Powering of the Superconducting Circuits: Procedures and Strategies for Circuit Validation

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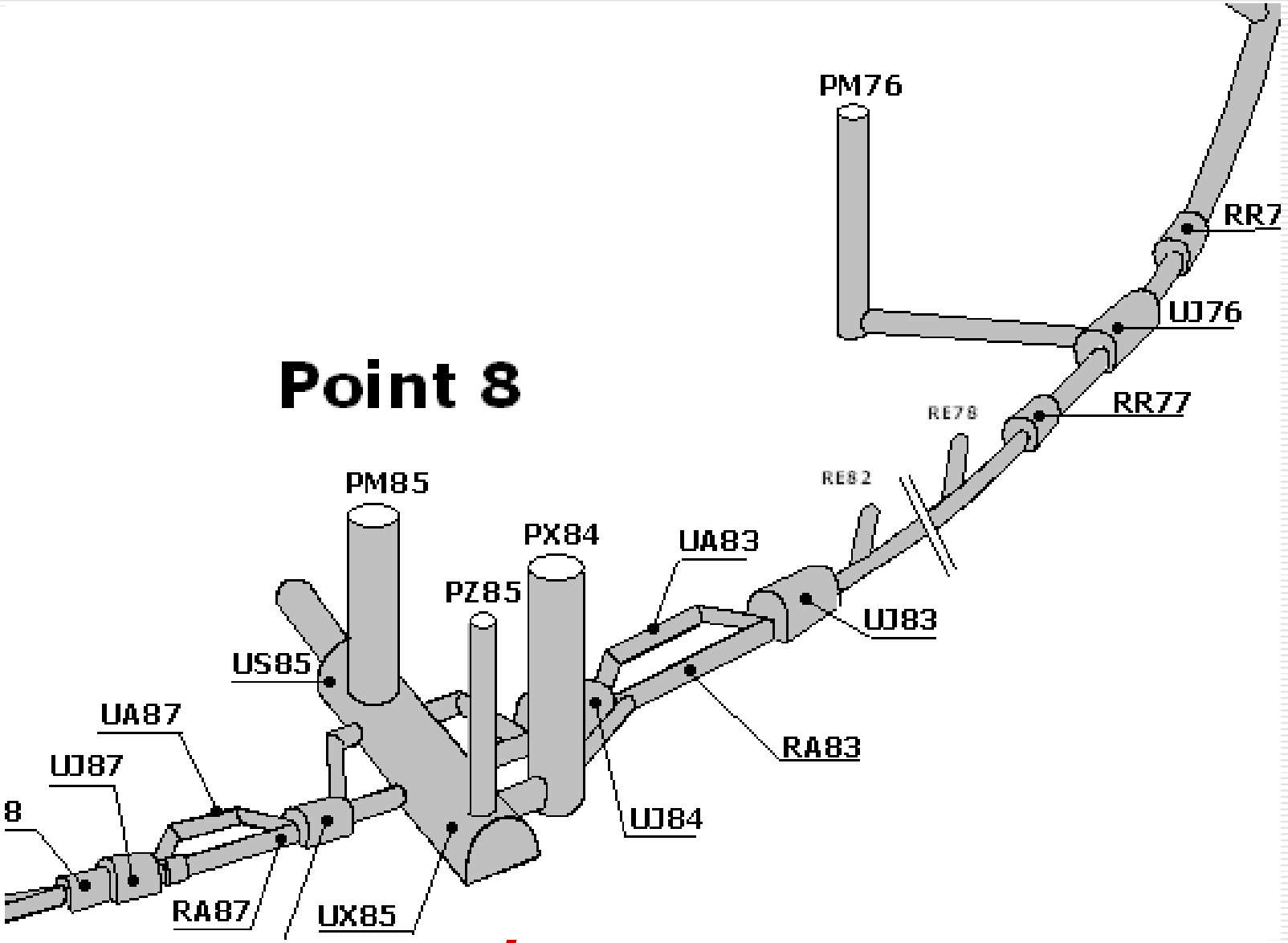
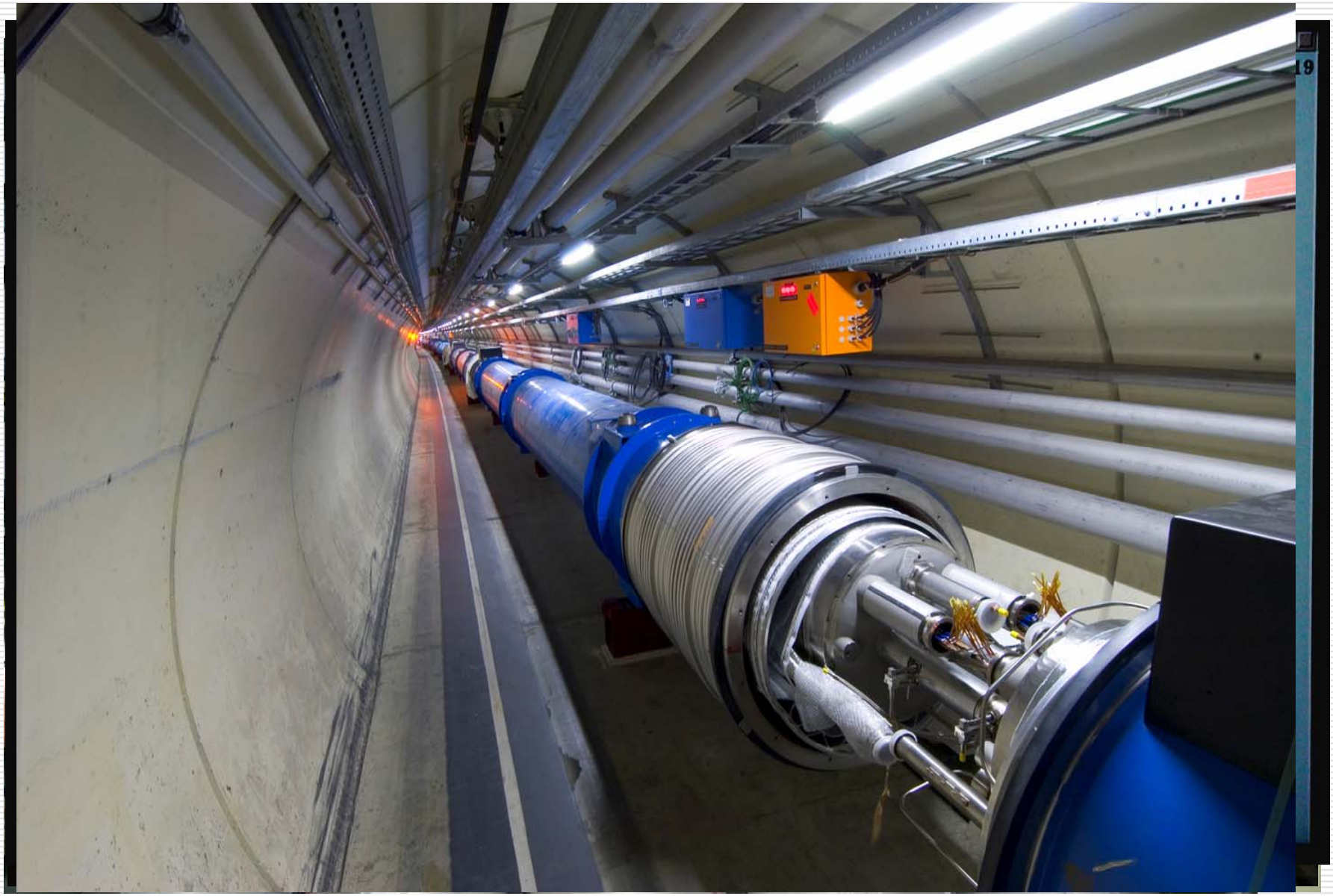
on behalf of the Hardware Commissioning Coordination Team
& SACEC

