SPS Schedule, Co-activities & Logistics
D. Mcfarlane EN-ACE

on behalf of all contributors
Content

- Organisation
- LS2 Master and Baseline Schedules
- LS2 Activities & ALARA works
- LS2 LIU Main Activities
- Critical Paths
- Documentation Status
- Summary
LIU Project: SPS

IEFC
LS2C
LMC

SPS Shutdown Coordination
Chair D. Mcfarlane

- Other projects in SPS, as needed

LIU Beam Dynamics Coordination
H. Bartosik, G. Rumolo

LIU SPS BD WG
Chairs E. Shaposhnikova, H. Bartosik

LIU Executive Committee

LIU SPS Technical Coordination
Chair B. Goddard
Deputy E. Shaposhnikova

LIU Commissioning Coordination
V. Kain, G. Rumolo, A. Huschauer

LIU SPS Commissioning WG
Chair K. Li

- LIU SBDS coordination (EC)
- LIU 200 MHz (FG)
- LIU aC/Impedance (PC)
- Ad Hoc meetings

- LIU RF integration (KL)
- LIU SBDS integration (FV)
- Ad-hoc meetings

January 2019
Closure of the SPS

Start of Access to the SPS

Period with possible access restrictions

More details of this will be presented in the talk given by James Ridewood in Session 3 tomorrow morning
SPS Linear Schedule *Baseline* https://edms.cern.ch/document/1892837/2.0

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LS2 machine activities

SPS

- 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)

Reconfiguration of LSS5 (ECAS, ECQS, LSS5)
- New Beam Dump
- New beam loss monitors
- Replace beam gas ionisation profile monitor (BGI)
- Replace the synchrotron light monitor (BSRT)
- New kicker magnet with vertical deflection for dumping MKDV (and generator)
- Reconfiguration of the enlarged quadrupoles (S1610, S1810)

Extraction protection devices:
- aC coating (OF SSS, MBB 5+ 6-, LSS drifts all)
- New flanges for the impedance reduction
- Replacement MOPOS electronics (Sextants 1,2,3,4,5,6)

LHC injection lines TI2 and TI8 (see LHC coordination)
- New collimators TCDIs
- New beam loss monitors
- New vacuum valves

LIU Project

- 200 MHz RF power upgrade (LSS3, BA3, BA5)
- 200 MHz low level RF upgrade

- New rotational Wire Scanners BWSRE (LSS4, LSS5)
- Replacement of TPSC4 (LSS4)
- Replacement of TPSG6 (LSS6)

- New collimators TCDIs
- New beam loss monitors
- New vacuum valves
LS2 machine activities

SPS
- New UA9 crystal and goniometer pair
- Change all the electrostatic septum ZS (LSS2)
  - Add a vacuum valve (sector 210)
- New beam loss monitors
- New upgraded scraper
- Replace one injection kicker MKP
- Reconfiguration of the enlarged quadrupoles (11610, 11710, 11810)

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)

Reconfiguration of LSS5 (EGAS, ECG5, LSS5)
- New Beam Dump
- New beam loss monitors
- Replace beam gas ionisation profile monitor (BGI)
- Replace the synchrotron light monitor (BSRT)
- New kicker magnet with vertical deflection for dumping MKDV (and generator)
- Reconfiguration of the enlarged quadrupoles (S1610, S1810)

Extraction protection devices:
- aC coating (OF SSS, MB8 5+ 6, LSS drifts all)
- New flanges for the impedance reduction
- Replacement MOPOS electronics ( Sextants 1,2,3,4,5,6)

De-cabling Project
- 200 MHz RF power upgrade (LSS3, BA3, BA3F)
- 200 MHz low level RF upgrade
- Consolidation of B83 cooling plant
- New modern static var compensator (BEQ1)

New access systems
- New personal access devices PAD
- New material access Devices MAD
- New emergency exit doors

