LHC Injectors Upgrade Workshop

Montreux, 13-15 February 2019
PSB

Content

• LS2 Timeline and Organisation
• LS2 Master, Baseline Schedules and Activities
  • De-cabling, Cabling & Consolidation (EN-EL)
  • Finemet Cavity Installation (BE-RF)
  • Injection and Extraction Upgrade (TE-ABT)
  • B.361 BHP Power Converters Refurbishment (TE-EPC)
• ECR and Integration Status
• Summary
• PSB LS2 has started
• EYETS 2016-2017 completed
• YETS 2017-2018 completed

EYETS and YETS were dedicated to the preparation of PSB infrastructure (decabling, civil engineering works (BSW transformer bunker), electrical systems) and advancing where possible LS2 LIU machine hardware installations (installation of LIU prototypes SEM grids and tune pick ups + Finemet)
ATC’s technically manage the on site coordination of activities involving multiple stakeholders. Activity Technical Coordinator Role described [https://indico.cern.ch/event/751429/]
LIU-PSB Structure Organigram described https://indico.cern.ch/event/791976/

Report on the status of PSB related LS2 activities.
5 weeks individual testing period identified
Ref slides J. Ridewood (session 3)
PSB Linear Schedule  

**Baseline**  [https://edms.cern.ch/document/1810496/2.0](https://edms.cern.ch/document/1810496/2.0)

---

**PS Booster LS2 schedule** - David Hay  
EN-ACE

---

**POPS-B Tests**

**Dismantling & Reinstallation Phase**

**Commissioning Phase**
**LS2 Machine Activities**

- **Remove RF cavities** (BR1.C02 10L1 & BR3.C02 10L1)
- **New Wire Scanner x4** (11L1)
- **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) & BT151L1

**Injection line BI:**
- New Injection bending (BHZ INJ)
- New Distributor (BI.DIS10)
- New Septa (BI.SMV10)
- Relocate beam instrumentation (BI.BTV30/40)
- Change of the magnets (BVTs, correctors)
- New BPMs
- New beam loss monitors
- New RF bypasses
  - Change the bending magnets (BT.BHZ10, BTM.BHZ10)
    - Change the beam stopper (BTP.STP10)
    - Upgrade magnets (quadrupoles) and add new corrector magnets

**Extraction line BT:**
- New extraction bending (BHZ EXT)
- New septum (BT.SMV10 and BT.SMV20)
- Relocate beam instrumentations (BT.BTV10)
- New kicker (BT.KFA10), Modify BT.KFA20
- Replace kicker KSW (16L4, 2L1)
- Change the magnets (BT.BVT10, BT.BVT20, BT.DVT10, quadrupoles)
- New beam loss monitors & BTV10 & 20
  - New vacuum window on BTM line before the PSB Dump

**Extraction line BTP:** *(Ref: PS&TT2 coordination)*
- Modification of the beam instrumentations
- New beam position monitor
- New beam loss monitors
- Change the quadrupoles

**All around the machine:**
- Laminated side plate on bending (BHZ MAIN)
- Parallel shunt resistors on quadrupoles (ODE, QFO) and bending (BHZ MAIN) magnets *(to be confirmed)*
- Cooling water pressure rating upgrade

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

**PS Booster LS2 schedule - David Hay**

EN-ACE
LS2 Surface Activities

- Consolidation of the cooling plant
- Consolidation of the chilled water cooling plant
- Refurbishment of the low voltage distribution system

New power converters
- Injection stripping foil chicane Bix.BSW
- Finemet cavities 7L1.
- New crates for the low level RF (BOR)
- RF Finemet cooling water circuits.

New PSB Inj power converters
- Injection QSTRIP
- Injection Correctors
- Injection Quadrupoles
- Injection Septa BI.SMV10

- Complete the metallic infrastructure for new layout of racks (BRF2)
- New power converters
  - Injection stripping foil chicane (Done)
  - Finemet cavities 5L1 (BRF2)

- Install new Bl. DIS10 PFN’s
- Upgrade the transverse feedback system
- New BIS, WIC interlock systems
- Cabling & Decabling

New PSB Inj power converters
- Injection QSTRIP
- Injection Correctors
- Injection Quadrupoles
- Injection Septa BI.SMV10

- Complete the metallic infrastructure for new layout of racks (BRF1)
- Finemet cavities 13L1 & 7L1 (BRF1)
Machine Opening and POPS-B test preparations

