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LS1 Status Report
LS1@LHCC – 116th LHCC

Frédérick Bordry

4th December 2013

Booster

- Access system installed
- Cabling complete

- Beam dump replacement in progress
  - New dump installed
  - Re-installation of the BTM & BTY lines
- Maintenance of the different equipment on schedule

- Already preparing for LS2: cranes renovation, new cable trench

PSB beam dump

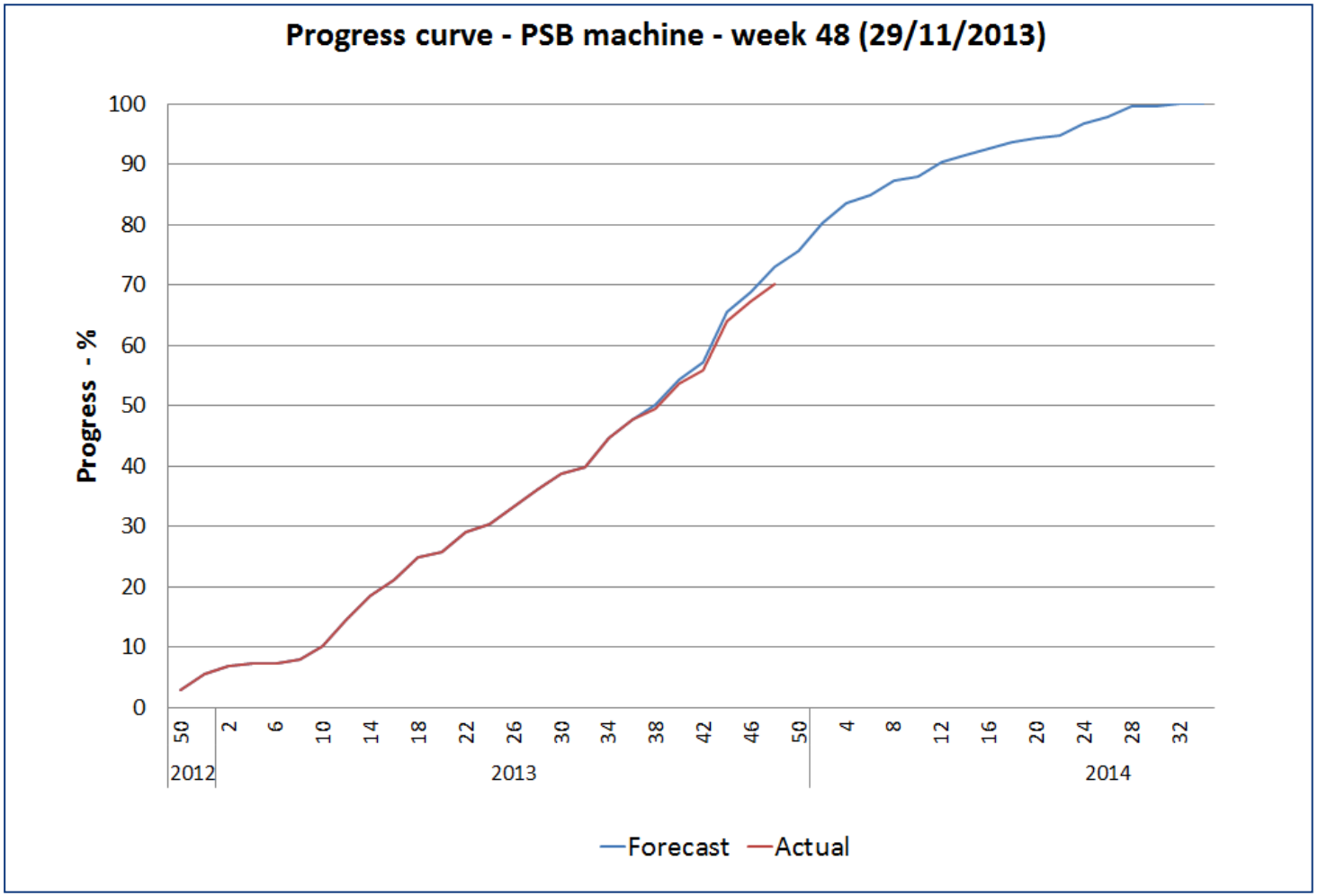
27/09

01/11

15/11

29/11

Booster


Progress curve - PSB machine - week 48 (29/11/2013)
Progress - %
100
90
80
70
60
50
40
30
20
10
0
50
2
6
10
14
18
22
26
30
34
38
42
46
50
4
8
12
16
20
24
28
32
2012
2013
2014
Forecast
Actual

PS

- Access system
- Ventilation renewal progressing well
  - Dismantling is finished
  - Automation test in progress
- Septum 16 shielding
  - Piling work is complete
  - Formworks going on
- Cabling campaign (and it starts with de-cabling !!)
- Magnet maintenance in progress
  - 6/7 main units are being overhauled in the workshop
- Renovation of the power house is in progress

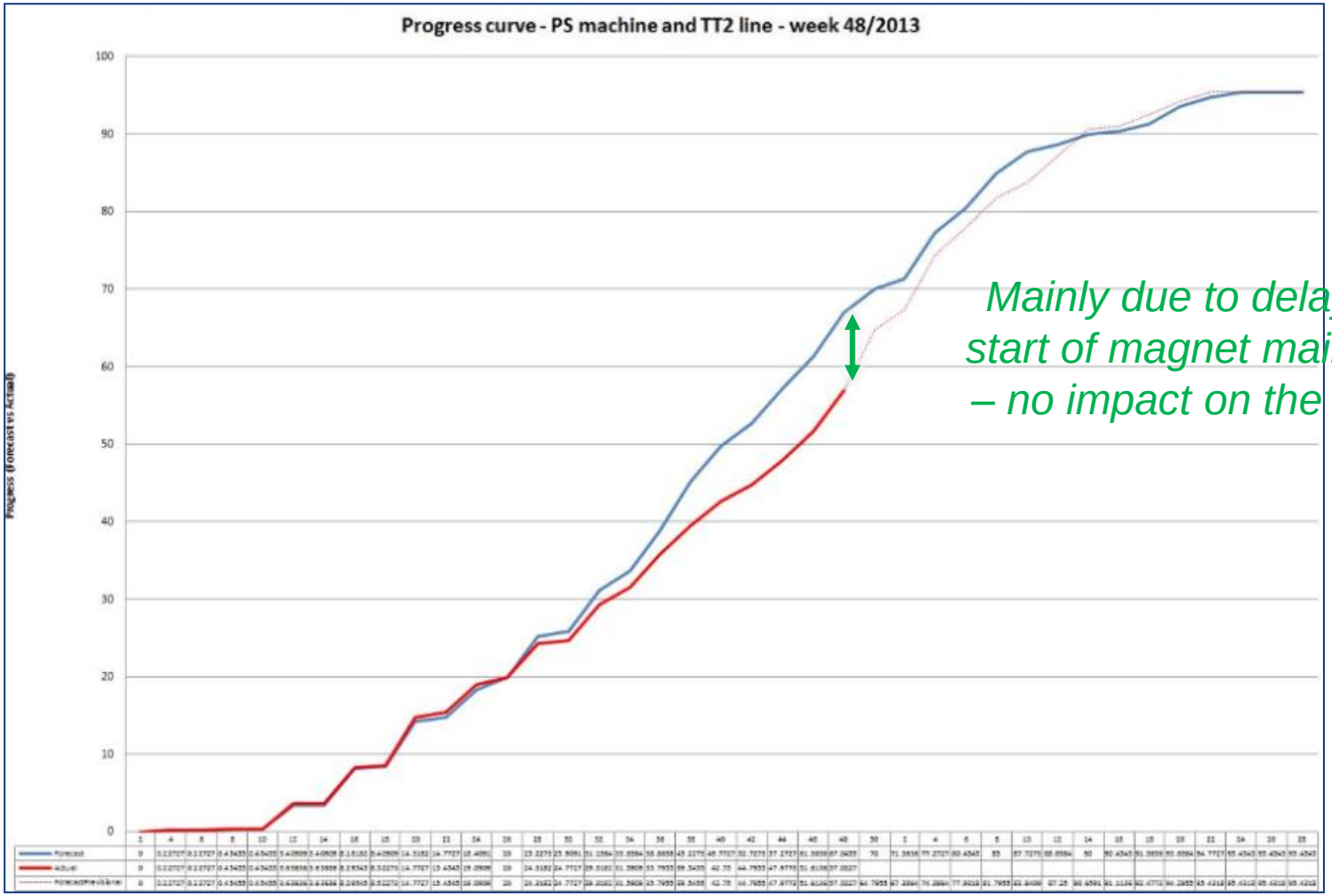
Septum 16 shielding - formworks

CV cabling works

TT2 decabling

6th MU being consolidated in workshop

PS



Mainly due to delay for the start of magnet maintenance – no impact on the end date

