• LS2 scope
• Safety and execution risk management
• Master, broken line schedules & dashboards
Definition of **main works** over the LS2 for the **whole CERN accelerator facilities** and of **potential arbitrations** based on priorities given to activities.

Definition of a CERN-wide “**resource-loaded planning**”, ensuring compatibility of resources and planning across **Injectors**, **LHC Machine**, **LHC** and **Non-LHC Experiments**.

**Preparation, coordination and follow-up till completion** of all activities.

Flexibility to use the **end-of-year technical stops** before and after the LS2 to decrease the load of the LS2.
LS2 Scope – 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**
LS2 Scope – LIU main activities

SPS upgrade
- Main RF system upgrade (new solid state power plants – 2 x 1.6 MW)
- Impedance mitigation to improve beam stability
- More robust beam dump and protection devices

PSB upgrade
- H-charge exchange injection at 160 MeV → improved beam brightness (weaker space charge forces)
- Energy : 1.4 GeV → 2 GeV
  - New main power supply
  - New RF systems

SPS
- LHC Injectors Upgrade
- 6.9 km
- 450 GeV

PSB
- 157 m
- 1.4 GeV

PS
- 628 m
- 26 GeV

Linac 2
- 50 MeV

Linac 4
- 160 MeV
- 160 MeV

Linac 4, has been built to take over.
- Higher energy 160 MeV
- Acceleration of H-ions (charge exchange H→p* in the PSB)
Construction completed in 2017
- Extensively tested in 2017-2018
- Ongoing work in LS2 to connect it to the rest of the chain
LS2 Scope – LHC main activities

1. Opening and final reclosure of 1360 interconnections
2. Mechanical opening of 2464 diode container covers
3. Cleaning and consolidation of 1232 dipole diode insulation systems
4. Installation of 1232 insulating inserts
5. Rewelding of 2464 diode container covers
6. More than 10,000 quality checks
7. More than 8,000 electrical quality assurance tests
8. 2,500 leak tightness tests
9. Maintenance of 2,829 current leads
10. Replacement of 22 cryomagnets
11. Installation of 4 full HL-LHC cryo-assemblies
12. Installation of 10 instrumentation systems for beam induced heat load study
• LS2 scope & benefits of the preparatory phase

• Safety and execution risk management

• Master, broken line schedules & dashboards

• Handover to RUN 3 and beyond
### Safety – LS2 Accidents

#### August 2019

<table>
<thead>
<tr>
<th>Facilities</th>
<th>Frequency Rate:</th>
<th>Severity Rate:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.6</td>
<td>0.11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Facility</th>
<th>Total</th>
<th>Minor</th>
<th>With days of absence</th>
<th>Total days</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>SPS</td>
<td>10</td>
<td>4</td>
<td>6</td>
<td>73</td>
</tr>
<tr>
<td>LHC inc. LEX</td>
<td>13</td>
<td>9</td>
<td>4</td>
<td>38</td>
</tr>
<tr>
<td>Surface</td>
<td>12</td>
<td>7</td>
<td>5</td>
<td>97</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>38</strong></td>
<td><strong>22</strong></td>
<td><strong>16</strong></td>
<td><strong>227</strong></td>
</tr>
</tbody>
</table>

#### HL-LHC Site

<table>
<thead>
<tr>
<th>Civil Engineering</th>
<th>Total</th>
<th>Minor</th>
<th>With days of absence</th>
<th>Total days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point 1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>Point 5</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>108</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td><strong>2</strong></td>
<td><strong>7</strong></td>
<td><strong>158</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HL-LHC sites:</th>
<th>Frequency Rate:</th>
<th>Severity Rate:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>65.3</strong></td>
<td><strong>1.47</strong></td>
</tr>
</tbody>
</table>

#### Description

<table>
<thead>
<tr>
<th>Description</th>
<th>All</th>
<th>Minor</th>
<th>With absence</th>
<th>Days of absence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling and Manipulation</td>
<td>13</td>
<td>5</td>
<td>8</td>
<td>132</td>
</tr>
<tr>
<td>Electricity</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>44</td>
</tr>
<tr>
<td>Hand tools and Power tools</td>
<td>9</td>
<td>7</td>
<td>2</td>
<td>44</td>
</tr>
<tr>
<td>Object in Movement</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>Machine tools</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Fall</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Collision, false movement</td>
<td>5</td>
<td>5</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Vehicles (Bicycle)</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>38</strong></td>
<td><strong>22</strong></td>
<td><strong>16</strong></td>
<td><strong>227</strong></td>
</tr>
</tbody>
</table>

