Monitoring splice resistances

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Introduction

- The QPS system, apart from protecting magnets from quenches, can also measure and monitor splice resistances.
- The so-called ‘snapshot’ method of the QPS system was used during October-December 2008 for finding out abnormal splice resistances.
- Two splices with abnormal resistance were found (one at about 100nOhm and the other at about 50nOhm) during that campaign.

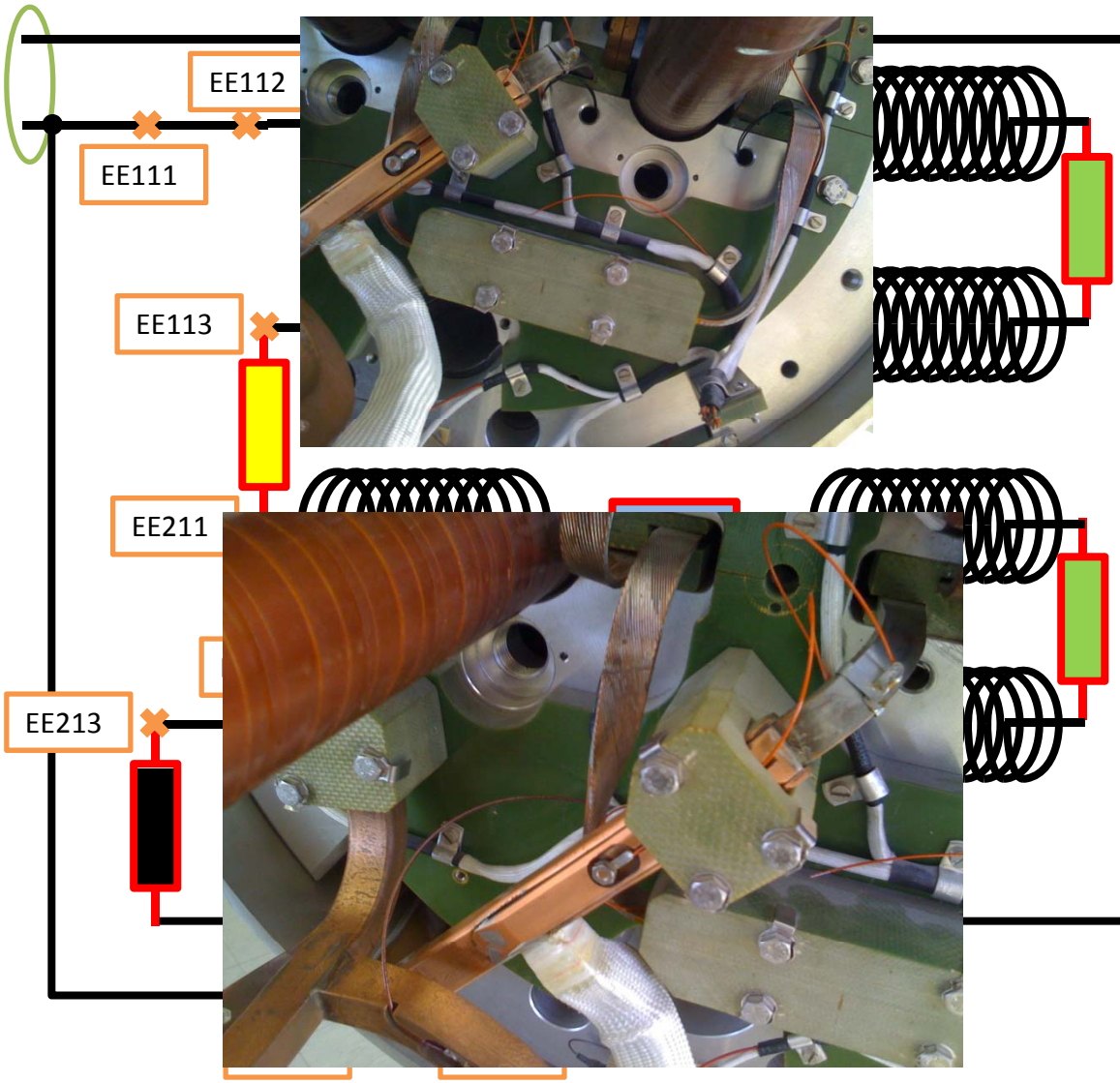
Inventory of splices in the main circuits

