



Horizontal Test Results of LQXFA/B02

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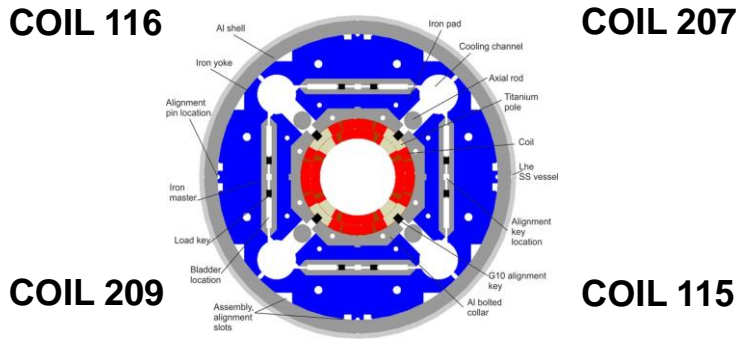


LQXFA/B02 Test Summary

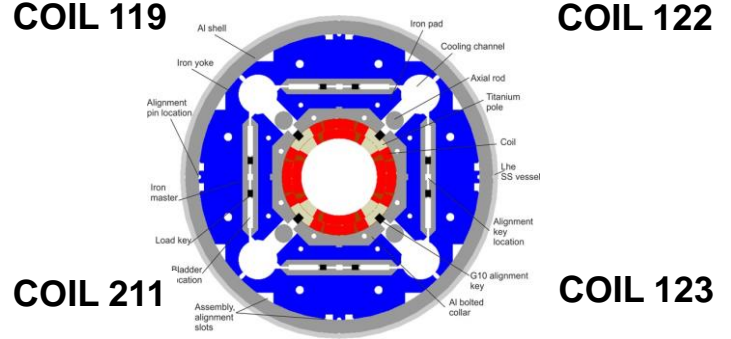
- LQXFA/B02 test goals are achieved
 - Electrical insulation tests passed at RT, at NOC, and at 100 K
 - Splice resistance requirements are met
 - Magnets survived a maximum temperature gradient of 50 K during a controlled warm-up and cool-down
 - After a quench at acceptance current, the magnets reached again steady operation at acceptance current
 - Quench performance requirements are met
 - Only one spontaneous quench in two test cycles
 - Nominal and acceptance currents were reached at 1.9 K
 - Nominal current was reached at 4.0 K
 - Ramp rate requirements are met
 - Ramping up at 30 A/s and down at 150 A/s successfully validated
 - Nominal current was held for 5 hours

LQXFA/B02

- MQXFA05 and MQXFA06 magnets of LQXFA/B02 have been trained at BNL

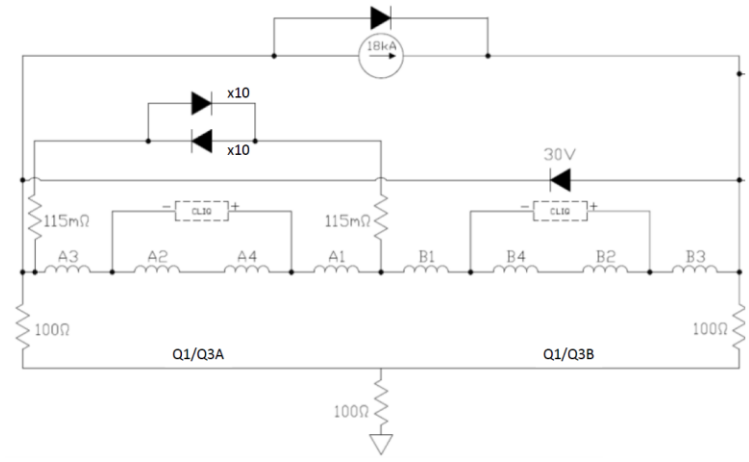


MQXFA05 (MQXFA.A)

