Status of the planning of the LIU-SPS requirements for LS2

LIU-SPS Coordination Meeting
17/09/14

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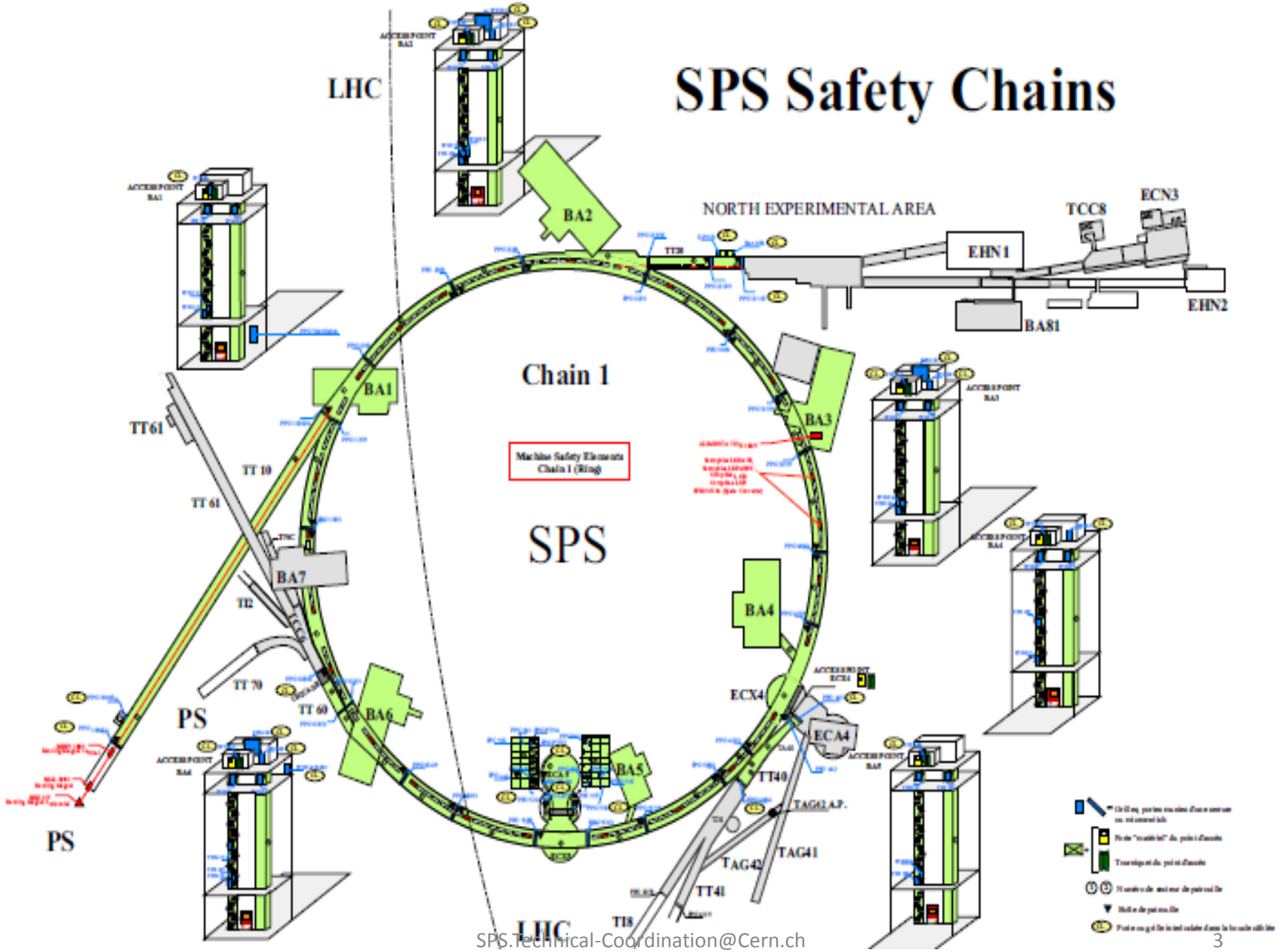
What is covered by the SPS.