Fire Safety
- Fire compartments
- Fires safety systems
- Manual fire fighting systems
- Automatic fixed fire fighting systems
- New emergency lighting systems
- New safety cable tray
- Consolidation of the B-train
- WIC and BIS deployment
- Refurbishment of the lift (BA3, BA6)
- Electrical sub-station consolidation (BA1,2,4,6)

New rotational Wire Scanners BWSRE
- (LSS4, LSS5)

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## ALARA level III

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<thead>
<tr>
<th>Facility</th>
<th>Work</th>
<th>Group in charge</th>
<th>Activity/Project Leader</th>
<th>Committee date</th>
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<td>SPS</td>
<td>SPS fire safety upgrade (reduced scope) [excl. cabling]</td>
<td>BE-ICS</td>
<td>Ronny Billen</td>
<td>November 2018 (1st Part approved) Mid 2019 (2nd part)</td>
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<td>SPS</td>
<td>Cabling BA1 &amp; BA2 [incl. cabling SPS fire, TIDVG LSS1 removal]</td>
<td>EN-EL</td>
<td>Guillaume Gros</td>
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<td>Gerardo Velazquez Gutierrez</td>
<td>November 2018 (Approved)</td>
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<td>TIDVG removal in LSS1 [excl de-cabling]</td>
<td>TE-ABT</td>
<td>Etienne Carlier</td>
<td>February 2019 (Approved)</td>
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<td>Installation of new ZS in the SPS LSS2 extraction channel</td>
<td>TE-ABT</td>
<td>Bruno Balhan</td>
<td>March 2019</td>
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**LIU related**
LS2 Main LIU Activities
LIU Beam dump activities during LS2 *(Point 1 & Point 5)*

ECR 1976294 / 1963473 / 1574176

Scope of the project:
Move the SPS Beam Dumping System from SPS1 to SPS5 (ECX5)

- Reconfiguration of the LSS5
  - Dismantling more than 100 meters of beam line
  - De-cabling / cabling campaign
  - Civil engineering in ECX5
  - Re-installation following the new layout including the new dump

- Reconfiguration of the LSS1
  - Removal of the dumps and their instrumentation
  - Transfer of the kickers to LSS5
  - Re-installation of the simplified LSS1, including e-cloud

More details of this project will be presented in the talk given by Etienne Carlier in Session 2 this afternoon
LIU Beam dump activities during LS2 (Point 1 & Point 5)

- Preparation
- Old dump removal
- Civil engineering
- Re-configuration
- Re-installation
LS2 Transport restriction due to LIU Beam Dump Works

BA5

The scheduling of works that require transport of equipment around the tunnel has taken this constraint into account.

Transport crossing other works will have to be carefully addressed.
The upgrade of the 200 MHz RF system, which is the frequency at which main accelerating system of the SPS operates. This involves the addition of two new travelling-wave cavities and the construction of two new RF systems that will feed them, as well as the installation of the surrounding equipment to ensure the correct functioning of said systems.

More details of this project will be presented in the talk given by Frank Gerigk in Session 2 this afternoon.
## De-cabling & Cabling Campaign

### SPS POINT 3

#### De-cabling

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<tr>
<th>Campaign Code</th>
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<th>QTY Cables</th>
<th>Duration [Weeks]</th>
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<td>2827</td>
<td>17</td>
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<td>SP3LIU0-CD01</td>
<td>69</td>
<td>1344</td>
<td>5</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>321</strong></td>
<td><strong>4171</strong></td>
<td><strong>22</strong></td>
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#### Cabling

<table>
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<td>SP3PPS0-CC03</td>
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<td>SP3SMT0-CL201</td>
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<td>1</td>
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<td>SP3SMT0-CL2M1</td>
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<td>SP3LIU0-CC06</td>
<td>53</td>
<td>22</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>89</strong></td>
<td><strong>36.5</strong></td>
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*Original estimation was 12 weeks*
Planning (LIU 200 Mhz RF Upgrade in BA3)

- Cavities removal
- De-cabling, Cabling & Auxiliary works
- Install cavities
- RF Commissioning

