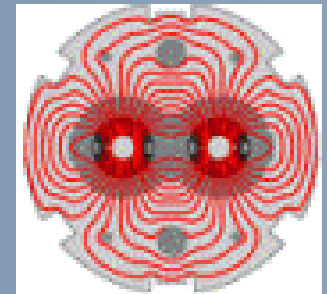


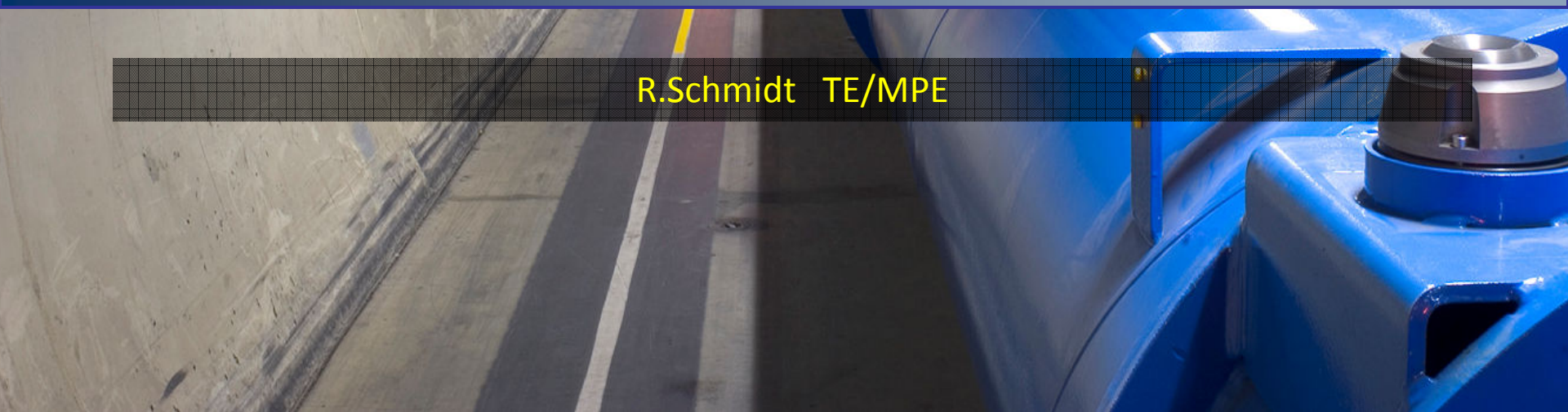


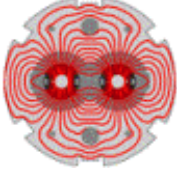
Hardware Commissioning 2010 and beyond R.Schmidt



Session 1 - 25th January 2010

R.Schmidt TE/MPE

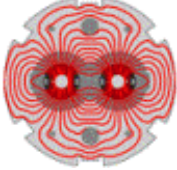




- For several years, extensive re-commissioning of the sc circuits is expected, after total or partial warm up...
 - adding relief valves, consolidation of splices, HC to 5...7 TeV (training, ...), upgrade/modifications of power converters, powering interlock system and QPS (e.g. upgrade with radiation tolerant electronics), other upgrades,....

It is worth to invest time and effort into further optimisation of hardware commissioning

- What needs to be done? (Does it really have to be done?)
- What can be improved?
- What can be automatised
- Resources – what is required?
- **Powering tests in three weeks?**

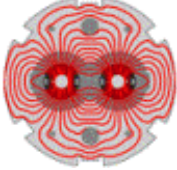


Many planned underground interventions

- Lock off power converters
- Disconnect powering cables (if not yet done)
- ELQA at warm
- Start monitoring main circuits during cool down
- Cool down and cryo tuning
- Stop monitoring main circuits during cool down
- ELQA at cold
- Connection of the power cables to current leads
- Unlock power converters

Few planned and unplanned interventions

- Preparation of QPS (charge quench heaters, close interlock loops and prepare QPS system for powering)
- Powering tests

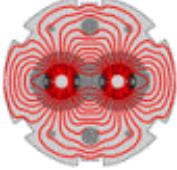


Activities that resemble **shutdown / technical stop activities**

- Planned activities
- Driven by the equipment teams
- **Coordinated by HCC**

Activities driven from CCC (mainly **powering tests**)

- Some planned and some unplanned activities underground
- Driven by operation
- **Coordinated by HCC** (that became smaller.....)

