

Long shutdown 1

LHC Machine Status Report

K. Foraz

June 12th, 2013



- ❑ Introduction
- ❑ LHC
 - Preliminary phase
 - SMACC project
 - R2E project
 - Maintenance and consolidation of Infrastructure
- ❑ Injectors
- ❑ Conclusion



LS1 - Accelerator complex

2013

2014

2015

F M A M J J A S O N D J F M A M J J A S O N D J F M A



beam to beam

available for works

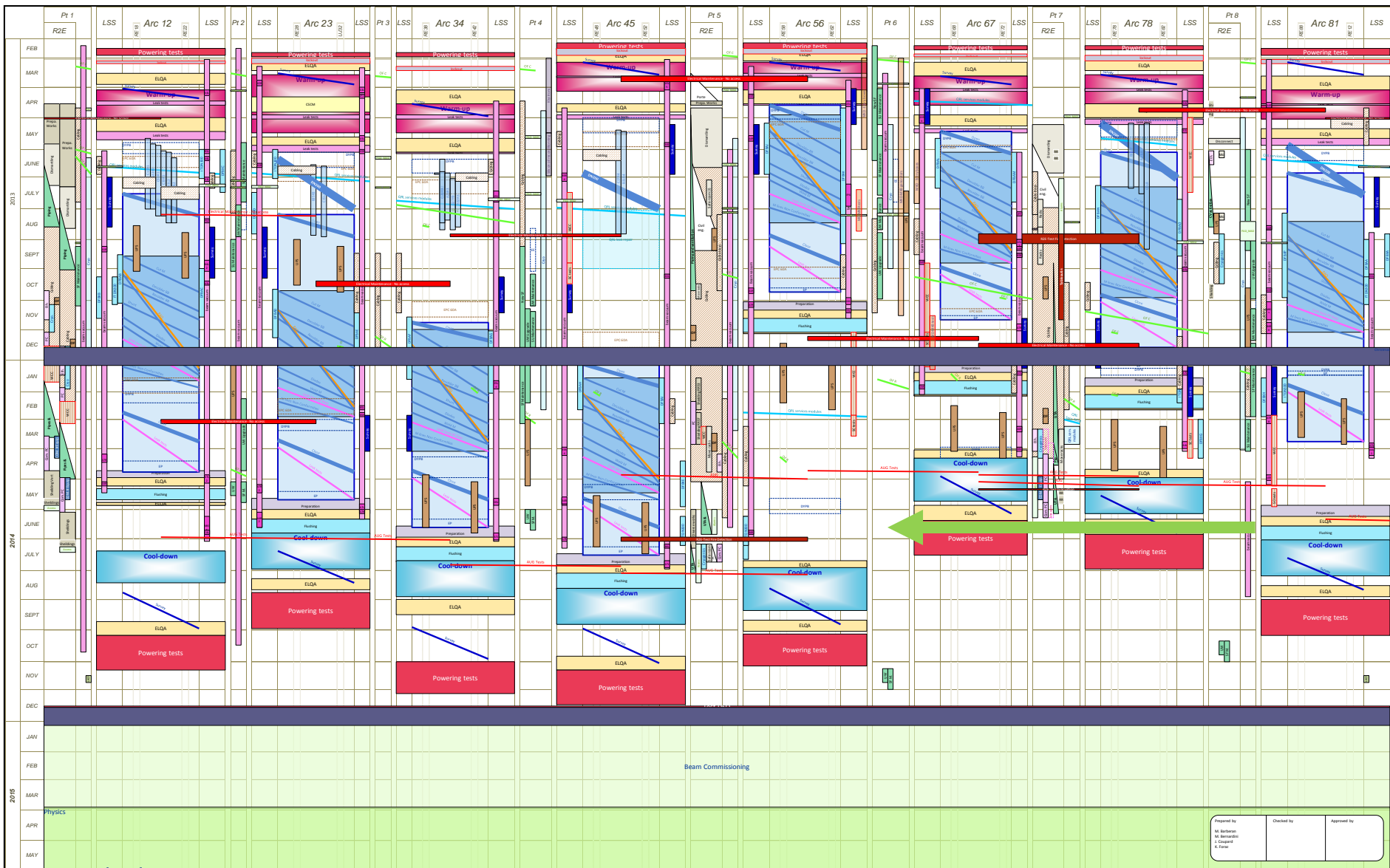
- Physics
- Beam commissioning
- Shutdown
- Powering tests

- Take all measures for a safe and reliable operation of LHC @ 7TeV/beam
 - Consolidate superconducting magnets and circuits → SMACC
 - Relocate radiation sensitive electronics → R2E
 - Perform full maintenance of all equipment's
 -





LHC LS1 schedule (v3.0)