The LHC SC Circuits

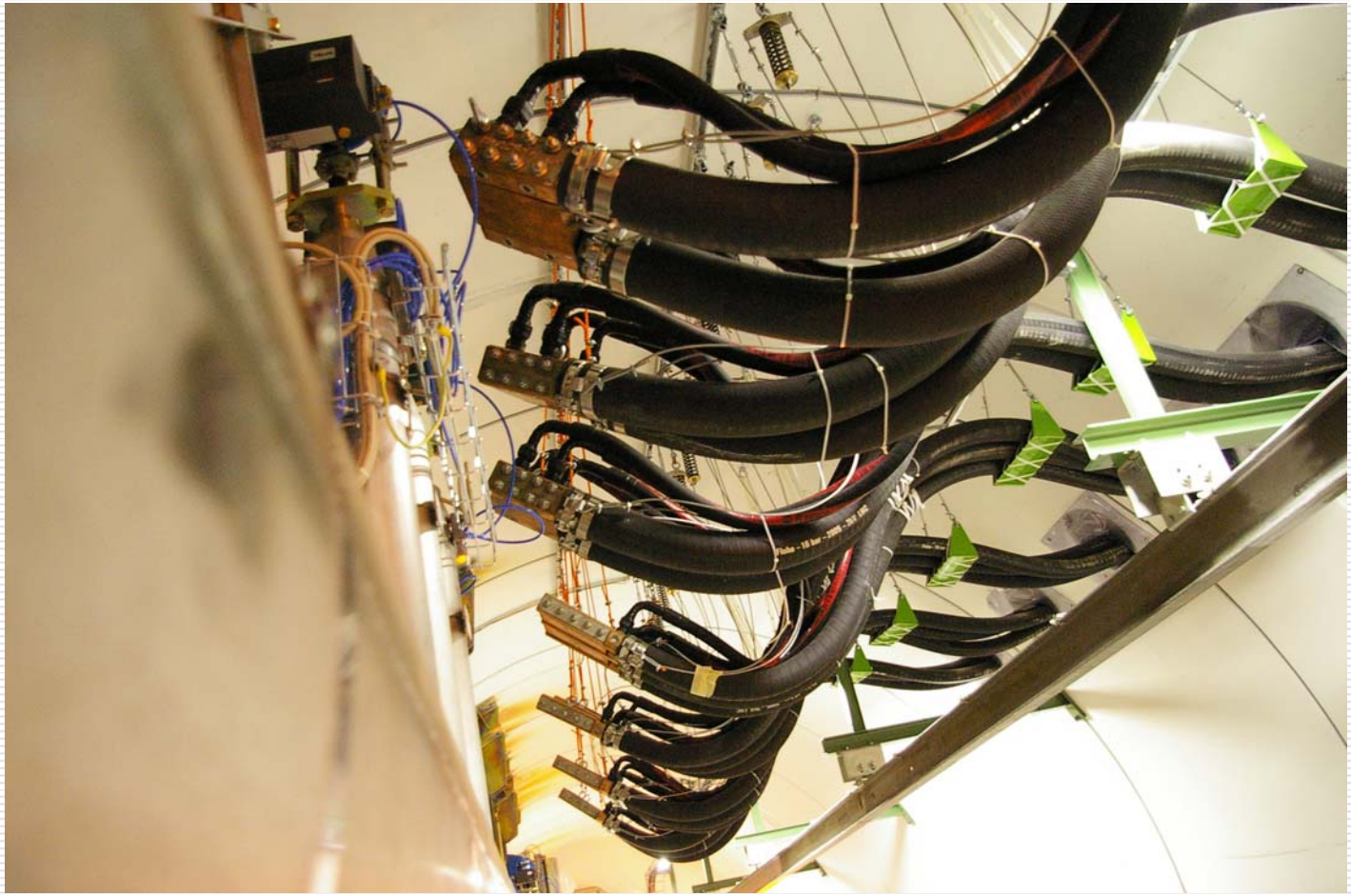


The LHC SC Circuits



Commissioning of a SC Circuit

1. Individual System Tests
2. Short-Circuit Tests



Commissioning of a SC Circuit

1. Individual System Tests
2. Short-Circuit Tests
3. Software Control Tests
   - Control software (Sequencer) debugging
   - PIC – Power converter – QPS Communication
   - Post-Mortem data transmission and analysis
   - Study of parallelisms and interferences between tests
   - Validation of the estimated testing times

Commissioning of a SC Circuit

1.
2.
3.
4.
5.