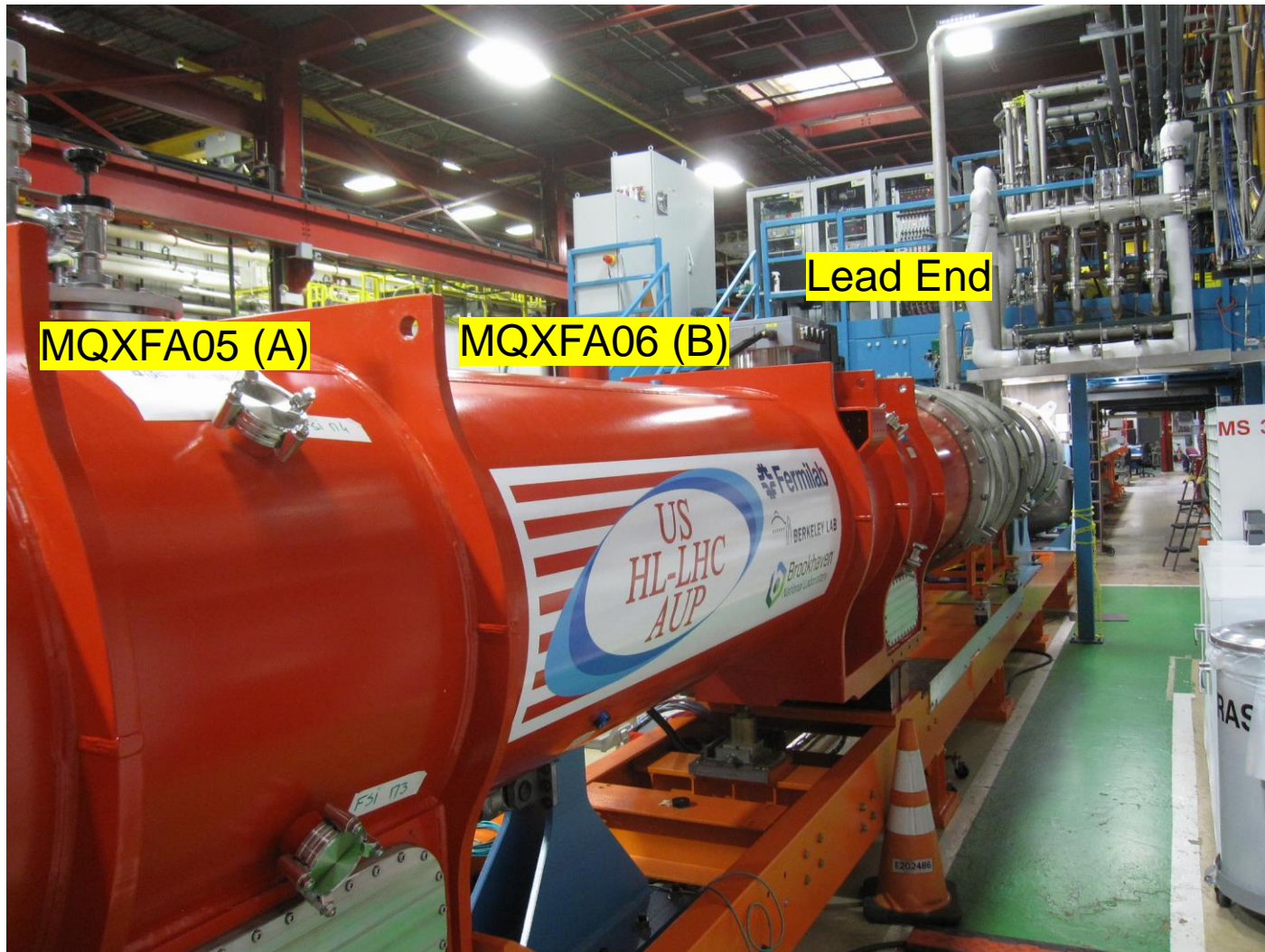


MQXFA06 (MQXFA.B)

- Quench protection includes CLIQ & Strip heaters on the outer coil
- No external EE (Dump delay 1s)



