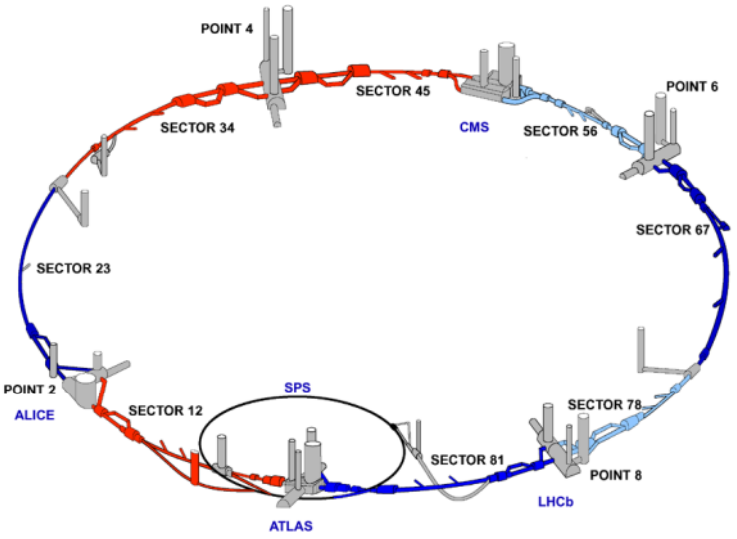
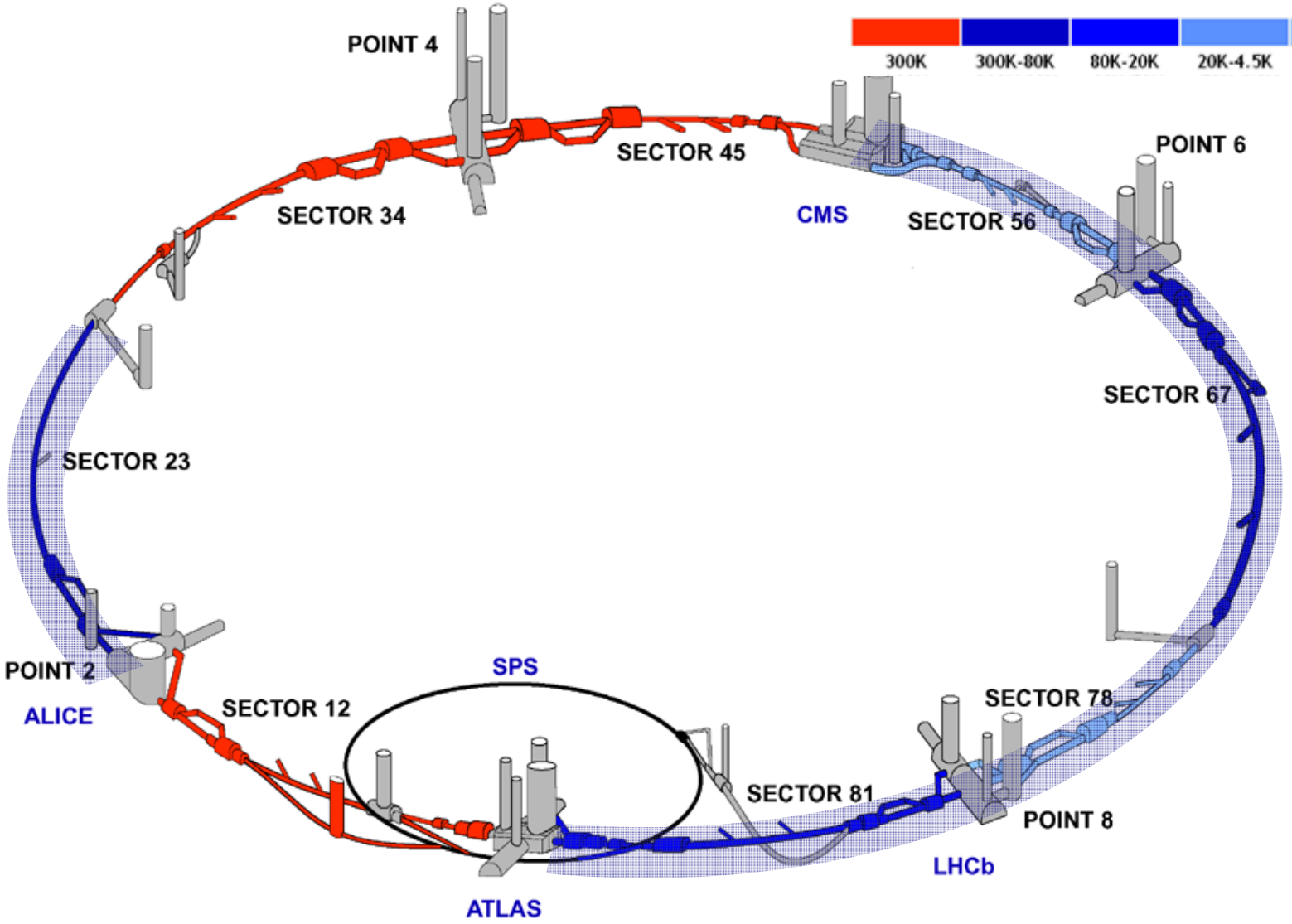
LHC MACHINE STATUS



