LHC Intensity Increase – Check list Update 2016

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Motivation and 2015 experience

- Systematically check and document **readiness** for next intensity step of **protection critical systems**/elements.
- **Detect non-conformities**.
- **Delay intensity increase** in case of issues in MP critical system **until resolved** or satisfactory understood.
- **Check and document each fill** with intensities, dump reasons and stable beams time during the intensity increase.
- 2015 **3x during scrubbing**: ~400b, at the end of 50ns and 25ns scrubbing.
- 2015 **14x during intensity ramp-up**.

Intensity ramp-up proposal for 2016

- Intensity **ramp-up >12b:** 3 fills, 20h stable beams, check list.
- **Interleave** increase of **injected intensity**.
- 3 – 12 – 48/72 - 288 - 570 – 860 - 1200 –1700 – 2300 – 2800

trains: 12b 72b 144b 288b

Establish cycle (3-4 fills a few hours SB)

MP dominated (3 fills 20h SB, change filling pattern in 3rd fill)

Intensity dominated (e-cloud) (Intensity increase in small steps, check lists at mentioned intensities)

- Actual filling schemes proposed by physics coordinators (144bpi, 216bpi schemes to follow):
  - Single_3b_2_2_2
  - chr_52b_46_37_38_12bpi_5inj
  - chr_85b_73_37_57_25bpi_indiv_12inj
  - chr_313b_301_276_276_72bpi_12inj
  - chr_601b_589_288_300_288bpi_indiv_12inj
- Scrubbing run: Intermediate checkpoint ~ 400b (with checklist to validate COLL, heating, RF,…)

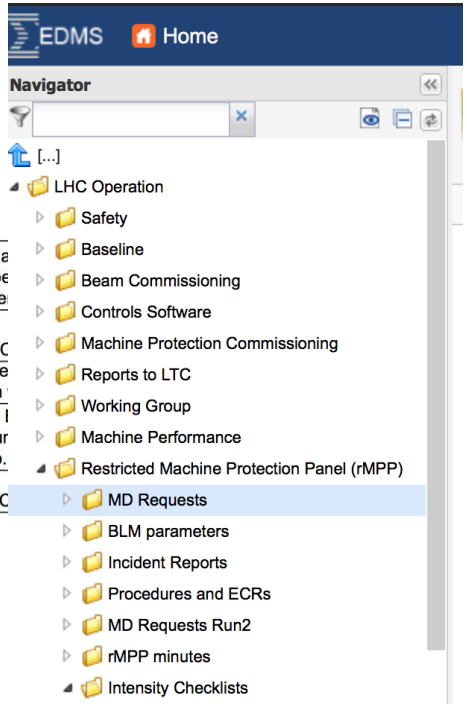
Intensity ramp-up check list sample 2015, 86b, 25ns

Check list period

Bunch pattern / intensity	25ns_26b_26_10_14_12bpi4inj AND 25ns_86b_74_53_54_24bpi7inj AND 25ns_86b_74_53_53_24bpi7inj
Start date	14-AUG-2015 16.25.54
End data	15-AUG-2015 00.56.49
Fill numbers	4201, 4204, 4205, 4207, 4208
Comment	
Next intensity	25 ns intensity ramp-up starting. Requested only one fill with a few hours of stable beam and 26 bunches, and at least three fills 20 hours of stable beam with 86 bunches

Non conform points in the following check lists: the intensity increase is put on hold pending a satisfactory understanding / resolution of the issue

Dump time	Fill #	Energy [GeV]	Intensity B1 [1e10]	Intensity B2 [1e10]	Stable Beams [hours]	Fill Luminosity [nb^-1]	Mps Expert Comment
15-AUG-2015 00.56.49	4208	6499680.00	849.00	937.00	5.22	2697.16	BLMBI.08L6.B0E10_MBB-MBA dumped beam due to a the order of 100 us, very fast. Magnet quench due to be dump much cleaner compared to 50ns ope
14-AUG-2015 16.25.54	4207	6499800.00	887.00	1004.00	4.35	2538.53	Main disturbance, beam dump via PIC
14-AUG-2015 06.24.40	4205	6499800.00	821.00	872.00	9.93	5068.47	EOF dump. However, the radiation in IR6 led to a single QPS for B10R6 that tripped the sector, when the beam
13-AUG-2015 15.19.42	4204	6499800.00	985.00	992.00	0.00	0.00	V instability developed on B2 just after the Q change. I BLMTI.06R7.B2I10_TCSG.A6R7.B2 in the 82 ms rur duration about 400 ms. Clean dump.
13-AUG-2015 08.15.36	4201	6499680.00	271.00	290.00	2.66	305.90	After the water fault beam dumped via the PIC. C



- **Fill summary, dump reasons + page for each system to be filled by responsible.**
- **Updated templates**
  - LHC intensity increase checklist
  - LHC intensity increase scrubbing
- **Link to EDMS of rMPP**

System / categories	Responsible / Deputy
Period	D. Wollmann / M. Zerlauth / J. Uythoven
Fills	D. Wollmann / M. Zerlauth / J. Uythoven
Dump Statistics	D. Wollmann / M. Zerlauth / J. Uythoven
Magnet Powering (MP3)	Z. Charifoulline / A. Verweij
Interlocks	M. Zerlauth / J. Uythoven
RF	W. Hoefle / A. Butterworth / L. Arnaudon
Beam Instrumentation	B. Dehning / B. Holzer
Collimation	S. Redaelli / R. Bruce
Operation, orbit, feedbacks	J. Wenninger / L. Ponce
Beam dump	C. Bracco / W. Bartmann
Injection	C. Bracco / W. Bartmann
Heating of Equipment	B. Salvant / ?

Summary / status

- Check list is a very successful tool for detecting and documenting issues in MP systems → **thanks to all contributors**!!
- **Essentia**l for the intensity ramp-up.
- Green light required from every system responsible **before increase in intensity**.
- Assure **readiness of all** protection relevant systems for next intensity step.
- **Action (all): Verify content** of checklist and update, if necessary.
- **First check list** probably to be filled after the weekend.