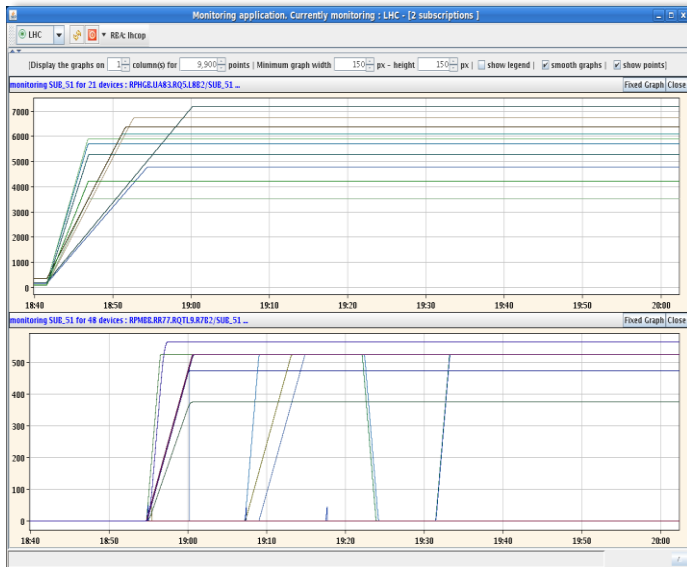
Approved by	Checked by	Approved by
M. Barison	M. Barison	J. Chapiro
A. Foraz	A. Foraz	A. Foraz



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❑ Powering tests

- 40 circuits were tested: (**almost**) all circuits were powered up to 7 TeV equivalent current
- **773 successful tests were executed in 10 days**



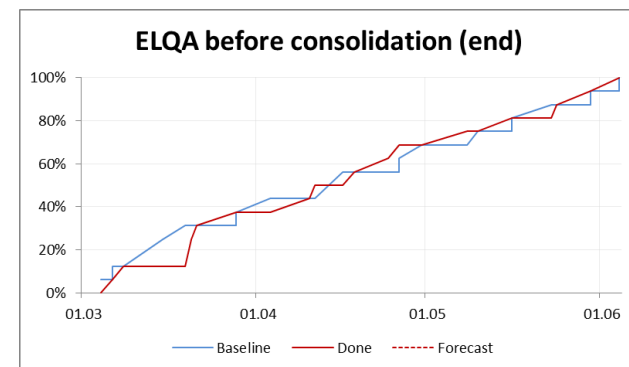
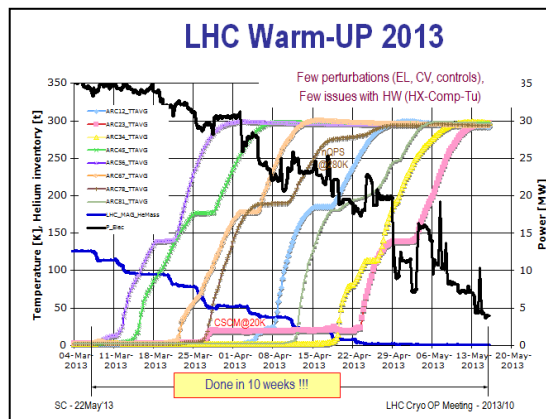
– All circuits reached the nominal 7 TeV equivalent current, but

- RD3.L4, commissioning **stopped at 6.9 TeV (long training) , but can be possibly pushed further**
- RQ5.R2 – I_Nom reduced to 4100 A from 4310 A (OK for 7 TeV)
- RCBYHS5.R8 – **Tested successfully to 20 A, but cannot be powered up to the nominal 72 A** (a similar failure was observed on the same corrector in 8L and that was replaced with a normal conducting magnet)
- RQTL11.R5B1 – I_Nom reduced to 450 A from 550 A
- RQTL11.L6B1 – I_Nom reduced to 350 A from 400 A
- RCSSX3.L1 – I_Nom reduced to 60 A from 72 A
- RQTL9.R3B2 – I_Nom reduced to 425 A from 450 A

- Electrical Quality Assurance (ELQA)
 - ELQA at 1.9K and at room temperature were performed in all sectors and are just finished
 - 37 NCs revealed. Most of them will be solved at warm, during SMACC. No showstopper!



- Warm-up is finished



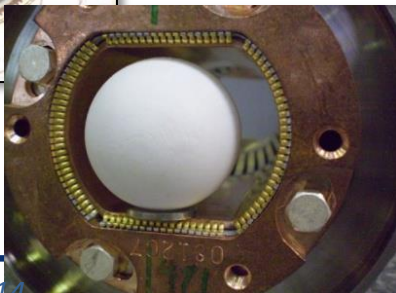
Leak tests

- 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



- ❑ After warm-up and before consolidation RF ball tests are performed in each sector
 - 6/8 sectors tested
 - 2 PIMs collapsed



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The main 2013-14 LHC consolidations

