THE COMMISSIONING OF THE LHC TECHNICAL SYSTEMS

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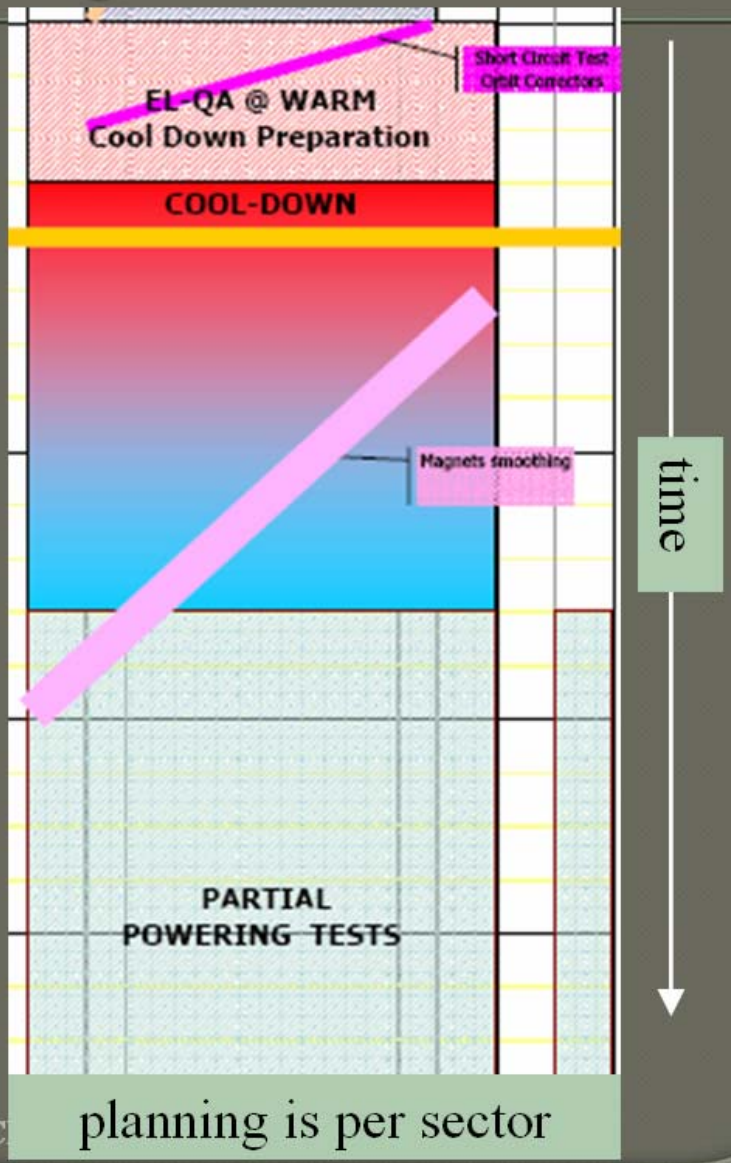
the commissioning unit is a sector

- there are 8 sectors
- the utilities and the machine systems are sectorised
- assembly and commissioning almost independent



a systematic approach

…..to unprecedented complexity

1. The systems to be commissioned in the cold sections of the machine
   - magnets, power converters, interlocks, quench detection and energy extraction system
   - the associated utility systems such as AC distribution, water cooling, ventilation, access control and safety systems
2. The systems in the long straight sections
   - injection, RF, beam dump, beam instrumentation, collimators, magnets, power converters, interlocks, etc.

a systematic approach

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   - injection, RF, beam dump, beam instrumentation, collimators, magnets, power converters, interlocks, etc.

a methodology for the commissioning of the technical systems and their interactions, preparation started in 2003

the mandate & the strategy

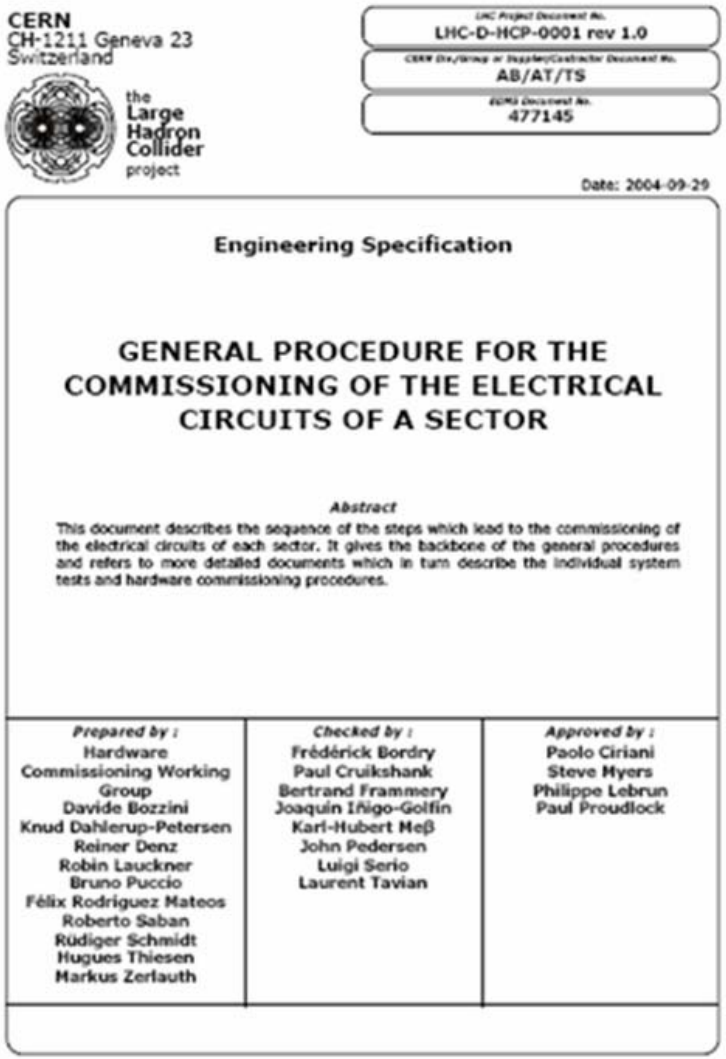
1. After the qualification for operation of the individual systems of a sector (vacuum, cryogenics, quench protection, interlocks, powering, etc.).

2. Each sector will be commissioned as a whole up to the powering to nominal current of all the circuits.

3. Validation and specific studies will be carried-out on the first commissioned sector.

- design the procedures
- evaluate the resources needed
- build the necessary environment (documentation, test folders, analysis tools, logbooks, collaborative tools, web pages, reporting structure, etc)

procedures & documentation



CERN
CH-1211 Geneva 23
Switzerland

the Large Hadron Collider project

LHC Project Document No.
LHC-D-HCP-0001 rev 1.0

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

EDMS Document No.
477145

Date: 2004-09-29

Engineering Specification

GENERAL PROCEDURE FOR THE COMMISSIONING OF THE ELECTRICAL CIRCUITS OF A SECTOR

Abstract

This document describes the sequence of the steps which lead to the commissioning of the electrical circuits of each sector. It gives the backbone of the general procedures and refers to more detailed documents which in turn describe the individual system tests and hardware commissioning procedures.

Prepared by :	*Checked by :*	*Approved by :*
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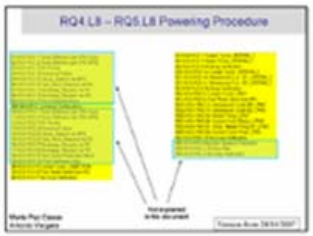
procedures & documentation

hardware commissioning coordination

- MAIN PAGE
- MEETINGS
- TWIKI
- MTF
- DOCUMENTS
- ELOGBOOK
- HC WORKING GROUP
- POWERING PROCEDURES
- CONTACTS
- CERN
- LHC
- TIMBER
- METER
- EDMS
- CDD
- LAYOUT DATABASE
- ELECTRICAL CIRCUITS
- INSTALLATION DRAWINGS

INTRO | SCHEDULES | TYPICAL HC PROGRAMME | ACCESS | TEAM | REGULAR MEETINGS | ACTIVITIES | THE FI

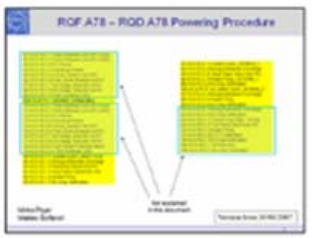
60A & 80-120A Powering Procedure



RQ4.L8-RQ5.L8 Powering Procedure

RD1-4 Powering Procedure

600 A Powering Procedure



RQF.A78 – RQD.A78 Powering Procedure

RB.A78 Powering Procedure

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Switzerland

LHC Project Document No.
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URE FOR THE
THE ELECTRICAL
SECTOR

s which lead to the commissioning of
backbone of the general procedures
turn describe the individual system

