



MQXFS8a test results discussion

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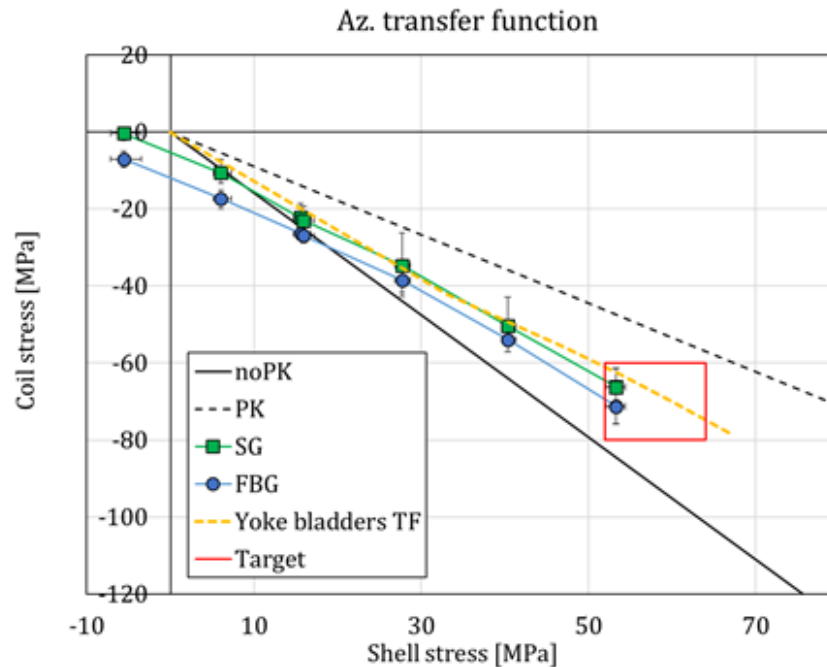
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<https://edms.cern.ch/document/2856459>



What is MQXFS8a?

- Two virgin RRP 108/127 coils (coils 115 and 116), with “mini-swap” QH
- Two PIT 192 with bundle barrier coils previously used in MQXFS6a-b-c-d (coils 210 and 212)
- New loading procedure (as MQXFB02)