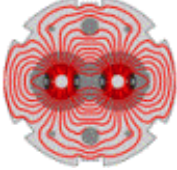


Activities that resemble **shutdown / technical stop work**

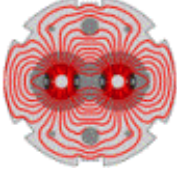
- Planned activities
- Driven by the equipment teams
- **Coordinated by EN-MEF** (shutdown coordination team)

Activities driven from CCC (mainly **powering tests**)

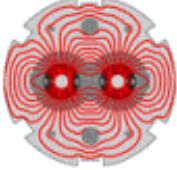
- Some planned and some unplanned activities underground
- Driven by operation
- **Coordinated by operation**
- **Four “point owners” are not too many!**
 - possibly two from EN-MEF and two from BE-OP
- **Major contributions** from several groups in **TE, EN** and **BE**



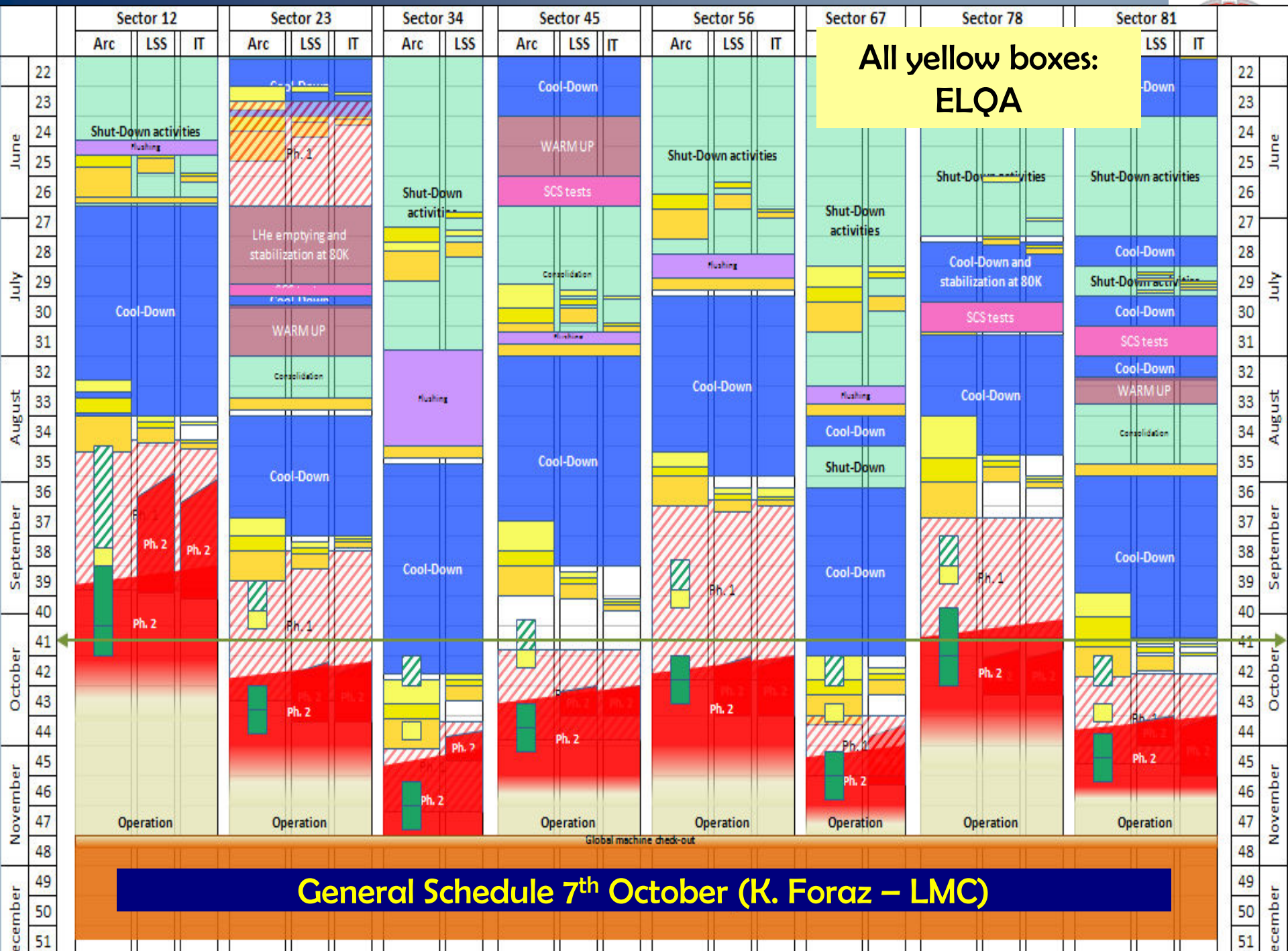
- Procedures ready in time
- Powering phase I and II – complex, but worked out ok
- Shifts 7 days / 3 shifts essential (do not start too early)
- Access Tuesday (and possibly Wednesday) during the morning
 - Help for giving access important
- MP3 support and QPS support essential
 - requires lot of experts in CCC – three – can this be reduced?
- Powering test page essential for following up progress
- Superlocking of circuits with an issue, and simple locking of circuits – works well (some ideas for improvements)
- Software tools in general very good
- Automatic analysis for PIC tests – good experience, can be extended to more tests and other systems (less need for experts)