**Frequency Rate:**
Accidents with absence per million hours worked

**Severity Rate:**
Days of absence per thousand hours worked
## LS1 Accidents

<table>
<thead>
<tr>
<th>Facility</th>
<th>Total</th>
<th>Minor</th>
<th>With days of absence</th>
<th>Total days**</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>SPS</td>
<td>7</td>
<td>6</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>LHC</td>
<td>30</td>
<td>20</td>
<td>10</td>
<td>93</td>
</tr>
<tr>
<td>Surface</td>
<td>50</td>
<td>34</td>
<td>16</td>
<td>151</td>
</tr>
<tr>
<td>Experiments*</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>95</strong></td>
<td><strong>64</strong></td>
<td><strong>31</strong></td>
<td><strong>273</strong></td>
</tr>
</tbody>
</table>

- **3.7 Million Hours worked**
- **64 minor accidents (no absence)**
- **31 accidents with total 273 days absence**

### Formulas:

- **Frequency Rate** = Number Accidents (with absence) per Million Hours worked
- **Severity Rate** = Number of days Absence per 1,000 Hours worked

---

LHC Long Shutdown 1 (LS1) Status and Outlook
F. Bordry
12th December 2014
1st of January 2019 – 31st of August 2019

Collective operational dose: 118.9 person · mSv

**SPS complex**
- Removal of the SPS LSS1 Beam dump system
- EL installation of SPS emergency lights
- Installation of dry risers in the SPS as part of SPS fire safety

**PS complex**
- PS main magnet and low-voltage renovation
- Warm water pipes & duct consolidation
- Dismantling of IL1 region, BI & BT Lines
- Installation of new lighting & power refurbishment
- De-cabling activities

**LHC complex**
- CMS Pixel detector upgrade
- CMS Beam Pipe Upgrade
- ATLAS LS2 beam vacuum system removal

---

**SPS**
- 1854 DMC dosimeters in use at CERN

1. North Area Beam Lines: 0
2. AWAKE: 0
3. HiRadMat: 0
4. GIF: 0
5. NA62: 0
6. Neutrino Platform: 0

**LHC**
- CMS Machine: 4
- ATLAS Machine: 0
- LHCb Machine: 0
- ALICE Machine: 0
- LCG: 0

**Safety – Operational Dosimetry**

1854 DMC dosimeters in use at CERN

PS complex
- 63.7 mSv
- SPS
- 28.7 mSv
- Other

LHC complex
- 6 mSv
- CMS
- ATLAS
- LHCb
- ALICE
- LCG

**PS complex**
- PS
- PS Booster
- Isolde
- AD-Target
- East Hall Target
- LINAC 4
- nTOF

---

**LS2 Coordination**

HL-LHC and LIU Cost and Schedule Review
November’19
Safety – Prevention

Barriers @ SPS-BA3

Access restriction @ SPS-BA2

Electrical lock-out @ PS Booster
Safety – Unexpected cleaning activities @ PS

Plaques bois à déposer en LS3
ZONE A ASSAINIR

Passage 20 à 60 cm
HT 50 à 70 cm
Safety – Unexpected cleaning activities @ PS
Execution risk management

• **Engineering Change Requests** as Quality Assurance tool (IEFC&LMC)

• **Integration** studies & 3D layouts combined with a **consolidated Layout DB**

• **Equipment readiness** and **Installation slots** used as a flexibility driver

• **Work package** analysis to assess equipment and installation risks

• **IMPACT** tool to coordinate daily activities

• **Logistics** including **Radioactive transports** optimised continuously
Execution risk management – Engineering Change requests (ECR)

ECRs – All / LS2

Number of ECRs: 243
Number of needed ECRs: 8

Status of March’18
Integration status

Data extraction: 2019-11-07

Link to the Track It report

CERN
LS2 Coordination
2015-2020

HL-LHC and LIU Cost and Schedule Review
November’19
Execution risk management – Integrations

Area Models

- Validated: 989
- In Progress: 308

Equipment Models

- Validated: 278
- In Progress: 50

ICL Validated

- Validated: 179
- In Progress: 17

Differential Layouts

- Validated: 96
- In Progress: 2

Data extraction: 2019-11-07
Execution risk management – 3D Integrations
## Execution risk management – Logistics