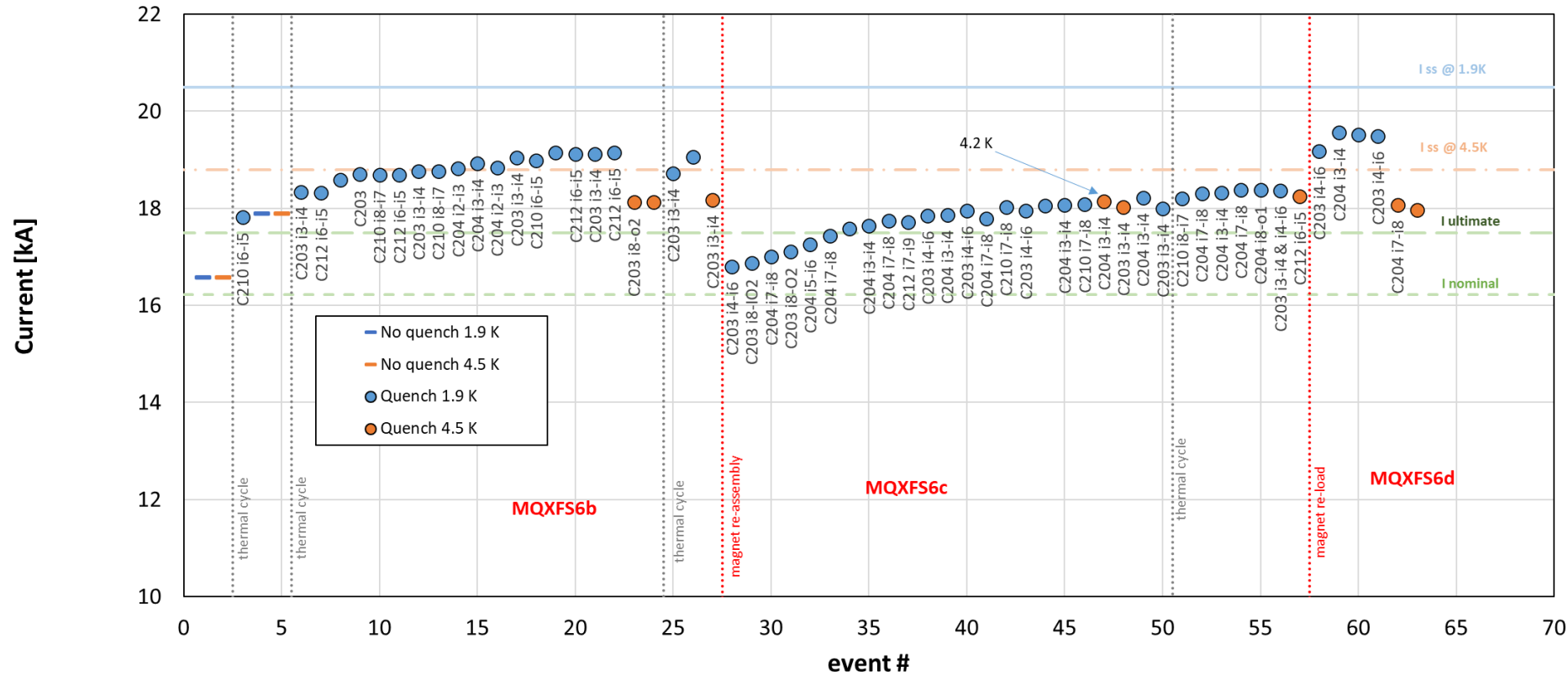


MQXFS8a test overview

- 1st CD: feb 2023 – 2 weeks
 - Training to ultimate current
 - Some protection studies
- 2nd CD: nov 2023 – 1 week
 - Training beyond ultimate
 - More protection studies
- 3rd CD: feb 2024 – 2 ½ weeks
 - Training beyond ultimate
 - Magnetic measurements
 - Even more protection studies
 - “CLIQ training”

Recall MQXFS6b-c-d

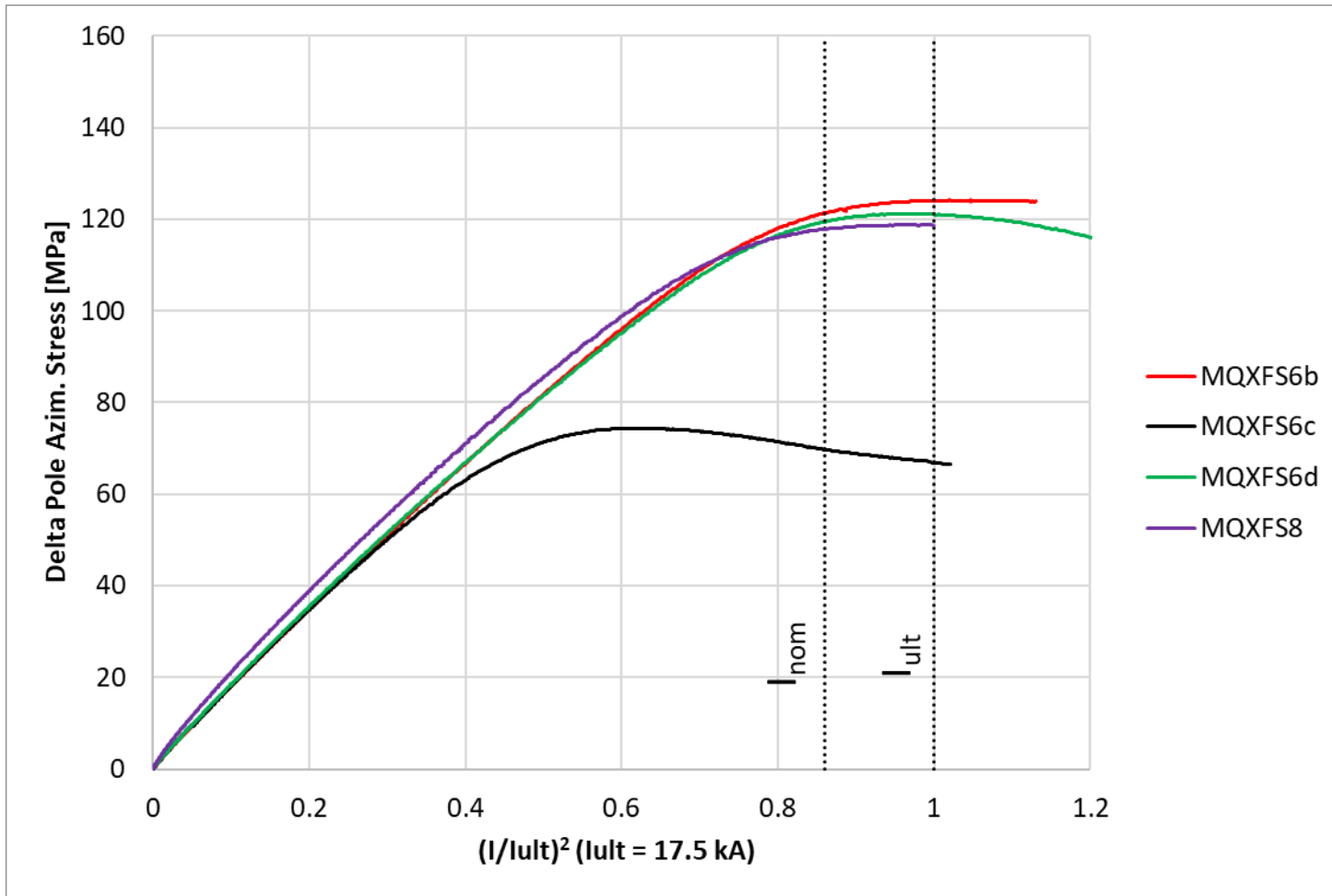
MQXFS6b & c & d powering at 20 A/s



Regarding coils 210 and 212:

- They were first trained in MQXFS6b, up to 19.15 kA
- In MQXFS6c (lower pre-load), these coils start training at 17.7 kA
- In MQXFS6d they don't quench up to 19.57 kA
- In MQXFS8a they start training at 18 kA

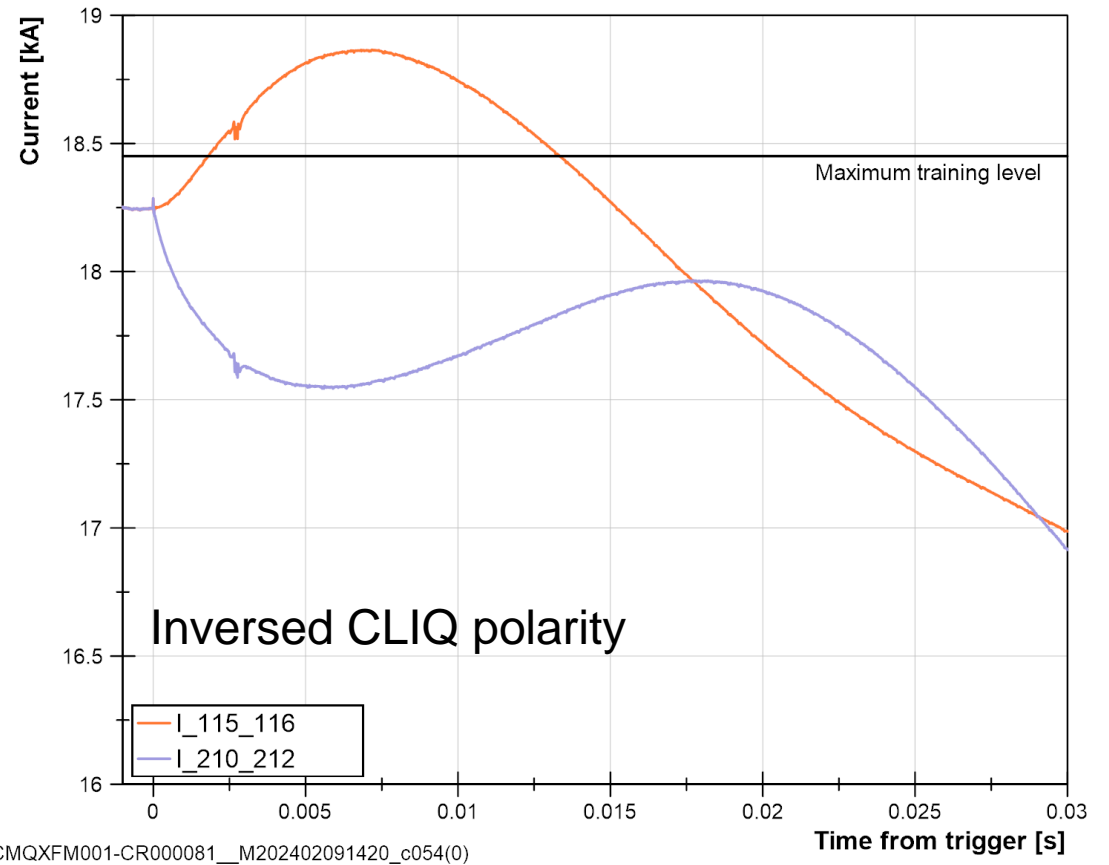
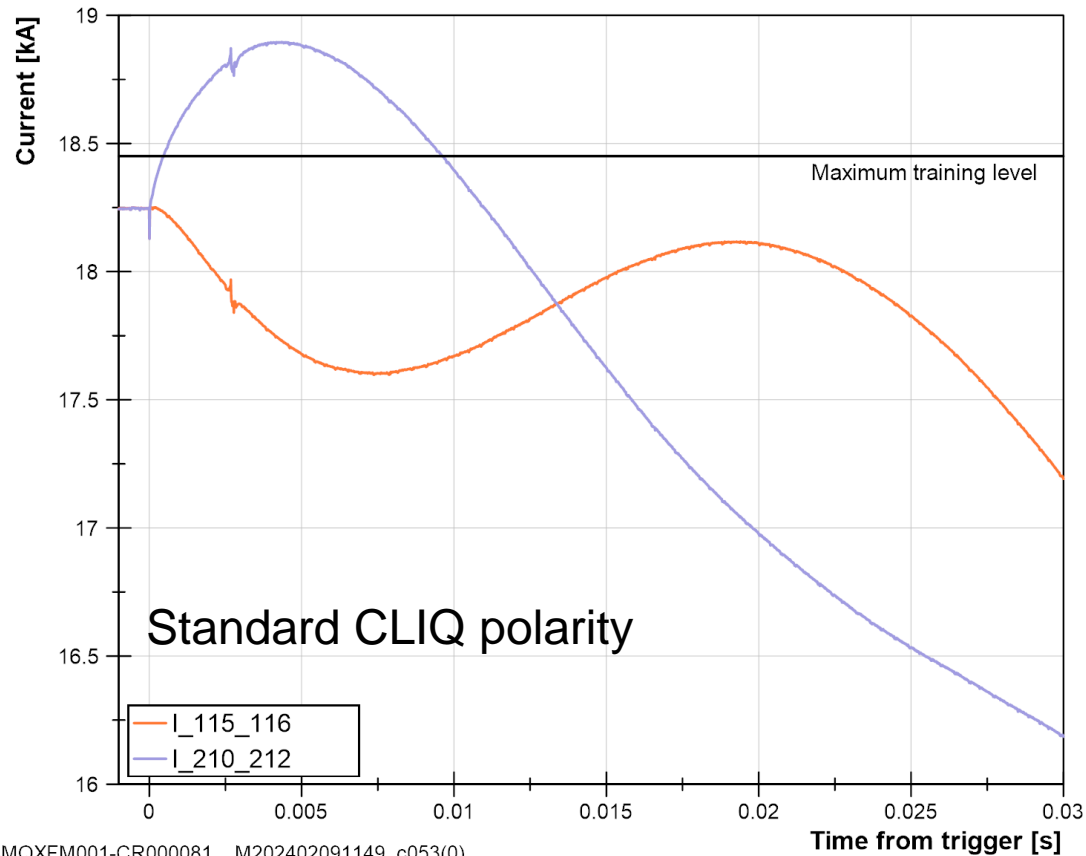
MQXFS6b-c-d and S8a preload