- DFB – **too many interfaces**, reorganisation will lead to simplification
 - team for performing ELQA
 - team for connection / disconnection of cables
 - will become more complex with additional system (such as interlock on current lead temperature)
 - team for cryogenic interventions (valves, ...)
 - team for locking / unlocking power converters
 - (sometimes) team for water cooled cables
- Proposal: only **one team for electrical intervention** on DFBs
 - being tried out during this technical stop
 - organisation and resources need to be addressed
- Helpful to **open doors in the centre of a sector** when lot of work in the tunnel (see presentation of Julie Coupard)



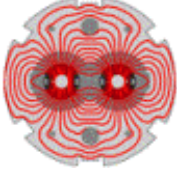
- Powering phase I and II: **RB can be powered at 110 A in phase I**, for starting the circuit and for checking interlocks
 - successful test last December
- **Software tools** to be improved (consolidation)
- **Automatic analysis** to be extended
- Safety: introduce a **hardware link between the access system and the powering system** (powering interlock)? to be studied
- **Giving access during powering** – can be simplified, avoid to switch off and lock via the PIC all circuits
 - ramp down to injection for all circuits (stand by current for RB of 110 A)
 - prevent increase of current at level of FGC during access
 - access
 - proposal being discussed with Ghislain Roy et al.
- **Access matrix** to be reviewed in light of operational experience



All yellow boxes:
ELQA

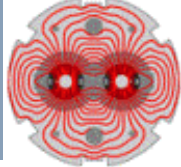
General Schedule 7th October (K. Foraz – LMC)

Global machine check-out

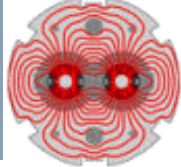


Already **well optimised**, can it be further optimised?

