Framework Schedule from EYETS 2016 to LS2

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LHC Performance Workshop
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Contents

General information
YETS and EYETS
  - activities related to the regular maintenance
  - length of the YETS and EYETS for the LHC and its Injectors
LS2
  - Framework for the LHC
  - Framework for its Injectors
Methodology & Interfaces with EN-ACE
LS2 Milestones
Conclusions
Overview

The LS2 PERIOD includes:
- Extended Year End Technical Stop (EYETS) 2016-2017
- Year End Technical Stop (YETS) 2017-2018
- Long Shutdown 2 (LS2)
General information

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Methodology & Interfaces with EN-ACE

LS2 Milestones

Conclusions
YETS duration: the frame

LHC

- CV maintenance in the LHC and its Experiments → 10 wk
- Safety tests (mainly during Christmas Break) by GS-ASE and EN-EL
- Minor regular maintenance on cryogenic equipment and rotating machines
- LHC Recommissioning → 1 wk can be considered as a baseline if no major intervention occurs during the YETS (the revision of the duration is under discussion)

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

→ In conclusion, the minimum length (beam to beam) of the YETS for the LHC is 13 wk (including the Christmas Break)
YETS duration: the frame

SPS
- Hardware tests (mainly magnet tests) before and after the shutdown → 2 wk
- 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

→ 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
YETS duration: the frame

PSB & PS
- Hardware tests (mainly magnet tests) before and after the shutdown \( \rightarrow 1 \text{wk} \)
- CV maintenance for PSB, PS, Linac2 and Linac4 (not including Isolde, AD, East Area, CTF3 and n-TOF) \( \rightarrow 5 \text{wks} \)
- Activities related to Recommissioning by BE-OP \( \rightarrow 3 \text{wks} \) 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

\( \rightarrow \) 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
EYETS 2016-2017: the frame

LHC

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

INJECTORS

The Injectors benefit from the Extended YETS of the LHC to maximize the activities related to the decabling project in the PSB and the SPS, and to anticipate activities related to LIU project.
EYETS 2016-2017

- For the LHC the duration of the EYETS is 19 wks
- For the SPS, PS and the PSB, the duration is aligned to the LHC. This is due to the requests concerning:
  - the decabling project and its implementation strategy;
  - the anticipation of LIU activities during the EYETS

*These durations includes the tests and HWC periods*
YETS 2017-2018

- For the LHC & the SPS: YETS kept to 13 wks
- For the PSB and the PS, the duration is aligned to the LHC and the SPS. This is due to the requests concerning:
  - the decabling project and its implementation strategy;
  - the anticipation of LIU activities during the YETS

<table>
<thead>
<tr>
<th>LHC Injectors</th>
<th>2017 Q4</th>
<th>2018 Q1</th>
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</thead>
<tbody>
<tr>
<td>November</td>
<td>December</td>
<td>January</td>
</tr>
<tr>
<td>45, 46, 47, 48, 49, 50, 51, 52</td>
<td>1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12</td>
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<td>PROTONS Physics</td>
<td>North Area Xenon physics</td>
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<td>Linac2</td>
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<td>PSB</td>
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<td>Linac3</td>
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<tr>
<td>PS</td>
<td>PS + BA1</td>
<td>PS + BA1</td>
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<tr>
<td>LHC</td>
<td>LHC3-7, IT</td>
<td>LHC3-7, IT</td>
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</tbody>
</table>

Duration of YETS 2017-2018

- LHC Performance workshop 2016 - https://indico.cern.ch/event/448109/
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Methodology & Interfaces with EN-ACE

LS2 Milestones

Conclusions
LS2 Framework for the LHC

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

LS2 Days: https://indico.cern.ch/e/436424

The Baseline – as for Chamonix 2014 – foresaw a length of LS2 of 18 months, but following the requests of the HL-LHC project and the outcomes of the cost and schedule review, the Length of LS2 has been extended to 24 months.

PLAN tool is the database used to “build” the schedules concerning the LS2 period.
Inputs* in PLAN tool - LHC  

* Only activities included, NO contribution

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Data in PLAN Tool - LHC

...not weighted data, but huge numbers related to maintenance & upgrade

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LHC Performance workshop 2016 - https://indico.cern.ch/event/448109/
HL-LHC Installation Overview for the LS2

Activities in:
- LSSs 2, 4, 6 and 8
- Civil Engineering in Points 1 and 5

Courtesy Paula Alvarez Lopez – LS2 Days

New transp. refrigerator
New Q5
TCSPM
Cryo-bypass+TCLD

In-situ a-C coating
Mask for D2
TAXN

Prep. works halo diagnostic systems
High bandwidth pick-ups
Fast wire scanners
BGV
TDIS
Mask for D1

LHC Performance workshop 2016 - https://indico.cern.ch/event/448109/
HL-LHC Civil Engineering @ P1 & P5

For HL-LHC, LS2 will be the period of D(TH)RILLING!