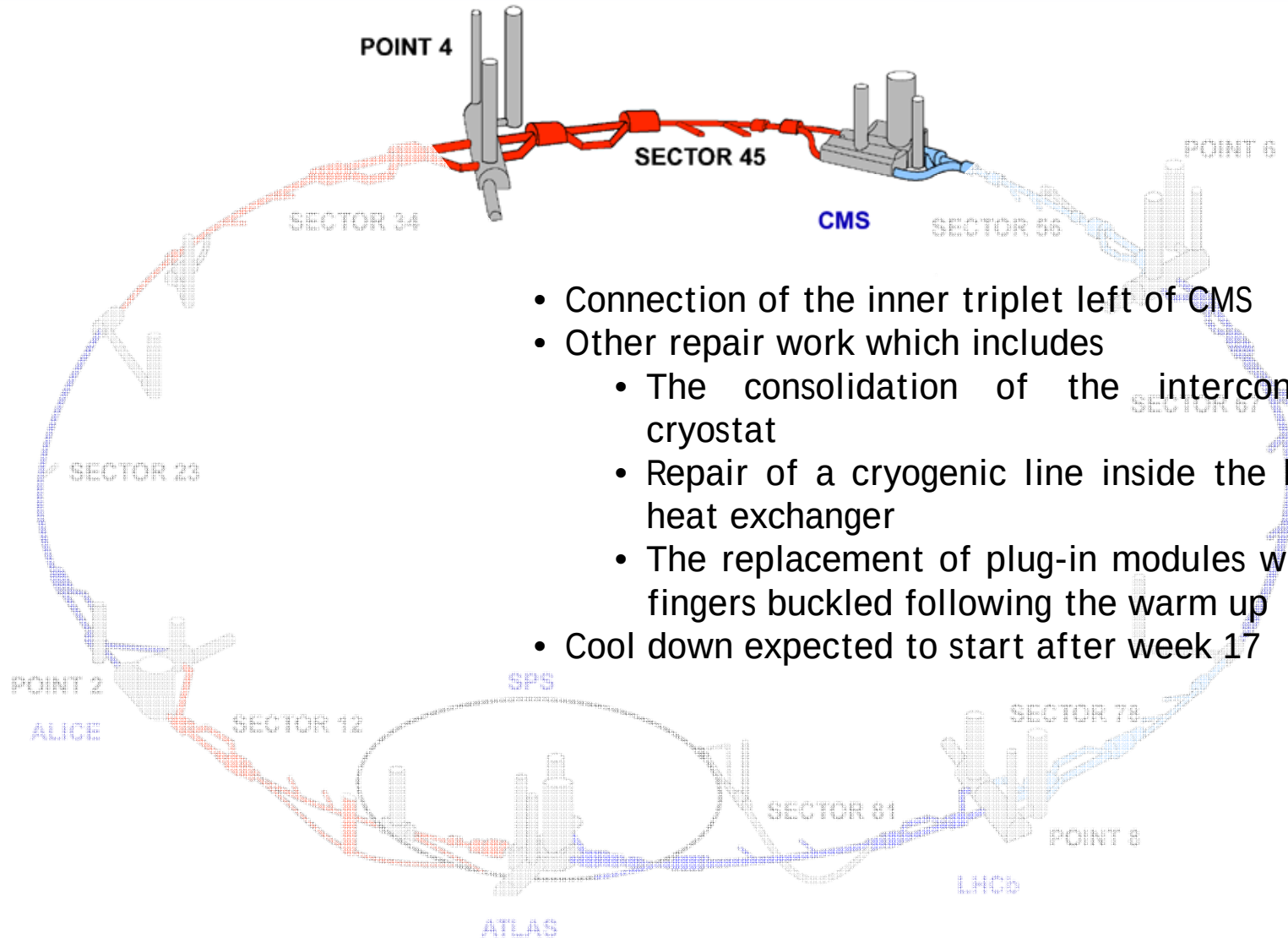
LHC EXPERIMENTS AND WORLD LCG RESOURCES REVIEW BOARDS APRIL 2008

Roberto Saban
Commissioning of the Technical Systems of the LHC

Status of the LHC

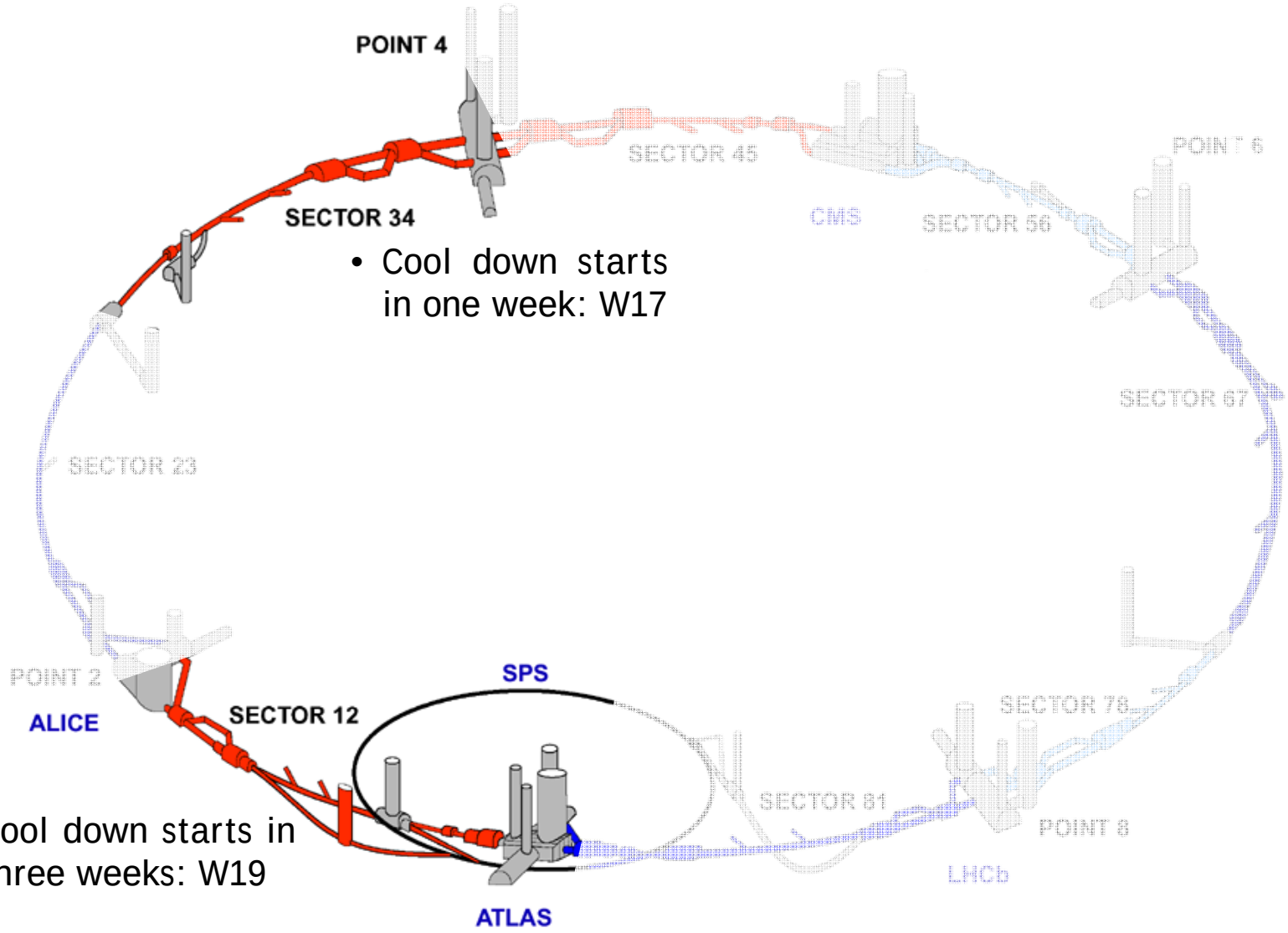


Consolidation



- Connection of the inner triplet left of CMS
- Other repair work which includes
  - The consolidation of the interconnection cryostat
  - Repair of a cryogenic line inside the bayonet heat exchanger
  - The replacement of plug-in modules where RF fingers buckled following the warm up
- Cool down expected to start after week 17