1695 Openings and final reclosures of the interconnections

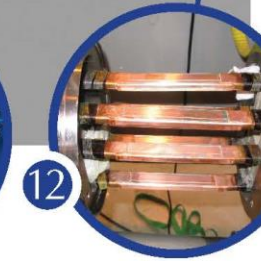
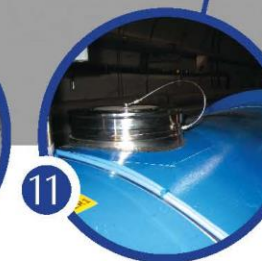
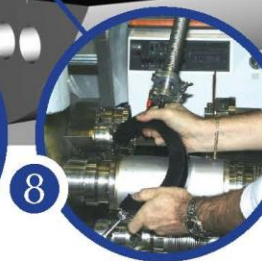
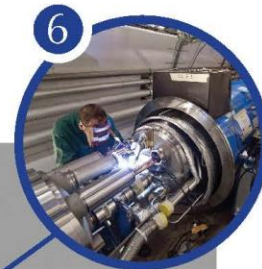
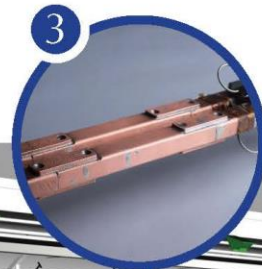
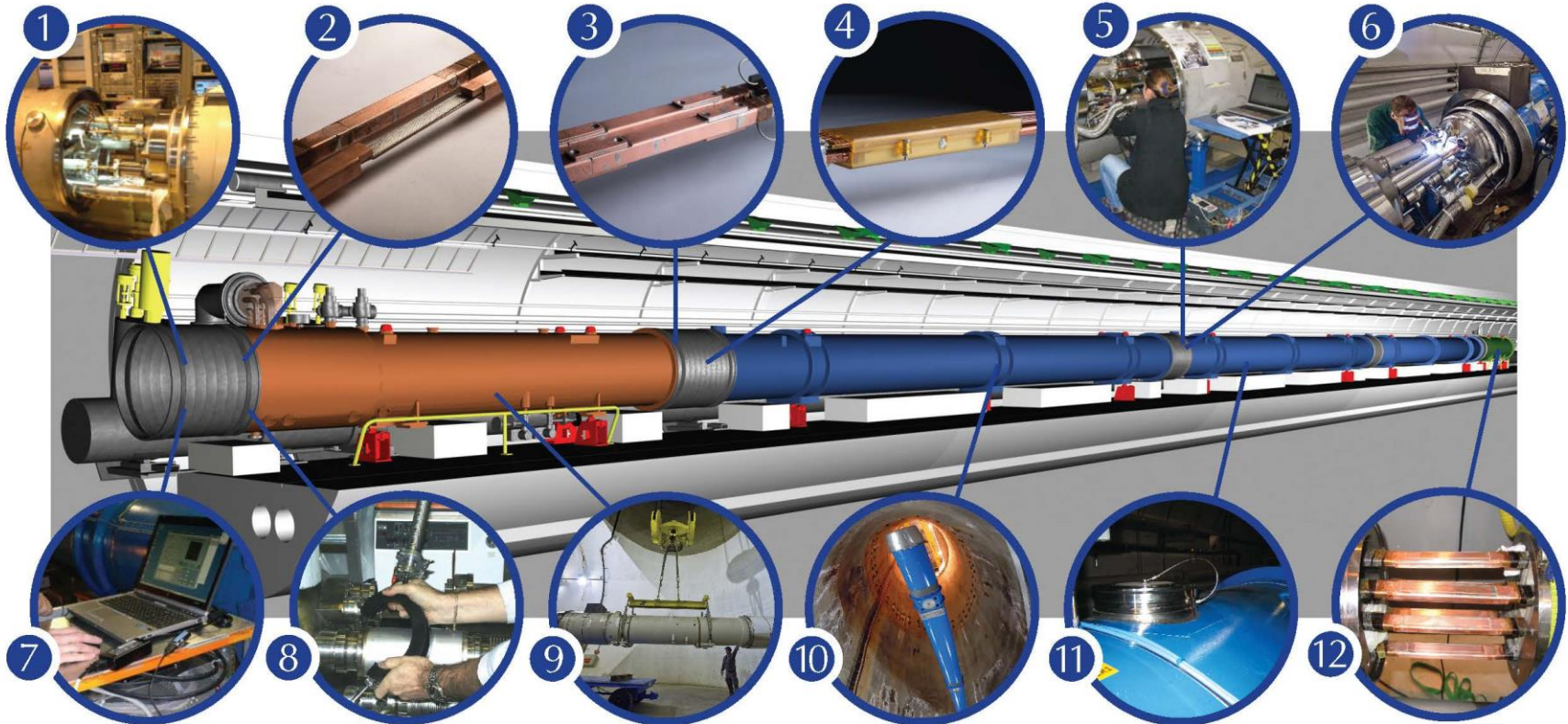
Complete reconstruction of 1500 of these splices