During May, June & July work teams will be split into Shifts to avoid co-activity in the same area.
In order to reduce high spark rate and vacuum activity with LHC beams in the LSS2 ZS electrostatics septa, a new layout has been proposed. The principal modifications to improve the vacuum in the ZS concern the installation of 5 new ZSs equipped with vacuum pumps directly onto the vacuum vessels. Each vacuum pumps will be equipped with a passive getters pumping system (Saes® CapaciTorr® D2000). Also the beam impedance of the new ZSs is reduced by introducing RF screens and grounding the anode support.
De-cable and re-cable ZS girder in LSS2

As presented in the LS2C #27 – 16th November 2018

- The LSS2 general re-cabling campaign to replace all (irradiated) cables has been postponed to LS3.
- The first cables start (Long HV cable in Sept ’18, short cable in BA2 in November) to die.

Particular cables have been identified and needing to be replaced in during LS2:
- 2.6 km cables for ABT from patch.
- 3.8 km for BI and VSC from TA.

An addition 8 weeks of cabling has been added to the planning to accommodate this additional works.
Planning (Installation of new ZS in the SPS LSS2)

- Removal
- Cabling Campaigns
- Installation
- ZS Cabling
- Testing & Commissioning
aC Coating & Flange Impedance Reduction: LS2

LS2:
- 87 QF to be coated in SPS: 2 benches
- 87 SSS QF to be coated in 867: 2 benches
- ~30 drifts to be coated in 181 (already started)
- Flange impedance reduction at 87 SSS QF (2-4 impedance improvements per SSS QF position)
- Work sequence BA5 to BA2 anticlockwise, then BA5 to BA2 clockwise.
Planning (aC Coating & Flange Impedance Reduction)

- Remove Magnets
- Coating in-situ
- Re-install Magnets
This LHC injection protection collimator system in the SPS to LHC transfer lines (TI2/TI8) needs upgrading in order to safely bring the LHC into the high luminosity era. The existing TCDI collimators will be removed and replaced with longer collimators, and a limited number of TCDIM masks will also be replaced.

As these collimators are physically located in the LHC ends of TI2 &TI8, the coordination of these works is being followed by the LHC coordination team.
Planning (TCDI Collimators)
SPS Beam Line Activities

Vacuum sectors

- Over 90% of the vacuum sectors will be open/closed (68 to 71 vacuum sectors)
- 3 long straight section will be mostly reconfigured for the LIU
- Activities related to LIU will be held in all points of the SPS
  - More than 75% of vacuum sectors will be opened due to LIU activities
SPS Beam Line Activities
VSC resources levelling

<table>
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<tr>
<th>Sectors Opened</th>
<th>Point 1</th>
<th>Point 2</th>
<th>Point 3</th>
<th>Point 4</th>
<th>Point 5</th>
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<td>Arc 3 - (2/2)</td>
<td>Arc 5 - (2/2)</td>
<td>Arc 4 - (2/2)</td>
<td>Arc 6 - (2/2)</td>
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<tr>
<td>111</td>
<td>311</td>
<td>511</td>
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<td>412</td>
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<td>632</td>
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<td>LSS 1 (8/11)</td>
<td>LSS 3 (9/9)</td>
<td>LSS 5 (5/5)</td>
<td>LSS 4 (5/6)</td>
<td>LSS 6 (6/8)</td>
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<td>321</td>
<td>520 - current</td>
<td>420</td>
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<td>134 - current</td>
<td>331</td>
<td>521 - current</td>
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<td>435</td>
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<td>550 - current</td>
<td>Arc 5+ (2/2)</td>
<td>Arc 6+ (2/2)</td>
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<td>142 - current</td>
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<td>435</td>
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<tr>
<td>143</td>
<td>336</td>
<td>Arc 5+ (2/2)</td>
<td>Arc 4+ (2/2)</td>
<td>TT60 (2/1)</td>
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<td>Arc 4+ (2/2)</td>
<td>Arc 3+ (2/2)</td>
<td>TT60 (2/1)</td>
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<td>Arc 1+ (2/2)</td>
<td>Arc 3+ (2/2)</td>
<td>Arc 3+ (2/2)</td>
<td>Arc 3+ (2/2)</td>
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- 19 sectors opened in line with planning
- 1 extra sector opened for TT10 access
- 1 extra sector opened for magnet campaign
- 2 sectors opened before for granting TT20 – TT60 access
- 2 sectors opened before for Maintenance/OP request
- 1 sector opened before for COLDEX

