





LHC Injectors Upgrade

Equipment Installation, Planning, Layout, organisation and updates

Simon Mataguez, Julie Coupard with contributions of the LIU-PLI team

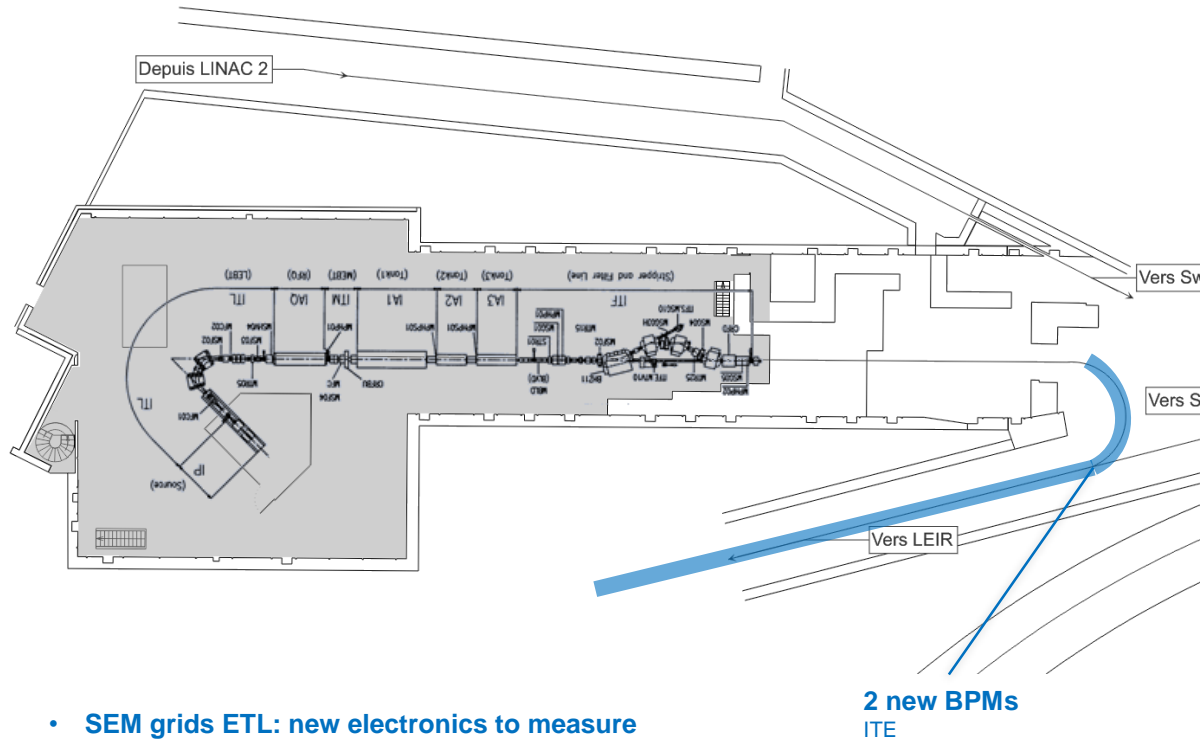
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LIU-IONS activities (Linac3 and LEIR)

EYETS 2016-2017

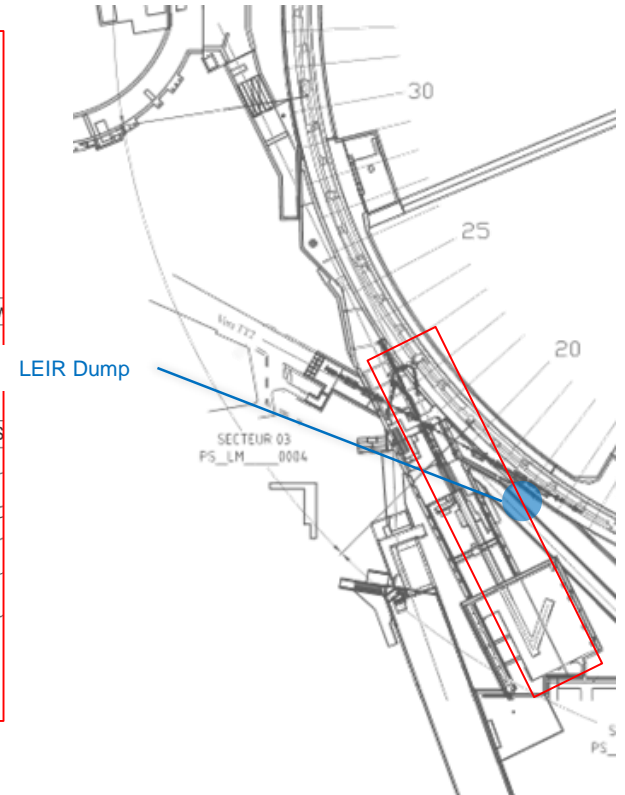
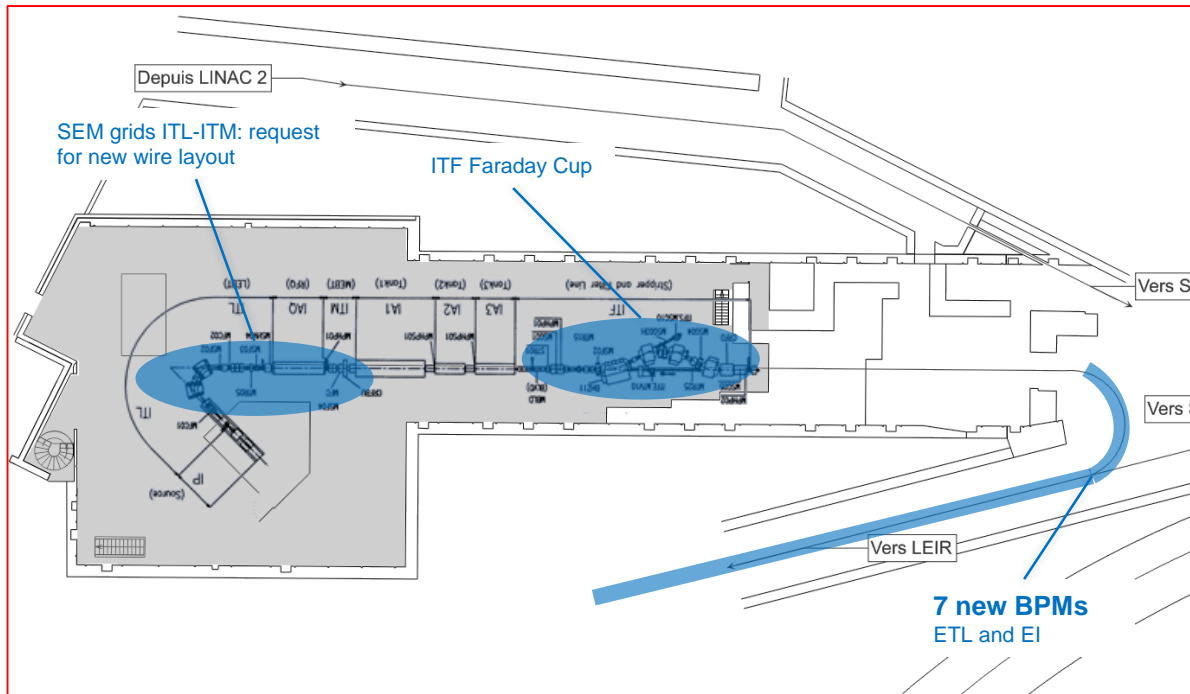


- SEM grids ETL: new electronics to measure injected and extracted beam properly
- Upgrade of LEIR ring orbit system