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the **Large Hadron Collider** project

LHC Project Document No.
LHC-D-HCP-0003 rev 1.3
CERN Div./Group or Supplier/Contractor Document No.
AB/AT/TS
EDMS Document No.
519716

Date: 2006-12-11

Hardware Commissioning Procedure

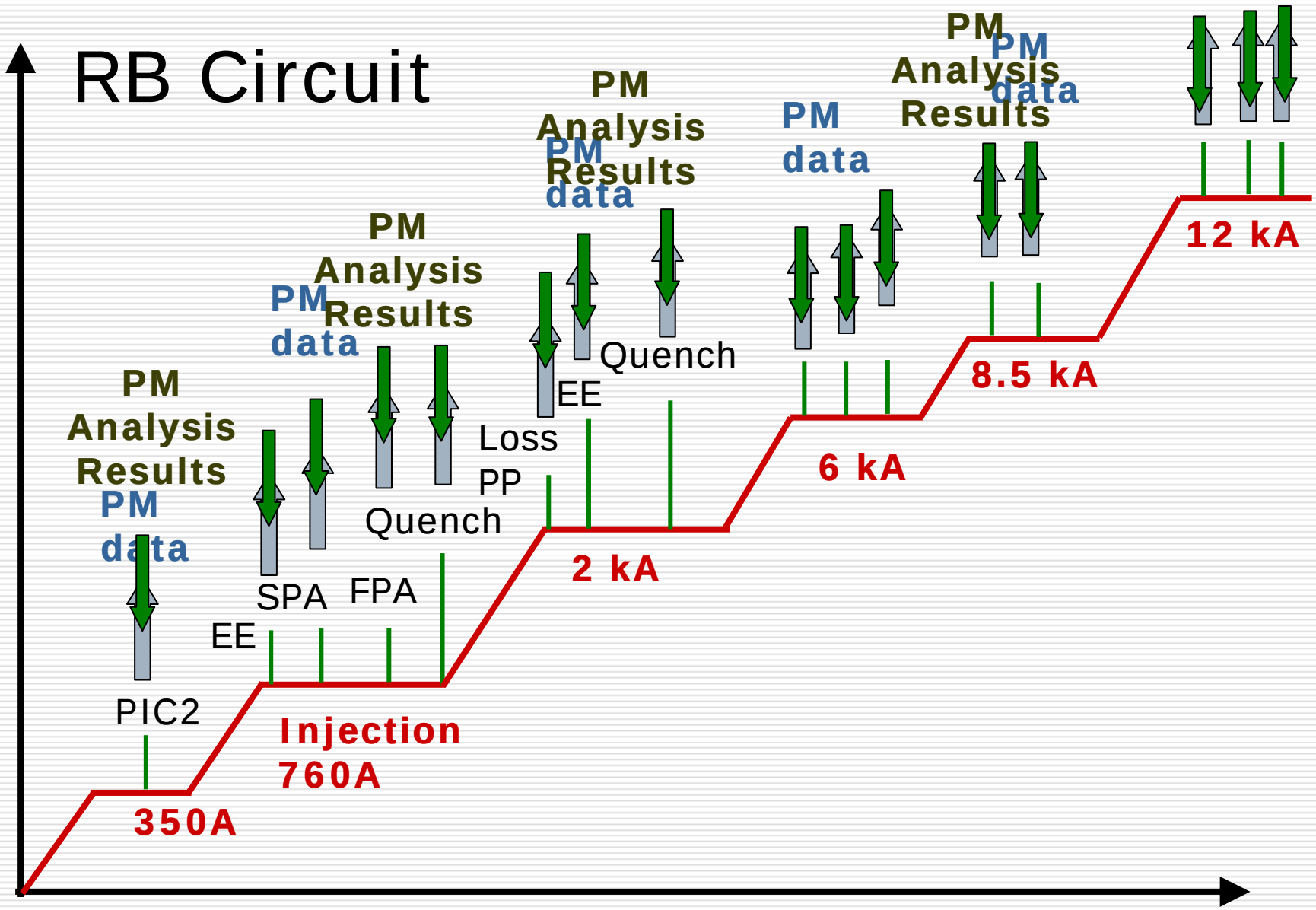
THE COMMISSIONING OF THE HARDWARE IN THE LHC SECTORS

POWERING OF THE SUPERCONDUCTING CIRCUITS OF A SECTOR UP TO NOMINAL CURRENT

Abstract

This document describes the sequence of the steps which lead to the powering of the superconducting circuits of a sector to nominal current. It covers the phases after the electrical connection of the power cables to the current leads up to the powering in unison of all the circuits of a sector to nominal current.