LQXFA/B02 at Fermilab's horizontal test stand

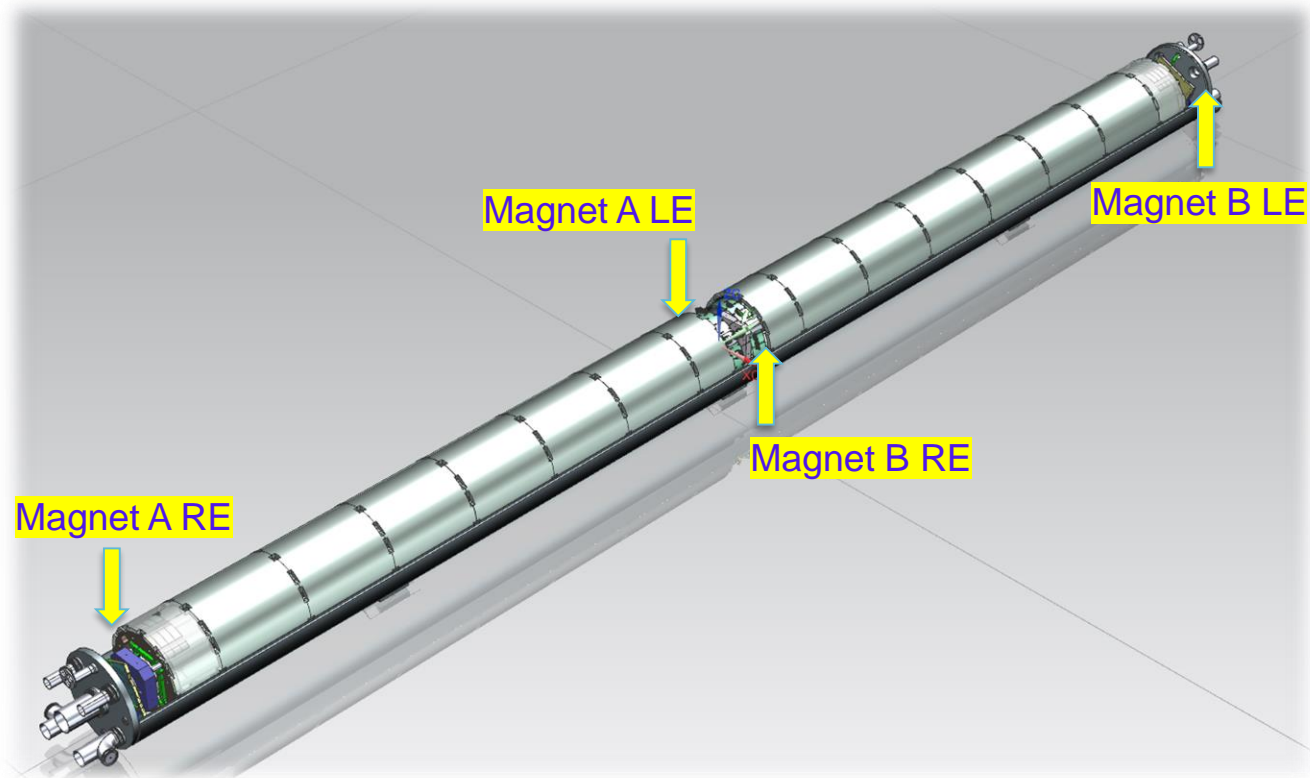


Electrical Checkouts

- All V-taps, temperature sensors and protection heaters functional
- Successfully passed room temperature insulation (Hipot) tests
 - Lead-to-ground at 2.5 kV, Top plate w/o magnets
 - Coil-to-ground (heaters grounded) at 368 V
 - Quench heater-to-coil (coil grounded) at 460 V
- Successfully passed cold insulation tests performed at 1.9 K
 - Coil-to-ground (heaters grounded) at 1840 V
 - Quench heater-to-coil (coil grounded) at 2300 V
- Successfully passed cold insulation tests at gaseous helium conditions (100 K)
 - Coil-to-ground (heaters grounded) at 425 V
 - Coil and Quench heaters-to-ground at 425 V