Preload in MQXFS6b, S6d and S8a very similar, while for MQXFS6c quite different

Training of coils 210 and 212 in MQXFS8a probably due to magnet reassembly

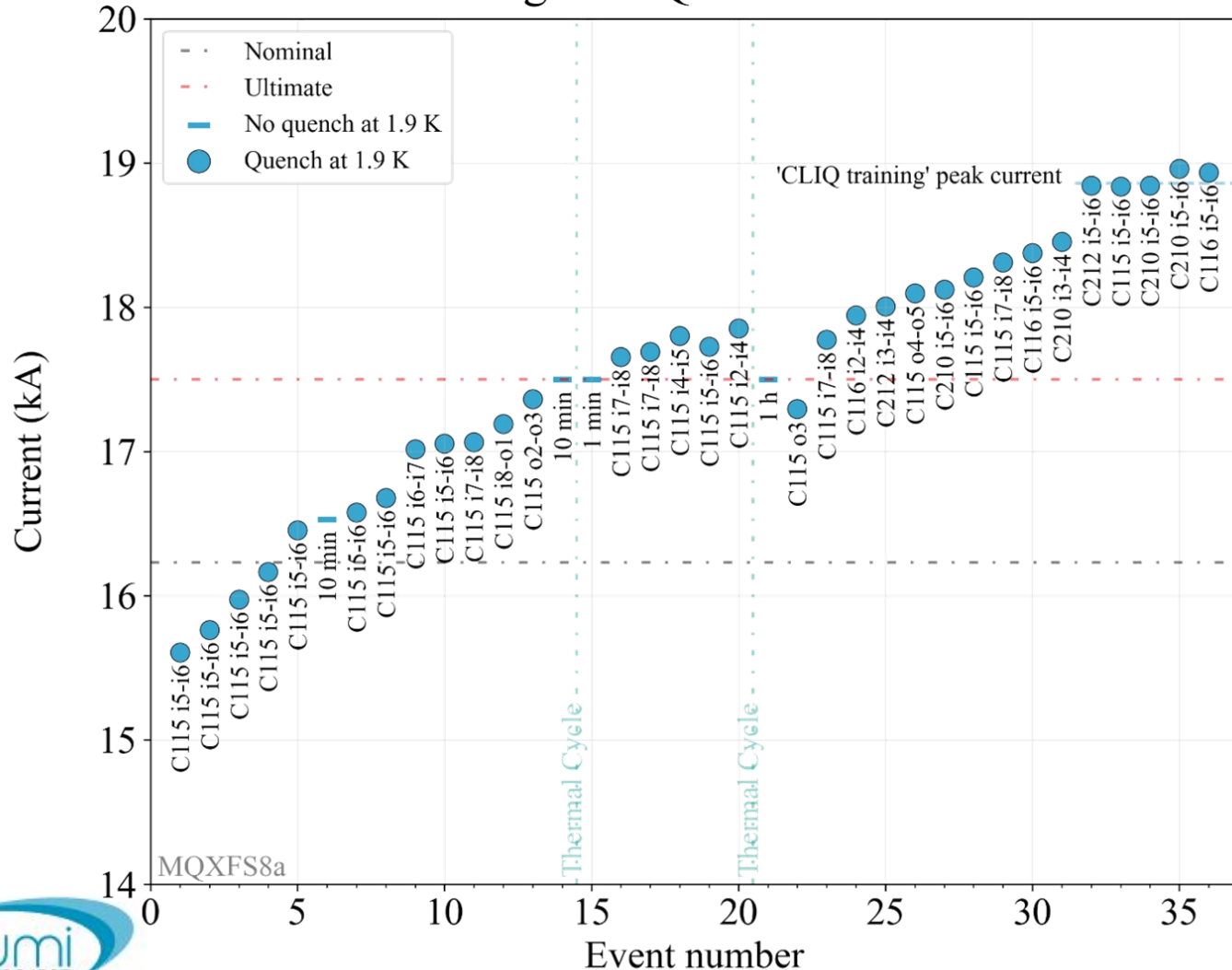
“CLIQ training”



Nominal protection (CLIQ + QH) triggered at 18.25 kA, which is 200 A below the maximum training level. Repeated this with inversed CLIQ polarity. All coils saw a peak current of ~18.85 kA.