Approved by :
Paolo Ciriani
Steve Myers
Philippe Lebrun
Paul Proudlock

the test folder

MTF
Equipment Management Folder

Home | Help | EDMS

Search : Equipment | Locati

Created on Thursday, 2007-6-21 for SABAN HwC Slots Step Report

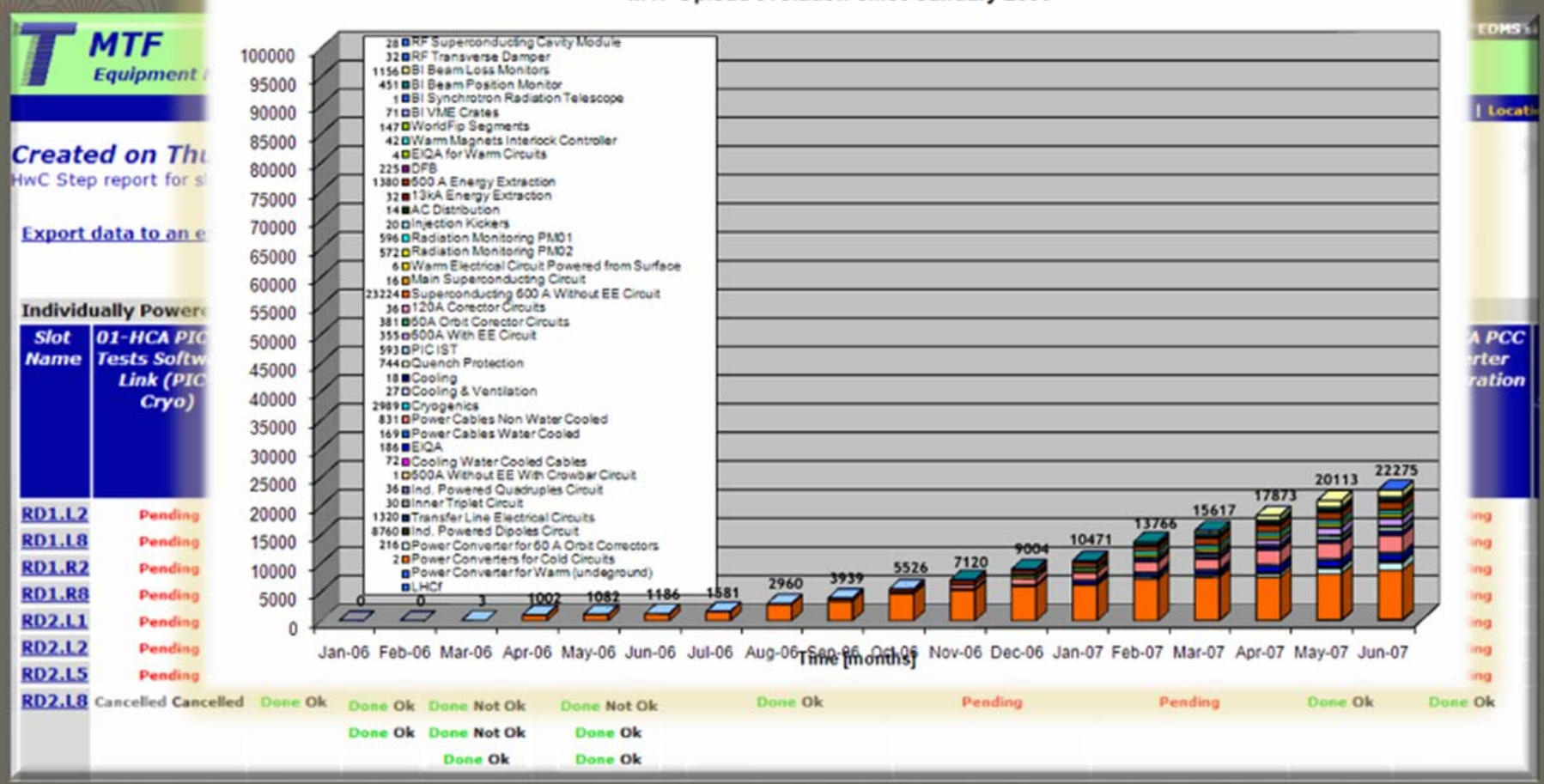
HwC Step report for slots

Export data to an excel file.

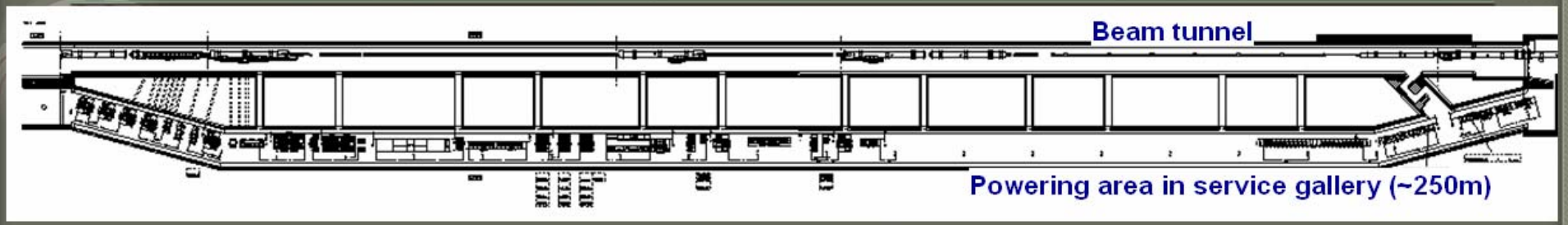
Individually Powered Dipole Circuit

Slot Name	01-HCA PIC1.1 Tests Software Link (PIC-Cryo)	02-HCA PIC1.2 Tests Software Link (PIC-QPS)	03-HCA PIC1.3 PC Permit	04-HCA PIC1.4 Powering Failure	05-HCA PIC1.5 Circuit_Quench via QPS	06-HCA PIC1.6 Fast_Abort_Request via PIC	07-HCA PIC1.7 Discharge_Request via PC	08-HCA PIC1.8 Discharge_Request via PIC	09-HCA PIC1.9 Test Hardware Links	095-HCA PCC Converter Configuration
RD1.L2	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
RD1.L8	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Done Ok	Pending
RD1.R2	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
RD1.R8	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
RD2.L1	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
RD2.L2	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
RD2.L5	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending	Pending
RD2.L8	Cancelled Cancelled	Done Ok	Done Ok Done Ok	Done Not Ok Done Not Ok Done Ok	Done Not Ok Done Ok Done Ok	Done Ok	Pending	Pending	Done Ok	Done Ok

the test folder

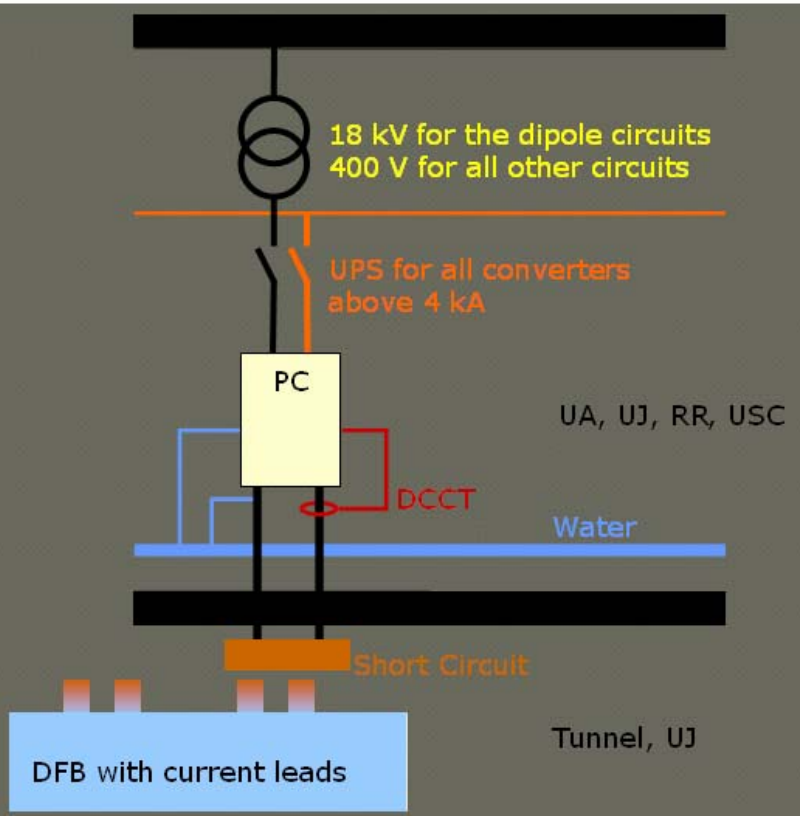


First results
power converters in short circuit



The objective is to validate

1. the warm elements of the circuits
   - the power converters,
   - the energy extraction system,
   - the powering interlocks,
   - the normal conducting cables
2. the utilities
   - demineralised water for cooling,
   - ventilation,
   - AC current supply and cables

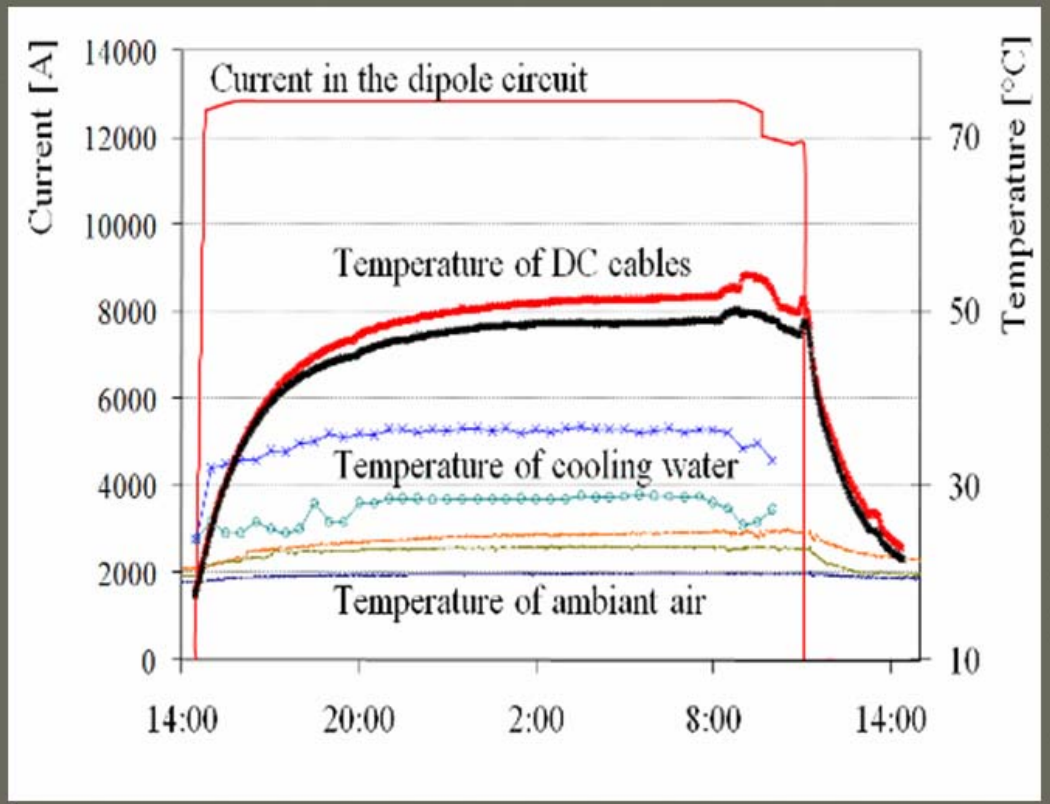


First results
power converters in short circuit

24 hour run of all the power converters at ultimate and then at nominal current.