SPS

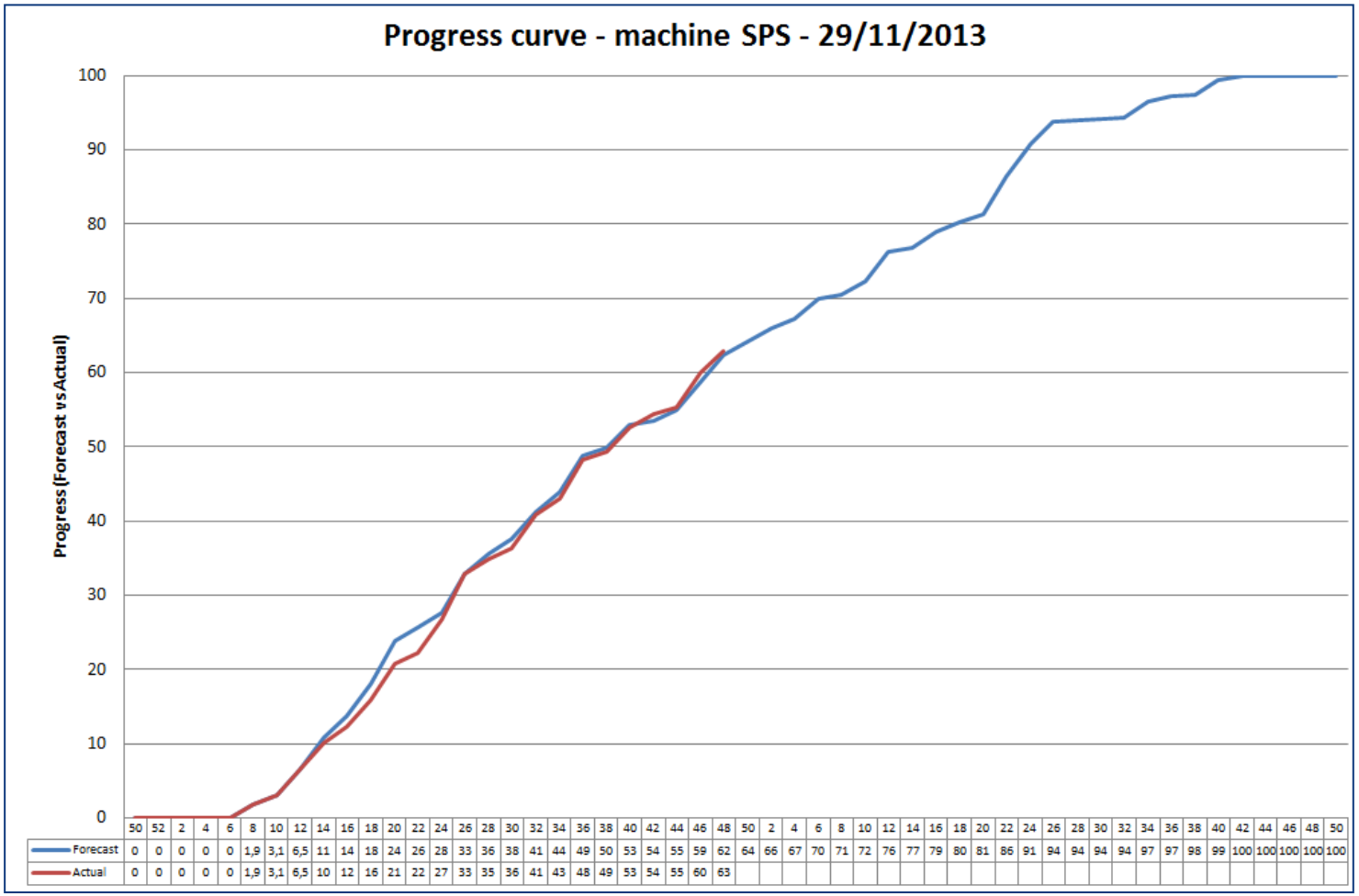
- BA1 - Irradiated cabling campaign
  - Progressing very well
  - slightly ahead of schedule
- TT10 – repair of the vault on going
  - Beam supports in place
  - Installation of protective mesh in progress
- Refilling of the primary circuits started
- Septa replacement in BA23 in progress
- Kickers conditioning in progress
- Magnet exchange
- Cabling and optical fibers campaign on going