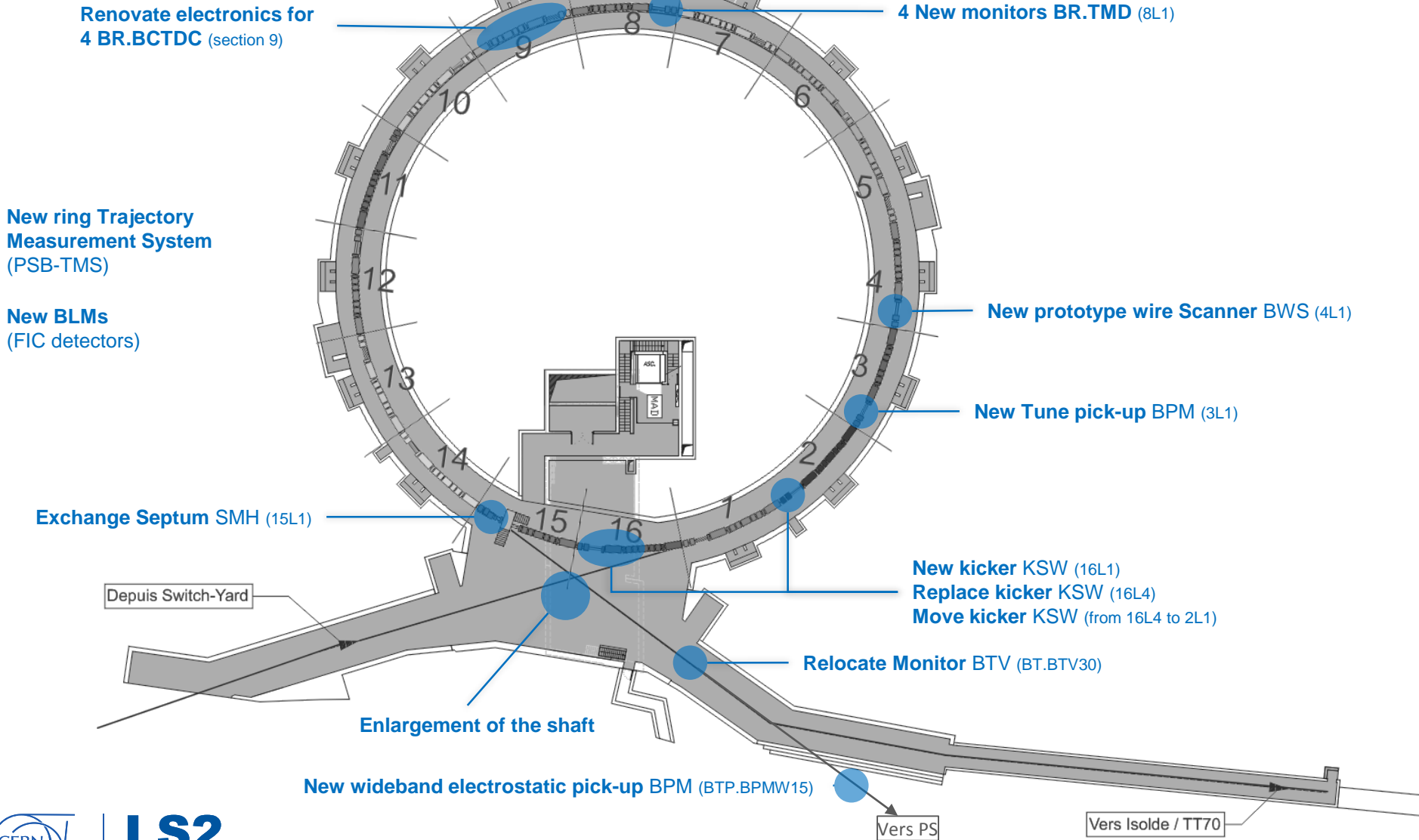
LIU-IONS activities (Linac3 and LEIR)

YETS 2017-2018



LIU-PSB activities

EYETS 2016-2017



LS2
Days

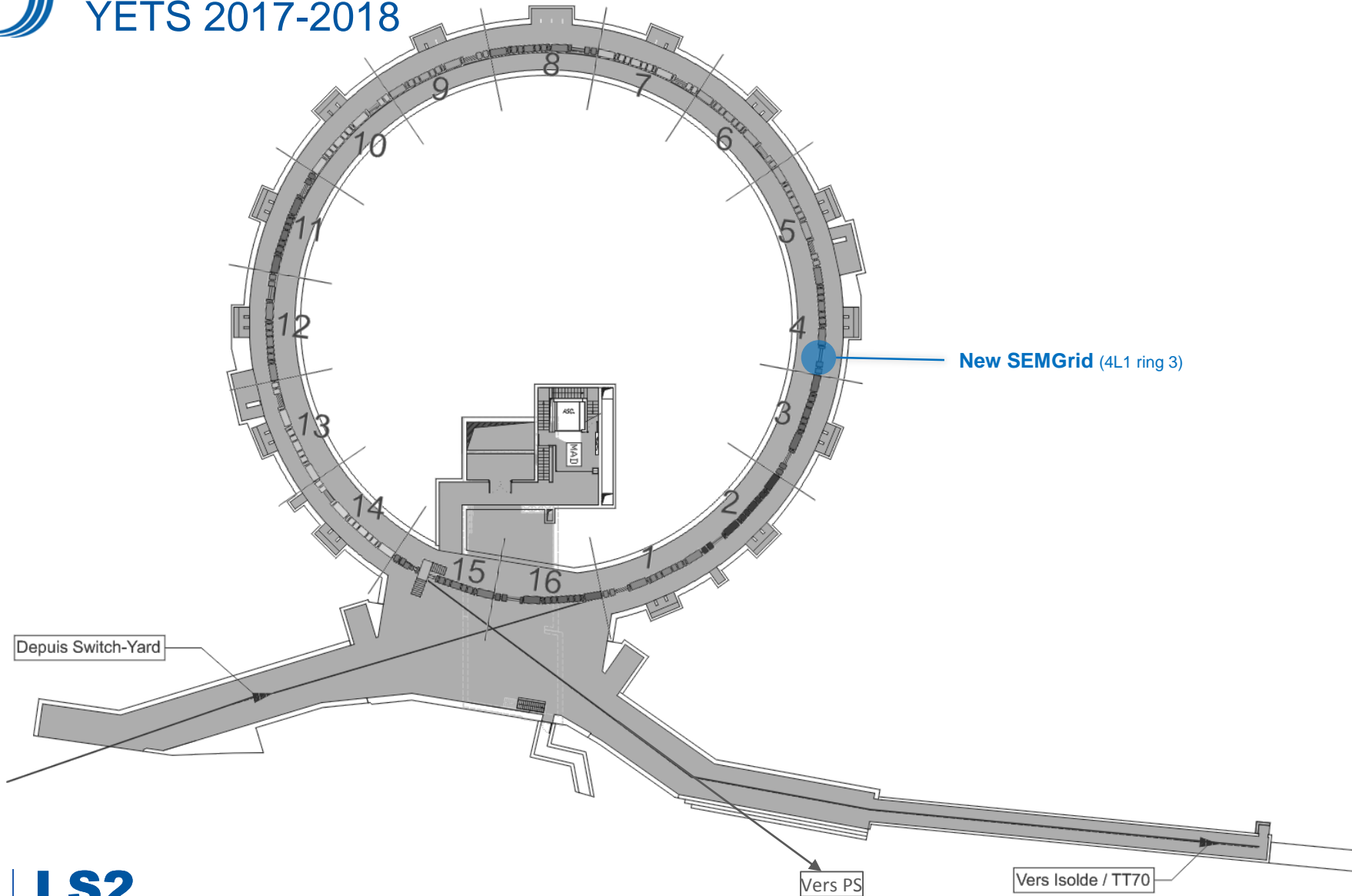
7th & 8th November 2016

<http://indico.cern.ch/event/564604/>



LIU-PSB activities

YETS 2017-2018



LS2
Days

7th & 8th November 2016

<http://indico.cern.ch/event/564604/>

LIU-PSB activities

LS2

New Absorber/Scraper

New Wire Scanner x4 (11L1)

New finemet cavities

- BR2&4.C02 7L1
- BRr.C04 13L1
- BR.C16.5L1

Under studies:

- Change of the beam stoppers
- New vacuum window before the PSB Dump

- New RF bypasses
- Laminated side plate on bending (BHZ MAIN)
- Parallel shunt resistors on quadrupoles (QDE, QFO) and bending (BHZ MAIN) magnets
- Transverse Feedback
- New interlock system PSB extraction to PS

New Wire Scanner x3 (4L1)

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)
- Relocate beam instrumentation (BT.BTV10)
- New kicker (BT.KFA10)
- Change the magnets