<table>
<thead>
<tr>
<th>Zone 1</th>
<th>Storage in racks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Linac3 Bertronix racks – deinstallation</td>
</tr>
<tr>
<td></td>
<td>PSB RF Racks and Power Converters</td>
</tr>
<tr>
<td></td>
<td>R2E LHC600A 10V Modules - Batch 1, Batch 2, Batch 3,</td>
</tr>
<tr>
<td></td>
<td>R2E LHC4-6-8kA Components - Batch 1, Batch 2, Batch 3</td>
</tr>
<tr>
<td></td>
<td>LIU PS - TT2 SIRIUS_S, TT2 SIRIUS_2P, TT2 SIRIUS_4P</td>
</tr>
<tr>
<td></td>
<td>LIU PS - Low Beta, SMH42, BSM42, BSM40-41-43-44, Racks, Injection Correctors</td>
</tr>
<tr>
<td></td>
<td>Conso AD Capacitor Discharge – MARXDISCAP, MEGADISCAP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone 2</th>
<th>Magnets from B180 and SMS18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Magnets from the B180 and SMS18</td>
</tr>
<tr>
<td></td>
<td>LHCb PS/SPD inner super modules in storage frames - includes attached VFE boxes and optical bundles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone 3</th>
<th>Magnets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LHCb OT Detector in storage frame</td>
</tr>
<tr>
<td></td>
<td>Magnets from the B954 and B954</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Zone 4</th>
<th>Plate steel from B927</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sheet metal Armco</td>
</tr>
</tbody>
</table>
Execution risk management – Equipment readiness @ LHC
• LS2 scope & benefits of the preparatory phase
• Safety and execution risk management
• Master, broken line schedules & dashboards
• Handover to RUN 3 and beyond
Direct access

https://acc-dashboard.web.cern.ch/ls2/

From LS2C web pages

https://mgt-ls2-committee.web.cern.ch/content/upcoming-meeting
Broken line schedules – L4

- Connection is completed
- Individual system tests and hardware commissioning started
- Survey smoothing in progress
- Low Energy Beam tests planned in October, followed by beam test until end of 2019
Broken line schedules – PS Booster

- New injection region installed
- New Finemet cavities installed
- Transfer lines installation in progress
- Infrastructure consolidation and upgrade in progress

Until 2018: PSB tunnel injection area

New injection region

BTV10

New injection system installed in the PBS
Broken line schedules – PS

New injection line
Broken line schedules – SPS

Pulling cables

Survey

Cutting of the vault in ECX5

Amorphous carbon coating

Fire Safety project

HL-LHC and LIU Cost and Schedule Review
November’19
Broken line schedules – SPS

New dump shielding mock-up assembly in BB5

Sketch of the new SPS Beam Dump layout

SPS 200 MHz RF system upgrade

HL-LHC and LII Cost and Schedule Review November’19
Broken line schedules – LHC
## Dashboards – LHC Beam vacuum sectors