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

4 quadrupole magnets to be replaced

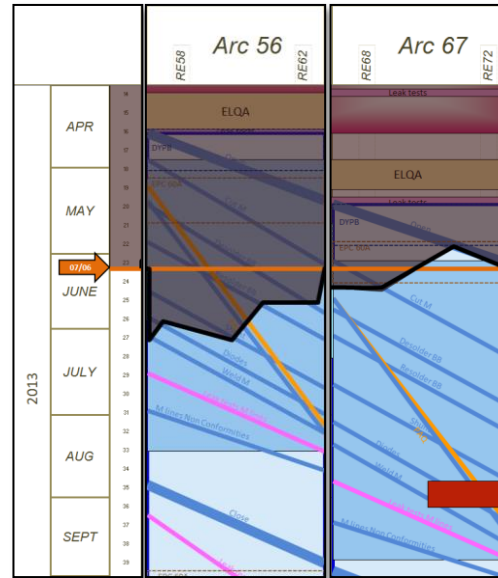
15 dipole magnets to be replaced

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

Consolidation of the 13 kA circuits in the 16 main electrical feed-boxes

- W opening
 - Completed in sector 56
 - In progress in sector 67

- Interconnection train
 - Sector 56
 - Sector 67



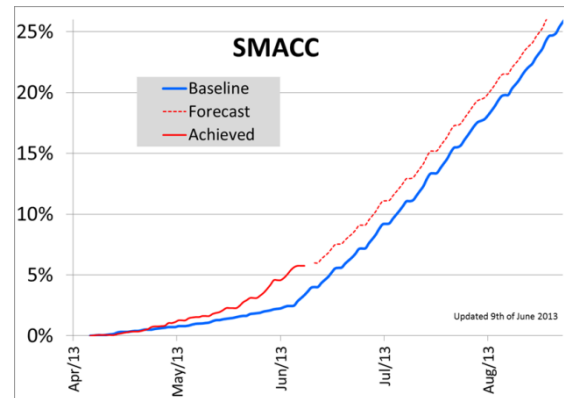
Diode container



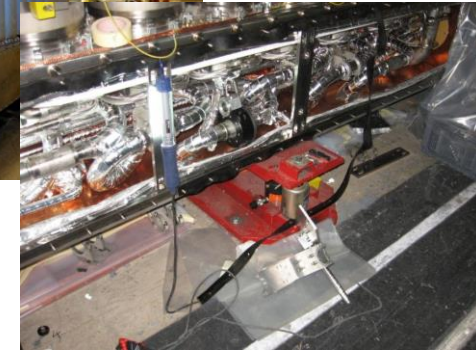
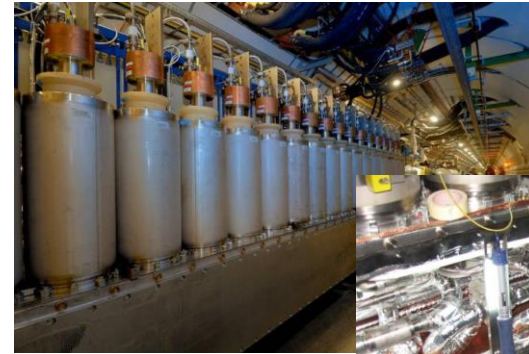
M line opening



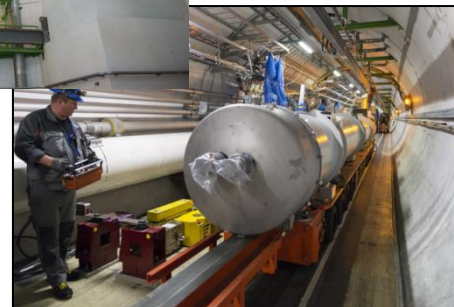
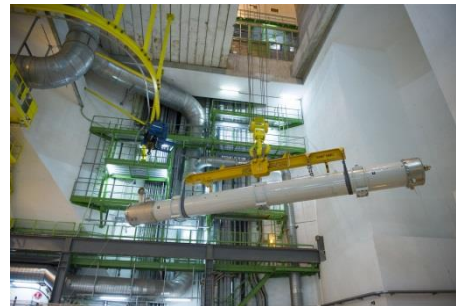
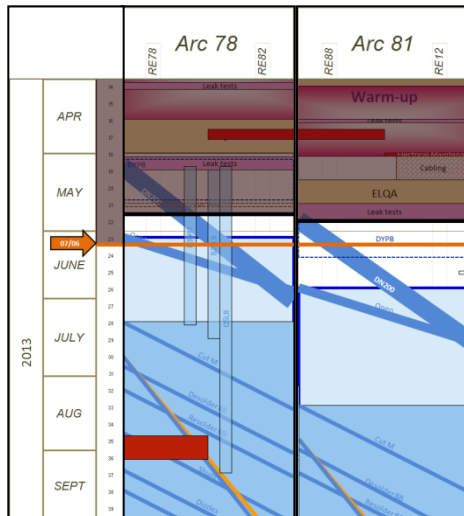
1st shunt resolder
26/04/13



- ❑ DFBA consolidation in sectors 56, 67, 81
- ❑ DN200 in progress in sector 78 (not started in sector 81)
- ❑ Magnets replacement in sector 78