BA1 -irradiated cabling campaign

TT10 vault

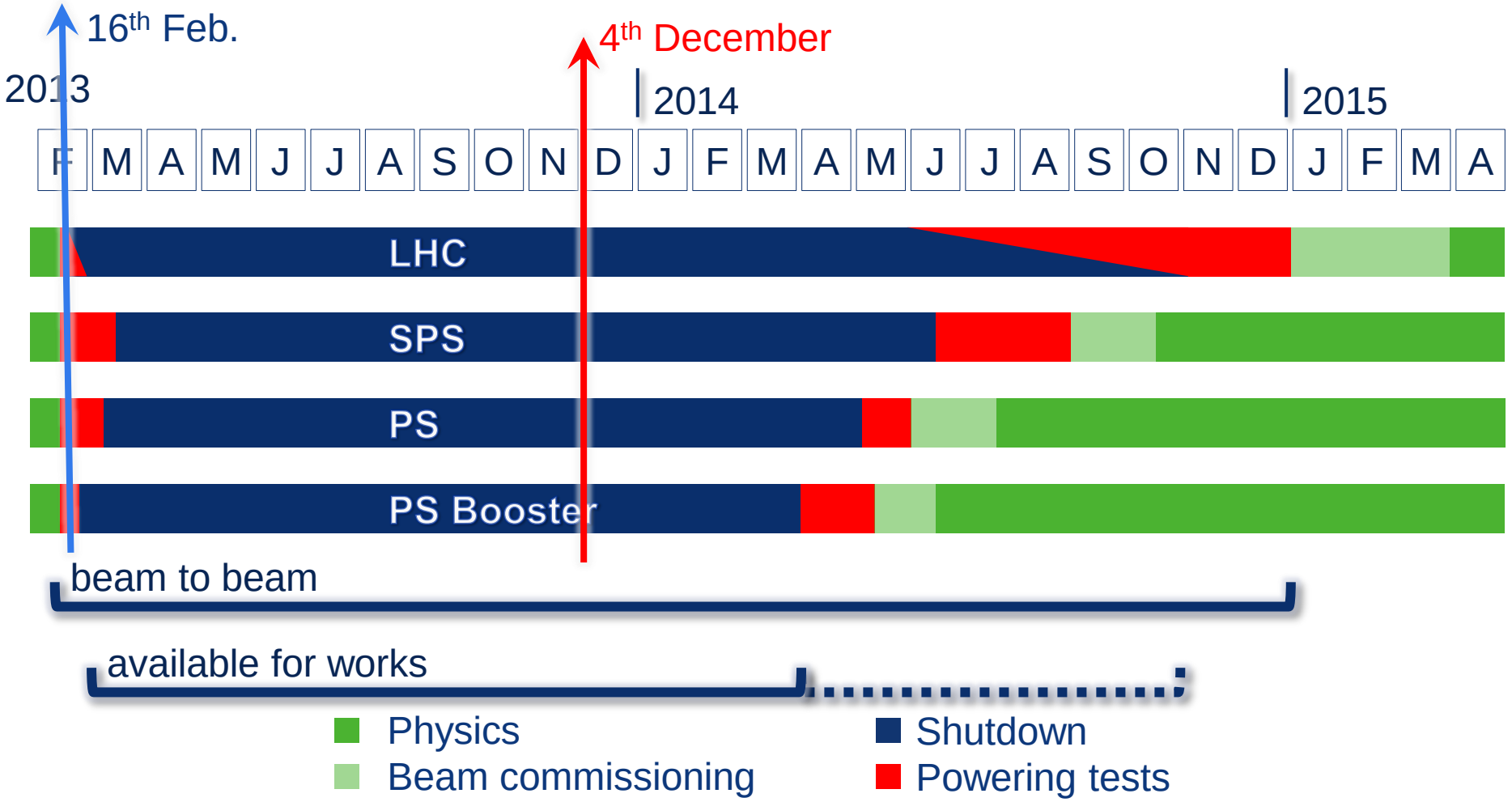
SPS magnet exchange

SPS

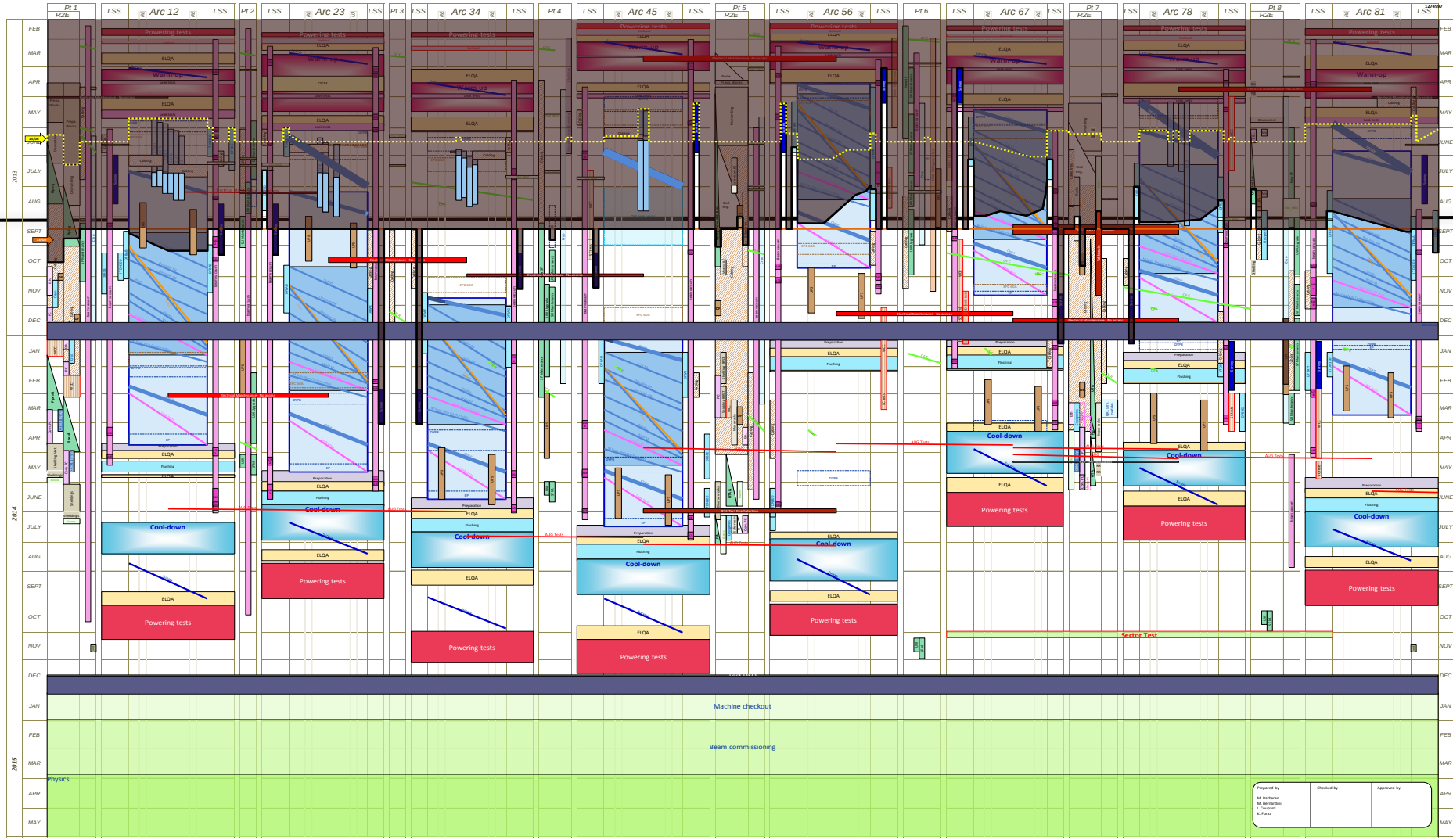


	50	52	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50
Forecast	0	0	0	0	0	1,9	3,1	6,5	11	14	18	24	26	28	33	36	38	41	44	49	50	53	54	55	59	62	64	66	67	70	71	72	76	77	79	80	81	86	91	94	94	94	97	97	98	99	100	100	100	100	100	100
Actual	0	0	0	0	0	1,9	3,1	6,5	10	12	16	21	22	27	33	35	36	41	43	48	49	53	54	55	60	63																													