- Areas covered by SPS coordination:
  - The SPS ring.
  - All injection and ejection tunnels.
  - All pits and surface Bas. (Including BA7)
- Areas NOT covered by SPS coordination:
  - The North Area
  - The AWAKE area (old CNGS)
  - Hiradmat.

Although not covered by SPS coordination, I still need to be aware of any works in these areas that may impact the SPS.

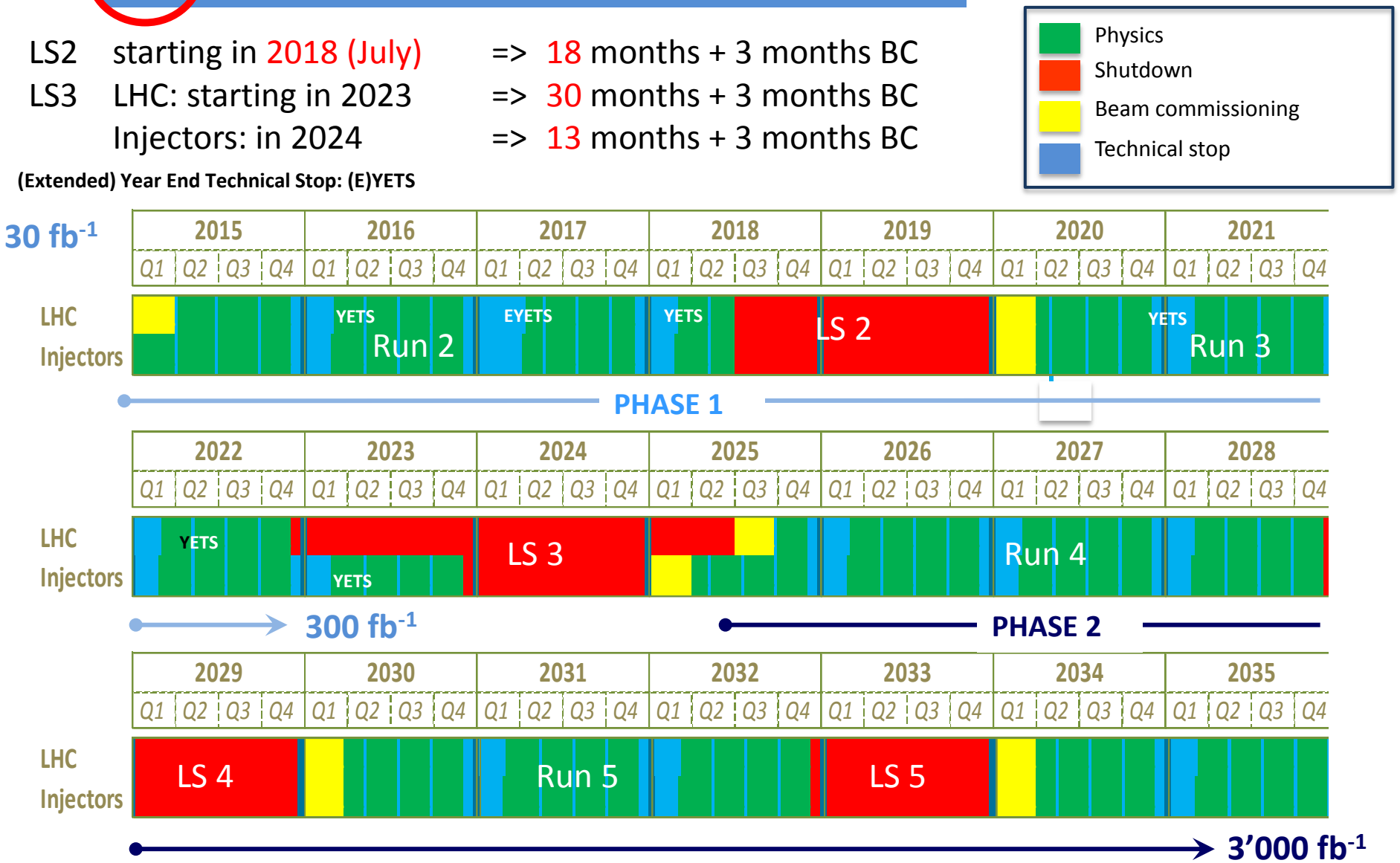
SPS Safety Chains



LHC roadmap: schedule beyond LS1

LS2 starting in 2018 (July) => 18 months + 3 months BC
LS3 LHC: starting in 2023 => 30 months + 3 months BC
