LHC MAGNET PRECYCLES

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- Why should we precycle

- Precycling strategies for each family of magnets
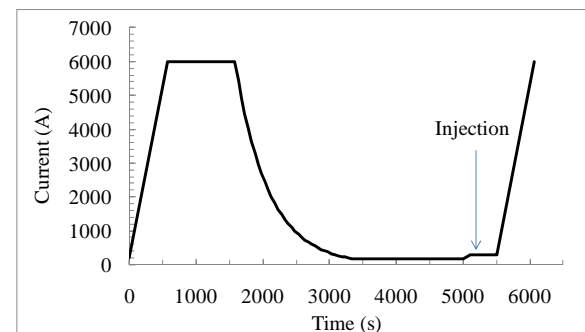
- Special cases

- What if

- Conclusions

- In superconducting magnets we have hysteresis
  - This means that going up or down with the current we have a different transfer function (same current, different fields)
  - This is not depending on the dI/dt: this only depends on the path, not on the speed on the path
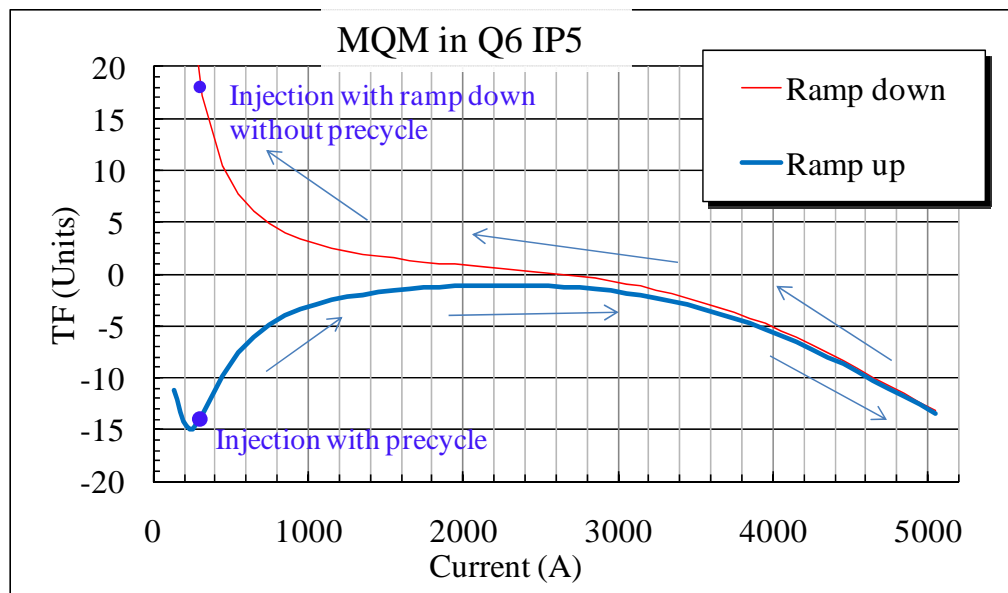
Need of precycling in MQM


Correct precycling in MQM to recover the right branch
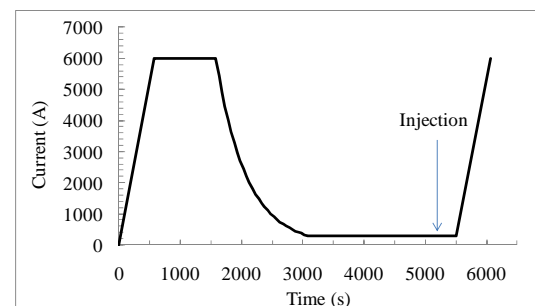
Wrong precycling in MQM ending on the wrong branch

- In superconducting magnets we have dynamic effects
  - The DC magnetization component decays during the injection plateau, and then snaps back at the beginning of the ramp
  - A good precycling allows to have always the same decay, i.e. the previous setting will work well for the next run
  - Critical parameters that can be changed during operations: time on the flattop and preinjection time
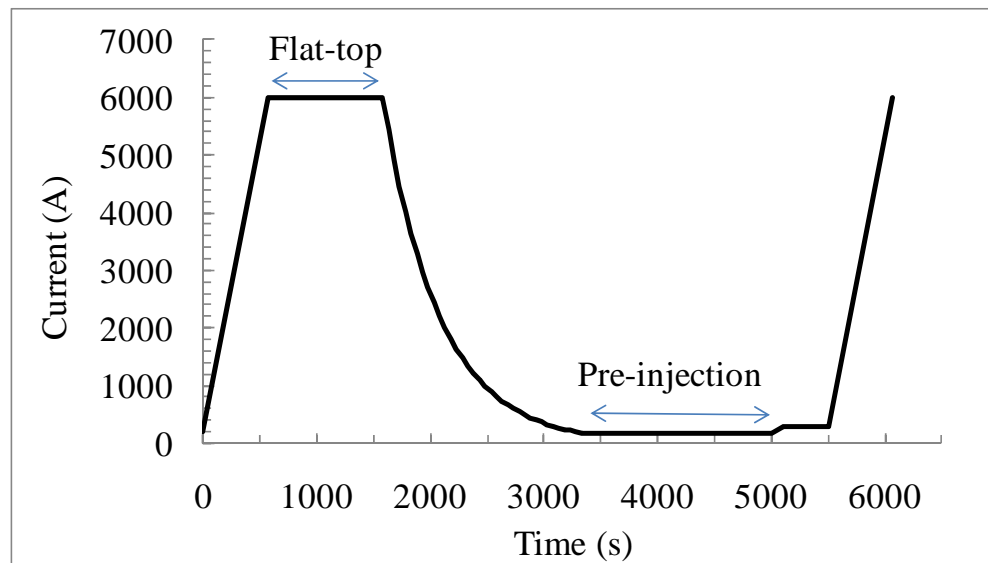
Critical parameters for decay and snapback reproducibility