1st sleeves cut in DFBK HCM



Magnet exchange



DN200



- Introduction

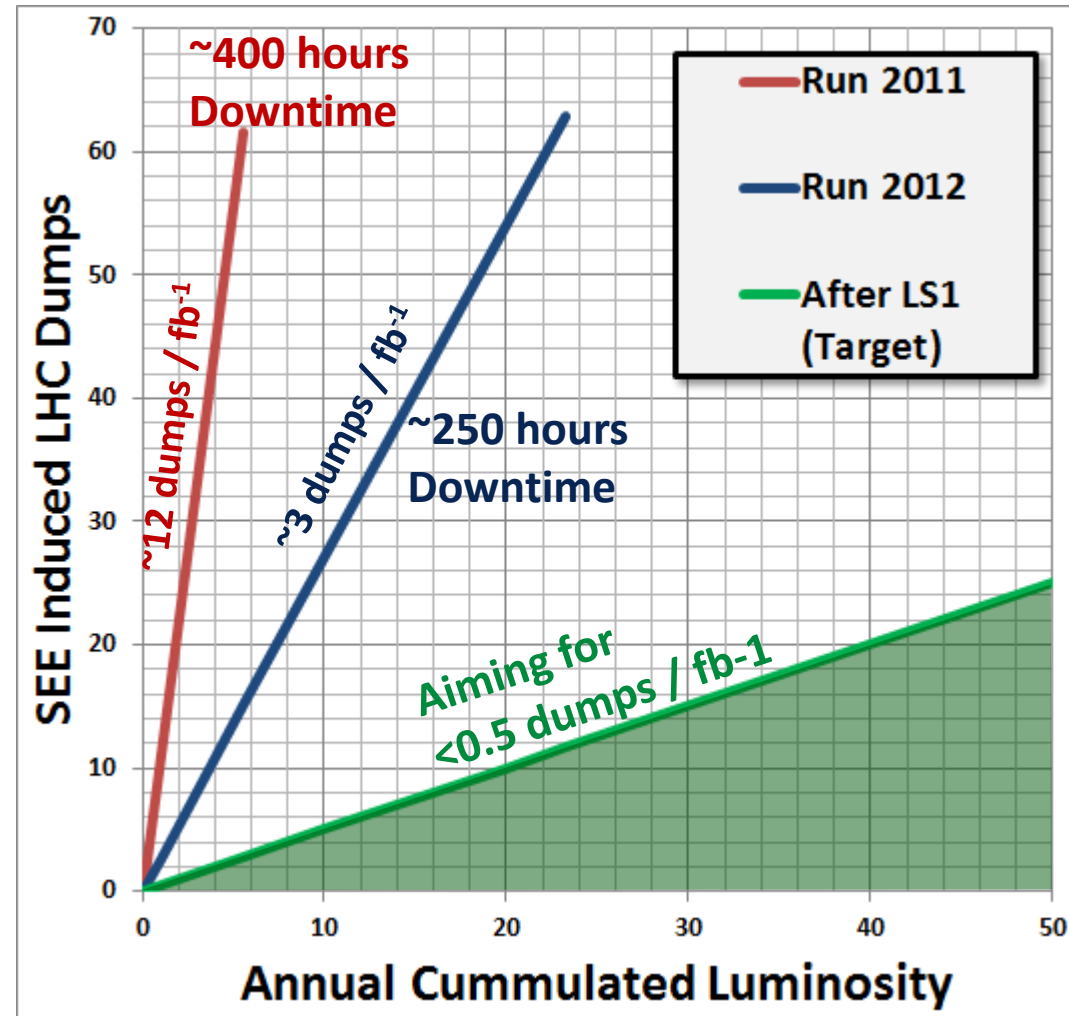
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- **R2E project**
- Maintenance and consolidation of Infrastructure