LS 1 from 16th Feb. 2013 to Dec. 2014

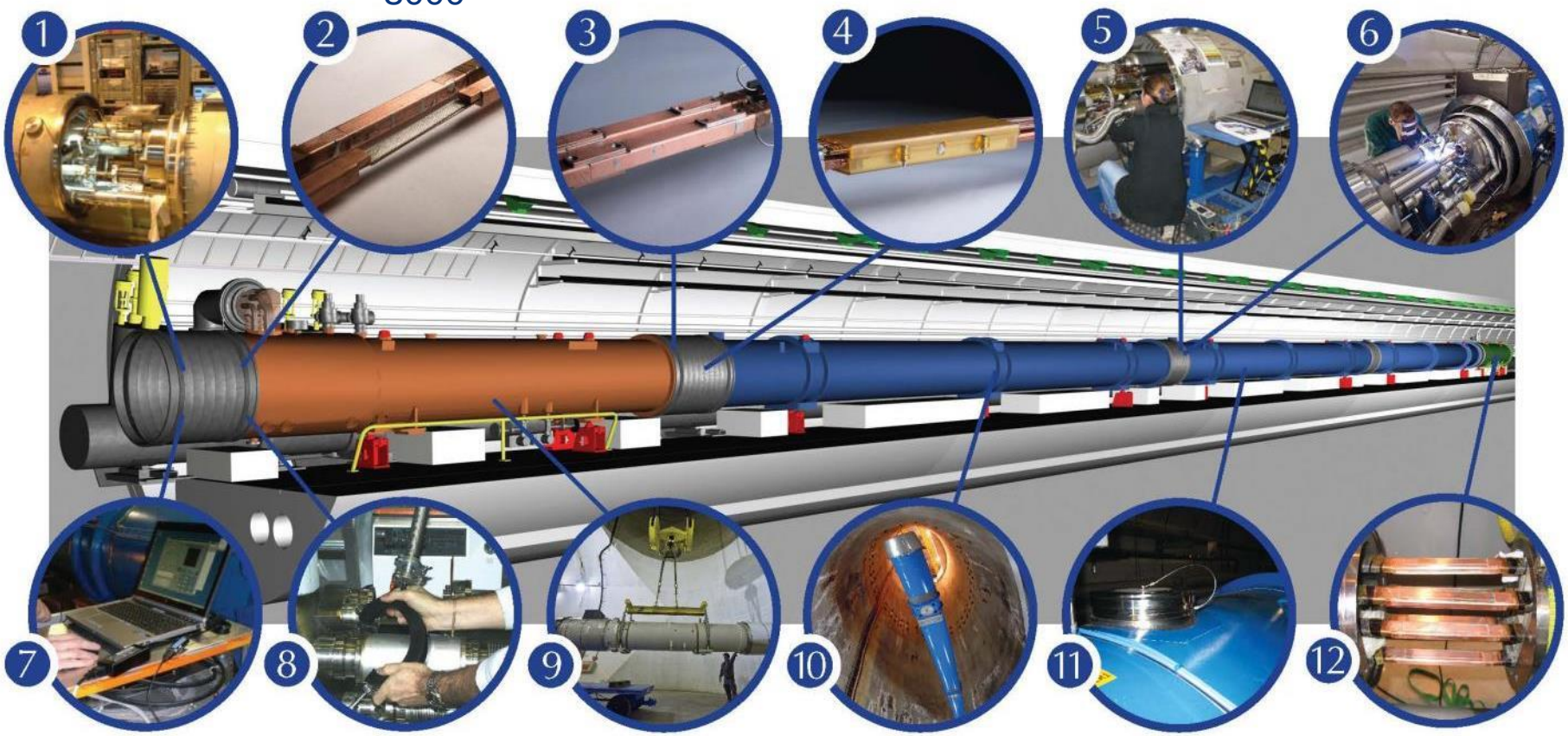


115th LHCC Meeting (25th September 2013)



The main 2013-14 LHC consolidations

60 % done



1695 Openings and final reclosures of the interconnections

Complete reconstruction of ~~1500~~ 3000 of these splices

Consolidation of the 10170 13kA splices, installing 27 000 shunts

Installation of 5000 consolidated electrical insulation systems

300 000 electrical resistance measurements

10170 orbital welding of stainless steel lines

18 000 electrical Quality Assurance tests

10170 leak tightness tests

3 quadrupole magnets to be replaced

15 dipole magnets to be replaced

Installation of 612 pressure relief devices to bring the total to 1344

Consolidation of the 13 kA circuits in the 16 main electrical feedboxes

Done **Done** **Done**

Reasons for splice repairs

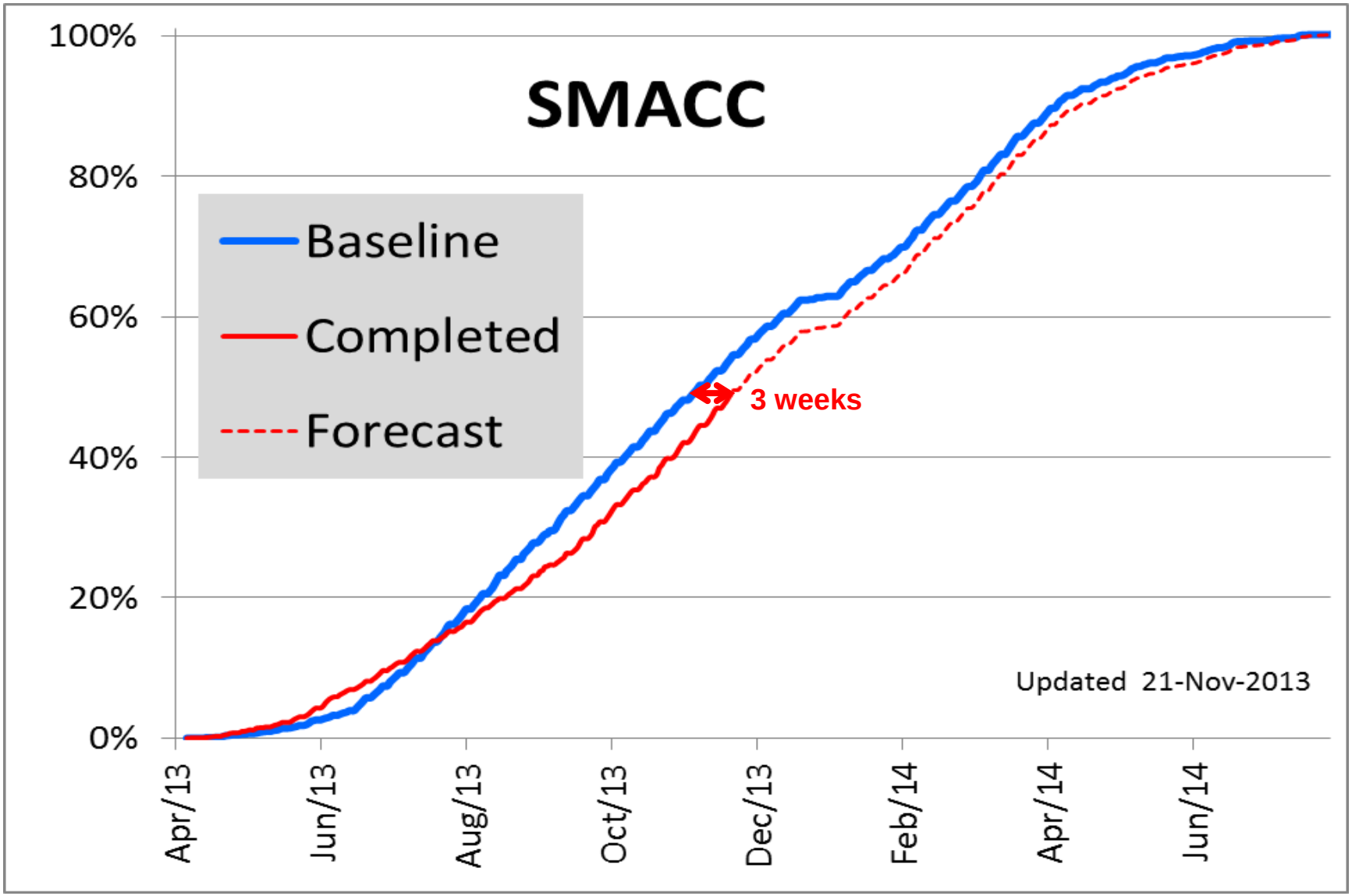
- In average 31% of the splices in the sectors 56, 67, 78, 81 and 12 have been redone for different reasons.
- In sectors 12 and 23 the number of redone splices is significantly influenced by magnet replacements (72 splices in 12 and 36 splices in 23 redone after magnet replacement).