- LIU cable identification and disconnection campaign (All groups)
- Dismantle the BR-RF infrastructure in BRF1 & BRF2
- Exchange main magnet damping resistors (POPS B related) and perform magnet power tests (TE-MSC).
- Reconfigure and test the access control system and EIS for the POPS-B connection (BE-ICS) and perform DSO tests.
- Configure and power test the POPS-B main power converters (TE-EPC).
- Configure and power test the BT2.KFA20 kicker magnet (TE-ABT)
  - SF6 cable insulation leak – repaired
  - Magnet powering and field measurement tests postponed to the IST period
Main sources of radiation removed first (ALARA 3 committee validated):

- BI.SMH1L1 Septum & BHZ11 magnet
- BHZ161 & BHZ162 magnets (TE-MSC)
- BHZ151 & BSW15L1 magnets (TE-MSC, TE-ABT)
- Removal of the Injection transfer line (BI line) BI.SMV10 & BI.DIS10 are under preparation...
Dismantling of PSB injection region sector 1L1
ATC W. Weterings

- BI.SMH magnet stack and chassis removed
- BHZ11 and BHZ162 magnets removed.
- KSW1L1 removed.
- BI.SMH transformer removed to temp storage
- De-cabling completed

PS Booster LS2 schedule - David Hay
EN-ACE
EN-EL de-cabling campaign (10 weeks)
- 10 week campaign, works started 09/01/2019
- Baseline end date: 15/03/2019
- ~3000 cables to be removed.
- BRF1 & BRF2 (BE-RF) completed
- BCER and BOR advanced
- De-cabling periods 6 to 14 Completed
- De-cabling period 1L1 Completed
- De-cabling pits periods 5 and 13 in preparation
B.361 BHP (transfer lines) Power Converters Refurbishment (TE-EPC)

ATC Maxime Sardano

Current configuration

Post LS2 configuration

- LIU cable identification and disconnection campaign
- De-cabling is progressing well and per planning
- DC cable disconnection in preparation (BHP & BCER)
- Removal of the power converters 18/03/2019 to 01/05/2019
- Modifications to the rack structures 02/05/2019
Finemet Cavity Installation (BE-RF)
ATC Matthias Haase

- BRF2 platform is complete.
- Cavity 13L1 removed.
- Cavity 5L1 in progress

ECR https://edms.cern.ch/document/1733551/0.1
Renovation of the PSB cooling system (EN-CV)

ATC G. Petrika

Scope:
- New cooling towers;
- New cooling station (pumps, heat exchanges...);
- New electrical & control system;
- New instrumentation;
- Distribution network modifications
- Pressure rating upgrade;

ECR’s https://edms.cern.ch/document/1969784/0.1 & edms.cern.ch/document/1969788/0.1

Work progressing as planned
- B361 BRF1 cooling infrastructure removed – Done
- B289, chilled water primary station dismantling – Done
- B237, cooling station dismantling – Done
- Cooling tower dismantlement in progress
RF Finemet Cavities powering tests shall start before the IST period: Declared from end of November 2019
Injection and Extraction Upgrade (TE-ABT)

ATC W. Weterings

PS Booster LS2 schedule - David Hay
EN-ACE
LIU-PSB ECR status

Number of ECRs: 32
Number of needed ECRs: 1

Table: LIU-PSB Scope ECRs currently In Work or Needed

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
<th>Group</th>
<th>Contact</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>New BLMs installation in the LT, LTB and BI lines for H-exchange monitoring</td>
<td>BE-BI</td>
<td>Christos Zamantzas</td>
<td>NEEDED</td>
</tr>
</tbody>
</table>
LIU PSB Integration studies status

Total number of registered Integration Studies:
• 47

Number of LIU related Integration Studies:
• 43

Number of needed Integration Studies:
• 0

The completion of all the ECR and Integration study processes (*life Cycle*) depend on the input and quality of information provided by the design offices in each Group.
Summary

- The PSB Baseline schedule has been validated by all the groups and is released
  - 2019 is dedicated to the completion of the machine infrastructure installations
  - 2020 is dedicated to Individual system equipment tests (BE-OP and EN-ACE collaboration) and machine commissioning which shall start in March 2020
- Several work package activities and equipment readiness are critical path, (ref: presentation J. Meignan session 2)
- The dismantling sequence of the PSB BI, BT lines and sector 1L1 was validated by an ALARA 3 committee.
- Coactivity bottleneck has been identified in the BCER: Multi activities; including the transport and installation of the BI.DIS PFN’s (1.2t) which require the installation of a dedicated reinforced transport route.
- One important ECR is still required to complete the planning; (New BLM’s installation in the LT, LTB and BI Lines for H- exchange monitoring)
- Activity Technical Coordinator’s (ACT) and Work Site Supervisors (WSS) are operational; with their roles defined https://indico.cern.ch/event/751429/
- On site follow up and a strong collaboration between the WSS’s, ATC’s and the facility coordinators will be a key factor for a successful LS2
- The PSB LS2 is progressing per schedule.
Thank you Q’s
Back up slides
**EYETS 2016-2017** was dedicated to advancing LS2 hardware installations:

1. False floor & rack stabilisation project (EN-ACE)
2. De-cabling project (EN-EL)
3. 48vdc, UPS & 400V distribution project (EN-EL)
4. Removal of redundant machine cooling circuits project (EN-CV)
5. Civil engineering works (SMB)
   - Construction of the BSW transformer bunker (H- Injection)
   - Enlargement of the Injection area access shaft (BT.BHZ10)
YETS 2017-2018 was dedicated to the continued installation of LS2 hardware

1. BSW chicane stripping foil magnet power converter & transformers installation for H-injection assembly at 1L1 (SMB, EN-HE, EN-CV, EN-EL & TE-EPC collaboration)
2. LV consolidation campaign (EN-EL).
3. Installation of the LIU SEM grid tank in 4L1 & 3L1 Tune pickups prototypes (BE-BI)
4. Test of the “facility coordinator” electrical network separation procedure.
Injection and Extraction Upgrade (TE-ABT)
ATC Wim Weterings

PS Booster LS2 schedule - David Hay EN-ACE 30

1. Identify and disconnect cables (Groups)
2. Open vacuum (TE-VSC)
3. Survey (EN-SMM)
4. De-cable (EN-EL)
5. Dismantle infrastructure (TE-ABT, TE-MSC, Groups)
6. Consolidate and connect cooling water circuits (EN-CV)
7. Marking campaign (EN-SMM & Groups)
8. Drilling campaign (EN-ACE)
9. Install supports (EN-HE & Groups)
10. Align supports (EN-SMM)
11. Install infrastructure (Groups)
12. Align infrastructure (EN-SMM)
13. Cabling (EN-EL)
14. Close vacuum/pump and leak test (TE-VSC)
15. IST’s (TE-ABT and Groups)
Readiness on the Critical Paths and Constraints
Readiness on the Critical Paths and Constraints

- Coactivity bottleneck in the BCER
- BTM.BHZ10 readiness August 2019
- BT.KFA10 readiness July 2019
- KFA.14L1 readiness November 2019
- Cooling required wk47 for RF powering
- Missing ECR for the BLMs Difficult to schedule works
- LIU Scraper/ beam absorber readiness end December 2019
BE-RF PSB LS2 progress report

Transport under control.

BRF1 & 2 Ident and disconnection

LIU Ident and disconnection
Summary of Machine Activities Completed

Renovate electronics for 4 BR.BCTDC

- EN-EL Consolidation.
- Lighting
- Power
- New EBD switchboard

New BLMs (FIC detectors)

New ring Trajectory Measurement System (PSB-TMS)

Exchange Septum SMH (15L1)

Civil engineering works to enlargement of the shaft

New wideband electrostatic pick-up BPM (BTP.BPMW15)

4 New monitors BR.TMD (8L1)

EN-EL cable campaigns
- LIU signal cables (PSBLIU-CC02)
- LIU DC cables (PSBLIU0-CP02)
- General cables (PSBINT0-CYC01)

Remove unused cooling pipes EN-CV

- New prototype wire Scanner BWS (4L1)
- New SEMGrid (4L1 ring 3)

New Tune pick-up BPM (3L1)

- New kicker KSW (16L1)

Relocate Monitor BTV.BTV30

EN-CV Remove heating system
- Terminal units
- Pipes and Valves

Install GSM leaky feeder cable
Summary of Surface Activities Completed

- Install pulse transformers
- Install power converters
- Install cooling circuit
- Cabling campaigns
  - LIU signal cables (PSBLIU-CC02)
  - LIU DC cables (PSBLIU0-CP02)
  - POPS-B cables (PSBL.IUO-CC05 & CP02)
  - General cables (PSBINT0-CYC01)
- Install 2 new racks for the BIC
- Wi-Fi consolidation
- Star point consolidation
- EN-EL Consolidation
  - Lighting
    - Power
    - New EBD switchboards + UPS
- EN-HE Install transformer lifting beam
- Civil engineering works
  - bunker construction
- DORFS system
- Install pulse transformers
- Install power converters
- Install cooling circuit
Storage and Temporary RP Work Space