- Normal conducting magnets
  - Several ramps up and down to stabilize the magnet and erase previous history
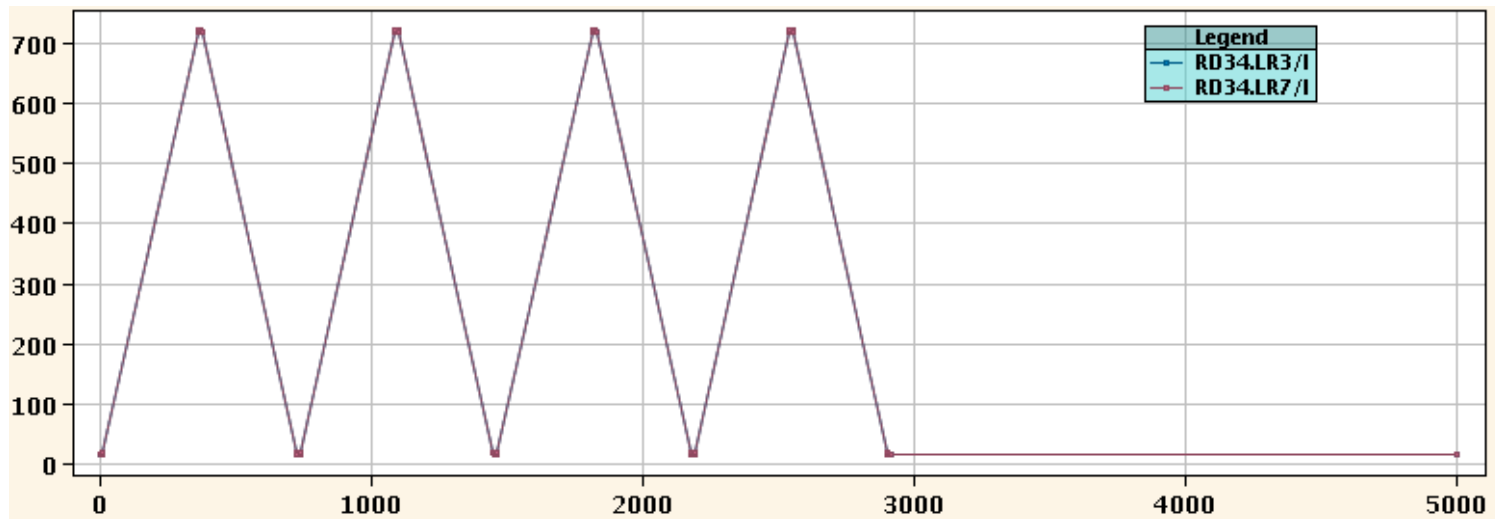
Pre cycle for a resistive magnet

- Why should we precycle

- **Precycling strategies for each family of magnets**

- Special cases

- What if

- First 2009 injection test

- Therefore, we divide in four categories
  - SC magnets with decay
    - Flattop time is critical (1000 s as in measurements)
  - SC with negligible decay
    - Flattop time is not critical, can be short (300 s)
  - SC with no decay (correctors)
    - Flattop time is not critical, set at a minimum value (10 s)
  - Resistive magnets
    - Several cycles up and down to stabilize

- Special topics
  - Nested magnets: one has to cycle the inner one, then the outer one
  - Magnets not used at injection (MO) should have a degaussing cycle

