

## LHC intensity increase – check list

Version 0.2 - 24-Oct-10

<b>Bunch pattern / intensity</b>	312 nominal bunches
<b>Start date</b>	16.10.2010
<b>Fill numbers</b>	1424, 1427, 1430, 1439
<b>Next intensity</b>	368 nominal bunches
<b>Comment</b>	<b>Ready to proceed to 368 bunches.</b>

Fill	Int B1/B2 [1E12]	Emittance [um]	Stable beams (h)	Dump reason
1424	35.0/35.0	~2.6	1	Small UFO (< 10% BLM threshold) in IR8 triplet, probably B2, dumped by LHCb.
1427	35.0/35.0	~2.6	10.5	OP dump
1430	36.0/36.0	~2.6	0.5	UFO at BSRTM
1439	36.5/36.5	~2.4	10.5	OP dump. <b>By mistake the programmed dump was triggered without PM.</b>

## Check list

Non-conform points: the intensity increase is put on hold pending a satisfactory understanding / resolution of the issue.

<b>Magnet powering</b>	<b>Status</b>	<b>Who</b>
No unexplained IPOC failure in Post Mortem for FMCM and PIC	OK	JW
No magnet quench after beam dump in RQ4.R/L6	OK	JW
No unexplained quench of a magnet	OK	JW
No unexplained abort of the 3 previous fills by magnet powering system	OK	JW
No problems with loss of QPS_OK for main circuits following injection process	OK	JW
<b>Comments:</b>		

<b>Beam interlocks</b>	<b>Status</b>	<b>Who</b>
No unexplained IPOC failure in Post Mortem for BIC	OK (1)	JW/MZ
No unexplained false beam dump from beam interlock system	OK	JW/MZ
No failure of BIS pre-operational check	OK	JW
<b>Comments:</b>		
(1) BIC_IPOC in Fill 1430 failed due to 2 <sup>nd</sup> breaking of BPL by BLMs in IR6. Known feature, OK to proceed.		

<b>BLM</b>	<b>Status</b>	<b>Who</b>
Internal test (sanity checks) results must be true	OK	JW/BD
Rise time (10 to 90%) of fast losses must be larger than 200 us	OK(1)	JW/BD
No unexplained BLM check failures	OK	JW/BD
Expected losses for the to be injected beam must be 30 % below threshold level	n/a	BD
BLM system modification (ECRs) have to be agreed on, EDMS: notified persons signature is needed	n/a	BD
No nonconformities in the energy transmission to the BLM crates	OK	BD
<b><u>Comments:</u></b>		
(1) UFO at BSRTM in fill 1430 had a risetime of only 0.2 ms, loss duration ~0.5 ms. The dump was on RS01 and RS02.		

<b>Collimation</b>	<b>Status</b>	<b>Who</b>
Betatron loss map	OK(1)	Coll. Team
Off-momentum loss map	OK(2)	OP
No observed violation of cleaning hierarchy	Seems OK	OP
<b><u>Comments:</u></b>		
(1) Loss map done on 18.10 in collision conditions.		
(2) Loss map done on 24.10 in collision conditions with fRF trim +800 Hz.		

<b>Post-mortem</b>	<b>Status</b>	<b>Who</b>
Loss leakage to TCTs below 0.5% during beam dump	OK	JW
UFO occurrences	2(1)	JW
No unexplained PM event above 450 GeV	OK	JW
<b>Comments:</b>		
(1) UFO affecting LHCb – dump by BCM, but well below LHC BLM thresholds (2) Super fast UFO in fill 1430 on BSRTM.		