Injectors: in 2024 => 13 months + 3 months BC

(Extended) Year End Technical Stop: (E)YETS



Year End Technical Stops & Extended (E)YETS between LS1 and LS2

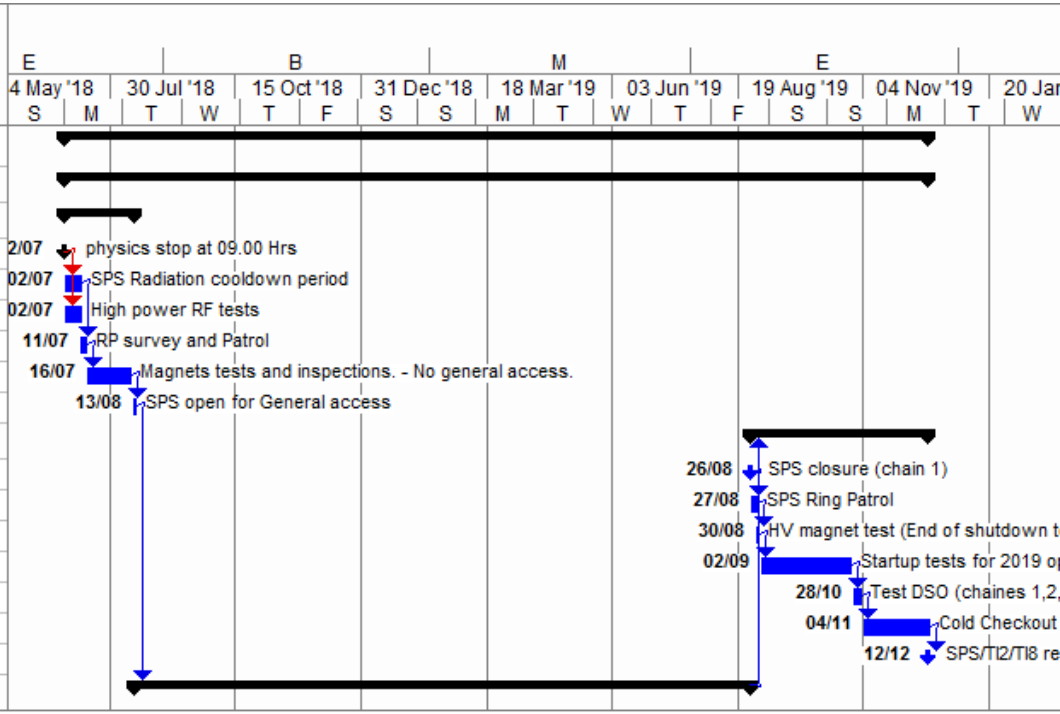
- YETS 2015-2016 = 3w + 2w* + 7w = 12 weeks (Beam to Beam in the LHC)
  - This will allow approximately 4 to 5 weeks of Access in the SPS.
- EYETS 2016-2017 = 3w + 2w* + 13w = 18 weeks (Beam to Beam in the LHC)
  - This will allow approximately 10 weeks of Access in the SPS.
- YETS 2017-2018 = 3w + 2w* + 7w = 12 weeks (Beam to Beam in the LHC)
  - This will allow approximately 4 to 5 weeks of Access in the SPS.