SC magnets with decay: MB

- Ramp up and down to go on the right hysteresis branch
- 1000 s flattop needed to have the reproducible (and low) decay and snapback
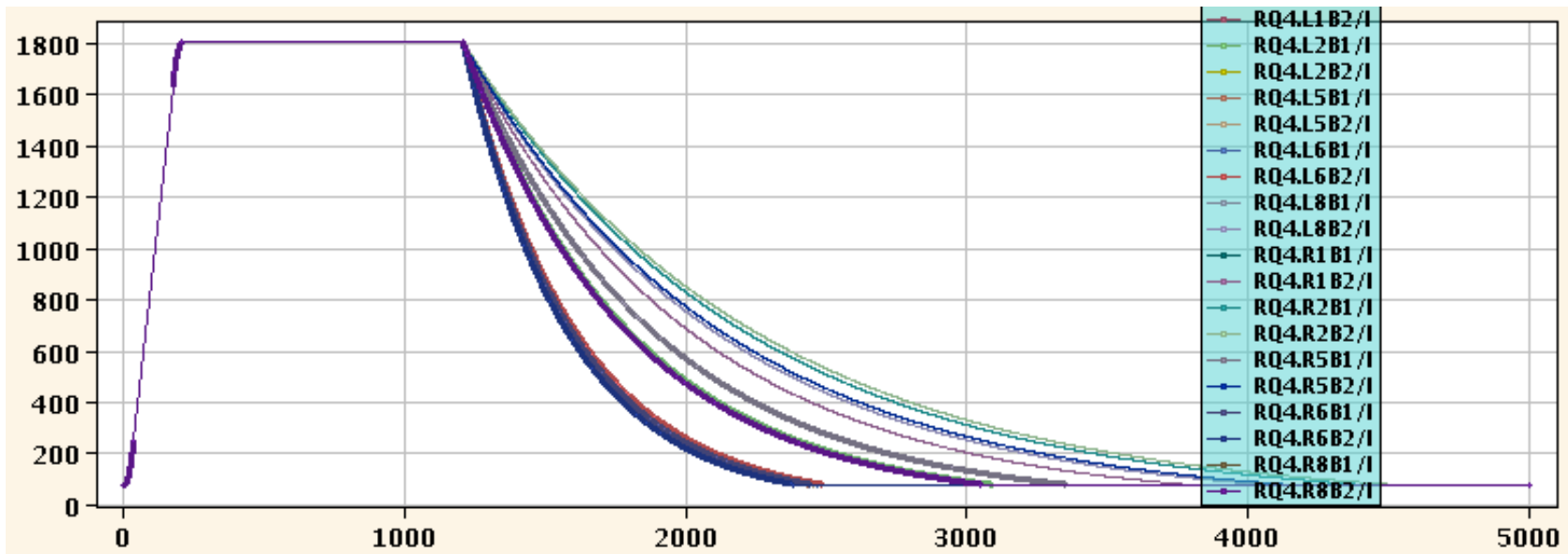- For the MB, reset at 350 A, and then a preinjection plateau at 500 A
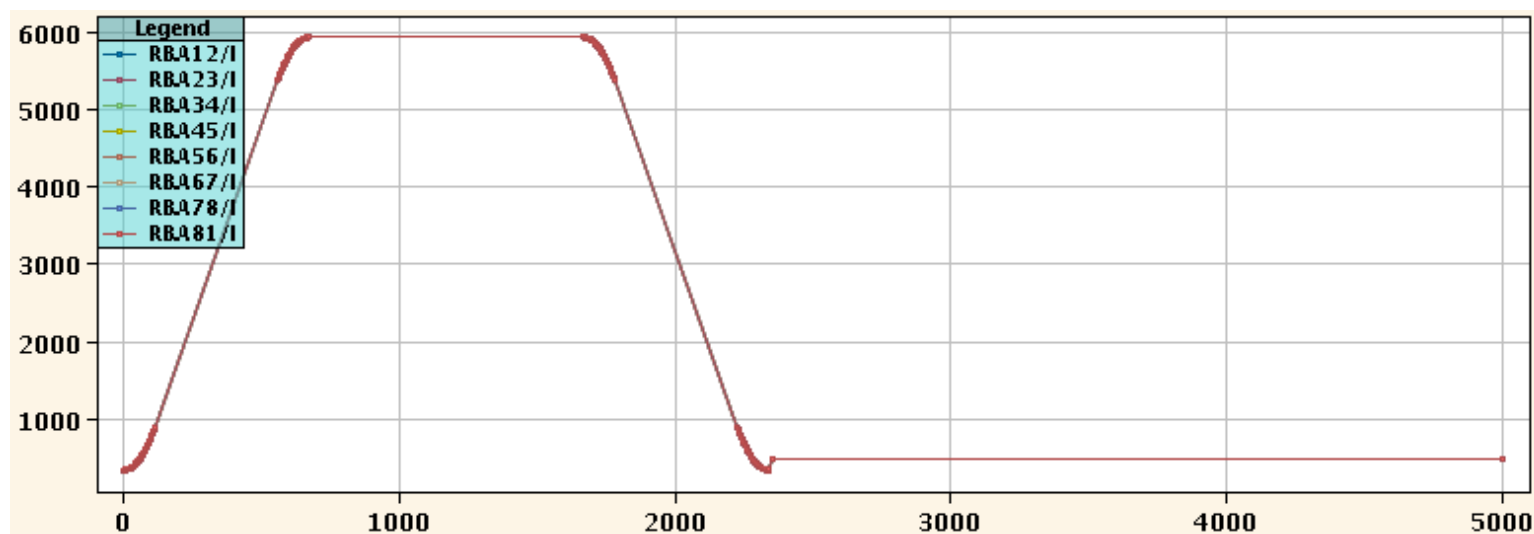
Precycle for the MB at 3.5 TeV