<table>
<thead>
<tr>
<th>Point 1</th>
<th>Point 2</th>
<th>Point 3</th>
<th>Point 4</th>
<th>Point 5</th>
<th>Point 6</th>
<th>Point 7</th>
<th>Point 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS51L</td>
<td>LS52L</td>
<td>LS53L</td>
<td>LS54L</td>
<td>LS55L</td>
<td>LS56L</td>
<td>LS57L</td>
<td>LS58L</td>
</tr>
<tr>
<td>AT1L</td>
<td>AT2L</td>
<td>AT3L</td>
<td>AT4L</td>
<td>AT5L</td>
<td>AT6L</td>
<td>AT7L</td>
<td>AT8L</td>
</tr>
<tr>
<td>BS1L</td>
<td>BS2L</td>
<td>BS3L</td>
<td>BS4L</td>
<td>BS5L</td>
<td>BS6L</td>
<td>BS7L</td>
<td>BS8L</td>
</tr>
<tr>
<td>AS1L</td>
<td>AS2L</td>
<td>AS3L</td>
<td>AS4L</td>
<td>AS5L</td>
<td>AS6L</td>
<td>AS7L</td>
<td>AS8L</td>
</tr>
<tr>
<td>BS1L</td>
<td>BS2L</td>
<td>BS3L</td>
<td>BS4L</td>
<td>BS5L</td>
<td>BS6L</td>
<td>BS7L</td>
<td>BS8L</td>
</tr>
<tr>
<td>AT1L</td>
<td>AT2L</td>
<td>AT3L</td>
<td>AT4L</td>
<td>AT5L</td>
<td>AT6L</td>
<td>AT7L</td>
<td>AT8L</td>
</tr>
<tr>
<td>LS51R</td>
<td>LS52R</td>
<td>LS53R</td>
<td>LS54R</td>
<td>LS55R</td>
<td>LS56R</td>
<td>LS57R</td>
<td>LS58R</td>
</tr>
<tr>
<td>AT1R</td>
<td>AT2R</td>
<td>AT3R</td>
<td>AT4R</td>
<td>AT5R</td>
<td>AT6R</td>
<td>AT7R</td>
<td>AT8R</td>
</tr>
<tr>
<td>IT1R</td>
<td>IT2R</td>
<td>IT3R</td>
<td>IT4R</td>
<td>IT5R</td>
<td>IT6R</td>
<td>IT7R</td>
<td>IT8R</td>
</tr>
<tr>
<td>AAR1</td>
<td>BCR1</td>
<td>AR1R</td>
<td>AAR2</td>
<td>BCR2</td>
<td>AR2R</td>
<td>AAR3</td>
<td>BCR3</td>
</tr>
<tr>
<td>AAR2</td>
<td>BCR2</td>
<td>AR2R</td>
<td>AAR3</td>
<td>BCR3</td>
<td>AR3R</td>
<td>AAR4</td>
<td>BCR4</td>
</tr>
<tr>
<td>AAR3</td>
<td>BCR3</td>
<td>AR3R</td>
<td>AAR4</td>
<td>BCR4</td>
<td>AR4R</td>
<td>AAR5</td>
<td>BCR5</td>
</tr>
<tr>
<td>AAR4</td>
<td>BCR4</td>
<td>AR4R</td>
<td>AAR5</td>
<td>BCR5</td>
<td>AR5R</td>
<td>AAR6</td>
<td>BCR6</td>
</tr>
<tr>
<td>AAR5</td>
<td>BCR5</td>
<td>AR5R</td>
<td>AAR6</td>
<td>BCR6</td>
<td>AR6R</td>
<td>AAR7</td>
<td>BCR7</td>
</tr>
<tr>
<td>AAR6</td>
<td>BCR6</td>
<td>AR6R</td>
<td>AAR7</td>
<td>BCR7</td>
<td>AR7R</td>
<td>AAR8</td>
<td>BCR8</td>
</tr>
<tr>
<td>AAR7</td>
<td>BCR7</td>
<td>AR7R</td>
<td>AAR8</td>
<td>BCR8</td>
<td>AR8R</td>
<td>AAR9</td>
<td>BCR9</td>
</tr>
<tr>
<td>AAR8</td>
<td>BCR8</td>
<td>AR8R</td>
<td>AAR9</td>
<td>BCR9</td>
<td>AR9R</td>
<td>AAR10</td>
<td>BCR10</td>
</tr>
</tbody>
</table>

- **Fully operational sectors**
- **Static vacuum (SAM, IT)**
- **To be done (mechanical works or NEG to be performed)**

*Updated: 05-11-2019*

---

**HL-LHC and LIU Cost and Schedule Review**

**November’19**
Dashboards – LS2 cryogenics milestones

Cryo Unlock Surface and Underground

- P18: 25-Feb-20
- P2: 25-May-20
- P4 (S.3-4): 23-Mar-20
- P4 (S.4-5): 20-Apr-20
- P6 (S.4-5): 21-Apr-20
- P5 (S.6-7): 21-Apr-20
- P8 (S.7-8): 06-Apr-20
- P8 (S.8-1): 06-Jun-20

Cryo Unlock Underground

- 1.1: 06-Apr-20
- 1.2: 16-Apr-20
- 3.4: 01-Jun-20
- 4.6: 04-May-20
- 5.5-6: 15-Jun-20
- 5.7: 29-Jun-20
- 7.8: 18-May-20
- 5.8: 06-Apr-20

Cryo Ready for ELQA@Warm and Cool Down

- 1.1: 04-Jun-20
- 1.2: 07-Aug-20
- 3.1: 17-Jul-20
- 3.2: 19-Jun-20
- 3.3-4: 31-Jul-20
- 6.6-7: 14-Aug-20
- 5.7-8: 06-Jul-20
- 5.8-1: 26-May-20