It may be possible to do minor LIU works during these periods.

* Christmas break

LS2 overview

ID	Task Name	Duration	Group	LIU SPS
0	**LS2 Shutdown_SPS**	**369 d...**		No
1	**Main Milestones**	**369 days**		**No**
2	**Start of LS2**	**31 days**		**No**
3	End of physics (stop extraction to North area)	0 days		No
4	SPS Radiation cooldown period	7 days	DGS/R	No
5	High power RF tests	7 days	BE/RF	No
6	RP survey and Patrol	3 days	DGS/R	**No**
7	Magnets tests and inspections. - No general a	4 wks	TE/MS	No
8	SPS open for General access	1 day		No
9	**End of LS2**	**78 days**		**No**
10	SPS closure (chain 1)	0 days	BE/OP	No
11	SPS Ring Patrol	3 days	BE/OP	No
12	HV magnet test (End of shutdown tests)	1 day	TE/MS	No
13	Startup tests for 2019 operation	8 wks	TE/EP	No
14	Test DSO (chaines 1,2,3,4 & 5(Test global Sy	5 days	BE/AS	No
15	Cold Checkout and start up of the SPS - TT -	29 days	BE/OP	No
16	SPS/TI2/TI8 ready to inject into LHC	0 days	BE/OP	No
17	**Shutdown works**	**260 day...**		**No**



- **18 months of Shutdown does NOT mean 18 months of access!!!!**
- **There is only 12 months access in the SPS during LS2!!!!!**
- **This is assuming the North Area does not request beam earlier!**

LIU works *Vs* Consolidation works

- From a coordination point of view there is no difference between these 2 types of works.
- When planning LIU works, any consolidation works in the same area must be taken into account.
- Any recourses required must be identified as soon as possible and the necessary requests made. (eg, Transport, Vacuum etc)