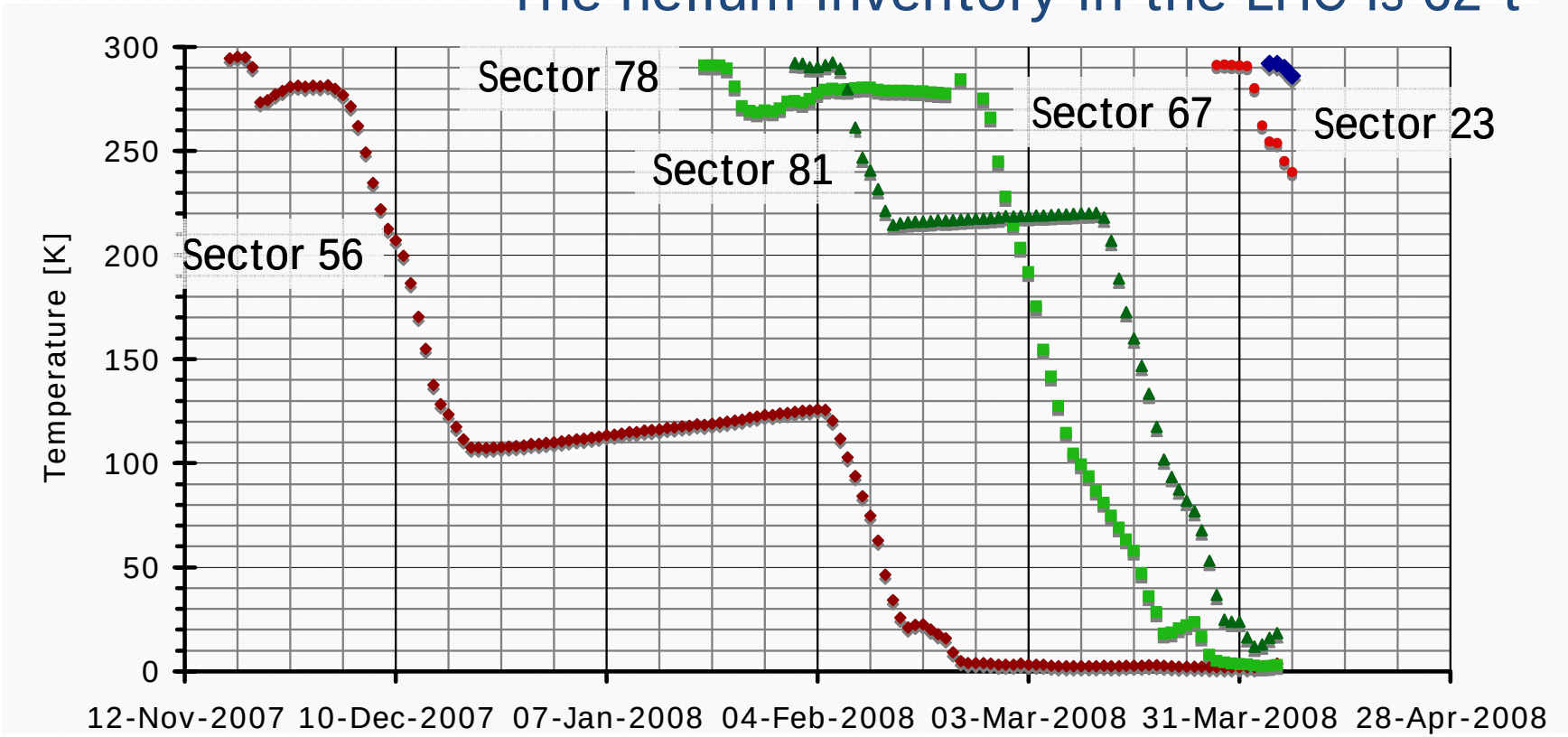
Preparation for Cool down



- Cool down starts in one week: W17
- Cool down starts in three weeks: W19

The latest cool downs

Presently two sectors are below 2K
The helium inventory in the LHC is 62 t



6 weeks to cool down from 300 to 2K +
3 weeks for stabilization at 2K

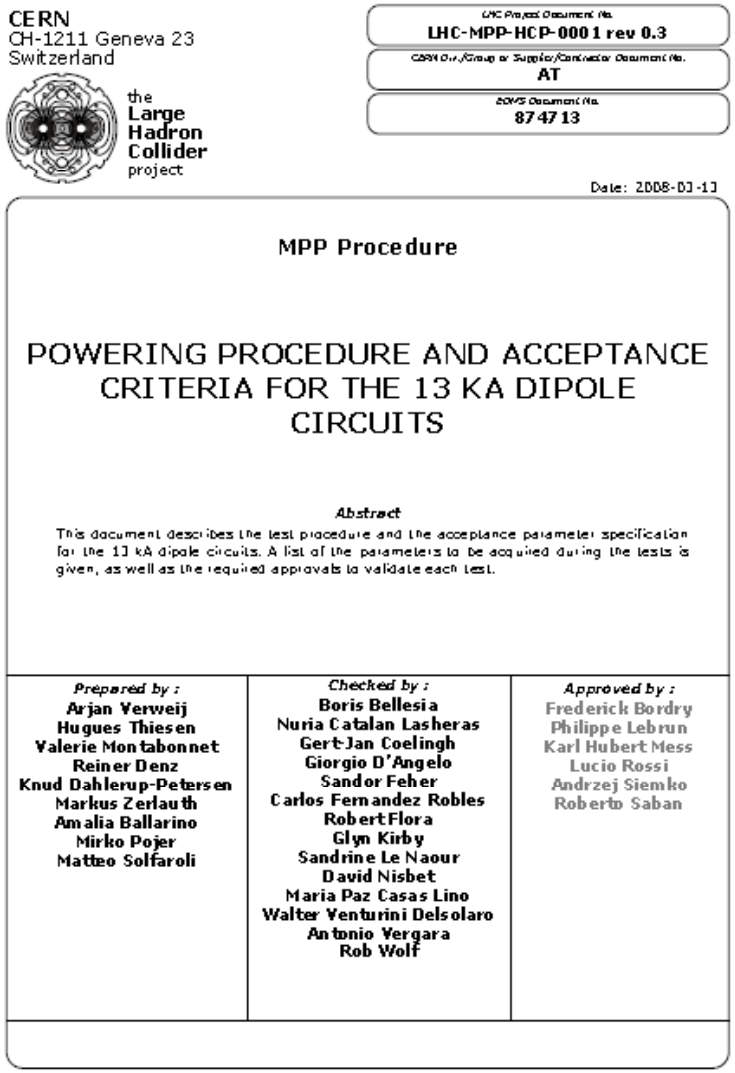
Courtesy S.Claudet

Powering Tests: the superconducting circuits

The objectives are:

1. the validation of the protection strategies under the different failure scenarios and
2. the evaluation of the behavior and of the performance of
   - the magnet chain,
   - the current leads and
   - the power converters

during a normal LHC ramp, in steady state and during a ramp down of the current.



CERN
CH-1211 Geneva 23
Switzerland

the Large Hadron Collider project

LHC Project Document No.
LHC-MPP-HCP-0001 rev 0.3

CERN Div./Group or Supplier/Contractor Document No.
AT

EDMS Document No.
874713

Date: 2008-01-11

MPP Procedure

POWERING PROCEDURE AND ACCEPTANCE CRITERIA FOR THE 13 KA DIPOLE CIRCUITS

Abstract

This document describes the test procedure and the acceptance parameter specification for the 13 kA dipole circuits. A list of the parameters to be acquired during the tests is given, as well as the required approvals to validate each test.