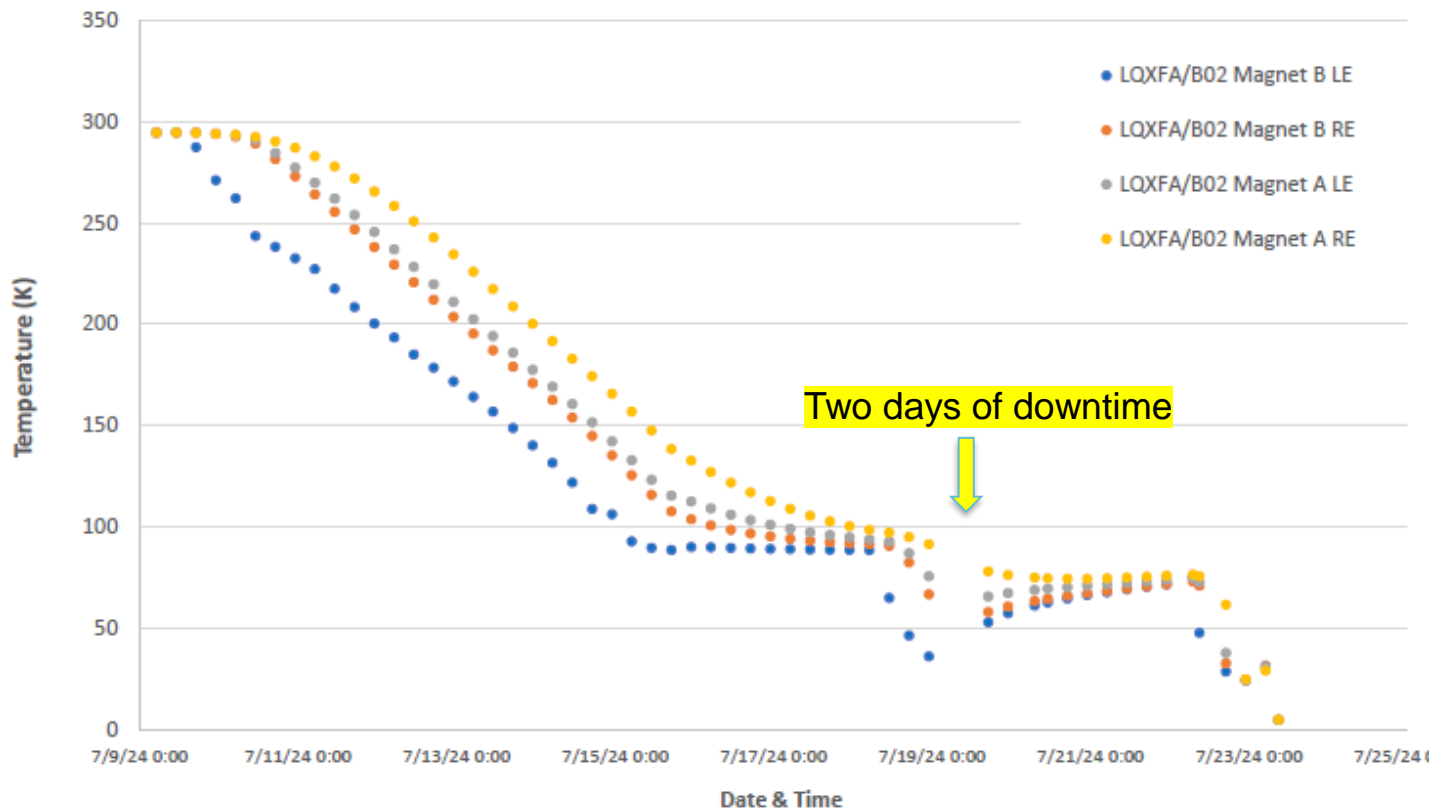
LQXFA/B02 controlled cooldown

- Fermilab RTDs are used for monitoring temperature gradient in each magnet



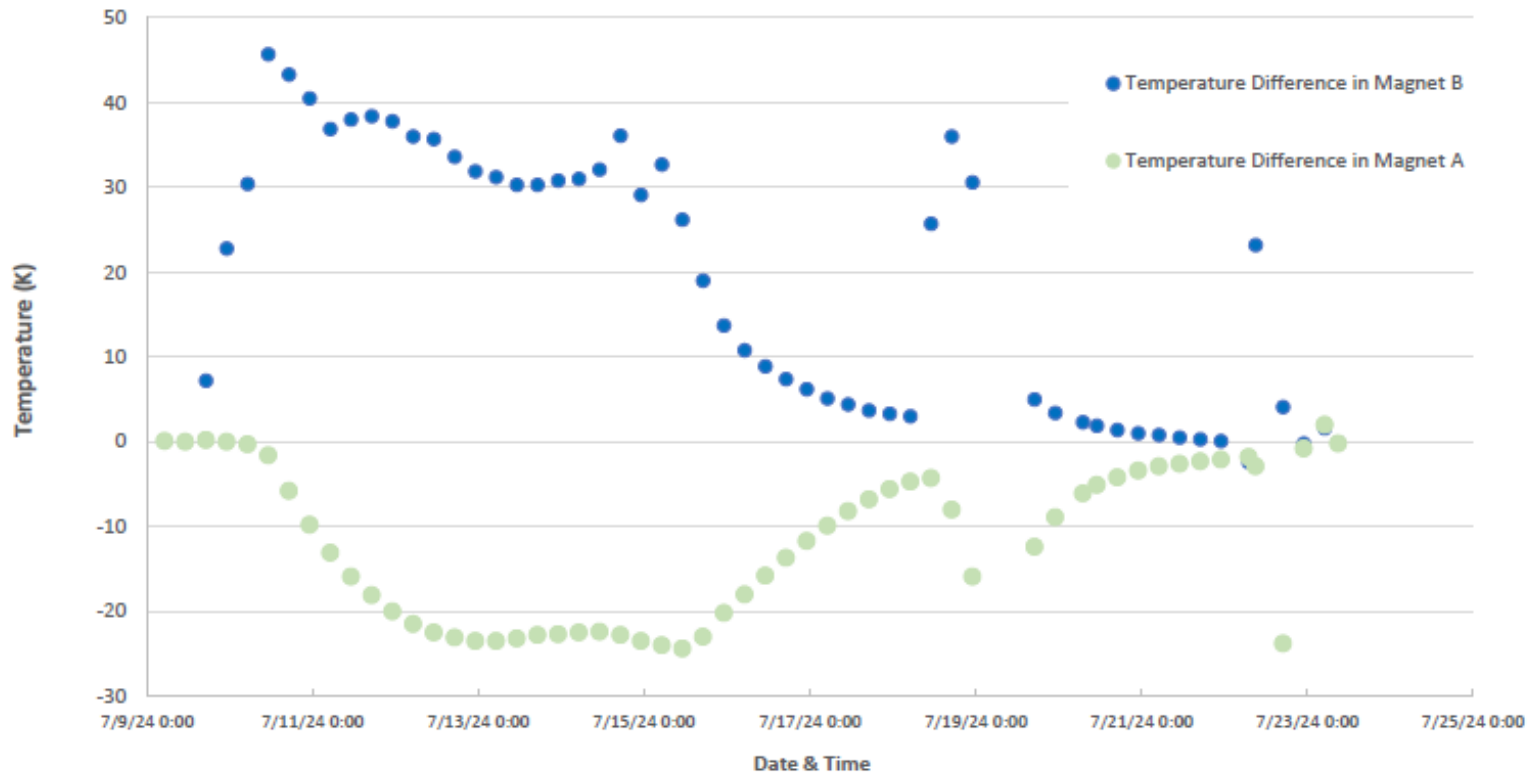
LQXFA/B02 controlled cooldown

- 14 days of controlled cooldown (compare to 19 days in LQXFA/B01)
 - 50 K requirement between the ends in each magnet
 - Two days of downtime due to cybersecurity issues