Sectors opened during LS2 (week 6): 26 of 68

Week 6

<table>
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<tr>
<th>In time</th>
<th>Extra*</th>
<th>In advance</th>
<th>Delayed</th>
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<tr>
<td>19/19</td>
<td>2</td>
<td>5</td>
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Critical Paths

Any delay in one work area will have a direct affect on the critical path in the other areas.
SPS Documentation Status (Engineering Change Request status)

Status for SPS complex, including the related surface buildings

54 ECRs/SRRs for LS2
35 related to the LIU project

10 ECRs “In Work”:
- SPS-B-EC-0006: “Dismantling of obsolete SPS equipment for K-modulation during LS2” (BE-BI)
- SPS-BLM-EC-0005: “Installation of new BLM system in TT10” (BE-BI)
- SPS-SFD-EC-0002: SPS fire safety - Fire partitions during LS2
- SPS-U-EC-0001: “SPS Fire Protection: Fire dampers and ventilation related works” (EN-CV)

Related to the LIU project:
- SPS-BSRTA-EC-0001: “Installation of a BSRT tank in LSS5 of the SPS during LS2” (BE-BI)
- SPS-LO-EC-0002: “Proposal for SPS octupole relocation to restore the lattice symmetry” (BE-ABP)
- SPS-TMASC-EC-0001: “New masks for SPS during LS2” (EN-STI)
- SPS-LJ-EC-0014: “LSS1 vacuum layout after LS2” (TE-VSC)
- SPS-LJ-EC-0015: “LSS5 Vacuum Layout after LS2” (TE-VSC)
SPS Documentation Status (Integration status)

Total number of registered Integration Studies:
- 82

Number of LIU related Integration Studies:
- 29

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.
### Dedicated Procedures

- **Mise hors tension partielle du SPS lors des YETS, EYETS et LS**
  - Under Approval
  - https://edms.cern.ch/document/2058234/0.1

- **Demande de « SEPARATION DU RESEAU » par le Facility coordinator**
  - Released
  - https://edms.cern.ch/document/2049809/1

- **De-cabling – SPS5 lock-out procedure for De-Cabling during LS2**
  - Released
  - https://edms.cern.ch/document/1983418/1.0

- **De-cabling – SPS3 lock-out procedure for De-Cabling during LS2**
  - Released
  - https://edms.cern.ch/document/1991126/1.0

- **De-cabling – Identification, labelling and disconnection procedure for obsolete cables SPS1 and SPS3 during LS2**
  - Released
  - https://edms.cern.ch/document/2052872/1.0

### 17 WPAs (5 of which are for LIU works)

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<td>Rénovation des montage-charges 25 T du SPS</td>
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<td>Nicolas Perez, Heider Lourenco</td>
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Summary

• 19.5 months of access into the SPS during LS2.
  • Open date: 14\textsuperscript{th} January 2019.
  • Closure date: 18\textsuperscript{th} September 2020.

• The LS2 is now in progress and we are currently on schedule.

• Additional projects have been taken into account when organizing the LIU planning.
  • Fire Safety project
  • New PPS
  • De-cabling / Cabling campaigns

• Co-activities cannot be avoided and are identified (multiple project activities).
  • These are being addressed (dedicated meeting, on-site visits, VICs etc.).
  • Mitigations are proposed and are being validated (ex. Shifts in BA3).

• Transport and Logistics to be carefully defined and are being followed-up on site.
  • We have already faced our first difficulties, but support of LS2 space management and very good reactivity of RP and HE ton unblock situation.