<b>Orbit</b>	<b>Status</b>	<b>Who</b>
Global orbit in tolerance in stable beams (< 0.2 mm rms)	OK(1)	JW
Orbit IR3/IR7 collimators within $\pm 0.2$ mm in stable beams	OK(2)	JW
Check that orbit is correctly measured	OK	JW
BPM IP6 (interlock BPM) during first beam with higher intensity and different bunch pattern	OK	ABT
Orbit at TCTs in tolerance in stable beams ( $\leq 1$ sigma)	OK	JW
<b>Comments:</b>		
(1) The BPM system was recalibrated during the TS, before fill 1439. The calibration seems good, except some offsets in IR7 (see point 2). IR7 is the point where the calibration predicted the largest differences. (2) After the technical stop, a shift of around $\pm 0.4$ mm was observed on BPMs BPMWE.4L7.B1, BPMW.4L7.B1 and BPMWE.4L7.B2. The offsets are not correctable with the correctors that are installed in the machine. From the loss maps, dedicated off-mom and parasitic during operation it seems that there is no hierarchy problem in IR7.		

<b>Feedbacks &amp; operation</b>	<b>Status</b>	<b>Who</b>
OFB operational status / no anomalies	OK	JW
QFB operational status / no anomalies	OK	JW/OP
<b>Comments:</b>		

<b>Beam dump</b>	<b>Status</b>	<b>Who</b>
Asynchronous dumps understood? Protection worked correctly?	OK	BG
Parasitic asynchronous dump data show no loss of protection	OK (1)	BG
No positioning errors on TCSG/TCDQ	OK	BG
No settings or thresholds mistakes/wrong sequences/unexplained faults on TCSG/TCDQ	OK	BG
No unexplained MKD, MKB kicker, TSU or BETS faults	OK (2)	BG
No potentially dangerous XPOC or IPOC failure on MKD or MKB	OK	BG
No unexplained synchronization problem with TSU	OK	BG
Pressure and temperature rise in TDE block within tolerances	OK (3)	BG
Requalification passed OK at 450 GeV and 3.5 TeV with pilot in case of any important component exchange	OK (4)	
<b>Comments:</b>		
<p>(1) below 6e-4 leakage for B1 and B2, except where UFOs gave high TCT losses. No PM data for last fill.</p> <p>(2) One MKB vacuum reading fault – logic changed to use only the digital signals. Also ASI-Monitoring module corrupted in BETS system - hard restart of the module solved the problem. Source of the corruption not identified, strong suspicion of a glitch on the safety power supply. No hardware modification performed.</p> <p>(3) 6-7 mbar pressure rise, corresponding to about 1.5 K average temperature rise.</p> <p>(4) dump testes after TS.</p>		

<b>Injection</b>	<b>Status</b>	<b>Who</b>
Injection oscillations within tolerance for all injections	Not OK (1)	BG
No unexplained large beam loss on TCDIs	OK	BG
No issues in injection procedure, settings or tolerances	Not OK (1)	BG
Orbit in injection region in tolerance wrt reference (tolerance <0.5 mm)	OK	BG
Resetting of TL trajectories and TCDIs done when needed	OK (1)	BG
No increased rate of MKI flashovers	Not OK (2)	BG
No increased rate of MKI switch erratics or missings	OK	BG
No unexplained MKI vacuum or temperature activity	OK (3)	BG
No machine-protection related injection system failures	OK (4)	BG
<b>Comments:</b>		
<p>(1) Aperture obstacle in B1 injection region, diagnosed as MSIA/MSIB interconnect module. Beam steered with TL bumps and LHC bump, and TCDIs reset. During the period with the problem, several transgressions of MP procedures and potentially dangerous situations arose:</p> <p>a) 12-13/10: shift crews took initiative to attempt to steer around obstacle, using 16 b injections, with injection oscillations of +/-3mm, in contradiction to procedure and instructions.</p> <p>b) 16-17/10: shift crews fill 4 times for physics with full intensity 24b injections, small emittance and injection oscillations of +/-2.5 mm, above the limit, in contradiction to procedure.</p> <p>c) 24/10 after recovery expert (BG) did not reset interlock (open by 2 sigma) on TCLIB.B1. During this time injected 4b.</p> <p>(2) Another flashover on MKI.D B2 – no associated beam loss seen before the event.</p> <p>(3) Factor 6-10 in vacuum pressure increase on MKIs for B1 and B2, seems to start during filling.</p> <p>(4) A not-yet understood change in the AGK timing led to 32b being injected onto TDI, not seen by SIS which was checking the previously OK timings. Now modified in SIS. TDI positioning OK.</p>		