The stability of
1.the current
2.the AC supply
3.the temperatures
- of the demineralised water,
- of the air,
- of the electronics,
- of the cables

are recorded in order to validate the correct functioning of the whole area

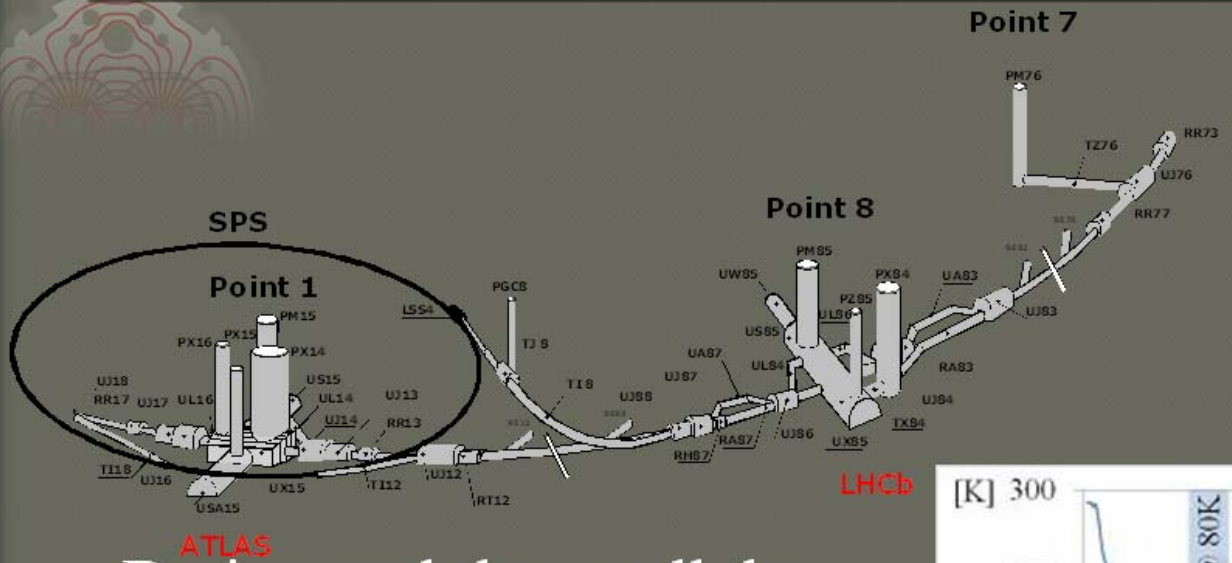


Powering areas contain between 34 to 81 power converters
22 out of 29 powering areas now qualified

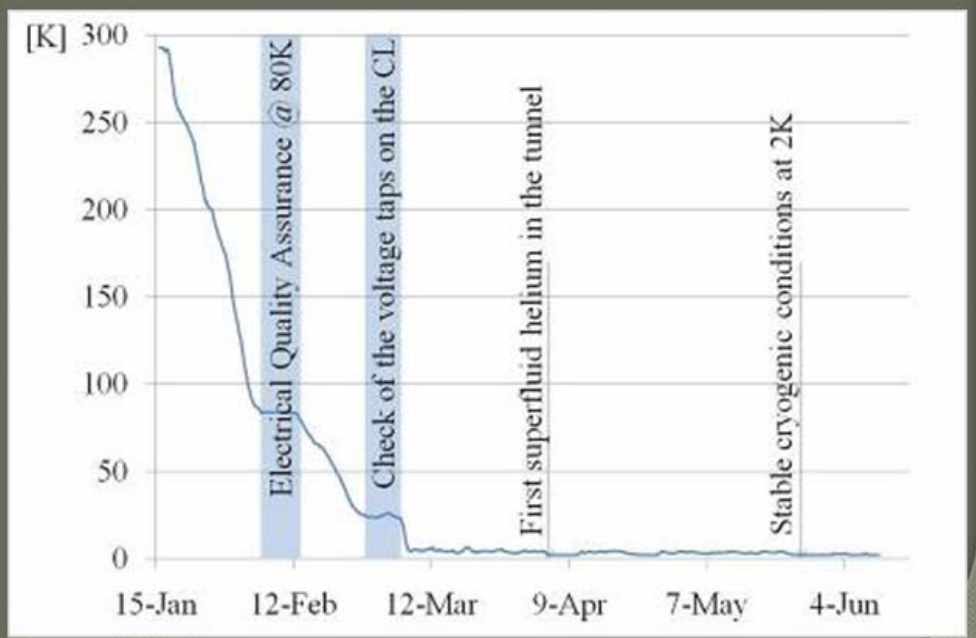
Not always successful, some need to be repeated (reasons EMC, ventilation, heating of powering cables)

First results

Sector 78: Electrical Quality Assurance & Cool down



During cool-down, all the circuits go through different electrical quality assurance tests at several temperature levels.



First results

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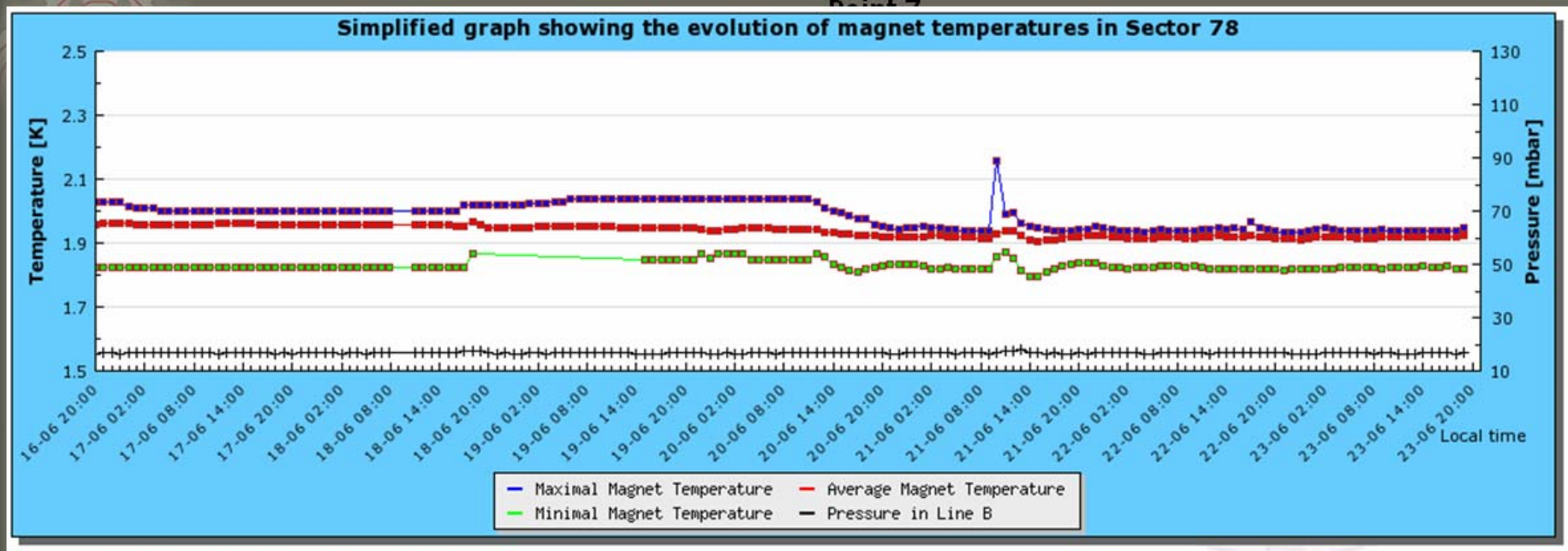

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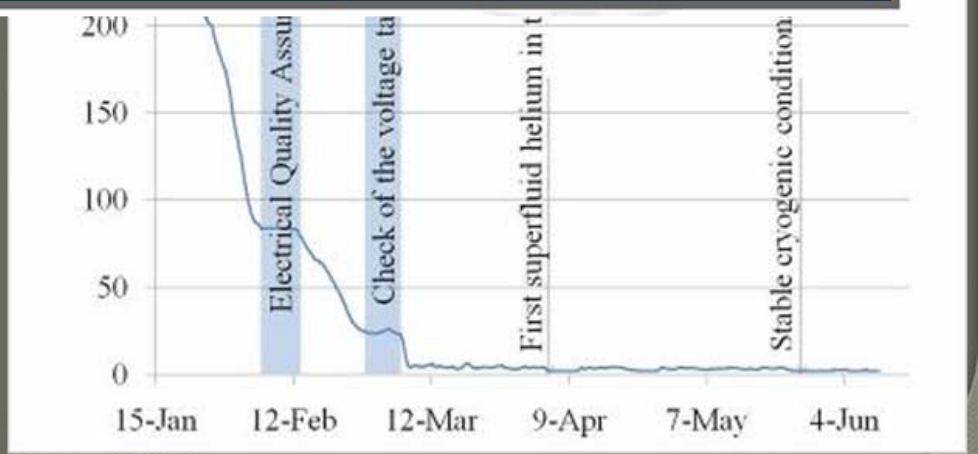

First results

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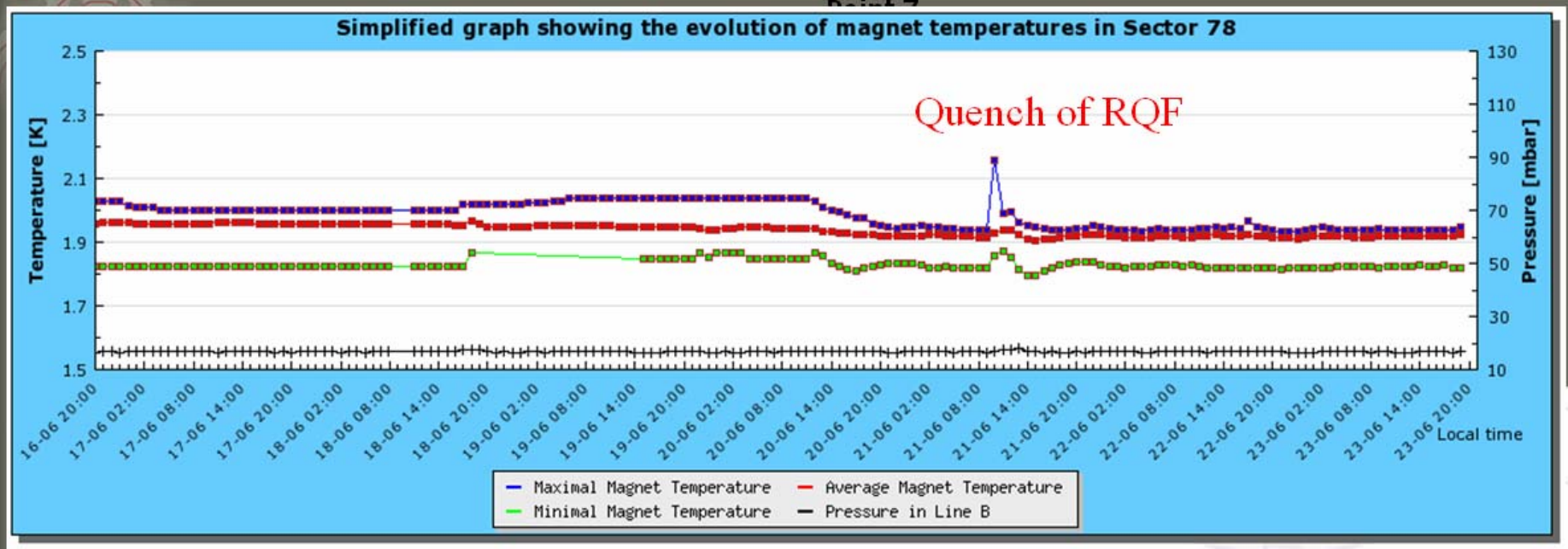