*Reasons for splice repairs in the different sectors (*updated 13.11.2013; **about 30% without magnet replacements).*

	Sector 56	Sector 67	Sector 78	Sector 81	Sector 12	Sector 23*
Number of splices	1216	1266	1272	1216	1208	486
Repaired (%)	27	32	30	30	35**	36**
R-8 excess >5 μΩ (%)	3	14	14	15	12	13
Geometrical (%)	21	16	12	12	15	14
Other (%)	3	2	4	3	8	9

Courtesy of C. Scheuerlein

SMACC Dashboards



Top ten R-8 outliers (*updated 13.11.2013)

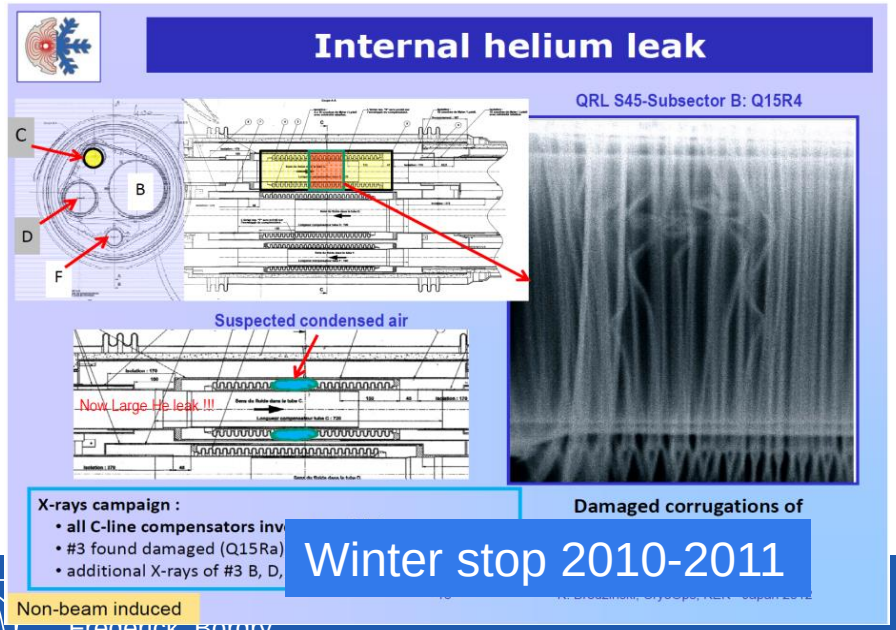
Dipole splice*	R-8 (μΩ)	Quad splice*	R-8 (μΩ)
QBBI.B24R7-M3-Ext-R	77.5	QQBI.20L8-M1-Ext-L	116
QQBI.22L8-M3-Ext-L	52.6	QBQI.27R1-M1-Int-L	54.8
QBBI.A14L8-M3-Int-R	49.9	QBBI.B18R2-M1-Int-L	52.5
QQBI.16R8-M3-Int-R	47.4	QBBI.B25L8-M1-Int-R	51.4
QQBI.22R7-M3-Int-L	43.3	QBBI.B31R1-M1-Int-L	45.9
QQBI.19L1-M3 Ext-L	41.8	QQBI.30L8-M1-Int-L	44.5
QBQI.32R7-M3-Int-L	41.6	QEBI.11L1-M1-Ext-L	43.7
QBQI.31R6-M3-Ext-L	40.6	QBBI.B16R6-M1-Int-L	41.7
QBBI.B27R7-M3-Ext-R	39.1	QBQI.19R1-M2-Ext-L	41.4
QQBI.30R7-M3-Ext-R	39.0	QBQI.32R1-M2-Int-R	41.3

Highest R-8 values of dipole and quadrupole splices per sector.

Sector	Max R-8 RB	Max R-8 RQ
56	**34.2 μΩ** (QBQI.18L6-M3-Ext-L)	**30.4 μΩ** (QBQI.26L6-M1-Int-L)
67	**40.6 μΩ** (QBQI.31R6-M3-Ext-L)	**41.7 μΩ** (QBBI.B16R6-M1-Int-L)
78	**77.5 μΩ** (QBBI.B24R7-M3-Ext-R)	**116 μΩ** (QQBI.20L8-M1-Ext-L)
81	**47.4 μΩ** (QQBI.16R8-M3-Int-R)	**43.7 μΩ** (QEBI.11L1-M1-Ext-L)
12	**35.2 μΩ** (QBQI.21L2-M3-Ext-L)	**54.8 μΩ** (QBQI.27R1-M1-Ext-L)
23*	*31.5 μΩ (QBQI.10R2-M3-Int-L)*	*52.5 μΩ (QBBI.B18R2-M1-Int-L)*

LHC Preliminary leak tests

- Arc subsectors all tested: 20 internal helium leaks identified
  - 14 identified to component (for repair).
  - For 6 leaks not identified to component, further tests to be performed in phase 2.
- QRL
  - 2 existing internal leak known
  - 5 new internal leaks – under investigation



Sector	QRL Insulation vacuum subsectors								
S5-6	I	H	G	F	E	D	C	B	A
S6-7	A	B	C	D	E	F	G	H	I
S7-8	I	H	G	F	E	D	C	B	A
S8-1	A	B	C	D	E	F	G	H	I
S1-2	I	H	G	F	E	D	C	B	A
S2-3	A	B	C	D	E	F	G	H	I
S3-4	I	H	G	F	E	D	C	B	A
S4-5	A	B	C	D	E	F	G	H	I

Measurements not made yet
Measurements made - no internal leak problem
Known internal leak problem
New internal leak problem

Repair plan for QRL compensators

Dcum	Cell #	Line		CW	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	18
					Aug		Sep				Oct					Nov				Dec				Jan					Feb				March				April				May				
				X-Ray of remaining QRL (~2 sectors)												(CRG & MME)																														
				CERN spare validation												(CRG & VSC)																														
				Delivery of new spares (5-10 units)												★	☆	☆																													
				New spare validation (5 units)														(CRG & VSC)																													
	29R8	C	DN100	Sector 8-1 - completed & validated				T1	T2	T1	T2			T3																							PT 12.03.2014								
	24L6	C	DN100	Sector 5-6 - completed & validated					T1	T2	T1	T2			T3										PT ?																				
	12L7	C	DN80	Sector 6-7 - completed & validated								T1	T2	T1	T2			T3							PT																				
	10R7	C	DN80	Sector 7-8									T1	T2	T1	T2			T3																		PT 13.02.2014								
	19R7	C	DN80	Sector 7-8												T1	T2	T1	T2			T3																							
2760	14L2	D	DN150	Sector 1-2													T1	T2	T1	T2					T3												PT 16.04.2014								
6867	6R3	C	DN80	Sector 3-4																T1	T2	T1			T2			T3									PT 25.06.2014								
25552	24L1	D	DN150	Sector 8-1																	T1	T2			T1	T2			T3															
26098	14L1	D	DN150	Sector 8-1																						T1	T2	T1	T2			T3												
26139	13L1	D	DN150	Sector 8-1																							T1	T2	T1	T2			T3				PT 22.05.2014							
4861	32R2	D	DN150	Sector 2-3				s2-3 elec. Int. 24.02-28.02																					T1	T2	T1	T2			T3										
5610	23L3	D	DN150	Sector 2-3																									T1	T2	T1	T2			T3								
8464	32L4	C	DN80	Sector 3-4																													T1	T2	T1	T2			T3				
8517	31L4	D	DN150	Sector 3-4																															T1	T2	T1	T2			T3			
10564	14R4	C	DN100	Sector 4-5																																	T1	T2	T1	T2			T3		
10992	22R4	C	DN100	Sector 4-5																																			T1	T2	T1	T2			T3	

T1 Mechanical preparation (CRG)

T2 Compensateur integration/welding and clamshell leak test (CRG & VSC)

T1 Screen and MLI interconnect integration (CRG)

T2 External envelop closure/welding (CRG)

