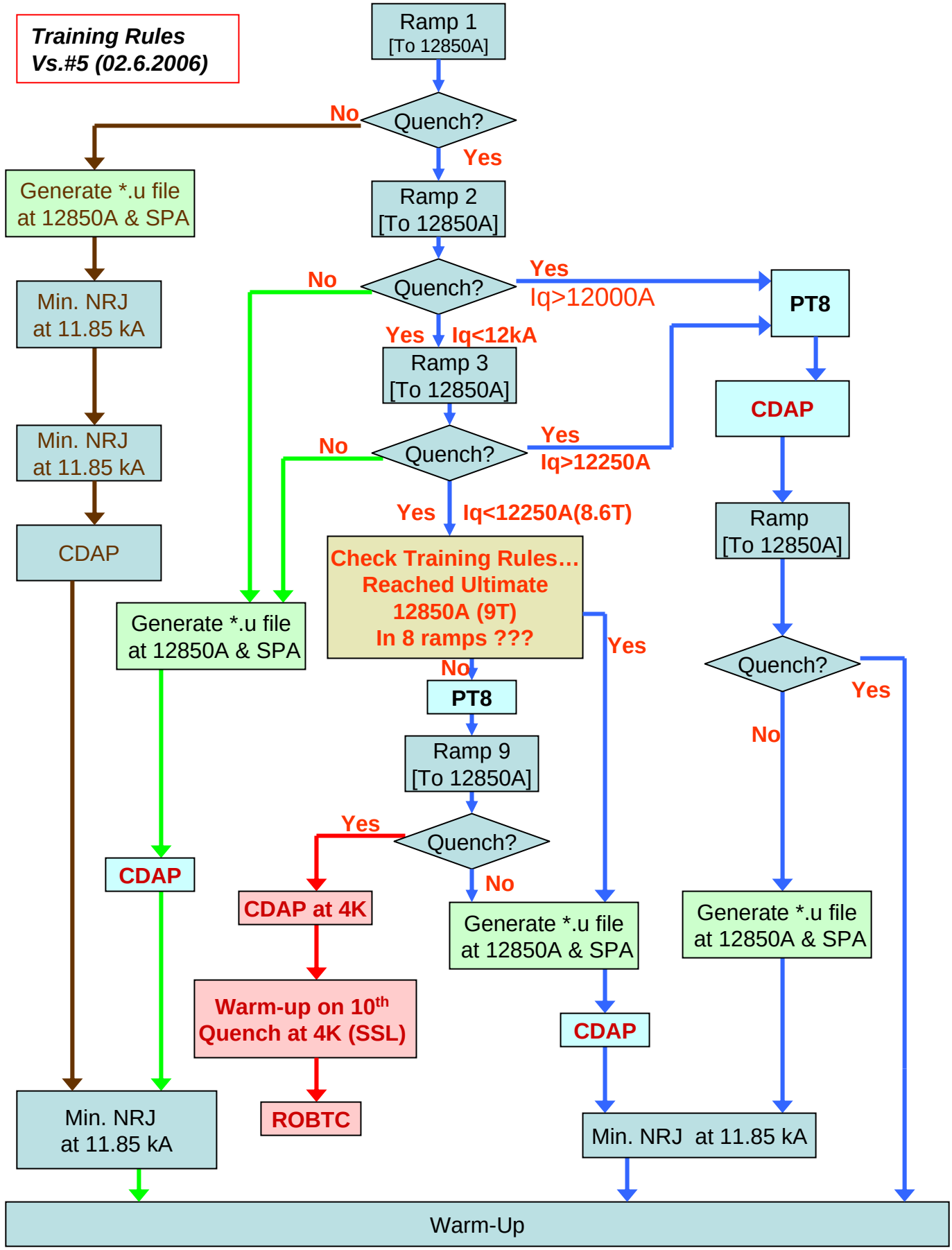
Training Rules
Vs.#5 (02.6.2006)
Ramp 1
[To 12850A]
Quench?
No
Yes
Generate *.u file
at 12850A & SPA
Ramp 2
[To 12850A]
Min. NRJ
at 11.85 kA
Quench?
No
Yes
Iq>12000A
PT8
Yes
Iq<12kA
Ramp 3
[To 12850A]
CDAP
Min. NRJ
at 11.85 kA
Quench?
No
Yes
Iq>12250A
Yes
Iq<12250A(8.6T)
Ramp
[To 12850A]
CDAP
Check Training Rules…
Reached Ultimate
12850A (9T)
In 8 ramps ???
Yes
Quench?
Yes
No
Generate *.u file
at 12850A & SPA
No
PT8
Ramp 9
[To 12850A]
No
Yes
CDAP
Quench?
Yes
No
CDAP at 4K
Generate *.u file
at 12850A & SPA
Generate *.u file
at 12850A & SPA
Warm-up on 10th
Quench at 4K (SSL)
CDAP
ROBTC
Min. NRJ
at 11.85 kA
Min. NRJ at 11.85 kA
Warm-Up

TRAINING Rules:

Max 9 Ramps to 12850A (9.0 Tesla) in the First Run;

Magnet is considered "TRAINED", If :--

(a) Iq > 12000 A (8.4 T) after Second Quench, OR

(b) Iq > 12250 A (8.6 T) after Third Quench, OR

(c) Current Reaches Ultimate value of 12,850 A (9.0 T) during or after second training.