- SC magnets with decay: MQM, MQY
  - Ramp up and down to go on the right hysteresis branch
  - 1000 s flattop needed to have a low decay and snapback
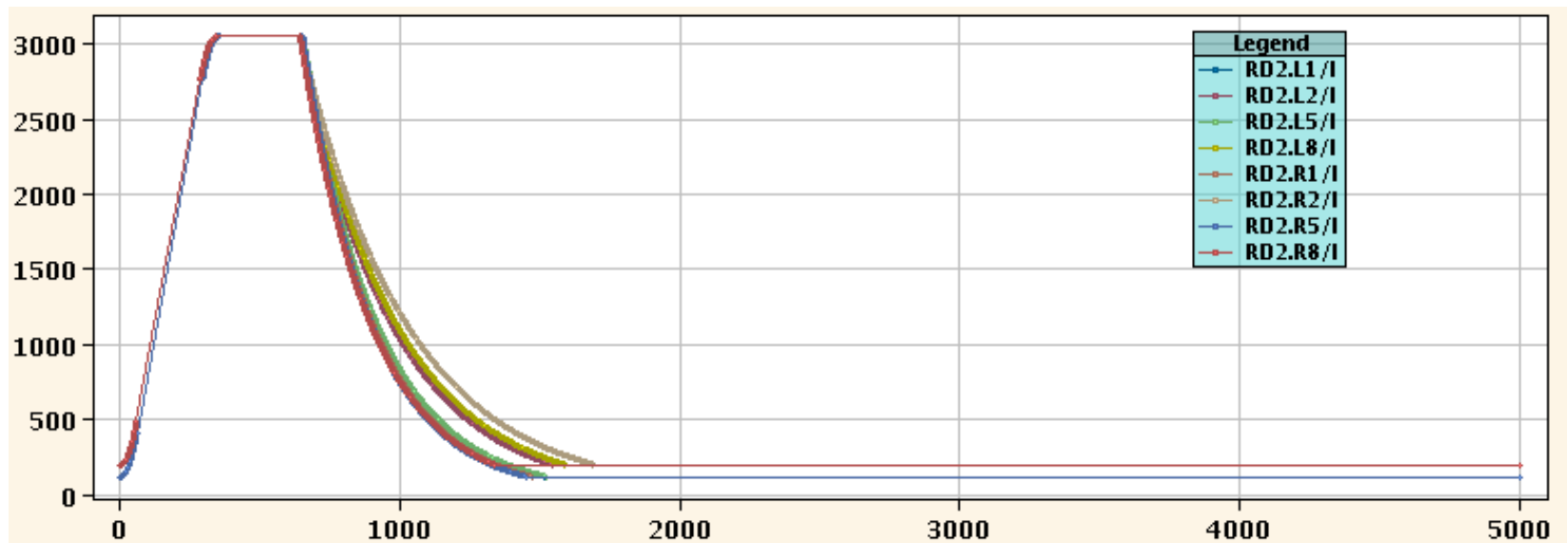 - Exponential decay since the PC cannot ramp down

Precycle for the MQY in Q4 at 3.5 TeV

- SC magnets with negligible decay: MBX, MBRS, MBRC, MBRB, MQ
  - Ramp up and down to go on the right hysteresis branch
  - Short flattop since decay is negligible (to make it faster)
  - Exponential decay since the PC cannot drive the current down