Prepared by :	*Checked by :*	*Approved by :*
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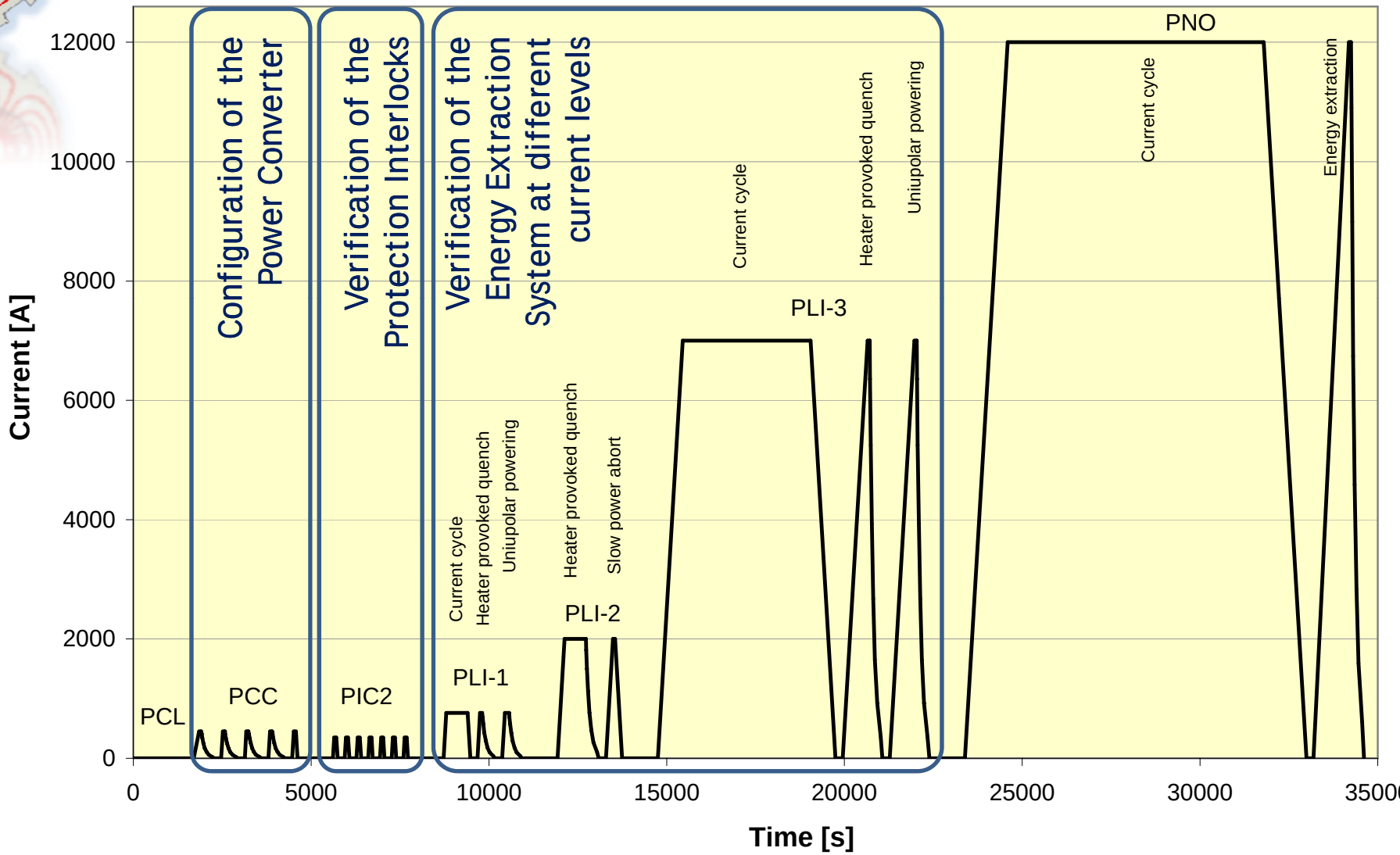
Powering Tests: the superconducting circuits



Powering Tests: the superconducting circuits

Circuit Type	Sector								LHC
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-1	
13 kA	3	3	3	3	3	3	3	3	**24**
Independently Powered Dipoles	3	2	2	3	1	0	2	3	**16**
Independently Powered Quadrupoles	14	7	6	13	12	5	7	14	**78**
600A with Energy Extraction	23	27	28	24	23	27	27	23	**202**
600A Energy Extraction in Converter	14	20	20	14	14	20	20	14	**136**
600A no Energy Extraction	16	9	2	9	9	2	9	16	**72**
80-120A Correctors	50	37	22	33	33	22	37	50	**284**
TOTAL	**123**	**105**	**83**	**99**	**95**	**79**	**105**	**123**	**812**

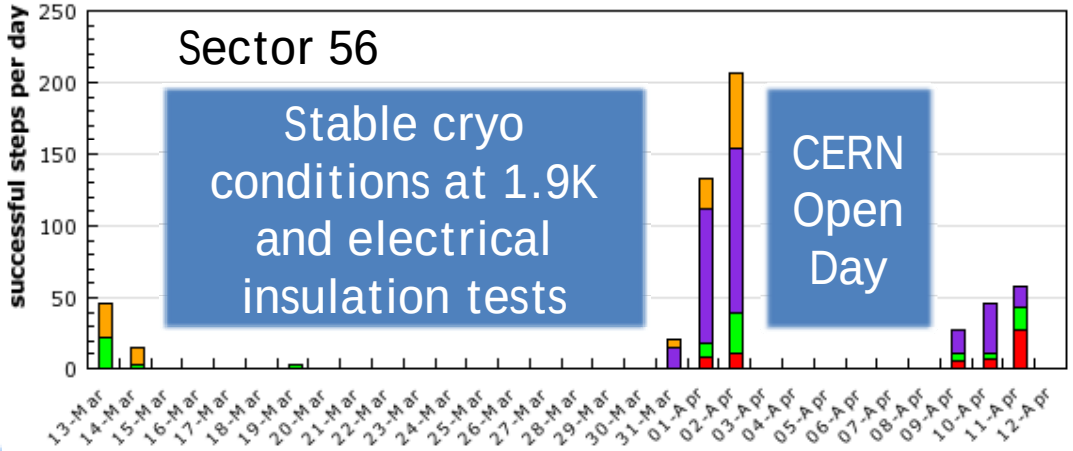
Circuit Type	Sector								LHC
	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-1	
60A Closed Orbit Correctors	94	94	94	94	94	94	94	94	**752**