We must keep a close eye on the critical path.
Thank you Q’s
Back up slides
RF upgrade in SPS 3 during LS2 (2019)

- RF upgrade works Surface/BA3/BAE3 → Jan’19-Feb’20
- De-cabling campaign surface → Jan-March & June’19
- De-cabling campaign shaft/TA → April & June’19
- Install RF coaxial lines shaft → Jan-Feb’19
- Install new ventilation dampers shaft → Feb’19
- Remote redundant CV pipework in shaft → Feb’19
- Install RF coaxial lines TA → June-July’19
- Install Fibre-optic ducts Shaft/TA → July’19
- Cabling campaign shaft/TA → July-Nov’19
- FS WP 2 & 4 Shaft/TA → Nov-Jan’20

LSS3

- Disconnection/removal of the Cavities & beam line → Jan-Feb’19
- Remove redundant CV pipework in LSS3 → March’19
- Install RF coaxial → April-May’19
- CV works for new RF Cavities → April-July’19
- De-cabling campaign → May-June’19
- Cabling Campaign → Aug-Nov’19
- FS WP 2 LSS3 then LSS3+ → Nov-Dec’19
- Cleaning of LSS3 → Nov’19
- Install new cavities & beamline → Dec’19-May’20

During May, June & July work teams will be split into Shifts to avoid co-activity in the same area.
RF upgrade in SPS 3 during LS2 (2020)

- RF upgrade works Surface/BA3/BAE3 → Jan’19-Feb’20
- FS_WP2 & 4 Shaft/TA → Nov-Feb’20
- EL Maintenance and AUG test → Beginning of Feb’20
- Testing of FS_WP2 & 4 → Feb’20 (Outside working hours)
- Dismantling old fire detection system → March’20
- New PPS access system → March -May’20
- Monte-Charge refurbishment → June-Aug’20

LSS3

- Install new cavities & beamline → Dec’19-May’20
- Testing of FS_WP2 & 4 → Feb’20 (Outside working hours)
- FS_WP3 Dry risers → March-April’20
- IST RF Conditioning → June-Sept’20

The location of Sprinklers in the LSS3 have not yet been identified by integration!
De-cabling project

As presented in the LS2C #23 – 27th July 2018

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David Mcfarlane EN-ACE 35
LIU Beam dump activities during LS2
(Point 1 & Point 5)

Scope of the project

- Move the SPS Beam Dumping System from SPS1 to SPS5 (ECX5)
SPS 1: Main works during 2019

- BA1/Shaft/TA
  - ABT racks reconfiguration
  - PPS upgrade
  - All underground areas
  - Fire safety WP3
  - Arc 1+/ Arc 1-
  - aC coating

- Removal of the dumps
- Removal of the beam line
- Cabling campaigns

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SPS 1: Main works during 2020

- LSS1
  - Re-installation of the beam line
  - Fire safety WP4
  - EN-EL cabling (High radiation areas)

- BA1
  - Fire safety WP3
  - Shaft/ TA/ LSS1
  - Fire safety WP2
SPS 5: Main works during 2019

- All underground areas
  - Fire safety WP2 + WP3 (ECX5 in 2020)
  - EN-EL cabling/de-cabling
  - Kickers transmission line

- Surface (BB5)
  - Mock up of new beam dump
  - LSS5/ECX5
    - Removal of the beam line
  - Civil engineering for SBDS

No access in ECX5/ECA5 from 01/04/19 until 20/12/19!