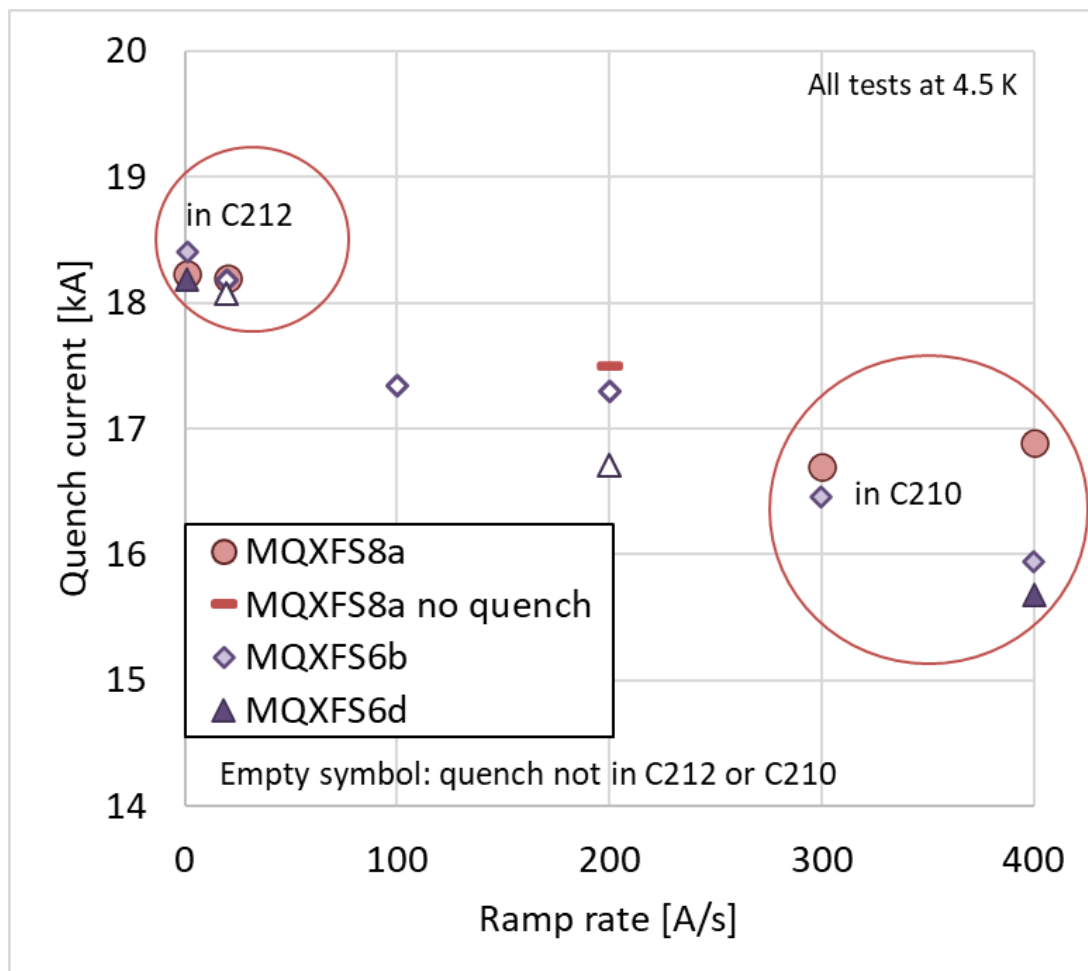
Effects of CLIQ training

Training of MQXFS8 at 1.9 K



- Before “CLIQ training”, training rate was at ~65 A per quench
- After the “CLIQ treatment”, the next three quenches are at the level of the peak current during the “treatment”, and the following two are just 100 A above.
- Note that after the “treatment” all coils quench at least once, in segment i5-i6 (inner layer poler turn straight segment, opposite to layer jump)