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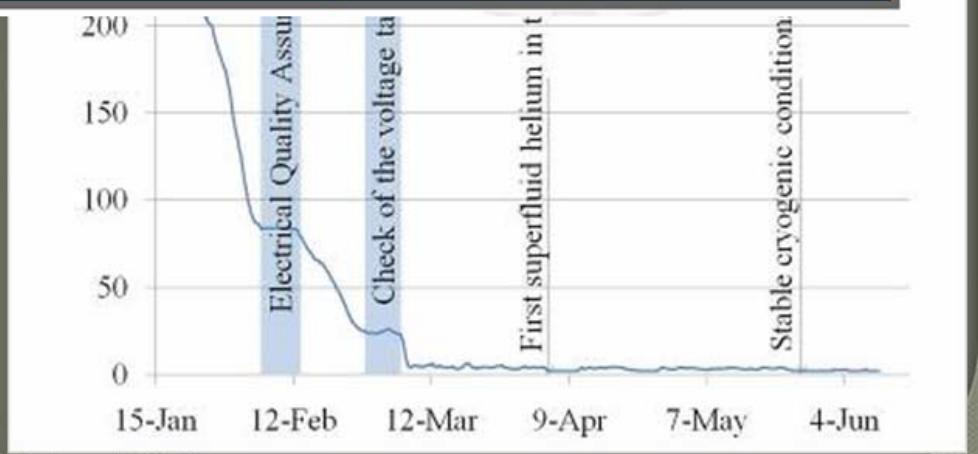

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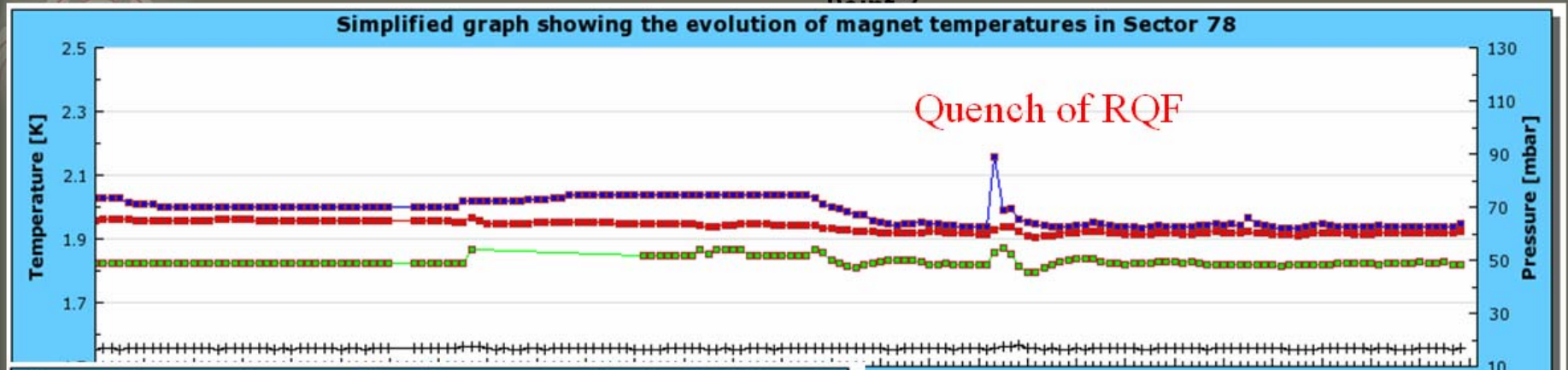
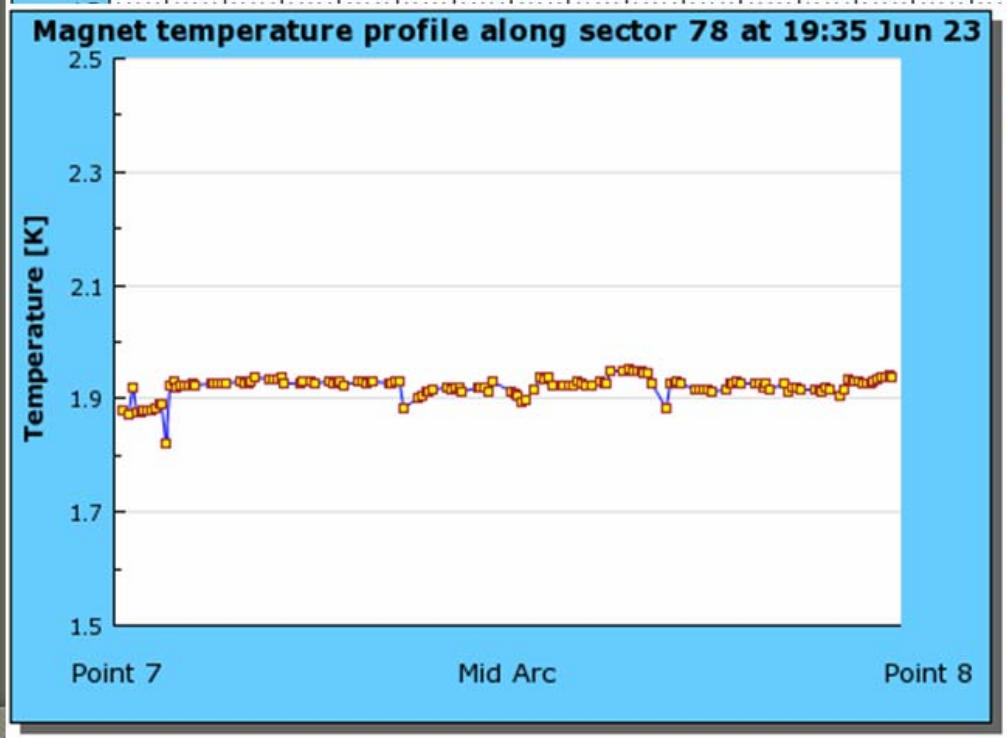
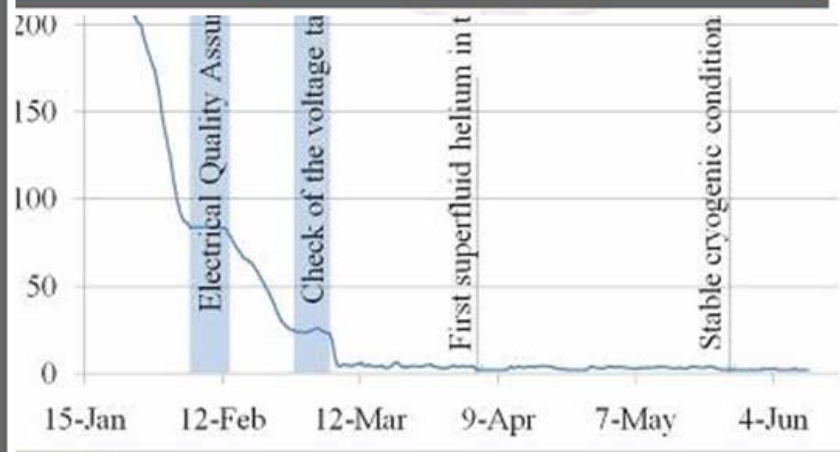
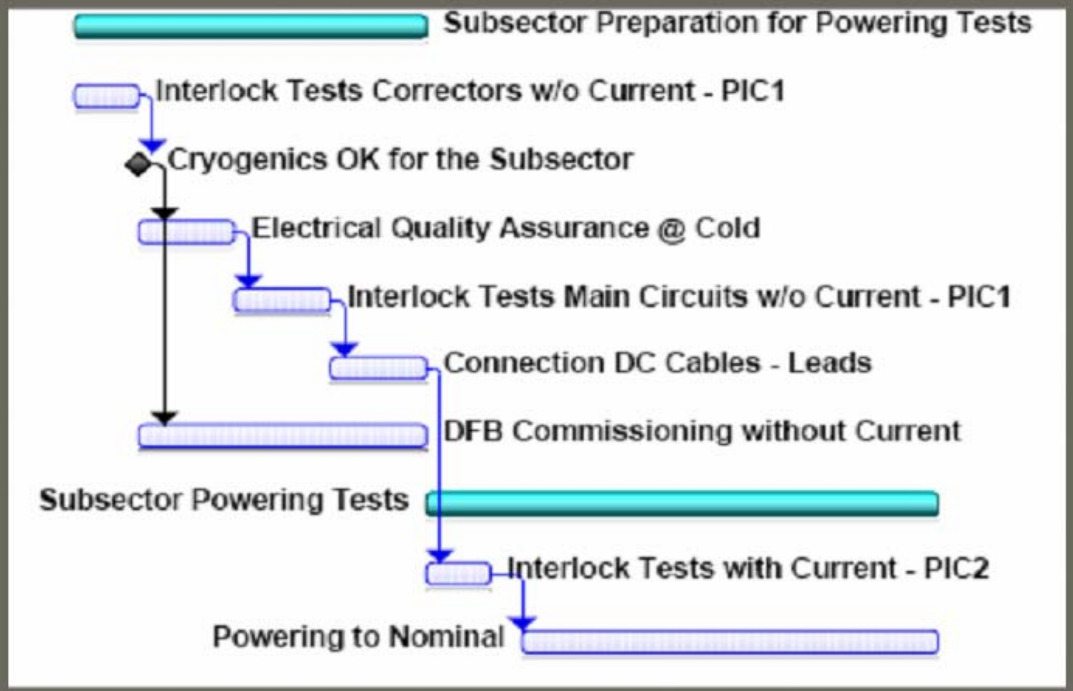
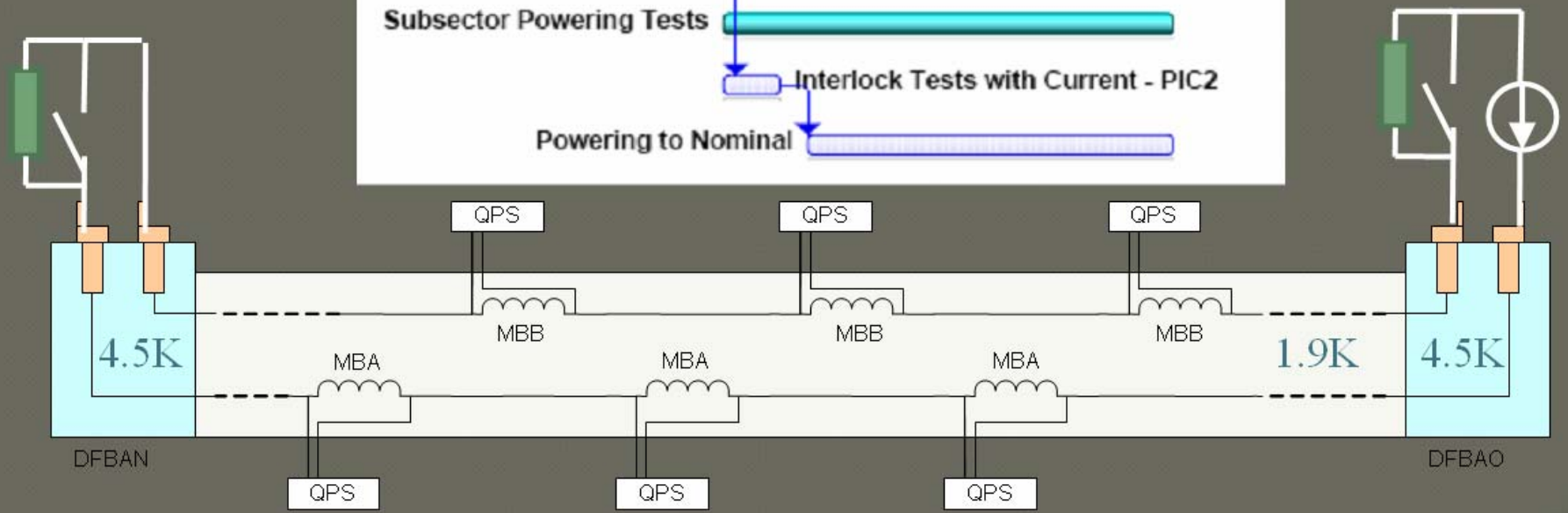