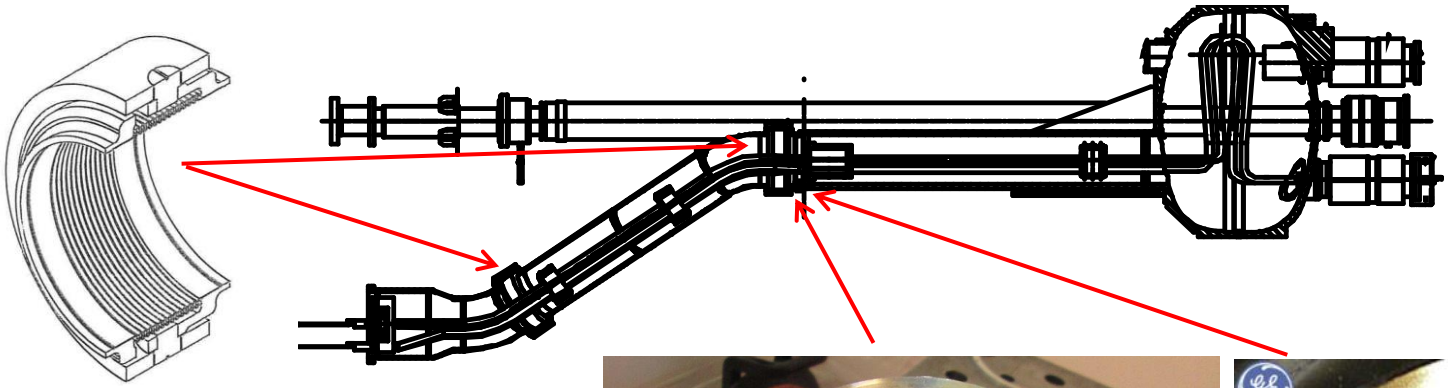
Subsector pumping

T3 Individual and global leak test (VSC)

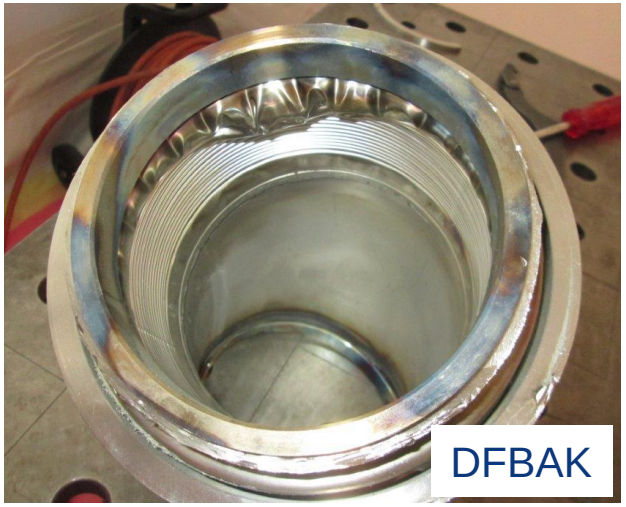
PT - preparation for pressure test (QRL to be closed)

T1 (Team 1): 2 persons (2 technicians)
T2 (Team 2): 2 persons (1 welder + 1 mechnanics) (TE-VSC support to be added)
T3 (Team 3): VSC support

DFBA gimbal bellows status

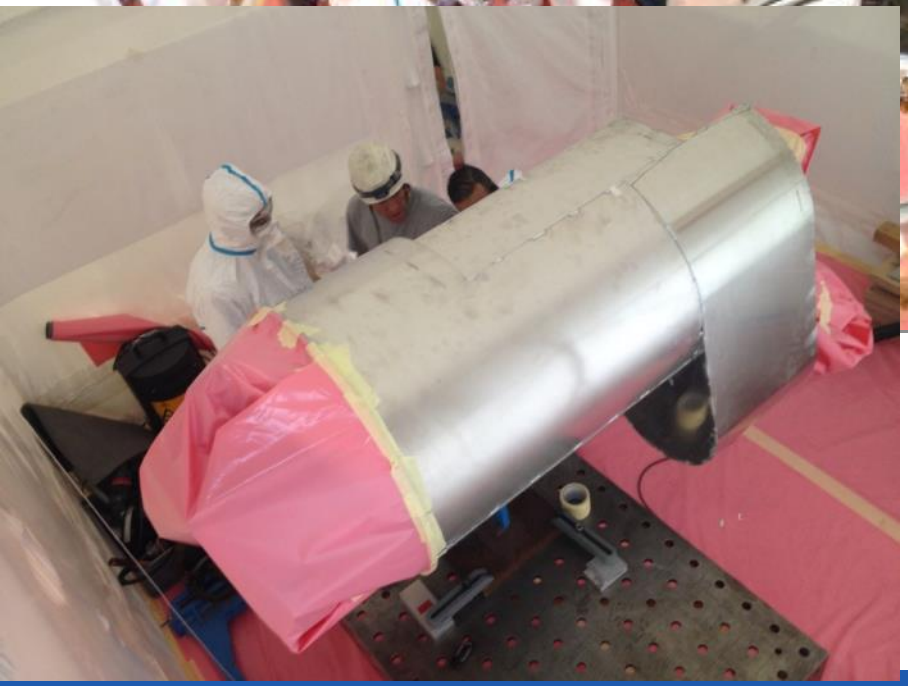


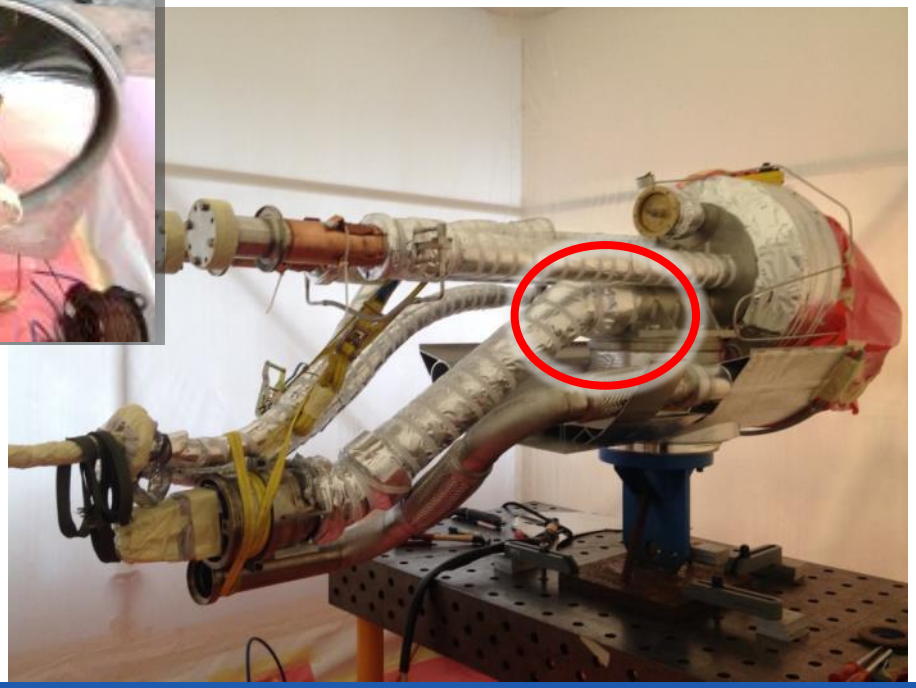
Thanks to EN-MME, TE-MSC, TE-VSC, EN-HE & EN-MEF!