Vers PS

Vers Isolde / TT70



LS2
Days

7th & 8th November 2016

<http://indico.cern.ch/event/564604/>

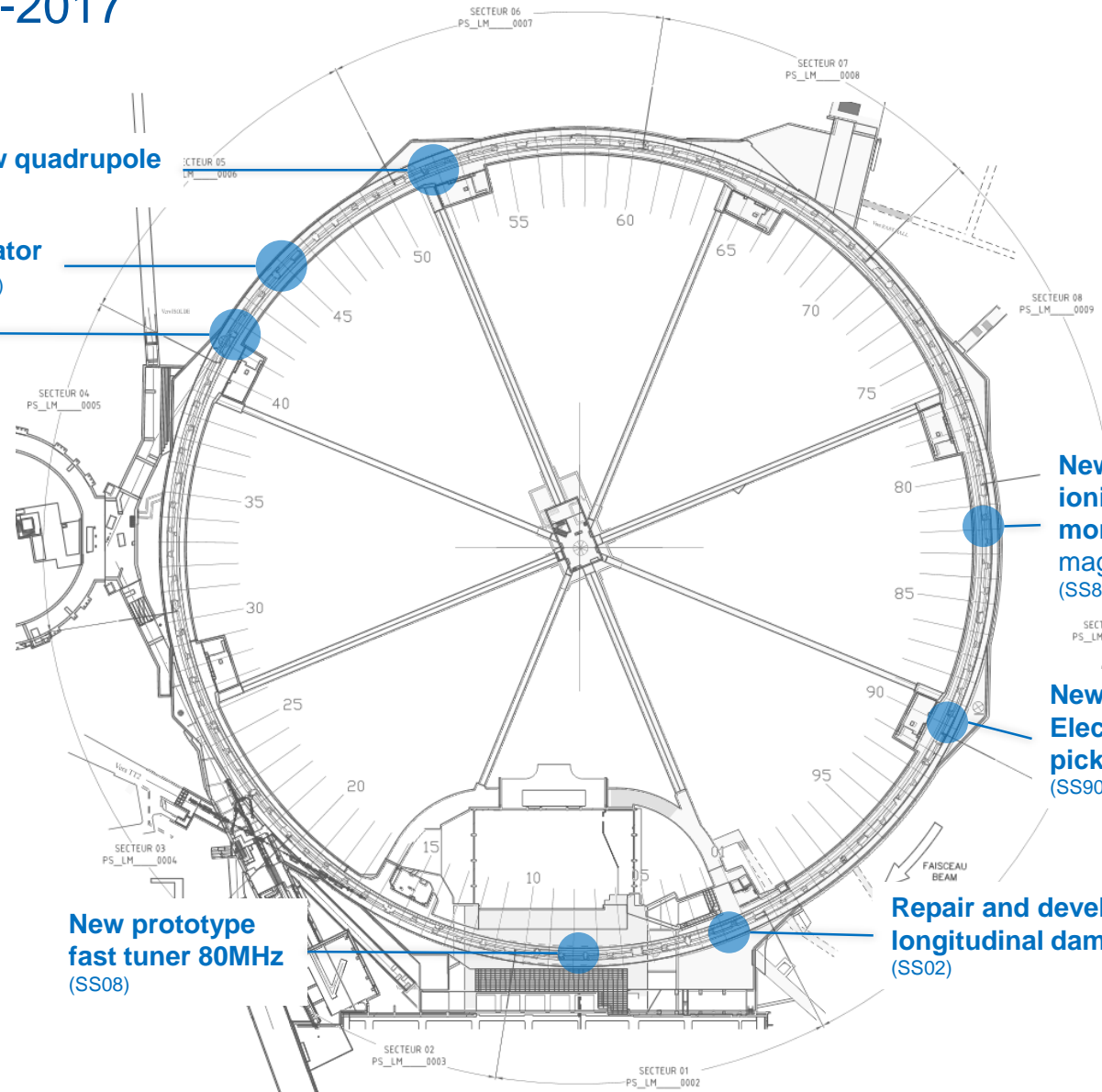
LIU-PS activities

KEYETS 2016-2017

Relocation skew quadrupole
(MU42 → MU52)

Upgrade injection kicker generator
Installation of short-circuit (KF45)

New vacuum chambers
(MU41, MU42)



New horizontal ionization profile monitor BGI and magnets (SS82)

New Wideband Electrostatic pick-up (SS90)

Repair and development of longitudinal damper (SS02)

New prototype fast tuner 80MHz (SS08)

New BLMs (Diamond & Ionization)
(Diamond detectors in SS14, 15, 17, 18, 40, 41, 42, 43, 44, 45, 46, 49, 71, 75, 79, 83 and 100 ionization chambers in each section)



LS2
Days

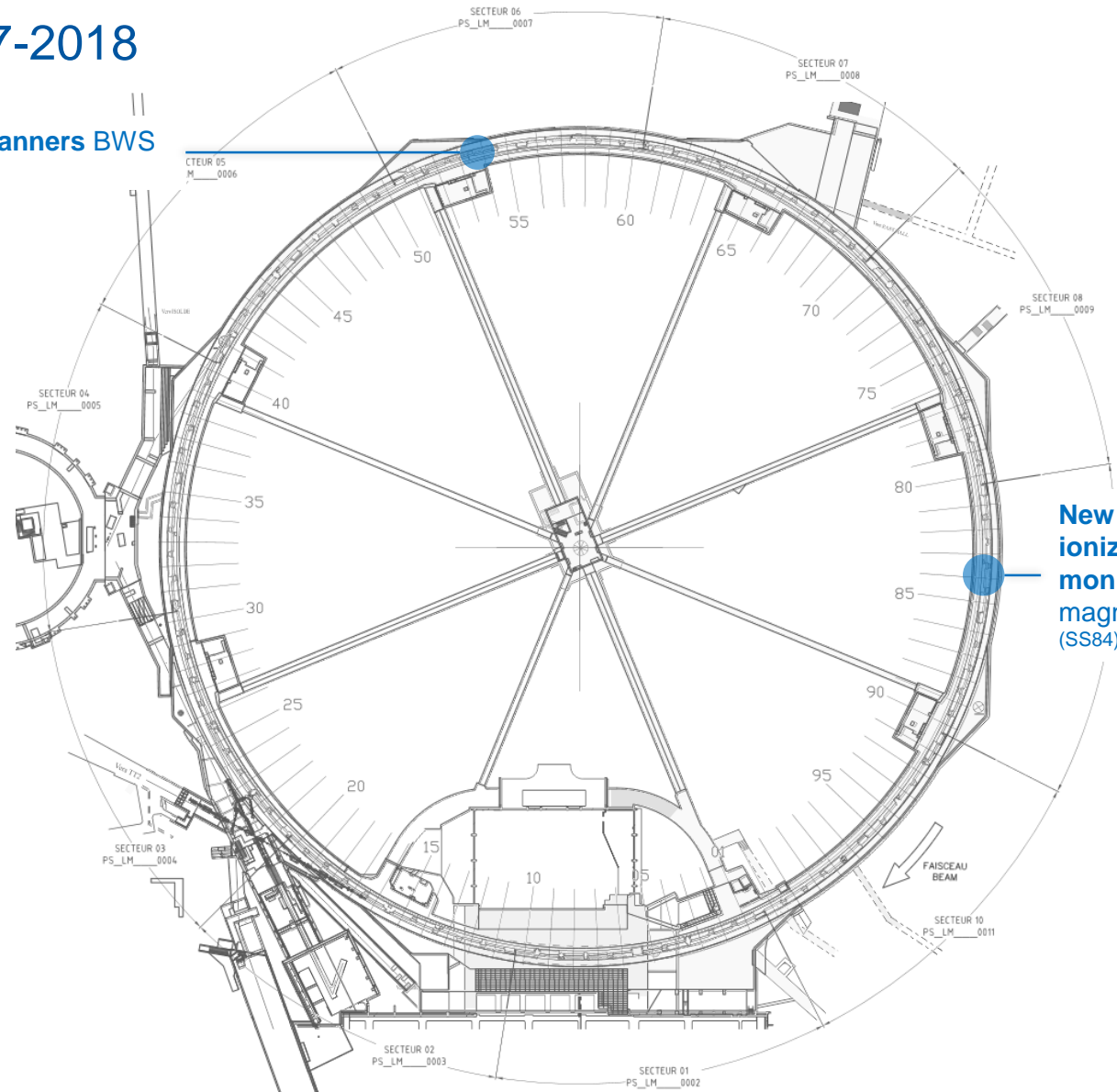
7th & 8th November 2016

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LIU-PS activities

YETS 2017-2018

New prototype beam wire scanners BWS (SS54)



