Quench Test Strategy Working Group

Date: 24th of August 2012

Chairperson: Mariusz Sapinski

Scientific secretary: Agnieszka Priebe

Presentations:

- Agnieszka Priebe "ADT fast losses MD results"
- Tobias Baer "Alternative approach: Fast Main Dipole Quench Test using D1"

Minutes:

- **Agnieszka Priebe "ADT fast losses MD results"**

A.Priebe presented the results of ADT fast losses MD performed on 22nd of July 2012. The ADT system was tested and studied in terms of the capability of the UFO-like losses induction. The applied configuration of the collimator jaws position was provided to create optimal conditions of the Quench Test which is foreseen in February 2013 (losses on one side of the aperture only). The impact of phase advance between ADTs and TCPs was investigated during the first part of MD at 450 GeV. During the second part of the MD, the loss duration and the temporal distribution of the losses at 4 TeV were determined. According to the performed analysis, beam 2 excited in the horizontal plane was proposed as the optimal candidate for the future Quench Test. The losses at 4 TeV were longer than UFOs by a factor of 7-8. Nevertheless, thanks to the existence of the heat transfer models, these longer losses would provide conclusive results for the UFO timescale. Measurements of a longer loss could be extrapolated to a short loss scenario. The ADT method of the beam excitation is good enough to be used during the Quench Test but other solution would be searched further as well.

Discussion:
J. Wenniger noted the importance of the number of particles lost on the collimators. R.Schmidt said that during the operation with fast losses the BCTs become less reliable and one should have a look on the BCTs located close to the beam dump. To answer these questions, the beam intensities and calculated losses are presented in the Appendix. Concerning the phase advance, J.Wenniger thought that there was no important influence. It was explained by the fact that the initial conditions of the beam were unknown. D.Valuch reported that by now (two months after the test) other ADT power amplifiers were changed and they all should be very efficient. It was noticed that when an excitation reaches a saturation level, the beam oscillations increase linearly (what is visible in case of vertical excitations). R.Schmidt noticed that performed test was good also beyond the initial targets. This was due to the fact that it

delivered knowledge for the machine protection in terms of the ADT worst failure scenario case. A.Verweij claimed that the spiky time structure of the loss should not be important for the quenching a magnet but only an integrated loss matters. Therefore it should be fine for the proposed Quench Test. D.Valuch proposed a test with an initially applied kick by the AC dipole and followed by the ADT excitation. That might induce faster losses. R.Schmidt asked if the losses during the test occurred at the same place of the collimators or had a certain distribution. He stressed the fact that in the future simulation should be done (not necessarily before the Quench Test) and they would explain the peaks in the temporal loss distribution. Moreover these simulations would provide better understanding of the collected data. M.Sapinski reminded the discussion with S. Redaelli about the SixTrack simulations.

- **Tobias Baer "Alternative approach: Fast Main Dipole Quench Test using D1"**

T.Baer presented a new idea of the fast change of the current in the warm separation dipoles in IR1 and IR5. This solution was proposed as an alternative to the ADT beam excitation. The calculations showed that the improvements in the loss durations development were not much different. A calculated RMS orbit change was 5 μm/turn (6.75 μm/turn in case of ADT). The advantage of that method was that there the phase would certainly matter and the initial conditions would be known (peaks were well-defined). Moreover synchronization of RD1.LR1 with RD1.LR5 could enhance that value by a factor of 2 (but it could be tricky). The difficulties lied in the fact that no multibunches could be excited separately and the close vicinity of the triplets could result in an undesirable quenching.

Discussion:
E.Todesco suggested that all non-standard conditions of operations should be discussed with experts. D.Tommasini was pointed as a contact person. J.Wenninger asked about the duration of the system adjustment and reported the fact that triplets should not be quenched. M.Sapinski added that the bump would also be needed. J.Wenninger said that with T.Baer they would have a closer look on the values in the databases to investigate further the proposed method.

Appendix (not discussed during the meeting):

The answers to R.Schmidt questions to the first presentation are given here.

Tab.1 contains exact timing of the beam dumps and the initial bunch intensities based on the Post Mortem records. The LHC ring is equipped with two redundant Fast Beam Current Transformers (FBCT) per beam measuring the bunch intensities. In the LHC the "B" system used to be developed but "A" system should be operational as well. Also two FBCTs per beam are installed in the beam dump (LHC Design Report). The beam intensity measured in the beam dump allows to estimate in the first approach the number of particles which were lost on the collimators.

A comparison on the assembled data is given in Tab 2. Measurements of two monitors per beam and per location are presented depending on the availability. A value of $(I_{ring}-I_{dump})/(I_{ring})$ expresses the number of particles lost on the collimators since no significant losses were observed along the ring. Nevertheless these results are subject to considerable uncertainty since the FBCTs have a strong dependency on the beam position (private communication with Jean-Jacques Gras, 3.09.2012).

Although the Direct Current Current Transformers (DCCT) provide the most reliable intensity measurements with high precision (an error less than 1%), they are limited for the low intensity beams. Therefore they couldn't be used here.

Case	Time	Monitor	Beam intensity [10^9 protons]
B2H	10:57:32.117	BCTFR.A6R4.B2	7.8
	10:57:32.816	BCTFD.623139.B2	4.8
B2V	11:08:11.117	BCTFR.A6R4.B2	9.2
	11:08:11.213	BCTFD.623130.B2	7.7
	11:08:11.213	BCTFD.623139.B2	6.7
B1H	11:31:39.057	BCTFR.A6R4.B1	8.2
	11:31:39.054	BCTFR.B6R4.B1	7.6
	11:31:39.398	BCTFD.683130.B1	3.7
B1V	11:39:28.118	BCTFR.A6R4.B1	10.6
	11:39:28.054	BCTFR.B6R4.B1	9.8
	11:39:28.969	BCTFD.683130.B1	9.0
	11:39:28.969	BCTFD.683139.B1	4.0

Tab.1: Beam intensities in the ring and in the beam dump.

B1H		Dump	
		BCTFD.683130	BCTFD.683139
Ring	BCTFR.A6R4	55%	-
	BCTFR.B6R4	52%	-

B1V		Dump	
		BCTFD.683130	BCTFD.683139
Ring	BCTFR.A6R4	16%	63%
	BCTFR.B6R4	86%	60%

B2H		Dump	
		BCTFD.683130	BCTFD.683139
Ring	BCTFR.A6R4	-	38%
	BCTFR.B6R4	-	-

B2V		Dump	
		BCTFD.683130	BCTFD.683139
Ring	BCTFR.A6R4	17%	28%
	BCTFR.B6R4	-	-

Tab.2: Numbers of lost particles.

Presentations can be found on indico page:

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Tentative agenda for the next meeting:

1. Agnieszka Priebe, “Steady State Losses Quench Test preparation: MD planning”
2. Krzysztof Brodzinski “Energy estimations with cryogenics measurements”

If you want to give a presentation, please let us know.

Next meeting will be held approximately in 2 months. The exact date and plan to be announced.