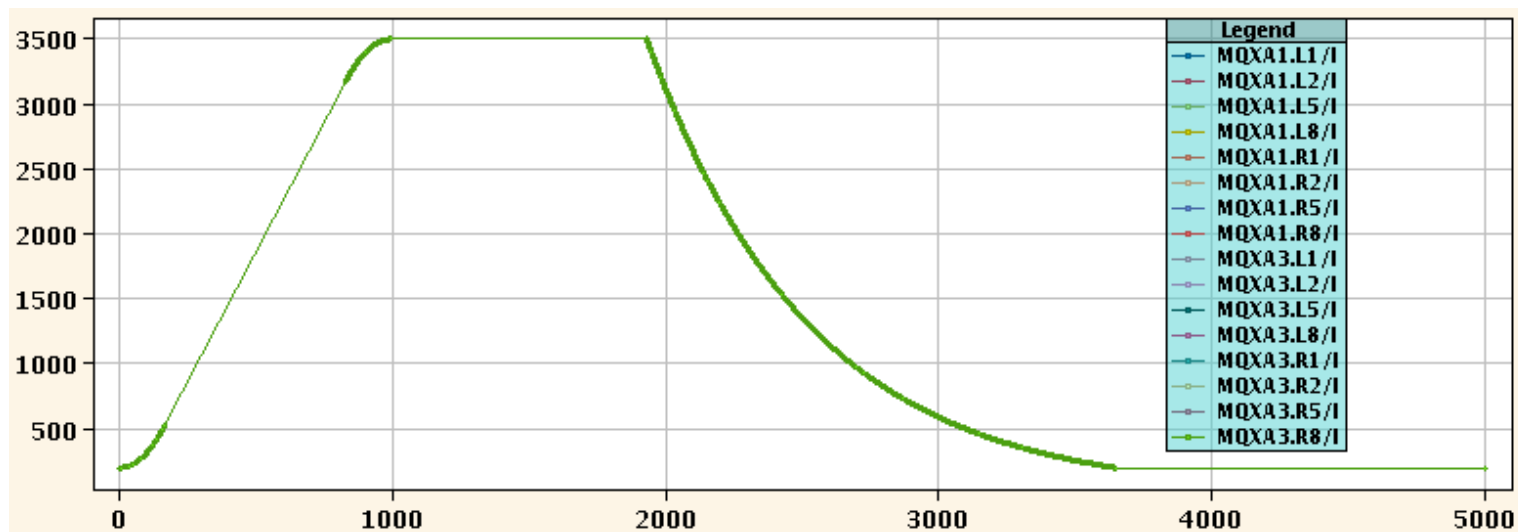Precycle for the D2 at 3.5 TeV

- SC magnets with negligible decay: MQXA, MQXB
  - Ramp up and down to go on the right hysteresis branch
  - Short flattop since decay is negligible (to make it faster)
  - Exponential decay since the PC cannot drive the current down
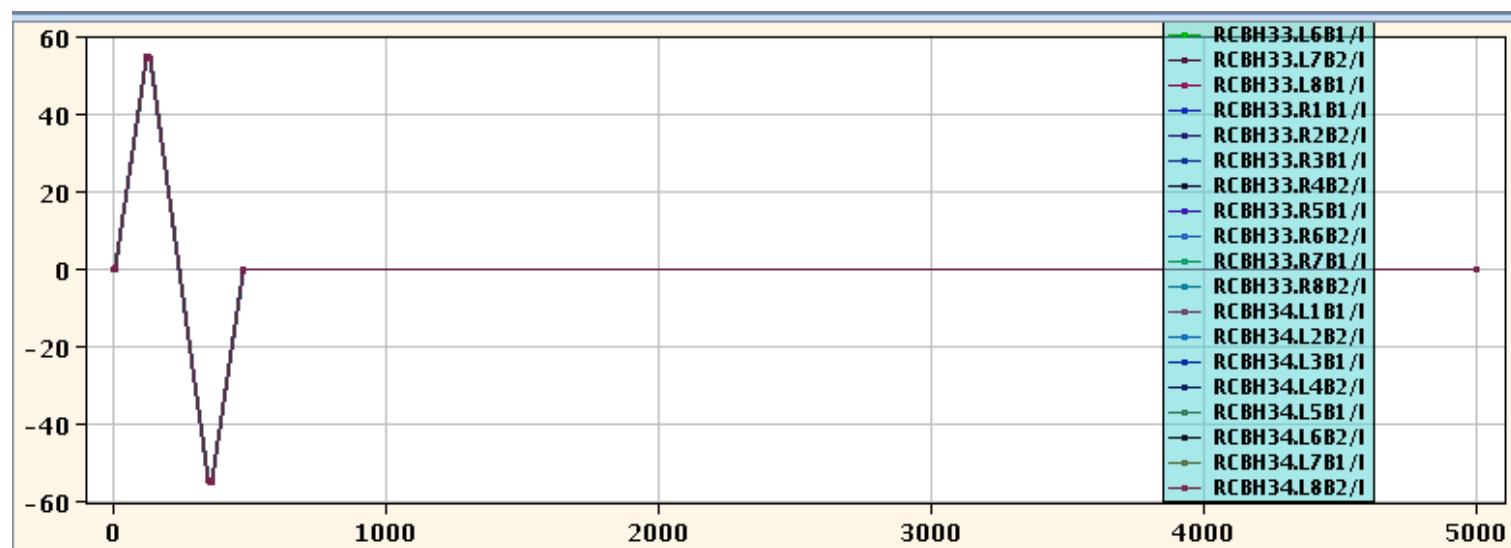 - Special case since powering is nested – the flattop could be further reduced