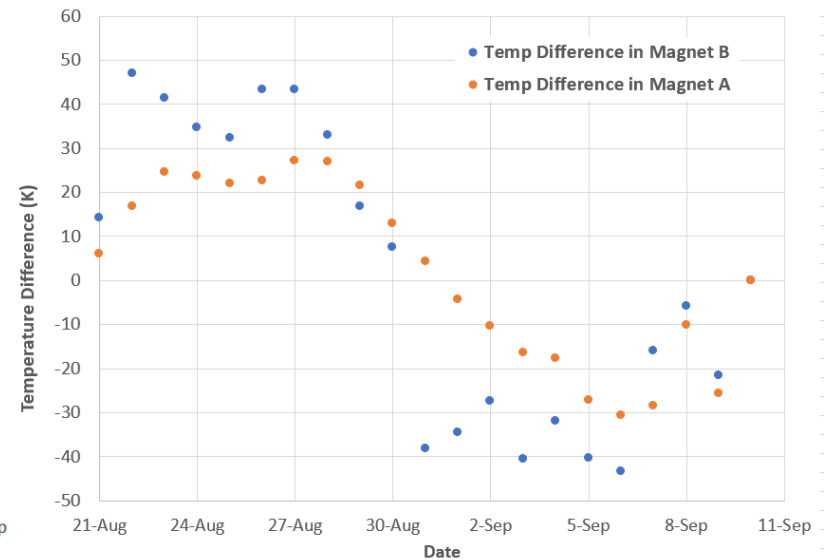
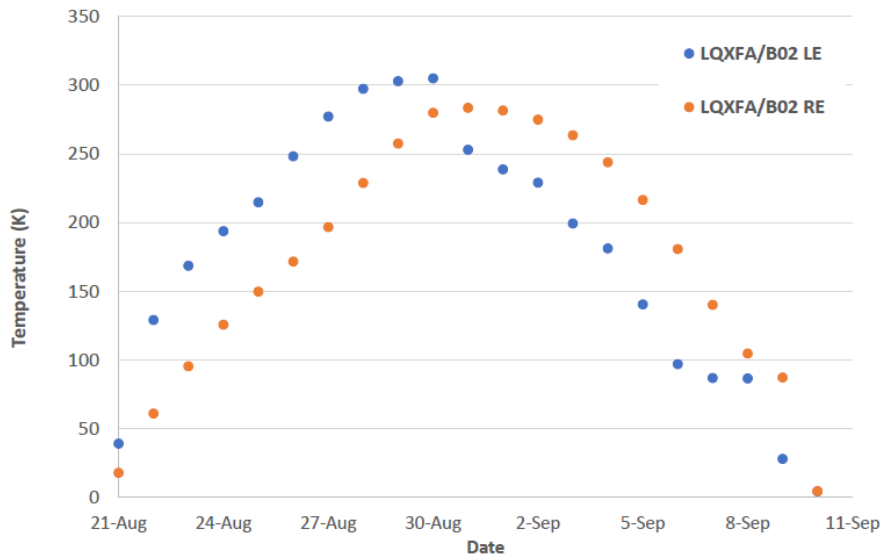
LQXFA/B02 Controlled cooldown (2)

- Better temperature control with temperature sensors installed on both ends of each magnet in LQXFA/B02



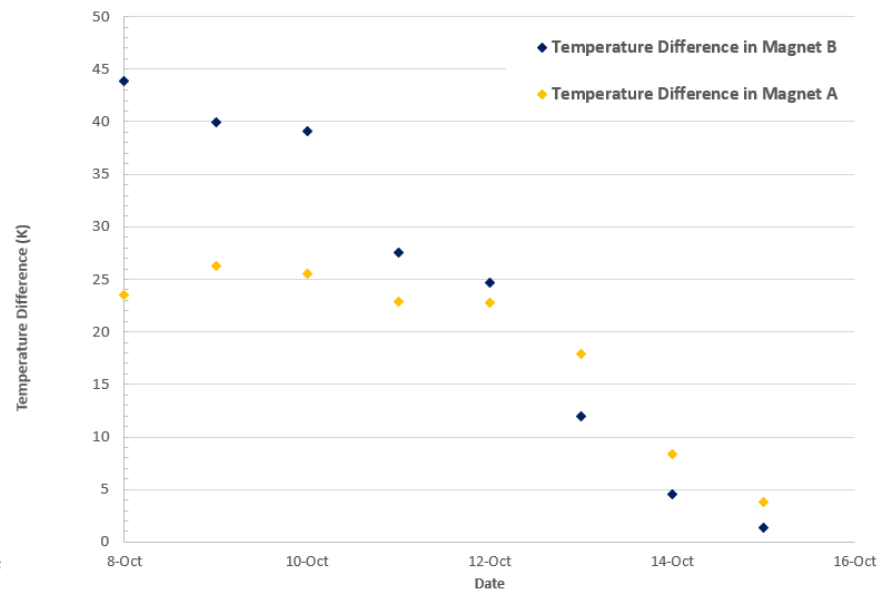
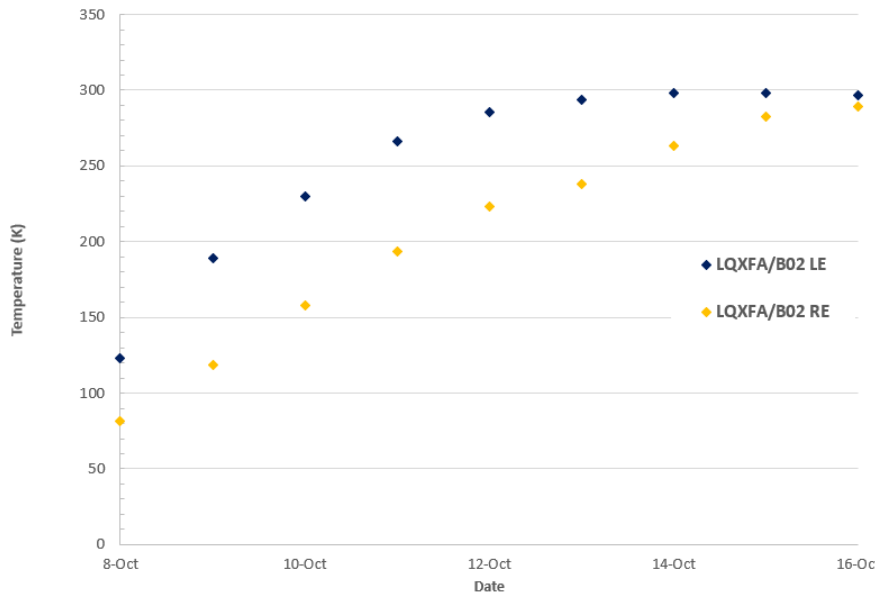
Thermal Cycle