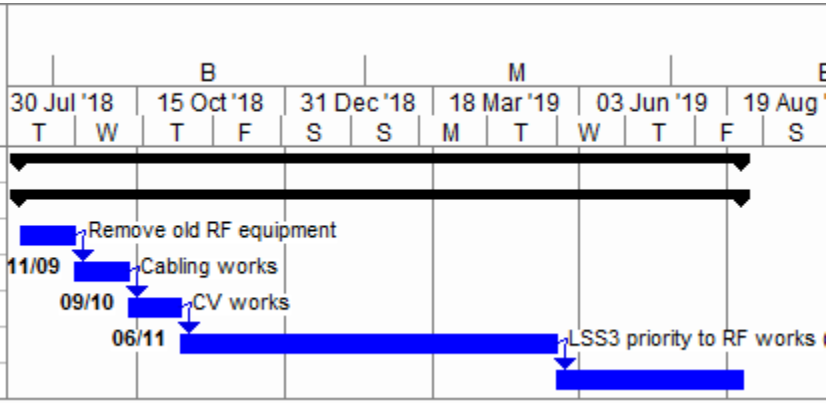
LIU Upgrade work activities

EDMS Id: 1296785 v.3

Action	Contact	Description	Risk if not done	PIC or Upgrade	Total cost	%"P" in PIC	Any risks if done	Total shutdown time needed	Possible to split across shutdowns?	Minimum single block of shutdown needed	Earliest shutdown date work can start	Services needed					Comment
					kCHF	%		Months		Months		Cabling	CV	SU	Transport	Vac	
Machine interlocks	R.Mompo	Replace obsolete electromechanical relays with PLC solution compatible with other SPS TL and CERN systems. Better reliability and maintenance, standard supervision and diagnostics	Possible reliability issue, extra maintenance costs, extra resources for keeping obsolete system operational	PIC	600	0%		6 (finished in LS1)	n/a	n/a	n/a	XX					Done
800 MHz upgrade	W.Hofle, E.Montesinos	Replacement of analogue control with digital. New 1-turn feedback and feed-forward (essential for beam control) in low level for amplitude and phase stability to remove sensitivity to beam loading. Consolidation of existing power system. Doubling available power (needed to match 200 MHz upgrade)	Beam instability (already at present intensity). Impedance and beam quality (difficult to perform controlled emittance blowup). Longer LHC filling time. Extra cost, resources and reliability risk to keep obsolete low-level running	PIC		50%		12 (finished in LS1)	n/a	n/a	n/a						Done
Improved vacuum sectorisation LSS1	P.Chiggiato	Addition of sector valves around TIDVG and MKP/D, to reduce personnel dose, protect sensitive equipment and reduce pump-down times	Increased risk of venting and damage to sensitive or very radioactive equipment. Increased radiation dose to personnel	PIC	800	75%		6 (finished in LS1)	n/a	n/a	n/a	X				X	Done
Scraper improvement	R.Losito, F.Cerutti	Construction of additional spares and improvements to local shielding	Insufficient spares. Reduced LHC performance (unable to clean transverse tails in SPS)	PIC	200	0%		0									Surface only
Beam Instrumentation	L.Jensen	Replacement of obsolete MOPOS electronics, plus new fibre backbone. Replacement of obsolete BLM electronics, using MOPOS fibres. Replacement of wirescanners with new devices. Improvement of BGI, BSRT, IMM and Head-Tail monitors	Extra cost, resources and reliability risk to keep obsolete systems running. No reliable transverse beam size measurement. Insufficient resolution and no bunch-by-bunch capability for LHC beams	PIC	5,600	75%	HOM heating for new WS	24	yes	3	LS1 (ongoing)	XXX				X	Only 4'600 in LIU budget
Transverse damper	W.Hofle	Move to dedicated pickups (forced by BI MOPOS upgrade). Improvement of low-level control (digital), essential for delay compensation with new pickups and for scrubbing beams. Move from 120 to 200 MHz local oscillator. Consolidation of damper cables	Extra cost, resources and reliability risk to keep obsolete systems running. Not able to properly damp Pb ion beams	PIC	1,300	50%		9	yes	6	LS1 (ongoing)	X				X	Done
Improved vacuum sectorisation arcs	P.Chiggiato	Reduce length of arc sectors by factor 2, to reduce pumping times. Improved protection against loss of ecloud scrubbing	Longer scrubbing times for ecloud	PIC	2,500	75%		6	yes	3	2015/16	XX				XX	Might need long recovery time (scrubbing)
New TIDVG core	R.Losito, O.Aberle	Replace present TIDVG core with improved version. Robust against present and future LHC beams	Damage to TIDVG for repeated dumping of intense/bright LHC beams. Long (months) recovery to condition with beam	PIC	2,900	50%	Long beam conditioning time of newly installed dump	3	no	3	LS2				X	XX	Might need long recovery time (conditioning)
Other kicker impedance reduction	L.Ducimetiere	Addition of transition pieces in MKD kickers. Serigraphy of MKQ kickers	Intensity limitation with high duty cycle beams due to other kickers. Limitation of scrubbing beam time	PIC	4,100	75%		3	yes	2	2015/16					X	
ZS improvements	J.Borburgh, B.Balhan	Improvement of pumping, impedance reduction, improvement of ion trap connections, short-circuiting of anodes	ZS sparking, limitations on other beams, longer switch to LHC cycle	PIC	1,000	50%		3	yes	2	2015/16 (or 14/15, tbc)					X	