Precycle for the MQXA at 3.5 TeV

- SC magnets with no decay: all correctors (with two exceptions)
    - Ramp up and down to go on the right hysteresis branch
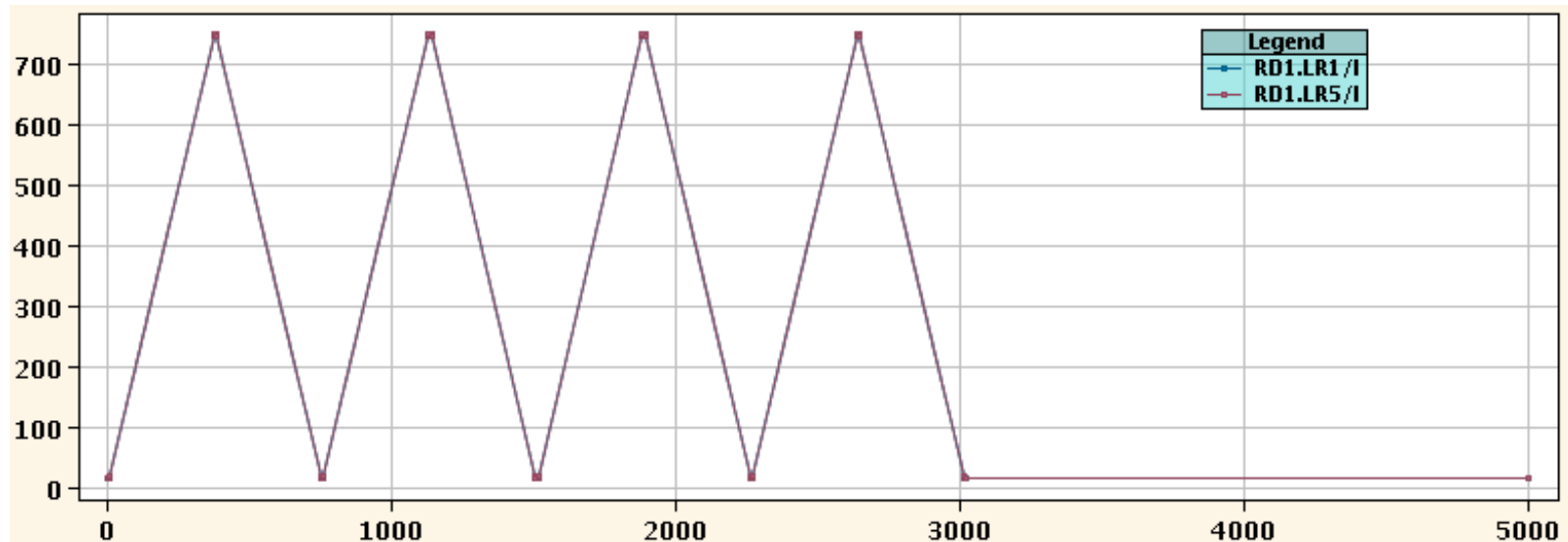   - Flattop not relevant, reduced to 10 s

Precycle for a MCBH corrector

- ## Resistive magnets
  - The cycle is used to put magnets in the reproducible state and to erase previous history
  - Flattop of 10 s is enough
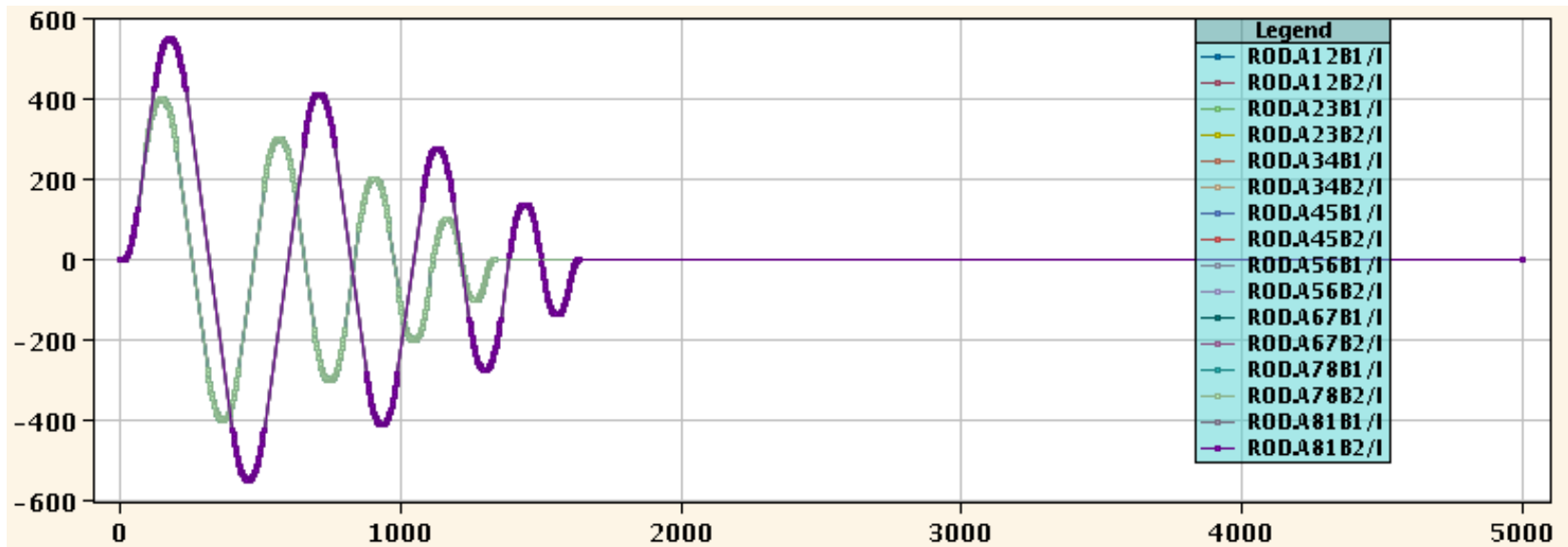 - Ramp rate as fast as possible (compatible with PC)
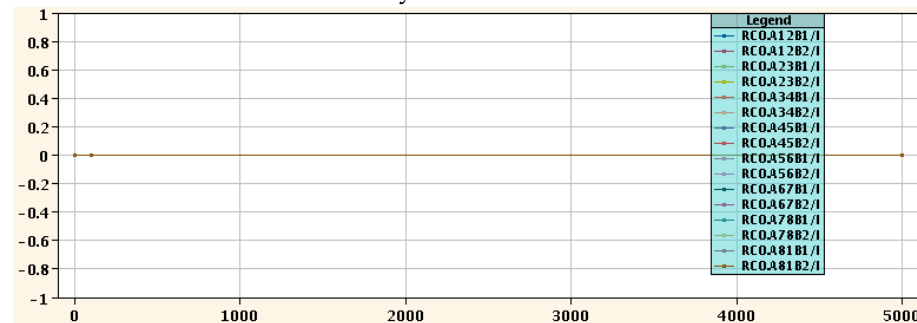