- Controlled warmup and cooldown from Aug. 21 to Sep. 10
 - Total of 20 days



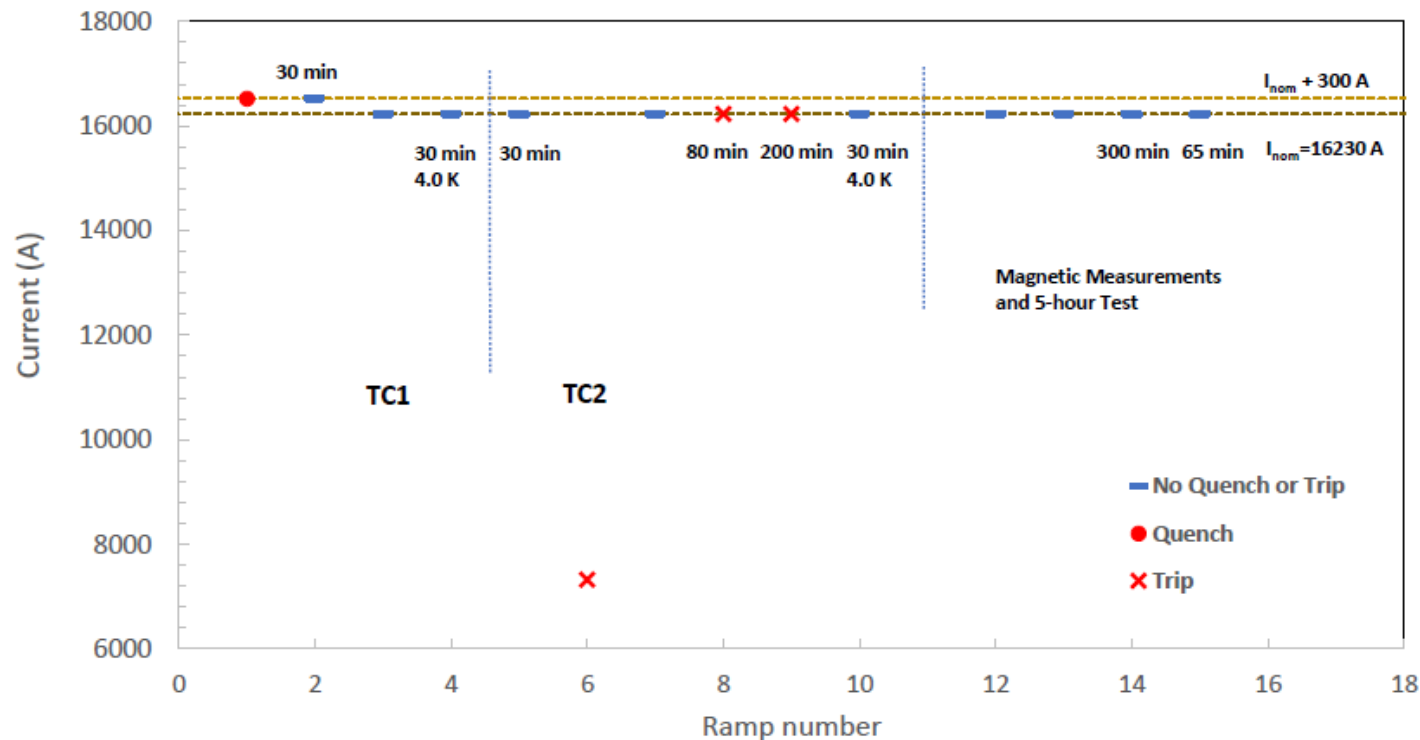
Final warm-up

- 8 days after 100 K Hipot from Oct. 8 to Oct. 16



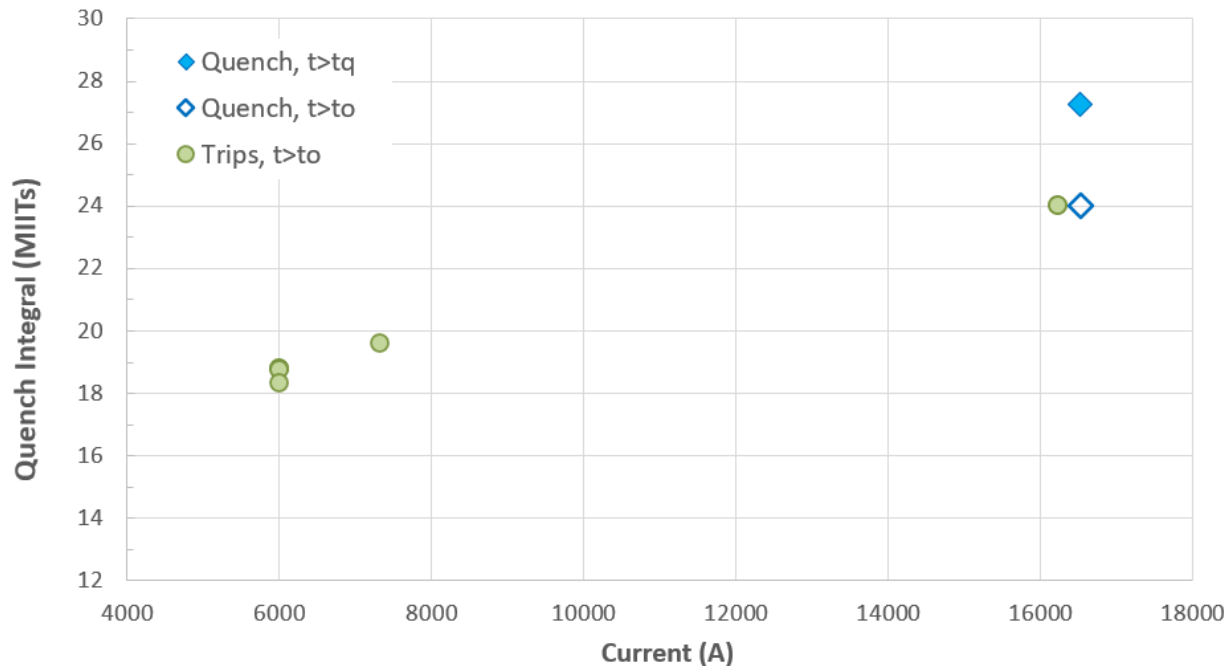
LQXFA/B02 Quench Performance

- Reached the acceptance current in one quench
 - Only one quench in two test cycles
- Power supply induced trips at 7323 A and during the holding current test at 16230 A