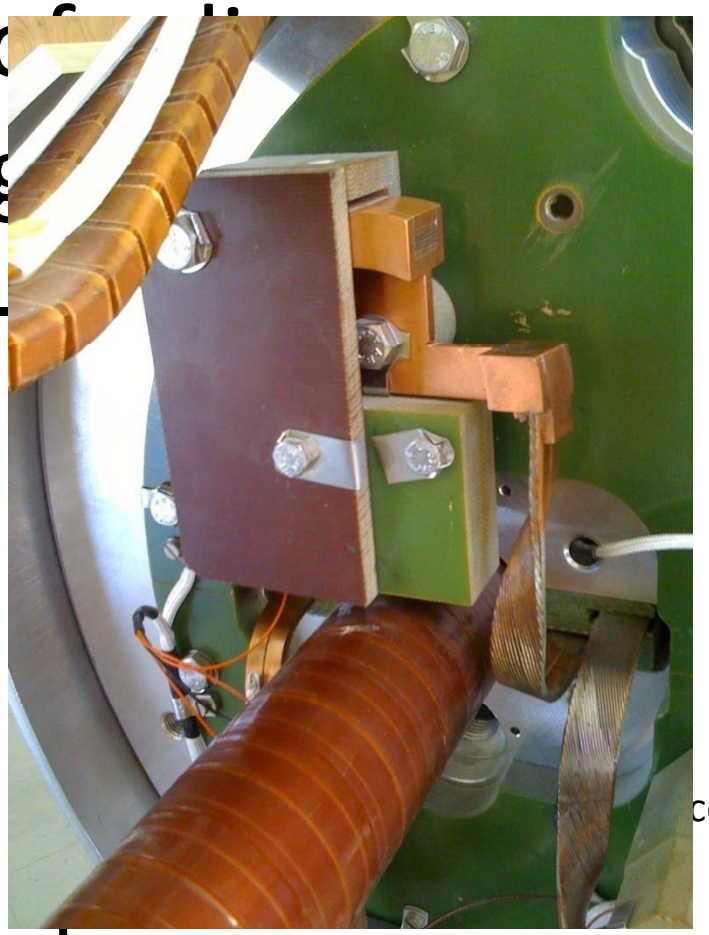
- The main LHC circuits (where the largest proportion of the energy is stored) – the MB circuit and the MQ circuit, include a certain number of splices.
- We have splices inside the cold mass (magnet splices) and splices between magnets (inter-magnet splices)
- The number of splices per magnet can be seen in the following slides:

RB bus

- Magnet splices:
  - 4 inter-layer splices per magnet
  - 2 inter-pole splices per magnet
  - 1 inter-aperture splice per magnet
  - 1 internal bus splice per magnet
- Inter-magnet splices
  - Two inter-magnet splices per interconnect