Precycle for the resistive D1
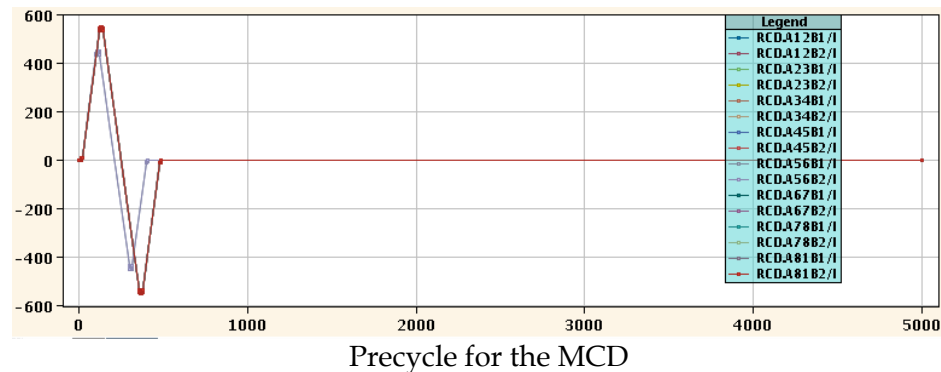
- ## Degaussing – MO
  - It has to be degaussed to avoid having residual field at injection, when it has zero current

Degaussing precycle for the MOD

- Nested correctors – three cases
  - (outer) MCSSX-MCOX-MCOSX (inner)
  - (outer) MCD-MCO (inner)
  - (outer) MCBXH-MCBXV-MCSX-MCTX (inner)
  - We cycle only the outer one, the others are not cycled

Precycle for the MCD

(No) Precycle for the MCO

- Why should we precycle

- Precycling strategies for each family of magnets

- Special cases

- What if

- What happened last week

- Any phase of commissioning not involving the ramp needs
  - A precycling with zero flattop to go on the right branch
- Any phase involving the ramp needs
  - A complete precycling with 1000 s flattop for MB, MQM and MQY

- If one of the circuits goes down during injection
  - Should be individually recycled, and the other magnets left there at injection
- If one of the circuits goes down at the beginning of the ramp
  - We should probably recycle everything

- If one of the circuits goes down at the beginning of the ramp
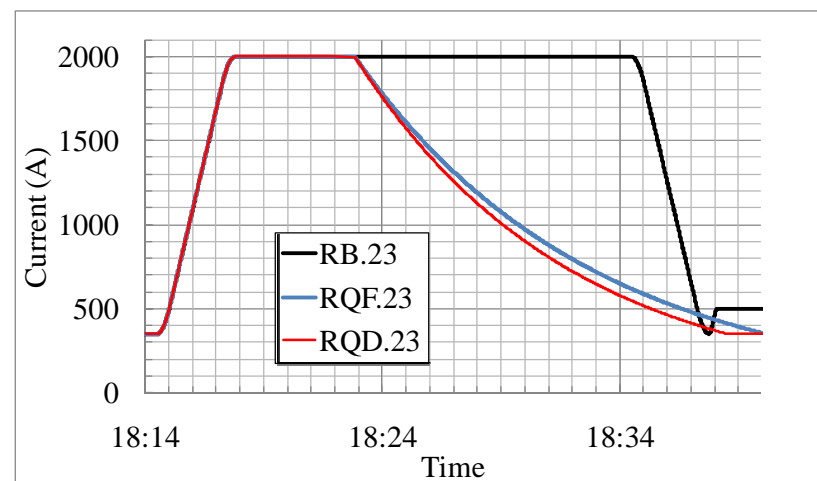 - We should recycle everything