200 MHz low level improvement	W.Hofle	Consolidation of drivers, cavity controllers, HV power supplies, CV and power couplers. Low-level improvement (replace obsolete system with new digital control)	Extra cost, resources and reliability risk to keep obsolete systems running. Insufficiently performing beam control	PIC	3,700	75%		6	yes	3	2016/17	X					
Extraction protection upgrade	J.Borburgh, B.Balhan	Replacement of TSPG4/6 by upgraded versions with better robustness and protection of MSE	Damage of TPSG or MSE in event of misteered beam at extraction	Upgrade	1,300			3	yes	2	2015/16					X	
200 MHz power upgrade	E.Montesinos	Rearrangement of RF cavities into new configuration with 2 additional 1.4 MW power plants, and 2 extra cavities. Reduce impedance by 15% and double RF voltage to allow operation with very high RF current.		Upgrade	22,800			12	no (for cavities rearrangement), yes (for all other activities)	12	LS2	X	XX	X	XXX	XX	
SPS and TI2/TI8 protection devices	R.Losito, V.Kain	Replacement or extenstion of present TCDI system, with more robust collimators and improved protection. Displacement upstream in TI2/8 to reduce losses in LHC injection region.	Damge to TCDI or TI2/8 magnets in case of steering error. Reduction in LHC availability due to losses at injection.	Upgrade	5,600			3	yes	2	LS2	X		X		X	
New wide band transverse damper	W.Hofle	New intra-bunch damping system in vertical plane to damp instabilities from TMCI or ECI.	Longer scrubbing times for ecloud, impossible to scrub and need for aC coating, lower instability thresholds	Upgrade	1,600		Extra impedance	3	yes	2	LS2	X		X		X	Decision end 2016
New external high energy beam dump	B.Goddard, R.Losito	New dump block based on TED design in existing beamline, using extraction already in place and new switchign series of magnets. Will allow dumping of high intensity LHC beam during setup.	Increased TIDVG activation, longer setting up times, reduced LHC availability.	Upgrade	10,000			6	yes	3	LS2	X	X	X	X	X	Civil engineering probably needed
Replace power supply of MSE septa	G.Le Godec, J.Borburgh	Replace MSE/T convertors with higher stability versions, possibly with faster pulse,	Hgher power consumption, longer LHC setting up time	Upgrade	1,300			6	yes	3	LS2	X	X		X	X	Assuming no civil engineering needed
aC coating of vacuum chambers	J.Bauche, M.Taborelli	Coating of all SPS main magnets and drift chambers to supress electron cloud. Coating to be done with chamber inside magnet, in ECA5 workshop.	Intensity limitation especially with 25 ns, long conditioning times, higher beam losses, larger emittance, poor beam quality	Upgrade	5,000		Vacuum pressure, ageing	18	yes	3	2016/17			XXX	XXX	XXX	Decision mid-2015
Upgrade injection damper for ions	W.Hofle	Low level RF upgrade to make damper work for ions (currently not available for ions at all)	Larger beam emittance for some bunches, lower luminosity, if decided later -> more costly	Upgrade	100			6	yes	3	2016/17						Done
100 ns rise time kickers for ions	B.Goddard, J.Uythoven	Addition of new kicker, thin in-vacuum septum, dump and BI to allow injection of ions with 50 ns rise time.	Lower luminosity in LHC for Pb ions	Upgrade	10,000		Extra impedance, reduced aperture	6	yes	3	LS2 + 1y	XX	X	X		XX	Gain wrt slip stacking to review

200 MHz power upgrade at BA3

ID	Task Name	Duration	Group	LIU SPS
119	**BE/RF**	**260 days**		**No**
120	200 MHz power upgrade	260 days	BE/RF	Yes
121	Remove old RF equipment	4 wks		Yes
122	Cabling works	4 wks		Yes
123	CV works	4 wks		Yes
124	LSS3 priority to RF works (installing new	26 wks		Yes
125	Auxilary RF works	14 wks		Yes



Potential Conflicts

- BA3 could prove to be quite a bottleneck regarding works already identified:
  - 200 MHz power upgrade.
  - EL cable campaign.
  - AC coating of vacuum chambers (Work area is ECX5/ECA5, but magnets will be moved from all over the SPS).
  - Civil Engineering want to repair the floor
  - The “Monte-Charge” at BA3 is the main one used for installing and removing any large items from the SPS.