Simplified diagram o
inductances and voltag





ce

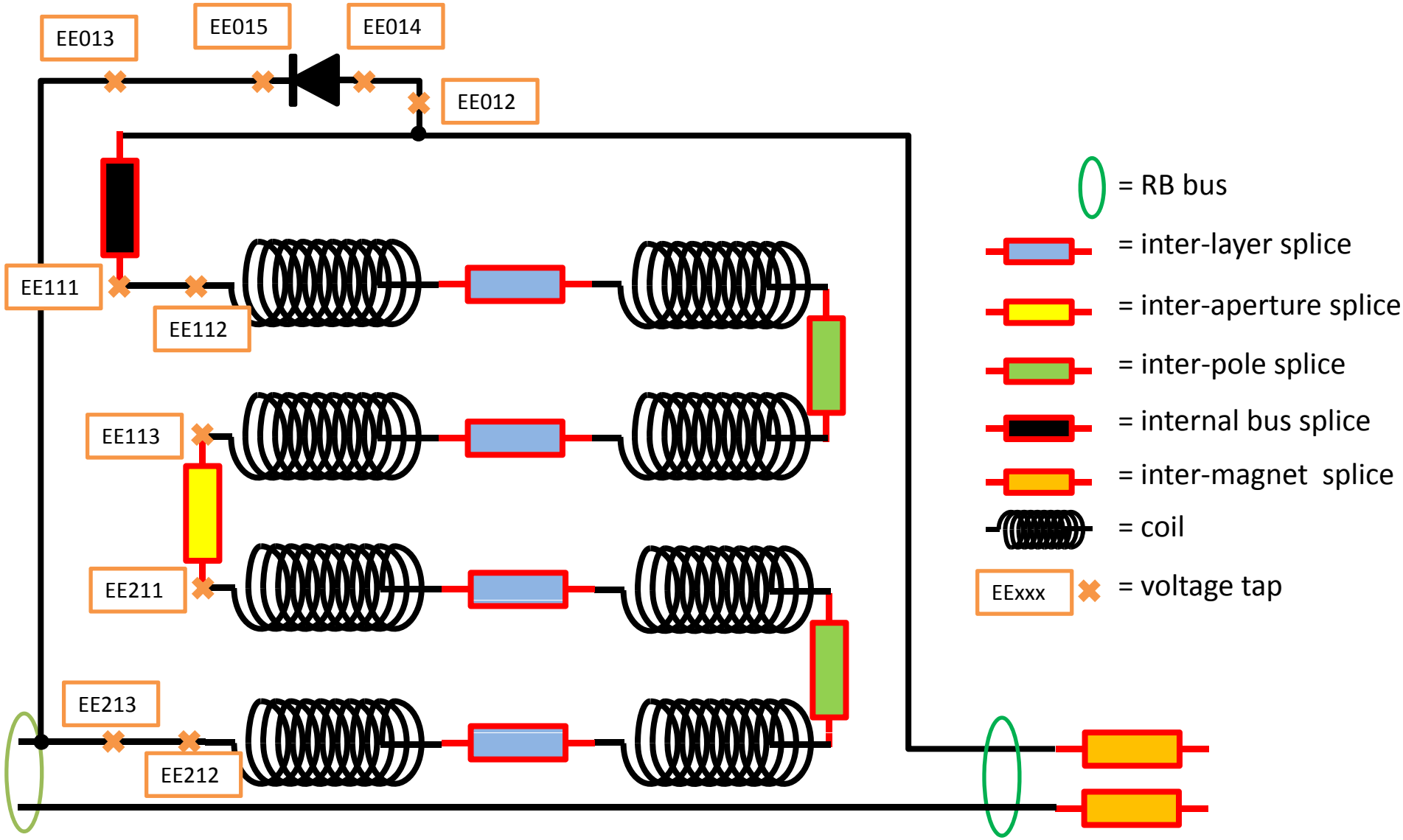
= bus splice

= inter-magnet splice

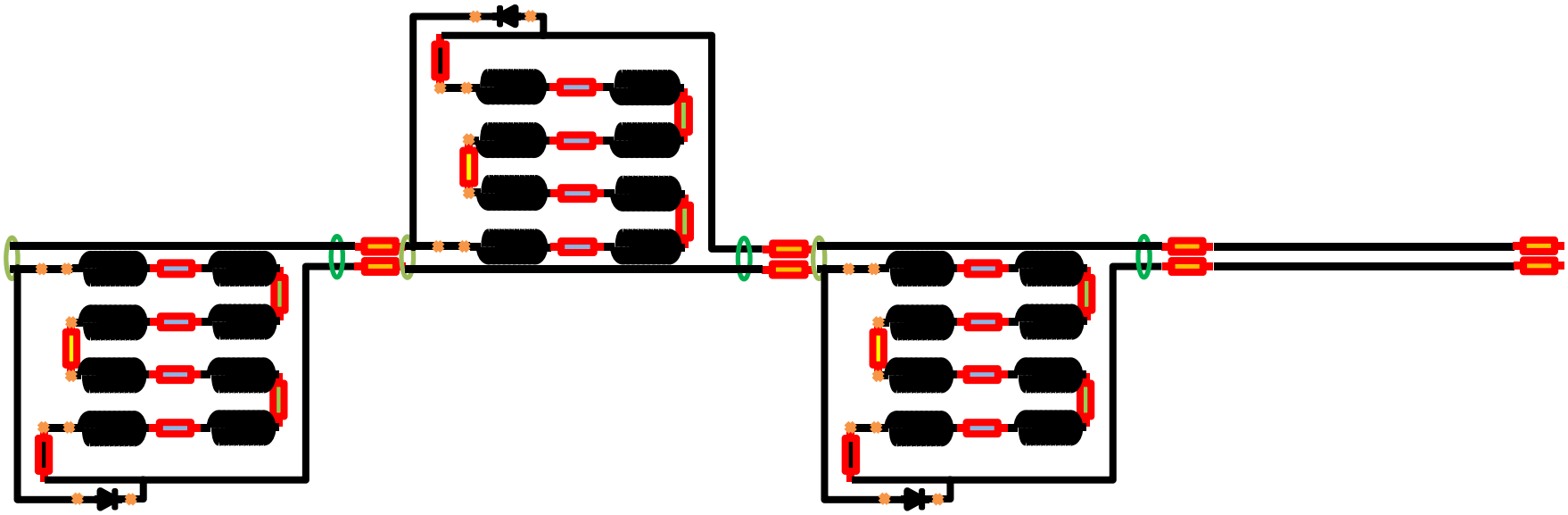