New vertical ionization profile monitor BGI and magnets (SS84)



LIU-PS activities

LS2

New injection septum + bumper SMH42 (SS42):

- New BTV (MU41)
- New SEMGrid (MU42)
- New bumper (SS42)

Replace injection (spare) kicker KFA45

New bumpers (40, 41, 43, 44)

New insertion quadrupoles (SS33, SS49)

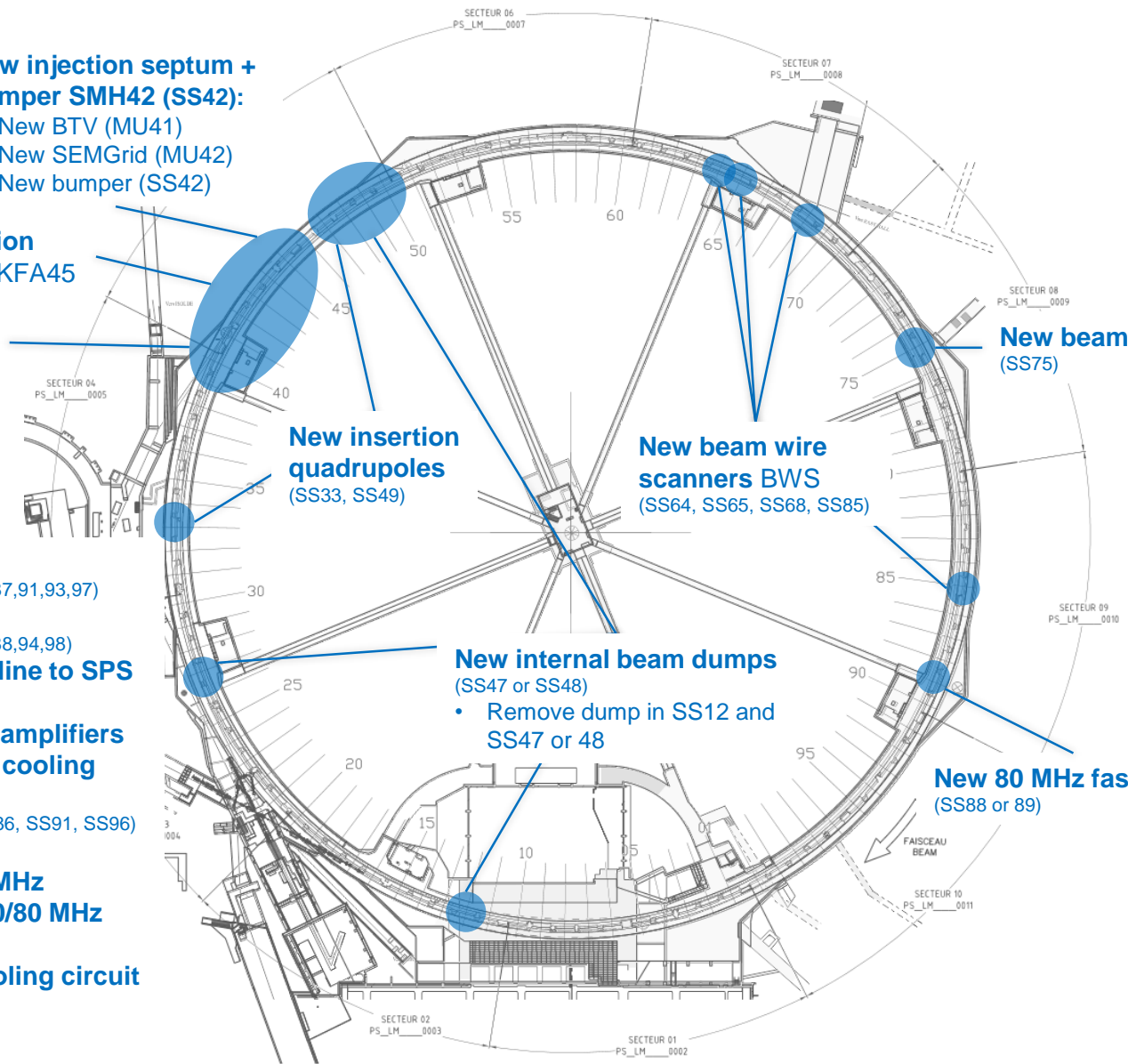
New beam wire scanners BWS (SS64, SS65, SS68, SS85)

New beam dumps (SS75)

New internal beam dumps (SS47 or SS48)

- Remove dump in SS12 and SS47 or 48

New 80 MHz fast tuner (SS88 or 89)



- **Replace skew quadrupoles** (03,07,19,23,29,33,37,41,43,47,53,57,69,73,79,83,87,91,93,97)
- **Replace vertical correctors** (02,04,08,12,20,22,24,30,34,38,44,54,64,70,76,80,88,94,98)
- **Replace 2 magnets in extraction line to SPS (TT2)**
- **Upgrade of the 10 MHz feedback amplifiers**
- **Modification of the 10 MHz water cooling circuit** (SS36, SS46, SS51, SS56, SS66, SS76, SS81, SS86, SS91, SS96)
- **Longitudinal beam control**
- **1-turn delay feedbacks 20/40/80 MHz**
- **New feedback amplifier for the 40/80 MHz**
- **Upgrade of the cooling plant**
- **Modify the copper secondary cooling circuit**