the commissioning of the superconducting circuits





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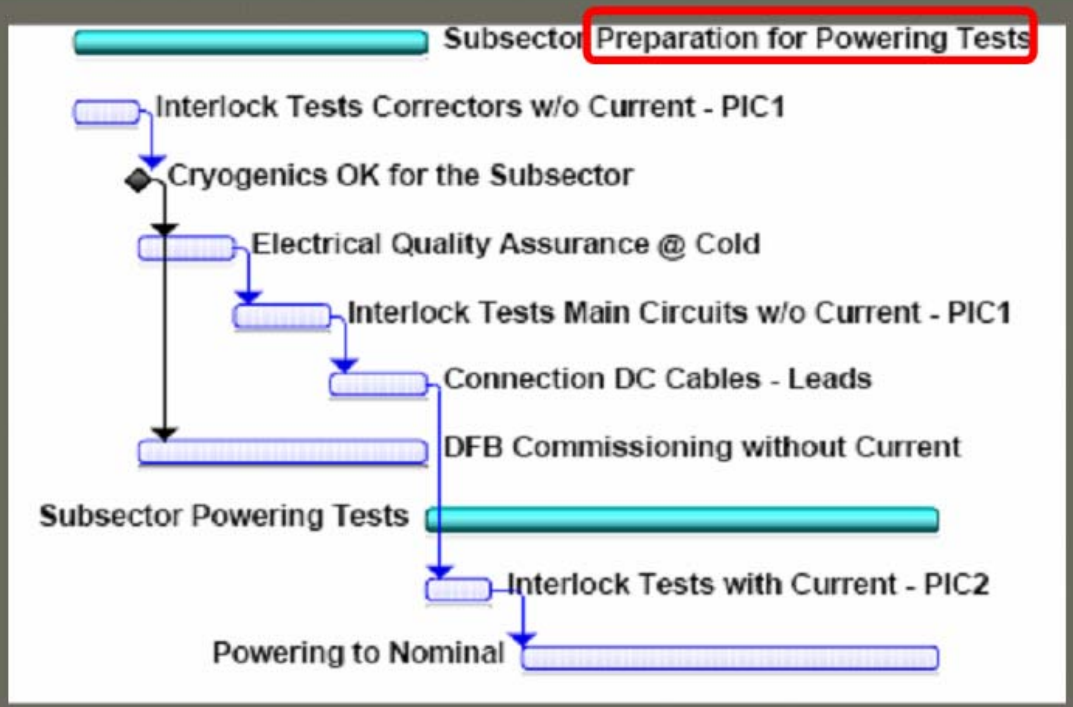

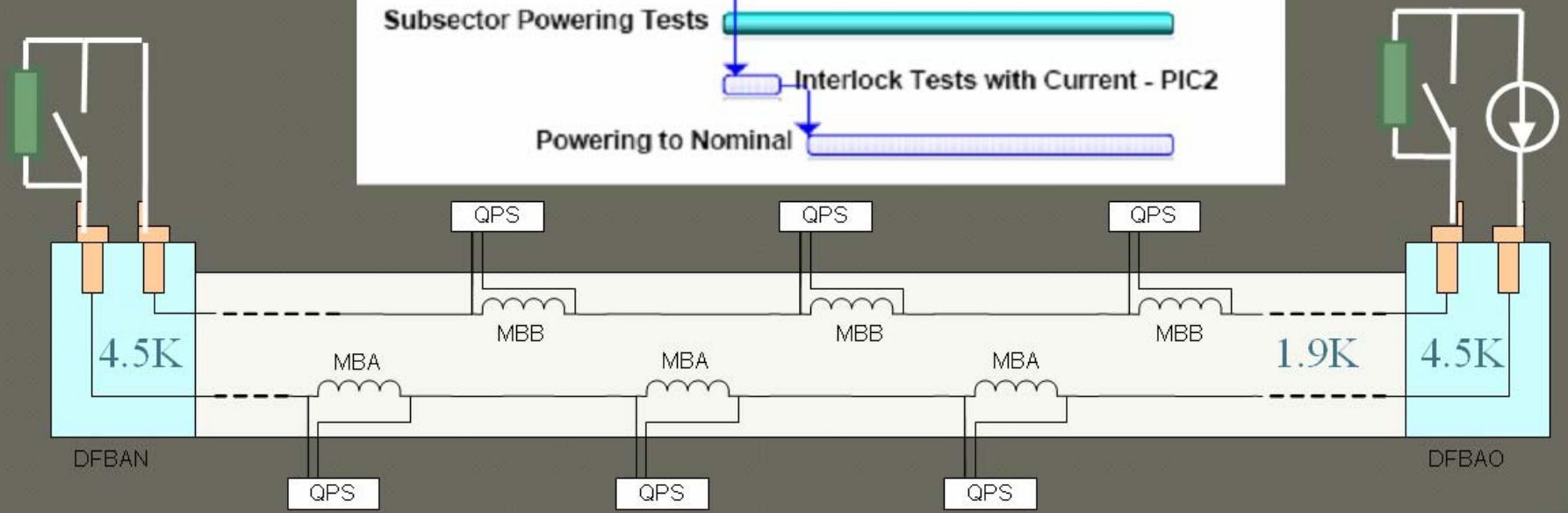

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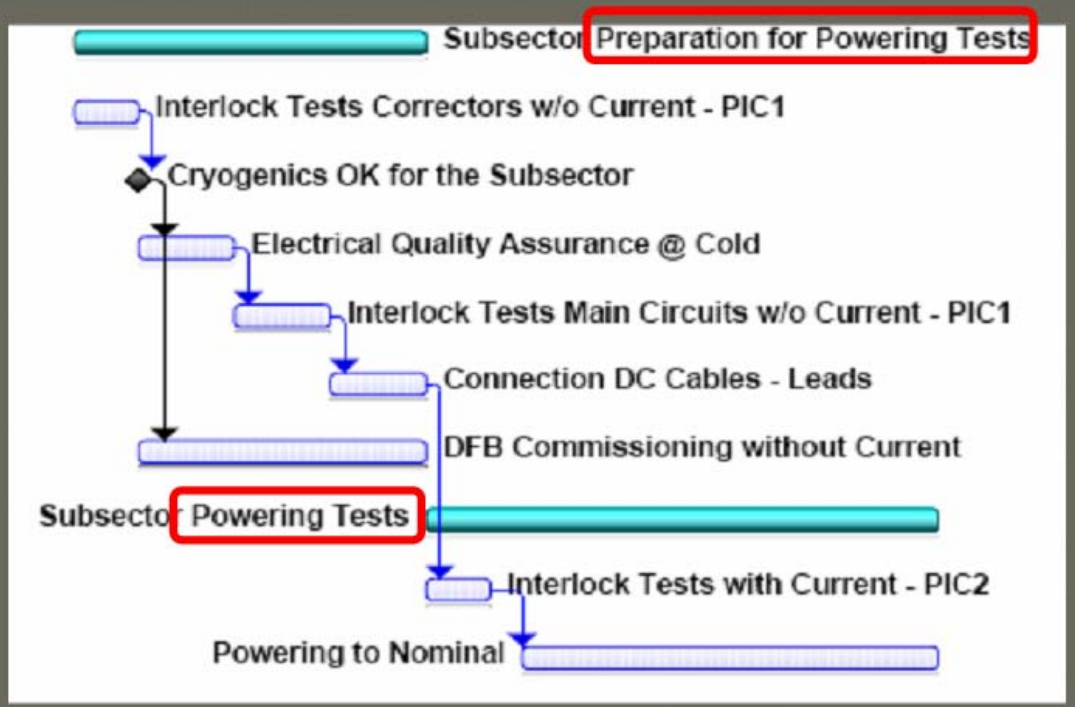
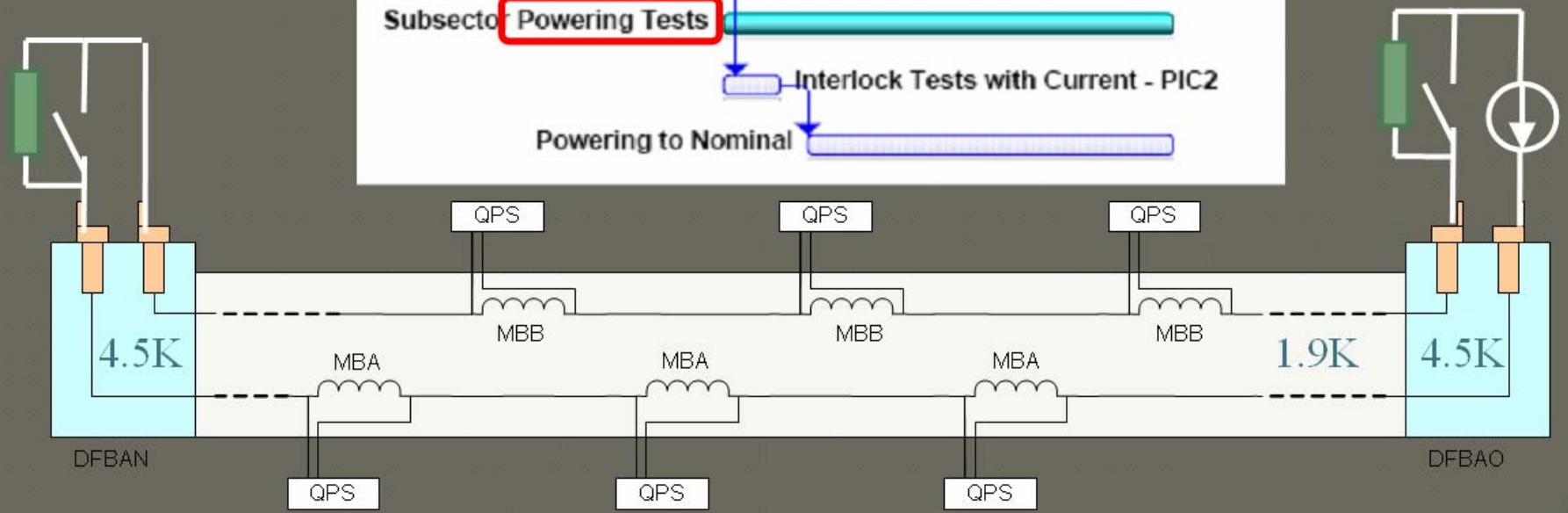