= coil

EExxx = voltage tap

Simplified diagram of splices, inductances and voltage taps, RBB

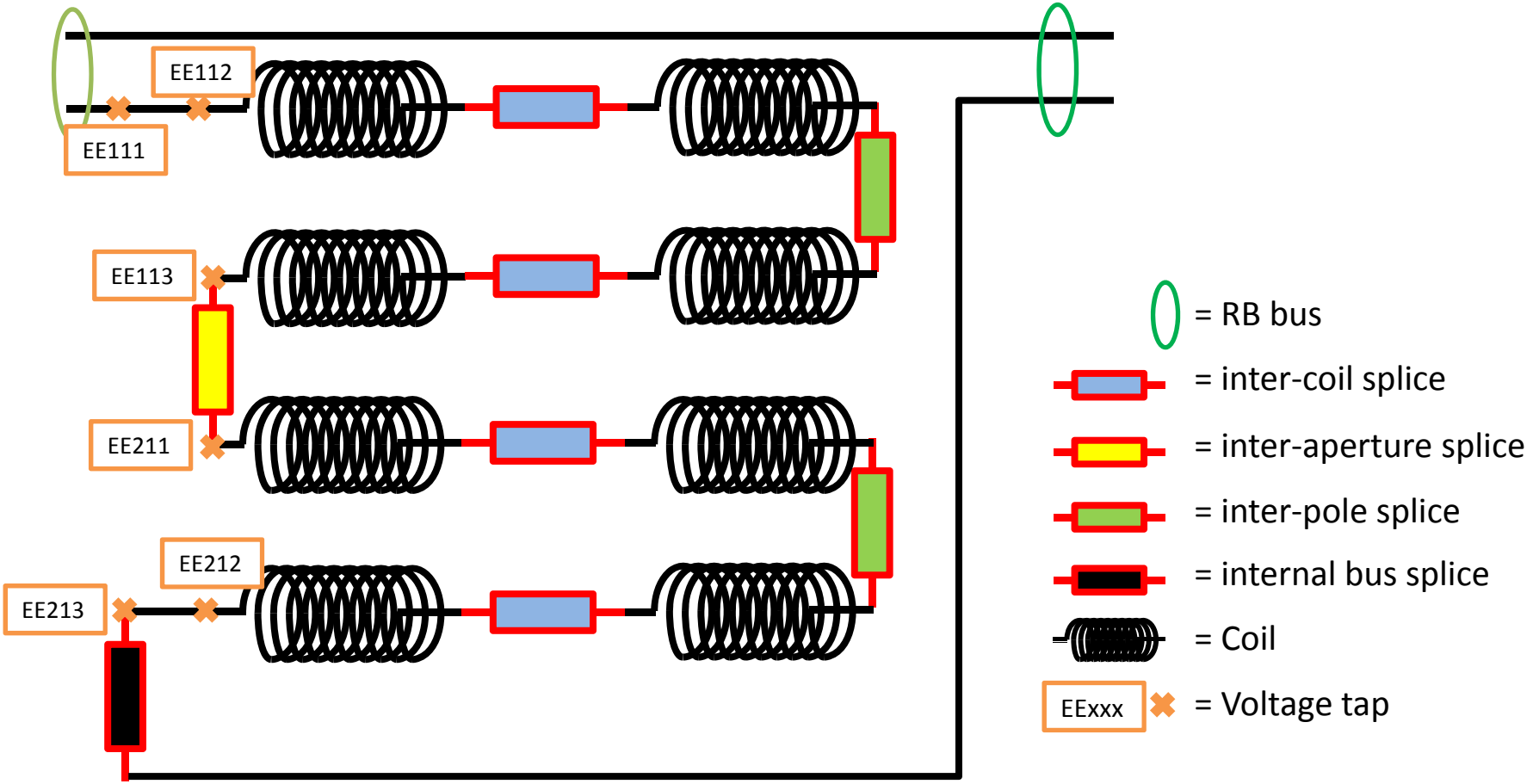


The RB bus



A B C Q