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SPS 5: Main works during 2020

- LSS5/ECX5
  - Re-installation of the beam line
  - SBDS cabling campaign 04
  - Dump installation
  - Cooling skid

- ECA5
  - Works in Kickers platform (EI + ABT + CV)
  - Surface (BA5/BB5)
  - Fire safety WP3 (+ECX5)
  - PPS upgrade
On-site storage strategy – “Bases de chantier”

As presented in the LS2C #22 – 22nd June 2018

1) Storage request via Sharepoint

2) Analysis + approval process

3) Space attribution on-site (see EDMS 1989344)
The implementation consists of a combination of four WPs

- **WP1**: Comprehensive active and passive fire compartment scheme with ventilation isolation
- **WP2**: Automatic fire detection and protection system
- **WP3**: Significantly enhanced manual fire fighting means with dry risers and Compressed Air Foam System trailers
- **WP4**: Modern water based automatic fire sprinkler protection system in access shafts, access galleries and long straight sections

The safety outcome depends on the integration of the four work packages acting as a whole.

The full period of SPS underground access during LS2 will be needed and used for the required works affecting all points of the SPS.
New access system (BE-ICS)

Renovation to cope with:
- Technical Obsolescence
- Commitments to Nuclear Regulatory Body
- Increase safety of the personnel

Complete refurbishing of the SPS Access System
Pilot access point installation in BB5 completed
LS2 Installation of 15 access zones and CCC tools
Surface activities (BA1)

Legend:
- SPS Fire Safety WP2 Fire detection Systems
- SPS Fire Safety WP4 Sprinklers
- SPS Fire Safety WP1 Fire Doors
- SPS Fire Safety WP3 Dry Riser
- SPS New Personnel Protection System
- MACAO Power Converter for the SPS Ring and Transfer Lines Dipole
- Consolidation Project
- Distributed Optical Fibre Radiation Temperature Sensing in the SPS ring and TT20
- Power converter modifications in building BA1/BA5 required by LIU-SPS
- BA1 reconfiguration after relocation of SPS Beam Dumping System to LSS5
- Consolidation of the SPS Tune Kickers during LS2
- BLM Installation
- Toilet refurbishment
- Cabling Campaign
Surface activities (BA2)

Legend:
- SPS Fire Safety WP2 & WP4
- SPS Fire Safety WP1
- SPS Fire Safety WP3 Dry Riser
- SPS New Personnel Protection System
- MACAO Power Converter for the SPS Ring and Transfer Lines Dipole
- Consolidation Project
- Distributed Optical Fibre Radiation Temperature Sensing in the SPS ring and TT20
- Toilet refurbishment
- Cabling Campaign
Surface activities (BA3)

Legend:
- SPS Fire Safety WP2 & WP4
- SPS Fire Safety WP1
- SPS Fire Safety WP3 Dry Riser
- SPS New Personnel Protection System
- MACAO Power Converter for the SPS Ring and Transfer Lines Dipole
- Consolidation Project
- Distributed Optical Fibre Radiation Temperature Sensing in the SPS ring and TT20
- De-cabling / Cabling Campaign
### Surface activities (BA4)

#### Legend:
- SPS Fire Safety WP2 & WP4
- SPS Fire Safety WP1
- SPS Fire Safety WP3 Dry Riser
- SPS New Personnel Protection System
- MACAO Power Converter for the SPS Ring and Transfer Lines Dipole
- Consolidation Project
- Distributed Optical Fibre Radiation Temperature Sensing in the SPS ring and TT20
- Cabling Campaign
Surface activities (BA5)

Legend:
- SPS Fire Safety WP2 & WP4
- SPS Fire Safety WP1
- SPS Fire Safety WP3 Dry Riser
- SPS New Personnel Protection System
- MACAO Power Converter for the SPS Ring and Transfer Lines Dipole
- Distributed Optical Fibre Radiation Temperature Sensing in the SPS ring and TT20
- Power converter modifications in building BA1/BA5 required by LIU-SPS
- De-Cabling / Cabling Campaign
Surface activities (BA6)

Legend:

- SPS Fire Safety WP2 & WP4
- SPS Fire Safety WP1
- SPS Fire Safety WP3 Dry Riser
- SPS New Personnel Protection System
- MACAO Power Converter for the SPS Ring and Transfer Lines Dipole
- Distributed Optical Fibre Radiation Temperature Sensing in the SPS ring and TT20
- Consolidation Project
- Cabling Campaign