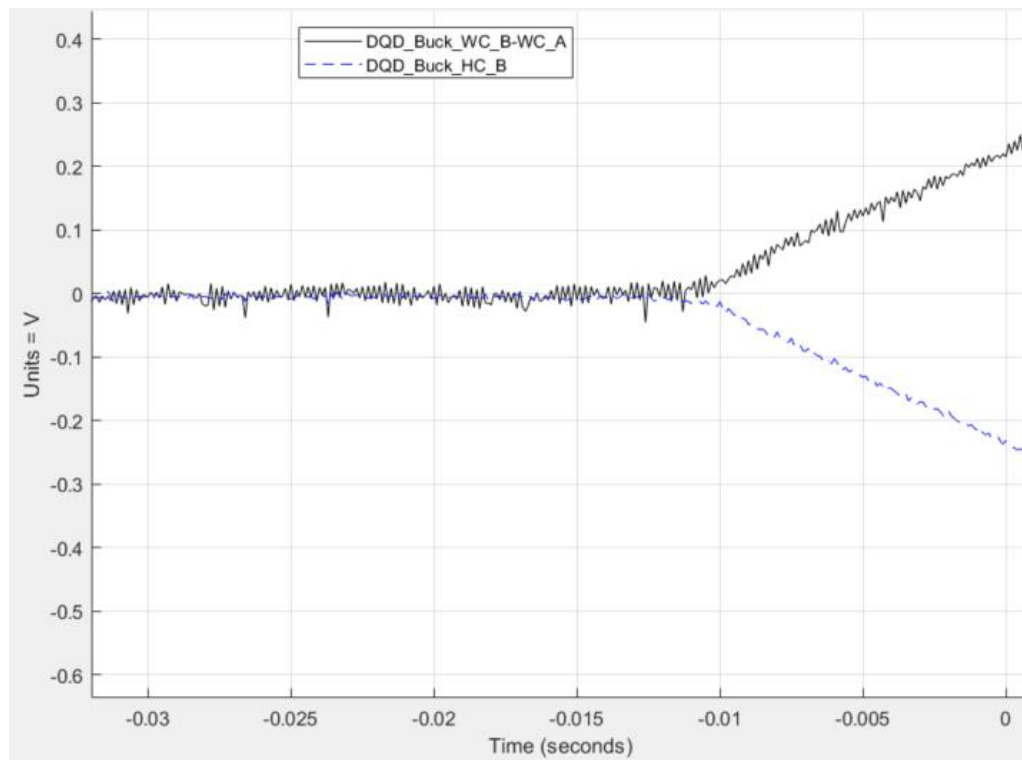
LQXFA/B02 Test Summary

- 4 provoked trips at 6000 A
- 2 ramps to 16530 A and 12 ramps to 16230 A
 - 1 natural quench at 16524 A
 - Holding current tests at 16230 A: 80 min, 200 min and 300 min
 - 3 trips due to power supply issues at 7323 and twice at 16230 A



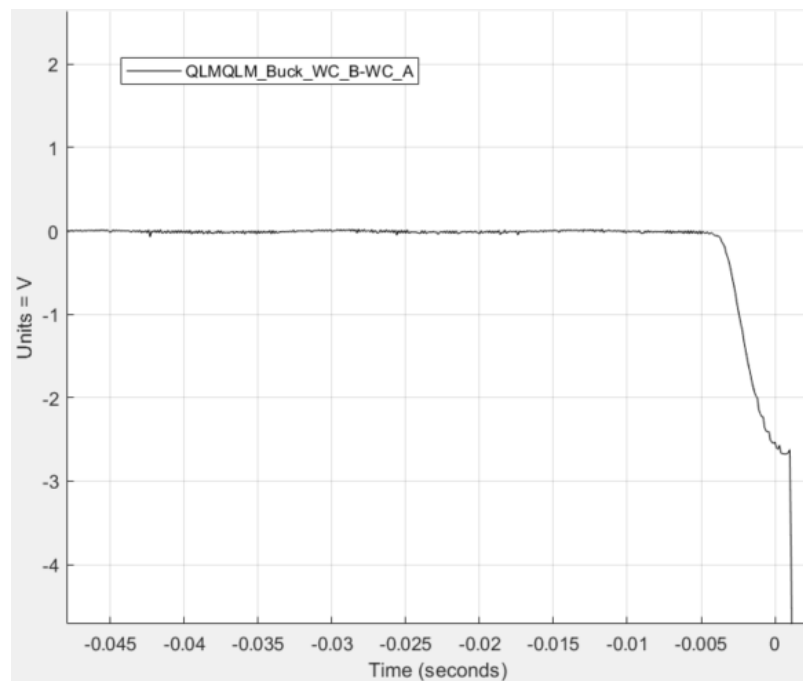
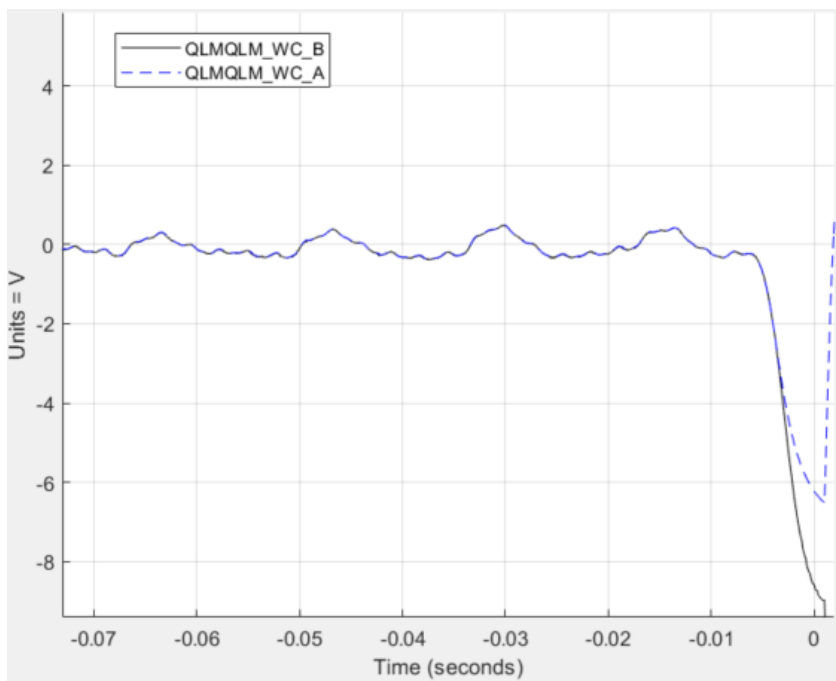
Quench in TC1

- Only one spontaneous quench in MQXFA06 (B), coil 122 (pole 1)
 - Quench current 16524 A
 - Quench Integral 27.2 MIITs



Trips at the nominal current

- Two trips at I_{nom} with very similar pattern
 - No resistive signals in coils or leads, only inductive signals in all coils
 - Quench detection has been triggered due to difference between the inductive signals in magnets B and A



Splice measurements

- All splices, made at Fermilab, have been measured
 - Includes two splices required for connected magnets to the test facility