The impact and the final scope of the civil engineering works is not yet finalized.

If the connections between the present LHC and the new galleries are realized during LS2, the impact on the other activities in Points 1 and 5 during LS2 needs to be assessed.
Depending on the cool down and warm up sequence,
the available window for the activities is between **18 to 22 months**
Inputs* in PLAN tool - Injectors

* Only activities included, NO contribution

Data in PLAN Tool - PSB, PS&TT2, SPS

![Bar chart showing the number of activities in PLAN tool for different years and categories: Maint & Upgrade, Cons, LIU.](https://indico.cern.ch/event/448109/)
LS2 Framework for Injectors
Defined by LIU project

Start of the LS2 for the Injectors:

- Surface activities for the Linac2, the Linac4 and the PSB machines will start in **November 2018 on surface**, during tunnel RP cooling.

- All other surface activities for the PS and the SPS will start at the end of the ion run, in **December 2018**.

**Courtesy Julie Coupard**
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Methodology & Interfaces with EN-ACE

LS2 Milestones

Conclusions
Methodology and Interfaces with EN-ACE

Management of the configuration relative to the machines (Space reservation, Engineering Change Request, Functional Specification, Engineering Specification, Installation Procedure, Tests Procedure etc…)

Update of the layout databases

Central information of the 3D models between all design office (services, mechanical etc…)
Identification of the interferences
Non-conformities of installation

Central information of the activities to schedule taking into account the logistic and operational safety aspects

Follow-up of the documentation (Space reservation, Engineering Change Request, Functional Specification, Engineering Specification, Installation Procedure, Tests Procedure etc…)
Follow-up of the Non-conformities of installation
Methodology and Interfaces with EN-ACE

COORDINATION & SCHEDULING

- Inside EN-ACE-OSS three working units
  - the LHC
  - its Injectors (SPS, PS ring&TT2, PS Booster, Linac4)
  - the Projects (EHN1, SM18, De-cabling, …)

- Coordination meetings are held by the different Facility Coordinators to plan the activities during the YETS, the EYETS and the LS2

- Groups announce their activities (approved in PLAN tool) - technical, safety aspects and interfaces are discussed

- Facility Coordinators gradually refine the schedule and the organization

- VIC and Risk assessment: under the responsibility of the Works and Services Supervisor

  GENERAL SAFETY INSTRUCTION GSI-WS-1
  SAFETY COORDINATION FOR WORKS AND SERVICES
  Implemented as from the 1st of June 2016

  “Work and Services Supervisor: person under the responsibility of the Project Leader or the organic unit responsible for the contract who monitors a specific activity in an operation on behalf of CERN.”
Methodology and Interfaces with EN-ACE

From Space Reservation (Project Phase) to ECR (Installation Phase)

Space reservation
- Existing situation and introduction
- Reason for change
- Detailed description
- Impact on other items
- References

ECR
- Existing situation and introduction
- Reason for the change
- Detailed description
- Impact on other items
  - Impact on items/systems
  - Impact on utilities and services
- Impact on cost, schedule and performance
- Impact on operational safety
  - Elément(s) important(s) de sécurité
  - Other operational safety aspects
- Worksite safety
  - Organization
  - Regulatory tests
  - Particular risks
- References
Global picture

Courtesy K. Foraz – LS2 days
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Methodology & Interfaces with EN-ACE

LS2 Milestones

Conclusions
**LS2 Project: Main Dates and Milestones**

<table>
<thead>
<tr>
<th>Yearly “LS2 day” as of 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities declared in Plan by end’15 both for injectors and LHC;</td>
</tr>
<tr>
<td>March’16, definition of activities for EYETS 2016;</td>
</tr>
<tr>
<td>Mid’16, definition of activities for YETS 2017 and LS2;</td>
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<tr>
<td>LS2 readiness review – mid 2018</td>
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</tbody>
</table>
Conclusions

• The YETS and EYETS 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 activities related to LS2.

• The LS2 duration has been re-adjusted to allow the completion of major activities related to LIU and HL-LHC:
  • From 18 months to 24 (+4) months for LHC & its Injector chain
  • The LS2 in the Injectors is mainly dedicated to the implementation of the LIU project
  • The LS2 in the LHC is mainly dedicated to major maintenance, HL-LHC and civil engineering activities in preparation of LS3

• …nevertheless a huge number of activities related to consolidation, maintenance and upgrade appears: resource allocation between all the activities should be assessed

• A consolidated list of tasks must be prepared to draft the first preliminary schedules