Cryo status 20th Sept. 2019, courtesy, F. Ferrand TE-CRG
Dashboards – DISMAC global status
Dashboards – Magnet exchange campaign

26/28 removed (takes into account WP11 HL-LHC + C16L2 + Q16L2)
22/36 reinstalled (takes into account 3 parts per 11T and cryo assemblies)

Q16L2:
- Disconnection starting from 20/09/2019
- Transport new magnet: 19/11/2019

C16L2:
- Disconnection starting from 24/09/19
- Transport new magnet: 11/11/2019

CC-C11L2:
- Disconnection starting from 26/09/2019
- Installation 2 LEP: 4 and 5/11/2019
- Installation LEN: 8/11/2019

CC-C11R2:
- Disconnection starting from 02/10/2019
- Transport 2 LEP: 26 and 27/11/2019
- Transport LEN: 29/11/2019

11T LSS7L:
- Disconnection starting from 19/03/2019
- Transport old magnet starting: 25/03/2019
- Transport 11T & LEN starting: 17/04/2020

11T LSS7R:
- Disconnection starting from 19/11/2019 (tbc)
- Transport old magnet starting: 26/11/2019 (tcb)
- Transport 11T & LEN starting: 13/01/2020 (tbc)
Dashboards – HL-LHC 11T installation

- Standard commissioning time in S.67
- Standard cool down time (5wks) allocated in sectors 67 and 78
- No extended training quenches duration allocated in S.67 and S.78

HL-LHC and LII Cost and Schedule Review November’19
Cold tests of S1 completed in SMA18

Cryostating of S2 completed in SMI2

Completion of S3 cold mass ass. in Bldg. 180

Completion of shells welding on S4 in Bldg. 180
Dashboards – WCC Hose exchange

**RR53 in stand by**
- DFBA OK completed
- DFBL cables replacement completed
- Electrical tests NOT completed on RQ4 (on hold for replacement of non-conform water hoses)

**RR57 in stand by**
- DFBA cables replacement completed
- Electrical tests NOT OK
- DFBL cables replacement completed
- Electrical tests NOT completed on RQ4 (on hold for replacement of non-conform water hoses)

**RR13 in progress**
- DFBL cables replacement completed, dielectric tests in progress
- DFBA in coming weeks

**RR17 in progress**
- DFBA cables replacement in progress
- DFBL cables replacement completed dielectric tests in progress

LSS2L: DFBX + DFBA + DFBM → **LS2 critical path**

LSS2R: DFBX + DFBA + DFBM
Dashboards – New Target Dump Injection Segmented (TDIS)

Necessary to inject LIU beam into LHC
Dashboards – SC RF cryomodule replacement

- Need to replace Asia module
- Activity starting in October 2019
- Support from multiple groups needed
- Time slot already allocated in Baseline 2.0 and readjusted according to new needs in Baseline 2.2
Dashboards – Removing the ULO in 15R8 (NC’s repairs)

During removal the polythene broke into 3 part, all of which are recovered (small fragment not shown).

The plastic appears blackened and locally brittle (presently at the RP control bunker)
Dashboards – 16L2 air inlet (NC’s repairs)

Decision to replace the quadrupole and dipole beam screens (to be done on surface)

- MB17L2
- Q16L2
- MB16L2
- P2
- P1

- Very oxidized surface with dark spot (up and down) on the beam screen slots
- Beam 1
- No important oxidation. White spots visible like dried liquid

- No important oxidation. Some white diffused mark
- Beam 2
- Important oxidation with dark and large spot on the beam screen slots

Percentage contribution of the detected gas species

- H2
- CH4
- H2O
- N2/CO
- O2
- Ar
- CO2

Temperature cold mass [K]

% of ion current

HL-LHC and LIU Cost and Schedule Review
November’19
Dashboards – FASER in UJ12 (new activity)

- Cores drilling completed
- Dismantling activities completed
- Crane installation completed
- Civil engineering Jan.- Feb 2020
- Experiment installation April-May 2020
Closing remarks

Excellent progress and follow-up

✓ Activities executed according to PLAN tool, only few new demands @ LS2C
✓ Equipment readiness evaluated and “flattening” are giving excellent results
✓ Master resource-loaded schedules reviewed to version 2.3 with no date changes
✓ Linear schedules reshuffled to allow an updated broken-line reporting