Ramp rate studies



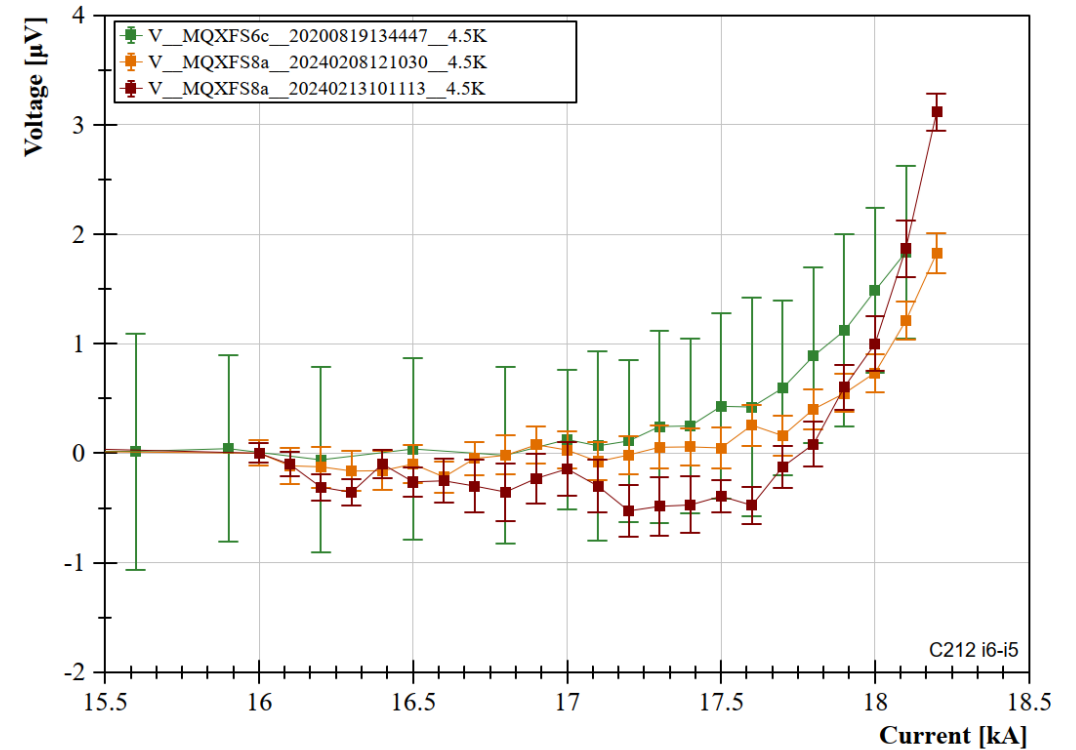
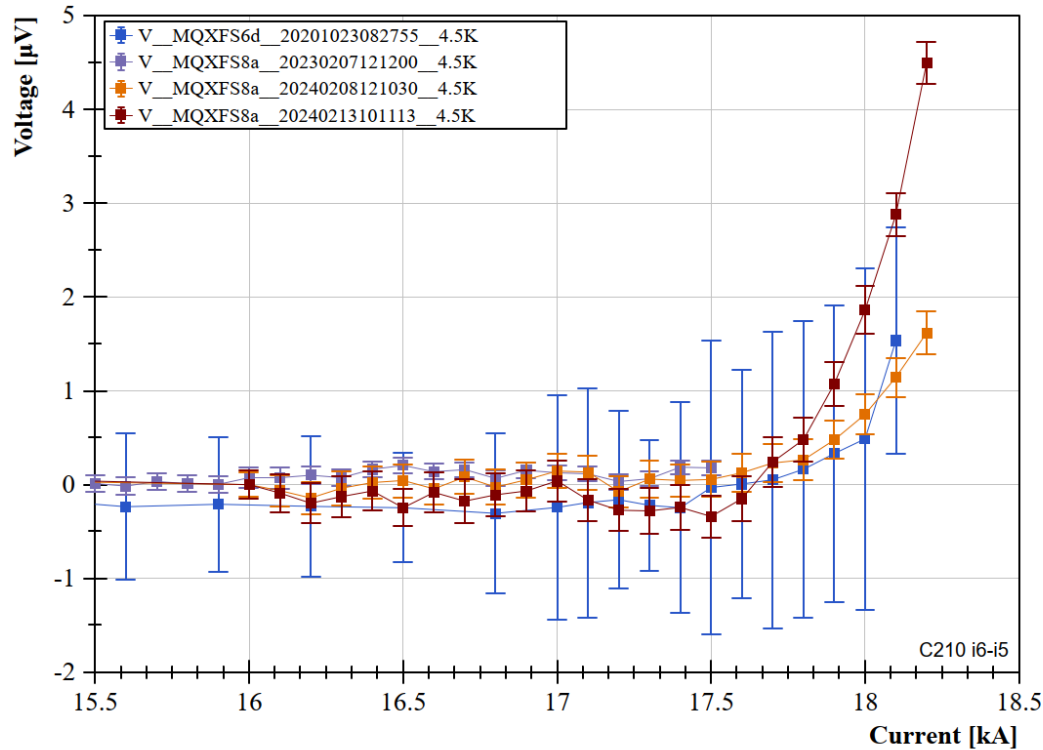
Ramp rate studies at 4.5 K:

- Quenches in coil 212 at lower ramp rates
- In coil 210 at higher ramp rates
- Intermediate ramp rates not fully studied

Comparison with MQXFS6b-d:

- Coil 212 seems unchanged
- Coil 210 can reach higher current at 400 A/s

V-I Measurements – short segments



- MQXFS6c
- MQXFS6d
- MQXFS8a – CD1
- MQXFS8a – CD3 – before CLIQ
- MQXFS8a – CD3 – after CLIQ

In the PIT coils: measurements from MQXFS6c-d are very similar to the measurements in MQXFS8a before the CLIQ treatment. However, there is an increase of voltage in both segments after the CLIQ treatment.