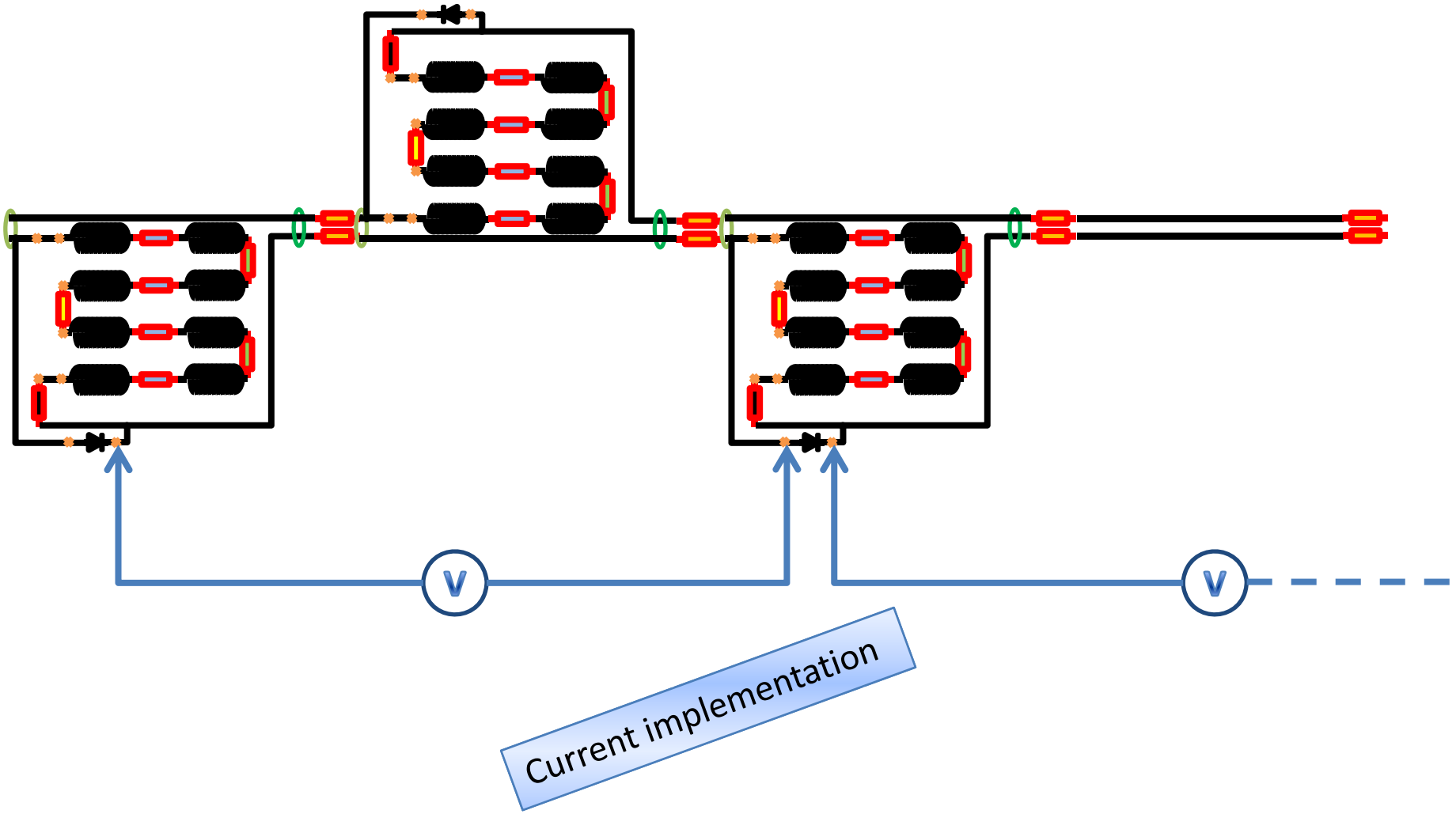
Current QPS measures four voltages:



Bridge A = [V(EE112) – V(EE211)] –[V(EE211) – V(EE213)]

Bridge B = [V(EE111) – V(EE113)] –[V(EE113) – V(EE212)]