LS2

Days

7th & 8th November 2016

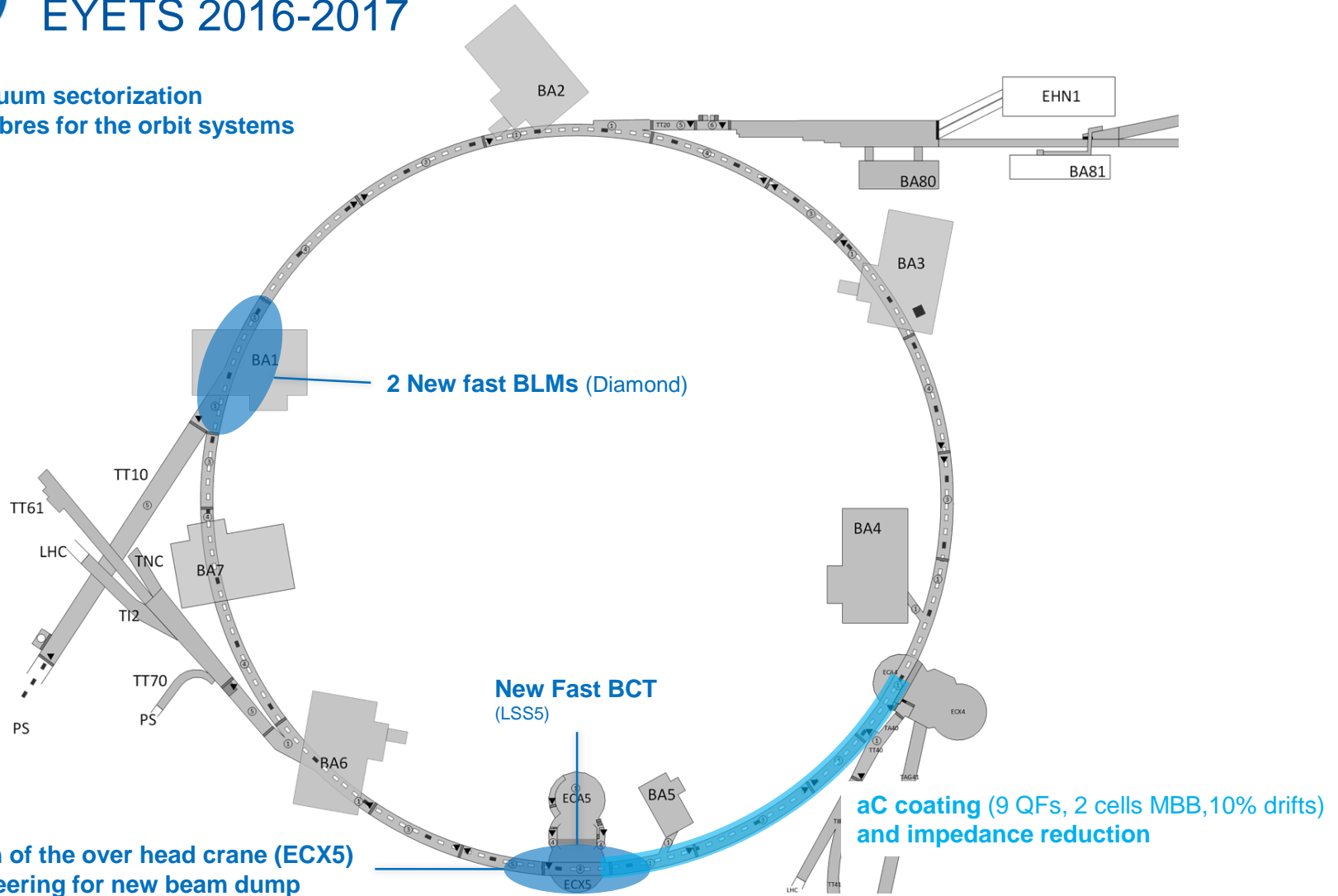
<http://indico.cern.ch/event/564604/>

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LIU-SPS activities

EYETS 2016-2017

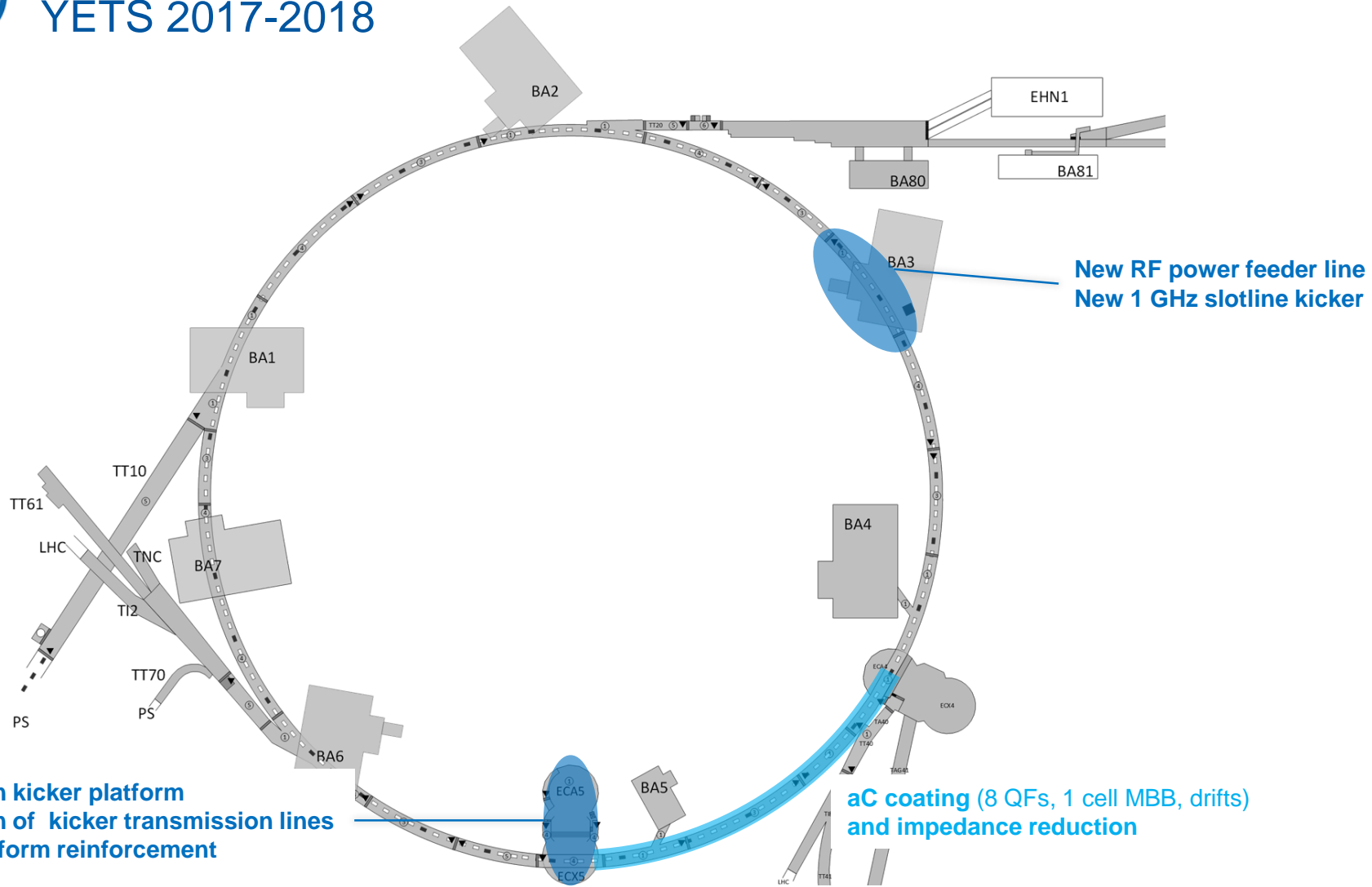
- New Vacuum sectorization
- Optical fibres for the orbit systems



- Renovation of the over head crane (ECX5)
- Civil engineering for new beam dump

LIU-SPS activities

YETS 2017-2018



Organisation of the LIU Planning, Layout and Installation activities

The Planning, Layout and Installation (LIU-PLI) working group ensures dispatching of all information and efficient work progress.