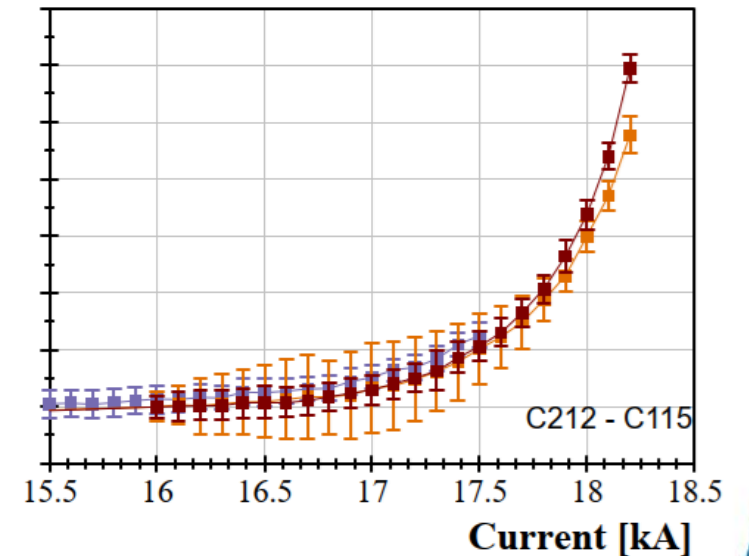
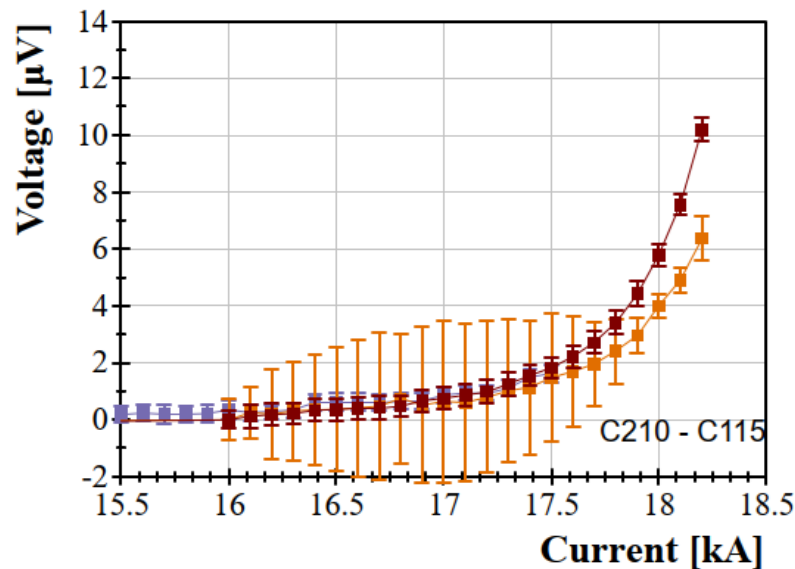
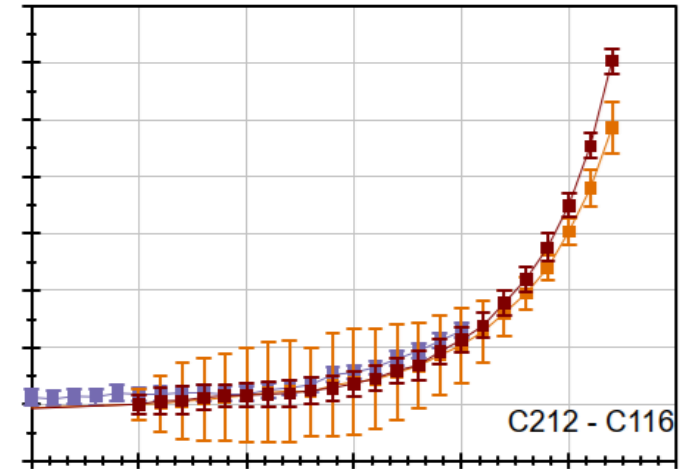
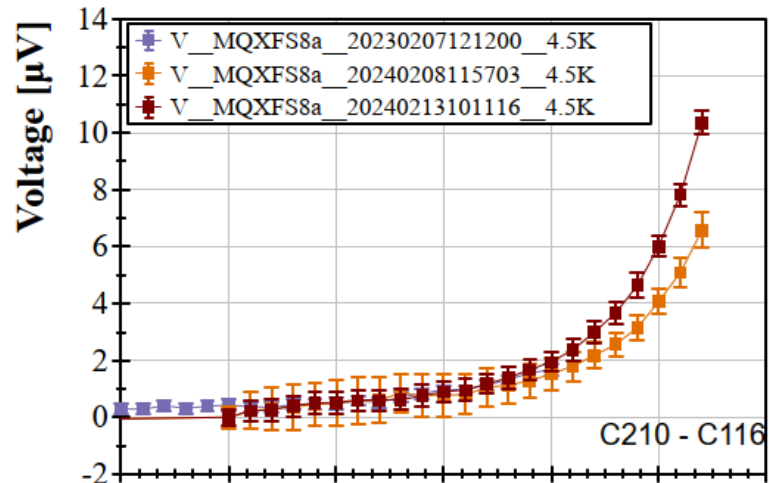
In the RRP coils: no voltage was observed, within the error bars.