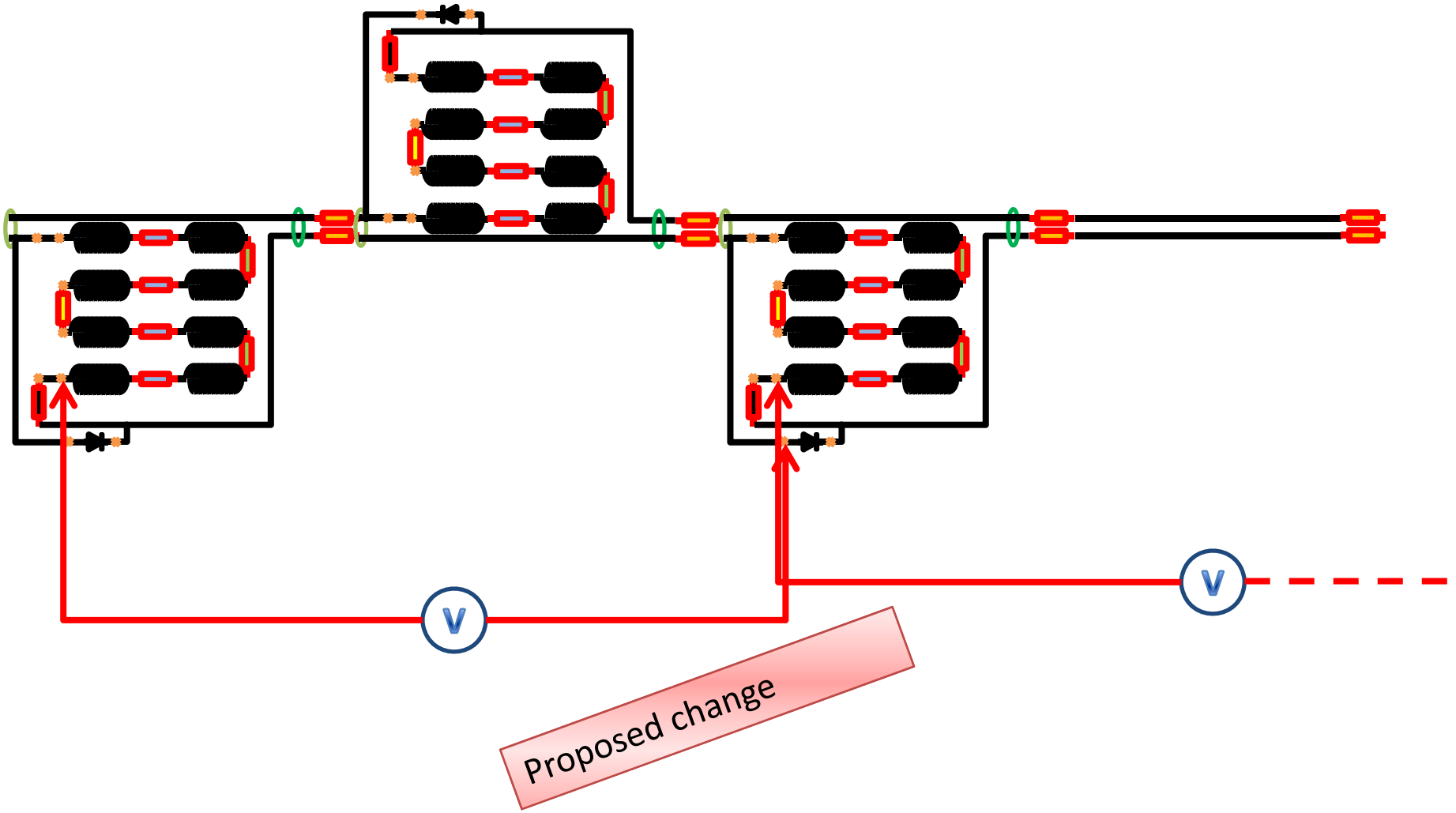
nQPS – MB bus (MQ similar) – this will monitor inter-magnet splices



Remarks on RB splices

- Current QPS system is sensitive to all magnet splices but one
- A modification to cover all splices is being considered – the technical constraints and implications are being evaluated