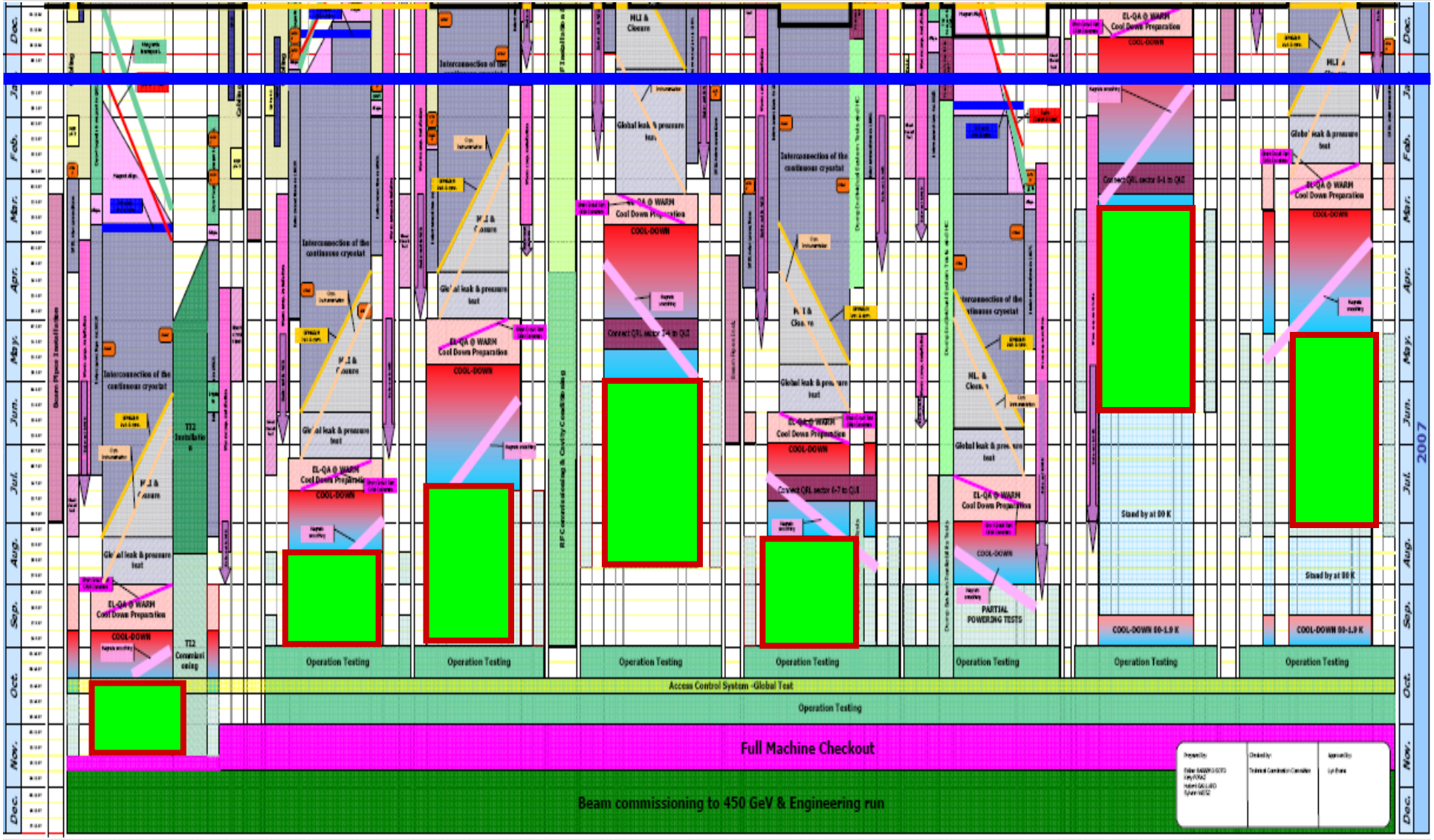
Single Circuit Powering Test



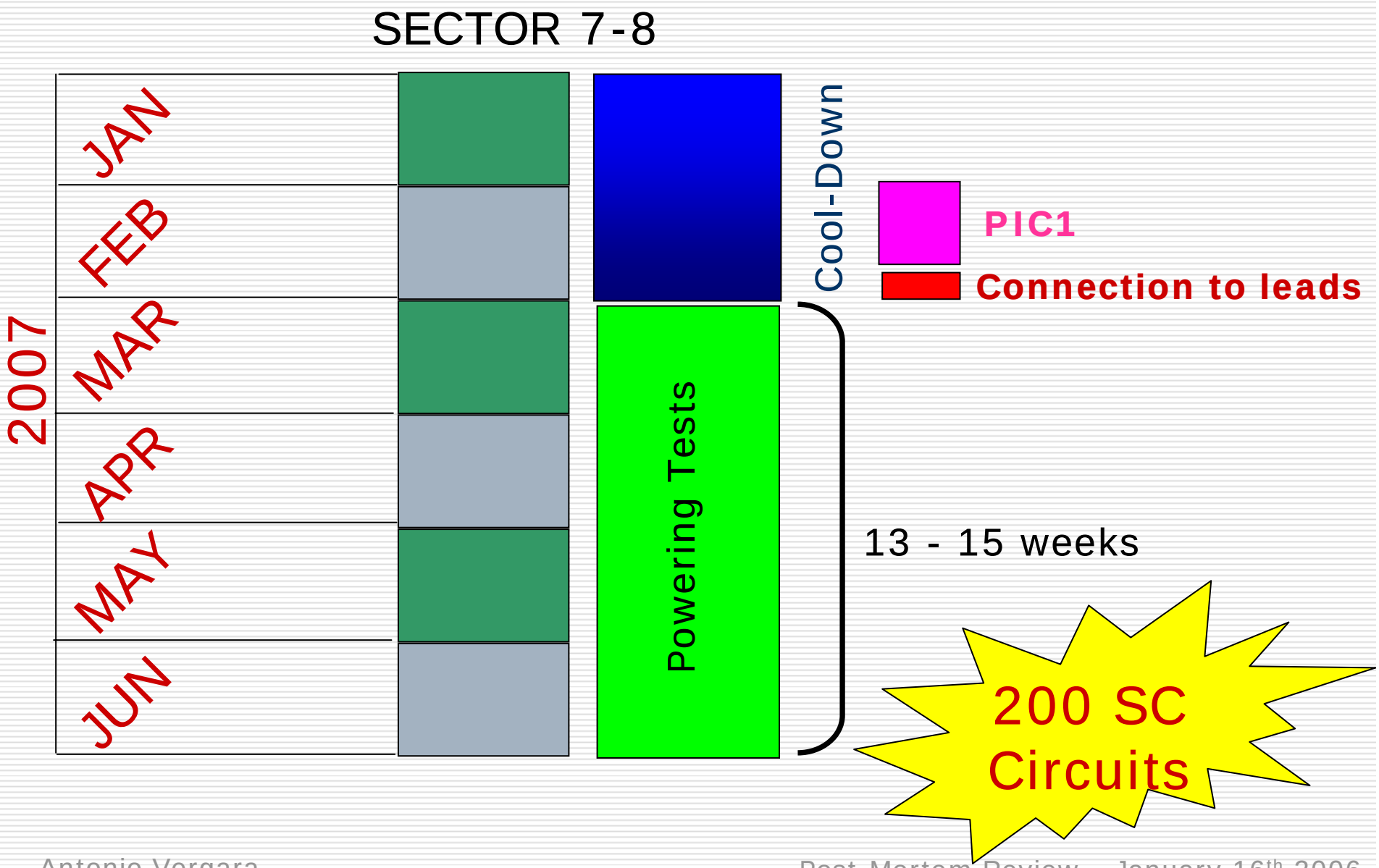
Circuit Types and Circuit Tests

		PIC2	PCS	PLI1							PLI2						PLI3				PLI4		PNO							PSQ	PAC
				1	2	3	4	5	6	7	1	2	3	4	5	6	1	2	3	4	1	2	1	2	3	4	5	6	7		
13kA Main		■		■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■			■		■
IP Q&D		■		■		■	■	■		■	■	■		■	■	■	■		■	■			■	■	■	■			■	■	■
IT	RTQX2	■		■		■	■	■		■	■	■		■	■	■	■		■	■			■	■	■	■			■		
	RTQX1	■	■	■		■	■		■	■													■	■		■		■	■		
	RTQXA	■		■		■	■	■		■	■	■		■	■	■	■		■	■			■	■	■	■			■		
	RTQXM	■		■		■	■	■		■	■	■		■	■	■	■		■	■			■	■	■	■			■		
	RQX	■		■		■	■	■															■	■	■	■			■	■	
600A EE		■	■	■	■	■	■			■	■	■	■			■	■	■		■			■	■		■		■	■		■
600A no EE CR		■	■	■		■	■		■	■	■	■				■	■			■			■	■		■		■	■		■
600A no EE		■	■	■		■	■		■	■													■	■		■		■	■		■
80-120A		■																					■	■		■	■	■	■		■
60A																							■			■	■	■	■		■

