MAGNET (RE)TRAINING

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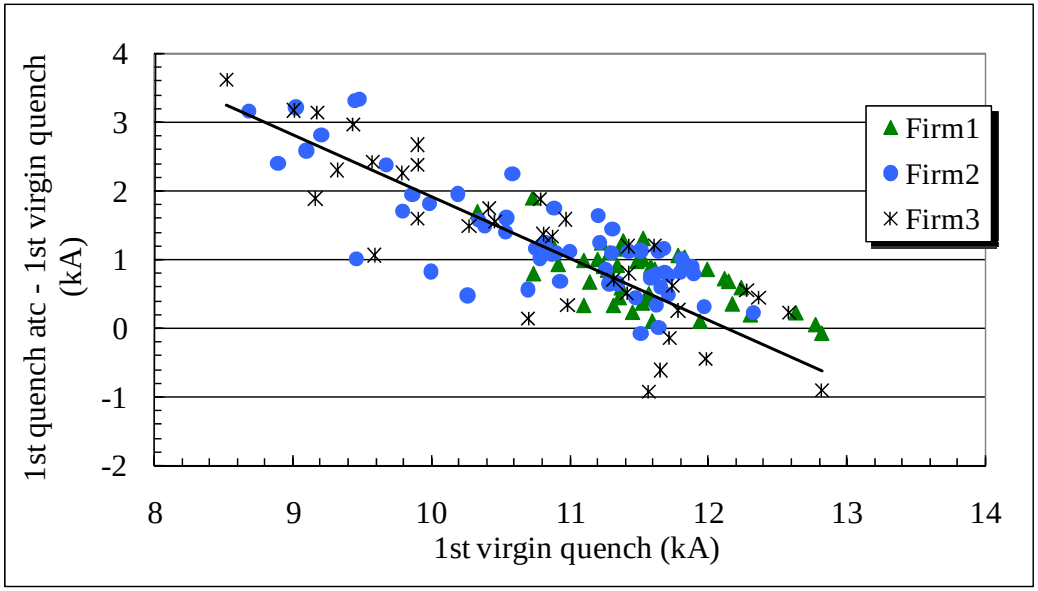
RETRAINING: DIPOLES AT 6.5 TEV

- Main dipoles and quads were not trained to 7 TeV
- All sectors reached 5 TeV without quench
- One sector (5-6) trained up to 6.6 TeV – based on this experience
  - To go to 6.5 TeV:
    - About 10 quenches per sector, for a total of 80 quenches
    - No quenches from Firm1
    - A few quenches (10%) from Firm2
    - All the rest (90%) from Firm3 – all in different magnets
  - This behaviour, observed in 5-6 during hardware commissioning, can be obtained by a model based on test data
  - Do we need training after each warm-up ? We do not know

