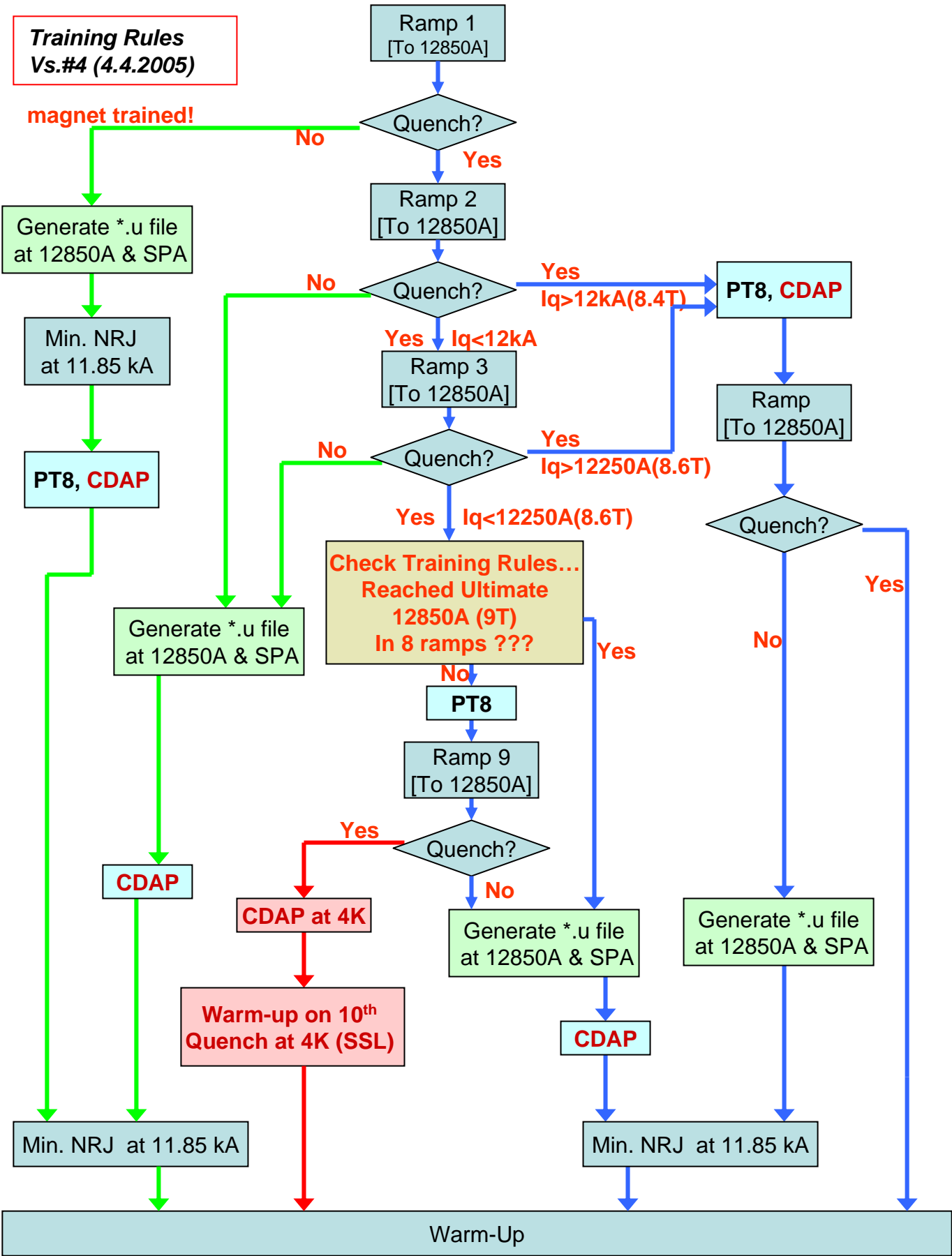


**Training Rules  
Vs.#4 (4.4.2005)**



## TRAINING Rules:

- # Max 9 Ramps to 12850A (9.0 Tesla) in the First Run;
- # Magnet is considered “TRAINED”, If :--
  - (a)  $I_q > 12000$  A (8.4 T) after Second Quench, OR
  - (b)  $I_q > 12250$  A (8.6 T) after Third Quench, OR
  - (c) Current Reaches Ultimate value of 12,850 A (9.0 T)

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  $I_q(1) > I_q(1)$  of Previous Run,  
AND

#  $I_q(2) > 12000$ A (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 ( $I_q = 6500$  A min.)

## DE-TRAINING Rules:

In case of De-Training ( $I_q < \text{Previous } I_q$ ) at any Stage,

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

# Else – If  $I_q < 12$ kA, 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 , first for hardware commissioning in the tunnel & secondly for future LHC operation.
- 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.**
- **De-Training:-** If a magnet with very good performance ( $I_q > 12\text{kA}$  after 2<sup>nd</sup> quench, or  $I_q > 12250\text{A}$  after 3<sup>rd</sup> ) exhibits some De-Training later, and still has  **$I_q > 12\text{kA}$** ; it is considered accepted, and we can **continue as per short-cut routes in Flow-chart.**  
BUT, If De-Training is such that  **$I_q < 12\text{kA}$** , 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.
- **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.