- 23.10.2009 at 18h00 cycling magnet sector 2-3
  - Main dipoles, main quads, IP quads … at 2 kA
  - Time needed: 1h 10 m
- For the first time, dipole had a reset at 350 A, stayed on pre-injection plateau at 500 A and then went to 760 A
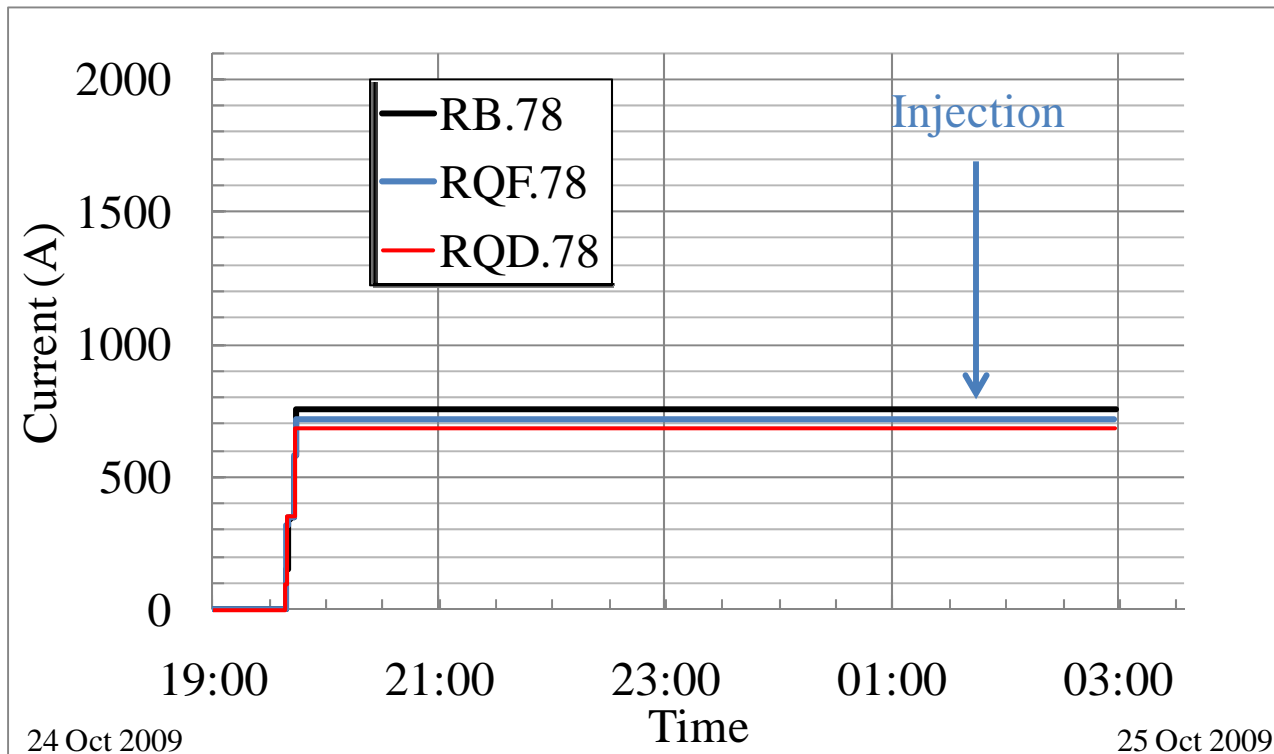 - Stayed about 40 min at pre-injection plateau
  - Stayed about 1 h at injection
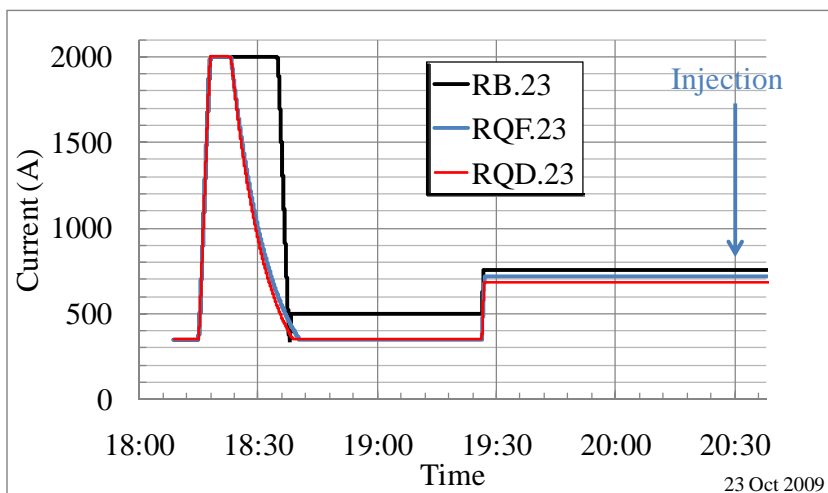
Precycle in 23, main dipoles and quads

Detail of precycle in 23, main dipoles and quads

- 7-8 has not been precycled due to hardware constraints
  - Beam injected after 6 h

Precycle of 78