Powering Tests: the superconducting circuits

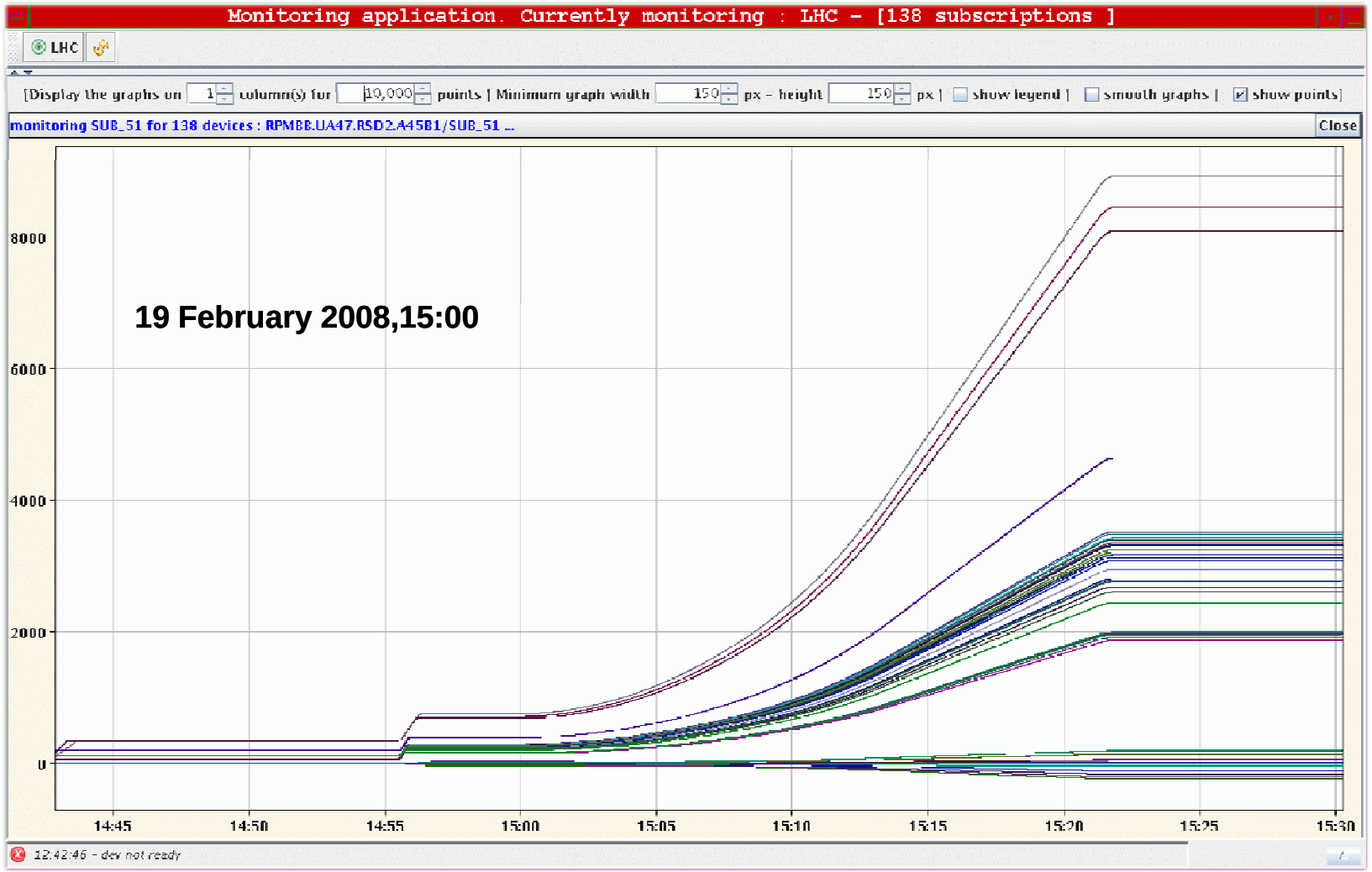
Experience from the commissioning of Sector 45

- All but the inner triplet circuits were commissioned.
- The main dipole circuit was taken to a current where it could steer beams of 5.5 TeV without any training quench. After three training quenches the circuit was taken to a current equivalent to 6 TeV.
- Almost all the circuits, including the correctors, were taken to a current equivalent to 6 TeV.
- This was achieved in 8 weeks. A review, which was organized following the campaign, indicates that less time will be required for the following sectors. About 5 weeks, but this remains to be confirmed.

60 test steps per working day were achieved at the end of the powering tests in Sector 45