V-I Measurements – coils

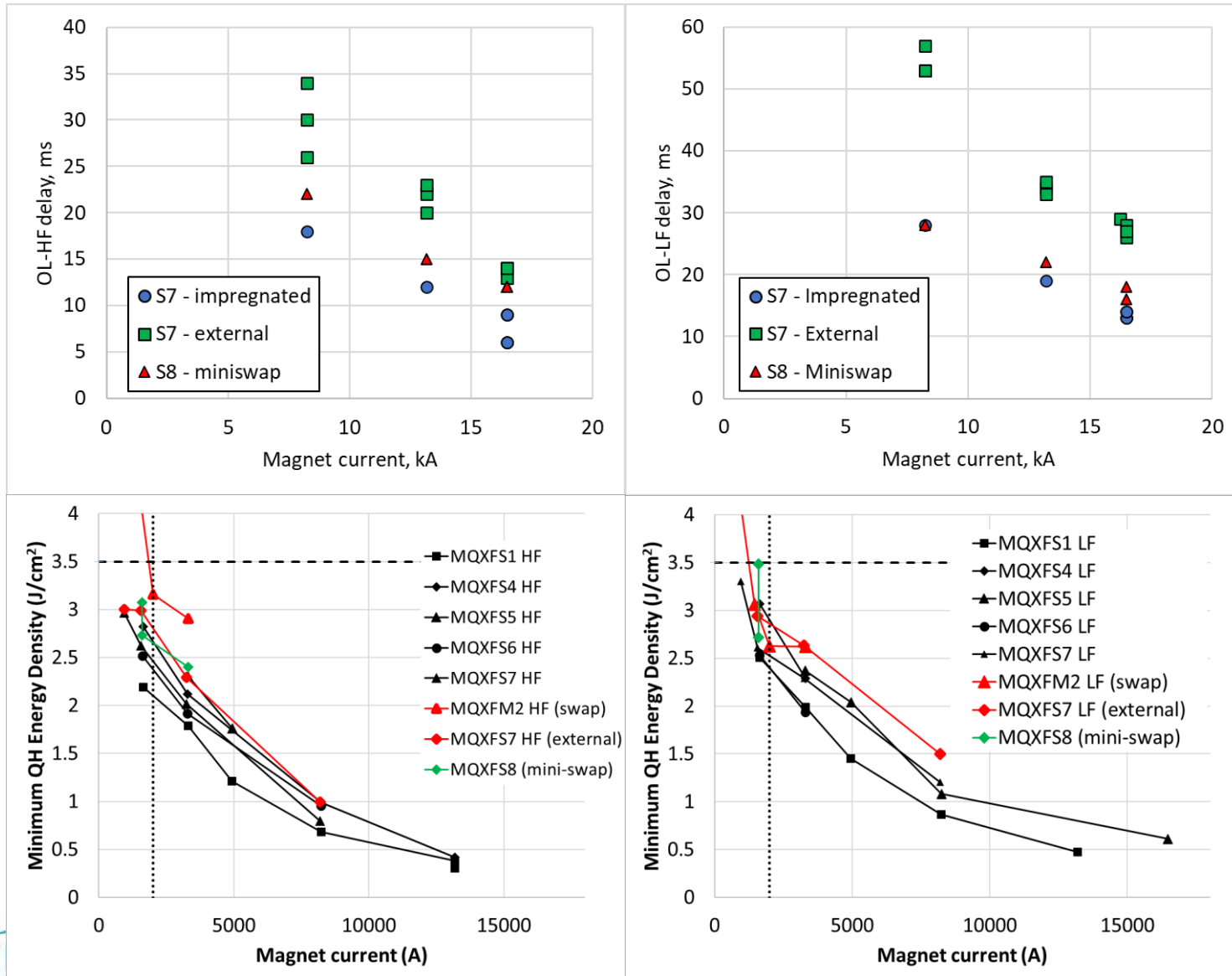
The full coil measurement shows the same behavior as the short segments.

Note that the measurements are in differential mode (i.e. one PIT coil vs one RRP coil).

- MQXFS8a – CD1
- MQXFS8a – CD3 – before CLIQ
- MQXFS8a – CD3 – after CLIQ



Protection studies



- 77 provoked quenches done for protection studies, including:
- Delay mini-swap QH
 - MQE mini-swap QH
 - MQE impregnated QH
 - QI tests nominal configuration (up to 18.25 kA)
 - QI tests with different CLIQ configuration

Conclusions

- Training
 - MQXFS8a reached 98 % of short sample limit
 - MQXFS8a reached 18.96 kA by the time we had to stop the test
 - No training in “old” coils until ~18 kA, beyond ultimate current
- “CLIQ training”
 - It seems to work for training acceleration
 - It also seems to have some negative effect on the VI measurements
 - Interesting topic to continue testing... (MQXFS9?)
- Protection studies
 - In line with expectations for MQXFB