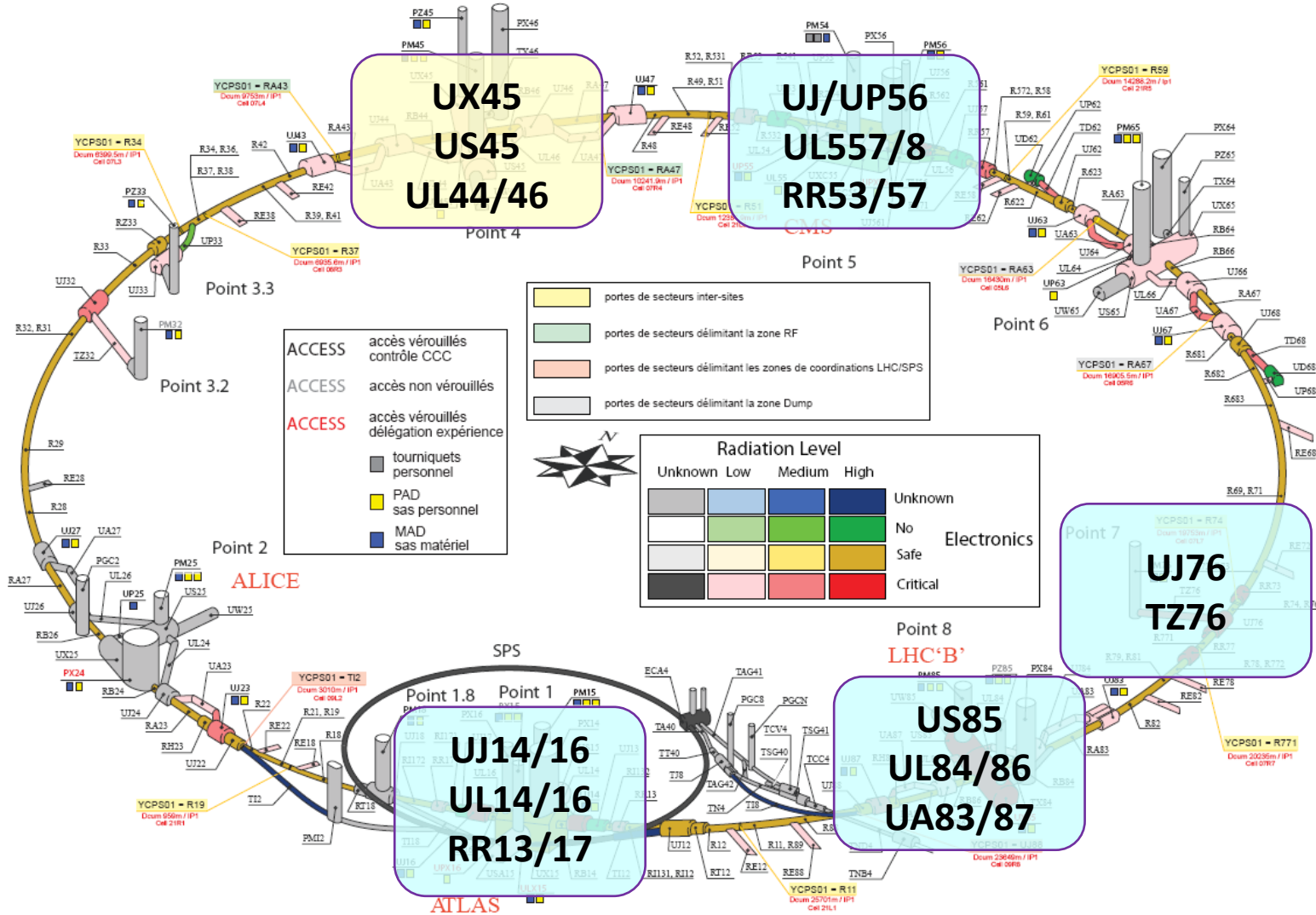
- Injectors

- Conclusion

- ❑ 2008-2011
 - Analyze and mitigate all safety relevant cases and limit global impact
- ❑ 2011-2012
 - Focus on long downtimes and shielding
- ❑ LS1 (2013/2014)
 - Final relocation and shielding
- ❑ LS1-LS2 (2015-2018)
 - Tunnel equipment and power converters



R2Eproject during LS1



R2E project progress

Point 1

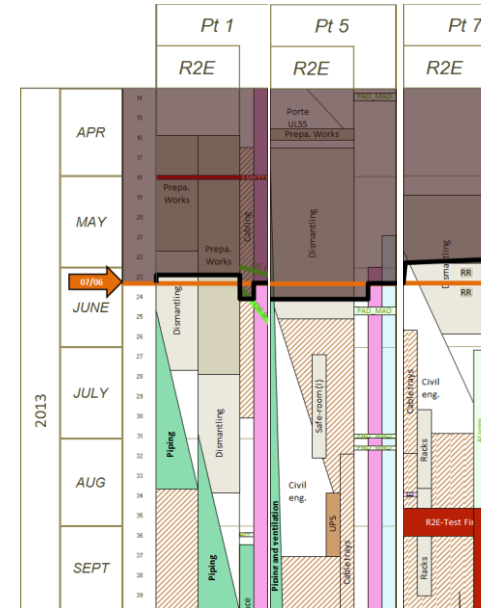
- Power converter dismantling in progress
- Electrical infrastructure in progress

Point 5

- Power converters disconnected
- Preparation and protection before drilling in progress
- Piping installation almost finished



P1 -shielding dismantling



UJ56

Point 7

- Power converters disconnection and cable removal in progress
- TZ76 – demolition wall in progress



*TZ76
Wall-E
in action*



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- **Maintenance and consolidation of Infrastructure**