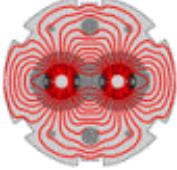
- avoid warming up to above 80K
- doing less? re-iterate what needs to be redone....
- doing it differently?
 - more automatic?
 - more test systems (never to be limited by the number of test systems)
- using more resources?
 - prepare test systems such that little training is required to perform tasks
 - help from outside collaborators
 - more help from inside CERN – why not?with qualified personal
- non conformities...take a long time to fix....
 - **Invest time before into quality**, to avoid non conformities
 - involve ELQA team from the start when equipment is designed that needs to withstand high voltage



- Responsible for **writing the procedures** together with the hardware commissioning coordination team
- Ideas for **future recommissioning – what needs to be redone?**
 - Review what test to be done as a function of the circuit history (warm up to room temperature to 80K,
- The **procedures need to be cleaned up and made coherent** starting SOON, and not some weeks before the next campaign – clear responsibilities to be defined – who should drive this effort?
- Simplifying **retesting groups of circuits** (test of main interlock functionalities) – similar to Powering Group Circuits for some of the interlock tests
 - some tests are being done in this technical stop



- **Further consolidation** of the QPS system will lead to less steps that fail ...non conformities take a long time to fix...
- The **nQPS commissioning procedure** needs to be integrated into the general RB and RQF/D commissioning procedure
- **Monitoring during cool down** to detect problems: can it be extended using the QPS system?
- **nQPS to individual powered magnets** to be installed (new steps in commissioning will be required)
- **Number of experts** for QPS: knowledge to be spread to more colleagues
- **Merge MP3 and QPS operation support** teams – long term commitment to keep competence

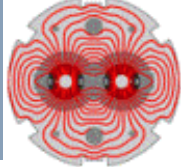


Powering interlock system

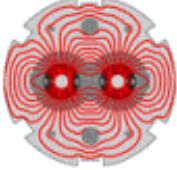
- Resources for PIC related tests required for tests did substantially decrease from 2008 to 2009, due to the automation of the analysis
- This can be extended, further reducing the resources required during commissioning

Power converters

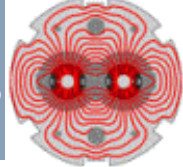
- Some **further automation of the analysis** is possible
- Cutting the water of the RB and RQF/D circuits locally for the interlock tests is time consuming and interrupts the tests
 - **remote operation of the valves** for these circuits is recommended



- **Remarkable improvement** of the stability of the cryogenic system between 2008 and 2009
 - Very little downtime due to cryogenic system in 2009
- Frequent replacement of the **valves for 600A** circuit were an issue, and took quite some time and effort from several teams
 - requires locking off entire DFB, could we find a procedure that does not require this?
- **Cryo tuning** is one of the limiting factors before starting powering (such as boil-off, etc.).
 - does it have to be repeated? Can it become more automatic / faster?
- Coupling between forcing a temperature of a valve and the power permit of a circuits should be considered (**link CRYO_Supervision and PIC_Supervision**, allows cryo expert to superlock circuit - not relying on email exchange)



- **Several tools** are being used today...one tool per team
- **One entry for tracking all aspects** during the life of a circuit
 - power converter locked off
 - circuit ready for ELQA (cryo start and cryo maintain)
 - cable connected / disconnected
 - ELQA at warm and at cold
 - connection and disconnection of monitoring systems before start of cool down (for main circuits)
 - QPS individual system tests finished (heaters charged, other conditions,...)
 - powering test steps (powering tests pages)
- More safe commissioning (less error prone)
- Improved tracking of progress (faster)
- Simpler communication between teams (less errors, faster)



Long term objective: Powering tests in three weeks

- Organisation: **Hardware Commissioning Coordination by TE-MEF** before powering, and **BE-OP when powering starts**
- DFBs: **define responsibilities**, reduce interfaces
- Tools: **prepare ONE entry** (one tool?) for tracking circuits
- **Retain (four) “Point Owners”**
- In order to be more efficient, the **preparations for the future campaigns must start soon. A team should prepare future hardware commissioning** with a mandate such as:
 - propose improvements of tools, follow development
 - follow up updating of the commissioning procedures
 - get new people involved into this activity
 - workshop and written report later this year to present the progress
- Members from OP, MEF, MPE/MP3, EPC, Controls, Cryo, MSC