the commissioning of the superconducting circuits

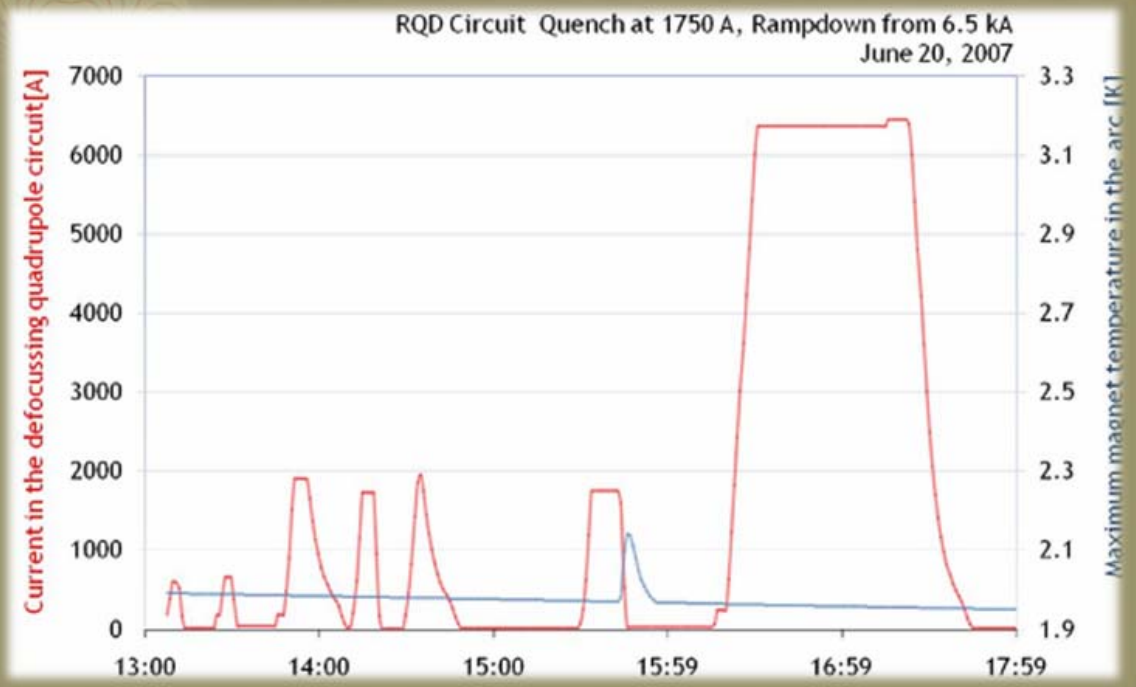
Powering Tests

1. interlock tests at minimum operational current
2. validation at different current levels (injection, 20, 50 and 70%) followed by powering to nominal current
    - ramp up to the test current
    - verification of the current leads performance
    - forced energy extraction
    - provoked quench
    - simulation of a Fast Power Abort from the powering interlock
    - simulation of a failure of the converter
    - simulation of a Slow Power Abort by the powering interlock

The aim of these tests is the validation of the *protection mechanisms under the different failure scenarios* and the *behaviour of the components of the circuit during a normal LHC ramp and steady state*

First results

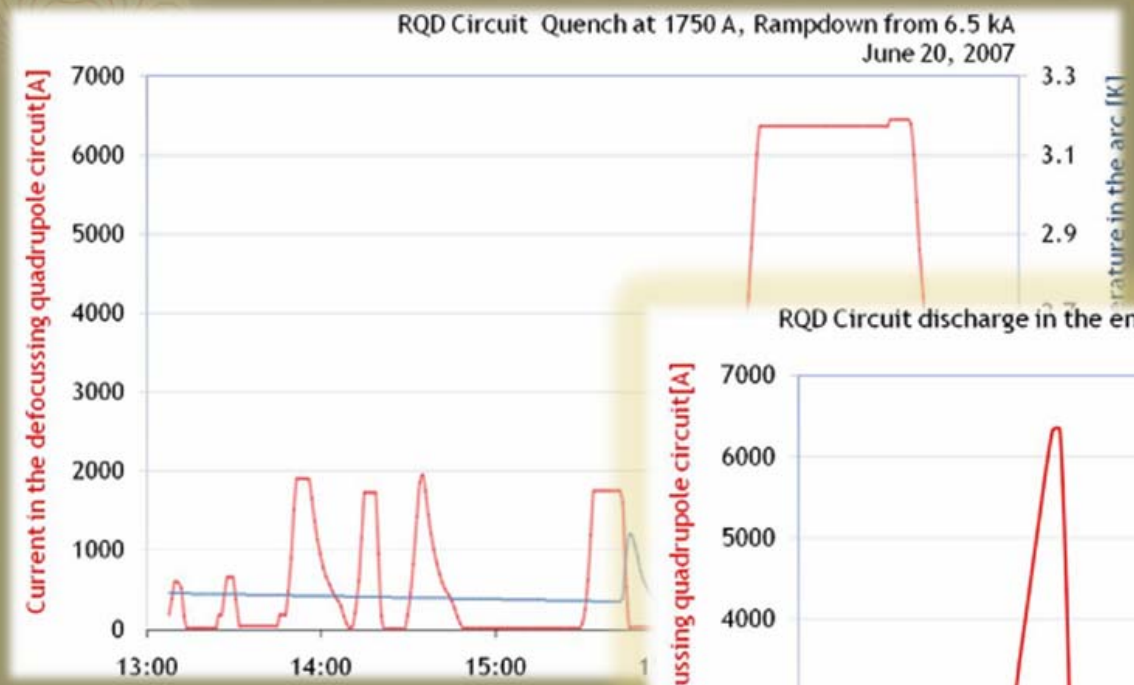
the commissioning of the superconducting circuits