LIU Planning and Installation www.cern.ch/LIUPLI Indico 5706

Integration www.cern.ch/project-Integration-Accelerateurs Indico 579563

Configuration www.cern.ch/cfg

Layout www.cern.ch/layout

Organization and Scheduling www.cern.ch/ls1tols2

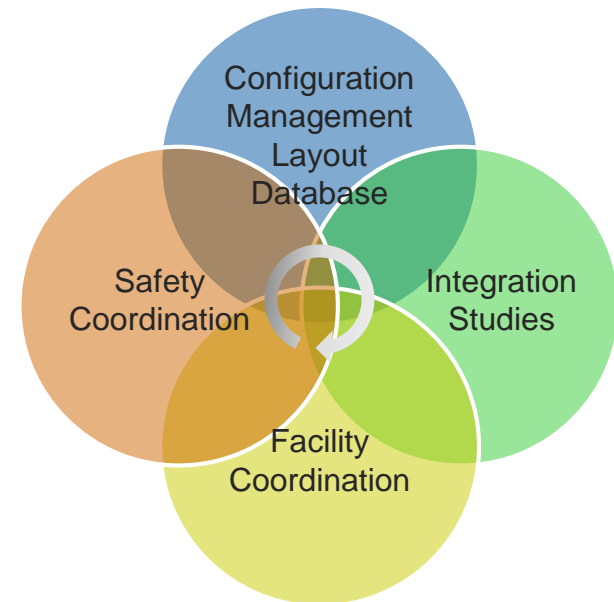
Planning and coordination meeting

Joint Linac2&3,PSB, PS indico 7157

SPS indico 3213

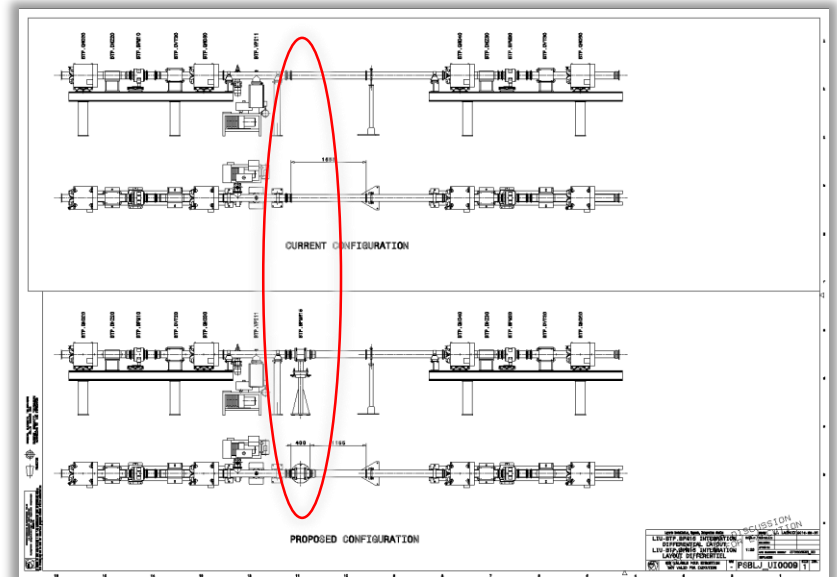
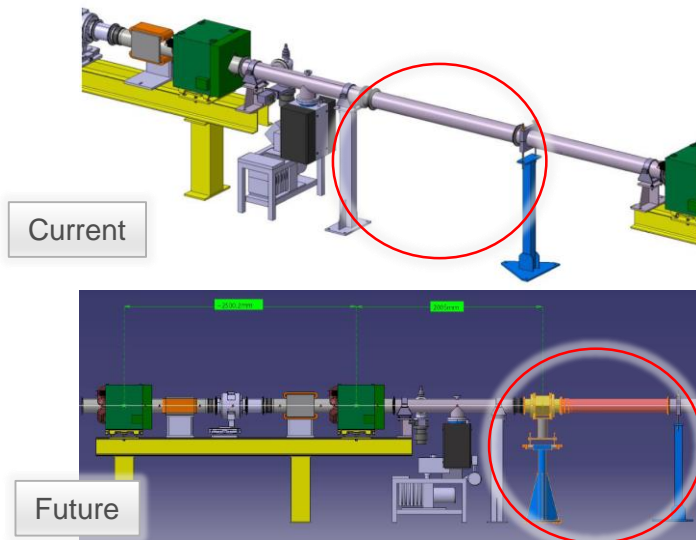
Planning

www.cern.ch/PACS/Projects.aspx



Layout drawings and integration studies

- The integration office is working on 2 versions of 3D models (current situation and post-LS2 situation) and provides differential layout drawings of the beam line when engineering changes take place.
- The layout drawings are controlled, approved and stored in the CERN Drawings Directory (CDD).



- The validation of the integration studies is part of the approval process of the Engineering Change Requests.
- Integration studies are also done for the facility surface buildings.



Space Reservation Requests, Engineering Change Requests: Documentation status

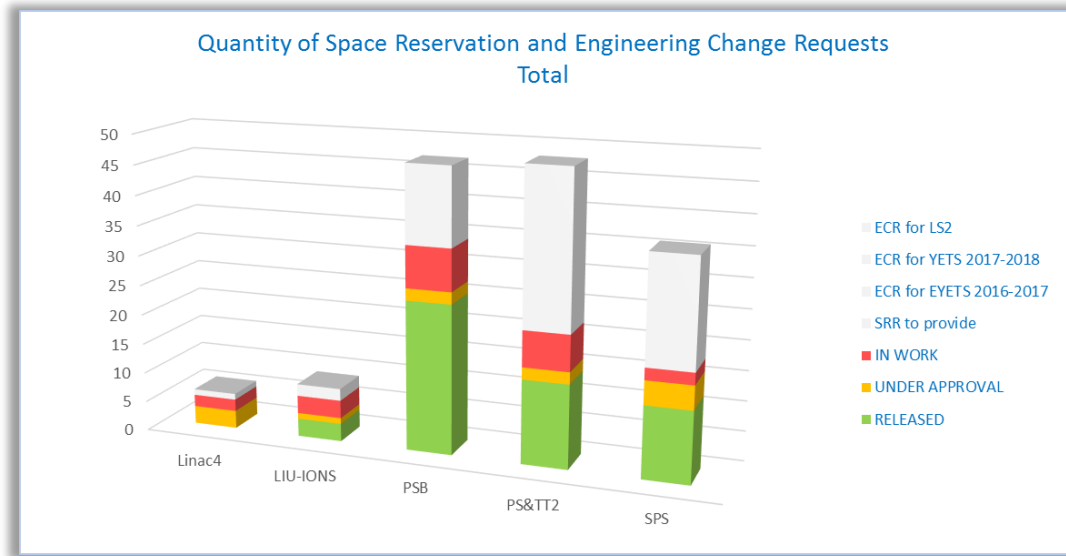
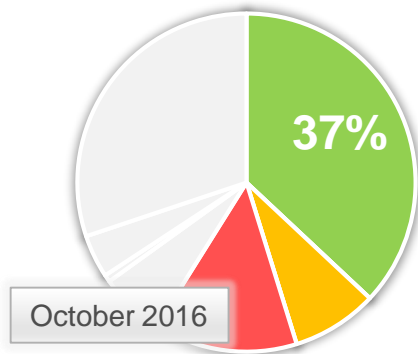
- Space Reservation Request (SRR)

A Space Reservation Request is sent for approval and released at least 1 year in advance in order to reserve the space and inform the different stakeholders.

- Engineering Change Request (ECR)

A Engineering Change Request is sent for approval and released before the installation in order to get the agreement of all the stakeholders and to perform the work in due time.

- Status of the LIU Project :

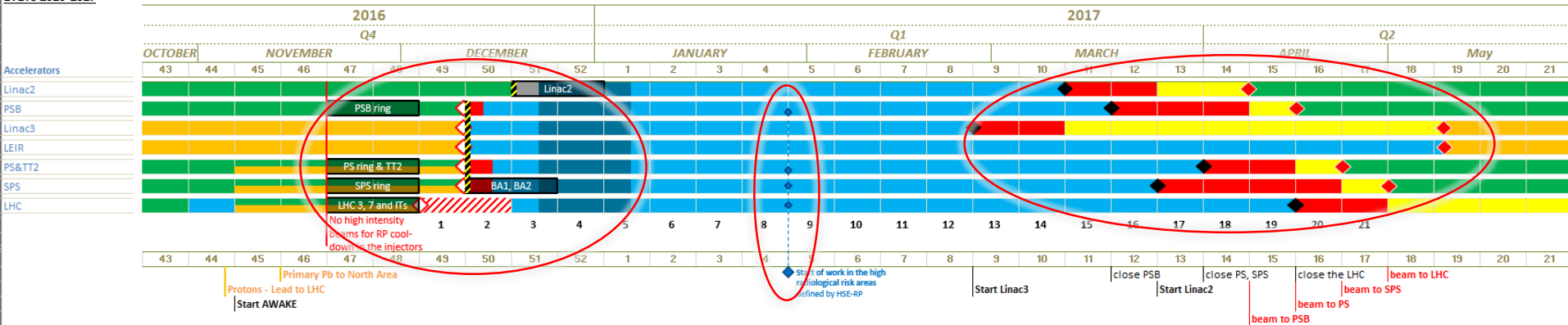


Work planning (EYETS 2016-2017)

1470895 v.2.3 | ATS-PM-MS-0001 v.2.3

Under Approval

EYETS 2016-2017



The master schedule has been more precisely defined, especially the estimation of the hardware commissioning tests and the beam re-commissioning of the accelerators chain.

The EYETS will allow us to:

- Anticipate upgrade activities
- Carry out the de-cabling campaigns

Machines	Opening of the machine (weeks) not including the xmas break of 2 weeks
PSB	11.5
PS	13.5
SPS	12.5 (BA1,BA2) – 13.5
LHC	15

legend

- stop of the beam
- closure
- beam
- RP survey before access
- protons operation
- ions run
- area
- rp cooling time before access
- technical stop (access to be defined)
- hardware commissioning + cold check-out
- beam commissioning
- Training quench in the LHC