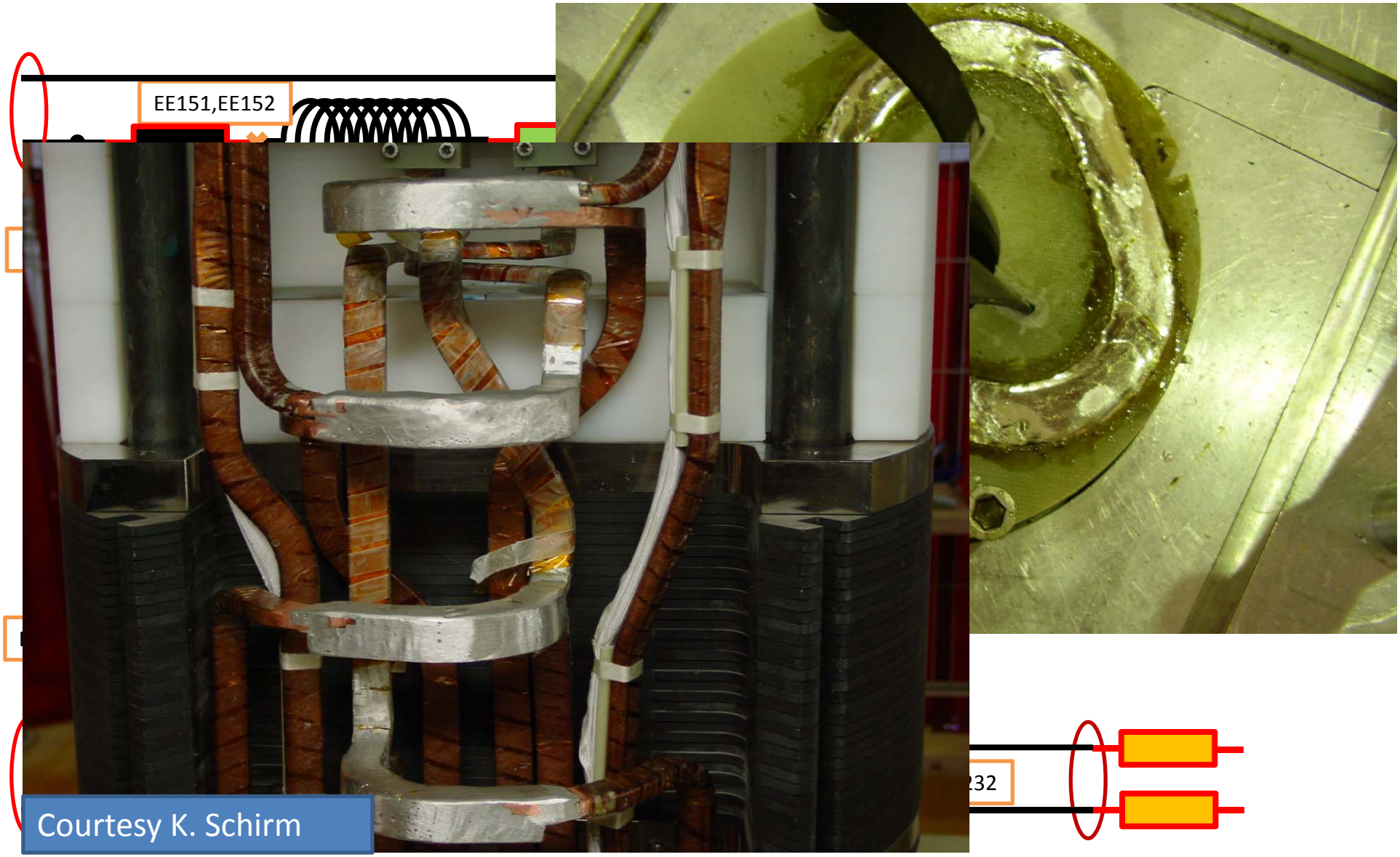
nQPS – MB bus (MQ similar) – a possible implementation



RQ bus

- Here the two apertures are powered independently by the MQF/MQD circuits
- Magnet splices:
  - zero inter-layer splices per magnet
  - 3X2 inter-pole splices per magnet
  - zero inter-aperture splice per magnet
  - 4 internal bus splices per magnet
- Inter-magnet splices
  - 4 inter-magnet splices per interconnect

MQ



Remarks on RQ splices

- As per dipole circuit, the four internal bus splices are not monitored by the QPS system.
- A similar modification to the system (as in the RB case) will allow the monitoring of those splices as well

Conclusions

- It is desirable to monitor as many splices as possible in the LHC electrical circuits.
- A (minor) modification will allow the new QPS system to monitor all splices of the main circuits of the LHC, both inside a magnet and inter-magnet.
- Technical implications are being considered, but we believe that if technically possible, we should implement it.