LABELLING |          |            |          |           |          |               |
| Cable disconnection |          | DISCONNECTION |      |            |          |           |          |               |
| Cable removal   |          | SPS-5 REMOVAL (left side) | |            |          |           |          | SP5-5 (right side) & SP5-3 REMOVAL |

| **PS (CA) & TT2** |          |           |          |            |          |           |          |               |
| Cable identification | PREPARATION PS CA | IDENTIFICATION PS CA | PREPARATION TT2 |          |          |           |          |               |
| Cable labeling    |          | LABELLING PS CA |          |            |          |           |          |               |
| Cable disconnection |          | DISCONNECTION PS CA |      |            |          |           |          |               |
| Cable removal   |          | REOMOVAL PS CA Phase 1 | |            |          |           |          |               |
|                   |          | REMOVAL TT2 Optional |      |            |          |           |          |               |

7th November 2016 - Marzia Bernardini
De-cabling project

**YETS 2017-2018**

**PS**

- Removal campaign in « centre anneau » of the cables identified during the EYETS 2016-2017
- Completion of the identification of obsolete cables in the PS

**TT2**

- Identification of obsolete cables, for a removal campaign during LS2 (ressource TBC by EN-EL)

**PSB & SPS5-**: if needed, completion of the removal campaigns

**LS2**

**PS**

- Removal of cables in « centre anneau »
- Removal of obsolete cables in TT2 and PS (if time and resources available)

**SPS**

- Removal of cables in SPS3, SPS5+,
Conclusions

• The EYETS 2016-2017 and the YETS 2017-2018 are mainly dedicated to the annual maintenance in the LHC and its Injectors. Nevertheless major projects as the de-cabling project, LIU and HL-LHC will benefit from these periods of time to anticipate the activities related to LS2

• The duration of the YETS 2017-2018 for LHC should be revised (Chamonix)

• The LS2 will allow the completion of major activities related to LIU and HL-LHC

• The LS2 in the Injectors is mainly dedicated to the implementation of the LIU project, and its preparation is really well advanced!

• The LS2 in the LHC is mainly dedicated to major maintenance, HL-LHC and civil engineering activities in preparation of LS3

• For the time being no ECR and or space reservations have been issued from projects, for the LHC activities during LS2…

• A huge number of activities related to consolidation, maintenance and upgrade appears: resource allocation between all the activities is being assessed thanks to Plan Tool