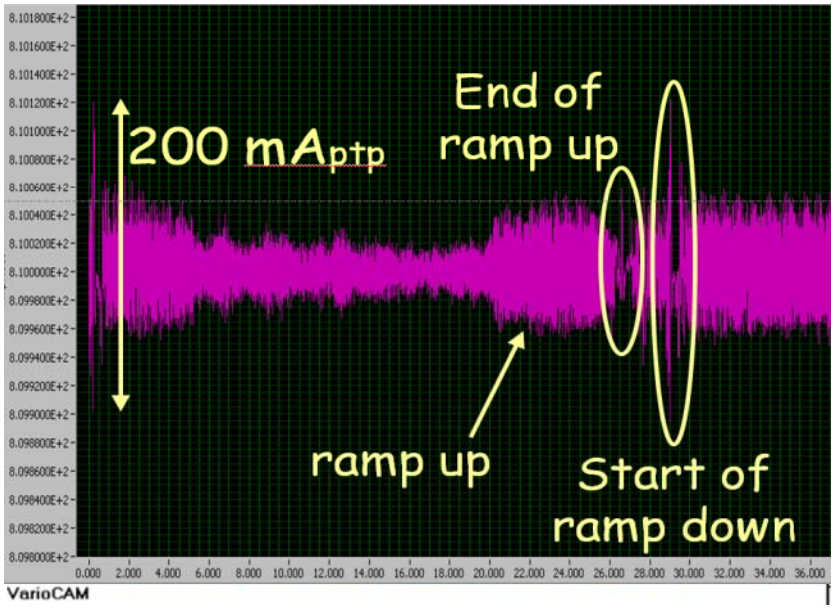


Ramp of 138 power converters in Sector 45 to a current equivalent to 5.3 TeV



Warm magnets

- Calibration of the Power Converters
- Electrical Insulation Tests
- Interlock Tests on the Magnet
- Interlock Tests on the Power Converter
- Connection to the Grid
- Configuration of the Power Converters
- Performance of the Power Converters
- Polarity Test
- HEAT RUN
- Verification of the interference from the TI pulsed magnets



	POINT 1	POINT 2 Comp	POINT 2 TI2	POINT 3	POINT 4	POINT 5	POINT 6	POINT 7	POINT 8 Old Comp	POINT 8 New magnet	POINT 8 TI8
PC CALIBRATION				WEEK 18-20						WEEK 15-16	
WELQA				WEEK 18-20						WEEK 15-16	
WIC MAGNET		MBWMD (19)		WEEK 18-20						WEEK 15-16	
WIC PC		MBWMD (19)		WEEK 18-20						WEEK 15-16	
SET UP CONNECTION TO GRID				WEEK 18-20						WEEK 15-16	
SET UP PC CONFIGURATION				WEEK 18-20						WEEK 15-16	
SET UP PC PERFORMANCE	Week 16			WEEK 18-20				Week 20		WEEK 15-16	
POLARITY TEST				WEEK 18-20						WEEK 15-16	
HEAT RUN		MBWMD (19)		WEEK 18-20				WEEK 20		WEEK 15-16	
TIx - COMP INTERFERENCES (I)	X	WEEK 15-16	WEEK 15-16	X	X	X	X	X	Not completed (12,13)	WEEK 18	Not completed (12,13)
TIx - COMP INTERFERENCES (II)	X	WEEK 19	WEEK 19	X	X	X	X	X	WEEK 18	WEEK 18	WEEK 18

X Non applicable
DONE OK
PARTIALLY DONE
NOT DONE
DONE NOT OK

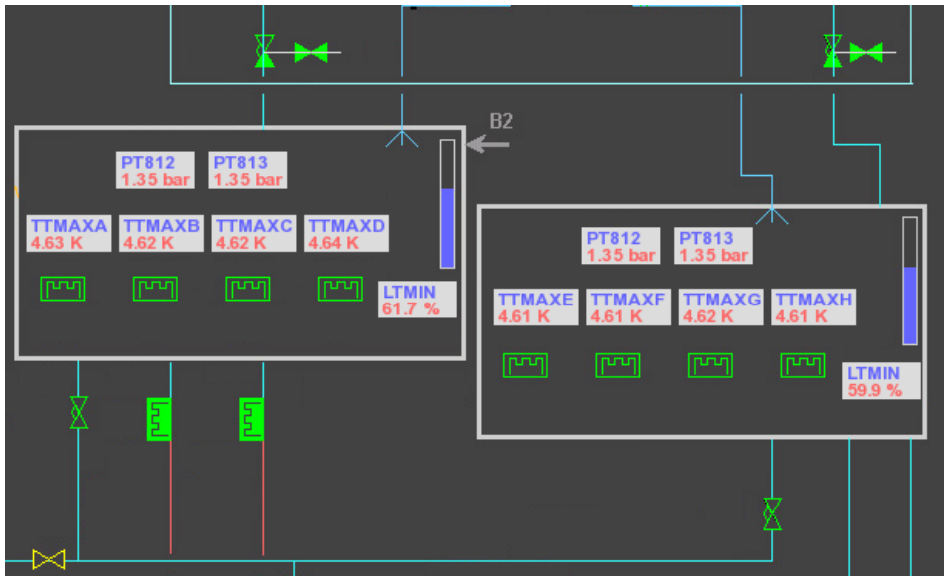
RF System

When Sector 45 was cold

- the parallel conditioning of eight cavities up to:
  ~150kW (1MV/cavity) with Q_L = 20'000
  was completed
- the parallel conditioning of four cavities:
  ~300kW intermediate position of movable Main Coupler nominal field (2MV/cavity with Q_L = 60'000)
  was completed
- the setting up of
  1. the Tuner Loop
  2. the RF feedback
  3. the Klystron Polar Loop