Status:
- DFBAI (lower gimbal) in-situ repair completed in S45
- DFBAF (lower gimbal) ready for in-situ repair in S34
- DFBAK (in S56) (upper gimbal) under repair in B112 workshop
- DFBAO (in S78) (upper gimbal) → meeting on 5/12 for decision (in-situ or workshop)

- *DFBAK shuffling module has been transported to workshop according to RP rules*





Courtesy TE-CRG, TE-MSC, TE-VSC, EN-HE, EN-MEF, EN-MME and …

Maintenance

Electricity Distribution Equipment

400 kV & 66 kV circuit breakers

Before

After

18 kV & 3.3 kV circuit breakers

Maintenance

Cooling and Ventilation Equipment

Lack of maintenance for several years …

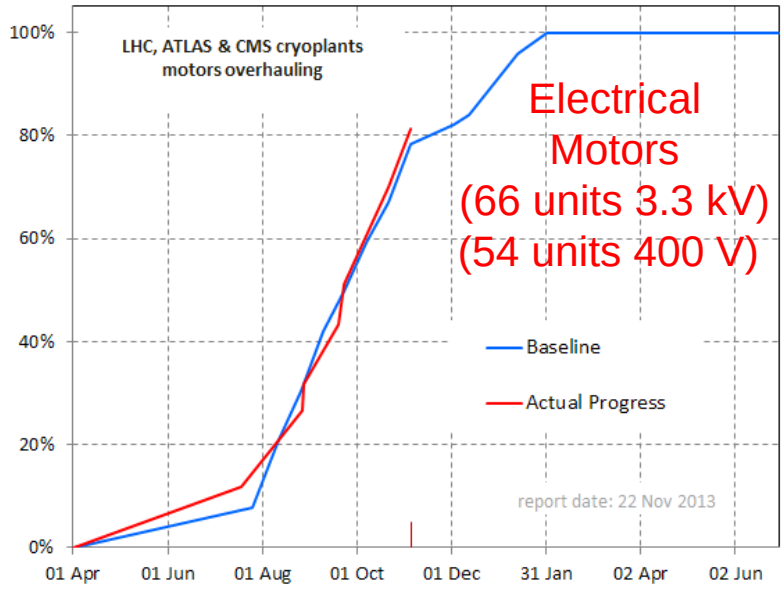
Replacement campaign of the membranes of one-way valve or of flexible sleeves

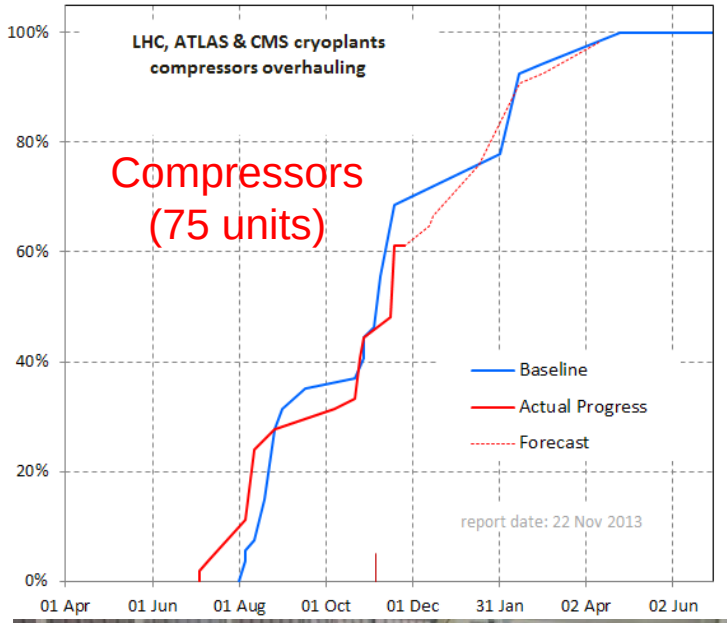
… mud inside a heat exchanger

Three years mechanical maintenance of motors and pumps.

Several critical situations found (e.g. shaft damaged at the connection with the impeller)

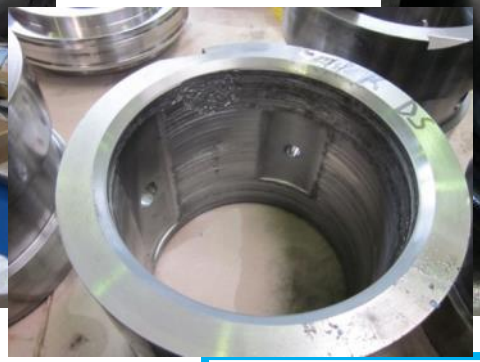
Major overhauling of cryoplants

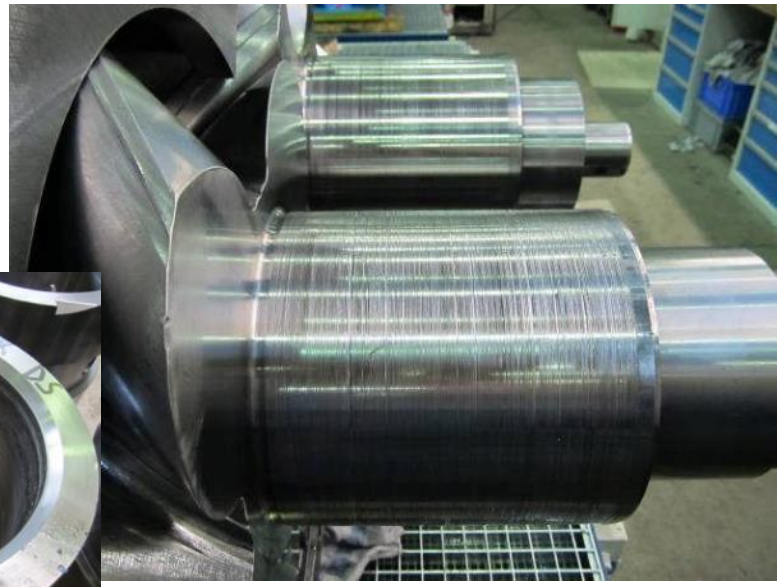




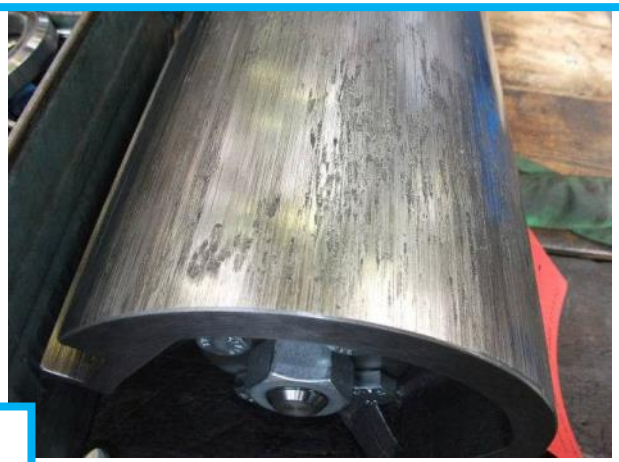
Courtesy of Laurent Tavian

LS 1 : major overhaul of LHC cryo compressors





Damaged slide bearing seat (QSCB-4-CP1)