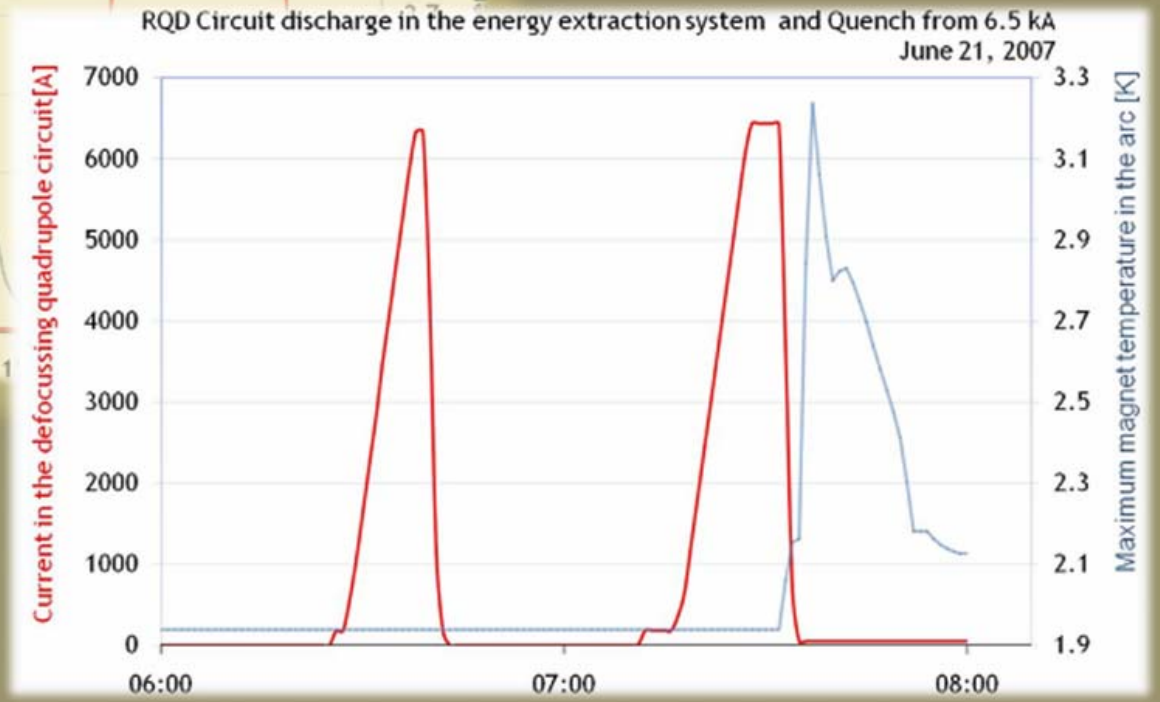


51 magnets over 2.7 km
0.286 H total inductance

First results

the commissioning of the superconducting circuits





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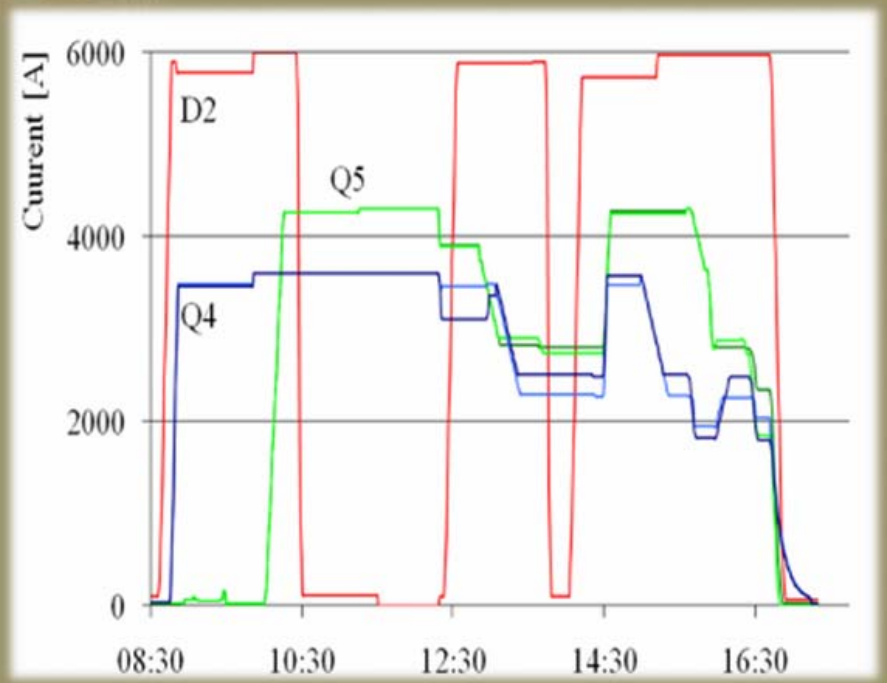
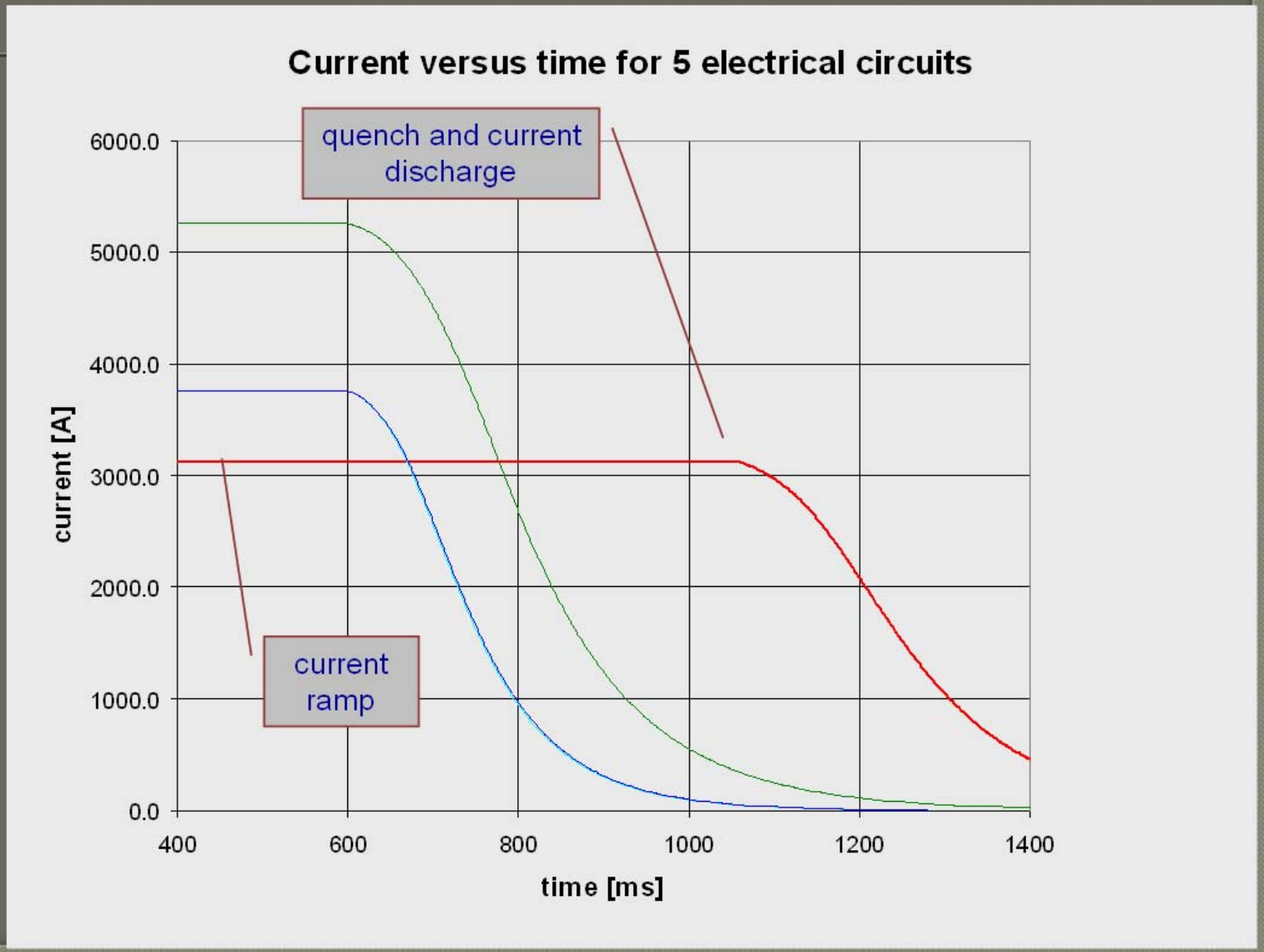
the commissioning of the superconducting circuits



A current cycle of the powering of two matching section quadrupoles Q4 and Q5 left of Point 8 and the recombination dipole D2 that is powered via the same DFB as Q4.

During first powering of this ensemble a coupling was observed: after D2 had been taken to its nominal current (6 kA), when the current in one of the two apertures of Q4 was increased, a quench in D2 was observed. The figure shows a later powering where this was not observed.