If ANY of above Three Conditions are met, STOP Further Training. Magnet is ACCEPTED…Follow Flow-Chart for Final Tests before Warm-up.

Else: Magnet is POOR & do warm-up on 10th Ramp (4K SSL quench for Dipoles; while in case of SSS, warm-up with PT10.1)…Prepare for Thermal Cycle.

THERMAL CYCLE Rules:

If the Magnet NOT Accepted in First Run, Then Go for a Second Run After "Rapid On-Bench Thermal Cycle" (With or Without AntiCryostats, whatever the case in First Run) with Following Rules:

Only TWO Training Quenches Always.

If Iq(1) > Iq(1) of Previous Run,

AND

Iq(2) > 12000A (8.4T), Then Magnet OK and Accepted.

Second Quench can be used as Warm-Up Quench, if PT8 and PT9(CDAP) are done between these Two Quenches, otherwise do them after Second Quench, and do PT10 (Min.NRG @11850A) for warm-up.

If Magnet NOT Accepted in Second Run (Rapid On-Bench Thermal Cycle), Go for a Third Run WITH Anticryostats and Loc.Quench Antenna After Another Thermal Cycle (In consultation with Experts)

Perform Max. 5 Quenches in Third Run

MM Rules* (If Shafts Are Present!)

- Shafts to be Inserted AND Removed below 80 K
- MM to be done AFTER Quench Current reaches 12 kA
- MM2: LHC Cycle to be Preceded by a Quench (Iq = 6500 A min.)

DE-TRAINING Rules:

In case of De-Training (Iq < Previous Iq) at any Stage,

If De-Trained Quench Current Iq > 12kA (8.4T), Continue as Per Flow-Chart, as Magnet quench current was still ABOVE Nominal Acceptance Limit of 12kA (8.4 T).

Else – If Iq < 12kA, Continue Training Further as per Training Rules UNTIL Magnet reaches Ultimate 12850 A (9 T)

Training Rules Explained !!!

- **If a Magnet reaches Ultimate current value of 12850A (9 Tesla) in LESS THAN THREE Quenches, the manufacturers get a Bonus !!! The Training Rule Flow chart is designed such that it is always clear whether a magnet qualifies under this criterion.**

- **We always make AT LEAST TWO QUENCHES (at or above nominal current value of 11850A) on EVERY magnet. This is done to check whether magnet is able to sustain electrical & mechanical shocks occurring due to quench. In fact, there has been such an incidence on a magnet (No.3004) which got BURNT during second quench even though the First quench appeared to be normal !!! Thus, by performing at least two quenches while Training, we are REASONABLY ASSURED that what we will install in the tunnel is unlikely to cause problems.**

- **If the magnet reaches ultimate in the first training itself, It should be quenched with two consecutive minimum energy at 11850 Amps before CDAP (PT9) . Magnet can be warmed-up thereafter.**

- **De-Training:- If a magnet with very good performance (Iq>12kA after 2nd quench, or Iq>12250A after 3rd) exhibits some De-Training later, and still has Iq > 12kA; it is considered accepted, and we can continue as per short-cut routes in Flow-chart.**

  BUT, If De-Training is such that Iq < 12kA, in order to clear all doubts, we will test it further and Train it upto Ultimate value of 12850 A (9 T) in less than 9 quenches as per Training Rules.

- **An HV Insulation test on cold magnet @1.9K is done towards the end of "Cold Power Tests". This test should be performed at the end of all cold tests, preferably JUST BEFORE the Final Warm-up Quench.**

- **PT8 De-excitation Test is done by increasing current upto 12000 A (8.4T) just like a Training Ramp. After maintaining that current stable for a period of 10 min., a file *.ub is generated to record that magnet attained this level. Then, current is reduced at a pre-determined rate (-120A/Sec for Dipole and -350A/Sec for QP) using SPA (Slow Power Abort) facility of Power Converter to simulate the current decay as expected during LHC operation.**

  On the other hand, if the magnet reaches Ultimate value of 12850 A (9 T) during a Normal Training Ramp, a *.u file is generated to record this condition. And then, SPA is performed.