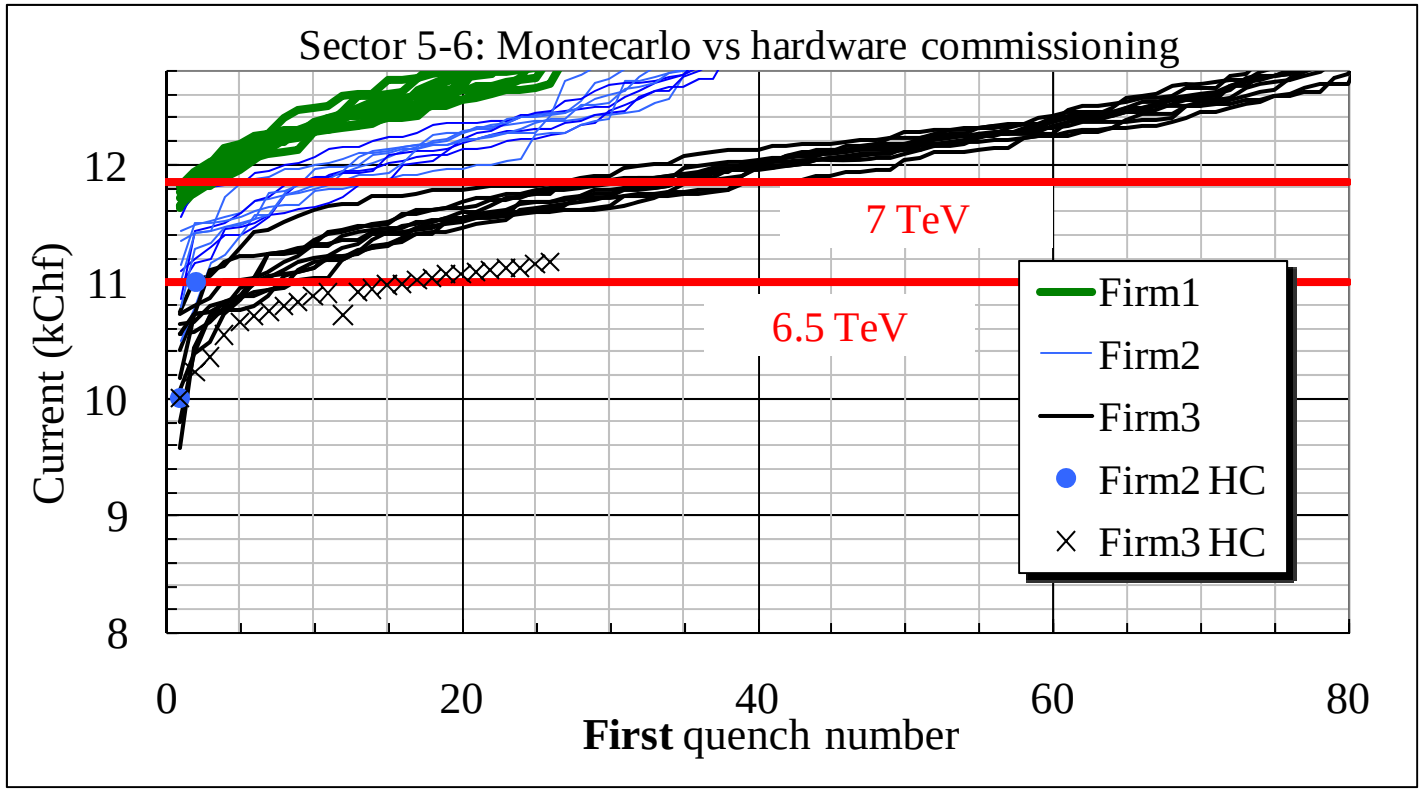
RETRAINING: A MODEL FOR DIPOLES

- Method: evaluate correlations between 1st virgin quench and 1st quench after thermal cycle
  - About 110 magnets available – random part modeled as Gaussian
  - Each firm treated separately
- Use these correlations to extrapolate the values of the virgin quench, measured in all magnets, to the condition after thermal cycle