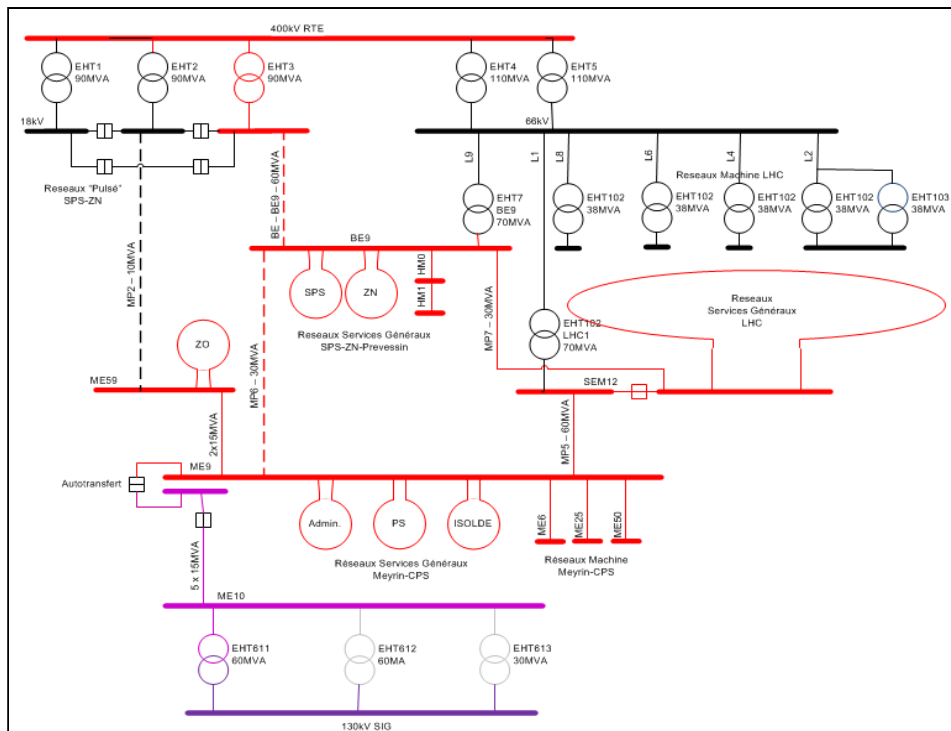
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□ Maintenance and consolidation of 400kV and 60kV

June 3rd – August 3rd

Power limited to 50 MW



Power Infrastructure

- ❑ Full maintenance of all the equipment in progress
- ❑ Several consolidation and upgrade in progress according to schedule
 - Demineralised water production
 - Additional cooling towers
 - UPS replacement
 - Replacement of the ducts of water cooled cables
 - ...
 - And of course cabling !



Electrical maintenance @ P8

Flexwell removal



New cooling tower @ P6



Water Cooled cables removal



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□ Main activities

- Preliminary powering tests complete
- Full maintenance of all the equipment
- PS Booster & PS
 - Installation of the new access systems
 - Cooling and ventilation renovation
 - Upgrade of the RF systems
 - Improve the radiation shielding over the PS and Septum 16



Magnet exchange in SPS



SPS irradiated cables



SPS – LSS1+ - test with robot



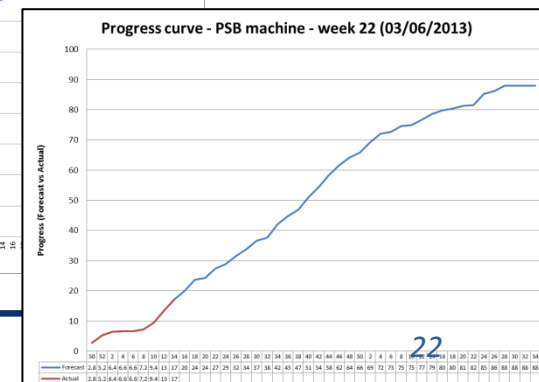
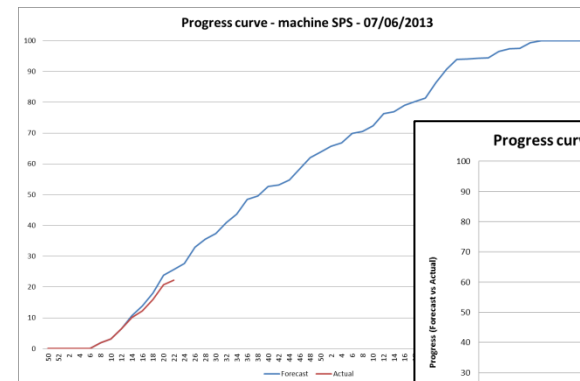
Goward road

– SPS

- Consolidation of **18kV transformers**
- Replacement of **irradiated cables** in BA1 and in TCC2
- Installing new Fibres systems in BA5, BA6 and BA1
- **New coated magnets** in BA5
- **Major consolidation of the valves – CV**
- Vertical realignment in BA6