LS2
Days

7th & 8th November 2016

<http://indico.cern.ch/event/564604/>

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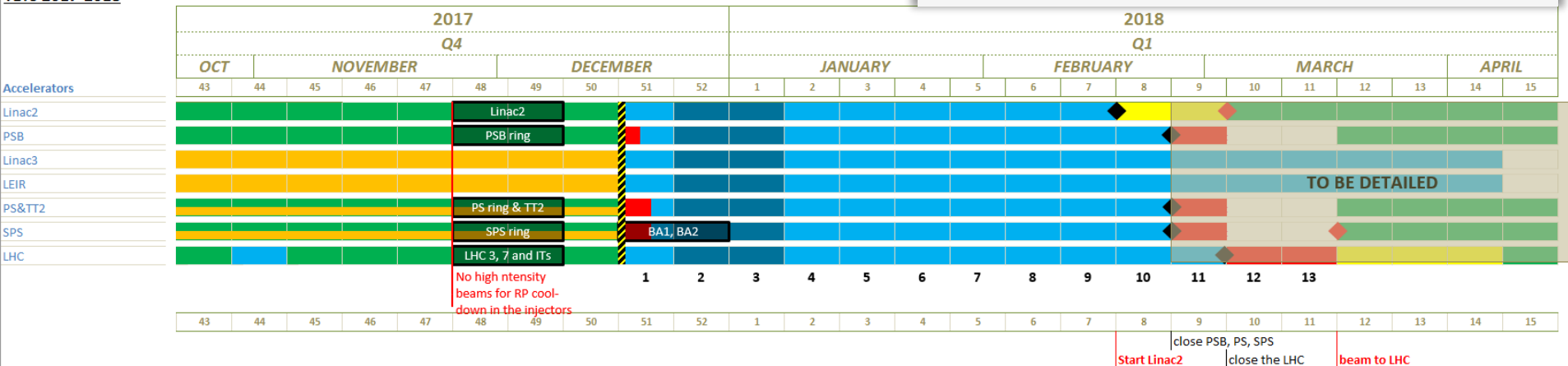


Work planning (YETS 2017-2018)

YETS 2017-2018

1470895 v.2.3 | ATS-PM-MS-0001 v.2.3

● Under Approval



The master schedule has been estimated and shall be reviewed next year and will take into account physics and operation needs.

The YETS will allow us to:

- Anticipate any minor upgrade activities
- Carry out the de-cabling campaigns

Machines	Opening of the machine (weeks) not including the xmas break of 2 weeks
PSB	7.5
PS	7.5
SPS	7 (BA1, BA2) – 7.5
LHC	9

legend

- ◇ stop of the beam
- ◆ closure
- ◆ beam
- RP survey before access
- protons operation
- ions run
- rp cooling time before access
- technical stop (access to be defined)
- hardware commissioning + cold check-out
- beam commissioning
- Training quench in the LHC



LS2
Days

7th & 8th November 2016

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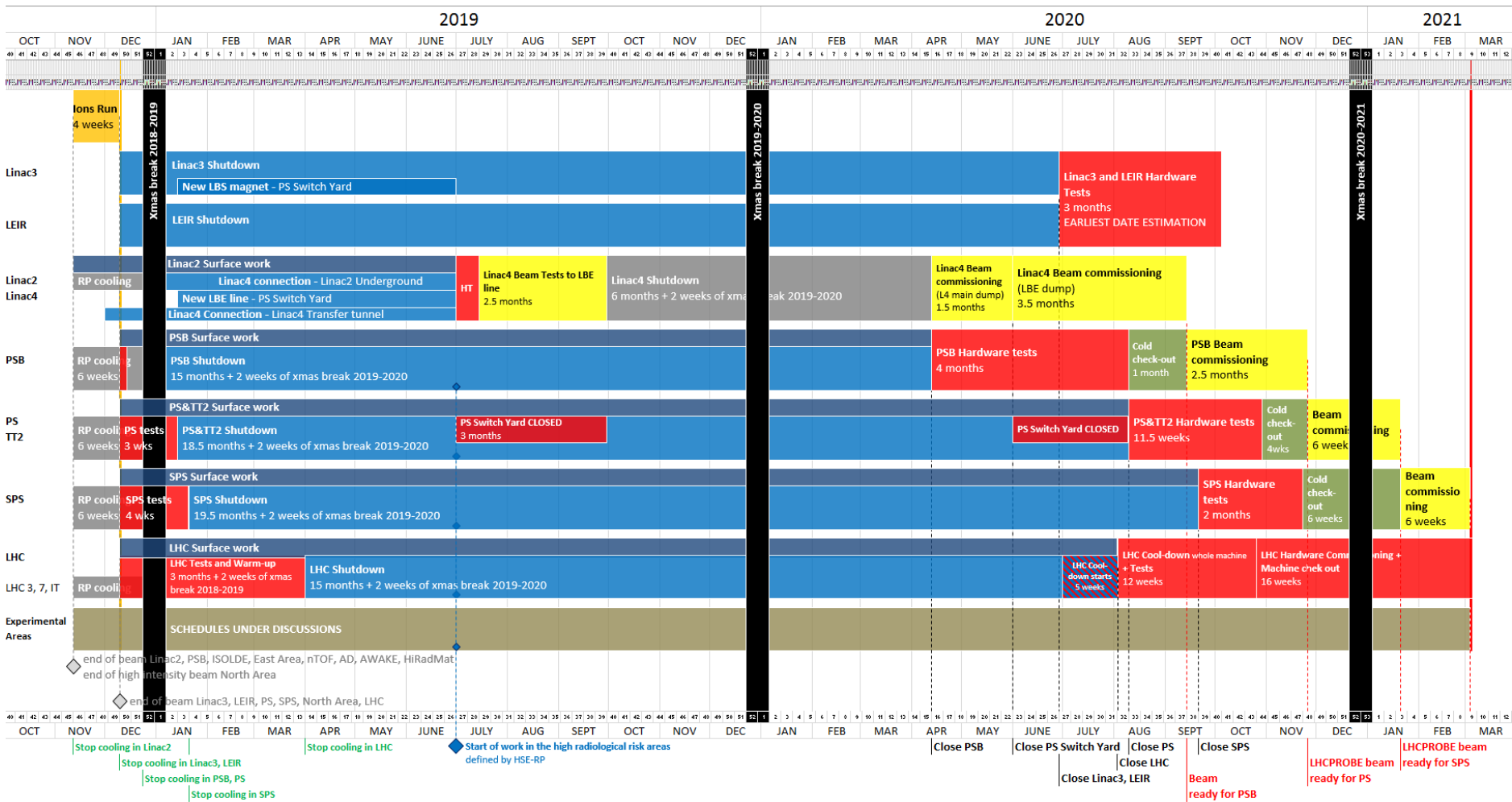


Work planning (LS2)

General Master Schedule

1687788 v.1.0 | ACC-PM-MS-0002 v.1.0

Released



LS2
Days

7th & 8th November 2016

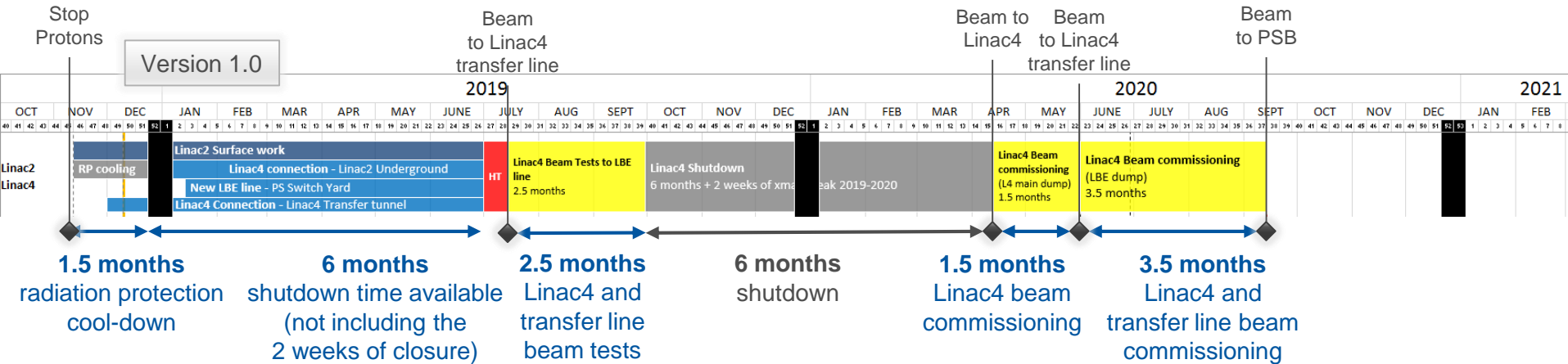
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Work planning (LS2)