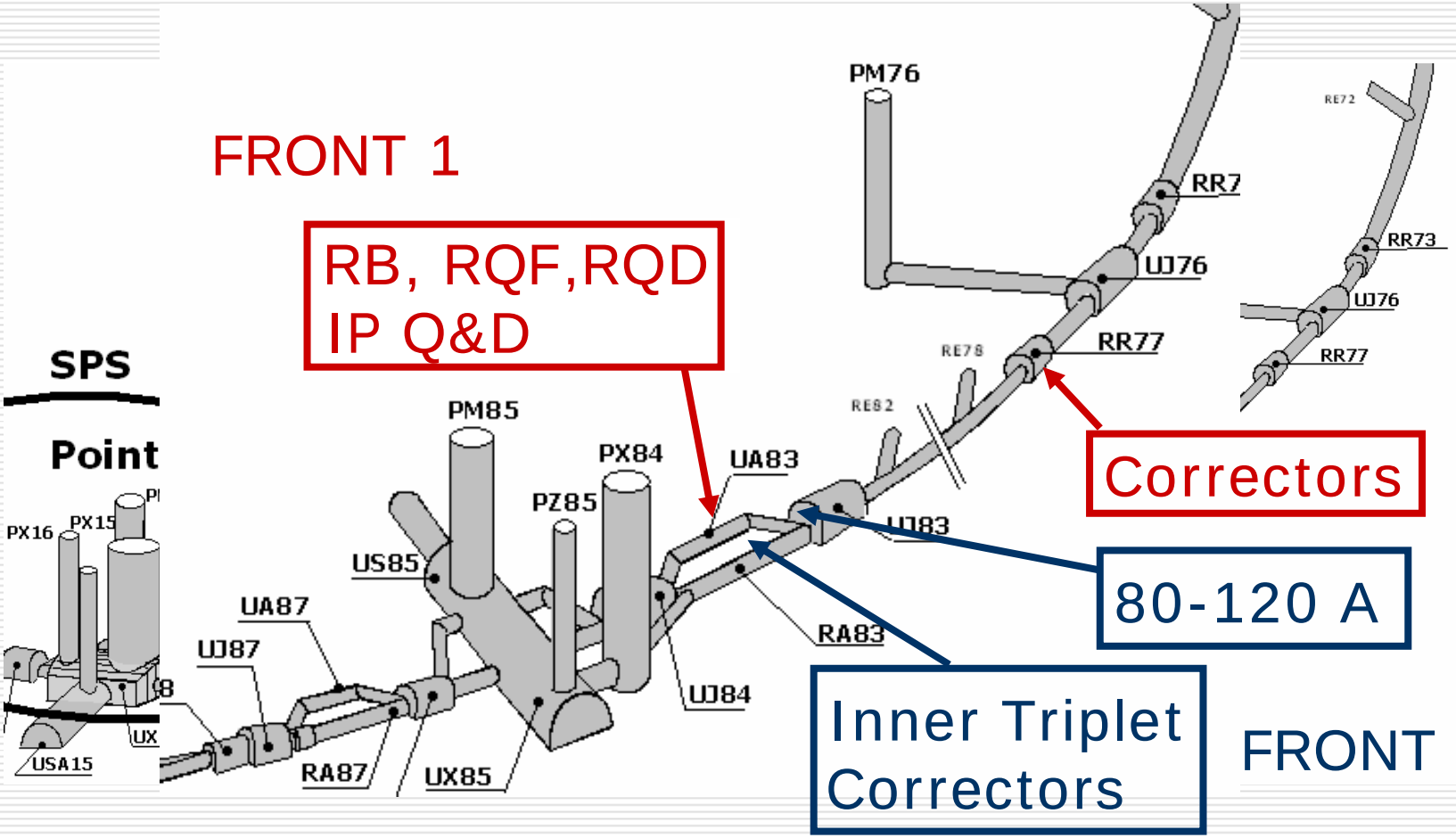
The Commissioning Scenario: Schedule



The Commissioning Scenario: Schedule



The Commissioning Scenario



Parallelisms and Constraints

- The 3 types of parallelisms:
  - Parallelisms between sectors
  - Parallelisms between fronts
  - Parallelisms between circuits – SOC

SOC: Set Of Circuits.
Battery of circuits commissioned in parallel by the same front

Definitions

- The 3 types of parallelisms:
  - Parallelisms between sectors
  - Parallelisms between fronts
  - Parallelisms between circuits – Battery

- General Constraints:
  - One Front can commission only one circuit or one battery at a time
  - Tests carried out by one Front should be transparent to the other ones

Constraints on Parallel Commissioning

1. Two sectors cannot test simmultaneously
   i. Two or more 13kA circuits
2. Two fronts cannot test simmultaneously
   i. Circuits in the same powering subsector
   ii. Circuits in the same DFB
3. A SOC (battery) cannot
   i. Include circuits above 600A
   ii. Imply more than one DFB
   iii. Imply more that two DFB chimenys
   iv. Include circuits sharing the same QPS controller
   v. Include circuits from different circuit type (?)
   vi. Include circuits from different powering subsectors

Developed Tools

- The Sequencer
- Reference and LSA Databases
- Individual Supervision Systems
- Alarms – Laser, Logging
- Test Management Software: SOC Editor
- Post-Mortem Local Analysis Tools
- Post-Mortem Global Analysis Tool
- MTF

What do we need from the Post-Mortem?

- The Post-Mortem data analysis tools should provide to the different experts (MPP, individual equipment experts, Mr Circuit, HCC, etc.):
  - Fast and reliable tools to analyse the behaviour of the different equipment after each commissioning step
  - Information automatically extracted from the Post-Mortem data after each provoked or natural event
  - Both a local and global overview of the systems under test reliable and clear enough to allow the go / no go for the next commissioning step.

The Post-Mortem analysis is an essential tool, not only for a reliable and safe operation of the LHC, but also for achieving proper commissioning of the LHC super-conducting circuits respecting the current LHC project milestones.

...thank you