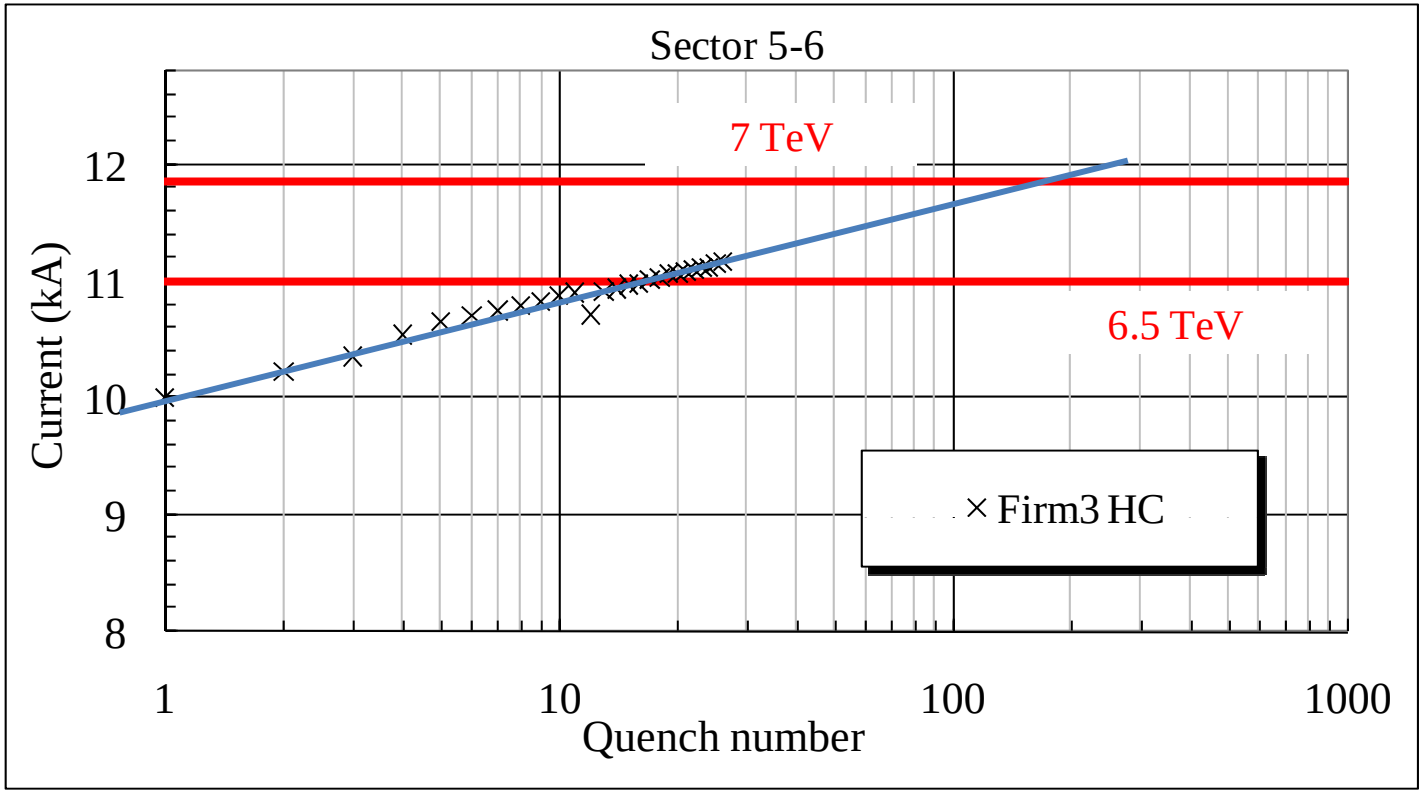
RETRAINING: DIPOLES TO 7 TEV

- From the model: in each sector in average 5 quenches from Firm1, 13 from Firm2, 20 from Firm3 – total of about 40 quenches per sector
  - This gives only the first quench in each magnet
  - The model is clearly too optimist after 6.5 TeV – we do not know why



RETRAINING: DIPOLES TO 7 TEV

- Estimate based on empirical exponential fit of HC data : about 110±30 quenches per sector (A. Verweij, Chamonix)
  - This fit implies that Firm3 magnets will get much worse than in their virgin condition (2 quenches per magnet to go to nominal instead of 1)



RETRAINING: MAIN QUADRUPOLES

- All MQ circuits reached 9.31 kA (5.5 TeV) without quench

- Two sectors have been trained more:
  - Sector 4-5 reached 6.6 TeV with one quench
  - Sector 5-6 reached 6.9 TeV with one quench
  - If the training of these two sectors is significant, we should expect reaching 7 TeV in the whole machine with a few quenches per sector

RETRAINING: OTHER MAGNETS

- Going to 7 TeV, based on hardware commissioning 2008 experience, for the other magnets (mostly individually powered)
  - ~0 quenches in the MQX
  - ~15 quenches in the separation dipoles
  - ~12 quenches in the MQY,
  - ~35 quenches in the MQM,
  - Contrary to the dipole case, we have some magnets quenching more than one time (up to ~5 quenches)

CONCLUSIONS

- Main dipoles: total of 80 quenches to 6.5 TeV
  - 7 TeV not reached, estimates based on empirical fit gives 900±300 quenches (upper bound ?)
  - Estimates for first quench based on a model give 320 that is clearly a lower bound
  - Up to 6.6 TeV quenches mostly from Firm3 magnets, and all in different magnets
  - According to the model, up to 7 TeV most quenches should still be in Firm3
- Main quads: should go to 7 TeV with 10-20 quenches
- Other magnets
  - ~15 quenches in the separation dipoles, ~12 quenches in the MQY, ~35 quenches in the MQM,
  - Some magnets quench more than one time (up to ~5 quenches)