QA and documentations just on time

✓ Up to date on 3D integrations and close to completion on differential layout drawings
✓ ECR approvals treated well through IEFC and LMC

Daily follow-up towards a successful completion of LS2 activities

✓ Intensive field coordination and safety follow-up (tunnel and surface)
✓ Radioactive transports and storages going very well, on site cleaning to get improved
Warm thanks to:
✓ All Contributors to this presentation
✓ LS2C Representatives for their help in the LS2 preparation and follow-up

Congratulation to:
✓ CERN Teams and Collaborators from Institutes and Universities
✓ Industrial Support Teams

Keep going! ...and my warm thanks to the LS2 Team 😊
Reminder on WP11 scope and deliverables

2 @ P2
1 spare

2 @ P7
1 spare
Introduction – 11T Dipole Full Assembly (2 + 1)

- LBH_A: By-pass cryostat with collimator
- LBH_B: 

16 + 8 + 6 coils

8 + 4 collared coils

2 + 1 TYPE A

4 + 2 cold masses

1st of series LMBHB002 is a type B
1st CC4C and by-pass installed in L2 – 2019.11.05

1st HL-LHC interconnect ready for jointing in L2

Existing CC removed from the tunnel, and new jacks installed

2nd CC4C (LEP) on its way to L2 – 2019.11.05
## Execution risk management – Logistics

<table>
<thead>
<tr>
<th>Zone 5 storage</th>
</tr>
</thead>
</table>
|   | Pres polynoel  
|   | Open Days equipment from EN EL  
|   | Transformers  

<table>
<thead>
<tr>
<th>Zone 7 Handling devices for the tunnel</th>
</tr>
</thead>
</table>
|   | Storage of transport and handling equipment  

<table>
<thead>
<tr>
<th>Zone 8 Storage from B927</th>
</tr>
</thead>
</table>
|   | SC-link and components for HL-LHC  
|   | Exhibition magnet  
|   | Armco Coil  

<table>
<thead>
<tr>
<th>Zone 9 Storage RP</th>
</tr>
</thead>
</table>
|   | TE-MPE DYPQ racks  
|   | Vacuum components  
|   | Single components from the tunnel.  

### Execution risk management – Logistics

| Zone 10 Storage | • Equipment from SMA18 and from the tunnel.  
|                 | • Pumping groups, Vacuum components, Transformers, Screens  
|                 | • R2E LHC600A 10V Modules - Batch 4 |
| Zone 11 Storage | • Storage of transport and handling equipment  
|                 | • Elevator equipment and motor  
|                 | • Support and magnet plates |
| Zone 12 Storage | ▪ Environmental monitoring equipment (INEMIA + RA)  
|                 | ▪ Energy storage capacitor banks  
|                 | ▪ Elevator equipment and motor  
|                 | ▪ Vacuum Controls crates |
| Zone 13 Storage in racks | ▪ TE-MPE DYPQ racks  
|                         | ▪ JPOs audiovisuel |
Session 4: Readiness for IST & HC

LHC re-commissioning after LS2

- Many modifications took place during LS2 both on HW and SW infrastructure...Powering tests are fundamental and will be a challenge!
  - The 11 T dipole commissioning should be easily absorbed, but surprises in commissioning duration cannot be excluded
  - One week dedicated to debugging has proven in the past to be crucial for the success
  - The present schedule is tight (also due to the impact from reduced resources in OP) → training to 7 TeV may require additional time, especially in some sectors

Presented by Matteo Solfaroli
Execution risk management – Integrations

All Accelerators / LS2

Number of registered Integration Studies: 278

Number of needed Integration Studies: 0

LHC / LS2

Number of registered Integration Studies: 77

Number of needed Integration Studies: 0

Link to the Track It report

Data extraction: 2019-11-07
Dashboards – HL-LHC LS2 activities

WP5 - Collimation
- 8 Target Secondary Collimators TCSPM in LSS7
- 2 Dispersion Suppressor Collimators TCLD in P7 (11T)
- 2 Dispersion Suppressor Collimators TCLD in P2 (CC)

WP8 - Collider & Experiment Interface: TANB both sides LSS8

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)

WP9 - Cryogenics
- Cryogenics upgrade of refrigerator

WP11 – 11T DS Dipole
- 11T in A9R7 & A9L7
- CC in C11R2 & C11L2

WP12 – Beam Vacuum: In-situ aC-coating Q5-Q6 at P2 & P8

WP17 – Infrastructure Logistics and Civil Engineering
- UPR connections at P1 & P5
Safety – ALARA Level 3 interventions