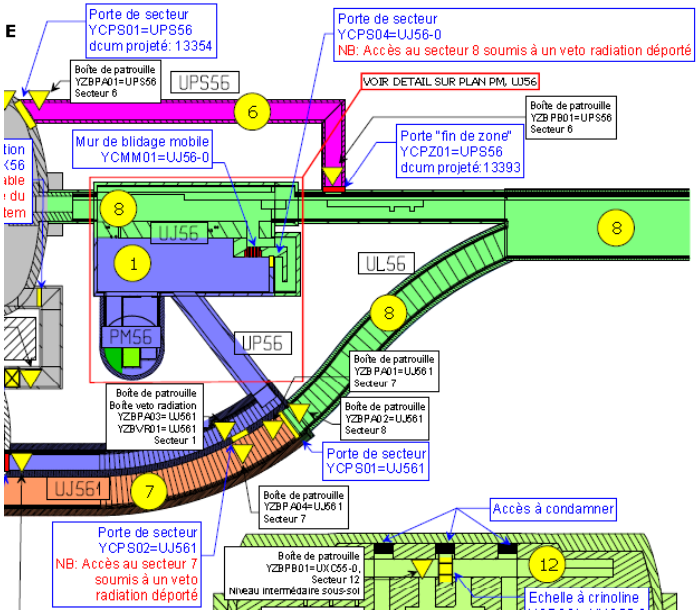
  was completed on three cavities

The commissioning of the other set of cavities has started at warm



Access safety and control systems

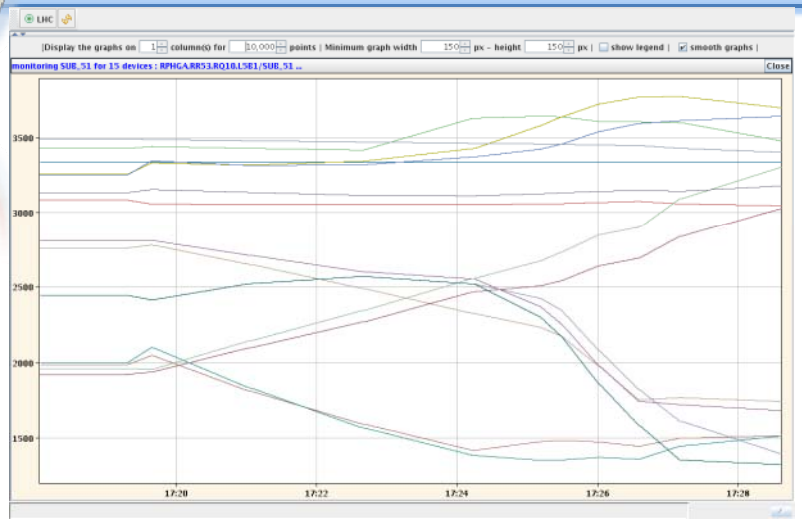
- The LHC access system was commissioned during the first week of January 2008 by a joint team in collaboration with the supplier's team.
- From early April access to the LHC is possible with dosimeter and biometric control.
- All the sectors in Hardware Commissioning today make use of the system



Objectives

1. Test the Access System when doing a patrol of all the LHC points
2. In « Access Mode », test the correct system behaviour when one or more EIS-beam becomes unsafe
3. In « Beam Mode », test the triggering of all the « EIS-BEAM» and external interfaces (BI, LBDS) in case of intrusion, door opening inside the LHC or Emergency stop.

Software for operation, controls and diagnostics

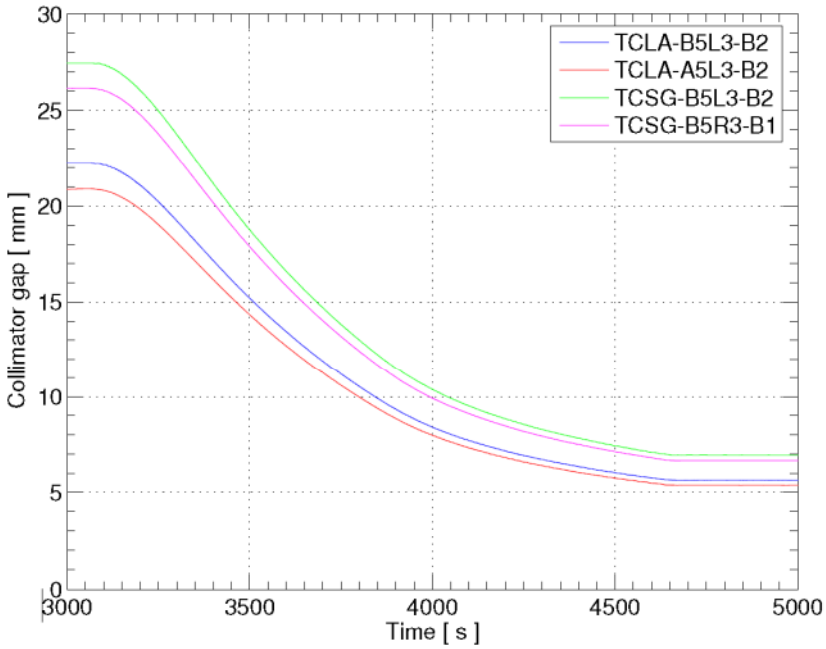


Using the final software foreseen for operation for the commissioning of the machine systems

1
- Sequencer
- Logging system
- Post mortem system
- On-line databases
- Industrial supervision systems

Dry runs

2
- Injection kickers system
- LHC Beam dumping system (kickers, energy tracking, diagnostics)
- Beam instrumentation (loss monitors, position monitors, current transformers, screens)
- Power converters in simulation mode
- Collimators
- Timing system
- Communication with experiments (handshakes, modes, fill number, beam based measurements, etc.)
- Post mortem data acquisition system
- Squeeze



… in summary

- Several teams are busy commissioning the technical systems (the superconducting magnets, the warm magnets, the RF, the injection system, the collimators, the beam dumping system, the access safety and control, the infrastructure systems, the software, etc.) of the LHC in parallel but in a coordinated manner.
- A strategy, where the initial beam energy is at least 5 TeV, is proposed to gain time with the training of magnets and meet the summer deadline.
- Recent results, obtained while commissioning Sector 45, indicate that this is feasible.