Current for two twin quadrupole magnets and one dipole magnet



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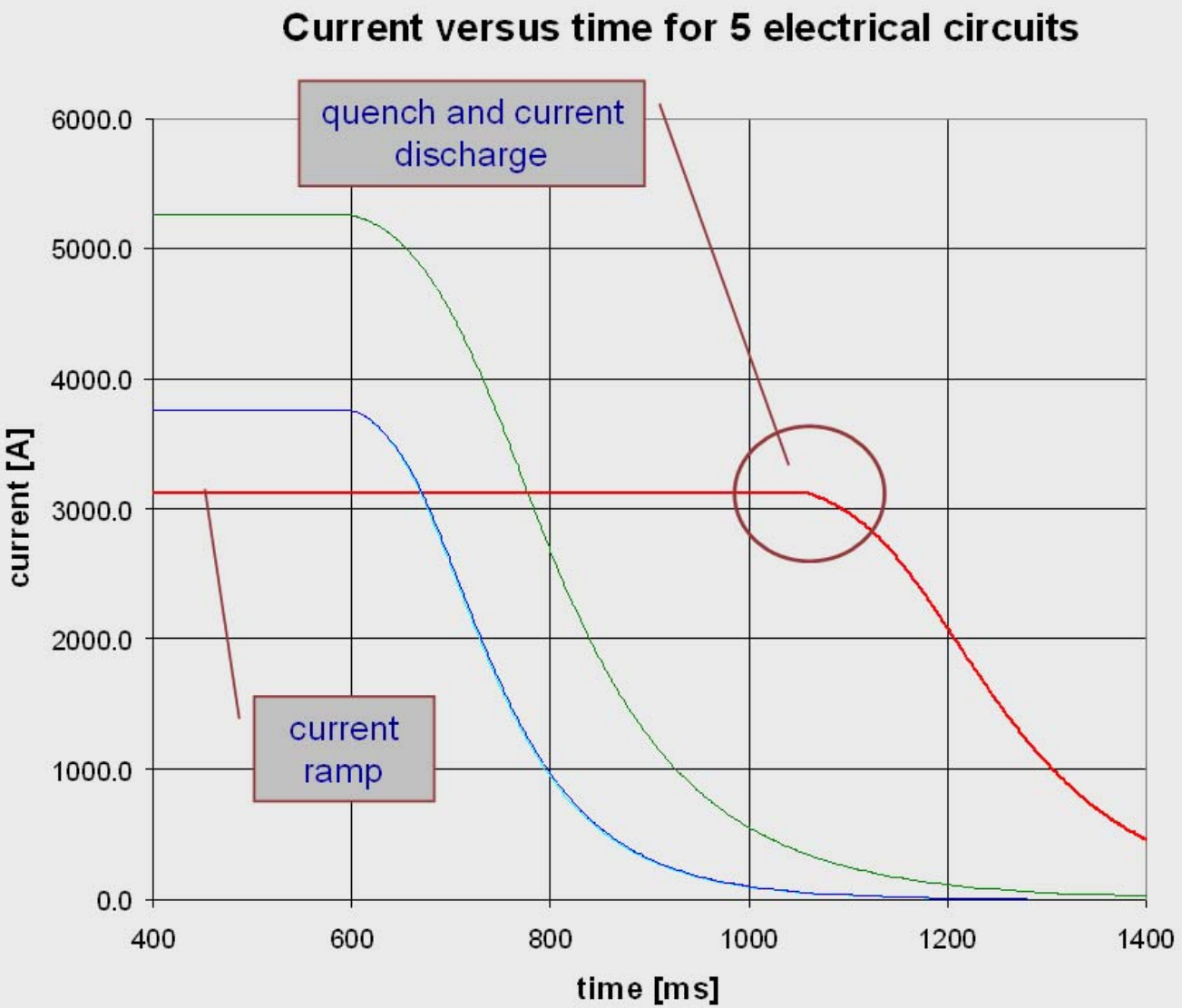
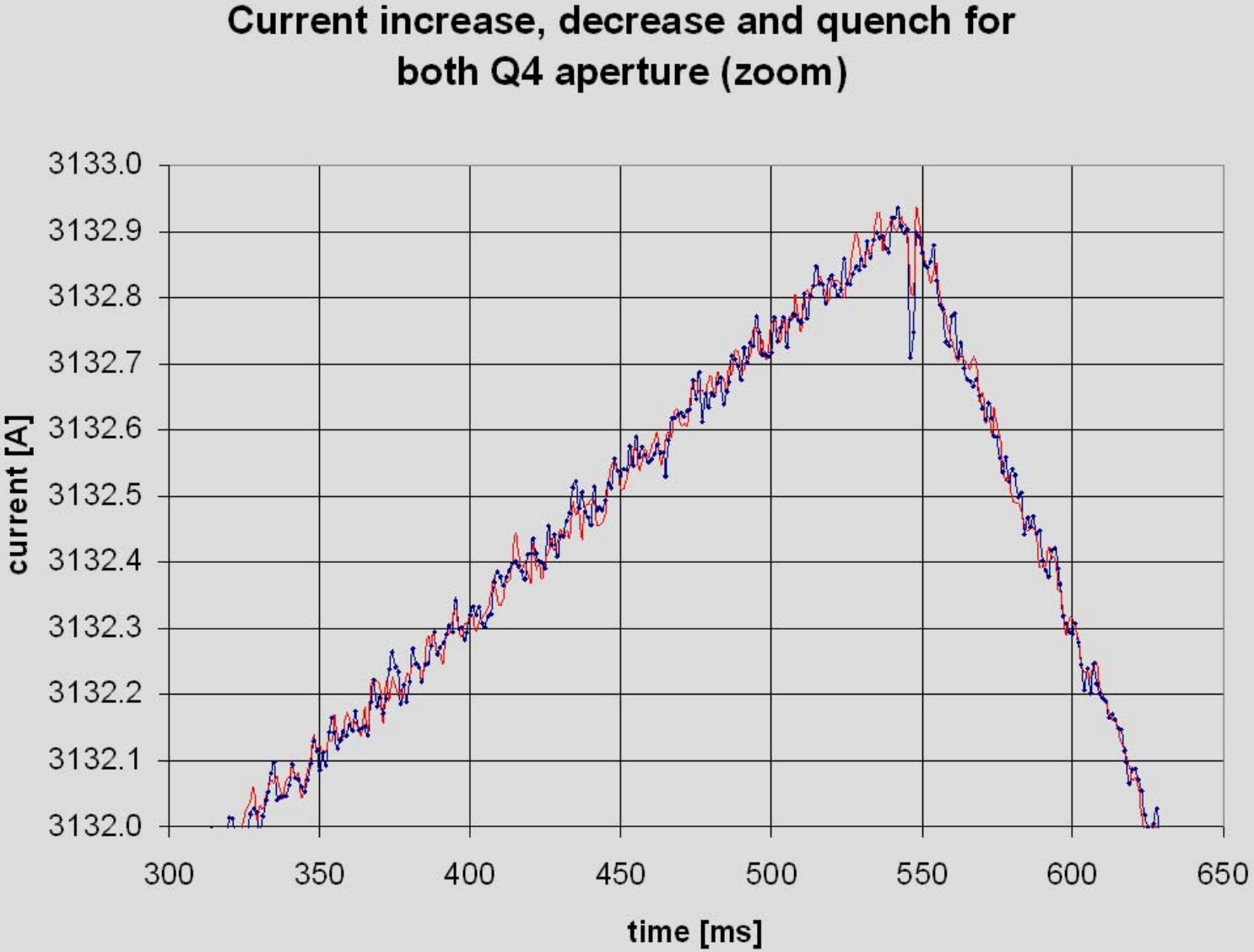
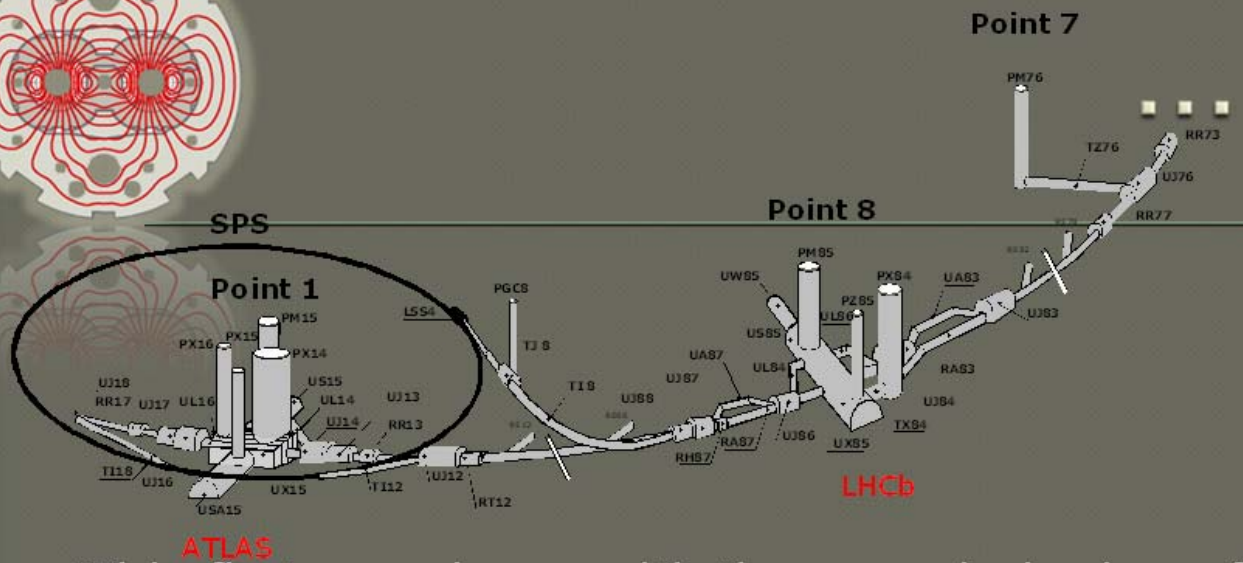


zoom – Q4 during ramp and discharge



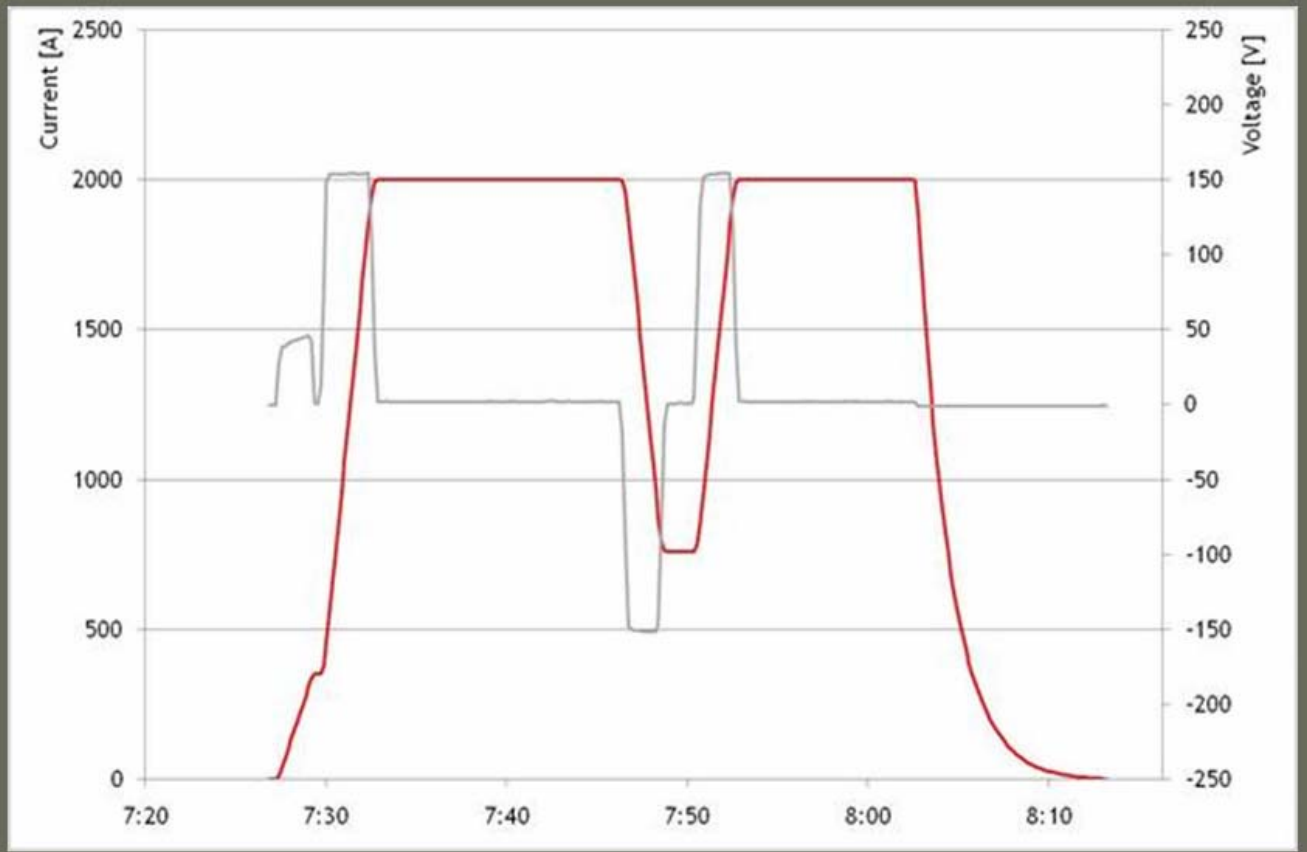
… in summary



- This first experience with the commissioning of Sector 78 has validated preparation, environment, procedures and tools which had been carefully setup during the last two years
- Although only very limited time was available, valuable experience was gained during the first powering tests of superconducting magnets. For the first time, all systems involved in the powering performed successfully together: power converters, powering interlock system, magnet protection system and associated controls
- Cryogenic quench recovery can be very fast….

……latest news 28 June

- First powering of the main dipole magnets in sector 7-8, 154 dipoles with a total inductance of 15 Henry



having been involved in the beam commissioning of several accelerators: LHC Hardware Commissioning is as exciting