Linac4 connection



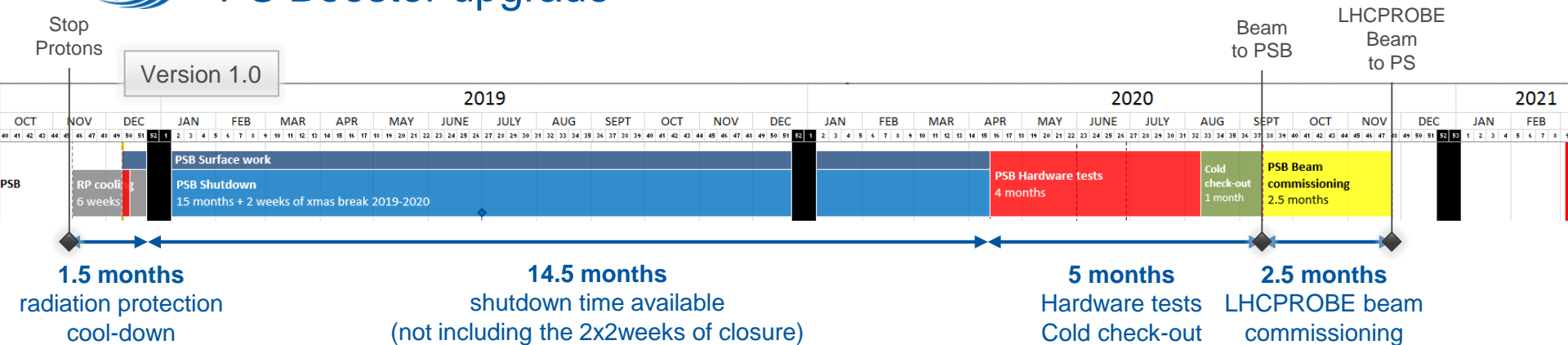
- A detailed schedule has been presented at the Linac4 connection readiness review in August 2016.
- The integration studies is completed.
- ECRs covering the work needed for the full connection have been circulated for first verifications.
- Sequence of beam tests during LS2 has been defined.

The shutdown duration is not critical for the Linac4 to the PSB connection activities during LS2. The resource needs are being identified by the LS2 committee (PLAN tool) and resource levelling still needs to be done through all of the facilities.



Work planning (LS2)

PS Booster upgrade



- Anticipated works before LS2 (→ reduced the LS2 workload)
- Identified, labelled and disconnected all of the obsolete cables to be removed
- Shall carry out the removal of the obsolete cables during the EYETS 2016-2017

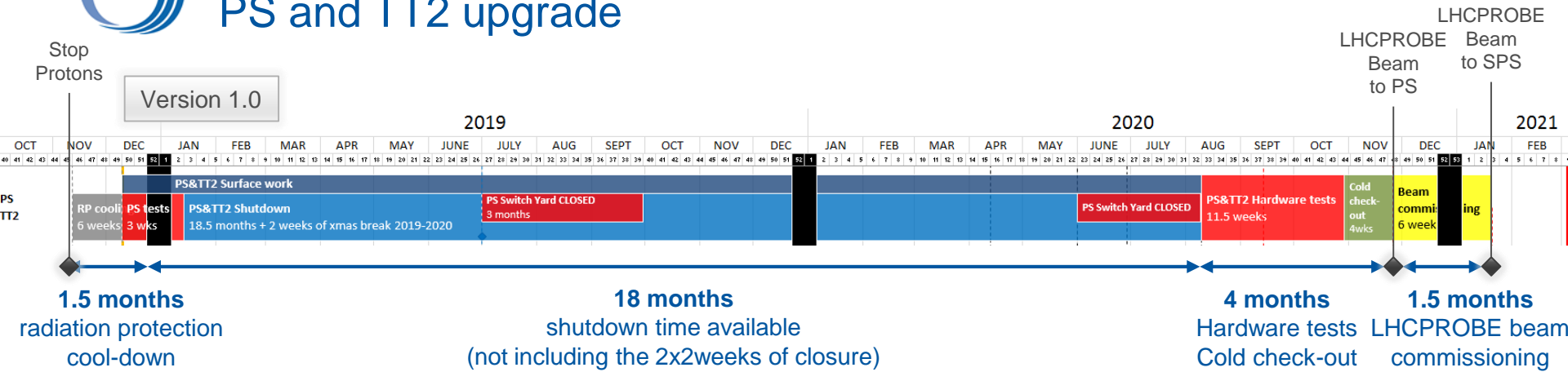
The shutdown duration is no more critical for the upgrade of the PSB during LS2. The resource needs are being identified by the LS2 committee (PLAN tool) and resource levelling still needs to be done through all of the facilities.

→ It is important to respect the shutdown duration of the PSB.



Work planning (LS2)

PS and TT2 upgrade



- Anticipated works before LS2 (→ reduced the LS2 workload)
- Shall identify, label and disconnect all of the obsolete cables which are to be removed during the EYETS 2016-2017
- Shall start the removal of the obsolete cables during the YETS 2017-2018

The shutdown duration is not critical for the upgrade of the PS and TT2 during LS2. The resource needs are being identified by the LS2 committee (PLAN tool) and resource levelling still needs to be done through all the facilities.

→ It is important to respect the shutdown duration of the PS and TT2.

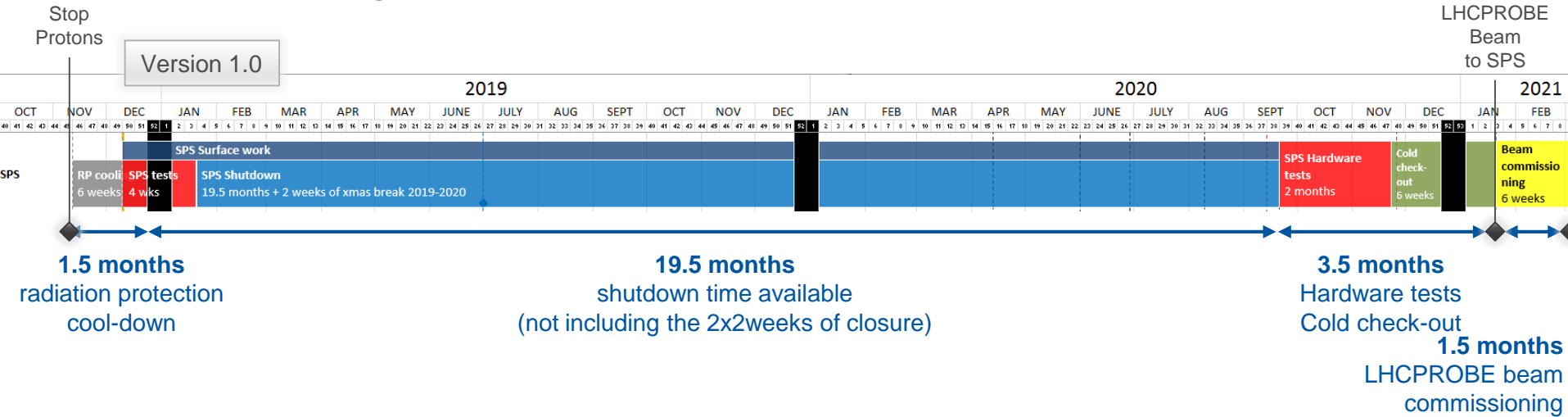




Work planning (LS2)

SPS upgrade

LHC PROBE
Beam
to LHC
LHC PROBE
Beam
to SPS



- Anticipated works before LS2 (→ reduced the LS2 workload, i.e. aC coating, impedance reduction, civil engineering for the new beam dump)
- Identified, labelled and disconnected all of the obsolete cables to be removed during the LS1 and the YETS 2015-2016
- Shall start the removal of the obsolete cables during the EYETS 2016-2017

The shutdown duration is not critical for the upgrade of the SPS during LS2 but the logistics for transport will be challenging. The resource needs are being identified by the LS2 committee (PLAN tool) and resource levelling still needs to be done through all the facilities.

→ It is important to respect the shutdown duration of the SPS.



U Outlook

The LHC injectors upgrade fits in the long shutdown 2 master schedule but it is important to note that the hardware tests and beam commissioning are planned in a critical path

Possible impacts on the master schedule:

- **The resource allocation (manpower and material) between the facilities**
- **The additional work (consolidation and maintenance)**
 - The consolidation requests shall be approved by the planning and installation team
 - The groups shall continue informing the planning and installation team of any maintenance or additional work to be carried out during LS2
- **The logistic and safety constraints between the facilities**
 - The identification of co-activities and safety aspects in a facility which could adversely affect other facilities is under study



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