□ Progress status

- overall progress is good

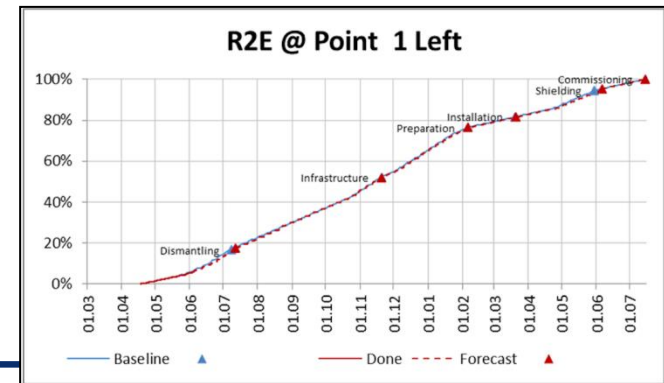
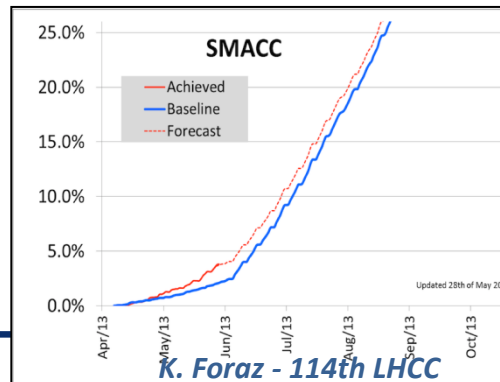
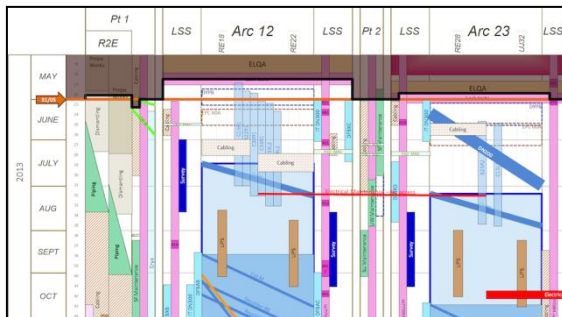
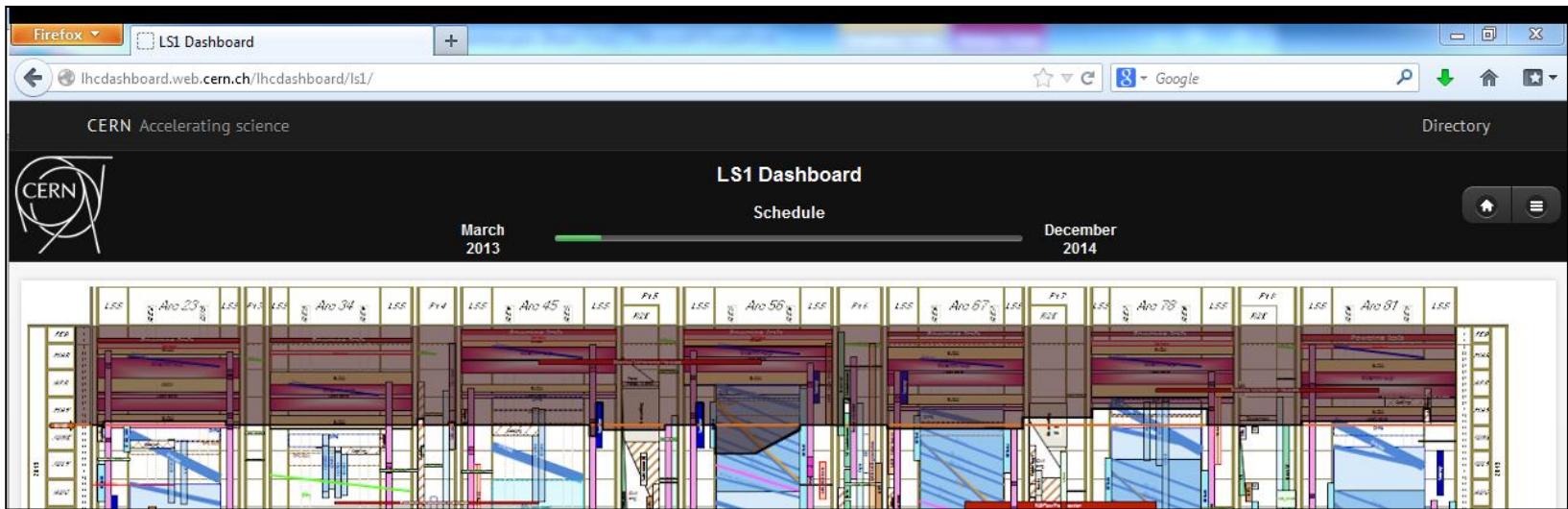




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□ General and detailed progress

<http://lhcdashboard.web.cern.ch/lhcdashboard/l1/>



So far, so good throughout accelerator complex

LHC

- Preparatory phase almost complete
 - Machine is warm
 - Electrical preliminary tests complete
- SMACC
 - IC train in 2 sectors – good progress
 - 1st magnets exchanged
- R2E
 - Good progress
 - Preparatory works almost finished
- Infrastructure activities on schedule