1st of January – 31st of August 2019
Collective operational dose: 59.0 person · mSv

<table>
<thead>
<tr>
<th>Facility</th>
<th>ALARA Committee Date</th>
<th>Intervention</th>
<th>Estimated dose (person·mSv)</th>
<th>Achieved dose (person·mSv)</th>
<th>Max. ind. dose (mSv)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS</td>
<td>21-Sep-18</td>
<td>Renovation of PS main magnet units</td>
<td>37.4</td>
<td>17.8</td>
<td>1.3</td>
<td>1.0</td>
</tr>
<tr>
<td>PSB</td>
<td>31-Oct-18</td>
<td>Dismantling of the PSB injection region and the BI and BT transfer lines</td>
<td>5.9</td>
<td>5.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>PS</td>
<td>02-Nov-18</td>
<td>PS Low Voltage distribution system refurbishment</td>
<td>24.0</td>
<td>5.0</td>
<td>1.2</td>
<td>0.5</td>
</tr>
<tr>
<td>SPS</td>
<td>09-Nov-18</td>
<td>Fire safety system SPS – part 1 : Installation porte coupe feu (WP1)</td>
<td>1.8</td>
<td>0.0</td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fire safety system SPS – part 1 : Fire detection (WP2)</td>
<td>6.7</td>
<td>0.4</td>
<td>0.8</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fire safety system SPS – part 1 : Dry risers (WP3)</td>
<td>5.2</td>
<td>1.8</td>
<td>0.9</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fire safety system SPS – part 1 : Sprinklers (WP4)</td>
<td>7.6</td>
<td>1.0</td>
<td>1.2</td>
<td>0.2</td>
</tr>
<tr>
<td>SPS</td>
<td>22-Nov-18</td>
<td>SPS safety lighting infrastructure installation</td>
<td>18.0</td>
<td>4.6</td>
<td>1.4</td>
<td>0.8</td>
</tr>
<tr>
<td>AD target</td>
<td>25-Jan-19</td>
<td>AD target area dismantling</td>
<td>8.0</td>
<td>3.7</td>
<td>0.9</td>
<td>0.4</td>
</tr>
<tr>
<td>ISOLDE</td>
<td>11-Jan-19</td>
<td>ISOLDE HRS front end exchange</td>
<td>9.0</td>
<td>3.5</td>
<td>1.6</td>
<td>0.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ISOLDE GPS front end exchange</td>
<td>7.7</td>
<td>2.3</td>
<td>1.5</td>
<td>0.3</td>
</tr>
<tr>
<td>SPS</td>
<td>08-Feb-19</td>
<td>SPS dump removal</td>
<td>9.1</td>
<td>3.6</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>EA target</td>
<td>01-Mar-19</td>
<td>East area target area renovation – F61 PS facility</td>
<td>1.5</td>
<td>1.0</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>East area target area renovation – Primary Area</td>
<td>5.1</td>
<td>2.7</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>SPS</td>
<td>08-Mar-19</td>
<td>SPS electrostatic septum magnet exchange</td>
<td>4.4</td>
<td>3.0</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>n_TOF</td>
<td>03-Jun-19</td>
<td>n_TOF target exchange</td>
<td>9.8</td>
<td>0.6</td>
<td>1.0</td>
<td>0.1</td>
</tr>
<tr>
<td>PS</td>
<td>23-Jul-19</td>
<td>PS asbestos cleaning</td>
<td>8.3</td>
<td>2.7</td>
<td>1.4</td>
<td>0.4</td>
</tr>
<tr>
<td>SPS</td>
<td>20-Sep-19</td>
<td>Fire safety system SPS – part 2 (BA1 and BA2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BDF target</td>
<td></td>
<td>Beam Dump Facility test target removal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AD target</td>
<td></td>
<td>AD target area installation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N4 extraction</td>
<td></td>
<td>TSCs collimator replacement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPS</td>
<td></td>
<td>BA1/BA2 cabling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Execution risk management – Engineering Change requests (ECR)

- LHC
- SPS
- PS Complex (PS Ring and PS Booster including transfer lines, excluding Linacs, AD and ELENA)
- SPS Fire Safety
- LINACs
- LIU

Data extraction: 2019-11-07