- EN-CV to confirm if a work area is needed for the cooling water pressure rating upgrade project
- TE-MSC and HSE-RP to confirm temporary shielding block compound to store activated machine infrastructure (ALARA)
  - BHZ151 & BSW15L1 magnets
  - BHZ161 & BHZ162 magnets
EN-EL proposal to advance some activities from LS2 to 2018 (run)

Presented at IEFC 01/06/2018 https://indico.cern.ch/event/733374/

PSB works authorised to start in October (non-technical areas) and in technical areas from 12th November (end of proton run) – 4 weeks

EN-EL confirmed a delay with the general services refurbishment program. https://indico.cern.ch/event/776115/

361 – 1st floor

- What: Installation of new cabling, socket outlet boxes, lighting system, and new switchboard for general services. Installation to take place during ion run (Nov. 2018).
- Procedure: New lighting will be installed in parallel to the existing system. Socket outlet boxes will be replaced sequentially. The remaining old infrastructure will be removed during LS2.
- Potential issues: Accidental activation of AUG button; accidental damage to existing electrical infrastructure supplying PSB accelerator; accidental damage to operating racks leading to accelerator downtime.

361 – 2nd and 3rd floor

Proposed works as 1st floor.
EN/EL Status – PSB works (J. Devine)

<table>
<thead>
<tr>
<th>Building</th>
<th>Task</th>
<th>Drawings</th>
<th>Order</th>
<th>Execution</th>
</tr>
</thead>
<tbody>
<tr>
<td>141</td>
<td>Basic Refurbishment</td>
<td>Complete</td>
<td>Complete</td>
<td>Complete</td>
</tr>
<tr>
<td>37</td>
<td>Complete electrical refurbishment</td>
<td>Complete</td>
<td>Awaiting confirmation of new start date.</td>
<td>Re-scheduled to October 2020</td>
</tr>
<tr>
<td>360 (PSB)</td>
<td>Completion of YETS works</td>
<td>Complete</td>
<td>Complete</td>
<td>80% complete, due in January</td>
</tr>
<tr>
<td>361</td>
<td>General services refurbishment</td>
<td>80% complete</td>
<td>Long lead items ordered.</td>
<td>Delayed – to be re-scheduled.</td>
</tr>
</tbody>
</table>

Explanations for delays:
Building 37 **re-scheduled** due to delay in producing the switchboard – works cannot be completed until it is installed, current fabrication progress 10% (S47) delivery expected late Jan 2019. Activity re-scheduled to October 2020 due to the need for alternative accommodation for occupants of building 37.

Building 361 **delayed** due to issue with existing drawings (quality + detail insufficient for launching order without major revision) and problem with magnets for rack protectors (see photo). Works on level 1 cannot start until rack protectors are installed (agreed with IEFC). Delivery date to be advised, works to be re-scheduled.

Early works (141, 37, 361) are low priority with no impact on machine operation, efforts now being focused on critical tasks to be completed inside PSB (and PS).
PSB-LS2 projects not coordinated by EN-ACE

- Consolidation and Upgrade of the PS Booster Chilled Water Plant [https://edms.cern.ch/document/1969788/0.01](https://edms.cern.ch/document/1969788/0.01)
- Consolidation and Upgrade of the PS Booster Cooling Plant [https://edms.cern.ch/document/1969784/0.01](https://edms.cern.ch/document/1969784/0.01)

EN-CV project leader G. Patrika

**Scope:**
- New cooling towers;
- New cooling station (pumps, heat exchanges...);
- New electrical & control system;
- New instrumentation;
- Distribution network modifications

- Pressure rating upgrade;

Replace flanges, connections, valves & instrumentation in the PSB machine (in master schedule)

New MPS for LIU Booster (POPS-B) [https://edms.cern.ch/document/1643409/1.0](https://edms.cern.ch/document/1643409/1.0)

TE-EPC project leader F. Boattini

PS Booster LS2 schedule - David Hay
EN-ACE
Balisage dans le cadre des travaux au booster et bâtiments rattachés (361,141, 237 et 269) avec coupure de la route RUTHERFORD
IST Period for PS Booster (Version 1.3)

PS Booster

- 5 weeks of Individual System Tests *(access restriction)*
- Declared powering tests that shall start *before* the IST period:
  - RF Finemet Cavities *from end of November 2019*
  - Power converters possible *from mid-January 2020* *(with dummy load, magnets not connected)*
- No works are scheduled later than February 2020