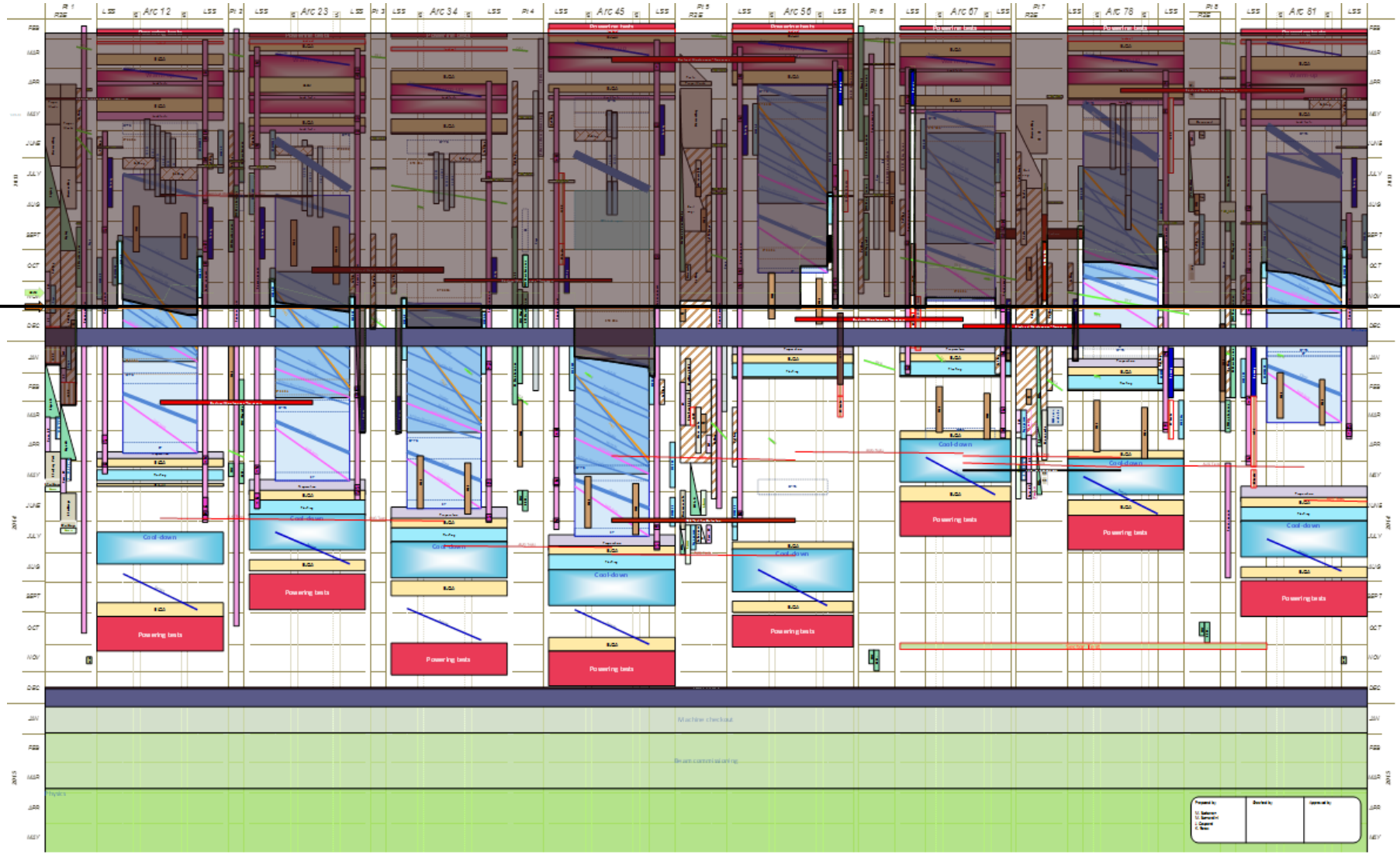


Capacity slide valve and support P6

Courtesy of Laurent Tavian

Conclusion

So far, LS1 is on schedule for beams in January 2015 for LHC

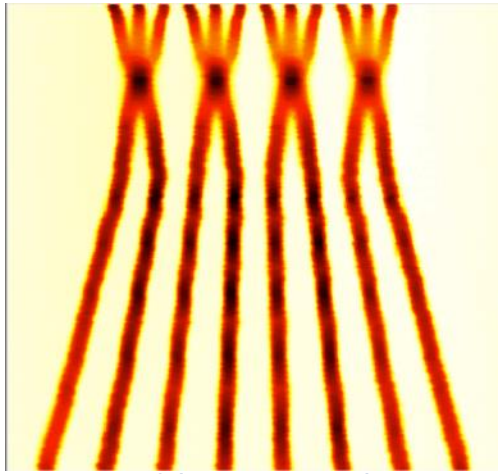


Expectations after Long Shutdown 1 (2015)

- Collisions at **13 TeV** c.m.
- **25 ns** bunch spacing

  Using new injector beam production scheme (BCMS), resulting in brighter beams.

Batch Compression and Merging and splitting (BCMS)



Courtesy of the LIU-PS project team

- **$\beta^* \leq 0.5$m** (was 0.6 m in 2012)
- Other conditions:
  - Similar turn around time
  - Similar machine availability
- Expected maximum luminosity: **1.6×10^{34} cm^{-2} s^{-1}** ± 20%
  - Limited by inner triplet heat load limit, due to collisions debris

	Number of bunches	Intensity per bunch	Transverse emittance	Peak luminosity	Pile up	Int. yearly luminosity
25 ns BCMS	**2508**	**1.15×10^{11}**	**1.9 µm**	**1.6×10^{34} cm^{-2}s^{-1}**	**~43**	**~42 fb^{-1}**

ECFA High Luminosity LHC Experiments Workshop

Physics and technology challenges

1st – 3rd October

Aix-les-Bains

France

https://indico.cern.ch/conferenceDisplay.py?confId=252045

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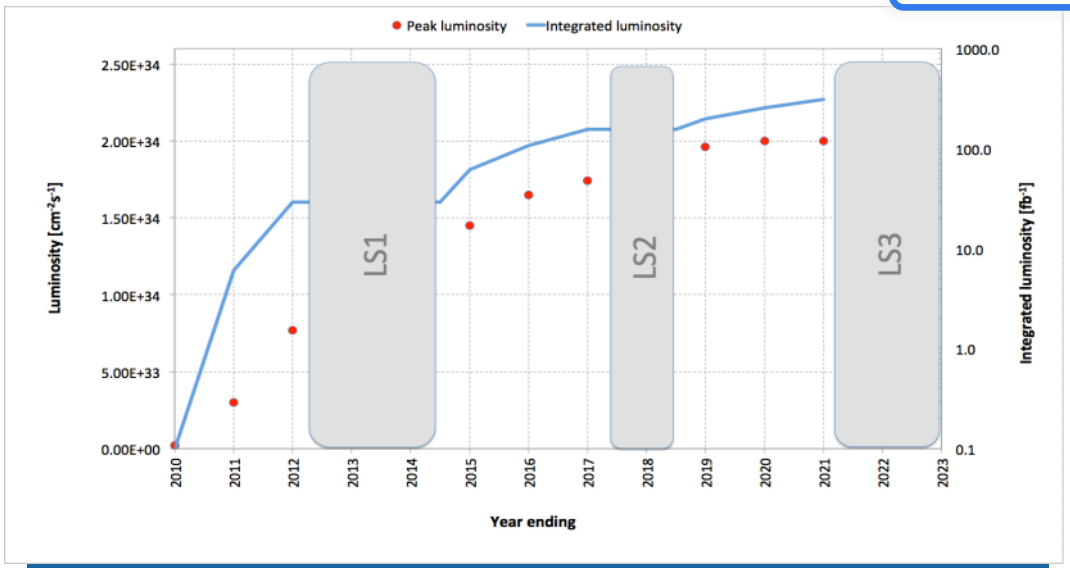
"Baseline" luminosity

~300 fb^{-1}



Review of LHC & Injector Upgrade Plans Workshop (RLIUP)

29-31 October 2013
Centre de Convention, Archamps
Europe/Zurich timezone

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Support

Acc-Tec-Director.Offi…

*** **Invitation Only*****

The workshop will focus on:

Review of the parameters of the LIU and HL-LHC projects following the experience and changes in the beam parameters experienced in the past two years

Produce a staged plan(beam parameters, technical work, all machines) of how we proceed from the performance at the end of 2012 to the required performance for the HL-LHC. In order to do this we need to know at what level of integrated luminosity will necessitate replacement of the inner detectors and the insertions. Also to see the importance of 3000fb-1 and what level of minimum integrated luminosity would be tolerated.

- Chairman : Steve Myers
- Co-Chairman : Frédérick Bordry
- Deputy Chairman : Mike Lamont
- Scientific Secretary: Frank Zimmermann
- Deputy Scientific Secretary: Brennan Goddard
- Technical Support Pierre Charrue

Editor of proceedings: Frank Zimmermann and Brennan Goddard

DRAFT timetable and session information

Deadline for registration:** Friday 27 September 2013

LHC schedule beyond LS1

Only EYETS (19 weeks) (no Linac4 connection during Run2)

LS2 starting in 2018 (July) 18 months + 3months BC (Beam Commissioning)

LS3 LHC: starting in 2023 => 30 months + 3 BC

injectors: in 2024 => 13 months + 3 BC

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